PPP FOR CITIES CASE STUDY

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# MES Barcelona: Driving the energy transition through public-private partnerships

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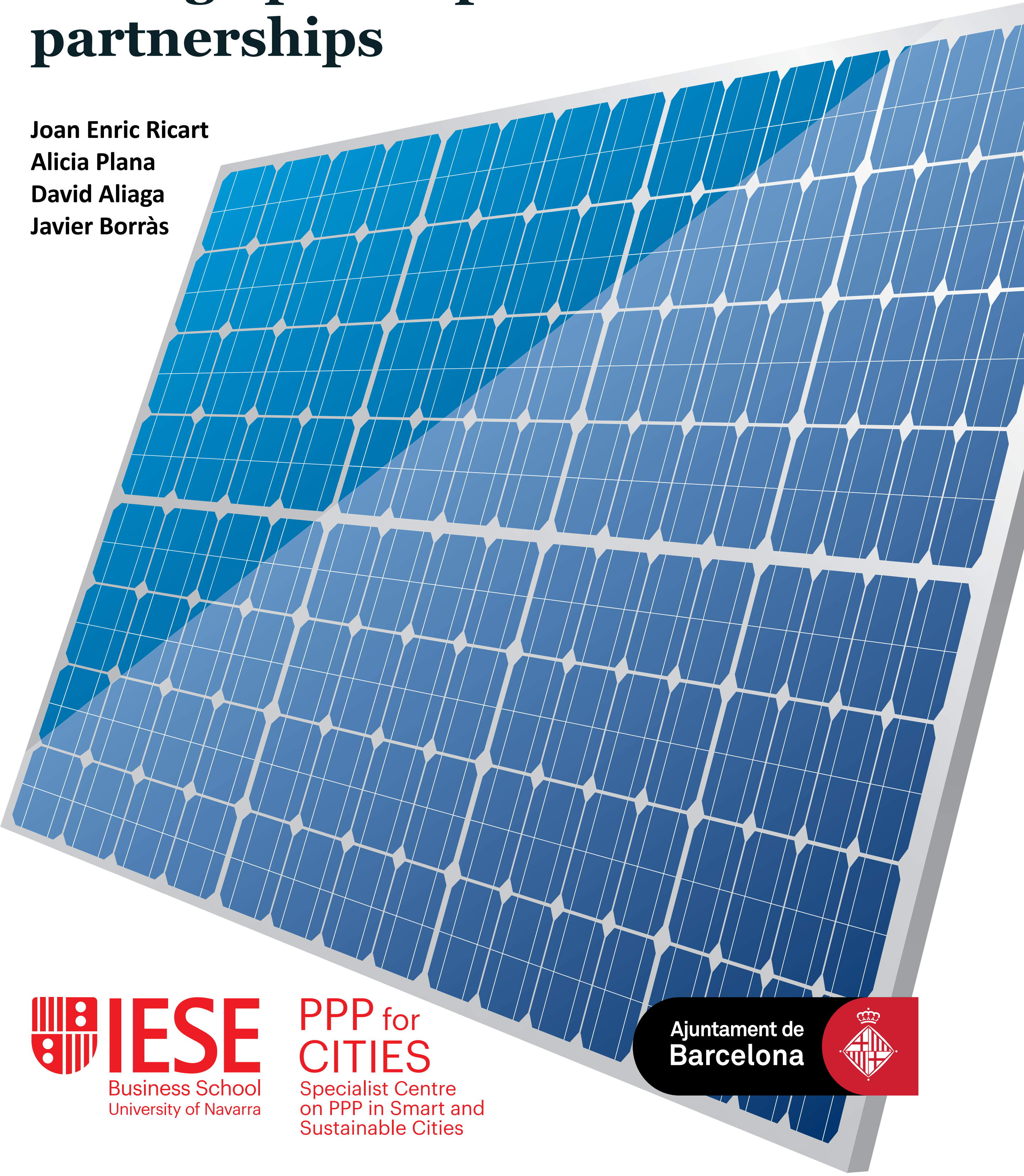

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Specialist Centre on PPP in Smart and Sustainable Cities

Ajuntament de Barcelona

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# CONTENTS

## ACRONYMS AND INITIALISMS

**ACM:** Catalan Association of Municipalities (Associació Catalana de Municipis)

**CDTI:** Center for the Development of Industrial Technology (Centro para el Desarrollo Tecnológico Industrial)

**CPI:** consumer price index

**DALY:** disability-adjusted life years

**ESG:** environmental, social, governance

**GDP:** gross domestic product

**GHG:** greenhouse gases

**GWh:** gigawatt-hour

**IEA:** International Energy Agency

**INE:** National Institute of Statistics (Instituto Nacional de Estadística)

**KII:** key impact indicator

**kWp:** kilowatt peak (equivalent to 1,000 watt peak)

**MES:** Sustainable Energy Mechanism (Mecanismo para la Energía Sostenible)

**MIBGAS:** Iberian Gas Market (Mercado Ibérico del Gas)

**MWh:** megawatt-hour

**OCU:** Organization of Consumers and Users (Organización de Consumidores y Usuarios)

**OMIE:** the nominated electricity market operator for management of the daily and intraday electricity market in the Iberian Peninsula

**PSI:** pressure-state-impact

**REE:** Red Eléctrica de España, electrical distribution market operator

**ROI:** return on investment

**SPV:** special purpose vehicle

**TIEPI:** interruption time equivalent to installed capacity *(tiempo de interrupción equivalente de la potencia instalada)*

**TTF:** Title Transfer Facility

**UN:** United Nations

## DEFINITIONS

**Cash pooling:** A centralized method of managing a company's cash balances to avoid deficit balances in individual accounts. Any deficits are offset by the accounts with surpluses.

**Catalan electricity mix:** The breakdown of all the technologies, with their respective energy sources, used to generate electricity in Catalonia. Coal is not present in the breakdown of electricity generating sources for this autonomous community.

**Clearing price:** The market price for hour *h* of day *D* is determined by the intersection of the electricity supply and demand curves of the market for that hour. This price determines the bids and offers that are cleared (i.e., the energy that will ultimately be exchanged at the market price).

**Combined cycle:** A process for generating electricity that uses a technological combination of a gas turbine (which uses natural gas as its primary fuel source) and a steam turbine. Combined-cycle generation is more efficient because it incorporates two operating cycles: the Brayton cycle (in which the gas turbine operates) and the Rankine cycle (in which the steam turbine operates).

**Core inflation:** The inflation figure obtained without considering unprocessed food and energy products.

**Electricity mix:** The breakdown of all the technologies, with their respective energy sources, used to generate electricity in a given territory.

**Energy carrier:** In the context of electricity, any technology or substance that allows electrical energy to be stored so that it can be released and supplied in a controlled manner during periods of shortage (reservoirs from which water is pumped to a dam and hydrogen are examples of energy carriers).

**PPA (power purchase agreement):** A contract for the purchase and sale of renewable energy between a generator that owns an energy asset and a consumer or retail supplier, typically at a predetermined price and on a long-term basis.

**Thermal gap:** The total amount of energy that must be supplied to the electric grid by thermal power plants, such as coal or natural gas plants, to offset generation shortfalls resulting from intermittent primary energy sources, such as wind, biomass, run-of-river or reservoir hydropower.

# 1. Executive summary

The COVID-19 pandemic and the geopolitical crisis triggered by Russia's invasion of Ukraine have had social and economic consequences for the world and, in the specific case addressed in this study, for the city of Barcelona.

To mitigate these impacts, the public sector must actively pursue short- and long-term measures aimed at stimulating economic activity and ensuring a sustainable future with greater energy savings and less dependence on fossil fuels. Specifically, in the energy transition, public-private partnerships are essential to address the challenges we face today.

In this regard, the **MES Barcelona** (Barcelona Sustainable Energy Mechanism) program, conceived and designed by the 2030 Agenda Office of the Barcelona City Council, exemplifies the determination of public administrations to join the private sector in the search for solutions to these energy challenges. MES Barcelona is a public-private partnership project that uses the tool of co-investment by public and private actors, with the specific objective of facilitating the energy transition and long-term sustainable energy savings by promoting self-consumption of electricity, in households as well as in companies and public facilities, through the use of photovoltaic collectors that harness solar energy.[1]

At present, the program is at an early stage, in which there are still areas to be defined and room for learning and improvement by all of the actors involved. For this reason, we believe it is appropriate and relevant to provide an overview of the context, goals, and first steps of this project in this report.

[1] Decision of the Economy and Finance Committee of the Barcelona City Council of December 15, 2020, *Boletín Oficial de la Provincia de Barcelona*, December 18, 2020, **https://bop.diba.cat/anunci/510607/bases-del-procediment-per-a-l-homologacio-d-inversors-privats-per-a-la-realitzacio-d-inversions-de-caracter-financer-ajuntament-de-barcelona**.

# 2. Context

In this section, we present the geopolitical, economic and energy context in which the MES Barcelona project was launched, focusing on how these factors affect the energy transition goals of the city of Barcelona.

## 2.1. The context of the energy crisis

The generation, distribution, and retail supply of electricity is a major topic of debate today because of the critical economic and social impact that electricity efficiency will have on the future of our society:

- Prices determined in the wholesale electricity market through negotiations between electric generation companies and retail suppliers have a significant impact on consumers. In July 2022, the 12-month change in the consumer price index (CPI), the benchmark indicator for assessing inflation in Spain, reached 10.8%.[2]
- In recent years, we have witnessed three crises that are interrelated and harmful to both household economies and the national economy: the natural gas crisis, the electricity market crisis, and the inflation crisis. As we will discuss below, the prices we observe for the goods and services we consume were correlated with the price of electricity generation. In addition, in the electricity generation system, determination of the price per megawatt hour (MWh) of electricity was closely linked to the price set in natural gas contracts.
- These two factors resulted in a high level of exposure to the price volatility of energy imports from geopolitically problematic countries.

In this introductory section, we discuss why this context of energy crisis in general, and electricity crisis in particular, implies that the idea of transitioning to cleaner sources of electric power is a viable and sound strategy, both economically and environmentally.

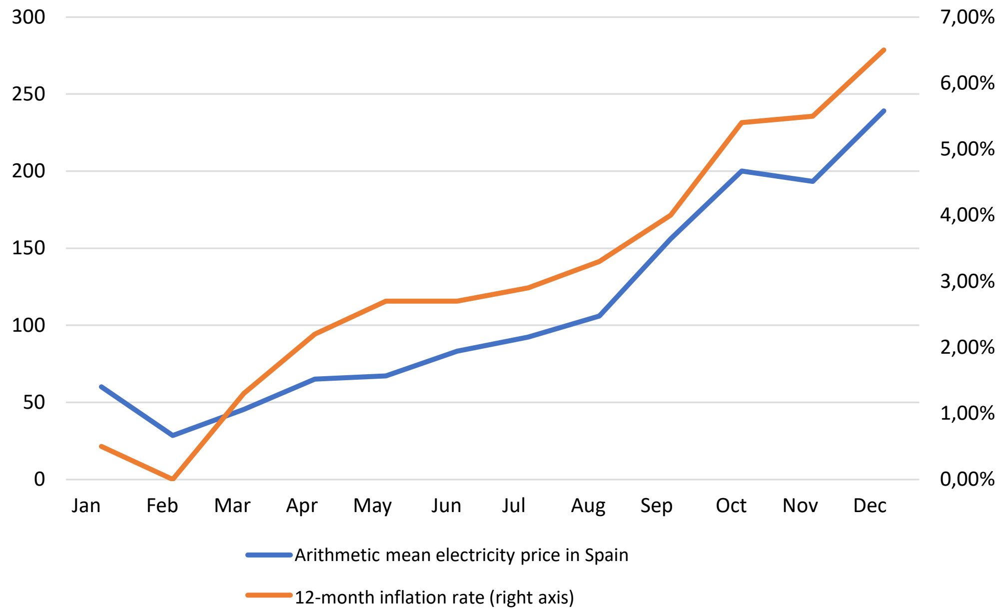
The period of contextual analysis for this case study spans from the launch of MES Barcelona in May 2021 to September 2022, months that included events of enormous importance in the energy market, such as the ongoing war in Ukraine and a spike in inflation. We have chosen to analyze this particular period to demonstrate the importance of the energy transition as a way to safeguard against geopolitical and economic vulnerabilities.[3]

### 2.1.1.The COVID-19 pandemic and its effect on Spanish electricity demand

The COVID-19 pandemic led to significant changes in the life habits of Spanish citizens, including a reduction in electricity demand. According to data obtained from Red Eléctrica de España (REE), electricity demand in Spain fell by 5.69% in 2020 (the year in which the pandemic began in Spain) and then grew by 2.43% in 2021 (the year in which economic recovery and the "new normal" began). Specifically, production increased from 245,912 gigawatt-hours (GWh) in 2020 to 251,746 GWh[4] in 2021. These two data points are particularly significant when we consider that electricity demand in 2018 and 2019 (the two years prior to the pandemic) was 264,660 GWh and 260,730 GWh, respectively. This sequence of data points suggests a recovery in both electricity demand and the price per MWh of electricity. This recovery led to a rise in inflation due to the close link between prices of goods and services and electricity prices (beyond the direct effect of higher household electricity bills; see **Figure 1)**. For the generation sector, the recovery was a positive development, given that in 2020 the price per MWh had fallen below €35 (see **Figure 2**).

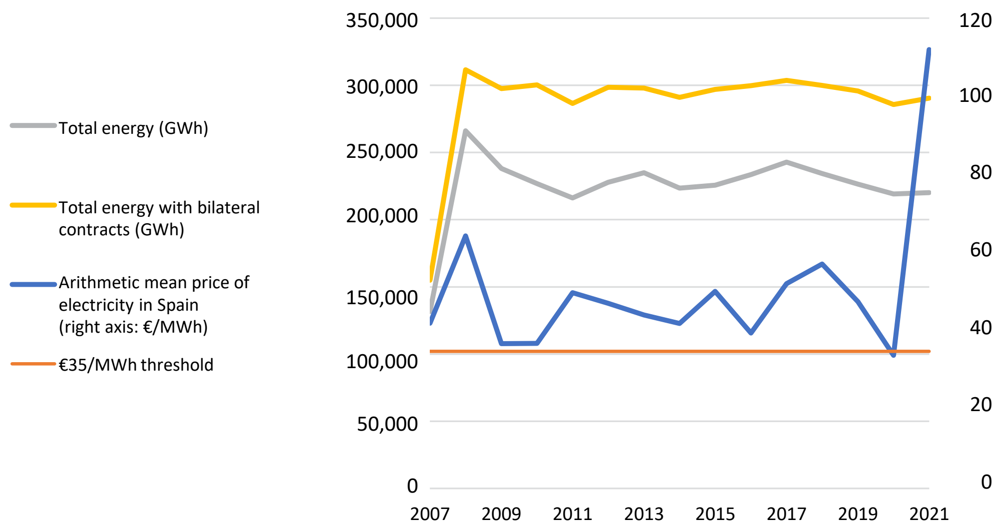
[2] "Consumer Price Index. Latest data," INE, accessed July 27, 2023, **https://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736176802&menu=ultiDatos&idp=1254735976607**.
[3] As this case study is limited to the period from May 2021 to September 2022, it does not cover in detail certain very important developments in the electricity market since that time, such as the agreement on the Iberian exception, which led to a significant reduction in the price of electricity.
[4] Fundación Naturgy, *El sector eléctrico español en números* (Madrid: Fundación Naturgy, 2021).

**Figure 1. Positive relationship between 12-month inflation (%) and arithmetic mean wholesale electricity price (€/MWh), 2021**




Source: Prepared by the authors based on data obtained from the OMIE and the INE.

**Figure 2. Trend in wholesale electricity price and total energy produced in the pre- and post-COVID-19 pandemic periods**




Source: Prepared by the authors based on data obtained from the OMIE.

## 2.2. The Russian invasion of Ukraine and its effect on Spanish electricity supply

In a situation of rising prices in the wake of the most difficult phase of the pandemic, with a subsequent rise in the CPI driven by the increase in the price per MWh of electricity and an excess of monetary liquidity, on February 24, 2022, the world learned that Russia had invaded Ukraine. At the outbreak of the conflict, the price of natural gas on the European reference market, according to the Title Transfer Facility (TFF),[5] rose sharply, exacerbating an upward drift that had already been underway since the second half of 2021, when electricity and final goods prices recovered (see **Figure 3**).

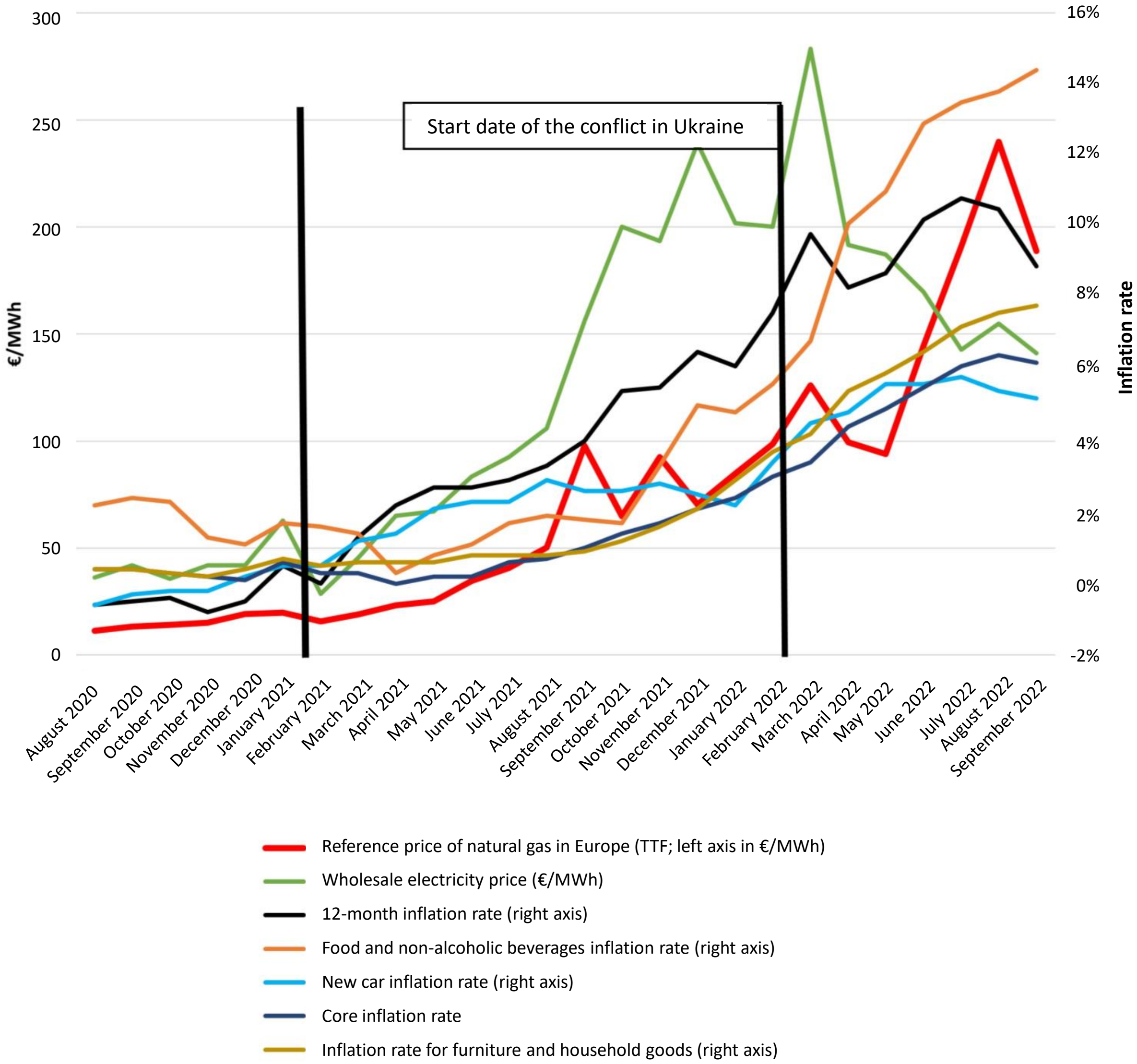
### Figure 3. Price of natural gas on the Dutch market; European reference market (ttf), in €/mwh


Source: Prepared by the authors based on data obtained from Refinitiv Workspace.

This geopolitical conflict showed society how the price of natural gas affects the cost of electricity and the price of general consumer goods.[6] The main nexus of this influence was the operation of the wholesale electricity market. A positive correlation was observed between the price of natural gas, the price of electricity per MWh (wholesale and retail), and the price of consumer goods (see **Figures 4** and **5** and **Tables 1** and **2**, which show the correlations).

[5] A Dutch index used as a reference point for the price of natural gas in Europe.
[6] Fundación Naturgy, *El sector eléctrico español en números* (Madrid: Fundación Naturgy, 2021).

## Figure 4. The price of natural gas partially drives the price of goods consumed through the price of electricity




Source: Prepared by the authors based on data obtained from the OMIE and Refinitiv Workspace.

There is a joint upward movement of natural gas prices in the TTF market and wholesale electricity prices, which pushes up prices for other goods and services (see **Figure 4**). The correlation holds when core inflation, which does not include energy products, is taken into account (see **Table 1)**.

### Table 1. Correlations between the TTF reference natural gas price and prices of some final goods and services, and between the wholesale electricity price and prices of some final goods and services

| | Price of natural gas on the TTF market | Wholesale electricity price |
|---|---|---|
| Wholesale electricity price | 0.834 | 1 |
| 12-month inflation on food and non-alcoholic beverages | 0.895 | 0.73 |
| 12-month new car inflation | 0.88 | 0.81 |
| 12-month core inflation[1] | 0.93 | 0.79 |
| 12-month inflation on furniture and household goods | 0.92 | 0.77 |

Key > 0.8 < 0.8

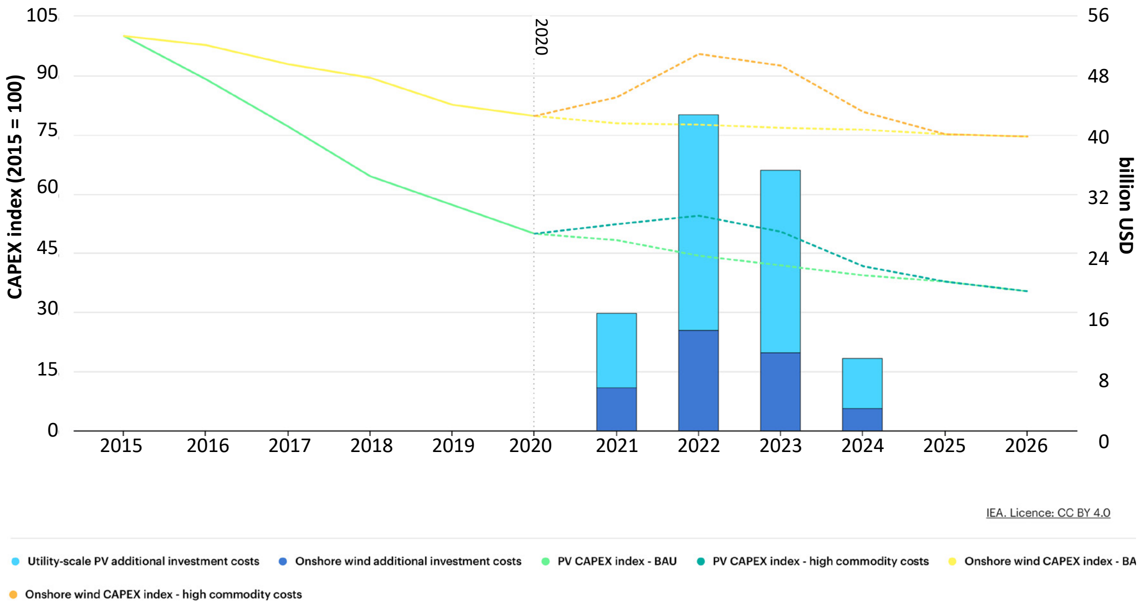
[1] Core inflation is the figure obtained without considering unprocessed food and energy products.

Source: Prepared by the authors based on data obtained from the INE, Refinitiv Workspace and the OCU.

As **Table 1** shows, the correlation coefficient between the natural gas price trend and the wholesale price of electricity is 0.834. The correlation between the price of natural gas and the price of various consumer goods is also strong. The price of electricity on the wholesale market is a significant factor in this correlation. The correlations obtained between the wholesale price of electricity and the prices of the various goods considered (including core inflation) are high (on the order of 0.7–0.8).

It is important to note that the energy crisis also had a significant impact on the cost of renewable energy installations (key assets for this case study), which had been on a downward trend in previous years (see **Figure 5**).

### Figure 5. Impact of the inflationary context on costs of renewable energy installations

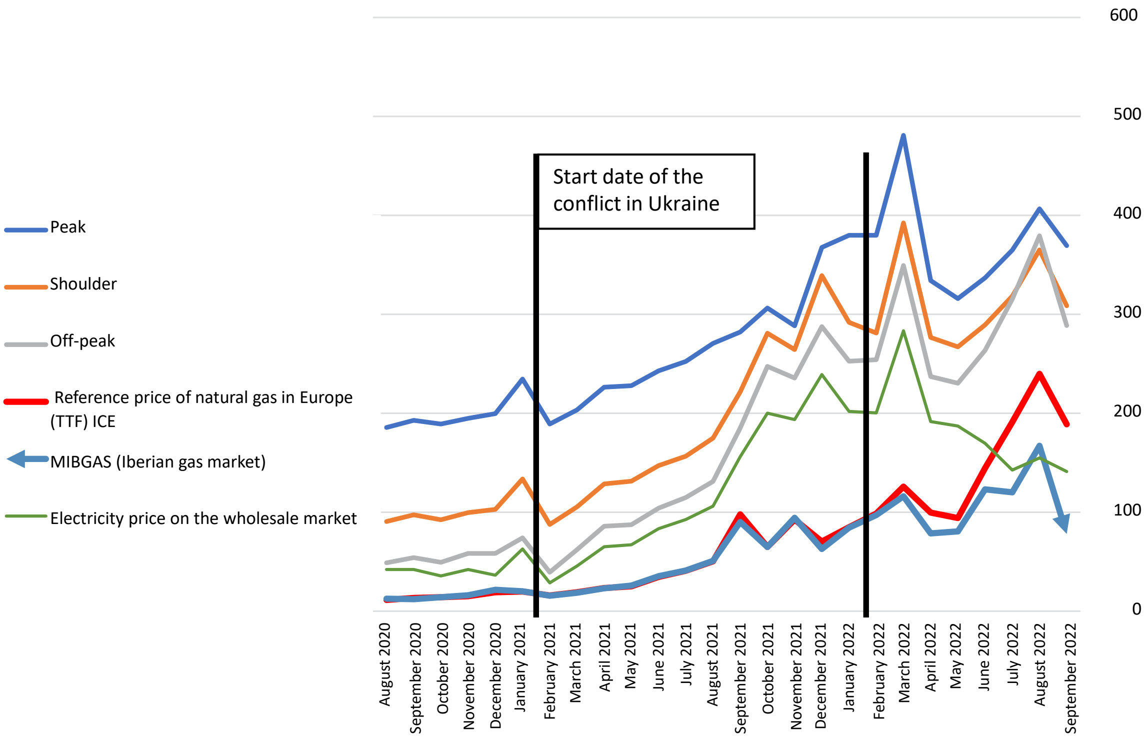



Source: International Energy Agency (IEA)[1].

[1] "Impact of high commodity price scenario on forecast total investment costs and CAPEX, onshore wind and utility-scale PV, 2015–2026," International Energy Agency, updated December 1, 2021, **https://www.iea.org/data-and-statistics/charts/impact-of-high-commodity-price-scenario-on-forecast-total-investment-costs-and-capex-onshore-wind-and-utility-scale-pv-2015-2026** (IEA, License: CC BY 4.0).

To see more clearly how natural gas prices affect electricity bills, it is important to observe the trend in time-of-use rates for the three periods used in electricity bills when the Voluntary Price for Small Consumers (PVPC in Spanish) is in effect (see **Figure 6**). All these data points show that both the price of goods and services consumed and electricity bills in the regulated market were significantly dependent on natural gas prices in the reference TTF market and the Iberian MIBGAS market[7] (see **Figures 6** and **Table 2**).[8]

## Figure 6. Joint trend for retail electricity prices and natural gas reference prices (in €/MWh)




Source: Prepared by the authors based on data obtained from Refinitiv Workspace, the OCU and the OMIE.

[7] MIBGAS is the reference index that establishes natural gas prices in Spain and Portugal.

[8] The wholesale electricity price curve diverges downward from the other curves from April 2022 due to the so-called *Iberian exception*. This is a government strategy of the Iberian countries (Spain and Portugal), implemented in June 2022, which consists of capping the price that electric generation companies using gas turbines must pay to obtain natural gas. The gas price cap was initially set at €40/MWh and was expected to remain in effect for one year, with an average annual cap of no more than €48.80/MWh. The compensation paid in relation to this cap on the price of natural gas affects bills in both the regulated and free markets.

**Table 2. Correlations between natural gas prices in the reference TTF market and rates for time-of-use periods used for bills with the PVPC tariff**

| | Price of natural gas on the TTF market |
|---|---|
| Wholesale electricity price | 0.834 |
| PVPC tariff rate for the peak period | 0.83 |
| PVPC tariff rate for the shoulder period | 0.86 |
| PVPC tariff rate for the off-peak period | 0.90 |

Key > 0.8 < 0.8

Source: Prepared by the authors based on data obtained from the INE, Refinitiv Workspace and the OCU.

In summary, in terms of trends over time, we observe a plausible positive relationship between natural gas prices, the rates that apply to electricity bills in the regulated market (which depends on wholesale market clearing prices), and the prices of various goods in the average household shopping basket (see **Tables 1** and **2** and **Figures 4** and **6**). The evidence suggests that natural gas prices may have a double effect on everyday spending, with electricity generation driving this effect. On the one hand, natural gas prices had an impact on gas and electricity bills, and on the other hand, they affected prices of final goods and services. Therefore, in a context of worrying inflation, decarbonizing the electricity mix would bring both environmental and economic benefits.

## 2.3. The electricity market in Spain

Technical factors, both economic and related to electrical engineering, come into play in electricity generation and the wholesale electricity market. In Spain, during the period analyzed in this case study, the wholesale electricity market operated under a marginal pricing structure; that is, for each of the 24 hours of the day, the clearing prices between electricity supply and demand determine the price of all electricity delivered to the distribution grid.

For each hour, the clearing price is applied to all MWh available for delivery to the grid, regardless of the generation technology used. For many hours, this price is determined by the cost of combined-cycle generation, which uses natural gas as its primary fuel source.[9] This is due to the way the aggregate electricity supply curve is drawn, whereby MWh supply offers at a given price from individual generators are added horizontally. This resulting aggregate curve includes offers from different technologies, since energy from various generation sources must be combined to supply the MWh required.

Therefore, the energy delivered to the distribution grid in any given hour will have been generated by renewables, nuclear, combined-cycle, etc. In principle, the objective is to cover demand at the most efficient price for the consumer. Of the different technologies used, supply from combined-cycle generation is usually the one that determines the clearing price, as it is usually the last to be added to the energy pool (see **Table 3** and **Figure 7**).

[9] See "combined cycle" in the list of definitions.

**Table 3. Percentage of hours in which combined-cycle thermal generation determined the combined price of electricity in Spain**

| Month | 2021 | 2022 |
|---|---|---|
| January | 5% | 24% |
| February | 3% | 19% |
| March | 5% | 22% |
| April | 10% | 12% |
| May | 8% | 19% |
| June | 24% | 37% |
| July | 22% | 46% |
| August | 21% | 18% |
| September | 27% | 44% |
| October | 13% | 41% |
| November | 25% | 46% |
| December | 23% | No data available |
| Monthly average | 16% | 30% |

Source: Prepared by the authors based on data obtained from the OMIE.

In the Spanish electricity system, the combined cycle (known for having a high opportunity cost in generation, although efficient in this respect and agile in coupling to the grid) provides essential flexibility to the system in a context of massive and subsidized incorporation of intermittent primary energy sources, such as renewables (especially wind power and run-of-river hydropower, i.e., hydro that does not require a reservoir). The incorporation of these intermittent technologies into the Spanish grid means that there is great uncertainty as to whether demand will be met, since this type of generation is characterized by its variability and unpredictability.[10]

It is important to note that **electricity cannot currently be stored in large quantities** because energy carriers (i.e., technologies or substances that can store energy) are not yet reached sufficiently developed. For the electrical system to function properly, **all demand must be covered and the energy required must be produced immediately**.[11]

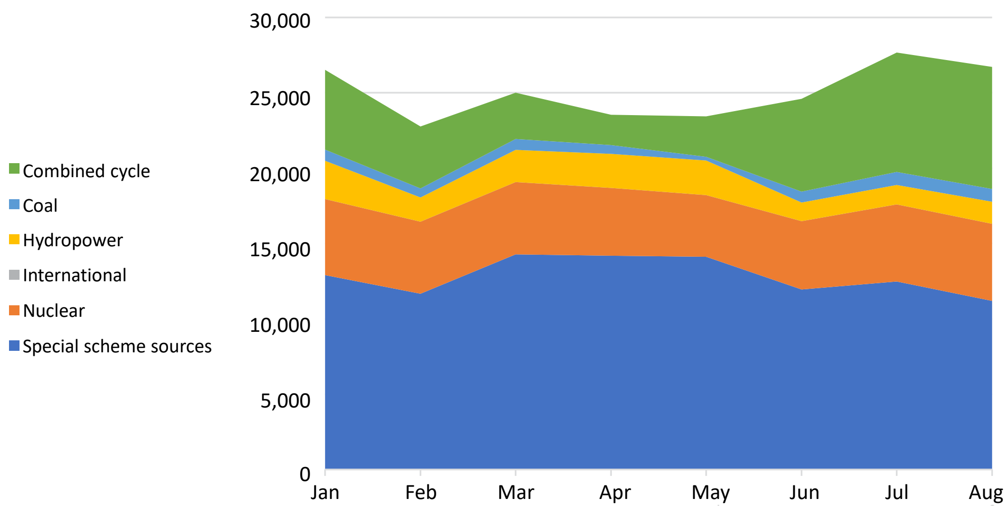
The plan to shift to greener electricity generation makes gas-turbine systems less of a baseload generation technology (i.e., one that operates continuously at lower variable costs) and more of a backup system, with the consequent increase in the clearing price when it is determined by the price of natural gas. The price increases because combined-cycle plants must offer electricity at higher prices to cover higher operating costs due to the intermittent operation of gas turbines. Therefore, in hours when the clearing price on the daily electricity market is determined by gas (i.e., when demand is high and little renewable energy is available) and gas prices are high, the clearing price may increase. This leads to a sharp increase in the price of electricity in the hours when gas dictates the price, which is exactly what happened in 2022.

[10] It should be noted that distributed generation of renewable energy at many points poses significant challenges. The Barcelona City Council believes that national investment is needed to eliminate bottlenecks in the capacity of the grid to absorb the energy generated, and to develop and implement new algorithms and management and storage systems. The aim would be to adapt more flexibly to demand needs while improving storage to absorb renewable energy supply and avoid situations of inefficient curtailment that reduce renewable energy production.
[11] Luis Atienza Serna and María Fernández Pérez, *La reforma del mercado eléctrico* (Madrid: Fundación Naturgy, 2021).

## 2.4. Recommendations regarding electricity generation

For all the reasons set out above, it is essential to boost green electricity generation. However, the flexibility that gas offers in covering demand is essential for this transition. Given the difficulty of decoupling gas and electricity, it is imperative to minimize the production of energy from polluting sources such as natural gas during hours of high solar radiation and to boost production from solar energy by increasing installed capacity. In addition, it would be a positive step to complement solar generation with further development of energy carriers, such as pumped storage,[12] to store excess power from solar or other intermittent renewable energy sources, thereby reducing reliance on natural gas as a backup source for hours when demand is high.

**Figure 7. Monthly energy produced by technology, 2022 (GWh)**



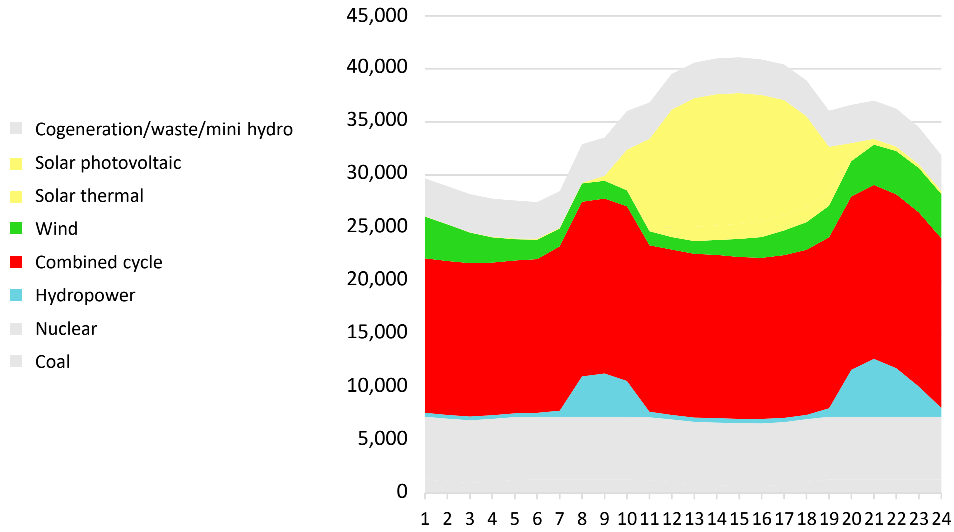

Source: Prepared by the authors based on data obtained from the OMIE.

[12] A pumped-storage hydroelectric plant consists of two reservoirs at different elevations where water can be stored, pumped to the higher level, or released to generate electricity, depending on energy demand. This system allows energy to be produced at times when it is more profitable and not when it would be less profitable.

The portion of demand that is not met by renewable energy sources and hydropower (including reservoir and pumped storage) and must be met by conventional and combined-cycle thermal power is known as the *thermal gap*. When this thermal gap widens, production from thermal power plants, such as combined-cycle plants, plays a bigger role at the expense of technologies that harness renewable energy sources, such as pumped storage and reservoir hydropower (see **Figures 8** and **9**). In this context, the MWh produced by natural gas drive the wholesale price of electricity during most hours over the year, including, in some cases, the hours with the highest electricity demand and low renewable generation. The resulting price is paid by retail suppliers and then passed on to end customers in their electricity bills.

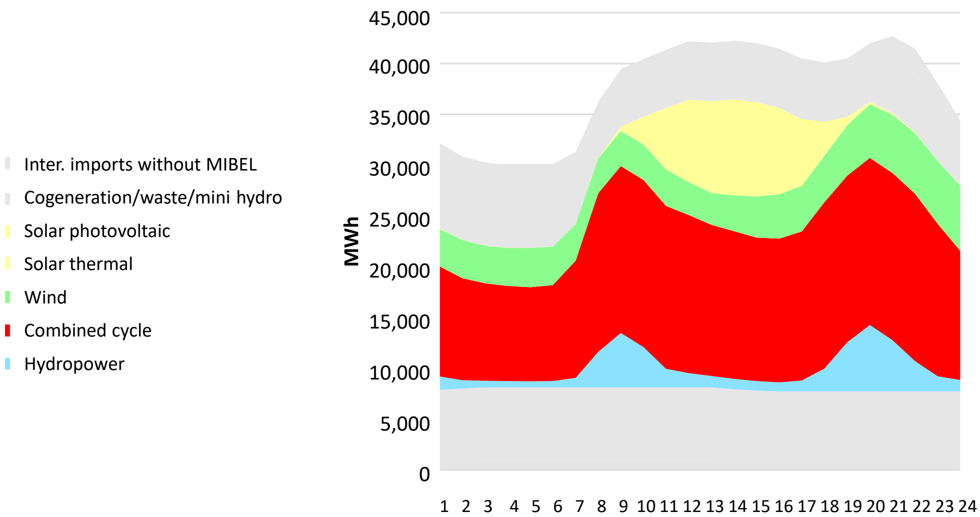
For all of these reasons, **in the current context of geopolitical crisis, with a strong impact on the price of energies such as natural gas, it is essential to focus on renewable sources of electricity generation.**

## Figure 8. Energy produced by technology (MWh) and by hour on October 13, 2022




Source: Prepared by the authors based on data obtained from the OMIE.

## Figure 9. Energy produced by technology (MWh) and by hour on February 3, 2022




Source: Prepared by the authors based on data obtained from the OMIE.

## 2.5. The situation in the city and the province of Barcelona

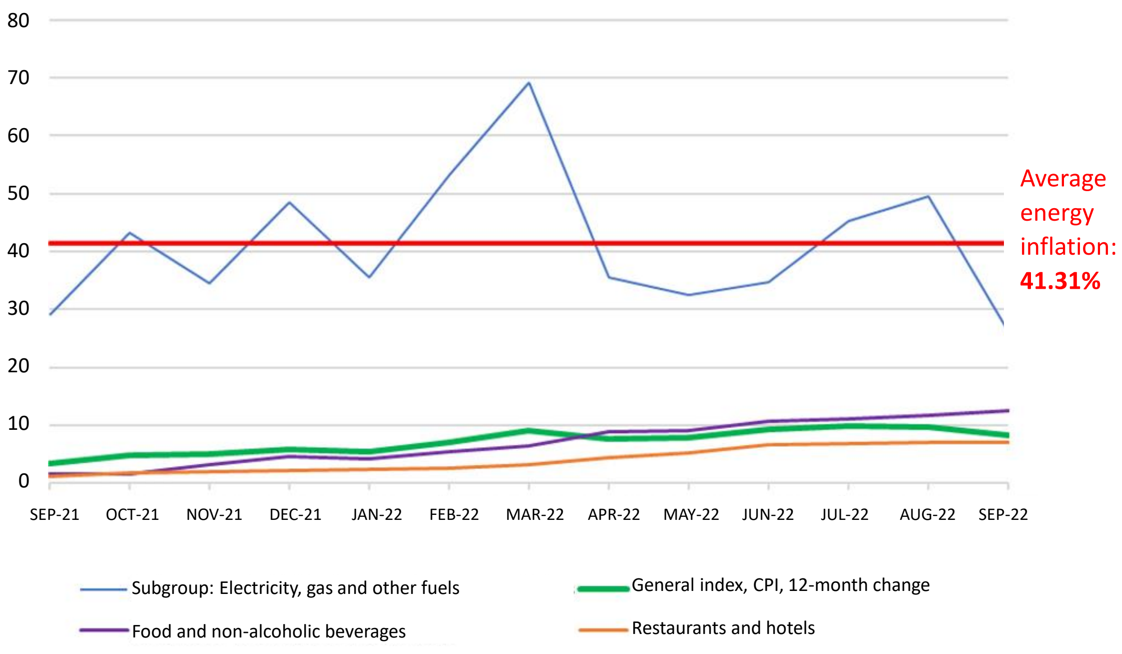
In this section, we discuss the impact of energy prices, the dynamics of energy transition, and the potential of renewable energies in the case of Barcelona.

### 2.5.1. Importance of the price of electricity in the household consumption basket

As noted above, reliance on non-renewable energy sources such as natural gas for electricity generation has an impact on the price of final consumer goods. The increase in electricity prices has been felt by both households and businesses. Higher production and logistics costs have led industries and retailers to pass these increases on to end consumers, pushing up the prices of the goods and services in their shopping baskets. The increase in the price of electricity has a double effect in reducing the purchasing power of households: through electricity bills and through the price of final products purchased. In the case of both Spain and Barcelona, the most significant cost in terms of household expenditure was higher electricity bills (see **Figure 10**).

In the province of Barcelona, the second most populous in Spain, the average inflation rate for energy consumed by households was almost four times higher than the rate for food and non-alcoholic beverages, restaurants and hotels, or the general consumer price index (CPI) for the province, for example (see **Figure 10**).

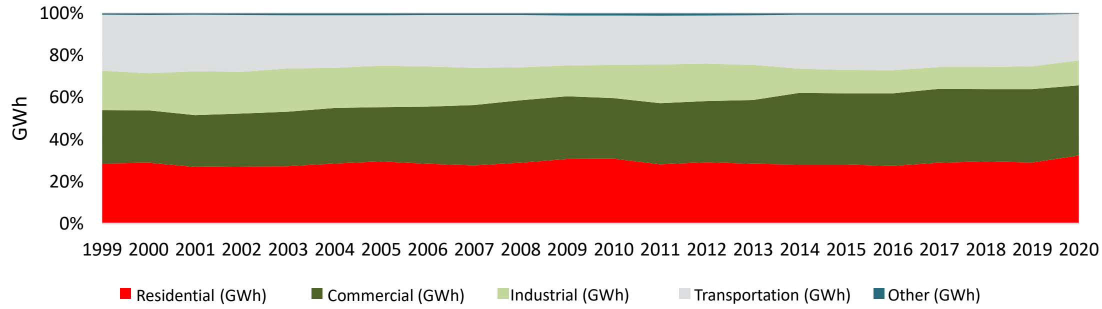
**Figure 10. 12-month inflation trend for the province of Barcelona**




Source: Prepared by the authors based on data obtained from the INE.

In the city of Barcelona, the energy consumption trend by sector in recent years (see **Figure 11**) shows that the **residential sector accounts for around 30% of total energy consumption** and that this proportion remained practically constant over time. **The commercial and industrial sectors together account for 40% of consumption,** which also remained stable over the period considered.

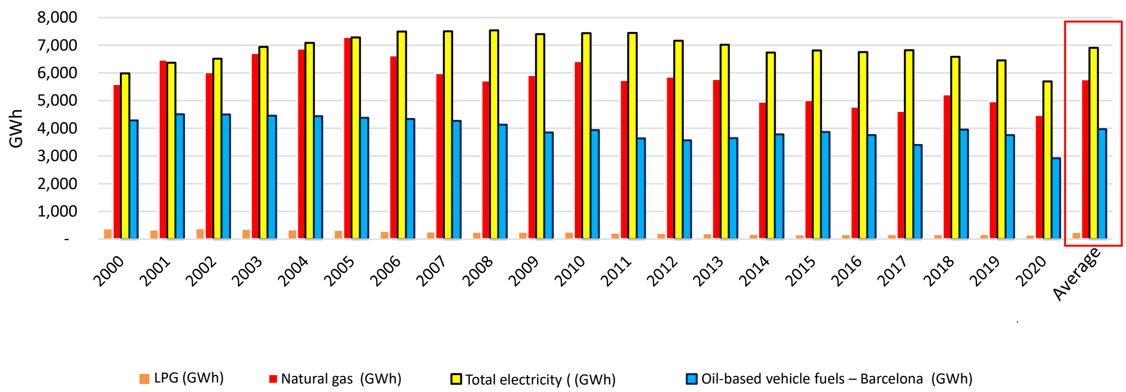
## Figure 11. Energy consumption trend by sector (percentage of total GWh) in the city of Barcelona




Source: Prepared by the authors based on data obtained from the Barcelona Energy Agency.

In 2020, these sectors accounted for nearly 80% of energy consumption in the city. **Electricity was the most used energy source, accounting for 45% of the total.** In fact, since 2000, **electricity has been the most consumed form of energy in Barcelona,** at nearly **7,000 GWh per year** (see **Figure 12**).

## Figure 12. Energy consumption trend by energy source (in GWh) in the city of Barcelona




Source: Prepared by the authors based on data obtained from the Barcelona Energy Agency.

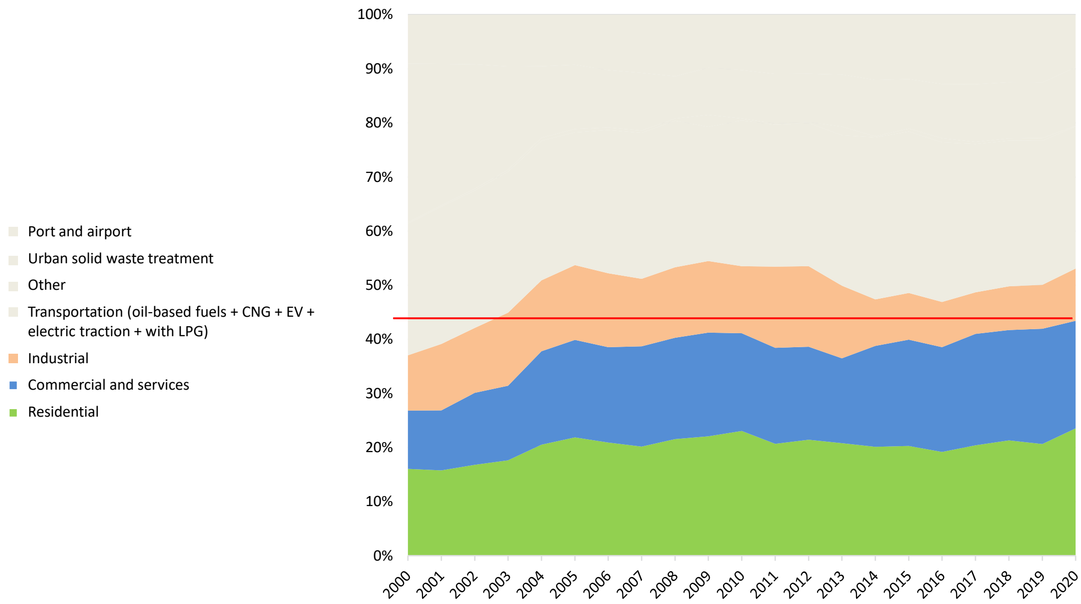
The cost of electricity is tied to the price of non-renewable energy sources imported from some countries involved in geopolitical conflicts and can therefore be subject to sharp and unpredictable fluctuations. For a city like Barcelona, where the majority of energy consumption is in homes, businesses and industries, and where most of this energy is consumed in the form of electricity, the price of electricity can be a critical factor for household and business economies.

### 2.5.2. Renewable generation in Barcelona and the fight against climate change

In the previous sections, we have explained the potential risk that electricity dependence on sources such as natural gas entails in times of geopolitical instability. We have also seen that the residential, commercial and business sectors account for almost all energy consumption in the city of Barcelona, and that electricity is the largest component of energy consumption in the city according to the 2000–20 time series data.

When we look at the amount of greenhouse gas (GHG)[13] emissions by sector, we see that households, businesses, and industries are significant contributors. The annual percentage weight of the three sectors remained at around 50% of total emissions from 2000 on, exceeding this percentage in some years (see **Figure 13**).

**Figure 13. Percentage of GHG emissions by sector in the city of Barcelona**



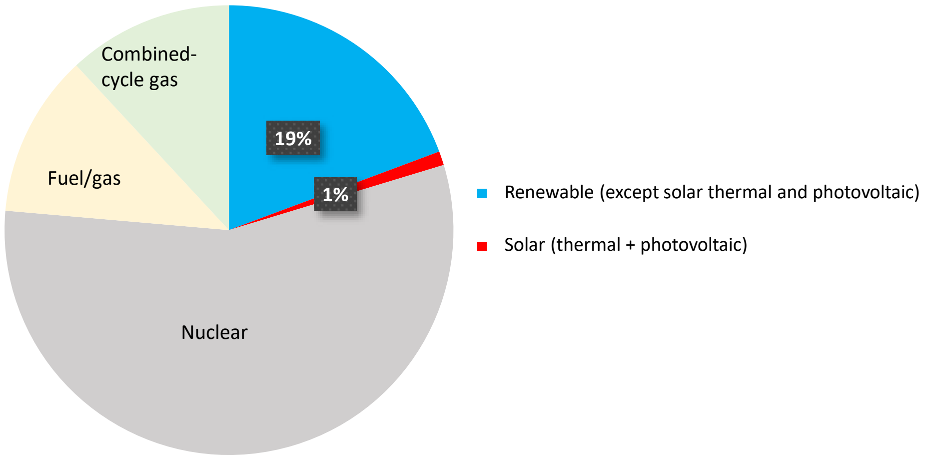

Source: Prepared by the authors based on data obtained from the Barcelona Energy Agency.

When these emissions are broken down by energy source, we find that **electricity consumption by households, businesses and industry accounted for 20% of the total in 2020. Natural gas, including gas consumed by households and businesses and gas used to generate electricity, accounted for 33% of total GHG emissions**. The significance of these data becomes particularly clear when we compare them to the figures for transportation, which generated 25% of GHG emissions.[14]

In 2020, it was clear that there was still significant room for improvement in terms of making the electricity mix more renewable: **Of Barcelona's total electricity consumption, only 20% came from renewable energy sources and only 1% from thermal and photovoltaic solar energy**[15] (see **Figure 14**).

[13] GHGs are carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$), as well as other fluorinated gases from industry that are not directly linked to energy consumption.
[14] Barcelona Energy Agency, Barcelona Energy Observatory and Environment and Urban Services Manager's Office, *Balanç d'energia i emissions de gasos amb efecte d'hivernacle de Barcelona: 2020* (Barcelona: Barcelona City Council, 2022), **http://hdl.handle.net/11703/124682**.
[15] Barcelona Energy Agency, Barcelona Energy Observatory and Environment and Urban Services Manager's Office, *Balanç d'energia i emissions*.

## Figure 14. Electricity mix for consumption in the city of Barcelona




Source: Prepared by the authors based on data obtained from the Barcelona Energy Agency.

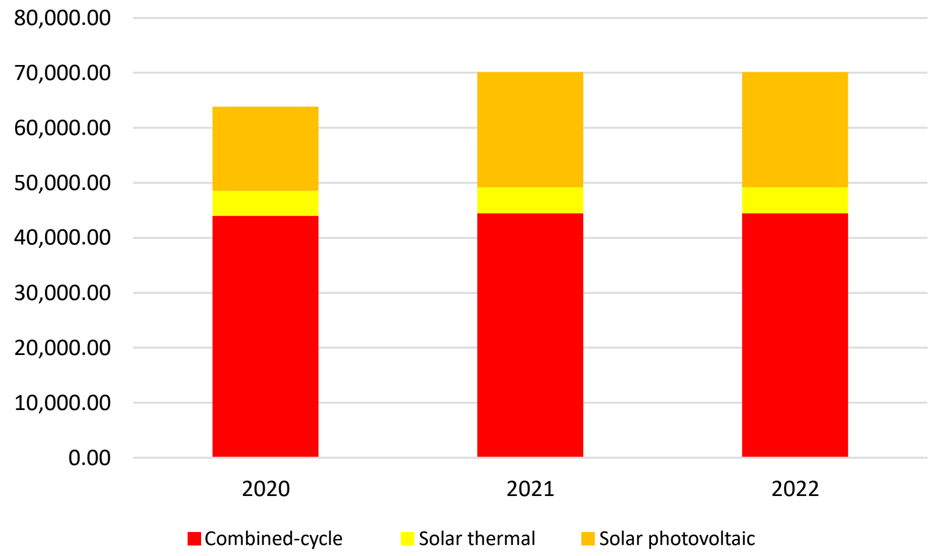
Nota: Barcelona Energy Agency, Barcelona Energy Observatory and Environment and Urban Services Manager's Office, *Balanç d'energia i emissions.*

Although considerable efforts are being made in terms of energy transition, these data are surprising in a city like Barcelona, which ranks ninth in Spain and fourteenth in Europe in hours of sunshine per year,[16] and where many buildings are ideally suited for the installation of electricity generating equipment. These buildings **have the potential to generate approximately 1,191 GWh/year of solar photovoltaic energy**, equivalent to around **60% of the electricity consumed by the residential sector in the Catalan capital.** Up to **5,495 GWh/year of solar thermal energy** could also be generated, which is equivalent to the annual consumption of enough domestic hot water to fill approximately 4,000 Olympic-sized swimming pools.[17]

The situation we found in Barcelona can be extrapolated to Spain as a whole. It is hard to understand that in a country with the climatic conditions that it enjoys, solar thermal and photovoltaic energy have had and still make such a negligible contribution to electricity generation. In fact, photovoltaic power generation is currently almost half that of Germany during the hours of highest solar radiation. Moreover, if we compare solar electricity generation with combined-cycle generation (the largest source of GHG emissions in recent years), the picture is even more alarming and underscores the need to **accelerate the decarbonization of our electricity generation** (see **Figures 15** and **16**).

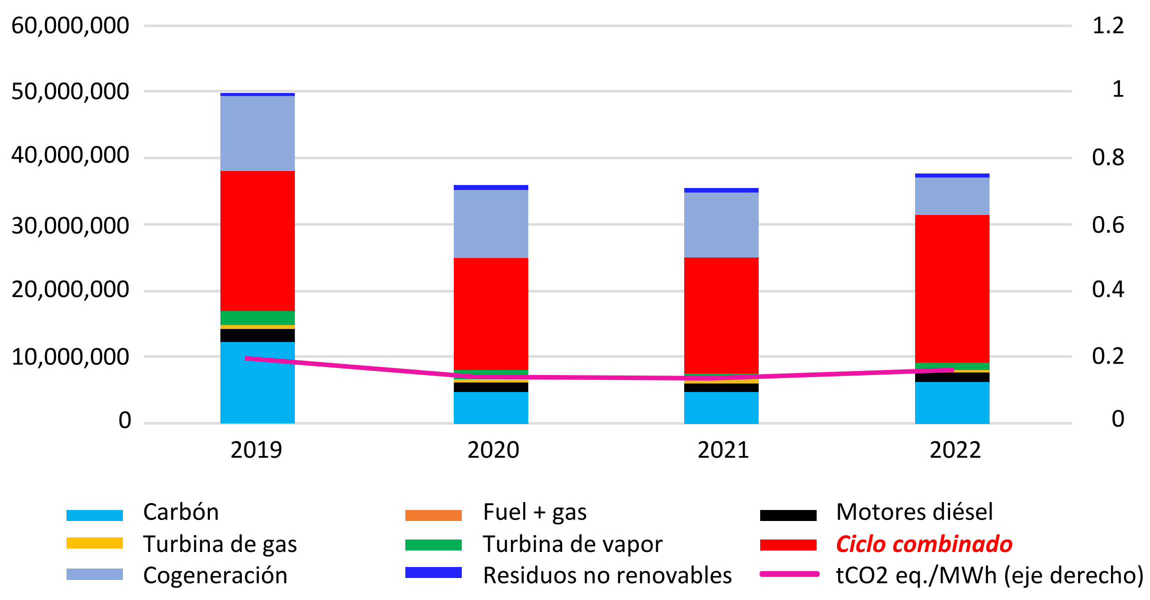
[16] Data obtained from **https://www.elperiodico.com/es/tiempo/20220426/ciudades-mas-sol-espana-dv-13570740**.
[17] Data obtained from the Barcelona Energy Agency.

**Figure 15. Electricity generation by technology in Spain (GWh)**




Source: Prepared by the authors based on data obtained from the OMIE.

**Figure 16. Emissions and $CO_2$-equivalent emission factor in Spain (tons of $CO_2$-equivalent and tons of $CO_2$-equivalent/MWh)**




Source: Prepared by the authors based on data obtained from Red Eléctrica de España (REE).

## 2.6. Barcelona and the energy transition

Faced with the challenge of decarbonizing electricity generation, various international organizations and public administrations have carried out actions based on the United Nations (UN) 2030 Agenda. Among the public entities tackling this issue is the Barcelona City Council, which has developed a decarbonization strategy for the city it governs.

### 2.6.1.The 2030 Agenda

The 2030 Agenda is a plan of action for people, planet and prosperity, which also aims to strengthen universal peace and access to justice.

- **Origin and objectives of the 2030 Agenda**

The 2030 Agenda was adopted on September 25, 2015 by a unanimous vote of the 193 member states of the United Nations. Some of its main points and key agreements—such as the Paris Agreement on Climate Change, the Addis Ababa Action Agenda for Financing for Development, the Sendai Framework for Disaster Risk Reduction, and the Education 2030: Incheon Declaration and Framework for Action towards inclusive and equitable quality education and lifelong learning for all—were developed at other global action summits.

At a time of pressing global challenges, in 2015 **the United Nations defined 17 Sustainable Development Goals (SDGs), laying the groundwork for what became known as the 2030 Agenda** (see **Figure 17**):[18]

**Figure 17. UN Sustainable Development Goals**


Source: UN.org

The 2030 Agenda proposes a model based on wealth creation, built on partnerships among all economic actors, that generates a sustainable economic and environmental system. According to this model, sustainability has three interconnected dimensions: economic, social and environmental. The 2030 Agenda proposes to solve the climate emergency through a distributive economic model that generates wealth and promotes social cohesion.

[18] Office of the Commissioner for the 2030 Agenda of the Barcelona City Council, *Estrategia de impulso de la Agenda 2030 en la ciudad de Barcelona. Medida de gobierno* (Barcelona: Barcelona City Council, Office of the Commissioner for the 2030 Agenda, 2020), **https://ajuntament.barcelona.cat/agenda2030/sites/default/files/2020-02/Medida%20de%20gobierno%20Agenda%202030.pdf**.

The aim is to create a virtuous circle in which finding solutions to mitigate climate change will in turn generate economic and social prosperity, while ensuring that no one is left behind as we promote the green economy.[19]

- **Barcelona's role in the 2030 Agenda**

In the consultation process that preceded the drafting of the 17 SDGs of the 2030 Agenda, local authorities participated to present their concerns and challenges. The participation of cities was reflected in SDG 11: **"Make cities and human settlements inclusive, safe, resilient and sustainable."**

Beyond this specific goal, the inclusion of the local sphere is essential to achieve the 2030 Agenda for the following reasons:

1. Fifty percent of the world's population lives in cities, and that number is projected to rise to 75% by 2050. In regions such as Latin America, the figure has already reached 80%.[20]
2. The concentration of population in cities generates clear negative externalities: Cities account for 70% of the world's energy consumption and 70% of global $CO_2$ emissions.[21]
3. Extreme poverty, unemployment, inequality and less sustainable behaviors become less visible in cities.
4. Cities are hubs of innovation and sources of wealth and opportunity. This is evidenced by the fact that they generate 80% of the world's gross domestic product (GDP).[22]

In the case of Barcelona, the city has made a firm commitment to integrate sustainable development into its municipal policies. Actions in this area began to take shape with the implementation of Agenda 21, which culminated in 2002 with the first citizens' commitment to sustainability. The Barcelona City Council has also promoted social sustainability through the 2006 Citizens' Agreement for an Inclusive Barcelona.

It is essential that the city of Barcelona adapts the 2030 Agenda to local conditions by engaging social, economic, cultural and political actors at the local level. The main coordinator of these efforts must be the City Council, since it is the public institutional authority with the most responsibilities and competencies in the social life of the city. Using the 2030 Agenda as a framework for action in Barcelona has several advantages:

1. The UN plan sets out a global and objective vision of the problems we face and the actions to be taken, integrating the three main dimensions of development: social, economic and environmental.
2. It raises awareness of the SDGs among citizens.
3. It is a long-term plan that is independent of the political makeup of the City Council.[23]

To harness these advantages, the Barcelona City Council adopted the 2030 Agenda as an overall framework for action defined in four work dimensions:

1. Political commitment
2. Modernization of municipal management and services
3. Social involvement in all areas and at all levels
4. Leadership and enhancing the city's international profile

[19] Office of the Commissioner for the 2030 Agenda of the Barcelona City Council, *Estrategia Agenda 2030*.
[20] United Nations Human Settlements Programme (UN-Habitat), *Cities and Climate Change: Global Report on Human Settlements 2011* (London: Earthscan, 2011), **https://unhabitat.org/sites/default/files/download-manager-files/Cities%20and%20Climate%20Change%20Global%20Report%20on%20Human%20Settlements%202011.pdf**.
[21] Office of the Commissioner for the 2030 Agenda of the Barcelona City Council, *Estrategia Agenda 2030.*
[22] "Urban Development. Overview," World Bank, updated April 3, 2023, **https://www.worldbank.org/en/topic/urbandevelopment/overview**.
[23] Office of the Commissioner for the 2030 Agenda of the Barcelona City Council, *Estrategia Agenda 2030*.

- **Definition of the strategic lines of the 2030 Agenda in the city of Barcelona**[24]

The City Council has defined a detailed strategy for the adaptation and integration of the 2030 Agenda in Barcelona, structured in three strategic lines:

– ***Strategic line 1: The 2030 Agenda in the City Council.*** Includes activities to be carried out by the local authority to achieve the implementation of the 2030 Agenda in the city.

– ***Strategic line 2: The 2030 Agenda in the City of Barcelona.*** Focuses on enabling other actors in the city to drive implementation of the 2030 Agenda. Disseminating and publicizing the initiative is a key element of this strategic line.

– ***Strategic line 3: Barcelona 2030 International.*** Aims to share the knowledge and experience gained in implementing the 2030 Agenda with other cities. Another goal is to position the city of Barcelona as a leader in commitment and dedication to implementing the 2030 Agenda, increasing the international focus of municipal cooperation.

[24] Office of the Commissioner for the 2030 Agenda of the Barcelona City Council, *Estrategia Agenda 2030*.

# 3. MES Barcelona's financing mechanism

As part of efforts to apply the 2030 Agenda and its 17 SDGs to the local world, the Barcelona City Council launched a project aligned with SDG 7, aimed at accelerating the city's energy transition with the help of private investment. This is the origin of MES Barcelona, which seeks to encourage public-private co-investment for the installation of photovoltaic panels and energy retrofitting of buildings in the city.

## 3.1. MES Barcelona in relation to the SDGs of the 2030 Agenda

The MES Barcelona mechanism is a cross-cutting tool to support implementation of the 2030 Agenda. The impact of investments made under the mechanism has a positive impact on 11 of the 17 SDGs, namely, SDGs 3, 6, 7, 8, 9, 11, 12, 13, 14, 15 and 17.

While all of these SDGs are important, two of them (SDGs 7 and 17) are particularly relevant in the case of MES Barcelona.

### *SDG 7: Affordable and clean energy*[25]

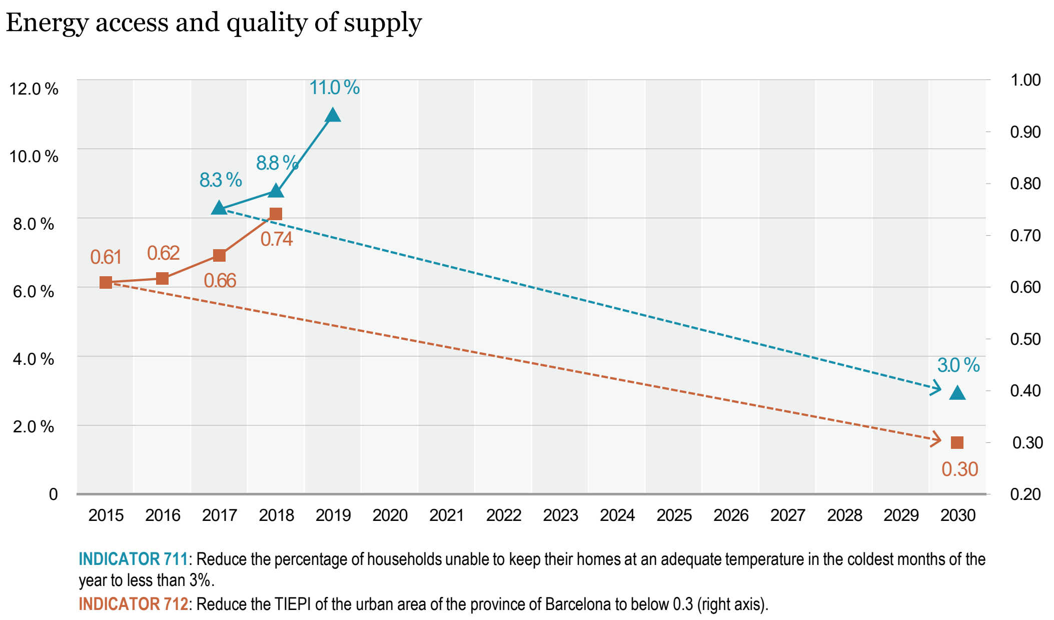
SDG 7 calls for access to affordable, reliable, sustainable and modern energy for all. Implementation of this goal in Barcelona is intended to achieve the following milestones:[26]

1. Ensure universal access to affordable, reliable and modern energy services so that the percentage of households unable to keep their homes at an adequate temperature is less than 3% and the TIEPI (interruption time equivalent to installed capacity [electricity supply]) indicator is reduced to no more than 0.3 (see **Figure 18**).
2. Achieve 50% or more of total energy consumed from renewable sources, and 6.5% or more of that energy from local renewable production (see **Figure 19**).
3. Double the overall rate of energy efficiency improvement by implementing an energy retrofit of 20% of residential and municipal buildings over 40 years old, at a rate of 3% per year (see **Figure 20**).

[25] "Objetivos de Desarrollo Sostenible," UN, accessed July 27, 2023, **https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/**.

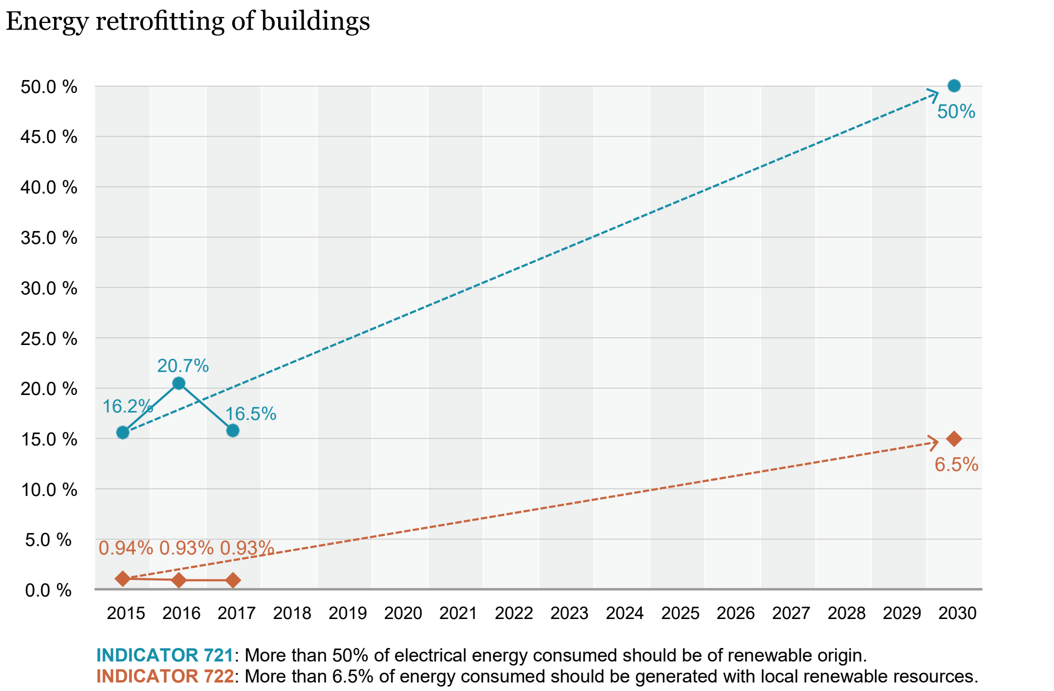
[26] Barcelona City Council, *Agenda 2030 de Barcelona. Metas ODS e indicadores clave* (Barcelona: Barcelona City Council, Office of the Commissioner for the 2030 Agenda, 2020), **https://ajuntament.barcelona.cat/agenda2030/sites/default/files/2021-03/Agenda%202030%20de%20Barcelona.%20Metas%20ODS%20e%20indicadores%20clave_0.pdf**.

## Figure 18. Forecast of energy access and quality of supply




Source: Barcelona City Council, *Agenda 2030*.

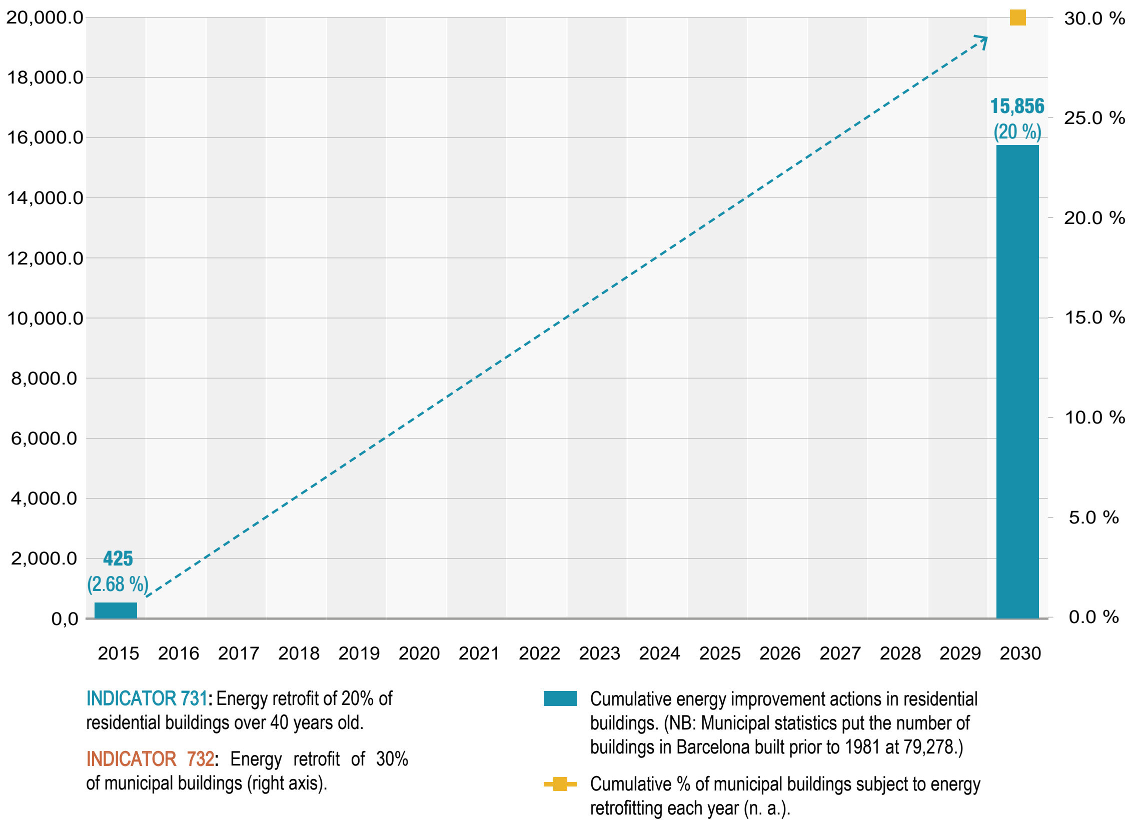
## Figure 19. Forecast percentage of total energy consumed from renewable sources




Source: Barcelona City Council, *Agenda 2030*.

**Figure 20. Forecast percentage of cumulative actions for energy improvement in residential and municipal buildings**

Energy retrofitting of buildings




Source: Barcelona City Council, *Agenda 2030*.

### *SDG 17: Partnerships for the Goals*[27]

SDG 17 notes that alliances and inclusive partnerships are essential to achieving the goals. More specifically, the MES Barcelona program addresses Target 17.17, which proposes to encourage and promote the formation of **effective public, public-private and civil society partnerships**, building on the experience and resourcing strategies of partnerships.

On this point, MES Barcelona has already achieved successes: The UN has recognized it as the most sustainable public-private partnership out of a total of 70 models that were nominated for this award.[28]

## 3.2. MES Barcelona

The transformation plan aims to drive the energy transition in Barcelona, generate economic activity and employment, and promote innovation. In the first phase, the focus has been on promoting the installation of photovoltaic panels through co-investment by the City Council and private investors.

MES Barcelona is based on a set of economic premises and a vision of the public sector as an entrepreneurial actor. It has a close precedent in the province of Barcelona (the Rubí Brilla project) and pursues economic, social and environmental objectives.

[27] "Objetivos de Desarrollo Sostenible," UN, accessed July 27, 2023, **https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/**.
[28] Barcelona City Council, "MES Barcelona, el nuevo plan de transformación energética para construir una ciudad más verde," May 2, 2021, **https://ajuntament.barcelona.cat/agenda2030/es/actualitat/1063322**.

### 3.2.1. Theoretical framework of MES Barcelona[29]

The project is built on a vision of the economy based on a series of premises about the role that the state can play in innovation, economic growth and ecological transition.[30] ,[31] According to the MES Barcelona vision, the public sector should also be an entrepreneurial actor,[32] taking risks to generate technological innovation in critical sectors where private capital does not have sufficient economic incentives to do so in the short term. According to this perspective, radical technological changes require initial support from the state, since they do not occur "naturally" in a market economy context.[33] This is true for the green economy and the energy transition, a sector that can deliver significant returns in the long term but will receive little financing in the short term if left to market forces alone.[34]

MES Barcelona is based on the view that that the green economy will be a major driver of the economy, job creation and technological innovation in the future. Promoting the energy transition requires both demand-side policies (i.e., regulations that affect consumption patterns) and supply-side policies that promote the generation and adoption of specific energy technologies and infrastructure. MES Barcelona focuses on supply-side policies, specifically those that seek to promote the adoption of solar photovoltaic energy through the provision of public capital.[35] The idea is for the public sector to take the initial risk and provide leadership, while a more wary private sector, which needs to make a profit and see tangible benefits in the short term, joins in the initiatives that it launches.

The expectation is that, in the long term, the transition to a green economy[36] will reduce energy costs, facilitate reduction of energy consumption, create jobs and improve the quality of life of citizens. Energy transition policies can also increase the pace of technological innovation in the sector, leading to a spillover of knowledge and talent in a global context of smart and sustainable cities. Finally, the public authority's initiative in this area can create a demonstration effect,[37] encouraging and inspiring other public-private projects in the energy transition sector.

### 3.2.2. Prior experiences: "Rubí brilla homeowners' associations: savings, comfort and energy"[38]

"Rubí Brilla Homeowners' Associations: Savings, Comfort and Energy" was a pilot project launched by the Rubí City Council (province of Barcelona) with the aim of establishing a work agenda to encourage savings, energy efficiency and the use of renewable energy in homeowners' associations in the city. In its first edition, the initiative sought to:

1. save energy, reduce $CO_2$ emissions, and lower electricity bills in order to create a more sustainable community;
2. improve the quality of life of citizens;
3. enhance the value of buildings participating in the project;
4. make it easier to sell or rent participating properties; and
5. extend the useful life of buildings.

[29] Conceptual foundation developed based on ideas set out in Mariana Mazzucato, *El Estado emprendedor* (Barcelona: RBA Libros, 2014).
[30] Josep Lluís de Villasante Tapias, "Barcelona emprenedora" (MES Barcelona internal document).
[31] Josep Lluís de Villasante Tapias, "La revolució industrial verda" (MES Barcelona internal document).
[32] Josep Lluís de Villasante Tapias, "Barcelona emprenedora" (MES Barcelona internal document).
[33] Josep Lluís de Villasante Tapias, "La revolució industrial verda."
[34] Josep Lluís de Villasante Tapias, "La revolució industrial verda."
[35] Josep Lluís de Villasante Tapias, "La revolució industrial verda."
[36] Josep Lluís de Villasante Tapias, "La revolució industrial verda."
[37] Josep Lluís de Villasante Tapias, "La revolució industrial verda."
[38] Information provided by the Rubí Brilla unit of the Rubí City Council, which is responsible for energy management.

The Rubí City Council identified several challenges during the implementation of the first edition of the project:

- **Demand:** 22% of homeowners' associations in Rubí decided to apply for subsidies. The buildings in question had previous architectural rehabilitation needs. No new demand was generated.
- **Heterogeneity:** Difficulties in management and decision-making within homeowners' associations were identified, mainly due to the diversity of housing types (e.g., households in energy poverty, owner-occupied and rented housing, properties owned by investment funds, elderly owners/tenants, etc.).
- **Knowledge limitations:** There was a lack of knowledge about the voting majorities needed to make decisions within homeowners' associations.
- **Perception of savings:** The savings associated with retrofits were perceived as potential, not guaranteed. Homeowners' associations had to bear the initial investment, and there were doubts about future economic savings. The explanations given to homeowners' associations were not clear enough, especially with regard to the initial investment required.

In follow-up interviews, private investors participating in the MES Barcelona program mentioned that one of the improvements of the Barcelona project compared to the Rubí initiative was greater and more direct involvement of the Barcelona City Council in the management of the project.

### 3.2.3. Description of MES Barcelona

MES Barcelona is an investment program that aims to accelerate the energy transition in Barcelona, encourage business participation and innovation in this process, generate economic activity through the creation of jobs related to the sector, and promote renewable electric power generation at the local level. The project aims to achieve improvements in areas such as the quality of the city's environment, energy saving and self-consumption, creation of energy communities, strengthening of local industry, and conversion of workers in declining industries to employment in the sector.[39]

The project starts from the premise that public-private partnerships are essential to solving the city's challenges. Within municipal expenditures, MES Barcelona takes the form of a financial investment by the City Council. The social aspect of the project is of paramount importance: It aims to ensure that the installation of photovoltaic panels goes beyond the areas with more resources and reaches the most socially disadvantaged neighborhoods, where it is more difficult for private individuals to make initial investments.[40]

The program was created after the Spanish government approved Royal Decree 244/2019, which allows for shared self-consumption of a renewable energy source within a radius of 2000 meters, giving impetus to the adoption of renewable energies.[41]

MES Barcelona is an investment mechanism endowed with €50 million within the annual budgets of the Barcelona City Council (with the possibility of being expanded in the future). The funding is allocated through the municipal budgets for fiscal years 2021, 2022 and 2023.

It is important to note that the **program is not vulnerable to changes in the political landscape of the city**, since it was set in motion by the municipal parliamentary groups of Esquerra Republicana de Catalunya (ERC) and Junts per Catalunya (JuntsxCat), and is supported by the current municipal coalition government made up of Barcelona en Comú and Partit dels Socialistes de Catalunya (PSC).

[39] Ibid.
[40] Interview with the current and former 2030 Agenda Commissioner of the Barcelona City Council.
[41] Announcement issued by the Barcelona City Council on June 9, 2021.

MES Barcelona is designed to be a vehicle for joint public-private investment. The aim is to multiply the initial public investment by involving the private sector. Investments are distributed among several types of actions:

- Active actions (installation of solar panels and other energy sources)
- Passive actions (rehabilitation of facades, windows and closures, etc.)
- Mixed actions (active and passive)
- Technological innovation actions in renewable and clean energies

These measures will be applied to assets such as residential, tertiary or service buildings of public entities and private companies, charging points (including public and private parking lots), infrastructure, industries and public spaces, as well as innovative companies in the field of energy improvement.

An essential feature of MES Barcelona is that the returns it generates must be not only financial, but above all environmental and social. The project includes various schemes for co-investment by private and/or public entities, as well as other forms of investment. The most prominent example of a co-investment scheme is the creation of an **SPV** (special purpose vehicle) in which the city of Barcelona will be able to acquire a 30% stake.

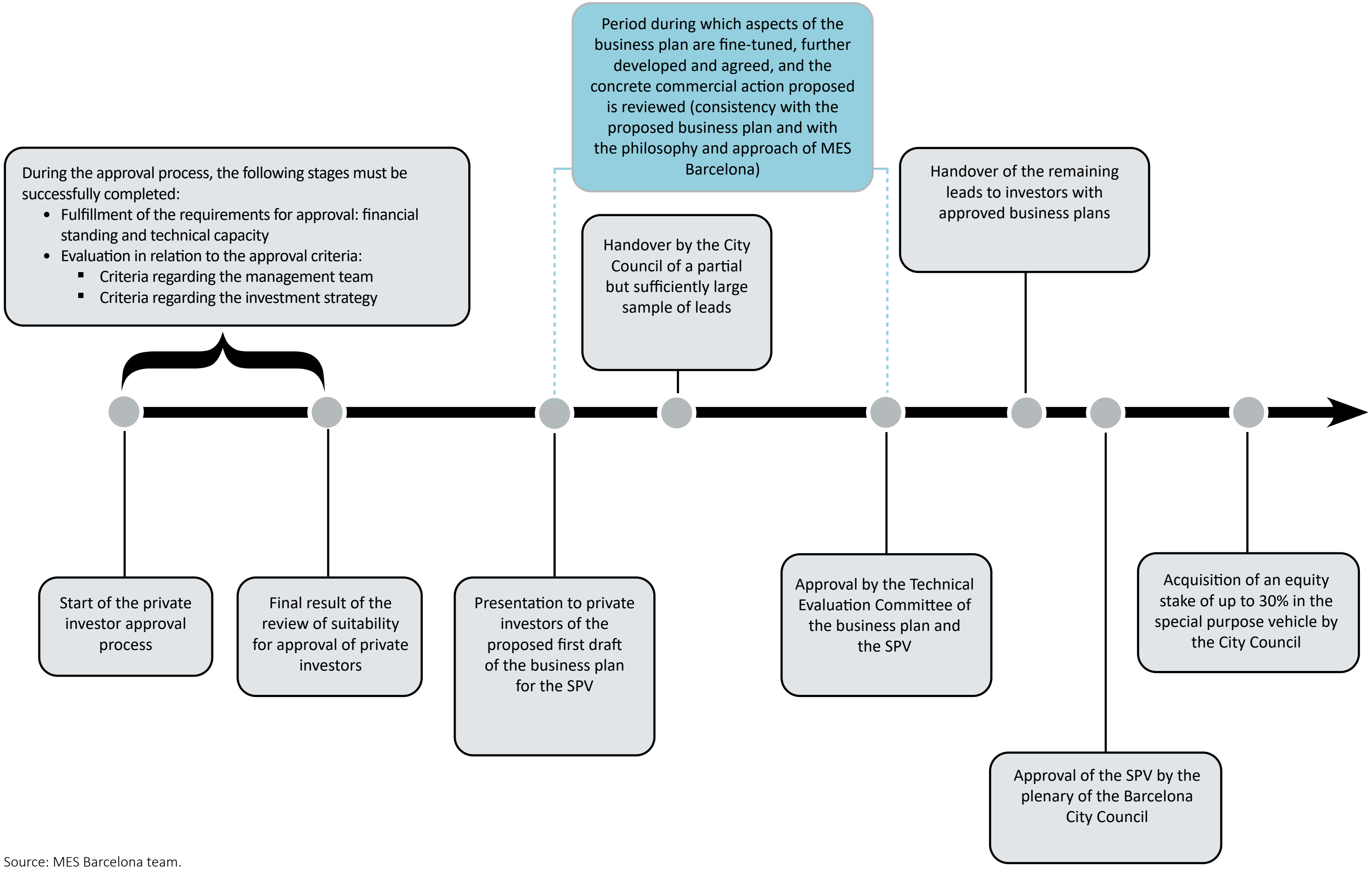
**All private investors must go through an approval process** as a necessary condition for any investment related to the MES Barcelona initiative. The approval process is based on the one used for the start-up investment program of the Center for the Development of Industrial Technology (CDTI).[42] In this public-private co-investment scheme, there must be an alignment of interests between the two investing parties. In addition to being approved, private investors must propose, evaluate, implement and actively participate in the management of the projects they submit.

**The administrative procedure for a project consists of several stages:** a) fulfillment of the approval requirements; b) evaluation of applications according to the approval criteria; and c) setting-up of an investee company (the SPV) by means of a co-investment agreement.

The details of the administrative procedure for the MES Barcelona project, from the start of the approval process to the point at which the City Council acquires a stake in the SPV, are shown below in **Figure 21:**

[42] Interview with the current and former 2030 Agenda Commissioner of the Barcelona City Council.

**Figure 21. Administrative process for establishing a public-private partnership**




Source: MES Barcelona team.

Broadly speaking, SPVs can be grouped into the following categories:

- **Residential SPV:** Used to carry out residential projects submitted to MES Barcelona through its website, when a citizen (directly or represented by a property manager or equivalent) shows interest in carrying out a photovoltaic energy project at the property where they live, by requesting information or directly submitting a proposal in the form of a quotation.
- **Collective SPV:** Used to carry out non-residential projects—that is, projects initiated by MES Barcelona in the institutional, industrial or service sectors, whose investment volume does not justify the creation of a specific SPV, but which can be grouped in a single SPV in order to optimize the use of financial and administrative resources. This category includes projects ranging from 50 kWp to 1.5 MWp.
- **Individual SPVs:** A single SPV for each of the largest projects (over 1.5 MW installed).

### 3.2.4. ESG analysis of MES Barcelona[43]

ESG (environmental, social, governance) analysis focuses on issues related to the environmental, social and governance impact of an institution, the three main areas of sustainable investment. Investors evaluate companies using ESG criteria to assess the impact of an investment and the risks it entails. These indicators play an increasingly important role in the decisions of many investors.

In this regard, it is important to note that renewable energy projects deliver tangible benefits in areas such as:

- Air pollution
- Energy prices
- Climate change
- Health and well-being
- Local supply
- Reducing depletion of energy resources
- Energy savings
- Employment

To assess the impact of MES Barcelona, 16 key impact indicators (KIIs) that cover benefits in different areas were selected:[44]

| Key impact indicators | |
|---|---|
| Thermal energy efficiency | Direct job creation |
| Electrical energy efficiency | Avoided particulate emissions |
| Total primary energy savings | Avoided photochemical ozone formation |
| Reduction of GHG emissions | Acidification potential avoided |
| Social ROI[1] taking climate change damages into account | Avoided ozone depletion potential |
| Percentage of service contracts that provide a contractual warranty | Social ROI (due to avoided air pollution damage) |
| Percentage of energy from renewable sources | Cost avoided due to availability of fossil resources |
| Percentage of local energy | Disability-adjusted life years (DALY) |

[1] A measure of the return on an investment that includes not only economic, but also social and environmental benefits.

[43] Information and data provided by Inveniam Group, a company that provides technical and financial advice to MES Barcelona.
[44] The methodologies used by the MES Barcelona technical team for this assessment include the DPSIR (Drivers–Pressures–States–Impacts–Responses) framework, the TIMM (Total Impact Measurement & Management) framework, and a Pressure–State–Impact (PSI) approach for assessing pressure indicators.

The initial goal of MES Barcelona was for the City Council to invest €50 million. Taking into account public investment, private investment and leverage financing from banks, the total investment would be €166 million. A total installed capacity of 83 MWp was planned for this total investment.

At this point, the City Council has made investment commitments of €11.07 million through agreements signed with private investors. This public investment, together with private investment and leverage financing, has mobilized a total of €75.62 million. With this level of investment, the business plans signed with the various private investors envisage a total installed capacity of 87.23 MWp, which exceeds the initial installation target.

Two factors made it possible to surpass the installed capacity targets with an investment significantly lower than the amount that MES Barcelona believed would be required. First, the agreed CAPEX cost has been very significantly reduced compared to the initial forecasts thanks to the negotiations carried out in relation to the various projects agreed with approved investors. The second factor is the inclusion of leverage financing in the SPVs created. Thanks to these factors, with fewer public capital resources committed, the initial installation target has been met and even exceeded.

Based on these figures, a projection has been made for the future of the project: If the public funds committed to date (€11.07 million) mobilized a total of €75.62 million and delivered 87.23 MWp of installed capacity, then if the initial investment target of €50 million is achieved, €341.55 million would be mobilized and a total of 394 MWp could be installed—a level of installed capacity almost five times higher than originally planned (see **Table 4**).

## Table 4. MES Barcelona: Initial targets, current situation and projection[45]

| | Public investment (€million) | Total investment mobilized (€million) | Installed capacity achieved (MWp) |
|---|---|---|---|
| Initial target | 50.00 | 166.00 | 83.00 |
| Current situation | 11.07 | 75.62 | 87.23 |
| Current projection with €50 million of public investment | 50.00 | 341.55 | 394.00 |

Source: Inveniam Group.

According to this projection, assuming that all investment is in photovoltaic panels to generate electricity from a green, local and renewable source, the impact would be as follows:

- Photovoltaic system: 394 MWp of solar panels installed
- Electricity produced: 531,900 MWh/year
- Total investment: €341.55 million
- Project life: 30 years

The installation of these photovoltaic systems would reduce many types of emissions (see **Figure 22**), which in turn would have a significant impact in terms of avoided costs due to increased availability of fossil fuels and avoided costs due to increased well-being. Total avoided costs could amount to €26,700,306 (see **Figure 23**).

Finally, considering that every million invested in photovoltaic plants generates about four jobs, the mobilization of €341.55 million could generate 1,366 new jobs in long-term projects, providing quality employment and further developing the local sustainable energy market.

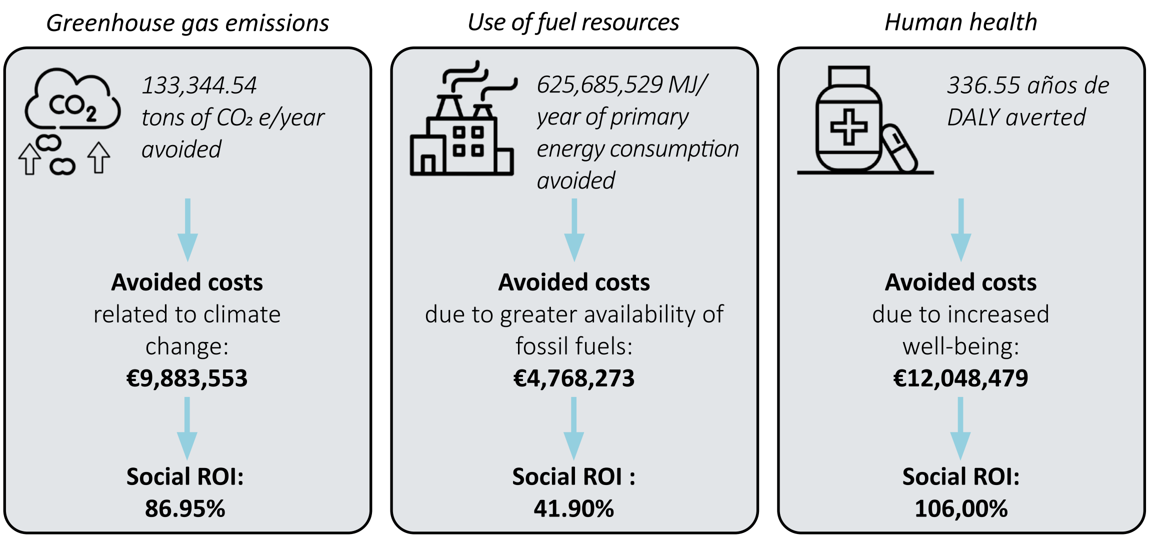
[45] Information and data provided by Inveniam Group, a company that provides technical and financial advice to MES Barcelona.

## Figure 22. Projected emission reductions attributable to the activity of MES Barcelona[46]

| AVOIDED EMISSIONS | | | |
|---|---|---|---|
| **Emission type** | **Amount** | **Units** | **Effect** |
| $CO_2$ equivalent | 133,344.54 | tons/year | Global warming |
| PM10 equivalent | 327,794.08 | kg/year | Threat to health |
| NOx equivalent | 665,693.76 | kg/year | Photochemical ozone generation |
| $SO_2$ equivalent | 1,420,721.50 | kg/year | Acidification |

Source: Inveniam Group.

## Figure 23. Avoided social costs and total social IRR projected for MES Barcelona[47]




| Total social costs avoided | Total social ROI |
|---|---|
| **€ 26,700,306** | **234.90%** |

Source: Inveniam Group.

### 3.2.5. Initial indicator data for MES Barcelona

To complement the previous section, a more granular description of initial data collected on the implementation of MES Barcelona projects, presented in February 2023, is provided below in **Figure 24**.[48]

- The City Council has reached agreements with five approved investors to **set up nine joint SPVs**:
  - – Six SPVs are for public, industrial and service buildings (€57.52 million of investment).
  - – Three SPVs are for the residential market (€18.10 million of investment).

[46] Information and data provided by Inveniam Group, a company that provides technical and financial advice to MES Barcelona.
[47] Information and data provided by Inveniam Group, a company that provides technical and financial advice to MES Barcelona.
[48] MES Barcelona internal document: "Balanç a 24-02-23."

- Together, these SPVs would represent an installed capacity of 87.23 MWp (more than the City Council's target of 83 MWp), for which the City Council will only have to invest €11.07 million (22.15% of the planned investment of €50 million).
- The **total investment will be €75.62 million,** provided by the City Council (14.65%), approved investors (34.48%) and through SPV leverage financing (50.8%).
- In terms of ESG impact indicators, these projects would deliver the following results:
  - Global warming: reduction of 28,618 tons per year of $CO_2$
  - Health: reduction of 70,351 kg of PM10 per year
  - Social benefit: €5,730,410 per year in avoided social costs
  - Economy: 349 jobs created
- There are currently 17 approved investors, and agreements have been reached with five of them (Acelera, Atlas, EIDF, RUBAU and Sorigué).
- The number of requests for information about the project (leads) has already reached 1,500 for buildings, the vast majority of which are residential. Information has been requested from 750 leads, and concrete proposals have been presented to over 100.

# Figure 24. Initial results for MES Barcelona

| | | Overall objectives | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Financial investment commitment of the City Council (max. 30% capital investment), in €m** | **Minimum total investment through MES Barcelona (in €m)** | **Power to be installed (in MWp)** | **ESG impact indicators (provisional)** | | | | | | | | | |
| | **Budget 2021–23** | **50.00** | **166.00** | **83.00** | **Global warming** | **Photochemical ozone formation** | **Acidification** | **Health** | **Savings in human health** | **Overall assessment of social benefit** | **Economy** | **Social return** | | |
| | **% achievement of budget-related targets with respect to overall objectives** | 22.15% | 45.55% | 105.10% | $CO_2$ equivalent reduction (in tons/year) | NOx equivalent reduction (in kg/year) | $SO_2$ equivalent reduction (in kg/year) | PM10 equivalent reduction (in kg/year) | Avoided costs due to increased well-being (in €/year) | Total avoided social costs for the project (in €/year) | Estimated number of jobs created | Social ROI of the project over 30 years | Overall social IRR of the project over 30 years |
| | **2022: Overall budget for SPV investment projects** | **11.07** | **75.62** | **87.23** | **28,618** | **142,871** | **304,915** | **70,351** | **2,585,840** | **5,730,410** | **349** | **225.60%** | **6.40%** |
| | **Subtotal indust-serv-public** | **8.49** | **57.52** | **73.42** | **24,118** | **120,404** | **256,965** | **59,288** | **2,179,202** | **4,829,271** | **293** | **249.60%** | **7.41%** |
| | **Subtotal residential** | **2.58** | **18.1** | **13.81** | **4,500** | **22,467** | **47,950** | **11,063** | **406,638** | **901,139** | **55** | **149.40%** | **2.81%** |
| Acelera | SPV1 (indust-serv-public) | 1.29 | 8.6 | 11.15 | 3,634 | 18,141 | 38,717 | 8,933 | 328,337 | 727,620 | 45 | 253.70% | 7.49% |
| Sorigué | SPV2 (indust-serv-public) | 3.03 | 10.1 | 8.33 | 2,715 | 13,553 | 28,925 | 6,674 | 245,296 | 543,594 | 33 | 161.50% | 3.42% |
| Sorigué | SPV3 (residential) | 0.93 | 3.1 | 2.5 | 815 | 4,068 | 8,681 | 2,003 | 73,618 | 163,143 | 10 | 157.90% | 3.24% |
| EIDF | SPV5 (indust-serv-public) | 1.05 | 10 | 13.85 | 4,514 | 22,534 | 48,092 | 11,096 | 407,845 | 903,815 | 55 | 271.10% | 8.18% |
| RUBAU | SPV6 (indust-serv-public) | 1.35 | 15 | 20 | 6,518 | 32,540 | 69,447 | 16,023 | 588,946 | 1,305,147 | 80 | 261.00% | 7.78% |
| RUBAU | SPV7 (residential) | 0.9 | 10 | 7.14 | 2,328 | 11,622 | 24,803 | 5,723 | 210,342 | 466,133 | 29 | 139.80% | 2.32% |
| Atlas | SPV8 (indust-serv-public) | 1.5 | 10 | 14.29 | 4,656 | 23,243 | 49,606 | 11,445 | 420,684 | 932,267 | 57 | 279.70% | 8.52% |
| Atlas | SPV9 (residential) | 0.75 | 5 | 4.17 | 1,358 | 6,778 | 14,466 | 3,338 | 122,677 | 271,862 | 17 | 163.10% | 3.50% |
| Mercabarna/Acelera | SPV 4 (industry specific) | 0.27 | 3.82 | 5.81 | 2,082 | 10,392 | 22,179 | 5,117 | 188,093 | 416,828 | 23 | 273.10% | 10.35% |

Source: MES Barcelona team.

# 4. Early challenges and the future of MES Barcelona

Since its approval in December 2020,[49] the MES Barcelona project has brought its first approved investors on board and a number of projects to extend the installation of photovoltaic panels in Barcelona have been given the green light.

However, since the implementation phase began, the project has also faced challenges and there is scope for improvement. Based on multiple personal interviews and two workshops with the various public and private actors involved in the project, the IESE's PPP for Cities research center has identified the main challenges facing this project in different areas, which are outlined in the following sections.

## 4.1. Approval and bureaucratic process

The main challenges and opportunities for improvement identified with respect to approval of investors and the bureaucratic process are as follows:

- *Mixed results in initial interactions between private investors and the City Council.* Although many initial interactions between private investors and the City Council led to positive outcomes, some did not. In some cases, the local authority received requests for information about the approval process, but after being informed of the requirements with regard to financial standing, the interested parties did not go on to submit applications.[50]

  Of the 17 investors that were ultimately approved, it was not possible to move forward with all of them on a joint and shared investment project due to difficulties in finalizing an agreed and effective co-investment commitment in accordance with the co-investment framework agreement signed during the approval process. For example, in the case of one investor, after lengthy negotiations, a collaboration agreement was ultimately proposed instead of a co-investment; with another investor, a co-investment proposal was considered as an alternative to the creation of an SPV, but the proposal did not lead to a concrete operational outcome. In both cases, considerable time and effort was expended in an attempt to reach an agreement, but at the final and critical stage, this proved impossible, or the proposed agreement directly contravened the previously signed framework co-investment agreement. In other cases, although the Catalan authorities expressed interest, the central Spanish authorities did not give final approval to a joint co-investment project. Finally, there are a number of approved investors whose projects have not been finalized because they are waiting for the right time to raise the matter internally.[51]

  In any case, as mentioned above, successful outcomes have been achieved with five approved investors. In these cases, the parties have signed co-investment plans consistent with the framework agreement for co-investment through the creation of up to nine SPVs targeting the residential, industrial, service and public sector markets.

- *Approval process.* Some participants were able to complete the approval process without any problems, while others experienced some administrative slowness[52] and found the procedures and rules for participation unclear.[53] There were requests from some participants to increase the flexibility of the approval process.[54]

- *Approval and tender procedures.* Pursuant to Law 9/2017, of November 8, on Public Sector Contracts, approved private investors are required to participate in public tenders. Approval to

[49] Announcement issued by the Barcelona City Council on June 9, 2021.
[50] Interview with the MES Barcelona team.
[51] Interview with the MES Barcelona team.
[52] Interviews with actors involved in MES Barcelona.
[53] Workshop 1, MES Barcelona.
[54] Workshop 1, MES Barcelona.

participate in the MES Barcelona program does not exempt them from this requirement.[55] Some private investors thought that they would not be required to participate in tenders and that the procedure would resemble the one used by the Central de Compres del Món Local (the central purchasing body for local entities) of the Catalan Association of Municipalities (ACM).[56] The ACM, through its central purchasing body, makes purchases throughout Catalonia for public authorities. The association currently includes 945 local councils. The central purchasing body conducts its own tender procedures, and municipalities can join if they wish to. Tenders are used for contracts related to electricity, gas, charging points, and public lighting, among other matters. Some investors thought that MES Barcelona would take this approach, but according to the City Council,[57] the tender procedure linked to the program offers advantages and is more straightforward. First, only investors who have been competitively approved in tenders for specific public projects can participate; second, less documentation is required than in regular tenders, since the approval process includes the submission of documentation that ensures the technical capacity and economic standing of approved investors. As a result, the process can be completed more quickly.

- *Bureaucratic rigidity.* Some private investors think that bureaucratic hurdles should be reduced and more flexible treatment should be offered for on-site[58] PPA projects within the framework of MES Barcelona. The City Council has responded that it is in the process of getting to know all of the actors in the bureaucratic process in order to understand the reasons for delays in the granting of approval and to establish timelines for action to cut the time it takes to complete processes and reduce margins of error.[59] Because this is an innovative and unprecedented project, the City Council has had to take on new challenges and embrace new concepts, a process that is not always quick or easy.[60]

## 4.2. Finances and business model

The main challenges and opportunities for improvement identified with respect to finances and the business model are as follows:

- *Single co-investment vehicle for all types of investors.* Once approved, some high-value private investors have found it problematic to have to articulate the co-investment agreement in the form of an SPV and have raised the possibility of using other financial structuring models.[61] However, on this point, it is important to note that the framework co-investment agreement signed by all approved investors prior to the completion of the approval process does not envisage mechanisms such as a loan, subsidy or non-repayable grant, since MES Barcelona is defined as a co-investment mechanism. In some cases, the creation of a new legal entity, such as an SPV, is not feasible because it does not fit in with the investor’s corporate structure.[62] This issue led two approved investors to propose alternative mechanisms to the City Council. In one case, the proposal consisted of a collaboration agreement that did not fit within the framework of the MES Barcelona co-investment agreement, as it provided for all the financing to be contributed by the investor. The proposal was rejected because it would have led to confusion, unfairness and unequal treatment; that is, different requirements and obligations for different investors when the purpose was theoretically the same.[63] In the other case, the approved investor proposed that they enter into a contrato de *cuentas en participación* (contractual joint venture). This type of contract (regulated by the Commercial Code) allows several companies to collaborate on a business project without creating a new legal entity. In this arrangement, there is a managing partner and one or more financial partners who make monetary contributions. The proposal was for the City Council

[55] Interview with private investors within the framework of MES Barcelona.
[56] Central purchasing body of the Catalan Association of Municipalities: **https://www.acm.cat/compres**.
[57] Interviews with actors involved in MES Barcelona.
[58] In an on-site PPA, the photovoltaic installation is located on the customer's premises. In an off-site PPA, the installation is located at another site and the customer receives the energy through the electric grid.
[59] Interviews with actors involved in MES Barcelona.
[60] Interview with the MES Barcelona team.
[61] Workshop 1, MES Barcelona.
[62] Workshop 1, MES Barcelona.
[63] Interview with the MES Barcelona team.

to participate as an investor, providing liquidity to the business and sharing in the returns of the project. However, the City Council is reluctant to enter into a contract of this type. In a contractual joint venture, a participant provides assets or rights to a manager who incorporates them into the assets used to conduct the business. In this case, the City Council would be the participant and the private investor would act as the manager. The latter would make annual payments to the participant in the contract based on the returns generated. There would also be a clause allowing the participant to remain in the contract for fewer years than originally planned (similar to an exit mechanism). A contractual joint venture, which does not involve the creation of a separate legal entity or give rise to jointly controlled assets, is an arrangement that avoids creating a joint SPV.

- *This type of contractual solution poses a problem*, namely the difficulty of ensuring that commercial proposals presented within the framework of MES Barcelona do not deviate from the program's main strategic lines, such as the "win-win" formula (customer-investor). The City Council is wary of the fact that under this type of contract, the participant's money is deposited in a bank account and does not become part of a pool of joint assets. Moreover, the private investor in this case operates under a cash pooling system.[64] The sum of these factors meant that the proposal would need to meet a number of information requirements intended to ensure effective oversight and control by a local public authority that operates with citizens' money to carry out its investments and must closely monitor operations and track invested capital.[65] The measures requested by the City Council to validate this type of co-investment via a contractual joint venture included access to information on the evolution of balances and on-line consultation of debits and credits of accounts; a table of movements, balances and accounts provided on a regular basis to facilitate analysis of investment projects at an individual level and to see the associated return in each case; and greater specificity regarding the cash pooling mechanism, with a model that would ensure that the City Council's funds would not finance the overall cash position of a private company, without any set time horizon. Despite an initial commitment to submit a concrete proposal that would meet the City Council's information and management requirements, at the time of writing, the company that proposed this arrangement has yet to do so, which may indicate that it has lost interest in the project.[66]

- *Insufficient leads.* With respect to the importance of leveraging economies of scale and increasing the number of end customers with whom project contracts can be signed, some investors see the number of leads provided by the City Council as too small to generate attractive financial returns.[67] The City Council wants to strengthen alignment and internal communication to involve more buildings and public entities in the MES Barcelona program. The managers responsible for this mechanism believe that it works well, but slowly, because moving forward depends too much on autonomous action, and there is less municipal support than MES Barcelona managers think would be needed to advance in a more agile way. Feedback from approved investors suggests that once they see that progress is being made at a faster pace, more human and commercial resources will be dedicated to collaborating with the MES Barcelona program. In any case, it is thought that greater internal coordination and an agreed and defined list of municipal buildings suitable for investment through MES Barcelona would be of great help.[68] At the same time, once the model for infrastructure investment through SPVs is more established, the possibility of direct co-investment in small and medium-sized companies in the renewable energy installations sector—allowed under the framework co-investment agreement signed by participants during the approval process—should be explored.

- *The "energy community" concept.* Some private investors have serious doubts about what the concept of an "energy community" implies. It is not clear who would make the investment in such a "community," and this creates uncertainty for the banks that could finance the projects. While energy communities can be a way to optimize the use of roofs and consumption, it is important to note that this requires mechanisms to facilitate coordination of efforts, as the easiest option for many private companies is to act individually. The spaces where energy communities for non-

[64] See list of definitions.
[65] Interview with private investors within the framework of MES Barcelona.
[66] Interview with the MES Barcelona team.
[67] Interview with private investors within the framework of MES Barcelona.
[68] Interview with the MES Barcelona team.

residential use are considered most viable are industrial parks. The goal would be to aggregate demand and get several private companies located in the same industrial park to agree to such an arrangement. To encourage the creation of such communities, it is considered important that a large private company, or one with a large roof area, start the project so that others will decide to come on board when they see the benefits.[69]

Some investors believe that municipal services and buildings could lead the way in creating energy communities. For example, it was pointed out that there are large areas that are ideal for the installation of photovoltaic panels, but without effective consumption, as in the case of some cemeteries. In such cases, it makes sense to supply energy to nearby homeowners' associations with greater demand. Regarding this possibility, the City Council is considering self-consumption projects in energy communities with Barcelona Municipal Services (B:SM)[70] and the Poble Nou and Sant Andreu cemeteries, given the interest already expressed by some of the most active private investors.[71]

## 4.3. Residential projects

The main challenges and opportunities for improvement identified with respect to residential projects are as follows:

- *Lack of incentives.* The various actors interviewed reported a lack of incentives or of the information needed to get self-consumption projects started in residential buildings. Investors considered these buildings less attractive than public buildings or spaces with more extensive photovoltaic installations. In addition, small property owners and homeowners' associations do not always have sufficient information or procedural tools to participate in projects like MES Barcelona.
- *Variety of end consumers, housing turnover and market fragmentation.* Several investors highlighted the fact that the particular circumstances of people residing in a dwelling for a given period of time vary significantly. One factor that is becoming increasingly important in Barcelona's urban housing landscape is renting, the option chosen by 38% of households in 2021.[72] This is considered a risk for MES Barcelona Residential projects in relation to its plans for on-site PPA projects in the field of photovoltaic installation. To calculate the size and power of an installation of this type for self-consumption, it is necessary to estimate the expected individual consumption of the residents. This step is essential to ensure a good financial return over the 10–15 years that the installation will be owned by the investor before being handed over to the customer. If the number of people living in a particular household varies greatly, the difficulty of calculating a cost-effective installation increases. However, according to the City Council, MES Barcelona is aimed at homeowners in buildings, and it is they, not tenants, who will consume the energy produced. Tenants and owners in buildings with a flat roof that is not designed for foot traffic or a shaded roof can access the energy generated indirectly, through shared self-consumption or via energy communities that can be developed at prices which improve on their usual electricity costs. In the case of buildings with roofs that produce more energy than the occupants consume, individual consumers or businesses can be added one by one, but initially MES Barcelona would arrange installations and sign investment contracts with the homeowners in a building.[73]

  Some investors also emphasize the problem of resident turnover due to changes of primary residence, which makes it difficult to forecast cash flows for planned investments. This makes residential projects less attractive to private investors, even when the effective distance from the point of generation to the point of consumption is extended.[74] However, it is argued that the

[69] Workshop 2, MES Barcelona.
[70] Barcelona Municipal Services is a company owned by the Barcelona City Council that brings municipal services in different areas together in a single company.
[71] Interviews with actors involved in MES Barcelona.
[72] "Los hogares que viven de alquiler en Barcelona aumentan hasta el 38%," *El País*, October 12, 2021, **https://elpais.com/espana/catalunya/2021-10-12/los-hogares-que-viven-de-alquiler-en-barcelona-aumentan-hasta-el-38.html**.
[73] Interviews with actors involved in MES Barcelona.
[74] Interview with private investors within the framework of MES Barcelona.

fragmented rental market poses less risk than a single very large customer with unique electricity consumption preferences. In a fragmented sector, there is a churn of residents, which creates a balance and reduces risk compared to the scenario of a single large customer. In other words, the risk is spread across thousands of customers, even though administrative management involves more work and requires tighter control. Given this fragmented market, some investors believe that a guarantee fund for MES Barcelona Residential would be a positive step.

- *The importance of having a single manager.* Several private investors stressed the importance of having a single self-consumption manager, that is, someone who acts as a single point of contact for both customers and retail suppliers and who has all the necessary information centralized. In the case of apartment buildings, this role could be fulfilled by property managers, who are trusted by the homeowners' associations they serve and can make impartial recommendations.[75]

- *Implementation process.* The implementation process for MES Barcelona Residential is slow because there are a series of steps that must be taken. Homeowners' associations contact the City Council, which forwards these leads to the approved companies, who then contact the president of each association. An analysis is made and the feasibility of each project is studied. If it is determined that a project is feasible, the resulting proposal must be approved at a meeting of the homeowners. All these steps take time.[76] However, according to the City Council, this slow pace is not limited to the MES Barcelona project, but affects the entire market of companies in the sector, due to the many steps involved: participation of multiple actors, calculations, design of installations, preparation of financial models, preparation of proposals and, finally, waiting periods during the customer's decision process, which in some cases involves a large number of residents.

## 4.4. Electric grid and distribution

The challenges and opportunities for improvement identified with respect to the electric grid and distribution are as follows:

- *Difficulties faced by distribution system operators.* Distribution system operators (DSOs), key actors in the MES Barcelona project, have encountered a number of problems in serving the solar photovoltaic market. First, according to one DSO, reconciling all the information provided by the participants in a self-consumption project poses a considerable challenge. Even though they are all part of the same project, they may have different retail suppliers, so the information the DSO receives will come from different companies. The DSO must know the number of participants, the amount of power injected into the grid, and the allocation coefficients of the participants. It must then check that all the numbers add up, a rather complex process that could be made easier by ensuring that there is a single manager for each project.

  In addition, when a request for access to the grid is made, the DSO submits a proposal for a connection point, and a response must be received within just 30 days (a deadline imposed by the regulator in order not to tie up power that other applicants may request). This deadline is considered very tight by some public authorities. Finally, DSOs have also encountered difficulties in installing some metering equipment required for self-consumption due to lack of space in cabinets or meter rooms. The high additional cost of expanding the installation space represents an extra cost for solar customers

- *Slowness and uncertainty generated by DSOs.* The delays experienced by self-consumption customers in receiving their first bills were identified as a problem by some private investors and the City Council. In this case, DSOs have the capacity to accelerate the process. If it takes months for their first bill to arrive, self-consumption customers may feel insecure and uneasy as they go through a period of uncertainty, wondering if it was a good decision to switch to self-consumption. The DSOs argue that although they are primarily responsible for this process, it could be expedited if there was a single manager to act as a point of contact for each project.[77]

[75] Workshop 2, MES Barcelona.
[76] Interview with private investors within the framework of MES Barcelona.
[77] Workshop 2, MES Barcelona.

- *Sizing of the electrical distribution network.*[78] Barcelona has a lot of sun and space with the potential to generate photovoltaic energy, but in some cases there could be a problem with respect to power line planning, in the sense that there is not always enough grid capacity, which means that for requests with high power requirements, the evacuation system required to connect to the grid can be costly. This is something that is occurring in different areas of the Iberian Peninsula and in non-urban areas of Catalonia. For very high power needs, there is a perception (on the part of different actors) that this issue is not being addressed quickly enough in Spain and that the distribution grid has limitations in some areas and is not being adapted to the speed of implementation required for decentralized generation of renewable energy. Therefore, grid planning, defined by the DSOs and agreed with the public authority, must take these points into account.

  The criteria for determining whether or not there is connection capacity in the grid are regulated at the state level. Since storage capacity for photovoltaic energy is limited, it is important that the energy produced is consumed immediately; otherwise, self-consumption systems are not economically viable due to the inability to evacuate the generated power or the high cost of evacuation. Some of the private investors interviewed said that there are problems of this kind with photovoltaic power plants and wind farms.

  In the specific case of Barcelona, Endesa Distribución maintains that the existing network and substations have sufficient capacity to absorb the energy generated. When a connection is requested, the DSO conducts a study and determines and indicates the point to which the potential consumer should be connected. Applicants must initiate this process without knowing whether or not work will be required to establish the connection. This poses an agility problem for applicants, who must dedicate resources to prepare and submit an access and connection request for each case. Applicants receive a work budget from Endesa Distribución, which must be executed or delegated. In any case, they will have to bear the cost of the work required to establish the connection.

## 4.5. Other issues

- *Communicating the model to end customers.* Many end users have found it difficult to understand how the MES Barcelona model works, including the benefits (economic, fiscal and health), but also the limitations and conditions that apply. The private investors and the City Council agree that there is room for improvement in the communication of the project.[79,80]
- *Political heterogeneity*. Some private investors have highlighted the challenge posed by a lack of coordination and the separation between MES Barcelona and the Barcelona Energy Agency.[81]
- *KPIs.* The following indicators were proposed to quantify the results achieved by MES Barcelona: lead conversion ratio, investment ratio per watt of power from solar panels (€/Wp), project profitability in the first and subsequent years, total and average installed peak power, energy savings achieved, social ROI and social costs avoided, energy production, and the number of residential buildings to which energy is sold.[82] All of these KPIs were already being considered, calculated and monitored by the project managers.[83]

[78] Based on interviews with private investors, Endesa Distribución and the MES Barcelona team.
[79] Workshop 1, MES Barcelona.
[80] Interviews with actors involved in MES Barcelona.
[81] Workshop 2, MES Barcelona.
[82] Workshop 1, MES Barcelona.
[83] Interview with the MES Barcelona team.

## 4.6. Internal challenges and the future of MES Barcelona[84]

The main internal challenges and future prospects of the project that is the subject of this report are as follows:

- *Absence of major energy sector players.* Although the project has been successful in attracting approved companies and creating SPVs, the MES Barcelona team recognizes that for various reasons it has not succeeded in attracting large companies in the energy sector. The absence of these big players has made it difficult to respond to the enormous number of leads (over 1,500) obtained at the start of the project.
- *Marketing.* The MES Barcelona team admits that when the project was launched they expected a higher level of commercial activity from approved investors. Confidence that companies will act as the primary commercial actors has waned. The MES Barcelona team has come to the conclusion that they should take the lead when it comes to contacting customers, both because they have the most incentives to take a proactive approach and because they can generate a high level of trust. They have also concluded that this means strengthening and expanding the commercial team at MES Barcelona. Another matter under discussion is the need to revise the approval process to include more commercial commitments on the part of approved investors.
- *Municipal facilities as a priority investment.* The City Council has decided that the project's mission is not to ensure that all buildings have photovoltaic panels, but that all buildings receive zero-emission energy, either from their own panels, through self-consumption, or via energy communities. To achieve this, it is important to have large projects that drive the sector forward and generate investor interest. Accordingly, it has been concluded that the first category of buildings that should be targeted for the installation of photovoltaic panels are municipal facilities and large public buildings. The most notable success story in this regard is the case of Mercabarna. The next area to be explored is the industrial sector. The MES Barcelona team has already held preliminary discussions with business associations representing companies located in industrial parks in Barcelona. As for residential projects, it has been concluded that those financed must be clearly viable and have sufficient scale or aggregation of demand to attract investor interest.
- *Consolidation and future strengthening of MES Barcelona.* One of the main conclusions drawn by the team is that the MES Barcelona project needs to be institutionally consolidated and have a larger internal team working on it full time, especially in marketing and management. For this to happen, the team believes it is essential to have a clear political directive that MES Barcelona is a priority project for the city's energy transition. A future option to be explored is the possibility of MES Barcelona being managed by a public energy company such as TERSA, which could contribute to the consolidation and continuity of the project. MES Barcelona could benefit from TERSA's experience and resources, including its commercial team, as well as the flexibility that comes from working through a public company rather than the City Council.

[84] Interview with the current and former 2030 Agenda Commissioner of the Barcelona City Council.

# 5. Conclusions

- In the context of the current energy crisis, committing to renewable energies has a positive environmental, economic and geopolitical impact.
- In the case of Barcelona, there is ample scope to increase the installation and production of solar photovoltaic energy, which would benefit both household and business economies, while reducing pollution levels and contributing to the global fight against the effects of climate change.
- The **UN's 2030 Agenda** and the SDGs provide an ideal framework through which the city of Barcelona can develop its strategy and implement various actions focused on a sustainable energy transition.
- In this context, the **MES Barcelona** project aims to promote the city's energy transition through **public-private partnerships**. In its first months of operation, MES Barcelona has focused on **co-investing in solar photovoltaic projects** in residential and non-residential buildings.
- The results of the interviews conducted and workshops held with the various actors involved in the project show that MES Barcelona is making progress and has attracted a number of private investors, but that the program also faces a series of challenges and there are areas for improvement.
- Early data from MES Barcelona is promising and underscores the potential for further public-private partnerships in other key sectors involved in the city's energy transition.

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- **David Martín de Bustos**, CEO of Eco2Next Solutions
- **Bàrbara Pons**, 2030 Agenda Commissioner of the Barcelona City Council
- **Griselda Ral**, Product and Operations Coordinator, Distributed Generation at Naturgy
- **Raúl Ramos**, Energy Efficiency Delegate at Ferrovial / Energy Solutions
- **David Rial**, Director for Catalonia at EiDF Solar
- **Miquel Rodríguez**, former 2030 Agenda Commissioner of the Barcelona City Council
- **Jordi Sarradell**, Head of Institutional Relations and Regulation, General Management in Catalonia at Endesa
- **Jordi Valls**, General Manager of Mercabarna
- **Josep Lluís de Villasante**, Secretary of the Technical Evaluation Committee of MES Barcelona
- **Lorenzo Viñas**, President of the Colegio de Administradores de Fincas de Barcelona-Lleida
- **Lorenzo Josep Vives**, Data and Digitalization Technician in the Rubí Brilla Unit, Rubí City Council

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