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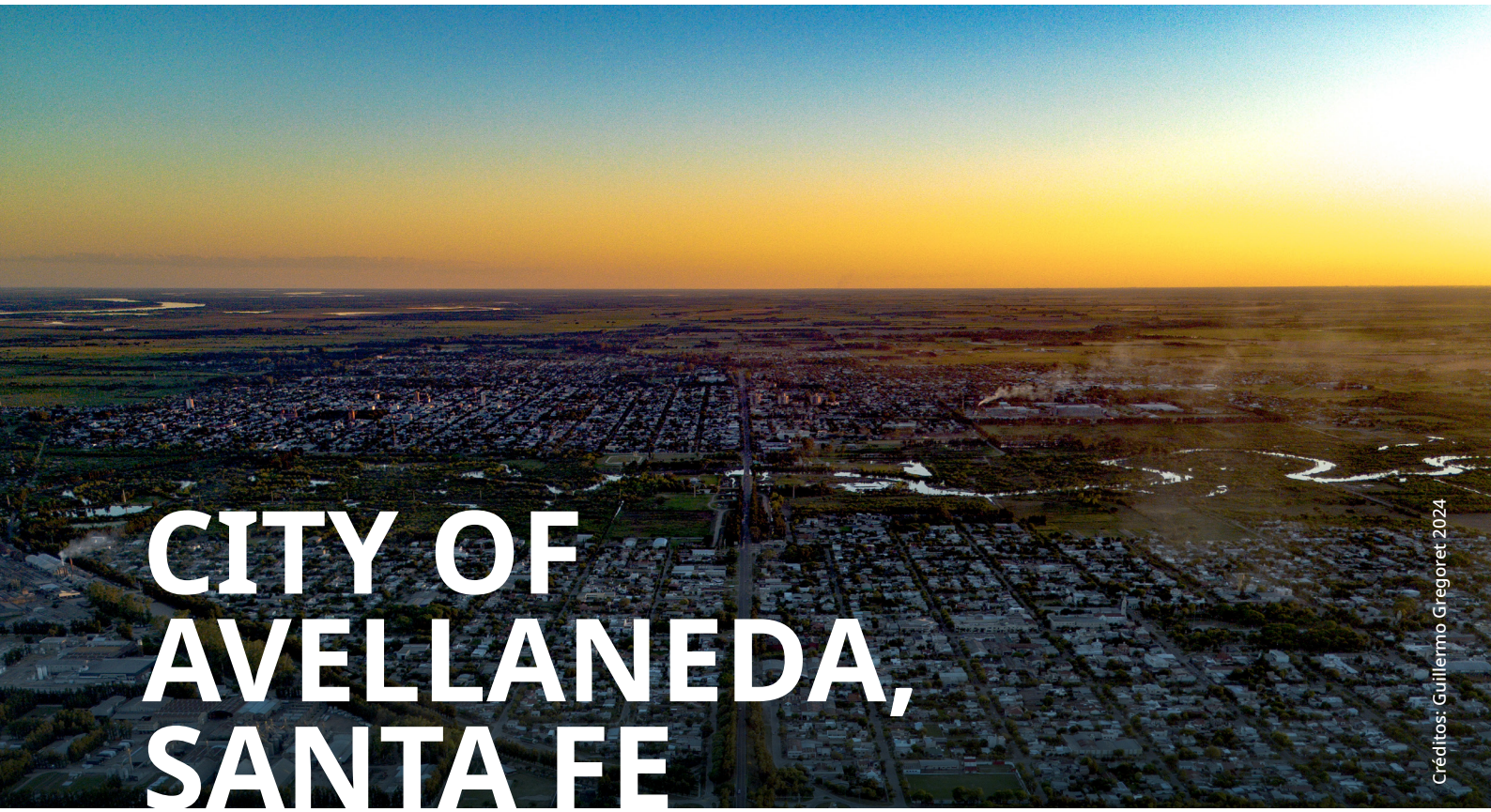
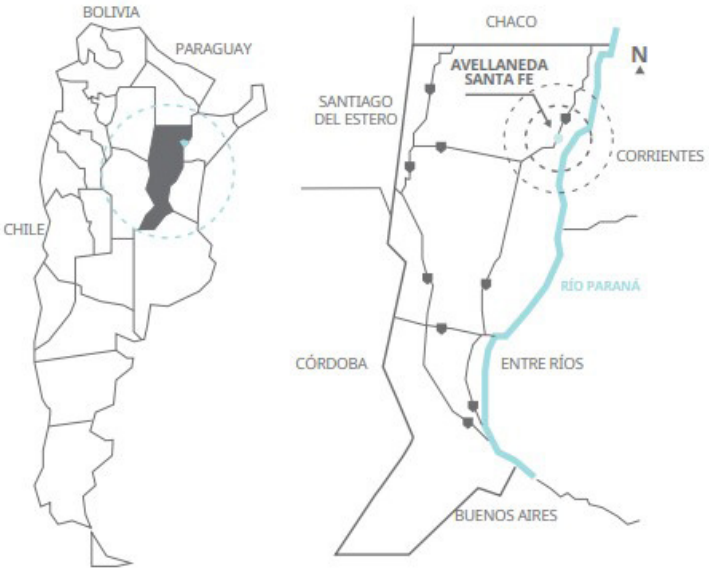


CITY OF AVELLANEDA, SANTA FE

Créditos: Guillermo Gregoret 2024

LOCAL 100% RENEWABLES ROADMAP DEVELOPMENT



City of Avellaneda, Santa Fe, Argentina

Facts and figures

Population:

30.897 inhabitants

Total area:

937 km^2

GHG emission indicator:

193.666,4 tCO2e[1]

Total energy consumption:

455,1 GWh/year[2]

1. Total GHG emissions (basic +) Base Inventory 2016. Avellaneda Local Climate Action Plan.
2. Energy consumption in 2019. 100% Renewables Energy System Modeling Results for Avellaneda, Argentina (2022).

Avellaneda, Santa Fe, was selected as a deep-dive city in Argentina for the 100% Renewables Cities and Regions Roadmap (100%RE) project in 2019. Since then, it has been working on its strategy to achieve 100% renewable energy by 2050, becoming the first city in the country to have an energy transition roadmap. This initiative is part of a broader vision to position Avellaneda as a model of innovative and sustainable urban development in the region.

> *"Renewable energy encompasses all renewable resources, including bioenergy, geothermal, hydropower, ocean, solar and wind energy. One hundred percent renewable energy means that all sources of energy to meet all end-use energy needs in a certain location, region or country are derived from renewable energy resources 24 hours per day, every day of the year. Renewable energy can either be produced locally to meet all local end-use energy needs (power, heating and cooling, and transport) or can be imported from outside of the region using supportive technologies and installations such as electrical grids, hydrogen or heated water. Any storage facilities to help balance the energy supply must also use energy derived only from renewable resources."*
>
> *– IRENA Coalition for Action, 2020 –*

Introduction

Tackling the climate emergency requires an unprecedented transformation of energy systems and an immediate transition to renewable energy at the global, national and local levels, guaranteeing universal access and promoting equitable and sustainable development. Local and regional governments are increasingly taking leadership in developing ambitious climate and energy plans to achieve a low-to-zero emissions future.

The 100% Renewables Cities and Regions Roadmap project (100%RE) supports local and regional governments in defining strategies, policies, and actions for renewable energy, driving the achievement of national climate and energy goals, and facilitating the transition to 100% renewables. It is implemented by ICLEI – Local Governments for Sustainability in Argentina, Kenya and Indonesia and funded through the International Climate Initiative by the German Federal Ministry for Economic Affairs and Climate Action with close cooperation from the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, and the Federal Foreign Office. The city of Avellaneda was selected to participate in the project with the objective of developing and implementing its Roadmap towards 100% renewable energy.

The city is located in the northern region of the Argentinian province of Santa Fe, on the right bank of the Paraná River, adjacent to an extensive wetland of international importance, the Jaaukanigás Ramsar Site. The district covers a total area of 937 km^2, of which 7.6 km^2 is urban, while the rest consists of natural and rural areas. It has a population of 30,897 inhabitants, of which about 89% live in the urban core and the remaining 11% in rural settlements.

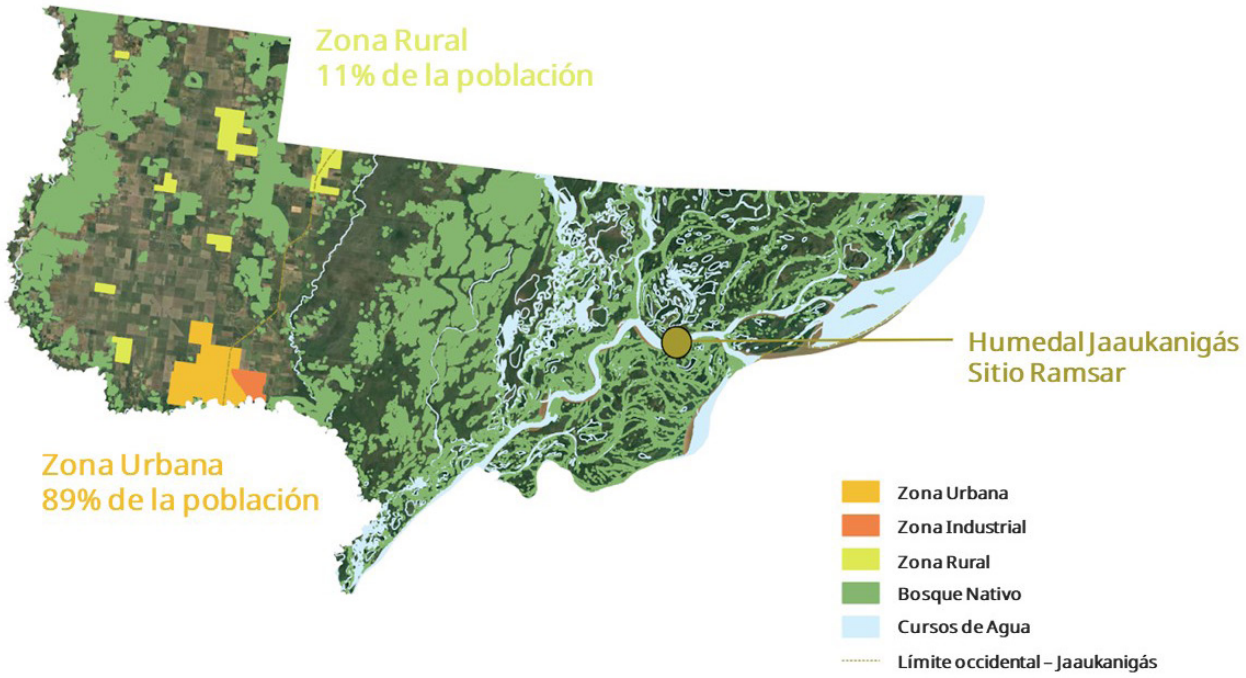


Figure 1: District of Avellaneda, Santa Fe

With an abundance of natural resources, productive land, and the presence of industry, Avellaneda is an important agro-industrial center in the region. More than 90,000 hectares are dedicated to agricultural and livestock activities, including the production of cattle, poultry, cereals and oilseeds. In addition, the city has an industrial park and a service sector with more than a hundred established companies.

The city's energy matrix is currently dominated by fossil fuels. However, there is established experience in the production of biodiesel, bioethanol and biogas using energy from local crops and industrial by-products, highlighting its potential in the use of renewable energy.

The development of a 100% Renewables Roadmap (100%RE Roadmap) for Avellaneda is an important milestone in achieving a fully renewable future and represents a shared commitment by both policy makers and the community to achieve net-zero emissions and sustainable development. This also entails an ongoing commitment by future governments to ensure that all the energy consumed in the city comes exclusively from renewable sources.

Political Ambition and Commitment

Since 2015, the city government has been strongly committed to climate action and sustainability, implementing waste management initiatives, reforestation and green space projects, safe and sustainable mobility, environmental education and renewable energy. In 2019, the city joined the ICLEI - Local Governments for Sustainability network. In 2020, it launched a Local Climate Action Plan with its climate change adaptation and mitigation strategy 2020-2030.

The 100%RE Project was endorsed by Municipal Ordinance (Ord. No. 1965/2020) and a Project Implementation Team (PIT) was established by Decree (Dec. No. 66/2020). The PIT is composed of the secretaries of all governmental areas, representatives of the municipal council, and the municipal delegate to the local electricity cooperative. It has the competence and responsibility to actively participate in project meetings, attend workshops and training sessions, as well as collect and provide energy data and participate in decision-making processes.

In 2022, the city reaffirmed its commitment by joining the global 100% Renewables Cities and Regions Energy Compact and the 100% Renewables Cities and Regions Network. This allows the city to access funding opportunities and technical support for renewable energy projects, as well as the ability to share and exchange with other leading cities.

Energy Assessment

The initial assessment of the energy situation was key to decision-making in the Roadmap development process. With the collaboration of ICLEI and experts in the energy sector, the PIT conducted an identification of stakeholders, policies and regulations at local and national level. These analyses resulted in three main documents: the National Energy Scenario Analysis and Stakeholders, the Initial Status Report and the Modelling of the Energy System of the City of Avellaneda. The main findings are presented below.

Energy Baseline

Based on available energy consumption data for the period 2014–2019, the energy profile of the city is as follows:

• 100% of the district is connected to the electricity grid. It is supplied by the Argentine Interconnection System (SADI) through the Provincial Energy Company (EPE) and the local cooperative COSEPAV. Of the total electricity contracted by the city (around 24 MW of power), large industries account for an average of 59% of consumption, followed by the residential sector with 25%. In 2019, the share of renewables in the electricity mix was 5.8%.

• The transport sector is supplied with hydrocarbon fuels with a mix of biofuels (12% ethanol in gasoline and 10% biodiesel in diesel, according to national regulations). Hydrocarbons can also be used for heating at certain times of the year and in certain areas.

• The industrial sector uses biomass, mainly firewood, and bulk liquefied petroleum gas (LPG) for its production processes.

• A natural gas network is provided to urban households for cooking and heating by the local company SyeSA GAS, which is supplied by the Northeast Argentine Gas Pipeline (NEA).

• The local company SyeSA GAS supplies natural gas to the urban sector for heating and cooking through a network via the Northeast Argentine Ges pipeline.

• Households not connected to the natural gas network use other energy sources, such as bottled gas or electricity.

National electric energy matriz

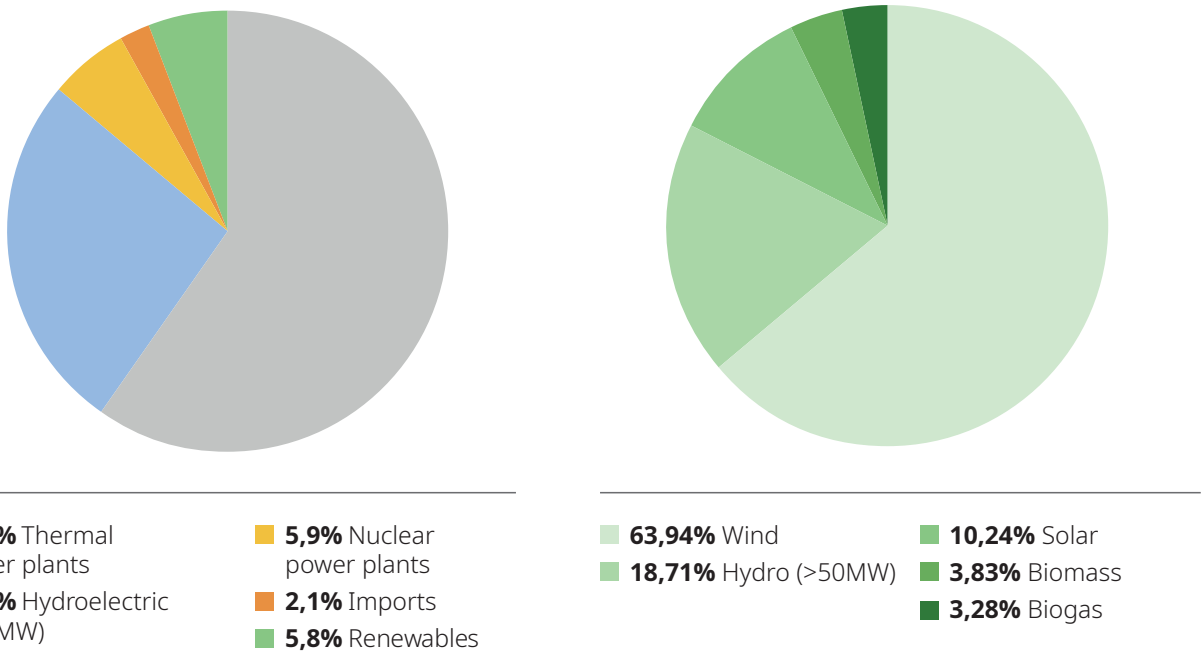


Figure 2: Participation of each electric energy source in 2019.
Source: own creation based on the 2019 CAMMESA Annual Report

The city's Greenhouse Gas Inventory attributes the highest emissions to the stationary energy sector (38.5%), followed by agriculture and livestock (38%), transport (20%) and waste (3.5%). Thus, the local energy transition and the use of agricultural by-products represent a major opportunity to achieve emission reduction targets.

Energy Modeling and Scenarios

A model of the city's energy system was carried out with the support of the German Fraunhofer Institute for Solar Energy Systems (ISE). This work enabled the analysis of the current and future energy demand, the local renewable energy generation potential and different scenarios for achieving the 100% renewable energy target. The KomMod model modeled an hourly time resolution that was used to ensure security of supply and to include all relevant demand sectors, i.e. electricity demand, cooking energy demand, heating demand, and energy demand for land transport.

> *"This document represents a valuable input for planning the Energy Transition and future policies to support this process and the ambitions of the Paris Agreement".*
>
> *– Gonzalo Braidot- Mayor of the city of Avellaneda. May 2022 –*

According to the projections, the total energy demand of the city could increase by 17% in a Baseline scenario and by 55% in a High demand scenario by 2050.

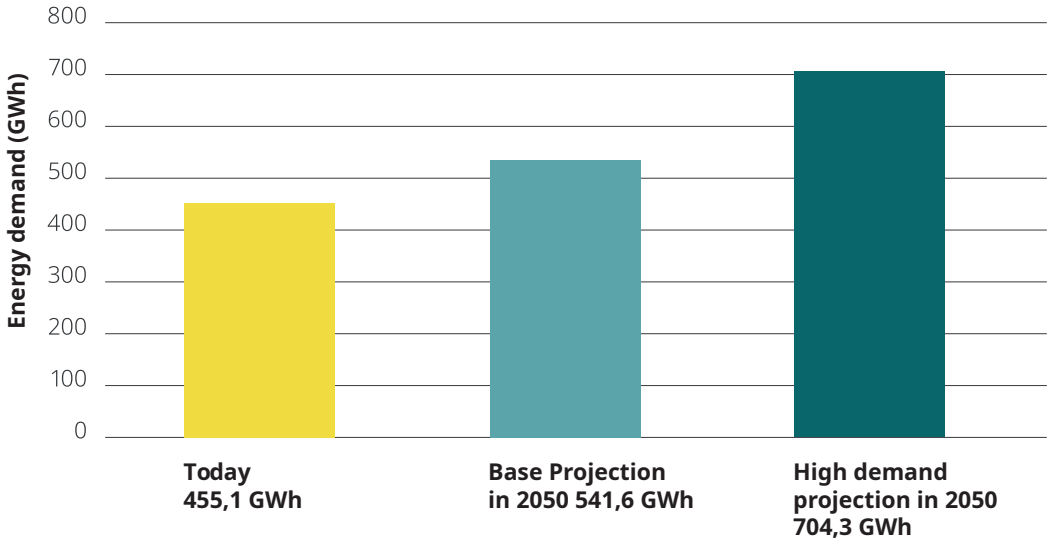
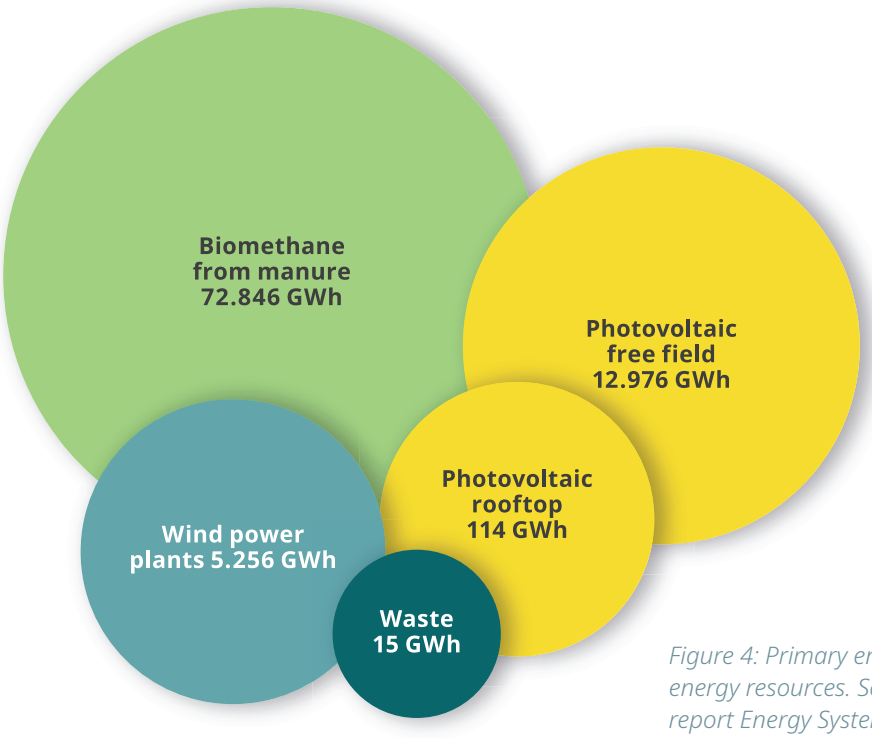


Figure 3: Energy demand today and in the two demand scenarios for 2050. Source: Own elaboration based on the report Energy System Modeling Results for Avellaneda, Argentina, by Dr. Annette Steingrube, Fraunhofer Institute for Solar Energy Systems, ISE, November 2021

The renewable energy potential was calculated using Geographic Information System (GIS), statistical data and studies for the city of Avellaneda and Argentina in cases where specific local data were not available. As livestock farming is one of the main economic sectors, biogas from manure emerges as the main source of renewable energy, with the capacity to generate electricity and heat. In second place is the potential of free-field photovoltaics, followed by wind energy.



Total renewable potential 91.207GWh

Figure 4: Primary energy supply potential of all renewable energy resources. Source: Own elaboration based on the report Energy System Modeling Results for Avellaneda, Argentina, by Dr. Annette Steingrube, Fraunhofer Institute for Solar Energy Systems, ISE, November 2021

A comparison between the six 100% renewable energy scenarios and the Business-As-Usual (BAU) reveals that all alternatives are both more cost-effective and emit less carbon dioxide than the BAU scenario.

Six 100% renewable scenarios were calculated by varying three characteristics: biomethane fuel price, energy demand, and a fixed share of wind power in the total electricity supply. In addition, a trend scenario—Business-As-Usual (BAU)—was modeled, which represents a possible national energy system in 2050 if no interventions are made. In this way it was possible to compare costs and carbon dioxide emissions.

A leading scenario was selected as the horizon for the city. It assumes moderate energy demand, low fuel prices (biomethane), and a fixed share of wind power in the electricity supply of 20%. Photovoltaics is the main electricity source with a share of 61%, while biomethane cogeneration plants (CHPs) cover 19% of the demand. Heating demand is covered by CHPs (49%) and is supplemented by heat pumps and boilers. The energy demand for cooking is mainly covered by gas stoves using biomethane and a small part by electric stoves. In the transport sector, there is a combination of electric vehicles and hydrogen.

The modeling showed that renewable energy resources far exceed the energy needs of the city. Therefore, the decision on which technologies to use in the future can be based on criteria other than costs and energy potentials, such as community acceptance and national and local policies. Energy produced in Avellaneda could also be exported to other neighboring regions in case a more coordinated regional approach is developed.

Roadmap formulation: A collaborative process

The Avellaneda 100% Renewables Roadmap is the result of a process of collaborative work and co-creation between the community and key actors across the local, provincial and national levels.

At the local level, the PIT, together with local actors—the industrial and commercial sector, local energy providers, academic institutions, environmental organizations and the community— collaborated to lay the foundations of the 100% RE Roadmap, addressing the following questions: Where do we want to be in 2050 in terms of energy production and consumption in the different sectors? How can we achieve it? Do we have the means and resources needed? What is feasible and achievable? What will it mean for the next generation(s)? What social, economic, financial and political dimensions need to be taken into account?

The collective construction of the city's Vision 2050 and the Principles frames the Roadmap and at the same time will serve as a basis for future climate and energy action planning.

VISION 2050

In 2050, Avellaneda is consolidated at the regional level as a model city in innovative and sustainable development, supplying 100% of its energy consumption with renewable sources, diversifying its productive system, and promoting responsible consumption habits that generate genuine work in a circular economy scheme, with a community that develops in an integrated and participatory manner.

Principles: Individual and collective commitment; Responsible consumption habits; Integral participation; Education; Multilevel governance; Perseverance; Collaborative and cooperative work; Transparency.

In addition, the National Advisory Group (NAG) was established to ensure multi-level governance to support and leverage the 100% RE Roadmap. This structure is composed of experts and key stakeholders, including the national government, other Argentinian cities participating in the 100% RE Project, and financial institutions. The NAG is responsible for providing strategic guidance to the project, developing recommendations for regulatory frameworks, improving access to finance, sharing knowledge and experience, monitoring activities, identifying synergies, and collaborating on the development of renewable energy solutions.

The Roadmap towards 100% Renewables was developed using a multi-step methodology in which stakeholders identified priorities through a series of "building blocks" that contribute to the construction of the framework for 100% renewable energy. The local strategies are organized into "axes", and each axis includes its specific objectives, targets, indicators and actions. For each component of the roadmap, the justification, leadership, responsibility, implementation timeframe, related policies, funding sources, supporting technologies, potential risks and their mitigation are indicated.

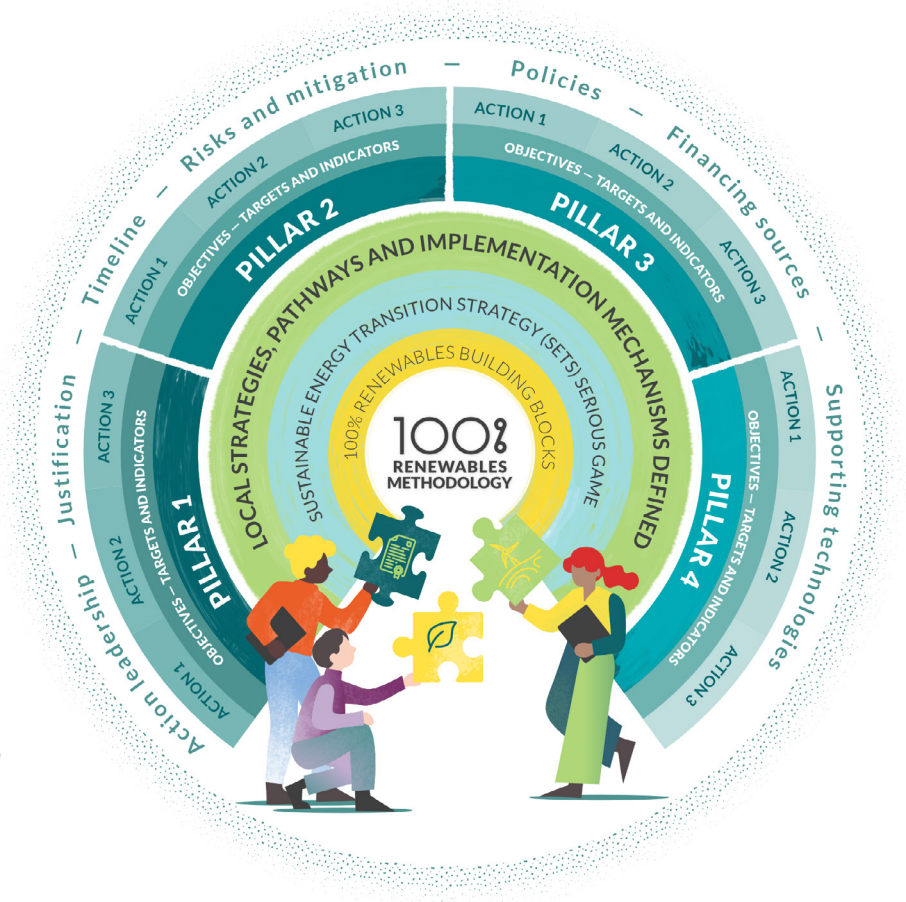


Figure 5: 100% Renewables Roadmap Methodology. Source: ICLEI elaboration

Local Capacity Building

A local capacity building needs assessment was carried out and a training plan was developed to promote the participation of local stakeholders in the development and implementation of the 100% Renewable Roadmap.

More than 50 municipal officials and stakeholders were trained in policy, technology and finance.

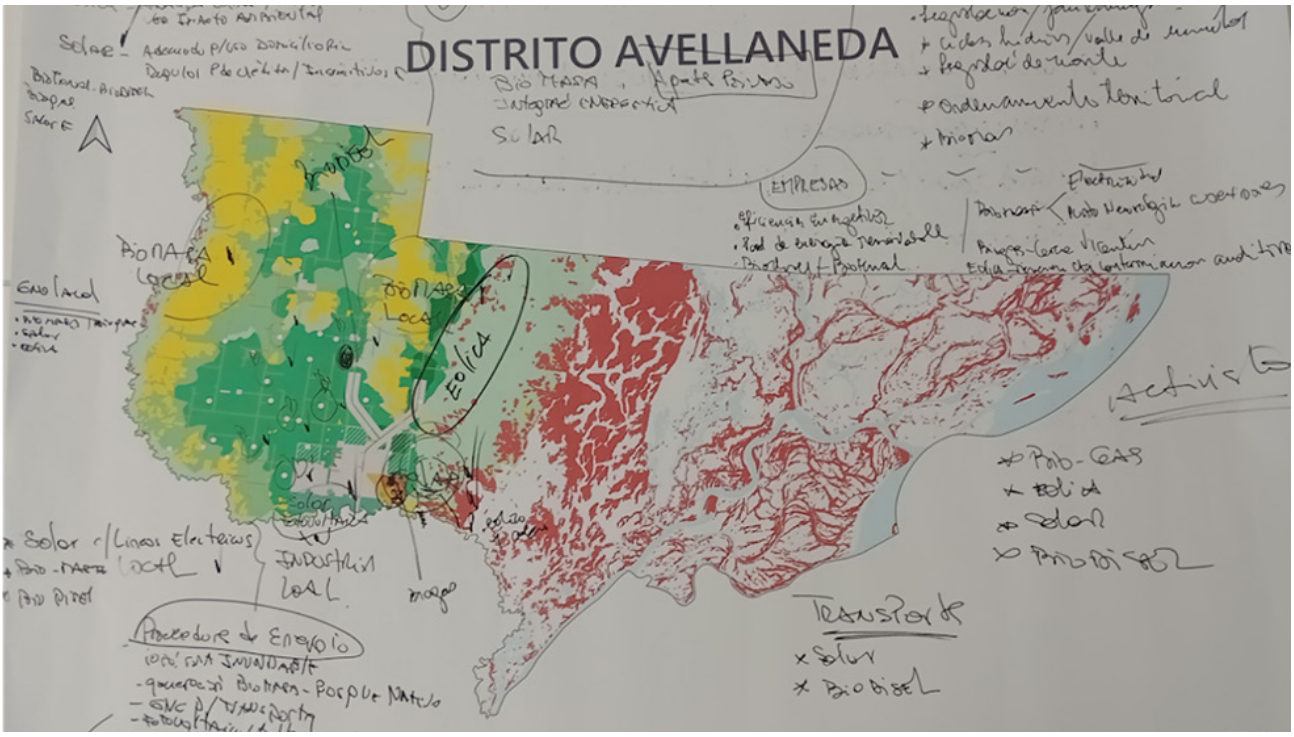
IMPLEMENTED TRAINING PROGRAM
Climate & Energy: Renewable Energy and Urban Development (2021)
Development of RE Projects in Argentina (2021)
Development of a RE Roadmap (2021)
Strategic energy planning and participation + Energy access and equity (2021)
Energy Efficiency for Industries (2022)
House Energy Labeling for Municipalities (2022)
Technologies for Renewable Energy Sources (2022)
Elaboration of Bankable Projects (2024)

In addition, numerous peer learning opportunities and collaborative activities with national and international experts have been established through study tours, webinars and Energy Exchanges sessions.

Innovative Mechanisms for Stakeholder Engagement

The Sustainable Energy Transition Strategy (SETS) Workshop was a role-playing exercise designed to create a platform for dialogue, consensus, and social legitimacy for the city's energy future. This in-person session was attended by representatives of local, provincial, and national governments, local stakeholders, universities and research institutes, businesses, landowners, energy providers, civil society organizations and community representatives.

Each participant plays a role in the local energy transition and brings different perspectives and resources to the table. The serious game aimed to reach a common strategy through discussion and allowed players to delve deeper into local renewable energy sources, the need to create coordinated policies and frameworks, and explore access to finance from both the public and private sectors.



As a result, the game revealed a clear consensus on the chosen path for Avellaneda's energy transition with a diversified, sustainable energy matrix adapted to the local context. The main agreements are highlighted below:

• The need for a strategic location of energy projects in order to reconcile environmental protection and energy production needs, preserving natural areas, and locating renewable projects in low productive soils and sparsely populated areas;

• To have an energy matrix with a significant preponderance of solar photovoltaic energy and biogas cogeneration plants, taking advantage of local resources and existing infrastructure;

• Increase the production of biodiesel for heavy transport, given the agricultural capacity of the region;

• Encourage the use of solar thermal collectors for residential and commercial heating needs.

Figure 6: SETS Workshop. Left: City map, collective analysis of suitable sites for renewable projects. October 2023. Right: Participants attend the Serious Game.

Avellaneda's 100% Renewables Roadmap

The pathways and milestones of the Avellaneda Roadmap are presented below:

2030

Electricity
60% Renewable

Thermal energy
30% Renewable

Transport
30%
of the public transport and municipal fleet is powered by renewable sources.

Equivalent to
20%
of the fuel consumption by private transportation is from renewable sources.

2040

Electricity
80% Renewable

Thermal energy
60% Renewable

Transport
50%
of the public transport and municipal fleet is powered by renewable sources.

Equivalent to
40%
of the fuel consumption by private transportation is from renewable sources.

2050

100% Renewable in all sectors.

Figure 7: Avellaneda's energy transition strategy path to 100% Renewables in 2050.

Strategic axes

Energy efficiency (EE): As the energy sector is the main emitter of greenhouse gas emissions in the city, more efficient use of energy resources is the most important measure to reduce these emissions. At the same time, it will be easier to meet this reduced energy demand through renewable sources, thus making the energy system more efficient. The challenge is to implement efficiency measures in all sectors, from public buildings to businesses and the productive sector, and thus to consider energy management from an overall urban planning perspective.

Renewable energy technologies (RE): For Avellaneda to move forward in diversifying its energy matrix with solar, wind, and biomass energy, as well as the possibility of incorporating green hydrogen, it is essential to develop both new technologies to exploit the renewable resources available in the region, and to adapt existing technologies for everyday use, thus promoting their mass adoption. In addition, the promotion of decentralized energy production at the community level is essential to actively involve people in the energy transition.

Transport and sustainable mobility (TM): Mobility is a fundamental component of urban planning for Avellaneda due to the particularities of the city, which include connectivity problems with other centers, a complex road network crossed by a national road, and the presence of heavy traffic. At the same time, transport represents a significant proportion of the city's energy consumption. Moving towards collective and sustainable transport is essential not only for urban planning but also for reducing the sector's energy demand. Additionally, it offers other socio-environmental benefits, such as improved air quality and reduced noise pollution.

AXIS 1 ENERGY EFFICIENCY	AXIS 2 RENEWABLE ENERGY TECHNOLOGIES	AXIS 3 TRANSPORT AND SUSTAINABLE MOBILITY
Energy efficiency programs for: • **EE 1. Municipal public buildings** • **EE 2. Productive sectors as commercial, industrial, service activities, and agricultural activities** • **EE3. Residential sector**	• **RE 1. Development of a smart grid** • **RE 2. Distributed generation for residential, industrial, and commercial sectors** • **RE 3. Circular economy strategy: energetic use of biomass waste**	• **TM 1. Plan for the promotion of Active and Low-Carbon Mobility** • **TM 2. Modernisation Plan for the public transport system and the municipal fleet for energy transition** • **TM3. Municipal programme for renewable energy in the transport sector**

AXIS 1 ENERGY EFFICIENCY	AXIS 2 RENEWABLE ENERGY TECHNOLOGIES	AXIS 3 TRANSPORT AND SUSTAINABLE MOBILITY
Promoted technology: LED lighting, inverter technology, heat pumps, smart meters, nature-based solutions, insulating materials, solar thermal energy. **Enabling conditions:** Energy audits and assessments of public buildings; Study on energy performance parameters for local economic activities; Collaboration with educational institutions for monitoring indicators; Municipal council consensus on regulations; Collaboration with professional associations; Collaboration with industrial, commercial, and agricultural establishments for energy diagnostics and implementation of improvements; Addressing energy poverty at national and provincial levels; Availability of specialist professionals for an interdisciplinary municipal team. **GHG EMISSIONS AVOIDED: 7,933 tCO2e.**	**Promoted technology:** Photovoltaic solar energy, solar thermal energy, wind energy, biomass combustion, biogas plants, cogeneration plants, green hydrogen, domestic and small-scale biodigesters. **Enabling conditions:** National and provincial regulations promoting smart grids; Feasibility analysis and technical design of the smart grid; Agreement and commitment between the local electricity provider and the municipality for the development of the smart grid; Modernization of the electric power distribution network; Agreement among different levels of government on distributed energy regulations; Study of telemetering points or bidirectional meters; Consensus with the local energy distributor on distributed generation mechanisms; Data on residual biomass generation; Agreement among different levels of government on waste management policies and criteria; Availability of biomass recovery technologies. **GHG EMISSIONS AVOIDED: 51,894 tCO2e/year (2050).**	**TPromoted technology:** Non-motorized transport, biodiesel production, bioethanol production, electromobility, green hydrogen, photovoltaic solar energy, wind energy. **Enabling conditions:** National and provincial regulations promoting sustainable mobility; Consensus among different levels of government on mobility policies; Infrastructure such as bicycle lanes, pedestrian walkways, and multimodal stations; Availability of renewable technologies in the transport sector; Presence of technology providers; Collaboration with local transport cooperatives; Alternative fuel charging stations. **GHG EMISSIONS AVOIDED: 118,453 tCO2e/year (2050).**

Figure 8: Summary of Avellaneda Renewable Energy Roadmap 2050. Source: own elaboration.

Lessons learned

Stakeholder engagement as a key driver in sustainable energy transition

The collaboration of all stakeholders involved in the city's energy transition is vital to establish a cross-sectoral framework for a shared vision and strategy. Building a broad platform for dialogue, consensus building and social legitimacy towards a sustainable future is also essential to ensure an effective deployment of the strategy.

Building multi-level governance to unlock local potential

Effective coordination of local policies and regulations with regional, national and international entities fosters collaborative synergy and results in leveraging opportunities for cooperation. This approach ensures alignment and coherence between different levels of government and organizations, facilitating the successful implementation of the strategy, and maximizing its impact on the local community.

Energy modeling as the backbone and horizon of the Roadmap

Energy modeling is crucial for local energy transition planning, as it helps to anticipate future technological developments, costs and energy demands. Understanding the interdependencies between different sectors—electricity, heating, cooling, and local transport—guides the design of integrated solutions. At the same time it helps the community and decision-makers to identify the most appropriate energy system for the city, taking into account the local context and resources, ensuring sustainability, resilience and security of energy supply. Energy modeling is a necessary step in developing a roadmap, but does not represent a final outcome. The model must be further developed based on local realities, available resources, etc.

Local capacity building for energy transition planning

In many cities, particularly smaller ones, energy efficiency and renewable energy are emerging topics. Capacity building is essential for local decision-makers and stakeholders to understand the local energy context, energy regulatory frameworks, and renewable technologies in order to develop and implement an effective and sustainable energy transition strategy over time.

Addressing enabling conditions to enhance local capacities

Recognising the enabling conditions in terms of regulation, technology, governance, infrastructure and human resources is crucial to ensure the feasibility and effectiveness of planning. Working on the enabling conditions provides an understanding of the circumstances, resources and critical factors necessary for successful action.

The 100% Renewables Roadmap evolves over time

Energy transition planning is dynamic and will need to be modified over time, influenced by global trends, national policies, technological developments, market prices and the local context. Commitment from local stakeholders is needed to regularly monitor the progress of the city's strategy, allowing for updates and adjustments as needed.

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Author

Yamila Pagura

Editors

María Julia Reyna

Rocío Pascual

Clara Mitchell

Josefina Bordino

Leticia Borges

Collaborators

Rohit Sen

Kanak Gokarn

Sastry Akella

Ángeles Tessore

Juan Ignacio Capilla

Design

Olga Tokareva

Julia Cena

The 100% Renewables Cities and Regions Roadmap project facilitates the energy transition by raising local awareness on renewable energy sources, showcasing how local and national governments can create coordinated enabling frameworks and policies, exploring access to public and private sector finance, and building local renewable energy projects to address electricity, heating and cooling.

The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded by the International Climate Initiative (IKI), which is implemented by the Federal Ministry for Economic Affairs and Climate Action (BMWK) in close cooperation with the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and the Federal Foreign Office (AA).

ICLEI Local Governments for Sustainability

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ICLEI – Local Governments for Sustainability is a global network of more than 2500 local and regional governments committed to sustainable urban development. Active in 125+ countries, we influence sustainability policy and drive local action for low emission, nature-based, equitable, resilient and circular development. Our Members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

Contact Us

Kaiser-Friedrich-Str. 7

53113 Bonn | Germany

Tel. +49-228 / 97 62 99-00