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Federal Ministry for Economic Affairs and Climate Action
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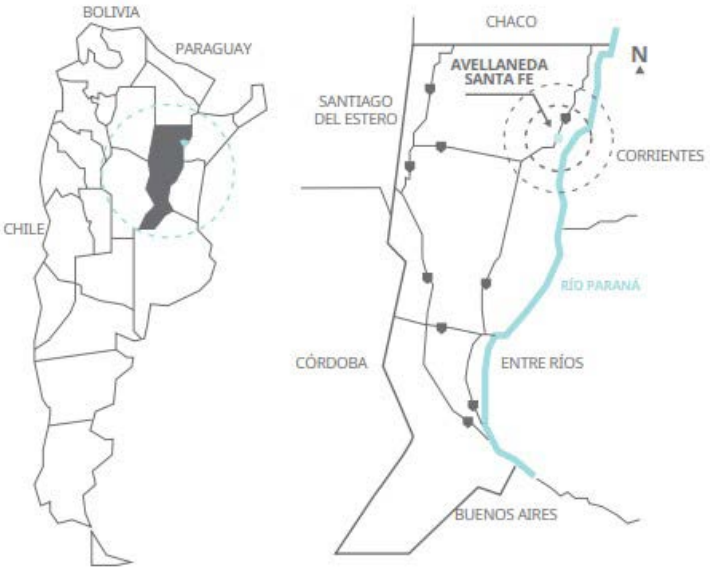
INTERNATIONAL CLIMATE INITIATIVE

CITY OF AVELLANEDA, SANTA FE

BANKABLE SOLAR PROJECT 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).

The City of Avellaneda, Santa Fe, is leading the local energy transition in Argentina. As part of the 100% Renewables Cities and Regions Roadmap project (100%RE), the city launched the first 100% Renewable Energy Roadmap towards 2050 in Argentina and developed a financeable solar project as the initial step toward a renewable future.

Introduction

Cities are responsible for 75% of emissions related to energy production. The energy transition to renewable sources is fundamental for cities to considerably reduce their environmental impact, save resources and ensure sustainable, reliable access to energy for their communities and activities. Securing bankable renewable energy projects allows for the guarantee of necessary resources, the attraction of investments, the reduction of risks and the achievement of climate objectives.

The city of Avellaneda is leading the pathway to renewable energy in Argentina. In 2019 was selected to participate, as a model city in Argentina, in the 100% Renewables Cities and Regions Roadmap project (100%RE), receiving support in defining strategies, policies and actions for renewable energy to facilitate the energy transition. This allowed the city to elaborate a 100% Renewables Energy System Modeling, develop a first 100% Renewable Energy Roadmap (100%RE Roadmap) and a financially viable and bankable project. The 4 MW Avellaneda Solar Project is one of the first major steps towards implementation of the city's roadmap.

> *"Today, developing the executive project to have a photovoltaic plant in Avellaneda, which will feed renewable energy back into the energy system, is a crucial step that marks a turning point, not just for the city, but for the entire region."*
>
> *– Gonzalo Braidot – Mayor of the city of Avellaneda, November 2023 –*

City context

The city of Avellaneda is located in the northern region of the province of Santa Fe, Argentina on the right bank of the Paraná River. It has a total population of 30,897 inhabitants and spans a total area of 937 km^2, with the urban area covering approximately 7.6 km^2, while the rest consists of natural and rural areas.

Avellaneda stands out as a significant agro-industrial hub in the region. It encompasses over 90,000 hectares dedicated to agricultural-livestock activities and 112 hectares for the industrial park and service area. With over a hundred companies established, the industrial and innovation sectors are projected to grow in the coming decades. Thus, large industries and productive activities represent the main energy demand. Currently, the city's energy matrix is primarily based on fossil fuels, reflecting the national situation.

The city's location, abundant natural resources and agricultural activities present a significant opportunity for renewable energy generation. The energy modeling of the city demonstrated that the renewable potential is significantly higher than the energy needs, with the highest potential sources being biomass, solar and wind resources. **The Sustainable Energy Transition Strategy Serious Game**

(SETS) was developed with stakeholders to outline a common transition strategy. With notable solar resources, a global horizontal irradiance of 1840.5 kWh/m^2 [3], suitable areas, and a high potential for local market growth in solar energy, the Avellaneda Solar Project was identified as the first agreed step in the local transition journey.

Planning and data collection

Planning was essential to the successful development of the project. In the first phase, methodologies and activities were defined and a working group was formed. The team included ICLEI - Local Governments for Sustainability, a technical and financial consultant with expertise in renewable energy from Argentina, and representatives from the city of Avellaneda.

An initial analysis was carried out, which included a review of current renewable energy regulations and the identification of key stakeholders to be considered in the development and implementation of the project. Relevant information was gathered to ensure the harmonious progress of the project.

Stakeholder interviews

A **round of interviews was** held with various stakeholders to explore different aspects of the renewable energy project in Avellaneda:

• *The municipality of Avellaneda:* Topics discussed included territorial planning, flood zones, permits for energy projects, and mapping of potential areas.

• *Local electricity provider (COSEPAV):* Discussed electricity demand, existing substations and their technical capacity, as well as the commercial and regulatory relationship with the Provincial Energy Company of Santa Fe.

• *Industrial and commercial sector:* Discussed the composition of the industrial park, electricity demand, and the interest of both the park and large energy consuming companies in participating in the project.

• *Provincial energy company (EPE Santa Fe):* Discussed the provincial energy regulatory framework, procedures for energy projects, and previous experience with renewable energy projects in the province.

• *National Energy Secretariat:* Discussed the national energy regulatory framework and future opportunities for renewable energy projects.

• *Association of Women in Sustainable Energy (AMES):* Discussed the gender perspective in renewable energy projects and opportunities for collaboration between AMES and Avellaneda's renewable energy projects.

This allowed for the gain of insights into the regulatory framework, determined the level of interest, identified business opportunities and the resources and skills that each actor could contribute.

3. Energy Production Report. Consulting for Development, design and engineering of a ready-to-finance renewable energy project, 100% Renewables Cities and Regions Roadmap project. February 2024.

Capacity building

With the aim of enhancing local capacities for the development of renewable projects, the workshop **"Challenges in Solar Energy Project Development"** was organized. This workshop addressed technical, regulatory, and financial aspects to consider for developing effective business plans and funding requests. Over 40 participants, including Avellaneda's authorities and technical teams, as well as representatives from the Municipal Council, the local Agency for the Promotion of Innovation, the local energy supplier cooperative, renewable project developers, and major energy consumers, successfully attended.

The workshop provided an introduction to renewable energy and explored the future of the industry in Argentina, as well as the implementation process for solar photovoltaic projects. Participants exchanged ideas and explored potential barriers to project development, environmental impacts and efficiency opportunities.

Technical design

The technical design has been developed under the parameters required by international standards for solar photovoltaic installations and national standards for power generation and transmission.

Land plot assessment

The site selection process began with a targeted search using specific criteria such as land requirements, environmental risks, and accessibility. Sites with direct access to roads were sought, while efforts were made to avoid protected areas and to avoid disturbance to native forests. Preference was given to locations with limited competition for land use to reduce costs and streamline negotiations. Areas at risk of flooding were avoided by analyzing canals, streams, low-lying areas, climate projections, and the Urban Drainage Master Plan. Variability in solar resources across the municipality of Avellaneda was found to be negligible, thereby having minimal influence on plot selection.

The selection of the land plot was performed through a **multi-criteria evaluation of potential sites** utilizing a weighted matrix to score and rank each plot. The criteria considered in the matrix included location, surface area, restrictions, and competition for use.

The preliminary site selection allows the city to initiate discussions with the respective owners of the most suitable fields.

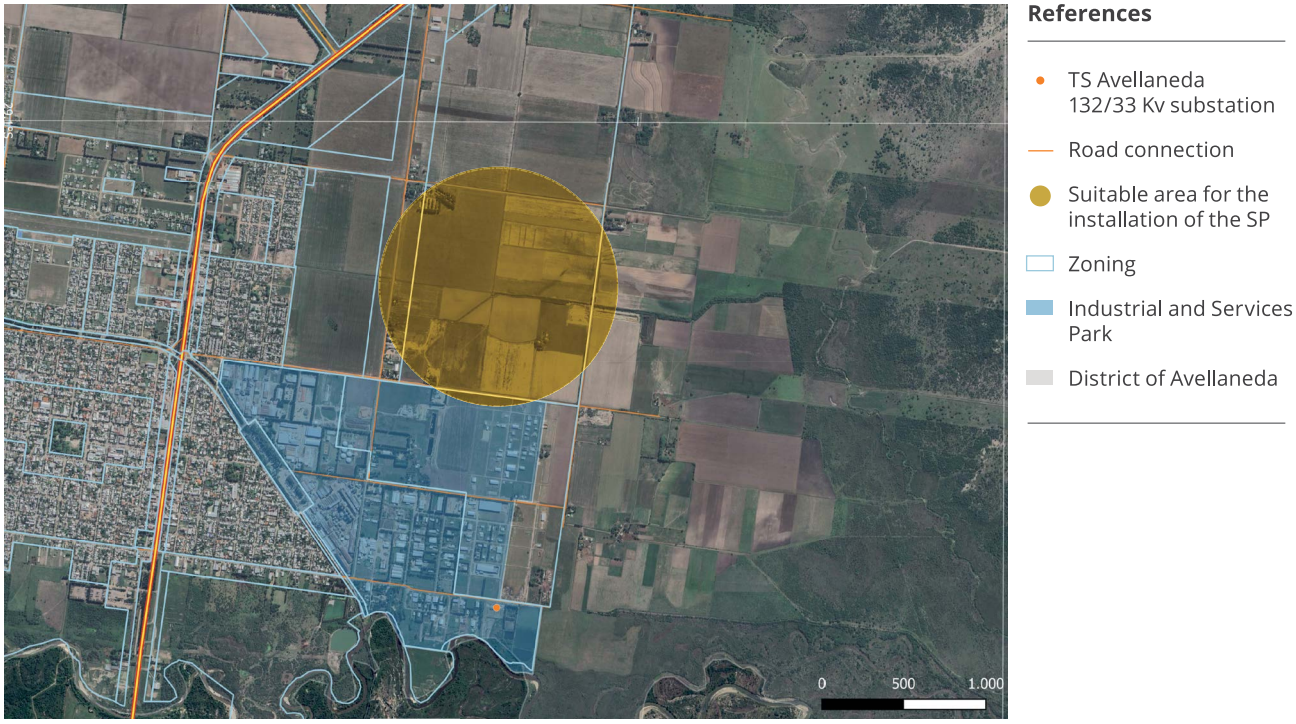


Figure 1: Selected area for the project.

CHARACTERISTICS OF THE LAND
Homogeneous leveling, minimal slope
Polygon with suitable shape (rectangular)
Convenient orientation for photovoltaic development
Short distance to the transformer station
Adequate accessibility to the land

Plant configuration and costs

The capacity of the solar park was established at 4 MWac, to be installed on 7 hectares and with possibility of expansion in future stages. The annual net energy generation is 8,682 MWh; and, with a capacity factor (CA) of 25%, the equivalent hours per year is 1,722 kWh/kWp.

Nominal power	4 MWac
Photovoltaic panels	7.308 monocrystalline modules 690 Wp unit power 29 modules per string
Structure	Fixed structure Inclination 30° North Pitch 5,5m
Inverters	14 inverters 330 kVA rated power
Transformer substatio	1 LV/MV transformer 7.038 MVA
Total area	7 hectares
Lifetime	30 years

The connection will be at medium voltage (13.2 kV). It will be connected to the Argentine Interconnection System (Sistema Internacional de Interconexión, SADI) through the Avellaneda Transformer Station (TS). The distance between the Plant and the TS is approximately 2.1 kilometers and three possible alternative routes are considered for the power line.

The total cost of the plant, in terms of CAPEX[4], amounts to approximately 3.75 million USD. This includes investments in physical assets such as equipment and infrastructure, as well as engineering studies and civil works necessary for its construction and commissioning.

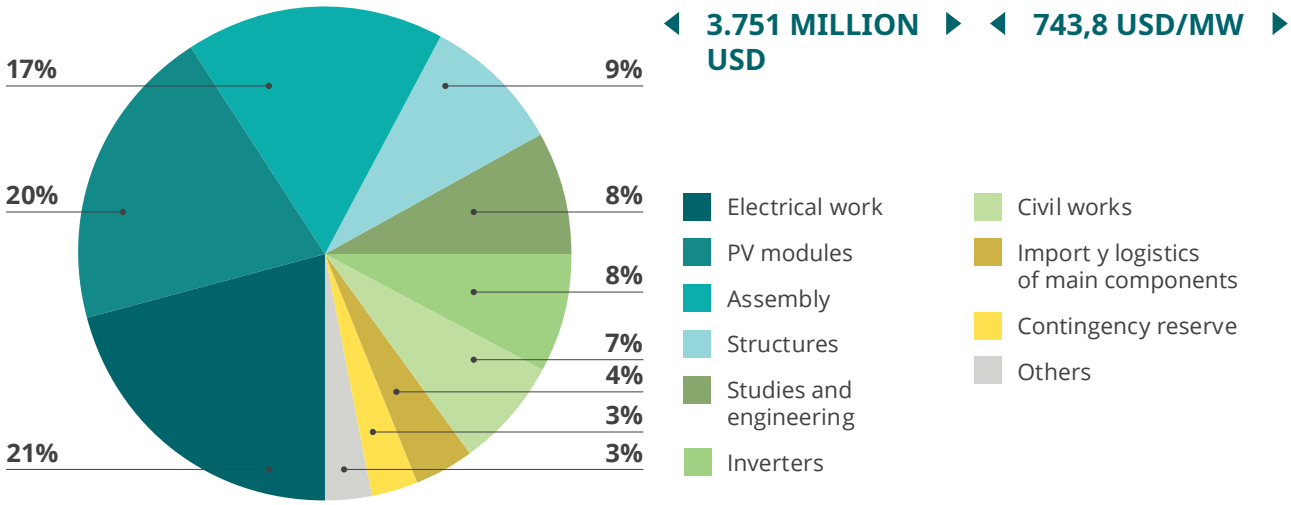


Figure 2: Breakdown of capital expenditure - CAPEX.

4. Capital expenditures

Financial strategy

Several potential business models for the project were identified and evaluated, considering their respective advantages, disadvantages, potential client bases, costs, and associated risks. The analysis included input from various local stakeholders to ensure a comprehensive evaluation.

Both quantitative and qualitative strategic aspects were considered. The business model deemed most suitable for ensuring the long-term sustainability of the project was selected, taking into account the specificities of the Argentine and local markets.

Business models

Through the analysis of the regulatory framework, business opportunities, and financial instruments, four business models were identified as suitable for further consideration: *i) Community self-generation; ii) Selling energy to the local distributor; iii) Selling energy to Avellaneda users from the Wholesale Electricity Market; iv) Selling energy to CAMMESA[5] or MATER[6].*

Each option was subjected to a financial evaluation through a simplified cash flow analysis for comparative results. The evaluation was complemented by a sensitivity analysis of the two main variables: the energy sales price, which affects revenues, and the investment capital cost, which impacts expenditures.

The business models were compared and ranked using a **multi-criteria evaluation** with a weighted matrix, taking into account financial results, risks, scalability potential and local focus. In addition, the adaptability of each model was assessed, with preference given to those capable of adapting to alternative business models in response to internal or external factors.

The selected model "sell energy to the local distributor" represents a local development in Avellaneda, contributing to technical and economic growth within the community. This involves enhancing local infrastructure, creating job opportunities, and promoting sustainable practices in energy production and distribution, benefiting both the environment and residents. The model includes acceptable nominal rates and payment periods, a single energy buyer (the distributor), and easy adaptability to other business models.

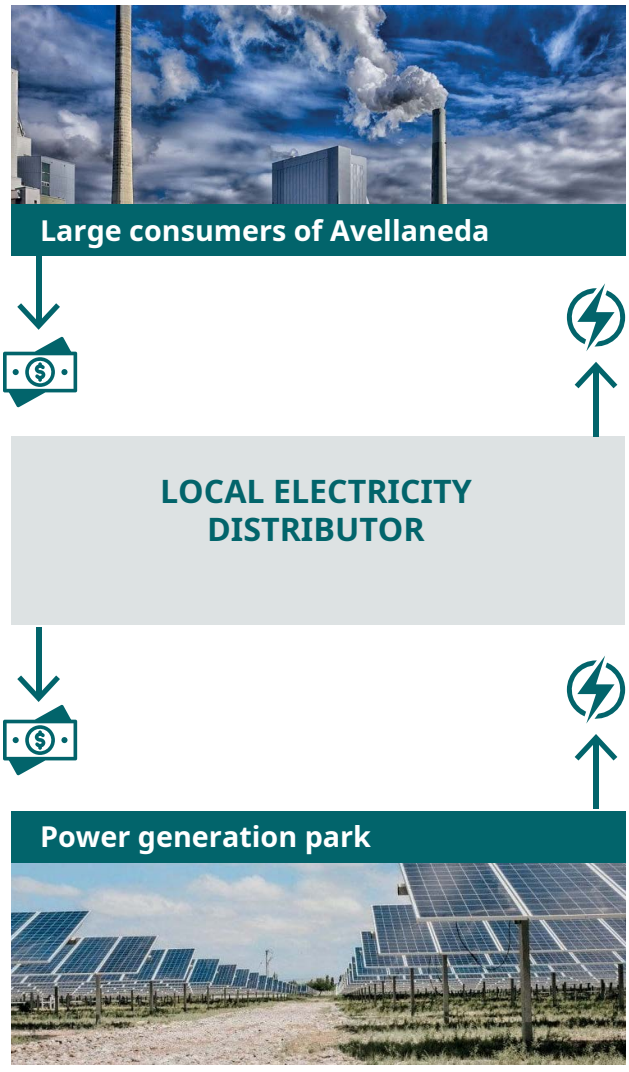


Figure 3: Business operation diagram

5. Compañía Administradora del Mercado Mayorista Eléctrico Sociedad Anónima (CAMMESA, Administrator Company of the Wholesale Electricity Market). It is the Argentine company responsible for operating the Argentine Interconnection System (SADI).
6. Mercado a Término de Energía Eléctrica de Fuente Renovable (MATER, Term Market for Renewable Energy). It is a regulated mechanism for trading renewable electricity between private parties.

Financial modeling and feasibility assessment

The selected business model was subjected to a feasibility analysis and the development of a financial model, which served as a basis for facilitating discussions with potential investors.

An energy price was set, consistent with the current context and future projections in the Argentinian market ($65 USD/MWh for the first 15 years and $70 USD/MWh for the following 15 years). The financial model combines debt (40%) and equity (60%), with the objective of achieving a debt service coverage ratio (DSCR) above 1.5.

The financial results indicate a robust internal rate of return (IRR) in the face of variations in generation, CAPEX, and selling price. The net present value (NPV) and levelized cost of energy (LCOE) were calculated with a discount rate of 2% per annum.

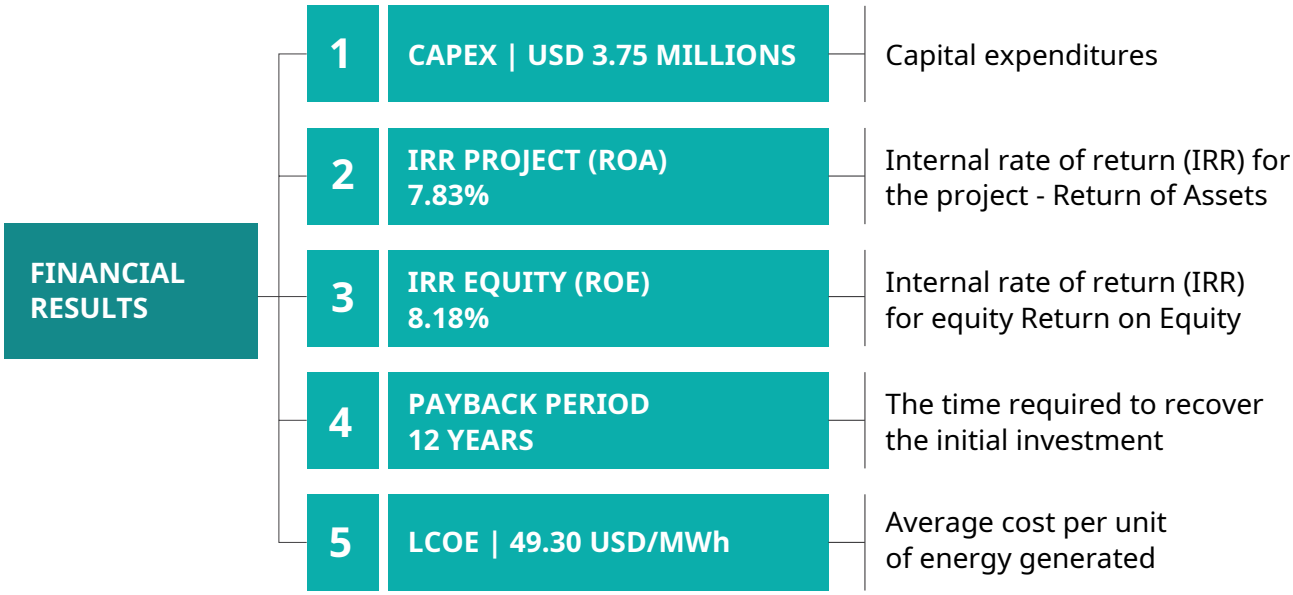


Figure 4: Key financial results of the project

In the search for funding, potential sources and financing conditions were identified, with a focus on a 'triple impact' perspective. This approach considers the project's positive impact on the environment and society, in addition to its economic viability.

Finally, a risk matrix was also developed to anticipate and address potential obstacles throughout the project implementation phase. It identifies a range of risks including political, regulatory, economic, territorial, natural, supply chain, technological, insurance, labor, operational, community acceptance, permitting, and others such as schedule extensions and loss of energy buyer interest. This approach ensures financial viability, risk mitigation, and effective project management throughout the project's lifetime.

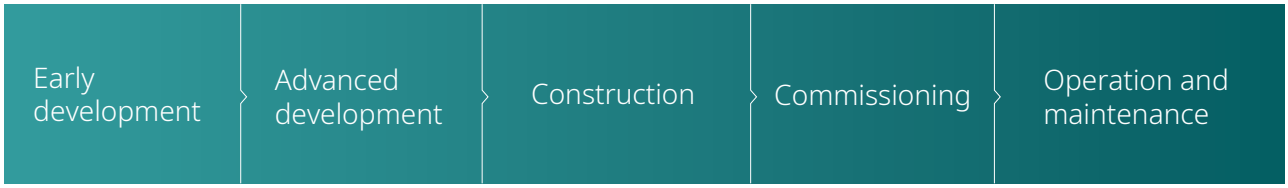
Business Matchmaking Event

A business roundtable was organized with the main objective of presenting the Avellaneda Solar Park to stakeholders and facilitating a networking session to attract potential financiers.

With the presence of over 50 strategic actors from provincial and local authorities, the energy sector, chambers of commerce, professional associations and energy developers, the event served as a platform for dialogue between the private and public sector. It provided the regional market with an opportunity to invest in renewable energy infrastructure while promoting sustainability and reducing greenhouse gas emissions. In addition, the event placed the project in its current context, highlighting its contribution to local development and technological innovation in the region and province, and including economic, social and environmental benefits.

Figure 5: Participants of the Business Matchmaking Event. City of Santa Fe, Argentina. 22nd May 2024.

With several participants expressing their intention to support the initiative financially or to participate in the implementation of the project, the positive response from participants reinforced the viability of the project and opened the door to new funding opportunities and long-term strategic alliances.



Next steps | Project development from signing of usufruct to "Ready to build"

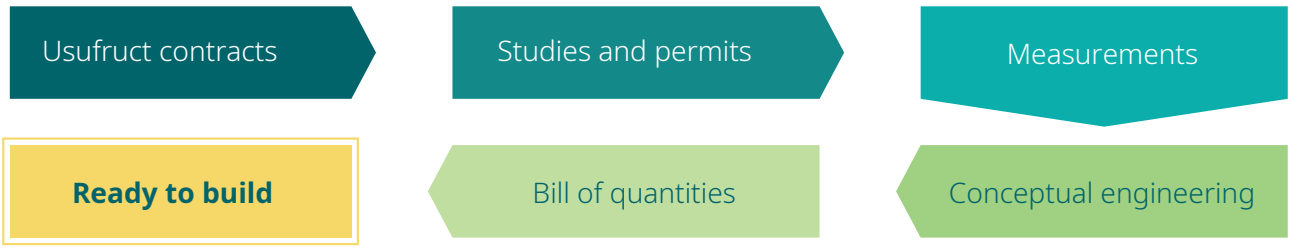


Figure 6: Project stages and next steps to a ready-to-build instance

Lessons learnt

Engaging stakeholders to ensure risk mitigation

Involving all stakeholders early on in the project, including local, provincial, and national authorities; large energy consumers; energy sector representatives; local energy providers; and the community, has enabled the identification, understanding, and mitigation of risks linked to the project's development and implementation. This inclusive approach fosters transparency, collaboration, and accountability, ensuring that potential challenges are addressed proactively and that the project is well-positioned for financial success.

Building capacity is necessary to formulate bankable renewable energy projects

Securing financing to implement the energy transition is a major challenge for cities. Access to finance is often dependent on the formulation of bankable projects. Local governments do not always have the technical capacity to develop well-structured projects that meet the expectations of financial institutions. Strengthening capacities to formulate technical and bankable projects is therefore an essential step towards effective financing. This requires the involvement of authorities, urban planners, administrators, local energy providers and private stakeholders. Improving their ability to obtain financing for RE projects requires navigating the pre-investment and investment phases, while addressing key issues related to project development, such as governance, and technical and financial aspects.

Adaptable business models is essential in dynamic markets

The ability of a business model to adapt to alternative frameworks is a key factor in ensuring the effective execution of a project in variable contexts such as Argentina. This adaptability provides the project with a number of potential avenues for success. It is crucial for models to be flexible in both

technical and regulatory terms. Such adaptability is essential for maintaining long-term competitiveness and sustainability, allowing the project to remain viable and resilient in the face of evolving market conditions.

Multilevel support for the implementation of bankable renewable energy projects

Active participation and continuous, coordinated support from national and provincial governments are key to facilitating the flow of financing and enhancing opportunities at the local level in the context of energy transition. Higher levels of government are responsible for creating favorable regulatory frameworks, financial incentives, and technical resources, thereby helping to create enabling conditions for renewable projects and strengthening local capacities to overcome barriers associated with securing financing.

Building bridges between public and private sectors is crucial to renewable development

Local, regional, and national governments are planning and implementing energy transition policies and developing bankable energy projects. Meanwhile, the renewable energy market, including development, technologies, construction, and operation, is rapidly evolving and is expected to expand significantly in the coming years. Strategic collaboration between the public and private sectors is key to leveraging the strengths of both in developing, owning, financing, operating, and maintaining renewable energy projects. Platforms for interaction, such as the Business Matchmaking Event, are critical to fostering this cooperation, providing risk mitigation arrangements for both parties and ensuring effective project delivery.

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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).

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100% RENEWABLES CITIES & REGIONS ROADMAP

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