

## 2 Argentine Republic

### 2.1 PESTLE or Macro Analysis

#### 2.1.1 Political framework

Argentina has been shifting between different parties and policies in the last 60 years. Socio-democratic and liberal policies take turns to be independently in power depending on the party in charge. This situation does not permit a long-term framework and influences the confidence of the different economic actors.

Society’s perception is strongly divided between these different concepts and perceptions of the country. Policies are also mostly influenced by external economic factors. During the last 60 years, the governmental sector has faced growing poverty increased segregation. There is a big bureaucracy that hampers new investments and the growth of new activities as the biogas sector.

The current composition of the Executive Branch includes only the Head of State and President, formally given the power over the Administration to follow through according to the interests of the Nation. The President is also the Chief of the Argentina Armed Forces. The President and the Vice President are elected through universal suffrage.

The national government system is organized in ministries and secretaries of state. In the following table lists ministries that have been selected with influence and decisions regarding the biogas sector in Argentina.

Table 2: Key government actor ministries

Ministry	Website
Ministry of Transport	<a href="http://www.transporte.gob.ar">www.transporte.gob.ar</a>
Ministry of Territorial Development and Habitat	
Ministry of Science, Technology and Innovation	<a href="http://argentina.gob.ar/ciencia">argentina.gob.ar/ciencia</a>
Ministry of Productive Development	<a href="http://www.produccion.gob.ar">www.produccion.gob.ar</a>
Ministry of Labor, Employment and Social Security	<a href="http://argentina.gob.ar/trabajo">argentina.gob.ar/trabajo</a>
Ministry of Health	<a href="http://www.desarrollosocial.gob.ar">www.desarrollosocial.gob.ar</a>
Ministry of Foreign Affairs, International Trade and Worship	<a href="http://www.cancilleria.gob.ar">www.cancilleria.gob.ar</a>
Ministry of Environment and Sustainable Development	<a href="http://argentina.gob.ar/ambiente">argentina.gob.ar/ambiente</a>
Ministry of Economy	<a href="http://www.minhacienda.gob.ar">www.minhacienda.gob.ar</a>
Ministry of Agriculture, Livestock and Fisheries	<a href="http://argentina.gob.ar/agricultura-ganaderia-y-pesca">argentina.gob.ar/agricultura-ganaderia-y-pesca</a>

The National Congress (Spanish: Congreso Nacional) constitutes the legislative branch of the government. The Congress consists of the Senate (72 seats), presided by the Vice-President of the Nation, and the Chamber of Deputies (257 seats). Senators stay in office for six years, whereas deputies have four years in office.

Each of the Provinces and the Autonomous City of Buenos Aires elect deputies and senators directly. Deputies are elected to represent the people, while Senators represent their districts.

Each district elects a number of deputies roughly proportional to their overall population by proportional representation, and three senators: two allocated to the party holding the majority of votes, and one to the second most voted. Members of both chambers can participate in indefinite re-elections. Within this system a great consensus was built around the key legislation pieces regulating renewable energy. Bioenergy and renewables in Argentina are by nature decentralised and political representatives of the provinces are always willing to support legislative measures to promote them. Within this system, consensus was built around renewable energy principal laws which directly or indirectly affects biogas projects and governmental programs established and implemented by the executive power in charge.

Argentina is divided into 23 districts called Provinces and one autonomous district, which hosts the national capital: the Autonomous City of Buenos Aires (Province of Buenos Aires). Each of the provinces has its own constitution, laws, and authorities, forms of government, etc., though all local governments must above all comply with the national constitution and laws. This is a key aspect for biogas developers since each province develops their own promotional framework and specific requirements related to environmental issues.

The government of each province has three branches. The Executive, Legislative and Judiciary. The Executive branch is led by a governor. The Legislative branch may be organized as a unicameral or a bicameral system (that is, either one or two chambers or houses). Each province, except for Buenos Aires Province, is divided into districts called departments. Departments are merely administrative divisions; they do not have governing structures or authorities of their own. They are in turn divided into municipalities (cities, towns and villages). Each province has its own laws and government systems for different kinds of municipalities. For example, Córdoba Province has *municipios* and *comunas* (towns); Santa Fe Province further distinguishes between first- and second-tier *municipios*. The Province of Buenos Aires has a different system. Its territory is divided into 134 districts called *partidos*, each of which usually contains several cities and towns.

Regardless of the province, each department or *partido* has a head town (*cabecera*), often though not necessarily the largest urban center, and in some provinces often named the same as their parent district. Municipalities are ruled by mayors, usually called Intendant (*intendente*) in the case of cities and towns (the larger categories). A city has a legislative body called the Deliberative Council (*Concejo Deliberante*). The smaller towns have simpler systems, often ruled by commissions presided by a communal president (*presidente communal*) or a similarly named authority. This is an important aspect in the case of biogas developments especially those that are aimed to treat municipal solid waste (MSW) and water treatment plants.

It is important to note that only minimum requirement laws, rules and legislation are enacted at the national level and provinces are autonomous and may promulgate their own legislation, which must comply with the minimum requirements of the federal legislation. This is particularly important in the case of activities such as biogas and digestate that are related with environmental issues especially those that lies under the provincial government's responsibility.

In the sixties, an increasing percentage of the population are below the poverty line and there has been an increase of governmental support for this part of the population. There is a con-

tinuous deficit of the national government that leads to external debt and inflation. As the government is an important actor which absorbs money, interest rates are generally high affecting risk investments for new construction of biogas plants.

Regarding the perception towards corruption, Argentina is in a region with an average score of 44/100 for three consecutive years. South America continues to fail in making any serious inroads against corruption. In Argentina, corruption levels have decreased one point since 2017 and 8 points since 2015, showing some significant improvement. The country has reached a score of 40/100 during the last administration according to Transparency International. However, public perception of this index is worsening. There are uncertainties of the future trend with the recent change of administration. The liberation of prominent corrupt politicians has not been a good signal.

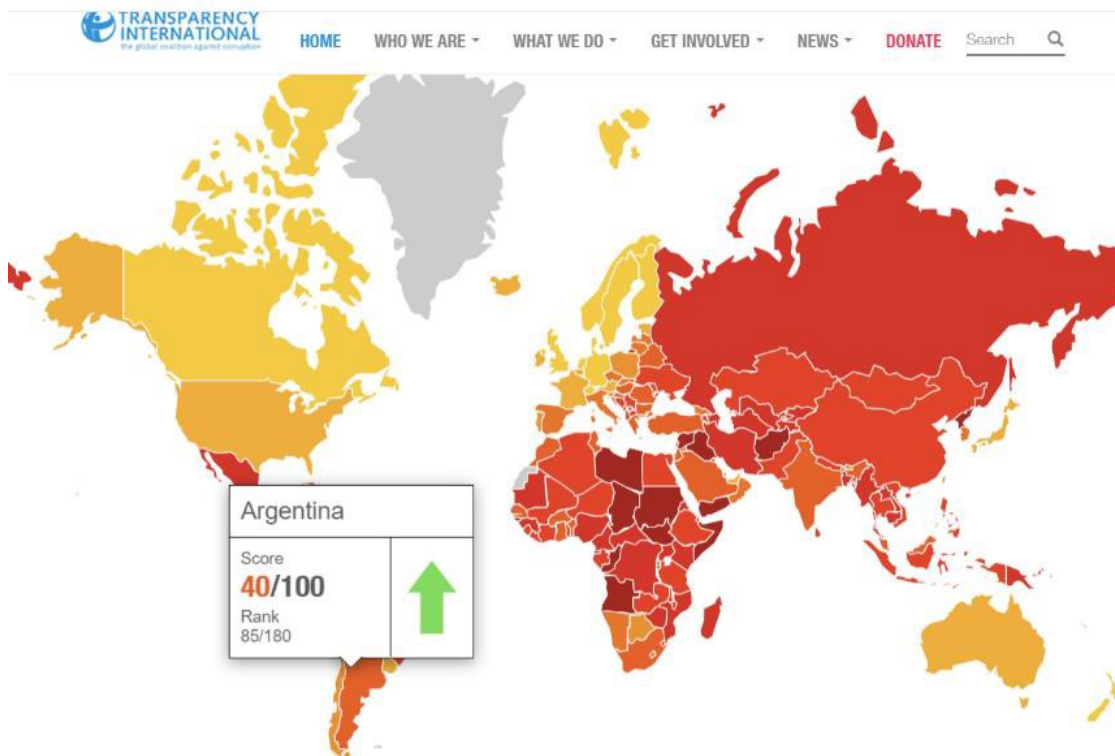


Figure 3: Argentina's Transparency index (Transparency International)

Argentina also face another challenge: the need to continue strengthening the independence of its judicial systems to ensure impartial prosecutions, and to ensure that those found guilty of corruption receive appropriate punishment.

Although freedom of the media and access to information is more robust in the country, it could be stronger. These fundamental rights are essential for curbing corruption and contributing to a more aware and involved society that includes minorities and vulnerable groups, and that can demand accountability from those in power.

Despite the political stability over the years, the country is still under the pressure of immense economic stress. Since the return to democracy, the system has been able to cope with severe crisis without interrupting elections and civil rights since the beginning of the early eighties.

### 2.1.2 Economic situation

One of the historic crucial issues for Argentina is its macroeconomic situation with periodic crises, and loss of confidence of the economic actors.

The economy remained in the doldrums in the final quarter of 2019. Economic activities shriveled in October-November 2019, while consumer confidence was rather pessimistic and export growth have cooled down in the fourth quarter. On a more positive note, industrial production expanded for the first time in 20 months in December. Meanwhile, in early February, the Senate ratified the lower house's decision to grant the government the power to restructure around USD 100 billion of the country's foreign-denominated sovereign debt. Around USD 44 billion of this is owed to the IMF.

Due to its fragile situation and a lengthy lockdown due to the 2020 health crisis, the impacts over the economy have been very significant. This is also being reflected by the confidence levels raising the country risk index over 2000. Banks have also found its financing efforts interrupted, and biogas projects currently under construction are being affected. There is an awfully long negotiation process with creditors, and deadlines are being postponed since the end of March.

Government deficit results in foreign debt and inflation crisis due to hard currency loans to fill the financial gap. However, inflation has seen a low temporal decline at an extremely high level valued at 53.9%. Predictions by economic experts before the COVID-19 pandemic initially expected inflations to reach 41,7% in 2020 and 28,1% in 2021. Due to an enormous increase in government aid, this numbers are now very conservative, and some expect hyper-inflation rates in the near future.

The monthly indicator for economic activity *Estimador Mensual de Actividad Económica* (EMAE) dipped by 0.3% in December, after logging a 2.0% contraction in November. In terms of productive sectors, the softer contraction in December 2019 was largely driven by rebounds in the fishing, manufacturing, and internal trade sectors. This was also partly the offset of a downturn in the agricultural sector and by sharper contractions in the construction and financial sectors. A month-on-month comparison showed that economic activity ticked up 0.2% in December according to a seasonally adjusted data, in contrast to the November 1.6% drop. Notwithstanding, the average annual variation in economic activity improved from a 2.7% contraction in November to a 2.1% decrease in December.

Latest numbers of industry contraction are significant, since the main economic area of Buenos Aires province and the federal district are in strict lockdown conditions.

GDP dropped a second year in a row in 2019, as high inflation and prohibitive interest rates linked to the monetary crisis triggered in April 2018 were still present, prevailing over the robust rebound in agriculture (following the 2018 historic drought). Indeed, the crisis gained further momentum after the presidential election primary of August 2019, when the strong showing by the current President Fernandez unleashed a new round of Peso (ARS) sell-off. Analyst predicts that the economy seems destined to remain in recession in 2020. The uncertainty regarding the economic policies of the newly elected government and to how it will handle the unsustainable public debt, should imply a continuing low level of private investments (notably for the moribund construction with some minimal impact in the biogas industry). Moreover, the fiscal deficit will limit policymakers' capacity to implement a desirable expansionary policy. Besides that, the skyrocketing inflation is not likely to ease significantly and will continue to erode real

income (causing knock on effects on household consumption). Finally, net foreign trade is likely to contribute positively to GDP, as imports should continue to drop and exports to benefit from a relatively higher economic activity in Brazil. There are many risks to the economic scenario, with the sensitive fiscal situation and the possible failure in renegotiating public debt likely to trigger new pressures on the exchange rate which ultimately affect the economy through higher inflation and possibly a tightening of capital controls. This scenario has become worse due to coronavirus and its multiple impact is seen in many crucial areas of the economy.

The current deficit registered a strong narrowing in 2019. It was mainly driven by a rebound in trade balance, from a large deficit of 2.3% of GDP to a surplus estimated at 2.9% of GDP (due to collapsing imports and recovering agrarian exports). Moreover, the services deficit (of roughly 2.1% of GDP) also registered an improvement (mainly driven by a narrowing of the travel imbalance). Alongside, the lower deficit also started to be fully covered again by foreign direct investments (estimated at 1.3% of GDP in 2019). Overall, the current account is likely to become slightly positive in 2020, as the economy is to remain in recession (thus implying low import level) and export is likely to continue climbing as a result of expected good crops this year and higher economic momentum in Brazil (Cronista commercial, 2020).

However, the fiscal scenario is more challenging. Although the previous government was able to reduce the budget deficit in the last two years (a condition of the IMF loan deal), a lot still needs to be done. As majority of the public debt is in foreign currency (roughly 81%), it is highly sensitive to strong exchange rate movements. Its amortization will be very high in the upcoming years (estimated at 16% of GDP in 2020 only) (Clarín económico, 2020). In December 2019, the new government of President Fernandez unilaterally postponed the payment of USD 9.1 billion short-term treasury bills issued under local legislation until August 2020. He also announced his intention to restructure long bonds term issued under local and foreign law in early 2020 (Ambito Financiero, 2020).

Argentina's economic freedom score is 53.1, making its economy the 149th freest in the 2020 Index. Its overall score has increased by 0.9 point, primarily because of a higher government integrity score. Argentina is ranked 26th among 32 countries in the Americas region, and its overall score is well below the regional and world averages. Alongside that fact, a more interventionist and fiscal expansionary approach that is expected could make the negotiations with the IMF difficult. Most importantly, considering the hard debt payment schedule ahead, with capital controls which came into force since September 2019 and were tightened after the presidential elections. This capital control is not likely to be eased in the short term and could even be strengthened. That is because of the strong slump in foreign exchange reserves in 2019 (net reserves give import coverage of roughly three months of imports). This strong slump in foreign exchange reserves was the consequence of the people's reaction after the primary elections in which they were inclined to purchase foreign currencies (i.e. the US Dollar). Two weeks in power the new government got congressional approval for his emergency plan, which includes measures to increase tax revenue, a 30% tax on hard currency purchases and higher taxes on agricultural exports. It also gives the government increased regulatory powers in areas such as service rates public and pensions.

Despite recent economic struggles, Argentina continues to play an important role within the global economy, especially with regards to its agricultural production (BCR, 2019). The sector is mainly based on livestock farming, cereal cultivation (wheat, corn, and soy), citrus fruits, tobacco, tea, and grapes (mostly for the production of wine) with an overall profit of 28.800

million dollars per year. Argentina is the world's largest exporter of soy-derived products and the world's third largest producer of such products. Soy and sugar cane and corn byproducts are also used for bio-fuel production. As a result, the country is the world's largest exporter and fourth largest producer of biodiesel. The agricultural sector represents 6% of the country's GDP, but it only employs 0.1% of the population. Additionally, given that the country is rich in energy resources, Argentina also has a great potential in terms of raw materials: it is the fourth largest natural gas producer in Latin America, and it has the world's third largest shale gas reserve and the fourth largest lithium reserve (BCR, 2019).

The industrial sector has vastly expanded in recent years: it represents 23% of GDP and employs 22.4% of the population. Food processing and packaging - in particular, meat packing, flour grinding and canning - and flour-milling are the country's main industries. The industrial sector also demonstrates strength in motor vehicles and auto parts, consumer durables, textiles, chemicals and petrochemicals, pharmaceuticals, printing, metallurgy and steel, industrial and farm machinery, electronics, and home appliances.

The biogas sector with its small dimension does not alter national figures although it can have a measurable impact at county levels (Secretary of energy, 2020). Looking at its overall potential in the country a significant expansion at great scale similar to Germany example could produce higher impacts. This impact would affect fuel imports. Such strategy needs a great consensus since these are strong forces that consider shale oil and gas a solution for the country deficit.

The service sector has followed the same upward trajectory as the industrial sector. It contributes almost 56.9% of the GDP and employs 77.6% of the active workforce. Argentina has specialized in areas of high-tech services and is highly competitive in software development, call centers, nuclear energy, and tourism. The telephone and ITC sectors are also developing dynamically, as well as tourism, which is increasingly becoming an important sector.

### 2.1.3 Social situation

With a Gross Domestic Product (GDP) of approximately US\$470 billion, Argentina is one of the largest economies in Latin America (World Bank, 2020). The size, historic background and potential of the country creates an image of unreal richness of the country in the urban population and the standard of living surpasses the actual capacity of the economy.

Argentina has vast natural resources in energy and agriculture. Within its 2.8 million square kilometers of territory, Argentina is endowed with extraordinary fertile lands, gas, and lithium reserves, and has great potential for renewable energy. It is a leading food producer with large-scale agricultural and livestock industries. In addition, the country has significant opportunities in some manufacturing subsectors, and innovative services in high tech industries.

However, the historical volatility of economic growth and the accumulation of institutional obstacles have impeded the country's development. INDEC reported that Urban poverty in Argentina remains high and reaches 35.4% of population, while poverty in children rises to 52.6% (Buenos Aires Times, 2019).

To deal with this situation, the country has prioritized social spending through various programs, including the Universal Child Allowance, a cash transfer program that reaches approximately 4 million children and adolescents up to age 18, representing 9.3% of the population.

In 2018, Argentina was hit hard by a series of external and internal factors including severe droughts, global financial volatility in emerging markets following the Federal reserve adjustment of the interest rate, and market perceptions on the pace of fiscal reforms.

The last administration has improved the protection of intellectual property rights, but deficiencies persist within the regimes for protection of patent and regulatory data. Secured interests in real property are recognized and enforced. The Marci administration's "Justice 2020" initiative was intended to improve transparency and rule of law, but the weakness of anticorruption bodies and politicization of the judicial system have hampered progress.

According to INDEC, the total value of exports and imports of goods and services is 30.8% of GDP. Other taxes include value-added, wealth, and financial transactions taxes. The overall tax burden equals 30.3% of total domestic income. Government spending has amounted to 40.5% of the country's output (GDP) over the past three years, and budget deficits have averaged 6.1% of GDP. Public debt is equivalent to 86.3% of GDP (BCR, 2020).

Procedures for establishing limited liability companies have been streamlined, but economic and political hurdles have blocked other pro-business reforms. Argentina has a highly skilled and well-educated workforce, but taxes for pensions, the cost of health care, and other labor taxes remain high.

The total value of exports and imports of goods and services equals 30.8% of GDP. The average applied tariff rate is 7.9%, and 139 nontariff measures are in force. Foreign investment in various sectors remains regulated. The government exercises considerable control of financial activities.

In Argentina, as in most Latin American countries, family ties are notably broader than in North America and northern Europe. The North American and northern European families usually consist of one's spouse and children (and occasionally one's parents). In Argentina, family ties remain remarkably close for most kinship relationships. Cousins, in-laws, uncles and aunts, nephews, nieces, and godparent relationships are customarily considered part of one's immediate family.

Consequently, Argentine family ties furnish much stronger admission (than in North America or northern Europe) to business joint ventures, to amiable terms in negotiations, and to access to relatives in high positions. The result is that in some cases North American or north European business visitors to Argentina find themselves unable to contact those in authority because they may not realize the importance of such connections.

Argentina has a comparatively egalitarian distribution of wealth, especially compared to other Latin American nations. At \$9,700 per capita GDP, Argentina has the highest per capita income distribution in Latin America. (INDEC, 2020) In this regard, Argentina has very little of the economic class stratification that so characterizes Mexico, Brazil, and other major Latin American trade powers. Instead, the vast majority of Argentines belong to the middle class, as is the case in North America, Japan, and Europe.

Regarding the educational level in Argentina, 96.2% of the population is able to read, Argentina has one of the highest literacy rates in the world, and the second highest (after Uruguay) in the Spanish-speaking world. The country has one of the highest primary school enrollment rates in the world, with just under 100%. Argentina has the highest percentage of university graduates in Latin America, with a rate of over three times the number of university students per

100,000 of Brazil or Mexico. Four out of five Argentinian adults have completed grade school, over a third have completed their secondary education and one in nine Argentine adults have college degrees (INDEC, 2020). Likewise, Argentina has the highest rate of university students in Latin America. It has also the highest number of professors and institutions awarded prestigious prizes and fellowships from philanthropic institutions within the Southern hemisphere.

This aspect is especially important in relation with the possibility of finding well educated labor force to work in biogas facilities along the country. It is also important since people are looking for new jobs that require higher levels of literacy.

#### 2.1.4 Technology

The most important aspects of science and technology in Argentina concern medicine, nuclear physics, biotechnology, nanotechnology, space and rocket technology and several fields related to the country's main economic activities. According to the World Bank, Argentinian exports in high technology are products with high R&D intensity, including aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. The sector takes advantage from Latin America's highest literacy rates. Argentinian researchers and professionals at home and abroad continue to enjoy a high standing in their fields. Argentinian Bernardo Houssay was the first Latin American awarded with a Nobel Prize in sciences. Educated in a National University, Houssay went on to establish Argentina's National Research Council, a centerpiece in Argentine scientific and technological development, fifty years ago. Many other Argentinians have contributed to scientific development around the world, though sometimes having to emigrate to do so.

All this important skills and research capabilities make possible to rapidly adapt, improve and innovate in biogas or other renewable energy technologies. There have been several institutional research biogas projects along the country. The knowledge of biogas systems behavior and operation has grown steadily in the last seven years. In the 2020 National Bioenergy Awards, a significant number of biogas research thesis were presented with outstanding quality.

Research on biogas has also been conducted in a vast network of Universities and some specific technological institutions including the National Institute of Industrial Technology (INTI) and the National Agricultural Technology Institute (INTA). Both institutes have extensive branches of experimental stations and extension agencies that cover the whole country. The institutes also have biogas programs with a vast territorial reach.

Argentine scientists also contributed to bioscience in efforts like the Human Genome Project, where they successfully mapped the genome of a living being, a world first. Argentina has its own satellite program, nuclear power station designs (4th generation), and public nuclear energy company INVAP, which provides several countries with nuclear reactors.

Other projects are focusing on IS, nanotechnology, biotechnology, helicopters, farming machinery and defense systems. Established in 1991, the CONAE has launched 8 indigenous built satellites successfully, AMSAT, MuSat, SAC-B, SAC-A, SAC-C, SAC-D/Aquarius, ARSAT I and ARSAT-2.



Among the public institutions devoted to research and development in Argentina are:

- CITEDEF: Defense Scientific and Technical Research Institute
- CNEA: National Atomic Energy Commission
- CONAE: National Space Activities Commission
- CONICET: The National Research Council
- INTA: National Agricultural Technology Institute
- INTI: National Industrial Technology Institute
- INVAP: Argentine high-technology research & development company

Coursera published the Global Skills Index (GSI) and ranked Argentina as the number 1 country in technological skills, obtaining a percentile of 100% within this category. This report emphasizes why Argentina is a highly developed country highly developed in terms of technological progress. As for Argentina's performance, it ranks first in technology, both in the region and in the world. This shows that the country offers a vast advantage in the most popular and required discipline in the world, providing advanced knowledge and technical skills of excellence which can take this field to another level. Reports show that Argentina stands out with a strong performance in Software Engineering with a score of 100% and in Operating Systems with a score of 95% (INDEC, 2020). Argentina outshines all its neighbors by a wide margin. This reflects the country's strong technology community and tech-savvy government, as well as its ambitious goal to be the center of the Fourth Industrial Revolution." These facts place the country remarkably high when it comes to outsourcing IT or software services. The software industry is positioned as the fourth largest exporter in the country. Other interesting data are provided by the Chamber of Software and Information Technology Companies (CESSI) in its latest annual report (Spa)<sup>8</sup> published last year. It mentions that during 2017, Argentina reached a historical record of exports, with US\$ 1.699 million surpassing the record of 2012 (US\$ 1.533 million), and as a result, foreign revenues in dollars increased by 26.5%.

### 2.1.5 Environment

Argentina faces serious environmental challenges, but it is one of the countries in the region that has developed a sophisticated body of environmental jurisprudence, from cases on mining and other industrial pollution to community water supplies. Argentina has developed a particularly important and sophisticated network of institutions related to agriculture and the agribusiness. The increasing influence of several organizations has been significant. Just to name the most important ones: INTA, *Asociación Argentina de Consorcios Regionales de Experimentación Agrícola* (AACREA), *Profesionales especializados en cultivo de Soja* (PROSOJA) and Argentina Association of Producers with Direct Soowing (AAPRESID) mainly focused on the primary production; INTI, *Asociación de la Cadena de la Soja Argentina* (ACSOJA), *Asociación Maíz y Sorgo Argentino* (MAIZAR), *Asociación Argentina de Grasas y Aceites* (ASAGA), *Cámara Argentina de Biocombustibles* (CARBIO) & ABH more orientated to the agroindustry and agribusiness.

An enormous evolution regarding sustainable development awareness is in place in the whole agricultural system with special emphasis in soybean production. This materializes in the

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<sup>8</sup> Latest Annual report of the software and computer services sector of the Argentine Republic, can be accessed in: <http://www.cessi.org.ar/opssi-reportes-949/index.html>

whole research made by the above-mentioned organizations. The increasing awareness on these aspects is incredibly positive for biogas projects, as they could improve the current situation specially in animal production farms.

There is also a parallel concern on social aspects coming from the public side (municipal, province and federal governments) and the private sector through new trends in enterprise management as fair trade, social enterprise responsibility and certification schemes.

The progress achieved is allowing premises promoting sustainable development to put in practice concrete initiatives:

- Criteria, development indicators
- Good agricultural and agro-industrial practices
- Certified agriculture
- Certification of biofuel schemes, International Sustainability and Carbon Certification (ISCC), CARBIO, Round Table Responsible Soy Round Table Responsible Soy (RTRS), Roundtable on Sustainable Biomaterials (RSB) among others.

Technological evolution has allowed unquestionable improvements in the preservation of the environment. Just to name a few:

- Reduction of agrochemicals toxicity
- Applied technologies (Good agricultural practices)
- Direct seeding technologies
- Precision farming
- Higher production intensity, reducing pressure over extension of land-use.

The development advance of the regulatory framework context has allowed a better control and the future development of land usage. In Argentina's case the Minimum Budget Law of minimum budget is an example towards that direction. Over the last decades, soybean cultivation has had an unprecedented evolution with no precedents. Since the 70's plantations implanted areas have grown, from sustain representing 37.000 hectares in the 1970/71 campaign to more than 17 million at the present (INTA & Ministry of Agriculture, 2020).

In Argentina, the no-till farming system has been developed in the late 1980s. Its first objective was to reduce soil erosion and degradation. This method is a way of growing crops from year to year without disturbing the soil through tillage, a system of conservation that lets on the soil the weeds from the precedent crop. This emergent agricultural technique prevents soil erosion and degradation, and improves physical, chemical, and biological soil conditions. Moreover, it has shown great results on the efficiency of water use, which is an especially important parameter and usually a limiting production factor.

Increased regulation has allowed for better control on the future development of land use. In Argentina's case Law Number 26.331 (The Native Forest Minimum Budget Law), is an example towards that direction, though implementation has been less effective. It is structured on the base of two central measures: one that strives to immediately stop deforestation, and the other producing an environmental territorial code for each province's land uses, including native forests. Its objective is to achieve conservation, sustainable forest use, and payment for ecosystem services, which are given to the local community. Thus, the code should reflect the different conservation categories - I (red), II (yellow) and III (green) – which reflect the environmental value of the different native forest units and environmental services provided.

In February 2009, the National Executive Power dictated the Decree N° 91/2009 that implements the Native Forest Law. Unfortunately, this Decree did not adequately finance the National Fund for the Enrichments and Conservation of Native Forests, whose purpose is to contract for the payment of environmental services (Di Paola et al., 2009). This fund has yet to be adequately supported since then, raising serious concerns about the implementation of Law Number 26.331.

Regarding pesticide use, glyphosate use is widely used. While it is less aggressive to the environment and human health than alternatives for large application volumes coming from soy expansion, it is essential to enforce the handling and application recommendations. We care for this technology making relevant studies to understand its action on the environment and human health and to optimize its therapeutic action and minimize its harmful effects. There had been isolated accidents with glyphosate bad handling. There are improvements in technologies, handling trainings and techniques. The main recommendations for safer handling that are followed are i) adjust timing, dose and avoid precipitation close to applications, ii) crop rotations and / or implementation of cover crops to reduce the amount and concentration of glyphosate and in surface runoff or deep drainage iii) buffer zones for protection of biodiversity, surface freshwater bodies and population in urban areas and to prevent contamination by drift, (INTA, 2011).

As part of the Paris Agreement on climate change, Argentina committed to reducing its greenhouse gas emissions by 18% unconditionally, with the possibility of increasing that figure to 37%, based on the availability of international funding. According to studies, Argentina is responsible for 0.7% of global emissions (Argentina.gob.ar, n.d.).

Though Argentina's commitment is considered as one of the more ambitious compared to other nations, is nonetheless still seen as insufficient by most climate organizations, whose say it is not in line with the goal outlined in the Paris Agreement: limiting global warming to a maximum of two degrees Celsius (2°C) above pre-industrial levels. With current pledges taken into account, experts warn, global warming would reach four degrees Celsius (4°C).

According to Argentina last inventory report published in 2017, the energy sector accounts for 53% of emissions in the country. Cattle represents 20.7%, followed by transportation with 15%. In these three sectors, biogas could play an important role if a significant development is achieved in these three sectors.

There are other groups in several rural towns concerned about agrochemical extensive use and their actions have led to several regulations at municipal and provincial level regarding restrictions to the use over small village's schools etc.

### 2.1.6 Environmental requirements applied to biogas plants<sup>9</sup>

In environmental matters, there are no regulations that specifically apply to projects of production or use of biogas. By application of the precepts of the National Constitution (Article 124), the competence in environmental matters corresponds to the provinces, with the limitations established in favor of the Nation. In this sense, the Nation has powers to dictate the minimum

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<sup>9</sup> A complete description of all the laws regulations, etc. applicable to biogas plants and artifacts can be downloaded from the PROBIOMASA project site [http://www.probiomasa.gob.ar/\\_pdf/01CEARE-InformeTecnico-web.pdf](http://www.probiomasa.gob.ar/_pdf/01CEARE-InformeTecnico-web.pdf)

budget standards for environmental protection, that impose a uniform floor throughout the national territory. In these cases, the provinces have complementary powers, without being able to establish legislation or parameters of protection that are lower than those established by the Nation, and are also obliged to adapt the provincial regulations that do not meet the minimum budgets. Thus, by application of the General Environmental Law, all projects that have risk of environmental degradation or affect the quality of life of the population in a significant way must have an Environmental Impact Evaluation (EIA). However, there is no national minimum budget standard for the performance of the EIA. The procedure is currently subject to the provincial regulations. Therefore, the elaboration of a technical regulatory guide is recommended. It would be important if in the coming years federal minimum environmental protection requirements are to be developed to give the provinces the chance to adopt them in their territory.

In addition to the relevant environmental conditions for the installation and operation of biogas production plants, the use of the digestate as fertilizer should be regulated, since, on the one hand, its nutrient content can contaminate the soil and water by eutrophication, and on the other hand, the soil on which the digest is applied may not be suitable for such application. Transport and adequate distribution can be awfully expensive since it is made up of 90% water and requires considerable expenses to transport it in tank trucks. Therefore, it is necessary to establish procedural rules for the final disposal of the digestate, whose absence are currently acting as a limiting factor for biogas projects.

## 2.2 Market Characterization and Definition

### 2.2.1 Traditional market

According to a report published by PROBIOMASA in 2020<sup>10</sup>, *in Argentina, the biogas market has gained a solid foothold over the last five years and is massively industrial. However, its growth is slowing down.* In 2015, Argentina has developed 100 biogas plants and has grown exponentially until 2020 through the RenovAr Programme. During 2020, INTA and PROBIOMASA has conducted a survey assessing 80 of the 100 plants built nationwide. INTA and PROBIOMASA has found that from the 80 plants surveyed, 76 of the 80 biogas plants developed up until 2015 were installed for environmental purposes, while 11 of the 80 biogas plants surveyed were utilised for energy development, consisting of large bio-digestion plants (1MW-2MW), consisting mostly of covered lagoon and mixed technologies utilising digesters, double membrane reactor, and a co-generation unit i.e. combined heat and power (CHP). This situation translates into a low rate of biogas utilization as renewable energy and underutilization of facilities. The study also found the existence of technical flaws in the construction, materials used, lack of safety and operation procedures of the installations and poor training of qualified personnel for handling of the plants. Such shortcomings correspond, in some cases, to norms or standards such as those related to safety conditions, environmental regulations and materials. Furthermore, a low use of thermal insulators, agitators, and control of key parameters among others were detected.

The most used substrates were industrial waste (37.5%); urban organic waste (28.1%); and virgin biomass (1.6%) (PROBIOMASA, 2020). Important shortcomings were observed in terms of security measures appropriate to the type of process and, also, in terms of standards that

<sup>10</sup> The complete PROBIOMASA report can be accessed in: <http://www.probiomasa.gob.ar/pdf/12-valoracion-externalidades-biomasa-seca-biogas.pdf>

regulate these aspects. In addition, there are deviations in the design of the plants with respect to the environmental conditions.

### 2.2.2 New market in development

In the last five years, the implementation of the RenovAr program has called for the development of a new professional and high-tech market. There was an important development of the technology with providers principally coming from Europe. There has been a rapid increase in the capacity of local developers in construction start up and operation of complex plants.

The RenovAr program was framed within the national plan of the Undersecretary for Renewable Energies. It responds to Law 27,191 which aims to achieve a 20% renewable energy penetration into the energy mix by 2025. Four rounds of the program have already been carried out successfully, RenovAr 1, RenovAr 1.5 and RenovAr 2 and miniRenovAr3. A more detailed explanation of the RenovAr program can be found in section 2.4.1.

The program is intended to generate 400 MW of power from different renewable electric generation technologies. In the case of the last call in 2019, Mini Ren 3, 10 MW are those destined for a tender for electricity generation from BIOGAS. The minimum power for each of the projects must be 0.5 MW, while the maximum accepted power is 10 MW.

The program has many benefits and incentives. In the first instance, the most important is the fact of signing an energy supply contract or Power Purchase Agreement (PPA) with the Management Company of the Wholesale Electricity Market (CAMMESA), for a term of 20 years. In this contract, the BIOGAS project undertakes to supply a certain amount of electrical energy to the national distribution network monthly against a payment in US Dollars by the provincial energy distributor in agreement with CAMMESA. In the case of biogas, the maximum price accepted to submit in the tender per MW-h of committed energy is USD 160.

It is the obligation of the entities responsible for the distribution of electrical energy in each province to accept the rate, committing to pay said rate, with the acceptance by CAMMESA. The provincial entities are responsible for the payment with the joint acceptance of CAMMESA.

This program produced an increasing market with the evolution of the calls, which were made friendlier with biogas technology.

In general, projects carried out by companies of national capital and financing in most cases, was structured with Banco BICE and the *Banco Nación de la República Argentina*. The loan structuring problem is observed in guarantees requested by banks, which do not consider supply contracts signed with CAMMESA as sufficient. To overcome this problem, the Fund for the Development of Renewable Energy (FODER) was created as an additional guarantee. In recent years, an important local knowledge base has been generated for dry biomass and biogas, which includes local developers, technologists, science agencies and technology, universities, input suppliers, financing sectors, distributors of energy, like users and communities. The conditions are in place to generate synergies to this strategic and fundamental sector for rural development and circular economies at the national level.

At the present stage there are in total 65 biogas projects in round 1, there are a total of 37 signed contracts for a total amount of 64,9 MW with an average price of 159,7 USD/MW<sup>11</sup>.

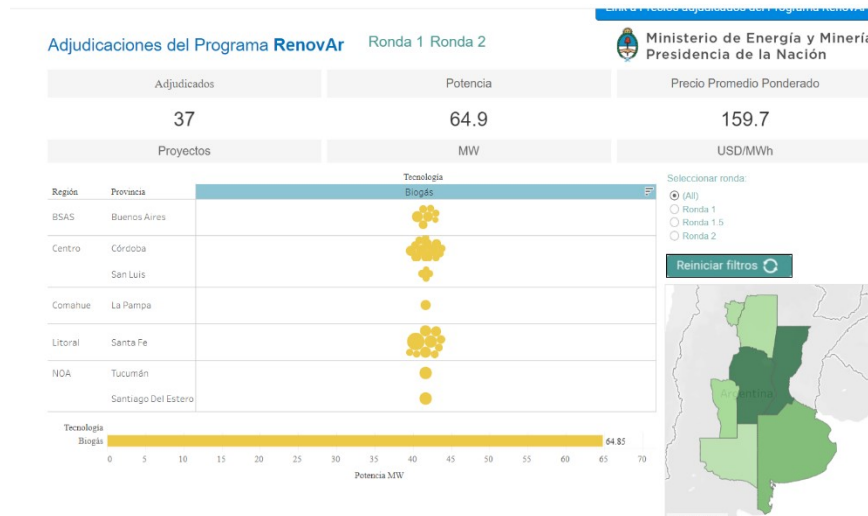


Figure 4: Print screen of the official ministry of energy page

<sup>11</sup> Live information of biogas projects can be accessed through the Secretary of Energy webpage: <https://www.minem.gob.ar/www/833/25897/proyectos-adjudicados-del-programa-renovar>.

Table 3: Biogas projects approved (partly operating and partly in construction)

ID	Name of project	Company	Province	Región	Price & Power sec row
BG-01	C.T. Río Cuarto 1	BIOMAS CROP	Córdoba	Centro	160
BG-01	C.T. Río Cuarto 1	BIOMAS CROP	Córdoba	Centro	2
BG-02	C.T. Río Cuarto 2	BIOMAS CROP	Córdoba	Centro	160
BG-02	C.T. Río Cuarto 2	BIOMAS CROP	Córdoba	Centro	1.2
BG-03	C.T. Yanquetruz	ACA / FERSI	San Luis	Centro	160
BG-03	C.T. Yanquetruz	ACA / FERSI	San Luis	Centro	1.2
BG-04	C.T. San Pedro Verde	ADECO AGRO	Santa Fe	Litoral	158.92
BG-04	C.T. San Pedro Verde	ADECO AGRO	Santa Fe	Litoral	1.415
BG-05	C.T. Huinca Renancó	FECOFE / COOP. HUINCA RENANCÓ	Córdoba	Centro	160
BG-05	C.T. Huinca Renancó	FECOFE / COOP. HUINCA RENANCÓ	Córdoba	Centro	1.62
BG-06	C.T. Biogás Ricardone	MARTÍN NACARATO / OTROS	Santa Fe	Litoral	118
BG-06	C.T. Biogás Ricardone	MARTÍN NACARATO / OTROS	Santa Fe	Litoral	1.2
BG-500	C.T. Bombal Biogas	TANONI HNOS S.A.	Santa Fe	Litoral	165
BG-500	C.T. Bombal Biogas	TANONI HNOS S.A.	Santa Fe	Litoral	1.2
BG-501	C.T. Arrebeef Energía	ARREBEEF S.A.	Buenos Aires	BSAS	150
BG-501	C.T. Arrebeef Energía	ARREBEEF S.A.	Buenos Aires	BSAS	1.5
BG-502	C.T. Pollos San Mateo	POLLOS SAN MATEO S.A.	Córdoba	Centro	156
BG-502	C.T. Pollos San Mateo	POLLOS SAN MATEO S.A.	Córdoba	Centro	2.4
BG-503	C.T. James Craik	ACZIA BIOGAS, S.L.	Córdoba	Centro	156
BG-503	C.T. James Craik	ACZIA BIOGAS, S.L.	Córdoba	Centro	2.4
BG-504	C.T. Recreo	ACZIA BIOGAS, S.L.	Santa Fe	Litoral	156
BG-504	C.T. Recreo	ACZIA BIOGAS, S.L.	Santa Fe	Litoral	2.4
BG-505	C.T. San Francisco	ACZIA BIOGAS, S.L.	Córdoba	Centro	156
BG-505	C.T. San Francisco	ACZIA BIOGAS, S.L.	Córdoba	Centro	2.4
BG-506	C.T. Bella Italia	ACZIA BIOGAS, S.L.	Santa Fe	Litoral	156
BG-506	C.T. Bella Italia	ACZIA BIOGAS, S.L.	Santa Fe	Litoral	2.4
BG-507	C.T. Pacuca Bio Energía	PACUCA S.A.	Buenos Aires	BSAS	171.85
BG-507	C.T. Pacuca Bio Energía	PACUCA S.A.	Buenos Aires	BSAS	1
BG-508	C.T. Ab Energía	AB AGRO S.A.	La Pampa	Comahue	156.85
BG-508	C.T. Ab Energía	AB AGRO S.A.	La Pampa	Comahue	2
BG-510	C.T. Resener I	INMADE S.A.	Buenos Aires	BSAS	176.4
BG-510	C.T. Resener I	INMADE S.A.	Buenos Aires	BSAS	0.72
BG-511	C.T. Enreco	CECILIA DEBENEDETTI	Córdoba	Centro	156.85
BG-511	C.T. Enreco	CECILIA DEBENEDETTI	Córdoba	Centro	2
BG-512	C.T. Santiago Energías Re	LOS AMORES S.A.	Santiago Del Estero	NOA	156.85
BG-512	C.T. Santiago Energías Re	LOS AMORES S.A.	Santiago Del Estero	NOA	3
BG-513	C.T. General Villegas	MARÍA ELENA S.A	Buenos Aires	BSAS	169
BG-513	C.T. General Villegas	MARÍA ELENA S.A	Buenos Aires	BSAS	1.2
BG-514	Ampliacion 2 Central Bioe	BIOMASS CROP S.A.	Córdoba	Centro	169
BG-514	Ampliacion 2 Central Bioe	BIOMASS CROP S.A.	Córdoba	Centro	1.2
BG-515	Ampliacion Bioelectrica C	BIOELECTRICA DOS S.A.	Córdoba	Centro	169
BG-515	Ampliacion Bioelectrica C	BIOELECTRICA DOS S.A.	Córdoba	Centro	1.2
BG-516	C.T. Bio Justo Daract	BIOMASS CROP S.A.	San Luis	Centro	175
BG-516	C.T. Bio Justo Daract	BIOMASS CROP S.A.	San Luis	Centro	1
BG-517	C.T. Biogeneradora Santa	BIOGENERADORA CENTRO S.A	Córdoba	Centro	156.85
BG-517	C.T. Biogeneradora Santa	BIOGENERADORA CENTRO S.A	Córdoba	Centro	2
BG-518	C.T. Yanquetruz li	BIO ENERGIA YANQUETRUZ	San Luis	Centro	177.85
BG-518	C.T. Yanquetruz li	BIO ENERGIA YANQUETRUZ	San Luis	Centro	0.8
BG-519	C.T. El Alegre Bio	ANTIGUAS ESTANCIAS DON ROBERT	Córdoba	Centro	175
BG-519	C.T. El Alegre Bio	ANTIGUAS ESTANCIAS DON ROBERT	Córdoba	Centro	1
BG-520	C.T. Don Roberto Bio	ANTIGUAS ESTANCIAS DON ROBERT	San Luis	Centro	175
BG-520	C.T. Don Roberto Bio	ANTIGUAS ESTANCIAS DON ROBERT	San Luis	Centro	1
BG-521	C.T. Biocaña	SESNICH, NESTOR OMAR	Santa Fe	Litoral	156.85
BG-521	C.T. Biocaña	SESNICH, NESTOR OMAR	Santa Fe	Litoral	3
BG-522	C.T. Pergamino	SEEDS ENERGY	Buenos Aires	BSAS	156.85
BG-522	C.T. Pergamino	SEEDS ENERGY	Buenos Aires	BSAS	2.4
BG-523	C.T. Venado Tuerto	SEEDS ENERGY DE VENADO TUERTO	Santa Fe	Litoral	156.85
BG-523	C.T. Venado Tuerto	SEEDS ENERGY DE VENADO TUERTO	Santa Fe	Litoral	1.998
BG-524	C.T. General Alvear	CARNES DE LA PATAGONIA NEUQUIH	Buenos Aires	BSAS	171.85
BG-524	C.T. General Alvear	CARNES DE LA PATAGONIA NEUQUIH	Buenos Aires	BSAS	1
BG-525	C.T. El Mangrullo	CARNES DE LA PATAGONIA NEUQUIH	Buenos Aires	BSAS	156.85
BG-525	C.T. El Mangrullo	CARNES DE LA PATAGONIA NEUQUIH	Buenos Aires	BSAS	2
BG-526	C.T. Avellaneda	INDUSTRIAS JUAN F. SECCO S.A.	Santa Fe	Litoral	160
BG-526	C.T. Avellaneda	INDUSTRIAS JUAN F. SECCO S.A.	Santa Fe	Litoral	6
BG-527	C.T. Citrusvil	CITRUSVIL S.A.	Tucumán	NOA	153
BG-527	C.T. Citrusvil	CITRUSVIL S.A.	Tucumán	NOA	3
BG-528	C.T. Jigena I	CLEANERGY RENOVABLES S.A.	Córdoba	Centro	171
BG-528	C.T. Jigena I	CLEANERGY RENOVABLES S.A.	Córdoba	Centro	1
BG-529	C.T. Villa del Rosario	CLEANERGY RENOVABLES S.A.	Córdoba	Centro	174.5
BG-529	C.T. Villa del Rosario	CLEANERGY RENOVABLES S.A.	Córdoba	Centro	1
BG-530	C.T. del Rey	SILVINA HACEN	Santa Fe	Litoral	169
BG-530	C.T. del Rey	SILVINA HACEN	Santa Fe	Litoral	1
BG-531	C.T. Don Nicanor	SILVINA HACEN	Santa Fe	Litoral	169
BG-531	C.T. Don Nicanor	SILVINA HACEN	Santa Fe	Litoral	1

Regarding the operation and performance of the plants, there is an online page called CAMMESA that monitors the production and operation of all the renewable energy plants (<https://despachorenovables.cammesa.com/renovables/>). Unfortunately, the biogas sector is not separated from biomass.

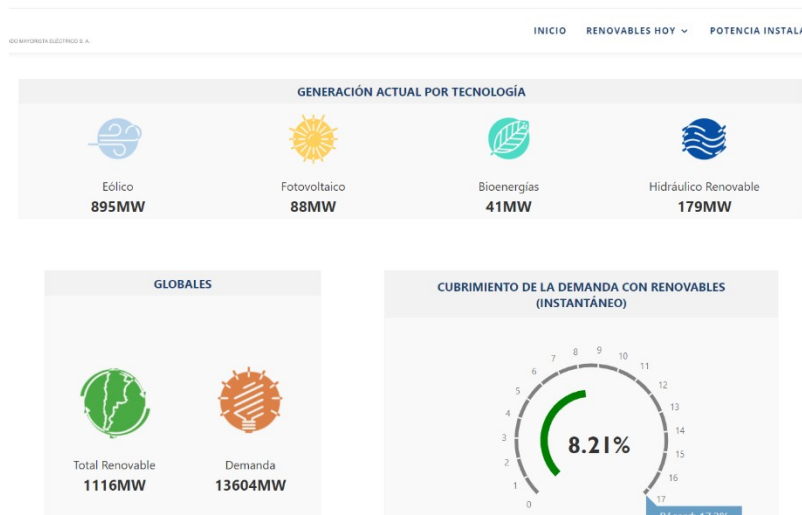


Figure 5: CAMMESA live generation information of Argentina

Detailed information of generation contracts and dispatch priority can be accessed in the annual reports of CAMMESA. The latest 2019 report can be downloaded from: <https://portalweb.cammesa.com/Documentos%20compartidos/Noticias/Mater/Informe%20Renovables%20DIC%202019.pdf>

According to this report biogas plants have generated a total of 231 GWh in 2019 with an increase of 57% compared to 2018. At the current stage, there are already 17 biogas projects running and delivering electricity according to the reports of CAMMESA.

Table 4: Electric energy generation from different sources

FUENTE DE ENERGÍA	AÑO 2011	AÑO 2012	AÑO 2013	AÑO 2014	AÑO 2015	AÑO 2016	AÑO 2017	AÑO 2018	AÑO 2019
BIODIESEL	32.5	170.2	2.2	1.6	0.0	0.9	0.0	0.0	0.0
BIOMASA	97.6	127.0	133.9	113.7	154.7	193.0	242.6	241.4	274.0
EOLICO	16.0	348.4	446.9	613.3	593.0	546.8	615.8	1443.9	4390.3
HIDRO <= 50MW	1255.4	1452.6	1274.0	1456.9	1623.8	1820	1695.9	1430.7	1312.4
SOLAR	1.76	8.1	15.0	15.7	14.7	14.3	16.4	109.3	677.6
BIOGAS	0.0	35.6	108.5	103.0	83.6	57.5	64.1	146.7	231.0
<b>Total GWh</b>	<b>1403.2</b>	<b>2141.9</b>	<b>1980.6</b>	<b>2304.3</b>	<b>2469.7</b>	<b>2632.5</b>	<b>2634.8</b>	<b>3372.0</b>	<b>6885.4</b>

DEMANDA MEM vs GEN RENOVABLE	AÑO 2011	AÑO 2012	AÑO 2013	AÑO 2014	AÑO 2015	AÑO 2016	AÑO 2017	AÑO 2018	AÑO 2019
Demanda MEM [GWh]	116349	121293	125166	126467	132107	132961	132507	132889	117744
Ren MEM / Dem MEM	1.2%	1.8%	1.6%	1.8%	1.9%	2.0%	2.0%	2.5%	5.8%

There is an online map locating all biogas plants in operation, this information can be accessed in: <https://aplic.cammesa.com/geosadi/>



### 2.2.3 Credit and financial constraints

Currently, banks do not accept only PPA as a guarantee to finance energy projects, and require also personal guarantees, financial guarantees or instruments that are difficult for some investors to comply with, even in cases where producers of agricultural and agro-industrial establishments have important patrimonial endorsements.

Financial engineering and knowledge of the banking sector has evolved. The sector has been trained in the analysis of biogas projects and biomass, which have their own peculiarities. The evolution will most likely make a clear differentiation in requirements between well-structured projects and those that are not, which will surely allow for a greater accessibility to financing for the best proposals.

In projects where investments are of significant size, the financial entities promote the project's development through the formation of Special Purpose Entities (SPEs). Through these, the promoters generate a new company, formed with initial contributions (initial share capital) not significant compared to the size of the investment. This company is in charge of signing the financing agreements, which determine the scheme and conditions of the debt to be provided by the creditors for the execution of the project, and to be the vehicle for the signing and administration of construction contracts, works, equipment and operation; necessary for the development of the project.

Specific Purpose Entities must be adapted to enhance the use of residual resources or produced by some companies without becoming a fiscal and economic obstacle to development and project financing.

The requirement of the SPE beneficiary by the incentive prosecutors separated from the main activities of the SMEs have limited the presentation of offers in past tenders. The agro-industrial entrepreneurs receive differential treatment when they come from the biomass and biogas sectors. Participants from these sectors come from agricultural and agro-industrial SMEs, which do not have experience in large scale energy commercial sector.

Another important pending subject for the sector remains in the differential treatment of imported components that are necessary for the construction of biogas plants. Due to the strategic energy generation from waste and effluents, biogas not only produces an important contribution to the trade balance during the cycle of projects but contributes to mitigation of CO<sub>2</sub> emissions, which favors the fulfillment of the objectives on climate change set by Argentina.

Furthermore, there is a major challenge in communicating the needs of the sector to key decision makers, so that the mechanisms are improved and implemented to continue consolidating achievements and promoting new projects.

The diversity of the situations in the biogas sector makes the definition very dynamic and complex for stimulus mechanisms, which are an important step for the sector to achieve further consolidation.

Another important challenge is to achieve a synergy between different organisms and the public-private dynamics to consolidate actions that enhance the development of the sector as well as highlighting the positive impacts of biogas on the environment.

As the sector evolves, it generates new and sophisticated demands that require new skills. The need to accompany developers has evolved, from the initial basic promotion of the sector, to a higher focus on operational aspects, quality services and security standards.

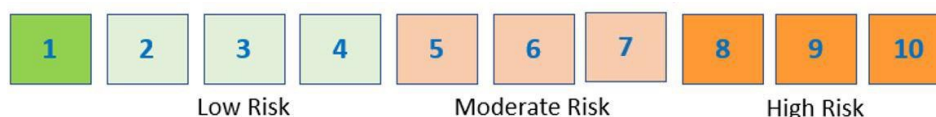
Key factors detected to secure and enlarge the biogas market in Argentina:

- Biomethane Law: promotion and regulation with a mandatory quota for cutting Natural Gas and bottled gas sold in Argentina (mandatory for large users and cargo and passenger vehicles).
- Optimization of financing mechanisms based on the experience gained.
- Improvement of tax compensation mechanisms also based on experience acquired.
- Expansion of quotas for biomass and biogas projects and new bidding rounds.
- Optimization of mechanisms for receiving biomass and biogas projects.
- Definition of incentives for the development of thermal exploitation (biogas and dry biomass in industrial and residential heat generation), and promotion of technology transfer for the takeoff of the sector.

## 2.3 Porter's 5 Forces

Each force indicator will be analyzed, scored with these following specifications, and illustrated using figure below<sup>12</sup>:

1. Is absolute zero risk
2. Is low risk<sup>13</sup>
3. Is low risk with straightforward operational solution
4. Is low risk which require strategic adjustment
5. Is moderate risk
6. Is moderate risk with straightforward operational solution
7. Is moderate risk which require strategic adjustment
8. Is high risk
9. Is high risk with straightforward operational solution
10. Is high risk which require strategic adjustment



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

Figure 6: Porter's Five Forces Scoring Diagram

### 2.3.1 Competition in the industry

Competition in the biogas sector has been steadily increasing in the last four years. There are local and European actors competing in the market and some joint ventures. The following table represents the main actors detected in the market in 2020.

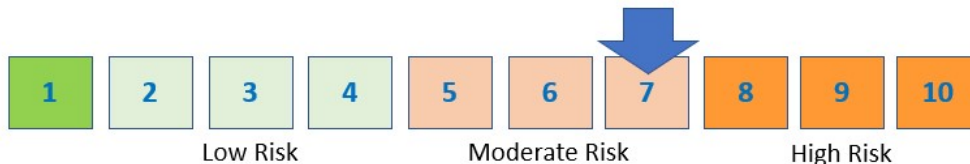
<sup>12</sup> Straightforward operational solution is defined as measures taken by business actors in the short term, for the most part addressing specific elements of a market e.g. technical aspects. Conversely, strategic adjustment is defined as long-term measures taken by business actors which involves an end-to-end approach.

<sup>13</sup> 'Is high risk', 'is moderate risk', and 'is high risk' are external risk factors that cannot be directly addressed. These risks require business actors to adapt to these existing external issues.

Table 5: Principal biogas actors in the Argentine biogas market

Name of the Company	Main Knowledge	Principal Business
<b>GRUPO IFES</b>	Biogas development projects building and initiation, consultant, training, capacity building	Industry, farmers, municipalities
<b>Tecnored</b>	Biogas development projects building and initiation, consultant	Industry farmers municipalities government
<b>CEAMSE</b>	Residue treatment operation in the largest landfill in Buenos Aires	Municipalities and Buenos Aires federal district CABA, other residue generation companies
<b>BERTOTTO BOGLIONE</b>	Tanks and liquid transport devices	Transport farms and industry
<b>ECS - ENGIE</b>	Contract energy negotiations, infrastructure studies, market studies forecast	Services
<b>ECOPRENEUR</b>	Water treatment, industrial effluents, renewable energy	Industry municipalities, local governments farms
<b>BGA Energía Sustentable SRL Biogás Argentina</b>	Biodigesters and solar systems	Farms industry
<b>Industrias J F Secco</b>	Electric generators, gas compression, material movements	Public and private sector industry, mining, oil & gas
<b>Mtu Detroit Diesel Allison Argentina S. A</b>	Big engines of different brands, services of maintenance and repair	Public and private sector, industry, mining, oil & gas
<b>IES Biogas</b>	Biogas plants in many countries	Farms industry
<b>Adecoagro</b>	Milk biogas and bioethanol production	General customers of their products
<b>Seeds Energy</b>	Biogas development projects building and starting up, consultant	Farmers
<b>Bio Argentina Sa (Bio-electrica)</b>	Biogas development, projects building and starting up, consultant, and operation	Farmers and agroindustry
<b>Fertec SRL</b>	Farm machinery for spreading biofertilizers	Farmers
<b>Benito Roggio Ambiental</b>	Recycling, residue collection, transport and treatment, land fill energy recovery	Municipalities, other residue, generation companies
<b>ARINCO</b>	Cement tanks platforms, construction	
<b>EG Ingeniería</b>	Biogas development projects, building and starting up, consultant and operation	Farmers and agroindustry
<b>TYSA</b>	Recycling, residue collection transport and treatment, land fill, energy recovery	Municipalities different type of cities residue generators

<b>SOLAMB</b>	Treatment of solids and liquids by different technologies including biogas	Municipalities, different type of cities, residue generators
<b>YPFTECNOLOGIA YTEC</b>	Tec	Research and development of new technologies
<b>OPENER SRL</b>	Tec	Different sources of renewable energy
<b>ACZIA BIOGAS</b>	Tec	Biogas plants in many countries
<b>BTS</b>	Tec	Biogas plants in many countries



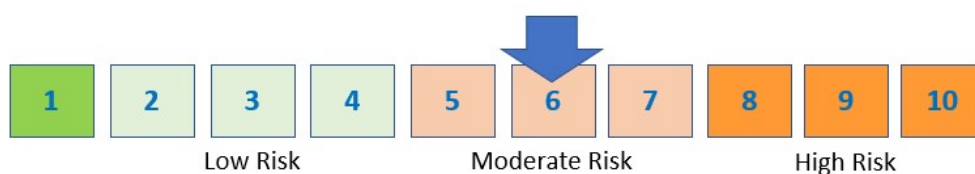
1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

### 2.3.2 Potential of new entrants into the industry

The potential of new entrants is affected by the technology and materials supplied. The greater window is for engines and generators that are not locally provided. Mixers, specific pumps, electric material, covers, and feeders have a shrinking share in the local market. As the potential new customers increase and the experience in constructing and operation plants enlarges more local companies start to develop and offer their products in the market.

There are some key technologies that have still not been developed in the country and could be a good area to explore and offer. These technologies are related to:

- Biogas upgrade in use
- Digestate upgrade into high value products
- Digestate use and application
- Heat recovery and use

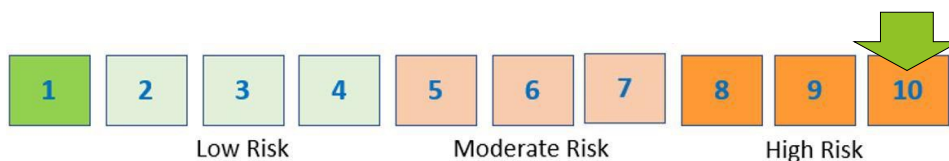


1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

### 2.3.3 Power of suppliers

Suppliers in Argentina are much affected by the macroeconomic instability. External providers need to cope with unpredictable strong changes in the value of the local currency. Although the revenue of biogas projects is mainly linked to contracts in dollars, there are strong variations between local and external prices.

This is mainly caused by strong variations in the labor and local costs expressed in hard currency. There are also incentives for national components in the plants in favor of local providers.

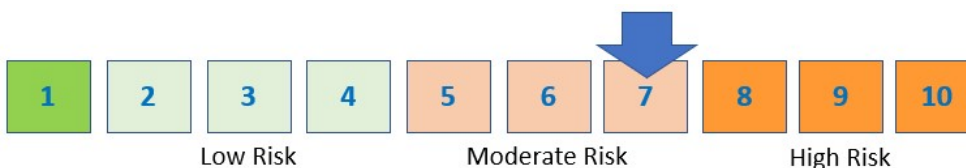


1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

### 2.3.4 Power of customers

The ability of customers driving prices down is increasing, influenced by national options of technology and project management. Since projects must compete and they are chosen based on the lowest energy price they can achieve reducing Capital Expenditure (CAPEX), CAPEX is one of the most important factors. This has a bigger importance in a market that suffers limitations in finance options. Interest rates are big, and this increases the importance of maintaining initial investment as low as possible.

This factor is being affected by the relatively small number of buyers or customers a provider company has—therefore, each customer is important. The cost that must be paid for a company to find new customers or markets for its output is increasing. A smaller and more powerful client base means that each customer has more power to negotiate for lower prices and better deals.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

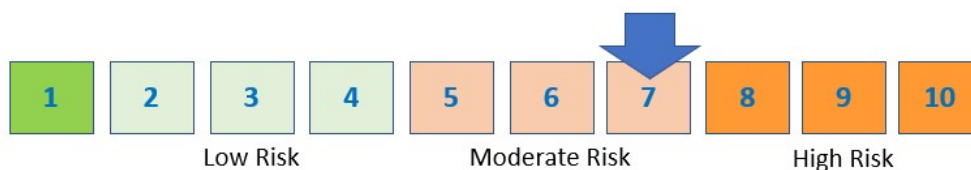
### 2.3.5 Threat of substitute products

The main risk in the specific electricity market comes from the increasing competitiveness of alternative renewable options such as solar and wind energy. Although there have been improvements in the valorization of indirect impacts of biogas technologies, there are always discussions and different pressures concerning prices between biogas electricity and the other renewables.

There is significant potential in the further use and application of digestate. The agricultural sector in Argentina has a chronic deficiency in nutrient reposition. With high costs, this represents an enormous potential market for the development of bio fertilizers based on digestate transformation.

There is also an important farm machinery industry that could develop specific machinery for the application of different organic fertilizers.

Another possible product for solid digestate could be bedding for animals since free stalls are growing in the dairy business.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

## 2.4 Market Policies and Incentives

Law 27191, approved in September 2015 with a broad political consensus, set goals for the development of renewable energy and created a legal framework allowing long-term market planning and providing visibility for investments. The rule establishes two contracting mechanisms: joint purchases through public tenders, and free and direct contracting between generators and Large Authorized Users (GUH), defined as those whose average power demand per year is 300 kW or more.



Figure 7: Argentina renewable energy targets

### 2.4.1 Renovar Program<sup>14</sup>

In May 2016, the former Ministry of Energy and Mining now Secretary of Energy launched the first round of the RenovAr Program, with the aim of attracting investments for the development of renewable energy projects that would allow meeting the established objectives. RenovAr is a plan for incorporating sources of renewables to the energy matrix, through an open call process for contracting, in the Wholesale Electricity Market (MEM), of electrical energy from renewable sources, based on the use of the sun, wind, water and biomass.

The RenovAr mechanism strives to address and overcome some of the problems that arose in the 2009 GENREN Program, which had a poor percentage of execution of awarded projects. The major change aimed at ensuring better financial conditions for auction winners through the Fund for the Development of Renewable Energy (FODER) and the World Bank guarantees made available to potential bidders. This guarantee scheme sought to offer a transparent framework and to promote the financing of these projects, which had a double objective: support buyer payments through the Administrative Company for the Wholesale Electricity Market (CAMMESA) and mitigate any systemic risk that may arise throughout the 20-year duration of the contract, also offering termination guarantees. The bidders were able to request these risk mitigators of the two tenders beforehand. Also, to decrease future transmission, capacity and availability of the connection nodes, the capacity was made available through public access to annexes 3.1 and 3.2 by the tender.

<sup>14</sup> All detailed information on the RenovAr program and different calls can be accessed in <https://www.argentina.gob.ar/energia/energia-electrica/renovables/renovar>

## 2.4.2 Mater Opportunity

As stated, Law 27191, National Development Regime for the use of renewable energy sources for energy production (which amended Law 26190/2006), establishes that all users must contribute with the targets for increasing use of renewable sources in the consumption of electrical energy, until it reaches the following goals: 8% at the end of 2017; 12% by the end of 2019; 16% by the end of 2021; 18% by the end of 2023 and 20% at end of 2025. At the same time, in its article 9, the law provides that self-generators, the large users of the Market Wholesale Electric (GUMA and GUME users) and the *Grandes Usuarios en Distribución Mayores* (GUDI users), with demands for power equal to or greater than 300 kW, must individually meet these objectives. These users are called Large Enabled Users (GUH) and represent an average annual demand of 31.4 TWh. Therefore, in 2025, they should consume a minimum of 6.3 TWh of renewable energy to comply with the objective of Law 27191.<sup>15</sup>

Large users (GU) have three ways to fulfil that obligation:

1. Generation, self-generation, or co-generation (own project covering such requirements).
2. Contracting the supply with the owner of a power plant from renewable sources (usually called Private PPA)
3. Joint purchases through rounds bidding for the RenovAr program, for those GU who choose such an alternative or refrain from exercising a given option (solution by default)

PPA lies within the process of renewable energy contracting between private companies where important improvements have been generated. Indeed, in the third quarter of 2017 the Energy Term Market Regime was disclosed. Electric Renewable Source Electrical (MATER, Resolution MEyM 281-E / 2017), which establishes the conditions to manage contracts between the new generation or renewable self-generation and large users of the MEM. CAMMESA has defined that this regime reaches about 2,000 GUH (19 with power greater than 20 MW; 92 with power between 5 and 20 MW, and 1,959 between 0.3 and 5 MW), through a list that will be updated in February of each year.

The option of exclusion from this mechanism is granted twice a year, in May and November. When communicating in exercising this option, the GUH must inform the estimated percentage of demand to self-generate or acquire through MATER, which must not be less than that required by the objectives of Law 27191. After exercising the option, the GUH will have 6 months to roll back and return to the joint purchasing mechanism. In case of confirming the exercise of the option, you can re-enter the purchasing mechanism jointly after a period of 5 years. To ensure compliance with the objectives of the law, CAMMESA will carry out an audit on those GUH that fall outside the joint purchases, on an annual basis, on the accumulated results of monthly transactions. As a benefit, those GUH who choose to leave of the joint purchasing mechanism shall not pay the administration and marketing charges, which began to apply from January 2019. These charges are applicable to the monthly energy supplied by the joint purchase contracts, up to the percentage corresponding to the objective of Law 27191.

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<sup>15</sup> A comprehensive elaboration of the MATER program can be accessed in: <http://minaaysp.cba.gov.ar/wp-content/uploads/2018/06/AIRECweek-2018-The-Argentina-Report.pdf> pg. 31

The marketing charge will be applied depending on the GUH monthly average power and the maximum charge established for each biannual period. Those GUH with higher monthly average power at 20 MW must pay 100% of the maximum charge, while GUHs with lower power will have a linearly proportional reduction in charge at its monthly power, reaching 20% for 0 MW.

In turn, those GUH who choose to be excluded from the joint purchasing mechanism will receive a discount on the power reserve charge, associated with firm power costs: at total value of firm power that they require, the average monthly power supplied by MATER, multiplied by the adjustment factor of the corresponding biannual period. As of May 2018, the approximate value of this charge without reduction was 7 USD/MWh.

The regime encourages the abandonment of the joint purchases to the extent that those who choose so decide and develop a renewable energy generation project (or contract with one of them through del MATER), which will not pay the marketing and administration charges. Meanwhile, your energy supplied from renewable sources will not pay extra costs energy and can also receive a discount on the maximum power requirement charges in depending on the renewable energy power and the moment of the option (100% until 2018, 25% in 2020; the bonus remains fixed according to the time chosen to exit joint purchases and while keep out of the joint purchasing regime). Those GUs who choose to exit the joint purchasing regime will receive oversight to verify compliance with the legal minimums:

1. Per year past due;
2. With a 10% tolerance margin a compensate in the following year;
3. subject to a specific penalty from the valuation of the deviation to the price of electricity generation with diesel (that is, the most expensive generation; diesel cost equivalent – CGOEQ– 2017: approximately, 100 USD / Mwh); 4) prior to the imposition of the penalty, the GU may wield his defense.

In order to manage the scarcity recognized by the transmission system, a priority access regime was established, in the case where two projects of renewable generation are competing for a single access (otherwise, the priority of the renewable source is already given by article 18 of Law 27191).

Beyond GUHs, GUs integrated into MEM -in general - they will be able to celebrate PPA private even if they have not chosen to leave the joint purchasing regime. GUHs will only receive the detailed incentives to the extent that exercise the option of supplying through MATER, leaving the joint purchase regime.

### **2.4.3 Distributed Electricity as A New Market**

According to the current national regulatory framework, distributed generation of electrical energy is considered generated by renewable energy sources, at the point of consumption, and by the users themselves that are connected to the electrical network of distribution.

Distributed generation generally occurs through systems designed for self-consumption with eventual injection of surplus energy to the existing distribution network. Users who adopt this generation modality have the capacity to produce electrical energy, remaining in turn connected to the supply provided by the electrical distribution network. This is the model adopted in Argentina by Law No. 27,424 published in 2017.



The installation of a renewable distributed generation system enables the user to cover part of demand for electrical energy without the need resorting to the network supply, which results in economic savings due to self-consumption. In turn, if there is a surplus of electrical energy generated by the renewable source, the user-generator can perceive an economic benefit from the injection of surplus to the network.

In early 2018, the law was regulated by decree 986, where the objective was to incorporate 1,000 MW of power from Distributed generation installations by 2030. In addition, the Secretary of Government for Energy (SGE) was designated as the Enforcement Authority. At the end of 2018, Resolution 314 of the SGE created the *Registro Nacional De Usuarios-Generadores De Energías Renovables* (RENUGER), which is the National Registry of Users-Generators of renewable energy categorizing them in three groups small (up to 3kW), medium (up to 300 kW) and large (up to 2MW). This resolution established the procedure for User-Generator Connection and standards for basic contract between the actors.

Law 27,424 establishes a promotional benefits regime, including a Tax Credit Certificate, also creates the *Fondo Para La Generación Distribuida De Energías Renovables* FODIS in order to grant loans, incentives, guarantees, capital contributions and acquisition of other financial instruments, all intended to enhance the implementation of distributed generation systems from renewable sources.

To implement one of these benefits, provision 48 of the *Subsecretaría De Energías Renovables Y Eficiencia Energética* (SSERyEE) in April 2019 was developed. It provides that the SSERyEE and the Administración Federal de Ingresos (AFIP) will be in charge of the instrumentation and application of the Certificates of Tax Credit under the Electronic Bonus modality, which may be applied to the payment of National Taxes.

In July 2019, Provision No. 83 is issued, by which the procedure defined fixing the amounts and the conditions for obtaining the Tax Credit Certificate for user-generators.

This document details a validity of 5 years for the certificate once granted and describes the mode of a fixed amount for each unit of installed power.

On the website of the Distributed Generation Directorate, it is possible to find information on the progress in the implementation of the law, as well as instructions for the use of the Digital Platform, a Solar Calculator and information on promotional benefits.

Some provinces had already implemented their own regimes and laws, such as: Mendoza (Law 7459), Salta (Law 7824 Net Balance), Santa Fe (Prosumers Program), San Luis (Law 921), Neuquén (Law 3006), Misiones (Law 97 of Net Balance), and Jujuy (Law 6023), which, in some cases, have been already implemented. The different provincial regimes may vary conceptually in relation to the national law.

Industrial parks, shops of large cities and the rural sector from all over the country were interested since the possibility of clean energy brings them a solution to two problems: increased cost of the tariff and the security of supply of electrical energy.

## 2.5 Resources

### 2.5.1 Natural Resources

#### Availability and characteristics of feedstock source



In 2018 INTA and PROBIOMASA (described in section 2.1.5), carried out 12 WISDOM-type studies<sup>16</sup> that included the provinces of Tucuman, Salta, La Pampa, Mendoza, Cordoba, Buenos Aires, Corrientes, Santa Fe, Chubut, Chaco y Misiones. WISDOM analysis includes a section to evaluate humid biomass for biogas purposes. These studies generated knowledge about the significant potential for biogas generation from **pig, dairy and feedlot manure**, which highlighted the environmental assessment of the waste generated in establishments, such as less pollution due to effluent management and/or fossil fuel replacement (PROBIOMASA, 2019).

### Pig Farm

Pig production is concentrated in the agricultural core zone, although it is also dispersed throughout the national territory (Figure 8).

The physical-chemical composition of the pig manure varies depending on the production system, the type of exploitation, the age of the animal, the diet, and the management of the farms. Of each gram of protein consumed by an animal, only 33% is used for the formation of tissue (meat) and the rest is eliminated through feces and urine. The slurry has 12% dry matter (DM), of which between 85 and 90% is organic matter. Regarding the power generation potential, the conversion of pig slurry into biogas is 0.06 cubic meters per kilogram of total solids (m<sup>3</sup>/kg ST). This numbers will finally depend on the implemented manure management system.

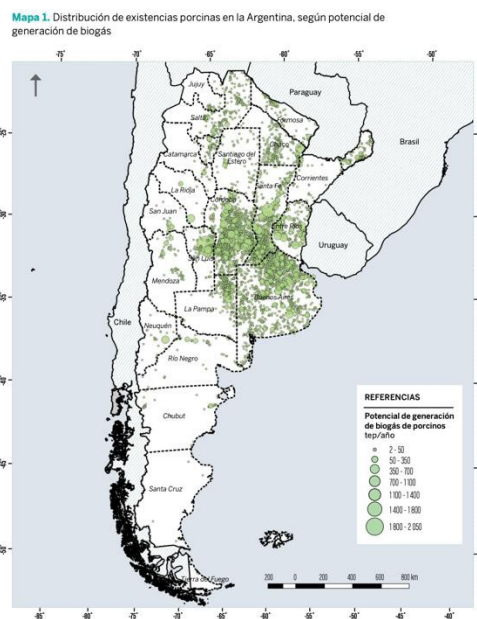


Figure 8: Swine manure feedstock (PROBIOMASA, 2019)

<sup>16</sup> The complete document of the study can be accessed through: [http://www.probiomasa.gob.ar/\\_pdf/Informe%20Tecnico%20Nro4-Estudio%20de%20cuencas%20de%20biogas-19-08-22.pdf](http://www.probiomasa.gob.ar/_pdf/Informe%20Tecnico%20Nro4-Estudio%20de%20cuencas%20de%20biogas-19-08-22.pdf) (In Spanish).

## Beef Feedlots

Mapa 13. Distribución de feedlots en la Argentina, según potencial de generación de biogás

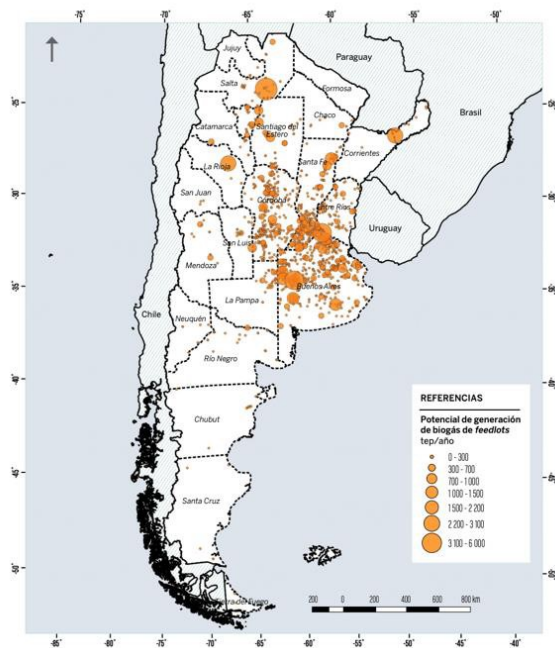


Figure 9: cattle manure in feedlots (PROBIOMASA, 2019)

Given its moist content (from 80 to 85%), there are 3 kg of dry residue per animal per day, on average. Depending on the digestibility of the diet, a 5,000 head feedlot can produce 6,000 to 9,000 tons of manure annually. The farmyard cattle fattening establishments in 2015 totaled 1,320,000 head, estimating their biogas generation potential at 198,748 toe/ year, or 361,360,077 m<sup>3</sup> / year of biogas (PROBIOMASA, 2018).

The fattening to farmyard (feedlot) has been developed in the last twenty years in Argentina as a complement in the finishing of beef cattle and has achieved a significant insertion in the chain. Currently, in the country there are more than 1900 feedlots, of various sizes with beef feedlots being the most common. Figure 9 shows the distribution of feedlots in Argentina according to the biogas generation potential.

In the pen, fecal matter and urine form a single type of inseparable waste, called manure. A cow excretes about 5 to 6% of its live weight per day, so a 400 kg steer produces 20 to 25 kg of manure per day.

## Dairy Farms

Mapa 22. Distribución de tambos en la Argentina, según potencial de generación de biogás

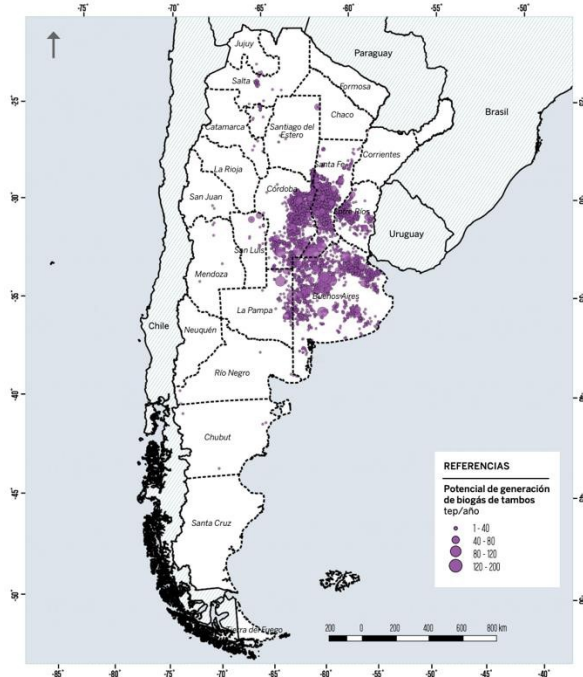


Figure 10: Dairy farms distribution (PROBIOMASA, 2019)

Although there is milk production in the provinces of La Pampa, Tucumán, and Santiago del Estero, 80% is concentrated in the provinces of Buenos Aires, Santa Fe and Córdoba (Figure 10). The main processes in the dairy industry that produce polluting residues are the cheese-, cream- and butter production processes, the washing of drying towers and alkaline cleaning solutions. Dairy industry wastewater is generally neutral or low-alkaline, but it tends to become acidic very quickly because of the fermentation of milk sugar producing lactic acid, especially in the absence of oxygen and the simultaneous formation of butyric acid, lowering the pH to 4.5 - 5.0. The composition of these waters includes dissolved organic substances such as lactose, mineral salts, and colloidal protein suspensions (casein, albumins, and globulins) with a COD between 2000 - 4000 mg/l and a BOD between 2000 - 3000 mg/l.

Water consumption in the dairy industries ranges from 8.0 - 35 l/kg of milk. There are different destinations for effluents. Of the 69% of effluents that pass through the stabilization lagoon, 29% is distributed in different paddocks, 25% is directed to water bodies, 17% is reused for fertilization, and 7% is dumped into gutter channels and the rest remains in the lagoon (22%).

### Productive Biogas Catchment Areas (Basins)

In 2015, a diagnostic study of biogas plants in Argentina was conducted by INTI and PROBIOMASA, in which 62 biogas plants were surveyed (although more than 105 were identified). Different aspects of the sector were quantified, identifying that most plants implement complete mixture technology treating residues from agribusinesses. An important result from this study is that 83% of plants aim to treat effluents rather than generate energy. Other results revealed that 53.1% are private, 52.4% are rural plants and 59.9% do not have imported components in equipment.

As a result of biogas national potential evaluation, productive biogas basins were conducted, considering residual biomass in different intensive livestock productions. This document was produced by the Bioenergy Sector of the Secretariat of Agribusiness and Institutional Strengthening of PROBIOMASA. The study aims to identify and classify the main basins producing effluents or residual biomass that can be transformed into biogas to provide basic information to drive the development of biogas generation projects.

To evaluate the potential for biogas generation at local scale, five main basins of each productive sector analyzed was evaluated:

Table 6: Locations of the Evaluation of the Local Biogas Generation

<b>a) Pig companies:</b>	<ul style="list-style-type: none"> <li>• Basin Unión – Marcos Juárez,</li> <li>• Basin Juárez Celman – Río Cuarto</li> <li>• Basin Roque Pérez – Saladillo</li> <li>• Basin San Andrés de Giles</li> <li>• Basin Bolívar</li> </ul>
<b>b) Feedlot companies</b>	<ul style="list-style-type: none"> <li>• Basin Saladillo – Roque Pérez</li> <li>• Basin Villa Constitución</li> <li>• Basin Rivadavia – Gral. Villegas</li> <li>• Basin Colón (Córdoba)</li> <li>• Basin Trenque Lauquen</li> </ul>
<b>c) Dairy companies</b>	<ul style="list-style-type: none"> <li>• Basin Central de Santa Fe</li> <li>• Basin Este Córdoba</li> <li>• Basin Oeste Buenos Aires</li> <li>• Basin Abasto Sur Buenos Aires</li> <li>• Basin Abasto Norte Buenos Aires.</li> </ul>

The estimates of biogas potential were made based on information provided by National Service of Agri-Food Health and Quality (SENASA). The location of each plant and its number of animals were considered. Based on this information, the residual biomass production was estimated by type of activity: cattle (feedlots and dairy) and pig (Flores et al., 2009). The main results of this study are the following.

### Pig Basins

In the southeast of the province of Córdoba, particularly in the departments of Unión and Marcos Juárez, PROBIOMASA has found that the pig-farm basin with the greatest bioenergetic potential from pig slurry. This basin, which covers an area of 5,072 km<sup>2</sup>, contains 280 pig farms, which together have 173,421 animals. Although in numbers of plants it constitutes 3.23% of the national total, in terms of number of animals it represents 5.20% of the national total.

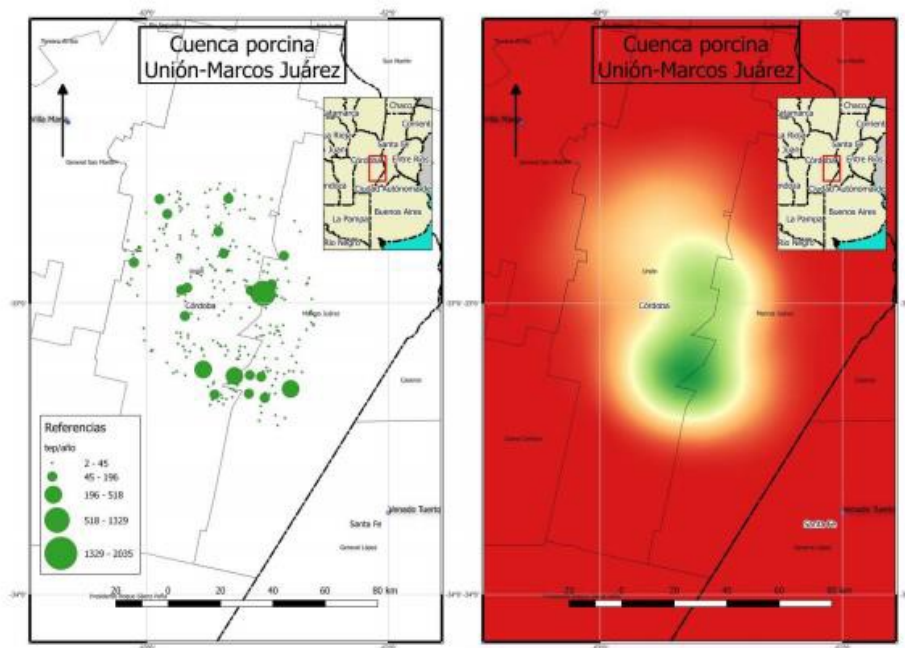


Figure 11: Example of a swine production concentrated area in Córdoba province (PROBIOMASA, 2019)

The bioenergy potential of this basin as a whole is 5,861 Tn/year 5,861 Tn/year (~118,000 m<sup>3</sup>/a of biogas, or ~70,000 m<sup>3</sup>/a of methane per year).

### Feedlot Basins

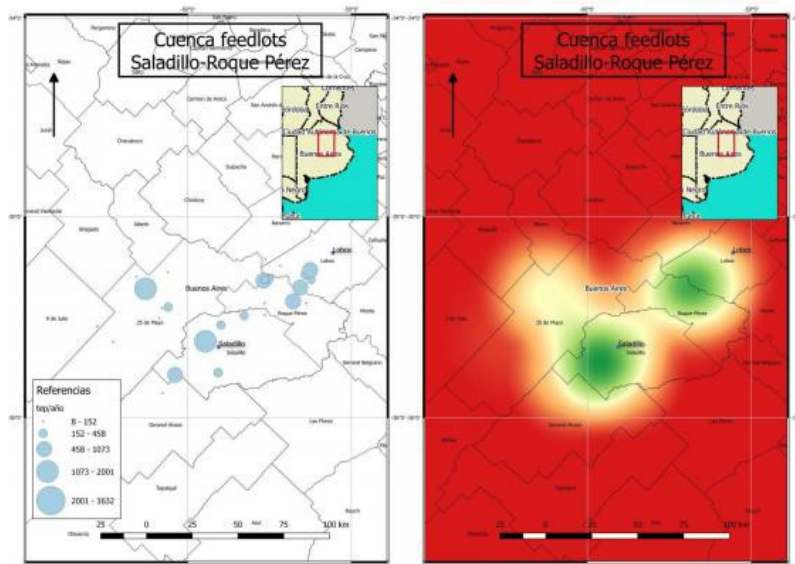


Figure 12: Example of feedlot concentration un Córdoba province (PROBIOMASA, 2019)

The area covered is 5,634 km<sup>2</sup> and contains 93 establishments (almost 5% of the national total), and in terms of the number of animals, the stock is around 87,000 heads. The estimate potential of biogas production from cattle excreta is 13.195 tep/year (Tonne petroleum equivalent), which represents almost 7% of the national potential.

There are more than 1,700 feedlots of different sizes and technologies, most of them are open with no floors although this is changing in the new companies entering the business. The feedlot basin, which has the greatest bioenergetic potential from the generation of biogas, covers the Buenos Aires province, including Saladillo, Roque Pérez, 25 de Mayo and Lobos.

The area covered is 5,634 km<sup>2</sup> and contains 93 establishments (almost 5% of the national total), and in terms of the number of animals, the stock is around 87,000 heads. The estimate potential of biogas production from cattle excreta is 13.195 tep/year (Tonne petroleum equivalent), which represents almost 7% of the national potential.

## Dairy Basins

The main dairy basin in the Province of Santa Fe, contains 4,150 dairy farms (42% of dairy farms in the country). The extension of the basin is 39,380 km<sup>2</sup> and has a potential of biogas generation estimated at 24.413 tep/year, representing a little more than a third of the total national estimate.

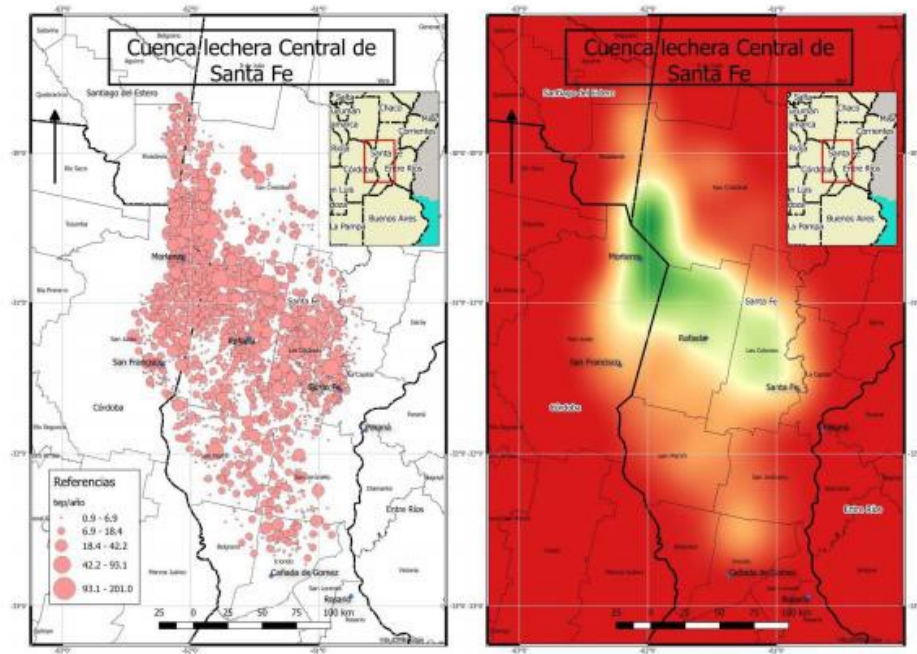


Figure 13: Example of dairy farm concentration in the south of the province of Santa FE (PROBIOMASA, 2019)

In these basins, there are 3 important projects, that together they add 7.2 MW of power to the grid, with a contribution of 2.4 MW each.

It is important to remark the following topics as conclusions from this pilot study:

- The Argentine Republic, and particularly the Pampa Region, has an important potential for generation of biogas from pig and milk production and feedlots.
- Of the three productive activities, the potential supply from the effluents of feedlots is the one that offers the greatest amount of bioenergy.
- Around 86% of pig farms hold between 1,000 - 5,000 animals, which represent a great potential for generating distributed energy.
- The potential resulting from the dairy basins is significantly lower in comparison to the pig and feedlot basins.
- Finally, the assessment of each basin not only involves the individual plants, but also the inter-relationship among them.

### 2.5.2 Human resources

Human resources are not an important constraint in any region in Argentina. There are Universities that cover the whole country with specific curricula on engineering, agronomy, and biology. The career offer is important, and the university population is one of the greatest in Latin America.

Regarding other non-specific skills and tank construction, piping, assembly etc. there are companies available with great experience in other industries that rapidly adapt to the specific requirements of biogas plants. There has not been any major limitation in the construction and assembly of large and complex plants.

Although there are professionals available in the biological sector, further specific training is needed. The number of specific biogas laboratories that give support and prepare professionals in this area is still low but increasing rapidly.

Both locally and internationally, it has been shown that the biogas sector acts as a generator of added value in the communities and regions where the projects are located. The experience of biogas plants in Argentina is that they provide skilled and high-income jobs to young professionals that find a way to stay in their communities without migrating to large cities.

In Argentina, the experience and knowledge that builds up as new biogas plants are constructed and start to run allow different local companies metalworking, construction, and process to grow and enlarge their personal. In this way, increasing amount of equipment and components are provided by the national industry complementing and / or competing with the international providers.

The employment multiplier differs according to the technology assumed, being more intensive in those related to biogas plants. However, it is noteworthy that throughout its range the sector requires technical specialization and professionalization that entails the creation of quality jobs and in some cases of high added value where the intervention of the education, science and technology ecosystem is necessary to continue going forward. The relevance of the industry in the regional economies has implied the opening of specializations and technicities in national and regional universities, and it begins to take shape as an alternative productive niche to the traditional careers. As noted in section 2.4.1, the sector has a federal character, where although in 7 of the 24 jurisdictions there are projects awarded under the national calls for the RenovAr program, in all of them there are developments related to the biogas energy industry. The samples range from pilot experiences in national universities, through laboratory facilities. In all cases, local capacities and investments have been strengthened and a learning path has begun with positive impacts at the public and private levels.

The Argentina 2040 energy scenarios platform to quantify jobs in the electricity sector of the different scenarios built, used an econometric model developed by the New Climate Institute of Germany.

Given that in August 2018 the sub secretariat of Renewable Energies of the Nation published the document "Job creation: renewable energy" (Sec. of energy, 2018) that analyzes the employment data declared by the bidders at the time of the tender, it was decided that for this work this document would be the starting point for calculating externalities and macroeconomic advantages related to employment. It is important to highlight that the data source of this document arises from the sworn statement of the bidders whose projects were submitted to

round 2 of the RenovAr and that the reported jobs only include those within the limits of the generation project without considering the jobs that are generated to manufacture the components that are installed in the energy project. The aforementioned document builds the direct employment Indicator of direct use of renewable energy (IEDER) in Argentina per MW. It accounts for the jobs required for the construction, maintenance and operation of 1 MW of installed power for each renewable technology for electricity generation (jobs / MW), based on



what has been declared by the projects submitted to the tender of the RenovAr Round 2 program.

As can be seen in the next table, biogas technology generates the highest impact on employment during the construction and operation & maintenance phase.

Table 7: Direct employment generation per Mw of renewable energies (Sec of energy and PROBIOMASA, 2018)

Technology	Construction			Operation & Maintenance
	Year 1	Year 2	Year 3	
Biogas	9.7	13.1	3.2	4.6
Biomass	4.3	7.3	4.4	2.2
Wind	1.6	1.9	0.7	0.2
Solar	2.3	2.8	0.2	0.2

According to the inquiries made with qualified sources in the case of biogas plants, the demand for personnel generated by a plant with an installed capacity of less than one MW is greater than that generated by a two MW plant. This is due to greater automation in larger plants. Therefore, the scale affects the generation of employment of each plant, although the impact is not proportional since some jobs are not duplicated by the doubling of power. Thus, for biogas plants with an installed capacity of less than 1 MW, the O&M IEDER can be 7 instead of 4.6.

The direct jobs are those required for the operation of the biogas plant during its commercial operation, and include administration, operation, maintenance, and management. For the case under study, the direct human resources identified were the following:

- Organic substrates loading area operator: 1
- Biogas plant operator: 3
- Electric-thermal energy generation plant operator: 1
- Administration: 1
- Direction / Management / Engineering: 1

Projects awarded less than 2 MW are 55% of total projects, so this consideration must be taken into account when deciding to support smaller-scale projects. However, the indicator of 4.6 per MW is used to keep the analysis homogeneous regarding the information base. The IEDER was prepared based on the information on the projects submitted to the bid for Round 2 of the RenovAr Program. Therefore, it is not an indicator that can be used for a particular project to estimate the human resources employed, but it does allow estimating the average labor force employed per MW for each type of technology. Based on the data collected from bioenergy projects in operation and / or execution, we can conclude that the biogas IEDER of 4.6 jobs per MW represents projects with an installed capacity between 1.5 and 2.4 MW.

### 2.5.3 Infrastructure and support industry

Argentina has a world known agroindustry, car manufacturing, nuclear, space and other new technologies development and use. There are many companies serving those sectors and the adaptation to biogas plant needs is not critical.

Product and services available include tank construction in different types of materials, piping, liquid pumps, transforms, power lines and electronic equipment. There is local capacity to develop and improve different technologies applied in biogas plants.

This situation is valid for all the main areas, which have biomass availability in either agriculture, agroindustry, or urban sector.

One of the characteristics of local providers is their speed of adaptation and the continuous innovative capacity to cope with new challenges.

Looking for external support infrastructure as roads, power lines and waste management there are local companies that can provide construction and maintenance in the main productive areas of Argentina at competitive costs.