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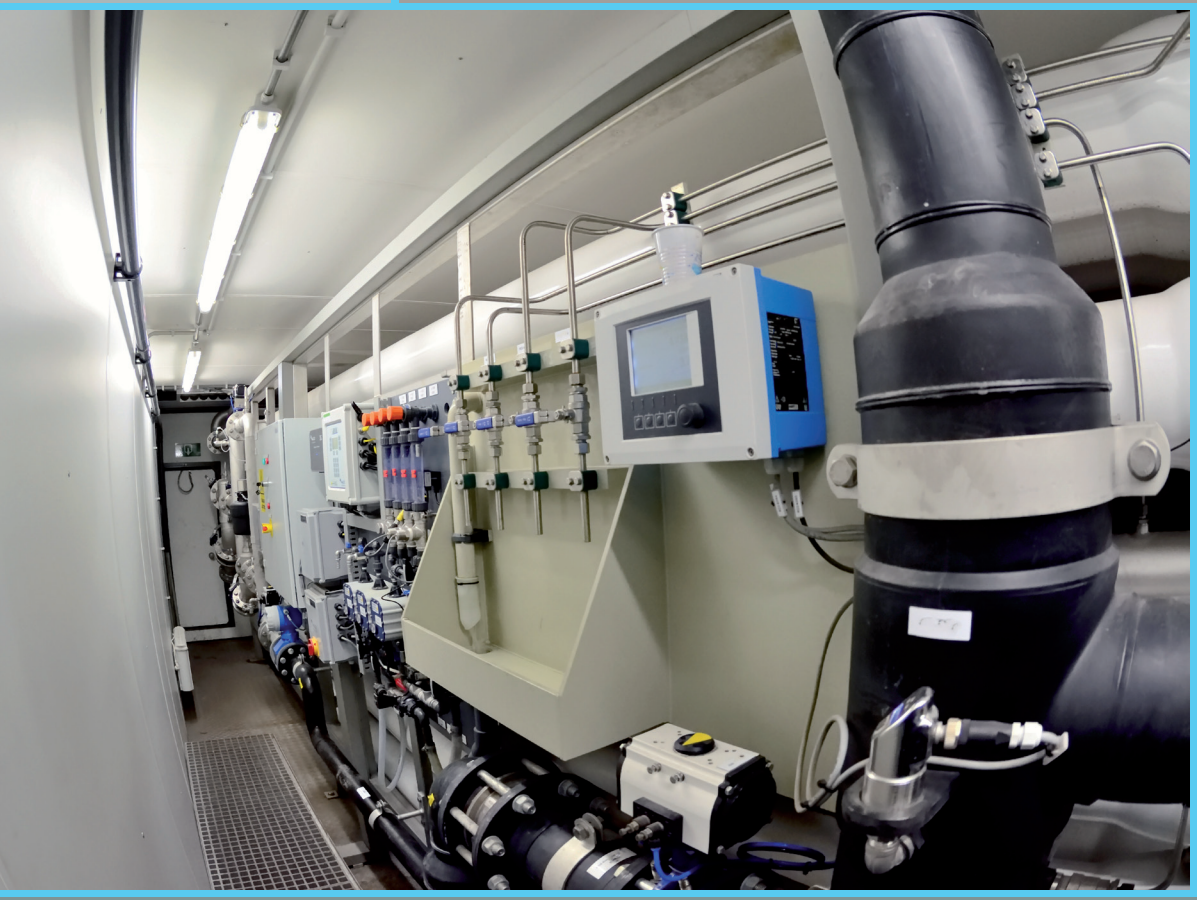
Assessment of Skills and Knowledge Gap in Energy Efficiency within the Building Sector in Argentina



Assessment of Skills and Knowledge Gap in Energy Efficiency within the Building Sector in Argentina

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Foreword

In compliance with the commitments assumed by Argentina with respect to the climate agenda, the Argentine Secretariat of Energy seeks to promote the most efficient use of energy resources in all areas. The National Directorate of Electric Generation, which operates within the scope of the Undersecretariat of Electricity, is responsible for making and implementing public policies on energy efficiency, which aim at increasing and improving the optimization of energy consumption in different sectors, with the purpose of promoting good practices, reducing costs and encouraging sustainable energy use.

Among the initiatives developed to generate the necessary technical capabilities in the stakeholders involved, the National Housing Labelling Program implements specific measures aimed at the building sector. Within this framework, over 15 courses on housing labelling have been delivered, which have enabled the training of over 800 professionals. The Program for the Rational and Efficient Use of Energy in Public Buildings (PROUREE), in turn, has registered more than 700 Energy Administrators and approximately 1,400 public buildings, involving the survey of 64,900 energy-consuming equipment.

The Energy Education area of the National Directorate of Electric Generation promotes, in the same sense, the generation of capacities in the responsible and efficient use of energy and the development of contents that promote pedagogical approaches to the rational use of energy, as well as the adoption of sustainable habits and consumption.

In this context, technical cooperation with the Copenhagen Center on Energy Efficiency has made it possible to develop the project "Assessment of Skills and Knowledge Gap in Building Energy Efficiency Sector in Argentina", together with the consulting firm Zoom Sustentable, whose purpose was to investigate the existing energy efficiency education and training for the building sector.

The main results of this study developed by C2E2 and Zoom Sustentable are presented below, which reflect the surveyed perceptions and highlight the need to strengthen the incorporation of comprehensive views that promote the consideration of these issues in the education and training instances.

Ángel Guillermo Martin Martínez
National Director of Electric Generation
National Secretariat of Energy

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Acronyms

AGBC	Argentina Green Building Council
AMBA	Buenos Aires MetropolitanArea
AR	Argentina
ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers
UNFCCC	United Nations Framework Convention on Climate Change
NDC	Nationally Determined Contribution
CONICET	Argentine National Scientific and Technical Research Council
COPIME	Professional Council of Mechanical and Electrical Engineering
CPAU	Architecture and Urban Planning Professional Council
CPIC	Civil Engineering Professional Council
CPII	Professional Council of Industrial Engineering
SD	Sustainable Development
ECM	Energy Conservation Measures
EE	Energy Efficiency
EEB	Energy Efficiency in Buildings
ENARGAS	Argentine Gas Regulator
ENRE	The Argentine National Electricity Regulatory Agency
EPB	Energy Performance of Buildings Directive
EPBD	The Energy Performance of Buildings Directive (Europe)
EPS	Expanded Polystyrene
ETP	Technical and Vocational Education
GHG	Greenhouse Gas
HDD	Heating Degree Day
HVAC	Heating, Ventilating and Air Conditioning
IEA	International Energy Agency
IMF	International Monetary Fund
INAP	National Institute of Public Administration
INDEC	National Institute of Statistics and Censuses
INENCO	Non Conventional Energy Research Institute
INET	National Institute of Technology Education
INV	National Institute of Housing
IRAM	The Argentine Standardization and Certification Institute
LEN	National Education Act

MEP	Mechanical Electrical Plumbing
MMO	Master Builder
NDC	National Determined Contribution
nZEBnear	Zero Energy Building
SDGs	Sustainable Development Goals
OED	Body Responsible for Dispatch
GDP	Gross Domestic Product
PLAC	Local Climate Action Plans
PPP	Purchasing Power Parity
RAMCC	Argentine Network of Municipalities against Climate Change
CSR	Corporate Social Responsibility
SCA	Central Society of Architects
SEA	Argentine Education System
SE	Secretariat of Energy
UBA	University of Buenos Aires
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNLP	National University of La Plata
UNNE	National University of the Northeast
UNSAM	National University of San Martin
UOCRA	Building Workers Union of the Argentina Republic
USGBC	United States Green Building Council
UTN	National Technological University
ZS	Zoom Sustentable

Executive Summary

The aspects that define the transition towards sustainable development include energy use strategies as well as measures for implementing energy efficiency in four main sectors: buildings, transportation, commerce and industry. Energy efficiency can be understood as the set of actions that improve the relation between the amount of energy consumed and the products and services obtained from using such energy, without affecting users' quality of life. To achieve this, it is necessary to implement energy management measures as well as to invest in more efficient technologies, to employ more efficient production processes and to improve habits leading to a responsible use.

Argentina, in turn, has proposed to implement energy efficiency measures aiming to reduce energy demand by 8.3% by the year 2030. According to the last National Energy Balance (BEN, for its Spanish acronym), buildings produce 33% of energy demand in Argentina and contribute to 20.8% of the country's greenhouse gas emissions. Therefore, those improvements implemented in building energy efficiency will have a direct impact on energy consumption reduction and will lead to a reduction of greenhouse gas emissions, which represents a key tool for climate change mitigation.

Within the context of the National Action Plan on Energy and Climate Change *[Plan de Acción Nacional de Energía y Cambio Climático]*, there are strategies focused on the supply side: renewable sources for grid-connected or isolated power, distributed power generation, biofuels, hydroelectric power plants, nuclear power plants, replacement of fossil energy with a higher emission factor by natural gas, and improvements in thermal power plants efficiency; and on the demand side: water economizers, solar water heaters, public lighting measures, efficiency in household appliances, heat pumps, building thermal envelopes, efficient heaters and residential lighting.

In addition, in accordance with many Sustainable Development Goals, it is possible to cooperatively relate the issue regarding energy efficiency in buildings (EEB) with many of them: Sustainable Development Goals 4 (4.7 Education for DG), SDGs 7 (7.3 Increase in world's energy efficiency improvement rate), 11 (11.c Support (financial and technical assistance to build sustainable and resilient buildings using local materials), 12 (12.2 Sustainable management and the efficient use of natural resources), 13 (13.1 Strengthening of resilience and ability to adapt to climate and natural disasters related risks, and 13.2 Incorporation of climate change related measures into national policies, strategies and plans), and 17 (17.6 Cooperation in terms of science, technology and innovation, 17.7 Promotion of the development, transfer, dissemination and diffusion of environmentally sound technologies, 17.9 International support for an effective and specific capacity development in SDGs implementation, among others. Argentina's commitment to monitoring and meeting SDGs targets can be an ally for the EEB expansion at national level.

Energy efficiency development in the building sector presents several challenges, from the need of a regulatory and institutional framework, the access to the technologies and capabilities needed for its implementation and professionals who have the skills and knowledge to meet the incipient demand of staff trained in the application of technologies for energy efficiency.

This project aims to look into the possibility of increasing and strengthening the skills of decision makers and professionals working in the private and public sector who are involved in the Building Energy Efficiency Sector (hereinafter referred to as EEB) environment by means of recommendations on how to provide and improve their skills and knowledge in such sector in Argentina.

In this context, a "skill" refers to the set of knowledge, attributes and competences that enable an individual to perform tasks that are usually productive, i.e., tasks that are related to the competence to do a job, and that can be expanded through learning and experience. Individuals require knowledge, skills, behaviour and values to empower them. Therefore, the role of education and skills development in its broadest sense becomes a key strategy for achieving development goals.

In this sense, the existing training programs and its contents that are available in technical and vocational and university education are analyzed, together with a characterisation of the profile of professionals working in the sector and a report on the current situation of the market (goods, services and stakeholders in the value chain).

For developing these tasks, the methodologies used included analyzing secondary information from official sources to characterise the Argentine education system and analyze the existing academic programs in

selected provinces, based on the presence of keywords in the analyzed contents. In addition, they included an identification of the market for goods and services and an analysis of stakeholders that are classified into government, education and private sectors, exploring their career paths, skills and perception of the sector's demands, by conducting semi-structured surveys and interviews. Finally, after this information had been processed, a virtual workshop was held with stakeholders, where circumstances defining and explaining the gap between the existing programs providing knowledge and the skill demands of the sector were collectively validated.

Regarding the analysis of the contents included in the existing educational programs, there is a conclusion published by the Secretariat of Energy in 2017[1] about the need to make dynamic curricula, with periodic updates and modifications or transformations with the corresponding accreditation by CONEAU, as the sector evolves. Based on these lines, we present in a complementary manner the conclusions arising from this research, which also include the feedback from sectors outside the design and development of public and educational policies. The eventual application of such conclusions will provide the necessary and appropriate tools for including, cooperatively, the subject in the basic contents of undergraduate courses. Additionally, other key strategies include the creation of specific technical degrees and specializations, as well as postgraduate courses and courses for continuing professional education, and it would be strategic to involve the perspective of the Ministry of Education portfolio as well.

The interviews and surveys conducted show that there is a practically absolute existence of a gap. Although there is a great deal of variability in the experience and background of the individuals involved, there is a correlation between seniority and background in the subject and the perception of the gap.

Among the conclusions of the workshop, it should be noted that the level of response shows the great interest that the topic arouses among the stakeholders consulted and, at the same time, the clear need to create exchange or networking spaces for technical strengthening and exchange.

The research results reveal how complex the Argentine context is for the expansion of Energy Efficiency in Buildings. The key findings show that the existing education programs are incomplete, superficial, geographically concentrated, and not widely spread or valued, which results into the field of EEB remaining a niche activity that does not achieve the required scale to become widespread and attractive in order to develop a sustainable market that does not rely on permanent incentive interventions.

This includes a general reflection on the importance of a systemic view and varied interrelationships among the components. The dialectic between existing programs and demand, which underlies the organization of the study, constitutes a dynamic of interdependence. In this sense, in the development of a public and educational policy agenda for the promotion of EEB in Argentina, it is essential to understand the potential of the combination/complementarity of restrictive/regulatory measures ("push") and incentive and promotion measures ("pull") to consolidate an effective strategy for the expansion and progress of the subject, operating both on the demand and on the supply of professional EEB-related goods and services.

Based on this analysis, a series of lines of action are proposed for the EEB expansion in Argentina, in order to strengthen the professional profiles by creating educational policies in accordance with the local needs and the state of the art at an international level. Such lines of action are grouped into the following areas: on the one hand, training and general awareness-raising measures on the subject, aimed at officials and/or decision-makers to catalyze the application/implementation of new regulations that belong specifically to EEB, to the student sector regarding EEB training existing programs and to promote the development of professional careers related to the subject; and training for Technical and Vocational Education, undergraduate and graduate teachers. On the other hand, develop educational policies that tend to increase the existing programs of EEB-related elective courses, offer "packages" of elective subjects divided by topic (even in other degrees or institutions, with the purpose of favouring an inter-institutional integration), consolidate EEB orientation as part of the curriculum in Architecture and Engineering degree programs, and create open program degrees (also referred to as *"à la carte"*). Develop contents that are adapted to the different climate zones, incorporate EEB-related content in Technical and Vocational Education in line with planned measures to reduce GHGs emissions resulted from a reduced energy demand, promote the development of interdisciplinary skills and ensure access to centralized/systematized and updated information on educational existing programs. In accordance with the accreditation organizations operation, it is proposed to implement the accreditation of the EEB content adaptation, to update periodically the curricula in EEB, to develop an accreditation system made by the State for professional practice in EEB and apply incentives for the EEB training of graduate technicians and professionals.

1 Directorate of Education, Secretariat of Energy (2017). Lineamientos Para La Mejora De La Enseñanza Sobre Eficiencia Energética En Carreras Estratégicas De Ingeniería Y Arquitectura. Retrieved from: https://www.argentina.gob.ar/sites/default/files/lineamientos_spu.pdf

In a complementary manner and considering the feedback from the workshop, some lines of action are proposed with regards to the financial/market aspects, addressing issues such as tariffs, access to credit, and retrofit funding. There are also some lines of action proposed in the regulatory area, such as the following proposals: regulatory analysis in successful cases of countries in the region, promotion of national industry production and consumption of EEB-related goods, technologies and services, and lines of an accessible mortgage loan or tax exemptions for houses with certified energy/environmental performance.

Among the relevant aspects that were studied, the supply of goods and services (applied competences and skills) are considered to play a key role for accompanying, promoting and making an effective EEB expansion locally. In accordance with the background information analyzed, the expected future growth in demand is correlated with the occurrence of a series of conditions. These conditions include a stable and predictable political and regulatory framework that allows for medium and long-term planning.

Ultimately, it is worth highlighting the competence for developing this sector, the commitment of practicing professionals, educators, researchers and government officials who are genuinely interested in continuing their training and providing content, time and will to contribute to the EEB expansive growth in Argentina so that it reaches its full potential. To this purpose, a series of contents are proposed by theme and target audience to develop training and contribute to the strengthening of EEB-related skills and knowledge.

Source: www.colourbox.com

1 Introduction

1.1 Energy Efficiency in the Building Sector

In recent years there has been a generalized tendency to adopt more sustainable policies due to severe consequences resulted from global environmental issues such as climate change, among others. In 2016, Argentina ratified the execution of the Paris Agreement, which involved making several commitments to sustainable development as proposed by the United Nations 2030 Agenda.

The aspects that define the transition to a sustainable development include strategies focused on the use of energy due to the key role played by energy services in the form of heat, power and labour, on which we rely for our daily activities. To this end, some measures should be adopted for implementing energy efficiency in four main sectors: buildings, transportation, commerce and industry.

Buildings produce 33% of energy demand in Argentina and contribute to 20.8% of the country's greenhouse gas emissions (Argentine Government, 2019a). As a result, those improvements implemented in building energy efficiency are related to a reduction of greenhouse gas emissions, which represents a key tool for climate change mitigation.

Argentina, in turn, has proposed to implement energy efficiency measures aiming to reduce energy demand by 8.3% by the year 2030. This energy demand reduction decreases the international market's reliance on energy, protecting the country from the uncertainty that such reliance entails.

Energy efficiency actions in houses, in turn, mitigate families' energy expenses, allowing them to reach minimum comfort levels that were not satisfied, especially in the case of the most vulnerable households (Secretariat of Energy[2]).

Energy efficiency development in the building sector presents several challenges, such as the need of a regulatory and institutional framework, the access to the technologies and the competences needed for its implementation. Regarding the latter, there is a growing need for skilled and qualified professionals to meet the emerging demand for personnel trained in the application of energy efficiency technologies.

Regarding the institutional framework, and having Argentina adhered to the 2030 Agenda, it is important to contextualize the development of the EEB within the Sustainable Development Goals framework. The SDGs are an initiative promoted by the United Nations, consisting of 17 integrated goals, with 169 targets and 231 indicators, which materialize the global commitment to development. Understanding the EEB development in this context allows us to identify joint efforts with other efforts that Argentina is currently facing as part of its management of the ratified goals. The aspects of the EEB that intersect with SDGs targets are presented below (Table 1).

1.2 EEB and GHGs emissions

Considering the environmental, social and economic consequences resulting from the current intensive energy demand patterns and their related greenhouse gas emissions, there is a need for measures that contribute to the transformation of the energy mix in order to slow down the increase of such emissions and build a sustainable habitat. In this respect, as mentioned in the previous section, buildings contribute to 20.8% of the country's greenhouse gas emissions (Government of Argentina, 2019a), and projections show that this trend will increase. However, the country has a regulatory framework that offers the possibility of directing efforts towards the design of policies and plans focused on reducing emissions. Such is the case of the Paris Agreement, by means of which Argentina committed to submitting its Nationally Determined Contributions.

Nationally Determined Contributions (NDCs) are the actions that all countries that are part of the United Nations Framework Convention on Climate Change (UNFCCC) must take to intensify their policies against climate change, either to reduce Greenhouse Gas (GHG) emissions (mitigation actions) or to adapt to the impacts produced by this phenomenon (adaptation actions).

Each country's contributions are established according to their national circumstances and their respective competences. Within the framework of the commitment undertaken in the Paris Agreement, Argentina committed not to exceeding net emissions of 483 million tons of carbon dioxide equivalent

2 Secretariat of Energy, Ministry of Finance, Presidency of Argentina (2019). Balance de gestión en energía 2016-2019. Retrieved from: http://www.energia.gob.ar/contenidos/archivos/Reorganizacion/sintesis_balance/2019-12-09_Balance_de_Gestion_en_Energia_2016-2019_final_y_anexo_pub_.pdf

SUSTAINABLE DEVELOPMENT AND ENERGY EFFICIENCY IN THE BUILDING SECTOR GOALS	
	The development of knowledge and skills related to energy efficiency in present and future professionals working in the building sector and the lines of action proposed in this regard are aligned with goal 4.7 (Education for Sustainable Development).
	The path towards a universal access to energy must take place within a sustainable framework, and therefore, along with the development of renewable sources, it is key to implement measures to improve energy efficiency (Target 7.3).
	The implementation of energy efficiency improvements in the building sector requires developing innovative, reliable and high-quality technologies and infrastructure, as expressed in targets 9.1 and 9.5.
	Argentina has an urban population of around 90%, therefore, ensuring the development of sustainable cities, including the incorporation of energy efficiency principles in their buildings, should be a priority. In this regard, Target 11.c establishes the need to provide financial and technical assistance to construct sustainable and resilient buildings using local materials.
	The implementation of energy efficiency measures will reduce energy consumption, contributing to the sustainable management and efficient use of natural resources (Target 12.2). To this end, the knowledge of professionals involved in the EEB value chain must be strengthened in order to promote the implementation of these measures (Target 12.8).
	The promotion of energy efficiency represents a key action for reducing greenhouse gas emissions, contributing to climate change mitigation measures. Such promotion should be implemented by incorporating it into policies, strategies and plans, as established in Target 13.2, as well as by awareness raising, education and competence development of individuals and institutions (Target 13.3).
	The implementation of energy efficiency measures requires international cooperation, transfer and support aiming to develop effective and specific competences and technologies for implementing SDGs (Targets 17.6, 17.7, 17.9).

Table 1: Sustainable Development (UN, 2015) and Energy Efficiency in Buildings Goals

($MtCO_2e$) by 2030. In 2017, a process was created for the attribution of greenhouse gas (GHG) emissions, which were estimated at 36444 $MtCO_2e$ total net, being the emissions observed in Figure 1[3] representative of the energy sector. According to IEA (2018), Argentine GHG emissions were 4.75 CO_2 metric tons per capita, compared to the world average of 5.16 and Latin America's and the Caribbean's of 3.06.

3 Secretariat of Sustainable Environment and Development, Ministry of Finance, Presidencyof Argentina (2019) *Plan de Acción Nacional de Energía y Cambio Climático*. Retrieved from: https://inventariogei.ambiente.gob.ar/files/monitoreo-energia-revision-2019-anexo.pdf

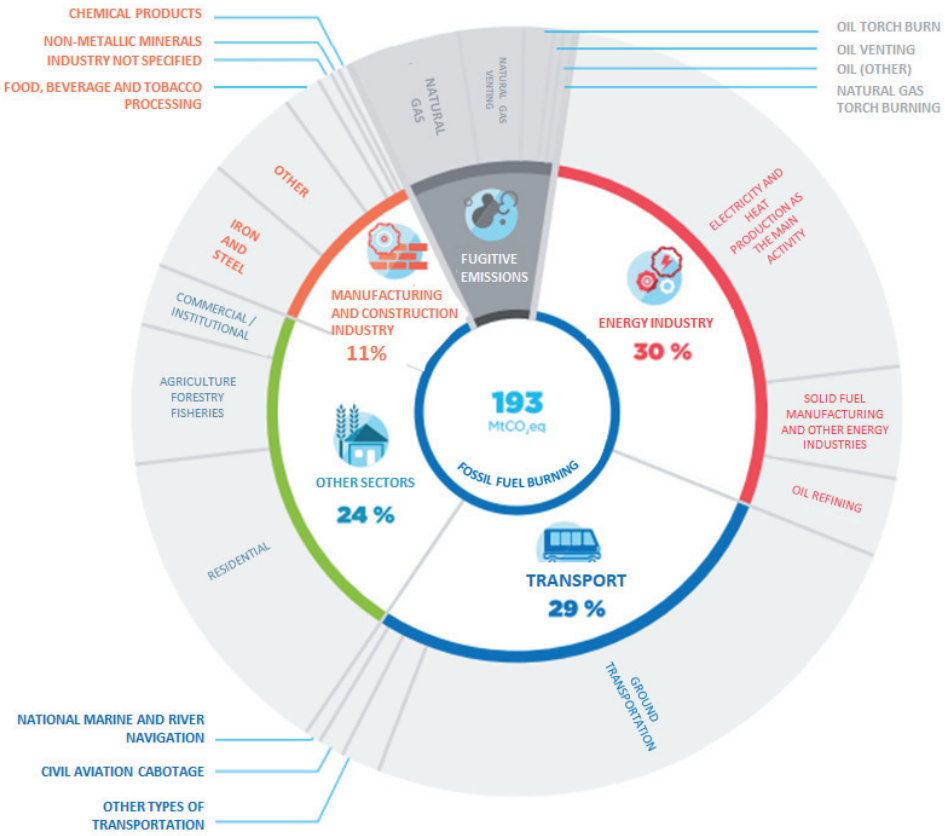


Figure 1: Energy sector inventory. Source: *Plan de Acción Nacional de Energía y Cambio Climático*. 2019 update

Subsequently, under the *Plan de Acción Nacional de Energía y Cambio Climático*, whichwaspublished in November 2019, severalsectoralPlansweredeveloped, includingthe*Plan de Acción Nacional de Energía y Cambio Climático*. This plan contains the mitigation measures and their roadmaps, scope and quantification. It also identifies the barriers and regulatory and economic instruments that allow it to be currently or potentially implemented. It also defines the existing and necessary funding for developing such measures, as well as the indicators and variables for monitoring results and progress.

In the context of the Plan de Acción Nacional sobreEnergía y Cambio Climático, mitigation measures focusing on electric energy include strategies concentrated on supply and demand. The first case includes: renewable sources for grid-connected or isolated power, distributed power generation, biofuels, hydroelectric power plants, nuclear power plants, replacement of fossil energy with a higher emission factor by natural gas, and improvements in thermal power plants efficiency. The second case includes the implementation of: water economizers, solar water heaters, public lighting measures, efficiency in household appliances, heat pumps, building thermal envelopes, efficient heaters and residential lighting.

In particular, due to the fact that EEB-related measures are identified in the case of those measures related to energy demand, they will be briefly described below:

- Water economizers: use of water flow regulating devices in faucets to reduce fuel consumption in water heating. Its implementation foresees an additional (not unconditional) emission reduction target of 3.10 $MtCO_2eq$ by 2030.
- Solar water heaters: use for domestic hot water heating. The distribution between unconditional and additional target is still being defined. In principle, a reduction of 0.64 and 0.39 $MtCO_2eq$ respectively is proposed for 2030.
- Efficiency in household appliances: replacement of household appliances with more efficient equipment. It includes the labelling of refrigerators, washing machines, air conditioners, and televisions and the incorporation of equipment with reduced consumption in stand-by mode. Its implementation foresees an unconditional emission reduction target of 10.62 $MtCO_2eq$ and an additional target of 1.30 $MtCO_2eq$ by 2030.
- Heat pumps: replacement of balanced draft stoves with hot-cold air conditioning equipment. Its imple-

mentation foresees an additional (not unconditional) emission reduction target of 3.00 $MtCO_2eq$ by 2030.

- Thermal envelope in housing: improvement of residential insulation and use of innovative materials that improve the building's thermal envelope, reducing fuel and electricity consumption. Its implementation foresees an additional (not unconditional) emission reduction target of 1.21 $MtCO_2eq$ by 2030.
- Efficient tankless water heaters and tank water heaters: use of more efficient tankless water heaters, without any pilot lights, and replacement of tank water heaters with tankless water heaters. Its implementation foresees an unconditional emission reduction target of 038 $MtCO_2eq$ and an additional target of 1.96 $MtCO_2eq$ by 2030.
- Residential lighting: replacement of conventional lamps with LED lighting in the residential sector. The unconditional 2030 target is for 100% of residential lighting to be LED. Its implementation foresees an unconditional emission reduction target of 2037 $MtCO_2eq$ by 2030.

In December 2020, when the Second Argentine NDC was published, this commitment was updated by establishing as an absolute and unconditional goal not to exceed net emissions of 359 $MtCO_2e$ in 2030, which meant a reduction of 25.7% compared to the previous NDC[4]. In this way, the country would maintain a 0.9% share of global emissions in 2030.

With regards to the energy sector, in this document Argentina establishes that it will make an energy transition, focusing its efforts on promoting energy efficiency, renewable energies and encouraging distributed generation, using natural gas as a transition fuel during this period. It also recognizes the significant potential of clean sources of energy deriving from wind, solar, hydroelectric energy and biofuels, as well as the development of nuclear energy and hydrogen.

It also states that energy security is one of the main strategies that will guide energy transition, i.e., guaranteeing the availability of energy to users and the reliability of the system. To this end, it highlights the need to promote the rational use of energy, innovation, development, as well as the transfer and incorporation of new technologies that are appropriate according to the national context.

The proposed Climate Change Adaptation Measures for the Energy Sector focus on reducing vulnerabilities, and they involve the following:

- To assess the impacts of climate change on the energy system, energy demand, economic activity and fiscal balance.
- To develop measures to ensure energy supply and access by adopting resilient and sustainable infrastructure (e.g., energy transport and distribution, fuel production, and power generation, with particular focus on water resource assessment and hydropower generation).
- To develop measures to ensure supply through technological and territorial diversification and increased access to energy, particularly by means of sustainable energy sources.

Finally, the country will present its long-term low-emission development strategy at the next Conference of the Parties, which will be held in Glasgow in 2021, with the purpose of achieving carbon-neutral development by 2050, as shown in the following figure.

Based on the above, there is an explicit will to reduce GHG emissions and it is one of its pillars to consider strategies related to the promotion of energy efficiency in general. Furthermore, correlative measures are directly encouraged by developing EEB strategies as one of the emission mitigationmeasures. This National Planning framework should be kept in mind when reflecting on the technical competences that are and will be available in the coming years to address the development of the sector.

1.3 Concepts of Energy Efficiency in Buildings

Nowadays, there are many ways to name or address energy efficiency in buildings. Several public and private institutions provide their own definition and specific requirements for sustainable buildings, where Energy Efficiency measures and/or strategies play a leading role within the broader range of other aspects involved in sustainability.

4 MAyDS (2020). Segunda Contribución Determinada a Nivel Nacional de la República Argentina. Ministry of Environment and Sustainable Development, Argentine Republic. Retrieved from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Argentina%20Second/Argentina_Segunda%20ontribuci%C3%B3n%20Nacional.pdf

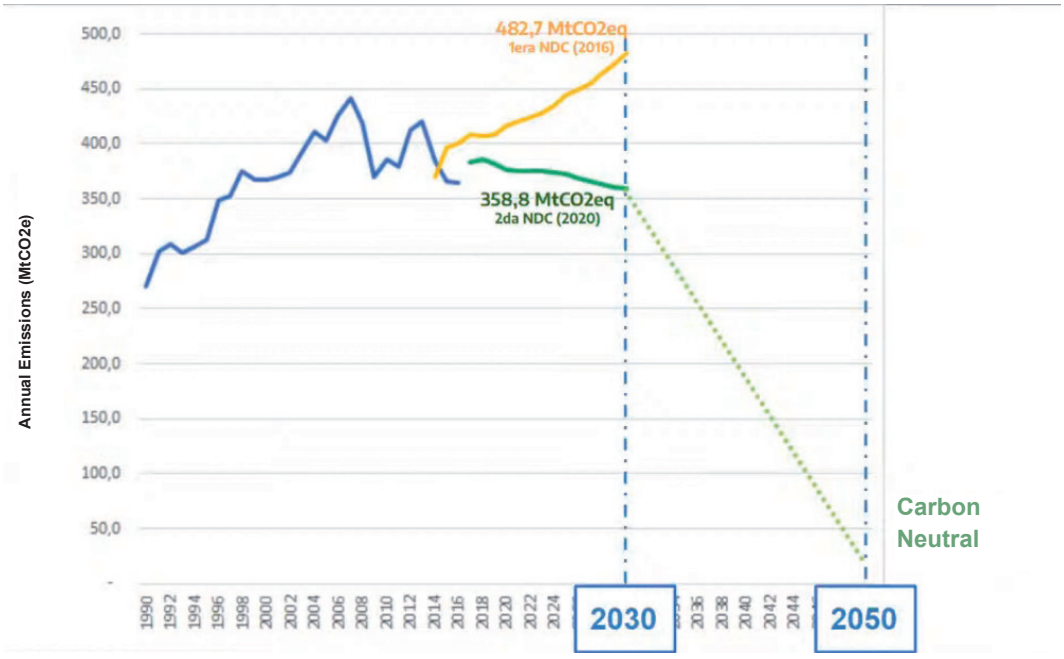


Figure 2: 2030 and 2050 mitigation target
Source: Extended Roundtable - Nationally Determined Contributions (NDCs) Presentation Table 2:[5]

Energy efficiency can be understood as the set of actions that improve the relation between the amount of energy consumed and the products and services obtained from its use, without affecting users' quality of life. To achieve this, it is necessary to implement energy management measures as well as to invest in more efficient technologies, to employ more efficient production processes and to improve habits leading to a responsible use (Secretariat of Energy[6]).

Similarly, energy efficiency in the building sector is understood as the set of design strategies and technologies that maximize the relation between the energy consumed by a building and the levels of comfort and operability required for its normal operation throughout its useful life.

In this sense, the European Commission's Energy Performance of Buildings Directive (EPBD) defines the concept of "nearly zero emission building" (nZEB) as a building that has a very high energy performance, taking into account aspects of thermal capacity, insulation, heating, cooling, thermal bridges, hot water supply, ventilation, building orientation, passive solar systems, among others (Torrejón Marina, 2020).

In this report, the concept of "energy efficiency in the building sector" (EBB) will be used instead of "near-zero emission buildings" (nZEB), since this is the expression used in the governing technical guidelines that provide the regulatory framework, mainly through IRAM, which is reflected in the educational content. It also reflects the approach proposed by the Secretariat of Energy for addressing the subject.

Although they are closely related concepts, it is important to differentiate between Energy Efficiency and Renewable Energies. When referring to the energy efficiency of a building, its performance is evaluated regardless of the origin of the energy powering it. By integrating complementary renewable energy systems (photovoltaic solar energy for electricity generation, solar thermal energy systems for domestic hot water and air conditioning, among others), the building's demand on the energy mix and the corresponding environmental impact are reduced. In addition, the use of renewable energy sources on a medium and large scale will contribute to reducing emissions of the energy mix as a whole.

Based on the synthetic contextual and conceptual framework on EEB, the following chapter describes the most relevant skills and knowledge to consolidate the bases of professionals' and workers' competency in the sector.

5 https://www.argentina.gob.ar/ambiente/cambio-climatico/mesa-ampliada-1

6 Secretariat of Energy, Ministry of Finance, Presidency of Argentina (2019). Balance de gestión en energía 2016-2019. Retrievedfrom: http://www.energia.gob.ar/contenidos/archivos/Reorganizacion/sintesis_balance/2019-12-09_Balance_de_Gestion_en_Energia_2016-2019_final_y_anexo_pub_.pdf

1.4 Basis for professional competency in the EEB sector

According to the general literature, a "skill" can be defined as the set of knowledge, attributes and competences that enable an individual to perform tasks, which are usually productive, —i.e., tasks that are related to the ability to do a job— and that can be expanded through learning and experience. Thus, "skill" can be understood as the competence to translate knowledge into action (Bevan, 2016).

Relevant precedents have determined that policy instruments or technological solutions alone are not enough and a transformative and profound change in the way people think and act (behavioural changes) is critical to address social challenges (Sugathapala, 2020). Individuals require knowledge, skills, behaviour and values that empower them. Therefore, the role of education and skills development in its broadest sense becomes a key strategy for achieving development goals.

The future of green jobs in the energy sector is promising; it is a growing market for both advanced and less skilled professionals (UNESCO-UNEVOC, 2020). In this sense, the continuing education of workers already working in the sector and the training of young individuals entering the labour market are essential for a smooth transition to an energy efficiency market.

The lack of efficient and quality training programs could lead to a shortage of technical positions as well as general occupations such as salespeople, inspectors, and auditors (ILO, 2011) (UNESCO-UNEVOC, 2020). Furthermore, professionals must acquire general communication, energy management and project management skills in order to provide services to local authorities, contractors and end users (Bevan, 2016).

As presented in targets 4.7 on education for Sustainable Development and 7 and 7.3 on increasing the energy efficiency rate, technical and vocational education and training plays a crucial role in the transition to a cleaner energy demand. The speed of this transition is determined by the ability to train organizations and professionals in strengthening the existing programs, and by the interest and willingness of experts to engage in initial and/or continuing training. Qualifying professionals prior to demand can be achieved through close cooperation between the industry, training organizations and the government (UNESCO-UNEVOC, 2020). Education makes it possible to meet the growing demand for individuals that are qualified to design, build, manufacture, install, service and market technologies, improve the quality of products manufactured and services offered, and ensure a lasting performance.

It is worth mentioning that relevant precedents of this work have identified that in the Argentine education system there is generally a scarce knowledge on sustainability and there exists a very lownumber of professionals who are trained in energy efficiency in the market (Torrejón Marina, 2020). This will be further explained in 4-4 Results of the identification of relevant content for EEB.

A series of work fields and skills related to EEB at each stage of the building process is described below. Likewise, these skills are classified according to their Level, which is understood as the complexity, deepening and integration of a greater diversity of theoretical and practical tools. From said classification, a series of keywords considered in the analysis of the EEB content in existing programs are associated, as shown in3-3 Survey of educational contents and 4-4 Results of the identification of relevant content for EEB.

	MANUFACTURE	PROJECT DESIGN	BUILDING AND INSTALLATION	OPERATION AND MAINTENANCE
High	- I+D	- Incorporation of building's thermal dynamics - Incorporation of the climate context and its response - Modelling - Design integration	- Active manageable strategies	- Measuring tools - Certification of carbon performance of buildings - Certification of energy performance of buildings
Medium	- Performance of materials	- User experience consideration - Technological knowledge and updating	- Retrofit	- Management of energy performance of buildings - Consumption management - Management protocol implementation
Low	- Management of generic/thematic technical concepts			

Table 2: Aspects and Skills related to EEB distinguished by level and stage of the building process. Source: Author's own elaboration

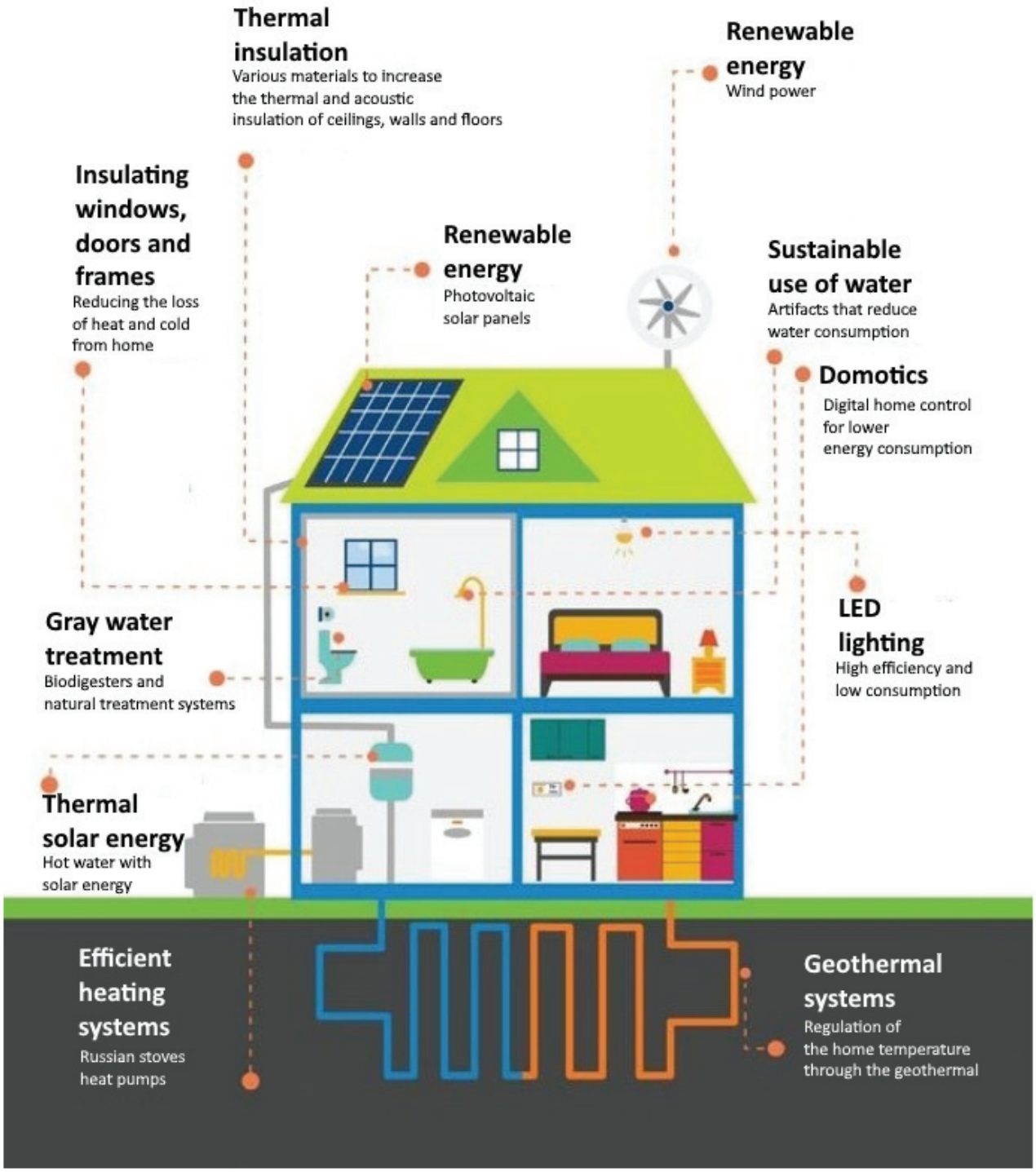


Figure 3: Representation of the NetZeroBuilding concept. Source: Fundación energizar https://cursos.energizar.org.ar/cursos/informacion/6/curso-de-arquitectura-sustentable

The relevant EEB skills identified can be divided as follows:

- **Management of thematic technical concepts:** it refers to the knowledge of terms that are transversal to any technical knowledge field and inherent to any analyzed technical/vocational training, i.e., concepts such as energy, environment, efficiency, sustainability, energy resources, etc.
- **Technological knowledge and updating:** ability to incorporate appropriate technologies for construction and building infrastructure, considering their permanent innovation. Such is the case of the appli-

cation of openings, ACS, HVAC, insulation, envelope, lighting, natural ventilation and incorporation of renewable energies such as photovoltaic solar and solar thermal energy.

- **Materials and project design capability:** it refers, on the one hand, to the ability to develop and subsequently assess the performance of materials for the EEB. On the other hand, it consists of the competence to project and assess the environment, providing feedback on the building design, mainly through thermal performance modelling and simulations, as well as considering the user's needs.
- The first case includes professionals involved in early stages of manufacturing, who develop lines of research on inputs, while the second case focuses on the incorporation of knowledge related with bioclimatic or passive design, thermal comfort and energy balance in building projects.
- **Execution capability:** it comprises the skills related to the concrete execution of constructions, the adjustment of active management strategies and retrofit as the ability to reconfigure already built space from an efficiency perspective, maximizing the possibilities of existing constraints.
- **Management capability:** it consists of the ability to apply technical knowledge to decision making. E.g.: measuring tools, energy certification and audit, energy performance communication, energy performance and consumption management.

The skills presented in this chapter are the basis for technical competency in EEB. Such skills are taken into account for analysing the existing educational content developed in Section 4-5 Suitability of the academic existing programs in EEB in order to be able to characterise the existing gap.

It is important to mention that there are also some required skills at all stages of the building process that, unlike those described above, are not associated with contents taught in the analyzed degrees, but are essential for the EEB expansion. These skills, which are usually referred to as "soft" skills (Bevan, 2016), are related to the development of human relationships in the work environment. They include interpersonal, communicative and behavioural skills associated with personal qualities such as leadership, teamwork and decision-making competences.

Furthermore, every project requires management skills, including planning, organization and monitoring to achieve goals in a timely manner, as well as the implementation of funding mechanisms, negotiation and budget control.

Although the presence of these skills is beyond the scope of the analysis methodology used herein, their incorporation should be taken into account as a key component to success when implementing EEB.

1.5 Background of the Project's Technical Specifications

The terms of reference for this work were prepared by the Secretariat of Energy of the Republic of Argentina, together with the direction and technical support of the Copenhagen Center of Energy Efficiency (C2E2)[7].The work was tendered by the Temporary Business Association (UTE, for its Spanish acronym) of 3 independent consultants, who have technical background in Energy Efficiency in Buildings, Sustainability and Public Policies, experience in research for international agencies, undergraduate and postgraduate studies, in a synergic agreement of the technical competences needed to carry out this project.

The following questions arise from the aim to conduct a contextual analysis of the skills and knowledge gap in professionals in the EEB sector and in their vocational training curricula:

- What changes and modifications need to be made to the current programs?
- What is being taught as part of the technical and vocational and university education? What needs to be done to address the energy efficiency skill and knowledge needs in the foreseeable future?
- In an attempt to achieve this, a detailed specification is developed calling for the execution of the following activities.

On the one hand, in order to achieve a correct interpretation of the existing educational programs, it is required to reinforce a baseline about how the education system in Argentina works that might let us understand the context of how all technical-vocational, undergraduate and postgraduate education levels work. It must also include the education funding regime, its regulation, curricular design and accreditation mechanisms. Furthermore, it should consider the career paths currently taken by technicians, planners, designers, auditors and managers to complete their education.

Next, it is necessary to characterise the skills of professionals working in EEB, their training and academic background, at all the aforementioned levels. In parallel, it is requested to create a profile of skills ideally required to design, execute and monitor EEB projects. The responses to these requests give rise to a preliminary difference between what is identified in the reality of active professionals and what is considered

7 For further information about the Center, please visit https://c2e2.unepdtu.org/

that would be ideal to find. Deepening this analysis consolidates the knowledge and skills gap in the sector.

On the other hand, in order to understand how the sector works in operational terms, it is necessary to conduct an analysis and characterisation of the market of goods and professional services in the EEB sector in Argentina and to identify the most important markets based on a simple hierarchical ranking according to their impact on EEB. To this end, it is essential to apply a value chain approach to represent how mature the market is, by also considering the associated ecosystem and the interaction with decision-makers, regulators, manufacturers, or product distributors.

After the contents, goods and services that articulate the dynamics of the EEB sector have been characterised, it is necessary to advance further through an analysis of the stakeholders involved.

It is required to include in the survey all stakeholders, from practicing professionals, relevant educational institutions, significant commercial actors (builders, developers) to institutional and governmental actors that have a direct and indirect impact on the development of the sector.

Based on the information gathered, an analysis of the knowledge and skills gap should be conducted with regards to the sector's needs at the level of the selected provinces and according to their climatic characteristics, identifying the profile of the contents in existing programs and describing the practicing professionals' skills.

It is also necessary to characterise, through interviews and surveys, the actors in the context of the value chain, their roles, skills and knowledge and how they acquired them, their perception regarding current and future demands in the sector and the gender balance of the studied field. Based on these interviews, it is proposed to proceed with the description of the relevant stakeholders, their professional profile and how they are connected with each identified and prioritized element/service. For that purpose, these stakeholders are consulted on the perceived demands for skills and knowledge and possible approaches to strengthening existing programs.

Based on this analysis, and putting the curricular profiles into context, it is requested to elaborate possible adaptations to the EEB expansion requirements in Argentina, indicating how these modifications can be implemented, regulated and accredited by government agencies. These advances constitute the report on the skills and knowledge gap in educational programs for the building sector.

After this report has been presented, it is suggested that it be shared with all stakeholders through a project dissemination presentation aimed at industry, educational and governmental institutions, among others.

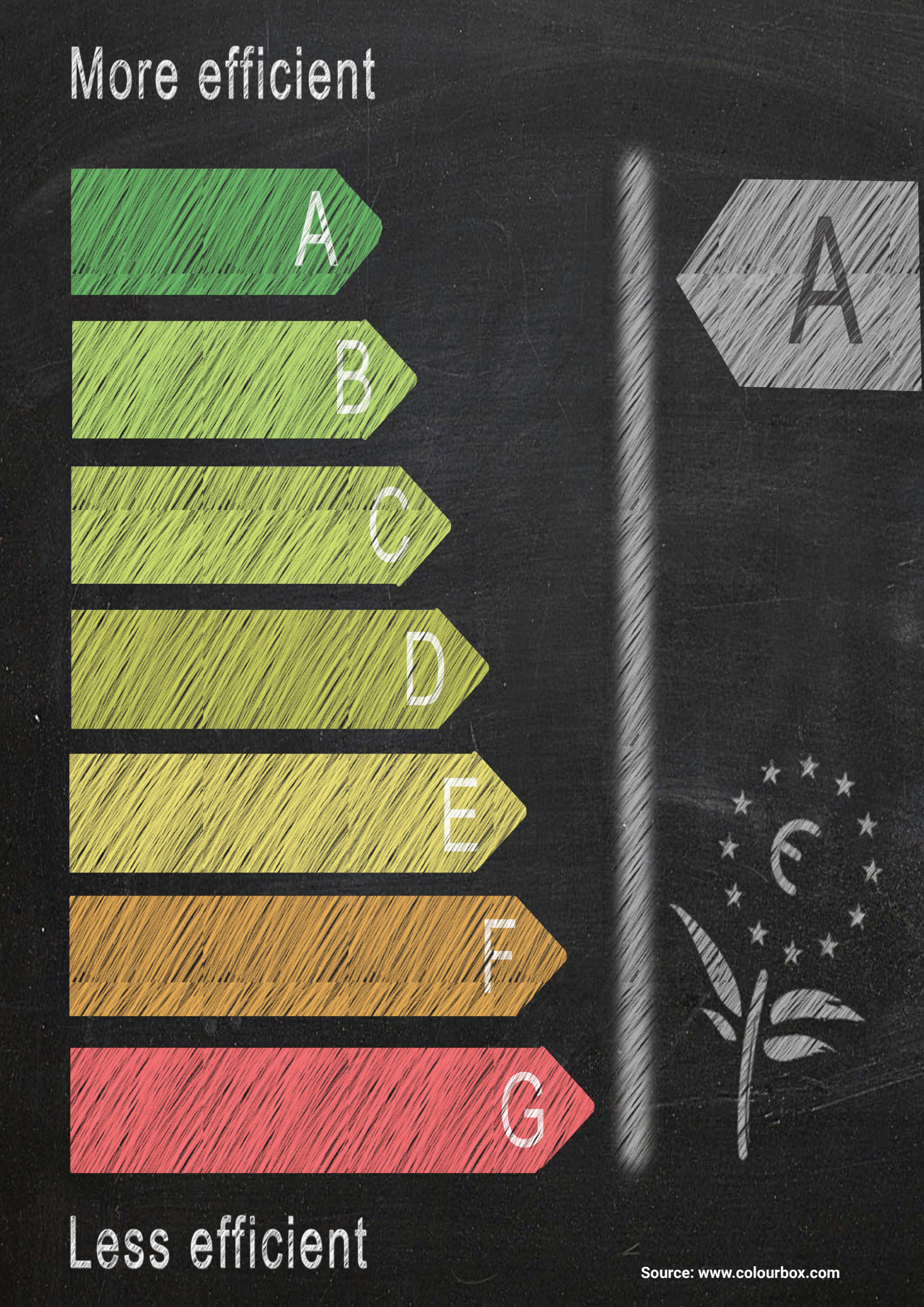
1.6 Project Goals and Scope

This project aims to develop a contextual assessment of the skills and knowledge gap among professionals working in the EEB sector and in the educational programs that train these professionals. Such diagnosis implies the possibility of increasing and strengthening the skills of decision makers, professionals working in the private and public sector who are involved in the EEB sector, by means of recommendations on how to provide and improve their skills and knowledge in such sector in Argentina.

While focusing on technical and vocational and higher university education, the following activities were carried out:

- A survey and analysis on the training existing programs available at both the national and provincial levels, and their respective contents.
- A characterisation of the professional profile(s) in the sector of individual professionals working in EEB.
- A status report on the market situation (goods, services, value chain) and stakeholders (professionals, education and government).
- A diagnosis of existing programs and demand to identify and evaluate gaps.
- Recommendations to enhance professionals' profiles by creating educational policies according to local needs and the state of the art at international level.

This report will develop the general context of EEB in Argentina, describing the main aspects of the country that condition its development, such as its regulatory and institutional framework, climatic characteristics and energy mix (2 - EEC IN ARGENTINA - OVERVIEW). The description of the methodological approach is detailed in 3 - METHODOLOGY. Next, a state of the art and general overview of the functioning of the education sector in Argentina will be established, describing the different levels, their functioning in terms of funding and regulations governing their contents and accreditation mechanisms, (4 –EDUCATION IN EEB). Then, there will be a further explanation of the selection of actors and stakeholders involved in the EEB sector, including those related to the associated goods and services market (5 - VALIDATION OF IMPEDIMENTS AND OPPORTUNITIES FOR EEB EXPANSION IN ARGENTINA). The proposals resulted from the gap assessment are presented in 6 –LINES OF ACTION Finally, the project conclusions are presented in 7 - CONCLUSIONS.



Source: www.colourbox.com

2 EEB in Argentina – Overview

2.1 Country's profile

Argentina, which is located in the southern area of South America, is a vast country with a territory that covers 2.8 million square kilometres with an estimated population of 44.9 million (World Population Review, 2018), registering one of the lowest population densities in the world of 14.4 people per square kilometre (The World Bank, 2018a).[8]

With regards to its political and territorial system, Argentina is a federal presidential representative democracy with a bicameral congress and is composed of 23 districts (provinces), which in turn are subdivided into departments and an Autonomous City of Buenos Aires, which is its capital city. The provinces, as well as the capital city, are fully autonomous as they can enact their own constitution and manage their own resources, provided they respect the national constitution and regulation.

Due to its great extension, Argentina's climate is very diverse with climatic zones ranging from tundra to hot desert and subtropical areas. For the purpose of this report, the classification is considered in 6 zones as defined by IRAM standard 11603 (2-4 Local climatic conditions). The diverse climate allows the country to be rich in natural resources, which also contributes to the fact that it is the second largest economy in South America after Brazil's (IMF, 2017). Argentina is classified as an emerging or developing economy and is a member of the G20, having chaired it in 2018.

With a growing urban population that has already reached 92% of the total population (The World Bank, 2018b), the agricultural sector constitutes 6% of its GDP, while industry and construction jointly account for 22%, resulting in the tertiary sector having the largest share (72%) in the Argentine economy (Secretariat of Economic Policy, 2018).

The provinces included (see Figure 4 above) to conduct the information survey were selected by the Secretariat of Energy team and was defined based on two complementary criteria: the climatic representativeness of the different regions and the presence of representatives that would manage the information.

Thus, the following areas were surveyed:

- Metropolitan Area of Buenos Aires[9]: it is the urban area comprising the Autonomous City of Buenos Aires and 40 districts of the Province of Buenos Aires: Almirante Brown, Avellaneda, Berazategui, Berisso, Brandsen, Campana, Cañuelas, Ensenada, Escobar, Esteban Echeverría, Exaltacion de la Cruz, Ezeiza, Florencio Varela, General Las Heras, General Rodriguez, General San Martin, Hurlingham, Ituzaingo, Jose C. Paz, La Matanza, Lanus, La Plata, Lomas de Zamora, Lujan, Marcos Paz, Malvinas Argentinas, Moreno, Merlo, Moron, Pilar, Presidente Perón, Quilmes, San Fernando, San Isidro, San Miguel, San Vicente, Tigre, Tres de Febrero, Vicente Lopez, and Zarate.
- It has a surface of 13.285 square kilometres. According to the 2010 census, it has 14,800,000 inhabitants, representing 37% of the inhabitants in Argentina, 2,890,151 from which correspond to CABA, which has a surface area of 203 square kilometres. As a megalopolis, it is constantly growing; thus, its territorial boundaries are not precise.
- With regards to the climate, it has hot summers and cold winters, with moderate thermal amplitude. Rainfall is more abundant during the summer season.
- Province of Chaco: Surface: 99,633 square kilometres. Population: 1,055,259 inhabitants. It has a semi-tropical and semi-septic climate in the East area and semi-tropical continental climate in the West area. Summers are very hot and winters are temperate.
- Province of Cordoba: Surface: 165,321 square kilometres. Population: 3,308,876 inhabitants. With regards to the climate, the south west has characteristics of the temperate Pampean climate and, towards the north area, it has a subtropical climate with a dry season. In the west, the subtropical mountain climate prevails. The eastern slopes of the mountain range are more humid, while the western slopes have a more arid climate.
- Province of Corrientes: Surface: 88,199 square kilometres. Population: 992,595 inhabitants. The prevailing climate is subtropical climate without any dry season, with abundant rainfall and high temperatures with little daily and seasonal variation, especially in the north west. The climate of the southern part

8 Petrichenko, K., &Zambianchi, V. (2019). Linking global, national and local levels. The case of Argentina. Copenhagen Centre on Energy Efficiency (C2E2)

9 https://www.buenosaires.gob.ar/gobierno/unidades%20de%20proyectos%20especiales%20y%20puerto/que-es-amba

Figure 4: Provincial map of Argentina The areas included in this study appear in green. Source: Author's own elaboration based on https://www.wikiwand.com/en/Provinces_of_Argentina

of the province is more associated with the warm Pampean climate.

- Province of Neuquen: Surface: 94,078 square kilometres. Population: 551,266 inhabitants. It has four types of climate: humid (mountain range area, to the south of Pino Hachado), snowy (high mountain area of the Andes), arid steppe (Patagonian Plateau and Transition Andes) and semi-arid (to the North and East of the province).
- Province of Rio Negro: Surface: 203,013 square kilometres. Population: 638,645 inhabitants. With regards to the climate, in the East and North area it offers a variety of temperate and arid climate, with short summers and intense winters. In the mountain

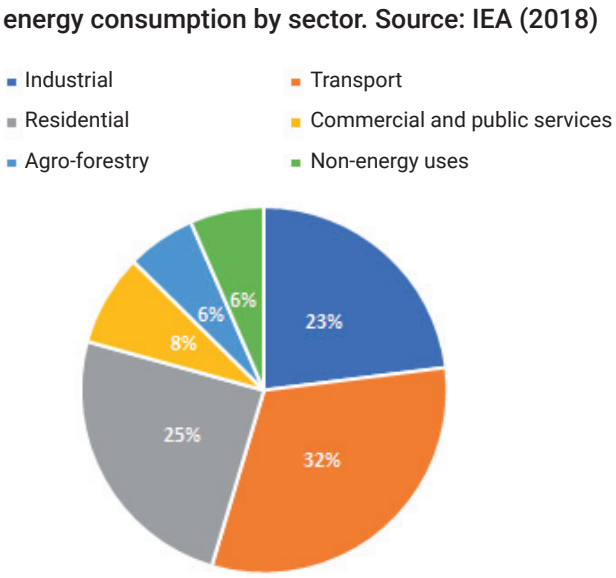


Figure 5: Final energy consumption by sector 2018. Source: Author's own elaboration based on IEA, 2018

range zone, it is cold and humid, due to the influence of the West winds, with high rainfall.

- Province of Salta: Surface: 155,488 square kilometres. Population: 1,214,441 inhabitants. In spite of being located in a tropical zone, its climate is warm, although there are quite marked variations depending on how varied its relief is. The east is dominated by a semi-arid climate with a dry season; the high plateau is characterised by sharp temperature fluctuations and low rainfall; valleys, ravines and sierras have a milder climate.

Argentine energy sector

The country's primary energy intensity, which is understood as the amount of energy required to produce one peso of Gross Domestic Product, is 4.34 MJ/$2011 GDP (PPP) compared to the global average of 5.47 and 3.82 in Latin America and the Caribbean (IEA, 2018).

Regarding energy production in Argentina, in 2016 it was 75.8 Mtoe, with net imports of 17.7 Mtoe (IEA, 2018). 87% of locally produced energy comes from fossil fuels, 54% of which corresponds to natural gas, 31% to oil and oil derivatives, and 1% to coal. Hydro and nuclear energy contributes 4% and 3%, respectively, and non-conventional renewable energy (biomass, small hydro, wind and solar) contributes 6%.[10]

On the other hand, according to the assessment of final consumption by segment, the transportation sector showed the highest share in final energy consumption, followed by the residential and industrial sectors, and finally by the commercial and public, and the agricultural sector (IEA 2018) (see below Figure 5) (ibid.).

As for electricity, the Argentine market is the third largest market in Latin America. In 2015[11], total production was 145 TWh with consumptions of 136 TWh (ibid.). Additionally, final electricity consumption has tripled since 1990 (see Figure 6 below) (ibid.).

The connection between the contextual characteristics of the building sector and its response with the energy mix, which together determine the conditions for the development of EEB, will be further described below.

2.2 National building profile

Buildings in Argentina (comprising the "residential" + "commercial and public" sectors) accounted for 33% of the country's total energy consumption during 2018 (Government of Argentina, 2019a[12]) which, in turn, accounted for 20.8% of the country's GHG emissions (Government of Argentina, 2019b).

10 MAyDS (2020). Segunda Contribución Determinada a Nivel Nacional de la República Argentina. Ministry of Environment and Sustainable Development, Argentine Republic. Retrieved from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Argentina%20Second/Argentina_Segunda%20Contribuci%C3%B3n%20Nacional.pdf

11 Data provided belongs to 2015 because it is the latest available data as of the date of publication of this report.

12 Government of Argentina (2019a). Balance Energético Nacional de la República Argentina, year 2019. Retrieved from: https://www.argentina.gob.ar/produccion/energia/hidrocarburos/balances-energeticos

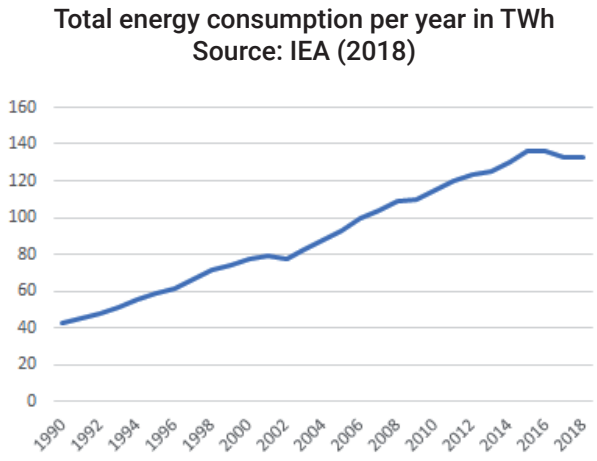


Figure 6: Total electricity consumption per year. Source: Author's own elaboration based on IEA, 2018

The efficient use of energy leads to objective benefits, however, its development is limited by a set of informational, cultural, economic, technical and regulatory barriers.

From 1990 to 2017, Argentina's end-use energy consumption per capita increased by 154% (IEA 2019). This increase may be due, on the one hand, to the low energy efficiency of buildings and, on the other hand, to the greater access to equipment that gave rise to an increase in the level of electricity consumption of 62.81% (Chévez et al, 2017). This trend is expected to grow due to a 23% increase in population over the next three decades (UN, 2019).

Particularly in the residential sector, the bigger demands are associated with population concentration and climatic conditions. According to the 2010 Population Census, at the residential level, 98% of households had grid-connected power, 57% from which used grid-connected natural gas for cooking and 40% LPG (liquefied petroleum gas) in its various commercial forms (cylinder, tube or bulk).

According to the consulted bibliography, there are multiple barriers to the EEB expansion in Argentina, which will be discussed below.

First, the lack of incentive to reduce consumption. This is due, on the one hand, to a policy of regulated prices and subsidies that made some goods and services cheaper, expanded consumption and discouraged investment in energy efficiency technologies (Discoli, 2016)[13]. On the other hand, it is due to the lack of depth in existing sustainable education programs, which results in a lack of knowledge in public awareness regarding environmental and social impacts of energy waste (Schwarz, 2017, as cited in Torrejón Marina, 2020).

Secondly, the prevailing constructive logics with low efficiency materials, without considering energy saving (Discoli, 2016). In general, buildings in Argentina show poor thermal performance, due to poorly insulated roofs and floors, single glazed windows with high leakage rates and low energy efficient equipment (González, 2013). Most residential houses could save 3 to 5 times heating consumption by implementing some of the energy conservation measures (ECMs), such as thermal insulation (Gonzalez, 2013, as cited in Torrejon Marina, 2020).

Finally, we should add the usual reluctance to change businesses and the lack of the required knowledge in the institutions (Schwarz, 2017).

Currently, from the point of view of the value chain analysis, the EEB market in Argentina is characterised by the participation of relatively few actors. Some of them have a greater participation in domestic production, as is the case of insulation materials and openings, and others have an almost exclusive dependence on imported supplies, as is the case of solar photovoltaic energy or LED lighting.

In any case, the variables conditioning the multiplicity of actors and available catalogue are the needs of or demands from the new building sector, i.e. those buildings that are being constructed at present and incorporate these elements from the initial conception stage of a project.

Likewise, there is a much larger market with a major impact on EEB in the adaptation of buildings that

13 Díscoli, Carlos A., & Martini, Irene, & Viegas, Graciela M., & Barbero, Dante A., & Rodríguez, Lucas G. (2016). Pautas Para El Reciclado Masivo De La Envolvente Edilicia Residencial. Urbano, (33),54-65.[Consulted on October 22, 2020]. ISSN: 0717-3997. Available at: https://www.redalyc.org/articulo.oa?id=198/19848041006

are already constructed and in use. The retrofit market, however, is a much more immature field. The aforementioned barriers are the main cause of its almost null development.

There is a fundamental need to act in the building sector by implementing energy conservation measures (ECM). The potential energy savings with moderate reforms is between 30-50% (Gonzalez, 2013). This can lead to a positive energy balance while complying with the Paris Agreement.

With regards to the future situation of the energy sector, the Argentine government has drawn up the document entitled *Escenarios Energéticos 2030*[14], which represents a planning tool for decision making in the sector, modelling four scenarios for the evolution of the energy mix: two of which are "existing policies" ("trend" and "efficient" scenarios) that include various policies that are being implemented in the energy markets, and the other two are alternative "active policies" ("natural gas industrialization" and "electrification" scenarios).

In the context of the present analysis, the implementation of lines of action for energy efficiency in the building sector is considered within a "trend" scenario, which is modelled on the basis of demand behaviour in recent years in top-down and bottom-up estimates.

It should be clarified that these scenarios do not have an assigned probability of occurrence, given the dynamic nature of the variables analyzed, such as the energy scenario in particular, the economic and geopolitical context in general, changes in Climate Change agreements or the occurrence of technological, political or economic disruption events.

According to the trend scenario projections, the final energy demand for the whole country in 2018-2030 period would grow at a cumulative annual rate of 2.2%, i.e., starting in 2018 with a final energy consumption of 53.2 MMtoe, in 2030 it would reach 68.9 MMtoe (see Figure 7). With regards to the origin of energy, in the baseline scenario, the residential sector would consume mainly electric power (32%) and natural gas (56%), which is similar to the consumption pattern of the commercial and public sector (55% electric power and 28% natural gas).

2.3 Sectoral regulations

The current strategic and regulatory framework for energy efficiency at national level is composed of a combination of laws, plans and standards covering different aspects of energy efficiency.

Institutional framework

Among the most relevant precedents in the development of the subject in Argentina, it should be considered that the process began in December 2007, with the publication of Presidential Decree 140, which ratifies the United Nations Framework Convention on Climate Change (Act No. 24295) and the Kyoto Protocol (Act No. 25438). Furthermore, an important legal framework was created by declaring the rational and efficient use of energy to be of national interest and priority, acting as a key tool for energy policies and environmental preservation. Thus, the National programme for the Rational and Efficient Use of Energy (PRONUREE, for its Spanish acronym) was created, which began with the exchange of filament lamps for energy-saving lamps in the residential sector, the replacement of public lighting fixture and continued, among other measures, with the Energy Efficiency Labelling of Household Appliances (which is mandatory for lamps, refrigerators and air conditioners, and is voluntary for washing machines and three-phase motors), and the creation of IRAM 11900 Standard "Energy Efficiency Label for Heating in Buildings. This classification is based on the thermal transmittance of the envelope". In 2015 Argentina created the Ministry of Energy which, among other responsibilities, promoted energy efficiency initiatives at national level through the Undersecretariat of Energy Saving and Energy Efficiency (Decree No. 231/2015). In September 2018, however, the Ministry of Energy changed its rank to Secretariat of Government within the scope of the Ministry of Finance, and the Undersecretariat of Renewable Energies and Energy Efficiency was responsible for the lines of action (Petrichenko&Zambianchi, 2019).

During this period, this Secretariat, working closely with the European Union's Energy Efficiency in Argentina Project[15], carried out the National Energy Efficiency Plan (PlanEEAr, for its Spanish acronym)[16] , which contributed to strengthening the lines of work developed by the national energy portfolio, such as: Energy Efficiency in the Productive Sectors, Transportation, Public Sector, and Buildings (Labelling of Homes, Windows and Self-Generation of Energy),

14 Secretariat of Energy, Ministry of Finance, Presidency of Argentina (2019). *Escenarios Energéticos 2030.*Retrievedfrom: http://www.energia.gob.ar/contenidos/archivos/Reorganizacion/planeamiento/2019-11-14_SsPE-SGE_Documento_Escenarios_Energeticos_2030_ed2019_pub.pdf

15 For further information about the Project, please visit https://eficienciaenergetica.net.ar/

16 For further information about the Project, please visit https://www.argentina.gob.ar/economia/energia/eficiencia-energetica

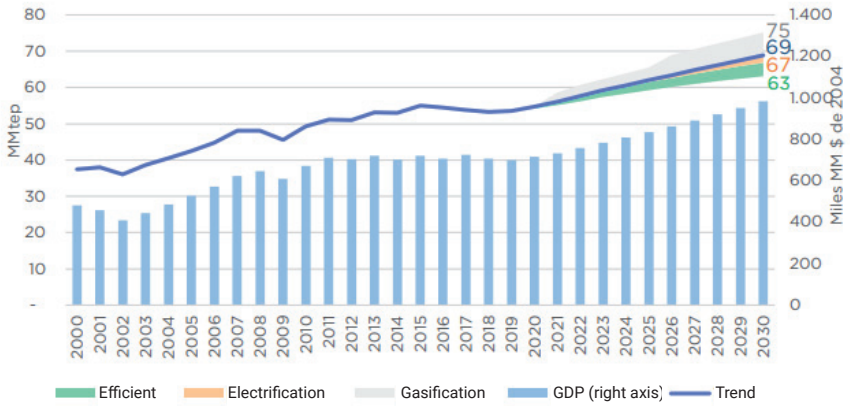


Figure 7: Final energy consumption development and GDP, 2000-2003. Source: *Escenarios Energéticos 2030* (Secretariat of Energy. Argentina. 2019)

National Residential Useful Energy Balance and the National Education Strategy for Energy Sustainability.

Furthermore, in 2017, the then Secretariat of Housing prepared the National Housing Plan, aiming to address the housing deficit within the framework of sustainable urban development. As part of this Plan, the Sustainable Housing Manual[17]was prepared in collaboration with the Secretariat of Environment and Sustainable Development and the Secretariat of Energy, which develops aspects of design, construction and sustainable use of neighbourhoods and housing.

In December 2019, the Secretariat of Energy became part of the Ministry of Productive Development and, in August 2020, it became part of and started to be within the scope of the Ministry of Economy. The Secretariat[18] currently consists of three undersecretariats: Electric Power, Hydrocarbons and Energy Planning. The Undersecretariat of Electricity manages four strategic areas, one of which is the National Directorate of Electric Generation, which in turn has three simple directorates: Directorate of Hydroelectric Generation, Directorate of Thermal Power Generation, Directorate of Renewable Energies. Currently, Energy Efficiency-related public policies are within the scope of the latter.

Although significant progress has been made in recent years, energy efficiency agendas are still limited at the local public policy level, with independent, small-scale or pilot projects, largely due to the lack of local capability and technical expertise, mainly focused on the municipal level. Local governments are regarded to strongly depend on the guidance and assistance provided from higher levels of government. In addition, some municipalities/departments experience challenges due to limited access to financial resources, as public and private funds and investments in energy efficiency tend to prioritize larger cities. This implies that projects are more likely to be implemented in cities such as the Autonomous City of Buenos Aires, Greater Buenos Aires, Rosario, Cordoba, contributing to the centralization of development in this region. However, it is important to mention that the development of training policies for housing labellers and enforcement pilots were deliberately implemented in medium-sized cities outside the central region, such as Rio Negro and Salta, which made a strong federal impression.

Additionally, the positive experiences in some municipalities are not replicated in other jurisdictions, missing the opportunity to enhance the knowledge and skills acquired, which prevented maximizing the results of energy savings and emission reduction on a large scale. In this way, the need for intermunicipal dialogue channels to share successful experiences or define joint policies, plans and projects is noted.

In this sense, an important role in supporting the development of policies at a local level has been played by the Argentine Network of Municipalities facing Climate Change (RAMCC, for its Spanish acronym), which is a body in charge of coordinating and promoting local public policies that address climate change in the cities and towns of Argentina, working together with 219 municipalities (2020). RAMCC coordinates working groups on efficient retrofitting of public buildings and provides training and support to develop Local Climate Action Plans (PLAC, for its Spanish acronym). The most notable is the recent collaboration of the Copenhagen Energy Efficiency Center, together with other educational and international collaboration institutions, with the RAMCC

17 To read the Manual, please visit https://www.argentina.gob.ar/ambiente/desarrollo-sostenible/vivienda/manual

18 For further information about the organization chart of the Secretariat of Energy, please visit: https://mapadelestado.jefatura.gob.ar/estructura_oescalar.php?n1=005

to carry out an Energy Efficiency Project in municipal buildings[19].

Regulatory framework

Act No. 13059 of the Province of Buenos Aires had been enacted in April 2003 prior to the aforementioned Presidential Decree No. 140 in order to establish the thermal conditioning conditions required in the construction of buildings, to contribute to a better quality of life for the population and to reduce the environmental impact through the rational use of energy. Thus, Buenos Aires became the first province to legislate on energy consumption in construction derived from buildings' air conditioning. Regulated in 2010 through Regulatory Decree No. 1030, it establishes that any new work or "intervention on an existing one, in whole or in part, either *in-situ* or by manufacturing any parts for a subsequent assembly" must comply with the current IRAM Standard on Thermal Conditioning of Buildings and Windows. The Act aims to improve comfort and health conditions in buildings and reduce energy consumption, in both heating and cooling, by improving the thermal insulation of the building envelope of walls, roofs as well as windows, and avoiding the risk of humidity due to water vapour condensation.

On the other hand, ActNo. 4458 entitled "Thermal Conditioning Standards in Buildings" of the Autonomous City of Buenos Aires of December 2012, which was incorporated in the Building Code, added the mandatory compliance with IRAM Standards for new constructions that are bigger than 1500 square meters.

Nowadays, there exists a variety of national legislation on energy management. However, it is more concerned with the promotion of renewable energies[20] than the promotion of energy efficiency, as detailed below:

- Act No. 25,019/1999: National wind and solar energy regime. Regulated by Decree No. 1597/1999.
- Act No. 26.093/2007: Regulation and promotion regime for the sustainable production and use of biofuels. Regulated by Decree No. 109/2007.
- Act No. 26,190/2009: National Promotion Regime for the use of renewable energy sources for the production of electricity. Regulated by Decree No. 562/2009.
- Act No. 26,473/2009: It prohibits the commercialization of incandescent lamps for general residential use.
- Act No. 27,191/2016: National Promotion Regime for the use of Renewable Energy Sources for the Production of Electricity. Amendment. Regulated by Decree No. 531/2016.
- Act No. 27.424/2018: Regime for the Promotion of Distributed Generation of Renewable Energy integrated to the Public Electricity Grid. Regulated by Decree No. 986/2018.
- Act No. 27,492/2019: It extends the aforementioned prohibition to halogen lamps.
- In another type of regulations, the following regulations stand out:
- The aforementioned Decree No. 140/2007: National Program for the Rational and Efficient Use of Energy. It states that the efficient and rational use of energy is a priority for Argentina, establishing a series of short and long-term action terms for many sectors, namely: industry, residential and commercial, services, education, public lighting and transportation. It also highlights the importance of clean development mechanisms, standards and energy labelling.
- Resolution 280/2008:The Providers of the Electric Power Distribution Public Service under provincial and/or municipal jurisdiction to the Body Responsible for Dispatch must be authorized to use generation units of less than 2000 kW.
- Resolution 108/2011:The execution of Supply Agreements between the Wholesale Electricity Market and the supply regarding availability of generation and associated energy must be authorized.
- ENRE Resolution No. 0086/2017: National Public Lighting Plan focused on LED modernization for selected municipalities. This Plan establishes that municipalities will receive either grants or lighting technologies to implement the National Plan. Requirements for selecting municipalities include: notable energy saving potential, proper infrastructure, capabilities with regards to the field and implementation time.
- Official Gazette Resolution No. 59/2019: It authorizes the "Minimum Quality Standards for Social Interest Housing", which are applicable to the "National Housing Plan". It incorporates sustainability components in housing solutions, focusing on bioclimatic design, energy efficiency and the incorporation of renewable energies.

It is important to mention the Energy Efficiency Bill[21] submitted to the National Congress in November 2019, which was to be dealt with within one year by the Mining, Energy and Fuels, Environment and Sustainable Development and Budget and Finance Commissions. The purpose of this Project is to promote the rational

19 For further information about the Project, please visithttps://ramcc.net/noticia.php?id=1031

20 For further information on renewable energy-related information, please visit https://www.argentina.gob.ar/economia/energia/energia-electrica/renovables/legislacion

21 For further information about the bill, please visit https://www.senado.gob.ar/parlamentario/comisiones/verExp/3290.19/S/PL

and efficient use of energy resources, as well as their saving and conservation. To this end, it establishes the creation of a National Energy Efficiency Plan for Argentina, savings goals and obligations for High and Very High Energy Consumption Users. Furthermore, it provides for the creation of the National Energy Efficiency Labelling and Minimum Standard Program, the Energy Efficiency Labelling Program for Housing, as well as the Program for the Rational and Efficient Use of Energy in the Public Sector. For the implementation of these goals, two entities have been created, the National Energy Efficiency Council (CoNaEE, for its Spanish acronym) and the National Center for Renewable Energy and Energy Efficiency (CeNEREE, for its Spanish acronym). Finally, it also sets objectives of coordination with other state agencies for the incorporation of the Rational and Efficient Use of Energy as curricular content in training programs.

Moreover, in May 2020, another bill, entitled "National Housing Energy Efficiency Labelling System"[22], was introduced. Its main objective is to establish a mechanism to qualify professionals to certify energy labelling. As with the aforementioned bill, it has not yet been dealt with in the legislature.

Within this context, among the regulations referring to the commitment assumed by Argentina in the fight against climate change, whose adaptation measures include interventions in the energy sector, the following regulations stand out:

- Act No. 24,295/1993: United Nations Framework Convention on Climate Change.
- Act No. 25,438/2001: Kyoto Protocol.
- Act No. 27,137/2015: Doha Amendment to the Kyoto Protocol.
- Act No. 27,270/2016: Paris Agreement.
- Act No. 27,520/2019: Minimum Budgets for Adaptation and Mitigation to Global Climate Change (Climate Change Act). Regulatory Decree No. 1030/2020
- Decree 891/2016: Creation of the National Cabinet for Action against Climate Change.
- Decree 499/2017: Implementation of 2030 Agenda for Sustainable Development.
- Resolution 447/2019: Creation of the National Plan for Adaptation and Mitigation to Climate Change.

The legislative portfolio of provinces and municipalities related to the energy sector has been growing in recent years (Chévez, Martini, &Discoli, 2016). The following are included at the provincial level:

- The aforementioned Act No. 13,059/2003 - Province of Buenos Aires. Regulated by Decree No. 1030/2010. It aims to establish the thermal conditioning conditions required in building construction, in order to contribute to a better quality of life for the population and to reduce the environmental impact through the rational use of energy.
- Act No. 13,903/2019[23]– Province of Santa Fe. It is the only provincial regulation in the country on Housing Energy Efficiency Labelling. It establishes the obligation to present the Housing Energy Efficiency Label in all deeds of conveyance that are managed within its jurisdiction.

In parallel, some municipalities are using their local legislation powers to introduce energy efficiency regulations. Some experiences of interest are mentioned below:

- Act No. 4458/2012 – Autonomous City of Buenos Aires. Thermal Conditioning Standards in Building Construction.
- Act No. 3871/2011 – Autonomous City of Buenos Aires. Adaptation and Mitigation to Climate Change. It includes evaluation and implementation measures for the energy sector.
- Ordinance 8757/2011 – Rosario. Hygrothermal Aspects and Energy Demand of Constructions. It regulates energy consumption for thermal comfort, including space heating and cooling, by establishing maximum allowable values of thermal transmittance for new and existing buildings with a land surface area of more than 300 square meters.

There has been a significant growth in the regulatory framework and action plans in recent years. However, the major changes are recent in historical terms and the technical aspects included are not always consistent and concurrent with all of them. In this sense, given the federal nature of the country, the existing and applicable specific legislation for the EEB is of provincial nature. For this reason, it is important to follow up on the national bill for the EEB, since it could present guidelines that consider the country's climatic conditions in a comprehensive manner, and thus make it easier for the rest of the provinces that do not yet have applicable regulations to adapt and expand these recommendations as well as promote interjurisdictional efforts by climatic zone (see next section).

However, the enactment of new regulations should not be deemed as the only solution for expanding the EEB, since experience suggests that a lack of training for their effective application, together with the lack of control by technical agencies, have led to a general lack of adherence and compliance.

22 To read the bill, please visit https://www4.hcdn.gob.ar/dependencias/dsecretaria/Periodo2020/PDF2020/TP2020/1990-D-2020.pdf

23 For further information on Act No. 13,903 https://www.santafe.gob.ar/ms/eficienciaenergetica/etiquetado-de-viviendas/

For the building sector, establishing a dynamic and positive relationship with the regulatory framework represents a major challenge. The quality of construction depends to a large extent on its public inspector and the EEB takes an intrinsic part of this. The existence of the regulatory framework is a key initial step that has already been taken. From now on, it is necessary to encourage, with proper training and resources, the implementation of the regulations in order to take advantage of their full potential and achieve the greatest possible adherence.

2.4 Local climatic conditions

Finally, in order to contribute to the contextual description of the country it is required to mention the climatic characteristics of Argentina, in accordance with constructive criteria.

a large ocean coast (Britannica, 2020)[24]. Therefore, Argentina's climate is very varied and depends on the location and geographical characteristics of the place.

IRAM standard 11603 "Thermal conditioning of buildings. Bioenvironmental classification of the Argentine Republic" includes six different specific climates (Figure 8). These climate types range from subtropical to sub-Antarctic climatic conditions and present different challenges and assumptions for designing a building.

Zone I or "very warm climate" is in the northern part and the hot weather prevails, with less than 390 heating degree days (HDD). During the summer season, all the area's temperature exceeds 34°C, with an average temperature of 26°C and thermal amplitude of 15°C. During the winter period, the coldest months have temperatures that exceed 12°C. In this area, the

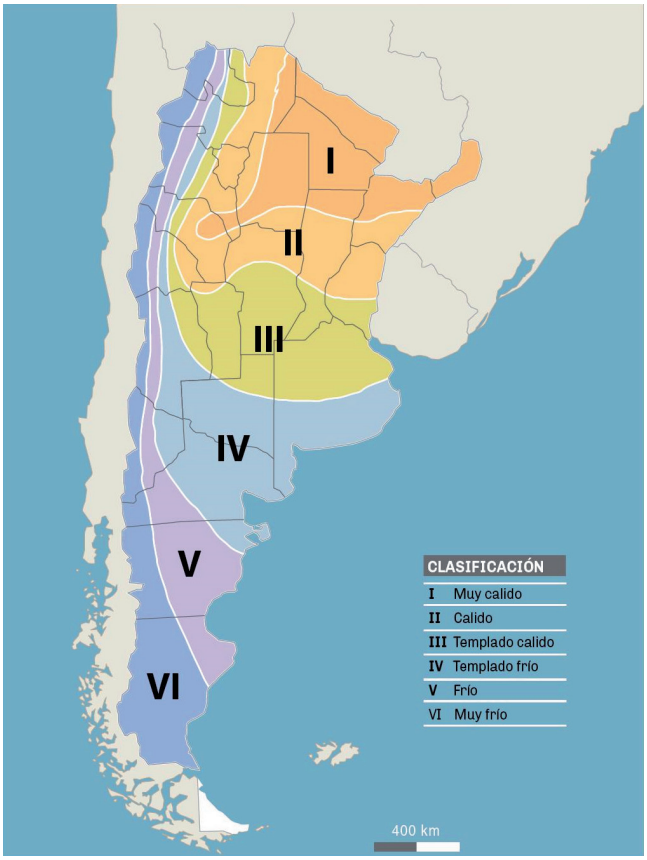


Figure 8: Bioclimatic zones of Argentina. Source: IEDS

Argentina is shaped like an inverted triangle with a base of 1420 Km and 3800 Km from the subtropical north to the sub-Antarctic south. The country can be classified into four main regions: Patagonia, the Pampas, the Andes and the North. It includes many different types of landscapes and climatic zones: plains, tundra, deserts, forests, jungles, mountains, large rivers and

strategy is to avoid west and east orientation, protect it from radiation, paint in white, and place shading systems, especially on the north side.

24 Torrejón Marina, V. J (2020) Review of engineering education for design and construction of sustainable buildings in Europe and what Argentina can learn (Master Degree thesis). DTU Civil Engineering. KongensLyngby, Denmark

Zone II or "warm climate" has between 390 and 780 heating degree days. During the summer season, the maximum temperature exceeds 30°C, the average temperature is between 20°C and 24°C, and the thermal amplitude is 16°C. During the winter period, the average temperature varies between 8°C and 12°C. In this zone, the strategy involves, in addition to what has been mentioned in Zone I, the arrangement of windows in north and south, to optimize heat gain in winter.

Zone II or "temperate warm climate" has between 780 and 1170 heating degree days. In the summer season, the maximum temperature can exceed 30°C, the average temperature is between 20°C and 26°C and the thermal amplitude is 16°C. During the winter period, the average temperature varies between 8°C and 12°C and it hardly ever reaches values below 0°C. The strategy involves windows in N, NE, NW and E, optimizing heat gain in winter, painting in white, shading systems on all windows, use of materials with high thermal inertia, "roof hatch" with solar protection to control the heat gradient.

Zone IV is considered as "temperate to cold climate" and has between 1170 and 1950 heating degree days. The summer season does not present high temperatures and the temperature rarely exceeds 30°C. During the winter period, the average temperature varies between 4°C and 8°C and usually reaches values below 0°C. In this case, the following orientation is proposed as a strategy: N, NE, NW, E, grouped dwellings to protect them from the wind without affecting solar gain, materials with high thermal inertia, "roof hatch" to control heat gradient and windows that are designed to benefit from the sun.

Zone IV is considered as "cold climate" and has between 1950 and 2730 heating degree days. The summer season has an average temperature below 16°C. During the winter period, the average temperature is 4°C and the minimum temperatures are below 0°C. Here the strategy also includes the strategies proposed in zone IV, but including double/triple glazed windows, condensation risk assessment and avoiding thermal bridges, making a transition zone between the home's exterior and interior.

Zone IV or "very cold climate" in which the heating degree days are above 2730. The summer season presents an average temperature below 12°C. During the winter period, the average temperature is 4°C and the minimum temperatures are below 0°C.

Over 90% of Argentina's population lives in places where there is a temperate climate and high levels of solar irradiation (INDEC, 2012). In this sense, the design of buildings should prioritize, as much as possible, energy efficiency strategies with a positive impact considering the characteristic of being low cost -due to the low purchasing power of a large part of the Argentine population- to mitigate the phenomenon of overheating.

The combination of sustainable architectural aspects such as location, building orientation, window position, wall-to-window ratio and shading systems along with building envelope improvements, passive ventilation strategies (ventilation ducts to allow for natural cross ventilation and night refrigeration/ cooling) and heat recovery units in active ventilation systems should be considered when developing an EEB project. Furthermore, efficient heating systems and improvements in building envelopes must be integrated in cold areas. Other aspects to be considered are the orientation of the building, as well as the position and location of windows of adjacent buildings to stop the wind.

Given the vastness of the Argentine territory and its climatic diversity, there is a clear need to develop regional solutions that take into account the particularities of each case and adapt to the local idiosyncrasy as well as to the catalogue of their own materials and techniques. As far as possible, the adoption of generalist standards or procedures, which are directly detrimental to the main objective of the EEB, should be avoided.

This chapter has described the energy efficiency sector in Argentina through the country's profile, as well as that of construction, regulations affecting the sector, the basis for competition, climate requirements and applicable strategies.

Currently, Argentina's energy mix is mostly of fossil origin, so in order to comply with environmental commitments and reduce greenhouse gas emissions, the energy transition must be accompanied by energy efficiency measures, particularly in buildings, which currently account for 33% of demand.

It was observed that there are institutional initiatives and an incipient regulatory framework that, although they represent an important precedent, still require some consolidation before they are adhered to and applied throughout the national territory. In this sense, Argentina presents a challenge due its great extension, which results in the existence of different climatic zones, each of which requires different EEB strategies.

The following chapter will discuss the methodology of work used to conduct this research.

Source: www.colourbox.com

3 Methodology

As presented in 1-5 Background of the Project's Technical Specifications, this work is in response to the request to develop an analysis of the knowledge and skills gap in the EEB sector in Argentina. The requirements details of the terms and references are presented there. This chapter describes, in order, the tasks undertaken for completing the project.

First, the context of the functioning of the education system in Argentina at the levels of interest was assessed. The institutions involved, the mechanisms for regulation and accreditation of content, and an assessment of the different career paths of in-service professionals working in the EEB sector.

Next, the characterisation of the demand for skills and knowledge was addressed by implementing a value chain analysis of goods and services related to EEB, in order to identify the main stakeholders involved. This analysis was expanded with a special example for a product - glass wool - in order to validate with an emblematic case the general characterisation that had been previously established. From these practices it was possible to consolidate stakeholders, their roles and functions in an enabling environment for EEB from the perspective of professional goods and services, across the value chain (including decision makers, regulators, manufacturers, distributors, designers, maintenance personnel, auditors and managers).

When the universe of relevant stakeholders was defined, the next step was to collect information directly through surveys and interviews to characterise their competences, skills and knowledge, how they acquired them and how they currently use them in relation to their activity in EEB. The analysis of this information made it possible to continue consolidating a characterisation of the current and future demand for skills for the sector.

In order to analyze the existing programs of skills and knowledge, a survey was conducted on educational content offered at the levels of interest, Technical and Vocational Education, Undergraduate and Postgraduate levels, for relevant degrees. This survey was originally planned to be conducted in person in the 4 selected regions, however, due to the COVID-19 pandemic, it had to be conducted remotely (for further details, see Annex 5: COVID-19 Contingency Plan).

Based on this information, the hypotheses explaining the gap and barriers to the sector expansion were enriched and, on this basis, contrasted with stakeholders in a workshop, in order to reinforce them with their direct feedback and validate the relevant findings.

Finally, a cross-sectional analysis of all sources of information consulted led to the elaboration of a series of proposed lines of action, which developed suggested measures to mitigate the gap and favour the EEB expansion in Argentina.

Finally, a webinar was held to present the work results and to raise awareness among stakeholders on the expansion of the proposed lines of action.

3.1 Methodological approach

The objective of implementing the methodology was to determine a baseline of knowledge and skills on EEB in Argentina, in both educational existing programs and existing professionals, and in the demand in the construction market.

To this end, the project involved a subsequent execution of the following stages:

- A characterisation of the professional profile in the sector of EEB individual professionals and a report on the state of the market (goods, services and stakeholders in the value chain).
- A survey and an analysis on the available academic existing programs at both the national and provincial levels, and their respective contents.
- An identification of relevant stakeholders (in-service professionals and other related workers) and their approach through surveys and in-depth interviews.
- Analysis of existing programs and demand in order identify and evaluate gaps.
- Establishing recommendations to support the EEB expansion from the education sector.

The first stages were the fundamental pillars for creating a baseline to characterise existing programs and demand in its different components: curricular content, materials (inputs, technologies, products) and the individuals involved (practicing professionals, educators and government agents). As a result, it was possible to continue consolidating a diagnosis that would identify and measure the gap between what currently exists and a more favourable scenario for the EEB expansion in Argentina. This is in terms of the skills acquired as well as the knowledge taught and

the evolution of what the market offers and requires to continuing encouraging the development of the EEB sector. Finally, based on this diagnosis, it was possible to outline recommendations to characterise and close the identified gaps and establish conditions for the optimal development of the sector.

The preliminary information survey and analysis stage, known as the "baseline", consisted, on the one hand, of consultations with multiple sources representing the different sectors considered at the national level: government, academic and private sector.

On the other hand, a preliminary survey and analysis contents at the different levels of the Argentine Education System were conducted:

- Technical and Vocational Education
- Undergraduate Degrees
- Postgraduate Degrees and Other Courses

Thus, two different vectors were identified and studied. On the one hand, the formal contents of the educational programs of all the aforementioned technical levels, on the other hand, the characterisation of diverse stakeholders, such as decision makers, construction regulatory agencies, and other public sector actors involved in the construction universe, both at the national level and at all governmental levels.

The stage of analysis and processing of the previously collected information contributed to the creation of the diagnosis of the skills and knowledge of the different stakeholders of the EEB sector. At the same time, this made it possible to identify and measure the gaps between existing programs and demand as the organizing pillars of the proposals for effective solutions in the medium and long term, in order to mitigate possible technical, educational and regulatory deficits in this area.

Based on this scope, a survey of information was conducted as well as a diagnosis of the perception of some of the stakeholders to whom it was possible to gain access, without prioritizing any so as not to limit the response in advance. This was achieved by conducting surveys and semi-structured interviews with stakeholder representatives, both at the national level and in several provinces (Salta, Córdoba, Chaco/Corrientes, Río Negro/Neuquén). This task was impacted by the slowed dynamics of public and private activity due to the COVID-19 pandemic containment measures (see Annex 5 for further information: COVID-19 Contingency Plan).

Once this information was gathered, a virtual workshop was held with the stakeholders, where the barriers and circumstances that explain the gap were collectively defined. On this basis, effective mitigation strategies were developed and suggestions were made regarding the necessary conditions for the optimal development of the sector within the Argentine context.

The proposal stage of the project addressed the study of missing or improvable aspects from which improvement alternatives were proposed, both to optimize formal educational contents and create mechanisms in a systemic manner, in an attempt to close the identified gaps. These mechanisms make it possible to nurture the dynamics of training and certification of professionals who are eligible to practice in the entire professional field, ranging from political and regulatory, educational and curricular, and technical aspects and even those related to the development of suppliers, the market for relevant supplies and technologies.

3.2 Scope of data collection

Based on the exchange with experts currently working in the EEB and sustainability market, and a general analysis of secondary information, the market for goods, technologies and services was briefly characterised.

In addition, a search and survey of the educational contents in existing programs were conducted, based on the use of keywords as a filter to determine the existence of related studies and their conceptual proximity to ideas in the field of EEB.

Next, an approach for the analysis of stakeholders was conceived through inquiries to learn about their behaviour and perception of the subject of interest aiming to achieve a multi-perspective characterisation of the existing programs scenario. For this purpose, classic instruments were used for a direct collection of information: survey, interview and workshop, the details of which are further described in 5-2 Surveys of Stakeholders, 5-3 Interviews and 5-4 Stakeholders' Workshops of this report.

On the other hand, in terms of the territorial scope of the project, the limit was defined jointly with officials of the Secretariat of Energy, determining those provinces and regions of Argentina where it was more strategic to establish an anchorage for the information survey (See Figure 4).

3.3 Survey of educational contents

The content survey process involved executing several tasks simultaneously. Conducting surveys and semi-structured interviews with stakeholders' representatives - the results from which are presented in 5-2 Surveys of Stakeholders and 5-3 Interviews of this report - both at the national level and in several provinces (Salta, Córdoba, Chaco/Corrientes, Río Negro/Neuquén).

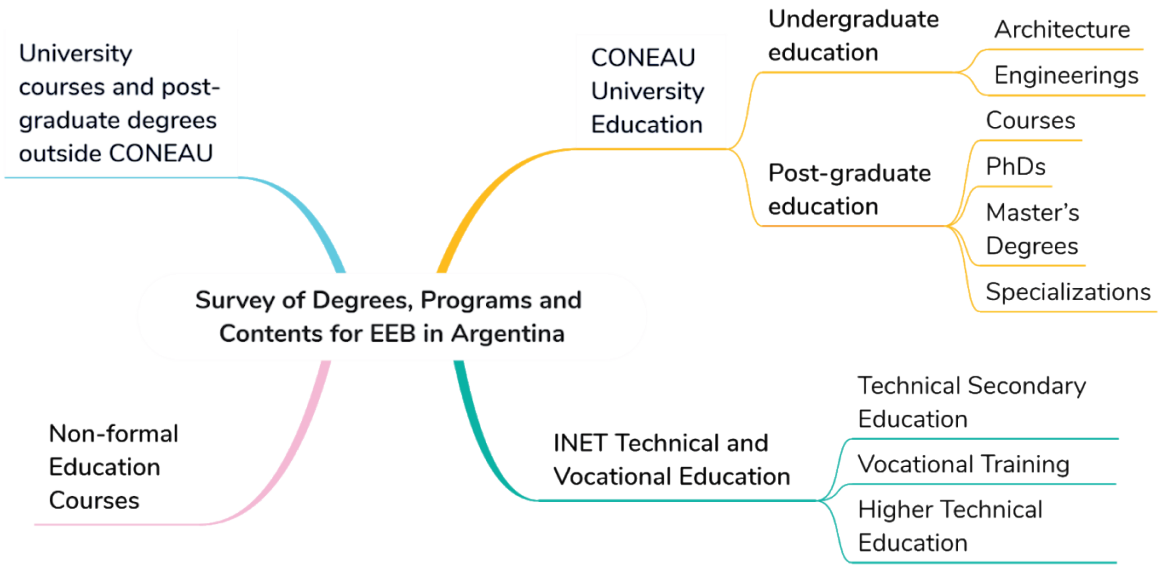


Figure 9: Universe of Courses, Degrees, Programs, and Contents that have been analyzed. Source: Author's own elaboration

Furthermore, the material prepared between 2017 and 2018 by the then Undersecretariat of Renewable Energies and Energy Efficiency was taken into account and worked on. This material made it possible to identify in detail the baseline of the educational/ curricular existing programs at the three relevant levels, the scope of which is shown in Figure 9.

To organize the information, an *ad hoc* method was developed, which associates the skills that are relevant to EEB with keywords (they are explained in Annex 2: Processes and results of the Survey and analysis of related contents) from which a search for related contents in the educational existing programs is conducted.

Technical and Vocation Education

Those technical degrees with potential proximity to EEB in the geographic areas defined for this study were considered.

For each of them, the following contents were surveyed online:

- Information and Reference Frameworks at INET
- Frameworks and programs in Educational Institutions
- Resolutions (Provincial Ministries of Education and other governmental institutions)

Next, keywords in them were searched for. If any of such keywords were found, it was considered that there was proximity to EEB, otherwise it was determined that there was no proximity.

Undergraduate Degree

In the case of undergraduate programs, Curricula, Course Syllabus and CONEAU's Resolutions were surveyed.

A diagram showing the logical sequence of tasks applied for determining proximity at this level is presented below.

For undergraduate content, the process was initiated by taking as a starting point the information provided by the Secretariat of Energy, as well as the surveys and interviews conducted with stakeholders within the framework of this project.

After identifying the undergraduate degrees accredited by CONEAU, we proceeded to investigate their curricula and then conducted a search for previously defined keywords.

For those cases in which keywords did appear in the curricula, we proceeded to carry out a second search, this time classifying them into two categories: "consistent" and "inconsistent". The former refer to those keywords that are directly related to EEB, such as "energy efficiency" or "bio-environmental design". The inconsistent words, on the other hand, are those generic keywords that, although they reflect an approach to the subject, do not do so as directly as the consistent words, such as "renewable energies" or "sustainable".

A high proximity was determined in those cases where the results of this search showed the existence of "consistent" keywords in the curricula.

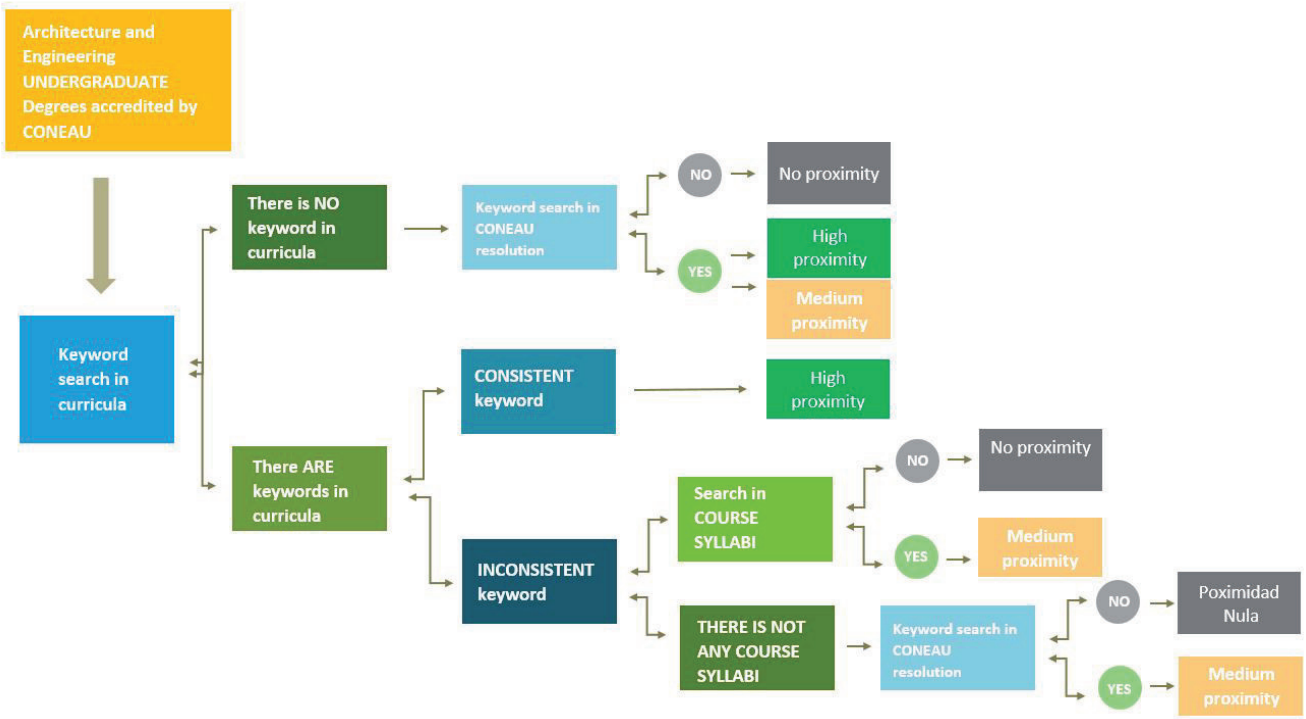


Figure 10: Diagram of the survey process based on keywords contained in UNDERGRADUATE studies. Author's own elaboration

On the other hand, for those cases in which the words searched for in the curricula were "inconsistent", we proceeded to a new instance of more in-depth search, at the level of the course syllabus of each subject, provided there were any syllabus available. If it was confirmed that the keywords found were connected with EEB, it was determined that there existed a medium proximity to the subject matter. Otherwise, we proceeded to the following level involving a search on CONEAU's resolutions using the same criteria. In cases where no connection was found at this level either, proximity was considered to be null.

For those cases in which NO keywords were found within the Curriculum, a new instance of search was conducted in the CONEAU resolutions, defining the proximity in the same way.

Postgraduate Degree

In the case of postgraduate degrees, as in the case of undergraduate degrees, the starting point was a universe of courses (specializations, master's degrees, PhDs, and courses in general) with a possible connection to EEB, and their curricula were surveyed.

A diagram showing the logical sequence of tasks applied for determining proximity at this level is presented below.

When the courses accredited by CONEAU, those obtained from the surveys conducted and those obtained from the general search of academic existing programs had been identified, we proceeded to research and search for keywords classified as "consistent" and "inconsistent" in each curriculum, applying the same procedure as in undergraduate degrees to define high, medium or no proximity to the subject matter.

3.4 Stakeholder data collection process

Using a generic methodology, based on the institutional framework proposed and taking into account the skills required for professional practice and market development conditions, three main types of actors can be distinguished as stakeholders in the context of this analysis.

- Government sector: governmental actors and current regulatory framework.
- Academy sector: curricular content and actors (authorities, professors, researchers, students).
- Non-Governmental Sector: practicing professionals, chambers and professional sector associations. Goods and services market.

Different instruments were applied in order to investigate and study more deeply the skills and

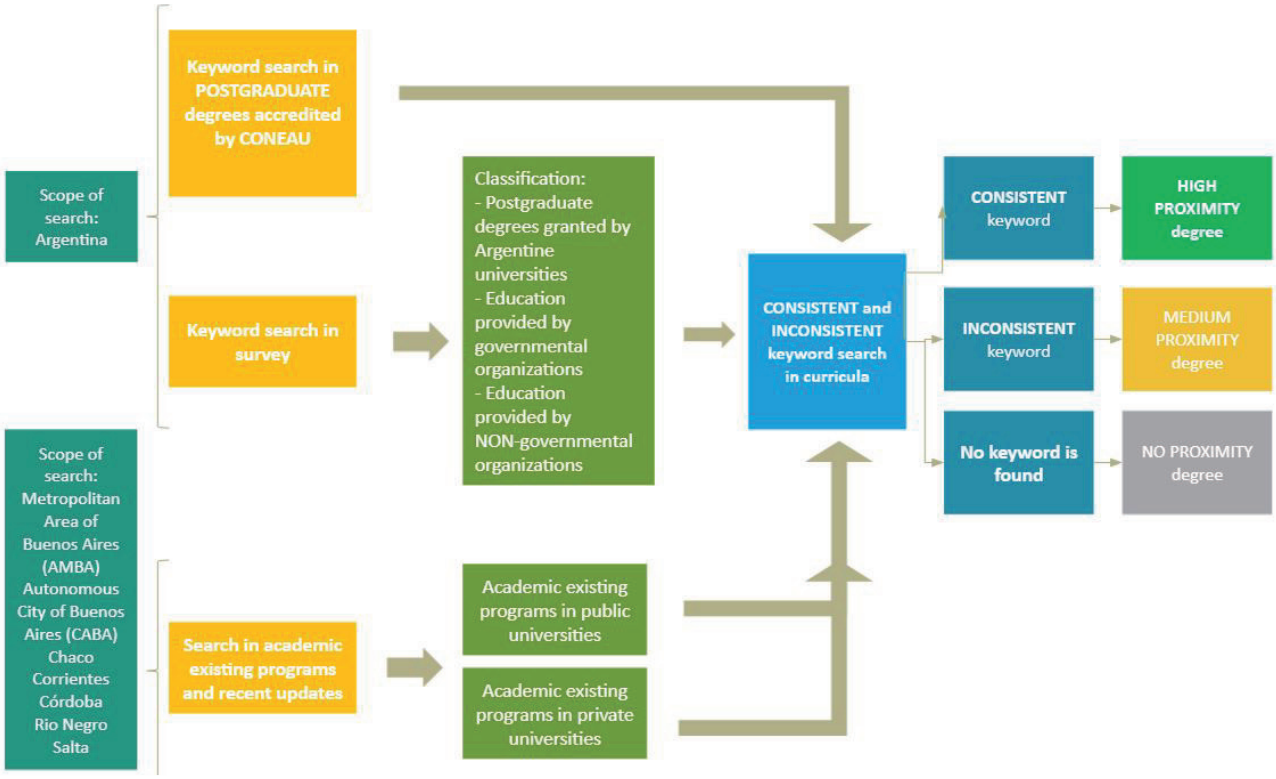


Figure 11: Diagram of the survey process based on keywords contained in POSTGRADUATE studies. Author's own elaboration

knowledge of the stakeholders of the EEB sector in Argentina. On the one hand, an analysis of the value chain of EEB was carried out through a specific product, in order to understand the field and the professionals involved in the life cycle of an emblematic element taken as an example. This transversal reading of the value chain made it possible to identify other professional profiles involved and to finish consolidating the list of relevant skills, providing feedback on the initial stage explained in 1-4 Basis for professional competency in the EEB sector. In parallel, two surveys were conducted, one of which aimed at practicing professionals (linked to the Energy Certifier Course of the Housing Energy Efficiency Labelling Program) and the other at educators, specialists and researchers working in the educational/academic field. Both surveys were conducted through Google Forms platform, and garnered a total of 196 responses.

In addition, in-depth interviews were conducted, in order to further characterise different key actors through a detailed exchange in successive stages.

Finally, a Stakeholders' Workshop was also held, in which around 90 people participated for 4 hours, sharing activities and contributing to the production and analysis of data.

The joint interpretation of these multiple and varied sources of information made it possible to characterise the gap and develop proposals for its mitigation or resolution, as well as to extrapolate valuable conclusions.

Source: www.shutterstock.com

4 Education in EEB

4.1 Overview of the Argentine Education System

The Argentine Education System (SEA) is composed of state and privately managed educational services of all the jurisdictions of the country (the Autonomous City of Buenos Aires and the 23 provinces of the Nation), at all levels, cycles and modalities of education[25].

Public education is free at pre-school, primary, secondary and higher education levels (for undergraduate university degrees, yet not for postgraduate degrees). Schooling is compulsory from the age of 4 and throughout primary and secondary school, and it includes the teaching of a foreign language at the primary and secondary levels of the country[26].

Private education is paid, although in some cases (especially in primary and secondary schools) the State provides funding to support its costs. Privately managed educational institutions must be authorized, recognized and supervised by the educational authorities. They must also comply with the standards of the national education policy and of the province in which they are located.

At present, the Argentine Education System is regulated by the National Education Act 26,206, which establishes that the State is responsible for guaranteeing equal and free education throughout the country. Article 121 of the LEN establishes the duties to be carried out by the provincial governments and the government of the Autonomous City of Buenos Aires. The regulation of the education system is adopted by various institutions in charge of managing, evaluating, accrediting and validating the degrees and certifications issued throughout the country.

The entire population has the right to access quality education to guarantee equal opportunities. The State is in charge of creating the necessary conditions for the fulfilment of these rights, guaranteeing the minimum contents, the coherence of competencies, and of organizing the education system to guarantee equality in all educational institutions within the Argentine territory.

25 The Argentine Education System is described in detail in the Initial Report for this Consultancy.

26 National Education Act No. 26,206. Official Gazette, Argentina. 14 de diciembre de 2006. Retrieved from: http://servicios.infoleg.gob.ar/infolegInternet/anexos/120000-124999/123542/norma.htm

4.1.1 Fundamental pillars of the Argentine education system

Integration. The Argentine Education System is integrated, due to the fact that it is equal for all educational institutions in the country, regardless of students' geographic location, gender, ethnicity or origin. The Education System comprises all levels and modalities and enables students to change from one institution to another. The National Education Act 26,206 grants national validity to all degrees conferred to by institutions at the pre-school, primary, secondary, higher and university levels.

State financing. In accordance with the provisions of the Education Financing Act 26,075, the National Government, the provinces and the Autonomous City of Buenos Aires must guarantee 6% of their gross domestic product (GDP) to finance the state education system.

4.1.2 Levels and Modalities of the Argentine Education System

According to the provisions of the Ministry of Education, the Argentine education system consists of 4 levels and 8 modalities.

Levels

- **Pre-school:** from 45 days to 5 years old. It is compulsory from the age of 4.
- **Primary education:** from 6 years old to approximately 11 years old. It is divided into two pedagogical units (first, second and third grade, and then fourth, fifth and sixth grade). It is compulsory.
- **Secondary or middle education:** from 12 years old until its completion. As in the primary level, it is divided into two pedagogical units (first, second and third grade, and then fourth, fifth and sixth grade). In the first unit, the basic knowledge is studied and, in the second unit, the orientation chosen by the student based on the curriculum offered by the educational institutions. This level is compulsory as well.
- **Higher education:** it includes all higher education studies in public or private university, higher education or tertiary institutions. It is not compulsory to complete this level and its duration depends on the chosen training.

Modalities

Modalities are organizational and/or curricular options of regular education within one or more educational levels that seek to respond to specific training requirements and address permanent or temporary, personal and/or contextual specific needs, in order to guarantee equality in the right to education and to comply with the legal, technical and pedagogical requirements of the different educational levels.

The existing modalities in the Argentine education system are: **technical and vocational education**, artistic education, special education, permanent education for adults and the youth, rural education, intercultural bilingual education, education in contexts of deprivation of freedom, home and hospital education.

The scope in the following levels and modalities was defined for this report:

- Technical and Vocational Education, in all its levels (technical secondary education, technical and vocational higher education and training)
- Higher level (undergraduate and postgraduate degrees)

4.2 Education financing

In the federal scheme of education administration, the responsibility for managing different educational levels, as well as the creation and implementation of educational policies, is shared by the national jurisdiction and the provincial jurisdictions.

The Education Financing Act, which was enacted in December 2005[27] and published in the Official Gazette in January 2006, incorporated some changes that brought about a significant progress (Claus, A. and Sanchez, B., 2019). On the one hand, the increase in educational investment and federal coordination to achieve its effective implementation through the creation of annual targets for an increase in educational funding as a percentage of GDP. Spending on Education, Science and Technology had to reach benchmark values for certain points in time (e.g. 6% in 2013). On the other hand, the role of the Nation and the provinces in this increase in consolidated spending was clearly defined: the former would contribute 40% of the increase, and the latter would contribute 60%, for

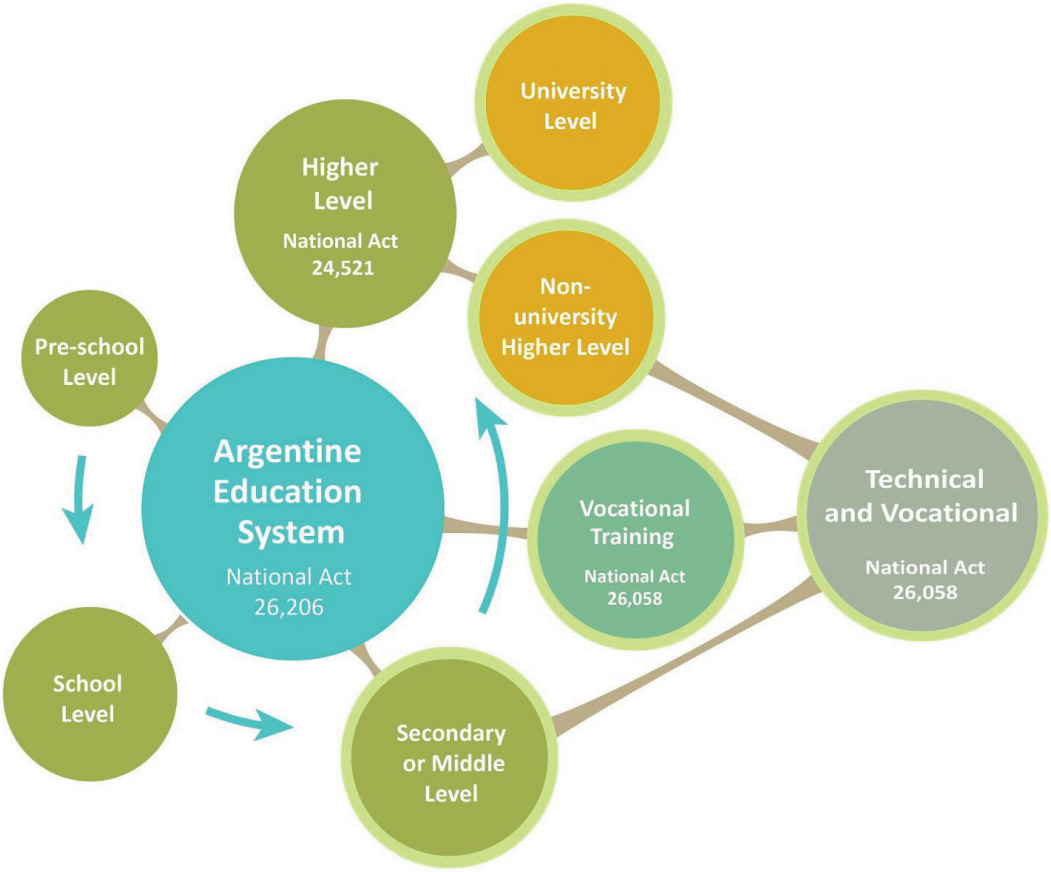


Figure 12: Argentine Education System. Technical and Vocational Education. Author's own elaboration

27 Education Financing Act No. 26,075 Official Gazette, Argentina. December 21, 2015. Retrieved from: http://www.siteal.iipe.unesco.org/sites/default/files/sit_accion_files/siteal_argentina_0848.pdf

which a specific allocation of co-participable funds was established to support such relative increases.

In terms of educational planning, the increase in investment was prioritized to eleven measurable goals, such as the inclusion of 100% of 5-year-old children in the pre-school level, the access of at least 30% of students to extended days primary schools, the incorporation of ICT in schools, and the improvement of technical and vocational education. As a result, a new horizon for educational policy was set and better practices in educational planning were proposed, starting with the reintroduction of the bilateral agreements tool between the nation and the provinces, which promoted the articulation of the monetary transfers from the former to the latter in order to advance in the achievement of educational goals.

Meanwhile, teachers' salaries and careers were backed by the National Teacher Compensation Program, aimed at compensating inequalities in entry-level salaries in those provinces that faced difficulties in paying them even with considerable budgetary efforts and efficiency improvements in spending. On the other hand, it created the possibility of establishing the National Teachers' Parity, an instance which assembles the national government, the provincial governments and the main Teachers' Unions with representation at a national level at the same negotiating table to discuss working conditions, the educational calendar, the minimum teachers' salary and the teaching career[28].

Additionally, in some cases, privately managed education may also receive subsidies from the state for the payment of teachers' salaries. These subsidies can only be granted according to objective criteria of social justice, considering the social function the educational institution fulfils in its area, its educational project, among other aspects.

4.3 Training paths

The structure of the training courses and certifications of the Argentine Education System are organized on the basis of a series of general and specific training contents and professionalizing practices included in curricular sections, cycles, teacher practices, subjects, or other training experiences.[29]

In Technical and Vocational Education, the training path integrates the essential disciplinary contents (the basis of the technician's professional practice), the mastering of appropriate techniques that allow the insertion in a specific professional sector, as well as the development of professionalizing practices. These contents are listed in the corresponding frameworks and resolutions of the National Institute of Technological Education (INET, for its Spanish acronym).

At the university level, the educational paths comprise contents common to all universities regardless of the subjects of which they are constituted. A given path is comprised of one or more subjects, depending on the curriculum of each university.

The Higher Education Act establishes that the curricula of courses corresponding to professions regulated by the State, whose exercise could jeopardize the public interest directly endangering the health, safety and property of the inhabitants, must consider basic curricular contents and criteria on the intensity of practical training as established by the National Ministry of Education in agreement with the University Council. Architecture and Engineering are part of this group of degrees with state regulation for basic contents. (See additional information in1-3 Concepts of Energy Efficiency in Buildings).

4.4 Results of the identification of relevant content for EEB

In order to proceed with the identification of relevant contents, those that include topics related to the development of the EEB were selected, according to the methodology of searching for keywords in subjects' syllabus, curricula, resolutions, reference frameworks, depending on the information provided by each institution.

The "universe" surveyed in the current project includes the technical and vocational modality in all its levels and the university level, all of them described in detail in3-3 Survey of educational contents.

In TVE, consideration was given to the levels of technical and vocational education by the INET (vocational training, secondary technical and higher technical education) with a possible link to the topic of EEB. At this level, the available programs, Frameworks of Reference and/or Resolutions of each certification were surveyed, without reaching the research by subject. Examples of such certifications are: Construction Foreman, Electricity Technician, Electromechanical Technician with Orientation in Electrical Energy, Electrician in Real Estate, Installer of Electrical Systems of Renewable Energies.

The university level accredited by CONEAU (National Commission for University Evaluation and Accreditation), includes undergraduate courses such as Architecture and Civil, Industrial, Environmental and Electrical Engineering, among others. As examples of the contents obtained, we can mention the following among the engineering courses: Buildings I

28 Regulatory decree No. 457/07

29 Retrieved from the National Academic Recognition System (SNRA)http://rtfsimulador.siu.edu.ar/

"Project and efficiency in energy consumption" (Civil Engineering, UNLP); Residential hot water systems with passive solar energy contribution (Mechanical Engineering, UNRC); Efficient use of electrical energy (Electrical Engineering, UBA). In Architecture, we found, for example, contents on Bioclimatic Architecture and Alternative Energies, introduction to Bio-environmental Design, Introduction to Solar Architecture, Energy in Buildings and Thermal Balance at the University of Moron, the University of Buenos Aires and the National University of La Plata.

Meanwhile, at the postgraduate level, courses, master's degrees, specializations and PhDs with a possible link to EEB, accredited by CONEAU, were considered. At this level, with a much greater variety of contents, the following were highlighted: Specialization in Architectural Technology (UNC - National University of Córdoba), Master's Degree in Housing Management and Development (UNC). University courses and postgraduate programs not accredited by CONEAU and other non-university courses (certificates and short courses) were also included at this level. It is very important to highlight that, in this case, the offer is more generic and of less depth, for example: Refresher Program in Sustainable Architecture (UBA), Specialization in Sustainable Architecture and Habitat (UNLP), and some certifications such as ASHRAE, LEED or WELL - EDGE.

The full list of the relevant contents identified can be found in Annex 2: Processes and results of the survey and analysis of related contents.

Technical and Vocational Education

The project entitled *"Lineamientos para la mejora de la enseñanza sobre Eficiencia Energética en la ETP"* conducted by the then Directorate of Education for the Responsible and Efficient Use of Energy, analyzed the educational existing programs of TVE regarding the teaching of Energy Efficiency in general. This publication was considered a fundamental precedent for this research, which was circumscribed, within the framework of this work, to the universe linked to the sector of interest: the construction of buildings.

After the cut was made, a universe of 57 Degrees and Certificates was consolidated in the geographic areas defined for this study, at the levels of Secondary Technical Education, Technical and Vocational Training and Higher-Technical Education. The list of these is developed inAnnex 2: Processes and results of the survey and analysis of related contents, in this report.

This pre-selection of academic training consists of degrees and certificates such as: Construction Technician, Foreman Builder and Installer of Renewable Energy Electrical Systems, among others.

A limitation in quantity, quality and accessibility of the information available on content for the Technical and Vocational Education level was observed, since it was only possible to access documentation for 38 of the 57 degrees. Of these, 120 documents were consolidated (programs, reference frameworks and/or resolutions published by INET), distributed in each of the three different modalities of Technical and Vocational Education, in which the proximity to the EEB was analyzed by the presence of keywords, as explained in 3-3 Survey of educational content.

The analysis to determine the proximity of the EEB in this level shows that technical secondary education has the lowest existing programs of available information (15.8%), followed by higher technical education (21.1%), in contrast to vocational training, which has a higher proportion (63.2%) (see Figure 13).

As regards the geographical distribution of the courses of Technical and Vocational Education with programs close to the EEB, such distribution is notoriously uneven (see Figure 14). 40% of the courses are located in the Autonomous City of Buenos Aires and some densely populated municipalities of the Buenos Aires metropolitan area, while there are provinces such as Corrientes and Chaco, which cover only 1% of the existing programs. Although it is important to remark that CABA and the surrounding municipalities of Buenos Aires concentrate around 40% of the country's population, in geographic terms, the concentration is quite remarkable.

In terms of the analysis of the relevant skills for EEB and their presence in the degrees and certifications evaluated, the classification presented in1-4 Basis for professional competency in the EEB sector and their level of correlation with Technical and Vocational Education is taken into account.

As it can be seen in Figure 15, in the Technical and Vocational Education certifications analyzed, medium skills stand out (58.2%) followed by low skills (36.4%). At this level, there is a minimal appearance of skills defined as High (5.4%), indicating a significant proportional difference, which could be expected at this educational level.

In Technical and Vocational Education, the majority of skills were classified as medium, mainly related to the handling of materials and technologies for building infrastructure, such as openings, insulation, air conditioning systems (HVAC), among others. Secondly, there are the low skills, linked to the handling of general concepts of technical degrees (energy, construction, etc.).

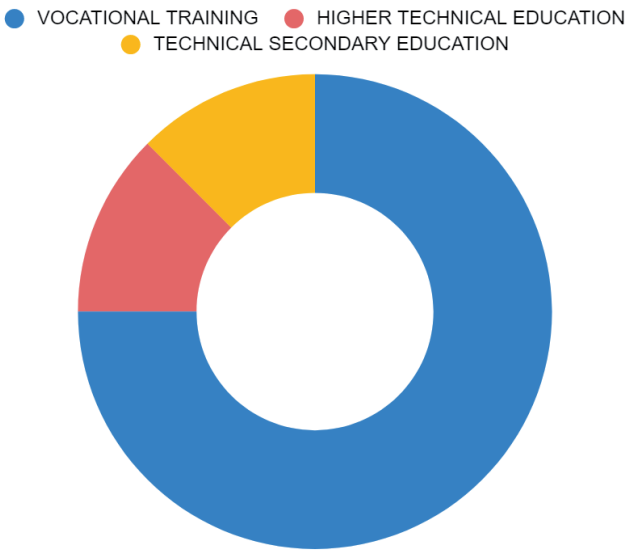


Figure 13: Distribution of degrees in Technical and Vocational Education according to the contents included for EEB. Author's own elaboration

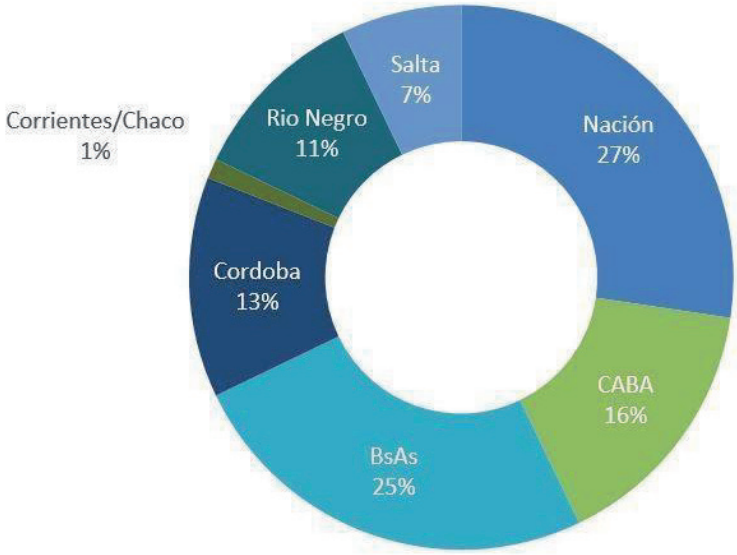


Figure 14: Geographical distribution of Technical and Vocational Education Degrees and Certificates relating to EEB. The "Nation" sector corresponds to Reference Frameworks and Regulations at the national level. Author's own elaboration

Undergraduate degree

Based on 12 pre-selected degrees with potential proximity to EEB (Architecture, Civil, Industrial, Environmental, Electrical, Electrician, Electromechanical, Electronics, Energy, Materials, Mechanical and Mechanical-Electrical Engineering), a database was generated with a total of 153 Academic Units that offer the abovementioned degrees, in the areas defined for this study. This research conducted over a total of 537 documents (Resolutions, CONEAU, course syllabus, curricula, among others).

Of the total number of the degrees surveyed, five did not show results of proximity (see3-3 Survey of Educational Contents) to the EEB, while the remaining seven did. The latter are distributed among the academic units detailed below according to their type of management:

- Architecture: a total of 11 undergraduate institutions were identified with contents linked to EEB , 7 of which are private and the rest are public.
- Civil Engineering: 7 institutions were identified that offer this degree course with contents related to EEB , 1 of which is private and the rest are public.
- Industrial Engineering: 4 institutions, 1 of which is private and the rest are public.
- Environmental Engineering: 1 public institution.

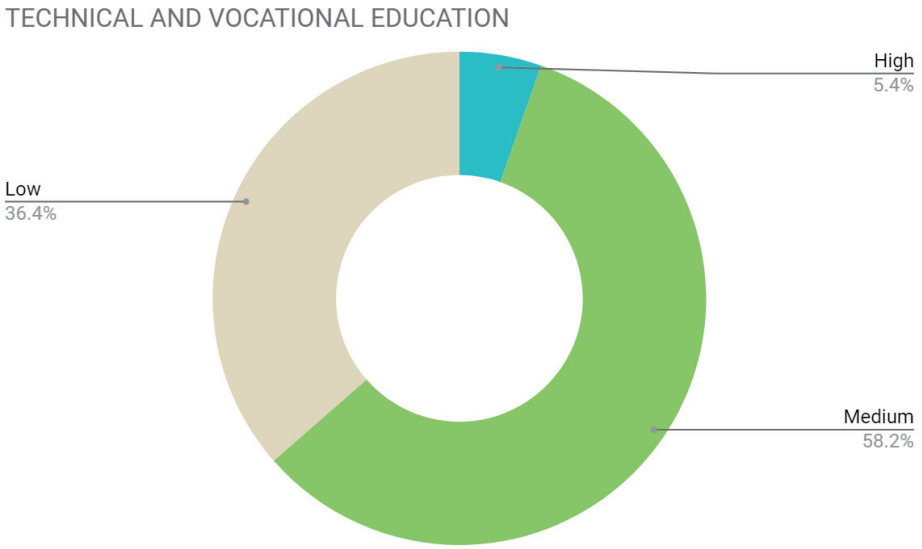


Figure 15: EEB skills in the Technical and Vocational Education level. Source: Author's own elaboration

- Electric Engineering: 4 institutions, all of which are public.
- Mechanical Engineering: 1 public institution.
- Electrical Engineering: 1 public institution.

Of the total number of degrees with proximity, Architecture is the most relevant, followed by Civil Engineering and Electrical Engineering, for the total number of geographical areas evaluated. The following graph (Figure 16) shows these results:

Regarding the scope of the institutions that offer undergraduate programs closely related to the subject matter of the EEB, it should be highlighted that most of the existing programs are concentrated in the Metropolitan Area of Buenos Aires (69%). A significantly lower percentage, at 13.8%, was found in the province of Córdoba, followed in the same proportion by the provinces of Salta and Río Negro at 6.9%, and finally, and to a lesser extent, the provinces of Corrientes and Chaco at 3.4%. The graph below (Figure 17) shows the geographical distribution of the undergraduate programs in relation to the subject in Argentina.

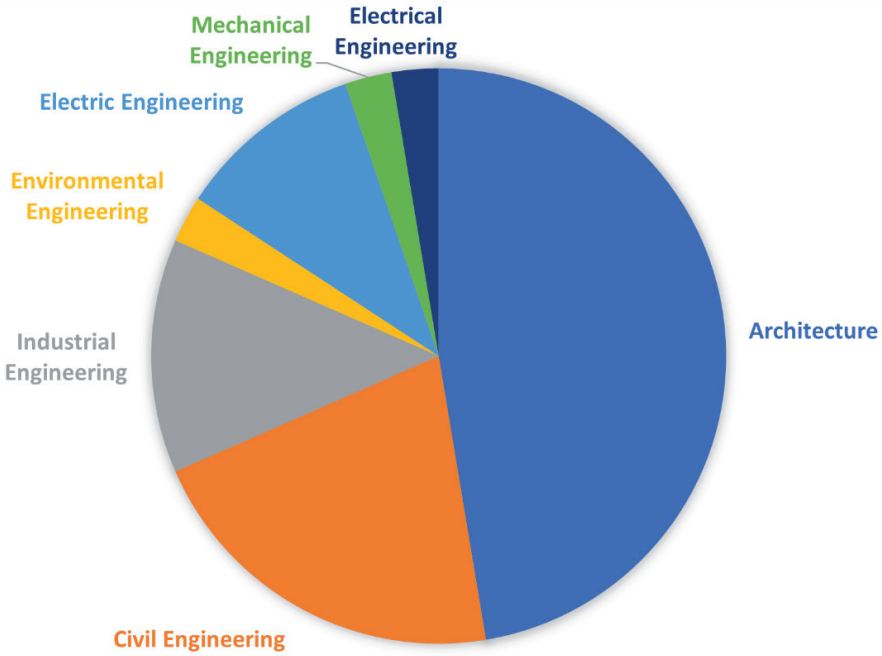


Figure 16: Percentage distribution of Undergraduate Degrees relating to EEB in all the Academic Units analyzed. Author's own elaboration

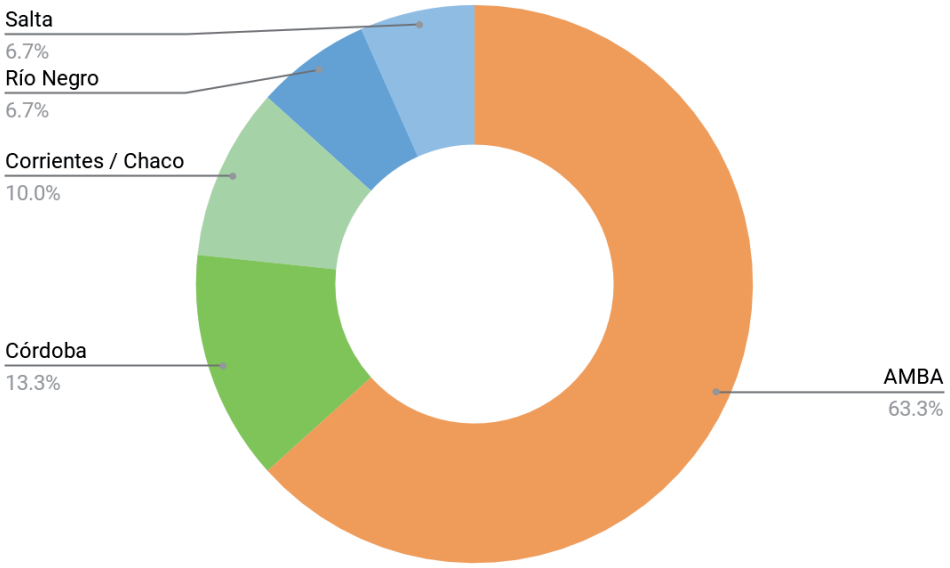


Figure 17: Geographical distribution of Undergraduate Degrees relating to EEB. Author's own elaboration

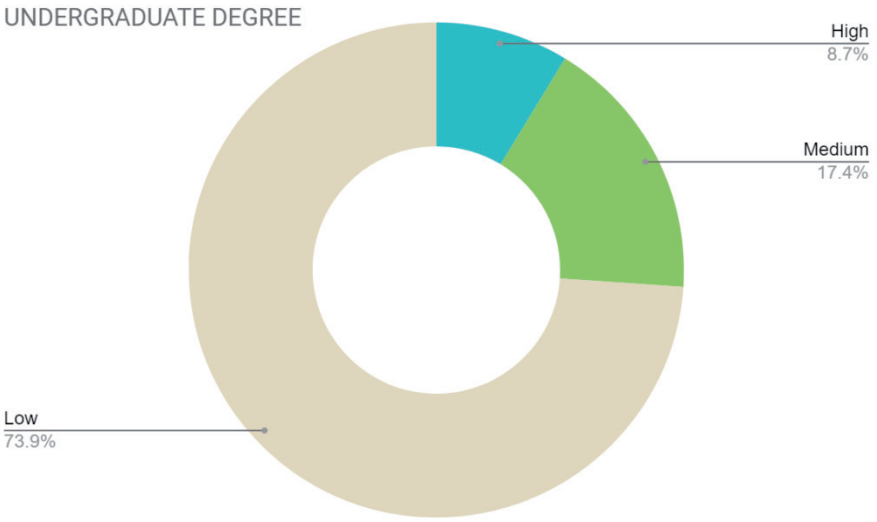


Figure 18: EEB skills in the UNDERGRADUATE level. Source: Author's own elaboration

The distribution of skills at UNDERGRADUATE level (see Figure 18) showed a significant result for Low (53.2%) and Medium (40.6%). Meanwhile, High (9.0%) is represented to a lesser extent at this university level.

At the undergraduate university level, the majority of the students had low skills, linked to the management of transversal concepts to the subject, such as energy resources, sustainability, among others. Next are the medium skills, mainly related to design competences, particularly bioclimatic principles, and technological updating, with a predominance of renewable energy.

Postgraduate and Other Courses

At the postgraduate level, an analysis universe of 182 courses with potential proximity in their contents to the EEB was considered.

Among them, 128 postgraduate and other courses were pre-selected, whose names indicated some thematic linkage with EEB. However, the topic was not addressed in almost 50% of the cases. As a result, only 69 were actually close and constituted the universe considered for this analysis, which are distributed as follows:

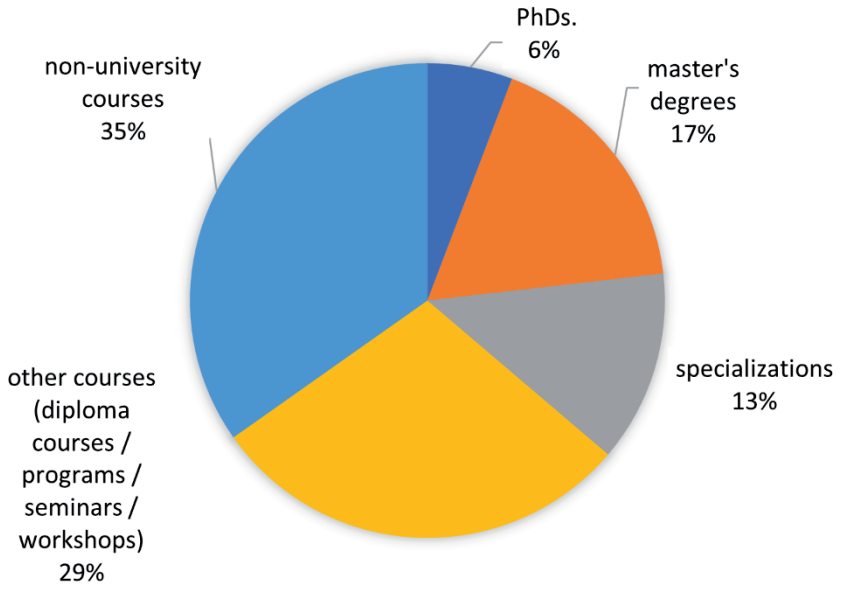


Figure 19: Academic level in postgraduate and other courses relating to EEB. Author's own elaboration

- 4 PhDs.
- 12 master's degrees
- 9 specializations
- 20 other courses (diploma courses / programs / seminars / workshops)
- 24 non-university courses

Of the 69 postgraduate and other courses with proximity to EEB, 76% are university courses (mostly diploma courses) while the remaining 24% are non-university courses. The graph below (Figure 19) shows the composition by level of the postgraduate courses and other courses surveyed.

As regards the location of the institutions that offer these courses, it should be noted that most of the courses are concentrated in the City of Buenos Aires and in some densely populated municipalities of the Metropolitan Area of Buenos Aires. On the other hand, there is also a much smaller percentage (18%) of courses offered online. This result indicates a sharp concentration of the existing programs for continuity of career paths, making it difficult to access specialization in the other provinces studied. The graph below (Figure 20) shows this distribution.

In Courses and Postgraduate studies (see Figure 21), High and Medium skills predominate (50% and 46.5%) over low skills (8.5%). Despite the fact that an undergraduate university degree is adequate for professional practice, the requirement for updating and specialization makes it necessary to continue training through postgraduate courses, in search of greater specificity. It is presumably for this reason that High and Medium skills are highlighted at this educational level.

In the Postgraduate and Courses educational instance, there was a significant presence of high skills, linked to design capabilities that integrate the evaluation of the thermal dynamics of the building and its interaction with the environment, as well as management capabilities that allow the evaluation of the energy performance of buildings through audits, certifications and labelling. Next, there are the medium skills, also linked to design capabilities, although of less specificity (efficient design, sustainable buildings, etc.), and technological capabilities, linked to building envelopes and renewable energies.

From the results presented for all levels, it is possible to confirm that there are significant gaps in the offering of contents of interest for the professional EEB expansion. Similarly, there is evidence of a high spatial concentration. The following chapter presents an analysis of the adequacy of the academic existing programs in the context of the analysis of the development of the EEB.

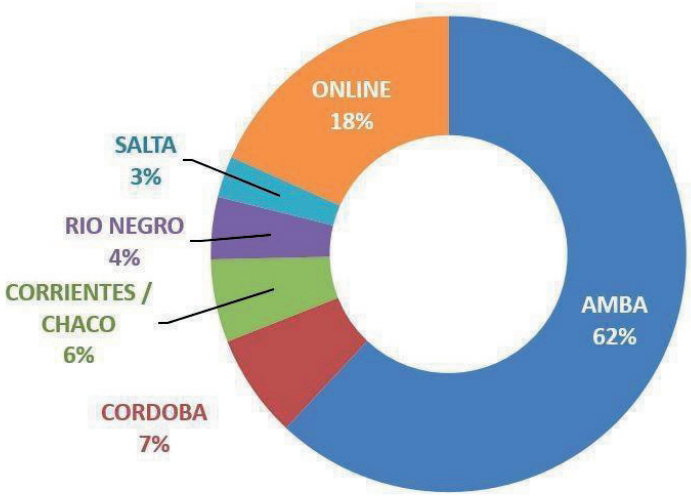


Figure 20: Geographical distribution of postgraduate and other courses with contents relating to EEB. Author's own elaboration

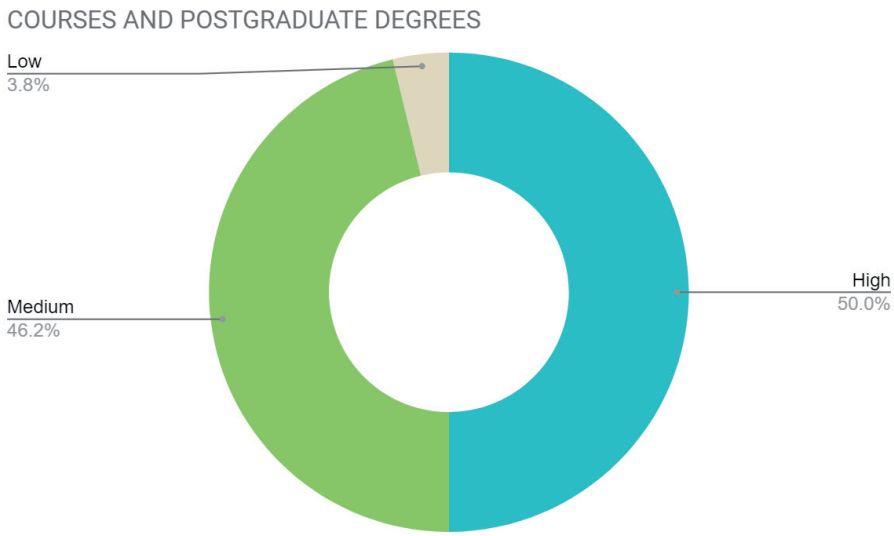


Figure 21: EEB skills in the POSTGRADUATE level. Author's own elaboration

4.5 Aptitude of the academic existing programs in EEB

In general terms, of the total number of degrees evaluated, a significant minority was identified with proximity to the EEB, at all educational levels. Therefore, the lack of specific technical content on energy efficiency in buildings is undoubtedly the main limitation of the offer.

At the technical and vocational level, firstly, it is observed that 34% of all the degrees selected do not currently have programs available online to conduct the study of proximity to topics related to the EEB. Of all the contents evaluated and endorsed by INET, Vocational Training has a higher level of proximity to the subject matter than Higher Technical and Technical Secondary Education. Nonetheless, it is worth mentioning that this could be related to the deficit of programs available for the survey as mentioned above.

At the undergraduate level, it could be assumed that Engineering degrees have more content related to EEB, given the greater presence of basic sciences as tools for the calculations required in specific EEB applications. However, according to the content survey, Architecture degrees present a greater proximity to the keywords related to EEB. Despite this, when evaluating the level of the associated skills, it is observed that they are, for the most part, of low or medium level, which could suggest that the approach of the content is rather superficial.

In this sense, among the relevant antecedents for this study, the paper "Review of Engineering Education for Design and Construction of Sustainable Buildings in Europe and What Argentina can Learn" (Torrejón

Marina, V. J, 2020) also develops its analysis on the curriculum of part of the undergraduate and postgraduate existing programs in Argentina and its link with nZEB (Near Zero Emission Buildings or nearly zero energy buildings), a concept that is close to, although not equivalent to, the EEB. This work points out, in agreement with the results of the content survey, that undergraduate programs barely contemplate the analyzed subject matter.

The postgraduate level and other courses provide professionals interested in EEB with the possibility of deepening their knowledge on EEB. However, since it is an elective course, the idea that EEB is a complementary, isolated and independent specialty is reinforced. In this way, transversality is lost at all levels. Likewise, this circumstance implies that access to these contents is mediated by both investment costs in terms of training time, since they require prior degrees, and significant monetary costs, given the fact that they are fee-based.

Other aspects to be explored in order to understand the limitations of the academic existing programs, linked to the development of "soft" skills, should also be considered. General background and information gathered from exchanges with experts have allowed identifying the scarce emphasis on the development of basic knowledge and skills for the management of interdisciplinary topics compatible with the complexity of the dynamics of systemic thinking. Complementarily, in *"Lineamientos para la mejora de la enseñanza sobre Eficienci aEnergética en carreras estratégicas de Ingeniería y Arquitectura"* (Secretariat of Energy, 2017)[30], university referents and specialists determined that the need to work in interdisciplinary teams and understand energy as a complex system are competencies that future professionals should develop in their training path.

On the other hand, when analyzing the geographic distribution of the educational existing programs in all modalities (Technical and Vocational Education, Undergraduate, Postgraduate and Courses), there is a marked concentration in AMBA. This goes against the federal development of the EEB and favours the waste of energy resources, since the construction systems are not adapted to the specific climatic conditions in each region. In this respect, the autonomous management of universities, which postulates the definition of interests and content curricula independently of any centralized instruction, is a tool of the education system that could favour the development of content for EEB linked to the climatic region in which each institution is located.

Complementarily, there are some characteristics of the education system that could represent limitations for the offer of EEB-related skills and knowledge. Torrejón Marina (2020) points outs that, in general, the Argentine educational existing programs of undergraduate and postgraduate courses use teaching methods which are mainly theoretical, which may not result in the most adequate approach for some skills related to EEB, especially those linked to the technological implementation and updating. Similarly, in contrast to other international training programs (based on independent elective learning courses), the Argentine curriculum presents mandatory and common contents for all students, shaping long, generalists careers with little flexibility for the rapid incorporations of contents.

Therefore, the analysis and research carried out so far suggest that the Argentine Education System presents different updating dynamics depending on the academic levels (Technical and Vocational Education, Undergraduate and Postgraduate). Hence, any attempt to modify curricula implies different strategies for its promotion. In the case of accreditations through CONEAU, which apply to undergraduate and postgraduate levels, the mechanism for updating curricula involves a series of regulated procedures such as self-evaluations, external validations and various accreditation procedures, which make the process not very agile, requiring several months or even years for its completion.

In general terms, the dynamics of updating in Technical and Vocational Education is less complex than at the undergraduate level since it is largely under the centralized coordination of INET. Particularly, in the Vocational Training courses, the dynamic of updating is even more agile, according to the interviews conducted with representatives of this Institution. The planning of the jurisdictional educational existing programs allows a better understanding of regional and local socio-productive needs, enhanced by the possibilities of articulation with public and private institutions (such as the agreements with UOCRA Foundation and CISCO)[31], with INET carrying out the validation and national homologation. Within this scheme, Continuing Vocational Training would represent the most dynamic and operative path for the specialization, reconversion and updating of technicians.

The undergraduate programs in general represent the scenario with the greatest challenges for the modification of their curricula, given that four characteristics converge: the lack of proximity of the contents to EEB, their long duration, the age of some

30 http://www.energia.gob.ar/contenidos/archivos/Reorganizacion/eficiencia/guias_de_uso_responsable/lineamientosspu-final-versionmodificada-noviembre2017.pdf

31 In an example provided in the context of an interview with INET, we refer to a series of Agreements with CISCO, UOCRA and the Municipality of Lanús to strengthen Vocational Training, which was retrieved from http://www.inet.edu.ar/index.php/convenio-con-cisco-uocra-y-la-municipalidad-de-lanus-para-fortalecer-la-formacion-profesional/

programs, and the long process of validation (internal) and certification (external) of the contents.[32]

Nowadays, the most dynamic updating possibility in undergraduate programs is found in elective courses[33], in which students have a number of courses to complete for their degree, whose content can be selected from a list -usually limited- of options that potentially allow them to be linked to a professional profile according to their interests. These elective subjects usually address topics which were not fully covered in the mandatory ones and allow the continuous updating of the training imparted[34]. In some universities, they can be attended in Academic Units other than the basic courses, expanding the possibilities of transversality of competencies. In general, they are included in the curricula at advanced levels of the degree program. The administrative deadlines for program approval depend on each academic unit, and are monitored by the degree management and the Boards of Trustees. Having said this, even though this option enables the possibility of introducing EEB into careers, it does not ensure that students will have access to this knowledge, given the "optional" status of these subjects.

Similarly, there are also careers, as is the case of some Engineering degrees, whose last year of training is divided into different orientations focused on a subject and whose choice is reflected in the degree obtained by the professional. As an example, the Civil Engineering degree at the National Technological University offers the following orientations: Construction, Communication Roads, Hydraulics and Environmental.

However, the incorporation of elective subjects is a more efficient system for expediting the accreditation of updates due to their dynamic nature (simpler approval processes than global modifications in course curricula and a validity period of 3 years, which forces them to be updated more frequently).

Considering the above, in order to guarantee the transversality of EEB in the curricula of undergraduate professionals, associated contents could be incorporated within the common core with intermediate level skills, such as those related to physical principles related to thermal dynamics and their incorporation in project design, as well as knowledge on available technologies and their updating. Then, an EEB-centred orientation could be used for developing content related to high skills, such as those linked to modelling and management systems.

In summary, this chapter characterized the Argentine educational system, selecting Higher Technical Education, undergraduate university education and postgraduate education for the evaluation of the academic existing programs of contents related to EEB. This evaluation was carried out by means of a survey of degrees, courses and certifications available with possible links to EEB, followed by a search for keywords in curricula and other relevant documents.

These keywords were linked to the relevant professional skills for EEB: management of thematic technical concepts, technological knowledge and updating, material and project design competence, execution competence and management competence. At the same time, the skills were classified as low, medium or high, according to the complexity and integration of the tools required for their development. In this way, the keywords found in the academic existing programs analysed were related to the skill levels defined. This made it possible to observe a predominance of low and medium skills in Technical and Vocational Education and undergraduate training, in contrast to the predominance of high skills in the offer of postgraduate training.

The analysis allowed us to observe, in the case of Technical and Vocational Education, the need to systematize access to information on the academic existing programs, as well as the potential to expand medium skills (e.g., consumption and efficiency, retrofit, materials performance) linked to technology in order to achieve a short-term incorporation of such skills. On the other hand, given the lack of high skills (e.g. thermal dynamics, modelling and energy performance) in undergraduate training, this instance presents a great potential to promote the EEB expansion, developing complex and specific contents. However, it was observed that updating mechanisms involve long processes, so that in the short term the incorporation of elective subjects would represent a training alternative, as changes are implemented in the curricula.

Finally, a geographical concentration of the existing programs in the Metropolitan Area of Buenos Aires is observed at all levels, which constitutes an obstacle for EEB federal development, taking into account the climatic particularities of each region.

From this point on, it is possible to move forward with the validation of this assessment with several Stakeholders in order to understand the nature of this gap and analyse possible approaches to address and mitigate the problem.

32 For those undergraduate courses that could compromise the public interest, in public and private institutions, minimum curricular contents are established, which are agreed upon and validated by the Ministry of Education and CONEAU.

33 Elective Subjects Superior Council Resolution No 2210/03 retrieved fromhttp://www.fadu.uba.ar/application/post/download-filename/3977

34 According to Resolution (Superior Council) No. 2210/2003, which establishes the periodic review of the elective subjects offered in the syllabi of the degree programs of the University of Buenos Aires, with the purpose of updating them and avoiding their automatic repetition.

Source: www.shutterstock.com

5 Validation of Impediments and Opportunities for EEB Expansion in Argentina: Its Link with Education

5.1 Identification and Selection of Stakeholders

Based on the experience of the development of this research, it is corroborated that the identification of Stakeholders is consolidated in successive iterations and nurtured as its participatory base expands. This iteration confers a cumulative maturity, which is manifested in the development of the process. The earlier they are involved, the more opportunities there will be to better incorporate their insights.

The first approach to the initial identification of Stakeholders relied on a network of governmental and academic contacts provided by the Secretariat of Energy. It was then expanded through consultations with specialists from the work team's network of professional contacts, who referred to institutions or outstanding colleagues to contact and, finally, after surveying these institutions, representatives of professional associations were contacted.

The contact process was based on a combination of different tools such as general consultations through surveys of practicing professionals and referents from the academic sector, semi-structured interviews with technical experts, government referents, representatives of non-governmental organizations and referents from the academic sector; the creation of a community of outreach, call and exchange in a professional social network and, ultimately, the holding of a workshop of Stakeholders.

It should be mentioned that student referents from the academic sector were out of reach, although their perceptions were gathered indirectly through the experiences of teachers who reported their interest and demand for training. Similarly, due to the timing of COVID-19, it was not possible to directly survey the opinions of final consumers in the market of goods and services related to EEB .

The formal criteria for the selection of Stakeholders are established on two axes (who affects it and who is affected) and can be understood from the following questions:

- Who is a "user" (related) to the scope of the EEB?
- Who benefits from its eventual expansion?
- Who would like to participate in its development but cannot?
- Who has an impact on the subject?
- Who has rights and responsibilities?
- Who would be affected by a change?
- Who manages it and can affect it with their decisions?

In this way, it is possible to identify all the groups that can affect or be affected positively or negatively, directly or indirectly. The following chapter presents the Stakeholders identified and selected.

Criteria for the Selection of Stakeholders

On the basis of a first identification, in accordance with the above, it was determined to consider those actors that influence and/or intervene in the development of the EEB through:

- Political figures, professional councils, chambers.
- Suppliers and manufacturers of specific products and supplies for thermal insulation in buildings and energy generation through renewable sources.
- Engineering, design, architecture and consulting professionals.
- Private certification bodies linked to the EEB, both in professional skills and in building energy performance.
- Designers and implementers of training programs in skills and knowledge related to EEB.
- Researchers and planners.

This process involves the classification of Stakeholders according to their origin and capacity for action related to the subject under study. The representation of the relationships between these components is called Map of Stakeholders and its Figure 22 is presented below.

Based on the contribution and progressive interaction with all the Stakeholders surveyed, the information was consolidated in order to characterise their different perspectives and thus continue the processing and development of the analysis.

Based on the above, the three main groups of Stakeholders surveyed are systematically classified and organized (for further details, please refer to2.5 Identification and characterisation of non-governmental associations).

1. Academic sector
    a. Teachers, students and principals of Technical Education establishments.

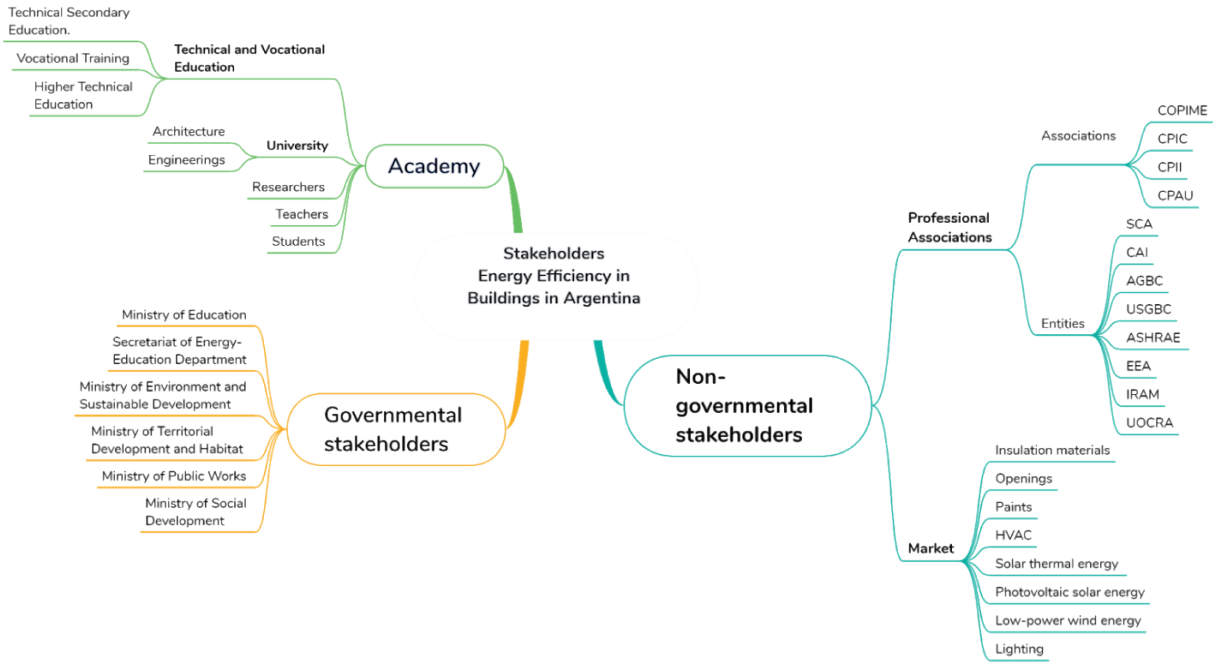


Figure 22: Map of Stakeholders in EEB in Argentina. Source: Author's own elaboration

   i. Technical Secondary Education
   ii. Vocational Training
   iii. Higher Technical Education
  b. Researchers, teachers, students at University level
   i. Architecture
   ii. Engineering
2. Governmental actors
  a. Secretariat of Energy
  b. Ministry of Productive Development
  c. Ministry of Environment and Sustainable Development
  d. Ministry of Territorial Development and Habitat
  e. Ministry of Education
  f. Ministry of Public Works
3. Non-Governmental/Private Sector Participants
  a. Professional Associations
   i. Professional Institutions
   ii. Entities (National, International, Actors, Projects, Trade Unions, Civil Society Organizations that affect and are affected by the decisions taken in the field of EEB in Argentina).
  b. Market (Suppliers and manufacturers of specific products and raw materials)

Since the Academic Sector was explored in depth in4 –EDUCATION IN EEB and the governmental framework was characterised in2 –EEB IN ARGENTINA - OVERVIEW, below, the Stakeholders of the non-governmental sector are ordered and presented according to some aspects that contribute to preliminarily identify their field of influence.

On the one hand, there are those institutions focused on the regulation of professional activities, understood as the control of compliance and certification of the scope of individual professional competencies and performance. Examples of this type include councils and institutions such as COPIME, CPIC, CPII or CPAU, which bring together and regulate professional activity and operate as a regulatory and professional traction body on a national scale.

On the other hand, there are those organizations that have a professional traction role, but through the offer of training, organization of debate activities, exhibitions, etc. whose purpose is the continuous improvement of the professional field. For example, the Central Society of Architects (SCA).

At the same time, we recognize those whose influence is verified in terms of the hierarchization of knowledge and practices, through the accreditation of specific and visible knowledge as a seal of approval or international exams. Institutions such as the Argentine Center of Engineers, the Argentine chapter of ASHRAE, the AGBC, USGBC, gather, certify and rank nationally and

internationally, practicing professionals. They offer the possibility of achieving certified training to certify knowledge in specific topics related to sustainability and resource and energy efficiency.

On the other hand, there are also trade unions, regulatory organizations, technical consortiums and other civil society groups that are increasingly becoming involved in the issue and that also gather, publicize and accompany the development and EEB expansion in Argentina. For more details on all those identified in the framework of this work, refer to Annex 2.5 Identification and characterisation of non-governmental associations:

It is worth mentioning that within the group of Non-Governmental Stakeholders, it is possible to characterise another subset, different from the previous ones, which in the context of this work has been called "the market". The market is constituted by a set of suppliers of typical construction products and materials with an Environmental Education (EE) and sustainability impression. A more detailed perspective of this group of Stakeholders is offered below through the analysis of the value chain of a particular product, typical of EEB in Argentina.

EEB-related materials and supplies, its value chain and Stakeholders

In order to integrate the analysis of materials and supplies linked to the EEB, we first proceeded by mapping all the components of the sector's goods and services production system. Figure 23 presents these components and their relationships.

The energy efficiency levels of a building construction are determined, among other aspects, by the technical characteristics of the materials used in the different parts and systems. The most relevant materials can be identified according to their contribution to the building's energy performance. By analyzing these materials of major impact through their value chain, it is possible to establish the stages of the design and construction process in which they are incorporated. On this basis, with the stages already defined, the necessary skills are identified -for their correct performance- in the professional profiles related to them. This dynamic is shown in Figures 24 and 25.

The range of supplies present in the construction market related to energy efficiency in housing includes a long list of products. In Argentina these are mainly found:

- Insulation materials: constituent elements of walls and roofs. Typical examples of this type of supplies are glass wool and expanded polystyrene. There are two main suppliers in the country: ISOVER and ESTISOL, which manufacture glass wool and expanded polystyrene, respectively. Both materials are affordable and widely used. In addition, we have the technical capacity to install them nowadays.
- Openings: all the elements that fulfil this function and serve as a boundary between the exterior and the interior of the building. There is a national industry for the manufacturing of aluminium, PVC and wood openings, which incorporate high thermal efficiency concepts such as hermetically sealed double glazing (DVH) and thermal bridge break (RPT).
- Paints: exterior coating products. The use of traditional white paint is widespread. There is a marginal market for reflective paint that reduces heat in buildings and increases energy savings.

Figure 23: Components and actors involved in the production of goods and services related to EEB. Source: Author's own elaboration

- HVAC: systems and products for building thermal conditioning. A large part of the equipment is imported, another part is assembled domestically, and there is a small portion of domestic manufacture, especially of heating equipment. Air conditioning is one of the few markets in which there is a high level of competition and a consolidated technical sales profile. The use of this equipment is more widespread, although not under considerations of energy efficiency but of thermal comfort.
- Solar thermal energy: systems and products for the collection of solar radiation and its utilization for thermal purposes. There is an emerging national industry of basic characteristics, initially supported by INTI, which included tests, training and even a census[35] of installed equipment. Due to the increase in energy rates, there has been an increase in the purchase of solar water heaters.
- Photovoltaic solar energy: systems and products for the collection of solar radiation and its electrical use. This technology is the most developed internationally, given its scalability and ease of implementation. However, mainly due to the high cost of the components, it is still a niche market.
- Low-power wind energy: systems and products for the electrical use of wind resources. This is a niche market, which requires the import of turbines with low efficiency.
- Lighting: electrical systems and products used for lighting. There is a massive and highly competitive market for domestic and imported LED technology. Its adoption is associated with energy efficiency, reduced consumption, greater durability and lighting efficiency.

Glass wool application

First, the glass wool value chain is described, starting with its stages and detailing the areas and tasks necessary for its achievement (Figure 24). This product is chosen as an emblematic example of a mass product, accessible in economic terms and widely used transversally for various construction solutions, even in the least advanced in terms of sustainability or EE.

Glass wool is a material commonly used in construction as a thermo-acoustic insulator, it is a mineral fiber made of millions of glass filaments bonded with a binding agent. The air space trapped between the fibers increases resistance to heat and sound transmission. Available in different formats such as rolls or sheets, it is a constituent element of walls and ceilings.

The production of glass wool involves professional profiles related to chemistry, physics, mechanical and process engineering, among others, linked to the I+D stage. It also includes technical profiles in the operation of production lines, quality control, packaging and dispatch, etc.

On the other hand, areas such as marketing and commercial distribution supplement technical aspects in their implementation/application -like any product designed and developed to fulfil specific functions- with commercial strategies that highlight and strengthen the spreading of their technical qualities.

In the instance of building design and development, the skills involved are those usually required in the development of the activity: design, civil engineering, etc. Particularly for EE-oriented construction, knowledge related to basic sciences is required, especially physics and mathematics, which are fundamental because they provide the tools to understand and model the thermal dynamics of the building. In addition, technical level profiles are oriented to the evaluation and incorporation of materials and construction solutions.

Financial and authorization management for the execution of a building project requires knowledge of legal, administrative and financing aspects for project management.

The use of glass wool as an insulation material is subject to the integration of technical and economic aspects considered in the thermal performance of the building and is quite internalized in the building construction of new buildings.

The installation of the product requires skills in civil engineering and construction and technical-professional resources with the capacity to install it according to the required specifications.

Below (Figure 25), we illustrate the relationship between the professional profiles and the phases required at each stage of the value chain of the product under study. All the professions involved are considered, including those that are not specific to the universe of the EEB.

In the case of the degrees addressed in this paper (engineering, architecture and related technical courses), we identify the areas of specialization within the glass wool value chain scheme.

In the manufacturing stage, the I+D areas will be developed by civil and industrial engineering. Technical/commercial development will be addressed by architects and technicians.

35 INTI (2016). Solar thermal energy census 2016: map of the sector in Argentina. Retrieved from: https://www.inti.gob.ar/publicaciones/descargac/524and INTI (2019). National Solar Thermal Census 2018: report period 2017. Retrieved from: https://www.inti.gob.ar/publicaciones/descargac/546

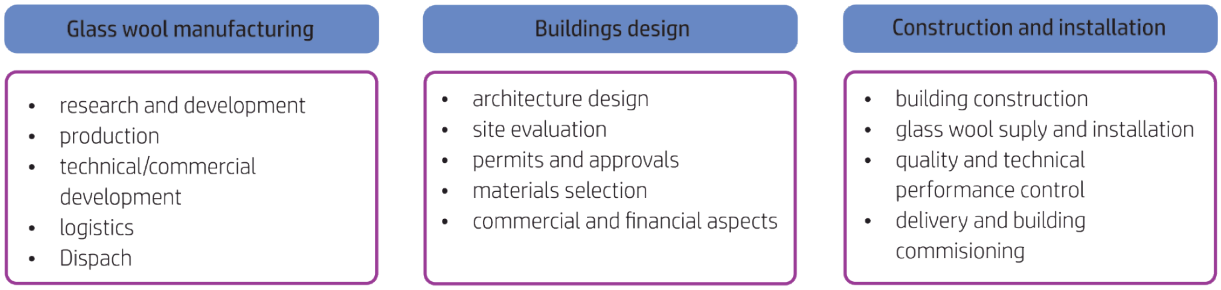


Figure 24: Phases of each stage in the glass wool value chain. Source: Author's own elaboration

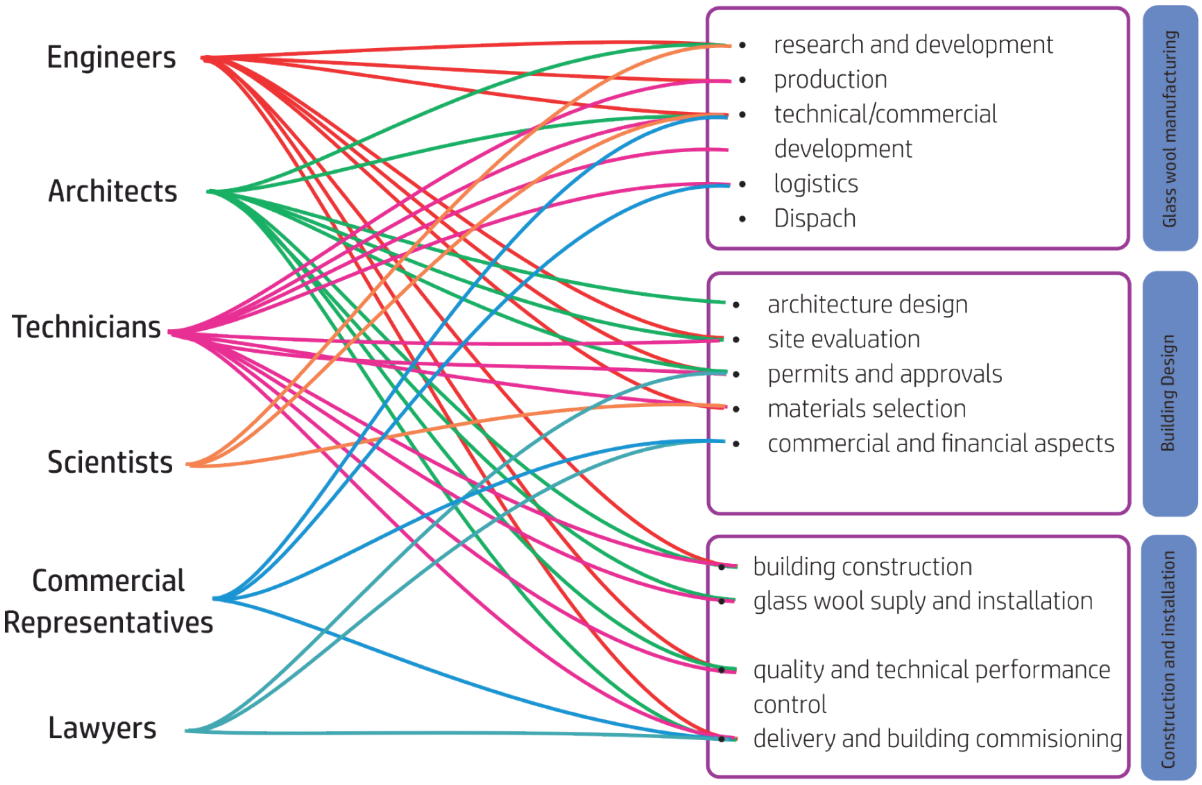


Figure 25: Relationship of professional profiles with phases by stage of the value chain. Source: Author's own elaboration

In the building design stage, the choice of materials will be the responsibility of architects, engineers and technicians.

In the final stage, construction and Installation, the supply and assembly will be carried out by technicians and architects.

In the following Figure 26, the phases that determine the critical path[36] for the use of glass wool are linked to each stage of the value chain.

It is clear that there is a multiplicity of areas in which professionals are needed -roles and profiles related to all educational levels- with specific training in EEB, including those that are an integral part of the sector. These areas are identified both in the execution of building projects and in the development of products and services.

The market existing programs for the segment is limited and has great potential for growth and expansion. The following is an in-depth analysis of the role and perceptions of the actors involved, classified into the Stakeholders described above.

36 The critical path is understood as the "Critical Path Method" or CPM, which was developed in 1957 in the USA. http://www.investigaciondeoperaciones.net/cpm.html

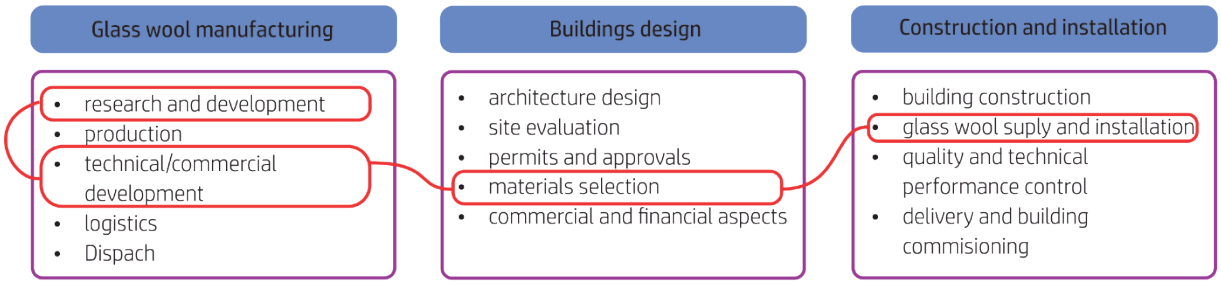


Figure 26: Critical phases for the use of glass wool. Source: Author's own elaboration

5.2 Survey of Stakeholders

Once the Stakeholders had been identified, instruments were designed to collect their experiences related to the offer and/or demand of skills and knowledge in EEB. For this purpose, surveys were designed both for practicing professionals and for referents in the education sector (Annex 3: 3.1 Survey of Practicing Professionals and3.2 Survey of Educators).

5.2.1 Survey of Practicing Professionals

The universe surveyed corresponds to professionals who attended the Housing Labelling Course for Certifiers within the framework of the National Housing Labelling Program, developed and promoted by the National Secretariat of Energy.

The survey was distributed to a contact base of 672 participants. Among them, 180 professionals (25% of those contacted) responded to the survey at the time the results were collected. There was a predominant participation of architects with 66%, followed by civil engineers with approximately 11%. The participation of technicians represents 8% (Foreman Builder+Technicians). These proportions were contrasted with the enrolment registered during the training, which made it possible to positively validate the representativeness of each group (Figure 27).

On the other hand, there is a clear preponderance of new specialists who have been joining the field in recent years, according to their declared years of experience. The graph below (see Figure 28) shows the percentage of professionals surveyed according to years of experience in the sector.

Likewise, it appears that the relatively low professional experience of this group of respondents is correlated with the low incidence of postgraduate education in the surveyed population, as shown in the following graph (see Figure 29 below).

In some way, this relatively little professional experience and the absence of postgraduate training could be indicating that the interest in participating in the Housing Labelling Course for Certifiers is the first step in the professional path that young professionals are forging, where the offer prevails in postgraduate studies.

Regarding the skills developed by the surveyed professionals, it is observed that architectural design and those related to the knowledge and handling of materials prevail (see Figure 30 below). These are mostly linked to the architecture career, which is consistent given that most of the professionals are graduates of this field. Similarly, the lower levels of experience reflected in specific technical aspects may be related to the lower participation in engineering. This demonstrates the need to develop professional areas of specific application of issues inherent to EEB.

In addition, respondents reported - through open and spontaneous contributions that expanded in a complementary way the options initially proposed by the survey - their areas of expertise in EEB, which include:

- Energy rehabilitation of heritage buildings
- Passive climate control systems
- Green roofs
- Energy Audits
- Energy Management Systems
- Bioenvironmental Design
- LEED and EDGE certifications
- Housing Labelling
- Energy Efficiency of Electrical Infrastructure
- Thermodynamic simulations, energy and economic savings calculations, forecasting, etc.

While many of the options initially proposed by the survey are repeated, they do not constitute significant values, but rather a spectrum of knowledge and topics considered of interest by the respondents, reflecting the training trend chosen.

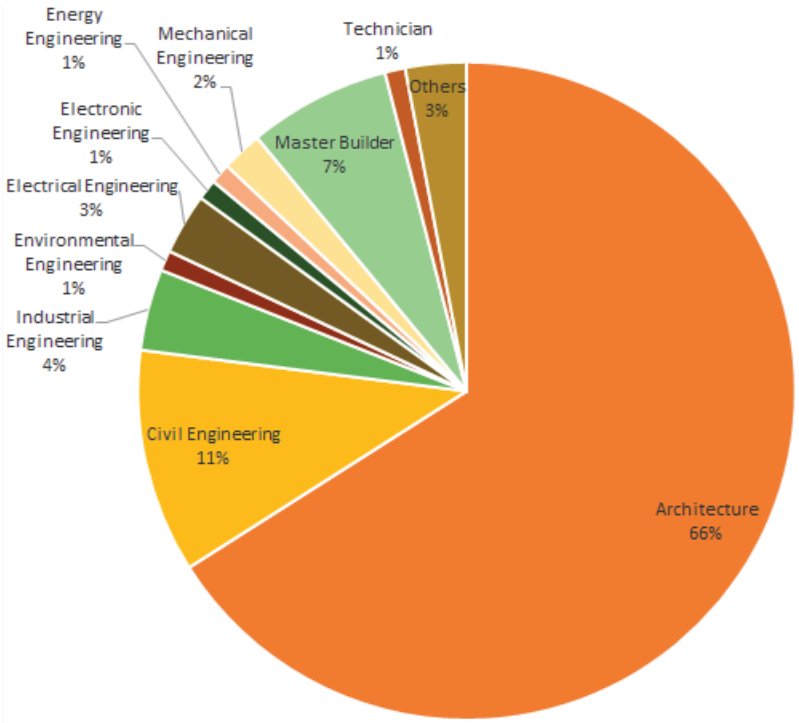


Figure 27: Participation of the diverse professions. Source: Author's own elaboration

Figure 28: Years of professional experience in EEB. Source: Author's own elaboration

On the other hand, the gender distribution is balanced, due to the fact that most of the professionals come from architecture, a degree that has a high female participation in Argentina.

Out of the total number of people surveyed, 65% consider that the market demands specialties not covered by formal education (see Figure 31 above), which gives a first approximation to the identifiable gap.

Based on this information, it is possible to extrapolate some characteristics of the technical profile of professionals currently working in the EEB sector in Argentina, particularly in this analyzed universe where all of them have attended the Housing Labelling Course for Certifiers. Summarizing the above, based on the surveys, it is possible to venture a definition for this profile of practicing professionals: interested in housing labelling, mostly relatively new professionals in the field (with less than 5 years of experience in the subject), mainly architects, without postgraduate training

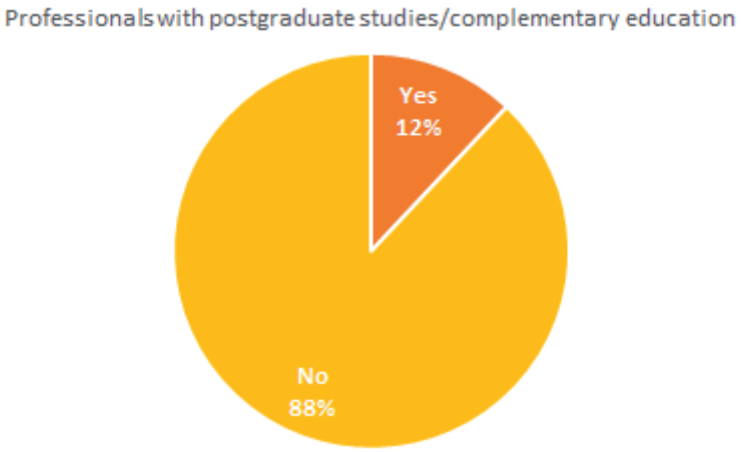


Figure 29: Number of professionals who hold a postgraduate degree. Source: Author's own elaboration

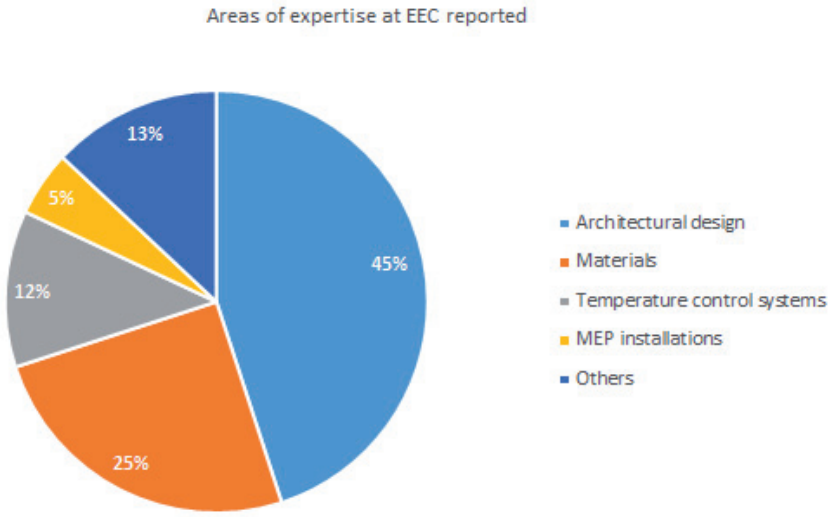


Figure 30: Developed skills. Source: Author's own elaboration

and with technical strengths in design, materials, air conditioning, MEP and others (in that order).

5.2.2 Survey of Professionals in the Education Sector

In addition to the survey of practicing professionals, a special survey was conducted to characterise the perspective of actors in the academic sector. After having identified a number of highly qualified actors whose professional backgrounds were relevant to this research, a survey specially designed for the education sector was developed.

The survey was distributed in a "word of mouth" scheme based on some contacts from the first surveys along with others that were spontaneously offered during interviews and other less formal instances of the survey (telephone exchanges with practicing professionals and lecturers). Finally, 16 specialists responded to this survey, fourteen (14) of which are architects, one (1) is a civil engineer and one (1) is an electromechanical engineer (see Figure 32 below), with the level of the educational system in which they work being 52.9% undergraduate and 47.1% postgraduate (see Figure 34 below).

It is observed (see Figure 33 above) that approximately half of the respondents have been involved in education in the EEB sector for no more than 5 years: a large part of the other half (37.5%) between 5 and 10 years, a small sector (6.3%) for over 10 years, and another sector of the same proportion that has been involved since the year 2000.

The areas of expertise referred to in EEB in order of frequency are: Bioclimatic Design, Materials, Renewable

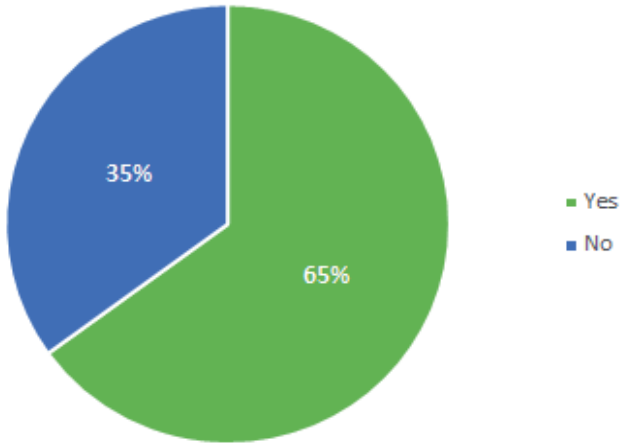


Figure 31: Unmet market demand. Source: Author's own elaboration

Energies, Air Conditioning Systems, Energy Simulation, Water, Energy Saving and Evaluation, and Simulation of Building Energy Performance (see below Figure 35).

Among the specialists consulted, most of them consider that the formal educational existing programs of the specialties is uncovered (see Figure 36) and that the little that exists is directed only to postgraduate degrees, reinforcing the idea of the importance of incorporating at the undergraduate level topics related to bioclimatic architecture, renewable energies, energy efficiency, environmental efficiency, the use of instrumentation, new materials for construction and waste management. In order to achieve this, the specialists propose the incorporation of compulsory subjects related to EEB in the undergraduate curriculum, a greater supply of postgraduate training at the national level, as well as a greater number of courses and workshops related to the subject (energy simulation, renewable energies, life cycle, among others).

As for the educational institutions of reference linked to EEB in Argentina, according to the respondents, the following stand out:

- UBA - University of Buenos Aires Master's Degree in Sustainability in Architecture and Urban Planning.
- UNLP - National University of La Plata Master's Degree in Architecture and Sustainable Habitat. Laboratory of Architecture and Sustainable Habitat.
- FAU- UNNE National University of the Northeast. Chair "Structure II".
- UNSAM National University of San Martín (Science and Technology Department)
- UTN - National Technological University. CLIOPE Group.

Regarding the tools to face the new demands for knowledge and skills, 62.5% of respondents consider that students do NOT receive and incorporate enough of them, as shown in the following graph.

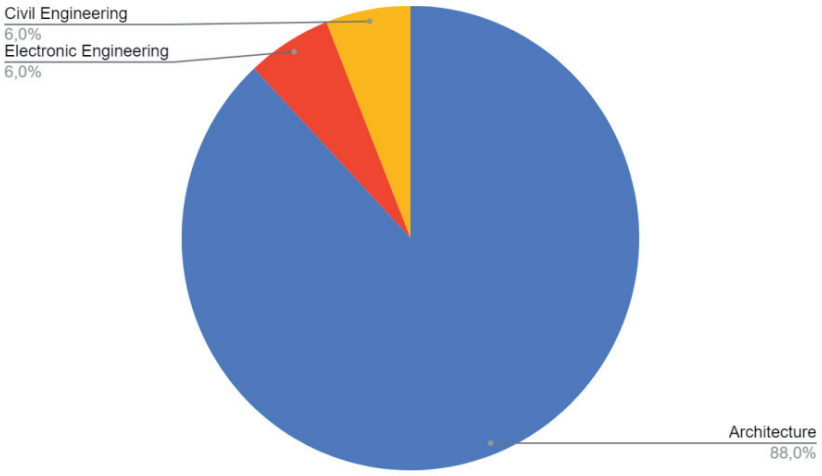


Figure 32: Participation of the different specialities. Source: Author's own elaboration

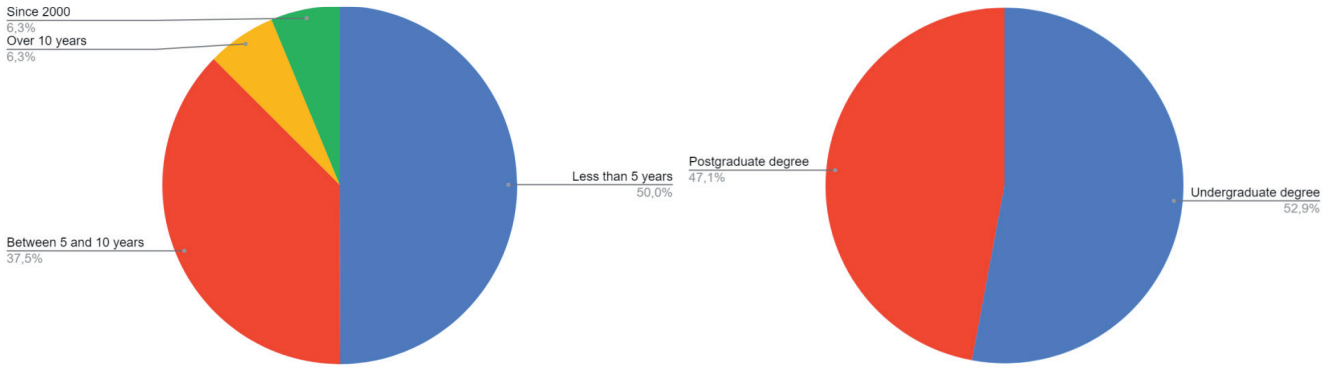


Figure 33: Seniority related to education in the EEB sector. Source: Author's own elaboration (left)
Figure 34: Education system level in which the specialists work. Source: Author's own elaboration (right)

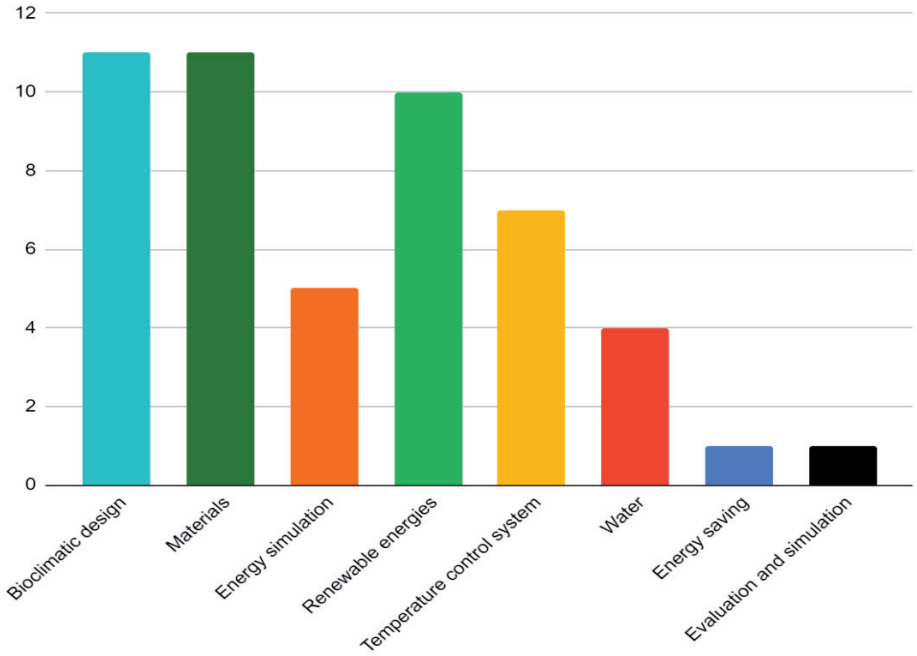


Figure 35: Specialists' areas of expertise related to the EEB sector. Source: Author's own elaboration

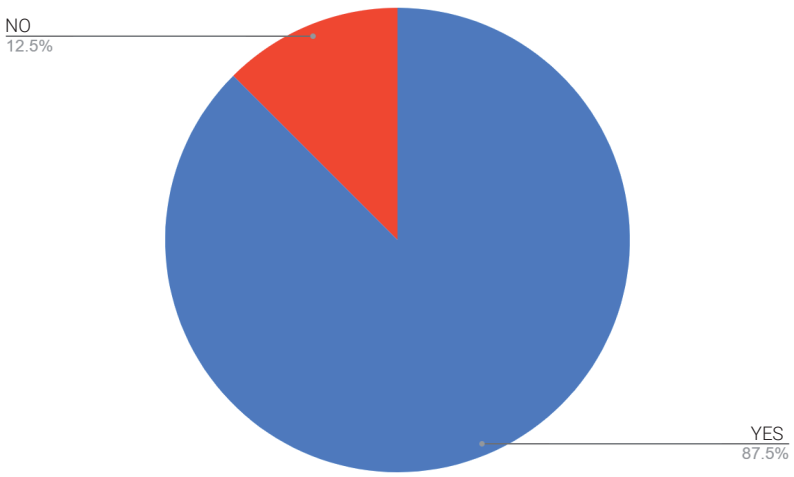


Figure 36: Do you think that some specialities are not covered by the existing formal education programs? Source: Author's own elaboration

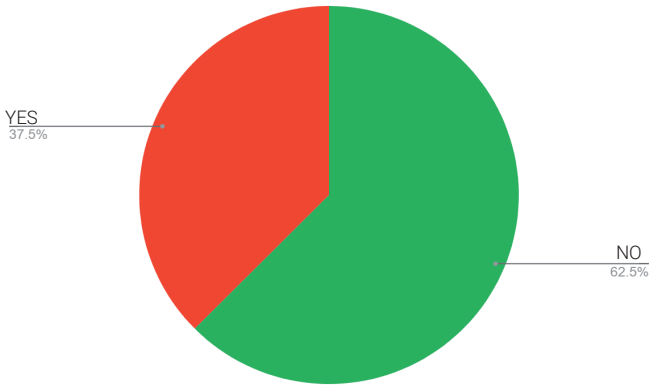


Figure 37: Do you think that students receive and incorporate enough tools to face these new knowledge and skills demands? Source: Author's own elaboration

The tools that the specialists consider especially useful are those for simulating and measuring energy balances in buildings, the generation of energy from renewable sources, the life cycle of materials, energy efficiency, bioclimatic development and design, standards and regulations, courses and electives related to the subject, and the development/use of software.

The gender distribution of the respondents was balanced with 50-50% of men and women.

5.3 Interviews

To consolidate the characterisation and analysis of Stakeholders, semi-structured interviews were conducted with actors from the academic, governmental and market sectors, with the objective of deepening their perspectives on the topics of interest.

Initially, these interviews were scheduled to be conducted in person during survey campaigns in the provinces selected for this project (Córdoba, Chaco, Corrientes, Rio Negro, Salta), but were finally conducted by means of video calls.

For the conducting of the interviews, a semi-structured approach was defined, within the framework of a qualitative survey, based on a basic thematic script on the topics to be discussed with the informant. The questions asked were open-ended and the interviewees were able to express their opinions, qualify their answers, and even deviate from the original script when faced with emerging topics of interest for the exploration.

The thematic script on which the interviews were developed was built on the following axes:

- Skills linked to EEB:
  - Perception of the skills in demand by the market (present and future).
  - Level of satisfaction with the skills acquired, in the exercise of the subject, in terms of what they know, research, develop, teach, regulate or market.
  - How they observe and where they establish themselves in the context of the supply/demand dynamic/dialectic.
- Acquired training:
  - Knowledge referring to the formal, non-formal academic supply and its content.
  - The relationship between the content and the level of satisfaction with one's own acquired skills.
  - Noteworthy institutions and contents.
  - Acquisition process: validation/perception of the scope and usefulness of the contents of the current/previous formal academic offer (on which one was trained).
- Professional career:
  - Experience in projects in the field of EEB (temporality, areas, projects, academic activity, publications).
  - Interests, motivations, general knowledge as an indirect indicator of the level of global perception of the interaction of EEB topics with other dimensions (crosscheck of the quality and reliability of the provided training).
  - Research about the interest groups that articulate in their area of expertise, relevant interest groups for EEB in Argentina.
- Subjective contributions of the interviewee
  - Local and regional context

- Identified obstacles to the development of EEB (personal, local, regional).
- Recommendations for the elaboration of policies to update educational profiles in conformity with local needs and international state-of-the-art practices in this area.
- Perception of gender distribution in EEB.

Number and type of stakeholders reached

As described in 5-1 Identification and Selection of Stakeholders, a group of Stakeholders was formed for the interviews according to the criteria applied to the selection, and finally 20 EEB referents were interviewed, who develop their activities in the provinces of interest selected by the Secretariat of Energy.

In the provinces of Chaco/Corrientes, five specialists from the academic field in undergraduate, postgraduate and research and one referent from the civil construction sector and architectural technological innovation (private sector) were interviewed.

In the province of Córdoba, two specialists from the academic, postgraduate and research area (CONICET) who also develop extension activities and participate in public-private projects were interviewed, as well as a professional from the building sector who carries out the real estate development of EEB projects.

In the province of Río Negro, the person in charge of the Project Evaluation and Regulation Department of the Energy Secretariat of the province, a local steel framing construction developer and the director of the Engineers Association of the province of Neuquén were interviewed.

In the province of Salta, we spoke with one of the people in charge of the Bioclimatic Building Laboratory, INENCO, and with two governmental referents of the Energy area, one of which was in charge of the Renewable Energies Directorate and EEB.

Other provinces and regions

We interviewed in depth a CONICET researcher (Mendoza) in life cycle analysis of building materials and a technical referent of another international cooperation project working in Argentina in the area of Energy Efficiency. Likewise, a series of interviews and less formal conversations were held with professionals graduated from and in training in Architecture, who are currently working in CABA.

For university curriculum issues, a meeting was conducted with the area of Strategic Planning and Institutional Evaluation of the Faculty of Architecture, Design and Urban Planning of the UBA.

Finally, an interview was held with representatives of INET, the National Director of ETP together with another technical collaborator expert on the EEB subject.

It is important to highlight that, in order to compensate for the possible distortion in the geographical representativeness of the regions due to the conditions imposed by the pandemic, special attention was paid to the federal participation in the subsequent Workshop and furthermore, a second survey of the education sector was conducted, aimed especially at teachers and researchers outside the Metropolitan Area of Buenos Aires, in order to re-establish the federal balance in the perspectives gathered.

The main results of the interviews performed are summarized below, grouped into the three cross-cutting areas of the work (governmental sector, academic/education sector and private sector).

Regarding the role of the governmental sector, there is a notable frequency of the conception implying that the state is the essential actor in EEB implementation, through different possible lines of action, and who determines the scope of its implementation from the corresponding management areas. In all cases, the key to implementation is determined by political will, in line with the level of knowledge and awareness of decision-makers on the issue. Similarly, they consider it necessary to have a medium- and long-term vision.

Several areas for governmental action are differentiated in detail:

- In the tax area: exemption and/or reduction of taxes, implementation of subsidies, etc. that have the virtue of being perceived in real terms by the end user of the building/house in question.
- In the area of public services tariffs: evolution of electricity and gas tariffs, in relation to real energy values. Targeting of subsidies, implementation of distributed generation schemes.
- In the regulatory area: establish laws and regulations that are effectively enforced, with current scientific support. In this regard, the promotion of housing energy labelling as an element of traction is positively valued. The work of the province of Santa Fe, a pioneer in EEB, is appreciated. The provinces of Salta and Rio Negro are working on their own regulations.
- In public management: the competence of public officials who must respond to the regulations requirements, ensuring compliance by the sector's actors.

Regarding the education sector, two cross-cutting aspects are clearly identified at all education levels. On the one hand, the lack of visibility of the reduced and concentrated current existing programs, which

generates scattering in the professional task and the isolation of cells or work groups with little or no mutual interaction between different regions. Thus, interdisciplinary synergy and enrichment are missed. However, there is a potential capacity for growth, expansion, improvement and specialization of EEB capabilities, partly due to the good academic level, suitability and preparation of the trainers and professionals who apply them.

On the other hand, they recognize the need to include the concepts of EEB and related contents in the curricula of key degrees (Architecture, Civil Engineering, Foreman Builder, etc.). It is identified, even among professors, the little relevance assigned to the subject. All this operates to the detriment of virtuous feedback within the educational environment, and the transfer to practicing professionals, the market and society in general.

As for the private sector, its protagonists play an important role in the development of both the materials and technologies market and in the consolidation of the demand for professionals with technical skills to enhance and achieve greater maturity and massiveness of EEB.

However, it is observed that the notion of energy efficiency is not understood in depth, partly due to an overlapping perception between this concept: renewable energy in particular and sustainability in general. This is reflected both in the lack of real valuation of professionals who could form integral technical teams with specific skills, and in the minimal or non-existent participation of the advantages of EEB in marketing strategies and market loyalty.

Moreover, the traction of traditional construction, present in the urban codes that define construction standards in the territory, perpetuates obsolete technologies, the inefficiency of traditional materials and the absence of incentives for new materials and construction systems.

Additionally, territorial asymmetries are reported with respect to the availability of solutions and technologies in the provinces' markets and the associated logistic costs.

5.4 Stakeholders' Workshop

In order to present intermediate advances, endorse preliminary hypotheses and validate the perceptions of EEB actors and stakeholders in Argentina, a workshop of stakeholders was held.

After having developed the survey and analyzed the information provided by the surveys and interviews, it was possible to deepen the understanding of the stakeholders contacted for the purposes of this research. From these inquiries, some ideas were extrapolated that served as preliminary hypotheses for the activities during the workshop dynamics.

Regarding the organization, in the weeks prior to the workshop, a first call was made by email to the Secretariat's contact lists and a profile was created in some social networks to attract various groups of potential stakeholders, reaching an impact of approximately 400 direct messages. Next, a registration form was sent, with a detailed description of the workshop's times and modality, which finally allowed obtaining the confirmation of 111 people. It is important to point out that in addition to those initially contacted in the interviews and surveys, the invitation was then opened to people linked to the EEB universe in Argentina, but without circumscribing a sampling with a particular objective.

According to the information gathered in the workshop, the main obstacles for EEB expansion in Argentina are the following:

- Lack of content on system thinking and interdisciplinary skills, resource efficiency and energy efficiency in the curriculum of technical and vocational training.
- A heterogeneous, anachronistic regulatory framework, with legal loopholes, overlapping between resolutions of different levels and irregular application in the territory.
- Insufficient incentives (both public and private) to mitigate investment risks, compensate for economic instability and overcome the high dependence on the supply of supplies from abroad.

At the same time, it has been identified that there is a technical difficulty for professionals in the process of calculating and certifying carbon footprint reduction associated with energy consumption reductions, although it is not necessarily clearly perceived yet. These certifications are the key to access private credits intended to EEB, within the framework of green finance programs.

Starting from these central ideas as preliminary obstacles consolidated from the interpretation of the information collected so far, it was possible to develop a preliminary concept for the dynamics, as the central axis of the workshop.

The workshop was held virtually on Wednesday, August 12, between 9:00 am and 2:00 pm. There were 84 participants at the beginning of the workshop, 70 of which remained until the end, after 4.5 hours.

9 moderators were needed in order to manage and regulate this number of people and the group work sessions. A detailed description of the dynamics of the

moderated group activities is presented in Annex4.1 Workshop information.

Based on the data requested in the registration form on profession, sector and geographic region, a first approximation of the participants' profile was made (see 4.2 Participants' profile). The following graph (Figure 38) shows the sectoral origin of the participants.

The workshop began with the presentation of the institutions that participated in the meeting, C2E2 and the Secretariat of Energy (see Annex4.4 Workshop development). Then, a brief interactive session was introduced in which some taxonomic data were requested in order to subsequently characterize the participants through a survey using the Slido platform. Afterwards, the questions and their answers are presented[37].

1. How long have you been working on EEB-related topics?
   Out of a total of 68 people who answered this question, 57% answered "less than 5 years", 25% "over10 years" and 18% "between 5 and 10 years".

   The seniority curve in the subject is remarkable and is repeated in the analysis of the results from the survey of practicing professionals. More than half are beginners, while a clear minority have intermediate seniority and a few more have much experience in the field.

2. What sector do you work in?
   Out of a total of 67 people who answered this question, 48% answered "Industry", 39% "Government" and 31% "Education".

   Despite this composition, there was agreement on the predominance of the role of the State in the promotion, advancement and expansion of the topic, as shown in question 4.

3. Which of the following topics do you consider most important for EEB in Argentina?
   Out of a total of 68 people who answered this question, 62% answered "Strengthening of professional skills", 59% "Management (public/private) of resource (and energy) efficiency", 56% "Regulatory policies and public incentives", 34% "Strengthening of private incentives (credits and facilities) and 32% "Adjustment and updating of the regulatory framework".

   These options are the central axes of the preliminary hypotheses on which this workshop is based.

4. To your mind, which would be the main actor to develop EEB in Argentina?
   Out of a total of 69 people who answered this question, 75% answered "The State", 46% "Education" and 22% "Industry".

   From this question, it appears that most of the answers point to the responsibility of the State to intervene in EEB development in Argentina.

5. In what time span do you think the EEB will be able to achieve significant development in Argentina?
   Out of a total of 69 people who answered this question, 39% answered "in the next 5 years", 30% "in the next 10 years" and 19% "in the next 3 years" and a 12% "in over10 years".

6. Which province/region do you operate in?
   Out of a total of 64 people who answered this question, they develop their activity in: Autonomous City of Buenos Aires, Province of Buenos Aires, Chubut, Rio Negro, Córdoba, Tucumán, Neuquén, Salta, Santa Fe, San Juan, Santiago del Estero.

Regarding this last response, it is important to point out that the Autonomous City of Buenos Aires-Metropolitan Area of Buenos Aires region (City and Buenos Aires and surroundings) predominates, beyond the effort of the call to have a federal scope. This reinforces the idea that, although there is participation from several provinces, the prevalence of the central ones (Buenos Aires, Cordoba, Santa Fe, Mendoza and Salta) is very clear.

From this exchange, a brief presentation of the project "Skills and Knowledge Gap in EEB in Argentina" was made.

The interaction dynamics of the workshop was divided into two stages. The first, called INTRA group dynamics, consisted of a team work for which the participants were separated into 9 different groups moderated by members of the ZS team and SE collaborators. Each moderator was in charge of delivering the instructions, collecting results and recording the discussion (for further details on the design and execution of the dynamics, see Annex4.3 Planning and preparation).

For the formation of the teams, the data provided by the participants at the time of the online registration for the event, carried out one week in advance, were used, where each participant declared to belong exclusively to one of the 3 pre-established groups:

1. Government sector
2. Private sector (market / professional / industrial).
3. Academic/Education sector.

In the following activity, each group, together with its moderator, was asked to choose one of the following slogans to work on:

A. The lack of content on systems thinking and interdisciplinary skills in the curriculum of technical/vocational training impacts on the capacity for EEB expansion in Argentina, at present.

37 The questions, in almost all cases, were multiple choice, so their aggregation does not add up to 100%.

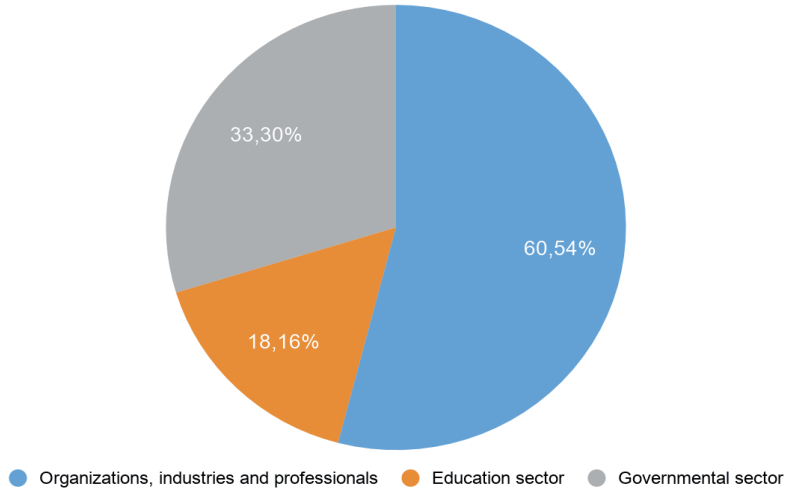


Figure 38: Distribution of sectoral representativeness of workshop participants. Source: Author's own elaboration

B. The lack of content on resource efficiency and energy efficiency in the curriculum of technical/vocational training has an impact on the capacity for EEB expansion in Argentina, at present.

C. A regulatory framework that is functionally obsolete (because it is anachronistic, with legal loopholes and overlapping between resolutions at different levels) and irregularly applied in the territory, has an impact on the EEB's capacity to expand in Argentina at present.

D. Insufficient public tax incentives to mitigate investment risk and project consolidation in the medium/long term due to economic instability and high dependence on foreign supply of materials.

E. Technical difficulty to demonstrate effective reductions in energy and material consumption and/or carbon performance, in order to access private credits that promote EEB.

Based on these problems/difficulties, each team developed a solution proposal, which each moderator then drafted and sent to the coordinating team during the break. Then, in real time, the proposals were assigned to teams from other sectors, for example, the "Education" sector received a proposal from the "Government" or "Market/Professional" sectors. In this way, a cross-cutting view on issues common to all areas was encouraged.

The following graphic (Figure 39 below) depicts the organization of groups and the proposed exchange:

The intersectoral analysis of the proposals consisted of providing adjustments and contributions to the strategies presented based on the following slogans:

- Improve the weak aspects.
- Enhance opportunities.
- Nurture from the sector's own perspective.

This activity resulted in the proposals presented in detail in the chapter on analysis on results. After this last activity, the workshop was finally closed by the convening institutions. Unfortunately, as it was not possible to carry out as planned, it was decided to send out a form for them to select the most valuable proposal from their own perspective, together with a satisfaction survey.

5.5 Analysis on Workshop Results

As a result of the first introductory activity, a list of prioritized barrier hypotheses was obtained, which was validated individually by the participants, pointing out those aspects or issues important for EEB development in Argentina:

1. Strengthening of professional skills (62%).
2. Management (public/private) of the ERyEE (59%)
3. Regulatory policies and public incentive (56%)
4. Strengthening of private incentive (credits and facilities) (34%)
5. Adjustment and updating of the regulatory framework (32%).

It is important to note that the strengthening of professional skills was the most chosen aspect, followed by aspects linked to EEB management. This was followed by regulation, private incentive and regulatory framework. This resulting assessment is partially consistent with the aspects most frequently mentioned in the problems developed during the intra- and inter-sectoral dynamics, in which the workshop

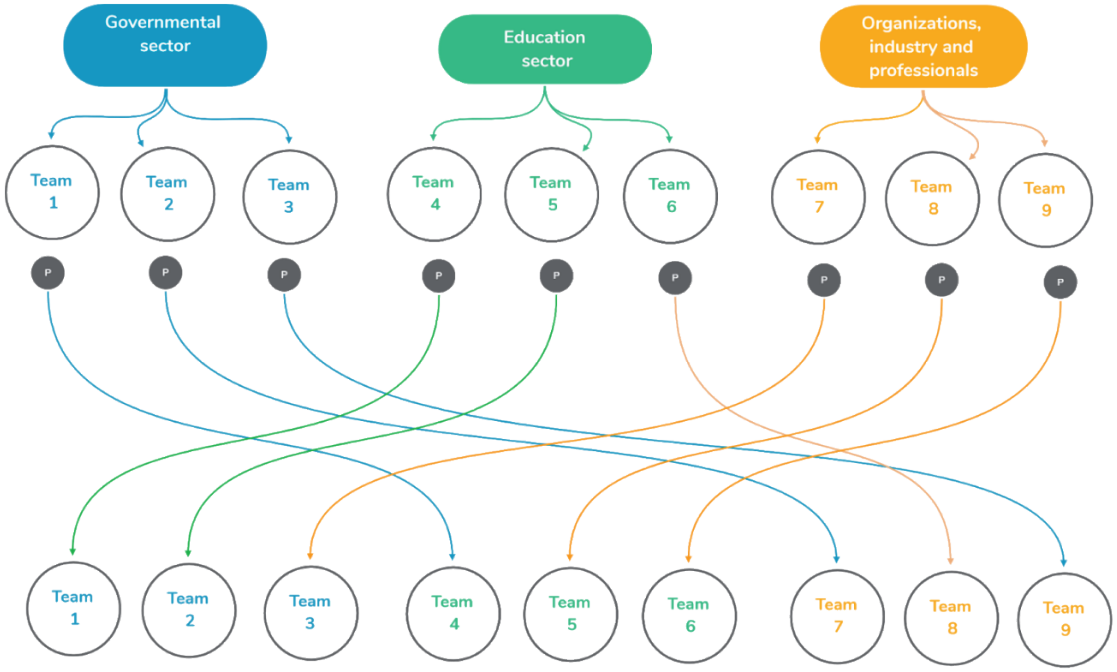


Figure 39: Organization of group dynamics. Source: Author's own elaboration

participants had the opportunity to discuss in depth and reach a consensus on diagnoses.

Despite the fact that certain opinions may have been left aside due to group consensus, it is important to point out that 80% of those who responded to the closing survey (60% of the participants) stated that they felt represented in the proposals of their respective groups.

A brief analysis of the process of the second dynamic, in which each sectoral group developed a slogan that was then adjusted by another group, reveals some emerging issues that are presented in the following paragraphs.

In the case of the slogans adjusted by the **Government** group, the most recurrent ideas were:

- Incentive for training, mandatory contents, vocational training, university and tertiary, personal training, technical robustness.
- Federalism, decentralization.
- Public policy, transversal, levels of government, incentive, penalization, fiscal, tax exemption, municipal regulations, bottom up public policy.
- Sustainability, SDGs, energy efficiency, social equality.
- Market, competitiveness, prosumer.

In the case of the slogans adjusted by the **Education** group, the most recurring ideas were:

- Public administration, building code, General Law, incentive, exemption, legislative, INV, INAP, EE standard, regulation
- Federal, provinces, municipalities, municipal
- Bioclimatic Design
- Public/private financing, credit, credit regulations, efficiency labelling
- Professional qualification, training and updating

In the case of the slogans adjusted by the **Industry** group, the most recurring ideas were:

- Technical training, teachers, educational levels, paradigm, curricular updating, professor, updating, suitability
- Reglamentations, incentives, regulation, exemption, state intervention, control, effective compliance with regulation
- Context, objectives, deadlines
- Economical viability, public-private, credit
- Sustainability, energetic efficiency

The other significant result of the workshop, derived in particular from the group dynamics, were the 9 proposals developed intra-sectorially and curated inter-sectorially. Based on the feedback from the survey, they were ordered according to the most chosen ones, as follows:

1. The supply to specialize in EEB, either postgraduate or specialization courses, exists and is available, we believe that it is a priority to focus on the inclusion of mandatory content in professional training, both at university and tertiary level. In addition, the concept of "sustainability" and the Sustainable Development Goals should be considered in a cross-cutting manner in each educational space.
2. Economic incentives are more effective than penalties. The aim should be a strong national industry, with a competitive market, in which investors see efficient products as a profitable option. This requires clear rules and the establishment of support frameworks to encourage the adoption of new technologies (e.g., bidirectional meters), also involving the energy companies. Particularly for the building sector, where basic efficient design criteria are not taken into account, incentives such as tax exemption for real estate should be considered.
3. Considering that the problem is the effective application of the regulation at the municipal level, where there are not necessarily suitable technical resources to carry out this task, the proposal is to articulate and accompany the municipalities from the provincial government in the challenge of effective compliance with the regulations and in turn promote the creation or adjustment of the technical regulations through a consultative body such as intersectoral roundtables.
4. The Legislative Power should elaborate a General Law with guidelines and directives for EEB promotion. For its implementation in the provinces, it should present incentives such as subsidized training instances for professionals and financing incentives for application projects. This law can be complemented with technical recommendations indicating energy efficiency standards in buildings and specific requirements for public administration buildings as examples. As a complement, each province should establish technical regulations with specific guidelines for its territory, to which each municipality should adhere.
5. Access to credit requires a concrete and clear regulation, which should be generated by trained professionals who can act and respond to the demands. The public sector should be the main promoter of distributed generation, providing an economic incentive to urban renewable micro-generation. Coordinate the public-private relationship from the educational part in order to strengthen the feedback of a virtuous scheme. To have a differential tariff scheme in EEB, including energy labelling certification.
6. Mandatory training of public servants/officials/controllers with updated regulations, with the active participation of organizations such as INAP, Housing Institutes, Municipal Offices (both in public and private works). It requires qualified professionals in public offices.
7. A shift of paradigm is needed in the education sector that incorporates sustainability and EE criteria across the board, with strong teacher awareness and training, through a guiding program or guide that is generally applicable to all educational levels.
8. Greater control by the National, Provincial and Municipal governments on Private or State investments, to benefit the investment of new buildings with EE, which, in turn, are regulated and coordinated with a legal framework, compliance and financial control, so that incentives reach the right people, either directly or indirectly and provided that the regulations on efficient buildings are respected.
9. Ensure that the current faculty as a whole is trained to teach new content, create new suitable positions and/or offer the possibility of incorporating external consultants. Promote that CONEAU elaborates and manages the modifications on university academic curricula, in order to include these topics in undergraduate subjects and update professional profiles. Meanwhile, make compatible with those contents of subjects currently taught that can be updated with these topics and ensure the supply of elective courses.

One possible way of revealing the richness and variability of the responses that emerged during the previously mentioned dynamics is the frequency distribution of the ideas/concepts exposed according to the repetition of the solution proposals elaborated and curated in the INTRA and INTER dynamics, as can be seen in the following word cloud (Figure 40).

As can be seen, the terms regulation, incentive, updating and training stand out above the rest, with words such as levels, exemption, professional, efficiency and public appearing in second place. On a third level are: technical, political, sustainability, energy, compliance, educational, transversal, municipal, credit and federal.

In general terms, there is a notable perceived influence of regulatory issues and the intervention of the State in them.

The lack of training of municipal employees to implement regulations and policies on the subject, in addition to the heterogeneous composition and suitability of the personnel is highlighted.

Feedback on the workshop experience

Feedback and impressions on the workshop were collected asynchronously through a closing form sent to all workshop participants, which was completed by 60% of them. From their responses, it was possible to extrapolate that:

- 60% consider that the relevant aspects of EEB were covered.

Figure 40: Cloud of proposed ideas/concepts. Source: Author's own elaboration

- 80% would not change the answers presented in the dynamics proposed in the workshop.
- 60% did not hear of / get to know new referents.
- 80%, 90% feel they exchanged valuable ideas.

They were also asked if any relevant or very relevant aspect of EEB development was left out of the discussion, their opinion on the representativeness of individual ideas reached in the group discussions and if they would have made any changes.

From these responses, it can be seen that over85% of the participants surveyed feel satisfied and represented by the results obtained from the group discussions. In addition, among the open-ended responses, there were very positive feedback and a notable interest in the continuity of this type of spaces for exchange and collective construction.

5.6 Workshop Conclusions

During the first dynamic, all the starting hypotheses were mostly validated.

- Of the barriers chosen:
  - The government and education groups considered and chose to work on barriers linked to governmental and educational management aspects by 50%-50%.
  - Private sector groups chose to work on government management barriers 100%.
- From the results:
  - From the work done by the 9 groups, it is observed that, in processing the first slogan, more than 60% of the groups developed a second proposal consistent with the selected barrier. That is to say, those groups that chose a government barrier developed contributions in the same aspect; likewise, the education groups worked with education; however, the private sector groups developed proposals linked to government management in 100% of the cases.
  - In the second dynamic, in accordance with the planned assignments, the government groups worked with 2 education proposals and one private sector proposal, elaborated in the first stage. The education groups received two from the private sector and one from the government, while the private groups received two from education and one from the government.
  - From the proposals received, only 45% worked to contribute some nuance or complement to the idea received, incorporating some other aspect.
  - At the same time, 65% ended up transferring the responsibility for the proposed solution to another sector.
- In more general terms, the level/depth of response shows the great interest that the topic arouses among the actors consulted and, at the same time, the manifest need to create spaces for exchange or networks for technical strengthening and exchange.
- In general, it is considered that the EEB is present in the educational field, with the need to include fundamental concepts in a transversal manner in under-

graduate/tertiary courses. There are also proposals related to materials and specific knowledge applied in the private/business sphere.

- The proposals that appear most strongly are those that link the responsibility of implementing solutions from the public sphere, with nuances between penalties, incentives, training (mandatory) and strengthening of the regulatory framework, but with preponderance over the interventions of the other two sectors. This implies that a greater impact in favour of EEB development depends on the active role of the State.
- In almost all cases, the various groups identify the origin of the problem in an area outside their jurisdiction.
- In general, it was a very positive experience, with substantial contributions and excellent teamwork between moderators and organizers.
- The participants were very enthusiastic and committed to the activities.
- The dropout rate was less than 20% in a 4.5 hour period.
- Feedback received through closing surveys and/or contacts has generally been very positive.
- Participants have expressed interest in continuing to be kept updated on developments in the project and EEB in general.

5.7 Overall Findings of the Stakeholders' Analysis

After the analysis of the supply of content, the analysis of goods and services relevant to EEB and the perspectives of Stakeholders, it was possible to gather information to characterise market demand and practicing professionals, as well as other Stakeholders.

First of all, it should be noted that the perceived gap is almost absolute among practicing professionals. Although there is a great deal of variability in the experience and career path of the individuals involved, there is a correlation between seniority and development in the subject and the perception of the gap. Hence, those with less seniority in the subject do not necessarily perceive a shortcoming, presumably because they are still in the middle of the postgraduate training stage, where there is a certain supply that can cover these shortages, even if they are only partially covered.

Reviewing the last chapters of this report, and with the aim of linking the analysis of contents (4 –EDUCATION IN EEB) with that of the Stakeholders (5 - VALIDATION OF IMPEDIMENTS AND OPPORTUNITIES FOR EEB EXPANSION IN ARGENTINA: ITS LINK WITH EDUCATION), we worked on sizing and evaluating in detail the perception of the actors belonging to the educational and governmental sectors.

Table 3 takes up the skills involved in each stage of EEB developed in 1-4 Bases for professional competence in the EEB sector, according to whether they are high, medium or low, but this time, instead of listing them directly, they are presented through the stakeholders that develop them. In this way, the link between the skill demanded and the content dictated in the technical and vocational or university training of each relevant stakeholder in the EEB universe is made explicit.

In the next chapter, the resulting analysis of demand and its impact on the configuration of the main characteristics of the gap will be developed in detail.

	MANUFACTURE	PROJECT DESIGN	CONSTRUCTION AND INSTALLATION	OPERATION AND MAINTENANCE
Low	Operators: production + logistics		Operators: execution + logistics	
Medium	Technicians: production + control	Technicians: project design assistance	Technicians: execution and/or supervision of service	
	Traders: sales/distribution			
High	Public officials: design, sanction and control of regulations, public policies and educational policies. Teachers: provide training for the achievement of the skills involved in all the stages			
	Scientifics / Engineers I+D	Architects / Engineers: project management	Architects / Engineers: project supervision	

Table 3: Stakeholders divided by stages and role at the different skill levels involved. Author's own elaboration

Source: www.shutterstock.com

6 Action Lines

6.1 Gap characterisation

First of all, it is important to remember that the starting point of this work is the hypothesis about the existence of a gap between the knowledge and skills of current practicing professionals and those needed for the effective expansion of Energy Efficiency in the building sector.

According to the content survey and the information obtained from the market analysis and the exchange with stakeholders, the gap does exist and can be characterised as follows.

On the one hand, the survey of the academic existing programs reveals the skills NOT covered by the contents analyzed/offered. Accessing them implies costs in terms of time and money, because most of them are present at the postgraduate level. Likewise, the main existing programs are geographically concentrated in large cities.

In turn, the process of exchange with stakeholders validated some of the findings resulting from the analysis that confirmed the gaps in the existing programs and the difficulties in the regulatory management of the subject within the different jurisdictions, providing a context to complete the demand characterisation.

In addition, there is a slow but steady trend of growth in demand and there is no immediate prospect that it can be satisfied with the training available today at the technical and undergraduate levels.

These aspects account for a multiplicity of transversal axes and, although it would have been desirable to achieve the consolidation of "one" gap, this is not possible because such gap is multidimensional. The difficulty to characterise it emerges from the complexity of the systems involved, characterised for the heterogeneity of contents at all educational levels, their changes and implementation deadlines, the conflicts between the interests of government and market actors, the multisectoral demands and a dynamic, unstable and restrictive economic context for medium and long term planning.

Therefore, it requires a harmonized management of all these aspects, which brings the challenge of planning in a systemic way, requiring the necessary plasticity to adapt to current difficulties, but preserving the appropriate perspective for managing the strategic and cross-cutting aspects of the issue. In terms of approach strategies for such management, a distinction is made between government initiatives focused on the market and professional regulation and, on the other hand, those focused on education and regulation of the educational system in terms of curriculum updating and other relevant related aspects. Although the validations of the Stakeholders pointed especially to market and professional regulation aspects, the line of this work focuses on the second aspect: the management of education and educational existing programs in the EEB sector, being that the reason why special emphasis is placed on this sector.

Considerations for gap management and mitigation in the education sector

For the treatment of educational gaps, any degree of modification that may be applied to curricula implies different implementation and application timeframes. Such dynamics affect the cost/benefit evaluation of proposals to mitigate or close identified gaps.

For TVE, in the case of validation by INET, both the thematic axes and the content are determined by this institute, which is national in scope, as opposed to universities, which are autarchic entities. This opens the possibility, at least for those careers under the scope of INET, to achieve the implementation of a shorter-term updating dynamic. This would make it possible to train professionals with specific skills to integrate interdisciplinary technical teams that strengthen the performance of EE from the stages of design, planning, execution, operation and maintenance of buildings.

In the case of undergraduate courses, given that universities are autonomous entities that define their interests and curricula independently, and considering that the minimum contents of programs such as Engineering and Architecture must be validated and accredited by the Ministry of Education through CONEAU, any modification in their academic proposal will have an impact in the long term due to their validation process. Likewise, elective subjects, whose incorporation modes into curricula are more expeditious, would make it possible to integrate EEB into curricula in the short or medium term. However, as it is an elective subject, there is a risk of only attracting students already interested in the subject, instead of achieving a basic training for all future professionals.

As for postgraduate training, as these are courses that respond to specific topics, of shorter duration and with specific and reduced contents, unlike an undergraduate course, it is a key area for the implementation of possible short and medium-term solutions due to the factthat its existing programs dynamics reflects in real time the demands of professionals and the market. These characteristics give it the opportunity to be the most effective and agile tool for EEB inclusion. Nevertheless, training at this level implies that access to these contents is mediated by significant costs, both monetary (as they are paid courses) and in terms of time investment (as they require a previous degree, implying training periods of over 8/10 years in total). At the same time, having only postgraduate training for the training of qualified professionals in EEB is detrimental to its massification, since only those previously interested in the subject have access to it, instead of guaranteeing a transversal training for all professionals with competences in the sector. This case shows that when facing a complex problem, solutions may present antagonisms that need to be considered in order to identify compromise agreements that best solve the opposing criteria.

On the other hand, from a territorial approach, it is difficult for professionals to deepen their careers outside the Metropolitan Area of Buenos Aires, given the variety of bioclimatic regions in the extensive Argentine territory. Another strategy to take into account is the dynamization of online courses and regional face-to-face courses. In this sense, the possible changes caused by the pandemic conditions will probably expand the virtual option in a previously unpredictable way, which could have a significant impact on decentralization and federal access to the same programs.

The existing content present in the certifications and degreesanalyzed is incomplete, superficial, geographically concentrated and little promoted or highlighted. This condemns the EEB field to remain as a niche activity that does not achieve the scale required to massify and become attractive to develop a sustainable market and to be able to become independent from permanent incentive interventions and other extraordinary conditions of promotion, in the context of an over-demanded State due to contextual difficulties.

6.2 Action lines proposed

Among the fundamental precedents for the execution of this study is *"Lineamientos Para La Mejora De La Enseñanza Sobre Eficiencia Energética En Carreras Estratégicas De Ingeniería Y Arquitectura"* (2017), which has been opportunely cited in other instances of this work. This document mentions a series of competencies identified as relevant for the training of Architects and Engineers in the country, among which are: visualizing the environmental, social and economic impact of each project; optimizing the use of natural resources with environmental awareness; visualizing energy as a complex system and being able to adapt to new situations; working in interdisciplinary teams, designing and making prototypes according to the impact; analyzing processes and life cycle of each input in the context of energy demand. On the other hand, among the key strategies defined are: the incorporation of minimum, cross-cutting and mandatory contents/concepts on the subject in key subjects of undergraduate courses, the promotion of professional practices of a social nature in the lines of action in progress, referring to the issues of responsible and efficient energy use, the incorporation of the subject in the final projects of undergraduate courses and the incorporation of legal and regulatory aspects on responsible use and energy efficiency in the subjects.

These findings and proposals are fundamental constitutive elements for consolidating these complementary lines of action, which include, integrate and deepen these antecedents.

Based on the analysis carried out throughout this report and in order to address the need to consolidate EEB development in Argentina, lines of action are proposed in the different studied areas.

Considering that the stakeholders consulted especially developed aspects related to the governmental and market spheres, it is considered pertinent that the measures proposed for the education sector, as the ultimate goal of this study, be complemented with others in those areas. This way, more comprehensive approaches are pursued, articulating with other extra-educational spheres, to strengthen the potential for implementation.

In the case of the educational lines of action, the measures to be developed focus on the adequate training of teachers, students and practicing professionals, through the consolidation of a technically sound, updated education that includes interdisciplinary skills. Regarding governmental actions, the proposals are oriented to establish and maintain the necessary conditions for developing the EEB sector.

Table 4 below presents the lines of action organized according to how the execution of each one contributes to or articulates with specific skills (high, medium or low) of the EEB universe.

N°	LINE OF ACTION	LINK WITH SKILLS	LEVEL OF SKILLS		
Training and Awareness Raising Axis					
1	Raise awareness (especially among officials and/or decision makers) by presenting EEB as a means to achieve: energy savings, increased housing comfort and climate change mitigation1.	Since awareness-raising is aimed at introducing public officials to general EEB concepts, it is mainly associated with low skills.			
2	Train officials to catalyze the application/ implementation of new EEB specific regulations.	The implementation of the EEB regulatory framework presents technical specificities that imply the development of medium skills.			
3	Raise awareness of the student sector (advanced secondary school) about the training existing programs in EEB to promote the development of career paths linked to the subject.	Given that awareness raising aims to introduce students to general concepts of EEB and sustainability, as well as the availability of academic existing programs for training in the subject, it is mainly associated with low skills.			
4	Train teachers of ETP, undergraduate and postgraduate courses. Integrate the topic in the current teacher updating systems according to the mechanism that corresponds to each educational level.	Since this is a "training for trainers" instance for higher levels of the education system, teachers will have to develop transversal skills of varying complexity.			
5	Offer more elective undergraduate subjects related to EEB.	The development of a greater supply of electives linked to the EEB will allow directing efforts towards the training of undergraduate students in specific EEB skills, classified as medium and high.			
6	Offer "packages" of elective subjects by subject (even in other degrees or institutions, in order tofavour inter-institutional transversality).	This line of action is presented as an instance subsequent to the one previously developed, which seeks to expand elective subjects in groups of related topics. In this way, for example, specific subjects can be developed for different technologies for EEB, and students can gradually complement their training in this aspect.			
7	Consolidate the EEB orientation as part of the curriculum in Architecture and Engineering curriculum.	The previous proposal can evolve and consolidate through the creation of an EEB orientation in undergraduate courses. This instance allows the development of highly specific skills, at the same time that it has a recognition in the professional degree.			
8	Forming open program degrees (also referred to as "à la carte").	This line of action suggests the development of a training model similar to the open program scheme, currently associated with the doctoral training cycle, which would allow students to be trained in higher level skills according to the professional profile they wish to develop.			
9	Propose that the contents offered by undergraduate institutions be linked to the climatic zone in which they are located in order to train professionals capable of developing EEB in any geographical context, but especially in their own.	With the purpose of raising the number of professionals capable of applying EEB measures adapted to every region, specific contents should be developed in order to develop high skills linked to bioclimatic design.			
10	Incorporate contents related to EEB in Technical and Vocational Education in line with the measures planned for the reduction of GHG emissions in the country associated with the reduction of energy demand (water economizers, solar heaters, envelopes, etc.). See Section 1.2)	Considering that Technical and Vocational Education has the possibility to being updated in a more agile way, and that its contents are mainly technical, a great potential is identified for the implementation of medium skills associated to technologies.			
11	Design pedagogical strategies that favour the development of interdisciplinary work skills among professionals.	The development of systemic thinking and interdisciplinary work skills constitute high skills that challenge the traditional training of current disciplines.			

12	Ensure access to centralized/systematized and updated information on educational existing programs. This is specially relevant in ETP, which presented the greatest lack of data.	The development of a platform that systematizes and presents in an updated way the degrees available from INET on the one hand, and CONEAU on the other, as well as the minimum contents of those degrees, would allow students to evaluate and compare the skills developed in each institution.			
13	Develop a mechanism that includes periodic curricular updating in each institution.	Updating efforts should be directed towards the incorporation of content related to medium and high skills, given the scarcity detected in the survey conducted.			
14	Develop a state accreditation system for professional practice in EEB (improve the technical and vocational offer of existing programs and promote comparative advantages)2. Similarly, the explicit incorporation of the issue of responsible use and energy efficiency in CONEAU's career accreditation standards is considered central.	Updating efforts should be directed towards the incorporation of content related to medium and high skills, given the scarcity detected in the survey conducted.			
15	Apply incentives for the EEB training of technicians and professionals received (short non-attendance courses that add points for obtaining interjurisdictional licenses, renewal of license plates, etc.).	This line is an agile measure to quickly insert high skills (linked to postgraduate studies) to favour the complementary training of practicing professionals.			
16	Promote the training and job placement of housing energy certifiers to massify certification in the real estate market.	The performance of certifications, audits or any mechanism for energy performance assessment is associated with management skills categorized as high			
Measures to promote EEB					
17	Promote the inclusion of EEB mechanisms in green credit lines taxonomy3.	The performance of certifications, audits or any mechanism for quantitative evaluation of energy performance is associated with management skills categorized as high			
18	Promote private financing of retrofitting for EEB, as CSR measures for companies in the sector.	It is expected that these measures encourage the acquisition of associated technologies with EEB, the application of which is considered a medium skill.			
19	Promote conditions to encourage the production of national industry and consumption of goods, technologies and services related to EEB.	It is expected that these measures encourage the acquisition of associated technologies with EEB, the application of which is considered a medium skill.			
20	Develop mortgage credit lines for homes with certified energy/environmental performance.	The performance of certifications, audits or any mechanism for energy performance assessment is associated with management skills categorized as high.			
21	Extend tax exemptions for certified A-B energy level homes.	The performance of certifications, audits or any mechanism for energy performance assessment is associated with management skills categorized as high.			

1 An example of this is Ley Yolanda, whose function is to train every public employee in environmental matters. Source: https://www.argentina.gob.ar/ambiente/accion/ley-yolanda#:~:text=Es%20la%20ley%20que%20establece,capacitaci%C3%B3n%20obligatoria%20en%20materia%20ambiental.

2 In other words, the secretariat itself, in alliance with the appropriate body (INET), should be able to certify/accredit specific knowledge/training in EEB. This would make it possible to standardize valuable contents for the professional profile related to building construction, at all levels.

3 The "green" taxonomy is a system of classification which defines the threshold for sustainable economic activities. Source: Johanson, Elena (April 27, 2020). Credit implications of brown taxonomy greater than green version. Expert Investor. Retrieved from: https://expertinvestoreurope.com/credit-implications-of-brown-taxonomy-greater-than-green-version/#:~:text=The%20EU's%20'green'%20taxonomy%20is,final%20report%20was%20recently%20released.&text=This%20could%20support%20the%20argument,a%20brown%20taxonomy%20is%20needed

Table 4: Lines of action by skill level. Author's own elaboration

In order to actually implement the above lines of action, the experiences, failures and lessons learnt in other countries should not be overlooked. This will make it possible to evaluate, value and adapt them to the local context in order to make a leap towards those experiences with greater proven effectiveness.

From the analysis and interpretation of the results from the characterisation of the gap and the proposal of lines of action for its mitigation, it is possible to advance on the conclusions of this research, which aim to provide context and, above all, prospective regarding how to deepen the diagnostic and research work conducted.

6.3 Proposal of specific contents related to the subject matter for strengthening competences of EEB's stakeholders

Next, a synthesis of specific technical contents related to energy efficiency in building construction, derived from the analysis presented in the previous sections, is presented.

The proposed contents are organized according to their technical relevance, considering the aspects that need to be strengthened in the current academic existing programs, but also including those aspects that other stakeholders (governmental and from the private sector) have stated as important to achieve the sustained EEB expansion in Argentina.

This expansion depends on several interdependent factors, which transcend the skills acquired in the academic training of practicing professionals and focus on the ability to promote more informed decision-making and provide the support conditions to strengthen the supply of goods and services needed to meet the increase in the foreseen future demand. Also, it will be able to contribute to the multiple efforts associated with the fulfilment of international commitments in this area.

The following graph arranges by conceptual, technological, management and execution axes, a series of contents which could be specifically addressed to different target audiences: practicing professionals, decision makers, housing developers and supply manufacturers, as actors of the value chain that can benefit from knowing more about the transversal approach to EEB and sustainability in construction.**thor's own elaboration**

From the effective implementation in the supply of these proposed contents, it would be possible to initiate a process that contributes to the mitigation of the characterised gap in the local context.

AXIS	CONTENT	PRACTICING PROFESSIONALS AND FUTURE EDUCATORS	DECISION MAKERS AND GOVERNMENTAL TECHNICIANS	CONSTRUCTION COMPANIES, REAL ESTATE DEVELOPERS, MANUFACTURERS AND DISTRIBUTORS OR GOODS AND RELATED SERVICES
Concept	Energy awareness: 'pro-environmental behaviour' Energy/carbon intensity from embodied energy in materials Low and zero carbon (LZC) technologies: heating, cooling, renewable energies,	◯	◯	
	Material circularity / retrofit	◯		◯
	Energy mix / Renewable Energies	◯	◯	
	Environmental impact of construction	◯	◯	◯
	The house as a functional unit / building thermal dynamics	◯	◯	◯
Technology	Climatic characterisation	◯	◯	◯
	Relationship with the environment	◯	◯	◯
	Sunlight/thermal comfort/insulation	◯		◯
	Material thermal performance	◯		◯
	Morphological design: Ventilation and air renewal / Filtration control	◯		
	Opaque/translucent ratio in facades (envelope) / thermal bridging / hermetically sealed double glazing openings	◯		
	Hygrothermal comfort	◯		
	Hot water	◯		
	Heating	◯		
	Lighting	◯		
	Acoustic comfort	◯		
Management	Operation and maintenance, control, efficient devices, consumption measurement. Energy management	◯		◯
	I+D, components design and manufacturing, modelling and testing, quality, marketing, sales, logistics	◯		◯
Implementation	Project management, Communication Research, Project development	◯	◯	◯
	Installation: construction, quality control, upskilling, professional technicians (plumbers, electricians and roofers) and other technical skills		◯	

Table 5: EEB contents proposed by axis and target audience. Author's own elaboration

Source: www.shutterstock.com

7 Conclusions

7.1 General conclusions and next instances of research

The starting hypothesis on the existence of a gap between the existing programs and demand (current and future) of skills and knowledge for the development of EEB was fully confirmed. The gap does exist and is manifested in several simultaneous, concurrent and mutually reinforcing axes.

It is worth reflecting on the importance of a comprehensive view and the various interrelationships between the components of the system under analysis. The dialectic between supply and demand, which underlies the organization of the study, constitutes a dynamic of interdependence. In this sense, in the development of a public and educational policy agenda for the promotion of EEB in Argentina, it is essential to understand the potential of the combination/complementarity of restrictive/regulatory measures ("push") and incentive and promotion measures ("pull") to consolidate an effective strategy for the expansion and progress of the subject, operating both on the demand and on the supply of professional EEB-related goods and services.

In accordance with the background information gathered, there is a correlation between the expected growth in demand in the future and the occurrence of a group of conditions. These conditions include a stable and predictable political and regulatory framework that allows for medium and long-term planning. With the aim of establishing which perspective conditions are considered favourable for the validity, applicability and effectiveness of the proposed lines of action, one of the prospective energy scenarios, elaborated by the National Energy Secretariat in 2019, was taken into account. Although it is understood that any projection prior to March 2020 has become obsolete due to the health emergency resulting from the pandemic and its multiple and still uncertain consequences, it is decided to consider the scenario in order to establish contextual conditions to fully develop the proposed agenda to address the problem under study.

In turn, the framework of the 2030 Agenda through its SDGs provides a space for aligning the dimensions of the proposed lines of action. By working to establish a more direct and explicit link between these measures and the SDGs, it would also be possible to catalyze these actions, within the framework of existing programs that have transcended changes in management. Hence, this team recommends aligning the proposed lines of action with the goals and targets linked in Table 1.

Other existing governmental frameworks, such as the effort committed to the management and reduction of national contributions to the country's GHG emissions, would allow aligning the potential positive results of the EEB agenda in Argentina through the implementation of simple and well-known technology (solar thermal energy, low-power wind energy, among others), whose production could be proposed to migrate to the national industry and thus ensure its independence from the alternating rhythms of access to goods from abroad.

It should be added that some existing public policies, such as the National Housing labelling Program, promote and bring about basic changes that make it possible to replicate other associated policies for the qualitative growth of the sector.

Regarding the analysis of the contents included in the educational existing programs, there has been found a conclusion published by the Secretariat of Energy in 2017[38] on the need to make the curricula, with periodic updates and modifications or transformations with the corresponding accreditation by the National Commission for University Evaluation and Accreditation (CONEAU, por its Spanish acronym), as the sector evolves. Based on these lines, we present in a complementary manner those conclusions derived from this research, which also include the feedback from sectors outside the design and development of public and educational policies areas. The eventual application of them will provide the necessary and proper tools for the inclusion of the subject in a transversal manner in undergraduate courses' basic contents. Additionally, other key strategies include the creation of specific technical degrees and specializations, as well as postgraduate courses and courses for continuing professional education, and it would be strategic to involve the perspective of the Ministry of Education portfolio as well.

The interviews and surveys conducted show that the existence of a gap is practically absolute. Although there is a great deal of variability in the experience

38 Directorate of Education, Secretariat of Energy (2017). Lineamientos Para La Mejora De La Enseñanza Sobre Eficiencia Energética En Carreras Estratégicas De Ingeniería Y Arquitectura. Retrieved from: https://www.argentina.gob.ar/sites/default/files/lineamientos_spu.pdf

and background of the individuals involved, there is a correlation between seniority and background in the subject and the perception of the gap.

Among the conclusions of the workshop, it should be noted that the level of response shows the great interest that the topic arouses among the stakeholders consulted and, at the same time, the clear need to create exchange or networking spaces for technical strengthening and exchange.

Among the studied relevant aspects, the supply of goods and services (applied competences and skills) are considered to play a key role for accompanying, promoting and making an effective EEB expansion locally. However, without a favourable context, technical knowledge and a demand that values these technologies, it will not be possible to sustain an effective expansion. Currently, the EEB-related products are presented as a "niche" market, and it does not seem possible to convert it into a mass access condition.

In this sense, there is a need to accompany this development by strengthening demand, promoting, for example, communication with greater emphasis on the real advantages that the end user will obtain when living in an efficient building. This would create a virtuous circle with the supply of goods and especially services related to EEB.

In addition, through the exchange tools analyzed, which represent the sustainable building sector, the almost non-existent demand in the retrofit or modernization market is evidenced. This is a key vector for the purpose of this paper. The potential for improvement in terms of energy saved or not consumed in the existing building stock significantly exceeds its equivalent in new buildings. Professionals should be able to address, quantify and manage their continuous improvement.

Finally, the methodological approach was consolidated as the project progressed through different stages. The changes of plan associated with the outbreak of the pandemic and the impossibility of forging direct contact with the actors and stakeholders imposed, and at the same time, prompted new modalities of data collection through telephone interviews, surveys and the online workshop. Not all of them have been equally effective and response and data collection time frames have been delayed, especially for face-to-face interviews.

The application of this methodology can potentially be strengthened in successive iterations to update the results, taking advantage of the consolidated information system, which includes a network of stakeholders and coordinates of relevant content to date.

Ultimately, it is worth highlighting the competence for developing this sector, the commitment of practicing professionals, educators, researchers and government officials who are genuinely interested in continuing their training and providing content, time and will to contribute to the EEB expansive growth in Argentina so that it reaches its full potential. To this purpose, a series of contents are proposed by theme and target audience to develop training and contribute to the strengthening of EEB-related skills and knowledge.

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Annex I: Detailed Characterisation of the Argentine Education System

1.1 Overview of the Argentine Education System

This chapter provides an overview of the structural and operational organization of the Argentine Education System. It considers the current regulatory framework, guidelines, regulation and financing.

Article 8 of the National Education Act 26,206 describes the scope and benefits of Education as a fundamental axis for human development: "Education provides the necessary opportunities to develop and strengthen the comprehensive training of individuals throughout their lives and to promote in each learner the competence to define their life project, based on the values of freedom, peace, solidarity, equality, respect for diversity, justice, responsibility and the common good."

The national validity of the law aims to unify the National Education System and guarantee that all educational offers at Pre-school, Primary, Secondary and Higher Education levels comply with the minimum essential requirements so that education is equitable and of quality throughout the national territory and consolidates a fairer society.

It is the duty of the **Provincial Governments** and of the **Autonomous City of Buenos Aires**, as established in Article 121 of the National Education Act:

> To ensure the right to education in its territory.

> To organize, plan, administer and finance the education system within its jurisdiction.

> To approve the syllabus (curriculum) of the different levels as provided by the Federal Council of Education.

> To organize and lead the state managed institutions.

> To authorize and control privately managed educational institutions. > To grant degrees and certificates of studies.

National Education System

National Act No. 26,206/0639

The National Education Act, which was enacted and published in December 2006, replaced the Federal Education Act (enacted in 1992) and established a new regulatory framework for the education system. The following points are relevant to the subject matter of this report:

1. Administration of the National Education System. The National State and the provincial jurisdictions, in a coordinated and concurrent manner, are responsible for planning, organizing, supervising and financing the National Education System, which is organized into four levels and eight educational modalities, stipulating their pedagogical, organizational and institutional specificity.

2. Educational equity and quality. The Ministry of Education, in agreement with the Federal Council of Education, is responsible for establishing and implementing public policies to promote educational equality, aiming to address situations involving injustice, marginalization, stigmatization and other forms of discrimination, which result from socioeconomic, cultural, geographic, ethnic, gender or any other factors that may affect the full exercise of the right to education throughout the system. It also obliges the national and provincial government to create the material and cultural conditions that allow for quality teaching and learning that promote social cohesion.

39 National Education Act No. 26.206, Thursday, 14 December 2006. Official Gazette. Argentina, February 6, 2007, number 31062, p. 1. Retrieved from: http://servicios.infoleg.gob.ar/infolegInternet/anexos/120000-124999/123542/norma.htm

National Education Act No. 26,05840

Technical and Vocational Education is the modality of **Secondary/Middle Education** and **Higher Education** responsible for training Secondary Education and Higher Education Technicians in specific occupational areas and for vocational training. It is governed by the provisions of Act No. 26,058 and is implemented in state or privately managed national, jurisdictional and municipal secondary, non-university higher education and vocational training institutions included in the Federal Registry of Technical and Vocational Education Institutions.

Technical and Vocational Education consists of a wide list of institutions, among which are the following:

> **Secondary or middle level** technical and vocational education Institutions.

> **Non-university higher level** technical and vocational education Institutions.

> **Vocational** training institutions.

Technical and Vocational Education covers different activities and professions in goods and services production sector, such as agriculture and livestock, manufacturing industries, electricity, gas and water, construction, transportation and communications, energy and information technology, health, economy and artistic specialties linked to the technical/technological matters, among others.

Technical and Vocational Education requires articulation within the Technical and Vocational Education modality through the development of different possible degrees: initial Technical and Vocational Education at the Secondary level; Vocational Training and Higher Education (offered by universities and provincial educational jurisdictions). In this way, the concept of "Lifelong Learning", which is the foundation of Argentina's education systems and Vocational Training, is fulfilled[41].

In the surveys conducted by the Directorate of Education in Energy Sustainability, 135 degrees/training courses with careers that are potentially related to Energy Efficiency in Buildings were identified, which are taught throughout the country.

Their distribution by level is as follows:

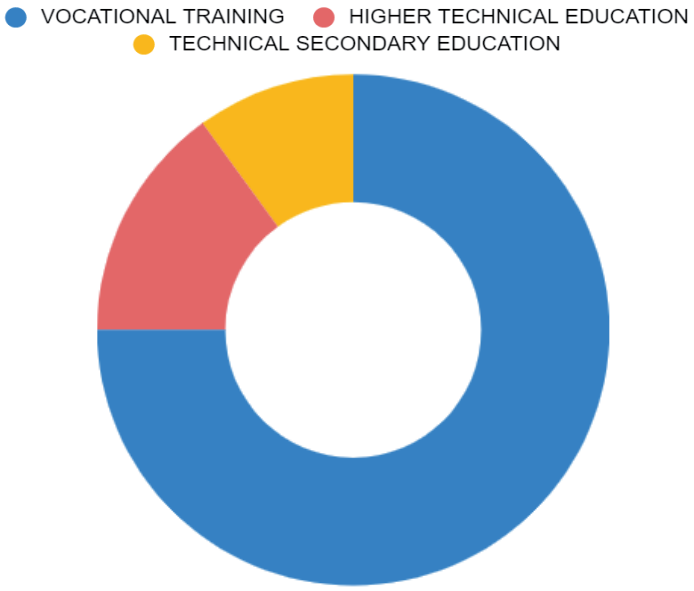

Figure I: Distribution by level of degrees that are potentially related to EEB. Source: Author's own elaboration

40 National Education Act No. 26,058, from September 7, 2005. Official Gazette. Argentina September 9, 2005, number 30735, p. 1. Retrieved from: http://www.inet.edu.ar/wp-content/uploads/2012/10/ley-26058.pdf

41 For further information about Technical Education modality, please visit https://www.educ.ar/recursos/113952/educacion-tecnica

And its sectorial composition is as follows:

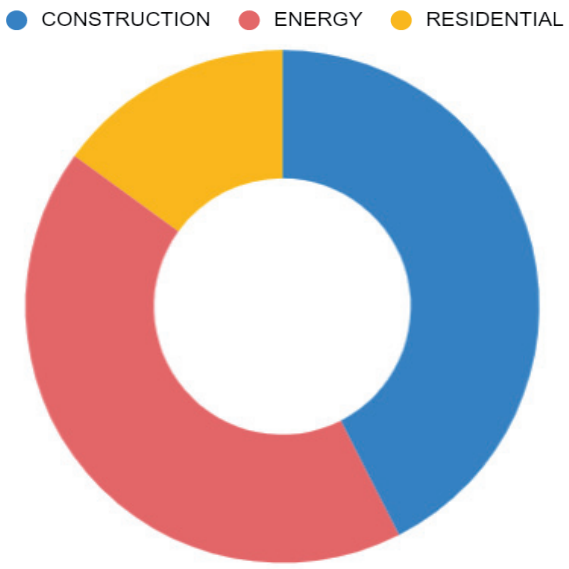

Figure II: Sectorial composition of degrees that are potentially related to EEB. Source: Author's own elaboration

Although there are more initial categories, the orientations of training courses were simplified in order to assign them to one of the 3 sectors of interest connected to EEB.

Technical and Vocational Education in Secondary Education Level

In Argentina there are more than 1,600 secondary-level Technical and Vocational Education institutions where students can choose from more than twenty specializations to obtain a technical degree.

The purpose of secondary technician training is the acquisition of quality vocational skills, with a solid general education and specific technical training that goes beyond the educational environment and is connected with the local social and productive system.

The specializations of the Technical and Vocational Education in Secondary Education Level that are potentially related with EEB are the following: Civil Constructions, Electronics, Electricity, Electromechanics, Renewable Energies, Mechanics, Process Industries, Mining, Food Technology, Programming and Industrialization of Wood and Furniture.[42]

Within the Secondary Technical Level, the following degrees related to EEB stand out, as an example:

> Master Builder
> Construction Technician
> Refrigeration and Air Conditioning Technician

Technical and Vocational Education Training Institutions

Vocational Training is the set of actions aimed at social and labour training for and on the job, which is intended both to the acquisition and improvement of qualifications and to the requalification of workers. It considers the specialization and updating of knowledge and skills, both in the different careers of Technical and Vocational Education and in the higher levels of formal education.

Furthermore, it accepts different forms of admission and development from the educational requirements of formal education levels and cycles.

42 To learn about the Reference Frameworks of Technical and Vocational Education in Secondary Education Level, please visit: http://www.inet.edu.ar/index.php/niveles-educativos/educacion-secundaria-tecnica/marcos-de-referencia-de-nivel-secundario/

Vocational training is divided into the following types of training according to the type of training purpose and the form of admission: Job training, Initial Vocational Training and Continuing Vocational Training.[43]

The Vocational Training existing programs consider the articulation with literacy programs, or programs for the completion of the levels and cycles included in compulsory and post-compulsory schooling.

Within the Vocational Training, the following degrees related to EEB are highlighted, as an example:

> Dry Construction with Light Components Assistant
> Construction Assistant
> Solar Energy Systems Installer (Note: The description of the Non-University Higher Level for Technical and Vocational Education appears in the following paragraph, which exclusively describes Higher Education, for a comprehensive understanding).

Higher Education

National Act 24,521[44]"

> *The purpose of higher education is to provide scientific, vocational, humanistic and technical training at the highest level, to contribute to the preservation of national culture, to promote the generation and development of knowledge in all its forms, and to develop the attitudes and values required for forming responsible individuals, with ethical and solidarity awareness, who are sensible, critical, and capable of improving the quality of life, consolidating respect for the environment, the institutions of the Republic and the democratic order".*

Higher education institutions, whether university or non-university, national, provincial or municipal, state or private, all of which are part of the National Education System, are included within the scope of this law.

Higher Education in Argentina comprises:

> Authorized state and private **Universities** and **University Institutes**.
> **Higher Education Institutes (Non-University)** of national or provincial jurisdiction, or of the Autonomous City of Buenos Aires jurisdiction, which are state or privately managed, providing teacher training courses and those for Technical and Vocational Training.

Higher Education is not compulsory in our country, and it is free in the public sector. The National State controls it, both at public and private levels. Such control is shared with the provinces where these universities operate and the institutes that operate in their territory.

In order to access Higher Education as a student, students are required to have passed the secondary level of education.

Technical and Vocational Education of Non-University Higher Level

Non-University Higher Education in the Technical and Vocational Education modality provides a response to those who wish to pursue post-secondary studies to enhance their professional performance.

It allows individuals to initiate and/or continue professionalizing itineraries, through training in specific occupational areas whose complexity requires the mastery and manifestation of knowledge, abilities, skills, values and vocational attitudes that are only possible to develop through extended and systematic training processes. Through Technical and Vocational Education, vocational skills are broadened and deepened, acquiring greater complexity in order to reach an optimum level of autonomy and responsibility in accordance with this level.

The requirement for being admitted in this type of training path is to have a Secondary Level Technical Degree in a specialization related to the specialization to be addressed.

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43 To learn more about vocational training, please visit: http://www.inet.edu.ar/index.php/niveles-educativos/formacion-profesional/

44 National Education Act No. 24,521, from July 20, 1995. Official Gazette. Argentina, August 10, 1995, number 28204, p. 1. Retrieved from: http://servicios.infoleg.gob.ar/infolegInternet/anexos/25000-29999/25394/texact.htm

Non-university institutes offer short courses called Technical degrees (which have 2 to 4 years of duration), consisting of pre-undergraduate degrees that provide students with the necessary tools to enter the labour market in jobs with specialized qualifications. Many students who complete their technical degree continue their studies at the university through what is known as articulation, in order to obtain the undergraduate university degree corresponding to their profession.

Within the Technical and Vocational Education of Non-University Higher Level, the following degrees related to EEB are highlighted, as an example:

> Construction Higher Technician

> Environment Management Higher Technical

> Renewable Energy Higher Technical

University Higher Level

Higher university education is provided by national universities, provincial and private universities that are recognized by the National State and well-known state or private institutes, all of which constitute the National University System.

> *"The purpose of university institutions is the generation and communication of high-level knowledge within an environment of freedom, justice and solidarity, offering an interdisciplinary cultural education aimed at the integration of knowledge as well as specific scientific and vocational| training for the different degrees studied in them, for the benefit of individuals and the society to which they belong.*
>
> *Institutions that are referred to as "University" must develop their activity in a variety of unrelated disciplinary areas, which have an organic structure divided into faculties, departments or equivalent academic units. Institutions that limit their academic existing programs to a single disciplinary area are called «University Institutes»" (National Higher Education Act, 1995, section 27).*

Universities and university institutes grant undergraduate (bachelor's, engineering, etc.) and postgraduate degrees (specializations, master's and doctoral degrees), and in some cases they also grant pre-undergraduate degrees, as intermediate degrees for those who are pursuing undergraduate degrees, or directly as short degrees focused on work practice in some disciplines (in this case also functioning as a tertiary institution). University institutes offer degrees in a single field of knowledge (e.g., business degrees) while universities comprise different departments - which are usually called faculties - covering different branches of higher education.

The CONEAU (National Commission for University Evaluation and Accreditation) is the body in charge of granting official validity to the degrees issued by these university institutions.

In Argentina, everyone who has passed secondary education may start higher education at the undergraduate level, and students over 25 years of age who have not passed secondary education may be admitted if they prove that they have sufficient training, work experience, skills and knowledge to pursue the studies they wish to be admitted to. Admission is free and unrestricted; there may be levelling and orientation processes, however, these processes should in any case be selective, exclusive or discriminatory in nature (National Higher Education Act, 1995, section 7).

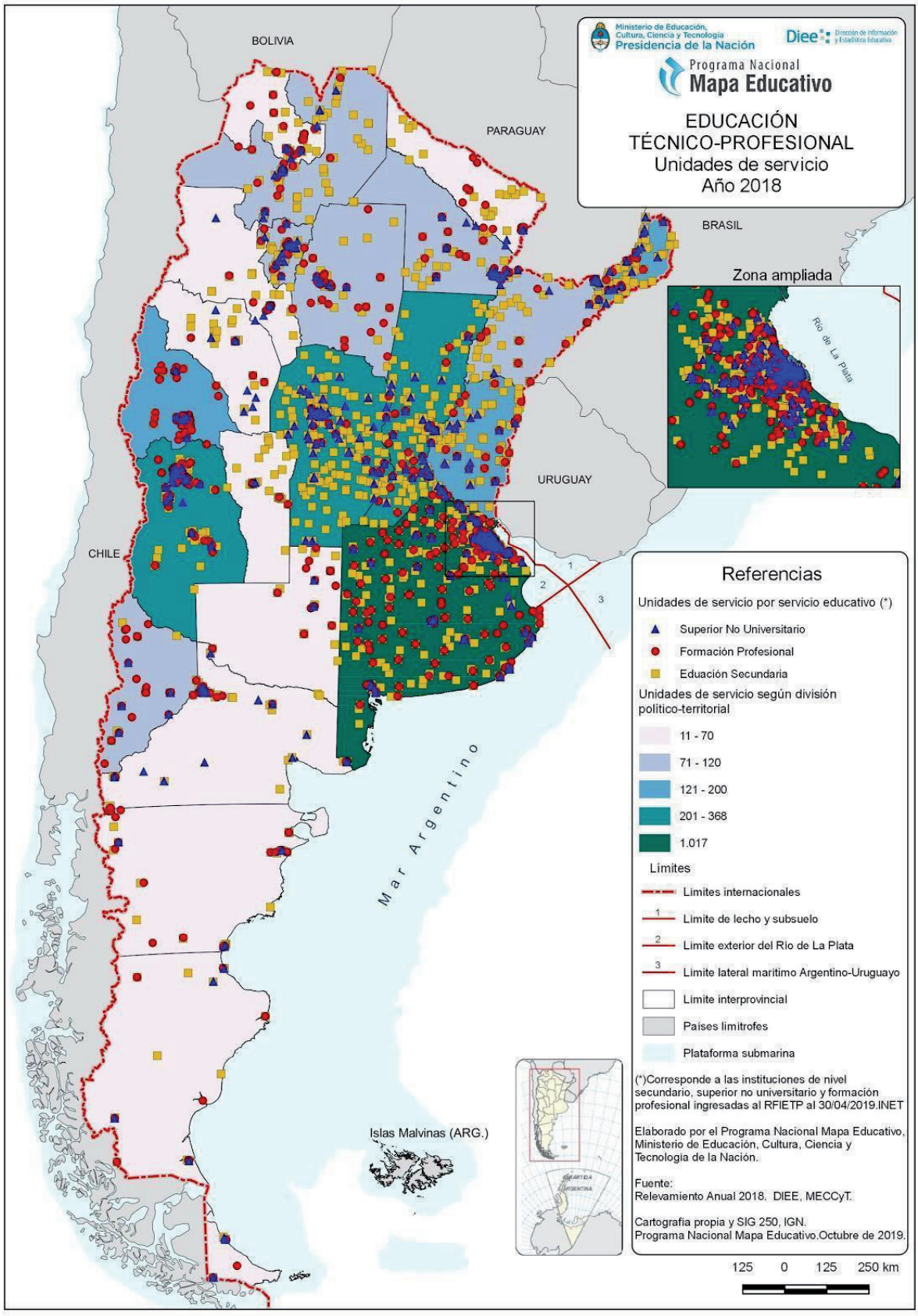

Figure III: Map of Technical and Vocational Education 2018[45]Source: Ministry of Education, Culture, Science and Technology (2018)

45 Retrieved from: http://mapa.educacion.gob.ar/img/tecnico_profesional_us_total_2018.jpg

1.2 Regulatory institutions of the Argentine education system

LEVEL / INSTITUTION	TECHNICAL SECONDARY EDUCATION	TECHNICAL AND VOCATIONAL TRAINING	NON-UNIVERSITY HIGHER TECHNICAL EDUCATION	UNIVERSITY HIGHER LEVEL
Federal Council of Education	Ensures unity and articulation of the National Education System			
CONEAU				Evaluation and Accreditation of university quality
University Management and Auditing				Organization and proper functioning
INET	Coordination of public policies related to the development and strengthening of Technical and Vocational Education.			
Office for National Recognition of Degrees and Studies	National Degree Recognition			
National Catalogue of Degrees and Certificates	Updated information on offering of Technical and Vocational Education			
Federal Registry of Technical and Vocational Education Institutions	Registration of accredited Technical and Vocational Education institutions			

Table I. Regulatory institutions of the Argentine education system. Author's own elaboration

1. Federal Council of Education[46]. It is the body in charge of ensuring the unity of the National Education System. It is comprised of educational authorities from the provinces and 3 representatives of the Council of Universities. The President of the Federal Council of Education is the Minister of Education of the Nation. As the National Education Act is federal in nature, the National Ministry of Education and the ministries of education of the provinces (including the Autonomous City of Buenos Aires) organize meetings and agreements within the framework of this Federal Education Council.

2. CONEAU National Commission for University Evaluation and Accreditation[47]. It is a decentralized agency under the jurisdiction of the National Ministry of Education. It was created with the purpose of contributing to the improvement of university education. Its institutional mission is to ensure and improve the quality of university degrees and institutions operating in the Argentine university system through activities of evaluation and accreditation of the university education quality. CONEAU evaluates institutional projects, annual reports of university institutions with provisional authorization, conducts external evaluations and accredits postgraduate programs; since 1999, it has evaluated applications for definitive recognition and applications from private agencies for the evaluation and accreditation of undergraduate programs.

3. National Directorate of University Management and Auditing (DNGyFU)[48]. Technical body specialized in dealing with issues related to the organization and operation of the university system as a whole.

4. National Institute of Technology Education (INET)[49]. It was created in 1995 with the purpose of providing the Ministry of Education with an agile instrument for developing policies related to Technical and Vocational Education, in view of the new scenario that arose in the Educational System after the enactment of the Federal Education Act and the consequent transfer of the National Schools to Provincial Jurisdictions under the provincial

46 For further information about the Secretariat of the Federal Council of Education, please visit https://www.argentina.gob.ar/educacion/consejofederaleducacion

47 For further information about CONEAU, please visit https://www.coneau.gob.ar/

48 To learn about the degrees with official and national recognition, please visit http://sipes.siu.edu.ar/buscar_titulos.php

49 For further information about INET, please visit http://www.inet.edu.ar/

Ministries of Education and the Autonomous City of Buenos Aires, as a continuation of the National Council of Technical Education (CONET).

5. Office for National Recognition of Degrees and Studies[50]. It intervenes and manages the national recognition of diplomas and certificates corresponding to presential studies at the Pre-school, Primary, Secondary and Higher Non-University levels.

The highest educational authority of the jurisdiction to which the educational institution belongs must apply for the national recognition of its diplomas and certificates of studies at those levels before the Office for National Recognition of Degrees and Studies.

Ministerial Resolution No. 982/13 created the **National Registry of Nationally Recognized Degrees and Certificates (ReNaV)** for Pre-school, Primary, Secondary and Higher Education, which is administered by the Office for National Recognition of Degrees and Studies. The purpose of this program is to register the degrees and certificates of Pre-school, Primary, Secondary and Higher Education Level throughout the national territory that have national recognition.

6. National Catalog of Degrees and Certifications of Technical and Vocational Education[51]. Published since June 2013 in compliance with the Vocation and Technical Education Act No. 26,058, it is a permanent service of updated and publicly accessible information on certifications and degrees and their corresponding existing training programs of Vocational and Technical Education.

It allows us to observe in an organized manner the offer of state and privately managed Technical and Vocational Education at the Secondary, Higher and Vocational Training levels, according to the "families and professional profiles" adopted for the definition of the existing training programs.

7. Federal Registry of Technical and Vocational Education Institutions[52] registers those institutions accredited to issue degrees and certifications of Technical and Vocational Education, in its three levels of education: Secondary, Higher and Vocational Training. It intervenes in the Institutional Improvement and Strengthening plans submitted by different institutions and jurisdictions.

1.3 Training paths

Training paths comprise contents that are shared by all degrees and training programs regardless of the subjects involved. A given path is comprised of one or more subjects, depending on the curriculum of each university.

The basic criteria and standards that define and characterise the educational existing programs of Technical and Vocational Education are defined in the Reference Frameworks approved by the Federal Council of Education.

The following is a description of some characteristics of the training paths corresponding to Technical and Vocational Education at all levels and Universities.

Training paths corresponding to Technical Degrees of Secondary School

Within the Technical and Vocational Education corresponding to the middle or secondary level, the following aspects stand out:

The curricula include general training, scientific-technological training, specific technical training and professional practices.

Therefore, the field of general education enables active, reflective and critical participation in the different areas of social, political, cultural and economic life, while the fields of scientific-technological and specific technical education are those that identify the knowledge, skills, abilities, values and attitudes that provide particular support to the professional field in question and the specific knowledge to each professional field.

50 For further information about the Office for National Recognition of Degrees and Studies, please visit https://www.argentina.gob.ar/educacion/validez-titulos/glosario/titulos-certificados

51 To learn about the National Catalog of Degrees and Certifications of Technical and Vocational Education, please visit http://catalogo.inet.edu.ar/pages/flias/construcciones

52 For further information on the Federal Registry of Technical and Vocational Education Institutions, please visit http://www.inet.edu.ar/index.php/estudios-investigaciones/registro-federal-de-instituciones/

The training field of professional practice contributes to and promotes the activities or spaces that guarantee the articulation between theory and practice in the training processes and the approach of students to real work situations.

Training paths in Technical and Vocational Education

These training paths stand out for providing: [53]

Knowledge, skills, attitudes, cultural and ethical values that comprise the fields of general, scientific-technological and specific technical training, as well as the development of professional practices and the mastering of appropriate techniques that help students enter a specific professional sector.

Technical and technological knowledge, with basic scientific theoretical support, that allows specific technical interventions in productive processes with a certain level of autonomy and responsibility when solving technological problems in different sectors of the production of goods and services.

Training for performing in specific occupational areas that require a set of specific technical skills and competences, as well as knowledge of the institutional work environments for such performance.

Training paths corresponding to Technical Degrees of Non-University Higher Level

Within the Technical and Vocational Education corresponding to the non-university higher level, the following aspects stand out:

> The curricula include general training, foundation training, specific training and professional practices[54].

> A minimum course load of 1600 hours is required depending on the profession to be studied.

Training Paths in Architecture and Engineering University Education

Training paths comprise contents that are shared by all universities regardless of the subjects involved. A given path is comprised of one or more subjects, depending on the curriculum of each university.

The Higher Education Act establishes that the curricula of courses corresponding to professions regulated by the State, whose exercise could jeopardize the public interest, directly endangering the health, safety and property of the inhabitants, must consider, in addition to the expected minimum hourly load, the basic curricular contents and the criteria on the intensity of practical training established by the Ministry of Education, in agreement with the Council and the Universities.

To set the universe of possible degrees for the survey of this Report, the Project entitled *"Lineamientos para la mejora de la enseñanza sobre Eficiencia Energética en carreras estratégicas de Ingeniería y Arquitectura"* (2017)[55], which was conducted jointly by the Ministry of Education of the Nation and the Ministry of Energy and Mining of the Nation, by the Undersecretariat of Energy Saving and Efficiency, Directorate of Education, was taken as a basis. This project aimed to create a space for debate and review of the profile of the professional graduate, professional competencies and disciplinary principal elements related to energy, focusing on the Engineering and Architecture degrees of all the universities in the country.

Architecture and Engineering degrees have been selected for three main reasons:

Its framework of action requires permanent articulation with non-collegiate organizations that are relevant for EEB, for example, electrical installers, sanitary fitters, lighting and air conditioning specialists.

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53 General Directorate of Technical Education and Vocational Training of Higher Education and of Youth and Education for the Youth and Adults (DGETyFP). Notes on technical and vocational education (TVE) in Argentina. Retrieved from: http://www.etpcba.com.ar/Documentos/Planes%20de%20Mejoras/INET%202013%20Entornos%20Formativos/Material%20para%20planificaci%C3%B3n%20Institucional/educacion_tecnico_profesional.pdf

54 pursuant to the Serial A Framework Agreement No. 23 by the Federal Council of Culture and Education (CFCyE, for its Spanish acronmy) of year 2005.

55 Retrieved from http://www.energia.gob.ar/contenidos/archivos/Reorganizacion/eficiencia/guias_de_uso_responsable/lineamientosspu-final-versionmodificada-noviembre2017.pdf

Its framework of action requires direct articulation with the market, for example, suppliers of automation and monitoring systems, electrical products, air conditioning systems, domestic hot water supply (DHW), lighting fixtures, openings manufacturers, thermal insulation materials suppliers.

As they are state-regulated degrees, they are required to be periodically accredited by the CONEAU in order to comply with the required standards.

As for the engineering specializations that would be connected to EEB, the aforementioned project selected, on the basis of the Basic Curricular Contents, several specializations, some of which were chosen in the first instance for this Report: Environmental, Civil, Electromechanical, Energy, Industrial, Materials, Mechanical, Electrical, Electrical and Electronic specializations.

1.4 Basic curricular contents

The Basic Curricular Contents for the Architecture and Engineering Degrees are detailed below:

Architecture[56]

In 2006, the Ministry of Education, together with the COUNCIL OF UNIVERSITIES, prepared the basic curricular contents, the minimum hourly load and the criteria for the intensity of the practical training for the Architecture degree, as well as the activities restricted to those who have obtained the corresponding degrees, and the accreditation standards for the degree.

The Basic Curricular Contents that the Architecture degree must mandatorily cover, because they are considered essential for the degree to be valid and recognized at a national level, can be divided into different areas and subareas: Communication and Language area: Systems of Representation, Operations with Language sub-areas. Project and Planning Area: Architectonic and Urban, Urban Planning and Planning Project Sub-areas. Basic Sciences, Technology, Production and Management Areas: Basic Sciences, Structures, Construction, Air Conditioning and Installations, Production, Management and Professional Practice Sub-areas. History and Theory Area: History of Architecture and Urban Planning, Theory of Architecture Sub-areas.

Engineering[57]

In 2001, the Ministry of Education, Science and Technology together with the COUNCIL OF UNIVERSITIES, prepared the basic curricular contents, the minimum hourly load and the criteria for the intensity of the practical training for the Engineering degree, as well as the activities restricted to those who have obtained the corresponding degrees, and the accreditation standards for the following degrees: Environmental, Civil Electric, Electromechanic, Energy, Industrial Engineerings, and Engeneering in Materials, Mechanics, Electrics. Electrician and Electronics[58].

The basic curricular contents that the Engineering degrees must mandatorily cover because they are considered essential for the degree to be valid and recognized at a national level can be divided into different areas and subareas. Basic Sciences Area: Mathematics sub-area: Linear Algebra, Analytic Geometry, Differential and Integral Calculus of one and two variables, Differential Equations, Probability and Statistics, as well as topics from Numerical Analysis and Advanced Calculus. Physics and Chemistry sub-areas: Mechanics, Electricity and Magnetism, Electromagnetism, Optics, Thermometry and Calorimetry, Structure of Matter, Chemical Equilibrium, Metals and Non-Metals, Basic Kinetics in levels and approaches adapted to Engineering degrees, each of them being able to incorporate additional content in Physics, Chemistry, Biology or Earth Sciences. Contents of representation systems and computer science.

For the Engineering degrees considered in the project, the following is a list of basic and applied technologies mandatory subjects that said degrees must include in order to be considered valid:

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56 Ministerial Resolution No. 498/2006 BASIC CURRICULAR CONTENTS FOR ARCHITECTURE DEGREE. Retrieved from: http://faud.mdp.edu.ar/files/EVALUACION-ACREDITACION/2-RESOLUCION-MINISTERIAL-498-2006.pdf

57 Resolution 1232/01 by the Ministry of Culture and Education.

58 Basic Curricular Contents and others. Retrieved from: https://www.coneau.gob.ar/archivos/538.pdf

Basic Technologies

Environmental Engineer: Environmental Chemistry, Physical Chemistry, Thermodynamics, Biology/Microbiology, Ecology, Earth Sciences, Fluid Mechanics/Hydraulics and Toxicology.

Materials Engineer: Thermodynamics, Materials Science, Mechanics, Metals, Polymers, Ceramics and Composite Materials.

Civil Engineer: Statics and Strength of Materials, Materials Science, Fluid Mechanics, Topography, Hydrology and Geotechnics.

Industrial Engineer[59]:Thermodynamics and Thermal Machines, Statics and Strength of Materials, Mechanics and Mechanisms, Electrical Engineering and Electrical Machines, Computer Systems, Fluid Mechanics and Materials Science.

Electrical Engineer: Electrical Engineering, Electronics, Electrical Machines and Mechanics.

Mechanical Engineer: Rational Mechanics, Statics and Strength of Materials, Thermodynamics, Fluid Mechanics, Materials Science, Electrical Engineering and Electrical Machines, Electronics, Mechanics and Mechanisms.

Electromechanical Engineer: Rational Mechanics, Statics and Strength of Materials, Thermodynamics, Electrical Engineering, Fluid Mechanics and Materials Science.

Electronical Engineer: Signal Analysis, Electrical Engineering, Electronic Devices, Linear and Nonlinear Circuits, Electromagnetics and Measurements.

Applied Technologies

Environmental Engineer: Unit Operations/Transport Mechanisms, Health and Safety/Risk Analysis, Technologies Applied to Liquid Media, Technologies Applied to Gaseous Media, Technologies Applied to Soils, Solids and Semi-solids, and Environmental Planning and Management.

Materials Engineer: Fracture Mechanics, Materials Degradation, Computer Simulation, Materials Transformation Processes and Materials Selection.

To get the degree of Civil Engineer: Building Installations, Building Construction, Architecture, Planning and Urban Planning, Structures, Applied Geotechnics, Sanitary Engineering, Hydraulic Works and Roadways.

Electrical Engineer: Electrical Installations and Lighting Technology, Transmission and Distribution of Electrical Energy, Power Plants and Transformer Stations, Industrial Electronics, Construction and/or Application of Electrical Machines, and Principles of Analysis and Protection of Electrical Systems.

Electromechanical Engineer: Measurement and Metrology, Electrical Machines, Electrical Installations, Electronics, Control Systems, Mechanical Technology, Mechanics and Mechanisms, and Thermal and Hydraulic Machines.

Industrial Engineer: Optimization and Control, Operations Research, Quality Management, Thermomechanical and Electrical Installations, Economics, Hygiene, Safety and Sanitation, Legislation, Business Organization and Administration.

Mechanical Engineer: Metrology and Quality Management, Thermal and Hydraulic Machines, Control Systems, Mechanical Technology, Mechanical Projects, Piping, Material and Energy Transfer, and Automation.

Electromechanical Engineer: Measurement and Metrology, Electrical Machines, Electrical Installations, Electronics, Control Systems, Mechanical Technology, Mechanics and Mechanisms, and Thermal and Hydraulic Machines.

Electronical Engineer: Digital Electronics and Theory of Control.

59 Resolution 1054/2002 by the Ministry of Education. Retrieved from: http://servicios.infoleg.gob.ar/infolegInternet/anexos/75000-79999/79103/norma.htm

Annex 2: Processes and Results of the Survey and Analysis of Related Contents

2.1 Survey of assessed contents

Based on the previous work conducted by the Secretariat of Energy, the following set of educational levels, modality and degrees were considered for the development of this project. It includes the following:

1. Technical and Vocational Education:

> Secondary or middle level

  > Technical Secondary Education: Electromechanical Equipment and Installations Technician; Master Builder; Electricity Technician; Electrician / Electrical Technician with Industrial Electronics Orientation; Renewable Energy Technician; Construction Technician; Building Maintenance Technician; Electromechanical Technician with Electrical Energy Orientation; Environment Technician; Energy Technician; Refrigeration and Air Conditioning Technician.

> Vocational Training: Administration of Horizontal Property Consortiums; Assistant Electrician of Medium and Low Voltage Distribution Networks; Assistant Industrial Electrician; Construction Assistant; Dry Construction with Light Components Assistant; Domestic/Industrial Electricity Assistant; Domestic Electrical Installations Assistant; Maintenance and Repair of Refrigeration Equipment Assistant; Basic Electricity; Construction Electricity; Domestic and Industrial Electricity; Rural Electricity and Agricultural Constructions; Electrician of Medium and Low Voltage Distribution Networks; Electrician in Real Estate; Industrial Electrician; Gas Technician of Uni-functional Units (3rd. Category); Household Gas Technician (2nd. Category); Elevator Installation and Maintenance; Domestic and Industrial Electrical Installations; Domestic / Auxiliary Sanitary and Gas Installations; Electrical Circuits Installer; Renewable Energy Electrical Systems Installer; Solar Energy Systems Installer; Domestic / Industrial Electrical Panels Installer; Domestic Electrician Installer; Refrigeration Equipment and Systems Installer and Repairer; Building Maintenance; Domestic Gas Installations Installer; Building Electrician Installer; Domestic Electrician Installer; Power Systems Board Installer; Gas Appliance Repair and Heating Systems Installer; Energy Manager in Buildings.

> Higher Education Level

  > Higher Technician: Higher Technician in Industrial Maintenance; Higher Technician in Environmental Management; Higher Technician in Construction; Higher Technician in Water Resources Management; Higher Technician in Renewable Energies; Higher Technician in Industrial Management; Higher Technician in Maintenance of Services / Health Institutions; Energy Higher Technician; Higher Technician in Electrical Energy; Higher Technician Environmental Analyst Priority Career - Bicentennial Scholarships; Higher Technician in Energy with Industrial Orientation; Gas Higher Technician; Higher Technician in Industrial Processes

2. University Level accredited by CONEAU:

> Undergraduate degree: Degrees in Architecture and Civil, Industrial, Environmental, Energy, Electrical, Electromechanical, Electronic, Mechanical, Materials, Mechanical-electrical, Electrical Engineering

  > Postgraduate degree:

    > Courses: Energy Assessment in Buildings Course; Energy Manager Training Program Distance Course; Energy Management in Commercial and Public Buildings Distance Course; Building Energy Efficiency Course; Energy Management Online Course; Architectural Design for Energy Efficiency in Buildings Course; Keys and Tools for a Successful Energy Transition Postgraduate Course; Sustainability in Architecture and Cities Postgraduate Course; Renewable Energy Course: Low Temperature Solar Thermal Energy Systems; AI Refresher Courses: Energy Efficiency (2018); Sustainable Design Postgraduate refresher course; Leed Standard course; Renewable Energy course.

    > Master degrees: Master's Degree in Renewable Energies; Master's Degree in Energy; Master's Degree in Energy for Sustainable Development; Master's Degree in Renewable Energies, specializing in Solar Energy, specializing in Wind Energy and specializing in Biomass; Master's Degree in Energy Management;

Master's Degree in Energy Auditing; Master's Degree in Concrete Technology and Construction; Master's Degree in Environment and Sustainable Development (Distance); Master's Degree in Sustainable Development; Master's Degree in Sustainable Development of the Human Habitat; Master's Degree in Environmental Engineering and Sustainable Development; Master's Degree in Environmental Management of Urban Development; Master's Degree in Housing Management and Development; Master's Degree in Habitat and Housing; Master's Degree in Metropolitan Environmental Management; Master's Degree in Environmental Engineering; Master's Degree in Environmental Sciences; Master's Degree in Environmental Studies: Master's Degree in Impact Assessment and Environmental Management; Master's Degree in Environmental Management; Master's Degree in Environmental Technologies; Master's Degree in Architecture and Sustainable Habitat; Master's Degree in Sustainability in Architecture and Urban Planning; Master's Degree in Urban Engineering Planning and Management; Master's Degree in Sustainable Urban Technologies; Master's Degree in Human Environmental Systems; Master's Degree in Environmental Economics and Energy Policy; Master's Degree in Energy and the Environment; Master's Degree in Engineering Sciences, Environment; Master's Degree in Environmental Intervention, Environmental Engineering; Master's Degree in Management and Development of Social Housing; Master's Degree in Environmental and Urban Territory Management; Master's Degree in Renewable Energy Generation; Master's Degree in Territorial and Urban Development; Master's Degree in Sustainable Development Management.

- Specializations: Specialization in Renewable Energies; Specialization in Construction Management; Specialization in Quality in Construction; Specialization in Environment and Sustainable Development (Distance); Specialization in Sustainable Development of the Human Habitat; Specialization in Metropolitan Environmental Management; Specialization in Architectural Technology; Specialization in Environmental Management; Specialization in Environmental Engineering; Specialization in Project, Planning and Management of Architecture for Education; Specialization in Sustainable Architecture; Specialization in Electrical Energy; Specialization in Sustainable Urban Technologies; Specialization in Visual Environment and Efficient Lighting; Specialization in Sustainable Architecture and Habitat; Specialization in Bioclimatic Design; Specialization in Energy Optimized Building; Specialization in Environmental Engineering; Specialization in Structural Design of Architectural Works; Specialization in Management of Territorial and Urban Development; Specialization in Environmental Engineering and Sustainable Development; Specialization in Management of Territorial and Urban Development.
- PhDs: Doctor in Renewable Energies; Ph.D. in Engineering, specialized in Environmental Civil Engineering; Ph.D. in Architecture and Urban Planning; Ph.D. in Renewable Energies; Ph.D. in Chemical Technology; Ph.D. in Architecture and Urban Planning; Ph.D. in Architecture and Urban Planning.
- Diplomas: Diploma in Energy Efficiency and Renewable Energies; Diploma in Sustainability of Spaces for Healthcare; Diploma in Energy Technology and Management; Diploma in Energy Management; Diploma of Postgraduate Studies in Solar Architecture; Diploma in Advanced Studies in Production and Integral Management of the Habitat; Diploma in Renewable Energies; Diploma in Energy Efficiency.

3. Education that has not been accredited by CONEAU

- Courses and programs: Renewable Energy Course; Sustainable Architecture Course; Technique for an Efficient Envelope; Efficient Heating; LEED Certification; Passive Architecture; Bioclimatic Design; Sustainable Building Maintenance; Housing Labelling Course (CEV, for its Spanish acronym); Energy Efficiency Technology Managers Training Course; Postgraduate Degree in Sustainable Development; LEED V4 applied to the Project, Management and Construction Certification Course; Sustainability and Energy Efficiency Course (2015); LEED V4 Certifications Course and WELL - EDGE introduction; LEED HOMES Introductory Course; LEED Green Associate Introductory Course; LEED v4 Introductory Course; LEED AP BD+C Course; LEED Materials in Construction Course; Energy Efficiency for Buildings Course; LEED O+M V4 Introductory Course; LEED in Construction Course; Green Real Estate Program; Implementation of LEED™ Certification in Construction Works; BREEAM Official Course (2016).

2.2 Processes and Results of the Survey Undergraduate Degrees

Once the Faculties and Degrees were identified, the programs and Contents (available) were analyzed based on a list of keywords determined by their relevance to EEB.

This research was carried out over **a total of 537 documents** (Resolutions, CONEAU, course syllabi, curricula, among others).

The keyword search defined two categories:

- Consistent: their appearance marks a high level of proximity to EEB, e.g. "bioclimatic design".
- Inconsistent or not precise: very low proximity to EEB, however, they act as a preliminary access route for the detection of a better consistency. These are generic keywords that do not define a real proximity to EEB. E.g. "efficiency".

Stages of the content research process:

- First, the courses accredited by CONEAU were identified.
- The faculties and degrees were identified, with their available links for online information.
- The programs and Contents were traced in the information provided by Faculties and Careers.
- In view of the lack of and poor information available on the degree websites, the Resolutions published by CONEAU related to these degrees were traced.

Based on the global search of the educational existing programs at the undergraduate level, those contents that include EEB-related topics were identified. The following table shows those cases that, from the keyword search, yielded results of high and medium proximity, the following being a portion of the total universe surveyed:

UNDERGRADUATE DEGREE	CONSISTENT	GENERIC / INCONSISTENT
ARCHITECTURE	Bio-climatic /bio-environmental	energy
	Energy efficiency in buildings	sustainable
	thermal balance	environment
	Passive	Sustainable architecture
	energy modelling or simulation	
	bio-environmental design	
	rational use of energy	
ENGINEERING	Energy efficiency in buildings	thermal balance
	energy modelling or simulation	energy modelling
	energy performance	sustainable
	thermal balance	energy management
	Bio-environmental design	design

Table II: Keywords searched for in UNDERGRADUATE level. Author's own elaboration

UNDERGRADUATE DEGREE	INSTITUTION	ACADEMIC UNIT	UNIVERSITY PROGRAMS LINKS
ARCHITECTURE	University of Flores	Faculty of Social and Environmental Planning	https://www.uflo.edu.ar/ver-info-sobre-19-arquitectura.php
	National University of Cordoba	Faculty of Architecture, Urban Planning and Design	https://faud.unc.edu.ar/files/plan-de-estudios.pdf
	University of Moron	Faculty of Architecture, Design, Arts and Urban Planning	https://www.unimoron.edu.ar/area/arquitectura/stream/af4002401-arquitectura
	University of Buenos Aires	Faculty of Architecture, Design and Urban Planning.	http://www.fadu.uba.ar/categoria/49-arquitectura
	Catholic University of Salta	Faculty of Architecture and Urban Planning	https://www.ucasal.edu.ar/postulantes/pdf/26-1-plan.pdf
	National University of La Plata	Faculty of Architecture and Urban Planning	http://www.fau.unlp.edu.ar/contenidos/estudiantes/informacion-academica-y-de-posgrado/plan-de-estudios/
	National University of the Northeast	Faculty of Architecture and Urban Planning	http://www.arq.unne.edu.ar/wp-content/uploads/2018/09/PLAN-DE-ESTUDIOS-2018_Carrera_Arquitectura-2.pdf
	University of Belgrano	Faculty of Architecture and Urban Planning	http://ub.edu.ar/sites/default/files/contenidos_minimos_arquitectura.pdf
	Interamerican Open University	Faculty of Architecture	https://www.uai.edu.ar/facultades/arquitectura/arquitectura/plandeestudios/
	Catholic University of Cordoba	Faculty of Architecture	https://www2.ucc.edu.ar/archivos/documentos/Folletos_digitales/2019/insert-arquitectura-2019.pdf
	University of Palermo	Faculty of Architecture	https://www.palermo.edu/arquitectura/arquitectura/plan_estudios.html
CIVIL ENGINEERING	National Technological University	Buenos Aires Regional Faculty	https://frba.utn.edu.ar/wp-content/uploads/2019/01/Correlativas-Plan-95-Adecuado-2019.pdf
	National Technological University	Avellaneda Regional Faculty	https://www.fra.utn.edu.ar/index.php/carreras/ingenierias/ingenieria-civil
	Santa Maria de los Buenos Aires ArgentineCatholicUniversity	Faculty of Engineering and Agricultural Sciences	http://uca.edu.ar/es/facultades/facultad-de-ingenieria-y-ciencias-agrarias/carrera-de-grado/ingenieria-civil/plan-de-estudio
	National University of La Plata	Faculty of Engineering	https://www.ing.unlp.edu.ar/sitio/grado/2018/civil-2018.pdf
	National University of the Comahue	Faculty of Engineering	http://fainweb.uncoma.edu.ar/ckeditor_assets/attachments/567/ord_0805_1997_16.pdf
	National University of the Northeast	Faculty of Engineering	http://www.ing.unne.edu.ar/ingenieria_civil
	Instituto Universitario del Ejército	"GrlDiv D. Manuel N. Savio" Technical School of Higher Education	http://wp.iese.edu.ar/?page_id=5032
INDUSTRIAL ENGINEERING	Catholic University of Salta	Faculty of Engineering; Faculty of Engineering and Computer Science	https://www.ucasal.edu.ar/postulantes/pdf/19-1-plan.pdf
	National University of La Plata	Faculty of Engineering	https://www.ing.unlp.edu.ar/sitio/grado/2018/industrial-2018.pdf
	National University of Cordoba	Faculty of Exact, Physical and Natural Sciences	https://fcefyn.unc.edu.ar/facultad/secretarias/academica/escuelas/ingenieria-industrial/ingenieria-industrial/
	National University of La Matanza	Engineering and Technological Research Department	https://ingenieria.unlam.edu.ar/index.php?seccion=3&idArticulo=34

ENVIRONMENTAL ENGINEERING	National University of General San Martin	School of Science and Technology	http://www.unsam.edu.ar/escuelas/ciencia/171/ciencia/ingenieria-ambiental
ELECTRIC ENGINEERING:	National Technological University	Regional Faculty of San Nicolas	https://www.frsn.utn.edu.ar/frsn/files/Ingenier%EDa%20El%E9ctrica%20correlatividades.pdf
	National Technological University	Delta Campana Regional Faculty	https://www.frd.utn.edu.ar/ingenieria_electrica
	National University of the Comahue	Faculty of Engineering	http://fainweb.uncoma.edu.ar/carrera?id=27
	National University of the Northeast	Faculty of Exact and Natural Sciences and Land Surveying	http://exa.unne.edu.ar/carreras/ingenieria_electrica.php
MECHANICAL ENGINEERING	National University of Rio Cuarto	Faculty of Engineering	https://www.ing.unrc.edu.ar/carreras/ing-mecanica-plan2005-ver0.pdf
ELECTRICAL ENGINEERING:	University of Buenos Aires	Faculty of Engineering	http://www.fi.uba.ar/sites/default/files/Ingenieria%20Electricista%202009%20actualizacion%202018_.pdf

Table III: Content survey and connection with Energy Efficiency Survey in UNDERGRADUATE degrees. Source: Author's own elaboration

2.3 Processes and Results of the Survey Postgraduate degrees and courses

A total of **182 courses and postgraduate courses** were surveyed, and once those programs and contents (available) were identified on the basis of a list of keywords determined by their relevance to the EEB, the same steps were followed as explained above for the undergraduate courses, both for the research and compilation of the information, and for the "Search by keywords".

POSTGRADUATE DEGREE	CONSISTENT	GENERIC / INCONSISTENT
PhDs, SPECIALIZATIONS, MASTER DEGREES, DIPLOMAS, COURSES, WORKSHOPS AND SEMINARS	Energy efficiency	Use of energy and efficient use
	Bio-climate / bio-environmental	Rational use of energy.
	Eco-design	Management of efficient use of energy
	Environmental energy simulation	Sustainable architecture
	Thermal comfort and energy balance	Energy management
	Energy modelling	Renewable energies
	Passive design	Energy
	Thermal comfort	Sustainability
	Building thermal conditioning	rational use of energy
	Sustainable building certification	Non-conventional energies
	Energy labelling of buildings	IRAM (50001)
	Carbon neutral buildings	Exterior building envelope
	Thermal balance	

Table IV: Keywords searched for in POSTGRADUATE level. Source: author's own elaboration

Based on the global search of the educational existing programs at the postgraduate level, those contents that include EEB-related topics were identified. The following table shows those cases that, from the keyword search, yielded results of high and medium proximity, the following being a portion of the total universe surveyed.

TYPE	COURSE	INSTITUTION	ACADEMIC UNIT	LINK
MASTER DEGREE	Master Degree in Energy	University of Buenos Aires	Faculty of Law	http://www.derecho.uba.ar/academica/posgrados/mae_energia_plan.php
SPECIALIZATION:	Specialization in Metropolitan Environmental Management	University of Buenos Aires	Faculty of Architecture, Design and Urban Planning	http://www.uba.ar/posgrados/arquitectura/3104.pdf
SPECIALIZATION:	Specialization in Architectural Technology	National University of Cordoba	Faculty of Architecture, Urban Planning and Design	https://drive.google.com/file/d/10ciDjFDz5mzfCLwnJSSj9ORSIqwMb3f5/view
MASTER DEGREE	Master Degree in Environmental Management of Urban Development	National University of Cordoba	Faculty of Architecture, Urban Planning and Design	https://drive.google.com/file/d/0B_tEjbnncEOlcy16clFCN2s3bVE/view
MASTER DEGREE	Master Degree in Housing Management and Development	National University of Cordoba	Faculty of Architecture, Urban Planning and Design	https://drive.google.com/file/d/0B_tEjbnncEOlOFVmMzBleElPcVk/view
MASTER DEGREE	Master Degree in Metropolitan Environmental Management	University of Buenos Aires	Faculty of Architecture, Design and Urban Planning	http://www.uba.ar/posgrados/archivos/MAE_Gestionambiental.pdf
SEMINAR	Seminar of Continuing Postgraduate Studies: Energy efficiency	University of el Salvador	Faculty of History, Geography and Tourism	http://extension.usal.edu.ar/extension_inicio#hgt&5
COURSE	Energy Assessment in Buildings Course	National Technological University- ASHRAE		https://sceu.frba.utn.edu.ar/cursopresencial/evaluacion-energetica-en-edificios/
COURSE	Online Energy Management Course	National Technological University	Buenos Aires Regional Faculty	https://www.sceu.frba.utn.edu.ar/e-learning/cursos-a-distancia/Energia.html http://www.sceu.frba.utn.edu.ar/e-learning/cursos-a-distancia/Energia/Gestion-de-la-Energia/temario.html
PROGRAM	Refresher Program in Sustainable Architecture	University of Buenos Aires	Faculty of Architecture, Design and Urban Planning	http://www.fadu.uba.ar/post/745-arquitectura-sustentable
COURSE	Architectural Design for energy efficiency in buildings course	University of Buenos Aires	Centro de Estudios de la Actividad Regulatoria Energética (CEARE) + RenewablesAcademy AG (RENAC) - ETRELA Project	https://www.renac.de/projects/current-projects/etrela http://ceare.org/
SPECIALIZATION:	Specialization in Sustainable Urban Technologies	University of Buenos Aires	Faculty of Engineering	http://www.fi.uba.ar/es/node/295
SPECIALIZATION:	Specialization in Architecture and Sustainable Habitat	National University of La Plata	Faculty of Architecture and Urban Planning	http://www.fau.unlp.edu.ar/contenidos/graduados/carreras-de-posgrado/especializacion-en-arquitectura-y-habitat-sustentable-ayhs-carreras-de-posgrado/
MASTER DEGREE	Master Degree in Architecture and Sustainable Habitat	National University of La Plata	Faculty of Architecture and Urban Planning	http://www.fau.unlp.edu.ar/contenidos/graduados/carreras-de-posgrado/maestria-en-arquitectura-y-habitat-sustentable/
MASTER DEGREE	Master's Degree in Sustainability in Architecture and Urban Planning	University of Buenos Aires	Faculty of Architecture, Design and Urban Planning	http://www.fadu.uba.ar/post/1032-67-sustentabilidad-en-arquitectura-y-urbanismo

MASTER DEGREE	Master Degree in Urban Engineering Planning and Management	University of Buenos Aires	Faculty of Engineering	https://www.ingenieriaurbana.com.ar/plan-de-estudio
MASTER DEGREE	Master Degree in Sustainable Urban Technologies	University of Buenos Aires	Faculty of Engineering	http://www.fi.uba.ar/es/node/1384
PhD:	PhD in Architecture and Urban Planning	National University of La Plata	Faculty of Architecture and Urban Planning	http://www.fau.unlp.edu.ar/contenidos/graduados/carreras-de-posgrado/doctorado-en-arquitectura-y-urbanismo/
NON-UNIVERSITY COURSE	Sustainable Architecture Course	Fundación Energizar		https://cursos.energizar.org.ar/cursos/informacion/6/curso-de-arquitectura-sustentable
NON-UNIVERSITY COURSE	Technique for Efficient Envelope	Centro de Formación en Arquitectura Sustentable		https://www.cfasargentina.com.ar/
NON-UNIVERSITY COURSE	Efficient heating	Centro de Formación en Arquitectura Sustentable		https://www.cfasargentina.com.ar/
NON-UNIVERSITY COURSE	LEED Certification	Centro de Formación en Arquitectura Sustentable		https://www.cfasargentina.com.ar/
NON-UNIVERSITY COURSE	Passive Architecture	Centro de Formación en Arquitectura Sustentable		https://www.cfasargentina.com.ar/
NON-UNIVERSITY COURSE	Bioclimatic Design	Centro de Formación en Arquitectura Sustentable		https://www.cfasargentina.com.ar/
NON-UNIVERSITY COURSE	Sustainable Maintenance of Buildings	Centro de Formación en Arquitectura Sustentable		https://www.cfasargentina.com.ar/
NON-UNIVERSITY COURSE	Housing Labelling Course (CEV, for its Spanish acronym)	Argentine Secretariat of Energy	National Directorate of Energy efficiency	https://www.argentina.gob.ar/produccion/energia/eficiencia-energetica/eficiencia-energetica-en-edificaciones/etiquetado-de-viviendas#4
NON-UNIVERSITY COURSE	Training Course for Technology Managers in Energy Efficiency	Federal Council of Investment	Energy Efficiency Program	CFI http://cfi.org.ar/nota/programa-de-eficiencia-energetica/
DIPLOMA	Diploma in Energy Management	Technological Institute of Buenos Aires	Double Degree Program with Karlsruhe Institute of Technology (KIT) from Germany	https://www.itba.edu.ar/postgrado/programas-ejecutivos/diplomatura-itbaeurem-en-gestion-de-la-energia/
NON-UNIVERSITY COURSE	Postgraduate Certification in Sustainable Development	Escuela Argentina de Diseño		https://www.ead.edu.ar/carreras-y-cursos/postitulo-en-desarrollo-sustentable/
SPECIALIZATION:	Specialization in Energy Optimized Building	National University of the Northeast	Applied Sciences	http://posgrado.unne.edu.ar/carreras/especializacion# http://posgrado.unne.edu.ar/pdf/resoluciones/resolucion_183.pdf http://www.arq.unne.edu.ar/eeeo/
SPECIALIZATION:	Specialization in Environmental Engineering	National University of the Northeast	Applied Sciences	http://posgrado.unne.edu.ar/pdf/resoluciones/resolucion_174.pdf
DIPLOMA	Diploma in Advanced Studies in Solar Architecture	National University of the Northeast	Applied Sciences	http://www.arq.unne.edu.ar/arq-solar/

SPECIALIZATION:	Specialization in Structural Design of Archirectural Works	National University of Cordoba	Faculty of Architecture, Urban Planning and Design	https://drive.google.com/file/d/0B_tEjbnncEOlcENVSGJYM3hlbk0/view
MASTER DEGREE	Master Degree in Renewable Energy Generation	National University of Cordoba	Faculty of Exact, Physical and Natural Sciences	https://fcefyn.unc.edu.ar/facultad/secretarias/investigacion-y-posgrado/-posgrado/maestrias-en-generacion-de-energias-renovables/
WORKSHOP	Applied Energy Efficiency Workshop	Almirante Guillermo Brown National University		https://www.unab.edu.ar/talleres.html https://www.unab.edu.ar/eficiencia-energetica.html
COURSE	AI Refresher Course: Energy Efficiency (2018)	National University of General San Martin	Institute of Architecture and Urban Planning	http://www.unsam.edu.ar/ http://noticias.unsam.edu.ar/evento/cursos-de-actualizacion-del-ia-eficiencia-energetica/
PhD:	PhD in Architecture and Urban Planning	Interamerican Open University		https://www.uai.edu.ar/facultades/arquitectura/doctorado-en-arquitectura-y-urbanismo/
PROGRAM	Postgraduate Program in Renewable Energies	Catholic University of Cordoba		http://uca.edu.ar/es/facultades/facultad-de-ingenieria-y-ciencias-agrarias/curso-de-posgrado/programa-de-posgrado-en-energias-renovables-1/plan-de-estudio
SEMINAR	Seminar: Housing Efficient and Sustainable Construction with Cement-based Solutions	Catholic University of Cordoba		http://uca.edu.ar/es/facultad-de-ingenieria-y-ciencias-agrarias/seminario:-construccion-eficiente-y-sustentable-de-viviendas-con-soluciones-base-cemento
DIPLOMA	Diploma in Energy Efficiency	University of Business and Social Sciences		https://www.uces.edu.ar/carreras-escuela-negocios/nuevas-tecnologias/diplomatura-eficiencia-energetica
PhD:	PhD in Architecture and Urban Planning	University of Flores		https://www.uflo.edu.ar/ver-info-sobre-41-doctorado-en-arquitectura-y-urbanismo.php#perfil_titulo http://www.lapiramide.net/abre-nueva-cohorte-del-doctorado-de-arquitectura-y-urbanismo/
COURSE	Postgraduate Refresher Course in Sustainable Design	University of Palermo		https://www.palermo.edu/arquitectura/noticias/disenio_sustentable_prf.html JORNADA SOBRE EE EN EDIFICIOS https://www.palermo.edu/arquitectura//eventos/XXI_Jornadas_Actualizacion_Tecnologicas.html
COURSE	Leed Standard Course	Torcuato Di Tella University	Argentina Green Building Council (AGBC) and *Centro de Estudios de Arquitectura Contemporánea* (UTDT)	https://www.utdt.edu/ver_evento_agenda.php?id_evento_agenda=6324&id_item_menu=449
PROGRAM	Sustainability Education Program	University of San Andres		https://www.udesa.edu.ar/pes/programa-de-formacion-en-educacion-para-la-sustentabilidad-y-la-ciudadania-global
NON-UNIVERSITY COURSE	LEED v4 Certification Course applied to the Project, Management and Construction	Central Society of Architects		http://socearq.org/2.0/2020/04/30/certificacion-leed-v4-aplicado-al-proyecto-la-gestion-y-la-obra-2/
NON-UNIVERSITY COURSE	Sustainability and Energy Efficiency Course (2015)	Professional Council of Land Surveyors, Architects and Engineers of Chaco		http://consejochaco.org/index.php/noticias/eventos/item/197-cursos-libres-y-gratuitos http://consejochaco.org/index.php/institucional/cronograma-de-cursos/icalrepeat.detail/2015/04/15/14/-/sustentabilidad-y-eficiencia-energetica

NON-UNIVERSITY COURSE	Course: LEED - V4 Certifications and WELL – EDGE Introduction	Association of Architects of Rio Negro		http://www.carn.com.ar/ http://www.carn.com.ar/noticias/curso-certificaciones-leed-v4-e-introduccion-well-edge
NON-UNIVERSITY COURSE	LEED HOMES Introductory Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php3
NON-UNIVERSITY COURSE	LEED Green Associate Introductory Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php3
NON-UNIVERSITY COURSE	LEED v4 Introductory Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php3
NON-UNIVERSITY COURSE	LEED AP BD+C Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php3
NON-UNIVERSITY COURSE	Materials in Construction LEED Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php3
NON-UNIVERSITY COURSE	Energy Efficiency in Buildings Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php3
NON-UNIVERSITY COURSE	LEED O+M V4 Introductory Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php3
NON-UNIVERSITY COURSE	LEED in Construction Course	Green Group		https://www.greengroup.com.ar/home.php https://www.cursosleed.com.ar/ofertas.php4
NON-UNIVERSITY COURSE	Green Real Estate Program	Argentina Green Building Council (AGBC)- de Estudios de Arquitectura Contemporánea (EIA)	Argentine Real Estate Chamber (CIA)	https://www.argentinagbc.org.ar/educacion/programas/curso-green-real-estate/
NON-UNIVERSITY COURSE	Implementation of LEED™ in Construction Works Certification	Argentina Green Building Council (AGBC)- *Escuela de Gestión de la Construcción*	Argentine Chamber of Construction	https://www.argentinagbc.org.ar/educacion/programas/leed-para-constructores/
NON-UNIVERSITY COURSE	BREEAM® Official Course (2016)	BREEAM - AcciónSustentable NGO		http://www.breeam.es/index.php/comunicacion/noticias/item/1329-impartimos-en-buenos-aires-el-i-curso-oficial-breeam-en-argentina

Table V: Content survey and connection with Energy Efficiency Survey in POSTGRADUATE degrees. Source: Author's own elaboration

2.4 Processes and results of the Survey: Technical and Vocational Education

A total of **120 programs, Frameworks and Resolutions** were analyzed based on a list of keywords determined for EEB. Some examples of these keywords include: DHW, thermal balance, bio-climate, temperature control system, among others.

The following online search criteria were used for the Contents:

- Information and Reference Frameworks at INET.
- Reference frameworks and programs in Educational Institutions.
- Resolutions (Provincial Ministries of Education and other governmental institutions).

TECHNICAL DEGREES	GENERAL DEGREES		
HIGHER TECHNICAL STUDIES, SECONDARY TECHNICAL STUDIES, VOCATIONAL TRAINING	openings	thermal balance	electricity
	DHW	Bioclimatic	electromechanics
	air conditioning	Certifications	energy
	insulation	temperature control	photovoltaic solar energy
	architecture	Construction	thermal solar energy
	sun exposure	energy efficiency	

Table VI: Keywords searched for in TECHNICAL AND VOCATIONAL level. Author's own elaboration

Based on the global search of the educational offer at the technical/vocational sector, those contents that include EEB-related topics were identified. The following table shows those cases that, from the keyword search, yielded results of high and medium proximity, the following being a portion of the total universe surveyed:

TYPE	DEGREE	PROXIMITY
Higher Technical Education Program	Higher Technician in Industrial Maintenance	Medium
	Higher Technician in Environmental Management	Medium
	Higher Technician in Water Resources	Medium
	Higher Technician in Renewable Energies	Medium
	Higher Technician in Healthcare Services/Institutions	Medium
	Higher Technician in Industrial Processes	Medium
Technical Secondary Education Program	Electromechanical Equipment and Installations Technician	Medium
	Master Builder	High
	Electricity Technician	High
	Renewable Energy Technician	Medium
	Electromechanical Technician with Electrical Energy Orientation	High
Vocational Training Program	Administration of Horizontal Property Consortiums	Medium
	Assistant Industrial Electrician	High
	Dry Construction with Light Components Assistant	Medium
	Domestic Electrical Installations Assistant	Medium
	Electrician of Medium and Low Voltage Distribution Networks	Medium
	Real Estate Electrician	High
	Industrial Electrician	High
	Gas Technician of Unifunctional Units (3rd. Category)	Medium
	Household Gas Technician (2nd. Category)	Medium
	Renewable Energy Electrical Systems Installer	High
	Domestic Gas Installations Installer	Medium
	Building Electrician Installer	Medium
	Domestic Electrician Installer	High
	Power Systems Board Installer	Medium
	Energy Manager in Buildings	High

Table VI: Content survey and connection with EEB in TECHNICAL AND VOCATIONAL level. Source: Author's own elaboration

2.5 Identification and characterisation of non-governmental associations:

ASSOCIATION	ACRONYM	SPHERE	ACTION	SCOPE	REFERENCE
Professional Association of Mechanical and Electrical Engineering	COPIME	It integrates and regulates the activity at the national level.	professional regulation and motivation	national	www.copime.org.ar/
Civil Engineering Professional Association	CPIC	It integrates and regulates the activity at the national level.	professional regulation and motivation	national	www.cpic.org.ar/
Industrial Engineering Professional Association	CPII	It integrates and regulates the activity at the national level.	professional regulation and motivation	national	www.cpii.org.ar/
Architecture and Urban Planning Professional Council	CPAU	It integrates and regulates the activity at the national level.	professional regulation and motivation	national	www.cpau.org/
Central Society of Architects	SCA	it brings together professionals	motivation	national	socearq.org/2.0/
Argentine Center of Engineers	CAI	it brings together professionals	positioning	national	cai.org.ar/
American Society of Heating, Refrigerating and Air-Conditioning Engineers	ASHRAE capituloargentino	it brings together and positions businesses and professionals in the market, it grants professional certifications and credentials	positioning	international	argentina.ashraechapters.org/
Argentina Green Building Council	AGBC	it brings together and positions businesses and professionals in the market	positioning	national	www.argentinagbc.org.ar/
United States Green Building Council	USGBC	it develops certification programs	positioning	international	new.usgbc.org/
Green Business Certification Inc.	GBCI	it grants professional certifications and credentials	positioning	international	www.gbci.org/
Argentine Chamber of Construction	CAMARCO	Business chamber	Not defined	national	http://www.camarco.org.ar/
Argentine Energy Efficiency	EEA	international cooperation consortium	financing research training	national	eficienciaenergetica.net.ar/
Argentine Standardization and Certification Institute	IRAM	Standard	Standardization	national	www.iram.org.ar/
Building Workers Union of the Argentina Republic	UOCRA	construction workers	motivation and training	national	www.uocra.org

Table VII: Non-Governmental stakeholders Author's own elaboration

Annex 3: Analysis of Stakeholders

Surveys

Within the framework of the project "Gap assessment of the skills acquired for approaching and expanding Energy Efficiency in Buildings (EEB) in Argentina", two types of surveys were conducted, one of which was addressed to professionals who took the Energy Certifier Course (within the framework of the Housing Energy Labelling project developed and promoted by the Secretariat of Energy of the Ministry of Productive Development of the Nation) and the other one was addressed to educators and specialists and was conducted by electronic means from the SSERyEE mailing list, in Google forms format, in order to obtain, as much as possible, a profile of the voluntary participants. These surveys are further described below:

3.1 Survey to practicing professionals

- E-mail address
- How would you classify the origin of your interest in the Energy Efficiency in Buildings field? Personal Interest / Professional Motivation / Employer's Requirements / All of the above
- What are your profession, studies or vocational training?
- How do you rate your level of knowledge on the EEB subject? From 1 (Low-in learning stage) to 5 (High - expert)
- How long have you been working in the EEB sector? Less than 5 years / Between 5 and 10 years / Over 10 years
- What are the areas of your expertise in EEB? Please, mark all that apply. Architectural Design / Materials / Temperature Control Systems / MEP Installations / Others
- If your previous answer was "Other", please indicate the areas of your specificity
- Do you consider that the labour market demands specializations that are not met by the formal educational existing programs? Yes / No
- If the above answer is affirmative, can you specify which would be those unmet demands?
- Did you find ways to get training in the academic environment? Which ones?
- What were the minimum contents? Can you provide a description of the institution or group or a link to its website?
- Do you think that the training received meets the current market demand? Yes / No
- Did you find ways to get training in the non-formal academic environment? Which ones? Did you find it useful in your professional activity?
- Do you plan to continue your training? In what areas? In what institutions?
- Within the United Nations framework, the gender perspective is a fundamental and strategic approach to achieve the commitments to equality. We appreciate your response in this regard. What is your gender?
- If you are interested in receiving news about the EEB expansion in Argentina, please specify below your e-mail address and location. Thank you very much for your participation!

3.2 Survey to educators

Are you involved in the transfer of skills and knowledge about Energy Efficiency in Buildings? What level of the Education System do you work in? Undergraduate Education / Postgraduate Education / Tertiary - Technical Education / Technical Secondary Education / Other:

- What is your profession or vocational training?
- How long have you been involved in the education of the Energy Efficiency in Buildings sector? Less than 5 years / Between 5 and 10 years / Over 10 years/ Other:
- What are the areas of your expertise in EEB? Please, mark all that apply. Bioclimatic Design /Materials / Energy simulation / Renewable energies / Temperature control systems / Others:
- Do you think that some specializations are not covered by the formal educational existing programs? Yes / No
- If the above answer is affirmative, can you specify which would be those unmet demands?
- What would you supplement this shortfall with?
- Is there any educational institution that is the benchmark on the subject in Argentina? Can you provide a description a link to the institution's or group's website?
- Do you think that students receive and incorporate enough tools to face these new knowledge and skills demands? Yes / No
- Could you describe such tools?
- Are you professionally updated on EEB-related topics? What institutions do you study in?
- Within the United Nations framework, the gender perspective is a fundamental and strategic approach to achieve the commitments to equality. We appreciate your response in this regard. What is your gender?
- If you are interested in receiving news about EEB expansion in Argentina, please specify below your e-mail address and location. Thank you very much for your participation!

Annex 4: Analysis of Stakeholders: Workshop

4.1 Workshop information

Schedule and timetable

Introduction	Welcome	9:30
	Meeting guidelines	9:33
	Institutional presentation (National Directorate)	9:35
	Institutional presentation (C2E2)	9:45
	Profile of registered participants	9:40
	Workshop program	9:55
	Team's introduction	10:00
Interative activity	Slido survey	10:40
	Joint analysis of results: Scattering in the "Problem diagnosis"	10:50
Project's theoretical aspects	Project's contents	10:05
	Introduction and context	10:10
	Scope and objectives	10:20
	Analysis of supply	10:25
	Analysis of demand	10:30
	Map of Stakeholders	10:35
	Working groups sessions	11:00
Group activity	INTRA group dynamics	11:05
	Activity	11:15
	Sectorial conclusion	11:35
	Back to main session	
Group activity	Sharing of sectorial proposals	11:40
	First part closing	12:00
Break	Break	12:20
	Resume	12:25
	Working groups sessions Part II	
Group activity	INTER sectorial assignment instructions	12:25
	Crossover strategy: adjustment and contributions to other groups' strategies	
	Results	12:50
	Back to main session	
Closing	Workshop closing	12:55
	Analysis and sharing of results	13:15
	(Institutional) Formal closing	13.20

Table VIII: Workshop's schedule and timetable. Source: Author's own elaboration

4.2 Participants' profile

During the Workshop, a survey was conducted using the Slido platform to further define the participants' profiles, asking the following questions and getting the following results:

Figure 1: How long have you been working on EEB-related topics? Source: Author's own elaboration

Figure 2: In which sector do you work? Source: Author's own elaboration

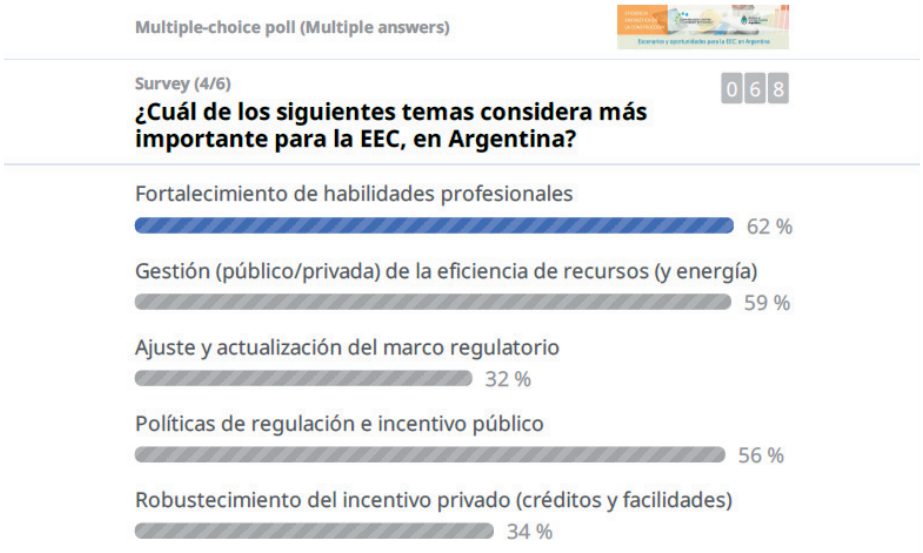


Figure 3: Which of the following topics do you consider most important for the EEB in Argentina? Source: Author's own elaboration

Figure 4: To your mind, which would be the main actor to develop the EEB in Argentina? Source: Author's own elaboration

Figure 5: In what time span do you think EEB will be able to achieve significant development in Argentina? Source: Author's own elaboration

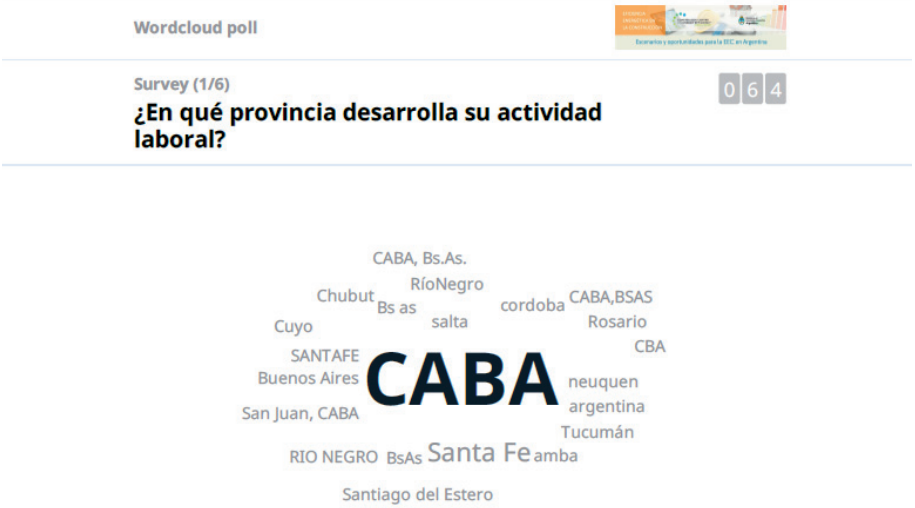


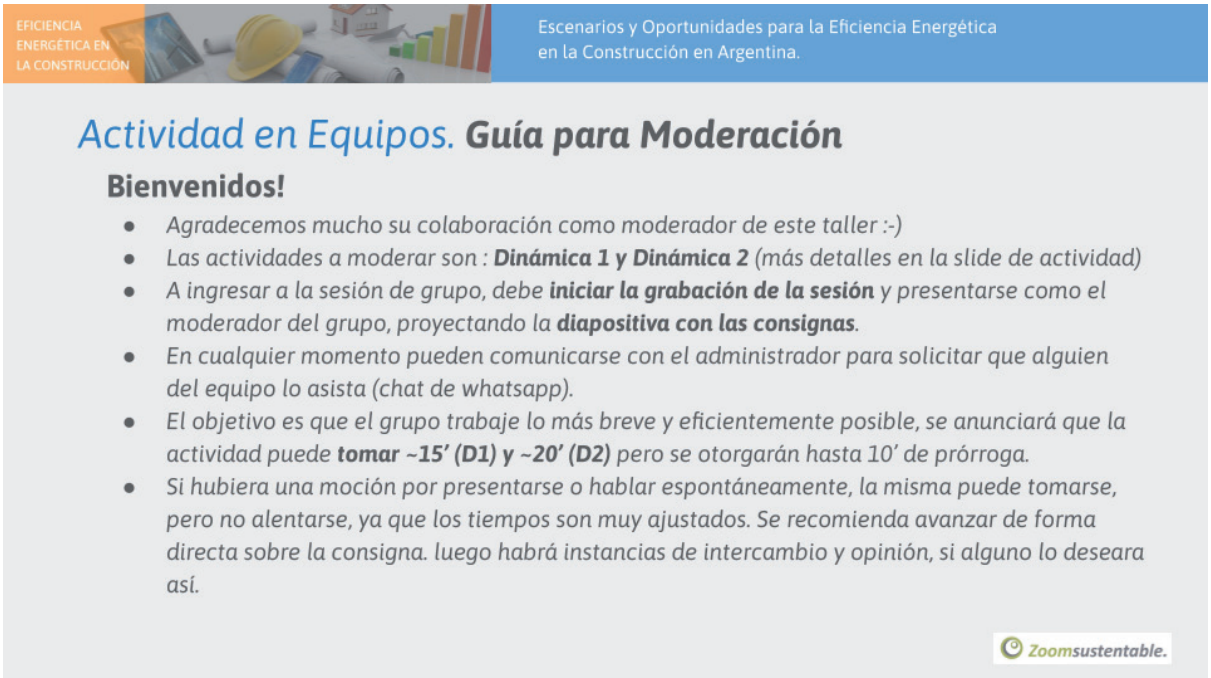
Figure 6: Which province do you operate in? Source: Author's own elaboration

4.3 Planning and preparation

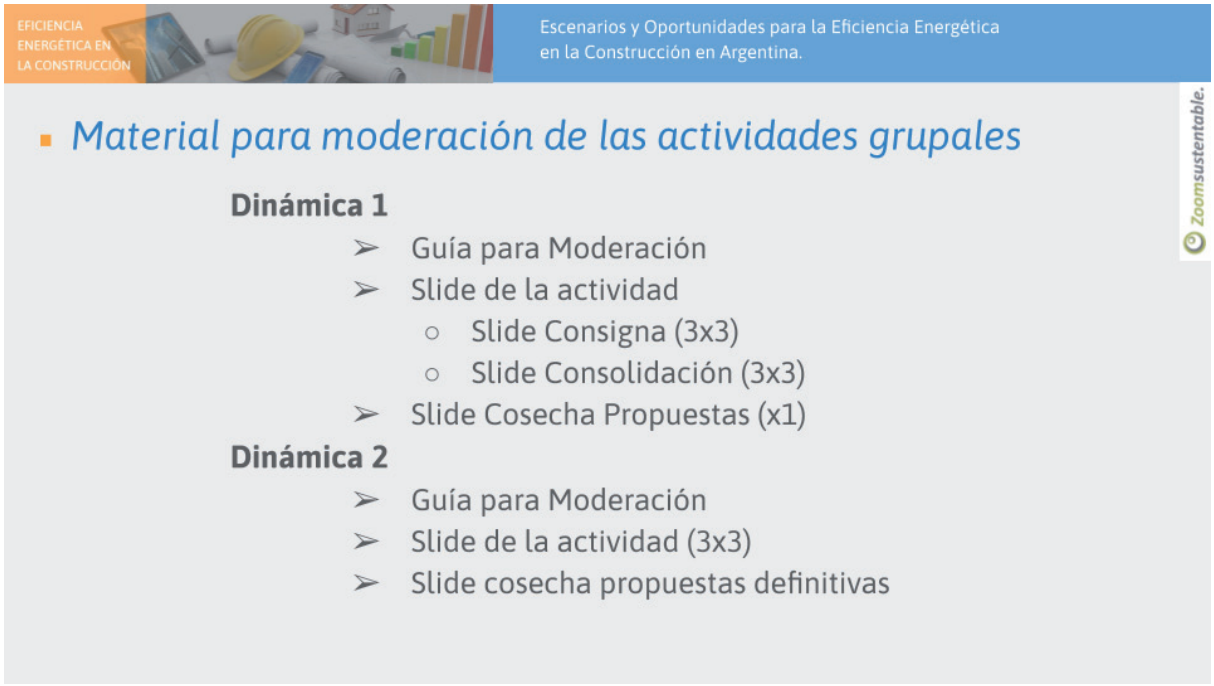
Brief description of objectives, means and equipment.

- The workshop was held on Wednesday, August 12, 2020, between 9:30 and 13:45, Argentine time.
- It was supported by a Zoom Pro platform license and a Slido educational license, provided by C2E2, in order to be able to edit and provide immediate feedback of the information gathered from the participants as a value/ input for conducting the workshop.
- Approximately 85 participants participated actively.
- For the group dynamics, we worked with a team of 9 moderators and the technical support of two people. The moderators were trained weeks in advance, and were provided different detailed instructions and recommendations for approaching these dynamics. For this purpose, each moderator was provided with different files containing the necessary information and the following steps were outlined for them:
  a. Analyze procedure and contingency plan:
     i. Review dynamics instruction
     ii. Checklist of key documents for moderators
     iii. Test login to group sessions, recording, use of chatbox and document sharing in Gslides
  b. Having read PDF entitled "*Dinámicas Taller Virtual 2020 C2E2*"
  c. Open the document (Google Slides) with the presentation to be used during the dynamics.
  d. Ensure offline contact with everyone (Whatsapp Group test)
  e. Install alarms at 5'- 7'- 9'-11'-13' etc. with snooze every 2 minutes once the group session has started.

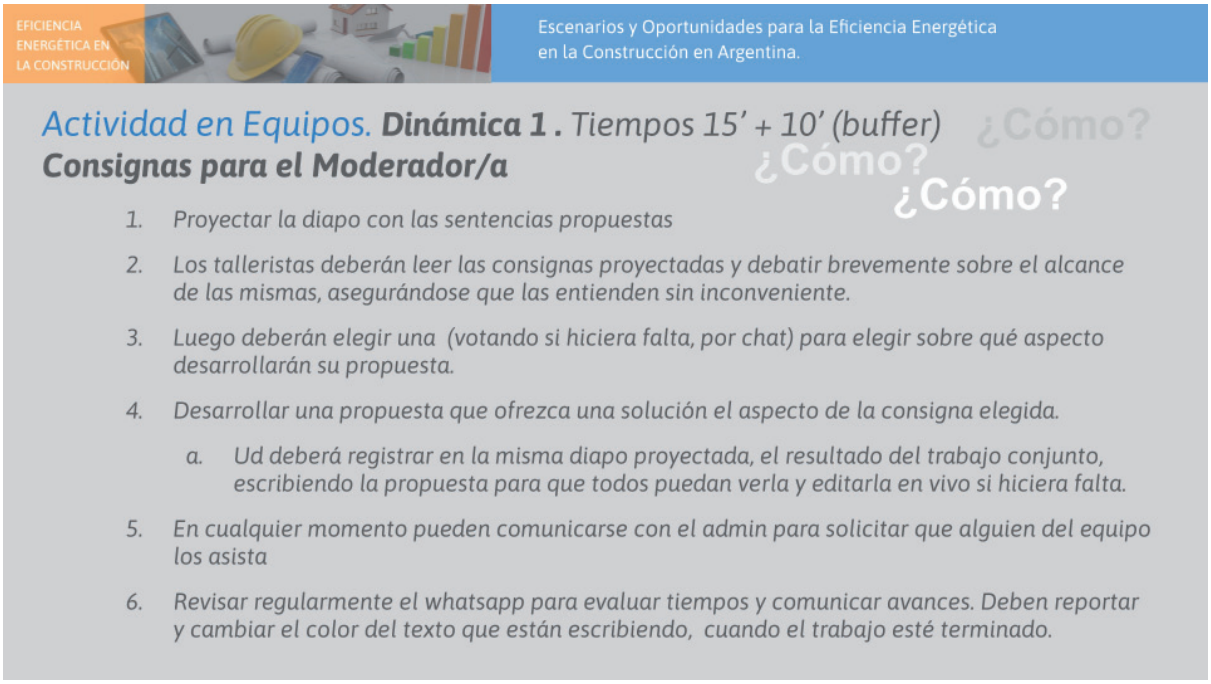
Moderation guidelines:



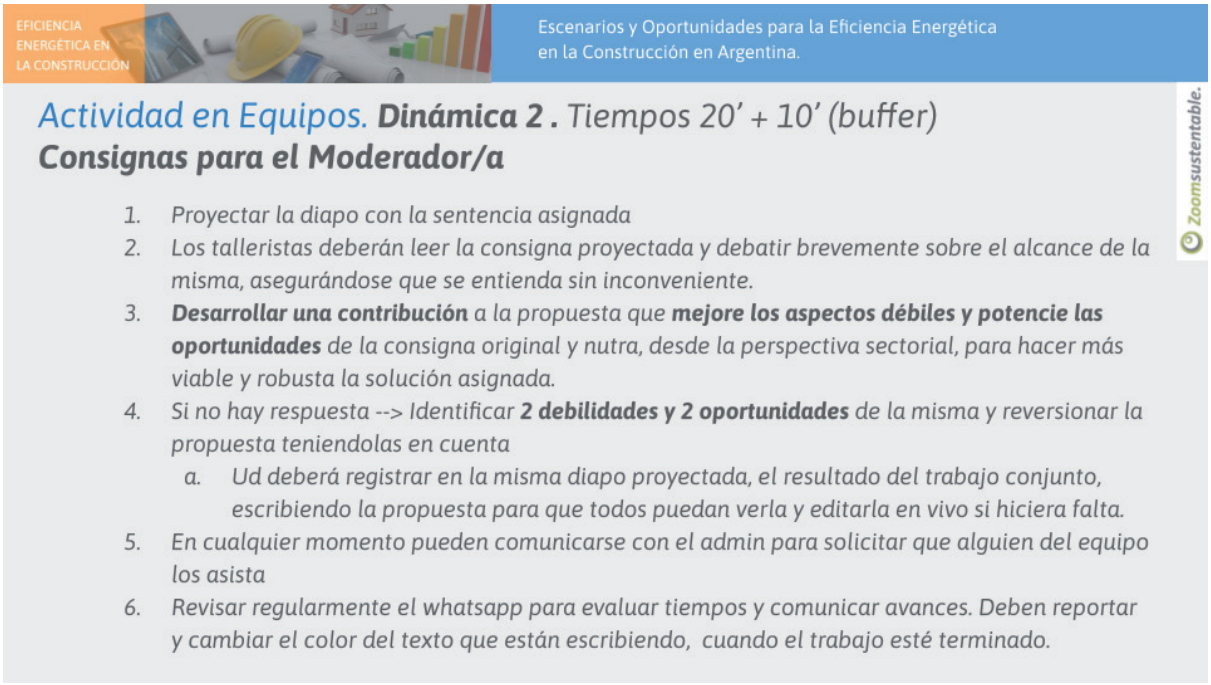
Slide I. Source: Author's own elaboration



Slide II. Source: Author's own elaboration



Slide III. Source: Author's own elaboration



Slide IV. Source: Author's own elaboration

4.4 Workshop development

Screenshots of the workshop sharing and presentation material:

Pre-registration

Flyer I: Pre-registration. Source: Author's own elaboration

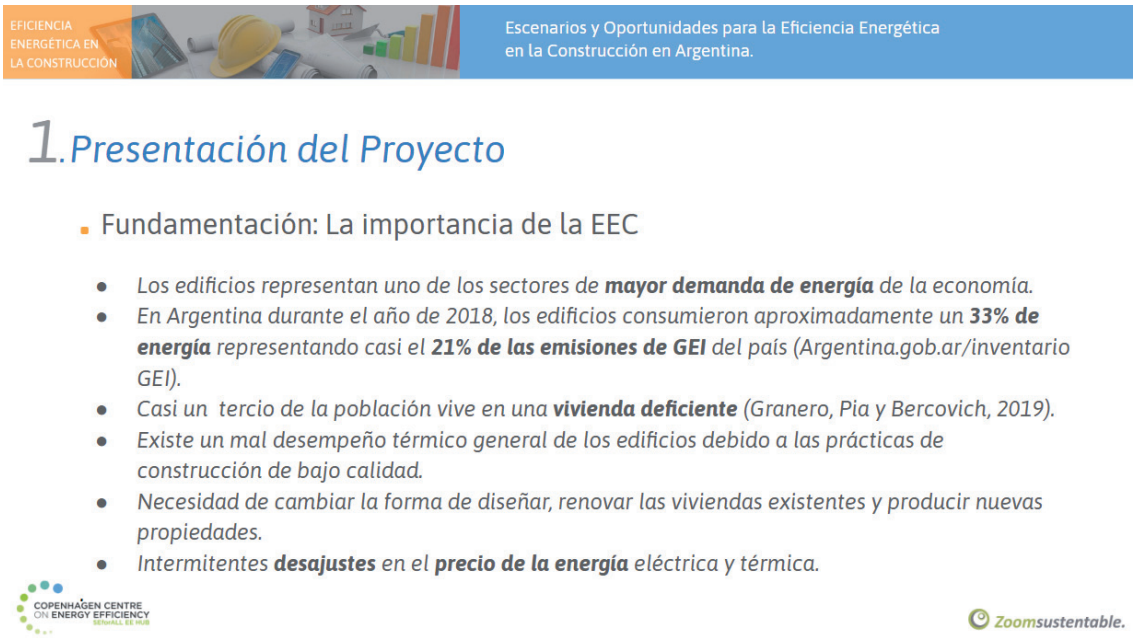
Definite Registration

Flyer II: Registration. Source: Author's own elaboration

Slides of the Participatory Workshop, connected to the activities and dynamics proposed.

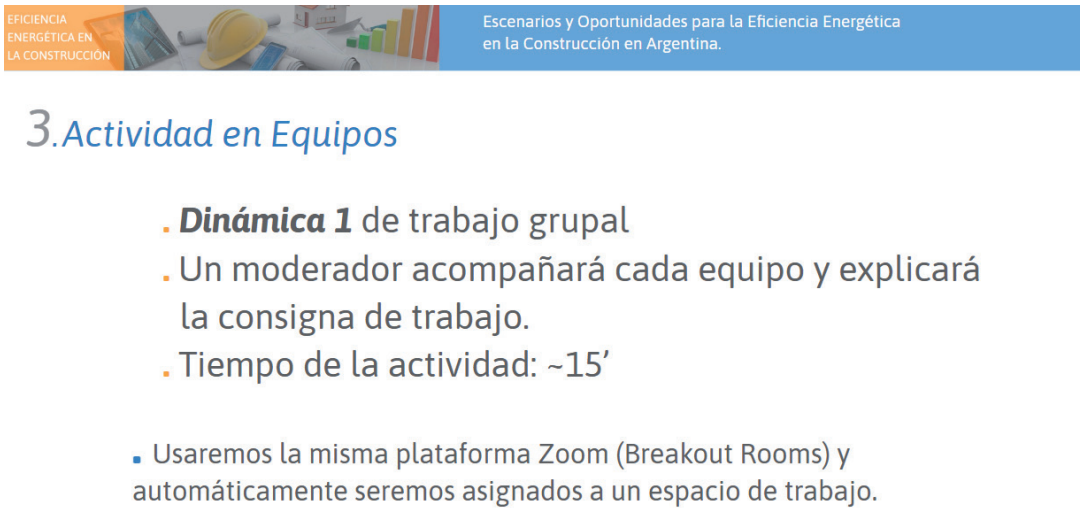
Slide V: Welcome Source: Author's own elaboration

Slide VI: Sectorial distribution. Source: Author's own elaboration



Slide VII: Project presentation. Source: Author's own elaboration

Slide VIII: National and provincial scope and approach. Source: Author's own elaboration



Slide IX: Dynamics 1. Source: Author's own elaboration

4. Actividad en Equipos

- ***Dinámica 2*** de trabajo grupal
- Un moderador acompañará cada equipo y explicará la consigna de trabajo.
- Tiempo de la actividad: ~20'

- Usaremos la misma plataforma Zoom (Breakout Rooms) y automáticamente seremos asignados a un espacio de trabajo.

Slide X: Dynamics 2. Source: Author's own elaboration

Annex 5: COVID-19 Contingency Plan

A meeting was held in the third week of April, in which a contingency plan for this project was presented in response to the changes made to work dynamics due to the COVID-19 pandemic. As a result, some internal dates were made more flexible and it was proposed to replace face-to-face instances with virtual methods to conduct the information collection and characterisation of stakeholders. This Contingency Plan was duly approved by the counterparts (C2E2 and the Secretariat of Energy).

The most evident changes were made in the field survey campaigns. Initially, the project involved inquiries, in the form of semi-structured interviews, to survey as many representatives of stakeholder groups as possible, within the framework of 5 visits to be made in the provinces of Salta, Córdoba, Chaco/Corrientes, Rio Negro/Neuquén and Buenos Aires. However, due to the fact that it was not possible to make direct contact with actors and stakeholders, we managed to conduct data collection by means of telephone interviews, video calls and surveys. However, not all of them have been equally effective and response and data collection time frames have been delayed.

As part of this modification and with the intention of strengthening the convening capacity in virtual instances, a project profile was created on LinkedIn. The objective of this was to consolidate a community of followers, stakeholders and actors that are relevant in the field, in order to broaden the response base to the instruments developed: surveys, interviews and, especially, the workshop, which made it possible to consolidate the stakeholders' characterisation and analysis.

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