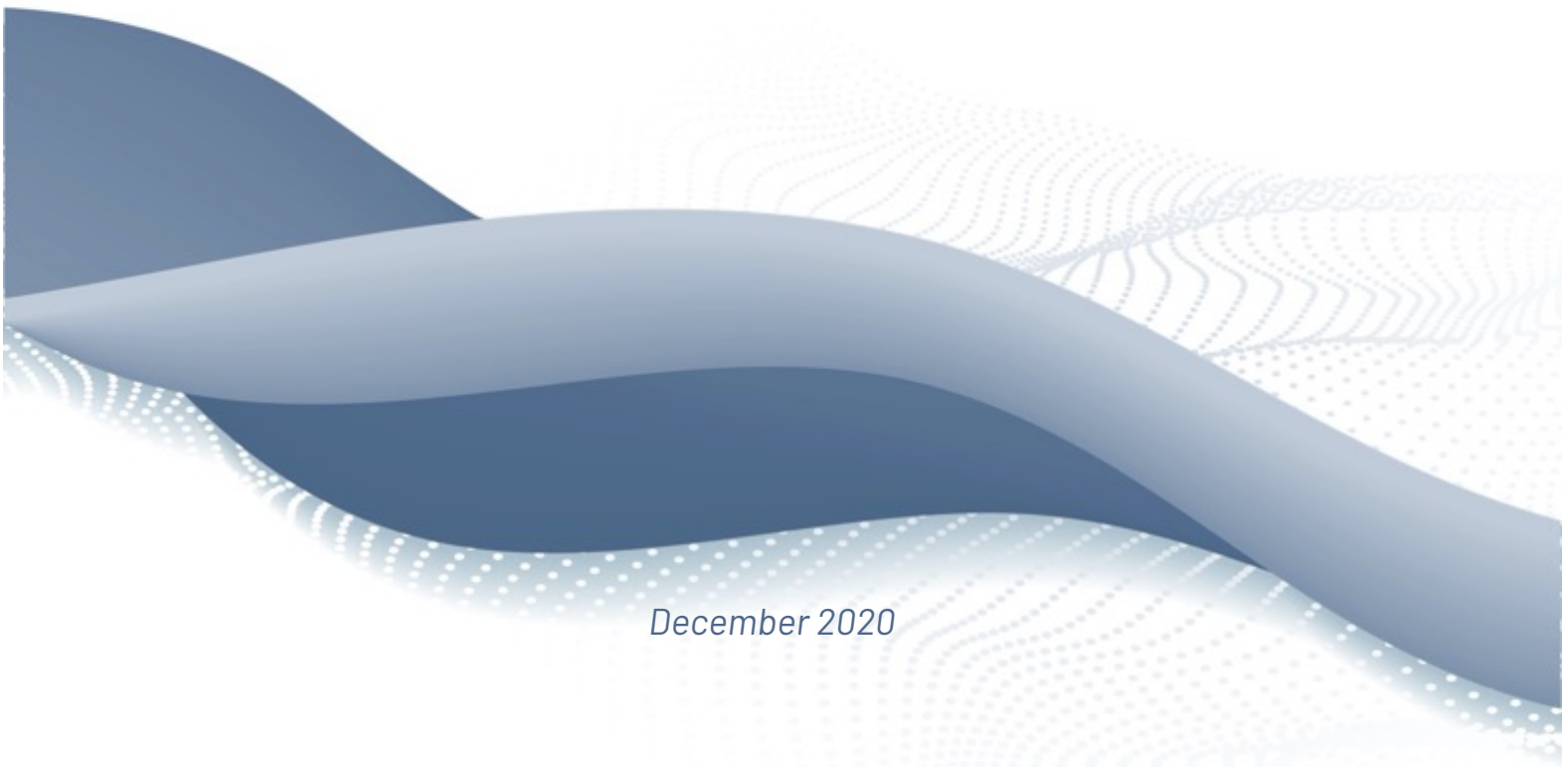
DECARBOOST
Catalysing Investment to Decarbonise LAC

FUNDACION TORCUATO DI TELLA

Report

Deep Decarbonization Latin America Project - Argentina -



December 2020

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Identification of regulatory, financial, economic, and technical barriers to implementation of NDC mitigation actions

Report Activity I-AR.1

Cross cutting and sectoral barriers

December 2020

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I. Introduction

1. The Project

The project aims to assist in contributing to creating enabling conditions to make finance flows consistent with needs related to low-carbon and resilient development pathways to be adopted by the three Latin American target countries Argentina, Brazil and Peru.

More specifically, in Argentina the major objectives of the regional project are interpreted at the national level as being the following:

1. Identify enabling conditions to make feasible the decarbonisation of the country's economy and strengthening resilience. To that end it is convenient to improve and broaden access to international climate finance, as well as enhancing the conditions to achieve and expanded flow of private resources to contribute to fund long-term climate action, in order to complement what might be relatively sparse resources from the public sector, in a context defined, initially, by the need to finance highly finance intensive recovery plans.
2. Provide robust information on the nature and extent of the challenge posed by climate change to create awareness and demonstrate that climate action should be a key element in enabling short-term economic recovery, while avoiding bad long-term investments and strengthening sustainable development.
3. Contribute to providing elements to enhance and strengthen the existing climate governance, policy and regulatory framework, pillars of a well-conceived, effective and fair long-term, sustainable climate action.
4. Identification of new and innovative financial instruments, at the economy-wide level and that are appropriate at the sectoral level, including those capable of assisting in modifying favourably the risk-return profile of investments.
5. Identify strategic investment opportunities in the selected sectors, that may be still under enduring major budgetary and financial constraints.
6. The overall aim is to avoid potential carbon lock-in and strengthen mitigation actions, while increasing the efficiency of investment decisions.
7. Consolidate a green and sustainable investment portfolio in a prioritized sector, while also assisting to explore and propose demand side policy approaches to reduce GHG emissions with a relative low investment intensity.
8. Showcase that a green recovery is feasible, attractive from an investor's perspective, and adding to sustainable development patterns.

According to the workplan, the objective of Activity I AR 1 is the Identification of regulatory, financial, economic, and technical barriers to implementation of NDC mitigation actions aimed at sustainable investment in key sectors: energy, transport, AFOLU and energy related actions in industry and infrastructure.

An initial identification and classification of barriers – based on documented barriers, research and validation through the multi-stakeholder dialogues – are: economic, financial, technical, political and cultural, and legal and institutional.

Existing barriers will be analyzed in order to understand root causes, extent and impacts, considering the concept note developed at the regional project level.

2. Activity Objectives

This Report has two main purposes. Firstly, it aims to outline the general conceptual framework that is being applied in the implementation of the project in Argentina to analyze the challenges and barriers to mobilize finance for climate change mitigation and adaptation.

This conceptual framework includes identifying barriers that could be potentially removed by specific public policy interventions and the use of innovative instruments and single out other barriers that should be considered 'structural' or functioning in practice as 'boundary conditions'. Structural barriers refer to some governance and macroeconomic traits (stemming from political, institutional and regulatory issues) that may not be addressed solely by the policy reforms, regulatory changes and new instruments to be proposed during the development of the Project in Argentina.

The second major purpose of this document is to outline the findings of the first stage of the assessment undertaken. In this regard, the document describes, on the one hand, the abovementioned structural barriers that tend to curb the effects of climate policy in Argentina and, on the other side, supply a detailed analysis of the specific sectoral barriers that have been identified during document revision and stakeholder consultation processes and that are susceptible to be overcome by appropriate policy intervention and the development of tailor-made innovative policy instruments.

This report is organized as follows. Section 2 describes the general conceptual framework for barrier analysis to climate investment as having been developed in the body of literature and as has been discussed within the shared framework of this Project at the regional scale. Section 3 describes the specific conceptual framework for barrier analysis that is being applied for this project in Argentina. Section 4 describes, on the one hand, the structural governance and macroeconomic barriers that might not be addressed entirely or partially through the Project.

On the other hand, a description of non-structural barriers is included, paving the way for further research on how to overcome them by instrument design and policy and regulatory reform. Finally, sectoral barriers in the Energy, Transport and AFOLU sectors are assessed. Section 5 explains the institutional mapping process that has been established to identify key sectoral stakeholders to conduct interviews with. Finally, Section 6 describes the findings regarding sectoral barriers in the Energy, Transport and AFOLU sectors in Argentina.

II. Methodological Approach

The methodological approach that was applied to undertake the barrier analysis in Argentina has been organized according to the following steps:

1. Definition of a conceptual framework and general assessment of possible barrier categorizations. This involved conducting an international literature survey as well as several internal team discussions.
2. Categorization of structural, quasi-structural and non-structural barriers to be applied in Argentina. This involved a thorough literature review, internal team discussions and consultations with sectoral stakeholders in order to validate hypothesis regarding what barriers could be removed and which ones would require profound structural economic, political, institutional and cultural amendments that are beyond the scope of this project.
3. Institutional mapping aimed at determining decision makers' representativeness, with the aim of further defining which stakeholders would be invited to the consultation processes. The product of this activity was a series of stakeholder maps developed for relevant sectors under analysis (Energy, Transport, AFOLU, Industry, Financial) and a general map positioning key actors.
4. Identification of specific sectoral barriers for mitigation measures in the Energy, Transport and AFOLU sectors. This has involved a thorough review of national documents and plans, internal team discussions and stakeholders' consultations. This has been a first step for further assessing possible regulatory frameworks modifications and instrument implementation to overcome identified barriers, considering the fact that not all of them have the same temporal validity - some of them involve longer terms than others and even some structural barriers could be reduced or removed in the future.

The implications of the methodological approach followed is further explained in a more detailed manner in the following sections.

III. Barrier analysis to climate investment: Conceptual Framework

1. General conceptual framework

Countries face several barriers and challenges to investment in climate change-related actions. The challenges and barriers to mobilizing finance for climate change mitigation and adaptation vary markedly from country to country and, even, between sectors within countries. Furthermore, barriers may vary according to the source of financing: public or private.

A considerable number of agencies and financial and research institutions worldwide, including UNDP, UNEP, CDKN, CPI and IFC, among many others, have carried out analyses to categorize barriers and examined means to overcome them (CDKN, 2013; CPI, 2017; IFC, 2013; UNDP, 2011, UNEP-MCTIP, 2013).

Even though some of these assessments focus on general barriers and others review specific barriers (such as finance for adaptation and sectoral barriers), they mostly coincide on a general conceptual categorization:

- **Institutional and political barriers**: They are related with insufficient legal, regulatory and institutional frameworks to support investment that accelerate climate change mitigation. Examples include deficient or inconsistent public policy orientations, bureaucratic inefficiency, regulatory frameworks volatility, lack of coordination between different governmental levels and weak enforcement.
- **Economic Barriers:** Two types of economic barriers can be identified. Firstly, those associated with the impacts of macroeconomic fundamentals. Examples of this type of barriers include budgetary constraints, fiscal deficit, currency risk, high and persistent inflation, and external trade deficit. The second type of economic barriers include distortions in the incentives structure and lack of clear market signals, which derive in failures to allocate scarce resources efficiently to more environmentally and socially beneficial activities such as mitigation and adaptation measures. Examples of this second type of barriers comprise subsidized prices and tariffs that remain below generation/production costs, lack of support and of incentives for innovative businesses and to attract investors and stimulate entrepreneurs.
- **Financial barriers**: They comprise limitations and/or imperfections of the local financial sector, which become unable to address the challenges and opportunities posed by a changing climate and prevent efficient allocation of capital or risk transfer. Examples include a shallow financial market characterized by long-term credit

scarcity, lack of a mature investor community, insufficiency of investment instruments suitable for the long-term nature of climate change related investments, high risk perception and country credit challenges (high interest rates), difficulties in accessing financing (i.e. factors influencing the ability of businesses, especially small and medium-sized enterprises, to obtain financial services, such as credit, insurance and other risk management services) and high capital costs.

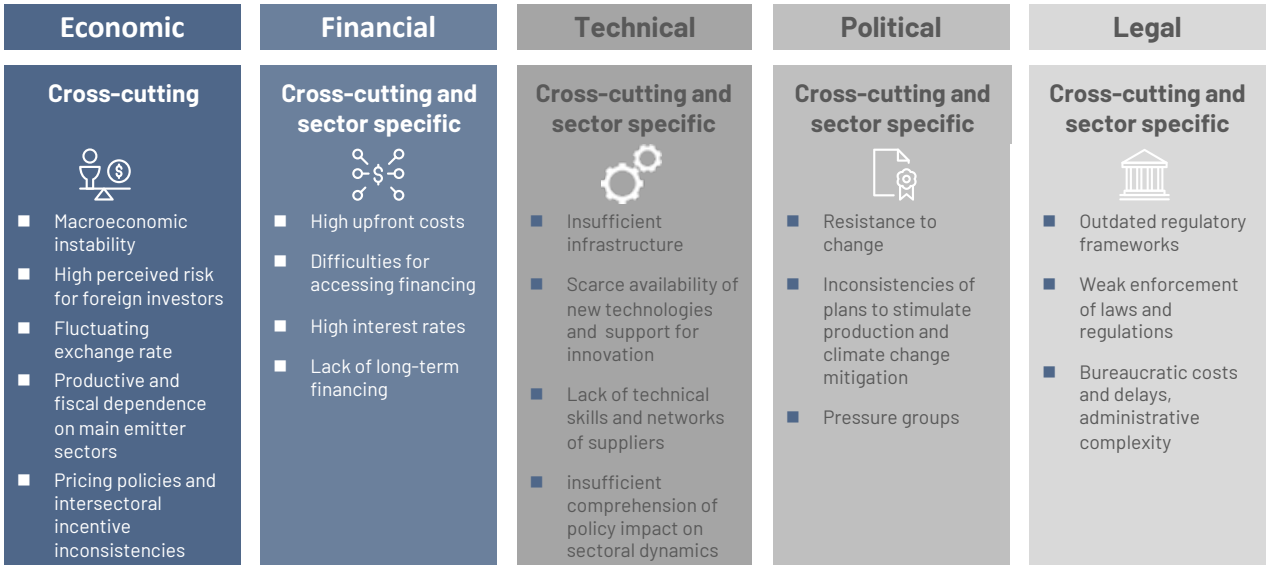
- **Technical and technological barriers**: They include infrastructure that needs to be adapted to climate change effects and mitigation, scarce access to new technologies, insufficient technical skills to adopt, adapt and utilize new technologies, networks of suppliers undeveloped, scarce overall support for research, development and innovation application and low degree of understanding of policy impacts on intra and inter sectoral dynamics.
- **Information barriers**: They refer to limited access to information and scarce available tools to assess risks and opportunities related to climate change actions and sectoral climate projections. For example, lack of data related to GHG emissions in certain sectors, mitigation potential and costs to evaluate and prioritize mitigation options, lack of quantitative data and tools to help investors to make informed decisions about future climate risks, lack of information regarding benefits, returns and payback periods resulting from the introduction of new technologies for mitigation and adaptation actions, insufficient availability and quality of climate data, unavailable or unknown tools and resources needed for investment planning and determination of portfolio composition, uncertainty associated with the results of different climate models.
- **Cultural and social barriers**: They comprise inter alia the individuals' and organizations' cultural background as well as social and cultural processes that govern how people and other stakeholders react to climate change and behave in relation to the need for climate action. This may result from different educational levels and skills and uneven gender norms, among other things. Examples of this type of barriers include ideological orientations, lack of awareness of the subject, uneven gender norms, public policy orientations and private sector prevalent perspectives.

2. Conceptual framework applied to barrier analysis in Argentina

Taking into consideration the abovementioned general categorization of barriers to climate investment, the barrier categories applied to the Argentinean assessment include the following:

- **Economic barriers** (cross-cutting): Macroeconomic instability, high perceived risk for foreign investors, volatile exchange rates, fiscal dependence on major emitter sectors (specifically, energy and AFOLU), pricing policies and intersectoral incentive inconsistencies, subsidies to high emitting sectors along the value chain: conventional fossil fuels production subsidies, shale gas production subsidies, low tariffs for natural gas and electricity.
- **Financial barriers** (cross-cutting and sector specific): High upfront costs, difficulties for accessing financing, high interest rates, lack of long-term financing, credit eligibility.
- **Technical barriers** (sector specific): Insufficient infrastructure required for climate change mitigation, scarce availability of new technologies, lack of support for innovation, lack of technical skills and networks of suppliers, insufficient comprehension of policy impacts on sectoral dynamics.
- **Political and cultural** (cross-cutting and sector specific): Resistance to change, public acceptance, pressure groups and vested interests (e.g. pressures derived from the key role that the agriculture and energy sectors have historically played as foreign currency generator and the latter in terms of energy independence), lack of information, inconsistencies of plans to stimulate production and climate change mitigation.
- **Legal and institutional** (cross-cutting and sector specific): Weak enforcement of laws and regulations, obsolete regulatory frameworks, excessive bureaucratic costs and delays, administrative complexity.

Figure 1: Barriers classification



Source: Own analysis

IV. Barriers to climate investment in Argentina

1. Introduction

The general conceptual framework described previously is further applied to assess barriers to climate investment in Argentina. Firstly, structural barriers are succinctly analyzed. Then, non-structural barriers and quasi-structural are identified, paving the way for further research on how to overcome them by instrument design and policy and regulatory reform. Finally, sectoral barriers in the Energy, Transport and AFOLU sectors are assessed in detail, according to the preliminary findings of the project during the exhaustive analysis undertaken during 2020.

That analysis is based on the review of national plans and programmes, review of the body of literature on barriers to investment and, particularly by means of semi-structured interviews, surveys, and bilateral and multilateral dialogues that were part of the multi-stakeholder dialogues in a process that was primarily digitally shaped due to the response to the COVID pandemics.

2. Structural and non-structural barriers

As it was stated previously, there are some structural governance barriers in Argentina that may be considered beyond the scope of this regional Project. Structural barriers determine boundary conditions, mainly of an institutional and macroeconomic nature.

Structural barriers are briefly described below with the aim of providing an understanding of root causes, extent and impacts of the existence of those barriers and their persistence along time, in particular in terms of effects on boundary conditions.

A. Structural barriers

There are some structural barriers that narrow the degrees of autonomy and effectiveness in designing and implementing climate policies in Argentina. The more relevant ones could be summarized by the following features:

- Lack of long-term vision and approaches

  Rules and institutions can change frequently and at times unexpectedly in Argentina. If institutions are expected to endure and rules to be enforced, actors would comply with the rules and uncertainty diminishes. If rules are neither enforced nor endure,

time horizons shorten and instability increases. As a consequence, and this is extremely relevant in assessing the environment in which determinants of policy design function in Argentina, in the absence of stable and binding rules, severe coordination difficulties amongst actors were the norm, inter-temporal agreements are hindered, institutional actors operate within shortened horizons and short-term goals prevail.

As a consequence, in addressing climate change, short-term policy, planning, targets, and milestones not always align with core elements of a long-term strategy. Sector-specific mitigation targets and pathways as well as key areas of action need to realize long-term goals (e.g., developing a low-carbon energy system, reducing non–carbon dioxide emissions, and sequestering carbon through forests, soils, and carbon-dioxide removal technologies) while concerns about the rules of the game, prevalence of short-term considerations in public and private decision-making, avoidance of collective actions initiatives and poor coordination arrangements, contributed to create persistent barriers to long-term initiatives and to the design and implementation of climate action and transitional efforts.

- Policy inconsistencies

Argentina public policies in the last several decades tended to be frequently unstable, poorly coordinated, weakly enforced, and highly rigid, primarily as a consequence of the lack of credibility on the decision-making process. Lack of coordination, silo like decision making processes and fragmented competencies created conditions for policy design inconsistencies and implementation gaps.

However, when planning is conceived as a centralized process, the nature of the existing governmental structure requires a strong compelling narrative in order to be able to negotiate a coordinated treatment of the issues at hand, including the definition of goals and the allocation of resources.

Policy design should focus on integrating economic development with a country's long-term climate goals, identifying overlap and synergies with existing national development strategies, and articulating sustainable development plans and technology needs assessment. Political will and ambition, strong leadership and a clear idea of the huge benefits of addressing the issues related to a climate change strategy may contribute at the inception of the process to progressively reduce this barrier.

- Infrastructure deficit

Typically, mitigation measures are associated with considerable investment and infrastructure requirements, development of new infrastructure, and an increasing pressure on existing infrastructure.

Argentina needs to repair, update, and expand the existing infrastructure where large deficits persist. These needed investments comprise not only those corresponding primarily to energy (generation, transport, distribution and storage), transport, and water and sewage, but also those including, inter alia, for industry, storage of production, communications, ports, commercial facilities, as well as the ones related to governmental, justice and legislative services, and social infrastructure and basic services (education, health and housing).

This daunting infrastructural modernization and expansion should also include investments in urban settlements at the different scales, as Argentina is primarily a urbanized society. Social infrastructure deficits in cities are huge and they should be part of the sustainable growth and equity narrative that belongs to the opportunities resulting from addressing climate change through mitigation and reducing climate vulnerability. Along the same lines, territorial imbalances in infrastructure and connectivity should also be included in these infrastructure challenge.

Investment requirements should be part of a process to enhance competitiveness, modernize government at the three jurisdictional levels and facilitate transparency. However, it is necessary to avoid decisions by which the removal of these large and widespread infrastructural barriers is undertaken avoiding completely carbon intensive technologies and processes.

As it was mentioned above, the analysis undertaken by the Project in Argentina will not consider further in depth these structural economic and governance barriers, but will rather focus on the types of barriers that could be addressed and/or removed at least partially through policy and regulatory reform as well as instruments design and development. These are assessed in the following sections. Notwithstanding that, these barriers are further referred to, with an integrated perspective, in the deliverable corresponding to Activity I AR 4 in a section dedicated to Strategic Climate Planning in Argentina.

B. Quasi-structural barriers functioning as boundary conditions

Quasi-structural economic barriers to climate investment in Argentina are mainly the legacy of the country's historical macroeconomic performance, which has resulted in periods of high inflation, volatile exchange rates, fiscal and balance of payments imbalances and high levels of external debt, typically associated with a set of deeply inconsistent macroeconomic policies applied off and on during an almost secular period.

This macroeconomic context has translated into periods of higher perceived risk for foreign and local investors and, subsequently, fluctuating levels of investment flows. In addition, a shallow financial system, a frequent trait in developing countries' financial systems, limits access to domestic financing while international finance is almost exclusively available for large companies particularly international corporations.

Furthermore, there were frequent spans marred by pricing policies and intersectoral incentive inconsistencies that if maintained could restrain decarbonization strategies.

- Sluggish growth

  Between 2010 and 2019 Argentina's average annual growth rate was of 1,4%[1]. If we consider a longer period of time, from 1960 onwards, Argentina's GDP fell year-on-year 24 times[2]. This illustrates the acute macroeconomic cycles the country has historically exhibited.

- High inflation rates

  Argentina has suffered inflationary and hyperinflationary episodes throughout its history. After a period of recovery that began in 2003, in 2007 the annual inflation rate started an increasing trend, launching an inflationary cycle that reached 54% in 2019, during the last administration[3].

- External indebtedness

  External indebtedness multiplied almost 6 times in less than 8 years during the 1976-1983 military dictatorship, growing from USD 8,000 million to USD 45,000 million. External debt growth continued among successive renegotiation and refinancing attempts, until the country defaulted on debt in 2001 (Carro, 2008). In 2020, after a four year period of rash indebtedness growth, Argentina's foreign debt amounts to USD 336 billion, representing 87% of GDP[4], and severely conditions economic and development policies, in particular launching vast recovery programs.

[1]Source:https://datos.bancomundial.org/indicador/NY.GDP.MKTP.KD.ZG
[2] The Argentinean GDP has fallen year-on-year in 1962, 1963, 1966, 1975, 1976, 1978, 1981, 1982, 1985, 1988, 1989, 1990, 1995, 1999, 2000, 2001, 2002, 2009, 2012, 2014, 2016, 2018, 2019 and 2020. Sources: https://datos.bancomundial.org/indicador/NY.GDP.MKTP.KN ; https://www.indec.gob.ar/indec/web/Nivel4-Tema-3-9-47 ; https://www.indec.gob.ar/indec/web/Institucional-Indec-InformacionDeArchivo-5
[3]Source:https://www.indec.gob.ar/uploads/informesdeprensa/ipc_01_20578B3E8357.pdf
[4]https://www.argentina.gob.ar/economia/finanzas/deudapublica/informes-trimestrales-de-la-deuda

- Devaluation episodes as evidence of economic policy failure

  Nominal exchange rate devaluation has been repeatedly applied in Argentina as a macroeconomic policy tool. Since the 1950s, there have been at least six significant devaluation processes with profound economic and social effects due to inflationary impacts. During 2016-2019 the peso-dollar exchange rate rose around 400%. Within this context, with the aim of stabilizing the national currency and control inflation, reference interest rates exceeded 70%, making credit even more expensive, limiting financing access for investment and therefore impacting negatively on activity levels and private consumption (GERES, 2019; Zack y Mira, 2019). At present, a fixed official exchange rate regime prevails based on strong restrictions on currency acquisitions.

- Low foreign direct investment (FDI) levels

  The economic context translated into periods of higher perceived risk for foreign investors and has therefore had negative effects on investment attraction. In 2010-2019, foreign direct investment in Argentina, measured as net capital inflow as a percentage of GDP, was on average 1.83%, below Latin America and the Caribbean average levels (3.88%)[5].

- Fiscal dependence on fossil fuels

  Hydrocarbon royalties and related taxes represent a crucial part of the national collection system as well as of subnational revenues in nearly half of the Argentinean provinces. On the other hand, expectations on currency generation of Vaca Muerta shale oil and gas basin are high given its exports potential.

  Taxes on liquid fuels and natural gas accounted for 3% of national tax collection in 2019[6]. Furthermore, there is an additional tax contribution of the oil and gas industry through their payment of royalties, income taxes, value added taxes, provincial taxes, municipal fees, infrastructure taxes, contributions to social security and import and export duties (approximately 50% of the final liquid fuels sale prices -gasoline and diesel- are tax charges) (Serra Marchese, 2017).

  Regarding sub-national (provincial) accounts, oil and gas sector direct tax income is heterogeneous. Some provinces exhibit high participation (Puente, 2020), measured as royalties collection income vis a vis total provincial income, such as Neuquén

[5]Source:https://datos.bancomundial.org/indicador/BX.KLT.DINV.WD.GD.ZS
[6]Source:AFIP:https://www.afip.gob.ar/institucional/estudios/serie-anual/

(28.5% in 2019), Chubut (25.9%), Tierra del Fuego (10.6%), Río Negro (8.9%) and Mendoza (6%).

- Pricing policies and intersectoral incentive inconsistencies

Argentina has incorporated some incentives aimed at fostering transition to more sustainable development trajectories such as fixed prices electricity purchase contracts for renewable plants, a carbon tax and subsidies to induce conservation of native forests and commercial afforestation. However, there is lack of incentive integration that generate some inconsistencies, tensions and even contradictions among sectoral objectives (Chidiak y Gutman, 2019). For example:

- There are incentives (subsidies) for unconventional gas extraction from Vaca Muerta basin, which increase technological lock-in risks.
- A 27% increase in the agricultural cultivated area was expected for the 2010-2020 period compared to 2010-2011 as stated in the 2020 Agroindustrial Strategic Plan. This expansion is incompatible with Argentina's NDC objectives of curbing deforestation driven by agricultural frontier expansion.
- There are incentives to promote commercial afforestation. However, they have generated perverse incentives for native forests conservation. Although native forests deforestation for exotic species implantation is prohibited by law (Laws N° 26.331/07 and 26,432/08), tension among incentives remain, since subsidies for commercial plantations are more attractive and easier to access than those available for native forests conservation.

3. Non-Structural barriers

The non-structural barriers the Project will focus on are briefly described below. They are organized according to the categories presented above in the overall Conceptual Framework (Section III):

- **Economic Barriers**: Distortions in the structure of incentives and lack of clear market signals, specially lack of support and of incentives for innovative businesses models and lack of a focused fiscal policy to attract investors and stimulate entrepreneurs to invest in climate friendly endeavors.
- **Financial barriers**: Insufficiency of investment instruments/models suitable for the long-term nature of climate change related investments and the particular characteristics of some of those investments (i.e, energy efficiency, renewable energy, innovative practices in agriculture).

- **Technical barriers**: Lack of coordinated support for innovation, insufficient technical skills, deficient comprehension of policy impacts on sectoral dynamics and decision-making processes that are not adequately designed to understand and address complex problems.
- **Political and cultural barriers**: Scarce awareness of low-carbon technologies benefits, of climate change risks -both at the public and private level (to physical, productive and social assets) and, more broadly, a still inadequate comprehension that the transition to the low- and zero-carbon economy represents an enormous opportunity for sustainable growth at the national level for the future, even if there is an increasing understanding in different sectors and by diverse stakeholders that this may be the case.
- **Legal and institutional**: Cumbersome and in rare cases even outdated legal and regulatory frameworks, that are not able to capture and reflect neither the needs of sectoral transformations nor those resulting from the introduction of new technologies and practices.

A. Economic Barriers

There are some tariff and price signals that currently hinder low-carbon measures introduction in sectors selected for the current study.

Analyzing and suggesting alternative pricing schemes and incentive mechanisms is key for fostering mitigation measures and implementation. During the dialogues with ministerial representatives and sectoral policy makers, as further commented below, they showed an open-minded attitude towards listening to new ideas based on informed technical analysis and willingness to cooperate.

B. Financial barriers

Both in the banking and insurance sectors as well as in local capital markets there are some financial instruments incipiently aimed at enhancing climate finance which use can be expanded and there are also new instruments and mechanisms that still need to be further explored. This is the case, for example, of the Energy Service Companies (ESCO) aimed at financing energy efficiency measures, which came up as a relevant support vehicle during the interviews held with industrial stakeholders.

A diagnosis of currently available financial instruments and models in the Argentinean financial system that could enhance climate finance will be undertaken during the next Project stages, with the aim of identifying and suggesting a portfolio of instruments to be deployed at the country level. Financial options to be explored will include, among others, "green" loans,

sustainability-linked loans, "green" funds, "green" project finance, "green" bonds, "green" indexes and sustainability reports as part of green finance. It is also necessary to examine the existing international climate finance flows in order to determine through which of them funds may be channeled to finance transformational investment for an expanded portfolio in Argentina. In addition, there are also traditional finance flows which may be considered as potential sources of finance for typical capital investments, for example in infrastructure, housing, water and sewage and waste management projects, that could be leveraged through the existing international finance sources and through commercial banking channels that are trying to adapt rapidly to changes in demand.

C. Technical barriers

Lack of support for innovation and insufficient technical skills emerged as two of the main technical barriers for low-carbon measures during interviews held with private sector stakeholders. For example, workshop participants highlighted that there are scarce local ISO 50.001 certifiers, which makes costs of efficient energy management certification even more expensive. They also remarked the lack of harmonization of minimum technical standards for some low-carbon equipment and practices, which produces uncertainties regarding, for example, health issues as well as heterogeneous product quality.

These barriers could be tackled by capacity building measures targeted at specific sub-sectors, activities and workers (for example, energy auditors, solar and wind farms technical maintenance personnel). In addition, they could be tackled by introducing new contents and technologies in university curricula.

D. Political and cultural barriers

There is a generalized lack of awareness in Argentina regarding several issues. For example, potential benefits of:

- energy efficiency measures (potential energy savings and their impact on energy bills),
- renewable energy kits in residential buildings,
- agricultural practices.

This lack of information regarding technologies and practices benefits reduces demand "pull" for sectoral low-carbon technologies and, therefore, for new instruments to be offered.

E. Legal and institutional

Finally, there are some legal and institutional barriers related to cumbersome regulatory frameworks that lag behind technology and market developments that could be assessed with the aim of suggesting changes and modifications.

There is a lack of adequate regulation, for example regarding installation procedures and standards for some type of equipment and practices. These issues could be disentangled in order to propose specific interventions to boost specific low carbon investment.

Therefore, suggestions to law enforcements and amendments, specific regulations creation and procedures simplification will be made. For example, proceedings digitalization and allowing all procedures to be done online through virtual platforms.

V. Institutional Mapping

A mapping exercise was undertaken with the aim of identifying key stakeholders in Argentina in the different sectors under analysis. The purpose was to make them part of the diverse consultation processes conducted, in order to review mitigation options status and level of progress and consider in depth the specific barriers that might delay or affect the implementation of significant mitigation options.

An initial mapping effort was conducted with the aim of identifying key stakeholders that would be invited to the consultation processes. For that purpose, existing information provided by the Argentinean Government in previous climate-related projects and other strategic planning exercises was reviewed. Such materials mainly included National Communications, NDC, NAMAs, Sectoral Plans and 2050 Visions in the Energy and AFOLU sectors

This resulted in an exhaustive process of identification and mapping stakeholder clusters, securing the representation of diverse interests and visions in order to achieve a balance among sectors, including: ministries of the line, government agencies, state enterprises, networks of institutions, economic agents (production transport, finance, trade), civil society representatives and members of the epistemic community.

An emphasis was placed in ensuring the participation of productive and financial sector actors, beyond the public sector actors identified, given that the private sector is key to identify and understand existing barriers to mitigation measures implementation and new or adjusted mitigation actions to be proposed.

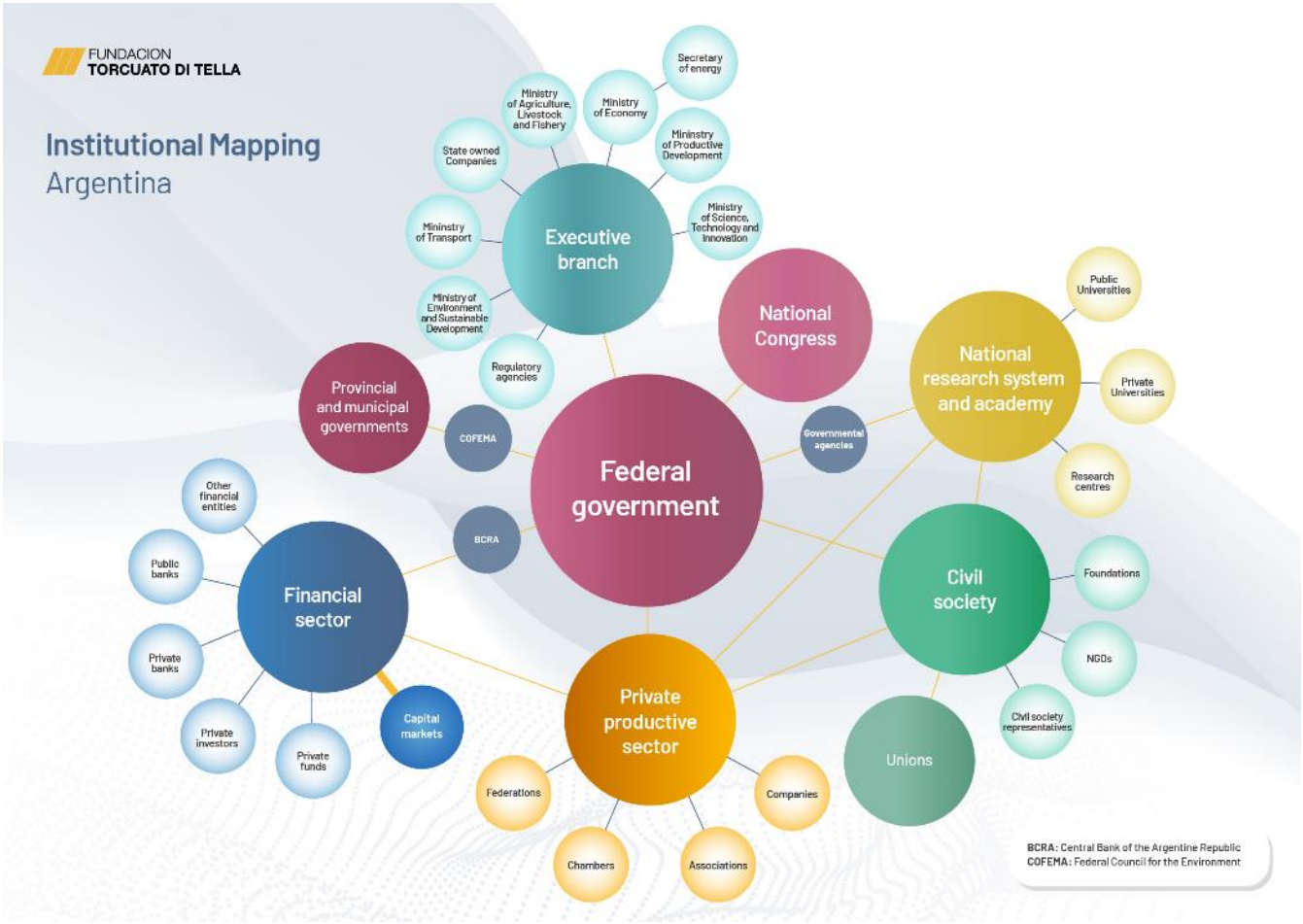
Special attention was given to map economic agents in the different selected sectors, or in other that may be relevant in the value chains operating within those sectors: production (agriculture, livestock, forestry); transport and storage; chains of suppliers; financial services; utilities, transport and distribution of energy, R&D.

This initial mapping stage was then validated, extended and complemented by suggestions made according to the sectorial knowledge and experience and previous work having been done by FTDT in these sectors. The mapping was further enriched by feedback received from stakeholders themselves during the consultation processes.

Actors were identified and selected based on their relevance in the national sector-specific arena and representativeness in the different segments.

As a result of this exercise, stakeholder maps for Argentina, the Energy, Transport, AFOLU, Industry and Financial sectors were elaborated[7].

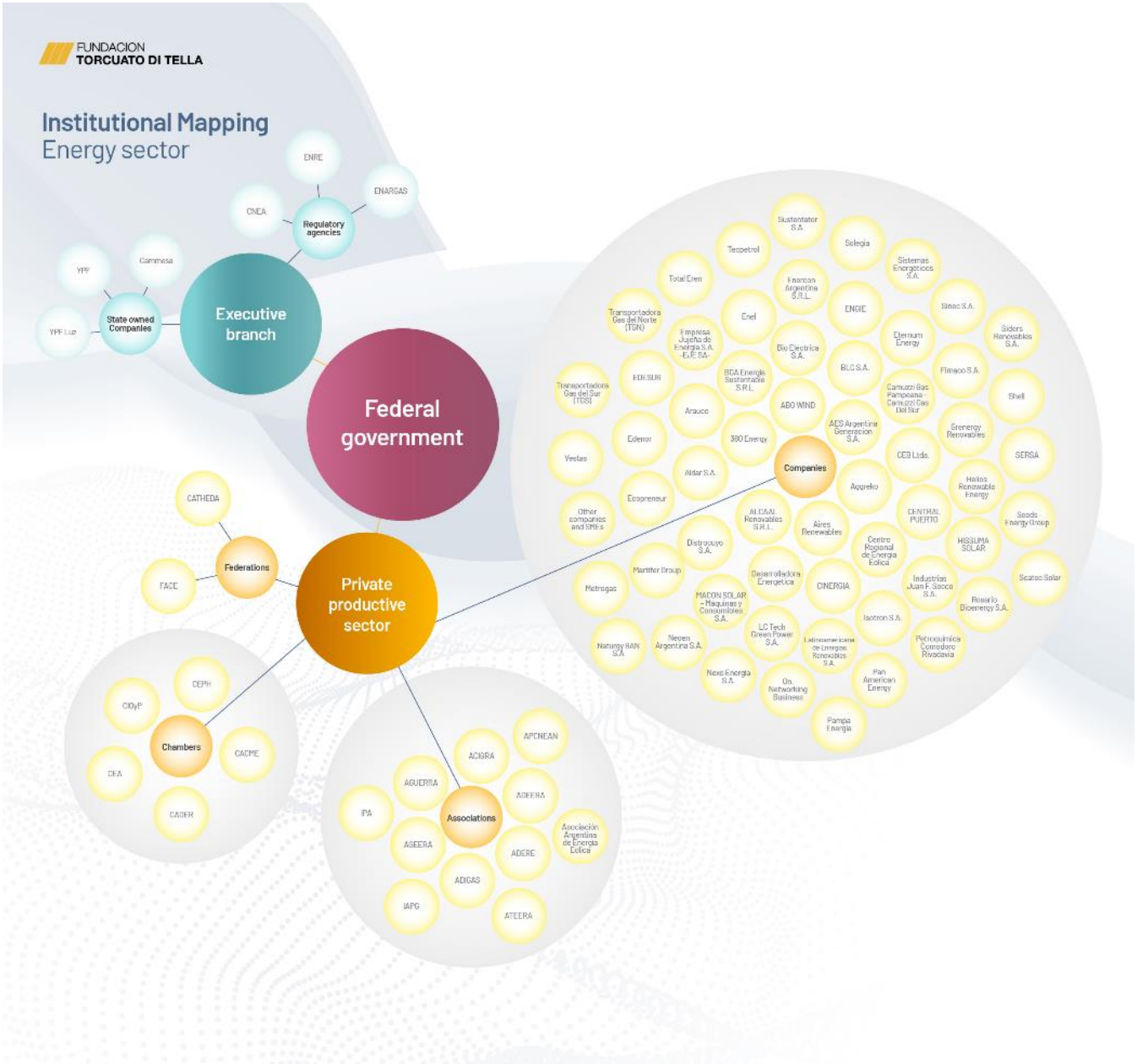
Figure 2: Institutional mapping – Argentina



Source: Own elaboration

[7] Given that several Mitigation Energy related measures are related to industry, the sector was assessed and stakeholders dialogues were also conducted with representatives of that sector.

Figure 3: Institutional mapping – Energy sector

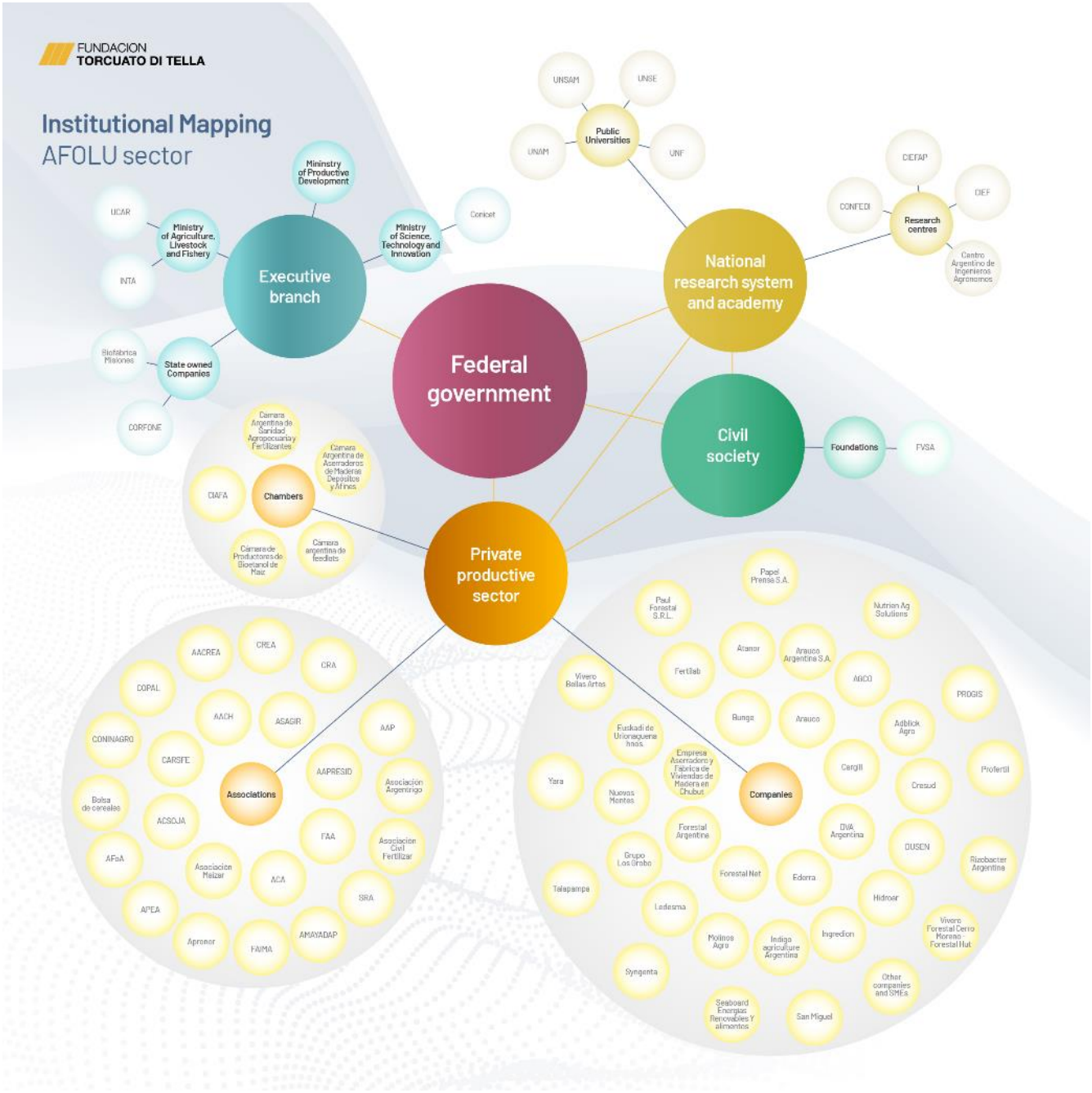


Source: Own elaboration

Figure 4: Institutional mapping – Transport sector

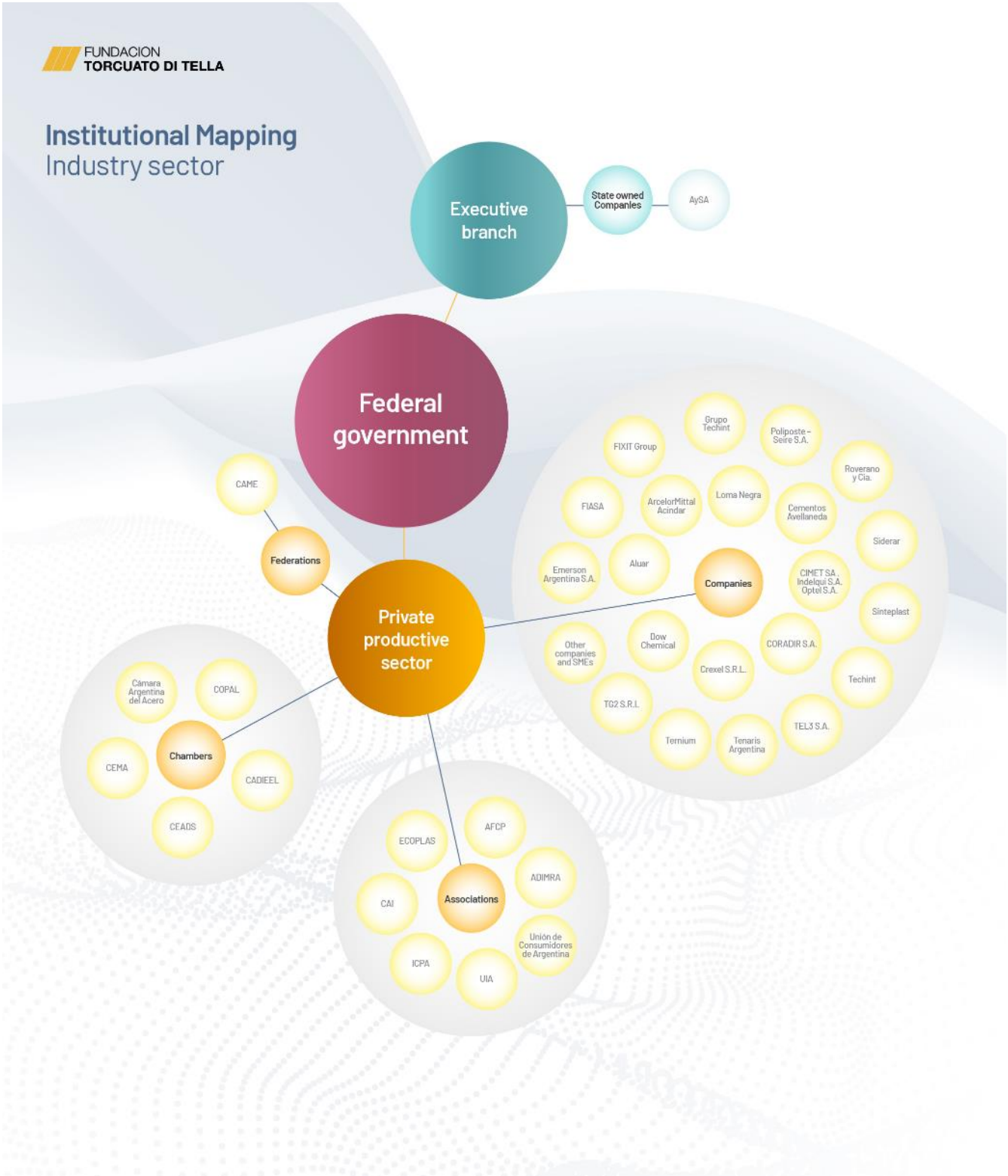
Source: Own elaboration

Figure 5: Institutional mapping - AFOLU



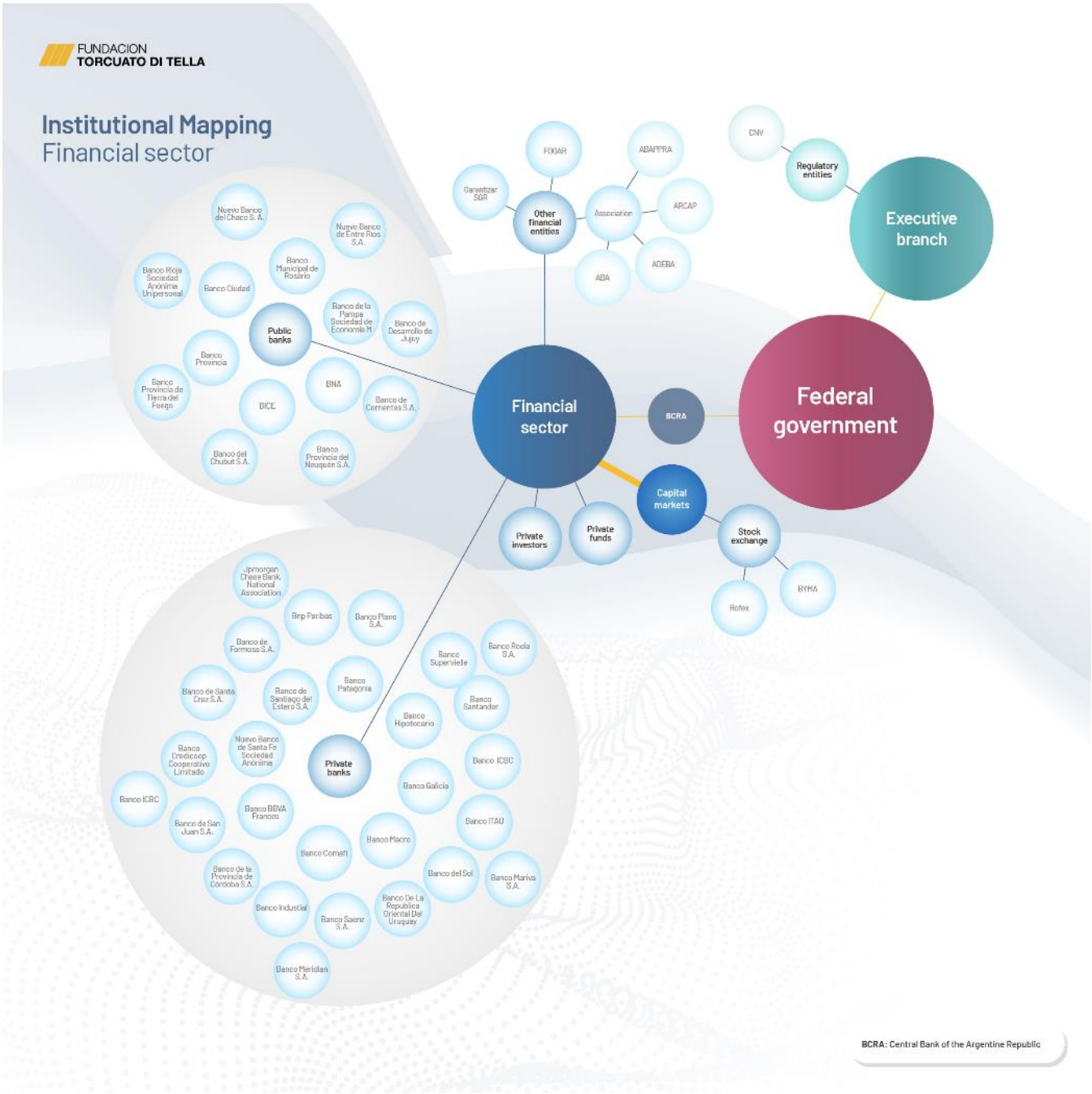
Source: Own elaboration

Figure 6: Institutional mapping – Industry sector



Source: Own elaboration

Figure 7: Institutional mapping – Financial sector



Source: Own elaboration

VI. Sectoral Barriers

1. Introduction

This section describes the core results of the sectoral assessments that have been undertaken on the barriers to mitigation measures included in the National Sectoral and Climate Change Action Plans that aim at enabling Argentina's NDC implementation in the Energy, Transport and AFOLU sectors.

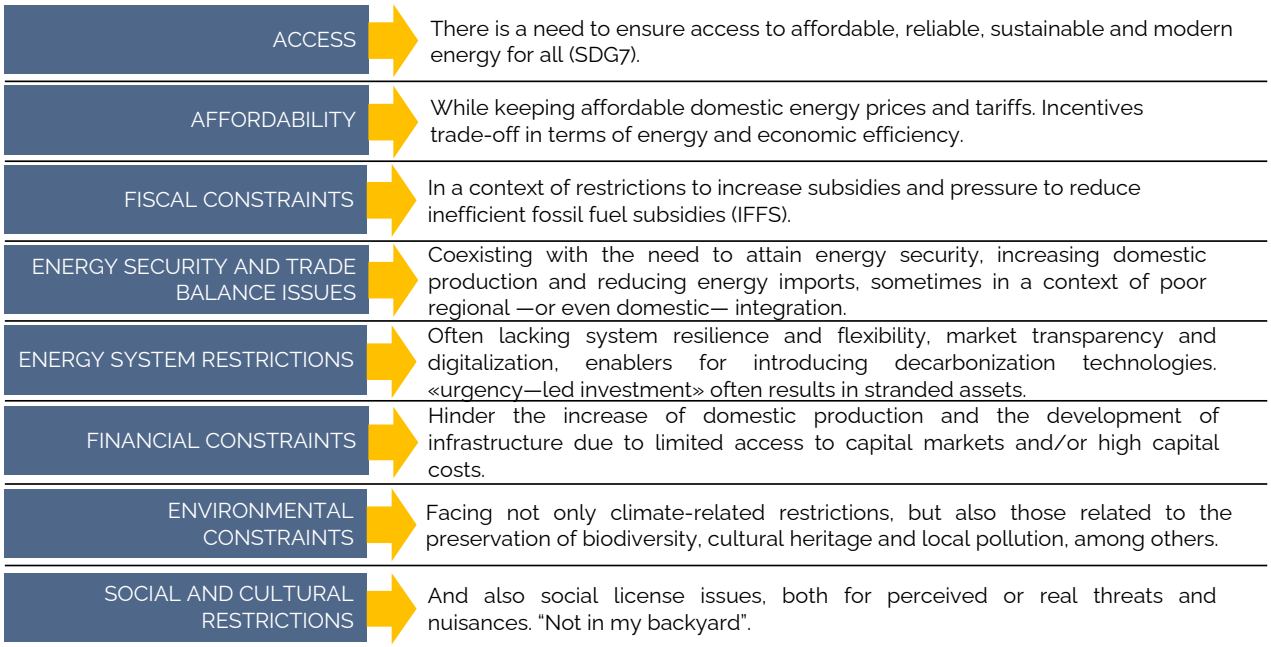
At the same time, dialogues were held with public and private sector stakeholders with the aim of understanding the current state of knowledge, the feasibility of adoption, barriers to climate change action and level of commitment/efforts from the productive sector and policy makers.

2. Energy

Energy policymaking in Argentina is constrained both by most of the cross-cutting barriers such as the structural economic and governance barriers and boundary conditions, as well as by sector-specific barriers compromising the climate and non-climate specific policies and measures for sustainable energy development.

Some of the most relevant high-level short- and medium-term restrictions for energy-related policymaking in Argentina are summarized in the following figure:

Figure 8: Restrictions for energy-related policymaking in Argentina



Source: Own elaboration

Characterization of sectoral features for the assessed barriers

- **Economic Barriers**: Some of the economic barriers acting on the energy sector were described in the previous figure, such as those related to artificially low energy prices and tariffs in a context of fiscal deficit, unemployment and, limiting the government's capacity to increase the share of economic costs of production being paid by a large part of the population.
- **Technical barriers:** Technical barriers in the energy sector are observable for large-scale deployments of new technologies, as well as in the development of capital-intensive infrastructure projects, such as the nuclear power plants featured in the National Energy and Climate Change Action Plan, often failing to comply with proposed timelines. The current state of the interconnected power grid requires increasing robustness and flexibility, with the need of investment in transmission and storage in order to accommodate large scale penetration for intermittent renewable energy sources in the long term. These barriers are more likely to operate in the long term, since renewable shares in the energy mix are still far from more complexity-inducing levels.
- **Financial barriers:** These barriers affect the energy sector mostly regarding supply-side measures due to the intensity of CAPEX requirements for long term

infrastructure and capital assets investments, restricted by reduced access to credit and increasing capital costs, what results in higher revenue requirements for financial repayment of power generation, transmission and distribution projects energy investment. These financial barriers result, in limitations to the development of new infrastructure, and in increasing pressure on existing infrastructure due to the widening gap between demand payment for energy services and their economic supply costs, both in regulated and deregulated segments.

- **Political and cultural barriers:** Political barriers act in the energy sector mostly in resistance to change, promoted by existing sub-sectoral lobbies (private and public, including provinces and unions) conditioning the design and development of long-term strategies and delaying long term development of new technologies. Cultural barriers typically materialize in information barriers and mostly become evident when demand-side measures are assessed, due to potential savings and mitigation impacts of different technologies and practices are not completely transparent to customers and users, and, in consequence, investment and consuming decisions are often insufficiently informed.
- **Legal and institutional barriers:** In the context of Argentina's energy sector, legal and institutional barriers materialize for example in coordination complexities among different government levels: federal, provincial and municipal governments, as in the cases of the electricity distribution regulation issues (e.g. distributed energy) and the ownership of hydrocarbon resources. Also, different federal level institutions, such as the Secretariat of Energy, Natural gas and Electricity Regulators (ENRE and ENARGAS). There is also a bias to promoting frequent —mostly minor— legislative modifications of existing regulatory frameworks as measures to mitigate political and economic uncertainties, or conversely existing inertia of regulatory frameworks lagging behind technology and market developments. Additionally, these regulatory frameworks are commonly associated with administrative complexity and bureaucratic costs and delays. Regarding the design of sectoral plans, institutional barriers often materialize in the lack of coordination in the design and implementation of policies and measures which often require system-wide approaches, as intersectoral and long-term consistency.

Identified barriers in previous analysis

A review of existing Energy and climate change mitigation measures and barriers for their implementation included in the National Energy and Climate Change Action Plan (2019), the National Infrastructure and Climate Change Action Plan (2018) and the National Industry and Climate Change Action Plan (2018) was performed. Only energy-related measures were evaluated in the case of the Infrastructure and Industry action plans.

This review consisted on surveying the barriers identified in the Government' documentation when they were developed, which were categorized according to the classification proposed in the conceptual framework (Section III), i.e. Economic; Technical; Financial; Political and cultural; and Legal and institutional.

This classification served as a basis to assess barriers constraining different proposed measures - identified by the Argentine government and presented in its sectoral plans - as well as to provide a better understanding on impacts per types of barriers in terms of mitigation potential.

The barrier appraisal was then validated against the stakeholders' views during the different bilateral and multilateral dialogues.

Mitigation measures were classified into Supply and Demand measures, and results are presented accordingly.

Concurrent barriers

Table 1: Types of concurrent barriers constraining measures contained in sectoral plans

	Number of concurrent barriers					
	1 barrier	**2 barriers**	**3 barriers**	**4 barriers**	**5 barriers**	**Total**
# of mitigation measures						
Supply	1	2	7	1	3	14
Demand	0	12	9	4	4	29
Total	**1**	**14**	**16**	**5**	**7**	**43**
Mitigation potential (MtCO2e)						
Supply	5.5	3.4	32.4	7.2	14.5	63.0
Demand	0.0	10.3	36.5	7.8	8.6	63.2
Total	**5.5**	**13.8**	**68.8**	**15.0**	**23.1**	**126.2**
Supply	9%	5%	51%	11%	23%	
Demand	0%	16%	58%	12%	14%	
Total	**4%**	**11%**	**55%**	**12%**	**18%**	

Source: Own elaboration

Regarding the concurrent barriers affecting the mitigation measures contained in the sectoral plans, 85% of the measures with 106.9 $MtCO_2e$ of emission reductions potential are —according to national plans— currently constrained by three or more types of barriers.

The measures affected by two or less barriers will be analyzed in order to assess the potential of finding quick wins related to identifying instruments or actions to address these barriers in the short term.

The National Energy and Climate Change Action Plan identified only one measure restricted solely by technical barriers (fossil fuel switch for power generation displacing liquid fuels with natural gas, with 5.5 $MtCO_2e$ mitigation potential), related to constraints in gas transport capacity. Nevertheless, this barrier needs to be reassessed in the short and medium term as a result of certain fiscal and economic conditions[8] affecting the sustainability of natural gas production, as well as the necessary investments to increase evacuation capacity from the Neuquina basin.

In second place, 14 measures representing 11% of the sectoral plans' mitigation potential (13.8 $MtCO_2e$) were classified as restricted by two types of barriers, with a higher concentration on the demand side (10.3 MtCO2e vs. 3.4 $MtCO_2e$ related to the supply side).

- On the supply side, the most relevant measure subject to two types of barriers is the improvement of power generation energy efficiency by introducing combined heat and power projects as well as converting open cycles (gas turbines) to combined cycles (3.32 $MtCO_2e$ mitigation potential). Although the measure was identified as restricted by Economic and Financial barriers, is being executed in the framework of a PPA auction celebrated by the Secretariat of Energy in 2017.
- A second measure on the supply side is the use of biogas in the industry sector, accounting for a potential of 0.11 $MtCO_2e$, and encounters Economic and Technical barriers, including the need to guarantee feedstock availability and to install backup capacity to cope with the seasonality of crops and residues.
- On the demand side, the most relevant measure constrained by two types of barriers is the plan for enhancing public lighting, affected by Financial and Political and Cultural barriers, and accounting for a potential of 4.62 $MtCO_2e$. According to the sectoral plan, the most important barrier is related to the lack of financing, since public lighting jurisdiction is municipal, and the switch of lamps requires an important initial disbursement. Additionally, the sectoral plan identifies technical issues related to O&M and the current technical capacity on-site to deal with more complex electronics associated to LED rather than incandescent lamps.
- In second place, the large-scale penetration of water economizers (mitigation potential of 3.1 $MtCO_2e$) is constrained by Financial and Political and Cultural barriers,

[8] Fiscal and economic conditions have changed since the development of the plans due to increasing fiscal dependency of domestic natural gas production in a context of increasing subsidies and lack of capacity or will to increase prices and tariffs., expanding the challenges to replace liquid fossil fuels with natural gas

associated to lack of domestic production and domestic suppliers, with most equipment being imported.

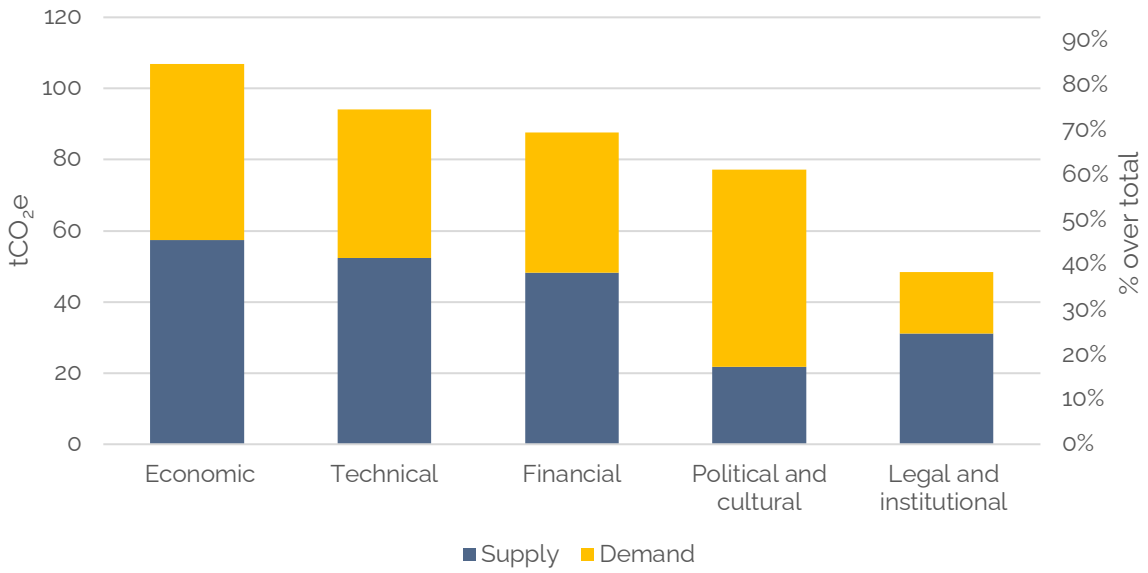
- Other resource and energy efficiency measure identified included recycling and reuse of materials —such as aluminum, steel, copper, battery lead, tires, paper and plastic— in the industry sector, accounting for a mitigation potential of 1.4 $MtCO_2e$. The main barriers acknowledged were Legal and Institutional barriers (e.g. the need for an amendment to the hazardous residues Law), as well as by Political and Cultural barriers, such as the lack of formal distribution networks bringing transparency and scale to this potential market).
- The use of black liquor to replace fossil fuels in the pulp and paper industry, was identified as an additional measure potentially contributing to reductions of 0.76 $MtCO_2e$. The measure faced Economic and Technical barriers, such as the need for conditions enabling investment, and to change feedstocks and adequate infrastructure to achieve better concentrations for the combustion process.
- Additionally, the replacement of commercial fridges to shut-case types could contribute with 0.45 $MtCO_2e$ and is restricted by Economy and Political and Cultural barriers.

Most of the mitigation actions affected by two or less types of barriers (9 MtCO2e out of almost 14 MtCO2e), imply 15% of the emission reductions included in the sectoral plans. Additionally, those measures have not been identified as strongly restricted by the most prevalent type of barrier: Economic. Thus, are key initiatives to be evaluated for early and concrete actions, such as addressing the Legal, Political and Cultural barriers hindering the development of reuse and recycle markets in the industrial sector.

Prevalence of barrier types

Existing and planned measures, classified also in Supply and Demand, have been analyzed regarding the types of barriers constraining their development.

Figure 9: **Prevalence of barrier types among the identified measures - Mitigation potential[9]**



Source: Own elaboration

The previous figure (Figure 9) and the next table (Table 2) show that economic barriers are prevalent among other types, affecting 85% of the mitigation potential identified in the sectoral plans, and reaching 91% in the case of the supply-side, where typically measures are associated with considerable investment and infrastructure requirements, while they also affect 78% of the demand-side measures.

In second place, Technical barriers are restricting 75% of the mitigation potential of the sectoral plans, mostly affecting supply-side measures. Prominently, these feature the large-scale penetration of renewables in the power grid, the most relevant single measure in all the sectoral plans, that accounts for 22.16 $MtCO_2e$ emissions reduction, the introduction of new nuclear power plants, contributing with 13.79 $MtCO_2e$, and the increase of the share of biofuels in fossil fuel blends, in which technical issues become less relevant than political and cultural barriers, adding 9.15 $MtCO_2e$ in terms of mitigation. On the demand-side, the most prominent measure affected by Technical barriers is the replacement of household lighting (20.37 $MtCO_2e$ mitigation potential), and is mostly related to the lack of minimum mandatory standards, but this technology's penetration has accelerated during recent years, and is mostly market-driven after initial government efforts.

[9] Please note that the sum of shares of the different barriers does not need to equal 100%, given that these are generally concurrent.

Financial barriers affect 69% of the sectoral plans' mitigation potential and are also more prevalent on the supply-side measures (76%), since these barriers hinder the access of funding for the construction of infrastructure and the acquisition of the required equipment for their implementation. Financial barriers also affect 62% of demand-side measures, and are also mostly related to the initial needs of investment in the industry sector, as well as to demand-side efficiency measures, where return on investment is usually hindered in a context of low energy prices and tariffs.

Political and Cultural barriers (62% over the total mitigation potential), on the other hand, are more prevalent in the demand-side set of measures (88% vs. 35% in the supply-side), since — as for the industry— tariff and price signals attempt against the natural inclination towards achieving savings in the short-term. These barriers, in consequence, affect mostly residential and commercial energy efficiency measures.

Finally, Legal and institutional barriers were identified as restraining 39% of the plans' mitigation potential, with prevalence in the supply-side (49%). These barriers have been identified as mostly related to the required institutional arrangements and jurisdiction issues, as well as the need to modifying or adapting existing laws.

On the supply-side, the most relevant measures affected by Legal and institutional barriers are nuclear and large hydro power generation (13.97 and 7.2 $MtCO_2e$ of emissions reduction, respectively) and the increase of the share of biofuels in fossil fuel blends (9.15 $MtCO_2e$ potential), while the demand-side's most relevant measures affected by these barriers are enhancing households with qualitative deficits (reduction of 7.38 $MtCO_2e$), increasing the energy efficiency of electrical motors (4.23 $MtCO_2e$ mitigation potential), and the large-scale deployment of heat pumps for household heating purposes (3.2 $MtCO_2e$ of emissions reduction).

Table 2: Prevalence of barrier types among the identified measures - Mitigation potential

Type of barrier	Economic	Technical	Financial	Political and cultural	Legal and institutional	Total
# of measures affected						
Supply	11	11	10	7	8	15
Demand	14	16	14	26	16	30
Total	**25**	**27**	**24**	**33**	**24**	**45**
Mitigation potential (MtCO2e)						
Supply	57.5	52.4	48.2	21.8	31.0	63.0
Demand	49.5	41.7	39.4	55.9	17.8	63.2
Total	**106.9**	**94.1**	**87.6**	**77.6**	**48.9**	**126.2**

Supply	91%	83%	76%	35%	49%	
Demand	78%	66%	62%	88%	28%	
Total	**85%**	**75%**	**69%**	**62%**	**39%**	

Source: Own elaboration

Barriers identified in previous analysis, including sectoral plans, per mitigation measure

1. Large-scale penetration of non-conventional renewable power generation in the national grid - E1a
Mitigation potential: 22.16 $MtCO_2e$ considering both unconditional and conditional targets

- **Technical barriers:** large scale penetration of wind power generates challenges in technical operation of the interconnected system, both at the High Voltage Transmission level as in dispatch levels, producing challenges regarding infrastructure, technical and operation standards, capacity reserve and frequency regulation. Regarding biomass and biogas, uncertainty about the availability of feedstock due to seasonal issues challenge the security of supply and hampers scale efficiencies of this type of projects.
- **Economic and financial barriers:** increase the cost of capital reducing competitiveness for capital-intensive projects.
- **Political and cultural barriers:** Reduced experience and specific know how in biomass and biogas power generation (mostly in anaerobic digestion).

2. Distributed renewable power generation - E1b
Mitigation potential: 0.88 MtCO2e – unconditional

- **Economic barriers**: low tariffs and high installation costs challenge the appeal of these types of projects in the perception of potential early adopters.
- **Political and cultural barriers / Legal and institutional barriers:** heterogeneous provincial implementation of the distributed energy promotion law conditions large-scale deployment.

3. Increasing the blend of biofuels in liquid fossil fuels - E1c
Mitigation potential: 9.15 $MtCO_2e$ – unconditional & conditional

- **Economic barriers**: Artificially low fossil fuel prices reduce competitiveness of biofuels for market penetration.
- **Technical barriers:** Existing old motorization installed capacity delays the penetration.

- **Political and cultural barriers:** Intense lobbying activity in the Oil and Gas and the automotive industry constrains further penetration of biofuels in the mobility sector.
- **Legal and institutional barriers:** The promotion law expires in 2021, and discussions regarding its future are being discussed in the Congress.

4. Large scale hydro power generation - E1d
Mitigation potential: 7.2 MtCO2e - unconditional & conditional

- **Political and cultural barriers/ Financial barriers/ Legal and institutional barriers:** Most prominent barriers are related to the delay of the completion of large-scale infrastructure projects, associated to the availability of funds and the obtainment of environmental permits.

5. Nuclear power generation - E1e
Mitigation potential: 13.79 $MtCO_2e$ - unconditional & conditional

- **Economic barriers**: Artificially low fossil fuel prices reduce competitiveness of nuclear energy in the power grid.
- **Financial barriers**: Long construction periods (more than 7 years per power plant), as well as high initial CAPEX requirements impact in repayment periods. The significative share of CAPEX over total costs demands for particular financing conditions and low financial rates.
- **Technical barriers:** CAREM 25 is still a prototype and has not yet reached commercial stages.
- **Political and cultural barriers:** Resistance for uranium mining in certain provinces condition the domestic fuel supply.

6. Off-grid renewable power generation (PERMER) - E1f
Mitigation potential: 0.05 MtCO2e – unconditional

- **Technical barriers:** Difficulty of access to generation sites increases O&M costs that exceed the capacity of payment of beneficiary communities.
- **Political and cultural barriers:** Lack of awareness in potential beneficiary communities reduces demand "pull" for these technologies. Further penetration of PERMER requires collaboration between different government levels both regarding information on potential demand and the development of the projects.

7. Fossil fuel switch of liquid fossil fuels for power generation by natural gas - E1g
Mitigation potential: 5.52 $MtCO_2e$ – unconditional

- **Technical barriers/ Economic barriers:** The Sectoral plan identified the lack of transport capacity of natural gas as the key barrier for further displacement of liquid fossil fuels in power generation. However, this needs to be reassessed in the short and medium terms due to economic barriers associated with the increasing fiscal dependency of domestic natural gas production in a context of increasing subsidies and lack of capacity or will to increase prices and tariffs.

8. Increasing efficiency in power generation (3.32 $MtCO_2e$ - unconditional) (E1h)

- **Financial barriers/ Economic barriers:** This measure is already under implementation, and most relevant barriers were identified regarding the compatibility of long term PPA contracts settled in USD in a context of increasing subsidies and lack of capacity or will to increase prices and tariffs, while financial barriers operate increasing the capital cost and, in consequence, increasing offered prices in the auction results.

9. Water economizers - E2a
Mitigation potential: 3.1 $MtCO_2e$ – conditional

- **Technical barriers:** The lack of capacity of the domestic producers results in imported equipment at higher costs.

10. Solar water heaters - E2b
Mitigation potential: 1.03 $MtCO_2e$ - unconditional & conditional

- **Economic barriers**: Artificially low fossil fuel prices reduce competitiveness of solar water heaters for market penetration.
- **Technical barriers:** Lack of harmonization of minimum technical standards produce uncertainties regarding health issues related to inappropriate equipment and heterogeneous quality. There is also need for customized equipment that cannot be immediately satisfied with standard equipment.
- **Political and cultural barriers:** Demand is limited and restricted only to sustainability- inclined users and entrepreneurs and pilot projects.

11. Public lighting - E2c
Mitigation potential: 4.62 $MtCO_2e$ – unconditional

- **Financial barriers**: the most significant restriction is financial, and is related to the lack of financing, since public lighting jurisdiction is at the municipal level, and the switch of lamps requires an important initial disbursement which is limited to the availability of municipal fiscal resources.

- **Technical barriers:** Technical issues are related to O&M and the current technical capacity on-site to deal with more complex electronics associated to LED rather than incandescent lamps.

12. Efficiency in home appliances - E2d
Mitigation potential: 11.92 $MtCO_2e$ - unconditional & conditional

- **Economic barriers**: Artificially low electricity prices reduce competitiveness of more efficient appliances, that are only substituted organically as they need to be replaced and the available technology is more efficient.
- **Political and cultural barriers:** The lack of information regarding potential savings and environmental impacts reduce the appeal of more efficient appliances in a context of increased initial purchase costs vs. lifetime costs.

13. Heat pumps - E2e
Mitigation potential: 3.2 $MtCO_2e$ – conditional

- **Legal and institutional barriers:** Currently, there are cno regulations limiting the production and sales of balanced draft stoves.
- **Political and cultural barriers:** The use of natural gas for space heating, when available, is deeply rooted in Argentina's residential sector.

14. Enhanced thermal envelope in buildings - E2f
Mitigation potential: 1.21 $MtCO_2e$ – conditional

- **Economic barriers**: Artificially low electricity and natural gas prices reduce incentives for introducing efficiency criteria in design, construction and overhaul stages.
- **Technical barriers:** There is a lack of technically capable resources for controlling the conformity to technical standards of new constructions.
- **Political and cultural barriers:** There is a generalized lack of information related to the benefits of these design criteria and practice among all jurisdiction, supply and demand levels.

15. Efficient tankless water heaters - E2g
Mitigation potential: 2.34 $MtCO_2e$ - unconditional & conditional

- **Economic barriers**: Artificially low natural gas and LPG prices reduce incentives for choosing this type of appliances.
- **Technical barriers:** Previous documents identified the lack of certain technical standards normalizing the equipment requirements.

- **Political and cultural barriers:** Lack of access to information and awareness regarding the existence and benefits of efficient non-pilot tankless water heaters reduces demand.

16. Household lighting - E2h
Mitigation potential: 20.37 $MtCO_2e$ - unconditional

- **Economic barriers**: Artificially low electricity prices, as well as higher initial costs, reduce incentives for the acquisition of more efficient lamps.
- **Technical barriers:** Most of the available more efficient LED devices are still imported, and not LED device types are currently to minimum standards.
- **Political and cultural barriers:** There is a generalized lack of information related to the benefits of efficient household lighting in terms of electricity consumption and environmental impact.

17. Efficient electric motors - E3b
Mitigation potential: 4.23 $MtCO_2e$ - unconditional & conditional

- **Economic barriers**: Artificially low electricity prices reduce incentives for investing in higher efficiency motors.
- **Financial barriers**: High financial rates condition the initiatives for energy efficiency projects, and particular for electric motor replacement in the industry.
- **Technical barriers:** There is a lack of capacity in qualified human resources aware of energy audits and the correct dimensioning and installation of SME. Lack of information about these technologies in university curricula, except for power engineering and certain engineering careers.
- **Legal and institutional barriers:** Lack of strategies and policies among different government levels for promoting energy efficiency, lack of coordination and centralized communication and coordination in an official government agency in general for energy efficiency.
- **Political and cultural barriers:** Generally, for energy efficiency, lack of awareness regarding options and benefits.

18. Efficient industrialized construction systems - E3c
Mitigation potential: 0.38 $MtCO_2e$ - unconditional

- **Financial barriers**: Lack of access to financing conditions the increase in the service providers' capacity.
- **Technical barriers:** Certain difficulties exist to adapt international and foreign methodologies to national circumstances. Costs and scale are still not sufficient to

attain scale economy benefits, which is also conditioned by the lack of specific skilled workers.

- **Legal and institutional barriers:** Lack of strategies and policies among different government levels for promoting energy efficiency, lack of coordination and centralized communication and coordination in an official government agency for energy efficiency.
- **Political and cultural barriers:** Lack of awareness among potential customers.

19. Efficient industrial lighting - E3d
Mitigation potential: 0.4 $MtCO_2e$ - unconditional

- **Economic barriers**: Artificially low electricity prices, as well as higher initial costs, reduce incentives for the acquisition of more efficient lamps.
- **Technical barriers:** Most of the available more efficient LED devices are still imported, and not LED device types are currently to minimum standards.
- **Political and cultural barriers:** There is a generalized lack of information related to the benefits of efficient household lighting in terms of electricity consumption and environmental impact.

20. Shut-case commercial fridges - E3e
Mitigation potential: 0.45 $MtCO_2e$ - unconditional

- **Economic barriers**: Artificially low electricity prices, as well as higher initial costs, reduce incentives for shut-case commercial fridges by supermarket and proximity stores.
- **Political and cultural barriers:** Lack of awareness among potential customers.

21. Resource efficiency in the food industry

This measure aims to reduce GHG emissions by the implementation of resource efficiency processes in the food industry. The measure is considered additional. However, along the National Industry and Climate Change Action Plan the measure had to be defined and, thus, was not considered during this phase of analysis for current review.

22. Recovery and use of residual currents in the petrochemical industry - E3g
Mitigation potential: 0.01 $MtCO_2e$ - conditional

- **Economic barriers**: Artificially low electricity and natural gas prices, as well as higher capital costs for capture and compression of residual currents limit attractiveness.
- **Financial barriers**: Difficulties in the access to credit limits sector-wide implementation.

- **Technical barriers:** Complexity of implementation and heterogeneity of currents condition initial setup and operation and maintenance practices.

23. Solar PV and wind power in industry - E3h
Mitigation potential: 0.12 $MtCO_2e$ - unconditional

- **Economic barriers**: Artificially low electricity gas prices reduce rate of return for this type of projects.
- **Financial barriers**: Lack of access to credit results in reduced attractiveness.
- **Legal and institutional barriers:** An apparent lack of coordination between system-PPA and industry initiatives was described in previous documents. However, specific instruments such as term-markets (MaTer) exist for industry purposes.

24. Solar thermal energy for Industry - E3i
Mitigation potential: 0.73 $MtCO_2e$ - unconditional

- **Economic barriers**: Artificially low natural gas prices, as well as higher capital costs for solar thermal facilities reduce demand.
- **Financial barriers**: Difficulties in the access to credit limits sector-wide deployment.
- **Technical barriers:** Lack of qualified human resources as a result of low penetration could condition future development.
- **Legal and institutional barriers:** There is lack of an adequate regulation regarding the installation and standards for this type of equipment. generalized lack of communication and information regarding principles and results of the implementation of these technologies. There is not a clear institutional responsibility for the promotion of solar thermal technologies, since most renewable energy authorities are focused on power generation.
- **Political and cultural barriers:** There is a generalized lack of communication and information regarding principles and results of the implementation of these technologies.

25. Biogas production - E3j
Mitigation potential: 0.11 $MtCO_2e$ - conditional

- **Economic barriers**: Initial investment costs are high when compared to existing fuel alternatives such as natural gas for facilities with access to the grid.
- **Technical barriers:** There is uncertainty about the availability of feedstock due to seasonal volatility, challenging the security of supply and conditioning how these projects attain scale efficiencies, and introduce processes that are not necessarily aligned with the specific business of the potential user.

- **Financial barriers:** Financial barriers increase cost of capital reducing competitiveness for capital-intensive projects.
- **Political and cultural barriers:** Reduced experience in biomass and biogas power generation (mostly in anaerobic digestion).

26. Use of black liquor in the pulp and paper industry - E3k
Mitigation potential: 0.76 $MtCO_2e$ - conditional

- **Economic barriers**: Initial investment costs are high when compared to existing fuel alternatives such as natural gas for facilities with access to the grid.
- **Technical barriers:** There is a potential need to switch feedstocks and adequate infrastructure to achieve better concentrations for the combustion process.

27. Circular economy: reuse of scrap residues - includes recovery and reuse of aluminum, steel, copper, battery lead, tires, paper and plastic – E3k-E3s
Mitigation potential: 1.41 $MtCO_2e$ – unconditional & conditional

- **Legal and institutional barriers:** There is need for an amendment to the hazardous residues Law and to specific regulation for the recovery and recycling management, as well as enforcing the prohibition of certain practices such as burning used tires.
- **Political and cultural barriers:** There is a lack of formal distribution networks bringing transparency and scale to these potential markets.

Stakeholder consultations: the sectoral perception on existing barriers

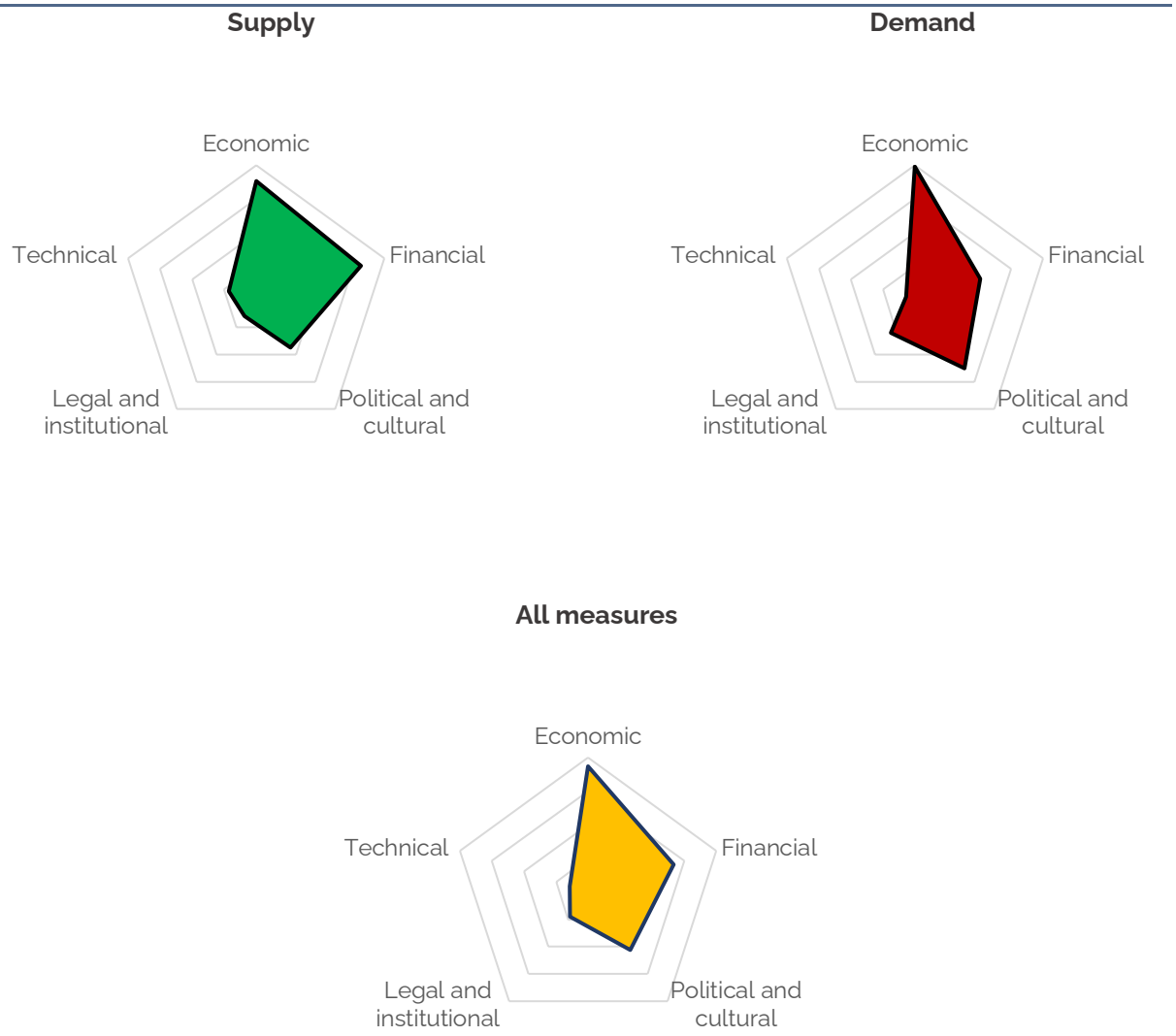
During bilateral and multilateral stakeholder dialogues, the approach to sectoral barriers consisted on a structured questionnaire followed by the request for insights regarding the underlying reasoning behind each response. Each respondent was asked to select the three most relevant barriers affecting each mitigation measure, and frequencies were computed for responses over each measure. Detailed methodology is described in document "Multi-stakeholder dialogues - III AR 2".

The following figures summarize the results for supply and demand-side measures, as well as for the complete set.

In most cases, and consistently with the results identified during the review of sectoral plans, Economic barriers prevailed, being present in 37% of the responses (35% regarding supply-side and 40% regarding demand-side), while in the overall results Financial barriers came in second place, in 27% of responses (33% of supply-side and 20% of demand-side), followed by political and cultural barriers (21% overall; 17% regarding supply-side and 25% regarding demand-side).

Legal and Institutional barriers were barely mentioned (9% overall; 6% in supply-related measures and 12% regarding demand measures). Finally, Technical barriers accounted only for 6% of responses (9% in supply and 3% in demand).

Figure 10: Prevalence of barrier types among the identified measures – Mitigation potential



Source: Own elaboration

Overall, the findings from the stakeholders' views on barriers are consistent with some of the results identified by the government when designing the sectoral plans: supply-side measures are mostly constrained by Economic and Financial barriers, while demand-side measures are mostly constrained by Economic and Political and Cultural (mostly the latter) barriers.

However, there is a notable disparity between the frequency in which Technical barriers were identified on official documents and the stakeholder's views, while Legal and Institutional barriers seem to be consistently less relevant than the other constraints both for official and private-sector sources.

As a complement to these responses, relevant insights where provided by stakeholders:

- Types of barriers identified by stakeholders in a bottom up approach:
  - Boundary conditions (oil price, US elections, etc.)
  - Enabling conditions (necessary, but not sufficient)
  - On the supply side, there is a different role in terms of decision making and investment between private and public actors. Renewables require fundamentally investment and R&D. In nuclear and hydro generation, the State stimulus is key for its development.
  - On the demand side, the multiple equipment based on different fuels (natural gas, LPG and in a less extent electricity) represent a challenge for consumers/users with insufficient knowledge.
- Renewable energy projects finance is challenging in terms of uncertainty and absence of long-term funding that enable growth in installed capacity.
  - The objective of 8000 MW is challenged by the different existing price mechanisms and the financial sector assess the projects in a traditional manner
  - Industry competitiveness is constraint by the energy taxes it faces and needs stringent market signals (carbon price) in order to internalize environmental impacts.
- The addition of 4.200 MW nuclear capacity by 2030 is not restraint by financial barriers given the Chinese funding, however, the cost of the central is high and based on an unproven technology. On the other hand, 4 projects in 9 years seem highly ambitious in terms of execution.
- In a 10-year term, the switch to efficient appliances will be achieved organically, based on the technological availability and, thus, the acquisition cost. In lighting, the replacement will depend on available technologies.
- The main challenge is how to economically stimulate necessary projects to achieve Argentina's commitments

3. Transport

Transport policymaking in Argentina is constrained both by most of the cross-cutting barriers such as the structural economic and governance barriers and boundary conditions, as well as sector-specific barriers compromising the climate and non-climate specific policies and

measures for sustainable development. Additionally, the mitigation options to be adopted by the transport sector are constrained by infrastructure, policies, prices and decisions made in the energy sector, thus requiring a strong coordination.

Characterization of sectoral features for the assessed barriers

- **Economic Barriers**: High fossil fuel transport subsidies, in conjunction with high investment requirements in infrastructure and overall uncertainty about global energy prices and domestic tariffs hamper strategic decisions in the public and private sector for long term investment.
- **Technical barriers:** Penetration of new technologies such as electric vehicles or electric public buses and Liquid Natural Gas (LNG) for freight transport is limited in part by the required infrastructure, as well as the equipment or parts imported, due to the lack of scale and the need to adapt manufacturing facilities and value chains to locally led manufacture.
- **Financial barriers:** Infrastructure-intensive or large-scale technology measures due to the CAPEX requirements for long term infrastructure, hindered by insufficient access to credit and increasing capital costs, resulting in higher revenue rate requirements, that translates as greater freight costs. Regarding particular user choices, financial barriers affect the access to credit, delaying in some cases the adoption of newer or more efficient vehicles and extending the average age of fleet.
- **Political and cultural barriers:** Resistance to change promoted by existing sub-sectoral lobbies (private and public, including provinces and unions) and excessive dependency of public and private investment decisions regarding infrastructure condition the design and development of long-term strategies and increase the delay for long term deployment of new technologies —or "old efficient ones", such as railroad transport. Additionally, the dynamics of the assignment of public funding for investment in road infrastructure during specific periods has been oriented to certain regions, resulting in inequalities and lack of adequate infrastructure in particular regions.
- **Legal and institutional barriers:** In the context of Argentina's transport sector, legal and institutional barriers materialize in difficulties of coordination among different government levels, such the federal, provincial and municipal governments. For example, the implementation of metrobuses and regional express railways and proliferation of technology biased legislative initiatives. Additionally, the dispute over the continuity of existing promotion regimes, i.e. the biofuels, contributes with uncertainty to the particular sector. The homologation of regulatory frameworks is commonly associated with high administrative complexity and bureaucratic costs and delays. Particularly, the implementation of fleet renewals with scrapping requires the amendment of the hazardous residues Law, as well as the creation of

additional regulatory tools in order to avoid the reuse of inefficient and contaminating units. For the design of sectoral plans, institutional barriers often materialize in the lack of official statistics and information and in the difficulties for coordination in the design and implementation of policies and measures which often require system-wide and inter-system approaches.

Identified barriers in previous analysis

A review of existing climate change mitigation measures and barriers for their implementation included in the National Transport and Climate Change Action Plan (2019) was performed.

This review consisted on surveying the identified barriers, which were categorized according to the classification proposed in the conceptual framework: Economic; Technical; Financial; Political and cultural; and Legal and institutional.

This classification served as a basis to assess the concurrence of barriers to different proposed measures, as well as to provide a better understanding on which types of barriers have higher impacts on the mitigation potential identified by the Argentine government and presented in its sectoral plans. The revision was contrasted to the stakeholders' views recollected during the bilateral and multilateral dialogues.

For the purpose of this document, all measures were categorized into Passengers and Freight transport measures, and results are presented accordingly.

Concurrent barriers

The National Transport and Climate Change Action Plan contained 17 measures, 46% of the potential emission reductions (2.7 $MtCO_2e$ out of 5.9 $MtCO_2e$) are —according to the national plan—constrained by two or less types of barriers, while the remaining 11% is constrained by three types of barriers.

This set of measures affected by two or less barriers will be analyzed in order to assess the potential quick wins through instruments or actions to address these barriers in the short term.

While the National Transport and Climate Change Action Plan left one measure without stating barriers constraining its development, (bicycle path development, accounting for 0.003 $MtCO_2e$), it will be considered not subject to barriers, given its state of development and the lack of information provided in the sectoral plan.

The plan identifies four measures subject to only one type of barrier (10% of the plan's stated total mitigation potential - 0.563 $MtCO_2e$), three of them categorized as passenger transport measures:

- implementation of metrobuses (0.457 $MtCO_2e$), constrained by political and cultural barriers, mainly the opposition from neighbors and commerce-owners because of the deviation of pedestrians —potential buyers— towards metrobus platforms;
- the renewal of urban buses, from Euro III compliant to Euro V (0.065 MtCO2e), subject to technical barriers, including the potential reuse of old units attempting against effective reductions if no scrapping occurs; and
- the construction of over or under-passes (non-level crossings) for railways, accounting for 0.041 $MtCO_2e$, but conditioned by political and cultural barriers, the opposition from neighbors, urban planners and local authorities affected by the construction.

One freight transport measure, the *National Road Plan to 2025*, not rated for emission reductions in official documents, stated as affected mostly by technical-cultural barriers —notably similar to the Khazzoom–Brookes postulate—[10], where the increase of transit and speeds in the new roads could increase consumption and neutralize emission reductions.

In second place, 7 measures representing 36% of the sectoral plan's stated mitigation potential (2.126 MtCO2e) were classified as restricted by two types of barriers, with a higher concentration on the freight transport (1.391 $MtCO_2e$) than on the passenger transport (0.736 $MtCO_2e$).

Regarding freight transport:

- truck drivers training programme, accounting for 1.04 $MtCO_2e$, and subject to technical, political and cultural barriers, for example regarding the use of simulation aids and recruiting qualified trainers, and on the cultural side the potential opposition of logistics companies to assign time for training —according to the plan—;
- development of railway express networks (RER, 0.733 $MtCO_2e$), mostly constrained by technical and financial barriers, in terms of access to reliable power supply;
- the renewal of truck fleets (including scrapping), contributing with reductions of 0.336 $MtCO_2e$ subject to technical and legal and institutional barriers, mostly related to the scrapping aspects of the measures; and

[10] "Energy efficiency improvements that, on the broadest considerations, are economically justified at the microlevel, [may] lead to higher levels of energy consumption at the macrolevel." Khazzoom, D. (1987). "Energy Saving Resulting from the Adoption of More Efficient Appliances". The Energy Journal. 8 (4): 85–89. doi:10.5547/issn0195-6574-ej-vol8-no4-8

- the construction of *Paseo del Bajo*, a new highway link in central City of Buenos Aires associated with emission reductions of 0.015 $MtCO_2e$ towards 2030, which faced technical, political and cultural barriers during its construction phase, related to the disruption of transit near the port of Buenos Aires and nuisances to the citizens.

One additional measure on freight transport subject to two types of barriers is mentioned in the official documentation —the introduction of maximum speed limitation devices into trucks— but has not been assessed for emission reductions, and is subject to technical, and political and cultural barriers.

Regarding passenger transport, the sectoral plan identifies the modernization of commercial aviation as potentially contributing with emission reductions of 0.003 MtCO2e by 2030, subject to political and cultural barriers, as well as legal and institutional barriers, based on the need to optimize institutional arrangements, and the lack of qualified human resources for the implementation of these new processes.

Finally, also on passenger transport measures, the National Transport and Climate Change Action Plan proposes the energy efficiency labeling of vehicles, subject to financial and to political and cultural barriers, both related to the dynamics of the lack of incentives to incur in higher initial costs for the vehicle, but does not disclose the potential reductions of the measure.

Five mitigation actions (54% of the sectoral plans' emission reductions) are shown as subject to three types of barriers, accounting for 3.215 MtCO2e in 2030, and mostly focused on freight transport.

The most relevant of these measures in freight transport are:

- the Rail Freight Investment Plan, which attempts to switch cargo from truck to rail (mitigation potential of 1.874 MtCO2e), subject to technical, financial, legal and institutional barriers, based on the reduced flexibility of rail freight when compared to trucks, the lack of incentives for private investment and the absence of regulation ruling the Argentine Railways Law, passed in 2015,
- the smart transport programme (accounting for 0.693 MtCO2e emission reductions) is currently constrained by economic, financial and legal and institutional barrier, due to the needs for high initial investments, the lack of funding for the adoption of best practices and the incentives (or lack thereof) for freight customers to prioritize sustainable practices rather than lower transport tariffs.

Regarding passenger transport, three measures are subject to three types of barriers.

- The development of low emission light vehicles —mostly focused on electric vehicles— (0.465 $MtCO_2e$ emission reductions), bound to economic, technical political and cultural barriers, such as higher retail prices, lower autonomy and slow charging for electric vehicles, distribution infrastructure challenges and lack of regulation.
- The use of alternative energy sources for urban buses (mitigation potential of 0.154 $MtCO_2e$) —mostly focused on electric buses— is subject to technical, financial, legal and institutional barriers, related to infrastructure issues, as well as the access to financing and the need for special regulation for their large-scale adoption.
- Finally, the recovery of inter-urban passenger rail services (0.03 $MtCO_2e$ mitigation potential) faces technical, political and cultural, as well as legal and institutional barriers, such as the longer travel times with the current infrastructure, the lack of boarding centers and the pressure from the automotive sector.

Table 3: Types of concurrent barriers constraining measures contained in sectoral plans

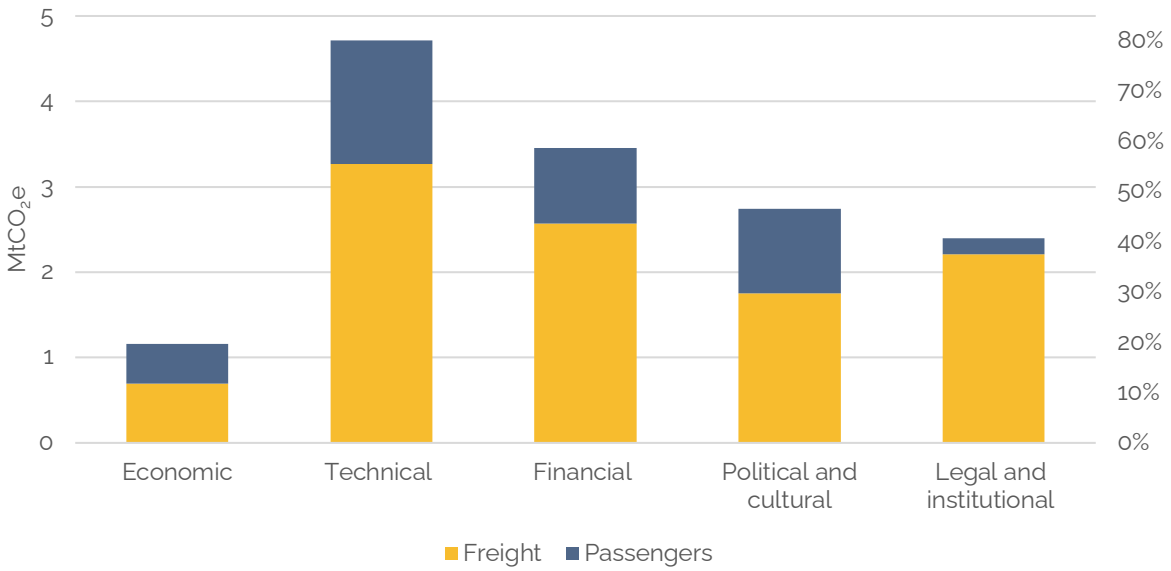
	Number of concurrent barriers						
	0 barrier	**1 barrier**	**2 barriers**	**3 barriers**	**4 barriers**	**5 barriers**	**Total**
# of mitigation measures							
Passengers	1	3	3	3	0	0	10
Freight	0	1	4	2	0	0	7
Total	**1**	**4**	**7**	**5**	**0**	**0**	**17**
Mitigation potential (MtCO2e)							
Passengers	0.003	0.563	0.736	0.649	0	0	1.951
Freight	0	0	1.391	2.566	0	0	3.957
Total	**0.003**	**0.563**	**2.127**	**3.215**	**0**	**0**	**5.908**
Passengers	0%	29%	38%	33%	0%	0%	
Freight	0%	0%	35%	65%	0%	0%	
Total	**0%**	**10%**	**36%**	**54%**	**0%**	**0%**	

Source: Own elaboration

Prevalence of barrier types

Existing and planned measures have been analyzed regarding the types of barriers constraining their development, following the same categorization as freight and passenger transport.

Figure 11: Prevalence of barrier types among the identified measures - Mitigation potential[11]



Source: Own elaboration

Most types of **Economic barriers** are identified as resulting from cross-cutting phenomena, and in consequence focus will be mostly made on the other types of barriers.

Figure 11 and Table 4 show that **Technical barriers** are prevalent, affecting 11 measures (80% of the mitigation potential) identified in the sectoral plan, reaching 82% in the case of freight transport, where typically measures are associated with larger investment requirements, while they also affect 74% of the passenger transport measures.

The most prominent freight transport measures constrained by technical barriers are the *Rail Freight Investment Plan* (1.874 $MtCO_2e$ mitigation potential) and the truck drivers training programme (1.04 $MtCO_2e$ emission reductions), followed by the construction of Paseo del Bajo (already finished, contributing a reduction of 0.015 in 2030), the truck fleet renewal (contribution of 0.336 $MtCO_2e$ reduction), the *National Road Plan to 2025*, and the use of speed-limit devices for trucks.

Regarding passenger transport, the most relevant measure is the development of regional express railways (RER), contributing to a reduction of 0.733 $MtCO_2e$ in 2030, followed by the promotion of light low emission vehicles (0.465 $MtCO_2e$ emission reductions) and buses (0.154 $MtCO_2e$ of mitigation potential), both bound to infrastructure and autonomy issues; the renewal

[11] Note that the sum of shares of the different barriers does not have to equal 100%, given the fact that these are generally concurrent.

of bus fleets, from Euro III to Euro V (0.065 $MtCO_2e$) and the recovery of inter-urban passenger rail services (0.03 $MtCO_2e$).

In second place, Financial barriers are constraining 58% of the mitigation potential of the sectoral plan, highly concentrated in five measures, and mostly affecting freight transport (65%). Railway-related measures, such as the *Rail Freight Investment Plan* (1.874 $MtCO_2e$) and the development of regional express railways (RER, 0.733 $MtCO_2e$) are considerably affected by this type of barriers due to their investment requirements, but also the Smart Transport Programme (0.693 $MtCO_2e$), the use of alternative energy in buses (as shown in the official document, biased towards electrical buses, accounting for 0.154 $MtCO_2e$) demanding high initial investments and requiring accessible financing.

Political and cultural barriers currently affect 46% of the reduction potential disclosed in the sectoral plan, restricting 51% of the passenger transport potential and 44% of the freight transport potential. Regarding freight transport, the most relevant measure subject to these types of barriers according to the plan is the training of drivers (1.04 $MtCO_2e$), followed by the Smart Transport programme (0.693 $MtCO_2e$) and the construction of *Paseo del Bajo* (0.015 $MtCO_2e$).

Regarding passenger transport, the two relevant measures subject to political and cultural barriers are the promotion of light low emission vehicles (0.465 $MtCO_2e$) and the implementation of metrobuses (0.457 MtCO2e), followed by minor measures, such as construction of over or under-passes (non-level crossings) for railways (0.041 $MtCO_2e$) the recovery of inter-urban passenger services (0.03 $MtCO_2e$) and the modernization of commercial aviation (0.003 $MtCO_2e$).

Finally, **Legal and institutional barriers** affect 41% of the emission reduction potential shown in the sectoral plan, and are mostly concentrated in the freight transport measures (constraining 56% of them), prominently the *Rail Freight Investment Plan* (1.873 $MtCO_2e$) and the renewal of truck fleets, including the scrapping of old units (0.336 $MtCO_2e$). When it comes to the passenger transport measures, the promotion of electric buses is the most relevant (0.154 $MtCO_2e$) measure affected due to the lack of specific regulation, followed by less-relevant measures such as the recovery of inter-urban services and the modernization of commercial aviation.

Table 4: Prevalence of barrier types among the identified measures - Mitigation potential

Type of barrier	Economic	Technical	Financial	Political and cultural	Legal and institutional	Total
# of measures affected						
Passengers	1	5	3	6	3	10
Freight	1	6	2	4	2	7
Total	**2**	**11**	**5**	**10**	**5**	**17**
Mitigation potential (MtCO2e)						
Passengers	0.465	1.447	0.887	0.996	0.187	1.951
Freight	0.693	3.264	2.566	1.748	2.209	3.957
Total	**1.158**	**4.711**	**3.453**	**2.744**	**2.396**	**5.908**
Passengers	24%	74%	45%	51%	10%	
Freight	18%	82%	65%	44%	56%	
Total	**20%**	**80%**	**58%**	**46%**	**41%**	

Source: Own elaboration

Detail of barriers identified in previous analysis, including the National Transport and Climate Change Action Plan, per mitigation action

1. Hierarchization of the railway - Development of Regional Express Railways (RER) - T2a Mitigation potential: 0733 $MtCO_2e$ - unconditional target

- **Economic and financial barriers:** There is need for construction of new accessible boarding centers equipped with parking stations for automobiles and bikes.

- **Technical barriers:** The most relevant need is securing a reliable electricity supply in order to avoid issues related to efficiency and involuntary service interruptions. This also results in the need to invest in distribution infrastructure. In order to reduce emissions, the electricity supply must be low-emission, and preferably CO_2 neutral.

  Quality service, providing the adequate comfort, avoiding delays and frequency issues is vital for the large-scale adoption of the service. Hence, technical barriers, for example the need to construct over or under-passes (non-level crossings) in order to ensure the enhancement of frequencies, and the need to improve pedestrian access to stations, as well as inter-jurisdictional arrangements have to be addressed.

- **Political and cultural barriers/legal and institutional barriers:** The mentioned inter-jurisdictional arrangements —both in terms of access and security— are mostly subject to political barriers when different jurisdictions are not ruled by the same political party. Additionally, security issues produce concern to potential users and have cultural implications regarding the safety of use and access of the service, which have to be dealt with both in terms of results and communication.

2. Hierarchization of the railway — Construction of non-level crossings
Mitigation potential: 0.041 MtCO2e - unconditional

- **Political and cultural barriers:** The most relevant barriers are cultural, and are materialized in the resistance of neighbors affected by the construction of tunnels and bridges, affecting land value (households and real-state brokers/investors), and access to existing commerce.

  Additionally, urban planners from affected jurisdictions might also oppose because of interference with local interests.

3. Development of low emission mobility — Energy efficiency labeling
Mitigation potential: has not yet been estimated

- **Economic barriers/ political and cultural barriers:** Artificially low electricity prices and tariffs promote the prioritization of lower initial costs regardless of the lifetime cost, hence turning efficiency information irrelevant. Culturally, these prices have affected customer choices and are hard to remove even after tariff-increase shocks.

4. Development of low emission mobility — Promotion of low emission light vehicles
Mitigation potential: 0.465 MtCO2e - unconditional

- **Economic barriers:** Higher retail prices reduce the appeal of EV vs. alternative technologies, such as internal combustion engines, turning these vehicles into a small niche market.
- **Financial barriers**: Generalized lack of financing for retail customers difficult the access to these vehicles given the higher retail prices.
- **Technical barriers:** EV have still less autonomy and need a high density of chargers in order to guarantee extended use (this excludes hybrid vehicles), in addition to slow charging times and the requirement of adequate distribution infrastructure and charging stations.

While the power generation mix is still 60% thermal fossil in Argentina, EV will not completely serve as a decarbonization option.

EV disrupt the installed capacity of domestic manufacturing facilities, since the switch requires changing more than 80% of the automobile parts.

- **Political and cultural barriers:** There is a relevant bias, —both in the plan and in cultural perception— towards electric vehicles, which hinders the adoption of other competitive technologies in the short term, such as NGV and biofuels.
- **Legal and institutional barriers:** There is still lack of regulation regarding domestic standardization, as well as unresolved issues regarding pricing and tariffs for distribution domestic users. Additionally, the regulation for fuel stations serving as charge stations is still incipient.

5. Development of low emission mobility — Promotion of alternative energy buses
Mitigation potential: 0.154 MtCO2e - unconditional

- **Economic barriers:** Electric buses have considerable higher investment requirements than conventional internal combustion engines (diesel oil, NGV or biodiesel), and currently part of the service cost is paid by the National Treasury in the form of subsidies.
- **Financial barriers**: Reduced access to financing options and high interest rates turn the investment unattractive for transport companies.
- **Technical barriers:** Recurrent reliability issues in the distribution grid and the need to invest into transformer stations at the bus terminals require substantial adjustments of current infrastructure.
- **Political and cultural barriers:** There is a relevant bias, —both in the plan and in cultural perception— towards electric vehicles, which hinders the adoption of other competitive technologies in the short term, such as NGV and biofuels. There is also a need to train drivers regarding certain characteristics of these types of vehicles for daily use.
- **Legal and institutional barriers:** There is still lack of regulation regarding domestic standardization for the adoption of these technologies.

6. Urban passenger transport — Renewal of bus fleets (Euro III to Euro V)
Mitigation potential: 0.065 $MtCO_2e$ - unconditional

- **Technical barriers:** If older units are not scrapped, these units can end-up in a post-commercial second-hand lifetime producing emission increases rather than reductions.

- **Political and cultural barriers:** Downstream oil and gas lobbies put pressure into delaying the effective entry into force of previously stated adoption of the Euro V standard.
- **Legal and institutional barriers:** There is a need to amend the hazardous residues Law in order to catalyze scrapping.

7. Urban passenger transport – Implementation of Metrobuses
Mitigation potential: 0.457 $MtCO_2e$ - unconditional

- **Political and cultural barriers:** There is resistance of neighbors affected by the metrobus, mostly related to and access to existing commerce, because of the detour of pedestrians —potential buyers— towards metrobus isles. It might also produce impact to land value (households and real-state brokers/investors). Additionally, inter-jurisdictional arrangements have resulted challenging when jurisdictions are ruled by different political parties.

8. Urban passenger transport – Modernization of commercial aviation
Mitigation potential: 0.003 MtCO2e - unconditional

- **Economic barriers:** Budget constraints for public institutions in charge of the design and implementation of the measure delay its development.
- **Technical barriers:** Low availability of qualified human resources for the implementation of new processes.
- **Political and cultural barriers:** New routes require negotiations with airlines before their definition and adoption.

9. Recovery of railways – Re-establishment of inter-urban passenger rail services
Mitigation potential: 0.030 $MtCO_2e$ - unconditional

- **Political and cultural barriers:** The perception of low-quality service, concurrent with the real longer duration of travel need to be addressed providing the adequate comfort, avoiding delays and frequency issues is vital for the large-scale adoption of the service. Hence, technical barriers, for example the need to construct over or under-passes (non-level crossings) in order to ensure the enhancement of frequencies, and the need to enhance pedestrian access to stations, as well as inter-jurisdictional arrangements have to be addressed.

10. Hierarchization of the railway (freight) – Rail Freight Investment Plan | truck-to-rail cargo switch
Mitigation potential: 1.873 MtCO2e - unconditional

- **Economic barriers/ regulatory barriers:** Current concessions are about to expire and investment decisions will probably be delayed until new conditions are determined and communicated.
- **Technical barriers:** Reduced flexibility of railroad vs. road freight transport reduces the appeal of the former. Transfer centers (inter-modal) such as truck-to-train and train-to-ship are required to be planned and developed in order to increase effectiveness of the switch.
- **Political and cultural barriers:** One of the most relevant barriers for this measure is the historically strong lobby and coercion of road freight transport unions against the resurgence of railroad freight transport. Additionally, historic issues regarding delays in railroad transport bias the preference of certain customers towards road transport.
- **Legal and institutional barriers:** There is still absence of regulation ruling the Argentine Railways Law, passed in 2015.

11. Enhancement of road freight transport efficiency – Smart Transport Programme
Mitigation potential: 0.693 MtCO2e - unconditional

- **Economic barriers:** There is need for high initial investments concurrent with the lack of awareness of the economic benefits of the programme.
- **Financial barriers**: Difficult access to funding for the adoption of best practices when these require technology investment.
- **Political and cultural barriers:** Lack of funding for the adoption of best practices and the incentives (or lack thereof) for freight customers to prioritize sustainable practices rather than low transport tariffs. Lack of awareness by the logistics companies regarding economic benefits. Additionally, there is still a small demand for "green" transport options except for niche customers.

12. Enhancement of road freight transport efficiency – Truck driver training
Mitigation potential: 1.040 MtCO2e - unconditional

- **Technical barriers:** training requires the use of simulation and practice aids and recruiting qualified trainers with reduced availability.
- **Political and cultural barriers:** Company owners might not understand the value of training in contrast to using the same time for delivery and other core business issues.

13. Enhancement of road freight transport efficiency – Renewal of truck fleets with scrapping
Mitigation potential: 0.336 MtCO2e - unconditional

- **Economic barriers:** Higher initial costs reduce competitiveness of new trucks vs. the current fleet for certain life-stages and service tiers.
- **Political and cultural barriers:** "Extended life" of disposed trucks by informal workers for secondary and first/last mile circuits could result in increased emissions rather than in emission reductions.
- **Legal and institutional barriers:** There is a need to amend the hazardous residues Law in order to catalyze scrapping. Informal part markets could arise due to the lack of regulation.

14. Enhancement of road freight transport efficiency – National Road Plan to 2025
Mitigation potential: has not yet been estimated

- **Technical/ Political and cultural barriers:** The increase of transit and speeds in new roads could increase consumption and neutralize emission reductions.

  The implementation of the *National Road Plan to 2025* is biased by design towards road transport and could probably result into reducing the competitiveness of railroad-related measures discussed in the transport and climate change plan.

15. Enhancement of road freight transport efficiency – Speed limiting devices for trucks
Mitigation potential: has not yet been estimated

- **Technical barriers:** Since not all trucks exceed speed limits and other variables affect consumption among different models, the mechanism of estimating and verifying emission reductions results challenging.
- **Political and cultural barriers/ Legal and institutional barriers:** Given the lack of regulation, freight customers prioritize speed when it comes to preferences.

16. Enhancement of road freight transport efficiency – Paseo del Bajo
Mitigation potential: 0.015 MtCO2e - unconditional

- **Technical barriers:** Disruption of transit near the port of Buenos Aires during the construction phase.
- **Political and cultural barriers:** The aforementioned disruption generated trouble and nuisances to the citizens during the construction phase.

17. Non-motorized mobility – Development of bicycle paths
Mitigation potential: 0.003 MtCO2e - unconditional

- **Political and cultural barriers:** Perception of vulnerability for riders in certain metropolitan areas and high crime record involving cyclists.

Stakeholder consultations: the sectoral perception on existing barriers

During six bilateral and multi-lateral stakeholder dialogues for the transport sector, several impressions were collected regarding the feasibility of mitigation measures presented and the most prevalent barriers were identified by sectoral specialists, both from the private and public sectors.

Notably, and in contrast to government documentation, where Technical barriers have a central role as identified constraints for the development of the proposed measures, hindering the implementation of 80% of the mitigation potential; political and cultural barriers have gained particular relevance among the perception of most stakeholders, not necessarily in quantitative terms, but in terms of their assessment of importance among others.

- **Economic barriers:**

Most of the economic barriers identified by stakeholders in the National Transport and Climate Change Action Plan *require high investment in infrastructure and capital goods. Particularly, 53% of the emission reduction potential stated in the sectoral plan, worth 3.16 $MtCO_2e$ are associated to public investment requirements.*

However, several energy efficiency opportunities could deliver quick wins requiring low-to-no investment.

Fossil fuel subsidies, and particularly those related to transport subsidies, are not transparent enough to make evident the modifications that need to be done.

According to several interviewees, there is uncertainty regarding what share of the current diesel consumption of the passenger transport sector is subsidized. Hence, fiscal benefits are not straightforward from the equation in order to assess net fiscal costs of measure. This affects the penetration of both, biofuels and natural gas.

Biofuels might not be able to compete pricewise in the medium to long-term unless efficiency gains are achieved and higher carbon taxes are set for fossil fuels, including natural gas, currently excluded by law.

Price is expected to continue to be a strong driver for consumer incentives and decisions in the medium and long terms.

Electrical buses require three times the investment of an internal combustion diesel bus, in contrast to biodiesel or natural gas vehicles, which cost 30% more than a diesel bus.

Biodiesel and natural gas vehicle options result in reduced economic barriers when compared to the electric vehicles. However, for example, NGV require additional infrastructure, such as compression stations and others, and these investments —according to the interviewees— will not be made spontaneously in absence of the right incentives,

The leap from light vehicles to heavy-duty vehicles fueled by natural gas (NGL) requires additional investment in infrastructure, and new natural gas subsidies to distribution users and power generation could drive natural gas prices up for vehicles, thus, turns NGV less competitive in the short-term.

Light electric vehicles are still highly priced reducing the appeal for mainstream customers.

However, in the short term, these could become competitive by 2023-2025, according to interviewees, driven by decreasing battery costs.

The lack of domestic production of light electric vehicles in the context of trade balance issues, reduces the incentives of authorities for promoting imported electric vehicles.

At the same time, the reduced domestic and regional market does not provide incentives for automotive companies to consider mounting production lines for EVs in their short and medium-term planning.

Freight transport constitutes a heterogeneous supply universe, constituted by large companies and an atomized number of small suppliers.

The economic incentives and policy design to address market failures often fail to address small companies of individual truck owners who constitute a large second-hand market for freight transport, concentrating between 5% to 10% of the load.

- **Financial barriers**:

A generalized, non-sector specific lack of access to credit and high interest rates were mentioned as issues reducing the appeal of investments in new capital assets by the private sector.

Argentina's risk rate not only affects the private sector but also the rates or terms for infrastructure development, for example for railway infrastructure or roads (such as the National Road Plan to 2025).

- **Technical barriers:**

Technology bias in the sectoral plan might attempt against efficiency in the cost-effectiveness of mitigation options.

The country does not have an integrated regulatory body, and in consequence certain competing technologies are promoted independently, and considered in isolation, making regulation prone to lobbying and to "overdetermined systems".

Lack of systemic approaches considering the transport sector as non-interacting with other sectors might lead into local, rather than global optimization.

Transport measures can't be planned without considering the mutual impacts of transport on the industry and agricultural sectors, as well as in the energy sector. Isolated measures, such as electrification, without considering and receiving feedback from the energy sector's impact could lead into emission increases, rather than reductions.

Road infrastructure faces several deficiencies which condition the real ability to enable short-term potential quick wins, such as increasing the admissible axle weight.

These conditions could be met, however, in conjunction with the national road infrastructure plan.

The large-scale penetration of natural gas for transportation (Compressed natural gas –CNG- an LNG) requires certainty regarding the future fuel availability.

Argentina's natural gas production is critical for the energy sector, but has proven to be highly volatile and vulnerable to short term policies and intervention, and spikes uncertainty regarding potentially stranded assets.

Currently, only one refining company is capable of producing Euro VI compliant fuels.

The technical and investment requirements needed to produce Euro VI or even Euro V compliant fuels in Argentina are high and thus the capability has not been committed by most refiners, what results in successive delays of the entry into force of these standards. Adopting Euro V, as planned, could result in "too little, too late", and delay the adoption of Euro VI.

The lack of standardized information regarding lifecycle emissions for certain fuels restricts the validation and adoption of mitigation alternatives by companies reporting to foreign headquarters with stringent MRV standards for their carbon footprint.

The lack of precise information regarding lifecycle emission reductions for each fuel might delay the early adoption of corporate consumers which could help catalyze the penetration of certain technologies for captive fleets.

Eventually, gas stations could constitute infrastructure bottlenecks regarding, for example, the installation of flex pumps (for biofuels), rapid chargers (for electric vehicles) or LNG charging stations, particularly for small business.

CNG requires a lot of space and affects return on investment for freight transport, thus the preference for LNG in freight transport.

However, B-doubles and modular trucks could leverage CNG, a simpler technology when compared to LNG, using lighter, carbon cylinders.

Power transmission and distribution, constrain the short-term potential of electric vehicles and, to less extent, of the recovery of railroads.

The required quality of transmission and distribution networks, including transformation stations is critical for the adoption and quality of both electric light vehicles, buses and railway services. Perceived or real lack of reliability attempts against market penetration of these alternatives. In consequence, a large-scale electrification of the transport sector could take from 20 to 30 years, according to interviewees.

The domestic production of electric vehicles requires considerable changes to the domestic lines of production and will probably not be feasible in the short-term, until large-scale adoption is achieved.

On the other hand, due to the economic barriers mentioned regarding Argentina's trade balance, large-scale adoption could be undesirable without a minimum share of domestic components in the manufactured product. The large-scale manufacturing of domestic electric vehicles requires the development of entire value chains.

Currently, Lithium-ion batteries have short lifespans and reduced autonomy, turning lifecycle management an important issue to consider.

Certain stakeholders have shown lack of hope regarding the possibility of producing these batteries domestically in the short- to medium-term, but rather expect assembling imported components domestically.

- **Political and cultural barriers:**

Regarding sectoral planning, the lack of public statistical information hinders the ability for sectoral planning, although university and research sources partially compensate for this reduced availability.

The decentralized design of policies and measures also hampers the ability of policymakers to determine their boundaries. This reduced availability of data also affects end users when it comes to mainstream information supporting consumption choices.

The lack of continuity of policies generate uncertainty to the private sector regarding the continuity of stated plans and infrastructure development.

In this context, articulating government initiatives with private initiatives, such as those promoted by freight transport associations and chambers might prove difficult when government criteria are expected to change.

Hierarchization of the railway requires the alignment of several factors, such as the materialization of the required investments, the correct design of incentives and of regulation, facilities for freight loading and unloading, and mostly foreseeability of measures and policies in a volatile political context.

There is certain resistance from the domestic automotive industry to adopt several of the technologies currently being considered as candidates for mitigation in the transport sector, such as efficiency labelling, increasing the blend of biofuels in fossil fuels (or flex-motors).

Certain options, such as the adoption of flex fuel motors or factory ready Natural Gas light Vehicles have been delayed by domestic automotive producers adducing technical barriers not necessarily consistent with their international or regional counterparts.

- **Legal and institutional barriers:**

Since large scale mandatory adoption of certain technologies is expected to be imposed via commercial policies by developed countries, lagging behind international regulations will potentially affect Argentina's competitiveness in the short to medium terms.

Regulatory restrictions to import certain types of vehicles and strenuous domestic homologation processes increase import costs and delay adoption of electric vehicles.

Several groups lobby for particular frameworks which might not be fully compatible, leading to local —rather than global— optimization.

The renewal of fleets with scrapping requires both an amendment to the hazardous residues Law, as well as a specific "command and control" framework regarding fleet age limits and prohibiting the resale of used vehicles.

The current biofuels promotion regime expires in 2021, and current unresolved Congress discussion has created speculation from affected stakeholders regarding short-term prices and volumes, as well as non-compliance to the mandatory blends in the context of the recent COVID-19 demand crisis.

The hydrogen promotion bill (2006) has so far not been regulated, and a new "hydrogen route" is also currently being discussed in the National Congress.

4. AFOLU

Within the AFOLU sector, the barriers to the implementation of mitigation actions in the Agricultural Crops, Planted Forests and Cattle Raising subsectors were analyzed.

These three subsectors are the most relevant within the sector in Argentina, and diverse actors and dynamics are involved. Bovine livestock and agricultural crops are relevant because of the spatial extension allocated to these productive activities in the country and because of their GHG impacts, while planted forests, on the other hand are relevant because of their mitigation potential.

Extensive crops are an annual activity and can change its management practices, allowing to relatively quickly adopt new technologies, year after year. Cattle farming, on the other hand, has slightly longer cycles and, therefore, introducing changes in the production system takes more time than for extensive crops. In the case of intensive perennial crops (fruit trees for example) require 3 to 5 years to come into production. Finally, forestry activity implies longer-term investments than the rest of the activities mentioned before and, thus, the incorporation of technologies is much more gradual, such as is the case with genetic improvement.

Identified barriers in previous analysis

A review of existing AFOLU and climate change mitigation measures and related barriers for their implementation included in the Agriculture and Climate Change National Action Plan (2019) was performed.

This review consisted on surveying the barriers identified in the Government' documentation when they were developed, which were categorized according to the classification proposed

in the conceptual framework (Section III), i.e. Economic; Technical; Financial; Political and cultural; and Legal and institutional.

This classification served as a basis to assess barriers constraining different proposed measures - identified by the Argentine government and presented in its sectoral plan - as well as to provide a better understanding on impacts per types of barriers in terms of mitigation potential. The barrier appraisal was then validated against the stakeholders' views during the multilateral dialogues and surveys.

Mitigation measures were classified in subsectors: Agricultural Crops, Planted Forests and Cattle and technologies to be applied in each, and results are presented accordingly.

Agricultural crops

1. PGPR technologies (growth promoters and nitrogen free fixers)

Identified barriers in previous analysis

- **Technical barriers:** information and capacity building and logistic requirements.
  - Lack of knowledge among technical professionals, especially in the field of N-free fasteners and growth promoters; heterogenous criteria regarding these technologies; low dissemination and visibility of benefits and results (joint responsibility of the sector, INTA and universities). As the effects are not highly visible, there is a lack of acceptance of this type of innovative technology by producers, especially for growth promoters and free fasteners. Ten years ago, there was diffusion of this type of products that did not appropriately work. At that time, these products were mistakenly tried to be sold as replacements for fertilizers, hampering their reintroduction.
  - The short life cycle of these products, in particular free fasteners such as Azospirillum, undermines storage in warehouses (commercial stocks), and thus, discourages local distributors to offer these type products. The seed treatment is a major barrier, as producers seek to speed up sowing and avoid time-consuming operations. In this context, the industry is developing long-life products so that they can be applied previously by producers or seed companies and distributors (although the logistical problem of treating the seed would only be a relative barrier, since this practice has been carried out for decades in soybean cultivation).
- **Economic barriers:** Development is gradual and expensive. Slow progress on adoption as demonstration, to technicians and producers, of the advantages of a new bacterium over existing ones is difficult.

Stakeholder consultations: the sectoral perception on existing barriers

To assess the current level of adoption of these technologies and its potential towards 2050, research and development experts were consulted.

In most cases, and consistently with the results identified during the review of sectoral plans, barriers previously identified remain:

- **Technical barriers:** information and capacity building and logistic requirements.
  - Although there is growing diffusion, there is still minor knowledge on potential impacts. The impact on C sequestration in soil is "not" direct on the mineralization/humification processes, but rather results from increased production of aerial and underground biomass. The PGPRs assessed and developed in Argentina show significant contributions in terms of biomass accumulation, which are not necessarily with an equal amount of grain production. In this regard, there is scarce work in field conditions to assess changes in biomass partition (aerial and underground) in order to specify increases in carbon fixation.
  - Adoption today is limited by the uncertainty of quantified processes at production scale. Technologies' contributions are positive; however, regional adaptability is, in many cases, insufficient in terms of impact quantification to justify their inclusion in production plans. The PGPRs evaluated and developed in Argentina show significant contributions in biomass accumulation, but not necessarily complemented by the same magnitude on grain production. In this regard, there is insufficient field work to evaluate biomass partition changes (aerial and underground) in order to specify increases in carbon fixation.
  - The use of PGPR should be managed integrating other practices that improve biodiversity and production, such as crop rotation, fertilization, etc. This practices integration results in lower emissions from the soil's carbon stock or even an increase in it (sequestration). Currently, there are no producers' networks (AAPRESID, CREA, Cooperatives) analyzing this technology within an integrated system, but rather done in isolation on experimental plots.
- **Economic barriers:** The cost-benefit ratio of these technologies is still unclear. Carbon markets could facilitate or accelerate their adoption, considering that there would be an additional revenue for the producer, due to the decrease of the emissions intensity per ton produced (lower C footprint).

In order to quantify the relevance of barriers to implement PGPR technologies as a mitigation measure, experts/actors "ranked" the barriers. Table 5 presents this score, organized by their relevance.

Table 5: Prevalence of barriers according to multi-stakeholder dialogues – Frequency of selection

Barrier	Important	Moderately important	Little or not important at all	Ranking	Score
Technical - Lack of knowledge of the technicians and producers	**5**	**3**	1	**1**	21.0
Economic- Cost-effective technology but its effect cannot be perceived	**7**	**2**	1	**2**	21.0
Technical – Lack of dissemination and experimentation by INTA, universities and producers' associations	**4**	**4**	1	**3**	22.5
Operational – Difficulty in its use or application in crops	5	1	**3**	**4**	24.0
Operational – Difficulty in the storage and handling of these products	2	3	**3**	**5**	25.5
Cultural – Disbelief in these technologies by the Producers	4	1	**4**	**6**	27.0
Economic – The investment is not repaid (higher cost tan benefits)	2	1	**5**	**7**	28.5

Source: Own elaboration

Issues related to operation and logistics (in technology use and storage or distribution) were relativized as being of lesser importance, as well as "disbelief" or scepticism and its relative cost. Therefore, dissemination of these technologies and an increase in experimentation opportunities could deliver quick wins requiring low-to-no investment and strengthen its adoption.

2. Urea volatilization inhibitors

Identified barriers in previous analysis

- **Technical barriers:** information and capacity building.
  - Lack of knowledge of technicians and experts on the dynamics of N losses due to volatilisation and its impact on the efficiency of urea application.
  - Urea distributors do not always have the necessary infrastructure to treat the fertilizer with the volatilisation inhibiting polymers.
  - Lack of information and dissemination on the environmental and productive benefits of technology.
- **Economic barriers:** higher cost.

- There is a 10-15% surcharge on the fertilizer cost. The producer perceives this as an extra cost without realizing the benefit.

In previous studies, barriers to the use of less volatile sources of nitrogen fertilizer than urea were analyzed. Barriers to the use of less volatile N sources are mainly technical:

- In the case of ammonium sulphate, it contains 20% N while urea contains 46% N, thus, is necessary to move 2.3 times more product to apply the same amount of nitrogen. Therefore, there is a logistical issue that translates in higher costs.
- Ammonium nitrate has 37% N, but its dangerousness in storage (explosiveness) is the main obstacle to its mass adoption.
- Both less volatile sources such as ammonium sulphate and ammonium nitrate are not readily available. Ammonium nitrate, mostly imported, is used for UAN synthesis and explosives manufacture.

These barriers are still in place, which makes this mitigation measure unlikely. The use of urea treated with volatilisation inhibitors is the most relevant application.

Stakeholder consultations: the sectoral perception on existing barriers

In multi-stakeholder dialogues, actors representing the commercial area of leading fertilizer companies and referents in the use of fertilizers were involved. Based on the dialogues results, barriers previously identified remain in place.

Additionally, views gathered during the dialogues highlight two aspects related to political barriers:

- Lack of incentives to the producer in order to reduce GHG emissions resulting from the use of nitrogenous fertilizers.
- Lack of policy coherence, on the one hand high taxes are applied to agricultural production demanding good practices utilization, but no compensation per use of environmentally friendly technologies.

Observations were also made regarding technical barriers that limit adoption of this technologies. There is still scarce dissemination, technicians and producers' knowledge and insufficient companies offering the technology.

The following table shows the ranking of barriers and their relative importance. Diffusion of this technology is as important as the cost of applying urea volatilization inhibitors. The cost may seem high precisely because of the lack of knowledge about potential benefits of the application of Urea volatilization inhibitors.

Table 6: Prevalence of barriers according to multi-stakeholder dialogues – Frequency of selection

Barrier	Important	Moderately important	Little or not important at all	Ranking	Score
Economic- This technology implies a 10-15% surcharge on the cost of the fertilizer. The producer perceives this as an extra cost without realizing the benefit	**8**	1	0	**1**	**15.0**
Commercial- Urea distributors do not always have the necessary structure to treat the fertilizer with the volatilization-inhibiting polymers.	**8**	0	1	**2**	**16.5**
Technical - Lack of knowledge of the technicians on the dynamics of N losses due to volatilization and its impact on the efficiency of urea application.	**7**	1	1	**3**	**18.0**
Cultural – Disbelief or lack of knowledge of these technologies by Producers	**7**	1	1	**3**	**18.0**
Technical – Lack of dissemination and experimentation by INTA, universities and producers' associations	5	3	1	**4**	**21.0**
Commercial - Fertilizer companies have no interest in spreading this technology	0	4	**5**	**5**	**34.5**
Operational – Difficulty in its use or application in crops	0	2	**7**	**6**	**37.5**
Operational – Difficulty for products storage and handling	0	2	**7**	**6**	**37.5**

Source: Own elaboration

In relation to the use of less volatile nitrogen sources, opinions were gathered on the use of green fertilizers with leguminous species (Vicia, White Clover) as a source of N for the following crop, replacing part of the fertilizer that would be necessary to apply. This strategy is being studied, still with very limited adoption by some producers in specific areas of the Pampas region.

3. Soil carbon content (crop rotation)

Mitigation action defined as "reducing emissions from changes in soil carbon stocks" encompasses a range of practices involving Rotations, tillage systems and crop intensification.

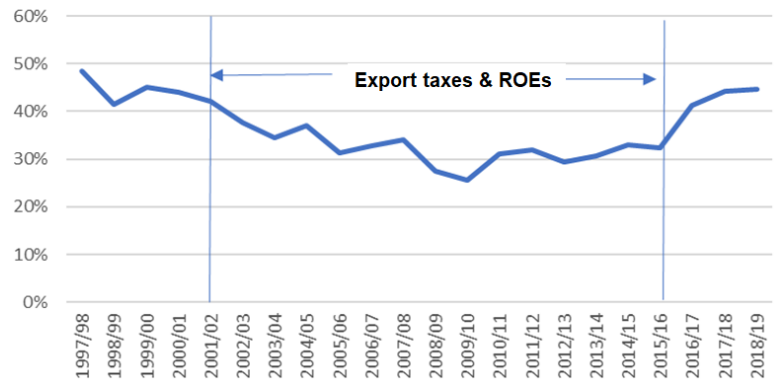
In previous studies, barriers were identified within the mitigation action called "Crop rotation". Certainly, rotation with grasses, either as a crop or as a cover crop, has a fundamental role in the conservation and recovery of soil carbon.

In the following sections, barriers previously identified are analyzed and new barriers to the conservation and sequestration of C in croplands and grasslands that have emerged according to the dialogues with stakeholders.

Identified barriers in previous analysis

The barriers to greater incorporation of grasses (winter and summer cereals) in agricultural rotations of extensive annual crops were assessed. The context has changed and new concerns have arisen regarding the emergence of weeds resistant to some herbicides, including glyphosate, and the normalization of grain commercialization. Both circumstances have led in recent years to a recovery in the rotation of oil crops with cereals, both because of production diversification and because of the need to rotate different herbicides in the crop sequence. The next figure shows the decrease and recovery of the cereals cultivated area between 1997-2018.

Figure 12: Land under cereal production (%) - Wheat, Barley, Maize and Sorghum



Source: Own elaboration based on public statistics

- **Technical barriers:** resources requirement and infrastructure
  - Cereals are more sensitive to water stress, thus, face greater production risk than oilseeds.
  - Freight rail transport is not fully operational yet, resulting in higher freight costs (road). This barrier is especially significant for regions that produce in the North of the country and send their production to the port of Rosario.
- **Economic barriers**

- Compared to oilseeds, cereals such as wheat and maize, have higher production costs (fertilizers, fungicides, hybrids, etc.) and higher freight rates. This implies higher investment requirements and stronger financial capacity. Export taxes reduce the price of the product, reducing profitability, especially at increasing distances from ports, where the freight is greater and the water risk is also higher.
- Main inputs as fertilizers and agrochemicals are commodities with international price: cereals are less competitive than oilseeds, given their lower profitability on the investment made (higher relative need of inputs compared to oilseeds).

⊃ **Political and cultural barriers**: agricultural policy that discourages the inclusion of cereals in the rotation:

- Control of wheat and maize exports (e.g. Exports operation registry, ROE in Spanish) has led to a decrease in the planted area planted of both crops.
- Closures of exports of both cereals result in product storage for relatively long and unscheduled periods by the producers, generating financial burden and damage to the storage stock due to fungus and insects.
- Withholding Export Tax: reduce competitiveness of regions far from ports.
- Lack of strategies that integrate into a single vision: a) the operation of agro-ecosystems in different areas of the country (C sequestration, water economy, production risk and inter-annual variability, etc.); b) the development of agro-economic systems with multiplier effects at the local level, together with the development of livestock (beef and dairy cattle, pigs and poultry) integrated with grain production (barley, sorghum and corn) and new industries (milling, refrigeration, food processing, etc.)

Stakeholder consultations: the sectoral perception on existing barriers

In order to update and validate the barriers related to the C sequestration in soil, specialists/experts, researchers from INTA and Conicet and advisors from CREA groups were consulted.

Through dialogues and surveys, consultations were held on management and conservation practices and regional differences in relation to the GHG emission reductions potential based on C sequestration in soil.

From the dialogues held, there was consensus on some of the barriers to achieving an increase in soil C levels at the national level, both on croplands and on grasslands.

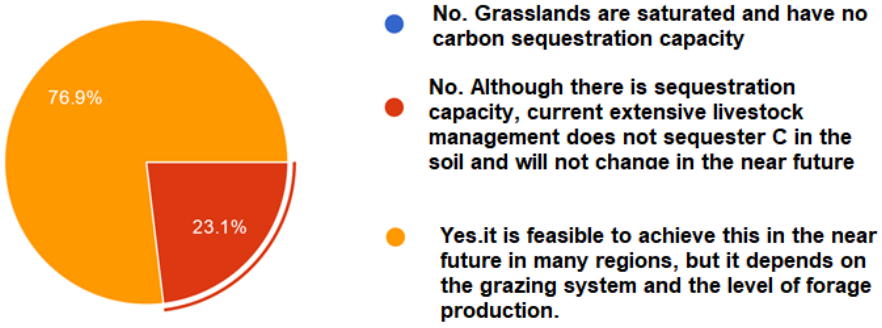
There was a vast majority agreement regarding the feasibility of an improvement in soil C levels on agricultural land, under continuous agriculture, still only if managed under direct seeding and in rotations with cereals and/or cover crops (Figure 13).

Figure 13: Dialogues results - Feasibility of soils under "Continuous Agriculture" to have "neutral" or "positive" Soil Carbon balances (sequestration)

Source: Own elaboration

There was also a large consensus that grazing lands in the country would have carbon capture capacity in soil, but depending on improvements in livestock system mangement, which is a significant barrier (Figure 14).

Figure 14: Dialogues results - Feasibility of increasing the Soil Carbon stock in pastoral livestock systems, in the next few years in Argentina



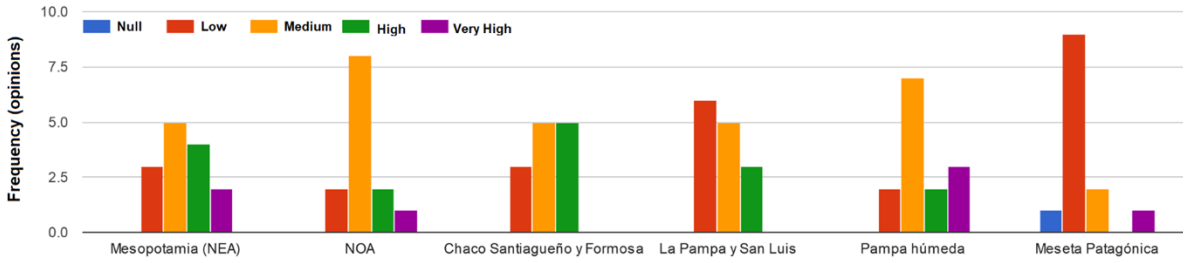
Source: Own elaboration

The overall perception is that grassland sequestration is an issue to be explored further and that capture capacity exists, but under very particular conditions that are not generally present in the country's current pastoral systems. This could be a path to be developed with the objective of reaching most livestock systems to adopt and adjust practices that allow C sequestration, in the different regions of the country.

Some pointed out that C levels in soil in grasslands in the Pampas region and Patagonia are stable, but that under conditions of increasing temperature and aridity, grazing lands could tend to lose C in the future, which could be avoided by implementing appropriate livestock systems management.

On the other hand, important regional differences in sequestration capacity in livestock systems were noted. The following figure shows the frequency of opinions regarding the sequestration capacity per region (Figure 15).

Figure 15: Dialogues results – C sequestration potential in soil in pastoral livestock systems



Source: Own elaboration

The Patagonian region was identified as the region with the least potential for C capture, followed by La Pampa and San Luis (Pampa Arenosa) with low to medium capacity for C sequestration in grazing lands. The humid Pampa and NOA regions were considered to have a medium potential for C sequestration, while the warmer regions, such as Mesopotamia, Chaco Santiagueño and Formosa, were assigned a medium to high capacity for C sequestration in grazing lands. This implies that there are ecological "climate and soil" barriers that limit soil carbon capture and, therefore, constrain the mitigation potential of the different regions.

In conclusion, to the previously already identified barriers, the following were added as a result of the dialogues held with private and public decision makers:

- **Technical barriers**:

- Not all regions have the same potential to capture C in soil: site conditions (climate and soil) limit carbon sequestration.
- Livestock management practices are a significant barrier to recovering or increasing C in soil: current extensive management must be adjusted to achieve a biomass and meat production balance, maximizing soil carbon input.
- Agricultural management practices should include rotations and practices that intensify annual biomass production. This implies intensifying rotations with more crops (cereals and other species, cover or services crops, grassland), increased fertilization, etc.
- Lack of knowledge about the degree of saturation of agricultural and livestock soils, their current situation and their sequestration capacity. It is key to have fixed sites for monitoring and follow-up of management systems in long-term trials.
- Lack of training programmes

⊃ **Political barriers**: Lack of policies that encourage C-oriented practices and incentives for producers to adopt them. Producers in Argentina are permeable to adopt resource-conserving technologies; nevertheless, cost efficiency and incentives to initiate or expand these practices is key.

4. Soil carbon content (biochar)

Identified barriers in previous analysis

This mitigation action was not included in previous studies.

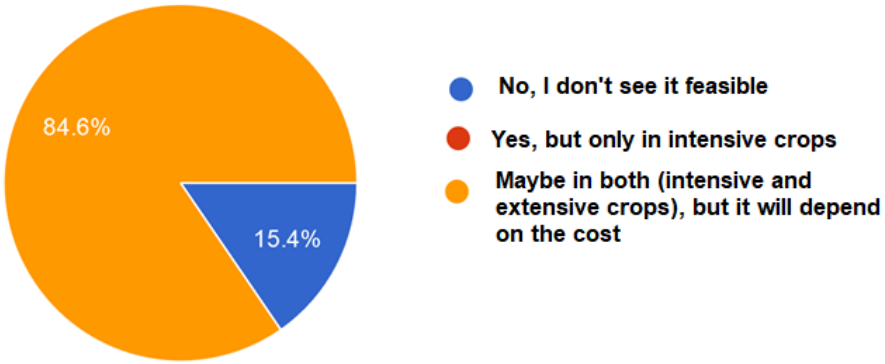
Stakeholder consultations: the sectoral perception on existing barriers

Dialogues and bibliographical review undertaken allow to conclude that the adoption of biochar is feasible, however, due to its cost the application is more cost-effective in intensive crops, mainly fruit trees (where it is already starting to be used), than in extensive crops.

The group of experts interviewed on the subject of C in soil was complemented by dialogues with specialists in research and production of Biochar.

A great majority (85%) perceive the adoption of Biochar in Argentina possible, depending greatly on its cost. A minority does not perceive the adoption of Biochar in Argentina as feasible in the medium term.

Figure 16: Dialogues results – Biochar adoption in agriculture



Source: Own elaboration

Regarding barriers to the use of Biochar in Argentina, there was consensus that the two main barriers are the lack of knowledge about its benefits as an amendment and the cost of its application. Thirdly, the interviewees do not consider highly relevant the carbon market as an additional revenue from reducing emissions in their crops.

Regarding the "lack of local studies" and its "limited availability due to low production in the country", opinions were more dissimilar. In fact, foreign literature exists on its use, although it would be necessary to understand its advantages and forms of application adjusted to local conditions. Additionally, the scarcity of local jobs would also be a barrier to be considered. On the other hand, the stimulus for its production would allow the availability of Biochar increasing its adoption.

Table 7: Dialogues results – Barriers to biochar adoption

Barriers	Important	Moderately important	Little or not important at all	Ranking	Score
Technical – Benefits of biochar adoption are nor disseminated	86%	7%	7%	1	1.82
Economic – High cost and low economic return	82%	9%	9%	2	1.91
Economic – Carbon Price is low as a measure to reduce Emissions	67%	25%	8%	3	2.13
Technical – Lack of local studies regarding Impacts of biochar	50%	29%	21%	4	2.57

Technical – Limited availability	46%	31%	23%	5	2.65

Source: Own elaboration

Technical barriers to Biochar Production:

- A barrier highlighted by experts was the location of production plants. The production process of biochar generates energy (exothermic process) that needs to be used or "sold" in the vicinity of the production unit. This particular feature of generating energy makes it sensible for it to be produced in an industrial zone to take advantage of "kilometre zero energy"
- In addition, it is key that the supply of biomass for its production is relatively close. For example, in the vicinity of areas that generate biomass waste, such as forest or fruit production sites, poultry or pig production centres, urban areas, etc.
- Therefore, the location of biochar production units depends on the combination of these two variables: close supply of biomass and close consumption of energy generated by the biochar manufacturing process.

Cattle and livestock systems

1. Reduction of "Emission Intensity" by increasing the national herd extraction rate (slaughter weight and weaning rate)

Identified barriers in previous analysis

- **Technical barriers:**
  - Emission intensity is an index that relates the absolute value of emissions (tons of CO2eq) per unit of production (t Res with Bone). In turn, beef production can be monitored at the national level by two indirect variables: the ratio of calves produced to total cows (T/Vc), as a driver of the weaning rate in producers, and the average slaughter weight (Average Weight - AW) as a driver of the extraction rate of a producer. The T/Vc ratio is an indicator associated with rearing, while the AW is an indicator associated with wintering (rearing-fattening).
  - Technical barriers to beef production can be characterised by type of activity and regionality.
    - Breeding activity: main barriers facing the increase in the weaning rate (T/Vc) are associated with the lack of incorporation of inputs and process technologies, in most cases. This refers to the lack of: clear production objectives that lead to the correct system choice,

implementation of fodder plans, management and handling of the production indexes and animal load in relation to production objectives, parking of the calving service, management of the calf and replacement of females, inadequate and insufficient health plans (it is based only on the mandatory plan), infrastructure. It is also important to mention the lack of management plans or planning to meet current and future challenges to climate variability that are becoming evident as a result of climate change, such as extreme droughts and floods.

- Fattening activity: The main barriers that face the increase in the average weight of slaughter (AW) are associated with the lack of incorporation of process technologies and inputs, mainly in the rearing stage. These are associated to the pastoral management with supplementation where the main deficiencies are seen in: production objectives, fodder plans and load management, supplementation, deficient sanitary plan, infrastructure. The challenges arise from the lack of incorporation of input technologies that would lead to greater precision in production, feeding and health management.
- Regionality: Argentina's heterogeneity in terms of climate, landscape and cultural diversity means that the technical barriers to the activities are unique to each region. In order to address the barriers mentioned for breeding and wintering, a specific site analysis of each barrier is required.

- The lack of information on livestock activity is further mobilizing the adoption gap. The technical and academic entities of the country (INTA, Universities, Conicet, Association of Producers) generate information and it is published in the institutional sites. INTA is especially active in the extension of the territory, taking all the information to the field. However, from information and extension to implementation there is still gaps to be narrowed.
- The generation of technical skills that can be used in the field is a constant challenge. Often, the location of professionals does not depend on the activity or the economy, but rather on the lack of infrastructure for the population to settle down. This puts at risk the growth of productive activities and villages.
- Barrier to scientific and technological development: There are many technologies that have not yet been tested at the local level, others of which the behaviour of the productive system is not yet known. The systems outside the Pampa are complex, with environmental variables that have not been studied very much, which requires the development of basic research.

⊃ **Economic barriers**

- The main barrier faced by cattle sector in Argentina is that it constitutes a low to medium profitability business, with low to medium risk. Characterizing

primary production in breeding, rearing and fattening, profitability becomes higher in the latter, resulting in many integrated systems. Until a few years ago, livestock and agriculture were part of the same integrated production system, managing the volatility, both in terms of production and prices.

- In breeding, there are two situations but that have negative impacts when production efficiency is analysed. There are diversified companies that use livestock as a financial instrument to safeguard value. The low risk assumed in the activity compared with rearing and fattening activities, or with agriculture, makes cattle the surplus preservation in the latter.
- Another important scenario in Argentina is the culture of safeguarding the value of the breeding cow in low-scale or subsistence economies. Producers who have their main economic activity in another area, but with the possibility of owning animals on nearby farms, neighbours or relatives. These are economies that normally cannot or do not wish to access credit to improve production, but over time increase the number of animals without being able to develop the necessary infrastructure. The informality of this producers makes their development unfeasible and negatively impacts regional livestock indices.

⊃ **Political and cultural barriers**:

- Livestock farming is a medium to long term business, facing challenges in unstable or highly uncertain national contexts.
- The main impact of the activity is on the export market. The rates of withholding tax are regularly changed and are even prevented. These changes in the regulatory frameworks according to political needs make the business unstable.
- On the other hand, it is frequent to apply financing policies with technical deficiencies that lead to unexpected results with negative impacts. It also causes instability in a business that requires time and planning.

Stakeholder consultations: the sectoral perception on existing barriers

In order to validate the barriers identified in previous studies and to find (if any) new ones, two surveys were developed for different audiences: 1) key actors of the national livestock sector, who could contribute with a national macro view and productive, business and entrepreneurial expectations to 2030 and 2050, and 2) producers and technicians who could enrich the barriers with the view in the field, contributing with the local particularities and challenges. The latter are mainly focused on activity in the medium term, up to 2030. In addition, in the case of the key actors, a dialogue was held to gather comments and contributions received with greater detail.

The low level of knowledge between the association of production parameters and those related to greenhouse gases has led to an initial attempt to validate the indicator of emission intensity in an indirect manner on the indices that make up the indicator.

Table 8 presents the ranking obtained based on the votes rating. The results confirm that the benchmarks are in line with the two indicators proposed for estimating the intensity of emissions from livestock farming in Argentina.

Table 8: Dialogues results - Ranking of national cattle production indicators

Indicators	1	2	3	4	Ranking	Score
Average slaughter weight	4	6	0	0	**1**	34
Calf/cow ratio	5	3	2	0	**2**	33
Export volume	1	1	7	1	**3**	22
Stock (total heads)	0	0	1	9	**4**	11

Source: Own elaboration

Regarding types of barriers, the main ones are Political and Cultural and Economic, with very little numerical difference between them. In third place are the Financial barriers, in fourth place Legal and Institutional and finally the Technical barriers.

Unlike what happens in other developed countries of livestock activity, the relevance of the technical barriers is diminished in front of the first group of quasi-structural barriers.

Table 9: Dialogues results – Frequency of votes per type of barrier

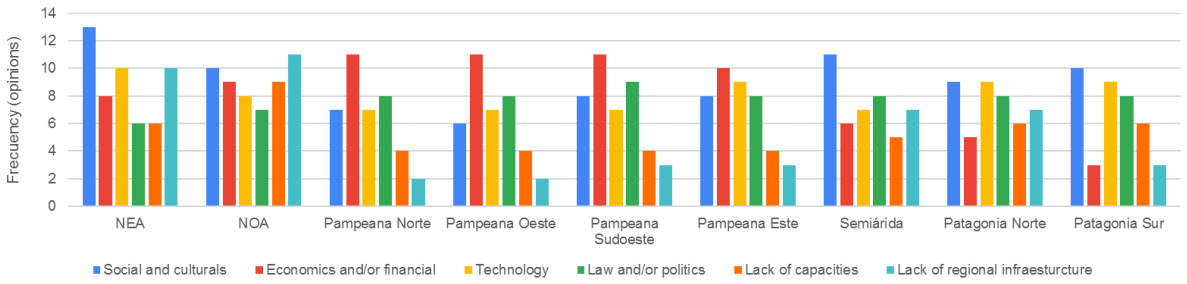
Indicators	1- No important	2	3	4	5- Highly important	Ranking	Score
Political and cultural	0	0	2	5	3	**1**	41
Economics	0	1	3	1	5	**2**	40
Financial	0	3	2	2	3	**3**	35
Legal and Institutional	2	1	3	1	3	**4**	32
Technical	1	2	3	3	1	**5**	31

Source: Own elaboration

Results obtained in the assessment of barriers in the breeding activity by producers and technical advisors are summarized in the following figure. Analyzing the barriers, Socio-cultural barriers are the most significant, followed by Economic and/or financial barriers, technical barriers are the third ones, afterwards regulatory and/or political barriers, the fifth place is the

lack of capacities and finally, the lack of zonal/regional infrastructure. Peculiarities of the regions do not always reflect the national result.

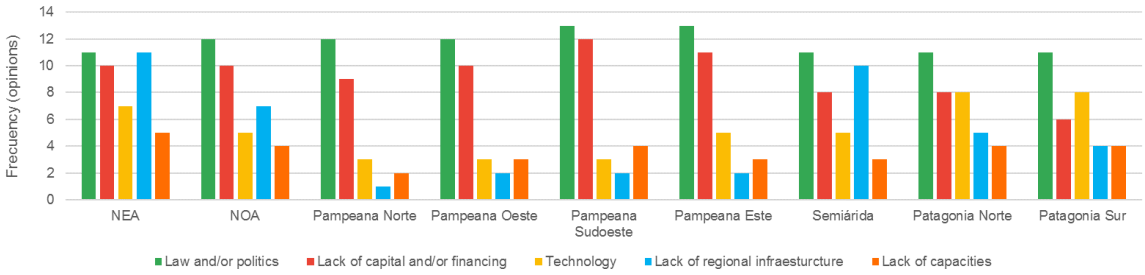
Figure 17: Dialogues results – Barriers for cattle development per region



Source: Own elaboration

Next figure (Figure 18) shows the results obtained in the barriers assessment for wintering activity by producers and technical advisors. Analyzing the barriers, the main barrier is regulatory and/or political, in second place the lack of capital and/or financing, next is technical barriers, afterwards the lack of regional infrastructure and finally the lack of capacities. The results of barriers to the wintering period are conclusive, coinciding with the results obtained by the benchmarks in the Argentine macro livestock sector.

Figure 18: Dialogues results – Barriers for cattle development per region



Source: Own elaboration

For the wintering/hibernation period, the point of view of referents concurs with that provided by producers and technicians: the main barrier is economic and/or financial and is followed by regulatory and/or political. Then the technical, socio-cultural, capacities and information.

Finally, some comments made are synthesized her in order to enrich the analysis of barriers done:

- Farmers' motivations in taking cattle as a defense asset to face economic cycles (accumulation asset not only productive asset). Beyond this cultural issue, the main challenge in cattle production is the lack of grassland, with growth potential when analyzing the averages and fodder production information from research and extension organizations.
- The need for a National Health Barrier in search of the basic health standard is highlighted. In this aspect the extension of the territory and the different geographical features make a health plan a challenge.
- The cattle should grow in calf achievement and slaughter weight without increasing the stock, collaborating with climatic and environmental commitments.
- Increasing the production of meat depends on the market traction and this will not happen while 70% of the meat is consumed in the internal market. On the other hand, the fundamental indicator should be Stock Efficiency in kg slaughtered/killed. The average weight can be increased by lengthening the wintering period and this does not result in efficiency and productivity increases, let alone reduction of emissions. The weaning rate has been stagnant for a long time and has cultural factors such as social stockbreeding, other business factors such as cow wintering and economic factors: economic result is maximized with 65-70% weaning (not with 90%).

2. *Other Livestock and Intensive Bovine Systems*

This measure comprises the estimation of the relative impact of the implementation of Biodigesters (or other techniques) on Manure Management in intensive livestock systems.

The management and use of animal production waste is widely used in developed countries. Their use is destined to: energy production and the agronomic use of nutrients in primary production. Studies carried out so far have not analyzed this mitigation action. The introduction of biodigestion technology in the country is very incipient and there are very few cases that use animal production residues, the vast majority use crop fiber as input due to its greater energy conversion efficiency.

Identified barriers in previous analysis

Identified barriers in previous analysis include:

- **Technical barriers**

  The energy conversion efficiency of biomass fibres largely exceeds that of animal excreta for digestion. It can be segmented between ruminant and non-ruminant excreta (mainly pig farms and poultry production) with conversion being favourable

for the former. There is technical potential to increase efficiency in animal production systems.

Animal production systems do not possess the required technology to incorporate biodigesters in their establishments. Beyond the cultural barrier, input (manure) management and conditioning requirements are necessary to supply the biodigester.

The absence of locally developed equipment design leads to the implementation of special features in imported designs for local adaptation, often with little success.

There is very minor research on biodigestion in Argentina, with biomass production being preferred due to other factors mentioned. There are gaps in basic knowledge about the potential for biodigestion of excreta in local systems.

Technical capacity and training of researchers in this area is very limited. It would still not be possible to develop the technology locally without importing technical skills to build local capacity.

- **Economic and financial barriers:**

Biodigestion technology requires an investment that is high for average producers in Argentina. Whereas only large producers would have access to stable contract conditions, the rest would have no access long-term credits.

The lack of stability in structural aspects discourages the development of the technology, thus no instruments or incentives are developed due to lack of demand.

- **Political and cultural barriers/ legal and institutional**:

Recently in Argentina, policies were implemented to promote the energy generation from renewable sources (see Energy Section for further details). In order to be subject to financing and to develop a plan, energy production must exceed 1 MWh. Therefore, the scale of production required to generate that amount of energy is significantly high compared to average production systems in Argentina.

For small energy suppliers' systems, provincial regulations must be followed. These generally state that the energy will be bought by the local supplier at the retail price, which makes projects unfeasible. It is also worth noting that many provinces do not have regulations for distributed energy, preventing energy injection energy into the network.

Another barrier to consider is the absence of regulatory framework for biodigester and digester waste. The digestate could not be applied as fertilizer through agronomic use nor be subject to commercial transactions.

Stakeholder consultations: the sectoral perception on existing barriers

Since this technology is not widely disseminated, references that are related to the subject were contacted. Producers who have implemented or are planning to implement biodigesters have been consulted.

Dialogues with stakeholders validated that barriers described above remain. The most relevant barriers, according to the dialogues, are regulatory and/or political and economic and/or financial. Technological and professional capacities deficiency were identified, but could be overcame by importing them.

3. Rolling or other mechanical work to replace burning grassland and savannah

This measure comprises the effects of replacing burning grassland and savannah by rolling or other mechanical work. Burning pastures practice is a mechanism that is highly utilized in the following regions of the country: Mesopotamia (NEA), NOA, Chaco Santiagueño and Formosa, La Pampa and San Luis and Pampa Húmeda. Even though the cattle breeders are aware of the practice, it is very specific, thus a survey to producers and technical advisors was developed.

Identified barriers in previous analysis

Identified barriers in previous analysis include:

- **Technical barriers**

  Equipment requirement for rolling practice. The rolo-tractor could be a piece of equipment that can be outsourced but this service arrangement is not yet developed.

  The practice management is not properly developed yet for all areas.

  Basic information is deeply studied and concepts are addressed in many of biological professions. However, the specific development by fodder resource, scale of production system and machinery still has opportunity for improvement.

The professionalisation is very low, and the necessary number of professionals is not available. Technicians are needed on site to be able to diagnose and implement the rolling.

- **Legal and institutional**:

  Moving from the practice of burning to mechanical work would imply that no regulatory framework would be required.

- **Economic and/or financial barriers:**

  Compared to the practice of burning, mechanical replacement is costlier for producers. Usually the extensions are large, increasing costs, challenging its viability.

- **Political and cultural**

  The burning practice has taken root in many of the areas. It is carried out in a very rudimentary way, even taking very high risks. The replacement implies deep cultural changes. Likewise, the need for professionals and machinery challenges the replacement as the burning practice achieves the same results without resources. The simplification of the fire practice is only possible in an informal process, where the necessary permits, safety measures and even technical concepts to ensure the good development of the practice are not considered.

  Producers who periodically face the process of prescribed (formal) burning will be more receptive to the change in practice.

Stakeholder consultations: the sectoral perception on existing barriers

A survey of producers and advisors was conducted to determine the likelihood of replacing the practices, and the results are presented in the following table.

Table 10: Dialogues results –Likelihood of fire use replacement with other practices

What is the probability of replacing the use of fire in grasslands with other practices such as rolling, weeding, etc. by 2030							
Indicators	**1- Unlikely**	**2**	**3**	**4**	**5- Very likely**	**Ranking**	**Score**
Pampa húmeda	2	3	6	2	8	**1**	74
Mesopotamia	1	3	3	2	8	**2**	64
La Pampa y San Luis	2	3	5	4	3	**3**	54
NOA	3	2	2	5	4	**4**	53

Chaco santiagueño y Formosa	2	3	3	5	3	**5**	52

Source: Own elaboration

The next table (Table 11) shows barriers prioritization to replacing grassland burning. The cultural and training barrier is the most important and can be read as the first limitation in the Chaco Santiagueño, Formosa region and NOA, where there is lowprobability of implementing the change.

Table 11: Dialogues results – Ranking of barriers to replacing grassland burning

How would you rank the barriers to replacing grassland burning with other practices by 2030?							
Barrier	**1- Poco importante**	**2**	**3**	**4**	**5- Muy importante**	**Ranking**	**Score**
Cultural	1	5	5	2	9	**1**	79
Capacity	0	3	8	7	4	**2**	78
Economic	1	6	4	5	6	**3**	75
Technical	0	6	4	9	3	**4**	75

Source: Own elaboration

4. Silvo-pastoral Systems

Identified barriers in previous analysis

- **Political and cultural**

  Native forest protection regulations are well known in the productive sector. There are also laws to promote forestry activity, also known in the sector. However, the political context and the instability of the country threatens the activity of forestation, enrichment of native forests and other systems that can be compatible with silvopastoral livestock.

  Livestock producers find it difficult to see the feasibility of incorporating another economic activity (usually livestock producers are very traditional). On the other hand, herd management in traditional systems does not require any change, but forestation requires certain adaptation.

- **Technical**
  - In the forest activity:

There is modest development of machinery, tools and technical materials for the different stages: implantation, maintenance, thinning, cutting.

The problems of stand pests in the early stages require a lot of presence, a requirement that has been able to be overcome in other activities.

- In the livestock activity:

  Implementation and management of fodder under the stands. Maximization of forage productivity.

  Tree-animal interaction often requires more infrastructure, mainly the first two years.

  Management of closure areas during forest implementation and machinery requirements to take advantage of fodder from highly controlled cutting or grazing.

- As silvopastoral systems are a livestock-forestry interaction, there is scarce human resources able to manage the integrated system. The technical forestry specificity does not address livestock and vice versa. There is a lack of technicians and advisors who can support each other in these systems.
- From the research point of view, there is need to advance in forestry aspects and the interaction with fodder. Fodder agronomy has not dealt with these systems profoundly.
- In terms of dissemination and extension, it is highly difficult to obtain economic information that could reflect the mixed nature of the system. There is lack of materials and extension showing economic information and results.

⊃ **Economic**

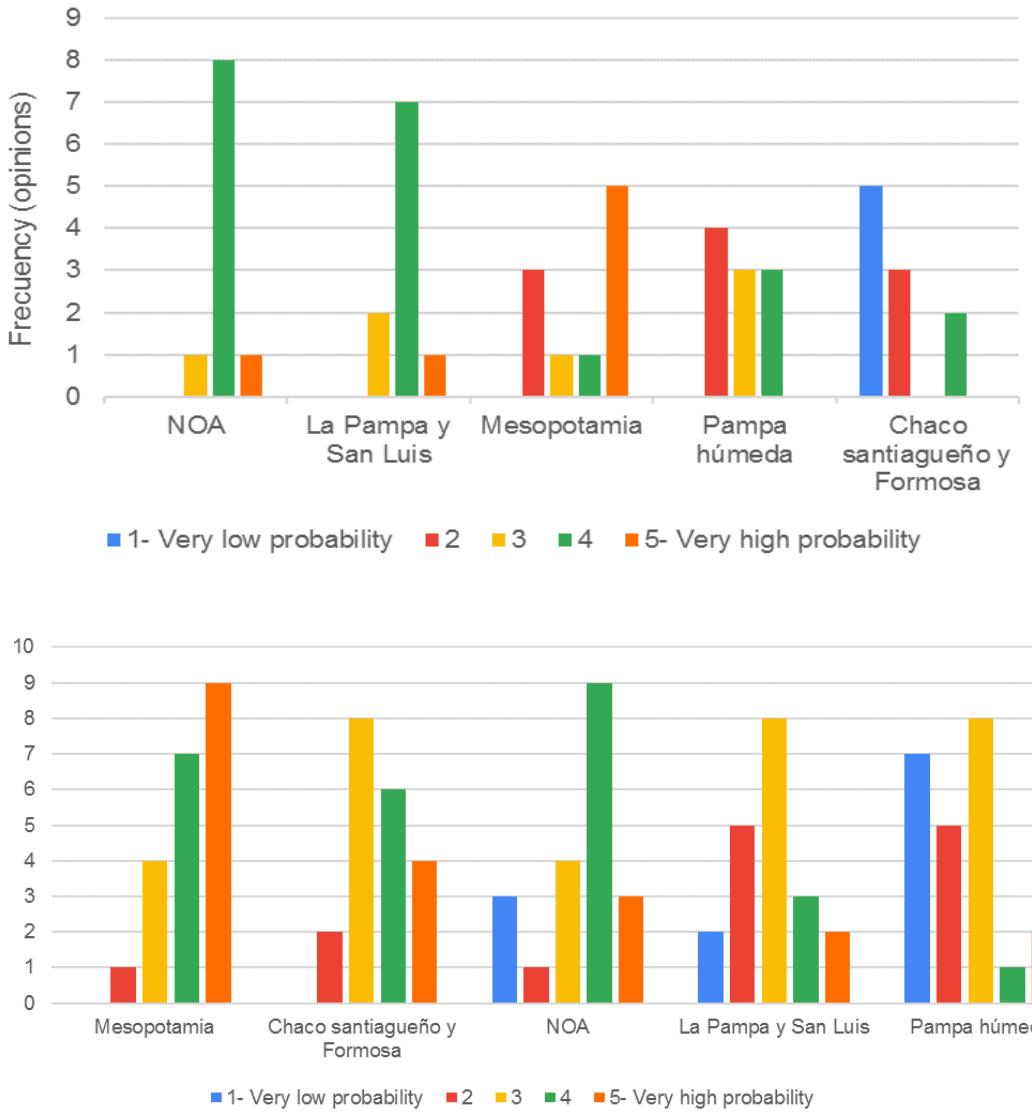
The difficulties are mainly oriented towards forestry activities. Investment, maintenance and commercialization requirements that translate in the need of sources of long-term credit.

Stakeholder consultations: the sectoral perception on existing barriers

For the assessment of barriers to silvopastoril systems adoption, livestock advisors and producers and forestry references were consulted. The results and analysis of the surveys are presented below.

The probability of forestation expansion in livestock fields in silvopastoral plans (SPP) by 2050 presents the following distribution per region is presented according to the votes of livestock referents (above) and producers (below).

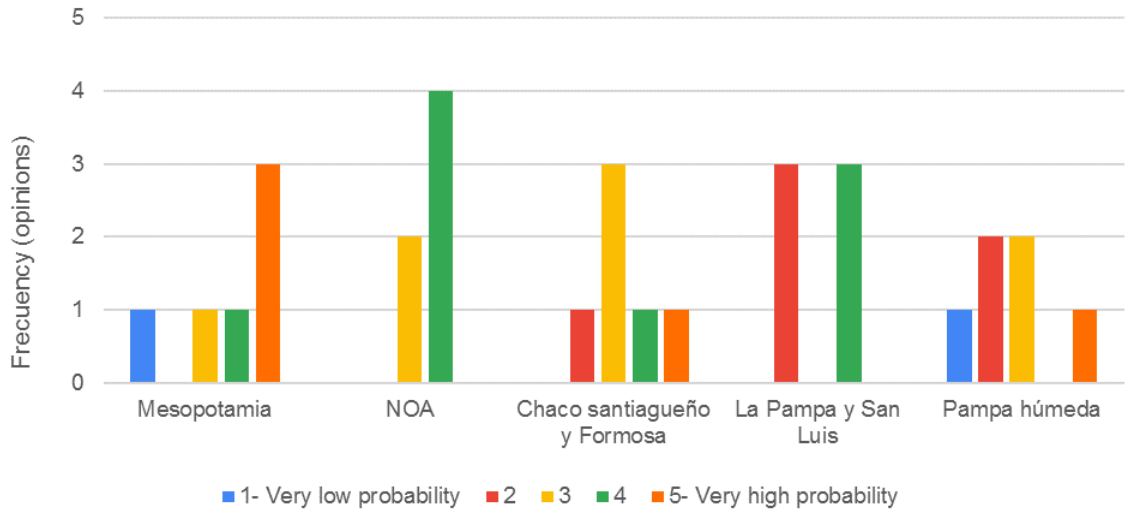
Figure 19: Dialogues results - Probability of incorporating SPP systems by region (livestock referents)



Source: Own elaboration

Forestry referents consultation threw the following probabilities:

Figure 20: Dialogues results - Probability of incorporating SPP systems by region (forestry referents)



Source: Own elaboration

In addition, the forestry references were consulted about the barriers they find in the activity.

Table 12: Dialogues results – Barriers to silvo-pastoral systems

How would you rate barriers to the replacement of livestock systems with silvopastoralism							
Barrera	**1- Unlikely**	**2**	**3**	**4**	**5- Likely**	**Ranking**	**Score**
Cultural (uses and customs)	0	1	0	3	2	**1**	24
Economic – investment repayment not achieved (high cost or low income)	0	1	1	2	2	**2**	23
Economic/Commercial- High cost of freight to port or industry	0	0	2	3	1	**3**	23
Technique - Inexperience of the producer	0	1	0	5	0	**4**	22
Financial -Lack of access	0	1	2	2	1	**5**	21
Financial - Lack of State Support	0	2	2	2	0	**6**	18
Structural - Lack of Contractors and Availability of Machinery	0	1	4	1	0	**7**	18

Source: Own elaboration

The abovementioned results confirm that the greatest accuracy regarding the insertion of forestry activity into livestock systems is provided by forestry references. Both livestock

breeders and producers and technicians (livestock breeders) have an aligned view of the barriers and haven't manage to study them in depth yet.

With regard to the regional potential, there is a partial congruence between the reference points and the producers and technicians. However, there seems to be a better consensus between forestry references and the group of producers and technicians on this issue.

Planted Forests

In the forestry sub-sector (planted forests), the barriers to the expansion of the forested area were reviewed and updated. Additionally, the adoption of genetics linked to the increase of growth rates in forest species was also considered. Finally, the issue of reporting Harvested Wood Products (HWP) and the issues that limit their inclusion in GHG inventories were addressed.

1. Forested surface increase

Identified barriers in previous analysis

- **Technical barriers**
  - Barriers related to the distribution chains and infrastructure for use and manufacture of raw material obtained (labor for implantation and management, installed capacity, inputs).
- **Economic barriers**
  - Barriers related to the long payback periods involved (15-30 years). This requires long-term legal stability conditions and a macroeconomic environment that minimizes the risk of ventures.
  - Barriers associated with the uncertainty of future demand to absorb the projected supply without lowering prices, so that the profitability levels are not affected.
  - Lack of private sector involvement
- **Financial barriers**
  - Lack of access to financing sources and high capital cost
- **Political and cultural barriers/legal and institutional barriers:**
  - Insufficient and/or partially enforced legislation or public policies

Stakeholder consultations: the sectoral perception on existing barriers

According to the experts' opinion that participated in the dialogues, the barriers previously identified remain, with some new and updated nuances. The following table (Table 13) presents the economic and financial barriers as priorities. This implies that the activity presents structural

difficulties which affect its viability (economic) and also restrictions in the financing of investment. Technical barriers were placed last, not being a limitation for the sector.

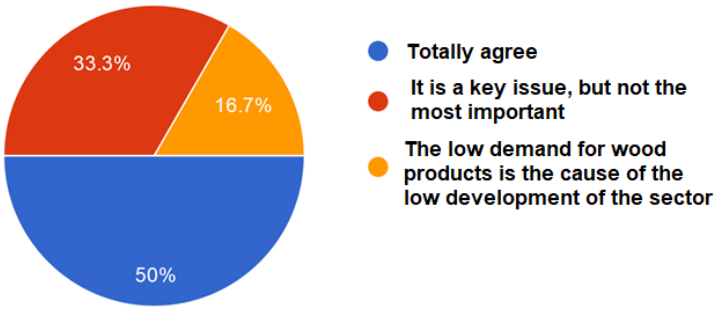
Table 13: Dialogues results – Ranking of barriers to forestry development

Barreras	Important	Moderately important	Little or not important at all	Ranking	Score
Financial	5	1	0	**1**	10.5
Economic	4	1	1	**2**	13.5
Political	3	0	3	**3**	18.0
Legal and Institutional	2	2	2	**3**	18.0
Technical	0	2	4	**4**	24.0

Source: Own elaboration

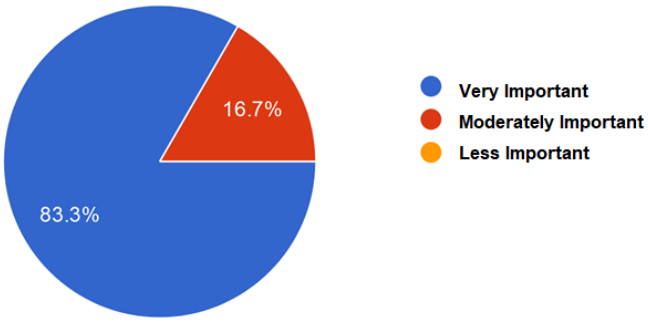
Although political and legal barriers were ranked in third place, they are closely related to the first two (financial and economic) and there was consensus that "Long-term policies, legal and economic stability, constitute the main barrier in the development of forest plantations by the nature of production" (Figure 21). This result concurs with the assessment of the Forest-Industrial Competitiveness Roundtable carried out in the Strategic Forestry and Industrial Forestry Plan Argentina 2030 (2019). Likewise, when asked about the importance of the periodic updating and regularity of the payments in the amounts granted through law N°. 25.080 for new forestry plantations, the majority considered it as "very important" (Figure 22).

Figure 21: Dialogues results - The role of "long-term policies, legal and economic stability as a major barrier" in forest development



Source: Own elaboration

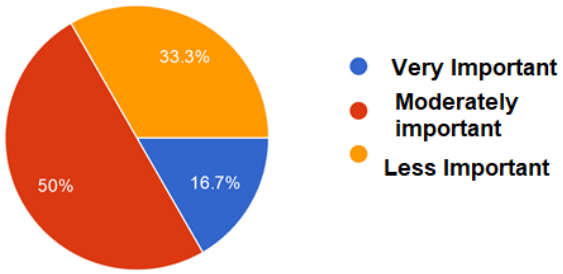
Figure 22: Dialogues results - Importance of the periodic updating and regularity of payments in the amounts granted through law Nº 25.080



Source: Own elaboration

Additionally, other legal aspects which may also be a direct or indirect obstacle to the forestry sector development were analyzed. It was consulted whether the Law on Land would be a barrier to investment in the forestry sector. Even though there was no consensus, stakeholders do not minimize the potential impact of it (Figure 23). This is due to the fact that foreign industrial forest investment could be impacted per a reduction of acquisition of land for forestry purposes.

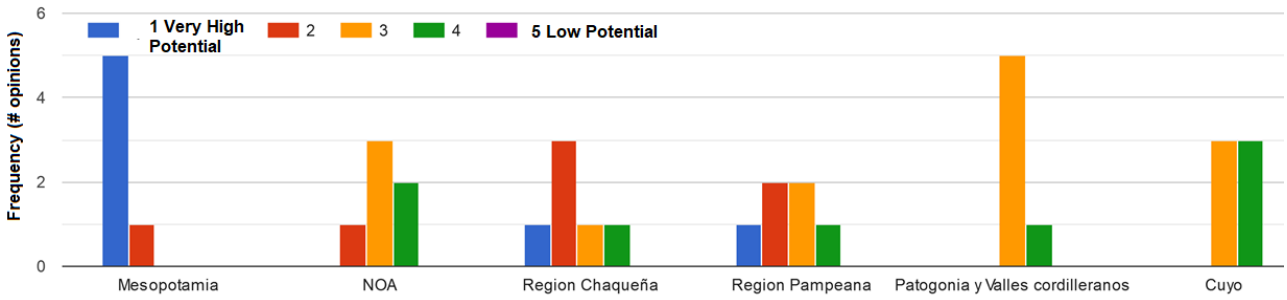
Figure 23: Dialogues results – Impact of land law on the growth of planted forests area



Source: Own elaboration

In relation to potential per region, the consulted actors prioritized the Mesopotamia as the forest basin with the greatest potential, since it has suitable land, excellent growth, established forest industries of different scales. In second place, priority was given to the Chaco region, NOA and the Pampa (Figure 24).

Figure 24: Categorization of forest regions according to current potential



Source: Own elaboration

In conclusion, the opinions gathered from experts and actors validate barriers previously identified for forest development, economic and financial issues, together with the lack of long-term policies, being the main causes of the sector's stagnation. Once these barriers have been overcome, others could be glimpsed which, due to the importance of the previous ones, have not yet been analyzed. For example, secure energy supply for industries that transform the raw material or the lack of road infrastructure (trains, routes) that raise the costs from the production site to the industry.

2. *Growth rate increase (genetic intervention) – Species and regions*

Identified barriers in previous analysis

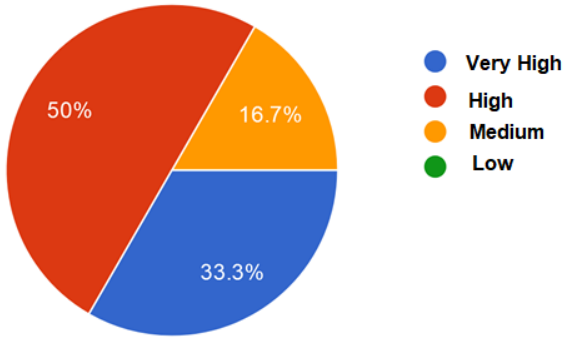
This mitigation action was not included in previous studies

Stakeholder consultations: the sectoral perception on existing barriers

In general terms, development is slow because the time taken to obtain, evaluate and disseminate new genetic material is a long process. Once it has been obtained, its adoption is progressive, as the plantations that are coming in turn are being replaced, thus, the main barrier to obtaining results in the medium term is the time needed to deploy new genetic material.

Incorporating genetics is a relevant issue in the forestry sector. In the dialogues with specialists there was a majority agreement that its impact on growth rates is high to very high (Figure 25).

Figure 25: Dialogues results - Impact of the incorporation of genetics on the growth rates of the different species implanted



Source: Own elaboration

In salicaceae, new improved commercial clones are being progressively adopted by private and official nurseries. These are currently being disseminated.

In Eucalyptus, experimental hybrid clones are being tested and information on growth rates is preliminary and limited to those trials. However, improved genetic materials of the seminal and clonal type have already been adopted in commercial plantations over the last few years.

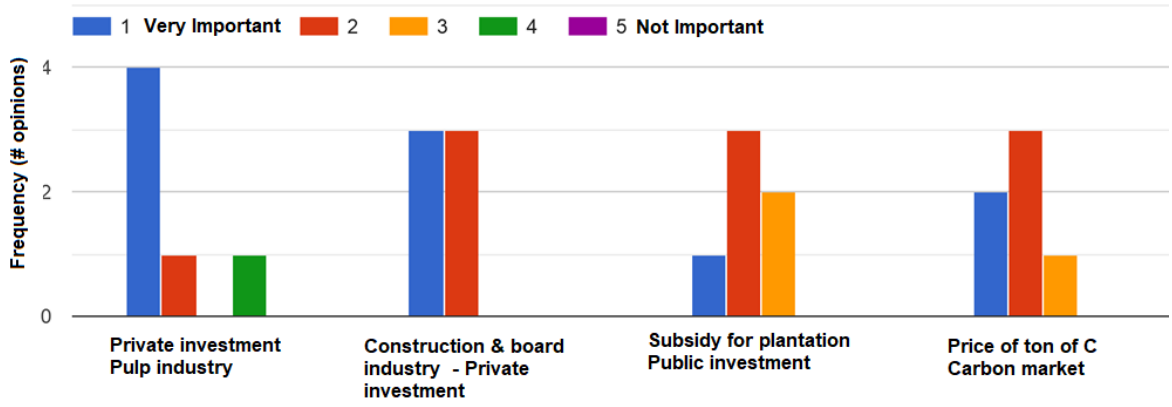
In conifers (P.taeda, P. elliottii, P.ponderosa, Pseudotsuga menziesii) improved seed genetic materials have been adopted.

3. Impact of capture in paper manufacturing, construction, furniture and other harvested wood products

The effect of harvested wood products on inventory reporting will depend fundamentally on the development of the panel and construction industry, which generates C sequestration over longer periods. The lack of such industries is a barrier to C sequestration in harvested wood products.

The development of the forestry sector is closely related to the installation and growth of lumber industrial sector. The specialists/actors consulted gave even relatively more importance to the development of the industry than to the value of ton of C (carbon market), and to the subsidies for implantation (Figure 26). This shows once again that the industry is an essential link if the forest area in Argentina is to be increased.

Figure 26: Dialogues results - Relevant aspects for the development of the forestry sector



Source: Own elaboration

4. Impact of the HWP Producers' Report on National Emissions

The Harvested Wood Products (HWP) report is relevant in the GHG Inventory and would generate in the medium term a decrease in the emissions reported by Argentina in the category of Implanted Forests. Not reporting this category implies overestimating the emissions from the forestry sector (or underestimating removals).

The main barrier is the lack of simple access to official records necessary to support the values used in the reporting of this category, in relation to the annual commercialization of wood products (domestic market, import and export). Usually public records of imports and exports are reported in millions of dollars. However, physical quantities (tons or cubic meters) of wood are required for the carbon balance estimation.

Only in some cases of thinning products commercialization is recorded. There are no statistics at the national level on the consumption of by-products (chips, sawdust, shavings) other than the energy purpose.

The growth of the sawmill, panel and construction industry is a priority for this category to have an impact on the inventory report.

A secondary aspect is the lack of emission curves for the different products throughout their useful life. Eventually the values of the IPCC 2006 guideline for paper and other harvested wood products (construction, furniture, etc.) could be used.

VII. Key findings

Major findings arising from the assessment that has been undertaken in Argentina during 2020 can be synthesized as follows:

- Besides some structural barriers to climate investment that as far as this Project is concerned are being considered as boundary conditions, there are also non-structural barriers to climate investment that could be addressed by targeted policy and regulatory interventions.
- The latter barriers are economic, financial, technical, political, cultural, legal and institutional and are mainly related to lack of support and of specific incentives for innovation and for innovative businesses, insufficiency of mechanisms suitable for long-term climate change-related investments, lack of technical skills, lack of awareness of low-carbon technologies benefits, out-of-date and unaltered regulatory schemes that do not capture sectorial transformations, lack of adequate regulation in some cases, and administrative complexity and excessive bureaucratic costs and delays.
- Energy sector-specific barriers restricting the abatement potential of the mitigation measures included in the Argentinean Energy and Climate Change Action Plan mainly involve Economic barriers, followed by Technical and Financial barriers.
- Sector-specific economic barriers are related to overall low energy prices and tariffs within a context of persistent inflation and fiscal deficit, high and increased percentage of household with low income, increasing unemployment and acute reduction in the level of economic activity, mostly due to the pandemics, which limits government's capacity to increase the share of economic production costs being paid by a large part of the population without creating additional social stress.
- The energy tariffs system exhibits distortions resulting from a succession of policies that aimed at benefiting diverse vested interests (i.e. subsidizing production of fossil fuels) and a shift of subsidies from consumption to production in the last four years that added to previous disequilibria.
- Sector specific technical barriers are mainly associated to large-scale deployments of new technologies and the development of capital-intensive infrastructure projects, such as nuclear power plants. Likewise, the current state of the interconnected power grid requires increasing robustness and flexibility, demanding investments in transmission and storage in order to accommodate large scale penetration for intermittent renewable energy sources in the long term.
- Sector-specific financial barriers affect the energy sector mostly regarding supply-side measures due to the intensity of capital requirements for long-term infrastructure and capital assets investments in a context of scarce access to credit

and increasing capital costs. These financial barriers result in limitations to the development of new infrastructure. In the case of demand-side measures, increasing capital costs affect the revenue rates for measures requiring capital assets investments, turning potential savings into less attractive.

- Transport sector-specific barriers that might constrain the implementation of the mitigation measures included in the Argentinean Transport and Climate Change Action Plan are mainly Technical, followed by Financial and Political and Cultural barriers.
- Sector-specific technical barriers are mainly related to the penetration of new technologies (e.g., electric vehicles or buses and LNG for freight transport), infrastructure requirements, lack of scale and the need to adapt manufacturing facilities and value chains to manufacture new equipment and/or new parts domestically.
- Sector-specific financial barriers affect the Transport sector mainly as regards the infrastructure-intensive and/or large-scale technology measures, given the capital requirements for long term infrastructure and capital assets investments, which impacts mainly on freight costs.
- Regarding particular consumer choices, financial barriers affecting access to credit delay the adoption of newer or more efficient units and extend the average age of the circulating fleets.
- The mitigation options to be adopted in the Transport sector are highly constrained by deficits in the existing infrastructure and by policies and price decisions being made in the Energy sector, reinforcing the need for strengthening coordination efforts and aiming at benefitting from potential synergies between both sectors.
- AFOLU sector has significant mitigation potential, however, the mitigation options to be adopted are constrained by deficits in qualified professional resources, technical skills and the existing infrastructure to access to ports for product exportation.
- The adoption and development of new technologies and practices in the AFOLU sector is slow because the time taken to obtain, evaluate and disseminate the results in order to stimulate their deployment. The adoption is progressive, according to production cycles (agricultural short-term cycles, livestock medium term cycles and forestry long term cycles).
- Barriers related to the long payback periods involved for some mitigation measures in the AFOLU sector require long-term legal stability conditions and a macroeconomic environment that minimizes the risk of ventures.
- Technologies' contributions to reduce GHG emissions in the AFOLU sector are positive; however, regional adaptability is, in many cases, insufficient in terms of impact quantification to justify their inclusion in production plans. Thus, availability of information and research is key to regional adoption of technologies.

- Sector-specific political and cultural barriers are mainly associated to resistance to change promoted by existing private and public sub-sectorial lobbies, including provinces and unions, as per strongly productive entrenched practices. This conditions the design and development of long-term strategies and increase the difficulty for long term development of new technologies.
- The undertaken analysis and specially the interviews and dialogues that have been held show that there is a large space to increase the consistency of incentives within the analyzed sectors, as well as at the national level.
- In addition, other means of improving the potential for implementation of the existing mitigation options are related, according to stakeholders, to
    - Having clear market signals
    - Improving data availability and quality
    - Enhancing sectoral regulations and legal frameworks
    - Designing and implementing innovative financial instruments for fostering low-carbon long-term investments
    - Developing capacity building measures and plans targeted at specific sub-sectors, activities, entrepreneurs, technician and workers
    - Simplify administrative processes.

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IX. Annexes

Annex A: Barriers per mitigation action