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NDC Alignment Report

Argentina

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This report is an output of the **Ambition to Action** project, which supports NDC implementation through technical assistance and research. The project is implemented collaboratively by the Energy research Centre of the Netherlands (ECN) and NewClimate Institute, over a three-year period until the end of 2019. Project funding is provided by the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

Ambition to Action's technical assistance aims to support the mainstreaming of climate and development goals at the sector level, through the development of robust evidence quantifying the social, economic and environmental benefits of mitigation actions and pathways. This benefits evidence, for example detailing employment, energy security, and air pollution impacts, will show how sector planning decisions can support NDC implementation as well as national development priorities, and can help reduce policy costs, identify trade-offs, and build stakeholder support for ambitious mitigation strategies at the sector level. The project focusses on the energy sector and provides direct support to Argentina, Kenya, Indonesia, and Thailand. Sector roadmaps will be developed to synthesise findings from the pathway analyses and outline options for effective implementation to feed into national NDC processes and planning.

In addition to sharing insights and lessons on the development and use of benefits evidence, the project's research pillar will consider the broader topic of NDC implementation progress. Through a series of country-specific reports, global NDC Update Reports and research papers, the project will provide a platform for discussion, analysis and sharing of lessons learned about NDC implementation in developing countries and emerging economies.

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1. Introduction

The development of Intended Nationally Determined Contributions (INDCs) ahead of the Paris COP21 negotiations was a hurried process for many countries. This led to contributions often being prepared by line ministries without time for cross-ministerial validation and alignment with other important policy processes. Argentina was the first country to submit a revised NDC in November 2016 following the first (i)NDC submission in 2015. The resubmitted NDC aimed to ensure increased transparency and better alignment with the policy processes of the relevant ministries for key sectoral and transversal climate action. This report focusses on the particularities of NDC development in Argentina and assesses with greater detail the alignment of the NDC with policies and developments focussing on the electricity supply sector.

The purpose of the report is to answer three central questions:

1. To what extent is the NDC aligned with existing targets and strategies on a national (or sub-national) level? Are there important measures missing in the NDC or are there sector strategies that counteract the objectives of the NDC? These could include energy or electricity sector strategies but also wider government strategies (e.g. development related) that could have an impact on electricity sector pathways.
2. To what extent is the NDC aligned with the “reality” of implementing emission reductions and energy sector targets? In other words, are the current sector strategies and policies sufficient to meet the goals of the NDC? How realistic is it that it gets implemented?
3. Are sector targets and strategies aligned with the long-term goal of the Paris Agreement to limit global temperature increase to well below 2°C? What are current obstacles and barriers to achieve this alignment and what could be done to address these?

In order to answer these questions, this report reviews the institutional set-up for climate policy and the Argentinian NDC. This is followed by an overview of key developments, policies and activities in the electricity sector. The sections on the NDC and electricity sector policies provide a basis for the subsequent sections, which analyse in greater detail the alignment of the sector policies and targets. In view of the high degree of alignment of the revised NDC with national policies in Argentina, the report delves deeper into the question of implementation, analysing whether the NDC and sector objectives are reachable. It also takes a forward-looking approach by assessing the potential for long term alignment of the sector with the goals of the Paris Agreement, i.e. limiting global temperature increase to “well below 2°C”. The concluding section synthesises key aspects of the analysis focussing in particular on the potential to raise ambition in the sector.

The document is intended as a briefing document for an internal audience and not for wider publication.

2. Argentina's climate policy and NDC

This chapter takes a closer look at NDC developments in Argentina providing an overview of the institutional and political context and brief analysis of the targets set in the current NDC. The key purpose is to get a deeper understanding of the role of the energy sector – in particular electricity supply – for the current and future NDCs with a view to providing additional insights into the degree of alignment of the sector with the targets presented in the NDC as well as the potential to achieve them or go beyond the current ambition level.

2.1. Setting the scene: institutional context of climate policy in Argentina

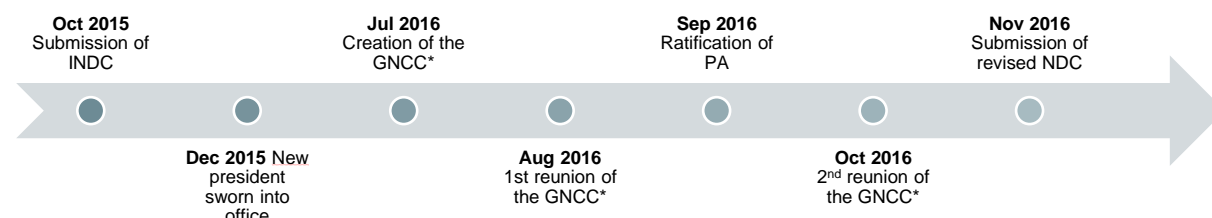
The new government elected in November 2015 has initiated a significant political and economic transformation in Argentina. After years of relative isolation from international financial markets and trade, the current government is seeking a 'smarter integration to the world' as one of its priorities (Government of Argentina, 2016b). This includes forging closer ties with various international organisations, including for example the G20, the WTO and the OECD (the latter Argentina is seeking to join as member). In this perspective, Argentina has taken a more proactive stance in international climate cooperation: it was one of the first 25 countries to ratify the Paris Agreement and the government took the formal decision to leave the 'Like-Minded' negotiating group in the UNFCCC negotiations citing the group's lower ambition as a reason (Ministry of Environment and Sustainable Development of Argentina, 2016).

There has also been heightened momentum for climate policy at the national level, thanks to interlinkages with other important policy priorities, such as the diversification of the energy matrix with renewable energies, and the creation of new institutions. The environment portfolio, which used to be the responsibility of a sub-ministerial level secretariat, has been elevated to a full Ministry (the Ministry of Environment and Sustainable Development or MArDS). The current Secretariat for Environmental Policy, Climate Change and Sustainable Development under the MArDS is the main governmental body in charge of climate policy.

Shortly after the election, the government announced the creation of a National Cabinet for Climate Change (GNCC) as one of its 100 priorities. The GNCC is a cross-ministerial body tasked with developing national and sectoral initiatives to reduce GHG emissions as well as formulating commitments in line with international agreements – such as the development of the NDCs. The creation of the national cabinet gave a fresh impetus to climate commitments: the cabinet took forward the ratification of the Paris Agreement and worked on a revised NDC soon after its creation. As a result, Argentina was the first country to submit a revised NDC to the UNFCCC in November 2016.

Figure 1 shows an overview of the timeline for NDC development in Argentina.

Figure 1: Timeline for NDC development



* Gabinete Nacional de Cambio Climático (National Cabinet for Climate Change)

The newly created GNCC operates under the helm of the Chief of the Cabinet of Ministers. Over half of the country's 20 ministries are involved:

- "Sectoral" ministries tasked with measures related to their sectors: Energy and Mining, Industry, Agroindustry, Transport, Environment and Sustainable Development
- Other ministries: Social Development, Foreign Affairs, Education and Sports, Science, Interior, Economy and Public Finances, and Culture.

Each ministry has identified a focal point to coordinate NDC related tasks. For the Ministry of Energy the focal point sits within the Secretariat for Energy Saving and Efficiency.

The work of the GNCC is organised at different technical and political levels. At the first level, sector or theme-specific technical working groups identify initiatives and measures, which are then validated at national level, involving the provinces via the Climate Commission of the Federal Council for the Environment (COFEMA). Decisions requiring high-level political coordination are then discussed and approved by the ministers. The resulting decisions and workplans are validated in an extended national roundtable, which includes representatives from civil society, businesses and academia. See Figure 2 for a schematic overview of the climate policy decision process.

Figure 2: Decision-making process of the GNCC (Ministry of Environment and Sustainable Development of Argentina, 2016)



2.2. Targets and measures in the NDC

The revised NDC submitted in November 2016 was central to ensure increased ownership and transparency of the measures across the ministries. Similar to other (i)NDCs Argentina's first submission was likely developed without time for full validation by all relevant government entities. As a result, the (i)NDC was subsequently questioned – including by the current government – for methodological reasons and a lack of transparency (Bergman, 2016). The first (i)NDC provided relative emissions reduction targets – both conditional and unconditional – compared to Business as Usual (BAU) emissions whereas the revised NDC now has absolute emissions targets. The central aim of the revised NDC, reassessed jointly by the ministries of the GNCC, was to ensure consistency and consensus between the quantified mitigation target and the operational decision-making of relevant ministries – including at a sectoral level (Télam, 2016). The revised NDC was the result of a bottom-up aggregation of existing and planned measures identified by line ministries, resulting in improved alignment between the NDC and other national planning processes. It is however important to highlight that the revision process did not aim to identify additional mitigation measures.

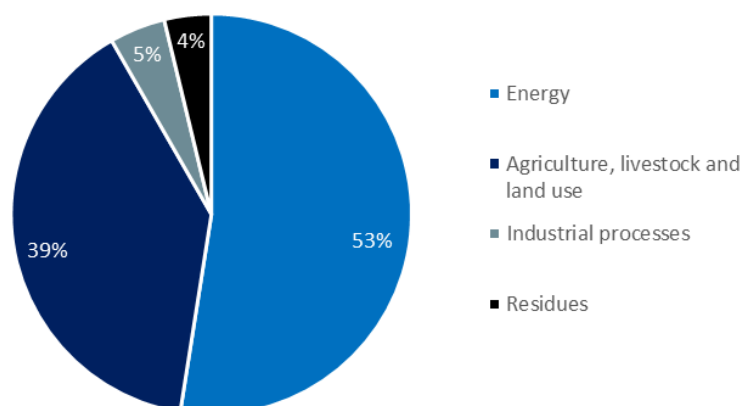
The unconditional target in the revised NDC is to achieve emission levels of 483 MtCO₂e by 2030 (or 310 MtCO₂e excl. LULUCF), which represents a 22% increase compared to 2010 and a 74% increase compared to 1990 levels (Climate Action Tracker, 2017). The conditional emissions target is of 369 MtCO₂e including LULUCF, or 30% below the unconditional target. The increase in ambition of this new target is small compared to that in the previous (i)NDC (around 1%). Beyond the minimal increase in mitigation ambition, the process-level changes were however important. The absolute mitigation target is arguably more reliable than the previous one, which was based on a relative reduction compared to a BAU scenario. In addition to this, the methodology for calculating historical emissions was adapted to the IPCC 2006 guidelines, which caused a decrease in the baseline scenario and relative emission reductions due to the change in GWP values. The government also revised some of the mitigation actions included in the NDC; for example, the revised NDC now includes energy sector emissions from co-generation. Finally, the ambition of the emissions target in the new NDC was reduced due to previous double counting of emissions reductions under the renewable energy target.

To support implementation of the NDC, sector plans are currently being elaborated under the lead of the GNCC in collaboration with line ministries. The first three plans were presented in November 2017 at COP23 in Bonn, namely the *National Action Plan for Energy and Climate Change*, the *National Action Plan for Forests and Climate Change*, and the *National Action Plan for Transport and Climate Change*.

2.3. Role of the energy sector in the NDC

The energy sector, including supply and demand sectors such as transport and buildings is the most relevant sector for Argentina's NDC followed by the land use sector and has the second largest contributions in the NDC. This reflects the current share of emissions by sector as shown in Figure 3.

Figure 3 – Emissions per sector (Government of Argentina, 2017b)



The National Action Plan for Energy and Climate Change, the elaboration of which was strongly supported by the Subsecretariat for Energy Saving and Efficiency, envisages to achieve emission reductions in the energy sector of 77 MtCO₂eq by 2030 as an unconditional target, and 101 MtCO₂eq conditional on international finance and support, compared to an emissions level of 105,8 MtCO₂eq in 2014. With this, the energy sector is being recognised as the sector with the highest mitigation potential in Argentina’s NDC. The proposed mitigation measures include the energy supply side as much as the demand side and will be implemented/addressed along four axes: 1) energy efficiency, 2) renewable energy, 3) fuels, and 4) large scale generation (Subsecretariat of Energy Saving and Efficiency, 2017b).

According to calculations made by the Ministry of Energy shown in Figure 4, supply-side measures in the electricity sector represent 44% of the mitigation efforts in the energy sector. The most important one is the development of grid-connected renewable energies (25%), followed by nuclear energy (13%) and hydroelectricity (6%). The remaining 46% are split between various energy efficiency measures (50%) and the development of biofuels (6%) as represented in Figure 4 below. Energy efficiency measures account for the bulk of foreseen emissions reductions (50%) with residential lighting accounting for the largest decrease in emissions. While lighting efficiency improvements are the most significant contribution to emission reductions, it is unclear how much of these would have happened under a Business As Usual (BAU) scenario. Efficient forms of lighting such as LEDs have now become the norm and can scarcely account for additional mitigation efforts.

Figure 4: Contribution of mitigation measures to energy sector NDC (%) (Subsecretariat of Energy Saving and Efficiency, 2017a)

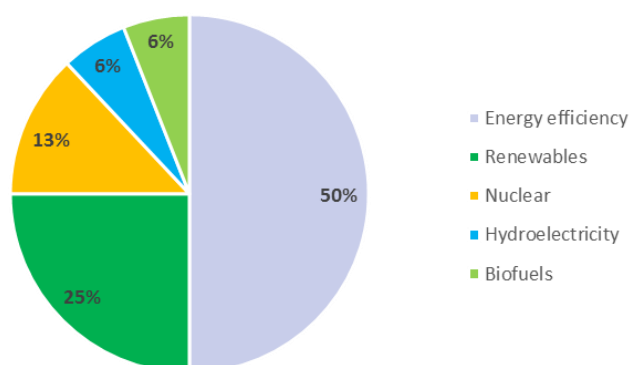
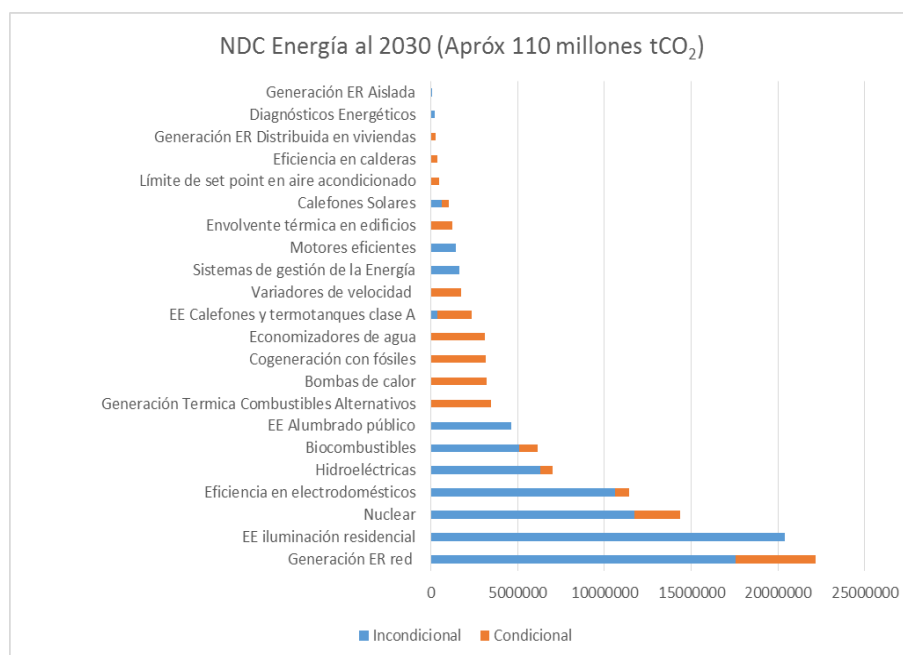


Figure 5 provides a list of measures in the energy sector which were considered for the definition of the overall reduction target in the current NDC. In total, the measures are expected to amount to emission reductions of approximately 110 MtCo₂e. As shown in the diagram some measures are exclusively considered under the unconditional NDC, whereas others assume a scaling up subject to obtaining international support for their implementation (shown in orange)

Figure 5: Energy sector measures in the revised NDC

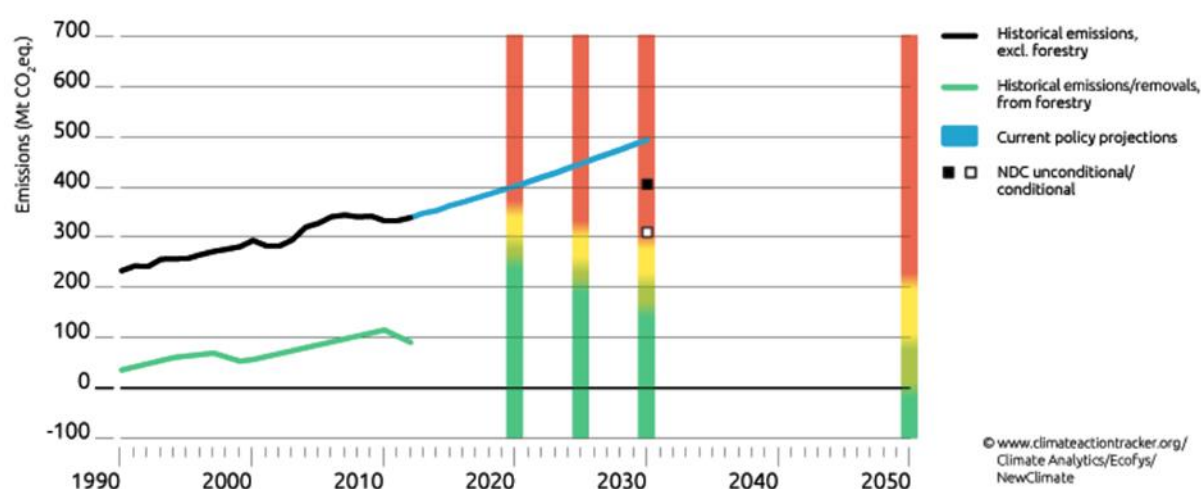


2.4. Assessment of compatibility with Paris climate targets

The Climate Action Tracker (CAT) rates the revised NDC as “Highly Insufficient”. The CAT rates countries on the basis of “effort sharing approaches”. Effort sharing approaches determine equitable emission levels for countries based on different principles. Over time, a large set of actors ranging from governments to NGOs have put forward their interpretation of equity and translated them into effort sharing approaches. The CAT aggregates all existing approaches and develops a range that is used for rating a country’s communicated mitigation effort.

Figure 6 shows the projected emission for Argentina in relation to Paris compatible pathways, colour coded in red (incompatible) to green (compatible with 1.5°C pathway).

Figure 6: Climate Action Tracker analysis for Argentina, available at [Climateactiontracker.org](https://climateactiontracker.org), accessed 01/09/2018



There are a number of broader contextual reasons for the low rating Argentina receives under the CAT. First, Argentina has seen an extended period of non-action on climate change following the country’s crisis and default in 2002 until the recent government change in 2015. For instance, previously adopted renewable energy targets, amongst others, for the year 2018, were not accompanied by meaningful actions to achieve them. No investment into the modernisation of the energy infrastructure was carried out, resulting in a currently unachievable 2018 target and a difficult starting point for setting ambitious policy targets in the sector.

A second reason for the low rating is the drastic transformation Argentina has undergone from one of the world’s biggest economies to an emerging economy. Because of its former relatively high level of economic development, a number of effort sharing approaches require Argentina to reduce its emissions rapidly, in particular those approaches that consider historical responsibility (measured as the contribution to historical emissions). According to the effort sharing approaches, Argentina’s past requires it to follow steeper reduction paths than other developing countries with historically weaker but presently stronger economies.

Despite these circumstances, there are also factors that can be influenced by the government to reach an adequate rating under the CAT. Even though the NDC is based on measures in a large number of sectors of the economy, it currently has a strong focus for significant action in a limited number of sectors. In particular it includes actions in the energy and land use sectors. Measures in other sectors are either very limited or inexistent (transport, buildings) or do not sufficiently reduce emissions (industry). Overall this leads to a targeted unconditional NDC level well above current emission levels. It is worth noting that the Climate Action Tracker excludes land use, land use change and forestry (LULUCF) emissions from its rating.

Argentina itself evaluates the ambition level of its mitigation target as fair. The main justification for a fair contribution is based on a comparison of Argentina's share of global emissions (0.7%) and the share of emission reductions achieved under the conditional NDC target in comparison to the total emission reductions reported in all NDCs (2.8%). While the emission reductions in this calculation achieved under Argentina's conditional NDC (109 MtCO₂e) are calculated by comparing the NDC trajectory with a BAU scenario, it appears (but is not documented) that the emission reductions achieved by all countries under their NDCs (3.9 GtCO₂e), as documented in the gap report (UNEP, 2016, 2017), is calculated by comparing the global NDC trajectory to the global policy trajectories. Given that emissions under BAU trajectories as reported by countries are almost always higher than their emissions under their policy trajectory, this justification will likely not stand up to international scrutiny.

2.5. Next steps in the NDC process and climate policy

In 2016 the GNCC was mostly dedicated to the identification of national mitigation measures and the revision of the NDC. According to sources from the Ministry of Environment, next steps would mostly be dedicated to the financing and implementation of the 2030 measures in cooperation with actors from the private sector (ComunicaRSE, 2017). In parallel, the GNCC and relevant ministries will continue to work on the remaining action plans for key sectors (namely industry, agriculture and waste). Once established, all sector action plans together with the National Adaptation Plan under preparation would then feed into a national strategy on climate change (the "*Plan Nacional de Respuesta al Cambio Climático*"), expected to be published in 2019. After this, the plan would be reviewed and approved by the provinces before being turned into law (ComunicaRSE, 2017). Once the national strategy is published, Argentina would be in a more informed position to submit a revised NDC ahead of the next round of NDC submissions. The Ministry of Environment has however signalled this is not among their priorities, as they have already submitted a revised NDC.

The coming year could be a transformative one for climate policy and international cooperation in Argentina, as it will be presiding over the 2018 G20. The strategy it will adopt to address climate action could in turn also have an impact on the Facilitative Dialogue and COP24 negotiations in Katowice. As part of the G20, Argentina is planning to present its Vision 2050 for the energy sector in the July 2018 G20 Energy Ministers' meeting. Based on conversations with representatives from the energy sector scenario initiative (www.escenariosenergeticos.org) this would mostly be a qualitative vision. Nonetheless, one could expect this to be a first basis for the long-term low emissions development strategy to be submitted by 2020 to the UNFCCC.

3. Overview of the electricity sector

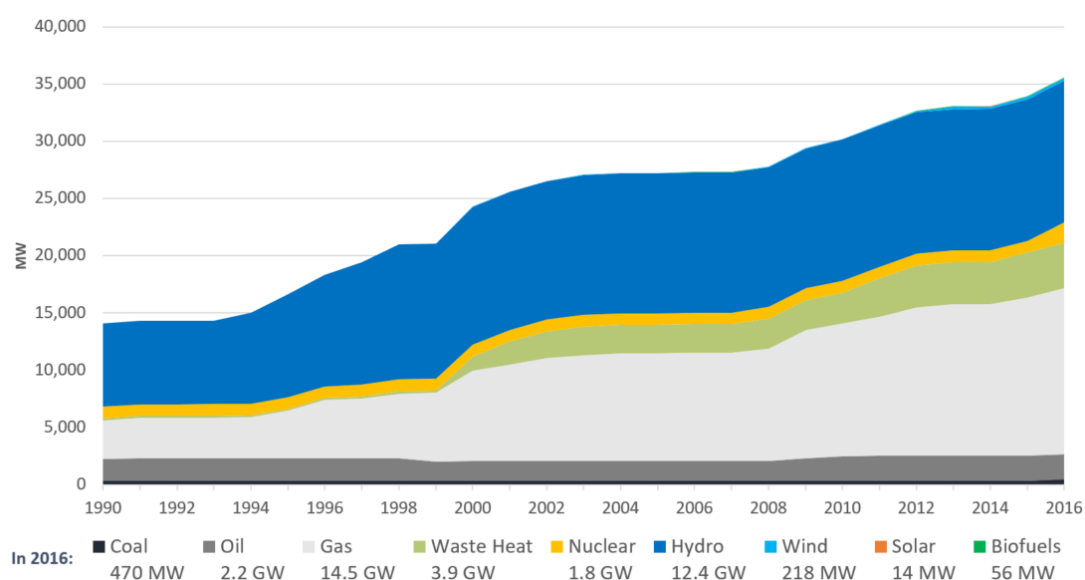
This section provides a brief overview of Argentina's electricity supply sector, key policies and developments which influence the sector's ability to achieve (progressively more ambitious) mitigation targets. The sector overview sets the scene for the subsequent analysis of the sector's transformation ability including taking a closer look at key barriers and obstacles.

In accordance with the terms used by the Argentinean government, renewable energy refers to all major renewable energy technologies (wind, solar, biomass/biogas, hydro, geothermal) but excludes hydropower larger than 50 MW – which is considered a conventional source of energy.

3.1. Electricity supply and demand

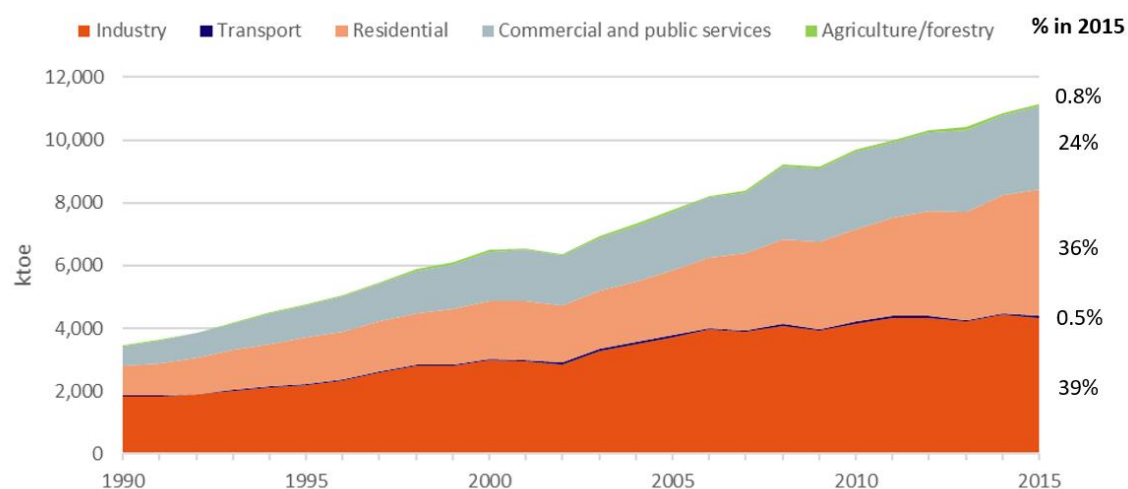
Argentina's electricity is mostly generated by gas-fired thermal plants and hydropower plants, which make up 41% and 35% of the installed capacity respectively. Beyond the 12 GW of hydropower, the capacity mix is dominated by fossil-based thermal generation, which makes up 64% of the total. In addition to the 14.5 GW of gas-fired plants, there is over 2.2 GW of oil-fired capacity (largely diesel plants) and around 0.5 GW of coal-fired capacity. Diesel-based power generation has been one of the fastest growing sources of electricity in the country over the past decade. It has been used as a 'quick fix' solution to provide electricity to rural communities and to prevent power cuts in larger centres of demand. While diesel capacity has increased only moderately since 1990, diesel-based generation has increased from less than 3 TWh in 2000 to close to 20 TWh in 2014 (IEA, 2015). There is currently 1.8 GW of nuclear capacity in Argentina, representing around 5% of the total installed capacity and generating close to 6% of the country's electricity. Despite abundant wind and solar resources, Argentina has so far installed little renewable energy beyond large hydropower. Wind and solar currently represent only around 1% of total installed capacity. Figure 7 shows the installed capacity by fuel type from 1990 until today.

Figure 7: Installed capacity by fuel type in 1990-2016 (S&P Global Platts, 2016)



Following a dip after the 2001 economic crisis in the country, both energy and electricity demand have been steadily growing. The Buenos Aires area is currently the most important electricity demand centre, representing half of the total electricity demand in 2016 - including both the city and province of Buenos Aires (ADEERA, 2016). At close to 40% in 2015, industry is the highest electricity consuming sector in Argentina followed by the residential sector (36%) and the service sector (24%). The residential sector has witnessed the fastest growth over the past decade, with demand nearly doubling between 2005-2015. The transport sector remains minor (0.5%) and currently comprises only rail transport. See Figure 8 for an overview of the final electricity consumption by sector.

Figure 8: Evolution of total final electricity consumption by sector (IEA, 2017b)



Due to an underinvestment in new capacity and infrastructure over the past decade there have been recurring imbalances between supply and demand leading to power cuts. Whereas these used to mostly occur in the summer months, in the past few years power cuts also happened at other times of the year. In response to the

issue, the government issued an energy emergency decree in December 2015 to rationalise the use of energy involving also the gradual reduction of subsidies for electricity consumption (Government of Argentina, 2015).

One of the key challenges of matching supply and demand in Argentina is the country's vast geographical spread. The grid spans over a surface that would reach from Algeria to Norway if mapped onto Europe. The Argentinian transmissions grid comprises almost 15.000 km of 500 kV transmission lines and another 20.000 km mainly at a 132kV level. A significant increase in the share of renewable energies in the electricity mix would require substantial investment into the currently ailing transmission infrastructure. This is particularly challenging as the key renewable energy resources are located far from the centres of demand (see also discussion on barriers in section 4.3).

3.2. Government objectives

Energy-related policies and measures feature prominently in the government's 100 objectives, which list main objectives across eight broad policy areas. It is worth noting that while the energy and climate sector roadmap is currently under preparation, the Ministry of Energy broadly has three priority axes for the electricity sector:

1. Ensure availability and competitiveness of electricity
2. Diversify supply with renewable energy
3. Efficient and transparent power sector operation

The government declared the year 2017 to be the year of **renewable energy** (Government of Argentina, 2017a). Beyond energy security and independence, the push for renewable energies is motivated by emission reductions and the promises the sector holds in terms of job creation. The creation of skilled local jobs was identified as one of the three benefits of developing renewable energies in the decree that announced 2017 to be the year of renewable energy (Government of Argentina, 2017a). The current government has recently been under significant pressure to deliver on its promises to revive the economy, with a rising unemployment rate in 2017 and a series of national strikes organised in the spring and summer of 2017. In this context, the development of renewable energies is seen as one of the industries that can contribute to better employment and a boost of local industries.

Aside from renewable energies, the shale oil and gas industry is also central in the debate around energy security. Despite having sizeable conventional hydrocarbon resources and the world's 2nd and 4th largest shale gas and oil reserves (EIA, 2017), the decline in hydrocarbons production combined with rising energy demand had led to increasing natural gas imports from Bolivia and Chile over the past years via pipeline and as Liquefied Natural Gas (LNG). The government aims to reverse the trend of increasing imports and associated public expenditure by developing the country's shale gas reserves. Argentina's main shale gas field – Vaca Muerta in the Neuquén province – is one of the world's largest shale gas fields. In addition to promoting energy security the development of the unconventional oil and gas industry is seen as a way to boost domestic jobs. A unit of

electricity generated with a combined cycle plant using gas from Vaca Muerta has been estimated to contain 70% of local content (IAE General Mosconi, 2017).

Figure 9: Imports and exports of oil (millions of m3) and natural gas (billions of m3) (IAPG, 2017)



3.3. Sector scenarios

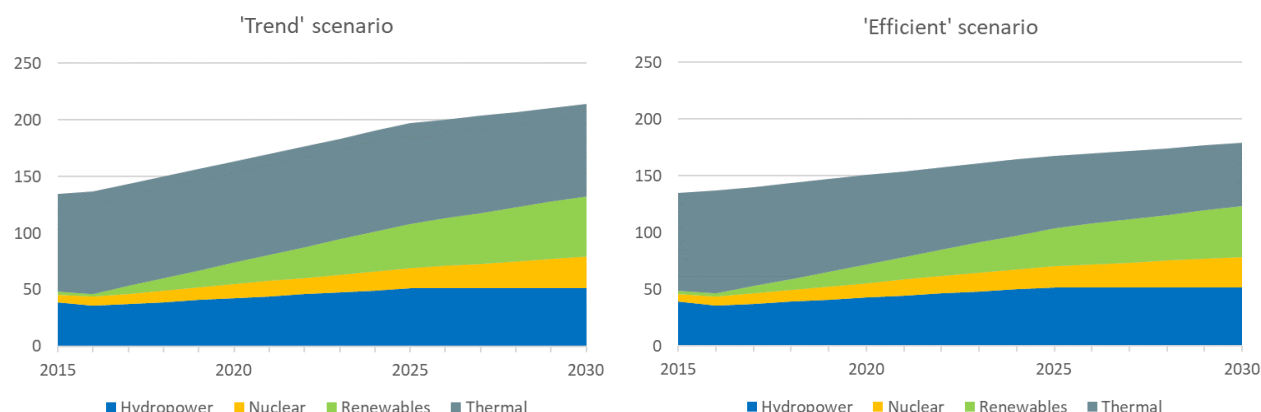
The Ministry of Energy operates two main scenarios for the electricity sector for the years 2025 and 2030 (published in December 2016 and 2017 respectively): one reference scenario (*“escenario tendencial”*), and one scenario with additional energy efficiency measures (*“escenario eficiente”*). Under the reference scenario, over 34 GW of new capacity would be added by 2030 whereas under the efficient scenario, only over 26 GW of new capacity would be needed (see Figure 10). By 2025, the Ministry of Energy expects an additional 24 GW of capacity under the reference scenario and 17 GW under the efficient scenario.

Figure 10: New installed capacity by 2030 in reference and efficient scenarios (Government of Argentina, 2016a)



The expected total electricity generation also differs between the two scenarios: it is 20% higher in the reference (~214 TWh) than in the efficient scenario (~180 TWh) in 2030 (see Figure 11).

Figure 11: 2030 Electricity generation scenarios (TWh) (Government of Argentina, 2016a)



The scenarios differ for the different technologies as follows:

- Renewable energy:** Both of the scenarios reach 20% of renewable energy in the electricity generation mix by 2025 and 25% by 2030. The difference lies in the expected new installed capacity of 9 GW in the efficient scenarios against 11 GW in the business as usual one between now and 2025 and 18 GW and 14 GW respectively between now and 2030. Hence, the absolute contribution of renewable energy sources is reduced under the efficient scenario. The expected investment for an additional 10 GW of renewable capacity is estimated at around USD 15 billion (Subsecretariat of Renewable Energy of Argentina, 2016). In 2017, the clean energy sector (excl. large hydro) attracted USD 1.8 billion in Argentina (BNEF, 2018), which is broadly in line with the annual investment needs to achieve the 2025 renewable energy objectives.
- Thermal energy:** An even stronger difference is observed in the expected new capacity for thermal generation (4 GW discrepancy in the two scenarios by 2030). Reflecting the expected installed capacity, thermal electricity generation is nearly 50% higher in the reference scenario by 2030. The planned investment figures published by the Ministry of Energy point to numbers closer to expected capacity in the efficient scenario, which leads to think this is the reference scenario for budget planning.
- Hydropower (>50 MW):** In both the 2030 reference and 'efficient' scenarios, the Ministry of Energy is foreseeing an additional 3 GW of large hydroelectric capacity. The government has launched work to construct two additional hydroelectric plants on the Santa Cruz river in Patagonia for a total of ~1.3 GW to be completed by 2022. The project consists of the 'NK' (Nestor Kirchner) plant of 950 MW and the 'JC' (Jorge Cepernic) plant of 360 MW.
- Nuclear power:** Both the reference and efficient scenarios foresee an additional 800 MW of new nuclear capacity by 2025 and 2 GW by 2030. The government is currently planning to build an additional three nuclear power plants and to extend the lifetime of an existing one. The government has already signed two MoUs with China's NEA to that effect. One of these projects – the 'Fifth Central' to be constructed

in the province of Rio Negro – however had to be cancelled following a decision by the governor of the province in response to public opposition to the construction of the plant (MINEM, 2017a).

The integration of additional capacity – particularly renewable energy - requires a substantial reinforcement of the **transmission capacity**. To this aim, the Ministry of Energy (Ministerio de Energía y Minería – MINEM) has set out plans for additional 3000 km of 500 kV transmission lines to be built by public private partnerships (BNEF, 2017). Furthermore, Transener which owns 100% of the highest-voltage transmission lines is aiming to invest USD 230 million to make up for the investment delays (El Cronista, 2017b).

3.4. Legislation and policies

A number of different regulations and programmes have been initiated and developed over the last five years in the energy sector, targeting both increased shares of renewable energy in the electricity supply mix as well as improved energy efficiency. MINEM shares the position that both renewable energy and energy efficiency measures are core components of the future development of the electricity sector and of climate change mitigation (MINEM, 2018). Institutionally, renewable energy and energy efficiency are kept separate within MINEM. While the responsibility for renewable energy lies with the Subsecretariat for Renewable Energy in the Secretariat for Electric Energy, the topic of energy efficiency is headed by the Subsecretariat for Energy Saving and Efficiency in the Secretariat for Strategic Energy Planning, which also serves as the focal point for climate change and the NDC.

In the following, the most relevant regulations and programmes in both areas are presented.

Renewable energy

The three main recent changes in the legislation of the electricity sector are the Renewable Energy Law 27.191, which sets mandatory targets for electricity generation from renewable energies, Resolution 202/16 allowing for third party PPAs between renewable energy producers and large electricity consumers, and the recently approved law on distributed generation.

The **new renewable energy law** replaced the former Renewable Energy Law 26.190 issued in 2007. It entered into force at the end of 2015, after being approved with wide political support (>90%) at both the Senate and the Lower Chamber (Subsecretariat of Renewable Energy of Argentina, 2016). The law sets compulsory targets for the share of electricity generation from renewables in 2018 (8%) and 2025 (20%). It declares electricity generation from renewables to be in the country's national interest, and provides fiscal incentives for renewable energy investments, such as exemptions from import duties, VAT refunds, exemption from dividend tax and accelerated depreciation, in particular to foster the deployment of local components. Article 4(6) of the law stipulates that companies integrating 60% of national components (or 30% in case no national production exists) in electromechanical installations are eligible for a tax rebate of 20% for the local content equipment (excluding civil works).

To complement this law on renewable energy, the government also passed Resolution 202/16 allowing private parties to sign **3rd party power purchasing agreements (PPAs)** between renewable energy producers and large consumers.

In December 2017 the Argentinean Senate also approved the **law on distributed generation**. This law allows for net-metering for SMEs and residential consumers on a national level and proposes the creation of a fund for distributed generation from renewable sources. Beyond national legislation at least seven provinces have passed their own distributed generation or net-metering policies, including Santa Fe, Mendoza, Salta, San Luis, Neuquén, Tucumán and Misiones.

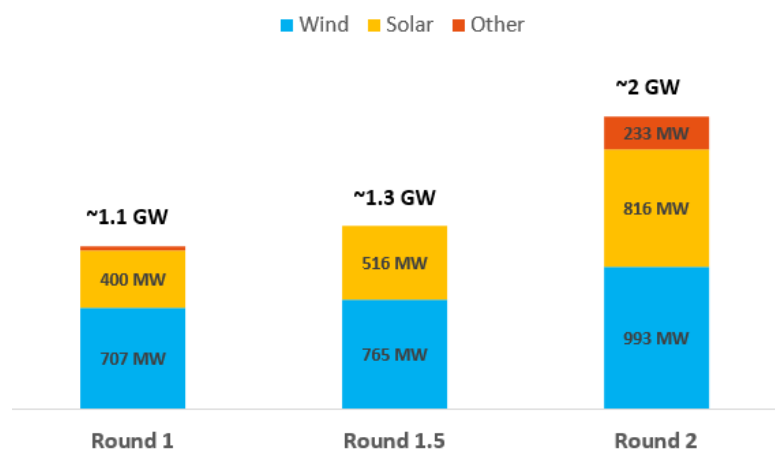
The government's primary policy for contracting new generation capacity in the electricity sector is through **competitive auctions for thermal, renewables and grid capacity**.

For thermal capacity, the government currently has two tender processes: one for combined cycle and cogeneration plants and another one for all thermal electricity generation. In the latest tender round for all thermal generation the government received offers for over 6 GW of capacity.

The **RenovAr auction programme** is the government's main policy to develop renewable energies and reach 8% and 20% of renewable electricity consumption in the electricity mix by 2018 and 2025 respectively. Under RenovAr three tender rounds have been issued to date. RenovAr Round 1 was launched in July 2016 and closed in October 2016. Due to the tender being significantly oversubscribed, the government subsequently decided to launch a follow-up '1.5' tender round, which closed in November 2016. The second round of RenovAr was launched in August 2017 and aimed to contract 1200 MW of renewable capacity. Ultimately 2 GW of renewable capacity was awarded in the tender which closed in late 2017. In this latest round the government announced they intend to increase the local component, particularly for wind turbines, and have initiated contacts with international wind developers to do so (El Cronista, 2017a). The average local component in RenovAr rounds 1 and 1.5 was of 17.1% and 19.1% for solar PV and 10.7% and 11.1% for wind (Gil and Álvarez, 2017).

The share of different technologies in the three auctions is shown in Figure 12.

Figure 12: Capacity contracted in RenovAr Rounds 1, 1.5 and 2 (MINEM, 2017c, 2017b)



In order to make the RenovAr programme more attractive for investors, the government also created a public trust fund to provide guarantees (the Fiduciary Fund for the Development of Renewable Energies, or FODER) to mitigate against the risk of failure of payment by the national utility CAMMESA. In addition to the national fund, the payments are also backed by a sovereign guarantee and an additional World Bank guarantee.

Other relevant policies and programmes to promote renewable energy include the following:

- **Probiomasa:** the programme aims to promote energy from biomass (including co-generation in the electricity sector) while encouraging regional development and climate change mitigation. It was launched in the early 2010s and is currently jointly managed by MINEM and the Ministry of Agroindustry in cooperation with the Food and Agriculture Organisation (FAO). Beyond a capacity building workstream to educate policy-makers and other stakeholders, the project provides technical assistance to local policy makers and supports pilot projects to demonstrate the viability of different biomass-based technologies.
- **PERMER:** is a programme that promotes access to sustainable energy – both electricity and heat – in rural and off-grid areas. PERMER was launched in 2000 when over 10% of the country’s rural population still lacked access to electricity (World Bank, 2015). The second phase of the project was launched in 2015 and aims to evaluate the success of the first phase while at the same time ensuring continued access to energy to the communities that received support in the first phase of the project.

Energy efficiency

Under the lead of the Subsecretariat for Energy Saving and Efficiency, a regulatory framework to effectively promote energy efficiency across sectors and institutions is currently being developed. A law on the prohibition of halogen lamps and one to promote efficient water heaters are pending final approval in the National Congress. Furthermore, a draft bill for a **National Energy Efficiency Law** (Ley Nacional de Eficiencia Energética) has been developed in 2015. Once adopted, this Law will provide guidelines for the development of national

energy efficiency policies and strategies and establish minimum environmental protection requirements. A special trust fund will be created to promote investments in energy efficiency projects and to boost R&D for national technologies. The Law furthermore mandates the development of a 10-year **National Energy Efficiency Plan** (Plan Nacional de Eficiencia Energética) to define concrete energy efficiency targets as well as measures to achieve them (Subsecretariat of Energy Saving and Efficiency, 2016).

Major programmes and measures related to energy efficiency and demand side management at a national level include the following (Subsecretariat of Energy Saving and Efficiency, 2018):

- **Efficient Lighting Plan** (Plan Alumbrado Eficiente – PLAE): the plan seeks to accelerate the replacement of conventional lighting with more efficient LED technology on public roads in municipalities and provinces. Implementation of the plan is estimated to save up to 50% of energy compared to current levels.
- **Energy Efficiency in Public Buildings:** under this programme, 15 energy assessments in different public administration buildings have been carried out in order to determine their energy consumption and identify opportunities for energy savings and efficiency. 5 of the 15 assessments were part of a pilot project aiming at developing the concept of Energy Performance Contracting (EPC) and Energy Service Companies (ESCOs) at the national level.
- **Energy Efficiency Labelling Scheme:** the labelling scheme aims to inform energy consumers about the energy efficiency class of household appliances, raising awareness of energy consumption and saving potential at a household level. During 2017, 4 new IRAM standards for energy efficiency were published (electric ovens, ceiling fans, wall and standing fans, and LED lamps). 7 IRAM standards became compulsory (television, microwaves, single-phase and three-phase induction motors, electric and gas-fired hot water tanks and stand-by for television and microwaves) and one more completed the review phase (washing machines).
- **Energy Efficiency Education Programme:** in close collaboration with the Ministry of Education, energy efficiency is being incorporated at different levels of formal education. During 2017, more than 1500 teachers at primary and secondary schools received on-site trainings on topics related to energy, environment and responsible energy use. More than 600 teachers were trained in on-line courses offered by the Ministry of Education. In 2016, a project was initiated which seeks to better integrate the subject of energy and energy efficiency into engineering and architecture degrees. Two new courses in energy management were opened at the University of Buenos Aires and University of Jujuy. In addition to that, the programme promotes “training for trainers” to increase awareness for energy related topics early in the education chain.
- **Argentina Fund for Energy Efficiency** (Fondo Argentino de Eficiencia Energética – FAEE): together with the National Fund for SME Development (Fondo Nacional de Desarrollo de las Pequeñas y Medianas Empresas – FONAPYME) the FAEE developed a medium- and long-term credit line for SMEs to support energy efficiency projects that aim to reduce and optimise the SMEs’ energy use. The FAEE emerged

from a GEF project aiming at promoting energy efficiency through the development of a sustainable and growing market for energy efficiency services and equipment in Argentina. To date, the Fund has allocated around USD 3 million to 37 SMEs in different branches of the production sector. The Fund is currently being restructured.

- **Argentina Efficiency Award:** the newly launched award seeks to acknowledge public and private organisations that show commitment and leadership on energy efficiency issues. In its first edition in 2018, a focus was placed on Energy Management Systems, appraising those organisations that implemented an Energy Management System in compliance with ISO norm 50.001.

3.4.1. Subsidies and taxation

Until recently, the government provided major subsidies for both energy production and consumption causing heavy strains on public finances (energy subsidies represented 3.7% of the country's GDP in 2014). In 2013-14 the fossil fuel subsidy bill alone reached over USD 2 billion (Folgar, 2016). The current government has scaled down subsidies for energy consumption in order to rationalise energy consumption, particularly in the electricity sector, but has so far continued to subsidise upstream activities. In November 2017, the government announced continued subsidies for shale gas producers in the two main production basins of the country – at USD 7 per MMBtu. At the same time the government passed a new carbon tax for fossil fuels at USD ~10 per tonne in December 2017.

3.4.2. Subnational plans and policies

Argentina has a federal governance structure and many policy and planning decisions are devolved to the 23 provinces and the Autonomous City of Buenos Aires. The diversity of the provinces in terms of wealth, access to infrastructure and distribution of natural resources, have an impact on energy sector planning in various ways. In order to address the unique circumstances and development needs of the different provinces the government has issued a National Policy for Development and Territorial Planning to manage the nexus between province-level development and national development priorities (Government of Argentina, 2016c). The policy categorises the provinces into six groups depending on availability of public services (road network, potable water and sewage system).

In addition to this overall strategy, the government has issued two regional development plans in the government's 100 priorities: the '**Proyecto Patagonia**' and '**Plan Belgrano**'. Poverty reduction, electricity access and the development of clean energies are important components of these plans.

More recently, the **City of Buenos Aires** announced during the COP23 negotiations in November 2017 it would seek to be carbon neutral by mid-century in a joint declaration with a number of other C40 member cities.

4. NDC and Paris alignment

This section looks at the alignment of the sector targets, policies and plans with the NDC to better understand the likelihood of achieving the NDC targets. Beyond the current NDC the analysis also takes a long-term perspective to assess the potential of the sector to align with the goals of the Paris agreement. The section also focuses on understanding current obstacles and barriers to achieving a sector transformation towards full decarbonisation by mid-century. Aspects around a long term “energy transition” and how this relates to current realities in Argentina are also discussed.

4.1. Alignment of targets, strategy and policy

The NDC is based on a set of targets agreed under the previous administration. Policies to support the implementation were only established since the new administration took office in 2015. Against this background it is important to understand whether the NDC targets can actually be achieved, not least since successful implementation of the current NDC is fundamental for an upward revision of the target for the next round of NDCs as required under the ambition mechanism of the Paris Agreement.

4.1.1 Targets and strategy alignment

The two central measures listed for the electricity sector in the NDC/second BUR are broadly in line with sector-level planning – including both the 20% renewable energy target by 2025 and the development of clean energies in rural areas. There is however a 5-year ‘hiatus’ in planning; the unconditional 2030 NDC mitigation measures seem to assume no increase in the share of renewable energy (but in absolute terms) in the power mix in 2025-2030 should the 20% of renewable energy already be reached by 2025 as mandated by law. Higher ambition is only included in the conditional target aiming at 25% of renewable energy in the power mix by 2030, which is in line with the Ministry of Energy’s 2030 scenarios.

All of the Ministry of Energy’s scenarios are geared towards reaching the 20% renewable energy target by 2025 and rise to 25% by 2030; this is the case both in the reference scenario and in the additional energy efficiency scenario. In addition to this, the renewable energy target has strong and high-level political buy-in (including from the president’s office), and is in line with the development priorities of the country – including the development of national industries, employment and access to stable energy (Government of Argentina, 2016b). The main concern now lies in the implementation of these plans and the pace at which renewable energy can be deployed.

The Ministry of Energy is currently working on a comprehensive energy sector strategy that will feed into the overall strategy on climate change expected to be published in 2019. As such, and due to the government’s political commitment to climate action and the cross-ministerial involvement in climate policy development,

one can expect the energy sector targets and strategies to continue to be in line with the headline emissions target in the current NDC.

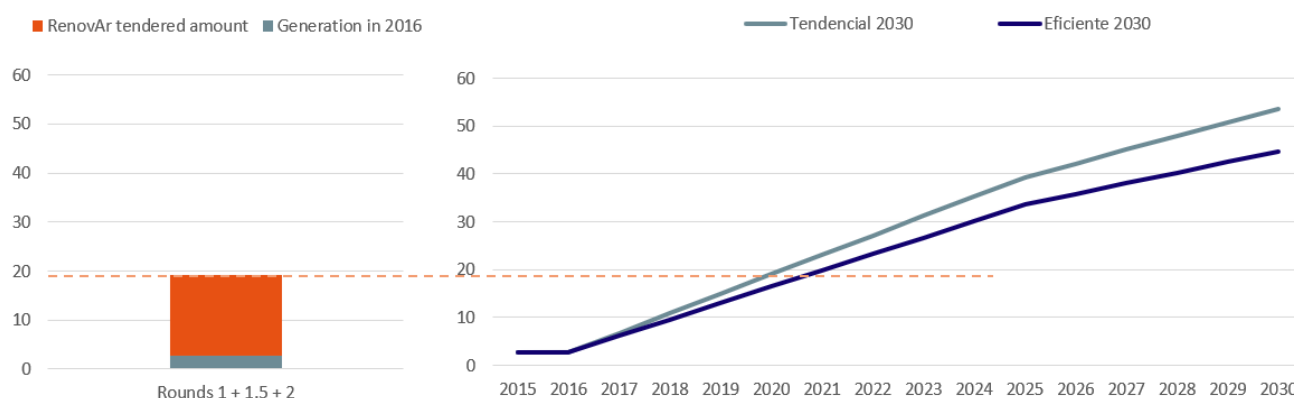
4.1.2 Policy alignment

Renewables

The RenovAr tender programme has been specifically designed to reach the objectives of the renewable energy law. As Figure 13 shows, the tendered capacity to date under the first RenovAr rounds (1, 1.5 and 2) – amounting to close to 4.5 GW – should roughly be able to cover the generation required between 2020 and 2021 under a linear target development path. Implementation of the capacity tendered will however be unlikely to materialise in this timeframe; while contracts have been signed, construction work for the projects will take longer than this. As of 2017, none of the large-scale RenovAr projects had come online. This does not necessarily mean that the implementation of the programme is being jeopardised, but it does speak to the long timeframes and frequent delays in major infrastructure works.

Going forward similar or faster renewable capacity growth needs to be ensured, either through tenders or other means (e.g. PPAs). The conclusion of the RenovAr 2 tender was an encouraging sign of continued progress but there will be a need to follow up relatively quickly with a further tender round in order to stay within the trajectory set by the renewable energy law for 2025 (see trendline in Figure 13).

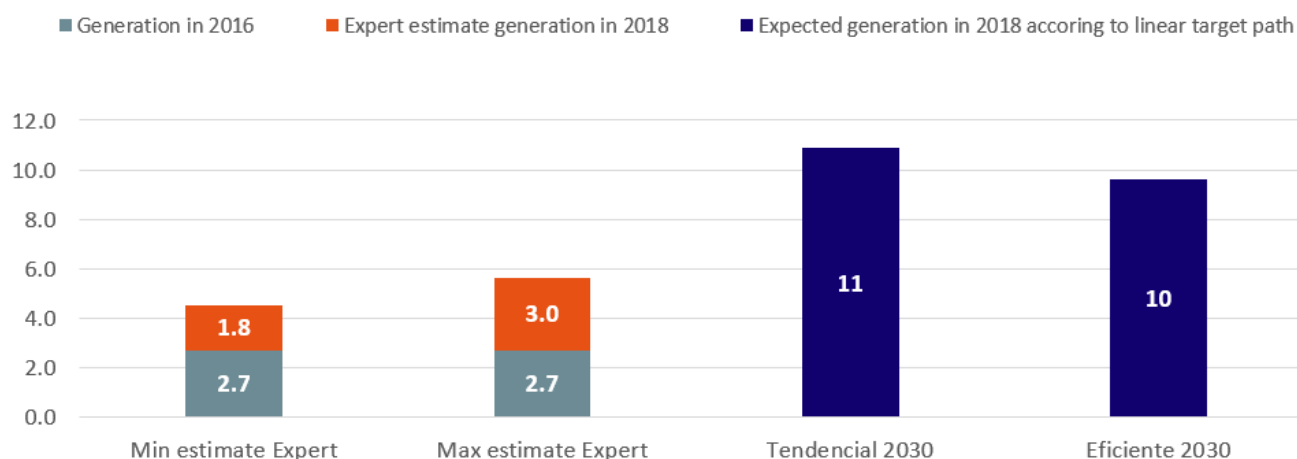
Figure 13: Projected electricity generation from tender rounds RenovAr 1, 1.5, 2 vs. (left side) vs. projected development of renewable electricity generation under MINEM scenarios [in TWh] A linear trajectory is assumed for the development of RE generation between today and 2030 (right side) (CAMMESA, no date)



As shown previously, the amount of renewable capacity tendered to date is sufficient to support a linear pathway towards achieving the Ministry of Energy's scenario targets and NDC target. For an assessment of the likelihood of achieving the NDC target the next two years will be crucial. If the tendered capacity was entirely installed, implementation progress would indeed be in line with the NDC targets. However, experts estimate the installed capacity to likely be much lower, equalling about 500 – 800 MW by the end of 2018 (see Figure 14

below for a comparison of expected generation) given significant current barriers faced by the sector (see 4.3 for a full discussion on barriers). As the figure shows, this would mean that renewable power generation will be about 1/3 of what is needed for a linear trajectory, hence far off target.

Figure 14: Expected unconventional renewable energy generation according to expert judgement (left two bars) and linear scenario pathway (right two bars) (CAMMESA, no date; BnAmericas, 2017)



A key question remains around grid capacity. In a situation where the grid upgrade is not implemented swiftly enough, much of the 'burden' to reach the 20% target beyond RenovAr rounds 1 and 2 would rest on small-scale technologies requiring low and medium voltage grid capacity or the success of the energy efficiency policies to reduce the total electricity demand. A tender for power lines was planned for the end of 2017 but it has to date, as of January 2018, not been started.

To sum up, implementation is currently moving forward but reaching the short-term renewable energy target (2018) is likely to be delayed due to previous inaction. None of the larger-scale RenovAr projects had yet come online in the first half of 2017 (CAMMESA, 2017), hence it is unclear in how far the long term RE target to 2025, which underlies the NDC, can be reached.

Other policy developments and sector plans

While the NDC target was in line with sector-level developments when it was published, the most recent developments have not yet been included. This is notably the case for the development of distributed generation (beyond the development of renewables in rural areas), for which a new law enabling net-metering was passed in late 2017 (see section 3.4).

In addition to this, some of the regional development plans, which strongly feature the deployment of clean energy technologies, have not been included in the NDC. These may overlap with the renewable energy target in the NDC and identifying how the deployment of renewables supports national development priorities could potentially strengthen the case for increased ambition in the next round of NDC development.

Other mitigation technologies (nuclear energy and hydropower)

As the third and fifth largest mitigation measures in the energy sector, the development of nuclear energy and hydropower are important determinants to meet the NDC mitigation targets. Out of the overall 110 MtCO₂e reduction planned in the sector, hydropower would contribute ~6-7 MtCO₂e or ~5-6% of total mitigation efforts in the energy sector) and nuclear would contribute ~12-14 MtCO₂e or 11-13% of total mitigation efforts in the energy sector (see Figure 5 on page 10). According to the Ministry of Energy's scenarios, 3 GW of large hydropower and 2 GW of nuclear would be added between now and 2030 (Ministry of Energy of Argentina, 2018). Contrary to renewable energy which is mentioned in the government's top 100 priorities and has received support from several stakeholders, both of the technologies have faced some resistance, and therefore the implementation of measures remains more uncertain. Beyond social acceptability, in the case of large hydropower plants it is important to consider the risks of future water availability in the face of climate change. The yields of hydropower plants can be expected to decrease in the future or will at least become more unpredictable than they have been in the past. The cost profile of nuclear energy also puts some doubts over future developments: according to the Ministry's own scenarios, the investments costs for nuclear energy are 2-6 times higher than that of solar PV and over 4 times that over wind energy (Ministry of Energy of Argentina, 2018).

Natural gas and other thermal sources

As for the development of renewable energies, the government has organised tenders for the development of thermal capacity – much of which has been smaller scale combustion engines which can run on either diesel or natural gas (Todo Logistica, no date). The impact of the natural gas (and primarily shale gas) sector on the electricity sector and the related targets (including the NDC) is still uncertain at this stage. The development of shale gas could be expected to displace natural gas imports in a first stage (therefore having a smaller net effect in terms of emissions in the electricity sector). It is therefore unlikely to have a major net impact on the country's national emissions in the immediate to short term, assuming that RE capacity extensions will be achieved as planned. The displacement of fuel oil imports for electricity generation with natural gas, which can be used in many of the same power plants as the fuel oil powered ones could even have positive implications. However, it is important to keep in mind that beyond the impact to national emissions in Argentina, the developments of the shale gas sector in Argentina could have implications for emissions development in the region and globally depending on export activities and price developments (although Argentina will likely only have a marginal impact on global natural prices).

4.2. Medium and long-term Paris alignment

Beyond the question of alignment of sector policies and plans with the current short to medium term NDC and sector target, it is important to understand the alignment of the sector with the long-term Paris goals of limiting the average global temperature increase to “well below 2°C” and pursuing efforts to limit it further to 1.5°C. This is especially important against the background that most countries' NDCs are not in line with the long-term Paris goals (Climate Action Tracker, 2017). Understanding the longer-term alignment of the sector and what would

be required by the sector to be Paris-aligned has importance for countries for two reasons. It allows policy and decision makers to future proof policy and investment decision. This is particular relevant in the context of infrastructure development and investment as non-aligned decisions today may lead to stranded assets and sunk investments. Secondly, it allows for a more cost-effective national implementation of the ambition mechanism of the Paris Agreement which requires countries to set progressively more ambitious mitigation targets in five-year cycles. Defining the long-term sector target can be used as a goal post to define short and medium-term targets of getting there.

4.2.1 What does the Paris Agreement mean for the electricity sector globally?

Analysis on the global efforts needed to reach the Paris Agreement shows that the electricity sector will need to be fully decarbonised by around mid-century to meet the objectives of the Paris Agreement (Rogelj et al., 2015). Under 1.5°C scenarios, the share of decarbonised technologies in the electricity mix would need to reach close to 100% by 2050. For limiting warming to 2°C, full decarbonisation would need to happen by 2060 (Kuramochi et al., 2018).

In order to retain a chance to meet the stricter 1.5°C temperature limit, further sectoral analysis on the power sector shows that the growth rate of renewables and other zero-carbon technologies need to continue growing at the current growth rates. In concrete terms, this means that growth rates for wind and solar of 25-30% are needed globally until 2025 after which growth rates need to continue in the order of 4-6%. At the same time, no new coal power plants should be built and emissions from existing plants should be reduced rapidly. The full list of global sectoral benchmarks to stay below a 1.5°C limit is included in the text box below.

Box 1: Ten sectoral benchmarks to limit warming to 1.5°C (Kuramochi *et al.*, 2018)

10 SECTORAL BENCHMARKS TO LIMIT WARMING TO 1.5°C

1. **Sustain the current growth rate of renewables and other zero and low-carbon power generation until 2025 to reach 100% share by 2050**
2. **No new coal power plants, reduce emissions from existing coal fleet by 30% by 2025**
3. Last fossil fuel passenger car sold by 2035–2050
4. Develop and agree on a 1.5°C-consistent vision for aviation and shipping
5. All new buildings fossil-free and near-zero energy by 2020
6. Increase building renovation rates from less than 1% in 2015 to 5% by 2020
7. All new installations in emissions-intensive sectors low-carbon after 2020, maximize material efficiency
8. Reduce emissions from forestry and other land use to 95% below 2010 levels by 2030, stop net deforestation by 2025
9. Keep agriculture emissions at or below current levels, establish and disseminate regional best practice, ramp up research
10. Accelerate research and planning for negative emission technology deployment

4.2.2 What does this mean for Argentina?

In Argentina, the deployment of renewable energy (excluding large hydropower) has historically been low but, according to MINEM's own calculations, is projected to increase at a much faster pace over the coming years, going from less than 2% of total electricity generation to 20% over less than 10 years (see section 3.3). This translates to a year-on-year growth of around 30% in both the 'reference' and 'efficient' scenarios between 2015 and 2025. The growth rate would then slow down to roughly 6.3% under the reference scenario and 5.9% under the efficient scenario year-on-year between 2025 and 2030. These projections are in line with the short-term steps needed on a global level to limit warming to 1.5°C. This does not however say much about the effective pace of development in the Argentinean context, as deployment achieved by policies can differ largely from the targets reflected in the scenarios presented by MINEM. An effective implementation and continuation of the policies, especially RenovAr, is key to achieve this (see Section 4.1).

Long-term scenarios

To get a better picture of how the Ministry of Energy's scenarios could relate to longer term developments and steps to align with the Paris Agreement, we have developed a few long-term scenarios to compare potential pathways for the electricity sector by 2050. It is worth noting that at this stage there are no long-term governmental scenarios available that go beyond 2030. The scenarios compared are the following:

- **Scenario 1 - MINEM scenarios + linear growth beyond 2030**
- **Scenario 2 - Conservative uptake of decarbonised sources**
- **Scenario 3 - 100% decarbonisation scenario with high renewables growth**

Each of the scenarios was developed for both a 'reference' and an additional energy efficiency scenario, in line with the Argentinean Ministry of Energy's scenarios. Due to a lack of a national energy generation and demand scenarios beyond 2030 we assumed electricity demand to follow a linear pathway beyond 2030 extrapolated from the MINEM scenarios for the years 2015 to 2030. This would mean electricity generation would more than double between today (~140 TWh) and 2050 (~330 TWh) under the reference scenario and slightly less than double in the efficient scenario (240 TWh). The other main assumptions under the scenarios are detailed in Table 1 below.

Table 1: Summary of main assumptions under the 2050 scenarios

Scenario name	2015-2030	2030-2050
Scenario 1 - MINEM scenarios + linear growth	<ul style="list-style-type: none"> • MINEM reference and efficient scenarios 	<ul style="list-style-type: none"> • Linear extrapolation of MINEM scenarios for all technologies
Scenario 2 – Conservative uptake of decarbonised sources	<ul style="list-style-type: none"> • Renewables: RenovAr rounds 1, 1.5 and 2 are implemented with delay by 2025, 5% growth beyond 2025 • Large hydropower grows at 1% yearly • Nuclear grows at 5% yearly 	<ul style="list-style-type: none"> • Hydropower and nuclear stay at 2030 levels • Renewable electricity increases at 5% yearly • Thermal electricity fills up the remaining energy demand
Scenario 3 - 100% decarbonisation	<ul style="list-style-type: none"> • MINEM reference and efficient scenarios 	<ul style="list-style-type: none"> • Hydropower and nuclear stay at 2030 levels • Thermal electricity gradually decreases to zero • Renewable energy fills up the remaining demand

Table 2 and Table 3 below present a summary of the 2030 and 2050 electricity mixes under each scenario. As can be seen from Table 3 (2050 timeframe), the linear growth scenario (Scenario 1) with a lower electricity generation (i.e. the efficient scenarios) could reach the objective of a decarbonised electricity sector by mid-century, in line with the Paris Agreement and in the Conservative uptake of decarbonised sources scenario (Scenario 2), the efficient sub-scenario reaches lower shares of thermal generation. This highlights that much of the decarbonisation efforts rest on the success of the planned energy efficiency policies. Should the electricity demand grow beyond what is currently planned (for example due to an increased electrification of the transport and building sectors), this could jeopardise the decarbonisation of the electricity sector.

The following sections give further details about the different scenarios analysed and their underlying assumptions.

Table 2: Summary table of projected shares of electricity sources in the generation mix by 2030 (own calculations)

2030	Scenario 1 – Linear growth		Scenario 2 – Conservative uptake of decarbonised sources		Scenario 3 – 100% decarbonisation	
	Reference	Efficient	Reference	Efficient	Reference	Efficient
Decarbonised sources¹	62%	69%	37%	44%	62%	69%
<i>Renewables – excl. large hydro (% of total)</i>	<i>25%</i>	<i>25%</i>	<i>10%</i>	<i>12%</i>	<i>25%</i>	<i>25%</i>
Thermal	38%	31%	62%	54%	38%	31%

Table 3: Summary table of projected shares of electricity sources in the generation mix by 2050 (own calculations)

2050	Scenario 1 – Linear growth		Scenario 2 – Conservative uptake of decarbonised sources		Scenario 3 – 100% decarbonisation	
	Reference	Efficient	Reference	Efficient	Reference	Efficient
Decarbonised sources¹	77%	98%	34%	48%	100%	100%
<i>Renewables – excl. large hydro (% of total)</i>	<i>39%</i>	<i>44%</i>	<i>17%</i>	<i>23%</i>	<i>68-76%²</i>	<i>46-61%²</i>
Thermal	23%	2%	62%	48%	0%	0%

Scenario 1 – MINEM scenarios + linear growth

Under Scenario 1, low-carbon electricity sources make up close to 77% of the total electricity generation under the reference scenario and around 98% under the efficient scenario by 2050 (see Figure 15 below). Renewable energy – excluding large hydro – would generate close to 40% of the electricity under the reference scenario and around 44% under the efficient scenario. Thermal electricity generation decreases from 66% in 2016 to 23% in the reference case by 2050 and to only around 2% under the efficient scenario. The “energy efficient” scenario

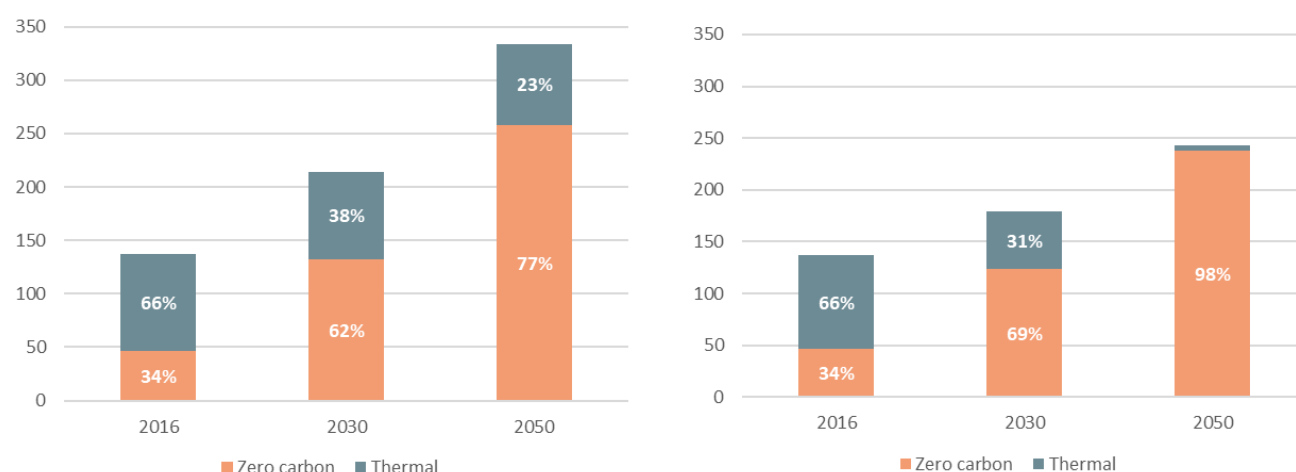
¹ Includes renewables, large hydro and nuclear energy

² This variation depends on the assumptions for the development of other low-carbon electricity sources

presented here would be compatible with the Paris Agreement – although a number of caveats need to be raised:

- In this scenario large hydro – as the other technologies – is assumed to follow linear growth beyond 2030. Due to the impacts of climate change on water availability and other concerns raised by large hydro (see section 3.3), there are significant uncertainties whether such a growth would be feasible. To contrast this assumption, we have assumed large hydro generation to remain constant beyond 2030 under Scenario 2.
- Similarly, this scenario also applies linear growth to nuclear energy. Given the cost profile of nuclear energy (for which investment costs are already 2-6 times higher than that of solar PV and over 4 times that of wind energy according to the Ministry of Energy’s own estimates, as mentioned in section 4.1) there remain doubts whether nuclear will really play a significant role in the future electricity mix in Argentina. Similar to hydro we have therefore assumed this technology to remain constant under Scenario 2.
- This scenario also assumes that renewable energy plans as laid out by the ministry for the period 2015-2030 are implemented on time and that deployment continues apace beyond that. The current state of implementation however shows that delays can be expected and should grid upgrades not materialise, large-scale renewable energy tenders beyond what has been auctioned so far could be jeopardised (see section 4.1).

Figure 15: Linear growth scenario - electricity generation in 2016, 2030 and 2050 (TWh) - reference (left), efficient (right)

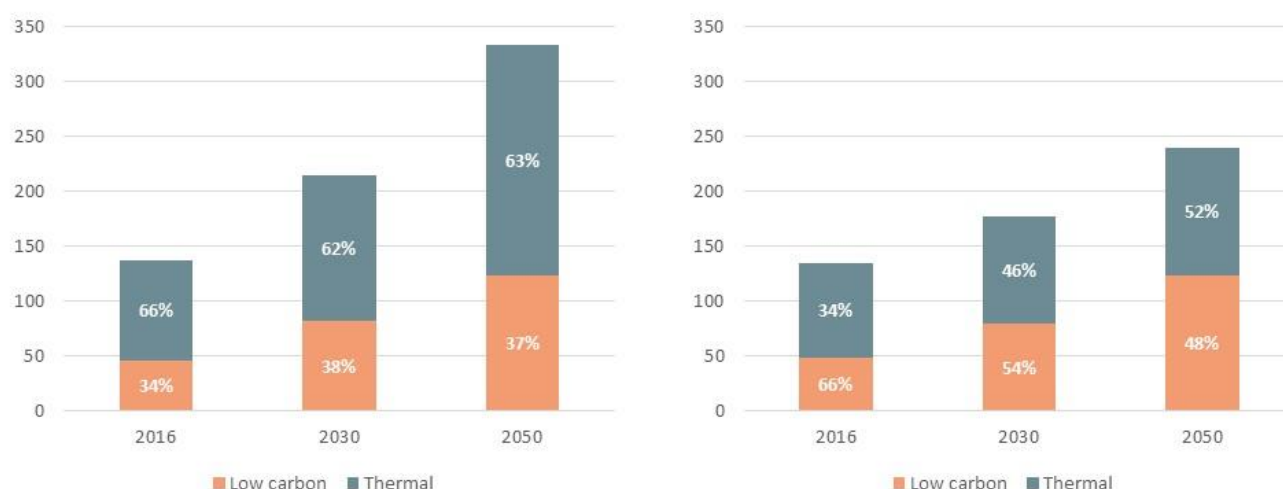


Scenario 2 – Conservative uptake of decarbonised sources

Scenario 2 presents a future in which renewables and other low-carbon electricity sources grow, but at much more modest rates than foreseen in the Ministry of Energy’s 2025 and 2030 scenarios. In this scenario, we assume the following:

- No further large-scale renewable energy tenders beyond the RenovAr rounds which have been awarded until now will be implemented. We assume capacity from the rounds tendered so far to gradually come online between now and 2025 (i.e. with a few years' delay). Beyond 2025 moderate growth (5% yearly) is assumed from small-scale renewables deployed thanks to the new net-metering regulation and 3rd party PPAs.
- Large hydropower generation grows at 1% yearly between 2017-2030 and stays constant between 2030 and 2050. While there are some new infrastructure projects under planning and construction phases (see section 3.3 for details), this scenario takes a conservative stance on the effective generation growth from large hydropower due to the uncertainty of water availability due to climate change and other environmental concerns associated with large hydro.
- Nuclear electricity grows at 5% until 2030 to account for planned projects (see section 3.3 for details) but then remains at 2030 levels to account for the high costs of the technology and possible resistance to new nuclear infrastructure projects.
- Thermal electricity makes up the remaining electricity generation.

Figure 16: Scenario 2 - Conservative uptake of decarbonised sources - electricity generation in 2016, 2030 and 2050 (TWh) - reference (left), efficient (right)

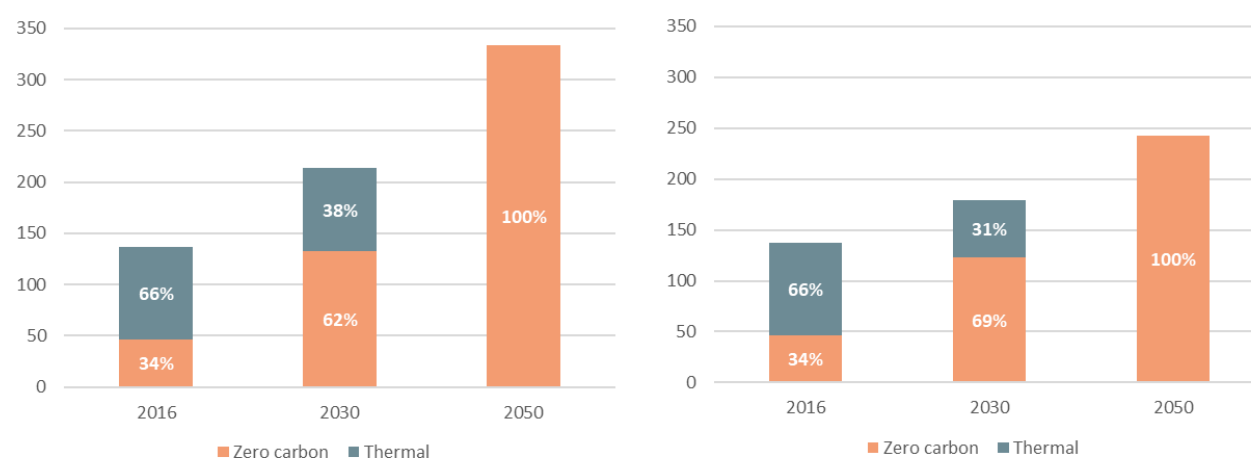


As with Scenario 1, the scenario with a lower total electricity generation (the efficient scenario) is projected to reach higher shares of decarbonisation. This scenario serves to highlight that if more is not done to remove some of the still existing barriers to renewable energy (see section 4.3) and should the large-scale RenovAr tenders stall after the rounds organised so far due to grid integration and other issues, the long-term objective of decarbonisation required by the Paris Agreement cannot be achieved. Alternatively, much more efforts to decarbonise the electricity system would need to be done beyond 2030; this would however be undesirable from a societal welfare and economic perspective, as the cost to decarbonise has been shown to be much greater in the future than if tackled now (Stern, 2006).

Scenario 3 – 100% decarbonisation / alignment with Paris Agreement

The decarbonisation scenario assumes full decarbonisation by 2050 – which would mean that thermal electricity generation needs to reach zero by 2050 (assuming CCS will not become viable). In this scenario, renewable energy contributes the largest share of the decarbonisation efforts: between 46 and 76% of total electricity generation by 2050 depending on the assumptions. Nuclear energy (8-21%)³ and hydropower (15-33%)³ however also remain important components in the electricity mix.

Figure 17: 100% decarbonisation scenario - electricity generation in 2016, 2030 and 2050 (TWh) - reference (left), efficient (right)



A transformation to fully decarbonised, largely renewable-based electricity systems has been demonstrated to be viable with currently available technologies (IEA, 2017a). While this is technically within reach, such transformation amounts to nothing short of a complete shift of paradigm in the electricity sector. In order to be feasible, such an energy transition therefore requires transformations that go beyond the electricity mix alone, including changes to linkages between sectors (e.g. with transport and buildings), electricity markets, storage capacity and system flexibility. To ensure this transformation is feasible, these interlinkages should be taken into account in the different and particular also early stages of climate and energy policy-making.

Ultimately, all these scenarios highlight the importance of energy efficiency to decarbonising the electricity sector. It is therefore important to ensure that current policies are well implemented and that efforts are made to turn the planned measures under the Ministry of Energy's efficient scenarios into action.

4.3. Barriers to renewable energy and policy responses

The discrepancy between official planning and realization of projects can be explained by a number of barriers to renewable energy development in Argentina which are relevant for both the discussion on NDC alignment as well as the long-term transition ability of the sector. Barriers exist at the financial, technical and regulatory level,

³ The variation in the share of both nuclear and hydro power can be explained by the uncertainty of their future role in the energy matrix. We assume that they could either remain constant or grow linearly.

and the government has already introduced policy measures to address some of them. For example, due to the currently highly insecure investment environment, actors had restricted themselves to short-term and piecemeal solutions in the electricity supply sector, including the installation of a number of small to medium sized gas fired power plants (single cycle) requiring little upfront costs. The creation of the FODER guarantee fund accompanying the RenovAr programme or the continued tax breaks given for renewable energy components are expected to pave the way for the implementation of projects on a larger scale. Whilst policy instruments are unlikely to fully remove structural investment barriers within a few months, the measures have contributed to an improved investment environment and are likely to enable better long term strategic planning necessary for large investments.

On a technical level, the current limitation of the electricity grid is an obstacle to the scaling up of renewables. Significant investment in the upgrading of the grid infrastructure will be necessary in particular considering that much of the best wind and solar energy resources are located far away from the main centres of demand. As such, connecting the promising wind site in Argentina's South and its sites in the north-west, best suited for solar PV, will be a key issue in future. This would not only allow for most harvesting but also for a complementing interplay of different technologies. Currently, the expansion of the grid is lagging behind the installation of new renewable energy plants posing a significant risk of shortages in the transmission capacity within the next years (BNEF, 2017). With this in mind, in some cases it may also be attractive to use second-best resource sites that are closer to major demand centres.

Table 4 provides an overview of some of the main barriers hampering the renewable energy development in Argentina and the policy instruments the government implemented to overcome those barriers.

Table 4: Overview of barriers and policy instruments applied to overcome those

Barrier	Description	Policy response
Financial barriers		
Limited access to finance and high cost of capital	<ul style="list-style-type: none"> Limited investor confidence due to Argentina's recent defaults on debts and double-digit inflation Risk perception of renewable energy projects and the country's low creditworthiness ('B' rating by Standard&Poor) result in high interest rates and short tenors Widespread "wait-and-see" approach amongst investors Perceived risk of long term ability of the government to fulfil PPAs Current financing mostly from bilateral or multilateral banks and corporate finance – limited local and project finance 	<ul style="list-style-type: none"> Argentina resolved defaulted debt and regained access to global financial markets. Inflation target of 15% for 2018 The country risk declined more than 100bp (-22%) in 12 months and recent public and corporate debt issuances have been oversubscribed by 4-7x 4-year plan to eliminate the primary fiscal deficit Long term PPA's including guaranteed purchase and a guarantee fund backed by the World Bank in case of default Removal of capital controls and repatriation restrictions

<p>High impact: If Argentina fails to attract investment it will not achieve its renewable energy targets. High interest rates may make projects unprofitable or at least cause higher electricity prices for the end consumer. However, almost all projects awarded under RenovAr 1 and 1.5 secured finance by November 2017, showing that Argentina has chosen convenient measures to overcome some of the outlined financial barriers.</p>		
Currency risk	<ul style="list-style-type: none"> PPA's are issued in Argentine Pesos, that may be subject to depreciation causing losses for international investors. 	<ul style="list-style-type: none"> PPA's are equipped with a price adjustment mechanism, that shall compensate depreciation of the Peso.
<p>Potentially medium to high impact: A significant depreciation constitutes a major threat for international investors. According to the Central Bank of Argentina the peso lost 14% of its value with respect to the USD in 2017. However, the annual price adjustment factor guarantees an annual increase of the nominal bidding price of 1.7%. If depreciation remains high, this may increase financial pressure on developers in the longer term.</p>		
<p>Technical barriers</p>		
Transmission capacities and grid operation	<ul style="list-style-type: none"> According to expert judgement, the high-voltage grid in its current state can only absorb the additional capacity contracted under tender rounds RenovAr 1 and RenovAr 1.5 (or ~3.6 GW of new renewable capacity). Much of the best wind and solar resources is located far away from residential and industrial centres of demand. The physical spread of the Argentinian electricity grid makes it less flexible compared to the European grid. There is limited regional inter-connectivity relevant to absorb national supply fluctuations. There is no experience in the operation of a grid with a high renewable energy penetration. Fluctuation of the generation and limited forecast ability pose new challenges to the grid operator. 	<ul style="list-style-type: none"> At least 3000 km of high-voltage transmission lines are planned to be built by private public partnerships (not yet tendered). CAMMESA is making some efforts to prepare for the operation of the grid with an elevated share of renewable energy.
<p>Potentially high impact: Expert's assessments vary. However, some fear that the grids may become the bottleneck of the Argentine energy transition. Furthermore, many are sceptical about the technical impacts of renewable energies on the grid stability.</p>		
Lack of experience	<ul style="list-style-type: none"> Local developers have only little experience and sometimes fail to 	

among developers:	meet the standards expected by international investors. (E.g. environmental studies and studies to estimate the renewable energy resource)
Medium impact: this may cause delay and higher cost but will not generally threaten the energy transition.	
Regulatory barriers	
No favourable market design for the integration of renewable energies:	<ul style="list-style-type: none"> • The Argentinian electricity market is not flexible and guarantees thermal generators certain purchase conditions making the integration of renewables costly. • Small scale generation and auto-consumption (unless isolated) require a metering system and a legal purchase framework. • A new law on distributed small-scale electricity generation – which includes net-metering – has been passed. However, it determines fairly unfavourable conditions for small producers.
Low impact: The additional costs that arise from the design of the electricity market may be significant but not crucial. Small-scale installations are a valuable asset to modern energy systems. However, a modest share of renewables (in contrast to a 100% share) is achievable without small-scale installation.	

5. Conclusion

“The energy transformation in Argentina has accelerated at a remarkable pace that no one could have predicted over two years ago” Adnan Amin, Director General of IRENA at OLADE in December 2017

As highlighted by the Director General of IRENA in the quote above, the energy sector in Argentina is undergoing rapid changes. Whereas Argentina only had 2% of new renewable energies in its electricity mix in 2016, this number will have to increase substantially over the coming years to reach the 20% of renewable energy targeted by law by 2025.

The speed of transformation needed is significant, and much will still need to be done to ensure the successful implementation of the 2025 target. This includes a timely implementation of the of large-scale RenovAr renewable energy tenders but also the planned energy efficiency policies, which can help to accelerate the share of renewables in the electricity mix thanks to a reduced demand. Current implementation of the RenovAr rounds however show delay and given the uncertainties around the development of the electricity grid to support higher shares of renewables, much of these developments still remain uncertain.

If the sector-level plans are however successfully implemented, the sectoral target of the NDC referring to renewables could even be overachieved, as the 20% renewable energy target in the electricity mix would already be reached by 2025 (and not 2030 as foreseen by the unconditional NDC target). Should the 2025 target be achieved and should the growth rate of renewable energy generation continue as foreseen by the Ministry of Energy, renewable energy generation would make up 25% of electricity generation by 2030 and would match the conditional NDC target. If the development of renewables is seen to be on track with the sector plans, this could then provide significant support for the case of increased ambition in the next round of NDC development.

Beyond the successful implementation of existing plans, there are still a number of measures which could be taken to increase ambition in the sector. Not all have been addressed at (equal) length in this paper, but each could benefit from further consideration in policy-making:

- Stronger development of distributed generation. Distributed generation was likely not taken into account (or only to a limited extent) when the NDC and the 2025 renewable energy targets were developed, as the new net-metering regulation was only passed at the end of 2017.
- Development of new and innovative renewable energy technologies– these could include battery storage for variable renewables, offshore wind energy and possibly even tidal energy and power to gas technologies depending on cost developments.
- Further consideration of additional energy efficiency policies. Beyond supporting a faster decarbonisation, energy efficiency policies have a wealth of benefits ranging from increased local employment to reducing the overall costs of an ambitious energy transition (IEA, 2014).

Beyond the sectoral developments, we have also noted in this paper that Argentina has taken a number of steps to align its NDC with sector-level policies thanks to institutional reforms. The current government has put in

motion mechanisms that provide the basis to ensure enduring institutional anchoring that go beyond the elaboration of a single NDC, including the creation of the National Cabinet for Climate Change, which enables cooperation of relevant ministries in the development of climate and sector policies. This process should become increasingly valuable in the future, as the decarbonisation of the electricity sector will likely require close coordination between the energy, transport and building sectors. In particular the expected medium and long-term electrification of the transport sector has a significant impact on the power sector as a whole.

The regional development programmes identified in the Argentinean government's 100 priorities (such as Proyecto Patagonia) have not been mentioned in the NDC but can further serve to lend higher legitimacy to the development of new technologies that improve access to sustainable energy and contribute to reducing the inequalities between Argentina's provinces. Local plans could also serve to increase ambition on a national level. Most notably the pledge made by the city of Buenos Aires to be carbon neutral by mid-century could have significant impacts on national developments as well and could lend legitimacy to higher decarbonisation efforts – and possibly a more ambitious NDC.

Finally, as was shown in the final sections of this paper, a full decarbonisation of the electricity sector by mid-century as required by the Paris Agreement can be within reach if the sector developments follow a similar trajectory to that foreseen by the Ministry of Energy's scenario with increased energy efficiency measures in the years 2015-2030. This highlights once again the importance of energy efficiency measures in achieving the decarbonisation of the electricity sector. The long-term scenarios we have developed further highlight two factors – renewables-based generation needs to increase rapidly while thermal electricity generation needs to start decreasing already now. Having the latter in mind when considering important infrastructure investments in the sector can not only help to reach the objective of the Paris Agreement but can also avoid significant stranded investments and lock-in effects in the long-term.

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