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Comment on the Paris compatibility of the 'Plataforma Escenarios Energéticos Argentina 2040'

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Authors

Marie-Jeanne Kurdziel, Markus Hagemann, Pieter van Breevoort, Frauke Röser

Contact

Marie-Jeanne Kurdziel: m.kurdziel@newclimate.org

Markus Hagemann: m.hagemann@newclimate.org

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Introduction

The third round of the *Plataforma Escenarios Energéticos Argentina 2040* represents a unique and inclusive effort to discuss a country's mid-term energy sector future, setting an example for other countries to follow. This memo intends to reflect on this process by putting its results in the context of the Paris Agreement, which for the first time unites more than 190 countries under a common cause to undertake ambitious efforts to combat climate change.

Article 2 of the Paris Agreement establishes the long-term goal of "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels". At the heart of this temperature goal and its achievement are the nationally determined contributions (NDCs) in which each country puts forward its individual effort until 2030 or 2035 and commits to strengthening this effort in the years ahead.

While the long-term temperature goal in the Paris Agreement shows unprecedented commitment, the effort needed to achieve it and the implications of failing to do so are not clarified in the Agreement. The recently published *IPCC Special Report on Global Warming of 1.5°C* helps to fill this gap. It leaves no doubt about the urgent need to maintain the strongest commitment to the Paris Agreement and to limit global warming to 1.5°C, in order to mitigate severe global and regional climate impacts. The assessment undertaken in this report shows that this is possible but requires unprecedented transitions across all economic and social systems (IPCC, 2018).

To make it operational, the long-term temperature goal in the Paris Agreement needs to be translated into pathways of decreasing GHG emissions. This raises two issues: first, a universally acknowledged global pathway does not exist as interpretations of the future are different. Various pathways towards 2°C and 1.5°C compatibility are available, depending on technology assumptions and choice. Second, any global pathway must be distributed across countries and sectors to be translated into concrete actions. While the *IPCC Special Report* clearly shows that all countries must do the maximum towards decarbonisation, different speeds may be allowed by countries and sectors, depending on individual capabilities and feasibility of mitigation actions.

Global pathways towards Paris compatibility

Most up to date information on global pathways towards Paris compatibility is available in the *IPCC Special Report on Global Warming of 1.5°C*. The report assesses and summarises the existing scientific, technical and socio-economic literature relevant to global warming and for the comparison between global warming of 1.5°C and 2°C. Based on this analysis, it outlines important implications for global emissions pathways and system transitions that are consistent with 1.5°C.

To limit global warming to 1.5°C, **global CO2 emissions** need to decrease, on average, by about 45% from 2010 levels by 2030 (compared to 20% for 2°C) and to **reach 'net zero' by around 2050** (compared to around 2075 for 2°C). [1] This implies a need to balance remaining emissions latest after 2050 by removing CO2 from the air (IPCC, 2018). Additionally, **global GHG emissions** (which include all global warming gases) need to **peak as soon as possible** and decline quickly (Rogelj *et al.*, 2018).

The results of the *IPCC Special Report* create a sense of urgency and momentum for all countries to raise their ambition, strengthen their NDCs and effectively accelerate the implementation of the Paris Agreement in order to reach the long-term temperature goal. It also becomes clear that current national pledges under the Paris Agreement are not enough to stay on track toward this goal. Current NDCs point to emissions of around 52-58 GtCO2eq/yr in 2030, whereas 1.5°C pathways are based on a 25-30 GtCO2eq/yr range (IPCC, 2018). 2°C pathways, in comparison, are based on a 38–45 GtCO2eq/yr range in 2030 (UNEP, 2018). **Emissions must decline substantially before 2030**. The idea to temporarily exceed and later return warming to 1.5°C (overshoot) comes with substantial risks and implies a firm commitment to large-scale CO2 removal (IPCC, 2018).

Paris compatibility in the energy sector

While the *IPCC Special Report* highlights the **urgency to act across all sectors**, several underlying studies consider variations between sectors and gases regarding the speed and depth of decarbonisation needed (Germanwatch & NewClimate Institute, 2018). For some sectors, it will be less feasible to achieve zero emissions by 2050 (e.g. in the agriculture, industry or aviation sector), which means that other sectors with proven mitigation options (e.g. the power sector) need to do more to achieve the Paris goal.

Several pathway analyses focus on energy as the most significant source of GHG emissions. In the energy supply sector, more options are readily available than in other sectors. Hence, it is critical that this sector moves quickly and efficiently in the near-term. The following key messages for the energy sector result from a range of pathways consistent with 1.5°C that fed into the latest analysis of the IPCC Special Report (IPCC, 2018):

[1] *The numbers relate to a scenario with no or limited overshoot of 1.5°C* (IPCC, 2018).

- A rapid and profound ***near-term decarbonisation of the energy supply sector*** is key. This can be achieved through strong upscaling of renewables and sustainable biomass along with an effective reduction of unabated fossil fuels and the rapid deployment of carbon capture and storage (CCS).
- ***Increased mitigation efforts on the energy demand side*** are needed. All end-use sectors must introduce significant demand reductions to reach decarbonisation around 2050.
- Significant ***shifts away from fossil fuels towards electricity*** in demand sectors are required, since recent developments suggest that decarbonisation can be more easily achieved through electrification than through a large-scale shift to low-carbon fuels. Studies point out that the transport and the residential sector need to cover larger shares of their demand through electricity by mid-century in order to stay on track with the 1.5°C target.
- ***Additional infrastructure development*** is pivotal to accompany the technology shift in both supply and demand sectors. This needs to be done carefully as infrastructure typically has a long lifetime and actions taken today may cause lock-in effects.
- Comprehensive ***emission reductions in the energy sector must be implemented in the coming decade***, i.e. between 2020 and 2030, to be able to reach carbon neutrality around mid-century. ***Additional emission reductions must come from CO2***, since the non-CO2 mitigation potential is already nearly fully deployed for reaching a 2°C pathway.
- ***Investment patterns in the energy sector need to shift considerably***. Investments into low-carbon technologies need to increase, while those into fossil fuels must decline, with investments in unabated coal coming to a halt by 2030. There is less certainty regarding investments in unabated gas and oil, but most studies suggest that these will only be needed as bridge technologies and need to be accompanied by CCS. Increased investment must also flow into energy demand side measures.
- The ***scale of carbon dioxide removal (CDR) measures needed*** directly depends on the level of energy intensity (e.g. renewables) demand reductions as well as mitigation efforts implemented in other sectors. Several 1.5°C pathways project deployment of bio-energy with carbon capture and storage (BECCS) at a large scale, while there are a few that do not include BECCS in their projection but focus on terrestrial CDR in the agriculture, forestry and other land-use (AFOLU) sector.

These key messages indicate the need for a comprehensive transformation of the global energy system by mid-century, focusing on four key indicators for decarbonisation: a) limitation of the increase of final energy demand; b) reduction in the carbon intensity of electricity; c) increase in the share of final energy provided by electricity; and d) reduction in the carbon intensity of final energy other than electricity (IPCC, 2018). To stay on track with the long-term temperature goal of 1.5°C**, rapid transitions of the energy sectors of all countries until mid-century are key**.

Paris compatibility at the country level

In its approach to define a global pathway to achieve the Paris temperature goal, the *IPCC Special Report* provides a clear signal towards the need for strong decarbonisation efforts across all countries and sectors by mid-century, aiming at net-zero emissions in the long run. Yet, to ensure that the necessary decisions are being taken and concrete actions follow, the global effort must be distributed to efforts at the country and sector level.

A variety of approaches have been developed over the past decades that help to break down global pathways to country and sector level pathways. These approaches differ in the criteria they use to distribute the mitigation efforts, which has implications for the speed and depth of decarbonisation considered adequate for a country and sector. Developed countries, for example, are expected to take the lead in the implementation of deep emission cuts given their historic responsibility and economic capacity, while developing countries may have more time.

While the most prominent approach to modelling regional emission pathways, Integrated Assessment Models (IAMs), base the effort distribution almost entirely on mitigation costs (least cost scenarios), other approaches such as energy sector models (IEA ETP, IEA WEO) take also the feasibility of actions into account. Table 1 provides an overview of the most relevant approaches to break down global pathways to regional, country and/ or sector level pathways.

Table 1: Overview of approaches to break down global pathways to the country level

Approach	*Criterion*	*Description*	*Scope*	*Example*
Integrated Assessment Models (IAMs)	Least cost	Minimise costs for mitigation	National or sectoral level	IAMs
Effort sharing models	Effort sharing	Based on fairness principles (responsibility/ capacity/ efficiency)	National level	Climate Action Tracker (CAT)
Energy sector models	Feasibility and costs	Ensure affordability and feasibility of implementation	Energy sector level	IEA Energy Technology Perspective (ETP) IEA World Energy Outlook (WEO)
National pathways	Nationally agreed decarbonisation	Ensure political and economic feasibility	National or sectoral level	

While all these approaches have their justification, ideally the decision on which approach is used in a country in order to define how it will contribute to decarbonisation is taken at the national level and informed by bottom-up analysis in the sectors, e.g. by developing national pathways.

Paris compatibility in the Argentinian energy sector

Argentina is part of the G20 and rates among the high-middle income countries. Although the country may not be expected to move as fast as other industrialised countries towards decarbonisation, it is particularly relevant that GHG emissions in the energy sector decrease quickly, given the strong dependency of the country's economy on the agricultural sector, where decarbonisation will be more difficult.

Since a **Paris compatible pathway for the energy sector in Argentina** does not exist yet, this analysis draws on the approaches outlined above that can be considered representative for Argentina to break down global and regional pathways to the country level.

To project Argentina's energy sector emissions, the *ETP Beyond 2°C Scenario* for '*world*' and '*non-OECD*' are taken as a reference. They are scaled down to the country level by applying their energy intensity growth rates to Argentinian growth rates, based on historical data (see Figure 1 and Figure 2).

Figure 1: Evolution of emissions from energy sectors (except for agriculture and waste) according to **ETP world** developments

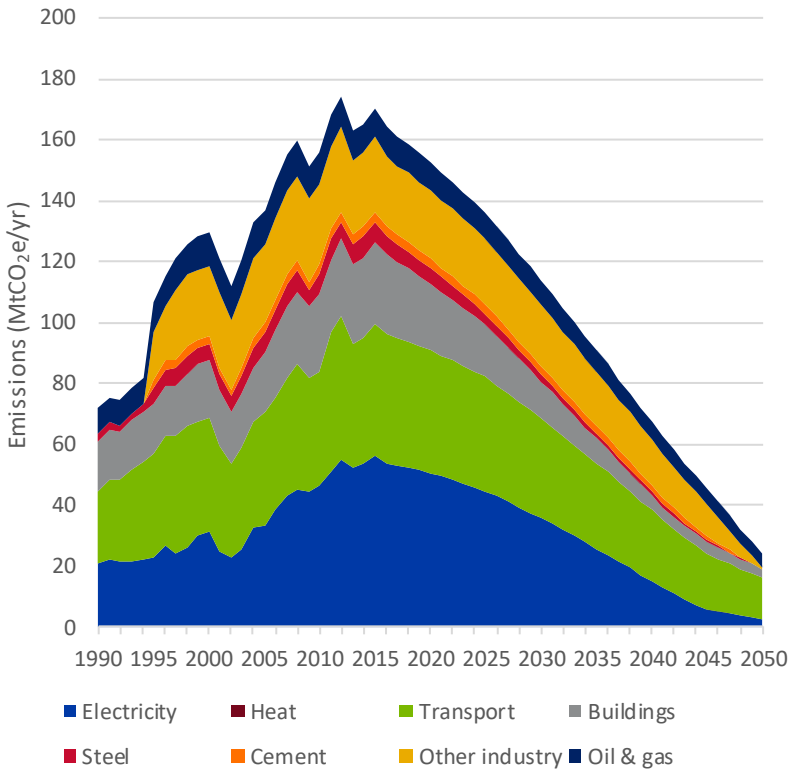
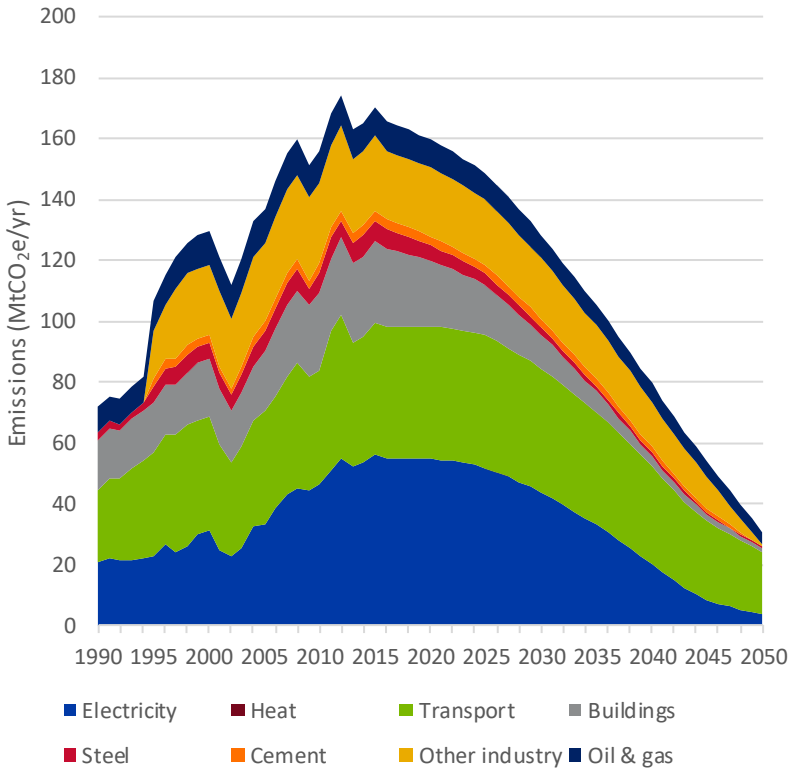


Figure 2: Evolution of emissions from energy sectors (except for agriculture and waste) according to **ETP non-OECD** developments



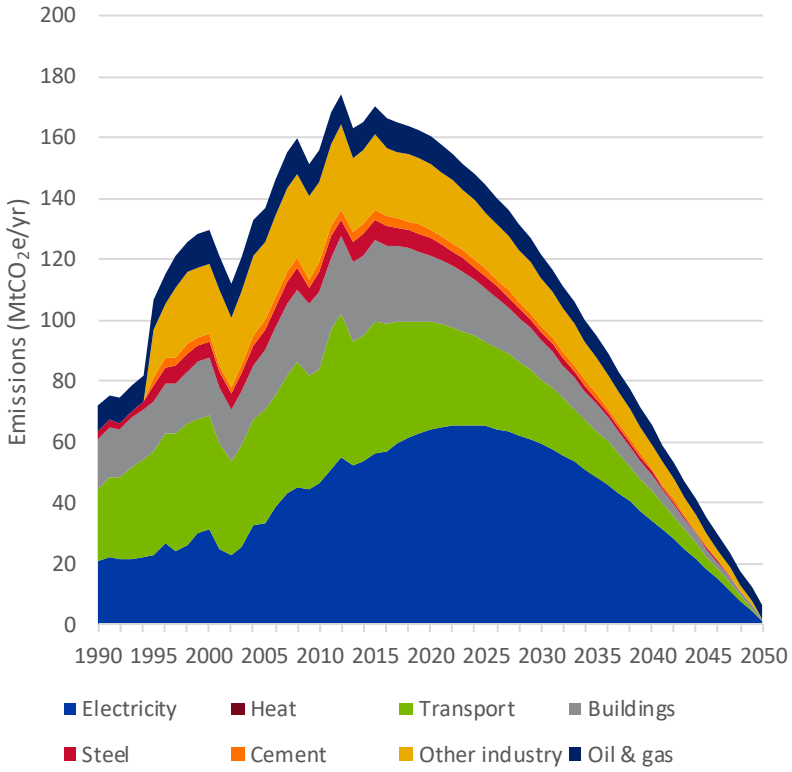
To project energy demand growth, the *ETP scenarios'* annual growth rates for electricity and other (non-electricity) energy demand are applied to historical data for demand growth in Argentina. In '*non-OECD*' regions, a stronger growth in electricity demand is projected, compared to '*world*' developments. This is largely due to higher economic growth rates in these regions as well as to increased electrification, resulting from a shift away from fossil fuels.

The *ETP scenarios* are being complemented by a scenario that assumes a linear decrease of emission intensities in the energy sector to (near) zero by 2050, in line with the Paris temperature goal. This decrease of emission intensity can be achieved using CCS, demand reduction measures and/ or a shift away from fossil fuels, while it avoids the use of negative emission technologies. [2] Specific assumptions in this scenario include 100% CCS in the industry and power sectors as well as an electrification rate of 100% in the buildings and transport sectors, and

[2] *According to the analysis of the IPCC Special Report, all pathways that limit global warming to 1.5°C project the use of carbon dioxide removal (CDR). However, existing and potential CDR measures (including afforestation and reforestation, carbon sequestration, BECCS, direct air carbon capture and storage (DACCS) and others) differ widely in terms of maturity, potentials, risks, co-benefits and trade-offs* (IPCC, 2018). *Currently, CDR deployment at larger scales is still subject to various feasibility and sustainability constraints and should therefore be treated with caution.*

60% in the agriculture sector. An initial increase in electricity emissions due to increased demand can be observed, which is stronger than the initial growth in zero-carbon electricity generation technologies (Figure 3).

Figure 3: Evolution of emissions from energy sectors (except for agriculture and waste) **when converging to zero emissions by 2050**.



The results of these three scenarios – the *ETP world scenario*, the *ETP non-OECD scenario* (both scaled down to Argentina), and the *zero-emissions intensity pathway* – provide the basis to calculate a range of Paris compatible pathways (including the minimum and the maximum of these scenarios) for the energy sector in Argentina. This range is used below as a reference for a Paris compatible development of the Argentinian energy sector.

Paris compatibility of the Plataforma scenarios

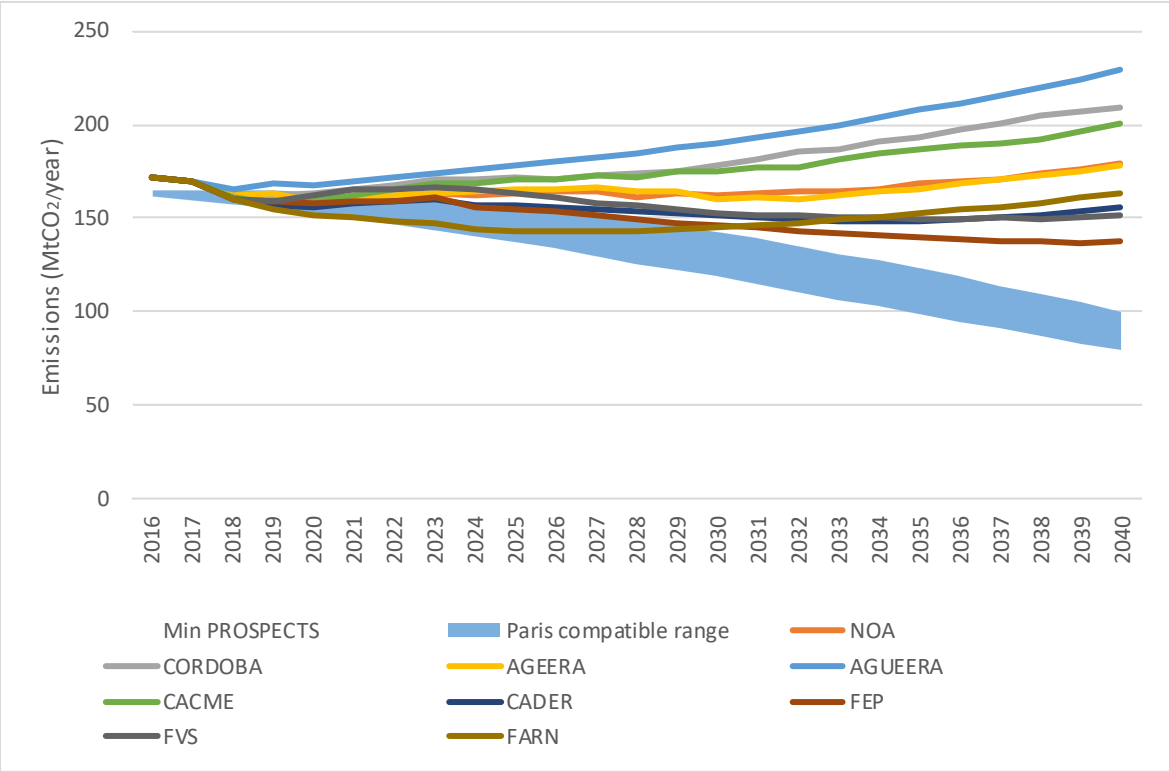
In its third round, the Plataforma Escenarios Energéticos reopened the dialogue about the direction of the Argentinian energy sector transition. While the process does not aim to accurately predict or project the future of the energy sector, it seeks to identify key elements that may affect the way in which this sector is evolving over the coming decades.

For this purpose, a total of eleven 'escenaristas', representing different energy-related institutions and interests[3], elaborated nine scenarios for the evolution of the energy sector up to 2040, applying a consistent methodological framework. An agreed set of indicators was used to quantitatively and qualitatively evaluate each scenario in its environmental, social and economic dimension (Plataforma Escenarios Energéticos, 2018).

From a climate change perspective, and with a view to the discussion around the need to decarbonise the global energy sector by 2050, the performance of the Plataforma scenarios in terms of their total emissions as well as emissions intensity can be assessed. Indicators evaluated in the Plataforma process along the environmental dimension include total GHG emissions in the energy sector, emissions from power generation, emissions intensity of primary energy, and emissions intensity of the power sector (Plataforma Escenarios Energéticos, 2018). Based on this data, the energy sector scenarios developed by the Plataforma 'escenaristas' can be compared with the previously identified range of Paris compatible energy sector pathways.

*[3] The 'escenaristas' represent the following institutions: 1) Asociación de Generadores de Energía Eléctrica de la República Argentina (**AGEERA**), 2) Asociación de Grandes Usuarios de la Energía Eléctrica de la República Argentina (**AGUEERA**) together with Unión Industrial Argentina (**UIA**), 3) Comité Argentino del Consejo Mundial de Energía (**CACME**), 4) Cámara Argentina de Energías Renovables (**CADER**), 5) Foro de Ecología Política (**FEP**), 6) Fundación Vida Silvestre (**FVS**), 7) Fundación Ambiente y Recursos Naturales (**FARN**) together with Universidad Nacional del Centro de la Provincia de Buenos Aires (**UNICEN**), 8) Grupo **NOA** (Noroeste argentino), and 9) Consejo Asesor de Política Energética de la Provincia de Córdoba (**CAPEC**) (Plataforma Escenarios Energéticos, 2018).*

Figure 4: Comparison of total energy sector emissions of Plataforma scenarios with a Paris compatible range

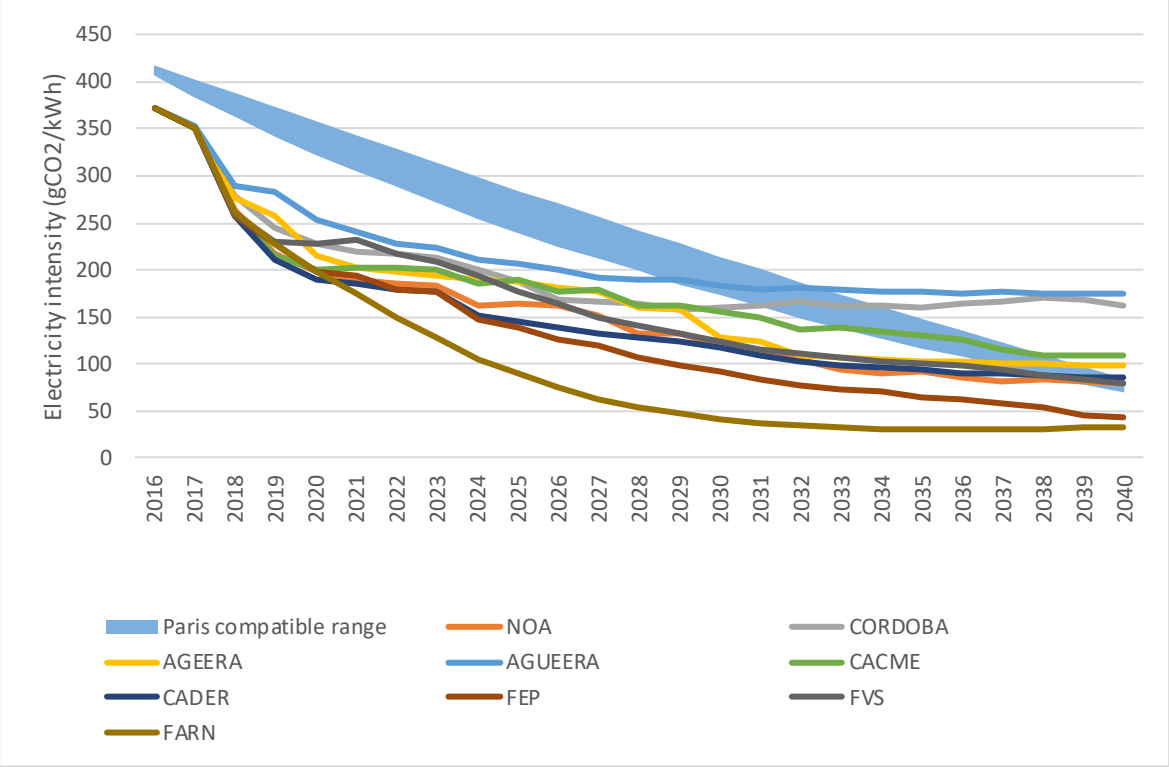


This analysis shows that – when looking at the energy sector as a whole – none of the Plataforma scenarios reaches emission levels that are compatible with the Paris temperature goal. On average, the Plataforma scenarios overshoot the identified Paris compatible emission levels by around 50% in 2040. Contrary to the findings of the *IPCC Special Report* that emissions must peak within the next years and reach near zero by 2050, the emissions projections in most Plataforma scenarios are still on the rise by 2040.

However, it is important to note that a Paris compatible energy sector would entail additional assumptions that have not been sufficiently considered in the modelling exercise undertaken by the Plataforma, and which might have altered the modelling results significantly. For example, almost all scenarios developed by the Plataforma 'escenaristas' foresee an increase in natural gas exploitation, and many scenarios envisage the export of natural gas to other countries in the future. While this is a reasonable assumption for a global scenario in which no other country strives for decarbonisation in the energy sector, it becomes a lot less attractive if more and more countries set themselves decarbonisation targets. In that case, more stringent emission reduction targets may lead to reductions in gas use across the globe and hence to a significant drop in the gas price, as is already being predicted by IEA (IEA, 2018). This will affect the economic feasibility of the technology in the future. Furthermore, in a global decarbonisation scenario, prices for renewable energy technologies may decrease even more than is predicted by the Plataforma model, due to the economies of scale involved. This may change the cost assumptions in the Plataforma scenarios, leading to lower costs for those scenarios that envisage significant deployment of renewable energy sources in the future.

The picture changes when the focus is placed on electricity sector emissions only, as a subsector of the energy sector. Emissions in the electricity sector are driven by the energy sources used for electricity generation and depend on electrification rates in the demand sectors. A gradual decarbonisation of the energy sources used, for example through expansion of renewable energy technologies, is reflected by a decreasing emissions intensity of electricity generation (Figure 5).

Figure 5: Comparison of electricity sector emissions intensity of Plataforma scenarios with a Paris compatible range



The emissions intensity of electricity generation displayed by the Plataforma scenarios is largely in line with the Paris compatible range presented in Figure 5. The Paris compatible pathway shows a pointed and steady decline toward 2040. The scenarios developed under the Plataforma perform well in the mid-term: all scenarios decrease before stabilising around 2025, and most scenarios continue to run below the Paris compatible range until 2035. However, stabilisation of the Plataforma scenarios happens at different levels of emissions intensity. While two scenarios, AGUEERA and CORDOBA, overshoot the Paris compatible range in 2032, several others, notably FARN and FEP, seem to stay on track even beyond 2040. Those scenarios that stabilise at a higher emissions intensity are likely to assume higher shares of natural gas also in the future electricity mix, while the Paris compatible trend implies the phase-out of all fossil fuels, including gas, in the long-term.

In a nutshell, a targeted analysis of the energy sector scenarios developed under the Plataforma process provides interesting insights into several options for energy sector development in Argentina, along the environmental, social and economic dimension. However, while all scenarios assess emission-related indicators, none of them reach Paris compatible emission pathways in the energy sector by mid-century. Electricity sector emissions, when considered in isolation and in terms of intensity, show a better performance in the mid-term. This shows that positive developments are underway in the sector that can be used as a basis to build upon in the context of effective decarbonisation. However, given the limited modelling time frame of the Plataforma process it remains unclear how the electricity sector emissions intensity of the different scenarios will develop beyond 2040.

In view of the commitment of more than 190 countries – including Argentina – to the Paris Agreement and to implementing ambitious efforts to combat climate change, future rounds of the Plataforma process may include additional assumptions that are more aligned with this commitment, such as decreasing gas prices and increased electrification of other sectors in the short- to medium-term. In doing so, the Plataforma process may consider the immense challenges as well as opportunities lying ahead toward a decarbonised energy sector and provide valuable input to an integrated and sustainable energy sector planning that reflects realistic developments, not only in Argentina but across the world.

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