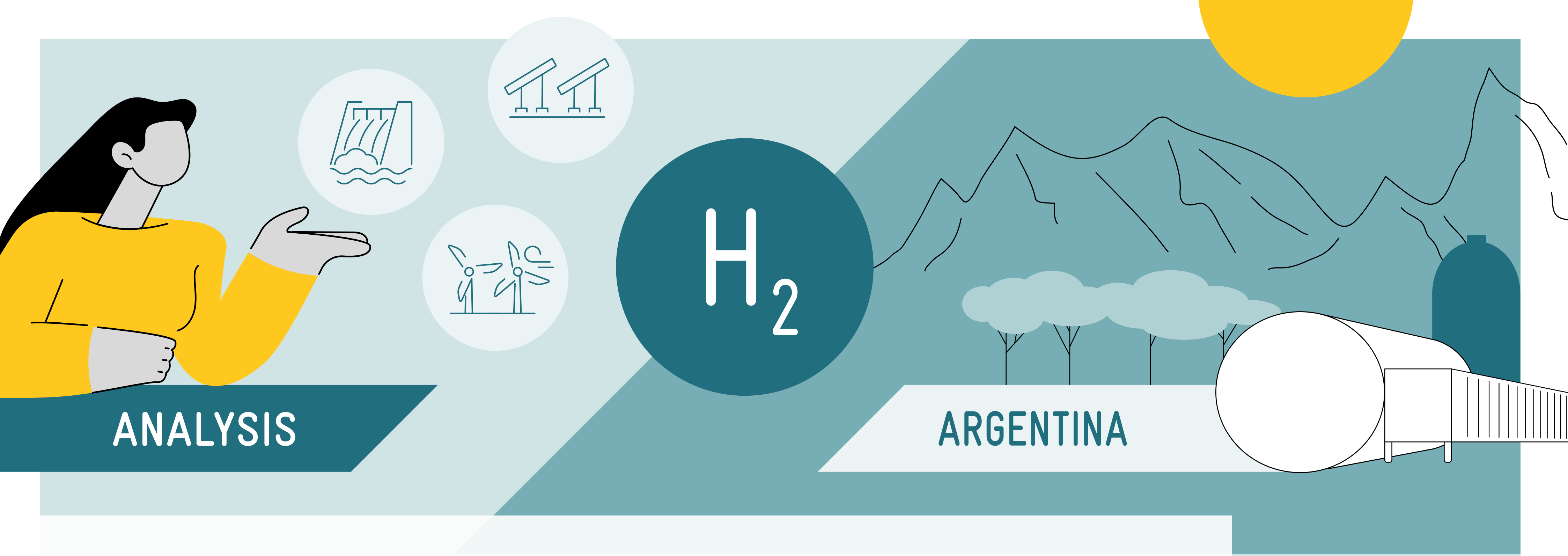


Sector Analysis Argentina

Green Hydrogen for the C&I Sector

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

This publication was commissioned by the German
Energy Solutions Initiative of the German Federal
Ministry for Economic Affairs and Energy (BMWE)

TABLE OF CONTENTS

TABLE OF CONTENTS

List of figures

List of tables

Currency units

ARS	Argentine peso
USD	United States dollar

Currency units and conversion rate as of 05.09.2024

EUR 1 = ARS 0.0009465
ARS 1 = EUR 1,056.51

EUR 1 = USD 0.92275
USD 1 = EUR 1.0838

Source: Exchange-Rates.org, 2024

Technical units

bbl	Barrels (plural)
EJ	Exajoule (10^6 TJ)
GW	Gigawatt
GWh	Gigawatt hour
kTPA	Thousand tonnes per annum
Mt	Million tonnes
MTPA	Million tonnes per annum
MW	Megawatt
MWh	Megawatt hour
TJ	Terajoule (10^12 joule)
TPD	Tonnes per day

Abbreviations/acronyms

AEC	Alkaline electrolysis
AEMEC	Anion exchange membrane electrolysis cell
AN	Ammonium nitrate
ASU	Air separation unit
AT	High voltage
BMWE	Bundesministerium für Wirtschaft und Energie (German Federal Ministry for Economic Affairs and Energy (BMWE))
BT	Low voltage
CAN	Calcium ammonium nitrate
CAPEX	Capital expenditure
CCS	Carbon capture and storage
CCUS	Carbon capture, utilisation and storage
CH_2	Compressed hydrogen
CHP	Clean Hydrogen Partnership
CO_2	Carbon dioxide
DAC	Direct air capture
DAP	Diammonium phosphate
DME	Dimethyl ether
DRI	Direct reduced iron
ENARGAS	National Gas Regulatory Agency
ENRE	National Electricity Regulatory Agency
ETS	Emission trading scheme
EU	European Union
FODER	Fondo para el Desarrollo de las Energías Renovables (Fund for the Development of Renewable Energies)
GEF	Global Environment Facility
GH_2	Green hydrogen
GHF	Green Hydrogen Trust Fund
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HB	Haber-Bosch
HV	High voltage
IADB	Inter-American Development Bank
IEA	International Energy Agency
LCOH	Levelised cost of hydrogen
LH_2	Liquid hydrogen
LNG	Liquefied natural gas
LOHC	Liquid organic hydrogen carrier
LPG	Liquefied petroleum gas
LV	Low voltage
MAP	Monoammonium phosphate
MCA	Multi-criteria assessment
MCH	Methylcyclohexane
MeOH	Methanol
MIGA	Multilateral Investment Guarantee Agency
MINCYT	Ministerio de Ciencia, Tecnología e Innovación Productiva (Ministry of Science, Technology and Productive Innovation)
MT	Medium voltage
MTBE	Methyl tertiary butyl ether
MTG	Methanol-to-gasoline
MTO	Methanol-to-olefins
MV	Medium voltage
NDC	Nationally Determined Contribution
NH_3	Ammonia
NPV	Net present value
PDP	Project Development Programme
PEMEC	Proton exchange membrane electrolysis cell
PPA	Power purchase agreement
PPP	Public private partnership
PSA	Pressure swing adsorption
PtX	Power-to-X (power-to-anything)
PV	Photovoltaic
R&D	Research and development
SME	Small and medium-sized enterprise
SMR	Steam methane reforming
UAN	Urea ammonium nitrate
VAT	Value-added tax
WACC	Weighted average cost of capital

ENERGY SOLUTIONS – MADE IN GERMANY
The German Energy Solutions Initiative

The German Energy Solutions Initiative of the German Federal Ministry for Economic Affairs and Energy (BMWE) aims to globalise German technologies and expertise in climate-friendly energy solutions.

Years of promoting smart and sustainable energy solutions in Germany have led to a thriving industry known for world-class technologies. Thousands of specialised small and medium-sized enterprises (SMEs) focus on developing renewable energy systems, energy efficiency solutions, smart grids, and storage technologies. Cutting-edge energy solutions are also built on emerging technologies such as power-to-gas, fuel cells, and green hydrogen. The initiative's strategy is shaped around ongoing collaboration with the German business community.

The initiative creates benefits for Germany and the partner countries by:

- boosting global interest in sustainable energy solutions
- encouraging the use of renewables, energy efficiency technologies, smart grids, and storage technologies, while facilitating knowledge exchange and capacity building
- enhancing economic, technical and business cooperation between Germany and partner countries

THE PROJECT DEVELOPMENT PROGRAMME (PDP)

PDP is a key pillar of the German Energy Solutions Initiative and is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It connects development cooperation with private-sector engagement and supports climate-friendly energy solutions in selected developing and emerging countries, enabling local businesses to adopt solutions in energy efficiency, electricity and heat supply, and hydrogen, while facilitating market access for German solution providers.

Developing and emerging economies offer promising business potential for climate-friendly energy solutions but also pose challenges for international business partners. The PDP team works closely with local industries to develop financially viable projects by providing technical expertise, financial guidance, and networking opportunities.

It identifies project leads, collects and analyses energy consumption data, and assesses projects from both a technical and economic perspective. This includes outlining the business case, calculating payback periods, and evaluating profitability. Companies can then choose to finance projects using their own funds or explore leasing and other financing options. PDP provides cost-free advice to local companies and connects them with German solution providers for project implementation.

Additionally, by offering training, organising reference project visits, and publishing studies on the potential of climate-friendly solutions and on navigating regulatory frameworks, the programme supports market development and fosters private-sector cooperation.

Executive summary

GREEN HYDROGEN FOR ARGENTINA'S C&I SECTOR

The H_2 sector analysis for Argentina aims to assess the potential for green hydrogen development in the country, providing a foundation for future projects. This study is part of a series to offer market insights and support pre-development efforts to generate both local and international interest in the green hydrogen economy.

The analysis explores the feasibility of introducing green hydrogen into Argentina's commercial and industrial sectors, evaluating specific use cases and providing techno-economic estimates for stakeholders – particularly companies based in Germany. The objective is to identify viable opportunities, address key challenges, and outline a pathway for green hydrogen integration that aligns with Argentina's broader energy and industrial development goals.

Argentina possesses vast renewable energy resources, with significant potential in solar photovoltaic (PV) and wind energy, particularly in regions such as Patagonia. The country's diverse industrial base, including sectors such as oil refining, ammonia production, and steel manufacturing, presents substantial opportunities for green hydrogen applications. Additionally, Argentina's strategic location and well-developed trade networks position it as a potential hub for regional hydrogen exports, further strengthening its long-term market potential.

Zusammenfassung

GRÜNER WASSERSTOFF FÜR DEN C&I-SEKTOR ARGENTINIENS

In der vorliegenden H_2-Sektoranalyse für Argentinien wird das Potenzial für die Entwicklung grünen Wasserstoffs im Land bewertet und eine Grundlage für zukünftige Projekte geschaffen. Die Analyse ist Teil einer Serie; sie zielt darauf ab, Marktinformationen bereitzustellen und Maßnahmen für die Vorentwicklung zu unterstützen, um sowohl lokal als auch international Interesse an der Grüner-Wasserstoff-Wirtschaft zu wecken.

Untersucht wird die Machbarkeit der Einführung grünen Wasserstoffs in den argentinischen Gewerbe- und Industriesektor, zudem werden konkrete Anwendungsfälle bewertet. Insgesamt liefert die Analyse technoökonomische Abschätzungen für Akteure – insbesondere für Unternehmen mit Sitz in Deutschland. Ihr Ziel ist es, a) Chancen zu identifizieren, die ergriffen werden können, b) zentrale Herausforderungen anzugehen und c) einen Weg für die Integration grünen Wasserstoffs aufzuzeigen, der mit den übergeordneten Energie- und Industrieentwicklungszielen Argentiniens im Einklang steht.

Argentinien verfügt über umfangreiche Ressourcen im Bereich der erneuerbaren Energien und bietet ein großes Potenzial für Solar-Photovoltaik (PV) und Windenergie, insbesondere in Regionen wie Patagonien. Die vielfältige industrielle Basis des Landes, darunter Branchen wie die der Ölraffination, Ammoniakproduktion und Stahlherstellung, bietet erhebliche Anknüpfungspunkte für den Einsatz grünen Wasserstoffs. Darüber hinaus stärken Argentiniens strategische Lage und das gut ausgebaute Handelsnetz die Position des Landes als potenzielles Drehkreuz für regionale Wasserstoffexporte und unterstreichen dessen langfristiges Marktpotenzial.

Green hydrogen could play a pivotal role in Argentina's energy transition by:

- **Supporting industrial decarbonisation:** Integrating hydrogen into processes such as oil refining, ammonia production, and steel manufacturing to reduce carbon emissions.
- **Enhancing energy security:** Diversifying the energy mix and reducing reliance on fossil fuels through the adoption of hydrogen-based solutions.
- **Facilitating export opportunities:** Leveraging existing infrastructure and trade relationships to position Argentina as a regional leader in green hydrogen exports.

BUSINESS OPPORTUNITIES FOR GERMAN SOLUTION PROVIDERS

Argentina's evolving energy landscape presents several business opportunities for German SMEs, particularly in renewable energy, electrolysis, industrial applications, and infrastructure development. Key advantages include:

- **Renewable energy potential:** Argentina's abundant solar and wind resources create a strong foundation for green hydrogen production. German companies specialising in solar PV, wind energy, and electrolysis technologies can play a crucial role in developing large-scale hydrogen projects.

Aus folgenden Gründen könnte grüner Wasserstoff eine zentrale Rolle bei Argentiniens Energiewende spielen:

- **Er unterstützt die Dekarbonisierung der Industrie:** Integration von Wasserstoff in Prozesse wie Ölraffination, Ammoniakproduktion und Stahlherstellung zur Reduzierung von CO_2-Emissionen
- **Er stärkt die Energiesicherheit:** Diversifizierung des Energiemixes und Verringerung der Abhängigkeit von fossilen Brennstoffen durch den Einsatz wasserstoffbasierter Lösungen
- **Er fördert die Exportmöglichkeiten:** Nutzung von Infrastrukturen und Handelsbeziehungen, um Argentinien als regionalen Vorreiter beim Export grünen Wasserstoffs zu positionieren.

GESCHÄFTSMÖGLICHKEITEN FÜR DEUTSCHE LÖSUNGSANBIETER

Argentiniens Energielandschaft wandelt sich und bietet deutschen KMU zahlreiche Möglichkeiten für Geschäfte – insbesondere in den Bereichen erneuerbare Energien, Elektrolyse, industrielle Anwendungen und Infrastrukturentwicklung.

Zu den wichtigsten Vorteilen zählen:

- **Potenzial für erneuerbare Energien:** Argentiniens reiche Solar- und Windressourcen bilden eine solide Grundlage für die Produktion grünen Wasserstoffs. Deutsche Unternehmen, die auf Solar-PV, Windenergie und Elektrolysetechnologien spezialisiert sind, können eine entscheidende Rolle bei der Entwicklung großskaliger Wasserstoffprojekte spielen.

- **Industrial integration:** The existing industrial base offers immediate applications for green hydrogen. German firms with expertise in industrial hydrogen use and process optimisation can support pilot projects and industrial-scale deployment.
- **Export and trade potential:** As a significant economy with strong regional trade ties, Argentina could develop into a green hydrogen export hub. German companies involved in logistics, port infrastructure, and industrial zones could benefit from early-stage investments in hydrogen supply chains.

CHALLENGES ON THE PATH TO A HYDROGEN ECONOMY

While the potential is significant, Argentina faces several hurdles:

- **Political and regulatory uncertainty:** Recent economic reforms have introduced regulatory changes that are still in the process of implementation and definition, creating an uncertain regulatory environment for new investments.
- **Economic challenges:** High production costs and limited initial demand make green hydrogen less competitive in the short term. Investments in cost-effective technologies and policy support will be essential for market development.
- **Infrastructure gaps:** Argentina's energy infrastructure requires modernisation to support large-scale hydrogen production and distribution. Collaborative efforts between the public and private sectors will be necessary to address these challenges.

- **Industrielle Integration:** Die industrielle Basis im Land bietet unmittelbare Einsatzmöglichkeiten für grünen Wasserstoff. Deutsche Unternehmen mit Erfahrung bei der industriellen Nutzung von Wasserstoff und bei der Prozessoptimierung können Pilotprojekte unterstützen und den Übergang zur industriellen Anwendung begleiten.
- **Export- und Handelspotenzial:** Als bedeutende Volkswirtschaft mit starken regionalen Handelsbeziehungen könnte Argentinien sich zu einem Exportzentrum für grünen Wasserstoff entwickeln. Deutsche Unternehmen aus den Branchen Logistik, Hafeninfrastruktur und Industrieansiedlung könnten von frühzeitigen Investitionen in Wasserstofflieferketten profitieren.

HERAUSFORDERUNGEN AUF DEM WEG ZUR WASSERSTOFFWIRTSCHAFT

Trotz des großen Potenzials steht Argentinien vor mehreren Herausforderungen:

- **Politische und regulatorische Unsicherheit:** Die jüngsten Wirtschaftsreformen haben regulatorische Änderungen eingeführt, die sich noch im Implementierungs- und Definitionsprozess befinden und ein unsicheres regulatorisches Umfeld für neue Investitionen schaffen.
- **Wirtschaftliche Herausforderungen:** Hohe Produktionskosten und eine zunächst begrenzte Nachfrage machen grünen Wasserstoff kurzfristig weniger wettbewerbsfähig. Investitionen in kosteneffiziente Technologien und politische Unterstützung werden für die Marktentwicklung entscheidend sein.
- **Infrastrukturelle Defizite:** Argentiniens Energieinfrastruktur muss modernisiert werden, um die großskalige Produktion und Verteilung von Wasserstoff zu ermöglichen. Gemeinsame Anstrengungen der öffentlichen Hand und des Privatsektor sind erforderlich, um diese Herausforderungen zu bewältigen.

OPPORTUNITIES FOR GREEN HYDROGEN PROJECTS

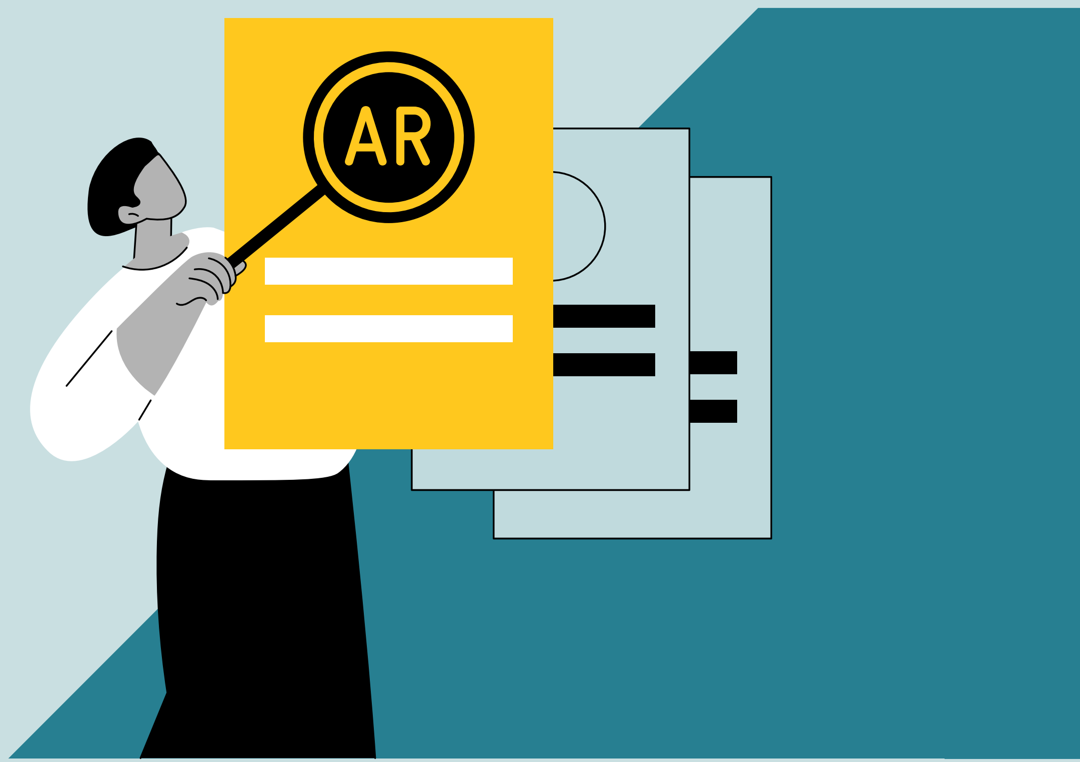
Argentina's vast renewable energy resources, industrial potential, and strategic location create promising opportunities for green hydrogen development. However, political and regulatory uncertainties, along with economic and infrastructure challenges, must be carefully navigated. German companies that engage early, leveraging their expertise and fostering collaborations, can play a pivotal role in shaping Argentina's green hydrogen future, driving both commercial success and sustainable development.

POTENZIALE FÜR GRÜNE WASSERSTOFFPROJEKTE

Argentiniens umfangreiche Ressourcen an erneuerbaren Energien sowie das industrielle Potenzial und die strategische Lage des Landes schaffen vielversprechende Chancen für die Entwicklung grünen Wasserstoffs. Jedoch erfordern die politischen und regulatorischen Unsicherheiten sowie wirtschaftliche und infrastrukturelle Herausforderungen ein umsichtiges Vorgehen. Bei der Gestaltung der Wasserstoffzukunft Argentiniens können deutsche Unternehmen, die frühzeitig aktiv werden, eine zentrale Rolle spielen – indem sie ihre Expertise einbringen und Kooperationen fördern – und dabei sowohl den wirtschaftlichen Erfolg als auch die nachhaltige Entwicklung vorantreiben.

1

Outline of the current context

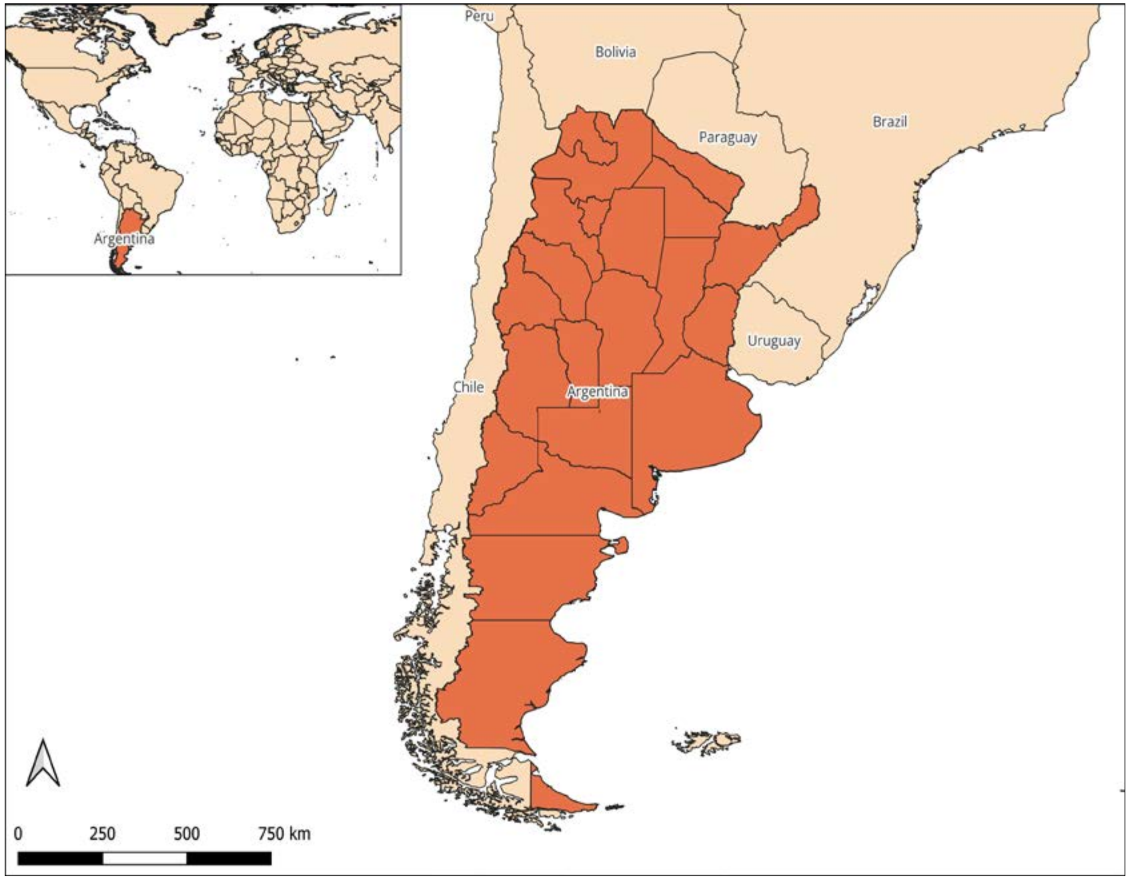


1.1 General country information

Argentina is situated in the southern half of South America (see Figure 1), covering an area of approximately 2.7 million km^2 and with a population of about 47 million as of 2023 (World Bank, 2024a). It is politically organised as a federated republic, divided into 23 autonomous provinces and the autonomous city of Buenos Aires, each with its own government and legislature. Argentina is one of the largest economies in South America. In 2023, Argentina's GDP reached USD 641 billion equating to USD 13,730 per capita (World Bank, 2024a).

Argentina's economy is greatly dependent on exporting agri-food products (e.g. cereals, oils seeds, animal or vegetable oils, meat products, food residues), automobiles and auto parts, and mineral fuels, mineral oils and products of their distillation. From an import perspective, machinery and equipment, electrical and electronic equipment, mineral fuels, mineral oils and products of their distillation, vehicles and auto parts, chemicals (organic chemicals, pharmaceutical products, fertilisers, other chemical products, and plastics) are the main imported products. In 2022, the total export and import volumes reached USD 87.2 billion and USD 76.9 billion respectively.

FIGURE 1. Location of Argentina



Source: Authors' own compilation, Fichtner (2025) based on (OpenStreetMap, 2024)

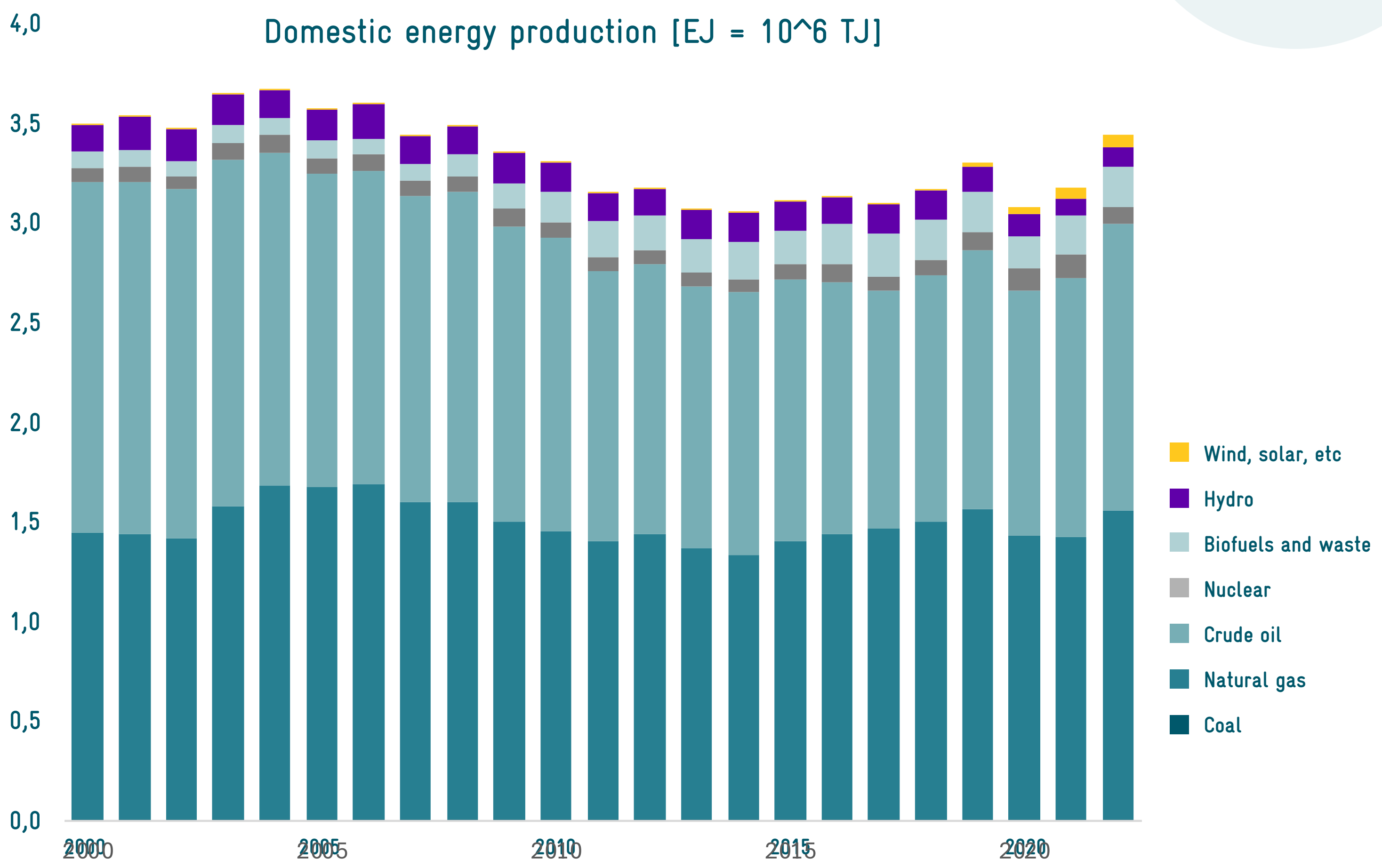
1.2 National energy sector analysis

1.2.1 Evolution of the energy sector to the present

Argentina has large natural gas and oil reserves. Energy production includes any exploration of fossil fuels, which can be burned to produce electricity or heat, or used directly as fuels, for example. It also includes energy produced by nuclear fission and renewable energy sources, such as biomass, solar PV, wind, geothermal, and hydropower. Domestic energy production in Argentina is dominated by natural gas and oil. Other energy sources, including coal, nuclear, hydro, biofuels and waste, and solar photovoltaic (PV) and wind, play a smaller role in Argentinian energy production. In 2022 there was an increase in oil and natural gas production, mainly from one of the largest basins, Vaca Muerta, which allowed Argentina to maintain its trend towards self-sufficiency in liquid fuels while also exporting a share of 17% of the total produced volumes. Biofuels and waste represent the third most important source of energy production, with wood and bagasse as the main sources. National coal production is rather negligible, since there is only one active coal mine in the country.

Domestic energy production has undergone notable changes over recent years, as shown in Figure 2, reflecting shifts in policy, investment, and resource utilisation.

FIGURE 2. Evolution of domestic energy production in Argentina since 2000 (in EJ)

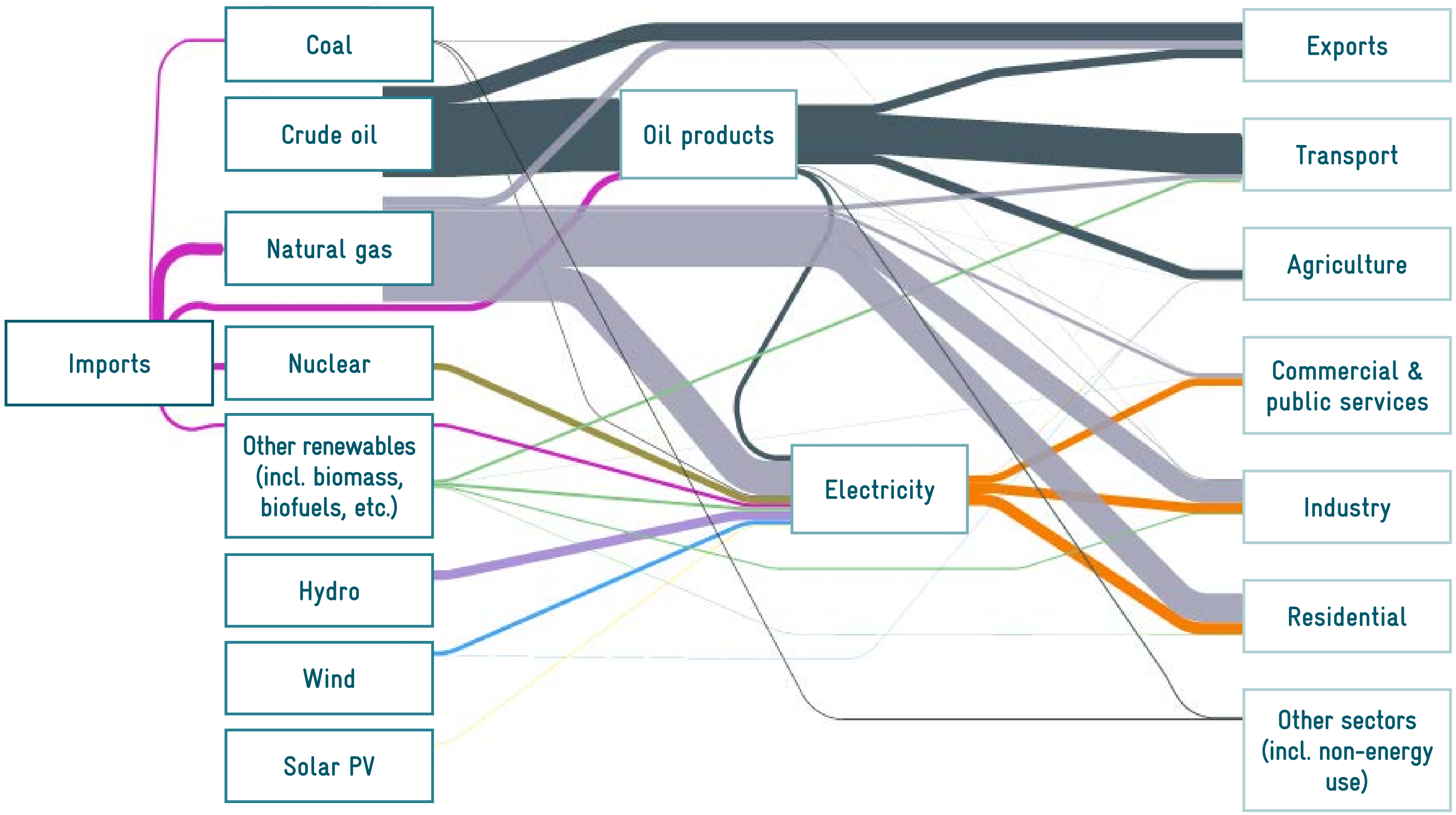


Source: Authors' own compilation, Fichtner (2025) based on (IEA, 2024a)

Final energy consumption (in EJ) has remained relatively constant at a level near to 2.5 EJ since 2010, with a strong dip in 2020, which was due to the altered conditions resulting from the pandemic. The highest consumer is the transport sector (32%), followed by residential (26%), and industry (23%). Other sectors include commercial and public services, agriculture and forestry, and non-specified or non-energy use; together these make up 20% of final energy consumption, each with a similar share. For more details refer to Annex 1.

The Sankey diagram in Figure 3 is based on the latest national energy balance published by Argentina's Secretary of Energy. It summarises the energy flows from primary energy sources to secondary sources and to different end users' sectors for 2023. Total primary energy available was 5 EJ. The main energy sources were natural gas (65%) and crude oil (26%). Around 10% of the crude oil and 4% of the natural gas is exported, while there are imports of coal, natural gas, and nuclear fuel, representing in total some 6% of domestic energy production. As for oil products and electricity, most of it is generated in the country with some imports and exports of oil products, and electricity imports. Final energy consumption is led by the transport sector, predominantly relying on oil products and accounting for 32% of final energy use. The residential (28%) and industrial (23%) sectors come next, primarily utilising natural gas and electricity. Other sectors, such as agriculture and commercial and public services and others, make up 17% of final energy use.

FIGURE 3. Energy flow in Argentina in 2023



Source: Authors' own compilation, Fichtner (2025), based on (Secretaría de Energía, 2024)

From being a net energy exporter until around 2010, Argentina has transitioned to a net energy importer, even though recent years have seen a near balance between energy imports and exports. As indicated in the previous Sankey diagram, imports, consisting of natural gas, coal, nuclear fuel, oil products, and electricity, have been almost offset by exports of natural gas, crude oil, and oil products. In this regard, it should also be highlighted that new gas pipeline networks have been implemented recently, which allows Argentina to supply additional provinces and to stop importing natural gas from Bolivia (infobae, 2024b). This reinforces current changes in the country's energy policy aiming for Argentina to become an energy exporter again.

Energy prices

Indicative energy prices for the main energy sources are listed in Table 1, complemented by applicable carbon taxes. The prices serve only as an indication of the current levels, since there will be variations within the autonomous provinces as well as over time. The natural gas prices at the wellhead are partially regulated and subsidised for some specific sectors, while distribution and transportation tariffs are regulated by the gas regulatory agency (Ente Nacional Regulador del Gas, ENARGAS). Monthly prices for natural gas for September 2024 are presented as published by the National Directorate of Hydrocarbons Economy (Secretaría de Energía, 2024) for Total Cuenca and various end users. Similarly, electricity prices are regulated by the Ministry of Energy, using a tiered system to differentiate tariffs based on consumption level and income and with subsidised tariffs for specific sectors. Maximum and minimum tariffs as published for November 2024 by the electricity regulatory agency (Ente Nacional Regulador de la Electricidad, ENRE) for Edenor are listed. Additionally, provincial governments may also regulate prices within their jurisdictions.

TABLE 1. Indicative energy prices for Argentina

Energy source		Price [ARS]	Price [USD]	Unit	Date
Coal	Steam coal	105,094	107.8	/ t	24.10.2024
Crude oil	Escalante	73,020	74.9	/ bbl	03.2024
	Medianito	69,802	71.6	/ bbl	03.2024
Natural gas	Distribution	12,940	13.3	/ MWh	09.2024
	Industry	11,177	11.5	/ MWh	09.2024
Electricity	General users Tariff 3, BT, MT, AT	min. 69,379 max. 80,299	71.2 83.4	/ MWh	11.2024
	Spot price	36,720	37.0	/ MWh	01.03.2024
ETS/CO_2	Carbon tax	696	0.8	/ t_{CO2}	2024

bbl	barrels
BT	low voltage
MT	medium voltage
AT	high voltage

Source: Authors' own compilation, Fichtner (2025) based on (Coal Price, 2024), (IAE, 2024), (Secretaría de Energía, 2024), (ENRE, 2024), (World Bank, 2024b)

1.2.2 Current infrastructure

The central part of the country is where the majority of the current transportation and power infrastructure is concentrated, while the southern part will require further development. Regarding port infrastructure, the main large ports are concentrated in Buenos Aires Province but additional ports (some currently dedicated to fishery) are located in the provinces of Rio Negro, Chubut, Santa Cruz, and Tierra del Fuego, and offer potential for future expansion of areas and activities (International PtX Hub, 2024). Similarly, electricity generation capacity is concentrated in the northern part of the country, as are the transmission and distribution grids. These require expansion in the south for the implementation of renewable energy projects. Argentina has infrastructure for natural gas distribution connecting major production fields to major cities, and the gas network is currently being expanded to supply additional provinces. Most urban areas have access to natural gas, either through the gas network or as liquefied petroleum gas (LPG) used for residential heating and cooking and for industrial use.

1.2.3 Forecasted evolution of the energy sector

In 2023, the Secretary of Energy of the Ministry of Economy approved two key documents: the National Plan for Energy Transition to 2030 (Ministerio de Economía Argentina - Secretaría de Energía, 2023a) and the Guidelines and Scenarios for the Energy Transition to 2050 (Ministerio de Economía Argentina - Secretaría de Energía, 2023b). These documents outline development pathways for Argentina's energy sector up to 2030 and 2050, aiming to achieve a cleaner, more efficient energy mix by 2050. This has been developed in line with the country's second nationally determined contribution (NDC), while taking into account the challenging macroeconomic environment.

The first document, which focuses on the period up to 2030, projects an increase in electricity demand of 1.5%/a and in natural gas demand of 1.1%/a. It also envisions increased production of natural gas and oil to meet local demand, a reduction in electricity generation from thermal power plants from 59% in 2022 to 35% by 2030, and an increase in renewable electricity generation to 57% (with 30% coming from non-conventional renewables, excluding large hydropower plants over 50 MW).

Building on these results, the second document introduces three decarbonisation scenarios: the base scenario, the optimistic scenario, and the ambitious scenario. The base scenario considers current energy policies and ongoing energy efficiency measures, while the optimistic scenario adds new actions and technologies to enhance decarbonisation. The ambitious scenario, which is closest to a net zero pathway, accelerates the adoption of decarbonisation technologies. All scenarios predict an increase in electricity demand, with the highest growth in the ambitious scenario due to high rates of electrification in transport and industrial processes. In contrast, natural gas demand remains steady in the base scenario but declines sharply in the ambitious scenario, reflecting greater electrification and substitution with low-carbon hydrogen.

Through these strategies, Argentina aims to leverage its local resources such as oil and natural gas in the short to medium term while gradually transitioning to cleaner energy options. By doing so, the country seeks to become self-sufficient and export surplus natural gas to neighbouring countries, while taking full advantage of its renewable energy potential, including hydro, wind, and solar PV. Nonetheless, it must be remarked that achieving these goals in the given timeline, especially for 2030, will be challenging: The share of non-conventional renewables in electricity generation was around 12% in 2022 or 14% in 2024, meaning that a strong increase in installed capacity will have to be achieved in the coming years to get near to the goals set by the strategies mentioned above (or the 20% renewable electricity for 2025 defined by the renewable energy law). To attain this, there is a need for large infrastructure developments and investments in expansion of the electricity grid and installed electricity capacity, for example. This offers an interesting opportunity for international project developers, but ongoing changes in the legislative and regulatory framework might have a negative effect.

1.3 Legislative and regulatory framework

In recent years, Argentina's legislative and regulatory framework relating to renewable energy, greenhouse gas (GHG) emissions reduction, and emerging sectors like green hydrogen (GH_2) and Power-to-X (PtX) has undergone substantial development, particularly following the release of the hydrogen strategy in 2023. However, in the same year, the president issued a Necessity and Urgency Decree (ClimateTracker, 2024), which introduces uncertainty regarding the government's commitment to the energy transition with respect to its focus on current energy sources (such as natural gas and oil).

A breakdown of the main national legislation that shapes the country's energy transition is shown in Table 2. It must be borne in mind that federal legislation might differ from national legislation and should be checked for specific developments.

Argentina's legislative framework for renewable energy and emissions reduction is robust, particularly for wind, solar, and biofuels, and continues to evolve with emerging sectors like GH_2. Its fiscal incentives, carbon pricing mechanisms, and developing hydrogen policies create opportunities for private sector investment in different areas. The country has had some challenges due to the macroeconomics affecting investment decisions; moreover, recent changes introduced by the new government could also alter this landscape for renewable energies. The actual effects of the announced and implemented changes are still not foreseeable and could include negative aspects, such as the cancellation of current funds, but also positive aspects, if the macroeconomics of the country improve in general.

TABLE 2. Summary of key energy laws and policies in Argentina

Law/policy	Primary objectives	Key provisions
Law 27.191	Promote renewable energy	20% renewable energy by 2025, fiscal incentives, creation of FODER for financing and payment guarantees
Law 27.424	Distributed generation	Net metering, tax incentives for users, technical standards for grid connection
Law 27.520	Climate policy	Minimum environmental protection budgets, development of financial instruments for climate change
Law 27.430	Tax on fossil fuels	Imposes tax on liquid fuels based on carbon content, revenue for power infrastructure projects
Argentina's NDC	GHG reduction	21% GHG reduction by 2030, carbon neutrality strategy by 2050
Hydrogen Strategy	Develop hydrogen economy	Produce 5 MTPA of low-emission hydrogen by 2050, develop infrastructure and employment
Draft law for low-carbon hydrogen	Promote domestic hydrogen market	Financial support, tax benefits, localisation provisions for hydrogen applications

Source: Authors' own compilation, Fichtner (2025), based on (Boletín Oficial de la República Argentina, 2015), (IEA, 2024c), (Boletín Oficial de la República Argentina, 2017) (IEA, 2024d), (Boletín Oficial de la República Argentina, 2017) (IEA, 2021), (Boletín Oficial de la República Argentina, 2019), (Ministerio de Ambiente y Desarrollo Sostenible, 2020), (Secretaría de Asuntos Estratégicos, 2023), (Global Trade Alert, 2023), (Ministerio de Economía, 2023)

2

Industrial applications of hydrogen

Global hydrogen demand reached 97 million tonnes per annum (MTPA) in 2023 and remains concentrated in traditional uses such as refining and industry applications, mainly ammonia and methanol production and steel manufacturing (IEA, 2024b). The hydrogen used to cover this demand comes almost exclusively from processing of fossil fuels. Considering current (or traditional) and potential new uses of hydrogen as a decarbonisation solution, this demand is expected to increase significantly to 200-600 MTPA by 2050, depending on the analysis and scenario selected, which should be covered primarily by clean hydrogen (produced either by electrolysis powered by renewable energies, so-called green hydrogen, or by reforming of fossil fuels combined with CCS, referred to as blue hydrogen).

2.1 Hydrogen production methods

Hydrogen can be produced through different processes according to the energy source and technology used, as summarised in Table 3. The hydrogen used to meet current demand comes almost exclusively from the processing of fossil fuels (natural gas and coal) within methane reforming and coal gasification.

TABLE 3. Production methods of hydrogen

Production process	Energy source	Technology options	Products	CO_2 emissions
Methane reforming	Natural gas	• Steam methane reforming (SMR) • Autothermal reforming (ATR)	H_2, CO, CO_2, N_2	• High CO_2 emissions • Potential combination with CCS to reduce CO_2 emissions
Coal gasification	Coal	• Gasification/reaction with O_2 and steam at high pressure and temperatures	H_2, CO, CO_2, N_2	
Methane pyrolysis	Natural gas	• Thermal decomposition at high temperatures without O_2	H_2, CO, CO_2	
Biomass gasification	Biomass	• Heating with limited oxygen	H_2, CO, CO_2	• Low to zero CO_2 emissions
Electrolysis	Electricity	• Electrolysis (AEC, PEMEC, SOEC, AEMEC)	H_2, O_2	• CO_2 emissions depend on electricity source • Low to zero for renewable energy sources

CCS	carbon capture and storage
AEC	alkaline electrolysis cell
PEMEC	proton exchange membrane electrolysis cell
SOEC	solid oxide electrolysis cell
AEMEC	anion exchange membrane electrolysis cell

Source: Authors' own compilation, Fichtner (2025)

2.2 Hydrogen uses

Hydrogen is a key component of the global energy and industrial landscape, with similar applications worldwide. The data presented in this section reflects the global context of hydrogen and is location independent.

Hydrogen demand reached 97 MTPA in 2023, when the largest consumers of hydrogen were refining (44%), ammonia production (33%), and methanol production (17%). Some 5% of hydrogen is used for direct reduced iron (DRI) in the iron and steel sector and small amounts are used in other segments such as glassmaking, electronics, and metal processing, accounting for 1 MTPA or 1% of current global hydrogen demand (IEA, 2024b).

Other minor current uses of hydrogen include aerospace, as a propellant, and energy storage for balancing renewable energy supply and demand.

TABLE 4. Current uses of hydrogen

Current uses	Main processes/products	Specific requirements
Refining[1]	• Hydrocracking, hydrotreating and desulphurisation	• Depends on refinery complexity and oil quality: 8-14 kg H_2/tonne refined product
Ammonia	• Fertiliser production • Chemical production: e.g. nitric acid, amines, explosives • Refrigeration	• Stochiometric: 178 kg H_2/tonne ammonia
Methanol	• Fuel: methyl tertiary butyl ether (MTBE) • Solvent • Antifreeze • Chemical feedstock: e.g. formaldehyde, acetic acid	• Stochiometric: CO_2 hydrogenation: 189 kg H_2/tonne methanol CO hydrogenation: 126 kg H_2/tonne methanol
Chemical industry	• Oxo alcohols	• Depends on olefin, process and product, stoichiometrically between 10-30 kg H_2/ tonne oxo alcohol
	• Fatty alcohols	• Depends on production process and product, stoichiometrically between 10-20 kg H_2/ tonne fatty alcohol
	• Hydrogen peroxide (H_2O_2)	• Stochiometric: 59 kg H_2/tonne H_2O_2
	• Cyclohexane (C_6H_{12})	• Stochiometric: 71 kg H_2/tonne cyclohexane
	• Hydrochloric acid (HCl)	• Stochiometric: 55 kg H_2/tonne HCl
	• Caprolactam	• Depends on the production process, between 30-50 kg H_2/tonne caprolactam

1 In refineries, hydrogen is required for hydrocracking and hydrotreating, but it is also generated, mainly during catalytic reformulation: 18 kg of hydrogen/tonne of crude oil (Fuel Cells and Hydrogen Observatory, 2021).

Current uses	Main processes/products	Specific requirements
Chemical industry	• Phenol production*	• Depends on the production process, between 10–30 kg H_2/tonne phenol
	• Acetone production* via hydrogenation of isopropyl alcohol	• Stochiometric: 34 kg H_2/tonne acetone
	• 1,4-Butanediol (BDO)	• Stochiometric: 23 kg H_2/tonne BDO
	• Fine chemicals and pharmaceuticals as reducing agent	• Depends on processes and products
Iron and steel	• As reducing agent in direct reduced iron (DRI) • As reducing atmosphere in annealing process in steel roll mills	• Depends on iron ore quality: ~60 kg H_2/tonne steel
Glass	• Glass melting as reducing agent to improve quality • Specialty glasses to control optical properties • Alternative fuel or furnaces to replace e.g. natural gas	• As reducing agent: 0.4 kg H_2/tonne float glass
Electronics	• Chemical vapour deposition, mainly e.g. for semiconductor manufacturing and LED production • Reduction agent	• 45–90 kg H_2/tonne semiconductor
Food industry	• Hydrogenation of oils (fats) and fatty acids	• Depends on oil/fat, required product and process: 5–100 kg H_2/tonne unsaturated fat processed
Metal processing	• Pure or in a mixture as shielding gas for welding processes	• Depends on process

Source: Authors' own compilation, Fichtner (2025) based on (Bressan, L. et all, 2009), (Fuel Cells and Hydrogen Observatory, 2021), (Wasserstoff Kompass, 2022), (Semiconductor Digest, 2018)

* The most common production process for phenol and acetone is the cumene process. This process does not require hydrogen directly, but it can be required for refining acetone (removal of impurities).

Additionally, hydrogen is produced within different production processes as a by-product.

In 2023, some 25% of hydrogen was produced as a by-product in refineries and petrochemicals production (IEA, 2024b). The main products that generate hydrogen as a by-product are listed in Table 5.

TABLE 5. Hydrogen generation as a by-product

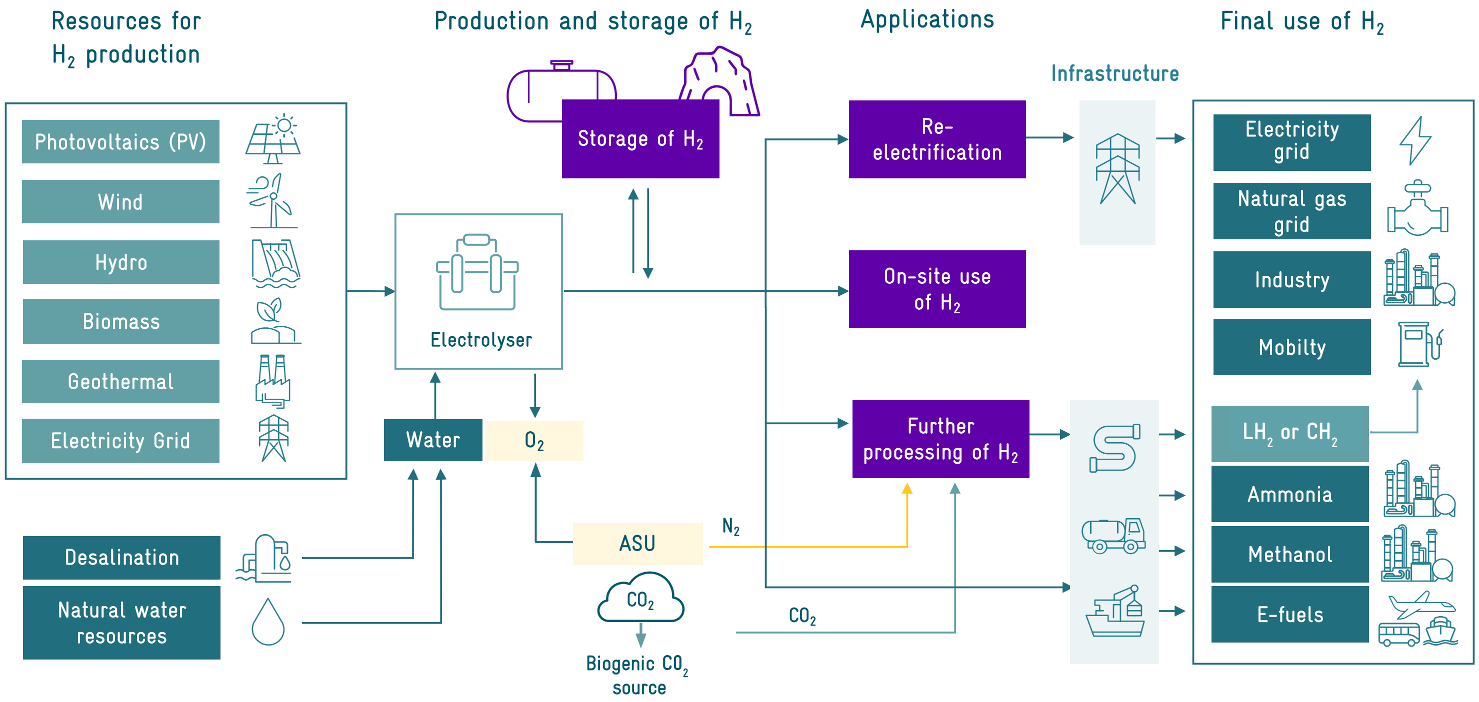
Final product	Typical use of H_2 by-product	Specific H_2 generation
Ethylene	• On site as feedstock for other processes	190 Nm³ H_2/tonne ethylene (11 kg H_2/tonne ethylene)
Styrene		220 Nm³ H_2/tonne styrene (20 kg H_2/tonne styrene)
Chlorine (via chlor-alkali process)	• Fuel for heat boilers and/or combined heat and power (CHP) units • Chemical feedstock: e.g. formaldehyde, acetic acid	270–300 Nm³ H_2/tonne chlorine (24–27 kg H_2/tonne chlorine)
Acetylene	• On site as feedstock for other processes	3,400–3,740 Nm³ H_2/tonne acetylene (305–336 kg H_2/tonne acetylene)
Cyanide		2,470 Nm³ H_2/tonne cyanide (222 kg H_2/tonne cyanide)

Source: Authors' own compilation, Fichtner (2025) based on (Fuel Cells and Hydrogen Observatory, 2021)

Demand for hydrogen has been concentrated in refining and some industrial applications, but the adoption of clean hydrogen in new applications will play a key role in the energy transition. This will include the replacement of current hydrogen demand with green hydrogen produced via electrolysis (as shown in Figure 4), for example, but also new areas of use such as mobility (road, air, and maritime transport), electricity generation, production of synthetic fuels (e-fuels), and high-temperature heat generation, among others. The switch from conventional production processes to electrolysis for hydrogen generation will require additional feedstocks for derivatives production, including a nitrogen source for ammonia production and a sustainable CO_2 source for methanol and synthetic fuel production.

These applications provide a first indication of how green hydrogen might be used in the future. Which applications gain traction will largely depend on possible alternative technologies with which hydrogen will have to compete, on national and international decarbonisation targets and commitments, and on available energy sources in the individual countries.

FIGURE 4. Value chain of potential applications of green hydrogen



Storage: In tanks or geological.

H_2	Hydrogen
LH_2	Liquefied hydrogen
CH_2	Compressed hydrogen
ASU	Air separation unit

Source: Authors' own compilation, Fichtner (2025)

Furthermore, the production of hydrogen by electrolysis generates 8 kg oxygen (O_2)/kg H_2 as a by-product. Some typical applications of high-purity liquefied oxygen include water treatment, medical purposes, and industry (metallurgy, pulp & paper, chemical, etc.). Nonetheless, taking into consideration that current technologies for oxygen production (air separation unit, ASU; pressure swing adsorption, PSA) are mature, easily scalable, and applicable to on-site oxygen generation, the use of oxygen generated by electrolysis in an economic feasible way is quite restricted and very location dependent.

2.3 Most common hydrogen downstream products

2.3.1 Ammonia and fertilisers

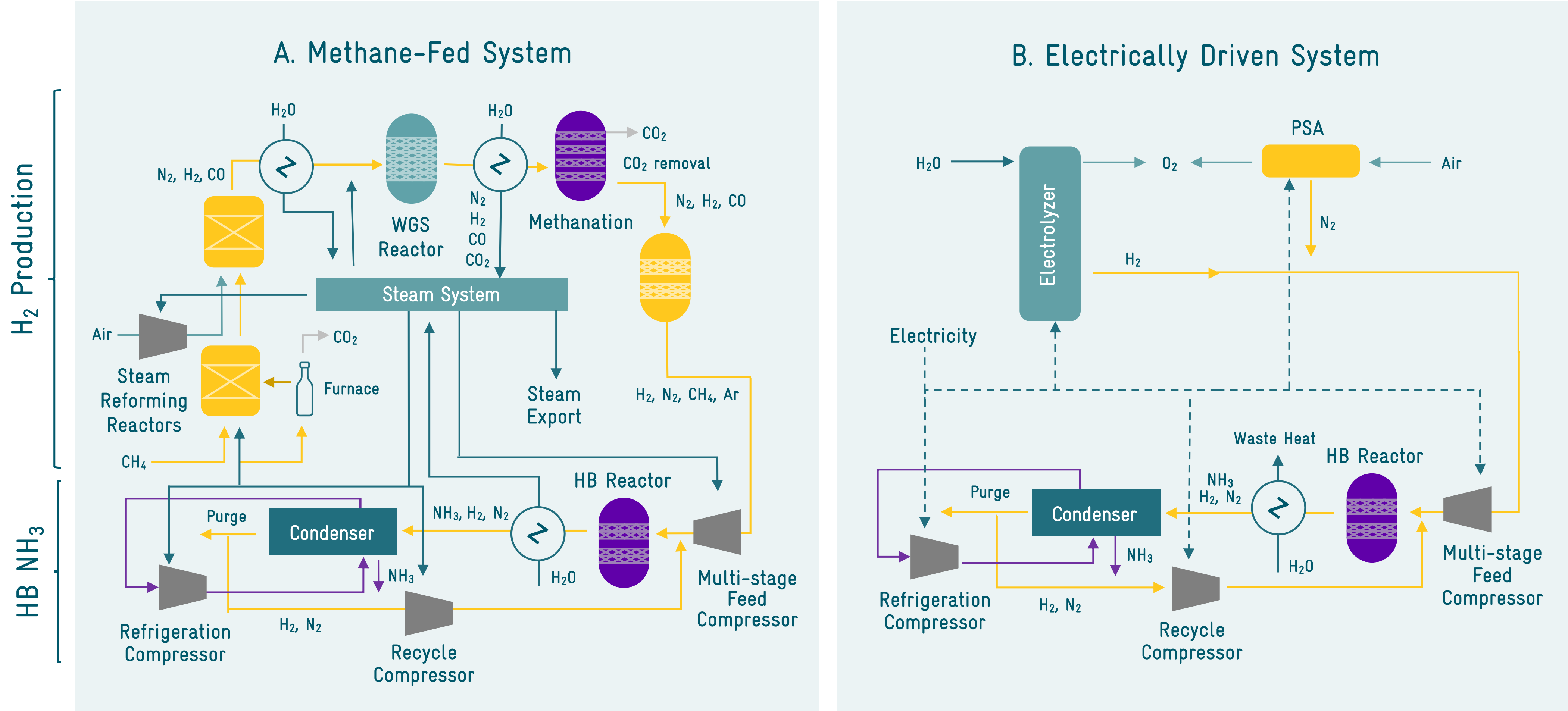
Ammonia production is the second-largest current use of hydrogen, accounting for 33% of total hydrogen demand. Ammonia is a key precursor in the industry and is mainly used for nitrogen-based fertilisers (around 70-80%), and other industrial applications such as plastic and explosive production.

Ammonia is synthetised via the Haber-Bosch (HB) process, in which hydrogen (H_2) reacts with nitrogen (N_2) to form ammonia (NH_3) under high pressures and high temperatures. Conventional ammonia production combines hydrogen – typically obtained through SMR of natural gas- with nitrogen, sourced directly from air. In the green ammonia option, an electrically driven system, an external source of nitrogen is required (e.g. from air through an ASU) and the compressors that are steam-driven in the conventional process are mainly electrically driven. Little to no steam is used in the green ammonia production process.

The Haber-Bosch process is a cornerstone of industrial chemistry, enabling large-scale ammonia production primarily for nitrogen-based fertilisers. Figure 5 compares the conventional Haber-Bosch process (A), which relies on fossil fuels, with the green Haber-Bosch process (B), designed to utilise renewable energy sources and reduce carbon emissions.

It should be noted that the production processes of some of the fertilisers require a carbon source, which needs to be sustainable in order to obtain green fertilisers. Possible solutions are direct air capture (DAC), carbon capture and use (CCU) from unavoidable industrial sources, or biomass treatment processes. Globally, only few industrial or commercial-scale projects are currently available for sustainable carbon sourcing.

FIGURE 5. Schematic of conventional (A) and green (B) Haber-Bosch process



Source: Smith, 2019

2.3.2 Methanol

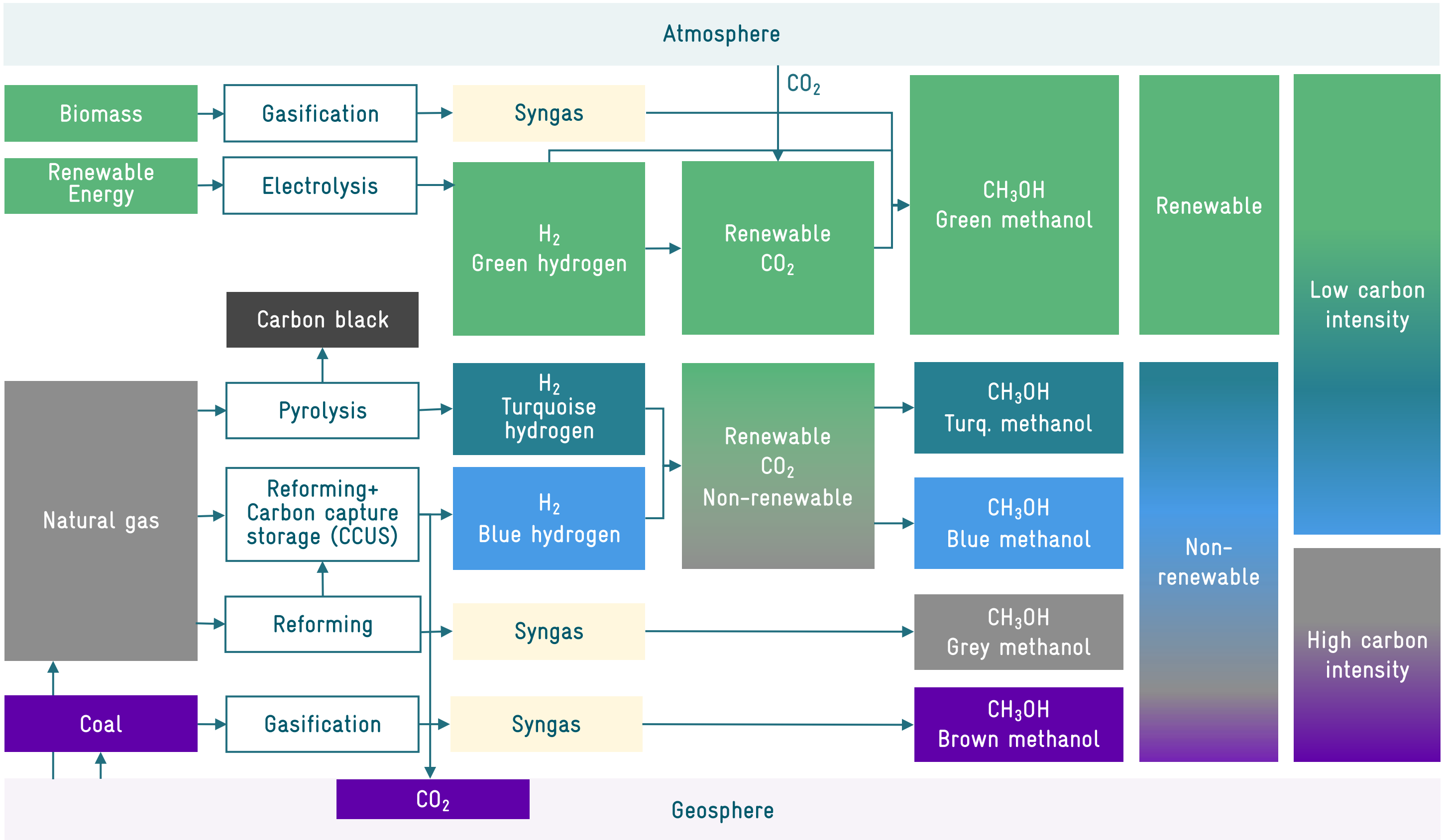
Methanol production is another major current use of hydrogen, accounting for 17% of hydrogen demand. Methanol is a widely used chemical, with its main uses including the production of basic chemicals (e.g. formaldehyde, acetic acid; 52%), olefins (e.g. polyethylene; 31%) and fuels/fuel additives (e.g. dimethyl ether (DME); 17%) (Methanol Institute, 2024).

In the case of green methanol, the hydrogen is generated by electrolysis and an additional source of carbon is required for the synthesis process. The sourcing of sustainable carbon and the deployment of technologies such as DAC or CCU at large scale might be limiting factors.

Today's methanol production depends mainly on natural gas consumption to produce hydrogen as well as the necessary CO_2 (see Figure 6). The mixture of hydrogen, CO_2, and CO generated in a steam methane reforming (SMR) reactor is passed over a catalyst at high pressure and moderate temperatures, with two key reactions:

$CO + 2H_2 \rightarrow CH_3OH$ and
$CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$

FIGURE 6. Pathways of methanol production



Source: Authors' own compilation, Fichtner (2025) based on (IRENA, 2021)

2.4 The hydrogen industry in Argentina

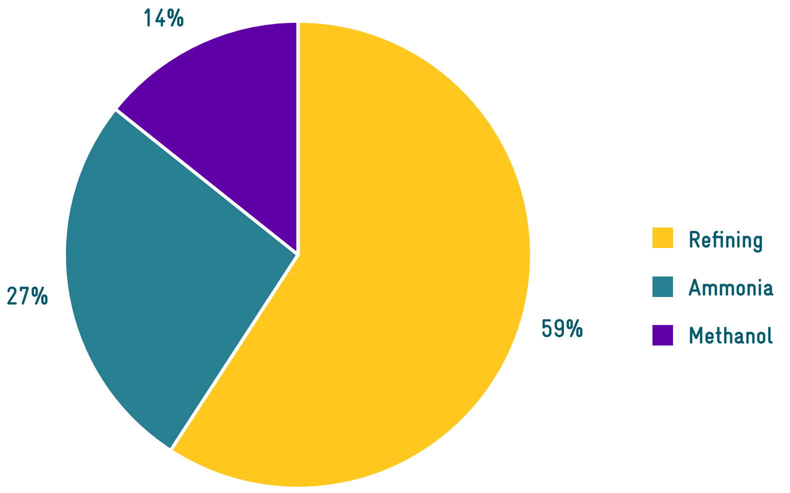
2.4.1 Overview of the national industry

The hydrogen industry in Argentina is mainly concentrated in oil refining, ammonia production (for fertilisers), and methanol production in the chemical sector.

Since hydrogen is typically produced and consumed on the same site, no large-scale trading takes place. Moreover, hydrogen statistics are not available for Argentina. For this reason, and to give an overview of Argentina's hydrogen industry, the estimation of current hydrogen demand for large consumers is based on known installed capacities, specific hydrogen demand ratios, and either full load operation of the plants or actual production volumes (where available). The results of these estimations are shown in Figure 7 and Table 6. Further details are provided in the following sections.

The estimates of hydrogen demand for the largest consumers indicate local hydrogen demand of approximately 0.5 MTPA. This demand could increase in the future, if, for example, local production of nitrogen-based fertilisers was to increase to reduce dependency on imports. Although demand in the small consumer sector was not taken into consideration here, total hydrogen demand in the country will remain within the estimated order of magnitude as it is mostly determined by large consumers.

FIGURE 7. Estimated local hydrogen demand in Argentina



Source: Authors' own compilation, Fichtner (2025)

TABLE 6. Estimated local hydrogen demand for main sectors

Product	Specific H_2 demand [t_{H2}/t product]	Local capacity [kTPA]	Potential H_2 demand [kTPA]
Petroleum refining	0.008	37	0.29
Fertilisers (various)	various	1.4	0.13
Chemical (methanol)	0.189	0.6	0.07
Total	-	-	**0.49**

Source: Authors' own compilation, Fichtner (2025)

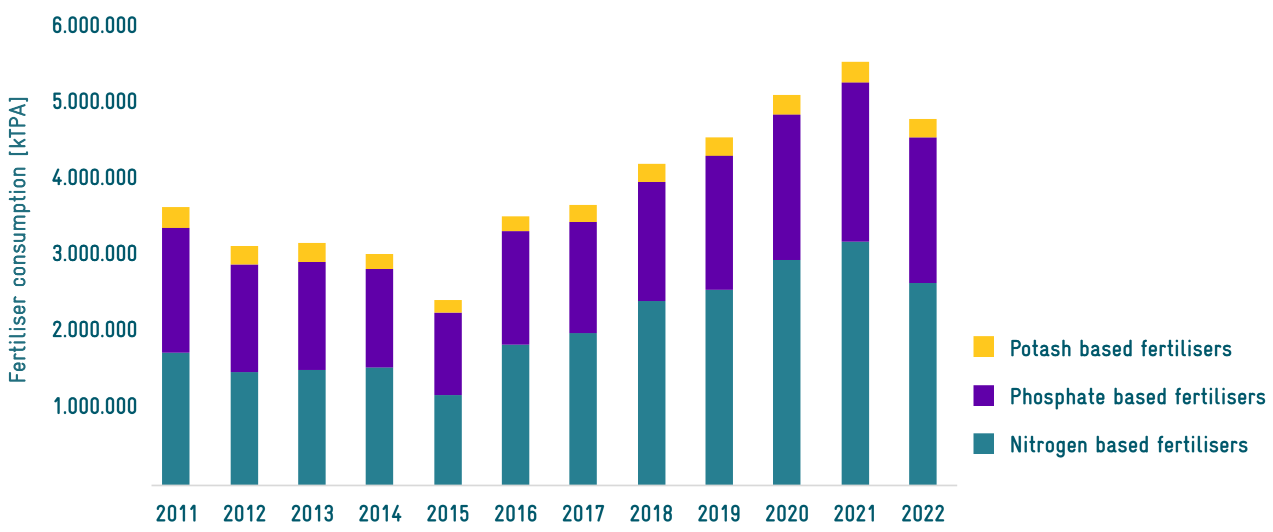
2.4.2 The fertiliser industry

Argentina is a major agricultural powerhouse, relying heavily on fertilisers to sustain its high crop yields, particularly for soybeans, corn, and wheat. Fertiliser consumption in Argentina presents fluctuations due to economic conditions, policy changes, and global price volatility. In recent years demand for fertilisers has generally increased, with the exception of 2022. This has been driven by the need to enhance productivity in the face of growing export markets. Figure 8 shows the consumption of nitrogen-based, phosphate-based, potash and sulphur-based fertilisers in Argentina since 2010. According to the data shown, fertiliser consumption has averaged around 3,900 kTPA in the last decade, with an upward trend from 2015 to 2021.

In recent years Argentina's domestic fertiliser production has ranged between 1,250 and 1,750 kTPA, while imports have played a crucial role in meeting national demand. In 2022, fertiliser imports reached approximately 3,000 kTPA, peaking at 4,200 kTPA in 2021. The primary imported fertilisers include nitrogen-based and phosphate-based products (Fertilizar, 2024).

Considering the installed production capacity for ammonia (a precursor for other nitrogen-based fertilisers), the estimated hydrogen demand is 0.16 MTPA, which represents a maximum potential demand, as it does not account for process efficiencies or actual operational conditions. Alternatively, if the estimate is based on actual ammonia production, Argentina has produced an average of around 750 kTPA in recent years (INDEC, 2024), resulting in an estimated hydrogen demand of 133 kTPA. A detailed table of existing fertiliser companies is shown in Annex 2.

FIGURE 8. Fertiliser consumption in Argentina



Source: Authors' own compilation, Fichtner (2025) based on (Fertilizar, 2025)

2.4.3 The chemical industry

The Argentinian chemical industry is strongly linked to the oil and gas sector, with a focus on petrochemicals and basic chemical production. In Argentina the petrochemical industry is made up of nine complexes, four of which are located in the province of Buenos Aires, while the rest are distributed in the provinces of Córdoba, Mendoza, Neuquén, Santa Fe, and San Luis (iae, 2022). Annex 3 summarises key petrochemical companies in Argentina including their locations, products, and capacities (if available).

Some petrochemical products, such as cyclohexane, require hydrogen for their production, while others, such as ethylene and caustic soda, generate hydrogen as a by-product. In 2021, 96% of Argentina's ethylene production was concentrated at the Bahia Blanca petrochemical complex, which has an installed capacity of 700 kTPA (iae, 2022). This brings the total installed ethylene capacity to approximately 730 kTPA, generating an estimated 8 kTP of hydrogen. Additionally, in 2021, 287 kTPA of caustic soda were produced, with 64% coming from the petrochemical industry, resulting in an estimated hydrogen generation of 12 kTPA. Petrochemical companies typically utilise the hydrogen generated as a by-product directly on-site for other processes.

Another important chemical produced in Argentina is methanol. In recent years, methanol production in Argentina has averaged 370 kTPA (INDEC, 2024). Based on this annual production volume, the estimated hydrogen demand is 70 kTPA.

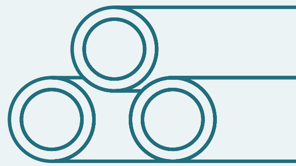
Other significant players in the chemical sector, such as Peróxidos do Brasil (which specialises in hydrogen peroxide), do not operate production plants in Argentina and instead focus on distributing their products within the country. In 2023, Argentina imported 30 kTPA of hydrogen peroxide, with over 70% of the supply coming from Brazil (WITS, 2025).

2.4.4 The steel and metallurgy industry

Argentina has a well-developed steel production capacity and ranks among the largest steel producers in South America, with an output of 4.9 MTPA in 2023 (World Steel Association, 2024). The country produces both crude steel and finished steel products. However, the sector has recently faced challenges, including rising production costs, weak domestic demand, and increased competition from imports.

There are several companies active in the sector with smaller production capacities. Some of Argentina's steel production plants, such as Tenaris and Acindar, operate DRI furnaces, creating an opportunity for the adoption of green hydrogen in steelmaking. If the entire production capacity of these two plants were to transition to H_2-DRI, the estimated hydrogen demand could reach approximately 141 kTPA. This potential could increase further if other companies invest in new DRI-based facilities – a path that Ternium, for example, has announced for steel plants in other countries (Ternium, 2023).

Annex 4 provides an overview of key players in Argentina's steel industry, including their locations and production capacities.



2.4.5 The oil and mining industry

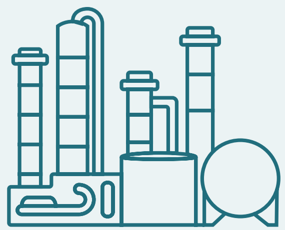
Argentina has a well-established oil industry, playing a crucial role in the country's energy sector and economy. It is one of South America's largest oil producers, with significant reserves in conventional and unconventional fields – notably the Vaca Muerta shale formation, one of the world's largest shale oil and gas reserves. The industry is led by YPF S.A., Argentina's state-controlled oil company, which dominates both exploration and refining. In general, refineries are located to meet the needs of different regions and minimise dependency on fuel imports.

Argentina's oil and gas sector is currently experiencing significant regulatory changes. In December 2023, the government introduced a comprehensive legislative package proposing nearly 100 modifications to existing energy laws, aiming to promote market liberalisation and private investment, and to reduce state intervention in the energy sector (argus, 2023).

The total available refining capacity is approximately 37 MTPA. Annex 5 shows the main oil refineries in Argentina, with their locations, production capacities, and estimated hydrogen demands.

Argentina's mining sector is a key driver of economic growth, with significant reserves of lithium, copper, gold, silver, and other minerals. The country is a global leader in lithium production, benefiting from its location within the Lithium Triangle alongside Bolivia and Chile. Copper and gold mining are also expanding, with major projects in the provinces of San Juan, Catamarca, and Salta. Key players in the sector include: Minera Alumbrera, operating the largest copper and gold mines located in Catamarca; Livent Corporation, specialising in lithium production in Catamarca; Sales de Jujuy and Minera Exar, both also engaged in lithium production in Jujuy; Yamana Gold Inc., operating several gold and silver mines in Santa Cruz; Barrick Gold Corporation, operating gold and silver mines in San Juan; and Glencore, with a project in development for copper mining in San Juan. Since gold, copper, and silver are typically extracted from hard rock deposits through open-pit or underground mining, drilling and blasting with explosives – such as ammonium nitrate fuel oil (ANFO) or dynamite – are standard techniques for breaking and removing the ore. Ammonia-based explosives present an opportunity for green hydrogen applications in the sector, supporting the transition towards more sustainable mining practices.

A key player in the explosives sector in Argentina is Austin Powder, with a plant in El Galpón, Salta, which produces ammonium nitrate for explosives (with a capacity of 85 kTPA) and two further plants in Rafaella, Santa Fe, where other explosives, such as ANFO, are produced (Austin Powder, 2025). Enaex is another player in the explosives sector, with manufacturing plants in Olavarría, Buenos Aires Province and Campanario, San Juan Province, to produce ammonium nitrate and ANFO (Enaex, 2025).



2.4.6 The food industry

In the food industry, hydrogen is primarily used in the hydrogenation of fats and oils, but it may also be involved in specific production processes, such as the manufacturing of some sugar alcohols.

Argentina is internationally renowned for its strong agricultural and livestock sectors, positioning it as a major player in food processing, meat exports, and agribusiness. As a leading producer of grains, oilseeds, and livestock, Argentina ranks among the world's top exporters of soybeans, corn, wheat, and sunflower oil. Annex 6 provides an overview of key players in Argentina's food industry, particularly in the fats and oils sector, with potential hydrogen demand.

In 2022, Argentina produced 9 MTPA of vegetable oil, with regional distribution as follows: Santa Fe (79%), Buenos Aires (11%), Córdoba (9%), Entre Ríos (1%) (Agencia Argentina de Inversiones y Comercio Internacional, 2023). Since no statistical data is currently available on the installed capacity or processed volume of hydrogenated oils, hydrogen demand for the sector is estimated, assuming that 10% of the vegetable oil produced undergoes hydrogenation[2], leading to an estimated hydrogen requirement of 45 kTPA for the sector. Although hydrogen may be required for additional processes, the volumes involved are relatively small. The estimated hydrogen demand therefore serves as an indication of the order of magnitude.

2.4.7 The glass industry

Although hydrogen is not always essential for glass production, it plays a role in specific processes. In modern float glass manufacturing, hydrogen is commonly used to prevent oxidation. In automotive glass production, it may be utilised in coating processes, while in pharmaceutical glass manufacturing, nitrogen-hydrogen atmospheres can help prevent oxidation.

Berazategui, Buenos Aires Province, is a major hub for glass manufacturing in Argentina and is often called the National Capital of Glass due to its concentration of glass industries. Glass container production, primarily bottles for beverages, as well as specialised containers for medical applications, is a major segment of Argentina's glass industry. However, Argentina also has significant flat glass production, mainly for construction and automotive applications. Annex 7 provides an overview of key market actors, detailing their locations, product offerings, and production capacities.

An initial estimate of hydrogen demand for the sector is based on a production capacity of 401 kTPA of float glass, assuming a specific requirement of 0.4 kg of hydrogen per tonne of glass, resulting in a hydrogen demand of 0.16 kTPA. Additional demand for pharmaceutical glass will supplement this, though at a lower volume.

2 Specific requirement of 5 kg of hydrogen per tonne of oil processed.

2.5 Industrial clusters and enabling infrastructure

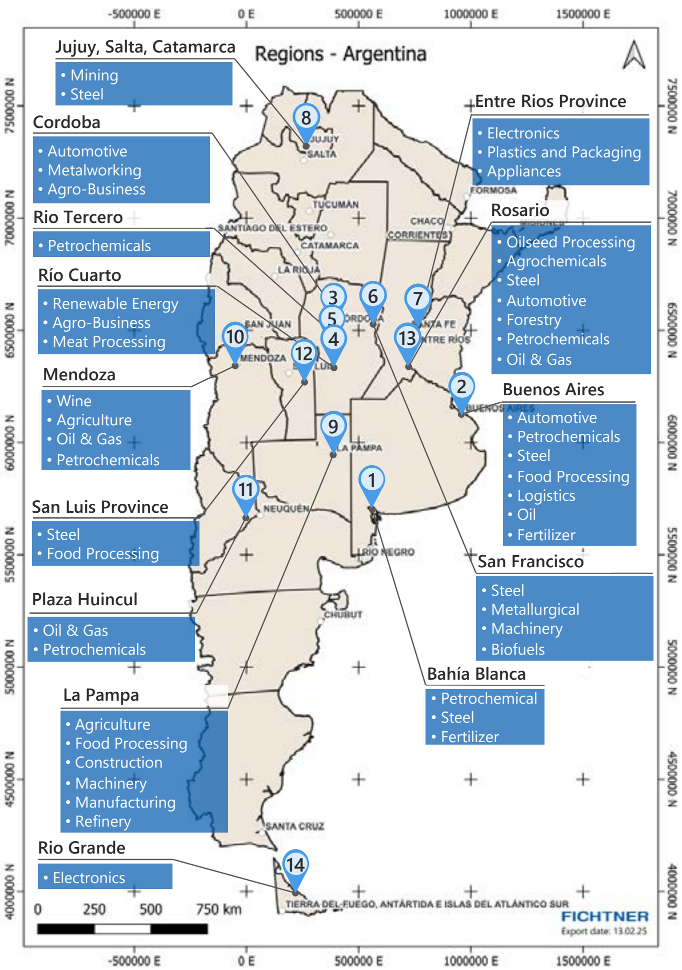
Argentina is a country with extensive industrial activity across the country. The main industrial clusters in Argentina with a higher likelihood of hydrogen use are depicted in Figure 9.

One key industrial cluster is located in Buenos Aires and its surrounding areas, encompassing a wide range of activities such as oil refining, steel manufacturing, chemicals and petrochemicals production, and oils and fats refining. This makes the cluster a significant potential off-taker for green hydrogen across various sectors.

Another prominent cluster in Buenos Aires Province is Bahía Blanca, one of Argentina's most important industrial hubs. Its deep-water port (Puerto de Bahía Blanca), access to natural gas, and established petrochemical complexes contribute to its industrial significance. The fertiliser production and oil refining sectors in Bahía Blanca present immediate opportunities for green hydrogen off-take.

FIGURE 9. Main industrial clusters in Argentina

Industrial clusters



Selection of key companies

	Company	[kTPA]
1	**Profertil S.A.** (NH3, Urea)	790/1,320
	Unipar Indupa (PVC)	240
	Dow Chemical Argentina (Ethylene, Polyethylene)	-
	Refinería Bahia Blanca S.A.U. (Refinery)	50,000*
2	**Bunge** (various Fertilizer)	867
	YPF Quimica (various petrochemicals)	918 (total)
	Petrocuyo (Polypropylene)	-
	YPF S.A. (Refinery)	190,000*
	Campana Refinery (Refinery)	90,000*
	Raizen Argentina S.A.U. (Refinery)	85,000*
	Ternium Siderar (Steel)	3,000
	Acindar (Steel)	-
	Molinos Rio de la Plata (Vegetable Oils, Margarine)	-
	Prodalsa (Fats, Margarine)	-
	Vidriería Argentina SA (Vasa) (Glass)	401
8	**Minera Alumbrera** (Mining)	-
	Livent Corporation (Mining)	
	Minera Exar (Mining)	
10	**Petrocuyo** (Polypropylene)	320
	YPF S.A. (Refinery)	90,000*
	Verallia Argentina (Glass)	-
11	**YPF Química** (Methanol)	411
	YPF S.A (Refinery)	36,000*
	Fox Petrol S.A	7,000*
12	**Tenaris Siderca** (Steel)	-
	Acindar (Steel)	-
13	**YPF S.A** (Refinery)	110,000*
	Tanoni Hnos (Vegetable Oils)	-
	Aceitera Chabás S.A.I.C (Vegetable Oils)	-
	Cargill (Vegetable Oils and Fats)	-

*** [bbl/d]**

Source: Authors' own compilation, Fichtner (2025)

Other regions in Argentina also show potential for green hydrogen applications. These include oil refining in Mendoza, Neuquén, and Santa Fe provinces, petrochemicals in Río Tercero, Mendoza, Neuquén, and Santa Fe provinces, biodiesel production in Córdoba, Entre Ríos, and Santa Fe provinces, and electronics manufacturing in Tierra del Fuego. Additionally, the provinces of Jujuy, Salta, Catamarca, and San Juan focus on mining, for which explosives are required, creating opportunities for green ammonia-based explosives as a potential off-taker for green hydrogen.

Table 7 lists a selection of industrial clusters across the country. The table is ordered alphabetically and includes the location of the clusters, the main sectors, products, and companies in each cluster. In addition to the sectors described in the previous sections, where hydrogen plays a role in established processes such as oil refining or fertiliser production, other sectors with potential demand have also been considered, such as electronics.

TABLE 7. Selection of industrial clusters in Argentina

Industrial cluster	Main sectors	Key products/Main companies
Buenos Aires Province and Autonomous City of Buenos Aires		
1 Bahía Blanca	Petrochemicals, steel, fertiliser, LNG	Ethylene, ammonia, polyethylene, steel, LNG terminal Unipar Indupa, Profertil, Mega (YPF, Dow, Petrobras joint venture)
2 Buenos Aires Autonomous City and greater area (Zárate, Campana, La Plata, Ensenada, Pilar)	Automotive, petrochemicals, steel, food processing, logistics, oil, fertiliser	Automotive & autoparts, refined oil, steel, pharmaceuticals, chemicals, polypropylene, oils & fats, plastics Transclor, Ternium Siderar, Acindar, Raizen, Egramar, Refinería Sudamericana, Refinería del Centro, Vasa, Stellantis, Volkswagen, Ford, Toyota, Axion Energy, Bunge, Tenaris Siderca, Bayer, YPF Refinery, Unilever, Bago, Nestlé
Córdoba Province		
3 Córdoba	Automotive, metalworking, agribusiness	Cars, parts, machinery, processed foods, metallurgy Aceitera General Deheza, Refinería del Centro, Fabrica Argentina de Aviones, Stellantis, Iveco, Renault, Arcor, Nestlé
4 Río Cuarto	Renewable energy, agribusiness, meat processing	Biogas, bioethanol, processed foods, poultry Bioeléctrica, Bio4.
5 Río Tercero	Petrochemicals	Petrochemicals, chemicals for water treatment Petroquímica Río Tercero (PR3)
6 San Francisco	Steel and metallurgical, machinery, biofuels	Metal processing, aluminium smelting, processed foods, biodiesel Inpack, WEG, Bianchi Cueros
Entre Ríos Province		
7 Paraná, Nogoyá, Concordia	Agriculture, food processing, forestry, pharmaceuticals, biofuels	Soybeans, cereals, meat, dairy products, poultry, vegetable oils, biodiesel, pharmaceuticals, packaging (cardboard) Bionogoyá, Cartocor, Egger
Jujuy, Salta, Catamarca and San Juan Provinces		
8 Jujuy, Salta, Catamarca, San Juan	Mining, steel	Lithium, silver, lead, zinc, copper, borates, iron ore Arcadium Lithium, Sales de Jujuy, Minera Exar, Minera Alumbrera, Livent Corporation, Minera Oroplata (MOM), Minera del Altiplano, Marhen Lithium, Yamana Gold Inc., Aceros Zapla, Austin Powder, Enaex, Barrick Gold Corp., Glencore, Refinor

Industrial cluster	Main sectors	Key products/Main companies
La Pampa Province		
9 La Pampa	Agriculture, food processing, bioenergy, construction, machinery manufacturing, refinery	Soybeans, cereals, meat, biofuels, machinery for agriculture Indelplas, Milkaut, Lartirigoyen, PAMPetrol
Mendoza Province		
10 Mendoza, Luján de Cuyo	Wine, agriculture, oil & gas, petrochemicals	Wine, grapes, glass containers, oil products, petrochemicals Bodega Catena Zapata, Verallia Argentina, Petrocuyo, YPF Química, YPF Refinery, Nestlé
Neuquén Province		
11 Plaza Huincul, Neuquén	Oil & gas, petrochemicals	Gas, oil, petrochemicals YPF Química, Pluspetrol Gas Plant, YPF Refinery, Fox Petrol (Refinery)
San Luis Province		
12 San Luis, Villa Mercedes	Steel, food processing	Steel products, chocolates Arcor, Colgate-Palmolive, Procter and Gamble, Cementos Avellaneda, Aluflex, CPA
Santa Fe Province		
13 Rosario and greater area (San Lorenzo, Villa Constitución, San Nicolás*) *** Buenos Aires Province**	Oilseed processing, agrochemicals, steel, automotive, forestry, petrochemicals, biofuels, oil & gas	Soy-based products, steel, fertilisers, automotive, vegetable oils and fats, packaging, paper, biodiesel, petrochemicals, oil products Cargill Aceitera, General Motors Argentina, Cofco International Argentina, Tenaris Siderca, Acindar
Tierra del Fuego		
14 Rio Grande, Ushuaia	Electronics	Electronics, home appliances BGH, Mirgor, Radio Victoria, Fapesa, Electro Fueguina, Solnik, Newsan

Source: Authors' own compilation, Fichtner (2025)

The listed industrial clusters have a well-developed infrastructure and good accessibility.

However, the current infrastructure in Argentina will require refurbishment and expansion in all areas:

- **Grid connection:** Connection to the grid is available in all selected industrial clusters, supporting energy-intensive industries such as steel and petrochemicals. The implementation of large-scale GH_2 projects will require expansion of the transmission and distribution lines only if they are connected to the grid. Connection to the grid can allow better use of the generated electricity and increase the share of renewables in the national energy mix.
- **Water supply:** An adequate regional water supply is available for all clusters. In order to implement large-scale GH_2 projects located near to the coast, seawater desalination plants might be required to ensure the sustainability of the projects.
- **Transport infrastructure:** Road conditions influence transport capacities and related costs, being a key driver of competitiveness for the clusters. All clusters have access to a well-maintained road network. Major extensions might be required for the southern region of the country in particular, where the existing road and rail networks are rather scattered.
- **Ports:** Argentina's main ports are currently concentrated in Buenos Aires Province and are adequate for imports and exports. Only the clusters in Buenos Aires Province and Santa Fe Province have direct access to port infrastructure.
- **Gas and oil infrastructure:** Argentina has a pipeline network connecting major production sites with some consumption sectors. There are also ongoing projects to extend the gas network. This network might offer either a direct advantage in later stages of project implementation, if it can be repurposed for hydrogen transport, or an indirect advantage in the event that a completely new network of pipelines is developed exclusively for hydrogen, under which circumstances the extensive experience in the gas sector can be applied to the new developments.

2.6 Pilot projects

Argentina is advancing GH_2 initiatives with multinational corporations. Table 8 shows GH_2 projects that could position the country as a hydrogen hub in Latin America.

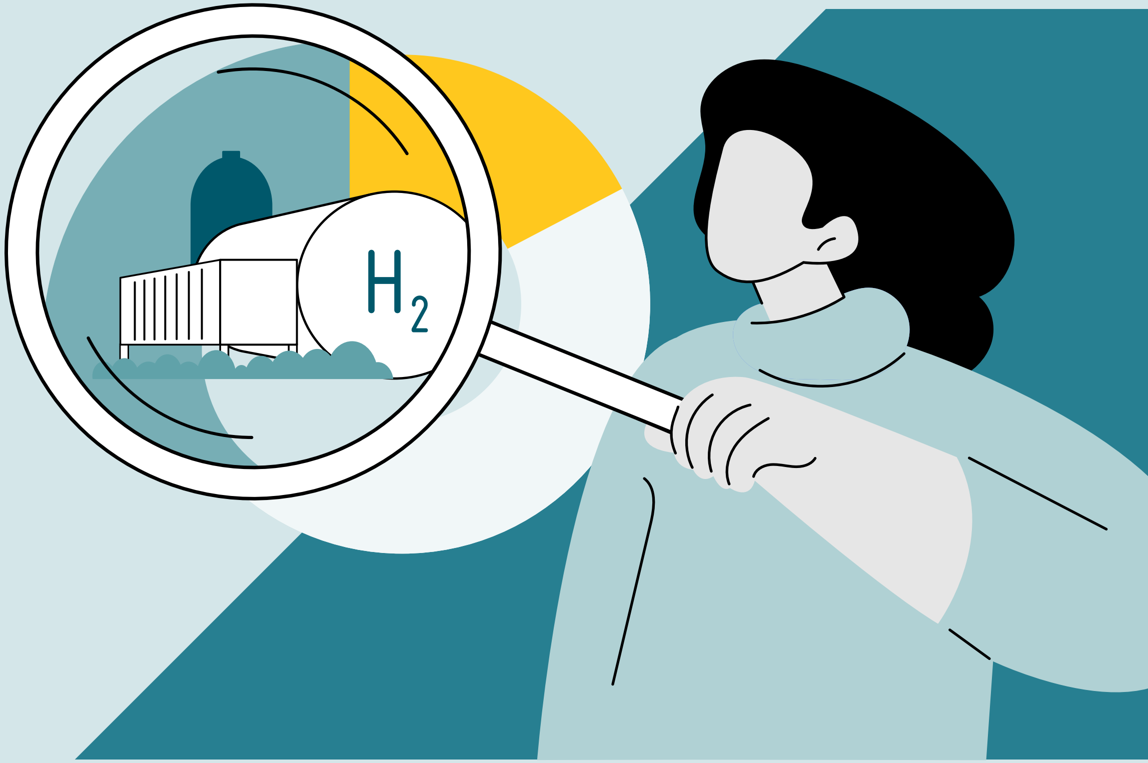
TABLE 8. Pilot projects

Project name	Location	Type	Scale	Key features
Hychico Pilot Plant	Chubut Province	Green hydrogen	Pilot	Operating since 2008, 2.3 km pipeline, geological storage
Pico Truncado Experimental Plant	Santa Cruz Province	Green hydrogen	Pre-industrial	500 kW electrolyser, 2.4 MW wind farm, training centre
Pampas Project	Río Negro Province	Green hydrogen	Large-scale	35 kTPA initial, scaling to 215 kTPA, USD 8.4 billion investment
Tierra del Fuego Project	Tierra del Fuego	Blue and green hydrogen	Large-scale	1.5 MTPA green ammonia (Yara)
Gaucho Wind to Hydrogen & Green Ammonia	Not specified	Green hydrogen/ ammonia	Large-scale	3 GW electrolysers, 4.2 GW wind farm, 1.7 MTPA green ammonia

Source: Authors' own compilation, Fichtner (2025), based on (Secretaría de Asuntos Estratégicos, 2023), (Swagath, 2021), (HVH, 2024), (Aprea, 2008)

3

Green hydrogen potential in Argentina and use cases



Argentina is uniquely positioned to become a global leader in green hydrogen production, thanks to its exceptional renewable energy resources, strategic geographic location, and established energy infrastructure. By leveraging these advantages and addressing key challenges, the country has the potential to support both domestic and international hydrogen markets, fostering sustainable growth and innovation in the energy sector.

3.1 Renewable resource potential within Argentina

Argentina's renewable energy landscape is both diverse and geographically dispersed, offering a strong foundation for green hydrogen production. The country possesses world-class wind, solar, and hydropower resources, each contributing to its renewable energy potential. Figure 10 illustrates the mean wind power density and specific photovoltaic power output across different regions.

Patagonia stands out globally for its exceptional wind energy potential, with average wind power densities exceeding 1,500 kWh/kW. The region's consistently strong wind speeds and vast, low-conflict landscapes make it ideal for large-scale wind farms and hydrogen production. Offshore wind resources could further enhance Argentina's green hydrogen potential; however, higher associated costs may limit their development compared to more cost-effective onshore wind generation.

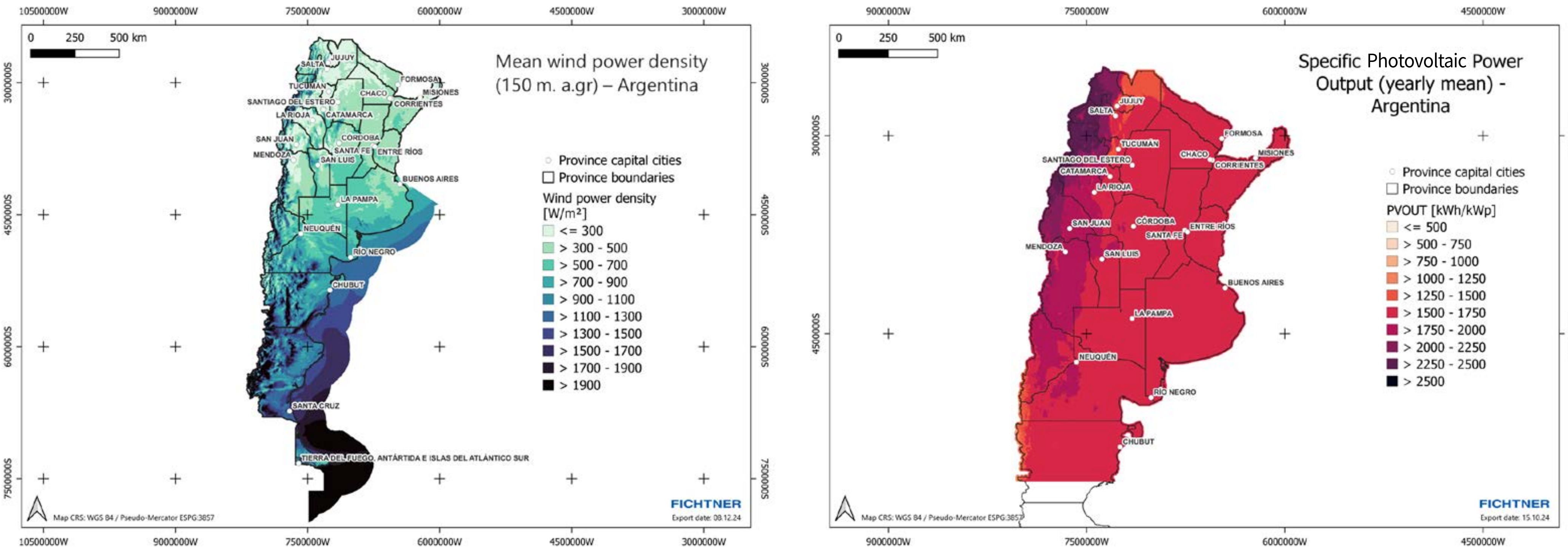
In the northwestern provinces of Salta, Jujuy, and San Juan, solar energy potential ranks among the highest in South America. These regions experience high solar irradiance, with specific photovoltaic outputs surpassing 2,200 kWh/kWp, making them prime candidates for solar-based hydrogen production. Conversely, the southern regions, while rich in wind resources, suffer from low solar irradiance, posing challenges for integrating diverse renewable sources.

Hydropower also plays a critical role in Argentina's energy mix. Provinces such as Córdoba and Mendoza have well-established hydropower infrastructure, contributing significantly to national electricity generation and presenting future potential for hydrogen production. However, large-scale hydropower deployment for hydrogen would require detailed feasibility assessments, factoring in national energy policies, environmental considerations, and economic viability. Given Argentina's superior wind resources and their scalability, wind energy is expected to be the dominant renewable source for large-scale hydrogen production.

Despite Argentina's abundant renewable resources, the geographical separation of high-quality solar and wind sites poses integration challenges. The north boasts high solar irradiance but low wind speeds, whereas the south is dominated by wind but lacks solar potential. Given that utility-scale hydrogen projects often operate off-grid, wind energy is expected to play a primary role in initial hydrogen project phases due to its higher capacity factors and lower production costs.

Water availability is another crucial consideration for hydrogen production, as it serves as the primary feedstock for electrolysis. Although Argentina generally possesses substantial water resources, their distribution is uneven across the country. Southern Argentina is largely arid, but seawater desalination presents a cost-effective and viable solution. As its contribution to the levelised cost of hydrogen (LCOH) remains minimal, water availability is unlikely to pose a significant barrier to hydrogen development, even in remote areas. However, strict adherence to environmental, social, and regulatory frameworks will be essential to ensure sustainable project implementation.

FIGURE 10. Mean wind power density and specific photovoltaic power output



Source: Authors' own compilation, Fichtner (2025) based on (Neil N. Davis, 2024)[3]

Source: Authors' own compilation, Fichtner (2025) based on (Global Solar Atlas, 2024)[4]

3 Data obtained from the Global Wind Atlas version 3.3, a free, web-based application developed, owned, and operated by the Technical University of Denmark (DTU). The Global Wind Atlas version 3.3 is released in partnership with the World Bank Group, utilising data provided by Vortex, using funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalwindatlas.info

4 Data obtained from the Global Solar Atlas 2.0, a free, web-based application developed and operated by Solargis s.r.o. on behalf of the World Bank Group, utilising Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info

3.2 Potential use cases in Argentina

Argentina's diverse industrial landscape presents several promising opportunities for integrating green hydrogen, particularly within the chemical, fertiliser, steel, food, and oil refining sectors. These applications can be segmented into **small-scale** and **large-scale** use cases, each with specific considerations regarding electrolyser capacities and sector-specific hydrogen consumption patterns.

Small-scale use cases (electrolyser capacity: 1+ MW)

Small-scale green hydrogen projects serve industries with moderate hydrogen demand or decentralised production needs. These setups prioritise on-site or near-site generation to minimise logistics costs and seamlessly integrate with existing processes.

Electrolysers will then typically be powered by local wind or solar PV plants, supported by battery energy storage or hydrogen storage to manage fluctuations in electricity supply and hydrogen demand. In most cases, the hydrogen is consumed directly on site, ensuring efficiency and reliability.

Typical small-scale applications include electronics, specialty glass production, welding processes, and the food industry – either for hydrogenation or as protective gas in food packaging. In Argentina, a key potential application is in the food industry.

1. Food industry

In the food industry, hydrogen is required for the hydrogenation of oils and fatty acids, for example. This process serves multiple purposes, such as enhancing the shelf life and stability of the products or modifying fats for industrial applications.

As a leading global producer and exporter of soyabean and sunflower oils, Argentina relies on hydrogenation to process these oils for both domestic use and export. By transitioning from fossil-based hydrogen to green hydrogen, the industry can reduce its carbon footprint, aligning with global sustainability goals.

The vegetable oil industry in Argentina is highly concentrated in Santa Fe Province, particularly in the Rosario area, which hosts most of the country's oilseed crushing and processing capacity and export terminals, but in Buenos Aires, too, there is a relevant concentration of activities around vegetable oils and fats processing. Key players include Cargill (Santa Fe) and Aceitera General Deheza (Córdoba).

Large-scale use cases (electrolyser capacity: 10 MW and above)

Large-scale green hydrogen projects serve industries with high and continuous hydrogen demand, maximising economies of scale through larger electrolyser installations and the utilisation of optimal wind and solar resources.

These projects typically feature large renewable energy facilities paired with nearby large-scale electrolysers, supported by infrastructure for electricity transmission, water supply, wastewater management, and hydrogen storage and transport to off-takers or ports. Extensive hydrogen storage is essential either to balance production fluctuations without disrupting downstream processes or to accommodate the periodic nature of maritime transport for export-oriented projects.

Unlike smaller-scale projects, large electrolysers are housed in dedicated buildings, as containerised solutions are more common for smaller installations. In some cases, desalination units may be required to ensure a sustainable water supply, depending on local availability.

Typical large-scale applications include ammonia and fertiliser production, chemicals (including methanol), and crude oil refining. In the future, iron & steel and cement may also emerge as major hydrogen consumers.

In Argentina, the key potential applications for large-scale green hydrogen include ammonia, fertilisers, crude oil refining, and iron & steel production.

1. Ammonia and fertiliser production and chemicals

- Ammonia is traditionally produced using hydrogen from natural gas, leading to high CO_2 emissions. Switching to green hydrogen reduces the carbon footprint, supporting Argentina's decarbonisation goals.
- Established industrial clusters in Argentina, particularly in areas like Campana and Bahía Blanca (Buenos Aires Province), already have ammonia production facilities and port infrastructure, facilitating the integration of green hydrogen and enabling the potential export of green ammonia.
- The global market for lower-carbon fertilisers is growing, driven by sustainability trends. Implementing green fertiliser production can enhance Argentina's competitiveness in agricultural exports, aligning with increasing demand for sustainably sourced products.

Production capacity of ammonia and nitrogen-based fertilisers is primarily located in the central and northern regions of the country, where key industrial infrastructure – natural gas supplies, port access, and agricultural demand – is well-established. Key producers such as Profertil and Bunge are located in Buenos Aires Province.

2. Steel industry

- Hydrogen direct reduction of iron (H_2-DRI) plants are replacing coal or natural gas with hydrogen, reducing CO_2 emissions in the steelmaking process. As the steel industry is energy-intensive, it will increasingly rely on large electrolyser installations powered by low-cost renewable energy to meet its hydrogen needs sustainably.
- As global steel markets increasingly prioritise low-emission products, this shift could drive higher willingness to pay among off-takers, potentially opening up new exports for green steel.

Key players such as Tenaris Siderca (Ternaris Group), Acindar (ArcelorMittal), and Ternium Siderar (Techhint Group) are located in Santa Fe and Buenos Aires provinces, respectively. Tenaris and Acindar operate DRI furnaces, generating potential for the adoption of green hydrogen.

3. Oil refining industry

- Hydrotreating and hydrocracking processes in refineries require hydrogen for desulphurisation and fuel quality improvement.
- Oil refineries have a large retrofit potential, as existing steam methane reformers (SMR) can be partially or fully replaced with green hydrogen, reducing operational emissions without the need for a complete refinery overhaul.
- Current refineries are located in a few key regions, and generally have access to raw materials, infrastructure, and ports for both domestic distribution and export.

With a strong oil and gas sector, Argentina's refineries play a central role in the national energy industry, with key players and potential green hydrogen consumers located in Bahía Blanca and La Plata, among other strategic locations.

Techno-economic calculations of the use cases

To provide a preliminary indication of techno-economic feasibility for projects of varying scales, three different scenarios were assessed for direct hydrogen use in Buenos Aires, where a transition to green hydrogen in different industries could be considered in the short term. For these selected cases, the analysis examined the levelised cost of hydrogen and ammonia based on different renewable energy mixes of PV and wind, necessary to meet a given annual hydrogen demand. Different electrolyser sizes are used. The main results of these three cases are summarised in Table 9. These results are based on model renewable profiles at the location (lat. -38.78051 long. -62.27962). It should be noted that the results may vary significantly if industries in other parts of the country are chosen, for example with different wind resources nearby, or if utility-scale projects with significantly larger component sizing are planned.

5 Excess RE is calculated for the value chain including ammonia. If only H_2 is to be produced, the amount of excess renewables can be increased by ~5%.

TABLE 9. Techno-economic calculations for direct hydrogen use cases

Case	Small-scale H_2 (wind & PV)	Small-scale H_2 (PV only)	Large-scale H_2 (wind & PV)
Demand (H_2) in tonnes/a	45	45	450
Installed RE (capacity) in MW	PV: 0.8 Wind: 0.5	PV: 4	PV: 3.5 Wind: 6.0
Electrolyser size in MW	0.6	0.9	4.5
Weighted average cost of capital (WACC) (%)	16.5	16.5	16.5
Total investment in million USD	4.2	6.3	32.5
Oxygen sales in million kg	0.33	0.36	3.4
Excess RE sales/ consumed in GWh[5]	0.5	3.1	7.7
LCOH grey (USD/kg)	16.7	16.7	16.7
LCOH proposed case/ green (USD/kg)	15.5	13.3	9.6
Project IRR in %	13.7	14.4	18.6
Net present value (NPV) in million USD	–0.6	–0.7	3.7
Finance gap (USD/kg)	1.2	3.5	–

Source: Analyses performed by GIZ (2025)

The complete assumptions, sizing, cost breakdown, financial parameters, and results are detailed in Annex 11 Techno-economic calculations. Based on the results presented in the table above, the following can be concluded:

- **Resource utilisation and cost analysis:** The analysis reveals that with the current high costs of grey hydrogen in the country and the good renewable conditions and possibility to sell excess renewables to the customer, the production of green hydrogen can be achieved at lower levelised cost than the production of grey hydrogen. With the 'small-scale H_2 (PV only)' case profiting from more revenues from the sale of excess renewables compared to the 'small-scale H_2 (wind & PV)'case, the levelised costs in this scenario are lower. Nevertheless, with the wind conditions in Argentina, a wind-only scenario could lead to potentially even lower costs. The green LCOH for the 'small-scale H_2 (PV only)'and 'large-scale H_2 (wind & PV)' cases is approximately 20% and 40% lower than the current grey hydrogen costs, respectively.
- **Financial viability:** With an LCOH for grey hydrogen of USD 16.7 per kg, which results from taking an external supply from a third party (no production of its own), among the analysed scenarios the 'large-scale H_2 (wind & PV)' case shows the highest IRR (18.6%), suggesting that it is the most financially feasible option for implementation based on these estimates. Lower LCOHs for grey hydrogen will correspondingly decrease the financial viability of the project and might lead to a finance gap.

Given that current hydrogen use in Argentina is dominantly linked to oil refining and ammonia-based fertiliser production, a complementary techno-economic analysis was conducted for three ammonia use cases that align with the hydrogen use cases presented above. The results are summarised in Table 10 below.

TABLE 10. Techno-economic calculations for ammonia use cases

Case	Small-scale NH_3 (wind & PV)	Small-scale NH_3 (PV only)	Large-scale NH_3 (wind & PV)
Demand (NH_3) in tonnes	270	270	2,700
Installed RE (capacity) in MW	PV: 0.8 Wind: 0.5	PV: 4	PV: 3.5 Wind: 6.0
Electrolyser size in MW	0.6	0.9	4.5
WACC (%)	16.5	16.5	16.5
Total investment in million USD	5.0	7.0	36.4
LCOA grey (USD/kg)	1.9	1.9	1.9
LCOA proposed case (USD/kg)	3.6	3.2	2.3
Oxygen sales in million kg	0.33	0.36	3.4
Excess RE sales/ consumed in GWh	0.33	3.1	7.7
Project IRR (%)	7.7	9.9	11.9
NPV in million USD	−2.2	−8.6	−2.3
Finance gap (USD/kg)	1.7	1.3	0.4

Source: Analyses performed by GIZ (2025)

- **Cost competitiveness:** Among the cases, the 'large-scale NH_3 (wind & PV)' scenario presents the lowest green LCOA at USD 2.3 per kg, making it more competitive relative to the alternatives.
- **Financial feasibility:** With the local prices for grey ammonia being significantly lower than those for green hydrogen, none of the projects can generate ammonia at lower cost and thus all projects have a financial gap. The 'large-scale NH_3 (wind & PV)' case has the smallest financial gap at USD 0.4 per kg of ammonia, highlighting its potential for large-scale implementation. This remaining gap might be closed by leveraging the funding mechanisms as described in section 4.3.
- **Investment returns:** Although the NPV is negative across all projects, the 'large-scale NH_3 (wind & PV)' scenario offers the highest return at 11.9%.

Overall, and under current assumptions, the results show the general rationale of larger projects being more cost efficient than small-scale projects. Nevertheless, they also require higher initial investment and are therefore associated with more risk in the course of market development. The LCOH is still not enough in the small-scale cases to compensate for this and to reach a positive NPV. It is therefore clear that these projects are not economically feasible in the short term without intensive funding. Nevertheless, the large-scale hydrogen case shows a positive NPV as a result of the high local cost for grey ammonia, making it an economically feasible option under the given cost assumptions.

It is important to note that the aforementioned options provide an estimate of potential green hydrogen and ammonia costs; however, cost evaluations should be conducted on a project-by-project basis since factors such as the local renewable profile and the required industry's offtake profile (the analysis above is based on a constant profile) can significantly influence the levelised cost, particularly due to their impact on the sizing of the electrolyser and storage system required. This effect is smaller for ammonia than hydrogen as the former has significantly lower storage costs. Additionally, securing an off-taker for the produced oxygen can be challenging, as revenue from the sale of this by-product generally does not justify investment in extensive transport infrastructure. The calculation further assumes that the full amount of renewable electricity generated can be sold to the industry attached for a price of USD 70.0MWh. It is likely that the industries will be interested in purchasing the otherwise curtailed renewable electricity, but this might not always be the case, and without the sales of excess renewables, implementation of battery storage might become an option. In certain scenarios, it may also be feasible to derive additional benefits from using the electrolyser's waste heat for applications such as district heating or industrial pre-heating processes and to conclude a PPA with other renewables, for instance to make use of the constant renewable profile of existing hydropower assets.

3.3 Analysis of hydrogen production potential

For large-scale hydrogen production, the alignment of renewable energy resources, water availability, export infrastructure, and regulatory frameworks is essential. Patagonia emerges as the most promising region for wind-powered hydrogen projects, offering high capacity factors, exceptional wind resources, and low land-use conflicts. These factors contribute to competitive production costs, reinforcing Argentina's potential as a global green hydrogen exporter.

Conversely, small-scale hydrogen projects require proximity to industrial end-users to minimise transportation costs and ensure economic viability. Industrial hubs such as Bahía Blanca and La Plata provide strategic locations due to their existing energy and water infrastructure and direct access to industries with hydrogen demand. Leveraging these established clusters can reduce capital expenditure (CAPEX) requirements and accelerate project deployment.

Argentina's existing export and transport infrastructure further strengthens its hydrogen market potential. With an extensive coastline and established trade links to Europe and Asia, the country is well positioned to export hydrogen and its derivatives. In the long term, Argentina's natural gas pipeline network could be repurposed for hydrogen transport, reducing the need for new infrastructure investment and facilitating domestic hydrogen distribution.

3.4 Multi-criteria assessment for small-scale hydrogen projects

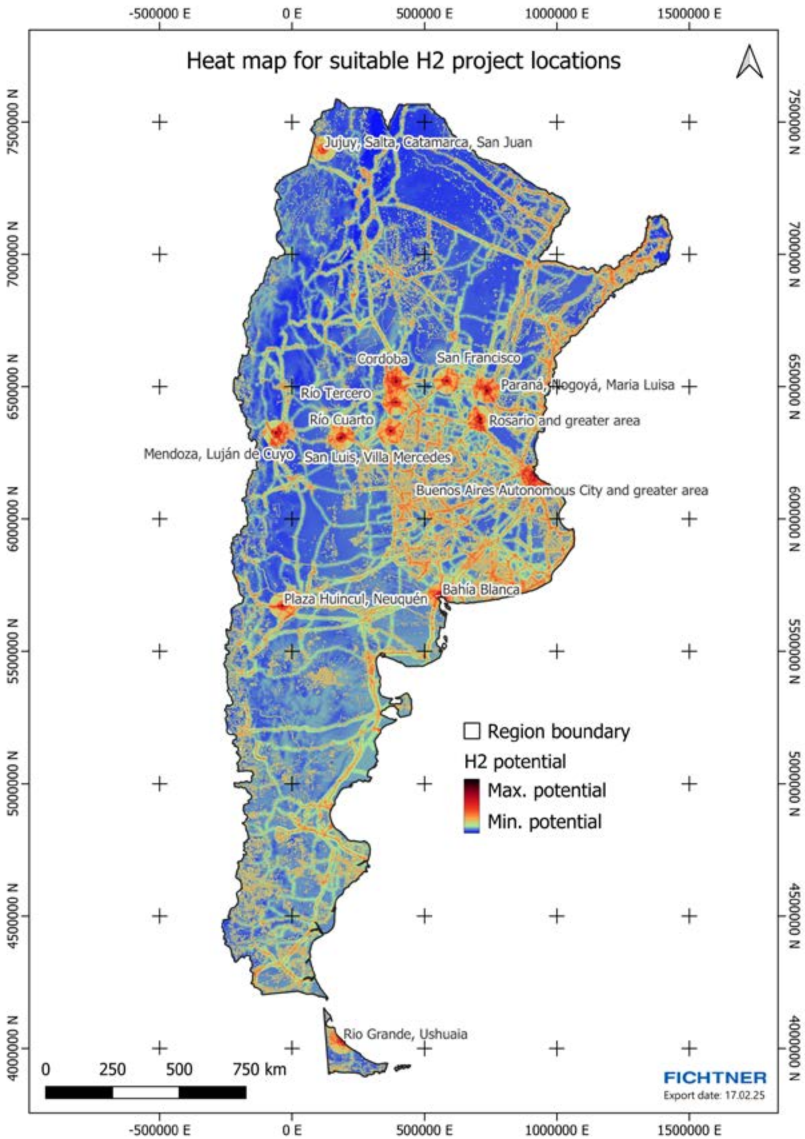
A multi-criteria assessment (MCA) was carried out in order to identify optimal locations for small-scale hydrogen projects. The evaluation considered:

- Renewable energy availability (wind and solar potential)
- Proximity to industrial clusters (potential off-takers)
- Access to water resources (for electrolysis)
- Connection to existing energy and transport infrastructure

Each criterion was assigned specific scoring thresholds based on factors such as distance to off-takers, high-voltage grid connections, water sources, roads, and port facilities. Industrial proximity received the highest weighting, followed by grid access, renewable resource quality, and water availability. Transportation infrastructure (roads and ports) was also factored in to assess export feasibility.

The results of the MCA are visually represented in Figure 11, highlighting high-potential areas in red as prime locations for engaging industrial off-takers and initiating project development. Areas with less favourable conditions are marked in blue, indicating greater development challenges.

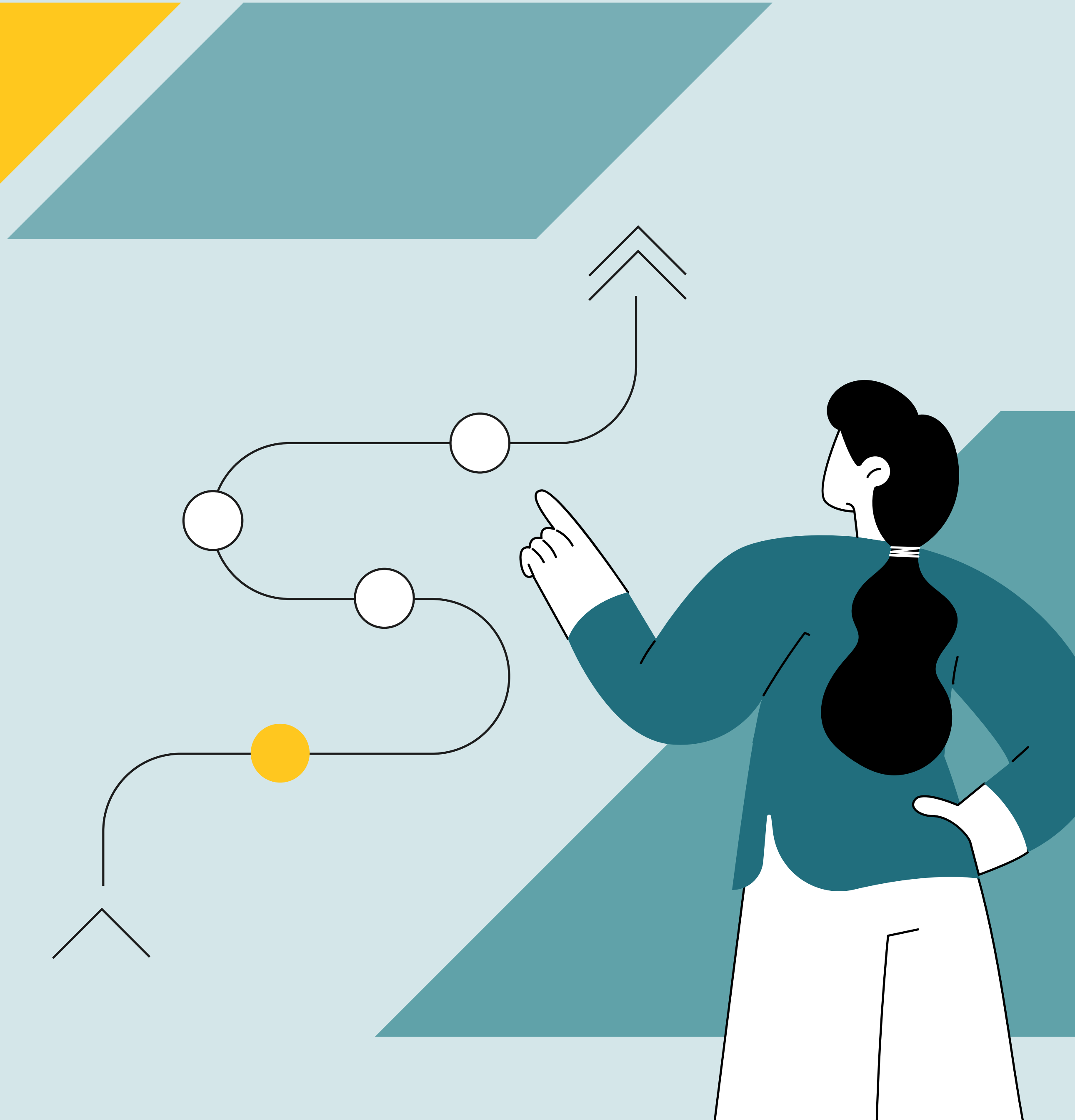
FIGURE 11. Country heat map indicating potential locations for green hydrogen pilot projects



Source: Authors' own compilation, Fichtner (2025)

4

The way forward



The analysis of Argentina's energy sector and its potential for green hydrogen adoption reveals both considerable opportunities and critical challenges. Argentina's world-class renewable energy resources, combined with its strategic export potential, create a favourable environment for green hydrogen development. However, challenges related to infrastructure, policy clarity, and financial viability must be addressed for the country to build a sustainable hydrogen economy.

4.1 Opportunities and supporting frameworks

Argentina is uniquely positioned to emerge as a global leader in the green hydrogen economy.

- **Supportive policy and strategy development:** Argentina's National Hydrogen Strategy outlines ambitious targets for electrolysis capacity and renewable energy expansion by 2050. Although recent government shifts towards prioritising the deregulation and expansion of the oil and gas sectors may reduce direct government incentives for green hydrogen in the short term, a deregulated market with reduction of bureaucratic barriers could foster private-sector innovation and attract investment.
- **Industrial base and market potential:** Argentina's strong industrial base, including sectors like petrochemicals, steel, and fertilisers, offers potential off-takers for green hydrogen, facilitating decarbonisation. Multinational corporations could also invest in green hydrogen solutions to meet global sustainability targets, particularly as Argentina aims to allocate 80% of its production for export.
- **Renewable energy resources:** Argentina's exceptional wind and solar resources, particularly in Patagonia (wind) and the northwest (solar), position it as an ideal location for cost-effective green hydrogen production. These renewable resources not only meet domestic energy needs but also enhance the country's export potential.
- **International interest and funding:** Despite the government's focus on fossil fuels, international interest remains strong. Notable announcements such as Fortescue Future Industries' plan for a USD 8.4 billion green hydrogen project in the province of Río Negro (Inspenet, 2023) and RP Global's plan to installed 3 GW of electrolysis capacity as part of the Gaucho Wind to Hydrogen and Green Ammonia project (Renewables Now, 2024) demonstrate significant and concrete international interest in the sector.
- **Economic and environmental benefits:** The development of green hydrogen projects aligns with Argentina's commitments under the Paris Agreement and its goal of net-zero emissions by 2050. Furthermore, the development of the sector has the potential to generate over 80,000 skilled jobs in Argentina by 2050 (Secretaría de Asuntos Estratégicos, 2023) and stimulate investments in local infrastructure, contributing to broader economic growth.
- **Market maturity and technological advancements:** Argentina has the opportunity to lead in hydrogen technology innovation, including electrolysis and carbon capture. This could reduce production costs and enhance the competitiveness of green hydrogen in both domestic and export markets.

4.2 Challenges and considerations

Despite the opportunities, Argentina faces economic, technical, and regulatory challenges that must be addressed for sustainable growth across sectors. Key obstacles include the lack of a dedicated regulatory framework, limited financial incentives, uncertainty around off-takers willing to pay a premium for green hydrogen, and constraints in available technologies. These global challenges, common to all emerging hydrogen markets, highlight the need for targeted policies and investment to support sector development in Argentina.

Economic challenges

- **High production costs and fossil fuel competition:** Argentina's vast natural gas reserves, coupled with relatively low domestic gas prices, create a difficult environment for green hydrogen to compete without subsidies or carbon pricing. The lack of clear carbon policies further weakens industry interest in transitioning.
- **Financial instability and investment risks:** Chronic high inflation rates and fluctuating currency values in Argentina increase the costs of imports, including essential components such as electrolysers and storage systems. These economic conditions also constrain access to international credit markets, making it more difficult to secure adequate financing.
- **Export dependence and market volatility:** With plans to allocate 80% of its green hydrogen production to export markets, Argentina is exposed to international price volatility, shifting energy policies, and geopolitical risks, such as changing hydrogen policies in key target markets (e.g. in Europe).
- **Uncertain domestic demand:** Although Argentina has a strong and diversified industrial sector with potential off-takers of green hydrogen, the absence of clear policies or mandates for decarbonisation in hard-to-abate sectors creates uncertainty about the future demand for green hydrogen. Industries are hesitant to invest in green hydrogen-based processes without assurances of consistent market demand, particularly considering the competitivity with natural gas resources.

Regulatory challenges

- **Policy and regulatory uncertainty:** While Argentina introduced a National Hydrogen Strategy in 2023, recent shifts in government priorities towards deregulating fossil fuels create uncertainty about support for green hydrogen. No binding targets or incentive mechanisms have been enacted to ensure sector growth. Furthermore, current policy of deregulating the economy and focusing on local available fuels, with actions such as dissolving the Ministry of Environment, creates uncertainty regarding the path for renewable energies and decarbonisation.

Technical challenges

- **Infrastructure gaps:** Considering the size of the country, the development of an infrastructure that connects all regions of the country is challenging, at least from an investment viewpoint. Infrastructure is currently concentrated in the central and northern part of the country, including transmission and distribution networks, roads and railways, and major ports. Large industries are concentrated in these areas too. Integration of wind potential in the southern part of the country and integration into the national energy system will therefore require major expansion of power infrastructure. Large-scale green hydrogen projects aiming for export can be implemented in isolation from the national grid, reducing long-distance electricity transmission and distribution, but roads, railways, and port infrastructure will have to be implemented or extended for these projects.
- **Water availability:** While Argentina overall has low water stress (Aqueduct, 2025), the southern regions, where much of the renewable energy potential lies, are arid. Large-scale green hydrogen projects in these regions may need to rely on seawater desalination and corresponding infrastructure, due to limited water resources and sustainability constraints.

4.3 Green hydrogen financing opportunities for German companies

The green hydrogen sector requires substantial financial investments to overcome high initial costs and infrastructure challenges. Several funding mechanisms exist to support hydrogen projects globally, particularly in emerging markets. These mechanisms are designed to reduce investment risks, facilitate project development, and encourage public-private partnerships. Refer to Annex 9 for mechanisms that may be useful in this context.

4.4 Stakeholder mapping and institutional overview for green hydrogen development

The development of green hydrogen in Argentina involves a diverse range of stakeholders from the public, academic, and private sectors. Each plays a crucial role in shaping the country's hydrogen strategy, from policy development and research to project implementation and commercialisation.

- **Public sector:** Key institutions such as the Ministry of Economy and several secretariats, related to energy and environment are instrumental in crafting national policies and ensuring compliance with environmental regulations. Provincial governments facilitate local partnerships, while state-owned companies such as YPF explore hydrogen production.
- **Academic sector:** Institutions such as the Argentine Institute of Hydrogen, National Institute of Industrial Technology, and National Scientific and Technical Research Council drive innovation through research and technical assistance.
- **Private sector:** Organisations such as the Hydrogen Cluster of Argentina and Consortium H_2AR promote collaboration and adoption, while international companies such as Siemens Energy and Air Liquide contribute to the sector's growth.

For a detailed breakdown of these stakeholders and their functions, please refer to Annex 10, which includes a comprehensive table outlining their roles and contributions to Argentina's green hydrogen landscape.

4.5 Next steps for German companies

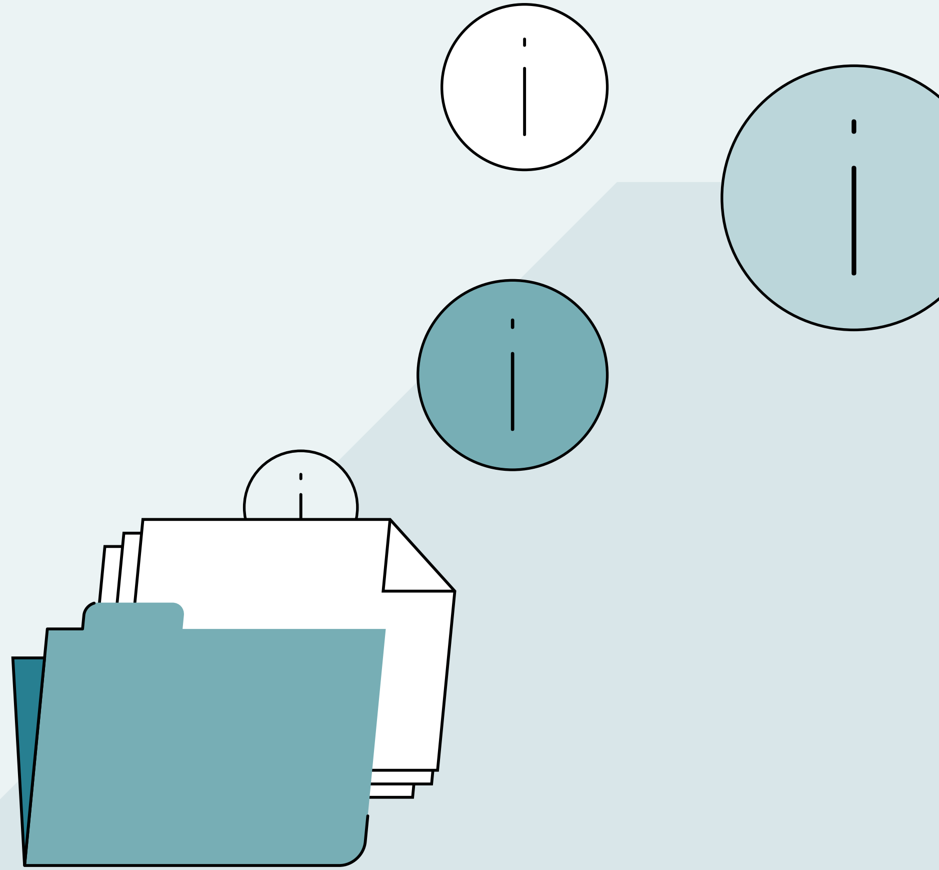
Argentina presents a significant opportunity for green hydrogen development, driven by its abundant renewable energy resources, strategic location, and increasing policy interest. Despite challenges such as high production costs, economic instability, and infrastructure gaps, Argentina's strong industrial base and growing international investment interest make it a potential leader in the hydrogen market.

For German companies considering green hydrogen projects in Argentina, the following steps are recommended:

1. **Engage with local stakeholders:** Build partnerships with key institutions such as the Ministry of Energy and the Energy Secretariat and with local energy regulators to stay informed about the latest policies, incentives, and investment opportunities.
2. **Leverage international financing:** Explore financing opportunities from sources such as H_2 Global, GEF, and multilateral funds supporting renewable energy projects. Look into programmes that might help mitigate risks and reduce the financing costs for green hydrogen ventures.
3. **Assess infrastructure and market potential:** Evaluate Argentina's renewable energy capacity, especially in wind (Patagonia) and solar (northwest). Consider pilot projects in sectors such as fertilisers, steel, and oil refining to generate initial demand for green hydrogen. Assess the potential for export routes, particularly via existing trade corridors.
4. **Monitor regulatory developments:** Stay updated on developments regarding Argentina's National Hydrogen Strategy and any changes in the political landscape, including the government's approach to energy and deregulation.
5. **Participate in R&D and innovation:** Collaborate with Argentine universities, research institutions, and industrial players to explore new hydrogen technologies, ensuring that projects align with both local needs and international safety and efficiency standards.

By taking these steps, German companies can position themselves at the forefront of Argentina's growing green hydrogen market, contributing to the country's transition to a more sustainable energy future while capitalising on the emerging opportunities.

Annexes



Annex 1 The energy market in Argentina

For more details of the Argentine electricity market, consult the document available at **12 insights on hydrogen - Argentina edition - PtX Hub**

Annex 2 Fertiliser industries in Argentina

Several companies produce fertilisers in Argentina, focusing on supplying the domestic market. Among these are Profertil and Bunge Argentina. Other large companies such as Yara Argentina do not currently have fertiliser production in the country. The main fertiliser plants in Argentina are presented in Table 11, including the location, production capacity, and estimated hydrogen demand.

TABLE 11. Main fertiliser plants in Argentina, with capacity and location

Company/plant	Location	Capacity [kTPA]	Estimated hydrogen demand [kTPA][6]
Profertil S.A.	Bahia Blanca, Buenos Aires	NH_3: 790 Urea: 1,320	For NH_3: 141
Bunge	Ramallo, Buenos Aires	SSP: 180 NPK (blending)	Not required
	Campana, Buenos Aires	NH_3: 115 Urea: 180 UAN: 250 Others: 142	For NH_3: 20

6 The estimations are indicative, as these do not consider processes' efficiencies or part load operation. Specific requirements 0.177 t_{H2}/t_{NH3} and 0.100 t_{H2}/t_{urea} have been considered. It is considered that ammonia is the main product and further processed to other fertilisers such as urea or UAN.

Source: Authors' own compilation, Fichtner (2025) based on (Profertil, 2024), (Rizobacter, 2024), (Bunge, 2024)

Annex 3 Chemical industries in Argentina

TABLE 12. Main petrochemical and chemical companies in Argentina

Company	Location	Capacity [kTPA]
YPF Química	Ensenada, Buenos Aires Province	• Propylene: 120 • Cyclohexane: 95 • Benzene, toluene, xylene, heavy aromatics: 526 • Others: 177 • Total: 918
	Luján de Cuyo, Mendoza Province	Propylene: 100
Unipar Indupa	Bahía Blanca, Buenos Aires Province	PVC: 240 Cloruro de vinilo (VCM) Caustic soda
Petrocuyo	Lujan de Cuyo, Mendoza Province Ensenada, Buenos Aires Province	Polypropylene: 320
Petroken Petro-química	Ensenada, Buenos Aires Province	Polypropylene: 100
Dow Chemical Argentina	Bahia Blanca	Ethylene, polyethylene
Transclor	Parque Industrial de Pilar, Buenos Aires	Cloro-Soda: 100
	Bernal, Buenos Aires Province	Aluminium polychloride

Source: Authors' own compilation, Fichtner (2025) based on, (GBR, 2023), (YPF Quimica, 2024a), (Unipar, 2023) (Petroken, 2024)

Table 13 provides an overview of the methanol production plants in the country, including their capacities, locations, and estimated hydrogen demand.

TABLE 13. Methanol production plants in Argentina

Plant	Location	Capacity [kTPA]	Estimated hydrogen demand[7] [kTPA]
YPF Química - Complejo Industrial Plaza Huincul	Plaza Huincul, Neuquén	411	78
Arauco Química - Puerto General San Martín	Puerto General San Martín, Santa Fe	50	9

7 The estimations are indicative, as these do not consider processes' efficiencies or part load operation. Specific requirements 0.189 t_{H2}/t_{MeOH} have been considered.

Source: Authors' own compilation, Fichtner (2025) based on (YPF química, 2024b) and (ARAUCO química, 2024), (Bicego, F et all, 2018)

Annex 4 Steel industries in Argentina

Table 14 gives an overview of key players in Argentina's steel industry, including their locations and production capacities.

TABLE 14. Main steel and metallurgy companies in Georgia

Company	Location	Capacity [kTPA]
Ternium Siderar (Techint Group)	Various	Finished flat steel: 3,000
Tenaris Siderca (Ternaris Group)	Various	Liquid steel: 950
Acindar (ArcelorMittal Group)	Various	Steel: 1,400
Aluar	Puerto Madryn Chubut Province	Aluminium: 460

Source: Authors' own compilation, Fichtner (2025) based on (Ternium, 2025), (Tenaris, 2024), (infobae, 2024a), (aluar, 2025)

Annex 5 Refineries in Argentina

TABLE 15. Main oil refineries in Argentina

Refinery	Location	Capacity [bbl/d]	Estimated hydrogen demand[8] [kTPA]
YPF S.A. - Luján de Cuyo	Luján de Cuyo, Mendoza Province	90,000	36
YPF S.A. - San Lorenzo	San Lorenzo, Santa Fe Province	110,000	44
YPF S.A. - La Plata	Berisso, Buenos Aires Province	190,000	75
Campana Refinery (Axion Energy)	Campana, Buenos Aires	90,000	36
Raizen Argentina S.A.U. - Dock Sud	Avellaneda, Buenos Aires	85,000	34
Refinería Bahía Blanca S.A.U. - Elicabe	Bahia Blanca, Buenos Aires	50,000	20
Total		**615,000**	**245**

8 An estimate of the hydrogen demand for these refineries is calculated on the basis of a specific consumption of 8 kg of hydrogen per tonne of refined product. This value is only indicative and can vary significantly depending on the type (quality) of crude oil and the refinery-specific technologies and processes. Furthermore, the estimated hydrogen demand assumes full operation throughout the year.

Source: Authors' own compilation, Fichtner (2025) based on (datos.gob.ar, 2022)

Annex 6 Food industries in Argentina

Other large players in the food industry include Arcor Group, which operates 23 industrial plants across Argentina and a diverse portfolio in mass-consumed foods (sweets, chocolates, cookies, ice), agribusinesses (sugar and maize processing products, including vegetable oils in five production units dedicated to maize milling), and packaging (cardboard, paper) (Arcor, 2025), and Nestlé, with seven production plants in Argentina, producing chocolates, dairy products, and instant coffee, among other things (Nestle, 2025).

TABLE 16. Main food industry companies in Argentina

Company	Location	Products
Molinos Rio de la Plata	10 manufacturing plants	Vegetable oils, margarine
Egramar	Berazategui, Buenos Aires Province	Refined bovine domestic fats and bakery fats, margarines
Compañía Argentina de Aceites SA (CAASA)	Lanús, Buenos Aires	Refined vegetable oils (soy and sunflower)
Refinería Sudamericana	Buenos Aires Province	Margarines
RDC Refinería del Centro	Buenos Aires, Córdoba	Refined bovine fats, vegetable oils, margarines
Aceitera General Deheza (Grupo AGD)	Córdoba, Santa Fe Province	Crude and refined vegetable oils, biodiesel*
Cargill	Villa Gobernador Galvez, Santa Fe Province (Oilseed processing)	Vegetable oils and fats, sweetening agents (polyols)

* Hydrogen is required 'indirectly': in the transesterification process, methanol reacts with oils or fats to produce methyl esters (biodiesel). Hydrogen is required for methanol production.

Source: Authors' own compilation, Fichtner (2025) based on (Egramar, 2025), (CAASA, 2025), (Prodalsa, 2025), (Grabya, 2025), (Refinería Sudamericana, 2025), (Hebos, 2025), (Tanoni Hnos, 2025), (RisBio, 2025), (Camilo Ferrón, 2025), (RDC, 2025), (AGD, 2025), (EMIS, 2024), (Aceites del Valle, 2025), (Cargill, 2025)

Annex 7 Glass industries in Argentina

Several smaller players also operate in the market, some of them focusing on e.g. flat glass processing, distribution, and commercialisation, but do not have their own manufacturing facilities.

TABLE 17. Main glass industry companies in Argentina

Company	Location	Product/capacity [kTPA]
Vidriería Argentina SA (Vasa)	Lavallol and Los Cardales, Buenos Aires Province	Float glass, architectural glass, automotive glass 1,100 TPD (approx. 401 kTPA)
Verallia Argentina	Guaymallén, Mendoza Province	Glass containers: 16 million units per year
Durax (Cooperativa Cristal Avellaneda)	Gerli, Buenos Aires Province	Tableware: 250,000 units per day

Source: Authors' own compilation, Fichtner (2025) based on (abc, 2022), (Rigolleau, 2025), (Verallia, 2025), (Durax, 2025), (Glass-International, 2017)

Annex 8 Details of industrial clusters in Argentina

There are various H_2 and derivative projects in different stages of development in Argentina. The work carried out by AHK and GIZ within the framework of the H2Uppp programme can be consulted on this site: **“De los vínculos a una visión conjunta: Alemania como socio estratégico de Argentina en la economía del hidrógeno verde”**

Annex 9 Green hydrogen financing opportunities for German companies

Refer to section 3.2 Mitigation and Financing Mechanisms of the document found on this site: **Fundamentals for the financing of green hydrogen and derivatives projects - barriers and strategies - PtX Hub**

Annex 10 Stakeholder mapping

Argentina's green hydrogen sector will rely on collaboration among government, regulatory bodies, academia, private companies, and international partners. This effort is vital for fostering a domestic hydrogen economy and positioning Argentina as a key player for global investment. Key stakeholders and their function are listed in Table 18.

TABLE 18. Key Argentine stakeholders for hydrogen development

Stakeholder	Function
PUBLIC	
Ministry of Energy	Develops national energy policies, including renewable energy strategies and hydrogen initiatives.
Energy Secretariat	Leads energy policy development and is responsible for implementation of the National Hydrogen Strategy.
Sub-Secretary of Environment of the Nation	Ensures green hydrogen projects comply with environmental regulations and promote sustainability.
Provincial governments (e.g. Río Negro)	Facilitate land use, local regulations, and partnerships for green hydrogen projects.
Energía Argentina (Enarsa)	Involved in renewable energy projects, including hydrogen.
Enargas	Regulates natural gas markets, including hydrogen blending initiatives with natural gas systems.
Federal Investment Council	Supports regional investment and economic development, including hydrogen sector projects.
YPF (Yacimientos Petrolíferos Fiscales)	Argentina's state-controlled energy company; exploring hydrogen production and renewable energy integration.
ACADEMIA	
National Institute of Industrial Technology (INTI)	Conducts research and technical assistance for green hydrogen production and use.
National Scientific and Technical Research Council (CONICET)	Provides scientific research and innovation in hydrogen and renewable technologies.
Agencia I+D+i	Fosters innovation and research in renewable energy technologies.
National University of Río Negro (UNRN)	Conducts academic research and offers educational programmes related to hydrogen technology.

Stakeholder	Function
San Martin National University (UNSAM)	Conducts research and academic programmes including renewable energy and hydrogen.
National Technological University (UTN)	Conducts research and academic programmes including renewable energy and hydrogen.
Buenos Aires University (UBA)	Conducts research and academic programmes including renewable energy and hydrogen.
PRIVATE	
Hydrogen Cluster of Argentina	Coalition of private companies and stakeholders advocating for hydrogen adoption and project collaboration.
Consortium H2AR	A consortium of public and private-sector stakeholders working to promote green hydrogen in Argentina.
Argentine Chamber of Biofuels	Supports the integration of Argentina's biofuels and renewable energy market.
AHK Argentina	Fosters partnerships between Argentina and Germany in the green energy sector, including hydrogen.
Private companies	Active in several Argentine industrial sectors, some with local production, others with distribution and commercialisation. E.g. Siemens Energy, Air Liquide, Yara, Toyota Argentina.

Source: Authors' own compilation, Fichtner (2025)

Annex 11 Techno-economic calculations

Parameter	Value
Equity cost (%)	19
Debt interest rate (%)	23
Debt tenor (years)	10[9]
Debt-to-Equity ratio (%/%)	80/20
Project lifetime (years)	25
Electricity price (Feed in tariff) (USD/kWh)	0.1
Water cost (USD/metric tonnes)	2.16
Grey hydrogen benchmark price (USD/kg)	10.83
Oxygen selling price (USD/kg)	0.57
Ammonia price (USD/kg)	1.62[10]
Corporate tax rate (%)	35

9 For big scale projects it is 6.49USD/kg
10 For big scale project it is 1.23USD/kg

Source: Analyses performed by GIZ (2025)

Bibliography

abc. (2022). *1,100 toneladas de vidrio al día.* Retrieved February 2025, from https://www.abc.com.py/mercado-inmobiliario/2022/12/16/1100-toneladas-de-vidrio-al-dia/

Aceites del Valle. (2025). *Productos.* Retrieved February 2025, from https://www.aceitesdelvalle.com/es/productos

AGD. (2025). *Commodities.* Retrieved February 2025, from https://www.agd.com.ar/es/commodities#subproductos

Agencia Argentina de Inversiones y Comercio Internacional. (2023). *Aceite comestible.* Retrieved February 2025, from https://www.inversionycomercio.ar/pdf/publicaciones/informe_ACEITE%20COMESTIBLE.pdf

aluar. (2025). *Descripción de la empresa.* Retrieved February 2025, from https://www.aluar.com.ar/seccion/descripci-n-de-la-empresa/2/32

Aprea, J. L. (2008). *Hydrogen energy demonstration plant in Patagonia: Description and safety issues. International Journal of Hydrogen Energy.* From https://www.sciencedirect.com/science/article/abs/pii/S0360319908010768

Aqueduct. (2025). *Water Risk Atlas.* Retrieved February 2025, from https://www.wri.org/applications/aqueduct/water-risk-atlas/#/?advanced=false&basemap=hydro&geoStore=720eb0045e5bf3c9fad8fd338834cb42&indicator=bws_cat&lat=-43.06888777416962&lng=-47.4609375&mapMode=analysis&month=1&opacity=0.5&ponderation=DEF&predefined=f

ARAUCO química. (2024). *Química.* Retrieved February 2025, from https://arauco.com/argentina/marcas/arauco-quimica/

Arcor. (2025). *Arcor en el mundo - Conoce nuestras plantas industriales.* Retrieved February 2025, from https://www.arcor.com/ar/plantas-industriales

argus. (2023). *Argentina sends second economic overhaul bundle.* Retrieved February 2025, from https://www.argusmedia.com/en/news-and-insights/latest-market-news/2522864-argentina-sends-second-economic-overhaul-bundle?utm_source=chatgpt.com

Austin Powder. (2025). *Divisón Explosivos.* Retrieved February 2025, from https://austinpowder.com/argentina/manufacturing/division-explosivos/

Bicego, F. et al. (2018). *Producción de metanol a partir de glicerina.* Retrieved February 2025, from https://ria.utn.edu.ar/server/api/core/bitstreams/bf2db0fb-548a-4cab-bbc6-dc55c3767634/content

Boletín Oficial de la República Argentina. (2015, October 15). *Modificación a la Ley 26.190 de Régimen de Fomento Nacional para el uso de Fuentes Renovables de Energía destinada a la Producción de Energía Eléctrica. / Ley 27.191.* Retrieved October 2024, from https://www.boletinoficial.gob.ar/detalleAviso/primera/134540/20151021

Boletín Oficial de la República Argentina. (2017, December 29). *Ley 27.430 Título IV. Modificación a la Ley 23.966 Impuestos sobre los combustibles líquidos y al dióxido de carbono.* Retrieved October 2024, from https://www.boletinoficial.gob.ar/detalleAviso/primera/176831/20171229

Boletín Oficial de la República Argentina. (2017, December 27). *Régimen de fomento a la generación distribuida de energía renovable entregada a la red eléctrica pública / Ley 27424/2017.* Retrieved October 2024, from https://www.boletinoficial.gob.ar/detalleAviso/primera/176726/20171227

Boletín Oficial de la República Argentina. (2019, December 20). *Ley de presupuetos mínimos de adaptación y mitigación al cambio climático global - Ley 27520/2019.* Retrieved October 2024, from https://www.boletinoficial.gob.ar/detalleAviso/primera/224006/20191220

Bressan, L. et al. (2009). *Hydrogen generation for modern refineries.* Retrieved November 2024, from https://www.digitalrefining.com/article/1000044/hydrogen-generation-for-modern-refineries

Bunge. (2024). *Somos Bunge / Historia.* Retrieved February 2025, from https://bunge.ar/Somos-Bunge/Historia

CAASA. (2025). *Inicio / Procesos.* Retrieved February 2025, from https://caasa.com.ar/#procesos

Camilo Ferrón. (2025). *Productos.* Retrieved February 2025, from https://www.ferronargentina.com/productos

Cargill. (2025). *Alimentos y bebidas.* Retrieved February 2025, from https://www.cargillargentina.com.ar/es/alimentos-y-bebidas

ClimateTracker. (2024). *Javier Milei y su mega decreto: Dónde queda la transición energética?* Retrieved October 2024, from https://climatetrackerlatam.org/historias/javier-milei-y-su-mega-decreto-donde-queda-la-transicion-energetica/

Coal Price. (2024). *Steam Coal Price.* Retrieved October 2024, from Coal Price: https://coal-price.com/

datos.gob.ar. (2022). *Refinerías de hidrocarburos.* Retrieved February 2025, from https://datos.gob.ar/dataset/energia-refinerias-hidrocarburos

Durax. (2025). *250,000 unidades x día.* Retrieved February 2025, from https://vajillasdurax.com.ar/inicio.html

Egramar. (2025). *Quienes somos.* Retrieved February 2025, from https://www.egramar.com/quienes_somos.php

EMIS. (2024). *Aceitera Martinez S.A. (Argentina).* Retrieved February 2025, from https://www.emis.com/php/company-profile/AR/Aceitera_Martinez_SA_en_1100084.html

Enaex. (2025). *Enaex near you - Enaex Argentina Scope.* Retrieved February 2025, from https://www.enaex.com/ar/us/enaex-argentina-scope/

ENRE. (2024). *Cuadro Tarifario - Período 11/2024.* Retrieved November 2024, from https://www.enre.gov.ar/web/TARIFASD.nsf/todoscuadros/7BA08F824E09B70103258BA800672043?opendocument

Exchange-Rates.org. (2024). *Trusted Currency Converter For Accurate Exchange Rates.* Retrieved September 2024, from https://www.exchange-rates.org/

Fertilizar. (2024). *Evolución consumo de fertilizantes en Argentina.* Retrieved February 2025, from https://fertilizar.org.ar/wp-content/uploads/2024/07/EVOLUCION-CONSUMO-DE-FERTILIZANTES-EN-ARGENTINA-2023.pdf

Fertilizar. (2025). *Estadisticas generales del mercado de fertilizantes en Argentina.* Retrieved February 2025, from https://fertilizar.org.ar/estadisticas/

Fuel Cells and Hydrogen Observatory. (2021). *Chapter 2 - 2021 Hydrogen supply and demand.* Retrieved January 2025, from https://observatory.clean-hydrogen.europa.eu/sites/default/files/2023-05/Chapter-2-Hydrogen-Supply-and-Demand-2021.pdf

GBR. (13 de January de 2023). *Global Business Reports - Interviews.* Retrieved February 2025, from Javier Sato - CEO Petrocuyo: https://www.gbreports.com/interview/javier-sato#:~:text=Petrocuyo%20has%20an%20annual%20capacity,30%2C000%20t%2Fy%20of%20compounds.

Glass-International. (2017, February). *South America: a glass-making hub. A global review of glassmaking, 40(2).* Retrieved February 2025 , from Javier Sato - CEO Petrocuyo: https://www.gbreports.com/interview/javier-sato#:~:text=Petrocuyo%20has%20an%20annual%20capacity,30%2C000%20t%2Fy%20of%20compounds.

Global Solar Atlas. (2024). *https://globalsolaratlas.info/map?c=11.523088,8.4375,3.* Retrieved December 2024, from https://globalsolaratlas.info/map?c=11.523088,8.4375,3.

Global Trade Alert. (2023). *Argentina: Government proposes a new law for incentivising projects in the hydrogen sector.* Retrieved October 2024, from https://www.globaltradealert.org/state-act/76561/argentina-government-proposes-a-new-law-for-incentivising-projects-in-the-hydrogen-sector

Grabya. (2025). *Grabya Srl Bienvenidos - Edible Fats - Margarines and fats.* Retrieved February 2025, from http://www.grabyasrl.com.ar/index.html

Hebos. (2025). *Aceites / Productos grasos / Margarinas.* Retrieved February 2025, from http://hebos.com/

HVH. (2024). *GIZ y RP Global se unen en el Programa H2Uppp de BMWK para desarrollar una cartera de proyectos de hidrógeno verde en el sur de Argentina.* Retrieved February 2025, from https://hidrogenoverdehoy.com.ar/giz-y-rp-global-se-unen-en-el-programa-h2uppp-de-bmwk-para-desarrollar-una-cartera-de-proyectos-de-hidrogeno-verde-en-el-sur-de-argentina/

iae. (2022). *Actividad petroquímica en la Argentina y Bahía Blanca.* Retrieved February 2025, from https://creebba.org.ar/iae/iae179/1_petroquimica_IAE_179.pdf

IAE. (2024). *Informe de tendencias energéticas abril 2024.* Retrieved October 2024, from https://www.iae.org.ar/wp-content/uploads/2024/05/Informe-de-tendencias-Abril.pdf

ICAP. (2024). *International Carbon Action Partnership.* Retrieved October 2024, from Emissions Trading Worldwide: 2024 ICAP Status Report: https://icapcarbonaction.com/en/publications/emissions-trading-worldwide-2024-icap-status-report

IEA. (2021). *National Programme for Distributed Generation (Law 27424).* Retrieved October 2024, from Policies: https://www.iea.org/policies/13020-national-programme-for-distributed-generation-law-27424

IEA. (2024a). *Argentina.* Retrieved October 2024, from Energy system of Argentina: https://www.iea.org/countries/argentina

IEA. (2024b). *Global Hydrogen Review 2024.* Retrieved November 2024, from https://iea.blob.core.windows.net/assets/89c1e382-dc59-46ca-aa47-9f7d41531ab5/GlobalHydrogenReview2024.pdf

IEA. (2024c). *Law 27.191 Program to Promote the Use of Renewable Energy in Electricity Generation.* Retrieved October 2024, from https://www.iea.org/policies/6129-law-27191-program-to-promote-the-use-of-renewable-energy-in-electricity-generation

IEA. (2024d). *Law 27.430 on taxing Liquid Fuels and Carbon Dioxide.* Retrieved October 2024, from Policies: https://www.iea.org/policies/19277-law-27430-on-taxing-liquid-fuels-and-carbon-dioxide

INDEC. (2024). *Estadísticas de Productos Industriales.* Retrieved February 2025, from https://www.indec.gob.ar/ftp/cuadros/economia/epi_03_24.pdf

infobae. (2024a). *Por la caída de la demanda de sus productos, Acindar volverá a paralizar su producción.* Retrieved February 2025, from https://www.infobae.com/economia/2024/06/18/por-la-caida-de-la-demanda-de-sus-productos-acindar-volvera-a-paralizar-su-produccion/

infobae. (2024b). *Reversión del Gaosducto Norte: finalizó un tramo de la obra que terminará con la importación de gas desde Bolivia.* Retrieved November 2024, from https://www.infobae.com/economia/2024/08/22/reversion-del-gasoducto-norte-finalizo-un-tramo-de-la-obra-clave-para-que-el-gas-de-vaca-muerta-llegue-a-siete-provincias/#:~:text=Reversi%C3%B3n%20del%20Gasoducto%20Norte%3A%20finaliz%C3%B3%20un%20tramo%20de,el

Inspenet. (2023). *Argentina's first green hydrogen plant will be ready in 2027.* Retrieved February 2025, from https://inspenet.com/en/noticias/first-hydrogen-plant-argentina-2027/

International PtX Hub. (2024). *Análisis de la infraestructura portuaria del litoral patagónico de Argentina para el desarrollo de proyectos de hidrógeno verde y Power-to-X (PTX).* Retrieved October 2024, from https://ptx-hub.org/wp-content/uploads/2024/05/International-PtX-Hub_202405_Ports-Infrastructure-Argentina.pdf

IRENA. (2021). *Innovation Outlook: Renewable Methanol.* Retrieved November 2024, from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jan/IRENA_Innovation_Renewable_Methanol_2021.pdf

Methanol Institute. (2024). *Methanol Price and Supply/Demand.* Retrieved from Methanol Institute: https://www.methanol.org/methanol-price-supply-demand/

Ministerio de Ambiente y Desarrollo Sostenible. (2020). *Argentina's Second Nationally Determined Contribution.* Retrieved October 2024, from unfcc.int > nationally determined contributions: https://unfccc.int/sites/default/files/NDC/2023-12/Argentinas%20Second%20NDC.pdf

Ministerio de Economía. (2023). *Ley Promoción del hidrógeno de bajas emisiones de carbono y otros gases de efecto invernadero.* Retrieved October 2024, from República Argentina - Poder Ejecutivo Nacional: https://www4.hcdn.gob.ar/dependencias/dsecretaria/Periodo2023/PDF2023/TP2023/0005-PE-2023.pdf

Ministerio de Economía Argentina - Secretaría de Energía. (2023a). *Plan Nacional de Transición Energética a 2030 (PTE 2030).* Retrieved October 2024, from Legislación y Avisos Oficiales: https://www.boletinoficial.gob.ar/detalleAviso/primera/289826/20230707

Ministerio de Economía Argentina - Secretaría de Energía. (2023b). *Lineamientos y escenarios para la transición energética a 2050.* Retrieved October 2024, from Argentina.gob.ar - Resolución 518/2023: https://www.argentina.gob.ar/normativa/nacional/resoluci%C3%B3n-518-2023-386322

Neil N. Davis, J. B. (2024). *globalwindatlas.* Retrieved December 2024, from globalwindatlas: https://globalwindatlas.info/en/

Nestlé. (2025). *Cuántas fábricas tienen en Argentina?* Retrieved February 2025, from https://www.nestle.com.ar/%C2%BFcu%C3%A1ntas-f%C3%A1bricas-tienen-en-argentina

OEC. (2024). *Argentina.* Retrieved October 2024, from The best place to explore trade data: https://oec.world/en/profile/country/arg?yearlyTradeFlowSelector=flow0

OpenStreetMap. (2024). *Argentina.* Retrieved October 2024, from Open Street Map: https://download.geofabrik.de/

Petroken. (2024). *About Us.* Retrieved February 2025, from https://petroken.lookchem.com/About.html

Prodalsa. (2025). *Prodalsa - La empresa.* Retrieved February 2025, from www.prodalsa.com

Profertil. (2024). *Quienes somos.* Retrieved February 2025, from https://www.profertil.com.ar/index.php/quienes-somos

RDC. (2025). *Cómo producimos.* Retrieved February 2025, from https://www.rdcindustrial.com.ar/como-producimos

Refinería Sudamericana. (2025). *Líderes en la industria alimentaria Argentina.* Retrieved February 2025, from https://refineriasudamericana.com/

Renewables Now. (2024). *Germany backs RP Global's green H2, ammonia giga-project in Argentina.* Retrieved February 2025, from https://renewablesnow.com/news/germany-backs-rp-globals-green-h2-ammonia-giga-project-in-argentina-874651/?utm_source=chatgpt.com

Rigolleau. (2025). *rigolleau Somos parte de tu vida.* Retrieved February 2025, from https://www.rigolleau.com.ar/

RisBio. (2025). *Prodcutos.* Retrieved February 2025, from https://www.risbionutricion.com.ar/productos.html

Rizobacter. (2024). *Rizobacter en cifras.* Retrieved November 2024, from https://rizobacter.com.ar/es/rizobacter-en-cifras

Secretaría de Asuntos Estratégicos. (2023). *Estrategia Nacional para el Desarrollo de la Economía del Hidrógeno.* Retrieved October 2024, from https://www.argentina.gob.ar/sites/default/files/2023/07/estrategia_nacional_de_hidrogeno_-_sae.pdf

Secretaría de Energía. (2024). *Balances energéticos.* Retrieved October 2024, from http://datos.energia.gob.ar/dataset/balances-energeticos

Secretaría de Energía. (2024). *Precios de Gas Natural - Res 1/2018.* Retrieved November 2024, from https://apps.energia.gob.ar/viz_3/pgas.php

Semiconductor Digest. (2018). *EUV lithography adds to increasing hydrogen demand at leading-edge fabs.* Retrieved January 2025, from https://sst.semiconductor-digest.com/2018/03/euv-lithography-adds-to-increasing-hydrogen-demand-at-leading-edge-fabs/?utm_source=chatgpt.com#

Smith, C. (2019). *Current and future role of Haber–Bosch ammonia in a carbon-free energy landscape.* Retrieved November 2024, from Royal Society of Chemistry: https://pubs.rsc.org/en/content/articlehtml/2020/ee/c9ee02873k

Swagath, B. (2021). *NS Energy.* Retrieved October 2024, from Fortescue Metals to invest $8.4bn in green hydrogen project in Argentina: https://www.nsenergybusiness.com/company-news/fortescue-metals-8-4bn-green-hydrogen-project-argentina/

Tanoni Hnos. (2025). *Empresa - Cifras.* Retrieved February 2025, from https://tanoni.com.ar/empresa/

Tenaris. (2024). *Tenaris debuts Consteel technology for cleaner steelmaking in Argentina.* Retrieved February 2025, from https://www.tenaris.com/en/news/2024/consteel-furnace-in-siderca

Ternium. (2023). *New projects on the horizon.* Retrieved February 2025, from https://www.ternium.com/en/media/news/new-projects-on-the-horizon--19484397023

Ternium. (2025). *Made of steel / Global Presence / Argentina / Production plants.* Retrieved February 2025, from https://www.ternium.com/en/made-of-steel

UFK-Garantien.de. (2025). *Untied Load Guarantees at a glance.* Retrieved January 2025, from https://www.ufk-garantien.de/en/products/guarantees/for-untied-loan-guarantees/untied-loan-guarantees.html

Unipar. (2023). *Reporte de Sustentabilidad 2023.* Retrieved February 2025, from https://unipar-institucional-prd.s3.sa-east-1.amazonaws.com/downloads_list_item/4078-unipar__r_s_2023__e_s_p__d2.pdf

Verallia. (2025). *Verallia en cifras.* Retrieved February 2025, from https://ar.verallia.com/s/?language=es_AR

Wasserstoff Kompass. (2022). *Wasserstoff im Stahlsektor - Factsheet.* Retrieved January 2025, from https://www.wasserstoff-kompass.de/fileadmin/user_upload/img/news-und-media/dokumente/Fact_sheet_Stahl.pdf

WITS. (2025). *Argentina Hydrogen peroxide imports by country in 2023.* Retrieved February 2025, from https://wits.worldbank.org/trade/comtrade/en/country/ARG/year/2023/tradeflow/Imports/partner/ALL/product/284700

World Bank. (2024a). *Argentina.* Retrieved November 2024, from https://data.worldbank.org/country/argentina

World Bank. (2024b). *State and Trends of Carbon Pricing Dashboard.* Retrieved October 2024, from World Bank Group: https://carbonpricingdashboard.worldbank.org/compliance/price

World Steel Association. (2024). *Total production of crude steel.* Retrieved November 2024, from https://worldsteel.org/data/annual-production-steel-data/?ind=P1_crude_steel_total_pub/CHN/IND

YPF Quimica. (2024a). *About us - Chemistry is everywhere, so are we.* Retrieved February 2025, from https://quimica.ypf.com/english.html?utm_source=chatgpt.com#quienes

YPF química. (2024b). *Productos.* Retrieved February 2025, from https://quimica.ypf.com/

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Project Development Programme (PDP)
Köthener Str. 2–3
10963 Berlin, Germany
T +49 30 – 40 81 90 – 219/285
F +49 30 – 40 81 90 – 109

E pep@giz.de
I www.giz.de/en

Programme/project description
Project Development Programme (PDP)

Authors
Fichtner GmbH & Co. KG
Stuttgart, Germany

Responsible/Editor
Anja Wucke, Paula Alfonso and Andres Agosti

Design/Layout
DITHO Design GmbH, Cologne

On behalf of
German Energy Solutions Initiative of the
German Federal Ministry for Economic Affairs and
Energy (BMWE), Berlin
Department VB4 German Energy Solutions Initiative, Market Entry
Programme Berlin

Berlin, 2025

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Sitz der Gesellschaft / Registered offices
Bonn und Eschborn / Bonn and Eschborn

Friedrich-Ebert-Allee 36 + 40
53113 Bonn, Deutschland / Germany
T +49 228 44 60-0
F +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1 - 5
65760 Eschborn, Deutschland / Germany
T +49 61 96 79-0
F +49 61 96 79-11 15

E info@giz.de
I www.giz.de/en