

The Road to Net Zero in Latin America:

Opportunities for investors, energy companies, and suppliers in the region

By Americas Market Intelligence

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About AMI

Americas Market Intelligence (AMI) is the leading market intelligence firm for Latin America and a celebrated thought leader in the LAC energy industry. In both the renewable and the conventional energy spaces, AMI is a unique source of regional knowledge and analysis for the emerging technologies that will shape the industry over the next 30 years.

Beyond solar and wind, AMI's energy expertise extends to biomass, hydrogen power, energy storage, oil and gas, transmission, power distribution, and e-mobility. AMI has project experience in over 20 jurisdictions in the Americas and its customized research reports deliver data-driven clarity and granular strategic direction based on expert sourcing.

Jointly led by Arthur Deakin and John Price, AMI's energy practice is focused on helping energy operators, institutional investors, and others make informed decisions that will help them generate shareholder profits while creating a positive impact for local communities. AMI's consultants help clients navigate the unique energy landscape in Latin America and compete in a rapidly evolving environment.

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I. Prologue

With the war in Ukraine, the threat of climate change, and a global economy that is outpacing the supply of energy, AMI decided to conduct a deep dive into the six main Latin American energy markets to identify opportunities and challenges that will arise from the region's transition to net zero. As fuel prices reach record highs and droughts plague the region, energy security during this time of transition has become paramount. Latin America's abundant resources, both in terms of renewable and conventional energy, will serve as an important foundation for newly installed capacity in the Western Hemisphere. Whether they leverage green hydrogen and liquefied natural gas (LNG) exports or distributed generation and biomethane, both investors and operators alike will find opportunities throughout the entire energy supply chain.

Going further

While we hope that our whitepaper will highlight the implications of a net zero world in the region's main energy sectors, this space is rapidly evolving, and many key questions remain unanswered:

- Among the 100+ renewable projects under construction in Latin America, which assets will offer the best risk-adjusted returns in the region?
- With energy companies at the center of the biggest corruption scandal in Latin America (Lava Jato), how do foreign companies avoid picking the wrong local partner and falling into the trap of systemic corruption?

- Backed by the nationalist ideologies of AMLO, the Comisión Reguladora de Energía (Energy Regulatory Commission or CRE) is suing privately owned Iberdrola for nearly half a billion dollars. Which companies in the region are the most likely to experience politically motivated lawsuits and interference?
- Will access to cheap renewable energy and favorable regulatory frameworks be enough for green hydrogen development to take off in the region?

Further research will answer these and other key strategic questions. AMI's experience in the energy space—which includes studies in over 20 Latin American jurisdictions conducted over the past 20 years—can help your company understand both current and future developments that can in turn inform your future strategies.

Please feel free to contact this whitepaper's authors or AMI directly at info@americasmi.com to find out more about how our teams of consultants placed across Latin America can conduct research studies, perform due diligence, monitor ongoing risks in markets, and advise your firm on your energy investments and developments in Latin America.

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II. Executive Summary

Weaning the world off dirty fossil fuels, a.k.a., the **road to net zero** emissions, is perhaps the most challenging task our society has ever faced. By 2030, it will require more than US\$2 trillion in annual investments in both conventional and renewable energy, ranging from green hydrogen to LNG.¹ In this whitepaper we focused on region-wide trends before delving into specific investment opportunities, challenges, and roadblocks in the six main energy markets of Latin America. Here is a quick breakdown of what investors should focus on in each market:

In **Brazil**, a land in which individual states are larger than entire countries, the opportunities within the energy transition are diverse and geographically widespread. Among renewables, PV distributed generation continues to be an attractive segment even with the phasing out of subsidies for projects approved after 2022. Investors and operators looking to secure a favorable taxation regime through 2048 should obtain project approval from Aneel before the end of this year. The privatization of Eletrobras means there are also cheap assets for sale in the generation, transmission, and distribution space—but expect competition as foreign investors swoop in to secure projects before the presidential elections. Within the conventional energy space, the natural gas market has opened more slowly than expected after a landmark bill broke Petrobras' monopoly, but biogas projects are gaining popularity due to a recent incentive program and large domestic feedstocks. And although Brazil's high-quality crude could serve as a good substitute for Russian oil in Europe, recent pre-salt discoveries have been few and far between.

Mexico has had the most controversial and volatile energy sector in the region for the past three years. AMLO, Mexico's president, has done all he can to prop up state-owned companies at the expense of private energy operators. Despite Mexico's world-class solar and wind potential in Baja California and Oaxaca, AMLO passed a law (now suspended, pending legal review) that would prioritize energy dispatched by state-owned CFE over independent power producers. Investments in Mexico's renewable space are not advised at this moment. In the conventional energy sector, AMLO is also restricting private competition. There is some potential for LNG export terminals in the Pacific coast to substitute Russian LNG in global markets, but they would require a public-private partnership (PPP) and a careful evaluation of the market demand. These assets, which often have a shelf life of 50 years, would need to be "transition ready" to ensure long-term profitability (i.e., equipped to transport low-carbon fuels such as hydrogen and renewable natural gas).

In **Argentina**, the Peronist administration has adopted an AMLO-esque approach by prioritizing state-owned oil company YPF at the expense of renewable energy development. With the Peronists in power, Vaca Muerta and its surrounding infrastructure (e.g., pipelines) stand out as the most appealing energy play in the country. Argentina's Plan Gas 4 (GasAr) provides operators with billions in subsidies and investor guarantees that mitigate some country risk. Although Vaca Muerta's development will continue independently of the party in power, a likely defeat by the Peronists in the 2023 elections will reignite renewable development in the country, especially in the Patagonia region. By obtaining local community buy-in, securing dollar-denominated PPAs, and rallying government support, wind projects should be a success.

¹ "World Energy Investment 2022." IEA, 22 June 2022.

In **Colombia**, the victory of Gustavo Petro is likely to accelerate the development of renewable generation and low-carbon fuels, such as hydrogen. With Colombia's dwindling gas reserves, inconsistent hydrological conditions, and Petro's expected ban of new oil and gas exploration, the country will need additional installed capacity. This should come mostly from solar and wind projects, but Colombia's slow permitting process and indigenous opposition in La Guajira has delayed development. Careful due diligence in selecting the right location and local partners is a must. Petro's unorthodox economic policies, and the growing role of Ecopetrol, could also lead to the divestment of assets. Investors and operators that are in tune with the market may find cheap opportunities as the *peso* depreciates.

In **Chile**, green hydrogen is attracting foreign stakeholders' attention. Although the country has cheap and abundant renewable power, as well as a favorable regulatory framework, there are limited domestic use-cases for H2, and the electrolysis technology is not yet commercially viable. Export-focused H2 projects are most likely to succeed, but operators should be wary of record droughts creating competition for water and renewable energy. In the energy storage sector, there are 400 MW in projects pending environmental approval, reflecting a prolonged backlog that is lacking regulatory clarity. Understanding when and how this regulation will move forward will allow energy investors and operators to capitalize at the right time.

Although **Peru** is seeking to "massify" its natural gas in the southern regions, obsolete gas tariffs, insufficient pipelines, and increased government scrutiny are hurting the competitiveness of the domestic natural gas market. Outside of natural gas,

there could be a PPP opportunity for liquefied natural gas (LNG) exports to substitute Russian LNG, but it would face a dominant Peru LNG Consortium. On the renewables side, a 2019 regulatory change approved solar and wind as firm power, but the alteration was lopsided in favor of wind projects. For now, wind continues to be the most viable opportunity.

As you can see, each of these markets differs significantly from the others in terms of its growth areas, risks, and roadblocks. More importantly, market and political conditions are constantly changing in all of them. As such, while *The Road to Net Zero in Latin America* will offer you a strong understanding of where this road could take investors and operators, a steady flow of market intelligence will prepare you for the twists, turns, and possible dead ends. Contact us at info@americasmi.com to find out how our team can provide a steady flow of essential insights, data, and crucial context to help you through each phase of an energy project, from determining the market size and feasibility of a technology to ensuring the success of an ongoing operation.

As the world navigates this energy revolution, we will continue to serve energy stakeholders with their market research, due diligence, political intelligence, risk assessment and forecasting needs, we will continue to share our learnings in this exciting space. We welcome your feedback at info@americasmi.com.

III. Glossary

- **Large customers:** Industrial or commercial customers (e.g., automobile, mining, and cement companies) that consume large amounts of electricity, usually above 500 kW of demand.
- **Unregulated market:** The “free” or unregulated market is often restricted to industrial and commercial customers that consume a large amount of electricity. In the free market, they can purchase electricity directly from energy suppliers, generators, or traders.
- **Regulated market:** Unlike free market customers, regulated consumers (often residential and small businesses) demand only small amounts of electricity and can only purchase electricity directly from an energy utility or a company with a distribution concession.
- **Consumers:** Residential customers (e.g., households) and small businesses that use small amounts of electricity and operate in the “regulated” market.
- **Advanced metering infrastructure:** Advanced metering infrastructure is an integrated system of smart meters, communications networks, and data management systems that enables two-way communication between utilities and customers.
- **Carbon offsets:** A reduction or removal of GHG emissions to compensate for emissions made elsewhere. This includes nature-based solutions (e.g., planting trees and repurposing land), utilizing carbon capture technology, and enhancing natural processes (such as using farming methods to increase carbon content in soil).
- **Demand-side flexibility:** The portion of demand in the system (including via electrified heat and transport) that can be reduced, increased, or shifted within a specific duration.
- **Independent power producer:** Private entities that own and/or operate facilities to generate electricity and then sell it to a utility, governments, and other end users.
- **Non-Conventional Renewable Energy (NCRE):** Energy sources that are not depleted, such as geothermal, wind, solar, tidal, biomass, and small hydroelectric plants. This excludes large-scale hydro plants, coal, gas, and diesel/oil.
- **Pool price:** The pool price is the dollar cost of a megawatt hour of electricity at the end of a given hour that is paid to electricity generators for supplying electricity to retailers.
- **Power purchasing agreement (PPA):** A contract between a producer of energy and a customer.
- **Paris Agreement:** An international climate change treaty between 180+ countries that aims to limit the rise in mean global temperatures to 2°C above pre-industrial temperatures by 2100 (ideally, the limit would be 1.5°C above industrial temperatures).
- **Fossil fuels:** Energy source that is formed in or on the earth’s crust and burned as fuel (e.g., oil, coal, natural gas). Emits carbon emissions when burned.
- **Carbon footprint:** Total greenhouse gas emissions emitted by a source.
- **Net zero:** The objective of negating greenhouse gas emissions (i.e., if you are emitting 5 tons of GHG, then you must account for the removal of 5 tons).
- **Electrification:** The process of replacing technologies using fossil fuels with technologies powered via electricity (e.g., electric vehicles, electric stoves).
- **Energy efficiency:** Using less energy to perform the same task (e.g., smart meters, smart thermostats, regulations).

IV. Introduction

A. Latin America's role in the energy transition

1. Renewable energy projects become cost-effective in most of the world

Since the first half of 2018, the Levelized Cost of Energy (LCOE) for renewable plants—a metric used to measure the long-term costs of building a project—dipped below that of coal-fired power plants for the first time in history. Now, two-thirds of the world's inhabitants live in countries where either solar or wind power is the cheapest source of new power generation.² Although coal still accounts for 27% of the world's raw energy consumption, investors and consumers have increasingly shied away from this type of fossil fuel.³ The United States' shale boom in 2009, which tripled the country's gas reserves and cheapened access to natural gas, also accelerated the transition away from coal.⁴

Across the globe, subsidies for renewable energy have made solar and wind technologies more affordable. For every doubling of cumulative production, the unit price dropped by almost 30%—in line with what the industry calls the “experience curve.” Between 2020 and 2026, global renewable energy capacity is estimated to increase by 60% and will account for nearly 95% of new global power capacity.⁵

With the fall of renewable energy costs across the globe, many developed countries have started to

reduce subsidies for their renewable projects. Spain, whose non-conventional renewable energy (which excludes large-scale hydro) already accounts for most of its installed capacity, began cutting its subsidies as early as 2010.⁶ In the United States, two important wind and solar tax credits were set to end in 2020 and 2022, respectively. In December 2020, the U.S. Congress passed a bill to extend its wind production tax credit to 2021 and extend the Investment Tax Credit for solar power until 2024.⁷ Although the legislature granted these last-minute extensions, it is now realizing that renewable energies are competitive without subsidies. (The United States government has been granting tax credits for renewable energy developments since 1970.)

The phasing out of renewable subsidies is not yet happening in many countries in Latin America, which rely mostly on large-scale hydro, coal, and thermal generation for their energy supplies. **The fiscal incentives for non-conventional renewable projects in Latin America, coupled with the region's rich renewable resources, make it one of the most appealing growth opportunities in the global energy industry.**⁸ As seen in Figure 1 on page 10, Latin America has one of the lowest renewable energy generation cost structures in the world, making renewables an attractive option for governments looking to add green capacity while simultaneously lowering costs for consumers.

² “Mexican renewables costs starting to compete with fossil fuels.” *BN Americas*, 22 July 2020.

³ “Time to make coal history.” *The Economist*, 3 December 2020.

⁴ “The New Map: Energy, Climate, and the Clash of Nations.” Daniel Yergin, 15 September 2020.

⁵ “Renewables 2021.” *IEA*, December 2021.

⁶ “Renewables represent 52% of total installed in mainland Spain.” *Renewables Now*, 16 March 2020.

⁷ “Congress Passes Spending Bill With Solar, Wind Tax Credit Extensions and Energy R&D Package.” *Greentech Media*, 22 December 2020.

⁸ “Energy Transformation: Latin America and the Caribbean.” In *Global Renewables Outlook: Energy transformation 2050*. *IRENA*, 2020. ISBN: 978-92-9260-238-3.

Figure 1: Average onshore wind and solar price, USD per MWh, by region and 2022 commissioning date

Region	Onshore wind	Solar
Latin America	\$20	\$35
Middle East*	\$28	\$22
North America**	\$29	\$29
Europe	\$36	\$66
Asia-Pacific**	\$40	\$36

* Latest data available is for wind projects commissioned for 2021 or earlier

** Latest data available is for solar projects commissioned for 2021 or earlier

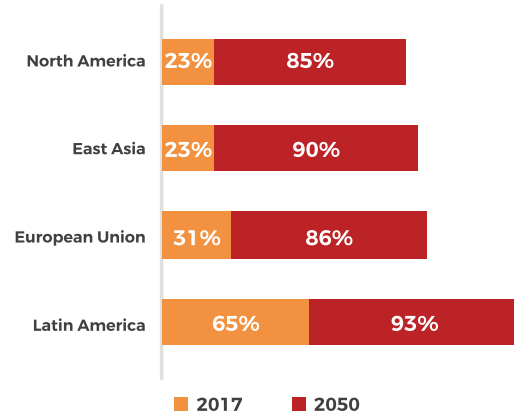
Source: International Energy Agency (IEA)

Latin America's sizeable middle class, combined with an increasingly urbanized and modernized society, will also drive up energy consumption in the region. In fact, Latin America's renewable energy sector is expected to reach 325 GW of installed wind and solar capacity by 2050, a nearly five-fold growth compared to 2020.⁹ In the "Transforming Energy Scenario (TES)," developed by the International Renewable Energy Agency (IRENA), as seen in Figure 2 on the right, renewable energy generation would account for 93% of power generation in Latin America in 2050, up from 65% in 2017. This outsized participation, when compared to other regions, is due to hydropower's large involvement in Latin America's energy matrix.

However, when looking at power generation solely via conventional renewable energy (e.g., solar, wind, geothermal and biomass), only Brazil and Chile are above the global average, which stood at 9% in 2020. As seen in Figure 3, non-conventional renewable energy (NCRE) generation in markets such as Mexico, Peru, Argentina and Colombia are far from where they need to be.

⁹ Installed electricity capacity in the region for 2020 was 54.8 GW, according to the International Renewable Energy Agency (IRENA).

Figure 2: Renewable energy share* in power generation, 2017 vs 2050, by region

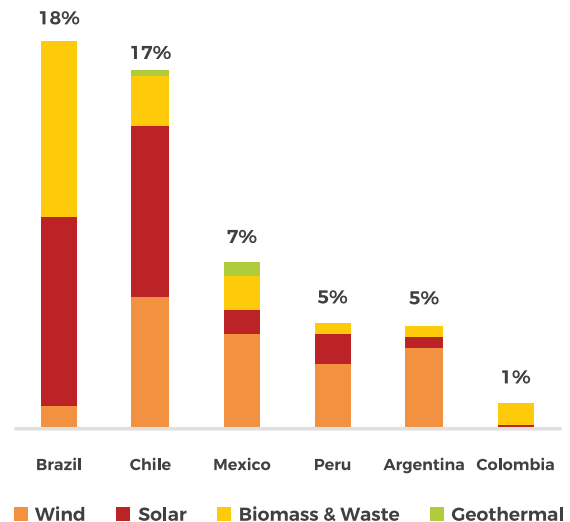


Source: Global Renewables Outlook: Energy Transformation 2050

*This includes hydropower

Note: These percentages are based on IRENA's Transforming Energy Scenario, in which the global energy system is aligned with keeping temperatures well below 2°C above industrial temperatures.

Figure 3: Percentage of power generation that is NCRE in Latin America, by market, 2019



Source: BloombergNEF

2. “Greening” the supply chain: From green bonds to a circular economy

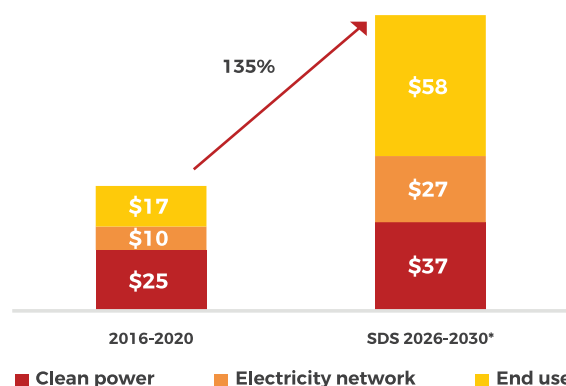
With thousands of pledges to reach net zero by mid-century, companies are seeking to “green” their entire supply chains. To do so, they aim to cut emissions throughout their operations by powering their factories via clean energy, implementing carbon-capture technologies, and reusing some of their waste. This is complemented by the issuance of green bonds to fund new and existing ventures. This financing instrument is used to establish sustainable metrics among investments or to directly fund environmentally friendly projects. In Mexico, for example, CEMEX created a sustainability-linked framework aligned with three undisclosed KPIs that seek to deliver net-zero concrete by 2050. This US\$3.2 billion green financing deal involves favorable interest rates that are contingent upon the company achieving those KPIs.¹⁰

Both globally and in the region, investor appetite for green bonds skyrocketed in 2020 and 2021. In February 2020, *Bloomberg* reported that green bonds were “selling like ice cream on a hot day.”¹¹ Six months later, Mexico’s Coca-Cola FEMSA issued a \$705 million green bond deal that was 11 times oversubscribed. Mexico’s first-ever local currency sustainable exchange-traded fund (ETF) also brought in US\$450 million within its first two months, making it one of the quickest-growing ETFs of the year.¹² The ability to drive forward climate-friendly initiatives, while simultaneously financing operations with favorable interest rates, is a blessing for both investors and companies alike.

Yet, despite the increased demand, green bonds still account for less than 1% of the total cumulative bond market.¹³ The International Renewable Energy Agency (IRENA) estimates that clean energy investments must nearly triple annually—to US\$800 billion by 2050—for most countries to meet the Paris Agreement (limiting

temperature increases to 1.5°C above pre-industrial levels). Developing markets face a more dire scenario—they only receive 15% of the total global investment made in renewables.¹⁴

Figure 4: Annual amount needed for the energy transition in Latin America, current vs. future spend



*Spend needed for Latin America to be aligned with the UN’s Sustainable Development Goals
Source: International Energy Agency

With the same objective of reducing carbon emissions, we also see some of the most innovative companies gravitating toward a circular economy in which they reuse the residues from their operations and transform it into energy. In Mexico, Heineken will use its operational residues from its Chihuahua brewery to supply power to nearby factories. It will be the first brewery of its kind in Latin America. In Brazil, agro-industrial companies have signed deals with ZEG (a biogas producer) to keep waste to a minimum. More companies are expected to follow this lead as new technologies facilitate the transformation of waste into power. The pressure to take sustainability to the next level, in this case zero waste, will push more large customers toward this strategy.

Zero waste is a challenging task that requires heavy investment and technological innovations that are not yet proven to work at scale. In the meantime, large customers and suppliers have the option to recycle their materials, source their power from renewable energy, and purchase carbon offsets—reducing carbon dioxide emissions to compensate for emissions released elsewhere.

¹⁰ September 2021, Cemex Press Release. “CEMEX reinforces leadership in green financing presenting Sustainability-Linked Financing Framework.”

¹¹ “Green Bonds Are Selling Like ‘Ice Cream.’ Latin America Wants In.” *Bloomberg*, 24 February 2020.

¹² “Mexican ESG ETF rakes in \$450 million in first two months -BlackRock.” *Reuters*, 6 October 2020.

¹³ “Financing the Global Energy Transformation: Green Bonds.” *IRENA*, 3 March 2020.

¹⁴ “Global Landscape of Renewable Energy Finance 2020.” *IRENA*, November 2020. ISBN: 978-92-9260-237-6.

3. Traditional energy players: The role of major oil companies in the energy transition

In 2020, the big five oil companies—ExxonMobil, Royal Dutch Shell, Chevron, British Petroleum (BP), and Total—lost US\$350 billion in stock market value. ExxonMobil, the largest of them all, was kicked out of the Dow Jones Index after nearly a century among the top industrial firms in the United States.¹⁵ Historic losses brought on by COVID-19, coupled with intense scrutiny from investors, has forced major oil companies to rethink their strategies amidst a transitioning energy sector. These companies slashed jobs, capital expenditures, and dividends, prioritizing strategic assets that can bring them the greatest financial and reputational return in the eyes of investors. **Dirtier, less profitable assets located in more volatile countries, such as Argentina and Mexico, could be key divestment targets.**

For ExxonMobil, those “priority” assets include the pre-salt area in Brazil and the offshore Guyana-Suriname basin. Santos, the largest basin in Brazil’s pre-salt region,

¹⁵ “Big oil’s diverging bets on the future of energy.” *The Economist*, 16 December 2020.

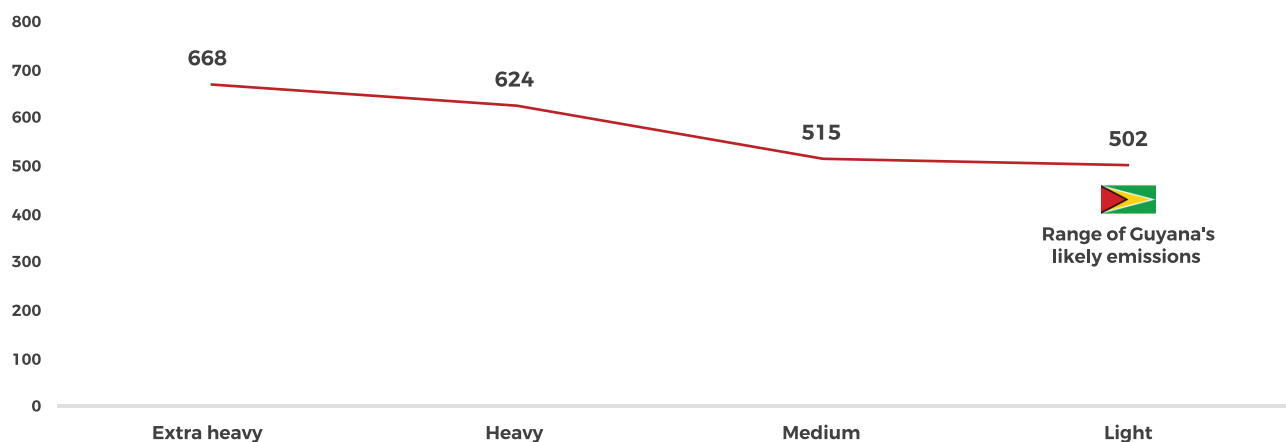
has an estimated 59 billion barrels of recoverable oil, 147 Tcf of gas, and 4 billion bl of NGLs. In the Guyana-Suriname basin the numbers are smaller, but more than 11 billion barrels of oil equivalent have been found there since 2015.¹⁶ Since the discoveries are relatively recent, and have been extremely successful, the actual recoverable reserves in the Guyana-Suriname basin are likely much larger.

In addition to having the largest undiscovered resources in the region, Guyana and Brazil have low break-even costs and produce high-quality crude, a type of oil that is seeing outsized global demand. Since January 2020, the International Maritime Organization has implemented stricter fuel emissions that have accelerated the global transition from heavy to lighter crude. Lighter, sweeter crudes have lower sulfur contents that make them more attractive to refiners that are adapting to these new content regulations. This crude is also cheaper and easier to refine, making it more profitable and less environmentally harmful.¹⁷

¹⁶ US Geological Survey.

¹⁷ “Is Brazil’s Oil Boom In Danger?” *OilPrice.com*, 30 November 2020.

Figure 5: Average greenhouse gas emissions, by type of oil (KG CO₂ equivalent per barrel of crude)



Source: Carnegie Mellon Oil-Climate Index, AMI analysis. The best estimate for Guyana, based on API gravity and sulfur content.

Unlike Guyana and Brazil, there are many large economies in Latin America—such as those of Mexico, Ecuador, Colombia, and Venezuela—whose resources are predominantly composed of a heavier, dirtier crude. These countries will need to adapt their energy production or find new markets willing to consume their products.

The major oil companies are also seeing increased pressure to invest in climate-friendly ventures that are focused on cutting carbon emissions. Some of the pressure is internal, as seen when several clean energy executives quit Shell after disagreeing about the speed of the company's energy transition.¹⁸ Mostly, though, it is external, as large shareholders pressure companies to increase their clean energy presence in search of improved financial returns.

On December 7, 2020, Exxon received a letter from activist investor Engine No. 1 that urged the company to focus more on clean energy.¹⁹ Six months later, after spending US\$30 million in an activist campaign while holding just 0.02% of Exxon's shares, Engine No. 1 elected three of its four proposed candidates to Exxon's board. Its campaign was supported by three of the largest U.S. pension funds, as well as asset managers BlackRock and Vanguard. **The activists' "victory" showed that small shareholders, with the backing of large investors, can have direct influence over the future strategy of the world's largest energy companies.** This will encourage similar efforts in the region and throughout the world.

Meanwhile, in Europe, the majors have declared significant shifts in strategies for the next decade. The European companies realize that they need to adapt to a new energy order, even if it means having to write down some dirtier, less-successful core assets. British Petroleum, the fifth-largest oil company, announced plans to cut oil and gas production by 40% by 2030 while simultaneously increasing investments in low-emission ventures tenfold over the next decade. In September 2020, French Total said it planned to cut oil product sales by 30% by the end of the decade. Unlike Total and BP, which are focused on increasing their renewable energy supply, Shell is targeting the demand side and aims to create a robust electric vehicle charging network.²⁰

18 "Shell executives quit amid discord over green push." *Financial Times*, 8 December 2020.

19 "Exxon faces proxy fight launched by new activist firm Engine No. 1." *Reuters*, 11 December 2020.

20 "Shell sets emission ambition of net zero by 2050, with customer help." *Reuters*, 16 April 2020.

Shell also wants to develop the infrastructure for the consumption of cleaner fuels, seeking to create hydrogen hubs and the necessary foundation to transport low carbon fuels.

In Latin America, these clean-energy efforts are seeing mixed adoption. The major oil companies, most of them state-owned, are pledging to cut greenhouse emissions but have not committed to net zero emissions, nor have they developed renewable energies. They prefer to focus on their core assets and existing areas of expertise. Companies with heavy crude reserves and refineries, such as Pemex and PDVSA, will struggle to compete in a cleaner world. Petrobras, however, has a strategic advantage over many of its competitors because of the medium-to high-quality crude found in its pre-salt reserves.²¹

Studies show that the pre-salt area in Brazil contains 176 billion barrels of undiscovered oil and gas, nearly 18 times the size of Petrobras' reserves at the end of 2019 and by far the most resources in the region. The break-even cost for Petrobras' pre-salt operations is also low, at \$21 a barrel, making its operations profitable even during times of crude declines.²²

By focusing on this sweeter, cleaner crude, Petrobras will be able to shed dirtier assets and use the proceeds from its pre-salt production to accelerate its energy diversification into renewable fuels. In fact, its five-year plan stipulates that nearly 60% of its \$55 billion capex will go to exploration and production of the pre-salt area. Petrobras also plans to invest roughly \$200 million in sustainability by 2025, as it seeks to reduce flaring and cut operational emissions by 25% by 2030.²³

Despite this, Petrobras' environmental efforts fall below par in its distribution, refining, and transportation segments. That is one of the reasons behind the divestment of 10 of the company's 15 refineries, with the remaining 5 being used to optimize capacity and produce renewable diesel. Although they are not quite at European standards, state-owned companies such as Petrobras and Ecopetrol are moving toward clean-energy initiatives. The inability to do so will make it more expensive to raise capital and more difficult to remain profitable.

21 "Reservas provadas de petróleo e gás da Petrobrás são as mais baixas do século." *Estadão*, 18 November 2020.

22 "Is Brazil's Oil Boom In Danger?" *OilPrice.com*, 30 November 2020.

23 "Petrobras aprova plano para 2021 a 2025 com previsão de investir US\$ 55 bi." *Uol*, 26 November 2020.

4. The rise of electrostates: Competition for highly coveted “green” metals

By 2040, electricity consumption in Latin America will grow 45% compared to current levels.²⁴ Most of this energy will be provided by renewables and other clean energy technologies, such as green hydrogen and biomethane. To develop these technologies at such scale, there will be tremendous demand for the minerals used in clean energy (as seen in Figure 6 below). Production of lithium, cobalt, graphite, and vanadium will need to increase exponentially. **In the next 25 years, the world’s copper production will need to equal the same amount it has produced over the past 5,000 years.**²⁵

A major concern is that many of these minerals suffer from market concentration in a few geographic locations. China is by far the largest producer of metals used in solar PV and wind technologies. It produces 70% of the world’s graphite, 80% of rare-earth elements, and 56% of vanadium. It has also established a monopoly over cobalt production in the Democratic Republic of Congo (DRC), where 50% of

²⁴ “Consumers can transform Latin America’s power systems: Here’s how.” *IEA*, 18 February 2021.

²⁵ “Time for a Responsible Clean Energy Supply Chain.” *Foreign Policy*, 14 January 2021.

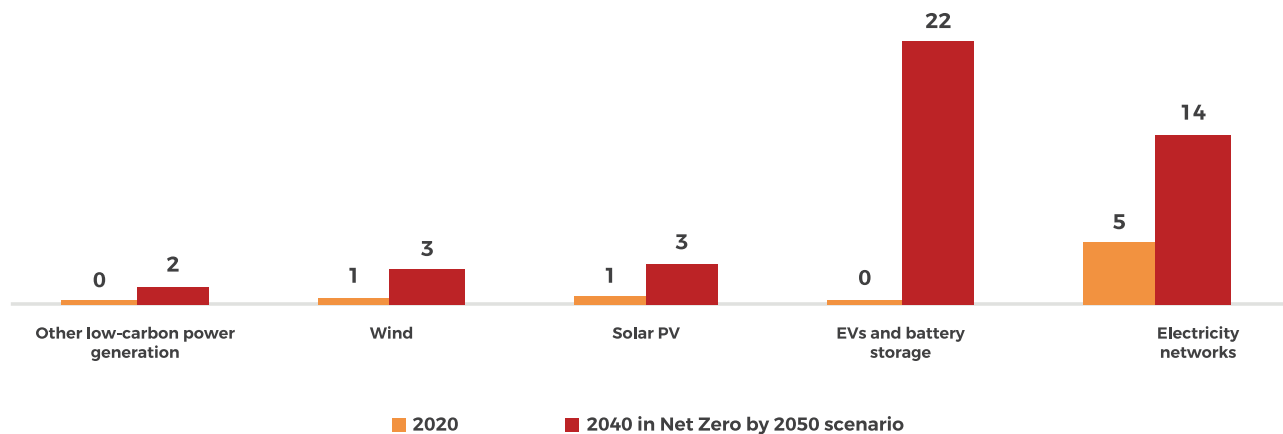
the world’s supply is produced. China Molybdenum Co. owns 80% of the giant copper-cobalt Tenke Fungurume mine and recently dished out \$550 million to acquire a 95% stake in the Kisanfu copper-cobalt mine in the DRC.²⁶

The concerning labor violations in the cobalt mines in the Congo, high costs for the metal, and China’s nearly monopoly on cobalt refining capacity has incentivized battery manufacturers to shift to lithium-ion phosphate batteries that are cobalt-free.

China’s control also goes beyond the production of these minerals. Although countries such as the U.S. and Australia have large reserves of rare earth minerals, they have stricter environmental and labor guidelines that delay the development of processing operations. The United States, for example, lacks the necessary technical expertise for the refining of the minerals, and therefore is forced to send the ore to China to be processed. The IEA estimates that China is responsible for the processing of 85% to 90% of mined rare earths into metals and magnets. China also accounts for 50 to 70% of global lithium and cobalt refining, even though Australia is the largest producer of lithium. This will lead to the creation of an electrostate, which is analogous to the 20th-century “petrostates” that were born as by-products of their large oil reserves.

²⁶ “China Moly buys 95% of DRC copper-cobalt mine from Freeport for \$550 million.” *Reuters*, 13 December 2020.

Figure 6: Total mineral demand for clean energy technologies, 2020 vs 2040, in metric tons



Source: IEA, The Role of Critical Minerals in Clean Energy Transitions.

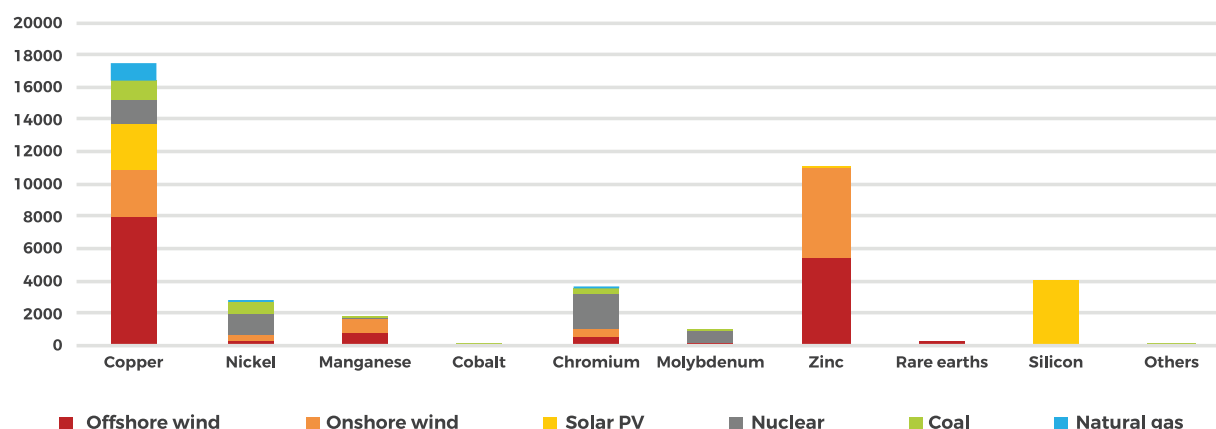
In Latin America, a region known for its rich minerals, there are several jurisdictions that have the potential to become electrostates. Bolivia, Argentina, and Chile are known as the lithium triangle, and process over 50% of global reserves.²⁷ Lithium—mostly used in batteries for electric vehicles and other electronics—will need its annual production to increase by nearly

500% by 2050.²⁸ All three governments within the lithium triangle are urgently seeking to capitalize on their reserves but have struggled to move up the production value chain. Outside of lithium, Peru, Chile, and Brazil have substantial gold, copper, and silver reserves. Brazil, in particular, also owns large nickel and rare earth resources that make it a leading candidate to become a new electrostate.

27 “Explainer: Latin America’s Lithium Triangle.” *AS/COA*, 17 February 2021.

28 World Bank: “Minerals for Climate Action,” based on the IEA’s 2DS.

Figure 7: Minerals used in power generation, in KG/MW



Source: IEA

Over the past decades, market concentration among few geographies has often led to supply chain disruptions as both demand and prices increase. Indonesia, which accounts for 25% of global nickel supply, banned nickel ore exports to increase its domestic smelting capacity. In retaliation for an attack on one of its vessels, China temporarily banned rare earth exports to Japan, increasing prices by 350%. Xi Jinping, as well as other global leaders of emerging electrostates, are likely to keep using their supply chain control to advance political agendas. With the COVID-19 pandemic, supply chain concerns also became more pronounced.

Many of these clean energy minerals are found in developing countries with poor governance and lax laws, allowing for easier extraction of the mineral. To balance the production and processing of these metals, Western economies could seek fairer environmental and labor conditions among Asian mines. If standard environmental regulations are

applied universally, the clean energy mining market will become more competitive, with less risk of environmental contamination.

Pledges by clean energy companies—and financiers—to source projects with 100% responsible supply chains could also help mitigate some of this dangerous market concentration that is subject to manipulation. Consumer-facing companies could particularly benefit the most from such initiatives. This type of pledge would allow them to showcase the origin of their products, increasing the reliability and transparency of a company’s supply chain. This would broaden their consumer impact beyond sales and position them as leaders in promoting fair labor standards, putting them at the forefront of government policymaking.²⁹

29 “Time for a Responsible Clean Energy Supply Chain.” *Foreign Policy*, 14 January 2021.



V. Main trends among Latin America's largest companies

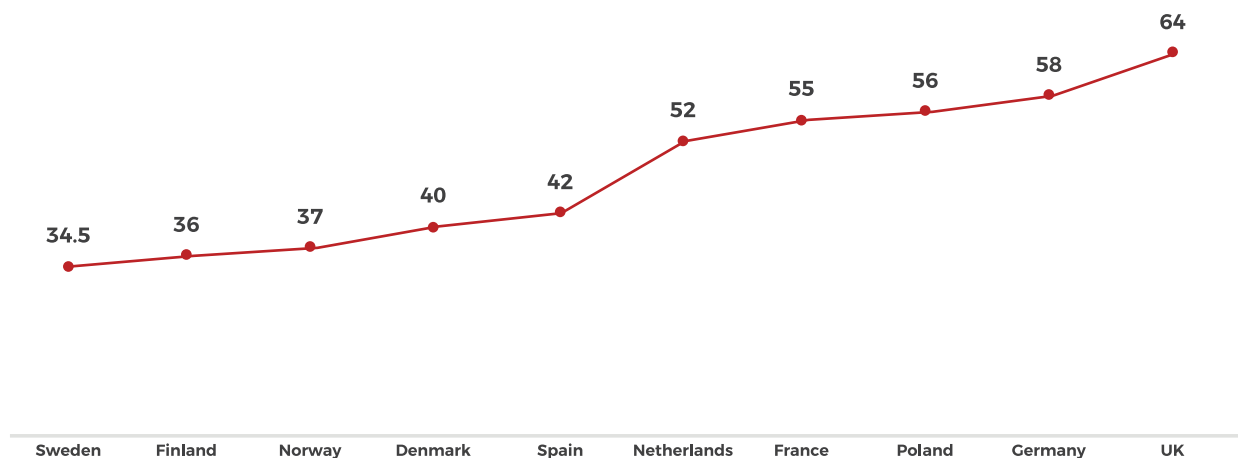
A. Large customers

1. The growing use of PPAs: Corporate, utility, and virtual agreements

Since the early 2000s, we have seen the largest tech companies in the world utilize corporate power purchase agreements (PPAs) to buy renewable energy at pre-defined prices. Corporate PPAs, used by large customers to purchase electricity directly from an energy generator (that is not necessarily licensed like utilities), have risen in popularity in

recent years as companies seek sustainable, long-term power solutions. Corporate PPAs allow large customers to comply with renewable energy targets with a predictable cost. In 2019 alone, corporate PPAs in Latin America amounted to 2 GW of energy, a threefold increase from the year prior. Although there is no data on PPA prices in Latin America, Figure 8 below shows a 7% annual increase in corporate PPA prices for onshore wind in Europe, a by-product of higher commodity costs and long-term unpredictability. This is also happening in Latin America, although the rate is unclear.

Figure 8: Onshore wind, estimated average corporate PPA price in H1 2022, EUR/MWh (nominal)



Source: Bloomberg NEF, AMI estimates.

Dollar-denominated PPAs are also favored among many emerging market “suppliers” (i.e., independent power producers, known as IPPs) because many of their capex expenses are dollarized. In essence, these PPAs reduce exposure to foreign exchange fluctuations and offer a cheap hedge mechanism.³⁰ Countries such as Mexico do not offer dollar-denominated PPAs. But Colombia, Brazil, and Chile, which have more advanced capital markets, financial tools, and stronger energy regulations, are seeing increased adoption of these types of hedge mechanisms. In 2021, Atlas Renewables, a large developer and operator of renewable energy in Latin America, agreed to US\$350 million in dollar-denominated PPAs with large industrial customers in Brazil.

Utility PPAs, in which utilities buy energy from suppliers to distribute to residential or corporate clients, are another common form of long-term power agreement. In contrast to corporate PPAs, the offtaker (the utility company) does not consume the energy itself. Rather, the offtaker delivers the energy to residential and corporate clients or sells it in the wholesale power market. In many cases, renewable energy developers prefer signing agreements with utilities because of their creditworthiness and government backing. The lower risk of working with utilities leads to a cheaper cost of capital, often leading to a lower PPA price.³¹

In jurisdictions where direct retail sales of energy are prohibited or regulations inhibits PPAs, companies often resort to virtual PPAs. Virtual PPAs are a commercial contract in which the corporate “customer” buys energy from a “supplier” at a negotiated rate. However, rather than selling the energy directly to the customer, the supplier sells it to the local grid at a wholesale price. The customer and the seller then settle the difference between the negotiated PPA price and the wholesale price, known as a Contract for Differences (CfD). When the wholesale price rises above the negotiated price, the supplier pays the difference. When the wholesale price is lower, the reverse happens.

Virtual PPAs are appealing because of their flexibility and higher returns. Since no energy is directly exchanged between the supplier and the customer, the two parties don’t need to be in the same

jurisdiction to sign an agreement. The customer also doesn’t have to pay a “sleeving fee” to the utility for feeding the energy into the grid. Moreover, virtual PPAs still count toward the customer’s renewable energy targets as they emit clean energy certificates.³² In fact, over 80% of the PPAs signed in the United States in 2019 were virtual PPAs.³³ In Latin America, the percentage is not as high, but it is expected to increase.

2. Self-generation, peak shaving, and demand-side flexibility: Solutions for large customers to cut costs

To take advantage of special self-generation subsidies, such as discounts for renewable energy feed-in tariffs in Brazil, many large customers resort to leasing, owning, or even operating their own power plants. This type of consumption has increased in popularity as customers seek a sustainable and flexible long-term solution for their energy needs.

There are three main types of self-generation structures:

1. The first one is self-generation in the traditional sense, where the large customer owns and operates a power plant. In Mexico, Grupo Bimbo and Cemex, two of the largest energy customers in the country, resorted to this model. However, since these companies did not operate in the energy sector, they found that the operational aspect was complex and costly, which resulted in them divesting from the plant.
2. The second form is co-generation, in which the customer owns a share of third-party plants in exchange for access to a portion of the energy generated. Vale, the largest mining company in Brazil, implements this model through its partnership with CEMIG, an energy-generation company based in the state of Minas Gerais. Together, they have a portfolio of seven generation plants and one wind farm.

30 “Dollar-indexed PPAs seen gaining ground in Brazil.” *BN Americas*, 29 March 2022.

31 “ICIS Power Perspective: Outlook for utility PPAs in Europe.” *ICIS*, 28 August 2019.

32 “The rise of corporate PPAs in Latin America.” *Atlas Renewable Energy*, 3 June 2020.

33 “An Overview of Virtual Power Purchase Agreements.” *Mexico Energy Partners LLC*, 24 May 2022.

3. The last model, and perhaps the most innovative, is when a customer “leases” a power plant from a utility or an IPP. In this case, a customer pays an annual fee to the owner of the power plant, in exchange for the operation and delivery of energy. This is an informal type of PPA that is profitable for both customer and seller, commonly used in large-scale distributed generation (up to 5 MW). Banco do Brazil utilizes this model by leasing a solar plant from EDP, a multinational utility.

Outside of self-generation, large customers and suppliers are working to find other innovative solutions to cut costs, both for themselves and for the end consumers. In many countries, electricity prices for large customers are based on their peak load. Hence, peak shaving is when customers level out their electricity use to avoid spikes in consumption that lead to those higher costs. This can be done by using on-site generation, utilizing batteries, or lowering one’s power consumption.³⁴

Micropower-Comerc, the first company to offer battery-Storage-as-a-Service (bSaaS) in Brazil, is offering the batteries for large customers to “peak shave.” The batteries allow for renewable energy to

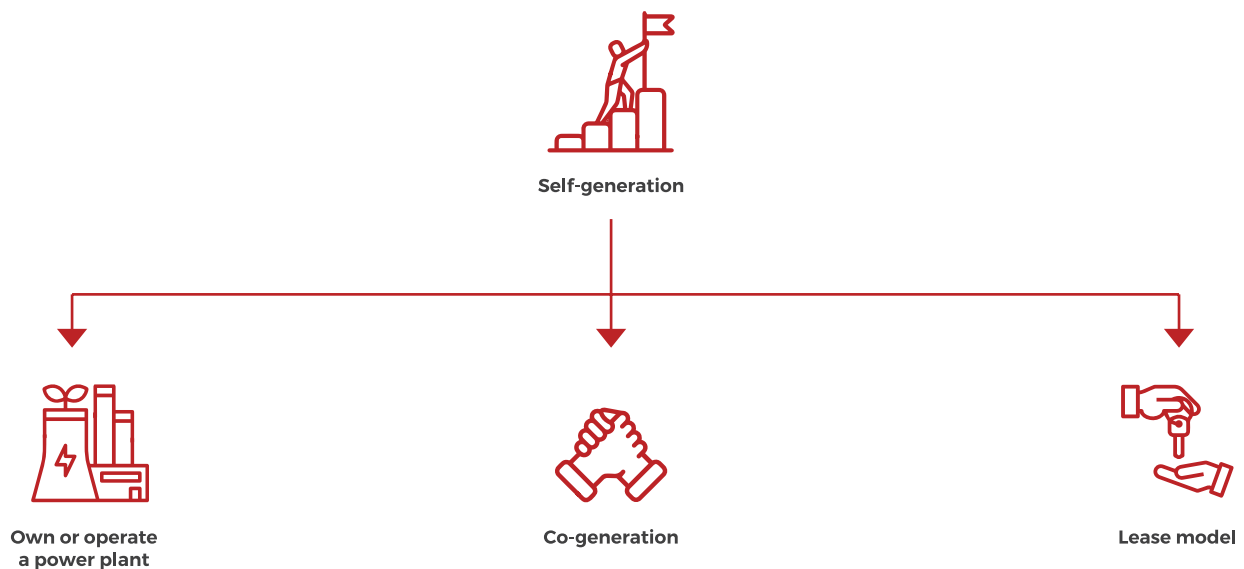
be stored during the day, when demand is often lower, and consumed during the night, when both the price and demand for electricity are the highest. Micropower-Comerc has already installed systems for Coca-Cola, Vale, and McDonald’s.

Changing one’s power consumption patterns is perhaps the toughest, but most effective, way to cut costs. In early 2021, Google announced that it would work toward 24/7 clean energy for all its data centers. Demand response, in which companies lower their power consumption in times of high demand, is quite common. **Google, however, will be the first company of its kind to increase its energy consumption to match moments in which renewable energy supply is abundant.** By shifting its “carbon-aware load,” the technology company will move tasks to different times of the day to make their operations more environmentally friendly. It is possible that Google will also save money while doing so, as they will be tapping cheap renewable energy when grid prices are near zero (due to the excess supply during the day).³⁵

³⁴ “What does peak shaving mean?” *Next Kraftwerke*, n.d.

³⁵ “Google Enters Upside Down World of Renewable Supply and Demand.” *Bloomberg*, 30 April 2020.

Figure 9: Three types of self-generation for large energy consumers



3. The push into green hydrogen

Green hydrogen, which is the production of hydrogen using renewable energy sources, has become a hot topic across the globe. For decades, hydrogen has been on the tip of the tongue of many energy experts, but it has failed to significantly gain traction. Now, with Latin America’s record-low renewable energy costs, growing renewable supply, and hydrogen-friendly government frameworks, green hydrogen is primed to take off.

Since 2008, Argentina has been producing green hydrogen in Patagonia via one of the country’s first wind farms. In 2018, Costa Rican President Carlos Alvarado signed a decree to promote the use of

hydrogen as a fuel.³⁶ But the most significant progress has been made in Chile, which presented a “National Strategy for Green Hydrogen” in December 2020. Chile’s strategy to become a top three hydrogen exporter, and one of the cheapest producers of hydrogen in the world, has attracted billions in investments and has led to several pilot projects with companies such as Enel X, Anglo American, and Engie. In September 2021, Colombia launched a similar hydrogen roadmap that aimed to replicate Chile’s success. Many other neighboring countries are planning to do the same.

³⁶ “The Decarbonization of Costa Rica goes through Hydrogen.” *The Costa Rica News*, 2 February 2021.

Figure 10: National hydrogen strategies in major Latin American markets



Source: AMI Analysis, IEA, Oil Price, Local Sources

4. Leading corporate “customers”: Who are they?

The major technology companies in the United States, from Google to Amazon, are global leaders in “greening” their supply chain. Recently, Amazon surpassed Google as the largest corporate investor in renewable energy in the world. Amazon’s 127 renewable energy projects have a total capacity of 6.5 GW, enough to power 1.7 million homes.

In Latin America, the leading companies establishing green supply chains are also those with international headquarters. Most of them tend to be in consumer-facing sectors such as food and beverages, clothing, and electronics. **This includes the likes of Coca-Cola, Heineken, Unilever, and Grupo Bimbo, whose operations consume large amounts of renewable energy and often implement circular economy ecosystems.**


Traditional sectors that are not public-facing, such as mining, chemicals, energy, or agriculture, tend to be slowest to make the transition to cleaner energy. These sectors are huge in Latin America and are responsible for a significant share of government tax revenues. They also tend to consume large swaths of energy. In fact, mining companies are the largest customers of corporate PPAs in Latin America.³⁷

³⁷ “The rise of corporate PPAs in Latin America.” *Atlas Renewable Energy*, 3 June 2020.

Due to a lack of understanding of the long-term cost efficiencies of renewable energy, and the need for consistent power 24/7, traditional sectors often resort to what has worked in the past—diesel or coal plants. In Colombia, land use and agriculture accounted for 40% of the country’s greenhouse gas emissions in 2020. In Peru, that number was 41%. To reduce that percentage, the Inter-American Dialogue suggests that governments prioritize climate change in extractive sectors by providing regulatory and technical assistance, as well as incentivizing climate-related projects using royalties from the sector.³⁸

Despite the slower transition vis-à-vis other sectors, many extractive companies used the clean-energy momentum from the pandemic to begin transitioning their operations. In Chile, global mining giant BHP paid US\$720 million for the early termination of two PPAs with a coal-fired power plant owned by AES Gener. Chile’s extractive sector is ahead of its regional peers, despite miners being “stuck” with long-term PPAs signed during a period of power uncertainty in the mid-2010s.

³⁸ “Combating Climate Change with Extractives Revenues.” *IEA*, 1 December 2020.



In Latin America, mining, chemicals, energy, and agriculture companies tend to be the slowest to transition to cleaner energy.

B. Large “suppliers”

1. COVID-19 and the war in Ukraine accelerate the push toward cleaner energy

The International Energy Agency (IEA) estimated that global energy demand experienced a 5 percent contraction in 2020. Renewable energy, however, experienced a 7% growth in electricity generation. This growth was fueled by long-term contracts, priority access to the grid, and increasingly favorable pricing among new projects.³⁹ Despite logistical delays caused by the pandemic, COVID-19 has increased the demand for clean energy around the world as the public embraces a preventative mentality. This new mentality—the belief that governments should act to avoid another preventable catastrophic situation—is fundamental in the acceleration of the energy transition.

With COVID-19, people have also become more climate-conscious and accustomed to less-polluted cities, reinforcing the idea that public pressure for climate-friendly policies will increase. The speed and aggressiveness of gubernatorial and investor actions will depend on the extent of this public pressure.

The war in Ukraine has been as significant as COVID in driving an acceleration of renewable adoption. **With record-high fuel prices, and the threat of energy rationing and economic recession, countries have become desperate for energy security in a time of energy transition.** Developing an independent source of clean power and building the necessary infrastructure to import other sources from reliable partners has become paramount. Renewable energy will be one of the few beneficiaries of this war, especially in jurisdictions with minimal hydrocarbon resources such as the Caribbean, Europe, Uruguay, and Chile.

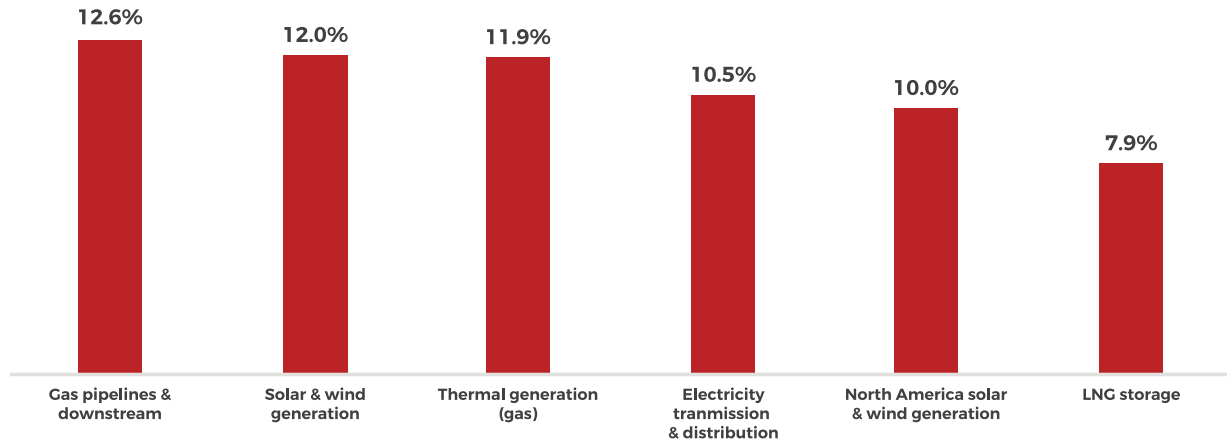
³⁹ “Renewables 2020: Analysis and forecast to 2025.” IEA, November 2020.

2. The risk of diminishing returns for renewable energy suppliers and investors

Despite the demand for new renewable energy capacity, the massive volumes of money flowing into renewable energy projects has lifted asset prices and subsequently lowered expected returns. In North America, brownfield renewable projects generate internal rates of returns (IRR) from 6% to 8%, a result of increased demand for those types of projects. Greenfield renewable projects, which have higher risk and are more capital-intensive, are generating IRRs between 12% to 14%. Thus, many private equity firms are looking at projects in the construction and development phases rather than in the operational stage. Greenfield solar projects, with lower costs and lower construction risks, are a particular favorite among investors. However, as a whole, **renewable energy investment levels are far from where they need to be.**⁴⁰ **The reality is that there is too much money chasing too few projects.** (See Figure 11 on page 22 for a breakdown of IRR in Latin America by energy asset.)

⁴⁰ “Renewable energy investors seek returns in project development.” *Private Equity News*, 4 January 2021.

Figure 11: Estimated unlevered IRR in Latin America, by energy asset, 2020*



*Includes both brownfield and greenfield projects. Estimates come from primary interviews and market research
Source: AMI Analysis, *Wall Street Journal*.

In contrast to the stagnant growth in renewable power investments, investment in the transition to carbon-free energy (which includes renewables, but also includes electric heat, energy storage, and electrified transport) grew by nearly 8% in 2020, reaching US\$501 billion. The reason behind this disproportionate growth is twofold. First, investment in energy storage, hydrogen, and carbon-capturing sequestration ventures grew by 21% to US\$8 billion. As investors seek to contain carbon emissions, these technologies are seen as the most viable solution do so. The second driver was the investment in electrified transport, particularly electric vehicles, which grew by 19% to US\$139 billion.⁴¹ It appears that investors are more comfortable betting on riskier assets with larger growth potentials, rather than on the diminishing returns reflected in renewable generation.

3. Electrification of everything: from e-mobility to electric stoves

Although electrification across the globe has become synonymous with the path to net zero, Latin America has been slow to embrace this trend. Due to a massive underinvestment in “green” infrastructure, complemented by fossil fuels’ strong contribution to the region’s economies, Latin America has been relatively slow to electrify its grids. Specifically in the transportation sector, unclear government guidelines and insufficient subsidies resulted in EV sales accounting for less than 1% of the region’s auto sales in 2021—versus 9% of total global sales.⁴² By 2030, Toyota’s regional CEO expects electric vehicles to make up 5% of the total passenger vehicles sold in Latin America⁴³, a much smaller share compared to the 45% that is expected for Germany in that year.⁴⁴

⁴² AMI analysis.

⁴³ “EV Sales in Latin America May Only Touch 5% by 2030.” *Bloomberg*, 20 December 2021.

⁴⁴ *BloombergNEF Electric Vehicle Outlook*, 9 June 2022.

⁴¹ “World Energy Investment 2020: Key findings.” IEA, 2020.

Figure 12: EV sales as a % of total light vehicle sales, 2021, by jurisdiction

Country	EV sales as % of total light vehicle sales, 2021, by jurisdiction*
Argentina	<0.1%
Peru	0.1%
Chile	0.2%
Mexico	0.5%
Brazil	0.7%
Colombia	1.2%
Costa Rica	2.7%
Latin America	0.6%
US	4%
EU + UK + EFTA	19%
China	16%
World	9%

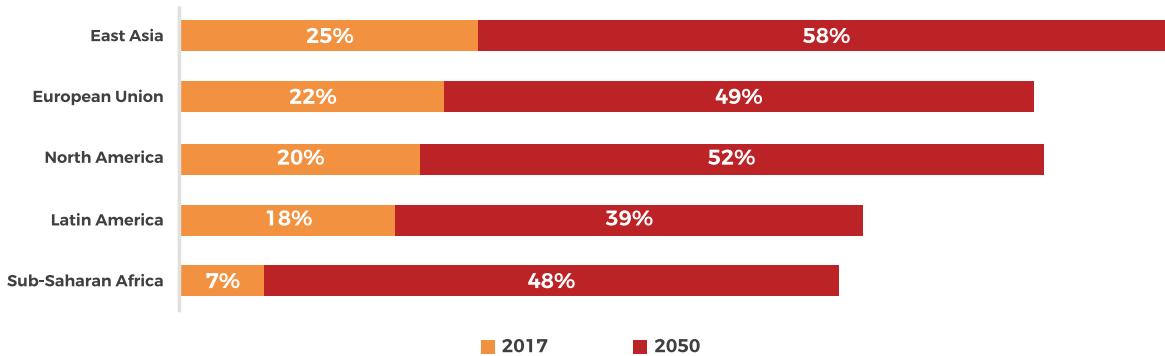
*Plug-in and BEV. Excludes hybrid.
Source: AMI Analysis, IEA, Local Sources, BNEF

Globally, the auto industry sells nearly 80 million vehicles a year; transportation is a tangible tool that humans use on a daily basis. Because of the scale and predominance of transportation, opportunities for disruption are massive. Transitioning from gas-powered vehicles to electric can realistically have more impact on companies and consumers than developing a solar farm. Large-scale renewable projects, such as wind and solar, are still relatively niche sectors that require billions of dollars in investments, technical expertise, and an abundance of metals. People are more likely to adopt new patterns in a familiar industry, such as transportation—as soon as the supporting EV infrastructure is developed and the cost of batteries decreases further.⁴⁵

Electrification of vehicles will be accompanied by the electrification of the wider grid as fossil fuel-powered technologies are replaced with technologies that use electricity as a source of energy. The media and the government will focus mostly on the installation of more renewable energy suppliers. However, just as important will be the introduction of electric stoves, heat pumps, and other cooling and heating household devices powered by electricity. **Despite Latin America's high hydropower usage, the region has the second-lowest electrification rates in the world. This shows that the region is ripe for electrification in sectors outside power generation, such as e-mobility.**

⁴⁵ "Energy Transition's Half-Trillion-Dollar Year Is Even Better Than It Looks." *Bloomberg*, 21 January 2021.

Figure 13: Percentage of electrification in end-use consumption, by region, in TFES (Total Final Energy Supply)



Source: Global Renewables Outlook: Energy Transformation 2050.
*This includes hydropower.

4. Privatizations via the sale of state-owned assets

In Latin America, the economic situation for many lower-income households has worsened, with poverty rates and unemployment accelerating during highly restrictive pandemic lockdowns. Elections since 2021 have revealed just how frustrated voters are with their governments, as they often voted against all politicians connected to the previous administration. Several governments in the region spent lavishly to counter the economic downturn caused by the COVID-19 crisis and now must narrow wide fiscal deficits or face worsening sovereign debt ratings, which will cost the region dearly. Regardless of political ideology, many governments will be obliged to sell off government assets, including energy assets, which is a better alternative than raising taxes on an economically battered populace.

In Colombia, for example, the major credit rating agencies have already warned the government that it will suffer a sovereign downgrade unless it raises revenues. To do so, the government could either raise taxes—a politically unpopular move—or sell stakes in state-owned companies. The government has 88.5% control of Ecopetrol, and it is seeking to sell 8.5% of that, since it's required to have a minimum 80% share. The Colombian government is also seeking to sell or liquidate some of Ecopetrol's subsidiaries, including 22 hydroelectric generators and Interconnexión SA (ISA), an electric utility.

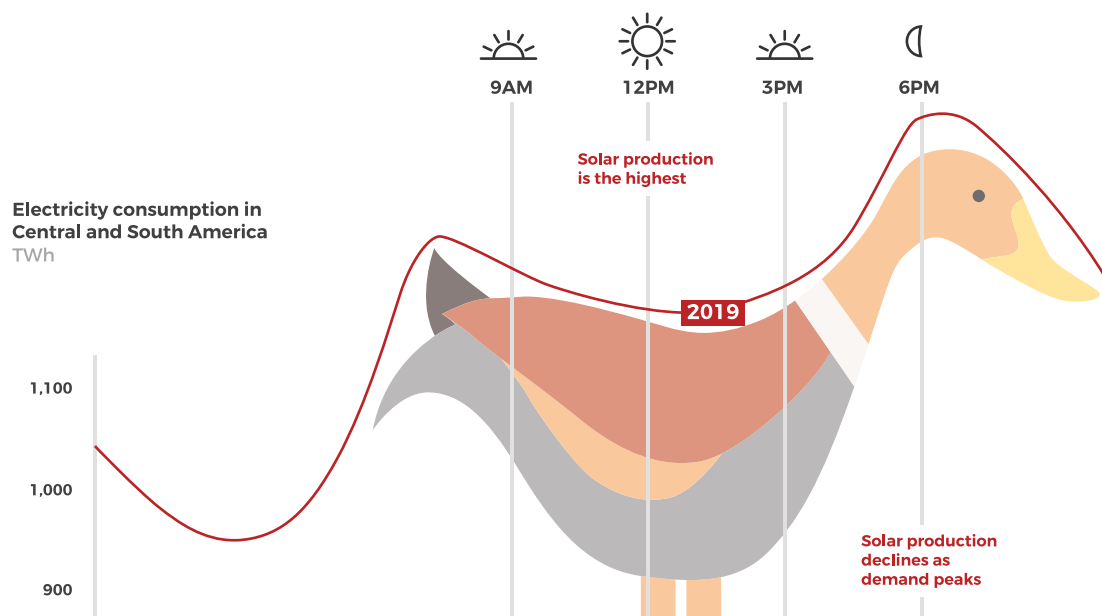
5. Duck Curve: The timing imbalances of renewable supply and energy demand

In a span of 20 years, starting in 1982 in Chile, 18 countries in Latin America underwent a series of electric sector reforms that liberalized the market and unbundled their generation, transmission, and distribution assets.⁴⁶ The reforms sought to modernize the energy sector through deregulation and investment, attracting private players and allowing state-owned companies to focus on more profitable assets. Although the reforms were broadly successful, the region's electric utilities still lack the adequate infrastructure, and in most cases the appropriate resources, to handle the influx of intermittent renewable energy.

One of the main concerns among large customers and suppliers is the discrepancy between the production capacity of a renewable plant and the demand of its consumers. The famous Duck Curve shows a timing imbalance between peak demand, which usually takes place at night, and the peak production of renewable energy, which usually occurs during the day when the sun is shining or the wind is blowing. (See Figure 14 on the next page.)

⁴⁶ "Privatization, Institutional Reform, and Performance in the Latin American Electricity Sector." *IDB*, December 2013.

Figure 14: The imbalances caused by the Duck Curve



Source: AMI analysis, IEA, Elements.

For large customers, many of which have factories operating 24 hours a day, seven days a week, the problem is aggravated as they require energy throughout the night. To help alleviate some of that problem, governments are looking at creating and improving battery regulatory frameworks to allow for cost-effective storage solutions and peak shaving. This would allow for renewable energy to be stored during low demand and disbursed during peak demand, avoiding the use of costly back-up thermal plants. Another solution on the table is to connect different regions under one National Smart Grid. This could help solve climate variability in certain parts of the country by allowing energy to be shared over large distances with greater ease.⁴⁷

⁴⁷ "Latin American Electric Utilities COVID-accelerated Evolution." *Institute of the Americas*, 18 December 2020.

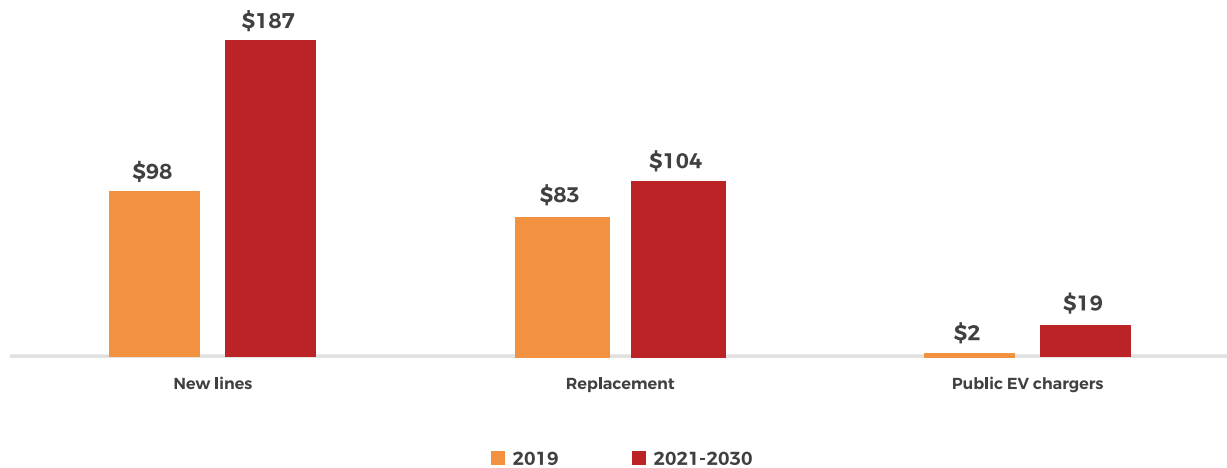
6. Connecting to the transmission grid: Bridging the distance between supply and demand

A main challenge for renewable generation in Latin America is also the connection of these alternative energies to the transmission grid. In fact, this is a problem in most of the world, as solar plants and wind farms tend to be most efficient in remote locations that are far away from large, urban centers. Transmission grids, especially in developing countries, fail to reach these remote locations and require additional development to connect the project. Many electric grids also lack high-voltage transmission lines that facilitate the transmission of large amounts of renewable energy from rural to urban areas.

By 2025, the top six countries in Latin America will have to invest nearly US\$20 billion in transmission lines to support their growing generation capacity. However, most governments do not have the financial resources to do so. The region's GDP contracted 7% during 2020, with hard-hit countries seeing declines of up to 15%. Over US\$100 billion in government stimulus was doled out to keep companies and individuals afloat, but both poverty and income inequality increased in Latin

America. It is likely that transmission lines, and the energy grid, will suffer from underinvestment over the next few years. Distributed generation, which does not require transmission lines, will enjoy increased adoption. Suppliers that can improve energy efficiency through advanced metering infrastructure will also help reduce the region's inadequate energy infrastructure while profiting immensely.

Figure 15: Global annual investment in distribution networks in the IEA's Stated Policies Scenario, in billions of USD



Source: IEA.

7. Leading suppliers: Who are they?

Outside of Latin America, many companies have successfully become large developers and suppliers of renewable energy. NextEra Energy, the largest generator of wind and solar power in the United States, is now worth US\$137 billion, about one-third larger than British Petroleum (BP). It will invest US\$60 billion in renewable energy projects between 2019 and 2022.^{48 49}

In Latin America, large suppliers are a mix of state-owned utilities, government-backed Chinese firms, and private European companies (IPPs). The largest

state-owned utilities are Eletrobras in Brazil and The Federal Electrical Commission (CFE, as per the Spanish-language acronym) in Mexico. Although the Brazilian government is seeking to reduce Eletrobras' role by privatizing the entity and selling its subsidiaries, its Mexican counterpart is growing its presence by implementing policies that hinder private competition. China—for the most part discreetly—has been able to build a massive portfolio of installed capacity by buying local companies and outbidding competitors with appealing offers. In November 2020, China's State Power Investment Corp. (SPIC) announced the purchase of Zuma Energy, the largest independent renewable power company in Mexico, which has an installed capacity of 818 MW.⁵⁰

48 "The New Green Energy Giants Challenging Exxon and BP." *The Wall Street Journal*, 11 December 2020.

49 NextEra and BP's market cap as of May 16, 2022.

50 "China's SPIC buys Mexican IPP Zuma Energia." *Renewables Now*, 20 November 2020.

In the private realm, many European companies have successfully replicated their renewable endeavors in Europe by introducing similar projects in Latin America. Using their previous experience, Italy's Enel, France's Engie, Portugal's EDP, and Spain's Iberdrola are some of the key players developing alternative energy in the region. Local private players, such as Colbún in Chile, are more involved in large-scale hydro and fossil fuel generation and are making a slower transition into renewables.

Although they are the “unconventional” players in this realm, some of the major European oil companies—such as BP, Total, and Equinor—are developing their own renewable energy portfolios. Their substantial financial and human resources will provide a strategic advantage over less-capitalized competitors, but analysts warn that they may have to accept lower (than conventional energy) returns to gain market share in the renewable sector. This may bring returns down for the entire market, hurting the profitability of renewable leaders such as NextEra and Enel.⁵¹

8. The opportunities and challenges of the six main Latin American energy markets

Despite growing demand for renewable energy on both the supplier and consumer side, the successful implementation of a typical energy project in Latin America is extremely complex and bureaucratic. The first step, finding and buying the land, can involve strenuous negotiations with conservative landowners who are loath to sell their property. Gaining a clean land title can also prove complicated

and time-consuming. Once the land is purchased, the developer needs to win the rights to develop said project, often via a public auction, which can tend to be highly competitive. If they can win the rights to the project, they then need to obtain all the necessary regulatory and environmental approvals from the pertinent government agencies. This process is not only bureaucratic and politicized, but it is also often accompanied by local community opposition, which can lead to regulatory delays and even the eventual cancellation of a project. If the developer can overcome these obstacles, they will finally be able to begin construction, during which a new set of risks and challenges will arise.

In addition to going deeper into some of these risks, in the next section this whitepaper will robustly analyze the opportunities and trends within the six leading Latin American energy markets—Brazil, Mexico, Colombia, Argentina, Chile, and Peru. The paper will explore the role of renewable and conventional energy within the wider context of energy transition, as well as the prospects for both large customers and large suppliers. It is our hope at AMI that this whitepaper will help any large energy company, investor and/or service provider deliver on sustainable, profitable, and successful energy projects in the region.

⁵¹ “The New Green Energy Giants Challenging Exxon and BP.” *The Wall Street Journal*, 11 December 2020.



VI. Brazil

A. New legislation and privatizations will unlock investment opportunities in the Brazilian energy market

1. Distributed generation is the golden ticket for investors looking into Brazil

Although it has the largest and one of the most developed energy sectors in the region, Brazil still requires important regulatory changes to improve the competitiveness and openness of its sector. Despite its access to cheap generation sources, the cost of electricity for both small and large customers is too high. Forty-eight percent of consumer electricity bills in Brazil are composed of taxes, fees, and subsidies used to fund an Energy Development Account (CDE) and to incentivize specific generation schemes.⁵² Brazil's heavy dependence on hydropower has also forced the country to turn on expensive thermal plants during periods of drought, leading to surges in energy costs.

As it stands, Brazil's energy market remains fragmented due to its unique sets of rules for different types of customers. Depending on the amount, the type of energy, and the setting in which they consume electricity, energy buyers can fall into five categories: free, special, distributed, self-generating, and regulated. A more unified set of rules for consumers would encourage price transparency and grid predictability in Brazil.⁵³

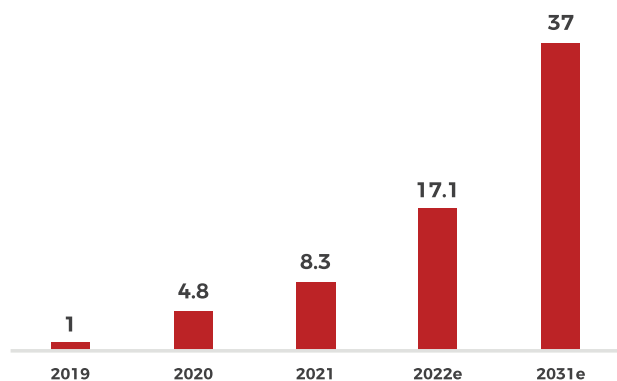
Despite the challenges, there are unique pockets of opportunity within Brazil's energy sector that are both attractive and lucrative. One key prospect is the distributed generation subsegment, where companies and homes use solar panels to generate decentralized power of up to 5 MW. Following the approval of a net-metering bill in 2012, the segment attracted 8 GW of installed capacity and US\$3.5 billion in investments through 2021. In December 2021, Brazil's congress passed a bill (PL 5829/2019) that extended the current distributed generation subsidies for existing projects through 2045 and provided 12 months for any new projects to be approved within this taxation regime. **In one year, this bill is expected to fuel the same amount of installed capacity that was developed in the past 10 years combined.**⁵⁴

⁵² Correio Brasileiro.

⁵³ AMI interviews.

⁵⁴ "Geração própria de energia pode crescer "dez anos em um" com contagem regressiva de isenção." *Au Online*, 18 March 2022.

Figure 16: Brazil's forecasted distributed generation capacity, in GW



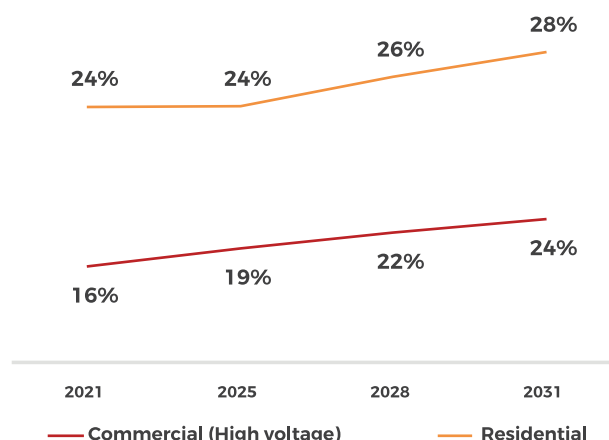
Source: Plano Decenal de Expansão de Energia, 2031; Absolar e = Estimate.

The growth in distributed generation can be largely attributed to two factors: First, the current regulatory framework exempts companies and individuals from paying distribution fees while generating this type of power. This creates lofty returns as solar technology becomes increasingly cheaper. Second, any distributed energy that is generated, but is not consumed, can be used as a credit to discount future bills. With the approval of the recent legislation, the sector expects R\$40 billion reais (US\$ 8 billion) in new investments.⁵⁵

Despite the attraction, many ordinary retail consumers struggle to find information about installing this type of technology. To solve this pain point, Sunalizer, a startup, created an online platform to standardize the procurement process for small-scale solar panels, allowing smaller companies and residential consumers to compare solar installation costs based on different suppliers. Sunalizer estimates that **solar PV consumers with demand above 300 kWh p/month will reach their break-even point within six years, experiencing a 20% unlevered internal rate of returns (IRR)**. The return would be even larger if distributed generation consumers were able to sell their surplus energy back to the grid. Instead, the current framework provides consumers with an energy "credit" that can be used for up to five years.

⁵⁵ "Geração própria de energia pode crescer 'dez anos em um' com contagem regressiva de isenção." *Au Online*, 18 March 2022.

Figure 17: Brazil's estimated distributed generation, real IRR, projection



Source: Plano Decenal de Expansão de Energia, 2031.

2. Natural gas law and the modernization of the electricity sector: The government's gradual opening of the energy market

In addition to creating a regulatory framework for the distributed generation sector, the government also took a large step toward improving the energy market in April 2021. After seven years of debate, Brazil's congress approved a bill (Law 4476/2020) to further open the natural gas market to private competition and break the monopoly held by state-owned Petrobras. The bill aims to promote fair competition in the distribution of piped gas, allowing private market players to access existing pipeline infrastructure. The construction of new pipelines will now be conducted via a simple authorization model, rather than the long-standing concession structure.

Although the federal law seeks to prevent vertical monopolies by prohibiting local gas producers from distributing gas, the Brazilian constitution grants a monopoly to states over the distribution of piped gas. For the federal law to be fully implemented, it will require each state to pass their own compliant regulations, which they purposefully may delay or even challenge. Nevertheless, four states have already passed laws, and more are likely to follow.

In the meantime, the new gas bill has already begun to attract private capital. Soon after the Senate first approved the bill in December 2020, Brazil's largest liquefied petroleum gas distributor, Ultragaz, said it would invest US\$43 million in expanding its infrastructure to handle the country's opening refining market. Since Brazil's gas infrastructure is underdeveloped, especially when it comes to pipelines, the government expects the bill to unlock US\$10.6 billion in private investment by 2026.

Currently, the United States' pipeline system is 50 times the size of Brazil's.

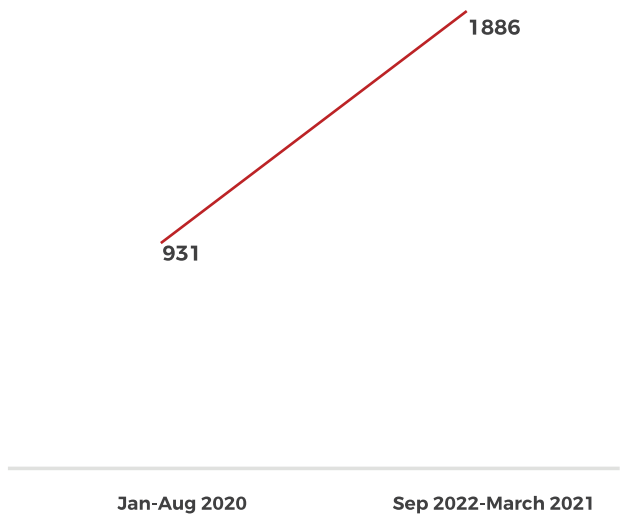
Another bill floating in congress is PL 414/2021 (formerly PLS 232/2018), which seeks to structurally reform, open, and modernize the electricity sector.⁵⁶ Initially, the bill would allow all consumers with a demand greater than 500 kW to buy energy from any generation source. After 42 months, this option would be opened to all consumers—regardless of their level of demand. The bill also seeks to end a compulsory quota regime to buy hydroelectricity and separates the supply and commercialization of energy. In simpler terms, it aims to change how energy is bought and sold in the country. Many proponents believe that the bill will fundamentally improve the country's much-needed energy efficiency, since Brazil is the only country in the G20 whose energy consumption grows faster than its economic production.⁵⁷

Generation-related subsidies to promote alternative energies have also been the subject of intense discussions in the government. A provisional measure in September 2020 declared a 12-month phase-out period for the 50% network tariff discount provided for renewable plants to connect to the transmission and distribution networks. The Ministry of Energy argues that these subsidies, which are often given to large customers, increase costs for retail consumers by US\$775 million per year. In line with some of the more developed markets, the Ministry argues that incentives for renewables were suitable 15 to 20 years ago, but not today, when renewable energy is advanced and competitive. The elimination of the tariff discount is also aimed at alleviating losses experienced by distributors, who are paid the discounted fees. Many of these distributors come

from the northeastern region of the country—home to several congressmen in the influential “Centrão” coalition formed by the Bolsonaro government.⁵⁸

In a rush to take advantage of the expiring subsidy, solar and wind developers have redoubled their efforts to build new renewable projects.⁵⁹ In some cases, developers seek project authorizations from Brazil's Electricity Regulatory Agency (Aneel) before they have even secured a deal with a distributor to buy the energy generated. This pre-approval is especially common among solar PV plants, which don't require a deposit when seeking authorization from Aneel. Without this requirement, developers limit their potential losses if the project never becomes operational. Since the elimination of this subsidy was expected to increase solar pricing by \$3.50 USD/MWh, it quickly ushered in more solar investment.^{60 61}

Figure 18: Brazil's initial authorization requests for solar and wind plants



Source: Aneel.

58 “MP acaba com subsídio a fonte renovável de energia.” *Valor Econômico Brasil*, 3 September 2020.

59 “Pedidos para novas usinas eólicas e solares dobram após governo anunciar que subsídio acabará.” *G1*, 14 April 2021.

60 Greener Consultancy.

61 “Fim do desconto acelera projetos de renováveis.” *Valor Econômico Brasil*, 5 October 2020.

56 “PLS n° 232/2016 - Modernização do Setor Elétrico.” *Greener*, n. d. Video: <https://www.youtube.com/watch?v=qsR7c7ewU8s>.

57 “A hora e a vez da eficiência energética.” *Folha de S.Paulo*, 15 December 2020.

3. Politics delay but do not bury the privatization of Eletrobras

Another fundamental aspect in the opening and improvement of the Brazilian electric sector is the privatization of the largest power utility in the region, Eletrobras. This company once held a vertically integrated monopoly over Brazil's electricity sector and its privatization has been a major policy objective for President Bolsonaro's administration. Eletrobras still owns 31% of Brazil's installed generation capacity and 47% of the country's transmission lines. Currently, the federal government holds 51% of Eletrobras' ordinary shares, which include voting rights.⁶²

Following a 21-day blackout period in the northern state of Amapá, where a private company's transformer suffered a defect and exploded, many anti-privatization politicians reinforced their calls to stop further privatizations. In Amapá, the partial privatization of the state's electric grid began in 2008, when the concessions for the transmission and distribution of energy were awarded to the private Spanish company, Isolux. During the recent blackouts, which left more than 700,000 people without power, Eletrobras successfully took over the grid and contracted supply from thermal-electric plants nearby.

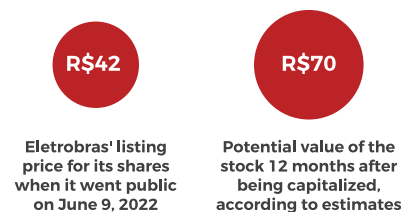
Using the "success" of the publicly owned Eletrobras and the "failure" of the privately owned Spanish company in Amapá, many old-school politicians, part of Brazil's traditional horse-trading politics, reiterated their refusal to support a privatization bill that did not preserve the government's "golden share" in Eletrobras. This golden share would allow the government to continue to have veto power over strategic decisions made by the company.

Despite congressional resistance, mostly from leftist parties, Brazil's house of representatives approved the Eletrobras privatization bill on June 21, 2021, one day before the bill expired. The following day, Bolsonaro signed it into law with no further changes. The bill will allow the government to issue more Eletrobras common stock, diluting its stake to 45%. **The new share issuance took place in June 2022 and is considered to be a bargain opportunity for investors—UBS expects the current stock price to double within a year.**⁶³ In fact, it has attracted the attention of

major global funds, such as the Canada Pension Plan Investment Board (CPPIB) and Singapore's GIC, who are seeking an 11% stake to design the company's post-privatization strategy.⁶⁴

The bill will also grant the government its "golden share" while allowing it to keep control of the Itaipu and Electronuclear power plants. Moreover, it mandated the purchase of an additional 2 GW of gas-fired thermal power in pre-defined regions, helping win support of certain lawmakers from those states.⁶⁵ Many of these regions lack access to gas and will require the construction of pipelines, which will create opportunities for development while simultaneously raising concerns over the feasibility of that provision.

Figure 19: Potential value of Eletrobras' shares 12 months after being privatized



Source: *Folha de São Paulo*. Eletrobras share price on May 13, 2022

Another important aspect of the bill is the 20-year extension of Proinfa, the Incentive Program for Alternative Sources, which aims to subsidize small hydro plants and a select few solar and wind projects. Through Proinfa, Eletrobras buys energy at pre-set preferential prices to incentivize the use of renewable sources that were not competitive at the time the energy was contracted. In 2020, Proinfa spent US\$670 million to support 131 projects, when the average tariff rate was US\$58 to US\$124 per MWh. In contrast, in the 2019 auctions, wind power was negotiated under US\$19 per MWh. The privatization bill also excluded the establishment of a transition period, from January 2023 to July 2026, for all power consumers to choose their suppliers of electricity. This issue will be dealt with in the previously mentioned PL 414/2021, the law that seeks to modernize the electricity sector.⁶⁶

buscar R\$ 25 bi na Bolsa." *Folha de São Paulo*, 6 March 2022.

64 "Brazil's Eletrobras privatization lures new investors including Singapore, Canada funds." Reuters, 8 June 2022.

65 "Brazil Congress approves Eletrobras privatization." Reuters, 21 June 2021.

66 "Spotlight: The hurdles facing a privatized Eletrobras." *BN Americas*, 23 June 2021.

62 "Brazil: Privatization of Eletrobras—the Largest Power Company in Latin America—Expected by 2021." *Mondaq*, 19 November 2020.

63 "Privatização da Eletrobras corre contra o tempo para

Including the primary share offering, concession fees and the potential sale of remaining shares, the economy ministry said that it could raise US\$17.7 billion (R\$100 billion) in the entire privatization process. Those funds will be used to lower consumer energy bills and renew concessions for Eletrobras' hydro plants and transmission lines. Critics call it a capitalization bill, intended to raise funds for the company while retaining government control, rather than a privatization law. They also said it will raise electricity prices for consumers.

Even as this privatization legislation unfolded, a June 2019 decision from the Supreme Court allowed both Petrobras and Eletrobras to proceed with selling their shares in regional energy subsidiaries. Eletrobras, for example, began privatizing utilities such as the CEEE-D in Rio Grande do Sul, the distribution company of the southernmost state.⁶⁷ Petrobras also sought to slash US\$30 billion in debt by selling its downstream refineries and gas distribution assets. These assets often come highly indebted, but at a cheap price.

On May 18, 2022, in one of the last steps needed before the privatization was completed, the Federal Court of Accounts (TCU) greenlit the deal with a vote of 7 to 1 in favor. As we go to press, the capitalization process is already underway.

⁶⁷ Supremo Tribunal Federal.

4. Political risk associated with Brazil's electoral agenda

By November 2022, the Brazilian populace will know the outcome of its presidential elections. Polls show that former president and leftist candidate Luiz Ignacio da Silva (Lula) has a 12% lead over incumbent right-wing president Jair Bolsonaro. Polls, however, should be taken with a grain of salt: In the 2018 elections, pollsters unanimously predicted Bolsonaro's loss, but he won by a 10% margin. If re-elected, Bolsonaro will likely move forward with the privatization of other state-owned assets, such as Petrobras, reflected by statements of the recently appointed Ministry of Energy, Adolfo Sachsida.

With a potential victory by leftist candidate Luiz Ignacio da Silva, Brazil would see a temporary freeze in the divestment of other state-owned energy assets. This was reflected in Lula's tweet after the TCU's approval of the Eletrobras privatization bill, where he stated: "Without a public Eletrobras, Brazil loses much of its sovereignty and energy security. Electricity bills are likely to become even more expensive. Only those who don't know how to govern try to sell strategic companies." Lula's recent statements that he would reverse the Eletrobras' privatization if elected are mostly campaign posturing. The financial and political cost of re-nationalizing the company would be nearly impossible and is unlikely to take place.



It will be nearly impossible for Lula to reverse Eletrobras' privatization, even if he is elected in Brazil's upcoming election.

B. The free market and a surge of new opportunities

1. Large customers explore clean and affordable energy in Brazil

With a 38% growth in investments from June 2019 to February 2021, the COVID-19 pandemic helped accelerate the growth of Brazil's "free" or "unregulated" market. **Between 2022 and 2026, 83% of generation projects under construction in Brazil will be unregulated projects, representing US\$30 billion in investments.**⁶⁸ This growth is largely explained by four factors:

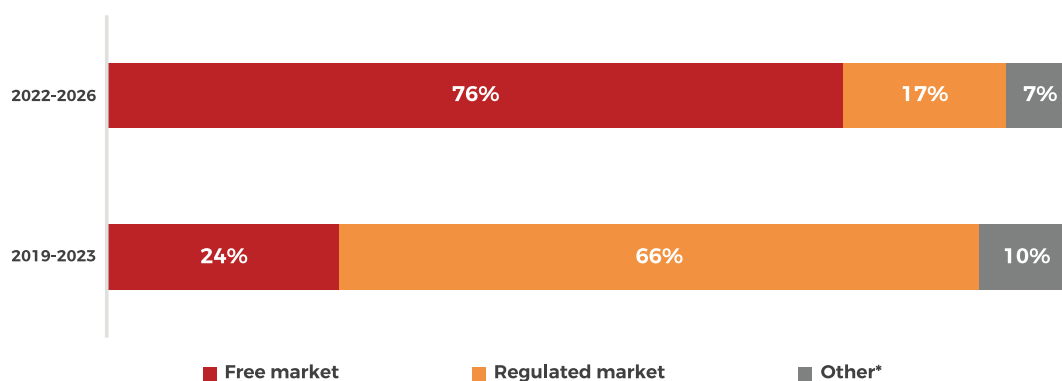
1. The consumption shock caused by the pandemic coupled with the suspension of all regulated government auctions

2. Falling prices in the free market, attracting both customers and generators
3. Growing confidence in the free market's regulatory framework and increased access to bank financing as more market players transition to the free market
4. The potential approval of Law 414/21, making the free market accessible to smaller residential consumers and SMEs⁶⁹

⁶⁸ "Mercado livre já é responsável por 83% da expansão da geração de energia elétrica no Brasil até 2026." *ABRACEEL*, 16 May 2022.

⁶⁹ "Mercado livre cresce e lidera expansão da geração no país." *CanalEnergia*, 5 April 2021.

Figure 20: Generation capacity under construction in Brazil, five-year horizon, free versus regulated markets



*Portion of energy destined for the free market from plants that are also contracted in the regulated market
Source: Abraceel, *Estudo de Expansão da Oferta para o Mercado Livre*, 2022

In addition to the free market, there are four different categories that large customers tend to fall in: special, distributed, self-generating, and regulated. Large customers tend to gravitate toward two of these categories—free and special—which operate inside the unregulated market. In fact, 85% of industrial energy consumption takes place in the unregulated market.⁷⁰ To qualify as a free market consumer, the 2004 energy market reform requires consumers to have a contracted energy demand of 3,000kW or above; “special” consumers can have a monthly demand of 500kW or above, but they can only buy energy from small-scale renewable projects.⁷¹

Large customers in the unregulated market can purchase electricity directly from energy suppliers, generators, or traders. These bilateral agreements, often in the form of PPAs, are attractive for both large customers and generators: Large customers are given the flexibility to negotiate affordable long-term contracts and to choose who they purchase their energy from, while generators are paid a higher price for energy vis-à-vis the regulated market. Unlike the free market, regulated consumers can only purchase electricity directly from a utility or a company with a distribution concession.^{72 73}

Figure 21: Renewable energy auction (A-4) prices in Brazil. June 2021 vs. May 2022

Technology	Average price June 2021, US\$/MWh	Average price May 2022, US\$/MWh	% difference June 2021 vs May 2021
Solar	\$28	\$36	29%
Wind	\$31	\$37	19%
Biomass	\$40	\$64	60%
Small hydroelectric	\$42	\$58	38%

Source: *Globo, Canal Energia, BN Americas*.
Note: US\$-R\$ exchange rate was R\$4.90/US\$

70 “Mercado Livre de Energia é uma importante ferramenta para economizar.” *Mercado Livre de Energia Elétrica*, n.d.

71 “Special” consumers can purchase energy from renewable projects with an installed capacity of 30 MW or below.

72 “To be or not to be on the deregulated market in Brazil—that’s the question.” E&C Consultants, 19 March 2018.

73 “Brazilian Energy Market: The Changing Definition of Free Consumer.” *NUS Consulting Group*, 25 November 2020.

Due to the falling demand in long-term auctions, large customers seek to secure energy supply via other avenues. A common type of energy purchase among unregulated large customers is the signing of short- to medium-term PPAs with independent power producers (IPPs). In fact, 41% of the total solar and wind installed capacity in Brazil is tied to private PPAs.⁷⁴ These contracts, negotiated in the free market, vary significantly in pricing based on the location of the plant, the type of energy source, the length of the contract, and other external factors. For example, utility-scale solar projects greater than 5 MW sign PPAs at roughly US\$23 p/MWh. This is highly attractive for large customers seeking to lock in contracts at stable and relatively low prices. In comparison, small-scale solar PV plants of up to 5 MW often sign “informal” PPAs ranging from US\$80 to US\$100 p/MWh, giving project developers large returns. In exchange for those returns, developers often allow large customers to become shareholders in the generating plant, providing discounts that make the pricing more affordable. This is similar to the “leasing” model that will be explained on page 35.⁷⁵

Another growing trend among larger Brazilian customers is the direct ownership of generation plants, allowing them to be energy self-sufficient. Vale, the country’s largest mining company, consumes just over 60% of its energy from self-production.⁷⁶ Its self-generation takes place through the joint venture with CEMIG (a generation company located in Minas Gerais state) that we mentioned earlier. The companies share a portfolio of seven hydroelectric plants and a wind farm. Self-generation is often cheaper for companies as they obtain a 100% exemption in the distribution fee (TUSD) and 50% discount in the demand fee for renewable energies.⁷⁷ As seen in Figure 22 on page 35, self-generation deals as a form of financing for solar and wind projects have increased from 6% to 26% of free market deals between 2018 and 2021 versus 2018 and 2020. *Note:* The inclusion of 2021 in the graph reflected a shift towards self-generation and project finance in Brazil, highlighting a trend away from corporate finance.

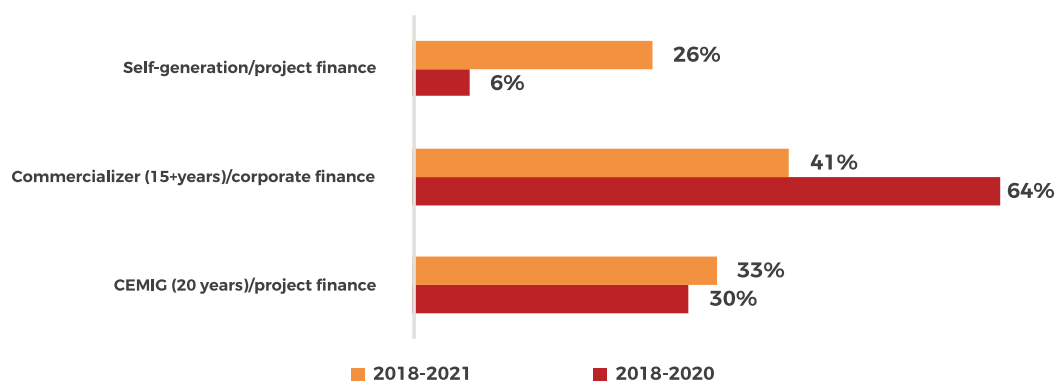
74 “Around 40% of Brazil’s wind, PV capacity is under private PPAs.” *PV Magazine*, 18 March 2022.

75 AMI interviews.

76 “Vale negocia compra de fatia da elétrica na Aliança.” *Valor Econômico Brasil*, 14 January 2020.

77 “Energia Incentivada / Especial: Tipos de Energia.” *Mercado Livre de Energia Elétrica*, n.d.

Figure 22: Wind and solar free market deals, by type of buyer and financing method, 2018-2021



2. Banco do Brazil and EDP: Self-generation via a lease model

Another type of self-generation is in the form of a lease, in which a large customer secures a long-term deal to “rent” a generation plant from a utility. The plant is built and operated by the utility, allowing the customer to remain focused on its core business. A recent example is Banco do Brazil, Brazil’s largest state-owned bank, which is leasing a solar generation plant from Portuguese-based EDP, one of the largest utility companies in the world. EDP owns and operates the solar plant in exchange for a lease payment from the bank.

EDP benefits from cost savings related to self-generation, and in return for the rental fee, Banco do Brazil is provided with a long-term supply of renewable energy at a cheaper price than a regular PPA. In addition to the attractive price, lease models have grown in popularity because they provide large customers with more control over their energy supply, while simultaneously freeing them from operating and owning the plant. As ESG factors become increasingly important for investors and shareholders, companies that have greater control over their energy supply chain will become more attractive investment targets.

3. Traditional sectors such as mining look at a “pay-as-you-save” model for renewable energy

Albeit more slowly, the important transition into renewable energy is also happening among traditional sectors such as manufacturing and mining. An iron ore loading port in Rio de Janeiro, Vale, in partnership with Siemens and Brazilian-based Micropower-Comerc, is installing a battery system provided by Tesla.⁷⁸ Vale intends to store energy during periods of low demand, often at night, and consume the battery power during peak hours when the cost of the electricity is high. This phenomenon, known as “peak shaving,” could reduce costs by almost 20% at the loading port.⁷⁹ ⁸⁰ This will be Brazil’s first battery-storage project for an industrial complex. Unfortunately, historically high import taxes on batteries—of up to 65% of the total battery costs—have limited Brazil’s battery storage capacity.⁸¹

⁷⁸ The lithium-ion batteries used in the system have a storage capacity of 10 megawatt-hours, enough to power 45,000 homes for one hour.

⁷⁹ “Vale is installing at Ilha Guaíba terminal (TIG), in Rio de Janeiro, one of the country’s largest battery energy storage systems to supply electrical demand.” *Vale*, 24 August 2020.

⁸⁰ “Ex-Tesla Executive Decamps to Brazil and Bets Big on Batteries.” *Bloomberg*, 17 September 2019.

⁸¹ “Projeto de energia da Vale marca estreia da Tesla no Brasil.” *O Globo*, 24 August 2020.

Although Micropower is responsible for the initial funding of the project, it will be paid back in increments as Vale saves on energy costs. This “pay-as-you-save” model is attractive among traditional sectors that are more hesitant to switch away from power generation sources that have worked in the past—such as diesel and coal. Although they require a smaller initial investment, diesel and coal emit significantly more carbon emissions and have higher operating

costs, making them more expensive in the long run. Companies that depend on these sources will also have higher credit risks and will have to pay a higher cost of capital as investors shy away from fossil fuels. Thus, a gradual repayment scheme based on cost savings should incentivize miners and manufacturers alike to overcome the hesitancy of investing a higher initial capex in their transition to cleaner energy.

Figure 23: Total estimated cost per technology type in Brazil, in US dollars

Generation type	Min CAPEX (US\$/kW) ¹	Max CAPEX (US\$/kW) ¹	O&M (kW/yr)	Fees/taxes (kW/yr)	Variable Unit Cost (US\$/MWh)
Biomass-sugarcane	\$385	\$1,058	\$17	\$28	
Solar PV	\$481	\$962	\$10	\$26	
Biogas-sugar to energy	\$577	\$1,923	\$92	\$48	
Onshore wind	\$615	\$1,058	\$17	\$29	
Natural gas (combined cycle)	\$654	\$1,135	\$31	\$48	\$74
Floating PV	\$731	\$1,250	\$13	\$29	
Storage batteries	\$962	\$1,885	\$12	\$52	
Coal	\$1,538	\$2,596	\$31	\$114	\$25
Offshore wind	\$1,885	\$3,577	\$69	\$80	
Nuclear	\$4,231	\$5,577	\$100	\$127	\$9

Source: Plano Decenal de Expansão de Energia, 2031.
¹USD-R\$ exchange rate was R\$5.20/US\$.

4. ZEG: An up-and-coming supplier seeks to use a virtual landfill to transform trash into energy

As of December 2020, hydroelectric generation accounted for 108 GW of Brazil’s installed capacity, equivalent to 66% of the total share. This was followed by 16 GW of wind power at 10%, and 14 GW for both gas plants and biomass, at 8% each. The remaining 8% came from solar, nuclear, and coal/diesel plants. By 2024, it is estimated that wind, gas, and solar will see the greatest increases; hydroelectric will see its share fall to 61% as the country’s hydrological conditions worsen.⁸²

To compensate for some of this decline, alternative energy sources, such as waste-to-energy and hydrogen, will likely see further adoption.

ZEG, a producer of biogas using agro-industrial residues, is one of the newest alternative energy suppliers in the country. In Brazil, trash is either incinerated or put in a landfill, which emits methane and carbon dioxide. ZEG aims to serve as a “virtual” landfill by transforming trash into energy via pyrolysis technology. Pyrolysis uses high temperatures to convert organic waste into energy, usually in the form of synthetic gas (e.g., biomethane) or oils. Brazil’s sugarcane, ethanol, and soybean sectors, which create vinasse and straw as by-products in their production process, could be the main beneficiaries of this technology.

ZEG is operating the first plant of its kind in São Paulo that produces biomethane from landfill. The biomethane, which is recognized as a renewable

⁸² “Evolução Da Capacidade Instalada No Sin - Maio2022/ Dez2026.” ONS, May 2022.

natural gas that emits 70% less CO₂, is produced from 8,000 tons of daily waste in São Paulo's eastern neighborhoods. The biomethane is then used to fuel commercial fleets—such as the gas-powered trucks owned by Scania—and to generate electricity for industries and homes.⁸³ ZEG's plant currently produces 30,000 m³/day of biomethane, but could triple capacity, if needed.

Since September 2020, ZEG has also helped MarBorges, a palm oil producer in the state of Pará, to utilize vinasse to generate biogas and water. The biogas is used as an energy source—either as fuel for industrial vehicles or electricity for the plant—and the water is used for irrigating crops. When factoring in logistical costs of transporting fuel, self-generation via biogas is 25% cheaper than using diesel. It also creates a circular economy in which the plant's residue is reused instead of discarded, making it self-sufficient and environmentally friendly. Another ZEG agreement, signed with global mining company Nexa Resources, uses ZEG's technology to transform residues from Nexa's steel mining plant (Arcelomittal) into renewable vapor. The vapor is then used for energy production in Nexa Resources' zinc production plant in Juiz de Fora, Minas Gerais.

Despite the promising use cases for biogas, Brazil only has 200 MW of installed capacity related to urban waste.⁸⁴ Since most people are unfamiliar with biogas as an energy source, there is uncertainty around its overall feasibility and the market demand for such a product. Historically, regulatory obstacles, insufficient technological innovations, and an unclear market demand hindered the larger-scale deployment of the resource. However, **in March 2022, Brazil launched a biomethane program with tax exemptions and certification programs that is expected to fuel R\$7 billion (US\$1.4 billion) in new investments.**⁸⁵

⁸³ "Vibra e ZEG unem-se para acelerar biocombustível." *Valor Econômico*, 21 September 2021.

⁸⁴ Aneel.

⁸⁵ "Brazil launches biomethane program." *BN Americas*, 21 March 2022.

5. Petrobras: A traditional supplier seeks to use green diesel to reduce emissions in transportation

Microsoft founder and billionaire Bill Gates recently suggested that switching to electric vehicles and alternative fuels (e.g., biofuels or electrofuels) is the most effective way that the world can move toward zero emissions in the transportation sector, which contributes 23% of global energy emissions.⁸⁶ Biofuel, which is largely underfunded and is not ready to be deployed at scale, is a renewable source made from organic matter or waste which is often blended with diesel or gasoline. The most common types of biofuels are biodiesel and bioethanol, both of which are gaining adoption in Brazil. Electrofuels, which cost three to seven times more than fossil fuels, are carbon-neutral fuels made by converting stored renewable energy into liquids. As it stands, the market demand is simply not large enough for either to grow in scale. Thus, innovation is required to make these technologies more affordable, more efficient, and most importantly, more scalable.⁸⁷

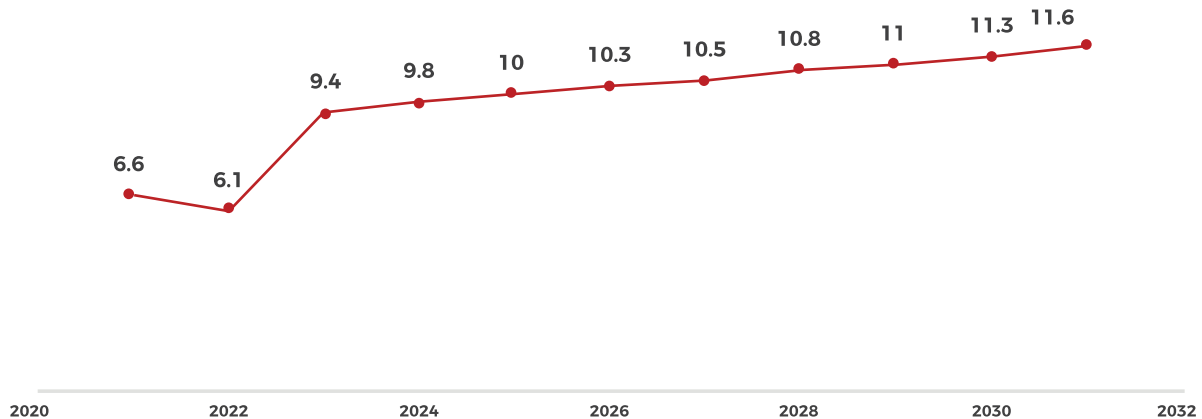
Improved regulatory frameworks are needed to promote the mass adoption of these technologies. Brazil, through its RenovaBio program, initially required that diesel fuels contain a minimum 13% biodiesel blend. Although the amount is expected to jump to 15% in 2023, President Bolsonaro mandated a temporary reduction to 10% to limit price increases for diesel. Biodiesel producers heavily criticized the government's decision, claiming that it was a clear market intervention that squeezed their margins.⁸⁸

⁸⁶ "Global energy-related CO₂ emissions by sector." *IEA*, 25 March 2021.

⁸⁷ "How do we move around in a zero-carbon world?" *GatesNotes*, 24 August 2020.

⁸⁸ "Mandato do biodiesel gera divergências no país." *Valor Econômico*, 12 April 2021.

Figure 24: Estimated biodiesel demand in Brazil, billions of liters



Source: Plano Decenal de Expansão de Energia, 2031.

Although a minimum requirement of biodiesel content promotes the use of cleaner fuels, both Europe and the United States limit their biodiesel thresholds to 5% to 7%. Requirements much higher than that can lead to engine complications, as seen among commercial trucks in Brazil. Biodiesel critics argue that a simple solution is the use of renewable diesel, known locally as green diesel, to fulfill the country's blending requirements. Renewable diesel is made from waste or residue oils; it is also cleaner than traditional biodiesel and chemically the same as diesel. Striking the right content requirements for biodiesel and renewable diesel will promote a higher-quality fuel, decreasing the environmental impact of the transportation sector and simultaneously causing biodiesel costs to fall.

With that in mind, and after facing nearly half a billion dollars in losses, Petrobras is transitioning from biofuels to producing a renewable diesel labeled HBio. Petrobras has begun divesting half of its refining capacity and proposes changing the biodiesel regulatory framework to liberalize the market. Currently, biodiesel auctions are fully executed by Petrobras, which also signs purchase and sale agreements, prepares the monthly biodiesel supply and demand schedule, and controls the daily loading capacity of biodiesel plants. To promote private competition, Petrobras proposes to eliminate auctions and remove the requirement that obligates

diesel producers and importers to purchase biodiesel, and allow distributors to purchase biodiesel directly from plants through private contracts.⁸⁹ More importantly, Petrobras wants new regulations to allow for the incremental use of "green diesel" in the country's blending requirements. This will create a direct competition between biodiesel, which Petrobras is transitioning away from, and "green" diesel, its new venture.

According to studies conducted by APROBIO (Brazilian Biodiesel Producers Association), green diesel reduces greenhouse gas emissions by 15% compared to biodiesel.⁹⁰ Some players, however, simply view this as Petrobras' attempt to preserve its market share as biodiesel eats into the company's sales of traditional fuels. Petrobras has responded by explaining that it is optimizing the use of its biorefinery infrastructure to produce a cleaner fuel used in both vehicles and airplanes. The state-owned oil company has completed the necessary tests and announced that it is ready to invest on an industrial scale, providing 50,000 to 60,000 m³ of HBio in 2021.

⁸⁹ AMI interviews.

⁹⁰ "Petrobras ready to launch renewable diesel production upon regulatory approval." *Green Car Congress*, 3 August 2020.

6. Conclusion: Navigating a tough investment climate to get a piece of the pie

Brazil's size and regulatory complexity should not discourage investors and energy players from entering the market. Despite its bureaucratic and political challenges, it is a country with favorable wind and solar capacity, as well as a tremendous amount of oil and gas. Brazil also has South America's largest manufacturing, agricultural, and industrial sectors, all of which require a sizeable amount of energy consumption. As investors pressure companies to go green, and the country's hydrological conditions worsen due to droughts, renewable energy will be the main beneficiary.

Foreign investors looking to purchase assets at a discounted price should look closely at the divestment of state-owned assets. Outside of the opportunities in Petrobras and Eletrobras, smaller segments, such as distributed generation and biomethane, are extremely profitable and less competitive. In fact, distributed generation in Brazil can generate 30% annual returns.⁹¹

Regardless of the political outcome in the 2022 presidential elections, Brazil's energy demand will continue to be the largest in Latin America. This demand cannot be satisfied without foreign monies and expertise. Understanding the country's on-the-ground risks, and how to mitigate them, will be fundamental in overcoming the challenges of operating in the Brazilian market. By locating key pockets of opportunity, capitalizing on its vast local network, and utilizing its proprietary knowledge to monitor risk, AMI can help ensure that your energy interests in Brazil achieve financial success.

Contact us at info@americasmi.com to explore how our market intelligence can help you leverage opportunities in Brazil's energy market to the fullest.

91 AMI interviews.





VII. Mexico

A. AMLO's volatile policies create opportunities for public-private partnerships in the energy sector

1. AMLO's personal vendetta to punish the private sector

For 75 years, Mexico's energy sector was nationalized and closed to private investment. Pemex, the state-owned oil giant, enjoyed a monopoly that gave it control of all aspects of the energy supply chain. The Federal Electricity Commission, known as the CFE, supported Pemex by providing the generation, transmission, and distribution of electricity.

Despite suffering from corruption, underinvestment, and financial loss, a large constitutional hurdle to any reforms delayed any significant transformation of the energy sector. In late 2013, the Mexican congress passed a constitutional amendment to open the energy sector to non-state players—including local and foreign companies. In 2014, additional laws were approved, including the end of CFE's monopoly on the supply of retail power to industrial and large customers. Private players were encouraged to develop their own services for the Mexican market.⁹² From 2013 to 2020, the new energy policies attracted US\$200 billion in committed investments for power generation and oil exploration.⁹⁵

92 "Mexico's New Energy Reform." *Wilson Center Mexico Institute*, October 2018.

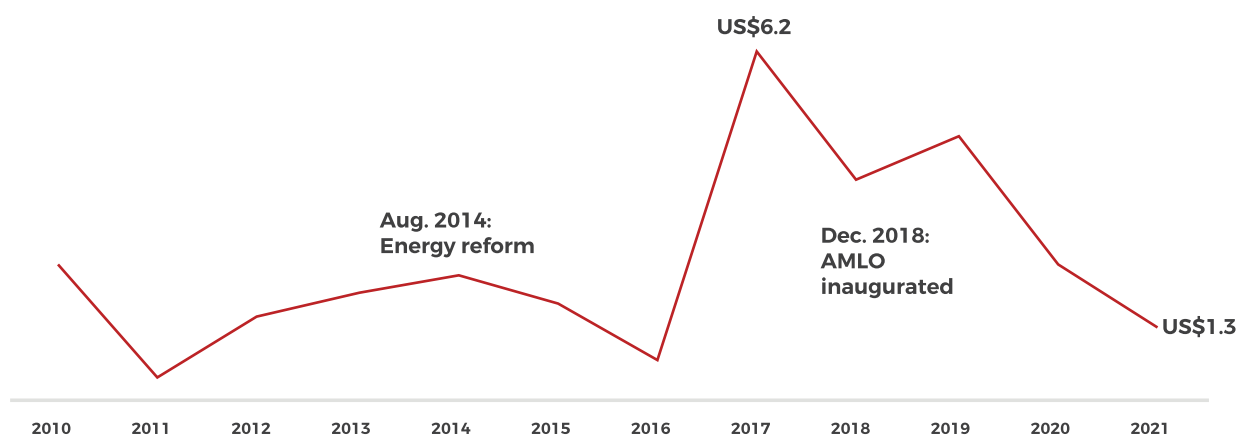
93 "Mexico to present projects open to private capital as it moves to undo energy reform." *S&P Global*, 8 September 2020.

Ever since the opening of the sector, Andrés Manuel López Obrador (AMLO), Mexico's current president, has berated the participation of international companies in the energy sector. **Resurfacing the idea of oil nationalism that was prevalent in the 1970s when he began his political career, AMLO has made it his obsession to reestablish the dominance of Mexico's two state-owned companies, CFE and Pemex, turning the briefly reformed industry completely on its head.** By doing so, AMLO has sought to exact revenge on the private sector, which he claims corruptly benefited from the former presidency of Peña Nieto. In May 2021, a bill proposed by AMLO to ban outsourcing was approved by the legislature, limiting the effectiveness of the private sector to ramp up capacity.⁹⁴ This type of political intervention has forced prominent foreign and local investors to freeze their Mexican investments and redirect capital elsewhere. Between April and June 2020, Mexico saw the largest outflow of money in the past 10 years. In fact, it is estimated that over \$100 billion in capital has fled the country since AMLO assumed office.⁹⁵

94 "Mexican president presents bill to ban outsourcing of jobs." *AP News*, 12 November 2020.

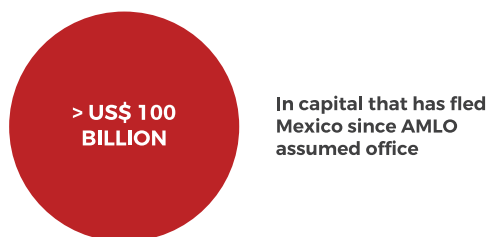
95 AMI analysis.

Figure 25: Clean energy investment in Mexico, billions of USD



Source: "Mexican Green Energy Investment Drying Up, Trade Groups Warn," *Bloomberg*, 26 January 2022.

Figure 26: Record outflow of investor capital in Mexico



Source: AMI analysis.

AMLO's policies have hindered the competitiveness of private companies to, in his words, "level" the playing field between the private and the public sector. In February 2019, the National Energy Control Center (CENACE), steered by AMLO loyalists, cancelled the country's fourth long-term electricity auction. In 2020, CENACE suspended the license for renewable energy plants—limiting the amount of renewable energy that could be generated in-country. CENACE also increased the transmission rates charged by CFE for renewable electricity—to benefit Pemex—and decided to bypass price-based power dispatch. A grid using price-based power dispatch is required to provide the cheapest electricity available, often renewable energy plants, in ascending price order.

With the newly proposed regulations, privately owned wind, solar, and combined-cycle plants would be the second to last in the dispatch order, giving hydropower and CFE-owned plants special priority.^{96 97} In December 2020, the CFE announced it would spend US\$3.1 billion by 2025 to add 4.3 GW to its generation capacity, with the objective of providing energy to the Mexican peninsulas where there is an energy shortage. The new capacity will be composed of six combined-cycle plants and five gas units, using aeroderivative turbines.⁹⁸

In addition to placing loyalists in charge of important energy agencies, AMLO was able to pass two major policy reforms in the sector: the Electricity Reform Law, passed in March 2021, and the Hydrocarbons Reform Law, passed in April 2021. The Electricity Reform Law sought to solidify the changes imposed by CENACE, allowing hydro-power plants and CFE-owned plants to have priority dispatch above renewable plants owned by private players. Although this law is currently suspended due to legal injunctions brought forward by energy players, AMLO resorted to another tactic: passing a constitutional amendment to reverse the energy

96 Proposed changes to dispatch order could dissolve Mexico power market – sources." *ICIS*, 11 September 2020.

97 "Mexico Darkens Power Sector Outlook." *Latinvex*, 22 October 2020.

98 "CFE invertirá 62 mil mdp para ampliar generación eléctrica." *El Financiero*, 8 December 2020.

reform passed in 2014. Although he was unsuccessful, Mexico’s energy generation has become dirtier and more expensive for the end consumer.

After PEMEX lost 50% of the retail diesel market and 30% of the retail gasoline market to competition, AMLO also sought to limit private competition by amending the hydrocarbons law.⁹⁹ The law would give the Energy Commission (CRE) discretionary power to grant or reject permits for the importation, exportation, transportation, and distribution of fuel. As occurred with the Electricity Reform Law, this law is currently suspended and awaiting a legal decision. Nonetheless, these laws have already severely impacted investor confidence by limiting private

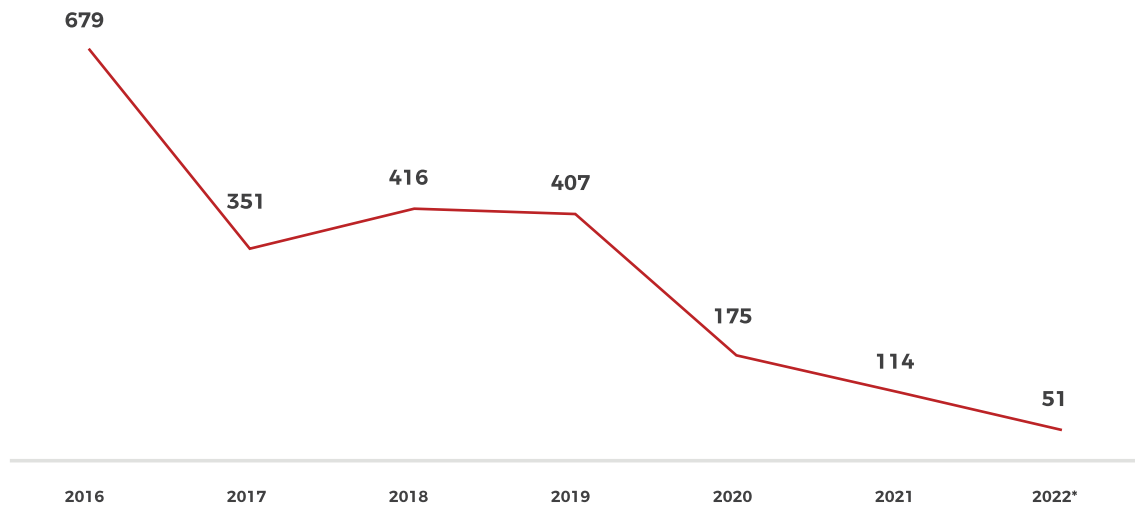
competition, impeding new licenses and slowing the development of new renewable projects in the country. In fact, **analysts estimate that AMLO’s policies threaten 150 renewable projects under development and over US\$40 billion in investment.**¹⁰⁰

In the 2021 mid-term elections, AMLO’s ruling coalition, the Morena Party, retained majority in both chambers of the legislature, but was unable to capture the two-thirds majority needed to approve constitutional changes. Nevertheless, he is attempting to move forward with either the energy reform or a favorable ruling for the suspended laws by creating alliances with the PRI and smaller parties.

⁹⁹ “Mexico set to pass bill likely to increase Pemex’s refined products market share.” *S&P Global*, 23 April 2021.

¹⁰⁰ “Mexico Darkens Power Sector Outlook.” *Latinvex*, 22 October 2020.

Figure 27: Number of retail gasoline permits issued in Mexico, through May of each year



*Through April 2022.

Sources: Petro PI Intelligence, ONEXPO.

2. The impact of AMLO's policies: A series of investor lawsuits and billions in losses

In mid-2020, a leaked document revealed AMLO's 17-point plan to "save" state-owned Pemex and CFE. The plan, focused on reestablishing the public sector's energy dominance, included a proposal to curb new permitting for their competitors—this took place via the recent hydrocarbons law.¹⁰¹ Shortly after the leak, AMLO vowed to change Mexico's constitution if he saw a threat to the well-being of Pemex and CFE.

By June 2020, in response to the leaked 17-point plan, 40 bipartisan U.S. congresspeople wrote a letter to President Trump complaining that AMLO was providing preferential regulatory treatment for Pemex and delaying (or even canceling) permits for U.S. energy companies. Although the letter was largely ignored due to the U.S. presidential elections, it fueled legal actions against the AMLO administration. The USMCA treaty, which replaced NAFTA, contains clear international arbitration laws and investor protections clauses that has AMLO facing several lawsuits for political interference in the energy sector.

This issue culminated in March 2022 with the appointment of Pemex as the operator of the 1-billion-barrel Block 7 in the Zama field. Block 7 was awarded to a consortium of companies—U.S.-based Talos Energy, Wintershall Dea of Germany, and Britain's Premier Oil—which had invested US\$335 million in exploratory and appraisal wells. In 2017, the consortium discovered over a billion barrels of crude, which overlapped into the adjacent block owned by Pemex. Despite studies showing that Block 7 owns 60% of the reservoir, in addition to Pemex lacking experience in deep shallow-water projects, the Energy Secretariat designated Pemex as the lead operator of the Zama field. These types of political concessions in favor of the state-owned company continue to discourage new investors from entering Mexico.¹⁰²

¹⁰¹ "Mexico's Assault on Energy Investors." *The Wall Street Journal*, 15 November 2020.

¹⁰² "Showdown in Mexico's Zama Oil Field." *The Wall Street Journal*, 27 June 2021.

Investors have also expressed that there is a large disconnect between what the policies are doing (hurting private investment and much-needed development of new generation capacity) versus what they are trying to achieve (promoting the development of the public sector). Credit agency Moody's predicts that private sector investment in the Mexican electric sector will stagnate through 2024 (when AMLO's six-year term ends).¹⁰³ The nationalist populism that AMLO has implemented throughout his presidency has undoubtedly made Mexico's energy sector the most controversial in the region.

Despite fiscal pressures, AMLO continues to heavily subsidize the operation of Pemex (considered by some to be the worst-managed major energy company in the world), doling out nearly US\$16.5 billion in his first 14 months at the helm, and championing a US\$8 billion oil refinery in his home state of Tabasco.¹⁰⁴ Even with those outsized allocations, Pemex's situation remains dire as it struggles to turn a profit. In the first quarter of 2020, with a depreciating *peso* and a decline in crude prices, Pemex recorded a US\$23.6 billion loss—one of its largest ever on record. This was slightly reversed with a US\$6 billion net profit posted in Q1 of 2022 (due to a surge in energy prices and foreign exchange gains), but Figure 28 on page 44 shows a dire financial situation for Pemex even before the pandemic.¹⁰⁵ **It is estimated that Pemex was losing US\$10 million dollars an hour during the first three months of 2020.**¹⁰⁶ With US\$108 billion in financial debt, Pemex is the most indebted oil company in the world.¹⁰⁷

¹⁰³ "Regulaciones y desinterés a energías renovables alejan a inversionistas en sector eléctrico mexicano: Moody's." *Infobae*, 22 June 2021.

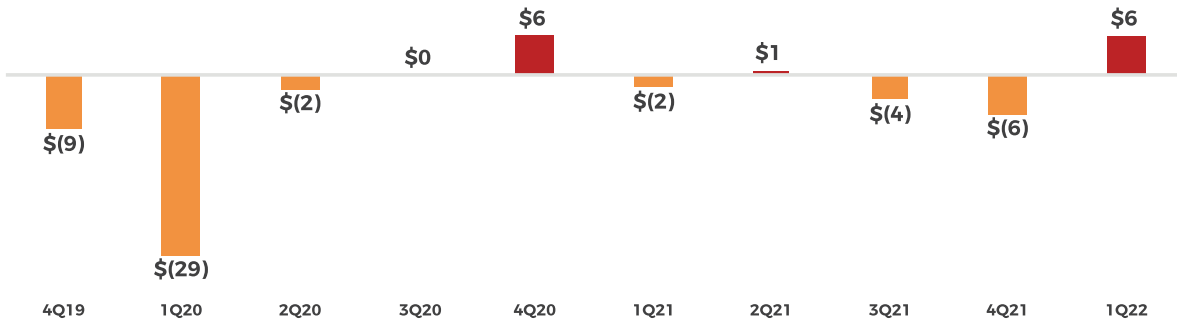
¹⁰⁴ "Global Fossil Fuel Subsidies Remain Large: An Update Based on Country-Level Estimates." *International Monetary Fund*, 2 May 2019. ISBN/ISSN: 9781484393178/1018-5941.

¹⁰⁵ "Mexico's Pemex swings to \$6 bln profit in first quarter, debt dips." *Reuters*, 2 May 2022.

¹⁰⁶ "Mexico's Pemex bleeds more red ink in nearly \$24 billion quarterly loss." *Reuters*, 30 April 2020.

¹⁰⁷ "Exclusive: Mexico's Pemex could look to Mexican borrowers for financing needs." *Reuters*, 10 September 2020.

Figure 28: Pemex quarterly financials, net income (loss), in BN of USD*



*Calculated using constant exchange rate from 31 March 2019, MXN 19.4 p/ USD.
Source: Pemex Investor Relations Reports.

Mexico's large crude oil reserves, estimated at 5.8 billion barrels, are also losing favor in the global markets. The country's resources are mostly heavy crude oil varieties, which are experiencing deflating global demand as countries transition to lighter, lower-sulfur content to comply with new, stricter fuel emissions.¹⁰⁸ Pemex must diversify its production if it wants to stay afloat. It could start by reigniting its involvement in petrochemicals, as the global demand for plastic will triple by 2050.¹⁰⁹ However, as seen in Figure 29 below, Pemex's petrochemical production has declined by roughly 50% between 2012 and 2020.

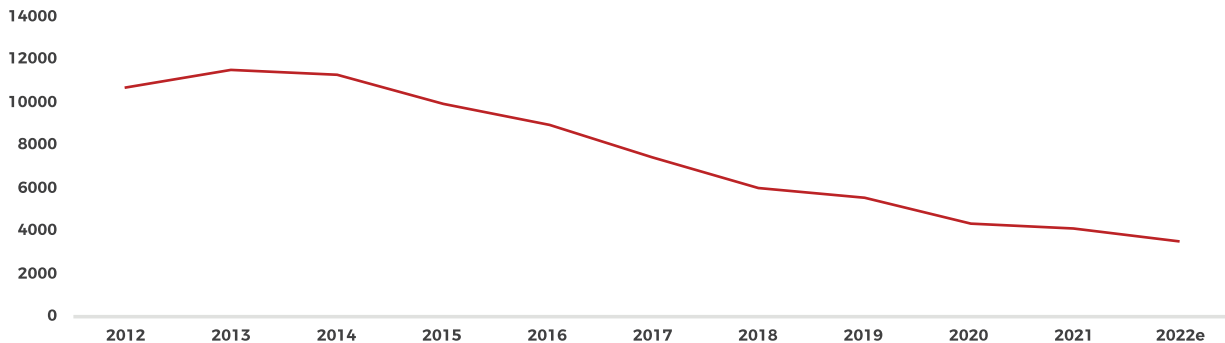
The country's high levels of fossil fuel subsidies also appear to be more harmful than beneficial. A study by the United Nations shows that Mexico would see a 1.2% increase in Revenue Total Factor Productivity (TFPR) and a 0.4% growth in profitability if there was a 10% increase in fuel prices. In essence, a decline in subsidies and an increase in fuel prices would encourage factories to replace old, fuel-powered assets with more efficient and productive technologies. Thus, both economically and environmentally, Mexico would benefit from a decrease in fuel-related subsidies and an increase in overall renewable capacity.¹¹⁰

108 "Country Analysis Executive Summary: Mexico." *U.S. Energy Information Administration*, 30 November 2020.

109 AON, Future of Risk: Energy.

110 "Too Much Energy: The Perverse Effect of Low Fuel Prices on Firms." *UNIDO*, 2019.

Figure 29: Petrochemical production of Pemex from 2012 to 2022, in thousands of tons



e = Estimate for 2022, as data is only available through April.
Source: Estadísticas Petroleras, Pemex, April 2021.

3. Desperate times lead to desperate measures: AMLO slightly opens the door to the private sector and creates PPP opportunities

Although the nationalistic ideology remains at the forefront of AMLO's popularity, the 2020 drop in the price of crude, coupled with the depreciation of the *peso*, the loss of investor confidence, and COVID-19 lockdowns, made the financial losses of Pemex unbearable for Mexico's purse strings. AMLO quickly realized that the country needed other sources of funding and investment, forcing him to turn to the private sector, thereby softening his ideologically charged position.

Between October and November of 2020, the government announced two infrastructure packages with the private sector to shore up weakening public expenditures. The planned investments will amount to roughly US\$25 billion, including a US\$2 billion liquefied natural gas export plant built by the Mexican subsidiary of Semptra Energy. The Pacific Coast LNG export plant, which is closer to Asian markets compared to its U.S. counterparts, was nearly scrapped after the government refused to approve a necessary 20-year export permit.¹¹¹ **Despite permitting obstacles and political interference, LNG export terminals in Mexico are an appealing substitute for Russian gas going to Europe and Asia.** In fact, in April 2022, AMLO announced that the country would tender three new gas liquefaction plants located in the Pacific and Gulf of Mexico¹¹², focused on converting natural gas to LNG and shipping it to global markets.

Comments from Energy Minister Rocío Nahle solidified the slight opening to the private sector. In October 2020, Nahle mentioned for the first time that Pemex could engage in strategic partnerships with private companies if "a feasible plan was presented." Not only did Nahle recognize that joint ventures (and even oil auctions) may need to resume, but also that foreign investment may be needed.¹¹³ By positioning themselves as vital technology and/or service providers

111 "Exclusive: Second Mexico investment plan worth up to \$10 billion - sources." *Reuters*, 26 November 2020.

112 "AMLO planea construcción de tres plantas de licuefacción de gas." *El CEO*, 1 April 2022.

113 "La Sener abre la puerta a que Pemex se asocie de nueva cuenta con privados." *Expansión*, 26 October 2020.

to Mexico's state-owned energy players, private players are more likely to succeed versus operators who come to compete against Pemex and CFE.

4. What's next? Mexico must capitalize on its rich wind and solar resources

The silver lining in Mexico's energy sector is the optimism around the country's energy resources. With an average solar radiation of 2,200 kWh/m² per year, Mexico's sunbelt in Baja California is one of the best solar spots in the world, comparable to Chile's Atacama Desert and the MENA region.¹¹⁴ Similarly, Oaxaca, a southwestern state with a coastline on the Pacific Ocean, has over 6,600 square kilometers of windy land with good-to-excellent wind resource potential that is roughly the size of 1.3 million football fields.¹¹⁵ In the entirety of Mexico, studies have estimated the wind potential to be around 70 GW, roughly the same amount of energy that was produced by all other energy sources combined in 2016.¹¹⁶

In 2015, prior to AMLO, the Mexican government introduced the Energy Transition Law, which pledged that 35% of its generation mix would come from clean energy by 2024—up from 17% in 2019. By 2050, that number is projected to rise to 50%.¹¹⁷ The Energy Transition law also set clean energy requirements for suppliers and large customers, mandating a 5% quota in 2018 with a gradual increase throughout the years.¹¹⁸ In doing so, the Mexican government created a market for bankable Clean Energy Certifications (CELs), in which companies could acquire CELs to fulfill their clean-energy requirements. Companies could do so via three methods:

1. Bilateral PPA agreements
2. Long-term auctions
3. The CEL market

114 "Renewable energy in Latin America: Mexico." *Norton Rose Fulbright*, October 2016.

115 "Wind Energy Resource Atlas of Oaxaca." *National Renewable Energy Laboratory*, August 2003.

116 "Mexico and its great potential as a wind power generator." *REVE News*, 1 July 2020.

117 "Demand analysis of emerging PV markets: Mexico of Central and Southern America." *InfoLink*, 15 April 2020.

118 "Mexico publishes requirements for clean energy certificates." *pv magazine*, 3 April 2017.

In October 2019, AMLO’s administration modified the scheme by allowing hydroelectric plants to issue CELs.¹¹⁹ The rule change was specifically targeted to benefit CFE, which has nearly 17 GW of hydro capacity, and will no longer need to rely on the CEL market to comply with Mexico’s minimum clean energy quotas. These abrupt changes create market uncertainty and investor concern, causing most operators and investors to shy away from the country, but they also create unique pockets of opportunity for those that are closely watching the sector.

¹¹⁹ “Mexico’s New Clean Energy Certificates (CELs) Decree and Why it Matters.” *Edison Energy*, 12 November 2019.

Figure 30: Clean Energy Certification (CEL) minimum requirements, by year

Year	CEL quota
2018	5%
2019	5.8%
2020	7.4%
2021	10.9%
2022	13.9%

Source: CENACE.

B. Large customers and suppliers of renewable energy fight to remain relevant

1. Large customers seek short-term PPAs

After the approval of 21 constitutional amendments and the energy reforms of 2013, Mexico’s newly opened energy sector improved dramatically. Mexico’s free energy market allows companies with aggregate consumption levels greater than 1 MW to buy and sell energy with qualified suppliers. In most cases, these large companies resort to PPAs, but they may also buy power via long-term auctions, spot, or future contracts.

PPAs don’t have a fixed price, since prices are negotiated privately between buyer and seller and are often indexed to a rate that factors in both the long-term electricity market (i.e., future contracts) and pool price forecasts.¹²⁰ Since 2013, PPAs have transitioned from longer-term agreements to shorter-term deals ranging between one and five years. These agreements rarely extend beyond six years. This is mostly because large customers want to avoid being locked into long-term contracts as long as renewable energy pricing continues to drop.

¹²⁰ The pool price is the dollar cost of a megawatt hour of electricity at the end of a given hour that is paid to electricity generators for supplying electricity by retailers.

2. Mexico’s adjustment-based strategy auctions

Mexico’s auctions use an adjustment-based strategy that is heavily dependent on a central planner’s ability to forecast the future needs of the system. This strategy is used to yield the most socially desirable outcome by incentivizing certain types of projects.

One way Mexico does this is by using grid integration as a criterion for selecting auction winners. This method awards projects a bonus or penalty according to the stress that they impose on the system. Thus, those projects that are closer to the grid, or have favorable technical characteristics, will be rewarded. This allows for greater grid flexibility, as it assigns the share of auctioned energy to different locations based on the competitive advantage of the project.

Mexico also utilizes a risk allocation mechanism that provides additional compensation to generators that have more compatible profiles with the grid. This allows generators to be shielded from market risks, such as inconsistent pricing or changes in regulation, while simultaneously incentivizing them to produce during times of higher demand. For countries without a strong market track record or with a higher risk profile, this mechanism provides some degree of reassurance for investors.¹²¹

¹²¹ Renewable energy auctions: Status and trends beyond price.” *IRENA*, December 2019. ISBN: 978-92-9260-190-4.

In Mexico's most recent renewables public auction, which took place in November 2017, Enel's bid reflected the cheapest wind power bid in the world at the time. Solar PV was also contracted for an average price of roughly US\$20 MWh, one of the lowest prices internationally. This value was down from an average price of US\$44.9 per MWh in the 2016 energy auction. Wind energy was sold even cheaper, averaging US\$17.70 per MWh, the lowest price among the six major Latin American markets. This reflected the strong investor confidence over the country's renewable sources.

3. Self-generation: Large multinationals look beyond PPAs but often face challenges

In addition to long-term auctions and PPAs, some of the market-leading multinationals have also attempted to self-generate electricity to cut transmission costs. Grupo Bimbo, a multinational bakery manufacturer, and Cemex, the fifth-largest cement company in world, were among the first Mexican companies to pursue this model.¹²² By purchasing a majority share in generation plants via Special Purpose Vehicles (SPVs), these companies were given the right to own and operate these plants. A small portion of the energy generated was provided freely to the companies that owned the plant, such as Bimbo and Cemex, and the remaining majority was sold to the electricity grid—ideally at a profit. Over time, these companies realized that the operation of generation plants was rather complex and unaligned with their business models. This made them look for financial partners to buy out their shares in the SPVs, transitioning them away from self-generation and back into a purely consumption model.

In certain cases, in exchange for electricity that is free of transmission costs, multinationals replicate the self-generation model by paying a symbolic US\$1 to the generation company. In essence, the plant is controlled entirely by the generation company, such as Enel or Ibedrola, but it is "owned" by the consuming multinational. Both AMLO and CFE's directors have complained about this model, arguing that Enel is taking advantage of Mexico's legacy contracts and self-supply scheme to violate the law.¹²³ In fact, AMLO claims that half of the country's 234 existing self-supply agreements are "simulated," allowing

¹²² "15 Largest Cement Companies in the World." Yahoo!, 17 November 2020.

¹²³ "CFE acusa a italiana Enel de violar la ley en mercado de energía." *Milenio*, 17 June 2021.

companies to purchase energy at lower costs from private generators rather than from the CFE. Prices charged by the CFE can be 30% to 50% higher than those produced by private generators, hurting the country's manufacturing industry. Nevertheless, while AMLO has attempted to modify the country's legacy contracts, a judge suspended his proposed changes in May 2021.^{124 125}

4. Green financing: CEMEX and Coca-Cola FEMSA look for sustainable capital

Despite AMLO's efforts to restrict access to affordable and clean power produced by private generators, companies continue to investigate new ways to improve the sustainability of their supply chains via "green" financing structures. In October 2020, Cemex incorporated green metrics for US\$3.2 billion in financial commitments as a part of a "green" financing deal. The metrics include reducing net CO₂ emissions related to cement products and using clean energy for their power consumption. Cemex's performance related to those metrics could result in adjustments of interest rate margins of up to 5 basis points.¹²⁶

Similarly, Coca-Cola FEMSA, the Mexican bottler with the world's largest sales volume of Coca-Colas, issued US\$705 million worth of 12-year green bonds in August 2020. Although the initial proposal was to issue US\$500 million in bonds, large investor demand turned it into the largest ever green bond deal for a Latin American corporation. The company priced the 2032 bonds at the US Treasury plus 120 basis points and a coupon of 1.850%. Despite its low coupon rate, the deal was 11 times oversubscribed.¹²⁷

¹²⁴ "Mexico suspends changes to legacy contracts." *BN Americas*, 21 May 2021.

¹²⁵ Mexico Takes Aim at Private Companies, Threatening Decades of Economic Growth." *Wall Street Journal*, 12 June, 2022.

¹²⁶ "UPDATE 1-Mexico's Cemex extends \$2 bln loan maturities in 'green' finance deal." *Reuters*, 13 October 2020.

¹²⁷ "Coca-Cola Femsa sells green bonds." *LatinFinance*, 27 August 2020.

C. Challenges and opportunities among renewable energy suppliers: Cheap natural gas and hindering policies

Electricity demand in Mexico has grown nearly 3% annually since 2000, reflecting a growing need for additional installed capacity. However, with the politically motivated regulatory delays surrounding private projects, especially those in the renewable sector, **Mexico's net additions of renewable energy from 2022 to 2026 will fall by over 50% compared to the previous five years.**¹²⁸ Data shows that AMLO has tried to prevent more than 40 privately owned wind and solar plants from connecting to the electric grid since assuming office in late 2018.¹²⁹ AMLO's recent policies, such as the elimination of the price-based power dispatch system, are also aimed at promoting CFE's gas plants at the expense of renewable powers. These regulations have lowered the rate of returns for clean energy projects and dissuaded most new investment.

Cheap natural gas coming from the United States makes gas plants relatively cheap in northern Mexico, serving as a competitor for clean energy. In fact, U.S. natural gas exports to Mexico reached a record high in 2020. With the completion of key gas pipelines in Mexico, including the Wahalajara network in northern Mexico, the Mexican government projects a 30% increase in dry natural gas consumption from 2017 to 2032.¹³¹ In April 2022, the Mexican government also announced that it was planning three new gas liquefaction facilities to export excess gas—much of it will likely replace the deficit of Russian gas in Europe.¹³²

Although Mexico's latest auction, in 2017, produced record-low bids for solar and wind energy, the LCOE, or the cost to build those plants over the long run, only dipped below coal plants in 2020 (globally, this

happened in 2019). This is likely because of a higher cost of capital for Mexican renewable plants, due to the country's high political and regulatory risks, in addition to the plants being located far from urban centers. Mexico's renewable generation capacity tends to be located in remote rural areas, complicating the connection point to the grid. The Mexican grid also lacks high-voltage transmission lines, which could efficiently transmit large amounts of wind and solar energy from rural to urban areas. With better transmission infrastructure, and more affordable and efficient solar photo-voltaic technologies, the LCOE for solar generation projects in Mexico is expected to dip below natural gas within a few years. Wind power, due to its higher costs related to turbines, will not underprice natural gas until the mid-2030s.¹³³

1. Enel Green Power and Heineken: Innovative renewable strategies connecting large suppliers and customers

Enel Green Power, a subsidiary of Italian utility giant Enel, is a leading supplier of green energy for large customers in Mexico. In an agreement with Heineken, Enel agreed to a 10-year deal to provide 100% clean energy for Heineken's brewery, which is located in Meoqui, Chihuahua. The plant will be supplied annually with 29 GWh of solar and wind energy, avoiding the emission of 16,100 tons of CO₂. The agreement also includes the sharing of operational residues with nearby companies, eliminating waste and creating the first brewery to operate within a "circular economy" ecosystem. Heineken aims to use 100% renewable energy for all its operations by 2030.¹³⁴

¹²⁸ IEA, *Renewables 2021—Analysis and forecast to 2026*.

¹²⁹ "Nothing can shake AMLO's fossil-fuel fixation." *The Economist*, 21 May 2020.

¹³⁰ "La Agencia de Energía dice que las renovables se están frenando en México." *Expansión*, 23 October 2019.

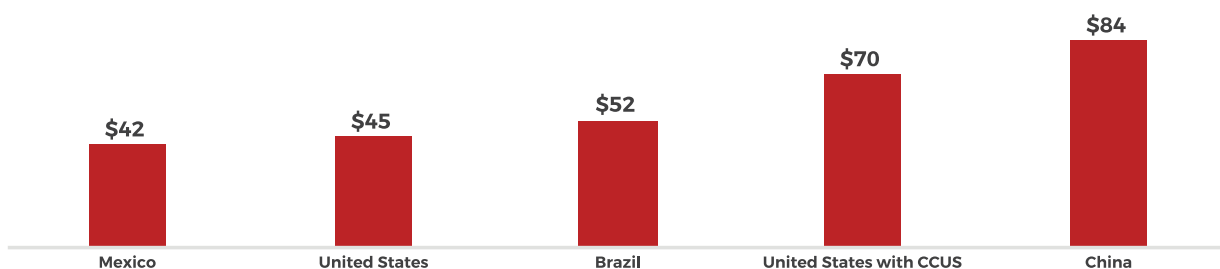
¹³¹ "Country Analysis Executive Summary: Mexico." *U.S. Energy Information Administration*, 30 November 2020.

¹³² "Mexico plans three gas liquefaction facilities, eyes tender process." *Reuters*, 2 April 2022.

¹³³ "Mexican renewables costs starting to compete with fossil fuels." *BN Americas*, 22 July 2020.

¹³⁴ "Heineken Mexico and Enel Green Power Mexico close a 100% Renewable Energy Agreement." *Enel Spa*, 9 March 2020.

Figure 31: Levelized cost of electricity (USD/MWh) for combined-cycle gas plants, per country



Source: International Energy Agency.
 Note: At 85% capacity factor and 7% discount rate.

Enel Green Power also won the rights to build four wind plants as part of a third long-term auction in 2017. In September 2020, the company concluded the construction of the 274 MW Dolores wind farm, the company's largest in the country. Instead of a PPA with a private customer, Enel signed a 15-year contract with CENACE, which operates the country's wholesale electricity market. The US\$290-million plant can generate up to 938 GWh annually and was contracted at an average price of \$17.70/MWh.^{135 136}

2. Conclusion: Further instability expected in Mexico's energy sector

Mexico, like Brazil, is a country with tremendous energy potential. Not only does it have significant crude reserves, but it also has world-class solar and wind geography. But Mexico is also a country that has undergone periods of political instability and S.O.E. (state owned enterprise) mismanagement, which has jeopardized the country's energy sector.

Similar to another regional neighbor, Argentina, the current AMLO administration is adamant about ensuring the success of state-owned companies. Nonetheless, the AMLO administration reluctantly recognizes that Mexico's energy demand will not be satisfied without the help of foreign investors and companies. This creates select opportunities, from LNG export plants in the Mexican Pacific Coast, to solar farms in Mexico's sunbelt, which can be satisfied via public-private partnerships.

The unpredictability of the current administration and its penchant for political interference makes it even more important to have an on-the-ground ally that can monitor and advise on local energy developments. Using AMI's local network and its extensive knowledge of the country's energy sector, energy players and investors alike are more likely to be able to mitigate unforeseeable obstacles, pinpoint opportunities, and have a successful venture in Latin America's second-largest energy market.

Contact us at info@americasmi.com to explore how our market intelligence can help you leverage opportunities in Mexico's energy market to the fullest.

¹³⁵ "Third Mexican Auction Awards Enel 593 Megawatts of Wind, Canadian Solar Awarded 367 Megawatts Solar." *CleanTechnica*, 28 November 2017.

¹³⁶ "Enel Green Power completes installation of the total capacity of its Dolores wind farm in Mexico." *Enel Spa*, 7 September 2020.



VIII. Colombia

A. How the Gustavo Petro administration will change the country's energy path

1. Presidential elections and the impact on the energy sector

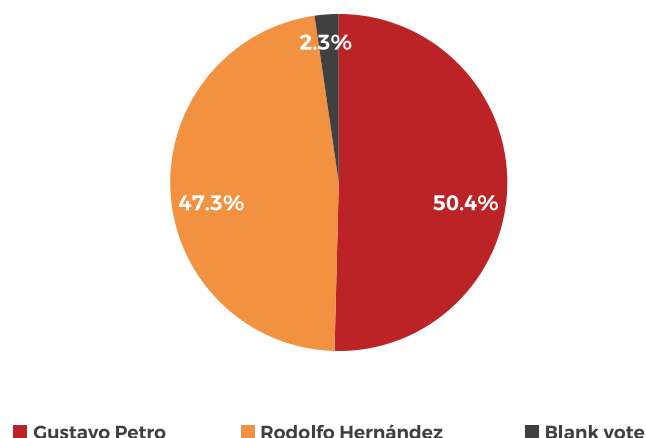
When President Duque was inaugurated in August 2018, Colombia had 28 MW of installed renewable energy capacity. By December 2021, that amount increased fivefold to roughly 150 MW, but still represented less than 1% of the total energy matrix. With Colombia seeking to expand its current renewable capacity to 12% of the energy matrix by 2023, the National Energy Planning Agency (UPME) has approved 8,000 renewable projects. However, the future of Colombia's energy sector has now taken a new turn. Elections in June 2022 elected the first leftist president in Colombia's history, Gustavo Petro, transforming both the country and its energy policies.¹³⁷

¹³⁷ "La capacidad instalada de energías renovables en 2021 ya supera 25 veces lo que tenía Colombia en 2018." *Infobae*, 22 December 2021.

As seen in Figure 32 on page 51, Gustavo Petro—a former left-wing guerrilla member and mayor of Bogotá—was elected in a tight race by winning 50.4% of the votes, overcoming the surging independent businessman Rodolfo Hernández. Recent elections among Colombia's neighbors had indicated that the Latin American electorate would continue to reject the current status quo: In Argentina, the ruling Peronist party lost its majority in the midterm elections; Chile and Peru replaced their center-right administrations with a leftist president; and Brazil has increasingly pointed toward the replacement of right-wing President Bolsonaro with left-wing Luiz Inacio Lula da Silva.¹³⁸

¹³⁸ "Latin American Voters Are Mad as Hell." AMI, 25 January 2022.

Figure 32: Percentage of votes, Colombian presidential election results, June 2022



Although the new cabinet is still being formed, based on Petro’s statements and previous actions, an energy sector under this administration would have the following characteristics:

- Potential nationalization of key energy players and an increase in coal and oil royalties. Higher taxes could lead to the divestment of assets, offering cheap opportunities for investors during a time of a depreciating *peso*
- The growing presence of state-owned entities such as Ecopetrol, with the appointment of new board members that are aligned with Petro’s policies
- Aggressive decarbonization of the energy sector with the accelerated replacement of coal and oil with solar and wind
- Immediate ban on new oil and coal exploration, including the prohibition of fracking, leaving 80% of oil fields underground
- Continued electrification of the transportation sector

The extent to which Petro will be able to stop oil and coal exploration is still unclear, as hydrocarbons account for nearly 20% of total fiscal revenue.¹³⁹ However, Petro will be able to rapidly expand the role of state-backed companies in the extractive industries, replicating efforts taken on by the populist presidents in Mexico, Peru, and Argentina. This will create a less competitive energy sector, discouraging much-needed foreign

¹³⁹ “Fuel for Thought: Leftist front-runner presents challenges to Colombia’s oil and gas sector in 2022.” *S & P Global*, 25 January 2022.

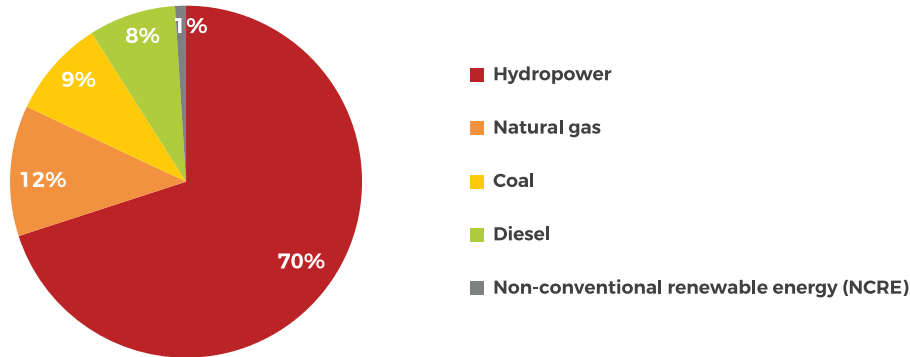
investments. Companies with state control, such as Empresas Públicas de Medellín (EPM) and Ecopetrol, will be favored over privately owned generators, such as Emgesa-Enel and Grupo Energía de Bogotá (GEB). In fact, in April 2022, Gustavo Petro urged an alliance between EPM and Ecopetrol to encourage the development of renewable energy.¹⁴⁰ Private generators that use fossil fuels will be especially punished.

Despite Petro’s move toward more aggressive decarbonization policies, investors should be wary of Colombia’s delay in deploying renewable energy projects. **At the end of 2021, nearly 3.5 GW in renewable energy had been contracted, but only 151 MW was installed and operating** (equivalent to 1% of the total matrix, as seen in Figure 33 on page 52). Although some of these projects don’t have a start date until the middle of the decade, renewable energy investors and operators are experiencing a disconnect between supply and demand caused by a lack of high-voltage transmission lines, challenges with connection points, and bureaucratic environmental permitting.

The slow pace in which renewable energy is coming online, coupled with higher electricity demand, declining gas reserves and poor hydrological conditions, will force Petro to choose between energy security and his campaign promises. Without a sudden acceleration in the renewable energy permitting process, or substantial changes in energy storage regulation, Petro may be forced to import gas from foreign markets or

¹⁴⁰ Petro promete industrializar a Medellín aunque “gane Duque dos.” *La FM*, 8 April 2022.

Figure 33: Installed energy capacity in Colombia, by source, 2021



Source: AMI analysis, SER, IHS Markit.

increase domestic fossil fuel generation. This could lead to higher prices for end-users, potentially erupting into protests (as seen in Ecuador) and community opposition towards certain assets.

Risk-adverse energy investors and operators must stay in tune with the changing dynamics of a new administration, which AMI is closely monitoring with its sources on the ground. Despite Petro’s idealistic views, he will struggle to implement meaningful changes in a time of high inflation, low growth, and a divided congress.

2. The dynamics of the Colombian electricity market

In July 2021, to allay some of the issues mentioned earlier, the Colombian government approved Law N° 2099/2021. This new energy transition law modifies Law 1715/2014, which marked the beginning of Colombia’s energy transformation. The main features of the law include¹⁴¹:

- A. Distribution companies need to contract 8% to 10% of their energy from non-conventional renewable energy sources (NCREs)
- B. Energy storage, smart meters, and green and blue hydrogen are now qualified as NCREs, granting them existing tax incentives

- C. A decrease from a five-year to a three-year depreciation regime for NCRE
- D. Streamlined environmental permitting for generation and transmission projects
- E. The extension of previously existing tax incentives for NCRE:
 - VAT exclusion for goods and services
 - Tariff exemption
 - Income-tax deductions equivalent to 50% of investment for up to 15 years
 - Goods and investments related to carbon capture and storage will qualify for an income tax credit of 25% of the investment, a VAT exclusion, and accelerated depreciation
- F. The creation of a regulatory framework and a National Registry for geothermal projects

This law has been the main driver behind the acceleration of low carbon assets in the country. Both sides of the political spectrum recognize its positive impact and wide popular appeal. This makes it less likely that it will be tampered with, irrespective of the new president.

Like other markets in the region and throughout the world, Colombia operates under two main markets: regulated and free. Although the free market is growing in Colombia, two-thirds of consumption is attributed to the regulated sector (i.e., households and small consumers). Consumers pay a tariff set by the country’s regulatory energy agency (CREG), leading

¹⁴¹ “Colombia enacts law modifying the tax incentives applicable to renewable energy projects.” *EY*, 20 July 2021.

to relatively low volatility over time and consistent demand. For large customers seeking to cut carbon emissions, the National Accreditation Agency (ONAC) certifies the consumption of renewable power by issuing Carbon Certificates (CERs) for every MWh of eligible renewable output. In turn, the CERs can be used to cut down the entities' National Carbon Tax.¹⁴²

Another important factor is that since 2006, thermal generators have been subject to a reliability charge (*cargo por confiabilidad*). Even if these plants do not generate electricity, they are compensated for their ability to supply a daily amount of energy at a moment's notice. This was created for periods of extended drought, common during El Niño years.¹⁴³ In a rare occasion, to attract more bidders, the *cargo por confiabilidad* was awarded in the May 2019 renewable auction.

3. The rise of private auctions

The government has held four renewable energy auctions, with mixed results. The results were the following:

- February 2019: No contracts awarded because bidders did not meet the auction's criteria
- May 2019: Following the disappointing February auction in which no projects were awarded, the grid operator (XM) contracted 1.39 GW of solar and wind in a reliability charge auction in May 2019.¹⁴⁴ Expected operation is to take place between 2022 and 2023.
- October 2019: Nine projects awarded for 1.3 GW of solar and wind at US\$0.028/kWh; 15-year PPAs in operation by January 1, 2022.¹⁴⁵

- October 2021: 11 projects for 796 MW of solar at US\$0.041/kWh; 15-year PPAs in operation by January 1, 2023; US\$870 million in investments.¹⁴⁶

The October 2019 auction was a double-sided renewable energy auction, in which both sellers and buyers bid for energy in terms of quantity and price. The contracts included a 15-year PPA, in addition to mandatory renewable energy purchase requirements among corporations, effectively reducing prices in the tender.¹⁴⁷ Price increases in the 2021 tenders were connected to higher investment costs, a by-product of the surge in raw materials and global supply-chain disruptions. With commodity and freight costs at record highs, auction prices throughout the world are likely to continue seeing increases. Colombian investors may have also priced in the political uncertainty of this year's elections.

There is also a rising interest in private power auctions, which involve a bilateral PPA agreement between generators, developers, and distributors. Private companies deal directly with each other, removing any government participation. Colombian energy supplier Renovatio launched the country's first private auction in January 2021, setting the stage for generators to contract 20GWh a month via contracts ranging from five to 25 years. In the same vein, in January 2022, Barranquilla-based distributor Air-e shortlisted 22 generators to supply its customers with 2.5 GW of solar and wind power. Air-e will award 15- or 20-year contracts on a take-or-pay basis: This mechanism forces Air-e to either use the power contracted or pay a specified amount.¹⁴⁸ **As consumers seek a more flexible, open, and personalized energy-buying experience, bilateral negotiations in the private sector—and more specifically private power auctions—will grow exponentially.**

¹⁴² "Colombia." *Brookfield Renewable U.S.*, n.d.

¹⁴³ "Colombia: Cargo Por Confiabilidad – 2019 Auction Process." *Clifford Chance*, 26 February 2019.

¹⁴⁴ "Colombia awards 1.39 GW of wind and solar in Reliability Charge auction." *pv magazine*, 4 March 2019.

¹⁴⁵ "Colombia names renewables auction winners." *Renewables Now*, 24 October 2019.

¹⁴⁶ "Colombia's renewables auction assigns 796 MW of solar at average price of \$0.041/kWh." *pv magazine*, 27 October 2021.

¹⁴⁷ Davos Energy Week, January 20, 2022, Diego Mesa, Colombian Minister of Mines and Energy.

¹⁴⁸ "Seven key trends in Colombia's energy sector for 2022." *BN Americas*, 14 January 2022.

B. Opportunities in Colombia's energy transition

On January 14, 2022, the Colombian government announced its 2022 energy policy agenda. It laid out four priorities:

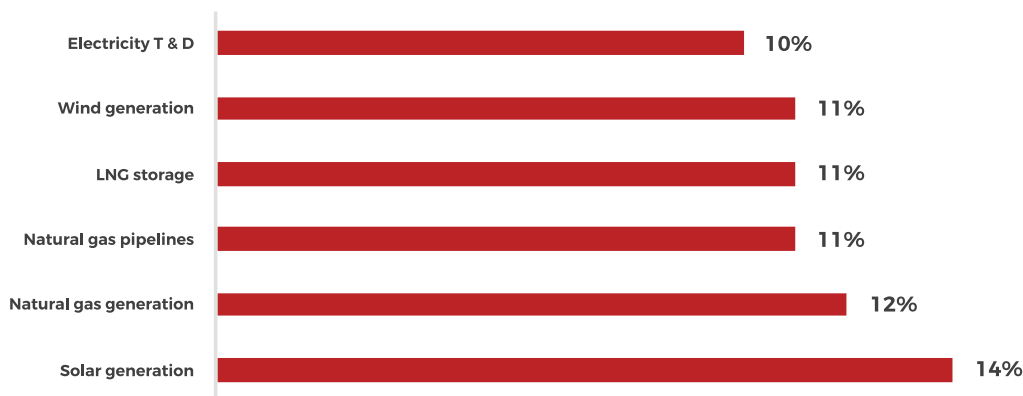
- A. Clean energy transition
- B. Rural electrification
- C. Transportation infrastructure
- D. Natural gas supply

These objectives are based upon the identified gaps within Colombia's energy sector and provide insight as to where the country's priorities currently stand. Based on interviews conducted with in-country experts, combined with AMI analysis, here is a breakdown of the opportunities that are ripe for both large energy investors and companies alike.

1. Solar generation and offshore wind are key energy sources for Colombia's clean energy transition

The scope of the clean energy transition covers a wide variety of different industries and technologies, but Colombia's solar generation is primed for growth in specific regions (known locally as departments). As seen in Figure 34 below, solar generation is expected to lead the internal rates of returns (IRR) for investors. Developers looking to enter the country should focus on the central departments, such as Cundinamarca and Tolima, because of their strong solar radiation and proximity to large urban centers. These departments have a more developed transmission infrastructure which facilitates the connection between the generating plant and the end consumer.

Figure 34: Estimated unlevered IRRs for different Colombian energy projects, in local currency



Source: IRR is based on AMI analysis and expert interviews.

Not only do solar projects face less community opposition than wind projects, but they also have a more developed track record in the country. This high demand was reflected in Colombia's latest large-scale renewable energy auction in October 2021, in which 53 qualified buyers opted to buy solely from solar generators. Celsia—one of the leading market players—is capitalizing on this opportunity by launching a solar investment platform in partnership with Bancolombia. The objective will be to finance and build 160 MW of solar energy projects for businesses in Colombia.¹⁴⁹

Colombia also has a world-class wind potential (9m/s) in the La Guajira department near the Caribbean, but it faces transmission challenges and strong opposition from the indigenous Wayuu communities. Of the 16 wind plants that have been approved by the Unidad de Planeación Minero-Energética (UPME, the government entity that oversees the energy sector),

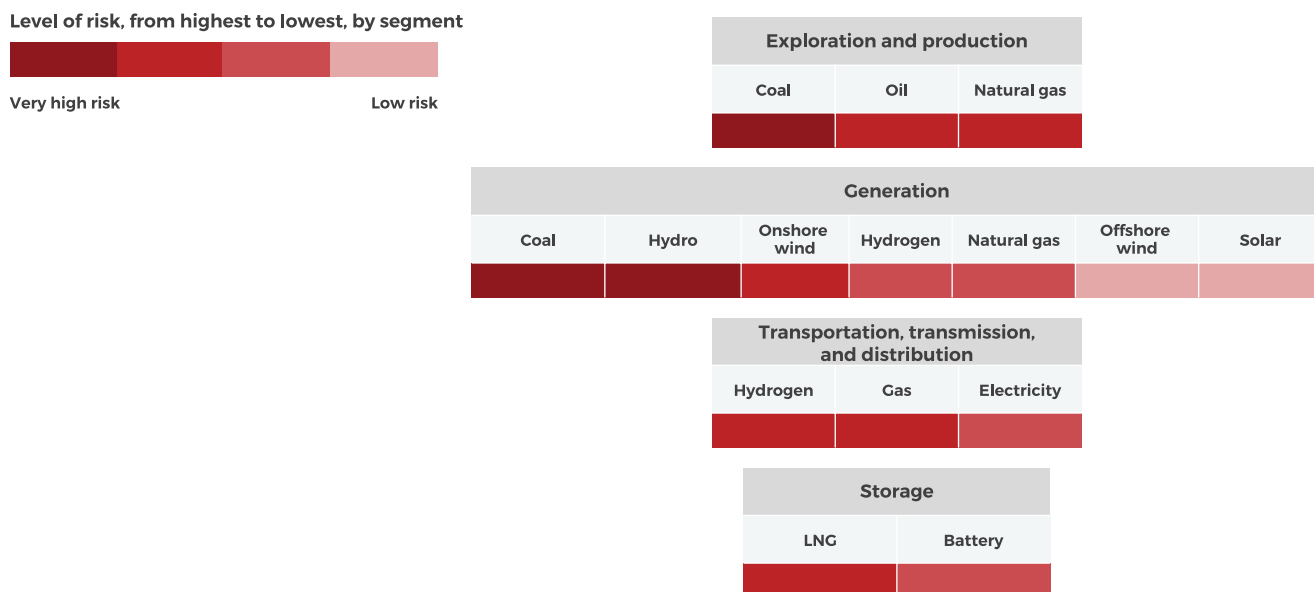
¹⁴⁹ "Celsia, Bancolombia Capital launch solar platform for Colombia's businesses." *Renewables Now*, 14 March 2022.

only 1 has been developed thus far. That is why, as we can see in Figure 35 (see below), onshore wind is one of the riskiest generation assets in the country, despite its appeal within the wider energy transition.

Offshore wind is another story. After a technical visit to study Denmark's successful wind development, Colombia launched its offshore wind roadmap. The country's offshore wind potential is evaluated at 37 GW of installed capacity, equivalent to 2.1 times Colombia's current energy matrix. Even though offshore wind will still struggle with the lack of transmission infrastructure in Colombia's Caribbean region, it will sidestep the local community opposition related to land disputes. In 2022, the Colombian government is also expected to release roadmaps for geothermal generation, which has a power generation capacity of 1.2 GW.¹⁵⁰

¹⁵⁰ "Colombia unveils rules for geothermal energy projects." *BN Americas*, 20 August 2021.

Figure 35: Risks related to various Colombian energy subsegments



Source: AMI analysis.

2. The rise of green hydrogen... but first, it will be blue

Inspired by the successful policies of Chile's national hydrogen strategy, in September 2021 the Colombian Ministry of Energy and Mines launched its "Green Hydrogen Roadmap." Its main objective is to become a world leader in hydrogen production, centered around five key targets:

1. The deployment of hydrogen for decarbonization
2. The reduction of CO₂ emissions
3. The establishment of value chains, which will foster an export economy
4. The deployment of hydrogen to promote a just and well-managed energy transition
5. The deployment of hydrogen to promote local development with regard to environmental protection

Despite its ambitious targets, most of Colombia's hydrogen production will likely be blue until 2030. This means that hydrogen will be produced via fossil fuels and paired with carbon capture technologies to reduce emissions. As it stands, its green hydrogen production is still too costly and inefficient (30-35% energy losses in electrolysis), even though it has access to abundant renewable energy sources and water.¹⁵¹ This problem, which is prevalent across the globe, is exacerbated by Colombia's infrastructure, which is insufficient for the transportation and storage of the clean fuel.

Starting in 2030, when Colombia hopes that renewable energy generation will account for 70% of its capacity, the production of green hydrogen will become a more feasible reality. Driven by a drop in renewable prices, improved technologies, and up to US\$5 billion in hydrogen project investments, Colombia will be better positioned to feasibly supply green hydrogen to the transportation and hard-to-decarbonize sectors. In the meantime, Ecopetrol and eight other market leaders have signed a commitment letter to develop hydrogen projects in the country. Among its 18 initiatives under analysis, Ecopetrol seeks to scale a hydrogen pilot project that

¹⁵¹ "Green Hydrogen: A guide to policy making." *IRENA*, 2020. ISBN: 978-92-9260-286-4.

began in March 2022 in its Cartagena refinery. Utilizing a Proton Exchange Membrane electrolyzer, Ecopetrol will produce hydrogen for exportation and domestic use.^{152 153} To that end, external partnerships and foreign investment will be fundamental to drive the growth of this promising new technology.

3. The threat of falling natural gas resources provides opportunities for investors

The second, third, and fourth objectives in Colombia's 2022 Energy Policy Agenda, which are focused on improving rural electrification, transportation infrastructure, and natural gas supply, are tightly intertwined with each other and the clean energy transition. Around 3% of the country's population, roughly over 600,000 people, are not connected to the national grid. These communities are located mostly in rural areas and depend on diesel to generate electricity.¹⁵⁴ Investors and companies that can develop clean energy solutions that are suitable for isolated areas, ranging from standalone microgrids to rechargeable batteries, will be in the good graces of both the government and local communities.

The third and fourth objectives are connected to the country's dwindling gas reserves and the lack of transportation infrastructure—specifically, connecting the Caribbean and eastern gas supplies to the rest of the country. Given that Colombia relies on hydropower for nearly 70% of its generation and droughts are particularly bad during El Niño years, the importance of developing a firm base has become paramount for the government. Since natural gas has been used mostly as a backup generation option during dry seasons, it has lacked adequate investment and a modern tariff structure. Leading gas operators have complained that the wholesale gas market is highly inflexible and illiquid.

Cognizant of the need for a revamp, Colombia's Law 2128/2021 declared the massification of natural gas to be in the national interest. CREG also offers the "open season" market mechanism, which allows an infrastructure developer to gauge market demand for gas by inviting potential users to submit their

¹⁵² "Colombia's Ecopetrol eyes 18 hydrogen projects." *Argus*, 1 October 2021.

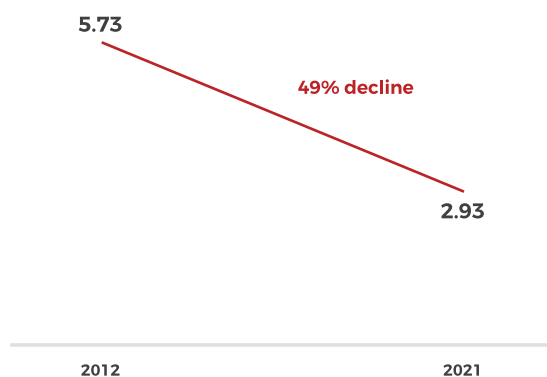
¹⁵³ "Colombia's Ecopetrol Starts Green Hydrogen Project In Cartagena." *FuelCellsWorks*, 19 March 2022.

¹⁵⁴ Procolombia.

proposals to contract transport capacity. If the demand is reasonable, the developer can move forward with executing the project without requiring a government concession.¹⁵⁵ Despite the goal of creating a more open and competitive market, the government still needs to reduce pipeline transport tariffs and allow for more flexible contracts between suppliers and transport companies. The high investment required to develop gas pipelines—and the complex technical aspects of the service—have created a natural monopoly led by Colombian Promigas.

Colombia's oil and gas sector has also suffered from the lack of new discoveries and social conflicts in resource-rich territories such as Cataumbo. At the end of 2020, Colombia's 1.8 billion barrels of proven oil reserves were equivalent to 6.3 years' worth of consumption, a three-year low. Its natural gas supply picture is worse—**Colombia's 2.95 trillion cubic feet (Tcf) of proven gas reserves have been on a continuous decline since 2012, when they were recorded at 5.97 Tcf.**

Figure 36: Colombia's proven gas reserves



Source: Rystad Energy.

Targeting the development of 3 billion barrels of oil equivalent by 2040 (part of Plan 2040), the Colombian government recently developed a more business-friendly investor framework for the exploration and production of oil and gas. Among other things, it eliminated the need for insurance coverage and gave companies the chance to nominate the acreage in the prospective blocks. Shell is one of the many international powerhouses involved in this prospecting; it recently acquired 50% of three

¹⁵⁵ Comisión de Regulación de Energía y Gas, Colombia.

Colombian offshore blocks in conjunction with Ecopetrol, where it will drill wells in the Caribbean Sea in 2022.¹⁵⁶ Colombia's latest oil and gas auction, in December 2021, was considered a success. It received bids for 30 blocks from seven different companies and will attract at least US\$148 million in investments.

The Colombian government is also building a safety net in case it fails to locate substantial new oil and gas finds. Looking at liquefied natural gas (LNG) as a substitute to supply its thermal plants, the government wants to push ahead with its US\$700 million Buenaventura LNG joint import-regasification terminal and pipeline in the Caribbean. The initial tender was declared void in October 2021, as it failed to attract any bids. The seven registered bidding companies cited uncertainty over risks, including the cost of the project, threat of delays related to the pipeline, and the impact on future tariffs.¹⁵⁷ This project is expected to be completed by 2026, but it will require meticulous due diligence and project planning to avoid community opposition and operational hiccups. As offshore reserves are being developed, micro-LNG import terminals are another option being considered by Ecopetrol.¹⁵⁸

4. Conclusion: The challenge of balancing energy security with the energy transition

Colombia, like many of its counterparts, seeks to find the optimal balance between oil production, the use of its legacy infrastructure (e.g., gas pipelines), and the development of renewable energy. A key example of this is seen in its state-owned oil producer Ecopetrol. Although it has stated that oil and gas will remain its core focus, Ecopetrol is seeking to integrate solar energy and green infrastructure into its business. In January 2021, the company announced that it would build six solar parks for a total installed PV capacity of 140 MW (aiming to reach 400 MW of installed PV power by 2023).¹⁵⁹ Ecopetrol has also said that it will prioritize hydrogen as a clean energy source for self-use and transportation. Most

¹⁵⁶ "Ronda Colombia oil auction draws bids for 30 blocks." *BN Americas*, 2 December 2021.

¹⁵⁷ "Colombia aborts pacific LNG tender." *BN Americas*, 25 October 2021.

¹⁵⁸ "The Hidden Gems in the Colombian Energy Sector." *AMI*, 10 February 2022.

¹⁵⁹ "Colombian Oil Giant Announces Solar Projects." *pv magazine*, 25 January 2021.

importantly, Ecopetrol acquired a majority stake in the largest transmission company in the country, ISA. This acquisition will allow Ecopetrol to directly participate in building the infrastructure needed to achieve net zero.

Colombia offers great opportunities in the energy sector, but also poses great risks. It faces strong local community opposition, an underdeveloped energy grid, decreasing gas supplies, and lengthy bureaucratic hurdles. Despite this, it has become a favorite for many energy investors, including top Canadian pension funds. Its advanced regulatory framework, high IRRs, its moderate politics, and its relatively stable currency has outweighed the country's risks. The political risk in 2022 caused by a new administration may alter the risk-return calculus for Colombia-focused energy investors. Only time will tell what changes the next

administration will bring. Recent congressional elections delivered a highly fragmented congress, which will complicate the implementation of any major policies by the Petro administration.¹⁶⁰ If Mexico's AMLO or Peru's Castillo is any indication, Colombia may be in for a rough patch. However, there are certain measures that foreign energy investors, companies, and service providers can implement to mitigate hiccups, ensure successful energy projects, and limit financial losses.

Contact us at info@americasmi.com to explore how our market intelligence can help you leverage opportunities in Colombia's energy market to the fullest.

¹⁶⁰ "Congressional Elections: Stalemate and Brinkmanship." *Colombia Risk Analysis*. March 2022.





IX. Argentina

A. Argentina's shift away from renewable energy creates opportunities in Vaca Muerta's oil and gas fields

1. Introduction: Gloomy economic prospects and a shift in energy policy

Despite its recent US\$44 billion IMF deal, Argentina will face the region's most daunting economic prospects through the end of 2022. Prior to the pandemic, the country was reeling from an economic recession and a messy US\$65 billion debt restructuring negotiation. In October 2020, the government's net currency reserves were near zero and inflation had risen almost 40%.¹⁶¹ Argentina's economy also fell 10% in the third quarter of 2020, compared to a 33% growth in the United States. As it stands, investors completely lost confidence in the Argentine *peso*.¹⁶² To compensate for the lack of capital, the Alberto Fernández administration has increased taxes on a variety of businesses and transactions, provoking additional foreign investors to flee the country. All signs point to the continued depreciation of the *peso*, a declining economy, and higher sovereign risk.

In 2015, users' electricity fees covered only 30% of the total energy bill in Argentina, forcing the government to become the largest subsidizer of energy in the region.

161 "Nearing zero: Argentine FX reserves drain puts central bank in a corner." *Reuters*, 20 November 2020.

162 *Latin American Risk Report* by James Bosworth, December 7, 2020.

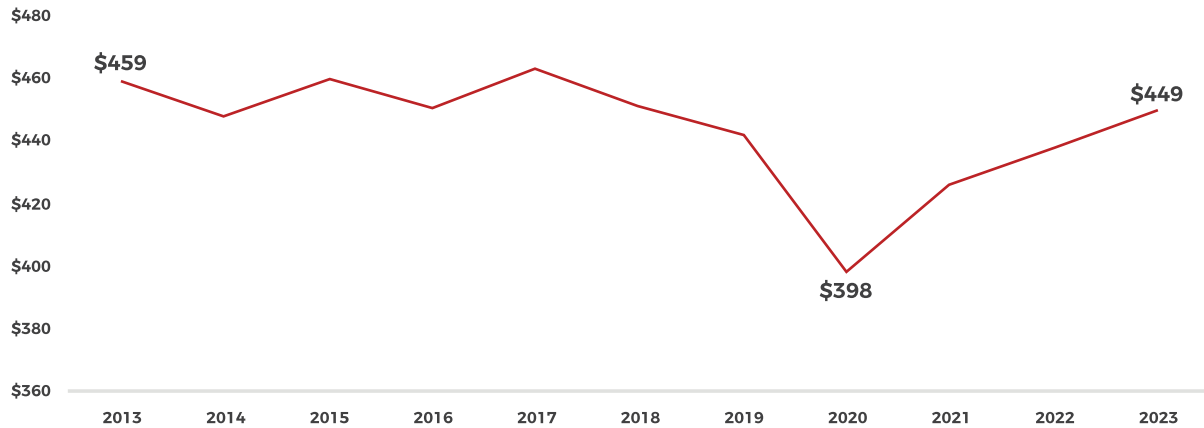
The number of power cuts also increased fivefold between 2003 and 2015.¹⁶³ Noticing the vulnerability of the system, Argentina's congress passed Law 27,191 (later amended with Law 26,190) in October 2015 to promote the use of renewable energy sources. In addition to several tax incentives, such as VAT tax rebates and accelerated depreciation, the law established that large energy users must consume 8% of their energy via renewables by 2018. This increased to 12% by 2019, 16% by 2021, and will reach 20% by 2025. This led to a significant increase in corporate PPAs as large customers sought to comply with the new clean energy targets.¹⁶⁴ It also created FODER, a trust fund that provides subsidies for renewable energy feed-in tariffs and guarantees the payment of PPAs.

Using the momentum of the law, former president Mauricio Macri introduced RenovAR—a program aimed at increasing the country's renewable energy supply. Through long-term bankable PPAs, tax incentives, and loan guarantees, the government sought to ensure investor confidence to attract billions in foreign capital. RenovAR's structural framework, coupled with US\$730 million in partial project guarantees from the World Bank, was deemed a success by investors. By 2019, the program reached its 8% renewable energy target and set the stage for reaching the 20% threshold by 2025. However, this trajectory changed with the inauguration of President Alberto Fernández in late 2019.

163 "RenovAr (Argentina): Scaling Express Edition." *IFC*, n.d.

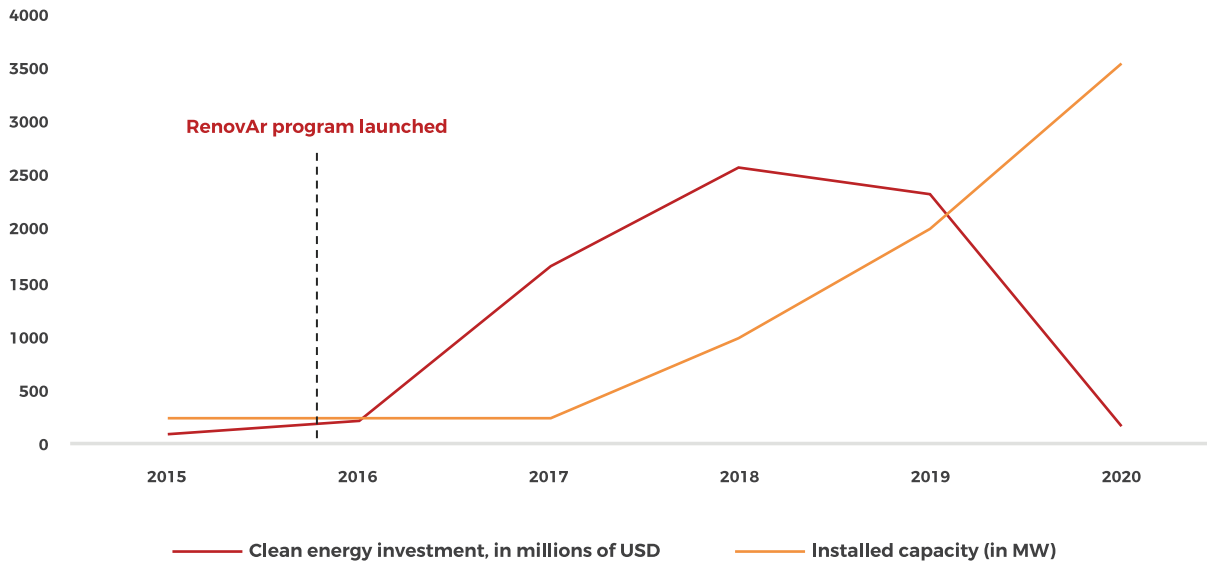
164 *ClimateScope*. *BloombergNEF*. 2021.

Figure 37: Real GDP, billions of USD at 2010 prices



Sources: Economist Intelligence Unit, BMI Latin American Monitor.

Figure 38: Clean energy investments and installed capacity in Argentina, 2015-2020



Sources: Bloomberg NEF, Climatescope.

2. Peronist takeover: The Fernández administration shifts to natural gas and Vaca Muerta

With Fernández and former president Cristina Fernández Kirchner leading the country, Argentina shifted its focus toward natural gas and the rebuilding of its state-owned company, YPF. In his inaugural speech to Congress, Fernández emphasized that hydrocarbons would serve as a “lever” for the development of the country.¹⁶⁵ To that end, he appointed Darío Martínez as the Minister of Energy and Mines (MINEM). Martínez is a former politician who is a close friend of Vice President Kirchner and the Santa Cruz province’s cluster of Peronist elites. Cristina Fernández Kirchner’s deceased husband, former president Néstor Kirchner, was once governor of Santa Cruz province, a leading oil and gas producer. The Kirchners have worked hard to promote the interests of their closest political and corporate allies in Santa Cruz since they rose to the national political stage.

Due to his political activism against Mauricio Macri and his involvement in the Frente de Todos (FdT) coalition—which elected Alberto Fernández—Martínez has been described as an “energy militant.”¹⁶⁶ Currently, Martínez is seeking to pass a hydrocarbon law to increase oil and gas production, foster the growth of YPF, and attract investments to Argentina’s massive shale formation, Vaca Muerta.

Comprising 30,000 square kilometers in the Nequén Basin, Vaca Muerta is the second-largest non-conventional gas-shale formation in the world. It has an estimated 9 million cubic meters of unconventional gas and 16 billion barrels of recoverable oil. **Despite energy companies drilling 1,000 wells and dumping US\$20 billion dollars in investment, less than 6% of its total land area is in the large-scale development phase.**¹⁶⁷ The low levels of exploration are a result of Argentina’s inability to stabilize its currency and provide a safe regulatory framework for investors. Vaca Muerta’s high break-even cost of US\$45-US\$50 per barrel of oil also limits investor appetite when other jurisdictions beckon. Although Argentina began to export some gas to neighboring countries in 2018,

¹⁶⁵ “Argentina halts renewables rollout amid coronavirus.” *Diálogo Chino*, 9 April 2020.

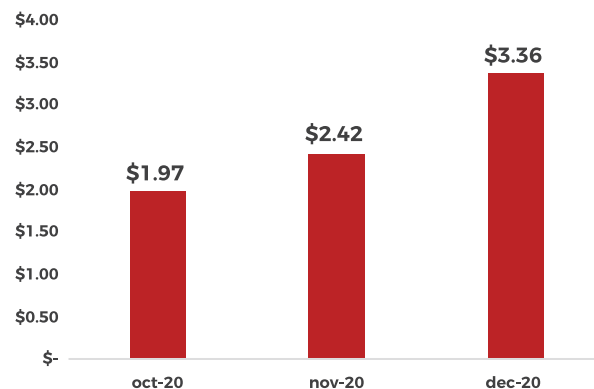
¹⁶⁶ “¿Quién es Darío Martínez, el nuevo secretario de Energía?” *Ámbito Financiero*, 21 August 2020.

¹⁶⁷ “Mesa redonda virtual sobre petróleo y gas en Argentina.” Institute of the Americas, 2020.

Vaca Muerta will need to emulate the success of the U.S. Permian Basin if it plans to become a large gas exporter. This would involve lowering operational costs and accelerating project development, both of which can be done through a pro-business regulatory environment and the use of more innovative extraction technologies.

To that end, the Fernández administration announced “Plan Gas 4” (Gas.AR) in November 2020. The plan aims to incentivize natural gas drillers, reverse the decline in production, and increase foreign and local investment in Vaca Muerta. The three-year plan includes US\$5.1 billion in gas subsidies from the government, a US\$1.8 billion investment from YPF, and a tender scheme in which natural gas producers can sell gas at a price of up to US\$3.70/MMBtu. The difference between the market price and the price awarded at the auction is subsidized by the government, which leads to guaranteed returns for the companies.

Figure 39: Natural gas auctions, average USD price in Argentina, in MMBTu



Sources: *BN Americas*, Argus Media.

To encourage participation in the latest tender, participants were also promised free access to the official foreign exchange market to convert investments, income, and debt maturities to U.S. dollars.¹⁶⁸ In December 2020, the ministry awarded 23 contracts to supply 67.42Mm³/d of natural gas at an average price of US\$3.36/MMBTU. The supply—provided by companies such as YPF, TecPetrol, Pan American Energy (owned by BP and CNOOC)

¹⁶⁸ “Argentina offers sweetener to firms investing in natgas: access to dollars.” *Reuters*, 19 November 2020.

and Total Austral (owned by TotalEnergies)—will be distributed between 2021 and 2024 to wholesale market administrator Cammesa, distributors, and subdistributors.¹⁶⁹ With the newly awarded supply, the government will substitute 30Bm³ of natural gas imports and save US\$5 billion in costs.¹⁷⁰ It plans to hold a new natural gas supply auction in 2022.

Despite Argentina’s slightly lower production levels of conventional oil, which use vertical wells and take place mostly in the Jujuy province, the country’s shale oil (99% of which is produced in Vaca Muerta in the Neuquén basin) is growing increasingly fast. This is

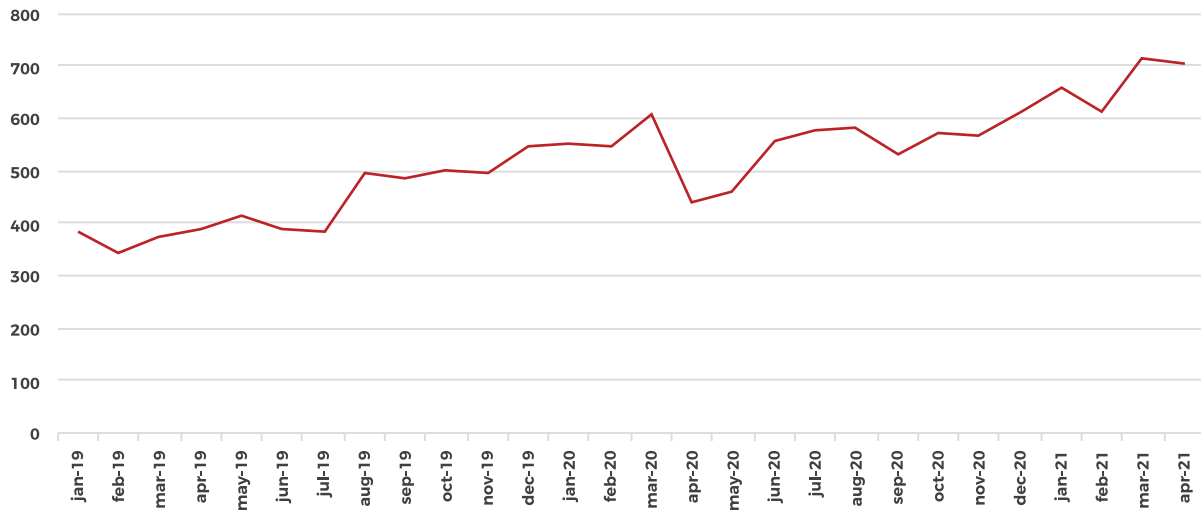
because the government’s tax incentives and improved technological innovations have reduced drilling times and costs. In fact, Vista Oil & Gas, owned by former CEO of YPF Miguel Galuccio, said they halved their drilling times between 2018 and 2021. They also experienced a 45% reduction in the drilling costs in Vaca Muerta since they first drilled wells back in 2019. This has reignited hopes that Vaca Muerta can produce enough oil and gas to support the local market during the winter months, when the country struggles to meet the increased energy demand, while simultaneously allowing for companies to export any surplus.¹⁷¹

169 “Pampa Energía to invest US\$250 mn to produce more natgas in Argentina.” *BN Americas*, 18 December 2020.

170 “Argentina’s Fernández Launches Natural Gas Production Stimulus Plan from Vaca Muerta.” *NGI*, 16 October 2020.

171 “Empresas globales aceleran sus desarrollos en Vaca Muerta y el shale marca el rumbo del crecimiento de la producción de crudo.” *Infobae*, 7 June 2021.

Figure 40: Monthly shale oil production, Vaca Muerta, in thousands of barrels

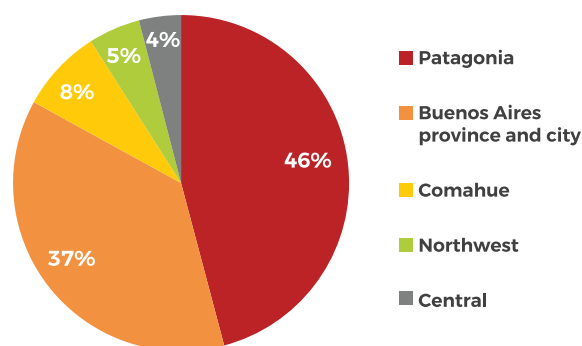


Source: Secretaría de Energía, Gobierno de Argentina.

3. A repeat of Mexico? State-owned favoritism and a preference for hydrocarbons

Argentina has some of the best renewable energy resources in Latin America. The Patagonia region has one of the highest wind energy potentials in the world, with capacity factors ranging from 38% to 50%. In fact, in the tripling of renewable energy capacity expected by 2030, 65% will come from onshore wind.¹⁷² In provinces such as Jujuy and Salta in the northwest, there is an abundance of solar resources.¹⁷³ Unfortunately, the rapid development of renewable generation projects has not been accompanied by the necessary expansion of the country's distribution and transmission networks. With COVID-19 lockdowns and the network at overcapacity, 99 renewable energy projects were halted in 2020.¹⁷⁴

Figure 41: Argentina installed wind capacity, by region, 2021



Sources: CAMMESA, Statista.

The current administration has also shown a lack of enthusiasm toward Macri's RenovAr program. This was reflected in the recent inauguration of Goldwind's 98 MW wind farm, where no government officials were present. Peronist lawmakers allege that the previous

172 "Argentina to increase its onshore wind power capacity by threefold during 2021-2030." *Power Technology*, 8 March 2021.

173 "RenovAr (Argentina): Scaling Express Edition." *IFC*, n.d.

174 "Argentina halts renewables rollout amid coronavirus." *Diálogo Chino*, 9 April 2020.

sale of the park to the Macri-owned group Sideco Americana involved "influence peddling, incompatible negotiations and the use of privileged information." The PPAs awarded to the plant took place in the RenovAr 1.5 tender, under resolution 202, which allowed Macri to reduce PPA prices from US\$85/MWh, as established by Cristina Fernández Kirchner, to US\$71/MWh. Although the renegotiation of PPAs happens on a case-by-case basis, it is possible that the current government may try to further renegotiate prices to avoid defaults.^{175 176}

In the province of Chubut, a tax was even imposed on the energy generated by wind farms in Puerto Madryn, a city off the Atlantic coast with favorable wind conditions. The tax costs a 100 MW wind farm an estimated US\$20 million and will likely discourage the development of new renewable projects in the region. Clean energy developments are already stagnating with the government's increased focus on fossil fuels and investors' general lack of confidence.¹⁷⁷ An additional tax would hinder much-needed growth of clean energy generation.

As foreign investors look for greater yields in emerging markets, Argentina's renewable energy sector is not an appealing option.

With the government favoring the development of fossil fuels and the growth of state-owned YPF, renewable energy projects may encounter difficulties in an already unstable political environment. That said, not all is lost. There are certain pockets in Argentina, such as Patagonia, with world-class wind conditions and local communities looking eagerly for job opportunities. If investors can obtain local community buy-in, guarantee dollar-denominated PPAs with well-financed offtakers, and rally government support, the project should be a success. Vaca Muerta is also a growing opportunity for investors looking at traditional energy sources. Not only is the sector highly subsidized, but the government is also determined to make it attractive for energy players. With careful due diligence, on-the-ground risk monitoring, and a strategy to mitigate local challenges, investors may see higher returns in Argentina versus any other country in the region. This is where AMI can help. Contact us at info@americasmi.com to find out how our market intelligence and due diligence services can help you navigate the turbulent Argentine energy market.

175 "Spotlight: Goldwind Argentina troubles." *BN Americas*, 17 December 2020.

176 AMI interviews.

177 "World's first wind tax leaves green developers scratching heads." *Buenos Aires Times*, 25 January 2021.

B. Finding a diamond in the rough: Opportunities for large customers and suppliers in Argentina

1. MATER: Creating a free market for large customers

Despite liberalizing the energy market and accelerating renewable energy development through the RenovAR program, the Macri administration cut electricity subsidies to shrink Argentina’s fiscal deficit. From 2015 to 2019, industrial electricity prices increased 1,082% and residential and commercial rates jumped by 1,074% and 973%, respectively.¹⁷⁸ Although Macri’s policies were highly unpopular, they were effective in reducing subsidies from 2.8% of GDP to 1% of GDP from 2014 to 2019. With the inauguration of the Fernández administration and the arrival of the pandemic, there was a 102% increase in energy subsidies in 1H2020 compared to 1H2019.¹⁷⁹ **Now, with the IMF deal, the Fernández administration will be forced to reduce “costly and untargeted energy subsidies.”¹⁸⁰**

Prices for renewable projects in the large-scale RenovAR auctions decreased subsequently in its three rounds: In the first auction, projects averaged US\$59.6/MWh, followed by US\$54/MWh in the second, and US\$42.4 for the third and final round. RenoVar also held “MiniRen” auctions, focused on smaller projects connecting to medium- and low-voltage networks. The latest round, which awarded 259 MW of contracted energy in July 2019, had a weighted average price for wind of US\$58.04/MWh, while Solar PV’s average price was US\$57.58.¹⁸¹ Naturally, the lack of scale among smaller projects leads to higher costs.¹⁸² The PPAs awarded under the RenovAR auctions have a duration of 20 years.

178 Climatescope, *BloombergNEF*, 2021.

179 “Spotlight: Argentina’s growing energy subsidies during H1.” *BN Americas*, 25 August 2020.

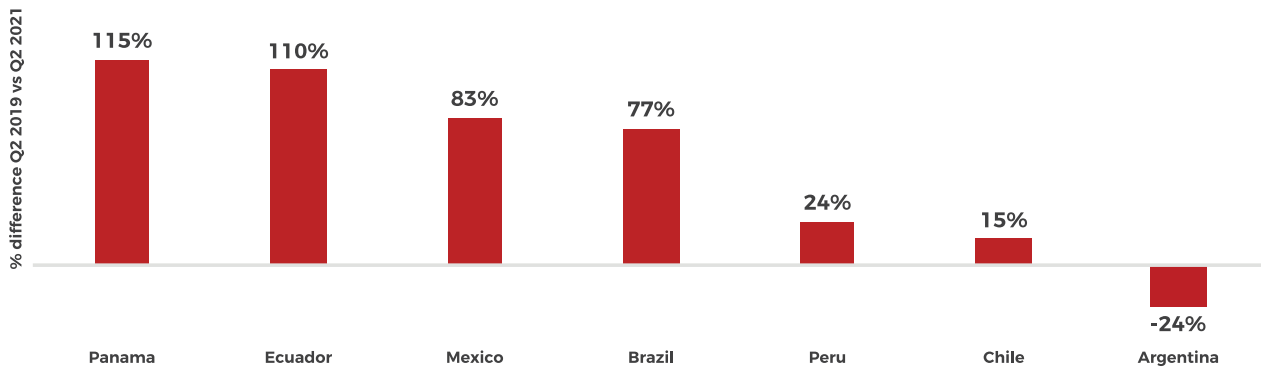
180 “IMF Executive Board Approves 30-month US\$44 billion

Extended Arrangement for Argentina and Concludes 2022 Article IV Consultation.” IMF, Press Release, March 2022.

181 “Argentina Renewable Energy Auctions - RenovAr Program (Round 3) - MiniRen Round.” *IEA*, 10 October 2019.

182 “Argentina awards 259 MW in RenovAr 3.” *Renewables Now*, 6 August 2019.

Figure 42: % difference in household electricity prices between Q2 2019 vs Q2 2021, in US\$ cents p/kWh



In addition to RenovAR, the Macri administration also established the Market for Renewable Energies (MATER) created via Law 27.191 and Resolution 281/2017, guaranteeing the right of large electricity users (those with demand greater than 300kW) to choose their renewable energy supplier and freely negotiate contracts. This was intended to create a more open and competitive market, while encouraging larger users to comply with the law's renewable energy targets. In these bilateral agreements, the PPA pricing and conditions are negotiated freely between the two parties but cannot exceed US\$113/MWh. Through MATER, renewable and thermal energy provider Genneia signed a 15-year agreement to supply 32,000 MWh to Grupo Bimbo, a multinational food manufacturer. Genneia's wind farms will power Grupo Bimbo's five factories and 15 sales and distribution centers in Argentina.¹⁸³

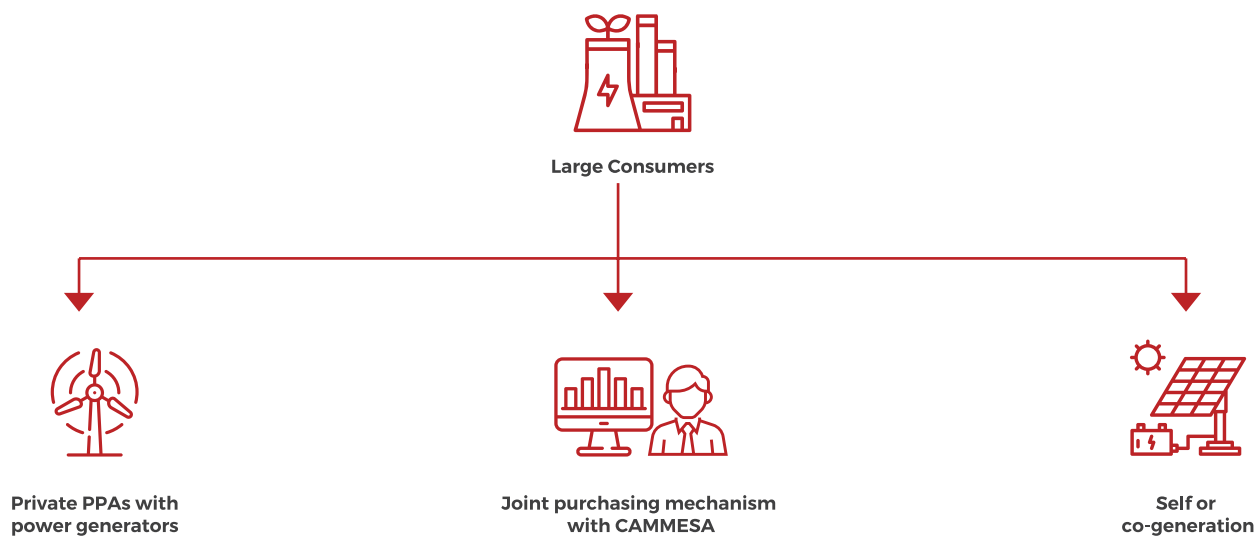
Large customers have two other options to satisfy the consumption targets set out by Law 27.191:

1. First, they can participate in a joint purchasing mechanism with CAMMESA (the company that administrates the wholesale electric market in Argentina), which will sign purchase agreements on their behalf in the RenovAr tenders. The price payable will be the average cost of the purchase agreements in the RenovAr tender, in addition to a fee for trading and administration.
2. The second option is to self-generate or co-generate energy with a third party. To be able to self-generate or sign PPAs, the large users must exclude themselves from participating in the Joint Purchasing Mechanism previously mentioned. Large users will be subject to penalties if they fail to provide information regarding their PPAs or if they do not meet their consumption goals. However, a leniency equivalent to 10% of the company's consumption goal can be compensated in the following year.¹⁸⁴

¹⁸³ "Grupo Bimbo buys power from Genneia's wind farms in Argentina." *Renewables Now*, 29 May 2020.

¹⁸⁴ "Power Purchase Agreements en Argentina." *WBCSD*, December 2017.

Figure 43: Options for large consumers to secure energy contracts in Argentina



Source: AMI research and design.

2. YPF: Oil and gas remain at center stage at the behest of the government

YPF is the government's state-owned darling, which owns 30% of the concession rights in Vaca Muerta. In 2020, amidst a decline in global oil demand, the oil and gas company shut its wells and saw a 11% decline in total hydrocarbon production. At the end of 2020, CFO Alejandro Lew expected fuel demand to continue to lag in 2021, seeing demand at 5% to 10% below pre-pandemic levels.¹⁸⁵

In a recent speech that defined the company's strategy, YPF's chairman reiterated that they are an oil and gas company, not a renewables company. Backed by the Fernández administration, YPF is focused on reviving Vaca Muerta's drilling effort. The state-owned company expects that Vaca Muerta will expand its oil production by 50% by 2023. Despite this, the company is undergoing a US\$6 billion debt negotiation with international creditors as it struggles to access U.S. dollars. YPF's initial proposal to exchange its old 2021 notes for seven new securities, which won't pay interest until 2023, was rejected by a group of market-leading investors such as BlackRock, Ashmore Group, and Invesco Ltd. In the first half of 2021, the group accepted an amended offer. The proposal came just five months after the Central Bank demanded that companies with sizeable debts push back their coupon payments through March 2021.¹⁸⁶

Adopting a similar policy implemented by the current AMLO administration in Mexico, the Argentine government is fiscally and legislatively implementing rules to help prop up its state-owned company. In February 2021, the country's central bank loosened rules to allow exporters to raise dollar debt abroad.¹⁸⁷ This favors companies such as YPF that are struggling to service their debt due to tough foreign currency restrictions. Like Pemex, YPF is also highly subsidized. Although end-users paid US\$26 per MWh for electricity during the first half of 2020, YPF's power generation unit, known as YPF Luz, had an average cost of generation of US\$58/MWh. The gap was covered by government subsidies, which averaged 48% of Argentina's total generation cost in the first half of 2020.¹⁸⁸

¹⁸⁵ "Argentina's YPF to rebuild oil, gas production with focus on Vaca Muerta." *S&P Global*, 11 November 2020.

¹⁸⁶ "Oaktree, BlackRock are among YPF creditors organising." *Buenos Aires Times*, 18 January 2021.

¹⁸⁷ "Argentina eases rules for exporters raising dollar debt, may help YPF." *Nasdaq*, 5 February 2021.

¹⁸⁸ "Spotlight: Argentina's growing energy subsidies during H1." *BN Americas*, 25 August 2020.

After freezing electricity and gas prices in 2019, Argentina resumed its policy of electricity price controls in 2021. Resolution 440/2021, a new tariff scheme announced in May, linked spot prices to the Argentine *peso* instead of the US dollar. This led to an average rate increase of 26% for spot generation tariffs, retroactively applied from February 2021. Despite the seemingly large rate increase, annual inflation in Argentina was up 46% through May 2021. Thus, in real terms, the actual spot rate was lower than it was prior to the new tariff scheme. Government subsidies are used to cover the difference between generation and consumption rates, subsequently worsening the country's fiscal deficit.¹⁸⁹

3. Despite limited suppliers, multinationals lead the charge in renewable energy consumption

In Argentina, there are relatively few options for large customers to purchase renewable energy. Among private, non-conventional renewable energy providers, the main players are Genneia, Pampa Energía, and CP Renovables (subsidiary of Central Puerto), which are large, local power and gas companies that are capitalizing on the country's favorable wind resources. In the public sector, the sole provider is YPF Luz, the power generation branch of state-owned YPF. Despite it not being explicitly out in the open, easier access to financing, favorable government policies, and large subsidies allow YPF to be extra-competitive compared to its independent peers. This facilitates deals with large customers that seek to be in the government's good graces.

For example, in the transportation industry, Japanese automobile manufacturer Toyota signed a 10-year deal with YPF Luz for the provision of wind power in its Zárate manufacturing plant. Toyota has a strategic partnership with YPF, which they aim to use to reach 100% renewable energy for its Argentine operations.¹⁹⁰ Similar deals were made with Coca-Cola FEMSA and cement producer Holcim.

The small number of renewable energy generators should be seen as a mid-term opportunity for renewable energy suppliers not currently present in the Argentine market. Many of the bigger suppliers that are present in other countries of the region have been alarmed by the country's political instability

¹⁸⁹ "Argentina watch: Thermo generator is 'working capital pressure,' solar powered pumps tender." *BN Americas*, 4 June 2021.

¹⁹⁰ "Toyota ya produce con el 100% de energía eléctrica renovable en su planta de Zárate." *Toyota*, 28 September 2020.

and currency depreciation. However, Argentina has clean energy mandates that companies are forced to fulfill; these require a large supply of renewable energy that cannot be satisfied solely by the existing market players. By signing dollar-denominated PPAs with reputable, well-financed multinationals, energy generators can circumvent the financial troubles and political mismanagement within the country. From Nestlé to DirecTV, 330 “large users” already buy energy via renewable energies. The remaining 1,820 are still up for grabs.¹⁹¹

4. Conclusion: With the right strategy, successful endeavors in Argentina are possible

In the coming years, Argentina will face increased pressure from multilateral lenders to implement fiscal austerity and social and economic changes. The March 2022 deal with the IMF will impose austerity measures that will force the government to slash energy subsidies. With skyrocketing fuel prices and inflation, the Peronist government will face a daunting choice: garner public support or default on its debt.

To make up for the shortfall in cash, the Fernández administration is asking China to invest US\$30 billion in key Argentine sectors such as energy and commerce. In fact, the Argentinian Secretary of Energy asked for Chinese investment in five major energy projects:

1. US\$2.5 billion for the San Jorge (Southern) Pipeline, which will transport energy from Vaca Muerta to Buenos Aires
2. The AMBA grid expansion to sustain growing energy demand in Buenos Aires

¹⁹¹ “Más de 330 grandes empresas compran energía renovable de manera directa.” *Más Energía*, 10 April 2021.

3. The Futaleufú-Puerto Madryn transmission line to provide more energy to southern Argentina
4. The Mesopotamia pipeline to provide energy to Northeast Argentina
5. The US\$5.3 billion Manuel Belgrano II 810 MW Combined Cycle plant¹⁹²

Despite China’s abundant financial resources and expertise in the energy sector, China often uses infrastructure financing to leverage its geo-political agenda. The current Fernández administration is already China-friendly, and it must be wary of becoming more susceptible to the whims of Xi Jinping.

Multi-billion debt restructuring, political shifts, and geopolitical game theory are a few of the many curveballs that foreign investors and energy players encounter when operating in Argentina. Having a reputable local partner, with an accredited track record, is one solution to mitigate some of these risks. Another option, which is not exclusive to the first one, is understanding the market’s risks, lay of the land, and its regulatory framework. Through comprehensive market intelligence, energy companies and investors alike will be better positioned to overcome the ongoing obstacles faced by resource-rich Argentina.

Contact us at info@americasmi.com to explore how our market intelligence can help you leverage opportunities in Argentina’s energy market to the fullest.

¹⁹² “Los cinco proyectos de inversión que le ofrecerá Alberto a China.” *Cronista*, 21 March 2021.



X. Chile

A. President Boric doubles down on Chile's energy transition

1. Creating the first environmental administration in history

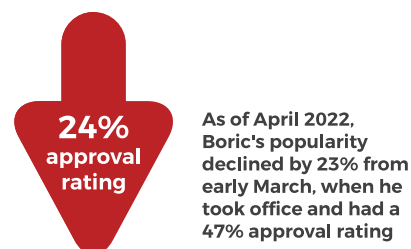
In 2019, the stable and exemplary Chilean form of governing came under fire after an increase in public transportation fees. Civil unrest, which was fueled by income inequality, diminishing pensions, and slower economic growth, led to the burning of metro lines and widespread damage throughout the country. It marked the beginning of the end of the constitution drafted by Sebastián Pinochet, a right-wing dictator who ruled during the 1970s. In 2020, to quell the violence, center-right President Pinera held a nationwide referendum to determine the rewriting of the constitution. Nearly 80% of voters voted in favor of drafting a new constitution.

In March 2022, Gabriel Boric was sworn in as Chile's newly elected president. Boric's administration is speculated to be the most left-wing government since the 1973 presidency of Salvador Allende. Boric seeks to expand tax revenues by raising mining royalties and personal income taxes, while also shifting from a private-backed pension program to a pay-as-you-go model. He will also influence the approval of a new constitution, set for a vote in October 2022, which aims to expand environmental and social rights while enlarging the role of the government. Despite his leftist ideology, Boric will have to temper his policies as his coalition lacks a majority in an otherwise center-balanced congress.¹⁹³

¹⁹³ "Chile's new president won from the left. Can he govern like that?" *The Economist*, 19 March 2022.

In the energy sector, President Boric is doubling down on the country's renewable energy transition as he aims to accelerate the retirement of coal-powered generation. **The new energy sector will see the expansion of government-backed entities, as well as higher royalties in extractive industries and stricter environmental guidelines.** If Chile approves a new constitution that increases the power of the state, the country will likely see a decline in foreign investment and a slowdown in the development of new greenfield projects. To assuage investor concerns, Boric could keep the private sector competitive and open by limiting the role of state-owned assets to areas with few to no private competitors. If he fails to do so, Chile could face energy insecurity and a decline in innovative R & D.

Figure 44: Boric's popularity declines



Source: *ABC News, Pulso Ciudadano.*

Outside of internal politics, the country is also facing a decade-long drought and escalating fuel prices that have led to the recall of some previously retired coal plants. Boric has signed a pledge saying that he would prefer that retired units not be recalled, but it is a non-binding agreement. To ensure Chile's timely transition away from its coal-based generation, the incoming government needs to focus on three main pillars:

1. Accelerate the development of other energy sources (from green hydrogen to wind to natural gas)
2. Implement energy efficiency measures (demand-side flexibility, automated metering infrastructure, etc.)
3. Invest in climate technology

The first pillar is well underway, as the Chilean Environmental Evaluation Service (SEA) recently approved US\$466 million in utility-scale projects in December 2021, including Greenergy's 220 MW solar park and Ibereólica's 180 MW wind project in the Atacama region.¹⁹⁴ The new government has also committed to ensuring the continuity of the country's hydrogen roadmap (albeit with some changes) and has recently reiterated its approval of the National Electric Mobility law. The national electric mobility strategy has regulations that allow electric vehicles to partake in net-billing activates, which means they can sell their stored energy capacity back to the grid while they are plugged in.¹⁹⁵ It also seeks to ensure that all small and medium vehicles sold by or after 2035 are emission-free.¹⁹⁶ Nearly 37% of Chile's energy supply is attributed to transportation, making the electrification of its fleet a fundamental piece of its decarbonization efforts.¹⁹⁷

194 "Chile bolsters renewable pipeline with US\$466mn of environmental approvals." *BN Americas*, 21 December 2021.

195 "Chile looks to speed up electric vehicle adoption through new strategy." *BN Americas*, 1 March 2021.

196 "Chile approves national electromobility strategy." *SustainableBus*, 8 March 2022.

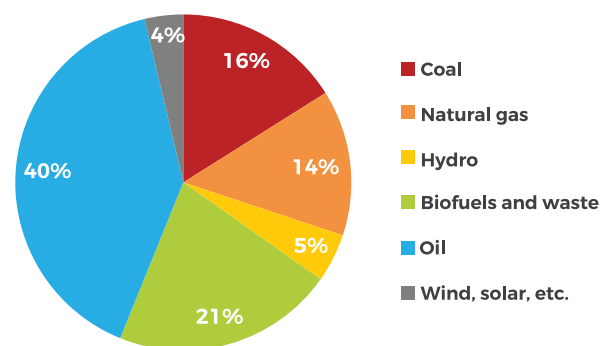
197 "Chile looks to speed up electric vehicle adoption through new strategy." *BN Americas*, 1 March 2022.

2. Chile's energy policies serve as a roadmap for the rest of the region

For the past few decades, Chile has served as Latin America's beacon of a free market, a stable and liberal democracy that has reduced poverty and improved living standards. Although it has recently struggled with civil unrest and the redrafting of its constitution, it has established the most advanced clean energy framework in the region. This began in 2015.

After a long and inclusive public consultation process, the Chilean Ministry of Energy published the National Energy Policy 2050 to promote energy efficiency in the country. Aiming for carbon neutrality by 2050, the policy set targets of 60% renewable electricity by 2025 and 70% by 2050. The policy also led to a landmark agreement between power generation companies and the government to phase out coal generation by 2040. Eighteen percent of Chile's total energy supply came from coal in 2015 (16% in 2020), reflecting 25% of its electricity generation.

Figure 45: Total Energy Supply in Chile, in 2020 (TJ)



Source: International Energy Agency.

In 2016, Chile launched a National Electromobility Strategy, with the objective of electrifying 40% of its private fleet by 2050. Driven by fiscal and tax incentives that encourage the consumption of EV sales and the development of EV infrastructure, the country expects

to have 5 million electric vehicles by 2050.¹⁹⁸ Chile's new government is also in favor of this policy, as it recently approved a modified National Strategy for Transportation Electrification.¹⁹⁹

In early 2021, Chile's congress passed an energy efficiency law that aimed to reduce energy intensity—the amount of energy a country needs to produce one percentage point of its GDP—by 10% between 2019 and 2030. The law requires that the Energy Ministry draft and update a five-year energy efficiency plan that establishes different requirements for energy consumers. Taking into account consumers' current consumption volume and capacity to adjust to energy changes, the Ministry will define companies that are "capable of energy management" and will include goals for them to reduce energy consumption.²⁰⁰ The bill does not include punishments for an eventual

198 "Chile leads the region on its way to sustainable energy-powered cars." *MercoPress*, 20 July 2021.

199 "Estrategia Nacional de Electro-movilidad." *Ministerio de Energía, Gobierno de Chile*, January 2022.

200 "Spotlight: Chile's energy efficiency bill." *BN Americas*, 7 January 2021.

failure to comply with specified reduction goals, but the Ministry can penalize consumers if they fail to install a system that allows authorities to monitor consumption patterns.

Chile's green initiatives and medium-term economic prospects have attracted the attention of global investors. In January 2021, Chile issued US\$1.5 billion in sustainability bonds, which at the time was the biggest Latin American sovereign sustainability bond in foreign markets. Chile also raised US\$2 billion in European markets to fund green and social projects. High demand from ESG-friendly investors led to oversubscription and record-low interest rates in those 10-year bonds.²⁰¹

Nevertheless, in 2022, investment has come to a halt. Both investors and operators alike, ranging from the energy to the mining sectors, are waiting for a resolution on the country's constitution. Until their is more clarity on this issue, Chile will have to rely on local public capital for new projects.

201 "Chile Sells Biggest Latin American Sovereign Sustainability Bond." *Bloomberg News*, 21 January 2021.

B. Supply-side innovation creates new low-carbon prospects

1. The green hydrogen pioneer in Latin America

Chile has also implemented a national green hydrogen strategy, aimed at developing the local hydrogen sector and turning it into a world-class exporter by 2040. **Through the adoption of a carbon tax, government-sponsored financing, and an investor-friendly regulatory framework, Chile believes it can produce the cheapest hydrogen in the world by 2030.** It also has the most developed and competitive renewable energy prices in the region, and a highly energy-demanding mining sector, which has created an appealing market for hydrogen development.

These factors have attracted several investors, such as giant Italian utility Enel, which is launching a green hydrogen business in Chile. By installing electrolyzers, Enel will use electricity from its solar and wind farms to produce hydrogen for energy storage or industrial consumption. The company plans to pilot a few projects a year to see if the business case is sound.²⁰² One of these projects is already underway. In a partnership between Enel X (the electromobility arm of Enel) and the mining company Anglo American, the project aims to use green hydrogen to decarbonize the large trucks and equipment fleets used in Anglo's mining operations.

202 "Enel to launch hydrogen business as part of green drive." *Reuters*, 19 June 2020.

Figure 46: Green hydrogen and ammonia pilot programs attract world-class talent to Chile

Ammonia exportation	Hydrogen	E-fuels and e-methanol
		
		
		
		
		
		

Sources: AMI research and design, H2Chile.

In August 2021, a consortium—led by Chilean AME, Enel, Siemens, and state-owned Enap—launched a \$35mn green H₂ pilot project to produce methanol and carbon-neutral Liquefied Petroleum Gas (LPG). Depending on the success of this pilot, they will develop a subsequent US\$800 million commercial plant (likely in the European Union). Soon after the consortium’s announcement, Engie LatAm and Chilean industrial explosive supplier Enaex SA announced a US\$47 million pilot project to produce green ammonia and green hydrogen.²⁰³ Unlike some of its regional peers, pilot projects in Chile have already become a reality and are quickly moving toward full-scale deployment. Nevertheless, the market for local hydrogen consumption is still small and unclear, making exports the best prospect for these initial hydrogen projects.

In December 2021, Chile was the first country to hold a national green hydrogen auction, in which it awarded Enel Green Power and Highly Innovative Fuels (HIF) a US\$16.9 million incentive to develop 240 MW of electrolyzers in southern Chile. The project must be commissioned by January 1, 2026, and is a symbol of the country’s commitment to becoming a green hydrogen hub for exports and domestic use.²⁰⁴

²⁰³ “Engie, Enaex plan green hydrogen-to-ammonia projects in Chile.” *Renewables Now*, 24 August 2021.

²⁰⁴ “Enel wins grant at world’s first national green hydrogen tender.” *Recharge*, 30 December 2021.

2. Contracting power: Technology-agnostic, innovative power auctions

Unlike Mexico, which resorts to a system operator utilizing an adjustment-based strategy for its auctions, Chile works under a price-based strategy which requires the developers to assume the responsibility of matching generation to the system. This strategy relies on having a market that can provide time-based price signals based on supply and demand.

In fact, Chile has adopted one of the most innovative and forward-looking power auction mechanisms in the world. In 2017, it held a “technology-neutral” auction for energy to be produced during certain time periods (yearly, quarterly, day, night). This type of system allows for solar and wind producers to account for the variability in demand at different times, allowing them to submit bids for blocks for which they are the most competitive. This led to a 75% decrease in the average price relative to its 2013 auction.²⁰⁵ To meet the different market demands during those time periods, Chile also awarded contracts with financial obligations that must be met by the generators. This means that generators must fulfill one of two options:

²⁰⁵ “Clean Energy Auctions in Latin America.” IDB, December 2019. DOI: <http://dx.doi.org/10.18235/0002133>

1. To be generating enough power to meet the total quantity committed in the auctioned contract
2. To purchase the difference between the committed and delivered quantities in the spot market

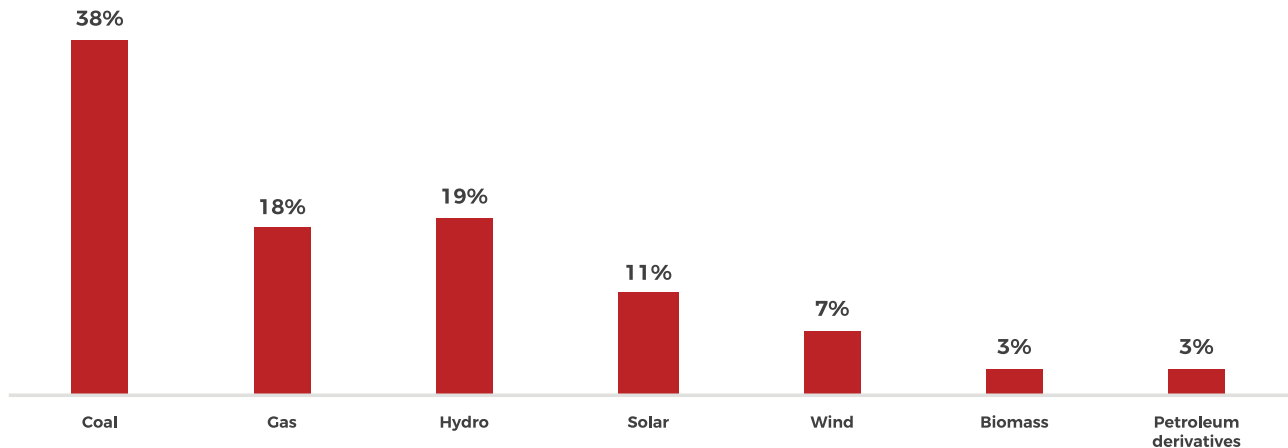
If the generator produces more than the amount committed in the auctioned contract, they can sell the surplus in the spot market. This mechanism guarantees that the generator will be able to supply the power it committed to while also giving it the flexibility to resort to the spot market. The downside is that generators

may purposefully cut their generation levels when spot prices are low (because selling the surplus is less profitable) which can lead to the activation of more expensive thermal plants.²⁰⁶ This happened in 2021, as a decade-long drought forced the country to resort to diesel, coal, and imported liquefied natural gas (LNG).²⁰⁷

²⁰⁶ "Renewable energy auctions: Status and trends beyond price (preliminary findings)." *IRENA*, March 2021. ISBN: 978-92-9260-136-2.

²⁰⁷ "Arid Chile returns to diesel, coal to ease grid stress." *Argus Media*, 13 August 2021.

Figure 47: Gross generation of Chile's grid, by source, July 2021



Source: Biblioteca del Congreso Nacional de Chile.

The surprising regulatory lag among emerging energy technologies is related to Chile's battery storage sector. The current regulation does not allow storage projects to sell energy back to the grid, limiting the use of the stored energy for self-consumption only. Not only does the lack of regulation make battery projects uneconomical, but it also causes uncertainty, delaying the approval of 400 MW of storage projects. Until there is a more concrete timeline for storage regulation (likely after the constitutional vote), energy players should remain wary of developing storage projects in Chile.

In August 2021, Chile held an auction for 2.3 GW of energy generation and storage. Qualified power distributors, which predict energy shortages between 2026 and 2030, signed 15-year PPAs and will start

delivering power in 2026.²⁰⁸ The most recent energy auction for homes and businesses in Chile, which took place in September 2021, registered a record-low price for Solar PV at US\$13.3 MWh. **The offer submitted by CanadianSolar was nearly 40% lower than the record low price in the 2017 auction, reflecting the continuous downward trend in the price of contracted renewable energy (despite higher costs for raw materials and inflationary pressures.)**

Cheaper renewable energy encourages large customers to gravitate toward cleaner sources, while paving the way for the development of Chile's National

²⁰⁸ "Chilean national energy commission sets schedule for 2021 power auction." *Renewables Now*, 23 December 2020.

Hydrogen Strategy. The cheaper the cost of renewable energy, the cheaper it is to produce green hydrogen through electrolysis. This makes Chile's dream of becoming the world's cheapest producer of hydrogen by 2030 a real possibility.

3. Conclusion: Chile's uncertain outlook reflected by diminishing returns in renewables

It has been several decades since Chile's future has been so uncertain. Investors, both locally and abroad, are concerned that the new administration will squeeze the private sector to benefit state-owned companies. The tightening of environmental and social rules, which may go beyond what is reasonably attainable, will likely delay new projects. The government also has its hands tied when it comes to future energy price increases, as widespread inflation increases the pressure on household incomes. This murkiness is complemented by the depression in renewable energy returns, a consequence of increasing projects costs, an excessive supply of capital, and the pull-back of subsidies.

The largest phasing out of subsidies has been in Chile's small- and medium-distributed generation sector, known as PMGD, which includes solar plants of up to 9 MW capacity that are connected to the grid. In 2020, the country announced it would change

its PMGD rules to adjust the remuneration provided to generators, who were being overly compensated for producing energy during the day. Requests for construction approved before April 8, 2022, will remain in the old regime for up to 14 years. This led to the approval of US\$88 million in distributed generation projects in April 2022, as developers sought to capitalize on the fading tax benefits—eerily similar to what is happening in Brazil.²⁰⁹

The Boric administration seeks to accelerate the energy transition, while simultaneously being fiscally stringent and favoring state-backed entities. These three concepts cannot coexist—in fact, the new administration is already seeking to double the size of a fund (Fuel Price Stabilization Mechanism) that will be used to mitigate spikes in fuel prices.²¹⁰ To ensure energy security and political support, Boric's new administration will have to compromise on its values. Here is where AMI can help investors navigate an increasingly thorny, unpredictable, and complex energy sector that is becoming more and more political.

Contact us at info@americasmi.com to explore how our market intelligence can help you leverage opportunities in Chile's energy market to the fullest.

²⁰⁹ "Spotlight: Chile's April environmental approvals grow pipeline by US\$600mn." *BN Americas*, 10 May 2022.

²¹⁰ "Chile proposes mitigating fuel hikes by doubling stabilization fund to \$1.5 billion." *Reuters*, 21 March 2022.





XI. Peru

A. The Castillo administration

1. What does the victory of President Castillo mean for the energy sector?

In his first few weeks in office, President Pedro Castillo pledged that mining and energy projects would only move forward if they were “socially profitable.” Since the criteria for socially profitable projects are still unclear, the government has broad discretion over what falls under that category. Initial reports indicate that projects will require the following criteria:

- A. Revitalization of the local economy
- B. Improved income distribution
- C. A provision that allows for technological transfers
- D. Increased local wages
- E. Preservation of the local culture and the environment

Castillo and his cabinet also stated that social profitability will go beyond the well-known “social license to operate,” requiring companies to pay net flows of foreign exchange and net taxes.²¹¹ ²¹² An eight-point document clarifying the issue was expected

211 “Peru’s Castillo says only mining, energy projects offering ‘social profitability’ will go ahead.” *BN Americas*, 29 July 2021.

212 “Social profitability is superior to social license.” *BN Americas*, 19 August 2021.

in late 2021, but it was never published. The theme continues to lack clarity and is a point of contention between local communities and extractive companies. In the mining sector, a Chinese-owned copper mine is currently paralyzed due to local communities’ protests on the mine site. The mine, owned by MMG Ltd., is responsible for 2% of the world’s copper production and produces US\$3 billion in annual revenues.²¹³

In the energy sector, the Castillo government took over a portfolio of 15 renewable energy projects—with a total installed capacity of 1.2 GW—left by the previous (and short-lived) Sagasti administration.²¹⁴ Each project will be re-evaluated within this new context of “social profitability.” The Castillo administration has also promised to expand the role of state-owned enterprises, like PetroPerú, and vowed to raise taxes on the mining sector to fund social programs. Higher taxes will likely force mining companies to cut investment in the country, leading to a delay in the mining sector’s transition toward alternative energy for its operations, which often requires a higher up-front capex. These factors will directly impact the way large customers buy and sell electricity.

In August 2021, to avoid the dissolution of congress and the possibility of an impromptu constitutional assembly that would allow President Castillo to redraft the constitution, Peru’s legislature approved the President’s proposed cabinet. Although this temporarily avoided a constitutional assembly, Castillo has signaled that he will nationalize companies that fail to comply

213 “Peru community wants its land back, threatening Chinese copper mine.” *Reuters*, 12 May 2022.

214 “Gobierno deja planes de energía renovable.” *El Peruano*, 19 July 2021.

with higher taxes and may even seek an illegitimate constitutional referendum to expand his powers. The threat of political interference by the Castillo administration will dissuade most energy and mining investors from taking on long-term projects in Peru.

On September 27, 2021, the Peruvian government submitted a formal request to renegotiate the Camisea Consortium contract, awarded in 2000, for the operation of the Camisea gas field. The Consortium, made up of PlusPetrol, SK Group, Hunt Oil, and Repsol, has been extracting and distributing gas for 17 years and has paid thus far US\$9.75 billion in taxes. The government, however, seeks to “renegotiate the distribution of profits in favor of the State” by increasing taxes. In late October 2021, the president asked the Peruvian congress to draft a bill that would nationalize the gas sector. **Although Peru’s right-leaning majority in Congress has impeded the approval of said bill, this approach reflects a government that is eager to overhaul existing private contracts to benefit the public sector.** Even though the bill was not approved, Castillo will try to implement regulatory decrees that will hurt private projects and scare off future investment.^{215 216 217}

215 “Peru Demands Contract Renegotiation For Huge Camisea Gas Field.” *Barron’s*, 27 September 2021.

216 “Peru PM warns gas sector: pay higher taxes or face nationalization.” *Reuters*, 26 September 2021.

217 “Peru’s Castillo urges Congress to draft bill to nationalize gas sector.” *Yahoo! Finance*, 25 October 2021.

The main target for renegotiation will likely be the export-focused Camisea Block 56, which is operated by Peru LNG. The price charged in the sale of gas coming from Block 56 is based on the final customer, often companies in Asia and Europe. Since those regions struggle with limited gas supply, Peru LNG is able to charge higher prices (compared to local customers) and is now becoming an appealing target for the Castillo government.²¹⁸

In the past 10 years, government revenues coming from the hydrocarbon sector have fallen. However, that is because of a decrease in energy investments due to unfavorable market conditions, such as the oversupply of gas and an unclear regulatory framework for the power sector, rather than a decrease in royalty rates.

2. The growing relevance of state-owned companies threatens the private sector

Backtracking from the private competition that led to the development of a competitive energy sector, **Castillo has asserted that strategic industries, such as hydrocarbons and mining, will be in the hands of the state.** To that end, state-owned PetroPerú will become a protagonist in the upstream sector as it vertically integrates along the crude value chain. PetroPerú

218 “Peru’s Camisea contracts could have room for renegotiation.” *BN Americas*, 1 October 2021.

Figure 48: Hydrocarbon revenues paid to the Peruvian government, in millions of USD



Source: PeruPetro.

will start its exploration activities in Block 192, which was producing 10,000 b/d in February 2020 under Canada's Frontera. The first Minister of Mining and Energy, Iván Godofredo Merino Aguirre (now replaced by Carlos Palacios Pérez), has already met with PetroPerú's unions and promised to expand the role of the state-owned firm.²¹⁹

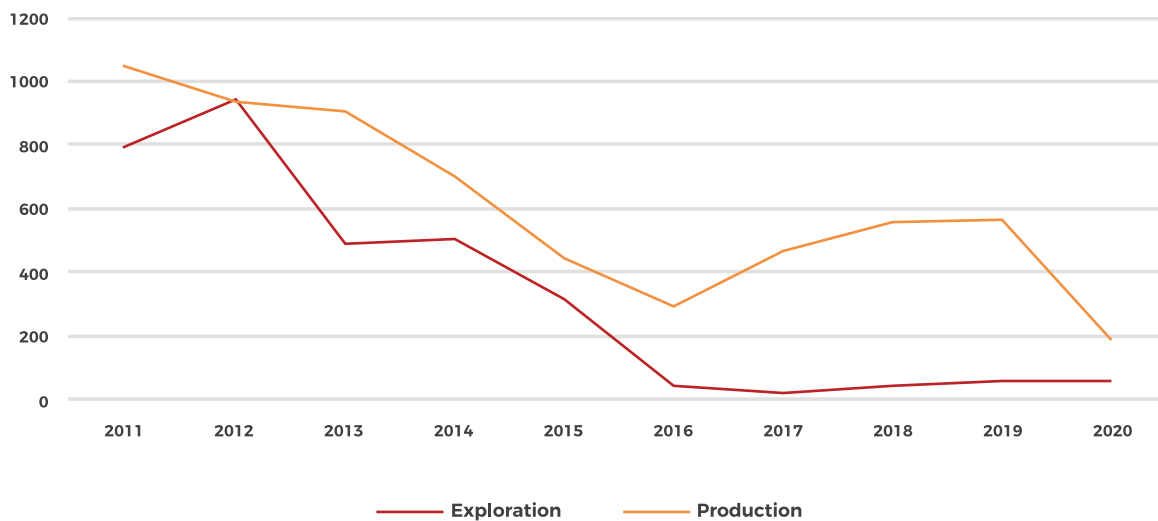
Although PetroPerú refines and markets about 40 percent of all liquid hydrocarbons in Peru, its oil and gas production has been declining since 2014 as it struggles to fund new upstream projects. With a US\$5.5 billion investment, it is currently upgrading the Talara refinery to increase its processing capacity to 95,000 barrels per day—allowing it to process heavy crude. This will permit Peru to refine crude from Argentina's Vaca Muerta, as well as Venezuela's Orinoco belt, two countries that are aligned politically with the new Castillo Administration and are becoming close allies. PetroPerú also operates the obsolete, 45-year-old North Peruvian Pipeline (NorPeruano), which is responsible for carrying oil from the Peruvian jungle to the country's urban centers. Increased royalties paid by the private sector will likely fund PetroPerú's new ventures.

Part of President Castillo's promise also includes lowering gas prices as consumers suffer from the global rise in the price of the commodity. He has vouched that PetroPerú will play a greater role in the distribution of natural gas, potentially taking over a project to distribute gas in seven central and southern regions.²²⁰ The lowering of gas prices will require subsidies, which the president may also seek to fund by increasing taxes on private companies. Not only will this lead to legal disputes, but it will also damage investor confidence and will scare away much-needed private capital.

219 MINEM: Qué prometió Merino Aguirre a mineros y chinos. El plan para Petroperú." *Mining Press*. 1 August 2021.

220 "New president appointed for PetroPerú." *Argus Media*. 17 September 2021.

Figure 49: Peruvian hydrocarbon investment in exploration & production, in millions of USD



Source: PeruPetro.

3. Mining’s impact on Peru’s energy sector and predicting what’s next

The sale and extraction of minerals, such as copper, gold, silver, zinc, and lead, account for 11% of Peru’s tax revenues, 10% of the country’s GDP and 60% of its exports.^{221 222} Mining serves as the backbone for the largely informal Peruvian economy, which contains some of the best mineral reserves in the world.²²³ The mining sector is the largest consumer of energy in the country, and purchases 60% of all electricity bought by unregulated customers. Large customers in the unregulated market can purchase electricity directly from energy suppliers, generators, or traders, rather than through a utility or a government tender.

221 “Informal employment as percentage of total employment in Peru from 2010 to 2020.” *Statista*, September 2021.

222 “Combating Climate Change with Extractives Revenues: Colombia and Peru Case Studies and Implications for Latin America.” *Inter-American Dialogue*, 1 December 2020.

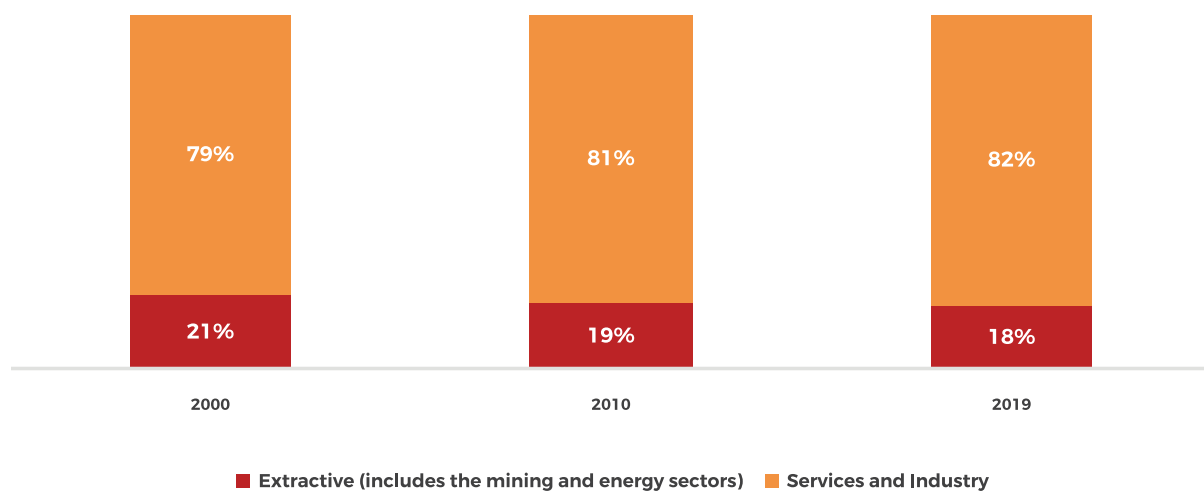
223 “Mining Equipment and Machinery.” *International Trade Administration*, 7 October 2021.

In mining, the cost of energy can equal up to one-third of the company’s total base cost, especially if the company is highly dependent on fossil fuels.²²⁴ In Peru, copper mining splits its energy consumption between electricity and fossil fuels (90% of which is diesel). Although renewable energy is cheaper than fossil fuels in three-quarters of the world, it does tend to require a higher up-front expenditure.

As the new Castillo administration hikes royalties on mining companies, miners are more likely to focus on short-term cost-cutting and maintaining their diesel dependency, making them less likely to invest in the long-term cost efficiencies of renewable energy. By electrifying heavy vehicles and mining equipment, as well as introducing renewable solutions such as green hydrogen into the mix, Peru will lower carbon emissions, decrease costs, and improve energy efficiency in the mining sector. Without those measures, Peru will likely fall short of its renewable energy targets.

224 “Will electrification spark the next wave of mining innovation?” *EY*, 2019.

Figure 50: Percent contribution to Peru’s GDP, by economic sector, 2019



Source: Instituto Nacional de Estadística

B. The opportunities and challenges in Peru's path to net zero

1. Setting the stage: How large customers contract energy

As seen in most markets, Peruvian consumers fall within three main markets based on the amount of energy they consume:²²⁵

1. Spot market
2. Regulated market
3. The free or "contracts" market

1. The spot market allows the Committee of the National Interconnected System (COES), which controls the country's main grid, the SEIN, to supply energy to residential and commercial consumers on a short-term basis. If there is a peak in demand, generators can quickly sell energy to the COES based on the cost of the last energy purchase made by the system. Given Peru's historical dependence on natural gas and oil, which provided 73% of its total energy supply in 2018, energy prices in the country are often subject to volatility and sharp increases. By reforming and modernizing its energy sector, Peru would increase its supply of renewable power, accelerate investment in the transmission infrastructure, and avoid large price fluctuations.

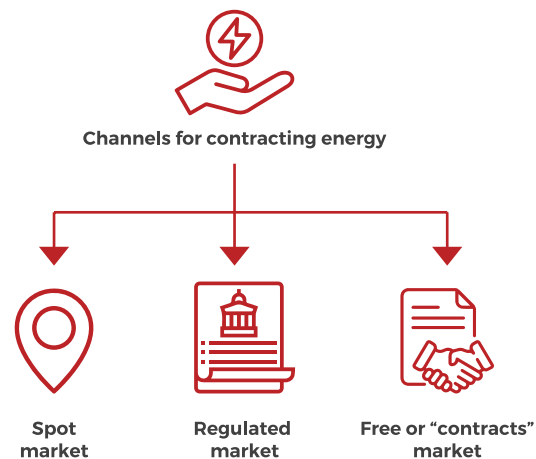
2. The regulated market applies for all customers with power demand lower than 200 kW. The sale is conducted by generation and distribution companies, which negotiate prices based on customer demand and a price ceiling set by energy regulator Osinergmin. Within the regulated market, the government also holds its renewable energy auctions for the sale of long-term energy contracts.

3. The free market applies for all generators, distributors, and customers with a power demand greater than 2.5 MW per month. Here, PPAs and other energy purchase agreements are bilaterally negotiated

between the large-scale customer, such as a mining company, and the seller, which consists of generation or distribution companies.

An important caveat in Peru is that the 2008 Renewables Law requires that the COES contract energy from power plants that have firm capacity. Until 2019, wind and solar power were not grouped as firm capacity, making them less competitive vis-a-vis conventional energy and limiting their deployment to regulated government contracts. This changed with the approval of Technical Procedure N° 26 of COES (PR-26), as solar, wind and tidal power produced during the peak hours of 5pm to 11 pm, were now considered as "firm." This change benefited wind projects, who tend to be stronger at night, but continued to limit the deployment of solar, who is strongest during the day. **For now, wind power continues to be the most appealing non-conventional renewable energy (NCRE) opportunity in Peru.**²²⁶

Figure 51: The three channels for large consumers to contract energy in Peru



Source: AMI research and design

²²⁵ "The Power Market & Renewables in Peru." *Renewables Now*, March 2018.

²²⁶ "Renewable energy law and regulation in Peru." CMS. 18 December 2020.

2. Solar opportunities in the south are needed to complement mining growth

Peru has a target of 15% renewable energy by 2030, with the goal of reducing emissions by 40%. To do so, it will have to transition away from its dependence on thermoelectric generation, which currently comprises 35% of its energy matrix. **Not only does southern Peru have solar capacity factors of around 50%, but it also has one of the highest solar radiation levels in the world, ranging from 5.5 to 6.5kWh/m².**²²⁷ This solar power should be used to complement the growing energy demand expected in that region.

Developing renewable energy in the south, where a portion of the country's mining takes place, would provide the country with the following multi-faceted benefits:

1. An additional source of clean energy for a region struggling with its energy demand
2. An improved image of mining's environmental impact
3. A surge in new investment and employment opportunities for the local communities
4. A win for developers, who will have a reliable—and guaranteed—oftaker

A promising yet complex project is being developed in the city of Arequipa, in the south of the country, by Continua, a renewable energy developer. In August 2020, the US\$210 million, 300 MW project received approval from Minem to develop the transmission line that would connect the project to the grid.²²⁸ With the country's regulatory framework barring the sale of solar power via private PPAs, the energy will have to be sold via a reverse auction, in which multiple generators present bids to satisfy the energy request made by buyers. This mechanism tends to drive prices down for the buyer, subsequently lowering returns for the generator. The project's remote location also complicates the interconnection to the grid.

²²⁷ "Engie's Peruvian bet on natgas, green hydrogen, and decarbonization." *BN Americas*, 8 September 2021.

²²⁸ "Otorgan a favor de CSF Continua Misti S.A.C. la concesión definitiva para desarrollar actividad de transmisión de energía eléctrica en Línea de Transmisión ubicada en el departamento de Arequipa." *El Peruano*, 27 August 2020.

3. The challenges of massifying natural gas

Peru's mountainous geography has disconnected many areas from the energy grid, limiting access to power for rural populations. One of these areas is the south of Peru, which struggles with climate issues and a lack of infrastructure that limits energy supply. The establishment of distributed generation and micro-grids using solar PV in the south would help expand energy access to remote areas. However, given the large Camisean gas reserves in the southern part of Peru, the government's main priority is for PetroPerú to provide clean, affordable gas to the masses, known as the massification of natural gas.

PlusPetrol, a private oil and gas company, has operated the Camisea gas mega-field successfully by developing two major pipelines that distribute gas to major cities. Yet, in Peru's south, there is no pipeline infrastructure to facilitate the distribution of the resource. In 2017, the US\$7.3 billion Gasoduct Sur Peruano, a major pipeline that would distribute gas in the region, was cancelled due to corrupt ties with construction company Odebrecht. The replacement project, known as SIT GAS, is still being evaluated and is unlikely to be ready before 2026.²²⁹ This has forced the temporary use of "virtual massification," which is the distribution of compressed gas, often Liquefied Petroleum Gas (LPG), via trucks. This distribution is often inefficient, costly, and can be dangerous, as seen in a 2020 LPG truck explosion that killed 34 people near Lima.²³⁰

In addition to the lack of gas transportation infrastructure, gas tariffs have suffered due to the following reasons:

1. The absence of a major industrial base in the south (except for specific large mining operations)
2. Unclear gas rates
3. An oversupply of gas

This has made final gas tariffs less competitive vis-à-vis other fuels and prevented players from rushing in to supply the market. This has caused the Camisea

²²⁹ "Gobierno prevé que el SIT Gas entre en funcionamiento el año 2026." *Rumbo Minero Internacional*, 16 December 2020.

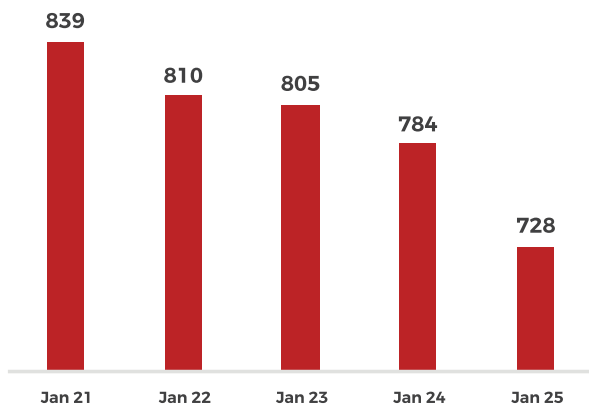
²³⁰ "Se elevan a 34 los fallecidos por explosión de camión cisterna de gas en Lima", 14 March 2020.

consortium to state that “there is not enough demand in the local market,” forcing them to reinject 25% of the extracted gas back into Block 88. The consortium is now asking for the accelerated development of industrial projects in sectors such as petrochemicals and mining, to meet the country’s growing supply of energy.²³¹

In the same vein, Naturgy Peru preemptively ended its southern gas distribution concession because of significant economic losses caused by high liquefaction and virtual distribution costs. With the government’s promise to fix these challenges, GASNORP, a subsidiary of Colombian Promigas, won a 32-year concession to distribute gas in the southern region in exchange for a US\$230 million investment in gas distribution networks. GASNORP will now face the growing presence of PetroPerú in the sector, as well as higher taxes.

The oversupply of domestic gas has provided an opportunity for Peru to turn its gas into liquid form and export it as liquefied natural gas (LNG) to Europe. In fact, Peruvian LNG exports have increased 74% in the the first six months of 2022, when compared to the same period in 2021. **As one of the only two LNG exporters in the region (Trinidad and Tobago is struggling with dwindling investments and reserves), Peru is poised to benefit from the Ukraine war.**²³²

Figure 52: Total contracted demand for the transportation of natural gas in Peru, in MMCF/day



231 “Peru’s Camisea contracts could have room for renegotiation.” *BN Americas*, 1 October 2021.

232 “In Latam, Peru streaks ahead in LNG race to Europe as Trinidad stumbles.” *Reuters*, 31 May 2022.

4. Case Study: Punta Lomitas, the first fully private power plant in the country

Since wind projects had to be built under government PPAs until 2020, it was only in 2021 when Peru developed its first power plant, consisting of an agreement between two private companies: Engie Energía Perú (subsidiary of French Engie) and British Anglo American. The US\$323 million, 260 MW Punta Lomitas wind farm, located in the Ica Province, will be the largest wind plant in the country and will supply the Quellaveco mining project starting in 2023. It will also have highest wind capacity in the world, at 60%. An eight-year PPA, from 2029 to 2037, was signed to provide 150 MW directly to the Quellaveco copper project. The plant will increase the country’s installed wind capacity by over 50% and its development will serve as a basis for future wind projects on the Pacific Coast.

In many situations, **project developers in Peru struggle to obtain the approval of local communities prior to developing projects. In fact, over US\$20 billion in Peruvian mining projects have been delayed due to social conflicts.** Through its experience handling local community stakeholder relationships, AMI helps companies obtain their “social license to operate.” Among other things, we recommend that companies:

1. Maximize local procurement and employment
2. Maintain close relationships with community leaders via monthly roundtable meetings
3. Reinvest proceeds into community development programs
4. Ensure proper environmental safeguards

Engie, which supplies 20% of the country’s energy supply, will recruit all non-skilled workers from the local district of Ocucaje to develop its Punta Lomitas Wind Farm.²³³

233 “Engie kicks off work on Peru’s largest wind farm.” *WindPower Monthly*, 18 October 2021.

5. Green hydrogen: Is it a feasible reality?

In early 2021, the Peruvian Hydrogen Association (H2 Perú) was created in partnership with Engie Impact to explore the potential hydrogen opportunities in the country. The continued decline in renewable energy costs in Peru could make the production of green hydrogen a reality by 2030. However, to make it more feasible, the government needs to adopt a regulatory framework that provides incentives to develop pilot hydrogen projects, complemented by tax deductions on imported technology used to build these plants. It also needs to improve its pipeline infrastructure to be able to transport hydrogen.

In the mid-term horizon, green hydrogen could be used to replace the large volumes of diesel used in the mining sector. A study by the IEA shows that replacing 20% of diesel-fueled mining haul trucks with green hydrogen could decrease CO₂ emissions by 1400 kt/yr in Peru, Mexico, Chile, and Brazil. Green hydrogen could also be used in other hard-to-decarbonize industrial processes such as transportation and petrochemicals. Since 1965, Peru's Industrias Cachimayo has been producing hydrogen using electrolysis to manufacture fertilizers for the mining industry. Thus, the capacity and expertise are not completely foreign, but new technologies and heavy investment are needed to accelerate these developments.²³⁴

6. Conclusion: Politics will hinder Peru's strong potential

When compared to other major markets in Latin America, large customers have more limited options when it comes to purchasing energy in Peru. The regulatory framework restricts solar developments to

²³⁴ "Hydrogen in Latin America: From near-term opportunities to large-scale deployment." *IEA*, August 2021.

public power auctions, and the country's 5% share of non-conventional renewable energy generation is next-to-last among major LatAm markets, ahead only of Colombia.²³⁵ However, it is not because of Peru's lack of potential.

In September 2021, regulator Osinergmin announced that Peru had an estimated 77 GW of wind potential on its Pacific coast, located mostly in the departments of Ica, Cajamarca, Piura, and Libertad. Hydroelectric potential offers another 70 GW, 86% of which would come from its Atlantic basin.²³⁶ Another 3 GW of geothermal capacity in the south, coupled with 260 GW of total solar PV potential, paints a promising picture for the country's future energy supply.²³⁷

Looking ahead, the biggest obstacle to successful energy ventures is political uncertainty, now in the hands of President Castillo and his political fate. Experts are unclear as to whether Castillo will remain in power for his entire five-year presidential term. His leftist views and inexperienced administration greatly concern the concentrated and powerful private sector, and they also embolden opposition from the center and right-wing factions of congress. In March 2022, President Castillo survived his first impeachment vote. Now, more than ever, being able to navigate the political and regulatory changes in Peru, while simultaneously understanding the changing market demand for new and old technologies, will be fundamental for any successful energy project in the country. That is where AMI can help.

Contact us at info@americasmi.com to explore how our market intelligence can help you leverage opportunities in Peru's energy market to the fullest.

²³⁵ Data is from Bloomberg NEF, 2019.

²³⁶ "Peru seen to hold great renewable energy potential." *BN Americas*, 2 September 2021.

²³⁷ "Technical Potential of Solar in Peru using the Renewable Energy Data Explorer." *NREL*, August 2019.

XII. Conclusion: Breaking down the opportunities in each major market

The path to net zero in Latin America will include several inflection points, and 2022 is one of them. It has been nearly half a century since the 1970s energy crisis made energy security the top government priority across the world. Now, with the war in Ukraine, disrupted supply chains, and the severe threat of global warming, the topic has once more become top of mind.

The third part of the IPCC (Intergovernmental Panel on Climate Change) report, released in April 2022, stated that the world has a 50% chance of meeting its climate goals if greenhouse gas emissions manage to peak by 2025. For the world to limit temperatures to 1.5°C above pre-industrial levels—a key objective of the Paris Agreement—it will have to reduce today's coal use by 95%, oil by 60%, and gas by 45% by 2050. This is a daunting task, but it is not impossible.

Investors, operators, and governments are the ones whose actions will dictate the success of net zero goals. The private sector will play its part if adequately incentivized. AMI breaks down the most appealing prospects for each main regional market in the path to net zero:

1. **Brazil:** Distributed generation's favorable tax regime will expire for new projects at the end of 2022. Those that can obtain approval before the deadline will see double-digit returns for several years. With the slower-than-expected opening of the gas sector, biomethane projects—under the recently launched program—are also aligned with environmental goals and are fiscally attractive.
2. **Mexico:** Under the AMLO administration, solar and wind projects are only attractive if they are done via public-private partnerships with the government's backing. LNG export terminals in Mexico's Pacific Coast are surging as a potential replacement for Russian gas in Europe and Asia.
3. **Colombia:** Offshore wind is still relatively green, but it has tremendous generation potential and bypasses the local opposition faced by onshore wind farms. Solar, in the center of the country where there are high radiation levels and more developed infrastructure, should also be considered by energy investors.
4. **Argentina:** Gas production in Vaca Muerta is highly subsidized via tax incentives and government guarantees. If the Peronists continue in power, fossil fuels in Vaca Muerta will be the best energy play in the country. If the Peronists are replaced by a more business-friendly administration, it is likely that renewable energy will see a revived acceleration in the country.
5. **Chile:** Across the region, Chile is the leading prospect for the large-scale development of green hydrogen. Not only does it have one of the cheapest and most developed renewable energy grids, but it also has a developed hydrogen framework that has attracted billions in investments.
6. **Peru:** Despite the strong solar radiation in Peru's southern region, the country lacks the necessary transmission infrastructure and renewable framework to provide confidence to solar investors. Until the firm power definition for solar plants is changed, investors should take a cautious approach. Gas generation and transportation are also highly competitive and suffers from unclear market guidelines and local opposition. Currently, Peru is not a leading choice for foreign energy investors.



Next steps: Ensuring a successful energy investment or project in Latin America

Beyond those outlined in this whitepaper, here are some of the strategic questions that AMI energy research can help answer:

- Many Latin American countries have recently elected populist presidents that shun the regulatory status quo. In those jurisdictions, will regulatory bodies suffer delays and obstacles in approving important legislation and new permitting licenses for energy projects?
- Given the recent political shift toward conventional energy in Argentina and Mexico, what headwinds will both conventional and renewable energy face in other Latin American markets?
- With the decline in long-term PPAs and a growth in the unregulated market, can energy suppliers and customers depend on free-market pricing to contract energy?
- With 15 wind projects on hold in the La Guajira region in Colombia, what is the level of local community risk for other wind assets in the region?

Phase-by-phase support

In addition to answering key strategic questions concerning the whole region or specific markets, AMI's energy market intelligence team can also help you in each phase of your energy project. For example:

1. **Strategy-defining phase:** We provide a market landscape, identify opportunities, analyze all competitors, and highlight investment roadblocks.
2. **Pre-acquisition phase:** Before your company invests heavily to develop or acquire a project or asset, we gather the latest intelligence about the opportunity to quickly point out the environmental, regulatory, social, reputational, or political issues that could present problems, as well as help you measure or verify the revenue potential of the project.
3. **Approval phase:** After purchasing a brownfield or greenfield asset, companies need to navigate a challenging approvals process. Project opponents will emerge. Understanding their motivations ahead of time (through AMI's on-the-ground intelligence) helps you address those opponents before they take damaging action against the project.
4. **Operational phase:** We provide ongoing monitoring of risks and potential threats to ensure successful operation for the project once it has finally begun. Our intelligence keeps your PR, GR, and CSR programs and budgets fresh, relevant, and effective.

Next steps

Contact us at info@americasmi.com or visit our website to find out more about these services.



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