Latin America
Solar investment opportunities
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Foreword

SolarPower Europe launched the Emerging Markets Workstream in 2018 to identify opportunities for business and cooperation and thereby contribute to the energy transition in emerging markets outside Europe. Since then, the Workstream has become an active working group with more than 120 experts from over 60 companies, working on a suite of reports presenting solar investment opportunities in new and emerging markets around the world.

The Workstream operates through a series of physical and virtual meetings. It organises visits to the selected markets and facilitates speaking opportunities at conferences. Member companies also are involved in relevant initiatives such as the EU-Africa Sustainable Energy Investment Platform, the RenewAfrica initiative and IRENA’s Coalition for Action. To shape the global energy transition, Workstream members exchange and cooperate with international stakeholders such as the European Commission, the International Renewable Energy Agency (IRENA), the International Solar Alliance and GET.invest, as well as key stakeholders such as national industry associations from various countries.

In this report we are glad to share our findings on solar investment opportunities in Latin America. This regional report, which covers four solar markets, was written by experts from Powertis, Finergreen, ABO Wind, BayWa r.e. and QOS Energy with the support of national solar associations from Brazil (ABSOLAR), Chile (ACESOL), Colombia (SER Colombia) and Mexico (ASOLMEX). This report provides a general overview of the four countries’ business environment, major macroeconomic, demographic and socio-political trends. Moreover, it highlights the countries’ energy context and relevant stakeholders, as well as the regulatory frameworks for investments in the solar sector. The report reveals the huge potential for the development of solar PV in the region, regardless of the different levels of political support. For each country, a list of recommendations was developed to further unlock this solar potential and improve the markets’ attractiveness in the eyes of international investors.

The Latin American report is the eighth in a series of SolarPower Europe market reports. Previous reports focus on India, Tunisia, Mozambique, Senegal, Ivory Coast, Myanmar and Kazakhstan. All reports can be downloaded from www.solarpowereurope.org free of charge. If you want to be part of our activities and discover new solar business opportunities, join SolarPower Europe’s Emerging Markets Workstream.
1. Economic, social and political context
1.1. Macroeconomic context

Brazil is by far Latin America’s largest market, representing 41.4% of the region’s economy (EIU, 2018). Its economy is based on a wide range of sectors, such as aerospace, agribusiness, automotive, oil and gas, mining, capital goods, medical equipment, chemical and technology industries (Invest in Brazil, 2020). Following a period of economic growth up to 2014, the country then faced an economic downturn in 2015 and 2016, which resulted in negative GDP in both years. This triggered a profound debate about various structural economic reforms in the country, aiming to increase the effectiveness of the macroeconomic policies applied to the public and private sectors.

In 2019, Brazil’s nominal GDP was US$ 1.84 trillion, positioning the country as the 9th largest economy in the world and the 2nd largest economy in the Americas, only behind the USA (World Bank, 2019). In late 2019, Brazil’s central bank cut interest rates to a record low, which was seen by the market as a positive sign and is expected to spark favourable market conditions and prospects for economic recovery. As in most other countries, social distancing measures to combat...
COVID-19 had a negative impact on the Brazilian economy, resulting in a projected decrease of the GDP in 2020. However, authorities have responded strongly to the COVID-19 pandemic, with decisive interest rate cuts, and significant fiscal and liquidity packages, including direct cash transfers targeted at vulnerable population groups. These measures were successful in keeping the economy from suffering as big of a toll as initially forecasted, with recent forecasts indicating a decrease in the economy by 5.8% in 2020 and expected recovery in 2021.

1.1.2. Business environment

Brazil is considered one of the most attractive markets for international investors in Latin America due to several factors: a domestic market of nearly 210 million inhabitants, availability of easily exploitable and abundant natural resources, a diversified economy that is less vulnerable to international crises, and a strategic geographic position that allows easy access to other South American countries. As a result, Brazil was the number one recipient of foreign direct investments in renewables in Latin America from 2009 to 2018, attracting more than US$ 20 billion during this period (Apex Brasil, 2020).

The country recently shifted significantly from high inflation and interest rates to lower ones, a move which reduced challenges for long-term investments and reduced dependence on public financing mechanisms. In addition, in July 2020, the Brazilian government cancelled import duties on foreign manufactured solar PV equipment, which exempts these materials from paying import taxes till the end of 2021. Nevertheless, volatile foreign exchange rates are a noteworthy risk factor for foreign investors, especially when investment is based on imported materials but generates turnover in local currency.

Brazil is ranked 124th out of 190 countries in the World Bank’s 2020 Doing Business report, a decrease from the previous year, when it was ranked 109th (see Figure 13, Annex section). It is worth mentioning that Brazil has a double taxation agreement with some European countries, though not with all of them, which helps when it comes to repatriating income generated in Brazil. However, currently, there are uncertainties regarding the pending ratification of a trade agreement between the EU and Mercosur.

1.1.3. Political and social context

Brazil has made tremendous progress in the previous decades in terms of improving its citizens’ quality of life. Looking at the Better Life Index, Brazil ranks above the OECD average in civic engagement and social connections. Nonetheless, the country is still working towards reaching the OECD levels in education and skills, personal security, income and wealth, jobs and earnings, housing, environmental quality, subjective well-being, work-life balance and health status.

In 2018, after political and social unrest prompted by public corruption scandals, far-right president Jair Bolsonaro was elected president. The elections left the country politically polarised and the consequences of the 2015/2016 economic recession remain present. The federal government is currently focused on implementing structural reforms to the Brazilian economy based on a free-market approach that is supported by several economists. In 2019, with the support of the National Congress, it succeeded in approving a broad social security reform to help reduce fiscal deficit of the federal government. This boosted the country’s credibility in financial markets. Now the government is working towards an administrative reform of the public sector, to further reduce public expenditure, a move also highly anticipated by financial markets. As for foreign policy, Bolsonaro has generally pursued a free-market agenda with focus on bilateral trade deals (Nordea Trade, 2020) and has sought approval from Congress to simplify the national tax code (Heritage, 2020).
1.2. Energy and electricity

1.2.1. Energy sector situation

With almost 83% of the total electricity generated by renewables, Brazil is the third-largest country in terms of renewables total installed capacity worldwide, only behind China and the USA (World Bank, 2020). Brazil is both the 9th largest power consumer and producer in the world and also the largest electricity market in Latin America (Apex-Brasil, 2020).

Brazil’s historical dependence on hydro generation has led to increased use of thermoelectric power plants to avoid power supply shortages in drought years, with energy spot prices surpassing R$ 800.00/MWh (€ 126.60/MWh) in 2014 (CCEE, 2020). The development of new large-scale hydropower projects has been very limited in Brazil due to a number of factors: (i) growing environmental and social concerns connected to large-scale hydropower projects; (ii) a high cost for grid extension to reach the northern

FIGURE 1 BRAZIL’S SOLAR PHOTOVOLTAIC POWER POTENTIAL

![Solar panel energy potential map of Brazil](https://example.com/solar-brazil-map)

**Daily totals**
- 3.8 kWh/kWp
- 4.0 kWh/kWp
- 4.2 kWh/kWp
- 4.4 kWh/kWp
- 4.6 kWh/kWp
- 4.8 kWh/kWp

**Yearly totals**
- 1387 kWh/kWp
- 1461 kWh/kWp
- 1534 kWh/kWp
- 1607 kWh/kWp
- 1680 kWh/kWp
- 1753 kWh/kWp


regions of the country, where the vast majority of the
dominant hydropower potential is located; (iii) electric losses resulting from long distance
transmission; and (iv) improving economic
competitiveness of other renewables, such as solar PV,
wind, and biomass led the federal government to a
diversification strategy for the Brazilian electricity mix. This strategy has made wind and biomass, respectively,
the second and third largest sources in terms of total
installed capacity in Brazil and solar PV is now following
the same trend (ANEEL/ABSOLAR, 2020).

In line with this, the 10-year plan (Plano Decenal de
Expansão de Energia, PDE 2029) of Brazil’s Energy
Research Office, Empresa de Pesquisa Energética
(EPE), predicts that solar PV and wind generation will
gain more prominence in Brazil in the coming decade. By 2030, electricity generation from solar PV is
estimated to increase to 20.4 GW between distributed
and centralised generation (EPE, 2020).

The economic difficulties related to COVID-19 directly
influence projections of energy consumption. EPE
initially forecasted a delay in growth of about two
years compared to projections from 2019, decreasing
the expected demand in 2029 by up to 10 GW, when
considering all sources combined (EPE, 2020).

According to Bloomberg New Energy Finance’s New
Energy Outlook, solar photovoltaic will become the
number one electricity source in terms of installed
capacity in Brazil, corresponding to 114 GW (or over
38%) of Brazil’s electricity mix in 2050, including both
utility-scale and small-scale PV.

1.2.2. Electricity infrastructure
Brazil is the largest electricity market in Latin America. It
generates and distributes electricity to over 85
million consumer units, more than all the electricity
produced in neighbouring South American countries
combined (Export.gov, 2019). The national
interconnected transmission system, Sistema
Interligado Nacional (SIN) is divided into four
subsystems: South, Southeast/Center-West,
Northeast and North, with borders defined based on
transmission restriction criteria. All four submarkets,
excluding some parts of the Northern submarket, are
interconnected through the transmission grid and
operated by a single national entity (ONS). This
facilitates the transfer of energy between subsystems and
increases its capacity to cope with variable
regional electricity sources, such as solar PV and wind.

The Brazilian electric market is divided into five
segments: Generation, Transmission, Distribution,
Trade and Consumption. The main characteristics of
each market segment are presented below.
Generation: The country’s generation segment is liberalised. A company can freely engage in generation activities by developing projects and interconnecting to the electricity grid, provided that projects comply with the respective regulatory framework (such as environmental authorizations, generation authorizations, interconnection rules).

Transmission: The Brazilian electricity transmission system is a federal concession, and it extends to all regions of the country, with an interconnected grid of 130,000 km of high voltage transmission line (equal or superior to 230 KV). About half of the power transmission companies in Brazil are privately-owned. International groups, such as Sterlite Power from India and State Grid from China, have actively grown their presence in this segment by winning several auctions for new transmission lines (Export.gov, 2019).

Distribution: The distribution system is also a federal concession. The state of São Paulo is the biggest distribution market of the country, with over 18.6 million consumers on the captive market with a consumption of approximately 11 million MWh/month. In this state distribution concessionaires are responsible for the consumers’ electricity supply in the regulated market (Secretaria de Infraestrutura e Meio Ambiente do Governo de São Paulo, 2020). The free and special consumers, which refers to those that use over 2,000 kW and 500 kW respectively, can choose from whom to buy energy as they are not obliged to use the local distributor.

Trading: The Brazilian Electricity Market is operated by the Electricity Trading Chamber (CCEE), a non-profit maintained by companies who trade electricity in Brazil. Their mission is to record the sale and purchase transactions in both regulated and free market environments, as well as in the short-term markets. The trading environment is strengthened by rules and mechanisms that promote solid and fair business relationships for all segments.

Consumption: The electricity consumption reached a total amount of 545.6 TWh in 2019, to which the industrial and residential sectors contributed 35.9% and 26.1% respectively. Together with the commercial sectors, those three segments are responsible for 79.4% of the energy consumed in the country. 16.3% was Self-production or an amount of 102.4 TWh. Of this total, 57.3 TWh were not injected into the grid, but consumed by self-producers in the industry and oil and gas sectors (EPE, 2020).

1.2.3. Stakeholders, tariffs and regulatory framework
The Brazilian energy sector is structured and overseen by the Brazilian Federal Constitution. The Constitution states that the sector can be exploited directly or through authorisation, concession or permission. Over the last 20 years, the energy sector has been restructured and opened to foreign investment in power generation. The electricity market was reshaped such that all concessions for major energy services must be granted through a public bidding process. This developed a partially free energy market, which became more competitive once some power consumers could purchase energy directly from suppliers. To regulate and supervise this new dynamic, the government passed Law No 9,427/1996, creating the National Electric Energy Agency (ANEEL). Subsequently, a wholesale market was incorporated under Law No 9,648/1998, and power trading companies emerged (Practical Law, 2019). In Brazil, the main regulatory authorities of the electricity market include:

- Ministry of Mines and Energy (Ministério de Minas e Energia, MME), which is responsible for formulating and implementing national policies in the energy sector. Currently, the MME is responsible for granting concessions and permissions to exploit electric power services and facilities, and responsible for hosting energy auctions to supply the regulated electricity market.
- ANEEL, an independent body linked to the MME, with technical and political autonomy to regulate, supervise and monitor activities related to the energy sector.
- Operator of the National Electricity System (ONS), a non-profit private entity that manages the national interconnected transmission system (SIN).
- Energy Research Company (EPE), a state-owned company that conducts studies and research to provide technical support for preparing long-term power planning in Brazil. It also identifies potential energy sources for national development and plays a role in the preparation of studies for power auctions.
- Electricity Trading Chamber (CCEE), a non-profit private entity regulated and supervised by ANEEL. It is responsible for registering and processing the volume of all the energy contracted in the electricity power market.
The Brazilian electricity market is divided into two parallel and independent market environments: the traditional regulated power market (Ambiente de Contratação Regulada, ACR) and the more recent Free Power Market (Ambiente de Contratação Livre, ACL) which as of 2017 is undergoing a process of modernisation, in accordance with Bill 232/2016 (MME, 2017). According to the modernisation objectives, the number of consumers migrating to the free market environment shall increase over time until in the long-term full deregulation is achieved. Another important pillar in this process is the need to readjust supply adequacy mechanisms by charging the contracted power (in MW) and the actual energy supplied (in MWh) separately.

Currently, approximately 69.7% of energy consumption is in the regulated market environment (ACR) (CCEE, 2020). Residential, small commercial and industrial, rural as well as many public consumers purchase their electricity from their local distribution company. The commercial relationship between buyer and seller is fully regulated by the national electric energy agency (ANEEL) and tariffs are non-negotiable. Distribution companies purchase the electricity through centrally organised energy auctions with long-term offtake agreements. In previous years, solar PV has become highly competitive during the last two “new energy” auctions, with price levels below R$ 70 (€ 11.17/2)/MWh in the A-4 auction, in July 2019 (Commercial Operation Date: 2023) and around R$ 85 (€ 13.46)/MWh on the A-6 auction, in October 2019 (Commercial Operation Date: 2025). Even though consumers pay significantly higher prices in the regulated markets, the Power Purchase Agreement (PPA) prices on the generation side are significantly lower when compared to free market PPAs. This difference arises from a combination of i) burdens applied to prices in the regulated market, ii) extension of contracts and iii) financing conditions. Additionally, companies have reduced their prices in regulated auctions to assure connection points to the transmission system and have directed more electricity to the free market, to monetize its operations.

For captive consumers in all major regions of the country the distributed generation through solar PV is already an economically viable alternative to purchasing electricity from the distribution company. In most Brazilian states and concession areas, high electricity tariffs make the business case for distributed solar PV attractive. Since January 2020, any consumer with contracted power above 2 MW is entitled to purchase electricity in the free market environment, through retail energy sales companies or bilateral agreements with Independent Power Producers (IPPs). The free market environment (ACL) currently represents the remaining 30.3% of the Brazilian electricity market (CCEE, 2020).

1.2.4. Update on solar market demand

According to ABSOLAR & SolarPower Europe’s market data, in 2019, annually added capacity for solar PV grew to a record 2.1 GW, with the largest part, around 1.5 GW, stemming from distributed generation below 5 MW, based on a national net-metering regulation. 657 MW stemmed from centralised generation, awarded through energy auctions held by the federal government, as well as from direct PPAs in the free electricity market (SolarPower Europe, 2020).

Before the effects of the COVID-19 pandemic, the Brazilian Solar Photovoltaic Energy Association (ABSOLAR) projected a total increase of more than 4 GW in 2020. This number was expected to suffer from the pandemic. However, as of October 2020, Brazil’s installed solar PV capacity has surpassed both solar analysts’ and all official government expectations, reaching over 6.7 GW, divided between the two main market segments (see Figure 3):

1. Utility-scale projects above 5 MW, with a cumulative installed capacity of 3.0 GW, awarded in energy auctions held by the government. The average size of utility projects is between 100 and 200 MW.

2. Commercial, industrial, rural, public and residential projects below 5 MW, with a cumulative installed capacity of 3.7 GW, based on net-metering, both on-site and off-site generation (local and virtual net-metering).

The COVID-19 impacts on the Brazilian economy have been much lower than anticipated so far despite one of the largest death rates in the world. SolarPower Europe has strongly revised upwards its earlier forecast, now expecting not a reduction in demand anymore but a 35% uptick year-on-year to 2.9 GW, from 2.4 GW in 2019. Thanks to a thriving market in Brazil.
both the centralised and the distributed segments, it appears that the solar PV target of 20.4 GW laid out in the 10-Year Energy Plan (PDE 2029) will be reached earlier than 2029. We expect a stable market in the range of 3 GW per annum in the next five years. The new decree approved in June 2020 is also expected to support renewable energy projects on the long-term, by making way for 30 GW of new capacity, including 8 GW for solar PV in the upcoming 10 years.

By 2018, the centralized (utility-scale) solar market in Brazil grew through PPAs awarded in the regulated market environment (ACR), under the federal government Reserve Energy Auctions and New Energy Auctions. The New Energy Auctions (Leilão de Energia Nova, LEN) held in June and October 2019 (LEN A-4/2019 and LEN A-6/2019) represent a new phase for large projects in terms of competitive prices. The auction in June reached an average sale price of 17.62 USD (€ 14.91) /MWh, whereas the auction in October reached 20.33USD (€ 17.20)15/MWh. Both results were lower than the average sale prices of wind, small hydroelectric, biomass, and fossil fuel power plants, highlighting solar PV as one of the most competitive energy sources in Brazil. In total, 733.7 MW of projects were contracted in 2019 and will be delivered and operational by January 2023 and 2025, respectively (ABSOLAR & SolarPower Europe, 2020). These projects sell around 35% of their electricity to the regulated market at the prices mentioned above, while the remaining electricity will be sold to the free market at significantly higher prices to enable economic feasibility of the generation asset.

Despite very low pricing, the ACR contracts remain interesting for most developers, due to advantages related to the interconnection capacity, the easier access to financing and the investor appetite. Nevertheless, the country is also witnessing a continuous growth of utility scale solar plants in the free market environment (ACL), which can be explained by several factors:

- Due to the current macroeconomic environment, public auctions are expected to represent a lower share of total contracted capacity than in previous years.
- PV plants securing regulated market (ACR) contracts in the public auctions sell between 30 and 40% of their generation to the ACR. The remaining share serves consumers in the ACL, with better average selling prices. That means that even public auctions indirectly increase the volumes contracted in the free market environment.
• PPA's average selling prices in the ACL are higher than prices in the ACR, but still attractive large corporate consumers and commercialisation companies. The extent of additional charges like transmission, distribution fees, taxes and more is significantly lower in the free market environment.

• The free market allows different modalities for selling the electricity, from indexation to US$ (reducing exchange ratio risks), to self-generation schemes (autoprodução) resulting in significant tax advantages for the electricity consumer, to bilateral PPAs with different terms and to selling electricity to a larger group of consumers through a commercialization company.

As for distributed generation, the country added a record capacity in 2019 amounting to 1,458 MW. This is due to the increasing competitiveness of solar PV under the net-metering regulation for projects up to 5 MW, including both local and virtual net-metering, as well as community solar mechanisms (SolarPower Europe, 2020).

1.3. Recommendations

Introduce attributes such as social, economic, environmental and technical benefits to compensate for the planned withdrawal of the grid usage fee discount for renewable energy projects. According to market sources, the economic impact of removing this discount can represent up to 10% of the renewable energy projects' gross revenue and is a threat to its financial feasibility and competitiveness. To support further growth of renewable energy, the draft Bill PLS 232 and MP 998 foresees consideration of these attributes to compensate for the discount withdrawal. However, so far, no specific measures have been defined.

Increase the transparency on grid connection processes for large-scale PV projects. While in many markets in Europe securing grid, connection is one of the first steps in project development, in Brazil it is one of the last and directly requires signatures of binding contracts between the grid operator and grid concessionary. To reduce uncertainty for solar PV development, it is recommended that information on grid access consultation and status of grid access solicitation is made publicly available. This would support developers' decision making by allowing more visibility of the evolution of other projects and hence visibility of how much evacuation and physical interconnection capacity is still available.

Standardise rules for environmental licensing procedures for large-scale PV projects, according to best practices used in leading Brazilian states. In Brazil, environmental licensing of solar PV plants and interconnection lines is usually carried out on a state level. There currently are significant differences between states regarding structure, rules, standards, timing, cost and compensation measures both for solar PV projects and interconnection licensing, as well as for the vegetation control. It is advised that these procedures are standardised between states, using the best practices from states that are already nationally leading the way in terms of solar PV development. On a federal level, waivers and approvals from federal agencies such as archaeological, indigenous, cultural heritage, and mining resources must be provided at different stages of the process. These steps could also be simplified to reduce cost and complexity in project development.

Reduce discrepancy of financing conditions between regulated and free market PPAs for large-scale solar PV projects. In the past, free market PPAs in Brazil had a contract duration between 6 months and 6 years, which was significantly shorter than the usual payback period for investments in solar PV assets. Nowadays, in the free market PPAs of up to 20 years are becoming more frequent, improving financial conditions for more long-term credit lines also on the free market. This may open new financing options, such as green bonds and other solutions focused on private investors. In light of the growing percentage of solar PV projects planning to sell electricity to free market off-takers, the financing institution will be asked to offer better conditions for such projects. In this respect the market dialogue to manage risk perception regarding free market projects will be crucial.

International financing institutions should provide financing alternatives for small and medium size investors in Brazil. While the main sources of financing for non-solar PV renewable energy projects have been Brazil's development banks (BNDES and BNB) with more than R$ 100 billion (€ 15 billion) placed in infrastructure projects, there are other interesting...
bilateral and multilateral financing alternatives for promoters and investors of this type of project. Solar PV has already especially taken advantage of other institutions such as Bando do Nordeste (BNB), Banco da Amazônia (BASA) and other national and international financial actors.

Unleash the full potential of distributed solar PV to support the economic recovery after COVID-19. Being a job and value intensive segment, distributed solar PV has proven to be resilient and prosper even during the pandemic. On the short to long term it can contribute to the economy, as it creates new investments, opportunities, and employment at municipal, state, and federal levels. ABSOLAR has been leading the way in mobilizing governments and public institutions in Brazil to further strengthen the country’s net-metering regulation, to include solar PV in public buildings and set a government target of 1 million solar PV rooftops by 2022 and 5 million solar PV rooftops by 2030. Creating state-level and municipality-level solar PV programs, policies and incentives to further promote the technology locally is also recommended.

Provide regulatory, technical and fiscal feasibility, as well as access to financing options for storage solutions. In Brazil there are many factors playing in favour of storage systems, such as decreased capacity of the national hydroelectric reservoirs and increased generation from variable energy sources such as solar PV. Storage systems are able to leverage PV self-consumption and perform important “behind-the-meter” services such as peak-shaving, demand response, backup and off-grid systems. In that regard, the integration of storage systems with PV decentralized generation represents an important tool to address remote and isolated populations in the Northern Region of Brazil without access to electricity, that currently rely on diesel generation to provide electricity during limited hours of the day. In particular, due to the national net-metering regulation and increasing electricity prices, storage solutions are becoming an attractive option in the small to medium-scale markets. The development and implementation of storage solutions could be supported by the establishment of a regulatory framework for grid-connected storage projects, reduction of the tax on storage equipment, and improvement of existing and open new credit lines to solar PV plus storage solutions.
2.1. Economic, social and political context

2.1.1. Macroeconomic context

Chile has one of the most robust and stable economies in the region, leading Latin America in income per capita, human development and lowest corruption perception levels. The country's rapid development translates into a visible increase in the quality of life of the Chilean population in the past decades. Some of the main drivers for this are a flourishing economy, a sound macroeconomic foundation and an adequate macroeconomic framework, including bold structural reforms, such as trade and investment liberalization. Consequently, some dimensions of well-being like wage increases, work-life balance, health, and subjective well-being are quickly approaching the OECD average. At a macroeconomic level, the catch up in GDP per-capita has been among the most rapid in the OECD in the last few decades (OECD, 2018).

2.1.2. Business environment

Macroeconomic stability and lower perceived corruption compared to its regional peers has earned Chile an S&P A+ credit rating, the highest in Latin

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### TABLE 2 MACROECONOMIC DATA FOR CHILE

<table>
<thead>
<tr>
<th>Official language</th>
<th>Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>Santiago</td>
</tr>
<tr>
<td>Currency</td>
<td>Chilean peso</td>
</tr>
<tr>
<td>Surface</td>
<td>756,950 km²</td>
</tr>
<tr>
<td>Population (2019)</td>
<td>19.1 million</td>
</tr>
<tr>
<td>Population density (2019)</td>
<td>26 people/km²</td>
</tr>
<tr>
<td>GDP (2019)</td>
<td>US$ 282.3 billion</td>
</tr>
<tr>
<td>GDP per capita (2019)</td>
<td>US$ 14,896</td>
</tr>
<tr>
<td>GDP growth (2019)</td>
<td>1.05 annual %</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean GDP growth average (2019)</td>
<td>0.8%</td>
</tr>
<tr>
<td>Literacy rate (2017)</td>
<td>96.4%</td>
</tr>
<tr>
<td>Internet connections (2017)</td>
<td>82.3% of population</td>
</tr>
<tr>
<td>Mobile phone connections (2019)</td>
<td>132 per 100 people</td>
</tr>
</tbody>
</table>

Latin America and a competitive rating compared to other developed economies in the world.

According to the last Doing Business Report, Chile stands in the 59th position out of 190 economies on the index (see Figure 13, Annex section) and in the first position in the Latin American and Caribbean region (World Bank, 2019). Notably, Chile ranks above the regional average in both general ease of starting a business and dealing with construction permits.

Further, Chile has implemented a series of business regulatory reforms across several areas in order to continue improving their business environment and attracting foreign investors. In the last few years, the country saw improvements for enforcing contracts, resolving insolvency and easiness of starting a business (World Bank, 2020).

2.1.3. Political and social context

Chile is a republic based on parliamentary democracy whereby the President is both Head of State and Head of Government. The country is divided into 15 regions which are headed by governors appointed by the President. Chile has often been referred to as the “economic star” of Latin America. Its relatively stable currency and a thriving economy, which resulted from freeing up the market during the Pinochet regime, allowed Chile to position itself as one of the most promising economies for investment in the region. Nonetheless, the market liberalisation in Chile did not impact everyone the same. According to the World Bank, income inequality, as measured by the Gini coefficient, remained around 0.44 in 2017, among the highest in Latin America. Furthermore, according to the Chilean Central Bank, in 2018 households registered a debt equivalent to 73.3% of their disposable income, which makes Chileans the most indebted people in relation to GDP in Latin America. These adverse economic conditions and a prevailing social unrest caused by a high level of privatisation, a lack of an efficient public healthcare system and low pensions for the elderly, caused a series of violent demonstrations which led to a referendum to modify the constitution. Voters overwhelmingly approved to draft a new Constitution, which will be carried out over the next two years, in an attempt to rectify critical current issues and define new economic and social rights.

2.2. Energy and electricity

2.2.1. Energy sector situation

With more than four thousand hours of sunshine per year in its northern regions, and very high irradiation levels, Chile is one of the most sought-after locations in Latin America to invest in solar energy projects. Traditionally, the Atacama Desert has been a coveted area for investors in search of exceptional yields, particularly for the utility-scale segment. Additionally, Chile’s massive coastline produces very powerful airstreams from the north to the south of the country, which are optimal for wind energy projects.

Chile has spearheaded an unprecedented shift towards cleaner energy in Latin America. Aided by strong policy support and extraordinary solar and wind resources, the country has managed to reduce its dependency on fossil fuels, and decided in 2020 to shut down coal power plants by 2040 across its territory.

Chile has three interconnected systems, the National Electric System (SEN), the Aysen Electric System (SEA) and Magallanes Electric System (SEM) which are strategically distributed along Chile’s vertical extension and aim to cater to almost all of Chile’s electricity needs. Due to population concentration and industrial activity, over 99% of Chile’s installed capacity is on the SEN.

The Atacama Desert located in the northern part of the country has one of the highest photovoltaic power potential levels on the planet and is one of the centre pieces of the country’s energy transformation.

The country’s energy market is shaped by the country’s extraordinary geography and resource endowment. Chile is 4,300 km long and on average only 177 km wide, which creates unique challenges for the country’s energy infrastructure planning. Nonetheless, the unprecedented solar potential in the Atacama Desert and in other highly irradiated areas keeps attracting national and foreign investment. Chile also has the world’s longest national mountain ridge and shoreline, which has a strong potential for wind and hydropower, as well as geothermal energy. Thus, Chile has a vast untapped potential for renewable electricity, which can help limit CO₂ emissions and air pollution and reduce import dependency. The government has set a target for
FIGURE 4 CHILE’S SOLAR PHOTOVOLTAIC POWER POTENTIAL
reaching a 60% share of renewable power by 2035 and 70% by 2050, among other ambitious goals. The share is currently around 40% (OECD/IEA 2018).

Electricity demand is increasing fast, along with economic growth, and is expected to keep growing rapidly, partly fuelled by the copper industry. Chile is the world’s largest copper exporter, and the energy-intensive nature of that industry creates a substantial need for power. The copper industry alone accounted for nearly half of Chile’s exports. Each year, the mining industry consumes an average of 30% of the total power generated in the country. If we consider a conservative scenario, demand would more than double by 2050. At the same time, Chile aims to meet a growing share of electricity from renewable sources. Renewable power plants have increased their participation in the system in the last few years. They went from representing 2% of the total generation in 2010 to 18% in 2018.

### 2.2.2. Electricity infrastructure

The Chilean electric market is divided into three segments: Generation, Transmission, and Distribution. The main characteristics of each market segment are presented below.

**Generation**: The country’s generation segment is liberalised. Companies can freely engage in generation activities by developing projects and interconnecting to the electricity grid, if projects comply with the applicable regulatory framework (such as zoning and environmental authorisations).

The Chilean electricity market is operated with the objective of minimising the cost of generation and maximising the security of supply. Two products are traded in the market: energy (kWh) and capacity (kW). Any power plant connected to the system receives revenues for its energy production and from its firm capacity.

**Transmission and Distribution**: The transmission and distribution segments are regulated in the form of natural monopolies since both entail very high investment costs. The national power system Sistema Eléctrico Nacional (SEN) is the main electricity system in the country, with an installed capacity of nearly 25 GW. The SEN was formed via the merger of two previously separate systems: the Sistema Interconectado Central (SIC) and Sistema Interconectado del Norte Grande (SING) systems, which respectively served the south-central parts and northern parts of the country. The country has two other small electricity systems (Aysén and Magallanes) in the far-south Patagonian region, each with less than 200 MW of installed capacity. Chile has an interconnection to Argentina’s grid, which could be used in the future to export energy to the region.
2.2.3. Stakeholders, tariffs and regulatory framework

The Ministry of Energy has the responsibility to elaborate, co-ordinate and implement national energy policy. The Ministry was established in 2010 and has led efforts to enhance the legal framework, strategies, and action plans to structure Chile’s energy sector.

The Ministry of Energy oversees and co-ordinates the work of several other organisations, which include, among others:

- The National Energy Commission (Comisión Nacional de Energía, CNE), which monitors prices, tariffs and technical norms with which energy production, generation, transport, and distribution companies must comply.

- The Superintendent of Electricity and Fuels (Superintendencia de Electricidad y Combustibles, SEC), which monitors and analyses energy markets to verify the quality of the services provided to users and regulation compliance.

- The National Petroleum Company (Empresa Nacional del Petróleo, ENAP), a state-owned company that monitors and executes all inbound and outbound operations related to hydrocarbons and its derivatives.

- The National Commission of Nuclear Energy (Comisión Chilena de Energía Nuclear, CCHEN), the organisation in charge of all aspects of nuclear energy.

A key feature of the 2010 institutional reform is the direct involvement of the central government (Ministry of Energy and Ministry of Environment) in energy-sector planning and regulation, which is in turn implemented by the CNE (IEA 2018).

Electricity distribution is organised through concessions. There is a total of 32 distribution companies. The distribution companies are responsible for having a permanent energy supply to meet the total consumption of their regulated customers in their concession area.

There are two types of user, regulated users or “Regulados”, which are customers with a connected load lower than 5 MW (previously 2 MW). And unregulated users or “Libres” with a connected load above 5MW. However, customers with a connected load between 0.5 MW and 5 MW can choose to be in the free market (‘Libres’). However, they will have to stay in the free market for at least four years and inform the distributor at least a year in advance. In 2016, regulated customers accounted for 55% of electricity purchases and unregulated accounted for 45%. Electricity supply for regulated customers is based on maximum 20-year power purchase agreements (PPAs) which result between open tenders and generators (IEA, 2017). The end-user prices are the sum of the distribution tender prices (energy charge), transmission charges and distribution charges.

The components that determine the electricity prices are determined by the law. The energy charge is calculated as the weighted average energy price of the current energy contracts (from tenders, see section below) in each distribution zone. Mid- and low-voltage losses are added to the charge. The resulting price is known as the average nodal price. Prices are regulated in such a way that energy prices in individual distribution zones cannot exceed the average price of the entire system by more than 5%. A special compensation mechanism is also applied to municipalities that have generation facilities, so that end-users may be offered lower prices.

In order to incentivise energy investment, Chile was one of the first countries to introduce a competitive wholesale electricity market as a central part of its electricity market regulatory framework, starting in 1982. In 2004 and 2005, Short Law I and Short Law II were passed to improve the market’s regulatory framework. This included measures aimed at enhancing the feasibility of Small Non-Conventional Renewable Energy (or “NCRE”) power plants’ access to the market. NCREs in Chile are defined as including wind, solar, small hydro power plants, biomass, geothermal, tidal power, and other similar plants.

The Supreme Decree 244 of 2005 established the Stabilized Price mechanism, under which distributed generation projects (Pequeños Medios de Generación Distribuida, PMGD) benefit from the right to:

- Sell at the regulated Stabilised Price
- Self-dispatch, independent of the system merit-order or transmission curtailment (in any case, PMGD projects have a very competitive position in the merit-order dispatch, given their zero variable cost and their NCRE technology).
To qualify as a PMGD project, a generator must (i) inject a power surplus lower or equal to 9 MWAC and (ii) connect directly to facilities of an electricity distribution company or other facilities that deliver electricity for the national electricity grid. In addition, the Superintendence of Electricity and Fuel (SEF), a regulatory body that works with the CNE to monitor the proper operation of electricity, gas, and fuel services, requires developers to show that PMGD plants are independent and not simply an artificial division of a larger project into smaller projects to take advantage of PMGD pricing.

2.2.4. Update on solar market demand

After the power market liberalisation and supportive policy measures were put in place, Chile began a rapid shift toward cleaner energy. In June 2019, Chile also unveiled a plan to retire all its 5 GW of coal-fired capacity by 2040.

Chile has had supportive net-billing rules since 2014 to encourage small-scale distributed energy power generation, which has translated into several thousand small PV systems coming online over the last few years. However, the contribution of distributed generation to overall PV deployment remains minor in comparison to the utility-scale segment. Besides the already mentioned PMGD mechanism, in October 2019, the Ministry of Energy, Ministry of Environment and public bank Banco Estado launched a credit line specifically dedicated to financing residential PV systems at a 0.52% monthly rate. However, since October 2019, the Energy Ministry has been reviewing regulations that govern the PMGD policy (Bloomberg, 2019).

Following two rounds of consultations with industry stakeholders, on October 10th, 2019 the Ministry of Energy submitted Decree 88, with certain adjustments to the PMGD regime, to the Chilean General Comptroller of the Republic (Contraloría General de la República, CGR). After being signed by the President and the Minister of Energy, it was approved in October 2020, to replace Decree 244, which is described above.

Decree 88 upholds the key features of the PMGD regime, including the right of PMGD projects to sell at the Stabilised Price throughout their useful lives, and the right to auto-dispatch independent of the merit-order or potential curtailment. It makes limited adjustments:

- Stabilised Price grandfathering period: a 14-year “grandfathering” period, during which PMGD portfolio’s projects will be eligible to sell at the current stabilised price.
- Subsequent modified formula: from year 15 onwards, PMGD projects can sell their energy at a modified Stabilised Price formula that weights the Basic Plan of the Electricity Supply & Demand (BPE). The BPE is broken down into six separate four-hour blocks to weight the price for the time of day that energy is delivered.
- PMGD projects will have to meet certain requirements to benefit from this grandfathering regime, as well as any other requirements that may be added in the Decree 88 as it is ultimately enacted. These include (i) having obtained an interconnection permit (ICC) within seven months after the publication of the final decree, and (ii) issuing a construction declaration to the CNE within 18 months of the date of the enactment of the final decree.

According to a market consultant’s projection, the change to the hourly block-weighted Stabilised Price will result in an approx. 13% reduction from year 15.

Decree 88 also specifies certain additional requirements that help to prevent developers from artificially sub-dividing large contiguous projects in order to qualify as PMGDs. The decree specifies that PMGD projects that have aggregate capacity above the 9 MWAC limit should not have been developed as a single project. Local lawyers have clarified that key areas in which the CNE will verify this include ensuring that projects have run separate interconnection and environmental approval processes, as well as having separate lease and construction arrangements. On February 20th, 2020, the Ministry of Energy withdrew Decree 88 in order to address certain comments made by the Comptroller. Local lawyers clarified that this is a customary step in the enactment of such decrees, and that such a withdrawal is the normal process by which the Ministry of Energy is required to address the Comptroller’s comments, including when comments are minor or ministerial in nature. On June 24th, 2020 and after several months of uncertainty, the Ministry of Energy re-entered to the Comptroller’s Office the Supreme Decree 88 which “Approves the Regulation for Small Scale Generation Means” (“DS 88”), for replacing Supreme Decree 244 (“DS 244”).
2.3. Recommendations

Enable higher shares of renewable energy by strengthening grids, deploying storage and increasing system flexibility. One of the major breakthroughs in Chile’s energy transition is the involvement of the state when it comes to infrastructure planning and project development, especially in electricity transmission. For instance, the interconnected national electricity system allows for a cost efficient and well-performing transmission system. However, in order to enable a high share of renewable energy, it is important to further improve the transmission infrastructure and deploy storage capabilities. For example, system flexibility could be increased by fostering local generation and territorial energy independence (e.g. in the territories covered by the Atacama Desert) as a compliment to the reinforcement of the main transmission grid.

Energy and climate aspects should also be an integral part of the long-term policies for transport and urban development. Those are two sectors where use of energy and emissions are key issues. Therefore, having
a clear direction towards clean mobility and heating methods sends the right signals to the energy market. This can be accomplished for instance, through the implementation of mandatory energy performance standards for a wider range of products, equipment, vehicles, and buildings.

**Liberalise the electricity distribution sector.** According to the World Bank, the trend for high income economies seems to be an increase in liberalisation of the distribution sector, which could be an interesting step for Chile (World Bank, 2019). Allowing the integration of more competitive market forces would make the country’s electricity supply more efficient.

**Development banks should further increase their support to micro, small and medium-size enterprises looking to invest in solar PV.** As of today, major international finance institutions have collaborated closely with the ministry of energy and other governmental institutions, making resources available for the development of utility scale renewable energy projects. Nonetheless, we believe that financial institutions should further increase their efforts when it comes to supporting self-consumption projects for micro, small and medium-sized enterprises, which are finding it increasingly difficult to find financing for their solar PV projects.
3. Economic, social and political context

3.1. Macroeconomic context

Colombia has a track record of a solid macroeconomic framework, in part due to its market size, the extent of its natural resources and a historical reputation as an exemplary debtor. After slowing down to 1.4% in 2017, and regardless of the fall in oil prices, economic growth accelerated to 3.3% in 2019, driven by robust private consumption and stronger investment.

Key components of Colombia's macroeconomic framework include the adoption of a full-fledged inflation-targeting regime, a flexible exchange rate, a Fiscal Rule (2011) for the central government, and a Medium-Term Fiscal Framework. Although private consumption and investment is expected to be significantly affected by the COVID-19 pandemic, the low interest rate environment, facilitated by the central bank, is expected to boost private consumption growth, once domestic containment measures have been eased, and facilitate a gradual rebound in investment (World Bank, 2020).

Nevertheless, one third of the Colombian population lives below the poverty line, and unemployment rates have been slowly increasing for the past five years, reaching 10.5% in 2019, against 9.7% in 2018 (Nortea Trade, 2019).

### TABLE 3 MACROECONOMIC DATA FOR COLOMBIA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official language</td>
<td>Spanish</td>
</tr>
<tr>
<td>Capital</td>
<td>Bogotá</td>
</tr>
<tr>
<td>Currency</td>
<td>Colombian Peso</td>
</tr>
<tr>
<td>Surface</td>
<td>1,141,749 Km²</td>
</tr>
<tr>
<td>Population (2019)</td>
<td>48,258,494</td>
</tr>
<tr>
<td>Population density (2019)</td>
<td>44 habitants per km²</td>
</tr>
<tr>
<td>GDP (2019)</td>
<td>US$ 323.8 billion</td>
</tr>
<tr>
<td>GDP per capita (2019)</td>
<td>US$ 6,432</td>
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<tr>
<td>GDP growth (2019)</td>
<td>3.32 annual %</td>
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<tr>
<td>Latin America &amp; Caribbean GDP growth average (2019)</td>
<td>0.83%</td>
</tr>
<tr>
<td>Literacy rate (2018)</td>
<td>95.1%</td>
</tr>
<tr>
<td>Internet connections (2019)</td>
<td>65% of population</td>
</tr>
<tr>
<td>Mobile phone connections (2019)</td>
<td>131 per 100 people</td>
</tr>
</tbody>
</table>

3.1.2. Business environment

According to Doing Business rankings from the World Bank, Colombia ranks in the fourth position in the Latin America and Caribbean region after Chile, Mexico and Puerto Rico and 67th position in the world (see Figure 13, Annex section). This means the regulatory environment is more conducive to the start and operation of a local firm, showing a favourable investment environment.

The country has a sustainable economic growth and an open and straightforward investment legislation. In 2019 the Foreign Direct Investment totalled US $ 14,572.2 million. More than 700 multinational companies launched investment programs in Colombia.

Colombia has modern port facilities on both the Pacific and the Atlantic oceans, which facilitate trade with Europe, the USA and Asia. In addition, Colombia has a platform of 10 Free Trade Agreements, including the European Free Trade Association and the Pacific Alliance.

The Government has set a strategy to attract foreign investment to the country. Some initiatives include a consolidation of existing tax incentives for new investments in each department.

In 2014, a series of incentives to stimulate investment, research and development for production and use of energy from renewable energy sources (known as Fuentes No Convencionales de Energia, FNCE) was established. The Law 1715 of 2014 regulates the integration of such sources into the national energy system, providing fiscal incentives, establishing a dedicated fund and by creating the legal basis for development of renewable energy support initiatives.

3.1.3. Political and social context

Colombia is a presidential democratic republic and a state with a decentralized government. The country’s power is divided into three branches: executive, legislative and judicial. The judicial power is exercised by the Constitutional Court, the Supreme Court, the Attorney General’s Office, and the Council of State which is responsible for the state administration issues. The president of the republic is the head of the Colombian government consisting of 13 ministers. Each of 32 departments is headed by a governor.

After more than fifty years of armed conflict, the government signed a Peace Agreement in 2016 with the country’s largest guerrilla group FARC. The Agreement seeks to prevent further casualties, violence and criminal activities by FARC and to focus efforts on building a stable and lasting peace. The agreement also includes an agricultural development plan with access to land and services and a sustainable substitution strategy for illicit crops. Although, the peace process is fragile in some areas, these are mainly regions with low population levels, and which are closer to the borders. The general situation has significantly improved over the last 10 years.

On April 28th, 2020, Colombia officially became an OECD member. Some expected advantages for Colombia include incentives for effective, transparent, stable and democratic institutions; and guidelines to improve trade and investment relations, giving a seal of quality for foreign direct investment to Colombia.

3.2. Energy and electricity

3.2.1. Energy sector situation

Colombia is bordered by Panama on the northwest, Venezuela Brazil on the east, Peru and Ecuador on the south. The coast to the north is flanked by the Caribbean Sea and to the west by the Pacific Ocean. With a Global Horizontal Irradiation (GHI) exceeding 2000 W/m² in several regions, Colombia has high photovoltaic potential in terms of natural resources.

The Colombian electricity mix is the sixth cleanest in the world, with 88% of the electricity produced coming from hydropower. Other renewable energies have minimal portions of Colombia’s energy market. Gas is the second most used resource, totalling 9% of generation in 2017 (Hydropower, 2020).

According to the projection of the Planning Unit for Mining and Energy (UPME), the electricity demand is expected to grow by 25% till 2030. The current national generation park is not able to cover such an increase, therefore new generation plants will be required to avoid electricity shortages in the mid to long-term.

Acceptance for large scale hydro power plants and the related dams has decreased significantly. The social and environmental impacts are major concerns and new projects face strong local opposition.
FIGURE 7 COLOMBIA'S SOLAR PHOTOVOLTAIC POWER POTENTIAL

The total installed capacity of the SIN is 17,604 MW of which 11,937 MW are hydro power plants, 5,451 MW come from thermal plants, 149 MW are cogeneration plants, 48 MW come from solar farms and 18 MW are wind farms (XM, 2020). Currently non-hydro renewable plants are still a minor part of the Colombian generation park. Nevertheless, the electricity mix is expected to change significantly during the next years through the construction of several large scale solar and wind farms.

The electricity sector is liberalized and unbundled into generation, transmission, distribution and commercialization since the reforms carried out in 1994. However, several actors are historically active in various segments and the market in praxis is dominated by a limited number of actors.

3.2.2. Electricity infrastructure

Colombia’s electricity network is made up of the national power grid, Sistema Interconectado Nacional (SIN), and the non-interconnected zones (ZIN). The SIN accounts for 98.9% of total energy capacity and is made up of all interconnected networks, including the generation system, the national transmission system, the regional transmission system and the local distribution system. It has over 200,000 km of transmission lines, divided into more than 500 circuits. In the ZNI, installed capacity is 118 MW, of which 108.5 MW correspond to diesel plants and the remaining 9.5 MW are small hydro and photovoltaic systems (Alliance for Rural Electrification, 2017).

Furthermore, in the past hydropower plants showed their vulnerability to extended drought periods due to El Niño phenomenon. Since the energy crisis of 2016, energy security and diversification of the energy mix are high priorities on the agenda.

Variability of solar and wind power has long been a concern for their integration in the Colombia grid. After many years of studies and discussion regarding the complementarity with hydropower, it is now clear that non-hydro RE are a feasible and affordable alternative.

The electricity sector is liberalized and unbundled into generation, transmission, distribution and commercialization since the reforms carried out in 1994. However, several actors are historically active in various segments and the market in praxis is dominated by a limited number of actors.

**Generation:** Any company can operate generation assets if it complies with the related regulation. The company must be founded as “ESP” (Company for Public Services) and registered by the electricity market authorities. Generators sell electricity either on the spot market or to a trader via private PPA.

**Transmission:** The transmission network includes the entire infrastructure with a voltage equal or higher than 220 kV. Since 1999, concessions for the construction and operation of transmission infrastructures are granted via public tenders. There are currently 9 major actors in this segment, mostly public companies.
Distribution: The distribution network includes the entire infrastructure with a voltage below 220 kV. Distribution is a natural regional monopoly. Distributors oversee the connection of the final users to the grid. These grid operators are responsible for the expansion of their networks and should allow indiscriminate access to the other market agents. All of them are integrated and active in the commercialization of electricity. Currently there are 30 grid operators.

Commercialization: Traders purchase the electricity from the generators and sell to the final consumers, either regulated or non-regulated clients depending on the consumption level. The regulator CREG must approve tariffs for regulated clients. There are about 85 active companies in this segment.

3.2.3. Stakeholders, tariffs and regulatory framework

The energy sector is overseen by five main government entities:

- Ministry of Mines and Energy (Ministerio de Minas y Energía), which is the most important entity of the Energy sector, as the one in charge of all the respective national policies. Energy and Gas Regulation Commission (Comisión de Regulación de energía y gas, CREG), which is the regulator of the energy sector and oversees issuing the regulatory framework for both electricity and gas sectors. The Commission was created in 1994 to ensure free competition, non-discriminatory participation of the different actors, and protection against market power and monopoly.

- Superintendent of Public Services (Superintendencia de Servicios Públicos Domiciliarios), which oversees the control and the surveillance of all the public services institutions, including electricity sector.

- Mining and Power Planning Unit (Unidad de Planeación Minero Energética, UPME), which is the entity in charge of developing and updating the Expansion Plan of the energy sector. This is meant to ensure that the demand attention is flexible enough to adapt to the changes that are determined by technical, economic, financial and environmental conditions. It also ensures that the requirements of quality, reliability and safety set by the Ministry of Mines and Energy are met.

- XM, which supervises and administrates all physical and commercial operations on the electricity market. This entity coordinates the operation of the generators and takes care of the dispatching. XM is composed of the ASIC (administrator of the spot market), the CND (national dispatching centre), the LAC (administration of the electricity network), TIE (administration of the international electricity exchange).

Tariffs

There is no specific tariff for electricity from renewable sources in Colombia. However, non-hydro renewables benefit from tax incentives including a special deduction up to 50% of the investment, an accelerated depreciation of the assets, an exclusion of VAT on certain goods and services and an exemption of a customs duty. Recently, the government updated the regulations for investment in renewable energy sources provided in Law 1715 of 2014 to facilitate the certification and access to such tax advantages.

Without specific tariffs, solar and wind projects must be competitive with hydro and thermal power plants which traditionally sell energy via short term bilateral PPAs (1-3 years) on base load to traders. The current average price of such PPA is close to 200 COP (€ 0.044)/kWh. Alternatively, generators sell energy directly on the spot market and face high volatility. The average spot market price for 2020 is around 280 COP (€ 0.062)/kWh but can vary between 80 COP (€ 0.018)/kWh and 444 COP (€ 0.098)/kWh. It is relevant that in both cases, the generator must pay a tax called CERE of around 80 COP/kWh.

A standalone auction for long term contracts dedicated to renewables took place in 2019. The average awarded price was 95 COP (€ 0.021)/kWh. In this case, the price does not include the CERE.

Regulatory Framework

The Regulatory Framework is complete but complex, frequently updated by the different entities.

In 2019, USAID, through its Scaling Up Renewable Energy (SURE) project, partnered with the Colombian Ministry of Mines and Energy (MME) to conduct
Colombia’s first-ever energy auction. USAID helped MME develop the policy documents and corresponding regulations, educate the prospective buyers of electricity, and attract potential bidders. This auction should provide long term power purchase agreements required for the financing of solar and wind projects.

The auction is designed as a double-side tender, involving multiple generators and traders. The UPME oversees the processes like qualifying bidders, collecting the offers, making matches between sellers’ and buyers’ bids and developing a standard bilateral long term PPA.

Participation in the auction is voluntary. However, the regulator introduced a mandatory energy purchase of 10% from non-hydro renewables from 2020. This quota helped to build-up the demand and ensure the participation of potential buyers.

The first auction, held in February 2019, did not award any contracts due to competition criteria not being met. After some adjustment, UPME held a second auction in October 2019 and awarded 9 solar and wind projects and 22 traders with a total generation capacity of 1,377 MW. The PPAs signed between sellers and buyers are in Colombian pesos, based on a take or pay model for the contracted energy and a period of 15 years.

The outcome is a historically low average price of approximately 95 COP (€ 0.021)/MWh (USAID, 2020). This auction brought new perspectives to the development of the renewable energy in the country. However, it is still a standalone process and there is no clear auction calendar for the next years.

Another common auction in Colombia is the Firm Energy Obligations (Obligaciones de Energía Firme, OEFs), which is a back-up auction. During normal conditions, the OEF receive bided prices corresponding to the committed energy, with a stable remuneration independently of the effective electricity production. During critical supply conditions and high electricity prices, typically due to low water levels in the El Niño period, generators commit to delivering a certain amount of energy. When the spot market price exceeds a threshold called scarcity price defined by the regulator, the OEF is obliged to deliver the committed energy at the same price.

Solar and wind farms can participate in those auctions but only to a limited extent, due to the variability of their production.

3.2.4. Update on solar market demand

According to the government agency UPME, as of July 2020, there were 385 renewable energy projects, totalling 15 GW at different stages of development, including 4 biomass, 17 wind, 93 hydro, 271 photovoltaic and 7 thermal ones.
The 271 photovoltaic projects currently being planned, developed or built in the country have a combined capacity of 8,855 MW. Of those, 54 were initiated in 2018, 159 last year and 58 so far in 2020 (PV Magazine, 2020).

The first harvest of all these activities will be already seen in 2020 (see figure 9). Jumping from only 43 MW installed in 2019 to an expected level of about 800 MW in 2020, Colombia is foreseen to become a solar heavyweight on the Latin American solar map as of this year. While it is not clear whether all this capacity in the pipeline will eventually be installed, it is beyond doubt that sustained solar growth will occur. Under our most-likely Medium Scenario, updated in October 2020, the Colombian market is expected to reach the annual gigawatt scale in 2022, the cumulative solar capacity will very likely reach that level already next year.

3.3. Recommendations

A long-term plan for deployment of renewables in the country would bring visibility and give a better sense of confidence to investors and developers. This can be achieved for instance by defining a tender plan over the next few years, including defined target capacities. This would allow all market participants, especially investors, to align their interests. This should be accompanied by a long-term plan for investment in essential infrastructure, including transmission grid infrastructure for renewable energy developments and a review of current grid codes. Such an investment plan would further reinforce the reliability of renewable energy investments, as infrastructure and grid codes are key foundations when it comes to accommodating higher shares of renewable energy.

The renewable energy project requirements to obtain an environmental license should be streamlined and optimized. This will reduce obstacles to such projects, making them more attractive. For instance, specific technology-oriented Terms of Reference (ToR) should be considered, boosting the positive impact in the environment of green development vs. traditional old-fashion hydrocarbon-based generation. Historically such ToRs have been developed with large hydro, mining projects in mind. This has led to exaggerated demands for renewables.

Increase bankability of PPAs, by structuring solid bilateral contracts through long-term renewable energy purchase obligations for large consumers. i.e. 20% of its consumption by 2030 and 40% by 2050. Under PPAs, contract prices for generators are currently adjusted on a monthly basis to reflect variations in the Colombian producer price index. There is no indexation for exchange rate fluctuations, which will be of concern for anyone using foreign sources to finance awarded projects. Additionally, the power purchase agreement requires the power purchaser’s approval for any assignment of seller rights, including any collection rights, which could hinder projects’ finance.
4.1. Economic, social and political context

4.1.1. Macroeconomic context

Mexico is the 15th largest economy in the world and 2nd largest in the Latin American and Caribbean region, just after Brazil. Mexico is considered an upper-middle-income country and its 10-year average GDP growth was 2.6% – which is higher than the region’s average of 2.07%. Its economy is characterized by large income disparity and a large informal economic sector. Although agriculture is crucial to the Mexican economy, it only accounts for about 4% of the GDP. However, the Mexican industrial sector accounts for about 30% of the GDP with a strong manufacturing industry, due to it’s a highly trained and relatively cheap labour force, mainly in automobile and electronics. The oil industry is also an important component, with the state-owned company PEMEX controlling most production and commercialization. Mining is an important industry as well, mainly of silver, gold, zinc, and copper. The principal component of Mexico’s GDP is services, accounting for about 60%, with tourism playing a central role. Mexico is a country with many free trade agreements but the most important one has just entered into force in July 2020: The new United States-Mexico-Canada Agreement (USMCA).
4.1.2. Business environment

Despite the current world economic contraction caused by the COVID-19 pandemic, the World Bank forecasts a global recovery in 2021, and Mexico's GDP is projected to grow at 3% which should bring new opportunities to do business. Mexico's 2019 Ease of Doing Business Score was 72.4 which ranks it as 59th worldwide and 2nd in the region just after Chile (see Figure 13, Annex section).

4.1.3. Political and social context

The president Andres Manuel López Obrador, elected in July 2018, counts among his mandates: priorities tackling corruption, social inequality, endemic violence, and young mass emigration, (BBC, 2018) in an ambitious social and political project dubbed Mexico's “Fourth Transformation”. However, the decline in oil reserves, weak labour productivity, limited capacity to collect revenue due to a large informal sector and rising trade tensions in the global economy might jeopardize the new president's transformation plans.

Mexico's unemployment rate remained steady at 3.3% and is expected to increase to 5.3% in 2020, due to the negative economic impact of the COVID-19 pandemic, and decrease to 3.5% in 2021 (Nordeatrade, 2020).

4.2. Energy and electricity

4.2.1. Energy sector situation

Mexico is the second-largest economy in Latin America, with more than 40 million electricity

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**FIGURE 10** MEXICO’S SOLAR PHOTOVOLTAIC POWER POTENTIAL

![Map of Mexico's solar photovoltaic power potential](image)

*Source: SolarGis 2020.*
customers, and a growing demand for power projected at about 2.5 - 3.5% per year for the next decade. With significant potential for untapped renewable energy resources, the country is well-positioned to expand its power generation from renewables. In Mexico about 15% of electricity is currently generated from renewable sources, with the aim of reaching 35% by 2024. Mexico is among the top three countries in Latin America for both wind and solar potential (Wilson Center, 2018), and has a potential for easily accessible solar resources (less than 2 km from the national power grid) of 237 GW (Secretaria de Energia, 2018). A 2013 comprehensive energy reform created many incentives to facilitate investment in renewables. Nonetheless, renewables in Mexico continue to face steep competition from cheap natural gas imports from the United States. Power in Mexico remains heavily weighted towards fossil fuels accounting for over 70% of total installed capacity in 2018, natural gas (which use is expected to grow significantly), oil, and coal.

In addition, a series of recent changes in the electricity sector have been proposed by the new administration which threaten the increase of renewables in the country. A substantial increase in opportunities brought about by an energy reform transformed Mexico into a leading destination for clean energy investment under the previous administration (2012-2018). Plans to strengthen state control under new president Lopez Obrador, potentially at the expense of the private sector, are forcing a change of course. The cancellation of Mexico's auctions upended the renewables industry. These new plans to strengthen state control raise questions around the durability of key elements of the reform, but its fundamental aspects remain strong, according to BloombergNEF Climate scope country analysis (Climatescope, 2019).

4.2.2. Electricity infrastructure

The transmission sector is expected to some extent to open to private capital investment, in order to improve the lack of infrastructure and the low line maintenance that the SEN currently has. It is also expected to promote the generation of electricity with renewable sources, or non-conventional and water resources, to continue in line with the energy policy proposed by the Mexican Government for the next few years.

4.2.3. Stakeholders, tariffs and regulatory framework

The Mexican electricity sector is managed by the State, and through its owned companies, such as the Federal Electricity Commission Comisión Federal de Electricidad (CFE) and the Energy Regulatory Commission, Comisión Reguladora de Energía (CRE), it
oversees ensuring the correct operation of the system composed of generation, transmission and distribution, and its subsequent development. This is to fulfil the public service mission that pertains to electricity in the Mexican Constitution and current laws.

The Federal Electricity Commission (CFE) is a parastatal company, to which the Mexican State grants, by law, all the necessary powers to satisfy the electricity demand at the level of public service, and to propose development plans for the electricity sector to the national government.

The Ministry of Energy (SENER) is the Mexican State secretariat whose main function is to conduct the country's energy policy. It is responsible for issuing the provisions related to the public electricity service, which the CFE must fully comply with—following the proposed guidelines in the national energy policy.

The National Centre for Energy Control (CENACE) is a decentralized public body that exercises the Operational Control of the National Electric System; the Operation of the Wholesale Electricity Market and guarantees impartiality in access to the National Transmission Network and the General Distribution Networks.

The Energy Regulatory Commission (CRE) is the regulatory body that issues all permits related to electrical activities (generation, distribution, and transmission).

The Wholesale Electricity Market (MEM) is a competitive environment with clear rules that seek to generate adequate incentives for a sustained reduction in system costs and service improvement. The MEM began operations in January 2016 and is executed and coordinated by CENACE. In the MEM, participants can carry out purchase-sale transactions for various products.

Changes were made at the constitutional level and secondary laws were established that allow private participation in generation and commercialization activities. Transmission and distribution will remain the responsibility of the State through the National Center for Energy Control (CENACE).

All these changes in the electricity sector led to the creation of a Wholesale Electricity Market (MEM), in which participants carry out transactions with different products for the proper functioning of the National Electricity System (SEN). This resulted in the elimination of the monopoly of the Federal Electricity Commission (CFE), an opening to investment and private participation, and the promotion of competition.

Based on the most recent regulations, these products are electric energy, power, clean energy certificates, financial transmission rights, related services, and associated products. Changes in the electricity sector also led to a new structure and new classification of actors involved in the different activities of the sector. In general terms, the actors can be grouped into generators, suppliers, and users, who may or may not be participants in the MEM.

- **Generator.** Based on its generation capacity, it can be classified as an exempt generator. That is, it does not require a permit to generate because its capacity is less than 0.5 MW. Alternatively, it can be classified as an MEM participant and therefore needs a permit issued by the Energy Regulatory Commission (CRE).

- **The supplier** is a marketer that oversees supplying electric power to off-takers and represents exempt generators in front of the MEM. It is an intermediary figure between the generator and the off-takers and necessary to give an orderly structure to the market.

- Finally, the **user** is the one who acquires electricity for their own consumption, either through a supplier or as a member of the MEM. In general terms, there are three types of users.

Currently, in Mexico there are 20 electricity tariffs according to CFE, which can be classified as a Specific Tariff, which includes the rates of public service, agricultural, aquaculture and temporary service and domestic. Alternatively, they can be classified as a General Tariff, which can be classified according to the voltage level.

The Mexican electricity market is characterized by relatively high wholesale prices overall, with both day-ahead and real-time prices rising steadily. Electricity price data shows that the average retail electricity price is US$ 126.21/MWh in 2018 (Climatescope, 2019). Off-takers with a load centre of at least 1 MW are classified as ‘qualified users’ and can purchase electricity directly from qualified suppliers.

In the context of growing electricity demand, Mexico's power market witnessed a major transformation...
under the energy reform, which was fully implemented in 2018. The reform broke the monopoly of the vertically integrated state utility, the CFE, and fully opened the generation market to private companies. The reform also created an independent system operator, CENACE and allowed private players to acquire transmission rights. In 2015, the government published clean energy power auction rules as part of the reform, and the wholesale electricity market started operations in 2018 (Wilson Center, 2018).

4.2.4. Update on solar market demand

The country has made some political efforts in the past years to promote renewable energies, such as its law on energy transition (Ley de Transición Energética -LTE started in 2015), its long-term auctions and clean energy certificates (CELs). From 2015 to 2017, three long-term electricity auctions took place for a volume of 7,563 MW of installed capacity, many of which reached record low prices of US$ 20.57/MWh. The first three long-term auctions were very successful, with numerous bidders and ranking as one of the most competitive auctions in the world, allocating more than 4.8 GW of solar power. Thanks to those efforts, the country experienced a new booming market in the past years. After a remarkable year in 2018 (see Figure 12 below), the installed capacity went from under 460 MW in 2017 to 3 GW at the beginning of 2019 (SolarPower Europe, 2020). Most renewable energy investments following the energy sector reform have come through public tenders, securing long term electricity supply. Still in 2019, the Distributed Solar Generation (GSD) market in Mexico, “solar roofs”, had spectacular growth with an installed capacity of almost 1 GW (975 MW) and 129,893 accumulated interconnection contracts, which yielded 41% and 37% growth respectively. The Energy Regulatory Commission (CRE) expected the growth of distributed solar generation in 2020 to be up to 45% despite the COVID-19 pandemic. However, in May 2020, the Mexican Energy Regulatory Authority (CRE) approved an increase in electricity transmission tariffs for all companies that signed a self-supply contract with the Federal Commission for Energy. This new measure has the potential to harm this growth trajectory and threaten the participation of private individuals in the market.

**FIGURE 12** MEXICAN ANNUAL SOLAR PV MARKET - HISTORICAL DATA AND FORECAST FOR THE UPCOMING 5 YEARS

![Graph showing historical and forecasted solar PV market growth in Mexico from 2015 to 2024.](source: SolarPower Europe, 2020.)
In addition, in 2019 the Mexican government cancelled Mexico’s fourth long-term clean power auction after it had been suspended in late 2018. To date, it is unclear whether a new auction round will take place. Later, the government ordered the suspension of operations in renewable energy plants, under the pretext of safeguarding the tightness of the electricity grid in a critical phase.

Contrarily to the other large Latin American solar markets, 2020 will be a very disappointing year for Mexico. As discussed above, the government’s hard stance against renewable energy materialised in the introduction of measures worsening the conditions for new wind and solar projects and putting an indefinite hold on grid connection for already developed projects. Large policy uncertainties were further worsened by the COVID-19 outbreak. For 2020, we expect the market to shrink by 65% to about 600 MW, going below the gigawatt scale for the first time in three years. The cancellation of solar auctions and an unclear policy framework for PV will cause the market not to reach the gigawatt market before 2024 according to our updated Medium Scenario.

4.3. Recommendations

The current administration needs to embrace the importance of renewable energy in the generation mix of the country and foster a healthy and competitive energy market for the benefit of the population they have vowed to protect. The current administration is trying to strengthen CFE by blocking private participants in power generation, particularly renewable energy. The sole objective of this initiative is to have control over resources used in social programs that ultimately are aimed to gain votes. Given the limited budget of the federation and the dire financial situation of CFE, the participation of the private sector will be fundamental in supporting the energy demand of the country moving forward. More so, Mexico needs to embrace the fact that renewable energy is undeniably the least expensive energy in the market and that any technical challenges such as reliability of the grid can be overcome with the correct framework. Not doing so will have significant negative economic implications that will impact the finances and social mobility of the country.

Certainty and stability for the renewable energy sector should be re-established in the current legal framework. National utility CFE’s plans appear to be heavily based on conventional generation expansion. This delivers a stark contrast to national energy and climate targets. The cancelation of the fourth renewable energy auctions also brought some instability to the renewable energy sector and damaged international investor confidence. In a liberalised and unbundled market like Mexico’s, a long-term PPA resulting from an auction can hedge the seller against spot-market variability and improve the bankability of projects. Auctions and other policies can further be designed in way to promote the participation of small and new players, develop local industries, as well as maximise community and subnational benefits including for minorities and marginalised groups.

Grid management improvement actions should aim at strengthening the capacity of transition and distribution systems, as well as incentivising more distributed generation and demand-side response. With the electricity demand expected growth, the country is planning to instal 70 GW by 2033 and large amounts of financing will be required, which will bring business opportunities for private lenders. However, the currently underdeveloped power grid poses a threat to future solar expansion, especially large-scale plants that are developed in remote areas. Prioritising these investments now could bring business opportunities, jobs and create overall strong stimulus effects during a time when this is much needed.

In addition to strengthening the electricity grid, the Ministry of Energy should support the deployment of storage solutions. The Mexican wholesale electricity market is still missing an energy storage regulation, which will be one of the key aspects for growing the decentralized market segment. Currently, there is a significant appetite among the key actors of the industry for storage solutions, for both utility-scale plants and distributed generation solutions. The latter would benefit regions such as Baja California and Baja California Sur, due to several restrictions by CENACE, with the reasoning that there is no more flexibility capacity available from the grid.
CRE should consider the initiative of the Energy Commission of the Chamber of Deputies to extend the benefits of the distributed generation systems. This initiative supports the industry call to extend the exempt generation cap for distributed generation projects from 0.5 MW to 1 MW. Exempt generators are, for example, not required to have a generation permit. This would benefit not only CFE but also final users such as residential and even industrial consumers.

Decision making should be based on regional and subnational cooperation to improve knowledge-sharing. There is a substantial body of evidence across Latin America showing the successful integration of renewable energy into electricity grids, for example in Brazil and Uruguay who operate a flexible grid supported by modern renewable energy forecast methods and production scheduling. Mexico’s energy authorities can restore certainty, security and confidence in their decisions by cooperating with other regulators in the region that can share their best practices on how to manage high levels of variable renewable energy safely and reliably without the need to incur higher system costs.

Mexico still offers a very interesting investment environment. However, developers should consider that the early development in renewable energy projects might become an increasingly critical issue, especially for large projects. There are still competitive local marginal prices in several regions in Mexico and securing a bilateral PPA is still feasible. However, when it comes to awarding the required permits and licenses for development, the Mexican authorities are becoming more and more selective, especially regarding utility scale projects.

Multilateral development banks should redouble efforts to bridge the gap between commercial banks’ conditions and expected developer returns. Development banks should be more flexible and leverage their capacity in order to allow more projects to reach financial close.
FIGURE 13 EASE OF DOING BUSINESS IN BRAZIL, CHILE, COLOMBIA AND MEXICO – RANKING AND SCORE

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