

Ease of Doing Solar 2022

In ISA Member Countries

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Foreword

In response to an unprecedented public health crisis, countries around the world had hoped to seize the post COVID-19 opportunity for a green and equitable recovery. In order to drive this energy transition, countries ultimately agreed to a provision calling for a phase-down of coal power and a phase-out of “inefficient” fossil fuel subsidies during the UN Climate Change Conference held in Glasgow (COP26).

With evolving initiatives like the One Sun One World One Grid (OSOWOG), the Green Grids Initiative (GGI) and technologies such as Green Hydrogen and energy storage, the development of solar ecosystem will be further fast tracked, as such initiatives will resolve the intermittency and supply-demand mismatches associated with solar. However, a bigger challenge for the world today is the energy crisis resulting from global geopolitical conflicts which are threatening to push billions of people into energy poverty. To mitigate this threat, governments must accelerate the deployment of solar and create a conducive environment in the form of pro-solar policies and regulations, strong project pipelines and enable investor-friendly markets within their countries.

As an Alliance of 110+ member countries, we work with governments across the world on deployment and scaling up of solar energy. To monitor progress of the solar ecosystem across these countries, ISA comes out with a flagship annual publication - ‘Ease of doing Solar (EoDS)’.

A full-scale edition of the EoDS report featuring 80 countries was released in 2020 after a pilot version of EoDS was published in 2019 covering four countries. With the addition of 18 new members to the Alliance, in EoDS 2021, 98 countries were covered. This year, for EoDS 2022, a few more members have joined ISA taking the coverage to 107 countries.

ISA, with an assistance from EY has conceptualized the EoDS 2022 framework for assessing countries across seven key drivers (Macroeconomy, Policy Enablers, Technological Feasibility, Market Maturity, Infrastructure, Financing, and Energy Imperatives). Findings from the assessment are detailed in this report that can be used by Governments, Investors and Financial Institutions (FIs) to identify major challenges and drivers. EoDS 2022 edition has been prepared through a structured framework, and extensive data research & analysis, and it aims to highlight and support our member countries to improve their strengths and address challenges. The report provides insights to stakeholders across the solar ecosystem on current progress, best practices, emerging models, digital technologies, financing mechanisms, etc. in ISA member countries.

We are continuously improving the usefulness of EoDS, and in response to suggestions received, EoDS 2023 will also provide a framework for enhancing the EoDS ranking.

ISA Secretariat is delighted to present the Ease of Doing Solar 2022 to our Member Countries, and we hope that it will continue to facilitate and support actions towards mainstreaming solar energy across the world.



Dr Ajay Mathur
Director General
International Solar Alliance

Glossary

| Abbreviation | Definition |
|--------------|---|
| ADFD | Abu Dhabi Fund for Development |
| AfDB | African Development Bank |
| AUD | Australian Dollar |
| BESS | Battery Energy Storage System |
| Bn | Billion |
| BU | Billion Unit |
| CIF | Climate Investment Funds |
| Ckm | Circuit Kilometer |
| COP | Conference of the Parties |
| CUF | Capacity Utilisation Factor |
| DRE | Decentralized renewable energy |
| EAPP | East African Power Pool |
| ECREEE | ECOWAS Centre for Renewable Energy and Energy Efficiency |
| EDSREP | Electricity Distribution System Reinforcement and Extension Project |
| EIB | European Investment Bank |
| EoDS | Ease of Doing Solar |
| ESP | Economic Stimulus Programme |
| EU | European Union |
| FDI | Foreign Direct Investment |
| FIT | Feed-in tariff |
| FY | Financial Year |
| GCF | Green Climate Fund |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |

| Abbreviation | Definition |
|--------------|---|
| GHG | Green House Gases |
| GHI | Global Horizontal Irradiance |
| GMG | Green Mini-Grids |
| GVC | Green Value Chain |
| GW | Gigawatt |
| GWh | Gigawatt-hour |
| IAME | Increased Access to Modern Energy Project |
| IBRD | International Bank for Reconstruction and Development |
| IDA | International Development Association |
| IEA | International Energy Agency |
| IFC | International Finance Corporation |
| IPP | Independent Power Producer |
| IRP | Integrated Resource Plan |
| km | Kilometer |
| kV | Kilo Volt |
| kW | Kilowatt |
| kWh | Kilowatt-hour |
| LEAF | Leveraging Energy Access Finance Framework |
| Mn | Million |
| MPA | Multi-phase Programmatic Approach |
| MU | Million Unit |
| MVA | Million Volt Ampere |
| MW | Megawatt |
| MWh | Megawatt-hour |
| NDC | Nationally Determined Contribution |

| Abbreviation | Definition |
|--------------|---|
| NFP | National Focal Points |
| NPA | Non-performing asset |
| NPLs | Non-performing loans |
| PAY Go | pay-as-you-go |
| PPP | Purchasing Power Parity |
| PV | Photovoltaic |
| RE | Renewable Energy |
| REF | Rural Electrification Fund |
| SAPP | South African Power Pool |
| SME | Small and medium enterprises |
| sq | Square |
| SHS | Solar Home Systems |
| TWh | Terawatt-hour |
| T&D | Transmission & Distribution |
| UNDP | The United Nations Development Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNIDO | United Nations Industrial Development Organization |
| US\$/ USD | United States Dollar |
| VAT | Value Added Tax |
| WAPP | West African Power Pool |



Executive summary

1. Overview

International Solar Alliance (ISA) brings out it’s annual flagship publication - Ease of Doing Solar, a dedicated platform for the international community (including governments, bilateral and multilateral organizations, corporations, industry, and other stakeholders). EoDS aims to leverage their efforts towards the common goal of promoting the use and improving the quality of solar energy in meeting energy needs in a safe, practical, affordable, equitable, and sustainable manner.

A full-scale edition of the EoDS report, featuring 80 countries, was released in 2020 after a pilot version of EoDS 2019 with only four countries. With the addition of 18 new members to ISA, EoDS 2021 covered 98 countries. This year, the number of member countries featured has increased to 107. Ease of Doing Solar's goal is to monitor, acknowledge, and encourage the development of the solar ecosystem in ISA’s member nations. All member countries are analyzed on a framework that examines the countries across seven key drivers: Macroeconomy, Policy Enablers, Technological Feasibility, Market Maturity, Infrastructure, Financing, and Energy Imperatives. To study and quantify the performance of ISA member countries across these drivers, various parameters and indicators have been selected under each driver to demonstrate the Ease of Doing Solar. These seven key drivers form the bedrock of the EoDS assessment with weightages assigned to individual drivers, parameters and indicators for a quantitative analysis to arrive at an overall EoDS score for the countries.

With assistance from Ernst & Young LLP (EY), ISA has conceptualized this framework. In the 2022 edition of EoDS, the framework and methodology from previous years was further reinforced through stakeholder consultations at the country and regional levels with increased focus on primary data collection.

The methodology has been supplemented by inclusion of new key performance indicators (KPIs) and improved data collection/validation standards to enhance the results and outreach of the report. The report provides current progress and best practices while serving as a ready reckoner on policies, regulations and their effectiveness among member countries paving way for building a robust solar ecosystem.

Chronology of Milestones for Ease of Doing Solar - EoDS



* Bangladesh, France, Peru and Uganda

The member countries have been classified across four segments, as below, basis the quantification of the total scores derived as a sum of scores of individual drivers.

| | |
|-------------|--|
| Achiever | Countries with most favourable policy, technical and commercial conditions for solar are perceived as most attractive for investments in solar |
| Influencer | Countries with moderately favourable policy, technical and commercial conditions for solar are perceived as adequately attractive for investments in solar |
| Progressive | Countries which are at initial stages in development of a favourable ecosystem in terms of commercial feasibility and investments for solar |
| Potential | Countries with untapped potential and at a nascent stage of development of favourable ecosystem |

The EoDS model is a Relative Ranking model, and the country classifications are dependent on the sample set considered. Since the sample set in EoDS 2022 (member countries and indicators) has changed significantly from EoDS 2021, the classifications presented in the following section are also bound to change on the basis of relative rankings.

2. Overview of the results

Owing to strong solar potential, enabling policy ecosystem, mature markets, and robust power infrastructure, a set of 28 countries have been identified as **Achievers**. The next set of classification, **Influencer**, has 50 countries followed by **Progressive** (22 countries) and **Potential** (7 countries). The results are presented below with **the countries arranged in alphabetical order under each classification:**

| Achiever | | | | |
|---------------------|----------------------|--------------------------|------------|--------------------|
| Antigua & Barbuda | Argentina | Australia | Bahrain | Barbados |
| Brazil | Cabo Verde | Chile | Denmark | Dominican Republic |
| El Salvador | France | Germany | Greece | India |
| Israel | Italy | Japan | Morocco | Netherlands |
| Nicaragua | Oman | Saudi Arabia | Seychelles | Sweden |
| Trinidad and Tobago | United Arab Emirates | United States of America | | |

| Influencer | | | | |
|----------------------------------|------------|---------------|-----------|-----------------------|
| Algeria | Bangladesh | Bolivia | Botswana | Burkina Faso |
| Cambodia | Costa Rica | Côte d'Ivoire | Djibouti | Dominica |
| Egypt | Fiji | Gabon | Gambia | Ghana |
| Grenada | Guyana | Hungary | Jamaica | Kiribati |
| Luxembourg | Malawi | Maldives | Mauritius | Mozambique |
| Namibia | Nauru | Nepal | Nigeria | Norway |
| Palau | Paraguay | Peru | Rwanda | Saint Kitts and Nevis |
| Saint Vincent and the Grenadines | Samoa | Senegal | Sri Lanka | Saint Lucia |
| Suriname | Tanzania | Tonga | Tunisia | Tuvalu |

| | | | | |
|--------|----------------|-----------|--------|----------|
| Uganda | United Kingdom | Venezuela | Zambia | Zimbabwe |
|--------|----------------|-----------|--------|----------|

Progressive

| | | | | |
|---------|-------------|---------|------------------|-------------------|
| Belize | Benin | Burundi | Cameroon | Chad |
| Comoros | Cuba | Eritrea | Ethiopia | Guinea |
| Haiti | Madagascar | Mali | Marshall Islands | Niger |
| Somalia | South Sudan | Sudan | Syria | Togolese Republic |
| Vanuatu | Yemen | | | |

Potential

| | | | | |
|------------------------------|-----------------------|-----------------|---------|---------|
| Democratic Republic of Congo | Equatorial Guinea | Guinea - Bissau | Liberia | Myanmar |
| Papua New Guinea | Sao Tome and Principe | | | |

3. Driver-wise highlights

Key insights, from the assessment of member countries, across seven drivers have been presented below:

Macroeconomy

- Robust GDP Growth rate, low country risks and strong investments (including foreign direct investments) have been key differentiators among countries assessed on Macroeconomy.
- Other key differentiators include investor protection initiatives and the extent of political stability in the individual countries.
- Most Achiever and Influencer countries have initiated structural reforms to strengthen economic competitiveness and establishing more favourable environment to promote investments.
- Most Progressive countries have a strong FDI growth trend along with a rising GDP growth trend though the size of the GDP is comparatively lower.
- The Potential countries have low GDP size with the better ranked ones having a comparatively higher GDP growth rate.

Policy Enablers

- Robust policy mechanisms to support renewables, sustainability targets and financial incentives are key scoring aspects on Policy Enablers.
- In addition, countries scoring high have created favourable downstream policy framework for renewable energy (RE) tendering, Renewable Purchase Obligations (RPO), Renewable Energy Certificates (REC), investment/production tax credits, emission reduction targets, incentives for solar developers etc to facilitate seamless policy execution.
- Most Influencer countries may not have demonstrated significant actions on policy front but have mandated clear policies to promote clean energy primarily through private participation.
- Progressive countries are in the initial phases of renewable specific policy formulation but have acknowledged the role of renewable energy in the country's developmental agenda.
- The Potential countries have been focussing on introducing favourable policies to promote renewable energy with limited on ground implementation.

Technological Feasibility

- High levels of Global Horizontal Irradiance (GHI) and normative capacity utilisation factors (CUF) are the key differentiators in Technological Feasibility.
- Countries in Africa and Middle East are bestowed with naturally high levels of solar irradiation and hence have scored comparatively higher in Technological Feasibility .
- Existence of energy storage projects and other additive technologies have also helped in improving technological feasibility scores for the leading countries.
- Another key differentiating criterion has been the extent of use of renewable to enhance electricity access in countries that are still not hundred percent electrified.

Note: Results from the assessment of countries across the drivers have been presented in the Appendix 2 of the document

Market Maturity

- Countries with high levels of access to electricity, presence of a structured and mature power market along with a robust pipeline of operational solar projects have scored high in Market Maturity.
- Another key differentiating factor has been the adoption of competitive bidding process for awarding power projects.
- Most Influencer countries have already achieved a significant level of/achieved full electricity access and have a strong focus on private participation across the sector value chain.
- The Potential and the Progressive countries are differentiated, primarily, from the levels of electricity access and the extent of initiatives to transition towards a comparatively mature power market in future.

Infrastructure

- Looking into the intermittency and other operational challenges related to solar integration with the grid, the need for robust infrastructure is indispensable.
- The Achiever countries have taken a planned approach towards strengthening the national grid infrastructure with a focus on integrating solar and other renewables.
- Leading countries have also encouraged private participation in not only solar infrastructure development but also to fast-track overall infrastructure development.
- Leading countries also have robust mechanisms in place to ensure reliability and operational transparency in the electricity distribution sector.
- Most Influencer countries have taken concrete steps towards developing a long-term infrastructure development plan with renewables at its core.
- Progressive and Potential countries are in different stages of building and operating a robust, high voltage integrated transmission grid to support better integration of solar in the long run.
- Other key differentiators in Infrastructure include capacity building initiatives to improve the quality of human resource as solar market development needs skilled professionals across the entire value chain.

Financing

- Low cost of financing, better accessibility to financial instruments, resolving insolvency metrics and presence of quality banking system are the key reasons for countries which perform better on financing. Extent of private credit by domestic banks, is also an enabling differentiator.
- Most Achievers have set up specialized institutions to develop targeted incentives for the industry such as climate funds, tax incentives, grants, financial programs and cooperation plans to encourage capital flows in the sector.
- Most Influencer countries present a stable financial outlook and a strong financial ecosystem which is inclined towards the levels of Achievers.
- The Potential countries are having certain levels of financial institutional setup especially for power sector financing though it is primarily focusing on government financing or from Developmental Financing Institutions (DFIs).
- There is significant dependence on financing from DFIs in most Potential countries. The institutional mechanism for project financing is still in the evolution stage.

Note: Results from the assessment of countries across the drivers have been presented in the Appendix 2 of the document

Energy Imperatives

- The existing per capita electricity consumption, historical growth in electricity demand and current solar installed capacities are the key differentiating parameters under Energy Imperatives. The Achiever countries have scored maximum on this criterion.
- Leading performers have high electricity - GDP elasticity indicating that the economies are effective in extracting value (by generating goods and services) from the electricity it consumes.
- Influencer countries have demonstrated strong growth in electricity demand and solar installed capacities. In addition to the high-income economies, a few developing countries have also performed relatively better in Energy Imperatives owing to their aggressive solar deployment in recent years, mostly in off-grid solar on account of rapid electrification.
- The Progressive countries have a strong potential in off-grid as well as on-grid solar but the same is yet to be explored. Owing to low electrifications levels, the demand growth is not strong but is expected to grow once electrification starts even using off-grid solar systems.
- Most Potential countries have had a good demand growth but score low in solar deployment over the years.

Note: Results from the assessment of countries across the drivers have been presented in the Appendix 2 of the document

4. Regional highlights

Key insights from the assessment of ISA member countries, across the 4 geographical regions ('Africa', 'Asia & Pacific', 'Europe and others', 'Latin America & Caribbean') highlighting the strengths and areas of improvements in each region have been presented below:

Africa (44 Member countries)

- Owing to higher levels of solar irradiation in the region, countries in Africa are bestowed with high solar potential and technological feasibility. Current low levels of access to electricity in some countries present a significant opportunity for off-grid solar technologies.
- Leading performers in the region have set renewable energy targets up to 2035 and also aim to electrify transport fleet by resorting to renewable energy sources.

Asia & Pacific (25 Member countries)

- Along with high levels of solar irradiation, enabling macroeconomic environment are driving the growth of solar adoption in the region.
- Leading countries in the region have long-term vision related to infrastructure growth and supportive investment ecosystem.
- Leading performers in the Asia & Pacific region have set renewable energy targets up to 2030 in its latest NDC submission and have been undertaking key steps towards these goals.

Europe and others (13 Member countries)

- The countries in the region perform exceptionally well on drivers such as Policy Enablers, Market Maturity and Macroeconomy related aspects. However, the Technological Feasibility scores (related to natural potential of solar) are lower than countries from other regions.
- Leading performers in the region, that effectively offset the Technological Feasibility scores through other measures have been ranked as Achievers.
- Leading countries in the region have targeted a complete phase out of coal-fired power generation in its latest NDC and have been undertaking key steps towards these goals.

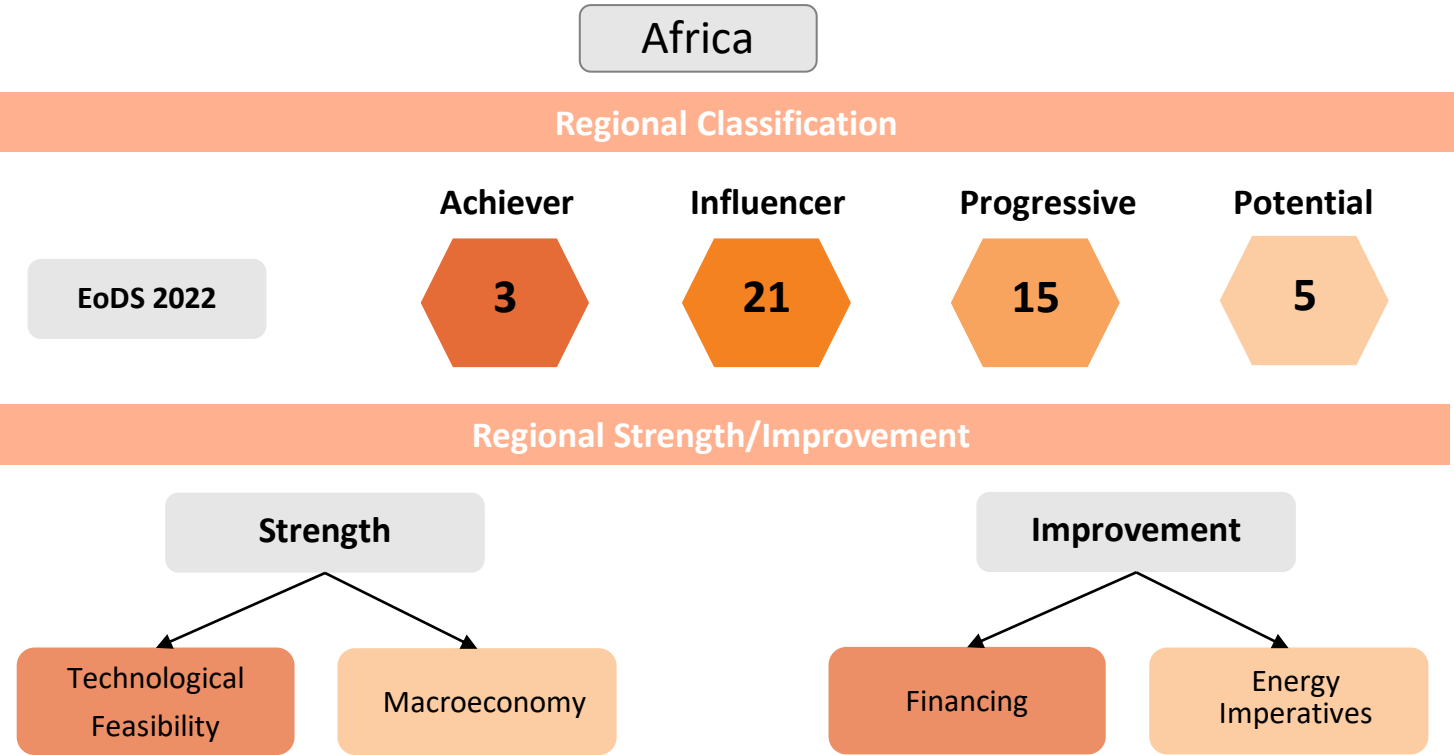
Latin America & Caribbean (25 Member countries)

- Like Africa, Latin America & Caribbean regions have also been bestowed with high solar irradiation. Besides, most countries have also performed well on Market Maturity and Macroeconomy related aspects.
- Leading performers in the Latin America & Caribbean region have set renewable energy targets up to 2030 and have been undertaking key steps towards these goals. Further, the countries in the region have targeted to transition towards electric vehicles powered through renewable sources.
- Leaders in this region also encourage private participation and have long-term vision related to infrastructure growth and associated investment plans.

Note: Results from the assessment of countries across the drivers have been presented in the Appendix 1 of the document

5. How Progressive & Potential countries may further move up in EoDS?

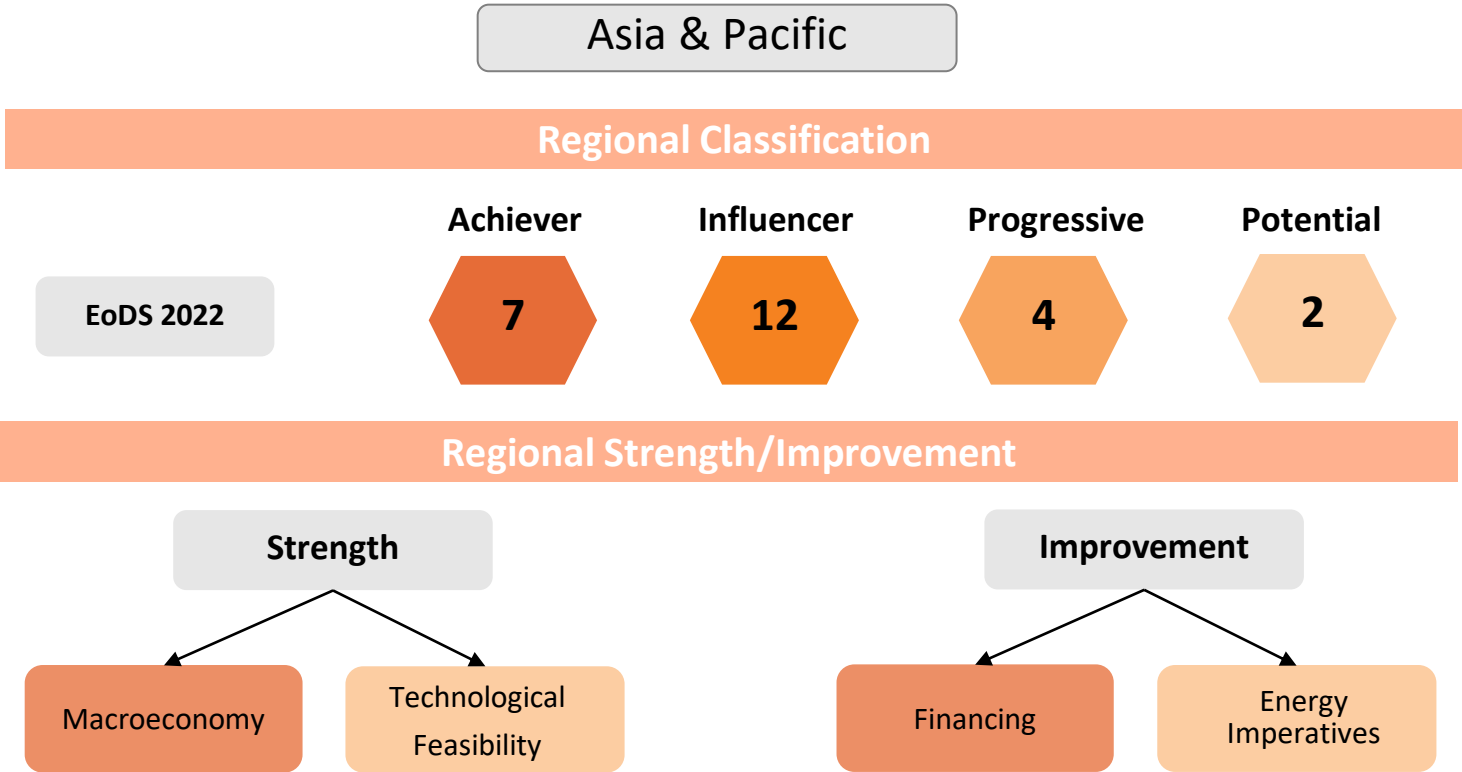
Based on our analysis, we have come across few areas of improvement for member countries to improve their EoDS ranking from Progressive and Potential categories. Our recommendations are limited to countries from three regions – Africa, Asia and Pacific, Latin America and Caribbean.



Most Progressive and Potential countries in Africa region have natural Technological Feasibility but need significant improvement in aspects like financing mechanisms, energy imperatives and infrastructure development. Aspects related to financing and policies need more focus that shall eventually lead to the development of an effective solar ecosystem in the region.

Key focus areas for Improvement

- 1. Access to financing:** The region would need a major impetus to further develop domestic financial institutions and banking systems to make the most of the rich solar resources primarily for the off-grid solar industry. Countries must ensure stable banking ecosystems, allocate and utilize public funds to finance RE projects and undertake activities to enhance private sector participation in the sector.
- 2. Energy Imperatives:** Improving the performance of national utilities and greening their power generation mix is a prerequisite to lower the costs of supply, thus expanding electricity access to the currently unelectrified, who are usually lower-income and often remote households.
- 3. Business Models:** Although several Public Private Partnership agreements exist in Africa for various projects, the extent of “due-diligence” need more thrust. Quite a few of these projects are either not completed or indicate a need of a more robust planning. Public Private Partnership is a viable tool that can be potentially adapted to boost infrastructure development, especially within Africa’s solar energy sector.
- 4. Hybridisation models:** Penetration of hybrid projects can drive solar energy development in Africa. The hydro-solar installation can enable Africa to harness its immense solar resources, combat low water levels during the dry season, and provide grid operators more flexibility to run the hydropower plant at night.



Progressive and Potential countries of this region are still at a nascent stage of developing conducive policy environment, financing mechanisms and a robust power infrastructure to make solar more viable.

Key focus areas for Improvement

1. Financing mechanisms:

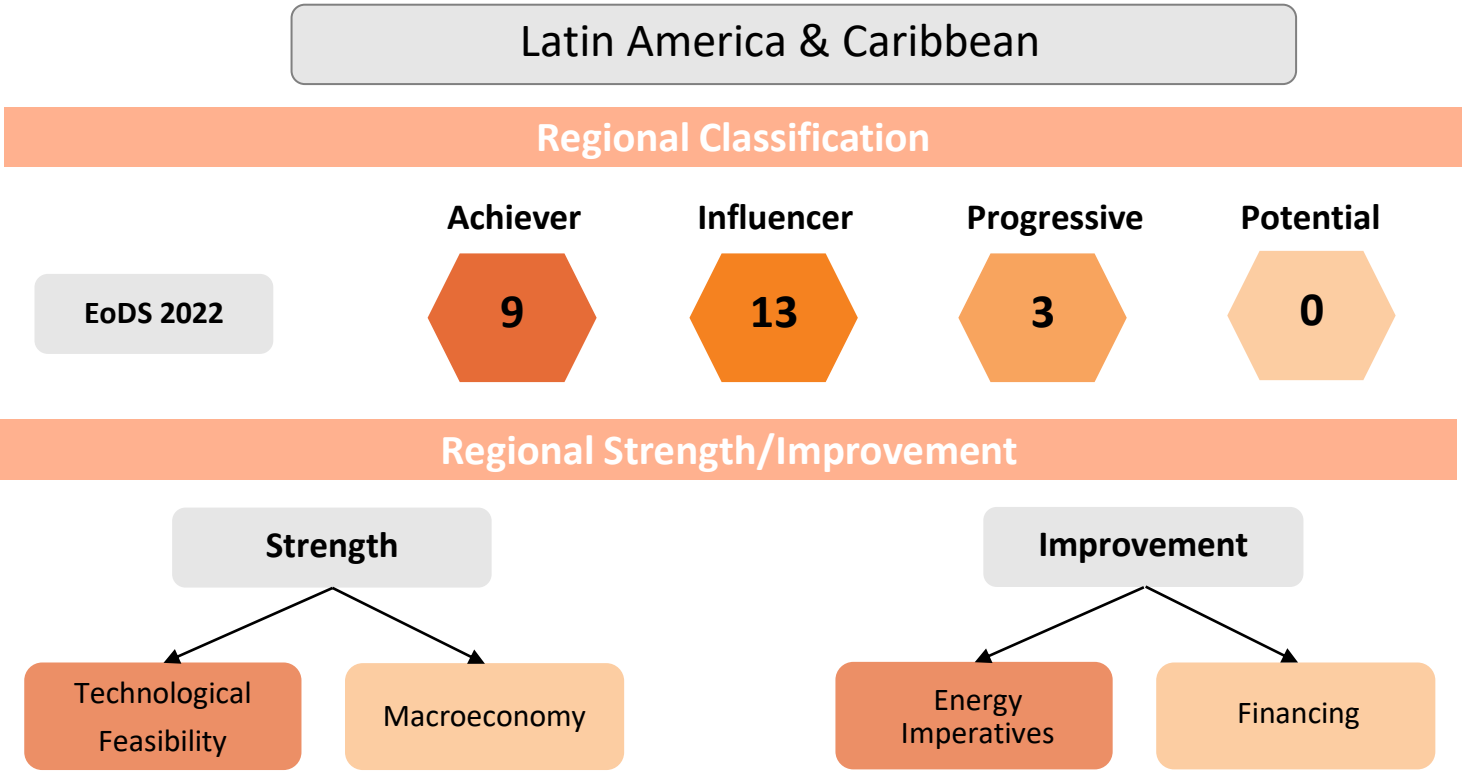
Increased investments require access to low-cost financing, along with a strong pipeline of bankable projects. Governments can help in this endeavour by making the sector more attractive to investors, through enabling policy environment, innovative financing mechanisms and strong stakeholder partnerships.

2. Energy Imperatives:

Large parts of the region are on prime equatorial and tropical land, enjoying the world’s highest solar insolation levels and boasting significant solar energy generation potential. With adequate policies and long term energy plans, the region can provide significant market opportunity for solar development.

3. Grid Infrastructure:

Countries in the region should capitalize on opportunities related to the interconnection of electricity grids across borders, which facilitates greater access to electricity and increases cross border electricity trade.



For the Progressive and Potential countries in the Latin America & Caribbean region, energy imperatives and financing have been identified as key areas of improvement.

Key focus areas for Improvement

1. Financial Support Mechanisms

The penetration of renewable energy has been slower in many parts of the region. Upfront capital costs associated with scaling-up of renewable energy act as a barrier to public financing. The slow pace of private financing further accelerates the situation. Caribbean countries should focus on strengthening their clean energy policies, regulations and incentives in order to create a robust market for private sector investment. This will be key to achieving investment at scale.

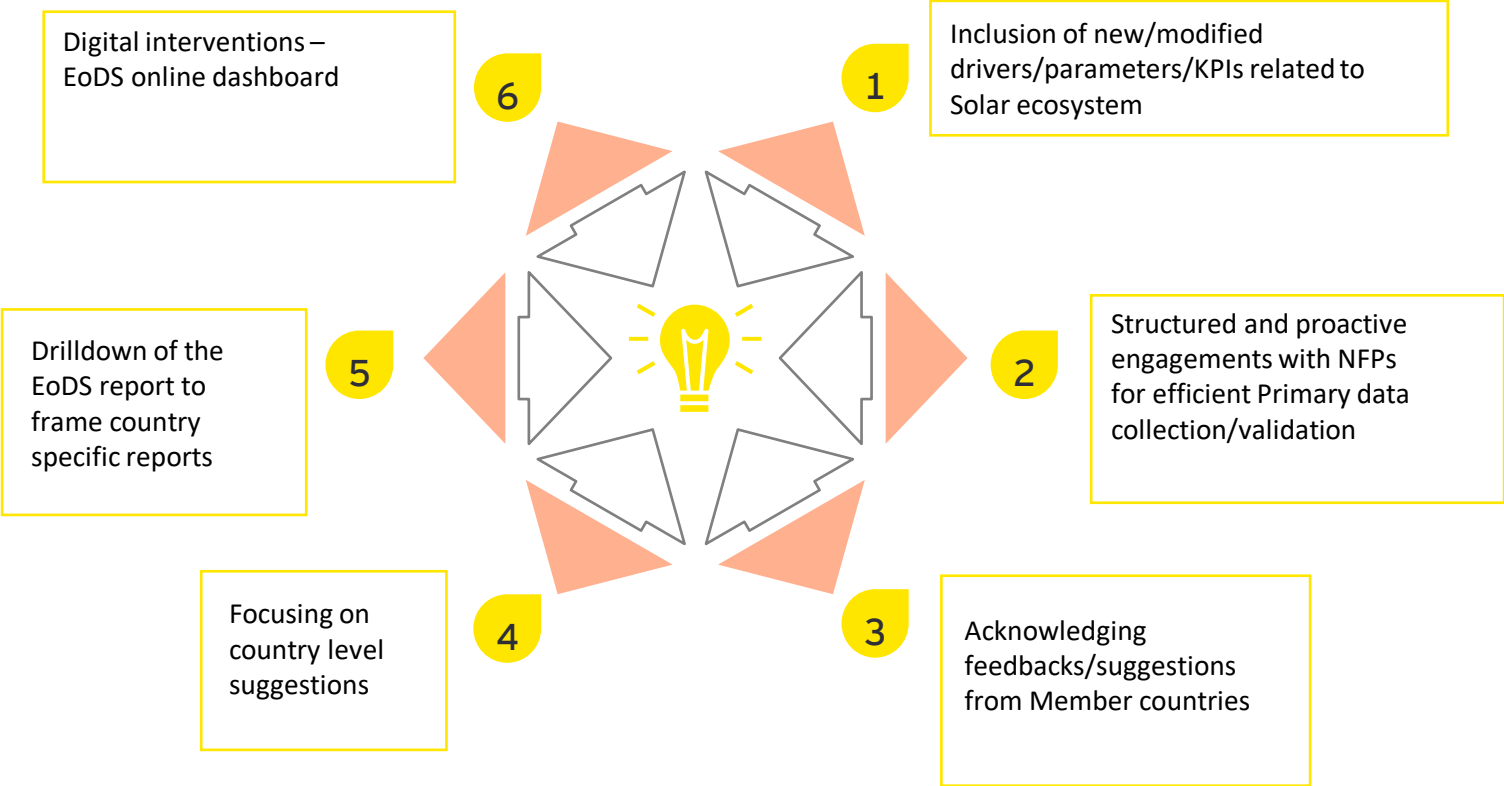
2. Energy Imperatives:

Latin America is a region with vast renewable energy resources and an enormous potential to further accelerate the clean energy transition. The region should reassess the options available and scale up efforts on transitioning to renewable energy.

6. Way forward

Future editions will aim to strengthen stakeholder consultations through regional and country level engagements which are critical to strengthen the EoDS framework. In addition, greater emphasis will be placed on online dashboards for better visualisation and user interaction allowing ISA to transition from a paper-based report to an interactive version. The transition to an **EoDS Digital report** is expected to encourage more proactive participation from member countries and a larger quantum of primary data in a more seamless and efficient manner.

Inclusion of new/modified drivers/parameters/KPIs, more focus on solar related aspects and focusing on country level suggestions are some of the additional initiatives planned to enhance the results and outreach of Ease of Doing Solar.



Future editions will also aim to promote more involvement from member countries for primary data collection so that the EoDS analyses the country on most recent and first hand data. The analysis would thus be more robust, capturing the most recent ground realities in the country and hence more relevant to the stakeholders.



Approach & Methodology



1. Overview

1.1. Framework for Ease of Doing Solar Report



A. Guiding Principles & Scoring methodology

| How is it done? | Key outcomes |
|--|--|
| A1. Review of past similar studies to assess various methodologies | Defining the Guiding Principles (Drivers, Parameters & KPIs) |
| A2. Parameters and KPIs identification & selection and formulation of rationales | |
| A3. Classification of KPIs | |
| A4. Stakeholder consultations to further refine Approach & Methodology | Rationales for selecting KPIs and their treatment |

B. Scoring Model & Data Research

| How is it done? | Key outcomes |
|--|-----------------------------|
| B1. Secondary data collection (Database based) | Validated Data set |
| B2. Questionnaire preparation and country-focused consultations | |
| B3. Identify and address data gaps for each country | Approach to treat data gaps |
| B4. Assigning weights for analysis | Weights for the Indicators |
| B5. Analysis of the KPIs across Solar, Parent Industry (Power Sector) and Macro Influencer | Scoring Model |
| B6. Model development | |

C. Data sensitization and verification

| How is it done? | Key outcomes |
|---|--|
| C1. Validation of data by country-level stakeholders | Verified datasets |
| C2. Preparation of country specific reports and consultation draft | Facilitate consultations & feedback from countries |
| C3. Country-level consultations and incorporation of feedbacks | Finalized Ease of Doing Solar 2022 Report |
| C4. Preparation of final country-level reports | Dissemination of findings and insights |
| C5. Capacity building workshops - to disseminate the methodology, findings and learnings from the study (to be conducted) | Knowledge sharing on learnings and methodologies |

1.2. What is new in EoDS 2022?

In the month of July 2022, EY organized a Capacity building workshop for ISA team and Country's /Regional coordinators to disseminate the methodology, findings and learnings from the 2021 edition. Participants actively contributed to the workshop by providing valuable suggestions for further improving the framework of the EoDS. The session facilitated stakeholders' active participation and their suggestions have been appropriately used to enhance EoDS 2022. The interaction has helped to update key inputs which has further added value to the EoDS 2022 framework.

Indicators related to financing and solar business ecosystem such as credit facilitation from micro finance institutions, promotion of private investment, development of private sector through trainings and knowledge transfer etc were suggested by various stakeholders during the Capacity building workshop. The indicators suggested during the workshop were added in the EoDS framework based on the data availability.

Below listed are some of the key updates in the EoDS 2022 analysis:

- **Inclusion of New ISA Member Countries:** In comparison to EoDS 2021 framework, 9 new countries have been added in EoDS 2022 framework such as Antigua and Barbuda, Bahrain, Hungary, Israel, Nepal, Norway, Syria, Tunisia and United States of America.
- **Incorporation of New KPIs:** In comparison to EoDS 2021 framework, 3 new secondary KPIs have been added in EoDS 2022 framework such as renewable energy tendering, resolving insolvency score and trading across borders bringing the KPI count from 64 to 67.
- **Efficient data collection:** To get better replies from the National Focal Points for EoDS 2022, a concise description of the questions were provided in the primary questionnaire. At a regional level spanning Asia-Pacific, Africa, Latin America & Caribbean and Europe & others, the data collection process facilitated better response for the Primary Questionnaire from 24 Member countries.
- **Enhancement of the Country Reports:** By providing additional information such as NDC target, financing mechanisms for clean energy, policies/schemes to support renewable energy development and fiscal incentives/ public financing for renewable energy.
- **More focus on primary data:** As part of the transition to digitise EoDS and make it more relevant to countries' needs, there was an increased emphasis on collecting primary data from National Focal Points. The report provides primary data on key parameters such as a financial support mechanisms, policies/schemes for solar, and emerging technologies/innovative models.

In EoDS 2022 study, primary data was received from 24 Member countries – Australia, Bangladesh, Benin, Brazil, Burkina Faso, Comoros, Costa Rica, Cote d'Ivoire, Democratic Republic of Congo, Djibouti, Gambia, Germany, Guinea, Japan, Madagascar, Mozambique, Paraguay, Saudi Arabia, Senegal, Sudan, United States of America, Venezuela, Yemen and Zimbabwe.



2. Guiding Principles

2. Guiding Principles for the EoDS Report

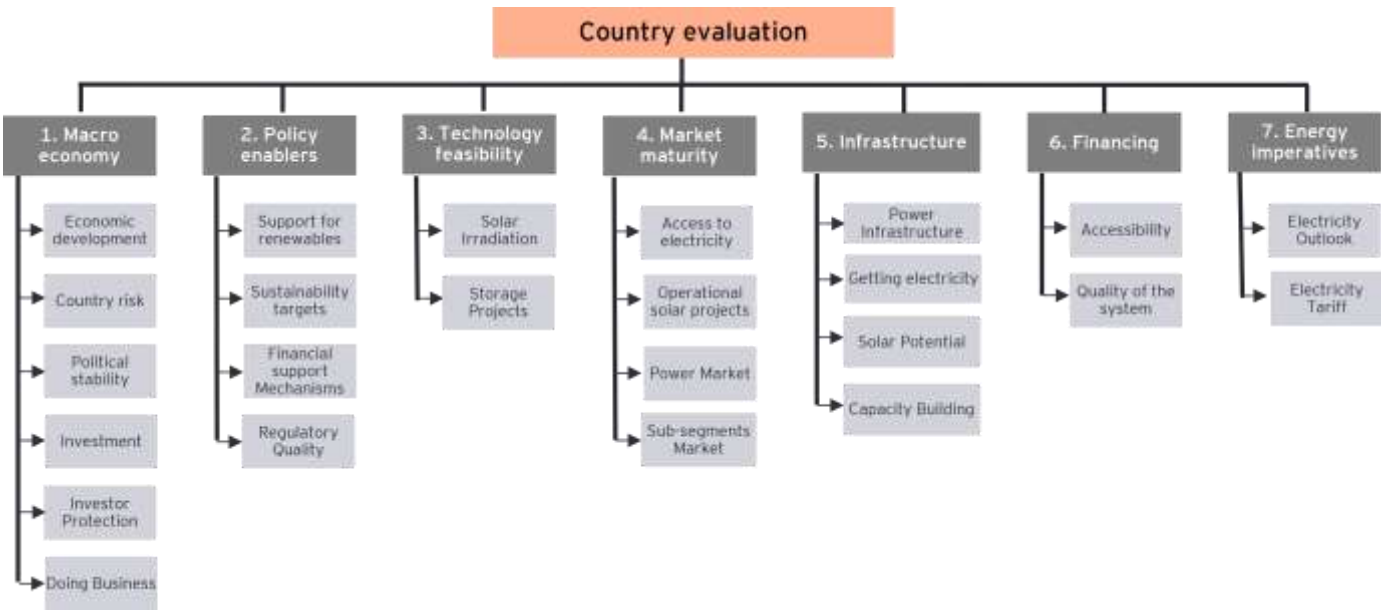
Further strengthening of the country analysis framework as well as incorporating greater insights on the solar ecosystem was the main objective of the EoDS 2022 edition. The EoDS report includes country-specific analysis and snapshots that assess countries capacity to draw on investments in solar space. Grid-connected solar, solar Mini-Grids, solar Rooftop and Off-Grid solar products and services are some of the segments that are covered in this report. Further, inclusion of the emerging technologies such as hybrid systems (i.e. wind/hydro + solar), e-mobility/electric vehicles is also covered in this report.

The Principles – Drivers, Parameters and Indicators have been developed based on the review of similar studies like 1) Ease of Doing Business by the World Bank; 2) State Investment Promotion Agency Framework by Invest India; 3) Global Investment Competitiveness Report; 4) Renewable Energy Country Attractiveness Index by EY; 5) Regulatory Indicators for Sustainable Energy (RISE) and the review of relevant literature from 1) International Energy Agency (IEA); 2) International Renewable Energy Agency (IRENA); 3) Lighting Global; 4) GOGLA; 5) World Bank and others. The basic skeleton of the study is similar to the previous editions of EoDS report.

The assessment was carried out, for each country, across seven key drivers: **Macroeconomy, Policy enablers, Technical feasibility, Power market maturity, Infrastructure, Financing, and Energy Imperatives**. These seven key drivers form the foundation of the EoDS model with weightages assigned to the drivers, parameters and indicators for a comprehensive assessment of the solar ecosystem in the individual country. The weightages were primarily determined based on the learnings from previous edition feedbacks, analysis of similar studies and consultations with the stakeholders and domain experts. In total, **24 parameters** which are measured through **62 indicators** to analyse the solar ecosystem.

A computation model had been built based on the data and weightages which would help develop the scoring for the countries.

Guiding Principles - Drivers & Parameters considered for EoDS 2022





Understanding the Drivers

3. Understanding the Drivers

| Drivers | Description | Parameters |
|---------------------------|---|--|
| Macroeconomy | Macroeconomic parameters are analysed to understand the economic strength, in terms of size of the economy, growth prospects and maturity. The macroeconomic driver also helps to assess the market associated risks. Strong macroeconomic indicators, for a country, signify business opportunities for the investors/ developers and translates to an optimistic view of the future of solar sector in the country. | <ul style="list-style-type: none"> Economic development Country risk Political stability Investment Investor protection Doing Business |
| Policy enablers | Effective policies and quality of regulatory ecosystem act as key enablers for growth in any sector. This is an important driver for the governments and investors to understand the roadblocks limiting the growth of solar segment in the country. Government initiatives, such as fiscal incentives and subsidies for solar energy deployment, not only helps in attracting new investments in the sector but also minimises the risks associated with such projects especially for nascent technologies/sector. | <ul style="list-style-type: none"> Support for renewables Sustainability targets Financial support mechanisms Regulatory quality |
| Technological feasibility | Analysis of various technical aspects is of utmost importance in order to determine the feasibility and cost-effectiveness of a solar project. Indicators such as solar irradiation in the region and capacity utilisation factor impact the viability of solar Projects. | <ul style="list-style-type: none"> Solar irradiation Storage Projects |
| Market maturity | Market maturity is a critical driver for the investors and project developers to have a better understanding of the overall electricity market in the country. A mature market ensures minimum risks and high certainty of returns to the investors, but also offers high degree of competition. On the other hand, a less mature market may offer significant opportunities for the new entrants but with a higher risk quotient. | <ul style="list-style-type: none"> Access to electricity Operational solar projects Power market Subsegments Market |

| Drivers | Description | Parameters |
|--------------------|--|--|
| Infrastructure | Availability of adequate transmission & distribution infrastructure/ network, efficiency of power utilities and capacity building activities are essential components of infrastructure that translates to the success of solar industry in the country. | <ul style="list-style-type: none">Power InfrastructureGetting ElectricitySolar potentialCapacity building |
| Financing | Analysis of domestic banking ecosystem is essential to understand business viability and risks in a country. Strong financial ecosystem and innovative financial products are important factors for large scale solar deployment. While availability of appropriate financing models is essential to attract private investments, low cost financing is also critical for the commercial viability of the projects especially off grid and new technologies. | <ul style="list-style-type: none">AccessibilityQuality of the ecosystem |
| Energy imperatives | This parameter analyses the total electricity landscape in terms of consumption, tariffs and installed capacities. The current status of off-grid solar products is also analysed to help identify the country’s potential for off-grid installations. | <ul style="list-style-type: none">Electricity OutlookElectricity tariffs |

In the EoDS 2022 analysis, few additional indicators have been included in the model beyond those considered in EoDS 2021. Indicators such as **renewable energy tendering, resolving insolvency score, trading across borders** have been added.

Description of the Parameters and the Indicators considered for the EoDS 2022 analysis has been included in the Annexure 3 of this report.

3.1. Determining Weightages for Drivers

EoDS analysis focuses on screening, prioritizing and classifying the countries based on a finite set of criteria. The scoring weights allocated to each criteria play a very significant role in the EoDS model and helps in arriving at the overall score. The weightages for the attributes – Drivers, Parameters and Indicators were primarily determined based on the learnings from previous edition feedbacks, analysis of similar studies and consultations with the stakeholders and domain experts.

Learnings from similar studies

- Multiple similar studies and their mechanisms for weightage determination have been analysed to understand existing methodologies and develop a robust assessment framework.
- State Rooftop Solar Attractiveness Index: Basis the importance/ ranks given by different stakeholders, the weightages to the parameters were decided.
- EoDB by World Bank uses a direct method: Weighing all topics equally and, within each topic, giving equal weight to each component.

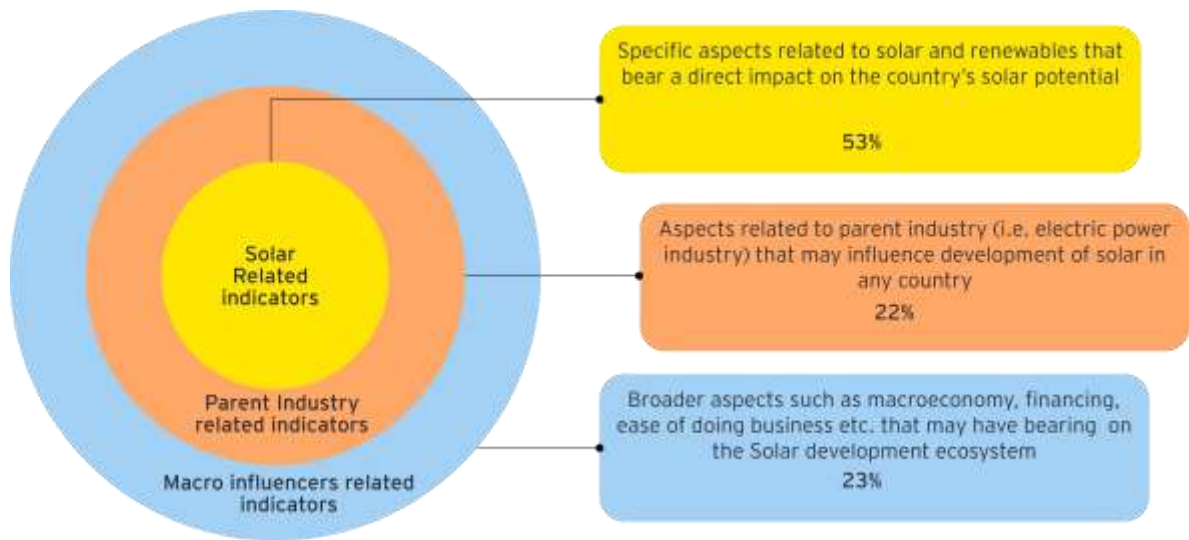
The learnings from similar studies helped develop a basic scoring framework which was subsequently refined through multiple stakeholder consultations. The process of consultation happens every year before initiating the report and hence has resulted in an evolved framework over the years.



5. Data research

5.1. Data Research

The EoDS analysis captures the indicators across three major segments - the Solar related indicators, Parent Industry related indicators and Macro Influencers related indicators. Below three segments of indicator classification ensure that the indicators are selected and assessed to cover all the aspects that have an impact on the country’s solar ecosystem. Solar related indicators have been given comparatively higher weightage in the EoDS analysis, followed by Parent industry and Macro Influencers.



| EoDS 2020 | EoDS 2021 | EoDS 2022* |
|---|---|---|
| 80 | 98 | 107 |
| Number of countries | Number of countries | Number of countries |
| 38 | 64 | 62 |
| Key Indicators Only secondary research | Key Indicators Only secondary research | Key Indicators Only Secondary research |
| 3,040 | 6,272 | 6,634 |
| Data points collected through secondary research | Data points collected through secondary research | Data points collected through secondary research |

*113 indicators targeted for 2022 study which includes 51 Primary and 62 Secondary data

While EoDS 2022 is based on both secondary and primary data, it is largely skewed towards secondary data. Primary data was received from 24 Member countries. The secondary research is based on credible sources like The World Bank, IMF, UN Foundation, IEA, and IRENA etc. The primary data research was carried out by developing and circulating the questionnaire among the National Focal Points (NFPs) of the member countries. A strong emphasis on involving key stakeholders (NFPs, Regional Co-ordinators etc.) for data collection and feedback has been the main stay of the EoDS 2022 edition.

5.2. Data Research – Primary

The primary data collection formats have been developed in multiple languages and were circulated to member countries through their respective NFPs. An indicative sample of the primary questionnaire is appended below for reference:

Sample format of the Primary data Questionnaire

| S.No. | Key Indicators | Response (Yes/No) | UoM | Source of Information | Year of Information | Remarks |
|-------|---|-------------------|--------|-----------------------|---------------------|---------|
| 4 | What is your country's National Determined Contribution (NDC) Target? | | % | | | |
| 5 | What share of solar energy (in the energy mix) is targeted to be achieved by your country in near future ? | | % | | | |
| | By which year will you achieve the above target ? | | Year | | | |
| | Are there specific policies/ schemes for the following Solar segments in your country? | | | | | |
| | a. Rooftop Solar | | Yes/No | | | |
| | b.Solar Mini Grids- Mini grid refers to an independent grid network which operates in isolation to the electricity networks of the DISCOM grid (standalone), but can also interconnect with the grid to evacuate power. | | Yes/No | | | |
| | c. Standalone solar systems | | Yes/No | | | |
| | d. Utility scale solar | | Yes/No | | | |
| 6 | e. Solar Parks- The solar park is a concentrated zone of development of solar power generation projects and provides developers an area that is well characterized, with proper infrastructure and access to amenities and where the risk of the projects can be minimized. | | Yes/No | | | |
| | f. Floating Solar | | Yes/No | | | |
| | g. Solar heating and cooling system | | Yes/No | | | |
| | h.Battery waste management | | Yes/No | | | |
| | i. Green Hydrogen | | Yes/No | | | |

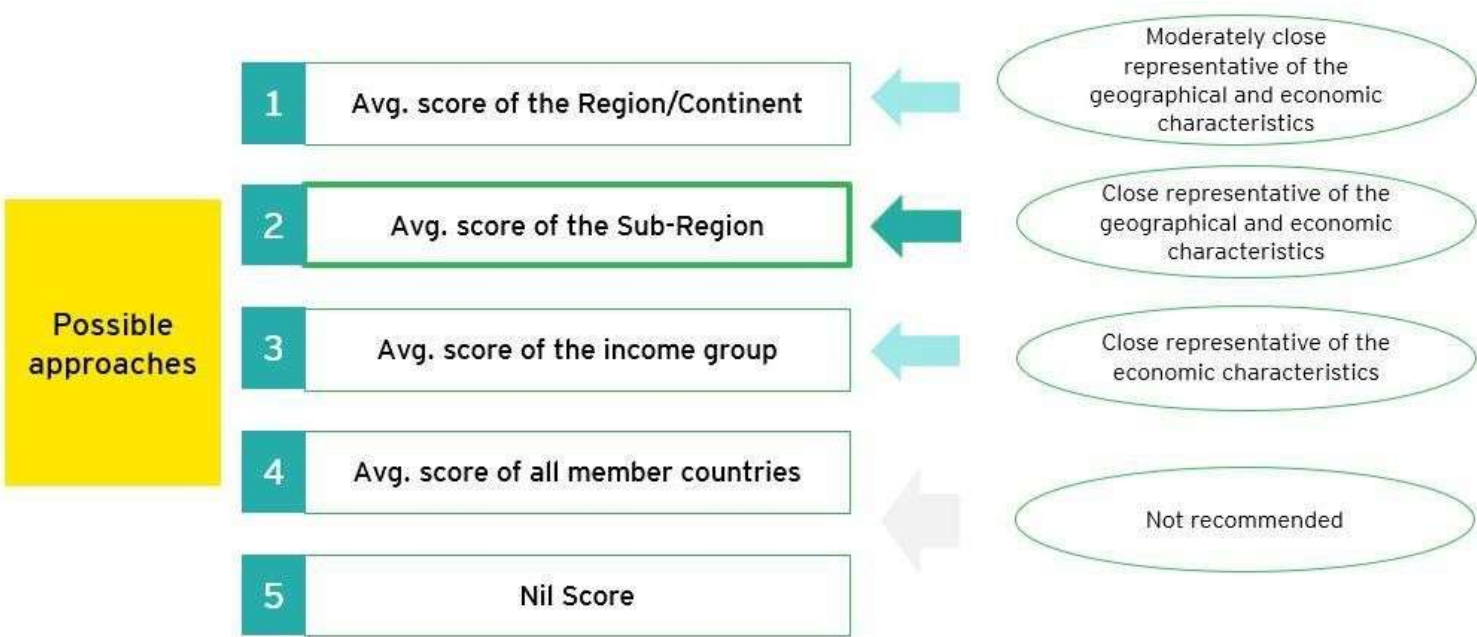
Procedure:

- Questionnaires have been prepared in English, French and Spanish languages to facilitate prompt data collection from primary sources.
- The Questionnaire has 57 questions. Responses were sought as Qualitative information (E.g: Yes/ No) and Data-based information for around 27 and 30 Indicators, respectively.
- The research is based on data for the year 2021. However, in instances where data is not available for 2021, earlier year's data was used by the NFPs.
- ISA secretariat provided appropriate guidance to member countries and helped to resolve clarifications.

5.3. Data Research – Secondary

- For a large set of indicators, database-based research has been conducted. As mentioned earlier, credible sources such as IEA, IRENA, World Bank, IMF, and other relevant databases have been used.
- Country-focused research has been carried out to address data gaps for few countries and to develop deeper insights into each member country.

5.4 Treatment of Data Gaps



Average scores at sub-regional level has been considered while treating data gaps. In addition to that, **Access to Electricity** levels are coupled with the EoDS study to arrive at the most closest representation of characteristics and quantitative scores.

For a standardized research and sustained progress:

- If data points are not available through secondary research, those KPIs have been requested through Primary sources (NFPs).
- If the missing data pointers for a country, across all the indicators, is less than average of overall missing datapoints, then the average score across the sub region are considered.
- For countries with more number of missing data pointers (i.e. more than average of missing data points) in a complete block of data (for any of the 7 drivers), minimum score from the averaging group have been used instead of average.
- If the data for a certain indicator is not available for a large set of countries (even after the support from NFPs), the indicator may be removed in consultation with ISA.
- Data points gathered through secondary sources will be validated from member countries through NFPs.



Country Reports

| S.no. | ISA member countries | Region | Page number |
|-------|------------------------------|---------------------------|-------------|
| 1 | Algeria | Africa | 42 |
| 2 | Antigua and Barbuda | Latin America & Caribbean | 44 |
| 3 | Argentina | Latin America & Caribbean | 46 |
| 4 | Australia | Asia-Pacific | 48 |
| 5 | Bahrain | Asia-Pacific | 51 |
| 6 | Bangladesh | Asia-Pacific | 53 |
| 7 | Barbados | Latin America & Caribbean | 56 |
| 8 | Belize | Latin America & Caribbean | 58 |
| 9 | Benin | Africa | 60 |
| 10 | Bolivia | Latin America & Caribbean | 63 |
| 11 | Botswana | Africa | 65 |
| 12 | Brazil | Latin America & Caribbean | 67 |
| 13 | Burkina Faso | Africa | 70 |
| 14 | Burundi | Africa | 73 |
| 15 | Cabo Verde | Africa | 75 |
| 16 | Cambodia | Asia-Pacific | 77 |
| 17 | Cameroon | Africa | 79 |
| 18 | Chad | Africa | 81 |
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| 21 | Costa Rica | Latin America & Caribbean | 88 |
| 22 | Côte d'Ivoire | Africa | 91 |
| 23 | Cuba | Latin America & Caribbean | 94 |
| 24 | Democratic Republic of Congo | Africa | 96 |
| 25 | Denmark | Europe and others | 99 |
| 26 | Djibouti | Africa | 101 |
| 27 | Dominica | Latin America & Caribbean | 104 |
| 28 | Dominican Republic | Latin America & Caribbean | 106 |
| 29 | Egypt | Africa | 108 |

| S.no. | ISA member countries | Region | Page number |
|-------|----------------------|---------------------------|-------------|
| 30 | El Salvador | Latin America & Caribbean | 110 |
| 31 | Equatorial Guinea | Africa | 112 |
| 32 | Eritrea | Africa | 114 |
| 33 | Ethiopia | Africa | 116 |
| 34 | Fiji | Asia-Pacific | 118 |
| 35 | France | Europe and others | 120 |
| 36 | Gabon | Africa | 122 |
| 37 | Gambia | Africa | 124 |
| 38 | Germany | Europe and others | 127 |
| 39 | Ghana | Africa | 130 |
| 40 | Greece | Europe and others | 132 |
| 41 | Grenada | Latin America & Caribbean | 134 |
| 42 | Guinea | Africa | 136 |
| 43 | Guinea-Bissau | Africa | 139 |
| 44 | Guyana | Latin America & Caribbean | 141 |
| 45 | Haiti | Latin America & Caribbean | 143 |
| 46 | Hungary | Europe and others | 145 |
| 47 | India | Asia-Pacific | 147 |
| 48 | Israel | Europe and others | 149 |
| 49 | Italy | Europe and others | 151 |
| 50 | Jamaica | Latin America & Caribbean | 153 |
| 51 | Japan | Asia-Pacific | 155 |
| 52 | Kiribati | Asia-Pacific | 158 |
| 53 | Liberia | Africa | 160 |
| 54 | Luxembourg | Europe and others | 162 |
| 55 | Madagascar | Africa | 164 |
| 56 | Malawi | Africa | 167 |
| 57 | Maldives | Asia-Pacific | 169 |
| 58 | Mali | Africa | 171 |
| 59 | Marshall islands | Asia-Pacific | 173 |
| 60 | Mauritius | Africa | 175 |

| S.no. | ISA member countries | Region | Page number |
|-------|----------------------------------|---------------------------|-------------|
| 61 | Morocco | Africa | 177 |
| 62 | Mozambique | Africa | 179 |
| 63 | Myanmar | Asia-Pacific | 182 |
| 64 | Namibia | Africa | 184 |
| 65 | Nauru | Asia-Pacific | 186 |
| 66 | Nepal | Asia-Pacific | 188 |
| 67 | Netherlands | Europe and others | 190 |
| 68 | Nicaragua | Latin America & Caribbean | 192 |
| 69 | Niger | Africa | 194 |
| 70 | Nigeria | Africa | 196 |
| 71 | Norway | Europe and others | 198 |
| 72 | Oman | Asia-Pacific | 200 |
| 73 | Palau | Asia-Pacific | 202 |
| 74 | Papua New Guinea | Asia-Pacific | 204 |
| 75 | Paraguay | Latin America & Caribbean | 206 |
| 76 | Peru | Latin America & Caribbean | 209 |
| 77 | Rwanda | Africa | 211 |
| 78 | Saint Kitts and Nevis | Latin America & Caribbean | 213 |
| 79 | Saint Lucia | Latin America & Caribbean | 215 |
| 80 | Saint Vincent and the Grenadines | Latin America & Caribbean | 217 |
| 81 | Samoa | Asia-Pacific | 219 |
| 82 | Sao Tome and Principe | Africa | 221 |
| 83 | Saudi Arabia | Asia-Pacific | 223 |
| 84 | Senegal | Africa | 226 |
| 85 | Seychelles | Africa | 229 |
| 86 | Somalia | Africa | 231 |
| 87 | South Sudan | Africa | 233 |
| 88 | Sri Lanka | Asia-Pacific | 235 |
| 89 | Sudan | Africa | 237 |
| 90 | Suriname | Latin America & Caribbean | 240 |
| 91 | Sweden | Europe and others | 242 |

| S.no. | ISA member countries | Region | Page number |
|-------|--------------------------|---------------------------|-------------|
| 92 | Syria | Asia-Pacific | 244 |
| 93 | Tanzania | Africa | 246 |
| 94 | Togolese Republic | Africa | 248 |
| 95 | Tonga | Asia-Pacific | 250 |
| 96 | Trinidad and Tobago | Latin America & Caribbean | 252 |
| 97 | Tunisia | Africa | 254 |
| 98 | Tuvalu | Asia-Pacific | 256 |
| 99 | Uganda | Africa | 258 |
| 100 | United Arab Emirates | Asia-Pacific | 260 |
| 101 | United Kingdom | Europe and others | 262 |
| 102 | United States of America | Europe and others | 264 |
| 103 | Vanuatu | Asia-Pacific | 267 |
| 104 | Venezuela | Latin America & Caribbean | 269 |
| 105 | Yemen | Asia-Pacific | 272 |
| 106 | Zambia | Africa | 275 |
| 107 | Zimbabwe | Africa | 277 |

What to look for in each section of the country report?

Country snapshot

This section primarily covers country's as-is scenario with respect to the power sector indicators such as annual electricity consumption, Average Solar PVout, Cumulative solar capacity, Getting electricity score, NDC target and Human Development Index (HDI).

Installed capacity drill down

This section depicts electricity mix of the country (in capacity terms) along with the drill down on capacity of solar sub-segment such as solar mini-grid, solar home systems etc.

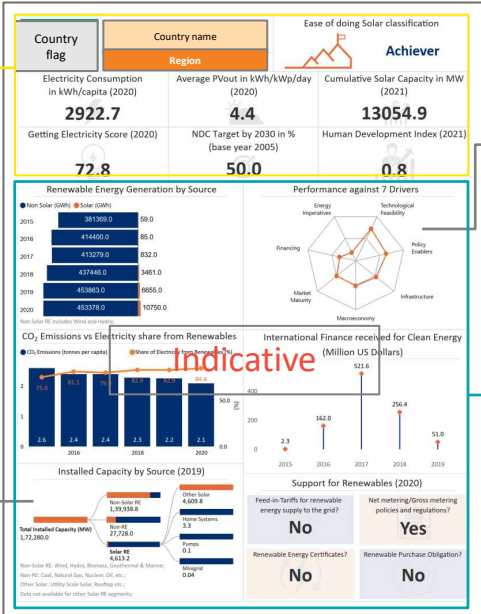
Country snapshot

This section provides the country snapshot covering indicators such as electricity consumption CAGR (2022-26), Solar investment data, Peak demand, Electricity storage cost, etc based on the data availability.

Qualitative assessment

This section depicts qualitative analysis of the country based on the NFP response data. It covers policies & schemes for Solar segments, Emerging technologies/ innovative models etc. based on the data availability.

Page 1



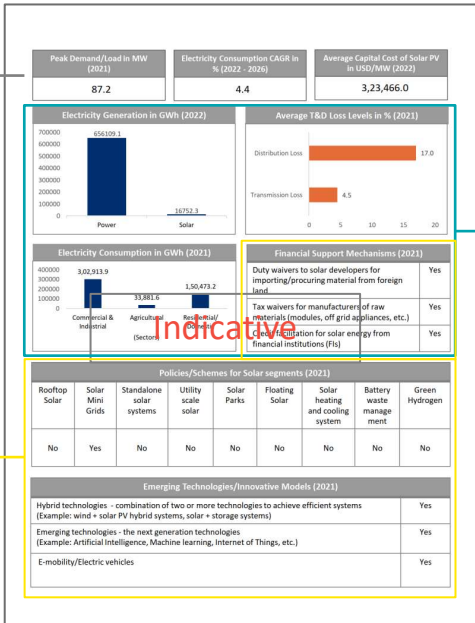
EoDS performance

This section indicate overall classification of the country (i.e. Achiever, Influencer, Progressive and Potential). It also shows countries performance across seven drivers as detailed out in the approach and methodology section of this report.

Power trends

This section is on international finance and support for renewables - more in terms of policies/regulations/procedures and processes, trends in RE generation by source, CO₂ emissions & Electricity share from Renewables.

Page 2



Quantitative assessment

This section includes quantitative analysis of the country based on the NFP response data. It covers electricity generation (Power & Solar), electricity consumption among consumer segments, T&D loss levels, solar tariffs etc based on the data availability.

Note: Page 2 is applicable for ISA Member countries who have responded to the Primary Data Questionnaire

What to look for in each section of the country report?

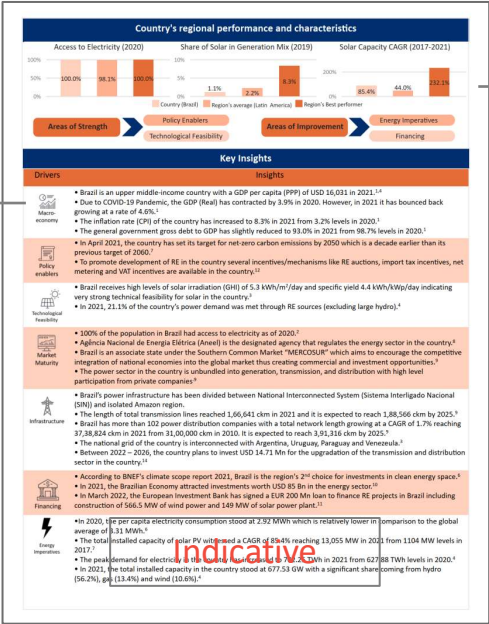
Page 3

Country's regional performance and characteristics

This section provides insights developed from the overall assessment of the member countries across seven drivers. Relative strengths and challenges have been identified for the country based on performance comparison within the country across seven drivers. The section also provides a comparative analysis on access to electricity, Growth in Solar installations and Share of Solar in generation mix. The country is compared with the region and also the best performer in the region.

Qualitative assessment

This section provides a crisp qualitative assessment of the country across seven drivers. References for the remarks under this section are provided in the Appendix of this report.





Algeria

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

1659.3

Average PVout in kWh/kWp/day
(2020)

4.9

Cumulative Solar Capacity in MW
(2021)

423.0

Getting Electricity Score (2020)

72.1

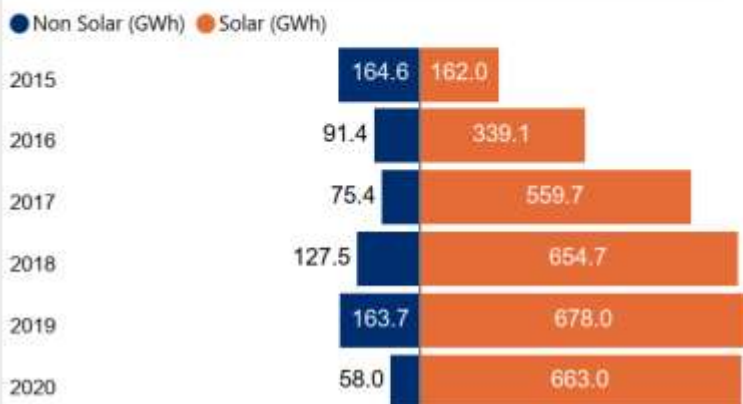
NDC Target by 2030 in %

7.0 to 22.0

Human Development Index (2021)

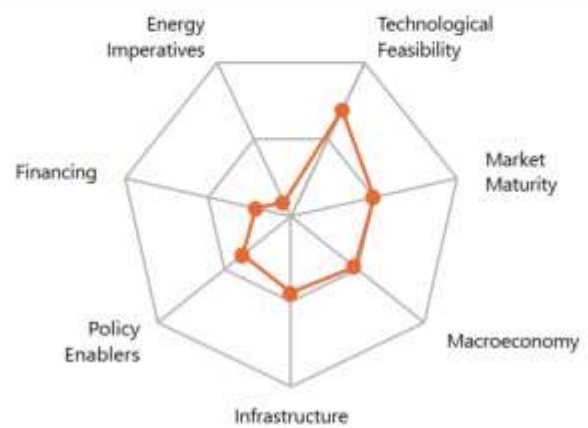
0.7

Renewable Energy Generation by Source

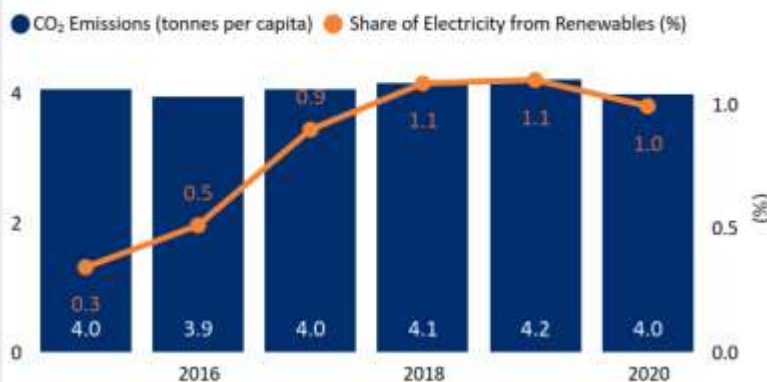


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



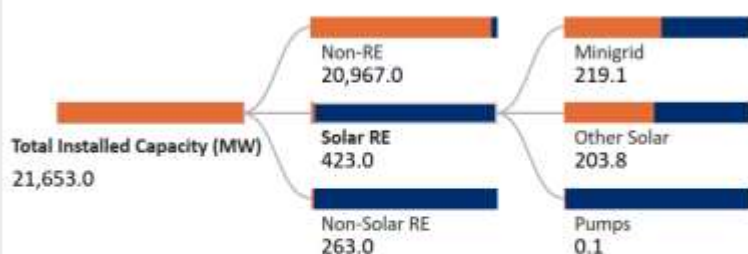
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Algeria is a lower middle-income country¹ having GDP per capita (PPP) of USD 12,128 in 2021² with oil and gas sector as the dominant contributor to the economy.⁴
- GDP (Real) is estimated to decline by 2.4% in 2022. The GDP grew at an annual rate of 4% in 2021³ with total public debt estimated at 59.2% of GDP in 2021.⁵
- Inflation rate in the country increased to 7.2% in 2021 from earlier levels of 2.4% in 2020.⁶



Policy enablers

- Ministry of Energy Transition and Renewable Energies (METRE) is the nodal ministry that is responsible for developing and implementing the energy transition plan.⁵
- The country aims to achieve 15,000 MW of electricity generation capacity through RE resources by 2035 with an aim to reduce its GHG emissions to 7% by 2030.⁵
- The Algerian government constituted the National Fund for Energy Efficiency and for Renewable Energies and Cogeneration (NFEEREC) to finance RE projects.⁸



Technological Feasibility

- Algeria receives very high levels of solar irradiation of 5.9 kWh/m²/day and specific yield of 4.9 kWh/kWp/day indicating a strong technical feasibility for solar in the country.¹⁰
- Algeria has an energy transition plan which calls for 25 GW of generation from green and blue hydrogen by 2030.¹²
- Algeria's Minister for Industry has launched a new national automotive strategy, which calls for domestic manufacturing of EVs – both full-electrics (BEVs) and plug-in hybrids (PHEVs).¹¹



Market Maturity

- 99.8% population in Algeria is having access to electricity since 2020.¹³
- SONELGAZ, the National Society for Electricity and Gas, is the authority responsible for distribution of electricity and natural gas in the country.¹⁴
- Algerian Electricity and Gas Regulation Commission (CREG) is the designated energy regulator in the country.¹⁴



Infrastructure

- The length of the electricity transmission network to be built over the period 2021-2030 is estimated to be 64,204 km. This includes 15,628 km at 400 kV, 25,516 km at 220 kV and 22,442 km at 60 kV for handling a capacity of 98,540 MVA.¹⁵
- The length of the electricity distribution network to be built over the period 2021-2030 is estimated to be 101,960 kms. Besides this, it is envisaged to build 38,864 sub-stations to supply 4.4 Mn additional customers.¹⁵
- In the Boukherana industrial zone the algerian company milltech has a factory capable of supplying 100 MW of solar panels per year.¹⁶



Financing

- The AfDB, through its Sustainable Energy Fund for Africa (SEFA), is providing technical assistance to promote the development of a transparent and competitive solar energy sector to enhance private sector investment.¹⁷
- The AfDB and Algeria have signed a loan agreement for a €900-Mn to support the country's industrial and energy competitiveness.¹⁹
- In Algeria, the World Bank has shown keen interest in providing technical assistance and analytical services in renewable energies and the investment climate.¹⁸



Energy Imperatives

- The total installed capacity of solar PV witnessed a CAGR of 1.4% between 2017-2021 reaching 423 MW in 2021 from 400 MW levels in 2017.²⁰
- In 2020, the per capita electricity consumption stood at 1.6 MWh²¹ which is significantly lower in comparison to the global average of 3.31 MWh.²²
- The peak demand for electricity in the country declined to 73 TWh in 2020 from 76 TWh levels in 2019.²³
- The price of electricity in the country was 2.20 US Cents/kWh as of 2019.²⁴



Antigua and Barbuda

Latin America & Caribbean

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

3267.7

Average PVout in kWh/kWp/day
(2020)

4.8

Cumulative Solar Capacity in MW
(2021)

12.9

Getting Electricity Score (2020)

83.5

NDC Target by 2030 in %
(base year 2005)

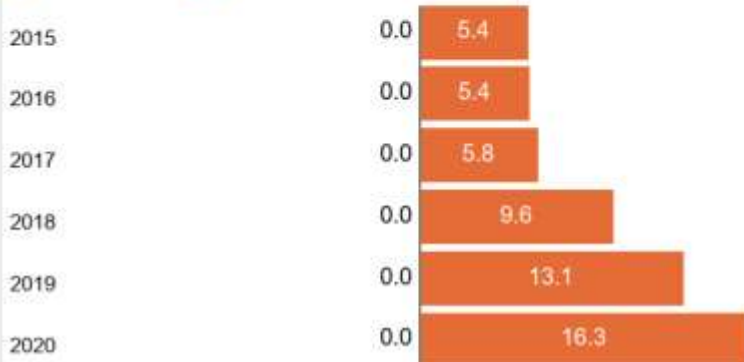
Not available

Human Development Index (2021)

0.8

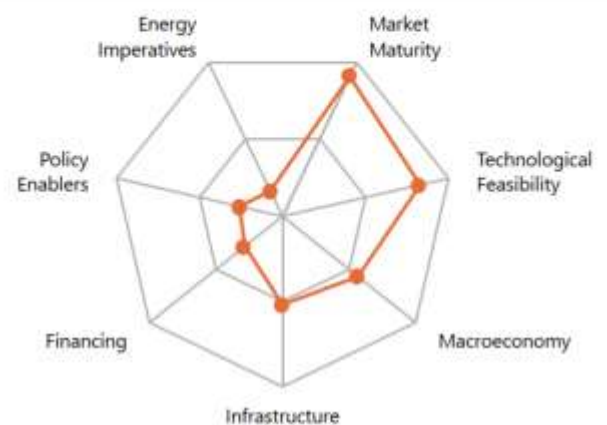
Renewable Energy Generation by Source

● Non Solar (GWh) ● Solar (GWh)



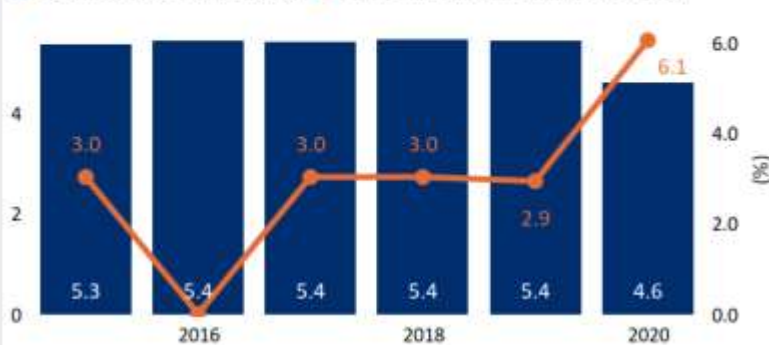
Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables

● CO₂ Emissions (tonnes per capita) ● Share of Electricity from Renewables (%)



Fiscal Incentives & Public Financing for Renewables (2020)

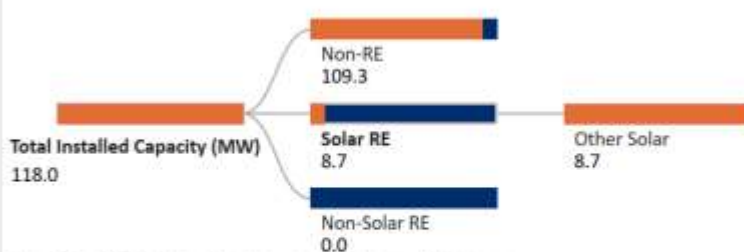
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

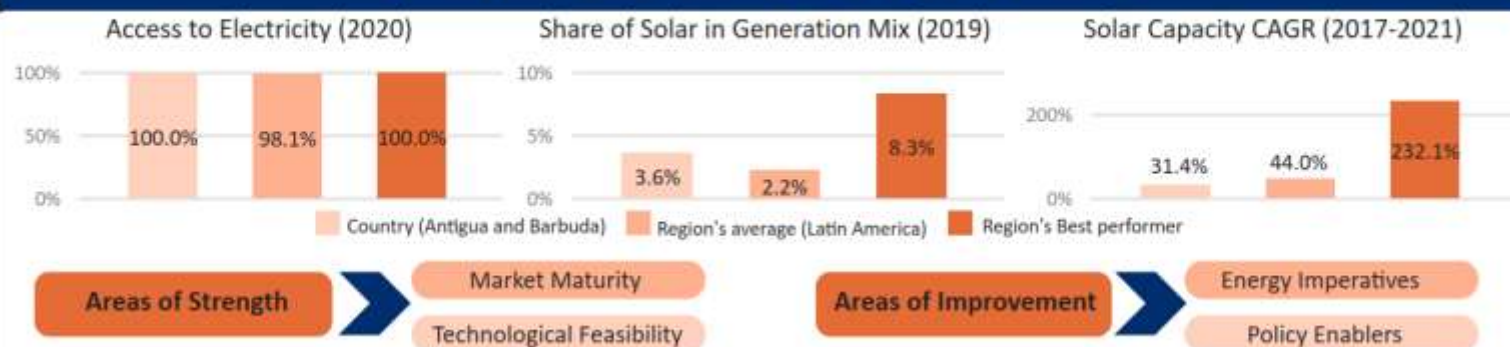
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Antigua and Barbuda is a high-income country with a GDP per capita (PPP) of USD 21,010 as of 2021.^{1,4}
- Due to COVID-19 Pandemic, the GDP (Real) contracted by 20.2% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 4.8%.¹
- The inflation rate (CPI) of the country has increased to 1.6% in 2021 from 1.1% levels in 2020.¹
- The general government gross debt to GDP has reached 102.2% in 2021 from 101.5% levels in 2020.¹



Policy enablers

- The country has submitted revised NDC targets in 2021 with a goal of reaching 86% share from RE in the generating mix by 2030. The country also have plans to ensure 100% of new vehicles sales to be EV by 2030.⁹
- To promote RE in the country interconnection standards, tax reductions and exemptions have already been implemented in the country.¹⁰



Technological Feasibility

- Antigua and Barbuda receive high levels of solar irradiation (GHI) of 5.8 kWh/m²/day and specific yield 4.8 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁵
- In 2021, 3.13% of the country's power demand was met through RE sources.⁶



Market Maturity

- 100% of the population in Antigua and Barbuda is having access to electricity since 2012.⁴
- Electricity, water, and communication services are provided in the country by the Antigua Public Utilities Authority (APUA).⁸
- The Ministry of Public Utilities manages and regulates the power sector in the country.⁸
- The country is highly reliant on imported fossil fuels for the generation of electricity leaving it susceptible to fluctuations in oil prices.⁸



Infrastructure

- The Caribbean Development Bank (CDB) authorised a grant of GBP 2.85 Mn to upgrade the island's 16 km long electricity network. Creating an underground network for electricity distribution and installation of hybrid solar systems are major areas to be covered.²
- The World Bank has carried out a variable renewable energy study to examine the island's power system and to determine the best approach to incorporate solar and wind generation into the grid and to protect the infrastructure against extreme weather occurrences. The government's revised National Energy Policy will also include the findings of the VRE Integration Study.¹²



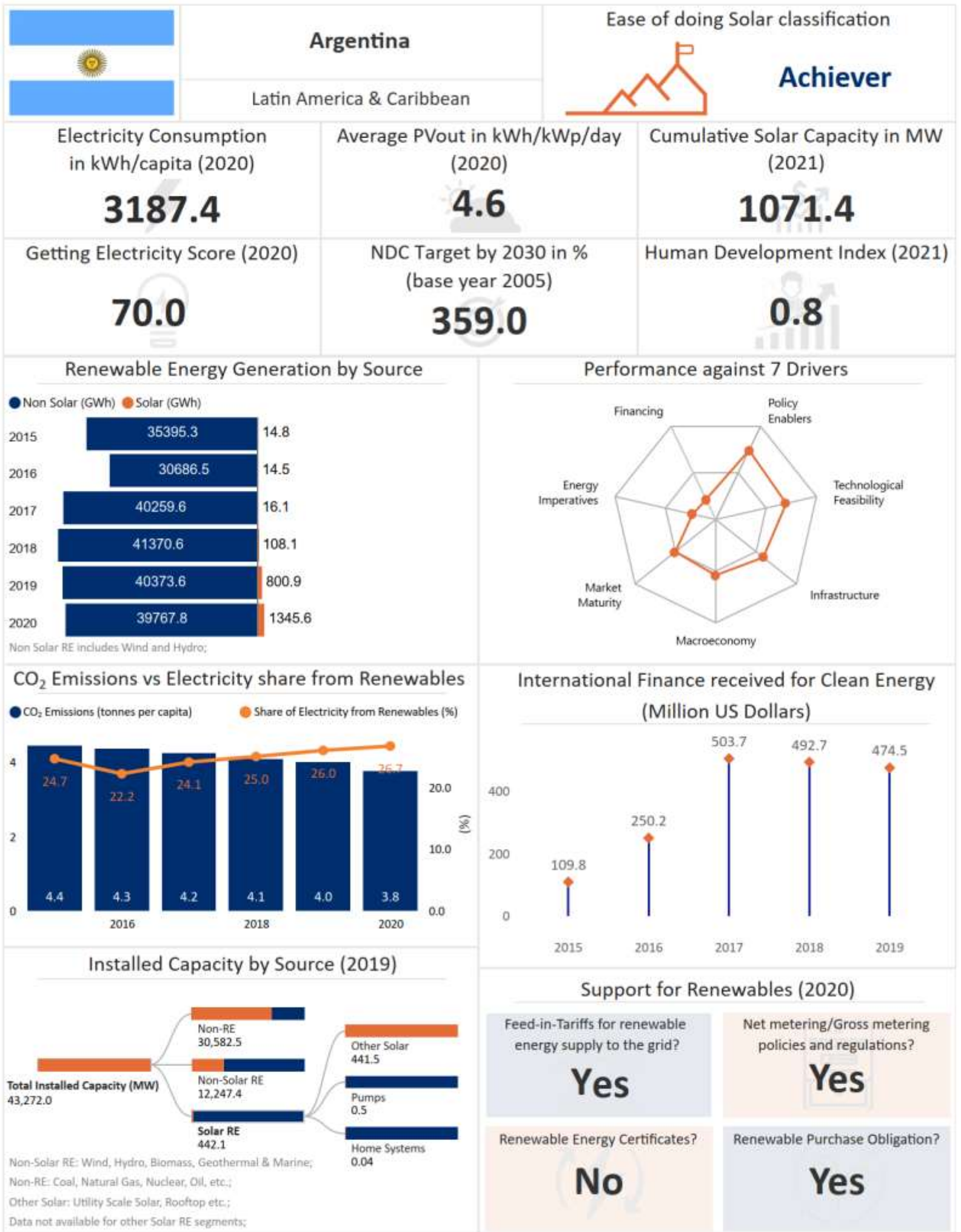
Financing

- The government has established the Sustainable Island Resource Framework (SIRF) fund to synergise internal and external funding from multiple agencies to achieve the climate and sustainability goals.³
- A funding of USD 15 Mn has been sanctioned by the Abu Dhabi Fund for Development (ADFD) for the construction of an 8 MW solar and wind hybrid power plant under the seventh cycle of the IRENA/ADFD project facility.¹¹
- The governments of the United Arab Emirates, Antigua and Barbuda, and New Zealand, as well as the Antigua Public Utilities Authority (APUA) and the Barbuda Council are providing financial support for the government's plans to build a hybrid power plant (comprising solar, battery storage, and diesel energy sources).¹²



Energy Imperatives

- In 2020, the per capita electricity consumption stood at of 3.27 MWh which is close to the global average of 3.31 MWh.⁶
- Peak electricity demand in the country has remained consistent at 0.32 TWh in the past two years.⁶
- In 2021, the total installed capacity in the country has reached 0.09 GW with thermal power plants having 88.89% share followed by solar power having 11.11% share respectively.⁶
- The total installed solar PV capacity has grown at a CAGR of 31.4% reaching 12.9 MW in 2021 from 4.3 MW levels in 2017.⁷



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Argentina is an upper middle-income country with a GDP per capita (PPP) of USD 23,649 in 2021.^{1,4}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 9.9% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 10.2% which is one of the fastest recoveries in the world.¹
- The inflation rate (CPI) of Argentina has increased to 48.4% in 2021 from 42.0% levels in 2020.¹
- The general government gross debt to GDP has shown improvement reaching 80.6% in 2021 from 102.8% levels in 2020.¹



Policy enablers

- To promote development of RE, many initiatives like auctions, net metering, import tax, vat incentives, FITs have been implemented.^{8,11}
- The government launched RenovAR (Argentina Renewable Energy Auctions) with an aim to achieve 20% share of RE in the generation mix by 2025.^{3,12}
- In 2021, the government announced a Law Project to boost domestic production of EV. This will facilitate the creation of a 20 year support scheme for electric mobility both for consumers and manufacturers and establishment of national agency for sustainable mobility.¹³



Technological Feasibility

- Argentina receives high levels of solar irradiation (GHI) of 5.1 kWh/m²/day and specific yield 4.6 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁵
- In 2021, 11.22% of the country's power demand was met through RE sources.⁶
- In June 2022, the government published "Resolution 330" in the official gazette launching an EOI request for the development of various energy projects in the country including renewables and battery storage.¹⁵



Market Maturity

- 100% of the population in Argentina had access to electricity as of 2020.⁴
- The power sector in Argentina is regulated by Ente Nacional Regulador de la Electricidad (ENRE). The generation, transmission, and distribution utilities are unbundled with multiple companies operating in these areas.³
- The Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) is the administrator of wholesale electricity market.¹⁰



Infrastructure

- The transmission system of Argentina operates on voltage levels ranging from 66 kV to 500 kV AC. The total length of the transmission network is expected to reach 37,152 ckm in 2022 from 35,096 ckm in 2021.³
- Interconnectors connect Argentina's national grid to that of Uruguay, Brazil, Chile, and Paraguay.³
- In Urban areas electricity distribution is handled by three major private companies: EDENOR, EDESUR, and Edelap while rural areas are being handled by the government and local co-operative organisations.³



Financing

- According to BNEF's climatescope report 2021, Argentina ranked 4th in the region and is the one of the top choices for investments in clean energy space. Furthermore, it has also ranked 25th in the EY Renewable Energy Country Attractiveness Index (RECAI) in 2022.^{9,19}
- "Fondo para el Desarrollo de Energías Renovables" (FODER) trust was formed in 2017 with an initial commitment of USD 819 Mn to support the development of RE in the country.³
- In the ensuing years, the country aims to attract USD 35 Bn investments in energy sector half of which will be utilized for renewable sector.¹⁴



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 3.19 MWh which is close to the global average of 3.31 MWh.⁶
- The total installed capacity of solar PV witnessed a CAGR of 232.12% between 2017-2021 reaching 1071.4 MW in 2021 from 8.81 MW levels in 2017.⁷
- In 2021, the total installed capacity in the country reached 43.14 GW with a significant share coming from natural Gas (53.0%), RE hydro (24.0%), wind (7.6%), oil (5.9%), nuclear (4.1%), solar PV (2.5%) and other sources.⁷



Australia

Asia & Pacific

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

10386.2

Average PVout in kWh/kWp/day
(2020)

4.7

Cumulative Solar Capacity in MW
(2021)

22867.0

Getting Electricity Score (2020)

82.3

NDC Target by 2030 in %
(base year 2005)

43.0

Human Development Index (2021)

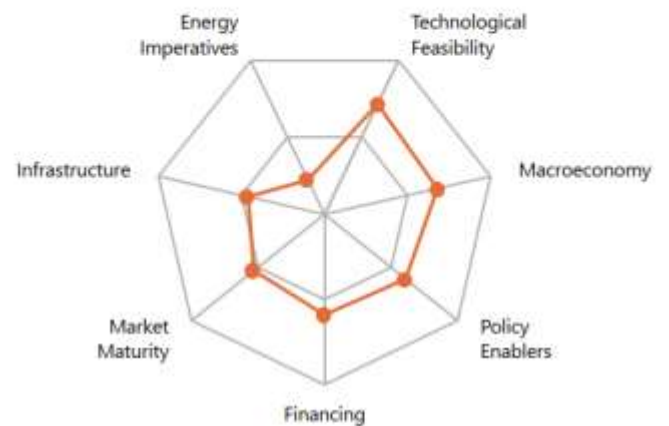
1.0

Renewable Energy Generation by Source

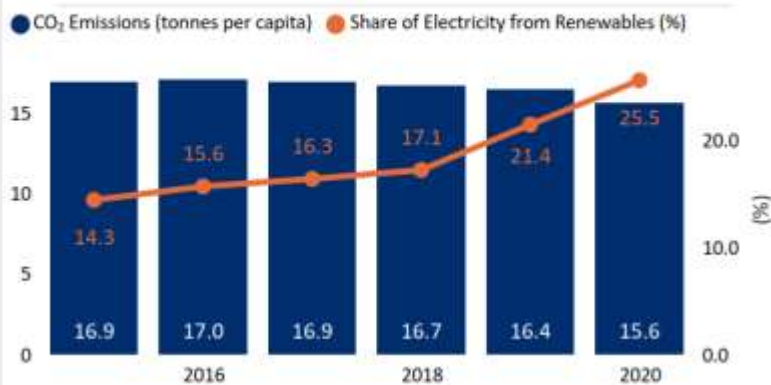


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

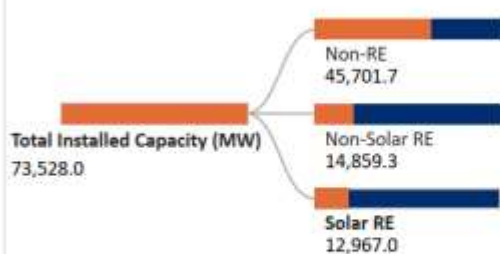
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

Yes

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

Yes

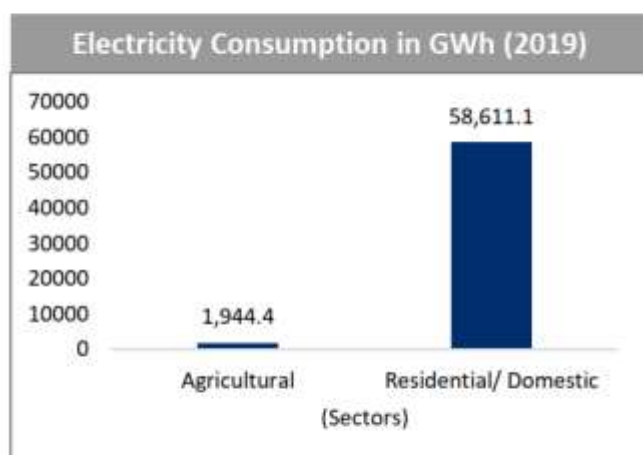
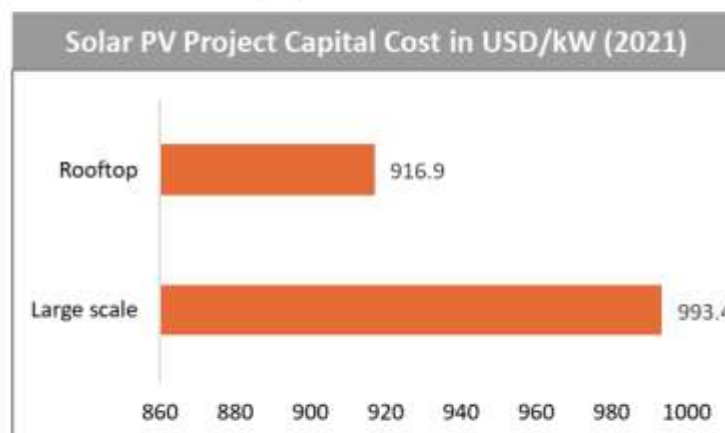
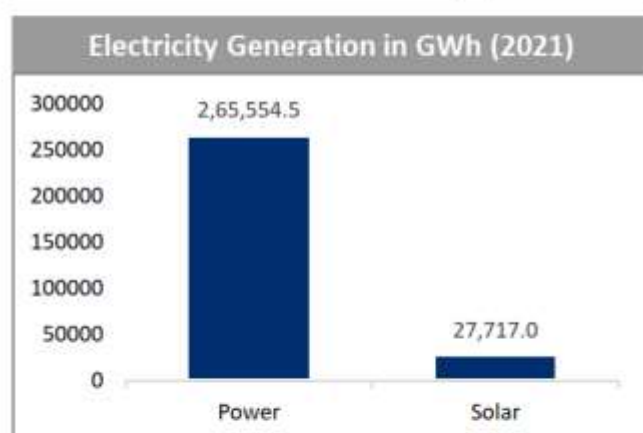
Renewable Energy Certificates?

Yes

Renewable Purchase Obligation?

Yes

| Peak Demand/Load in GW (2021) | Electricity Consumption CAGR in % (2022 - 2026) | Diesel based Electricity Generation in GWh (2021) |
|-------------------------------|---|---|
| 31.9 | 1.4 | 4,662.0 |



| Financial Support Mechanisms (2021) | |
|---|----|
| Duty waivers to solar developers for importing/procuring material from foreign land | No |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Australia is a high-income country¹ with GDP per capita (PPP) of USD 55,949 as of 2021. Service and manufacturing sectors are the major contributors to the economy with 72% and 26% of total GDP respectively.³
- GDP (Real) grew at an annual rate of 4.5% in 2021 and it is estimated that it will further grow at 4.2 % in 2022.⁴
- Inflation rate in the country increased to 2.8% in 2021 from 0.9% levels in 2020 while the estimated public debt is at 59.81% of GDP as of 2021.^{5,6}



Policy enablers

- Australian Renewable Energy Agency (ARENA)⁷ is the nodal agency to support energy transition to net zero emissions.
- By 2030, the country aims to reduce GHG emissions by 43% below its 2005 levels and is slated to reach net zero emissions by 2050.²⁶
- The Ministry for Climate Change and Energy aims to increase the renewable electricity generation to 82% of total electricity generation by 2030.²⁶
- The Small-scale Renewable Energy Scheme (SRES) provides a financial incentive for households and businesses to install eligible small-scale renewable energy systems.⁹



Technological Feasibility

- The country receives very high levels of solar irradiation (GHI) of 5.8 kWh/m²/day and specific yield 4.7 kWh/kWp/day indicating a strong technical feasibility for solar in the country.¹¹
- The country typically receives 58 Mn petajoules of sunlight per annum.²⁶
- ARENA has supported Power Water Corporation in developing handbooks for solar/diesel mini grid to provide information about the key technical, design, implementation and operational considerations for planning solar/diesel hybrid mini-grid systems in remote Australia.¹²
- ARENA has funded two battery storage projects named as Yuri Renewable Hydrogen to Ammonia Project and Darlington Point Energy Storage System (both started in 2022) with USD 55.96 Mn and USD 20.77 Mn respectively.¹³



Market Maturity

- 100% of the population in the country has access to electricity as of 2020.¹⁴
- The power sector is vertically unbundled and there are separate entities for Generation, Transmission and Distribution¹⁵ with two national grids.¹⁶
- Australian Energy Regulator (AER) regulates energy network, retail energy market and wholesale energy market.¹⁷



Infrastructure

- The present transmission network length is 9,18,000 ckm²⁸ which is comprises of voltage levels from 11 kV to 500 kV with 99.5% availability of electricity grid.¹⁸
- In 2018-19, 26,850 jobs in renewable energy activities were created which was 27% more than previous year levels.¹⁹
- The seasonal/yearly peak demand for the National Electricity Market that has been met during 2021 is 32,761 MW (summer) and 31,945 MW (winter) respectively.²⁶



Financing

- The Clean Energy Finance Corporation (CEFC) is a state-owned green bank that facilitates finance to clean energy projects by investing USD 6.67 Bn on behalf of the Australian Government.²⁰
- The Australian Government with its Powering Australia Plan would invest USD 13.37 Mn to upgrade electricity grid and to support renewable power plan.²²



Energy Imperatives

- As per 2021 data, coal dominates the total installed capacity with a share of 31% followed by solar PV (22%) and natural gas (21%).²³
- The total installed capacity of rooftop solar and solar mini-grids are 16,500 MW and 30 MW in 2021.²⁶
- Of the total electricity generation of 2,65,554 GWh, solar electricity generation contributed 27,716 GWh in 2021.²⁶
- In 2020, the per capita electricity consumption stood at 10.4 MWh which is significantly higher in comparison to the global average of 3.31 MWh.²⁴



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Bahrain is a high-income country¹ with GDP per capita (PPP) of USD 54,256² as of 2021. 56.65% of share of the GDP is dominated by services, 40.28% by Industry, 18.13% by Manufacturing and 0.31% by Agriculture.⁴
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 4.9% in 2020. However, in 2021, the GDP bounced back with an annual growth rate of 2.2%.²
- The inflation rate (CPI) of Bahrain has increased to -0.6% in 2021 from -2.3% levels in 2020.²
- The general government gross debt to GDP has reached 128.5% in 2021 from 129.7% levels in 2020.³



Policy enablers

- The Government of Bahrain has recently come up with a National Renewable Energy Action Plan (NREAP) with a target of taking up the RE share in the generation mix to 10% by 2035.⁵
- To meet the country's renewable energy targets, Bahrain's Sustainable Energy Authority (SEA) has outlined a target of 80 MW of electricity from renewables by 2025 and 710 MW by 2035.⁶
- SEA has also come up with Green Building Labelling Programme to achieve energy efficiency goals as envisaged by National Energy Efficiency Action Plan (NEEAP).⁸
- To stimulate private sector investments policies such as net metering scheme, tender-based feed-in tariffs and renewable energy mandate for new buildings have been rolled out for private investors.⁹



Technological Feasibility

- Bahrain receives high levels of solar irradiation (GHI) of 5.8 kWh/m²/day and specific yield 4.9 kWh/kWp/day indicating a strong technical feasibility for solar in the country.¹⁰
- Bahrain's SEA has planned to develop a 4 MW Plant for the production of Green Hydrogen at an estimated cost of USD 150 Mn.¹¹



Market Maturity

- 100% of the population in Bahrain has access to electricity.¹²
- Bahrain accounted only 0.14% share of RE in generation mix in 2021.¹³
- The power sector in Bahrain is regulated by Electricity & Water Authority (EWA).¹⁴
- The generation sector has presence of EWA owned power plants and Independent Power Producers (IPPs) while transmission and distribution sectors are wholly controlled by EWA.¹⁵



Infrastructure

- The transmission system of Bahrain operates between 66 kV to 220 kV AC voltage levels.¹⁵
- Bahrain, being an energy surplus country, has exported 0.45 Bn kWh of electricity in 2019.¹⁶
- Bahrain Electricity & Water Authority has signed USD 28.7 Mn Contract with GE Digital for Grid Software Solutions in 2021.¹⁷



Financing

- The Kingdom's Economic Recovery Plan is funding over USD 30 Bn of investments in strategic projects which includes renewable projects as well.²²
- Kuwait Finance House (KFH) would be financing a solar energy farm at the Bahrain International Circuit which would support Bahrain's endeavours towards reducing carbon emission.²³



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 17.5 MWh, which is significantly higher than the global average of 3.31 MWh.¹⁸
- The installed solar PV capacity witnessed a CAGR of 17.2% between 2017-21 reaching 11.3 MW in 2021 from 6.0 MW levels in 2017.¹⁹
- The peak demand for electricity in Bahrain stood at 29.83 TWh remaining same in 2021 and 2020.²⁰
- In 2021, gas based thermal power plants dominated the generation mix having 99.9% share in the mix.²¹
- In the last decade, the total power demand in the country has risen at a CAGR of 5.4% reaching 361,462 GWh in 2019 from 225,662 GWh in 2010.⁴



Bangladesh

Asia & Pacific

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

458.6

Average PVout in kWh/kWp/day
(2020)

3.9

Cumulative Solar Capacity in MW
(2021)

329.1

Getting Electricity Score (2020)

34.9

NDC Target by 2030 in %

15.12

Human Development Index (2021)

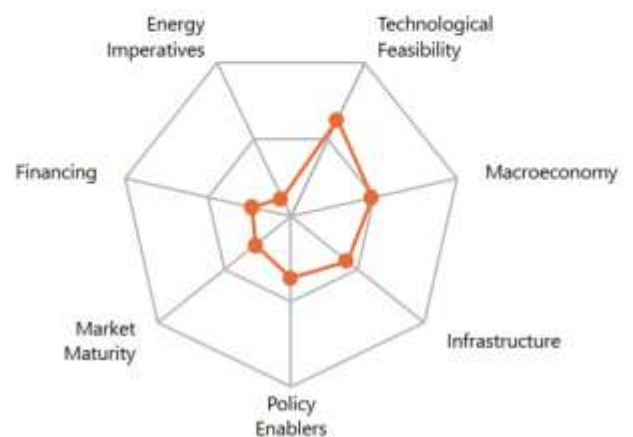
0.7

Renewable Energy Generation by Source

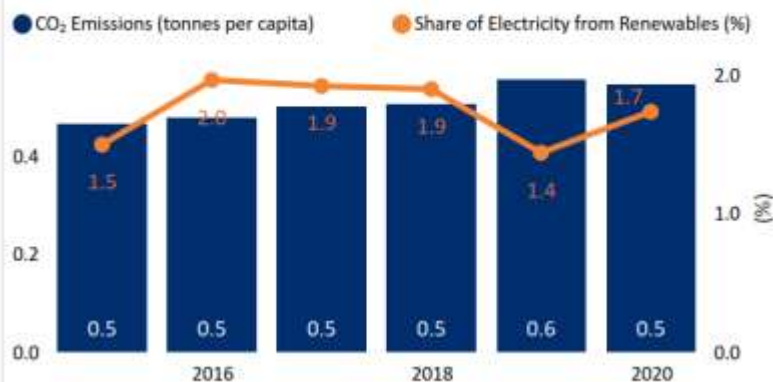


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



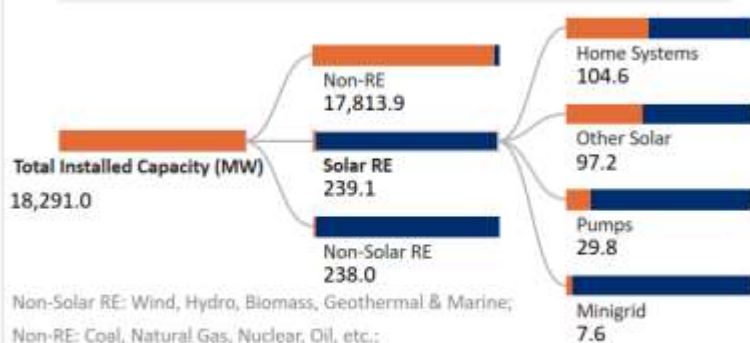
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

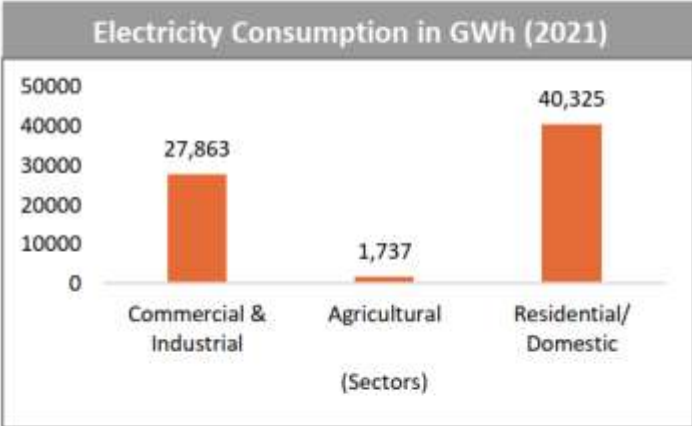
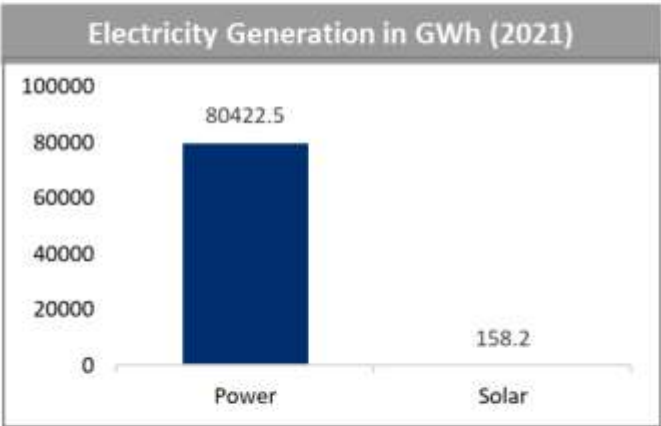
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

| Peak Demand/Load in GW (2021) | Average Term of Solar PPAs in years (2021) | Threshold for licensing Solar in MW (2021) |
|-------------------------------|--|--|
| 13.8 | 20.0 | 5.0 |



| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| Yes | Yes | Yes | Yes | Yes | No | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | No |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Bangladesh is a lower middle-income² country having GDP per capita (PPP) of USD 6,494 in 2021¹ with service and agriculture sectors as the dominant contributors to the economy.⁶
- Bangladesh's GDP (Real) grew at an annual rate of 5% in 2021 and it is estimated to grow at 6.4% in 2022³ with public debt of 41.39 % of GDP as of 2021.⁴
- Inflation rate in the country marginally decreased to 5.6% in 2021 from 5.7% levels in 2020.⁵



Policy enablers

- Bangladesh has constituted Sustainable and Renewable Energy Development Authority (SREDA) as the nodal agency for all RE related initiatives.⁷
- Bangladesh targets to increase the share of solar to 10% of the energy mix by 2030.³⁰
- Bangladesh government directed all scheduled banks to allocate a minimum of 2% of their financing towards green finance and 15% towards sustainable finance (including green finance).¹¹
- Bangladesh Council of Scientific and Industrial Research (BCSIR) is working towards setting up full-fledged hydrogen energy laboratory.¹⁴



Technological Feasibility

- The country receives moderate levels of solar irradiation (GHI) of 4.6 kWh/m²/day and specific yield 3.9 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.¹⁶
- The country typically receives 8 hours of sunlight per day.³⁰
- Infrastructure Development Company Ltd (IDCOL) is the implementing agency for all mini grid projects and currently there are 7 solar PV-diesel hybrid mini grids operating in Bangladesh.¹⁷



Market Maturity

- 96.2% of the population in the country had access to electricity as of 2020.²⁰
- For generation & distribution-Bangladesh Power Development Board is the sole entity whereas for transmission PowerGrid Company of Bangladesh owns and manages the network comprising of 132 kV, 230 kV and 400 kV voltage levels.²¹
- Bangladesh Energy Regulatory Commission (BERC) advises to the government regarding electricity generation, transmission, marketing, supply, distribution, and storage of energy and has also formulated the Electricity Grid Code.^{25,22}



Infrastructure

- The country's transmission network voltage is at 11 kV and 132 kV with 6,29,000 ckm and 13,889 ckm of transmission lines.³⁰
- Bangladesh is modernising its electricity distribution network through Electricity Distribution Modernization Program, funded by World Bank with Bangladesh Rural Electrification Board as the implementing agency.²⁶
- The country's average transmission and distribution loss levels are 3% and 8% respectively in 2021.³⁰



Financing

- The Asian Development Bank (ADB) is one of the key financing agencies in Bangladesh. In 2020 it had signed USD 17.7 Mn financing package with Spectra Solar Park Ltd (SSPL) to install 35 MW solar PV plant.²⁹
- The World Bank has helped Bangladesh by providing financing for building a modern, reliable and sustainable electricity supply system.²⁸
- The Asia Infrastructure Investment Bank (AIIB) being an investment agency continues to finance multisectoral project through IDCOL in Bangladesh.²⁹



Energy Imperatives

- Of the total electricity generation of 80,422 MU, solar electricity generation contributed 158 MU in 2021.³⁰
- The total installed capacity of rooftop solar and solar mini-grids are 85 MW and 6 MW in 2021.³²
- The average capital cost of a solar PV project in Bangladesh is USD 770,930/MW as of 2022.³⁰
- The average solar tariff in Bangladesh stood at 0.1075 USD/kWh and 0.1025 USD/kWh in 2019 and 2021 respectively.

30



Barbados

Latin America & Caribbean

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

3375.4

Average PVout in kWh/kWp/day
(2020)

4.7

Cumulative Solar Capacity in MW
(2021)

50.0

Getting Electricity Score (2020)

66.2

NDC Target by 2030 in %

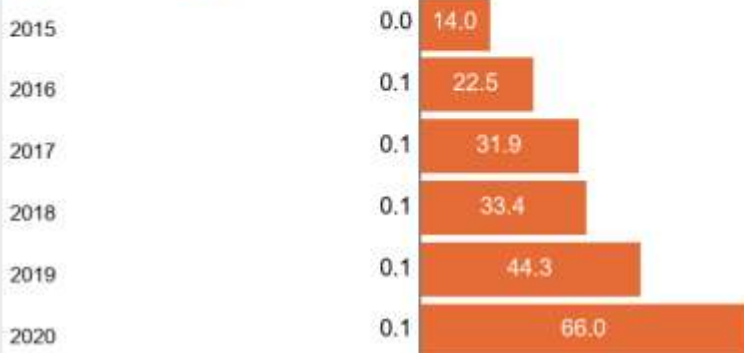
70.0

Human Development Index (2021)

0.8

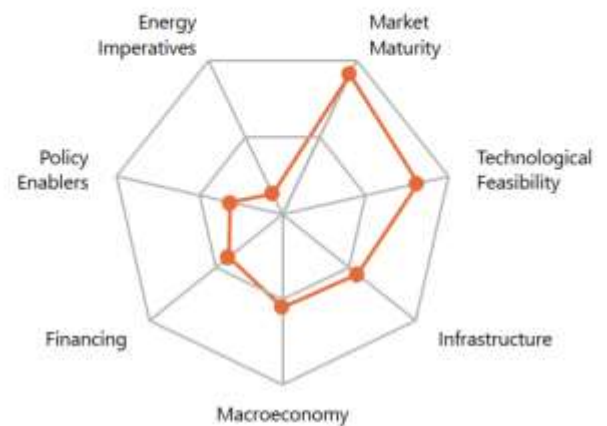
Renewable Energy Generation by Source

● Non Solar (GWh) ● Solar (GWh)



Non Solar RE includes Wind and Hydro;

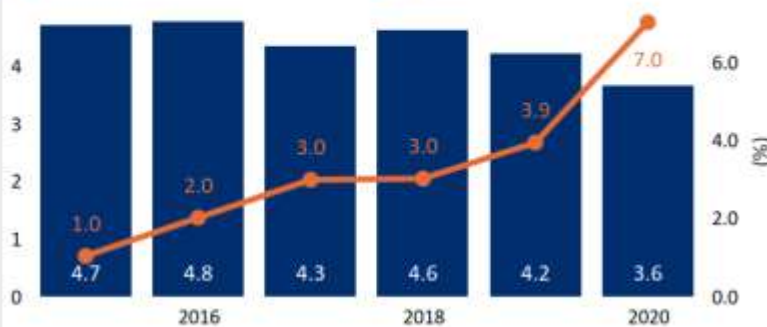
Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables

● CO₂ Emissions (tonnes per capita)

● Share of Electricity from Renewables (%)



Fiscal Incentives & Public Financing for Renewables (2020)

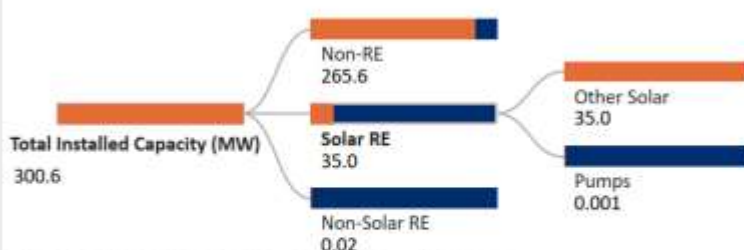
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

Yes

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

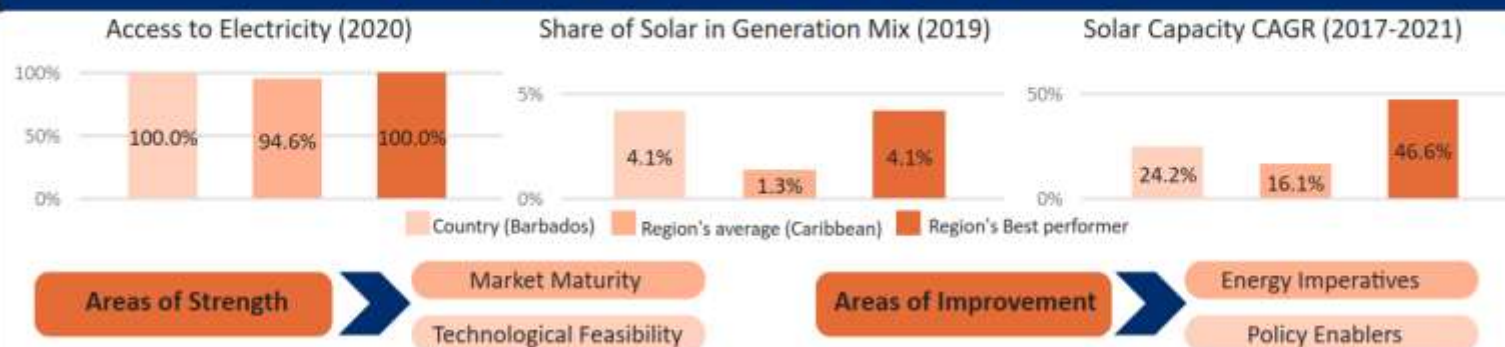
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Barbados is a high-income country with a GDP per capita (PPP) of USD 15,111 in 2021.^{1,4}
- Due to COVID-19 Pandemic, the GDP (Real) contracted by 13.7% in 2020. However, in 2021 it has bounced back growing at a rate of 0.7%.¹
- The inflation rate (CPI) of the country has increased to 3.1% in 2021 from 2.9% levels in 2020.¹
- The general government gross debt to GDP has reduced to 135.4% in 2021 from 147.0% levels in 2020.¹



Policy enablers

- By 2030, the country aims to achieve a 100% share of RE in the electricity generation mix.⁹
- To promote the development of RE in the country several incentives- such as tax credits, tax exemptions/reductions, availability of interconnections standards and net metering- have been implemented in the country.⁶



Technological Feasibility

- Barbados receives high levels of solar irradiation (GHI) of 5.8 kWh/m²/day and a specific yield 4.7 kWh/kWp/day indicating very strong technical feasibility for solar in the country.³
- In 2021, 4.12% of the country's power demand was met through RE sources.



Market Maturity

- 100% of the population in Barbados had access to electricity as of 2020.²
- Utility Regulation Department, Fair Trading Commission is the designated agency that regulates the energy sector in the country.⁶
- The Barbados Light and Power Company (BL&P) is responsible for generation, transmission, and distribution of electricity in the country.⁶



Infrastructure

- The country has reported T&D losses of 5% in 2018 indicating an efficient power infrastructure.⁹
- The power infrastructure in the country operates at voltages ranging from 115 V to 69 kV with transmission and distribution lines spanning more than 150 kms and 2,800 kms respectively.¹⁰



Financing

- Backed by Inter-American Development Bank (IADB), the USD 45 Mn Sustainable Energy Investment Programme (Energy Smart Fund 2) aims to provide funding and technical support to the RE projects in the country.⁸
- As per the country's National Energy policy (2019-30), the government aims to develop international financing and assistance program to catalyse the growth of RE in the country.⁷



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 3.38 MWh which is slightly higher in comparison to the global average of 3.31 MWh.⁴
- The total installed capacity of solar PV witnessed a CAGR of 24.2% reaching 50 MW in 2021 from 21 MW levels in 2017.⁴
- The peak demand for electricity in the country has remained constant at 0.92 TWh in 2021 and 2020.⁴
- In 2021, the total installed capacity in the country stood at 0.32 GW with a significant share coming from oil (84.4%) followed by solar (15.6%).⁴



Belize

Latin America & Caribbean

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

1483.8

Average PVout in kWh/kWp/day
(2020)

4.2

Cumulative Solar Capacity in MW
(2021)

6.6

Getting Electricity Score (2020)

73.7

NDC Target by 2030 in
KtCO₂e

5647.0

Human Development Index (2021)

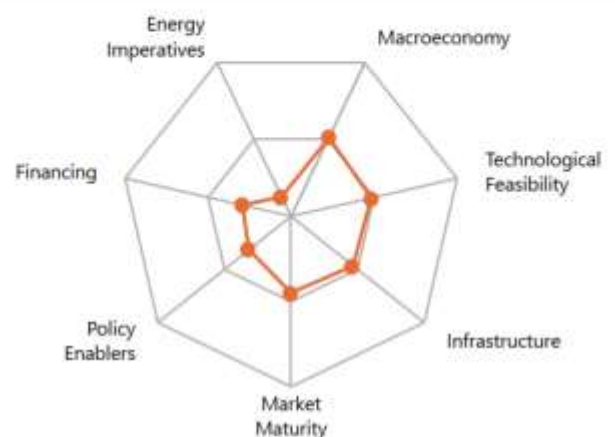
0.7

Renewable Energy Generation by Source

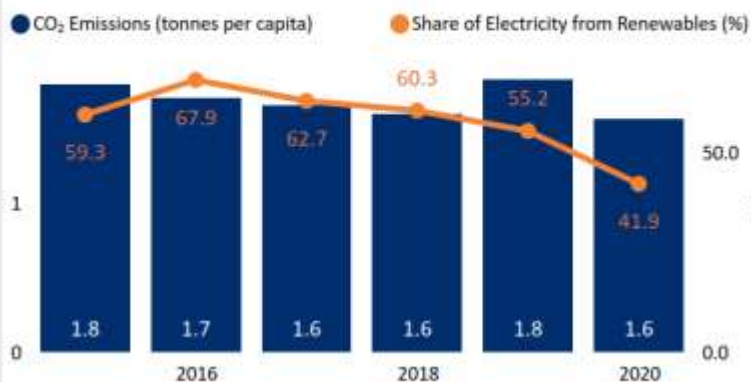


Non Solar RE includes Wind and Hydro;

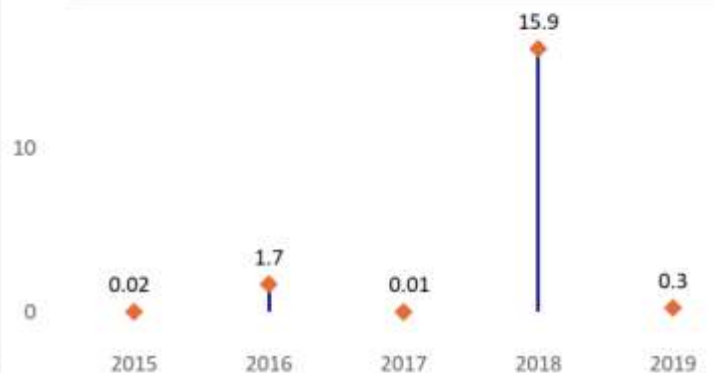
Performance against 7 Drivers



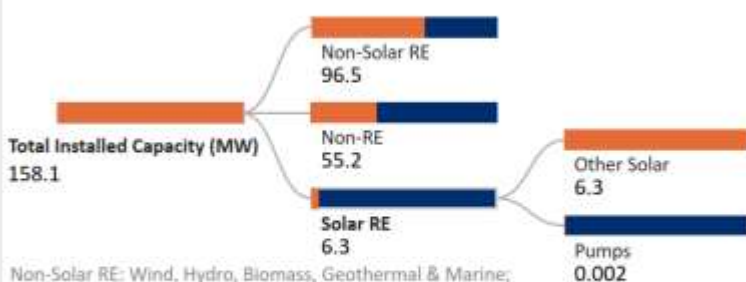
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

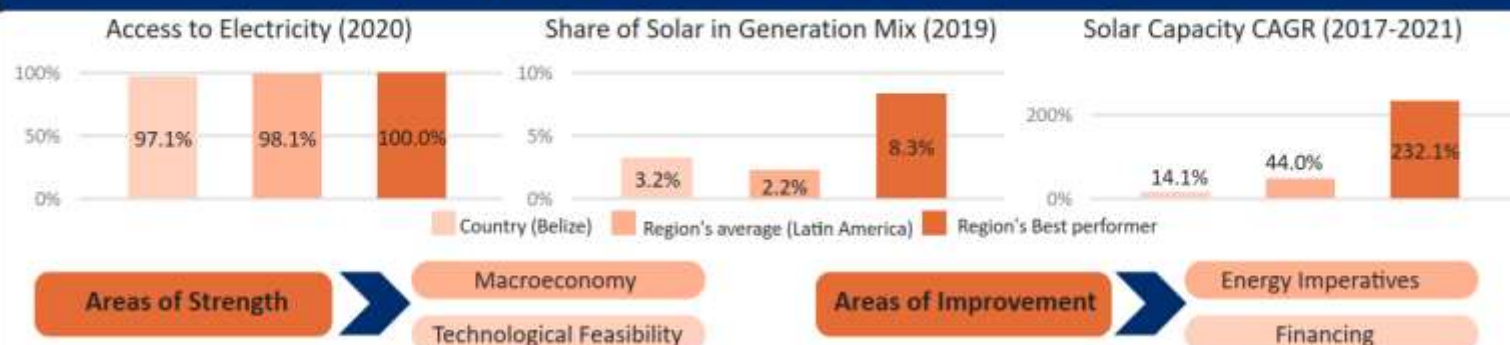
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Belize is upper middle-income country with a GDP per capita (PPP) of USD 9,627 in 2021.^{1,4}
- Due to COVID-19 Pandemic, the GDP (Real) contracted by 13.7% in 2020. However, in 2021 it has bounced back growing at a rate of 16.3%.¹
- The inflation rate (CPI) of the country has increased to 1.5% in 2021 from 0.6% levels in 2020.¹
- The general government gross debt to GDP has reached 60.6% in 2021 from 59.3% levels in 2020.¹



Policy enablers

- By 2030, the country aims to achieve 85% share of RE in the generation mix.⁷
- To promote the development of RE, the country offers various incentives such as tax exemptions, tax credits, RE auction.¹²



Technological Feasibility

- Belize receives high levels of solar irradiation (GHI) of 5.05 kWh/m²/day and specific yield 4.2 kWh/kWp/day indicating strong technical feasibility for solar in the country.³
- The country is highly dependent on imported fossil fuels for generation of electricity thus making it susceptible to fluctuating oil prices.⁴
- In 2021, 27.1% of the country's power demand was met through RE sources.⁴



Market Maturity

- As of 2020, 97.1% of the population in the country had access to electricity.²
- The Public Utilities Commission regulates the energy sector in the country.⁶
- Belize Electricity Limited (BEL), a public utility, is responsible for the generation, transmission, and distribution of electricity in the country.
- While the transmission and distribution sectors are controlled by BEL, the generation sector has presence of other companies such as HML, BELCOGEN, SSEL and BAPCOL.⁶



Infrastructure

- By 2030, the country aims to increase system efficiency by bringing the T&D losses to 7% level.⁷
- The power infrastructure operates on 115 V to 69 kV with the total length of transmission lines reaching 442 km as of 2021.^{10,11}



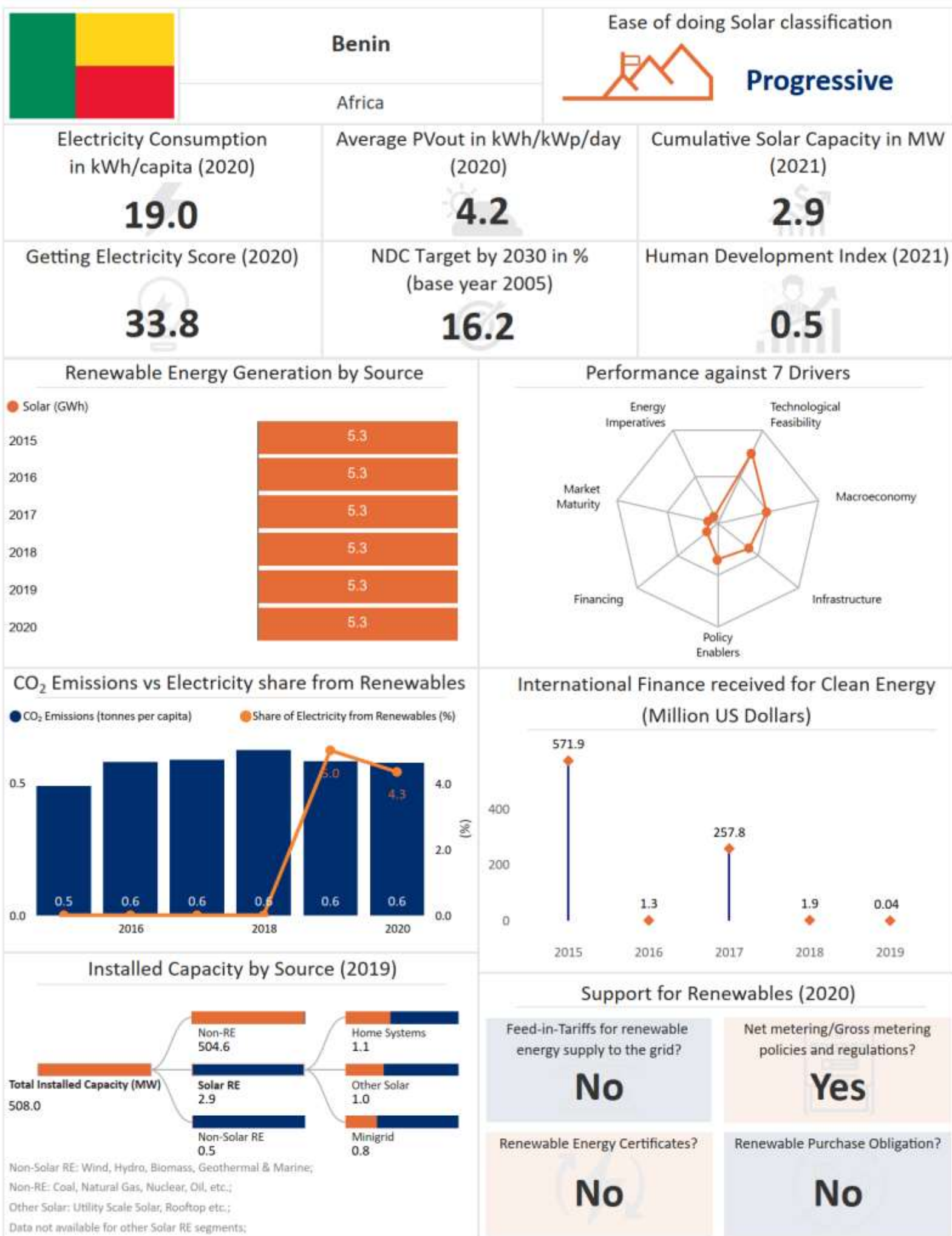
Financing

- The development finance corporation of Belize offers 100% financing up to USD 300,000 at low interest rates for RE projects, EVs and other solar based appliances to accelerate the adoption of these technologies.⁸
- The UAE-Caribbean Renewable Energy Fund (UAE-CREF) in 2020 has sanctioned a USD 50 Mn loan for hybrid solar-diesel power plant equipped with battery storage.⁹

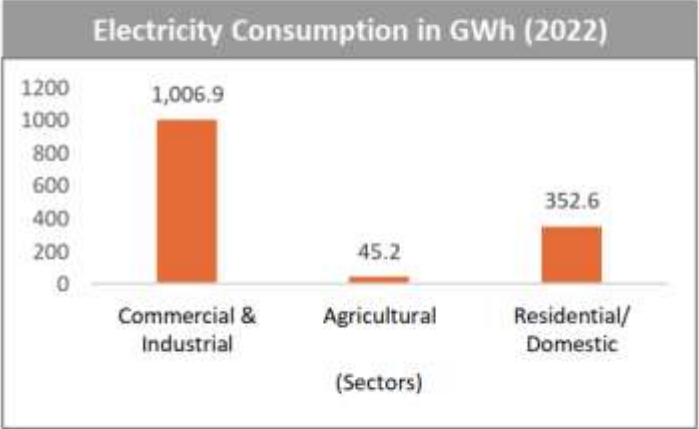
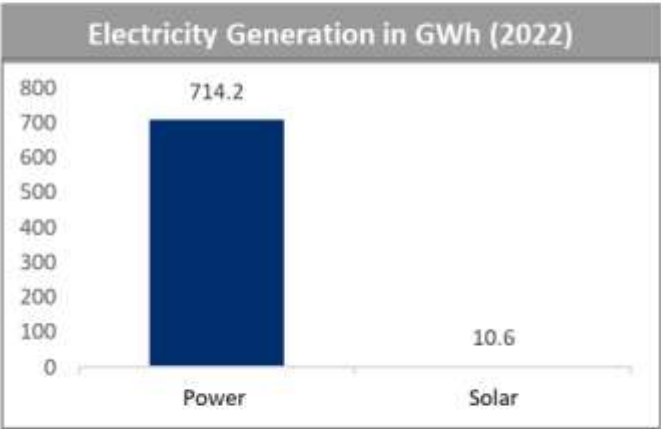


Energy Imperatives

- In 2020, the per capita electricity consumption of 1.48 MWh is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The peak demand for electricity in the country has decreased in 2021 reaching 0.59 TWh from 0.83 TWh in 2020.⁴
- In 2021, the total installed capacity in the country stood at 0.19 GW with a significant share coming from oil (43.4%), renewable hydro (30.01%), bioenergy (22.8%) and solar PV (3.3%).⁴



| Peak Demand in MW (2022) | Electricity Consumption CAGR in % (2022 - 2026) | Threshold for licensing Solar in MW (2018) |
|--------------------------|---|--|
| 310.0 | 1.4 | 0.5 |



| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| Yes | Yes | Yes | Yes | No | No | Yes | Yes | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Benin is a lower middle-income country¹ having GDP per capita (PPP) of USD 3,649 as of 2021² with agriculture (27.1% of GDP) and service sector (48% of GDP) as the dominant contributors to the economy.³
- GDP (Real) grew at an annual rate of 6.6% in 2021 and it is estimated to grow by 5.9% in 2022.⁴
- Total public debt in the country increased to 47.2% of GDP in 2021 from 46.1% levels in 2020.⁵
- Inflation rate in the country decreased to 1.7% in 2021 from 3% levels in 2020.⁶



Policy enablers

- Ministry of Energy is responsible for formulating and implementing national energy policy and regulations.⁷
- Benin aims to reduce its GHG emissions to 16.17% over the period 2021 to 2030.²⁴
- The Interprofessional Association for Renewable Energy Specialists (AISER) is an association mandated with development of RE in Benin.⁸
- Benin targets to increase the share of solar to 35% of the energy mix by 2030.²⁴
- The National Fund for Environment and Climate (FNEC) is a funding mechanism for promoting sustainable development in Benin.⁹



Technological Feasibility

- The country receives high levels of solar irradiation of 5.3 kWh/m²/day and specific yield of 4.2 kWh/kWp/day indicating a high technical for solar in the country.¹⁰
- The country typically receives 7 hours of sunlight per day.²⁴
- Engie Energy access operation aims at facilitating energy access for households and micro-entrepreneurs by financing the design, production, distribution, installation, and payment plans for 107,000 solar home systems in 2022.¹¹



Market Maturity

- Electricity Community of Benin (CEB) handles production, distribution, and importation of electricity in both Togo and Benin.¹³
- Benin Agency for Rural Electrification and Energy Control (ABERME) is the energy regulator and is responsible for rural energy supply across Benin.¹³
- The Benin National Electrification Strategy (SNE) aims to achieve universal access to electricity by 2030.¹⁴



Infrastructure

- The distribution network consists of 13 substations of 30/6.6 kV, 7,627 km of MV lines (at 6.6 kV and 30 kV), 6,761 km of low voltage lines and 3,511 MV/LV substations.¹⁵
- Benin imports electricity from Nigeria, Cote d'Ivoire, and Ghana through the Benin Electricity Community (CEB).¹⁶
- The country's average distribution loss levels in power sector is 21% in 2021.²⁴
- Benin's expected investment in the Transmission & Distribution Infrastructure over next 5 years (2022-2026) is USD 15.74 Mn.²⁴



Financing

- In 2022, the EIB has agreed to provide a EUR 10 Mn loan to support the deployment of 107,000 high-quality solar home systems to Benin.¹⁷
- The International Development Association (IDA) supported the Government of Benin with a credit of \$ 52.7 Mn. Also, Global Environment Facility (GEF) granted \$ 1.8 Mn under the Increased Access to Modern Energy Project (IAME).¹⁸
- In 2021, the World Bank approved \$100 Mn investment to support the Government of Benin for improving access to reliable and sustainable energy and improve fiscal and debt management.¹⁹

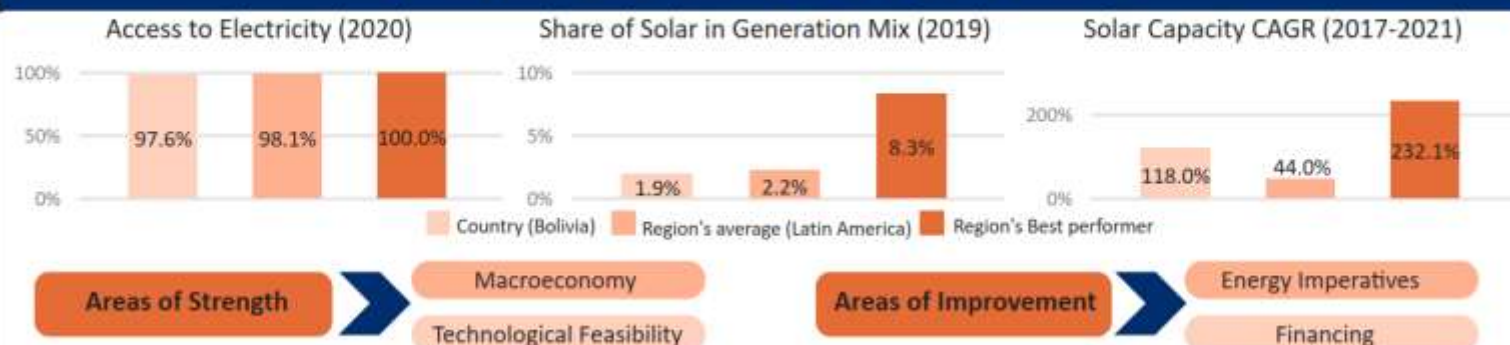


Energy Imperatives

- The total installed capacity in the country was 508 MW in 2019.²⁰
- In 2020, the per capita electricity consumption stood at 0.019 MWh which is significantly lower in comparison to the global average of 3.31 MWh.²²
- The price of electricity in the country is 19.6 US Cents/kWh as of 2019.²³



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Bolivia is a lower-middle income country¹ with a GDP per capita (PPP) of USD 8,846 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 8.7% in 2020. However, in 2021 it has bounced back recording an annual growth rate of 6.1%.³
- The inflation rate (CPI) of Bolivia has decreased to 0.7% in 2021 from 0.9% levels in 2020.⁴
- The general government gross debt to GDP has marginally increased to 80.5% in 2021 from 78% levels in 2020.⁵



Policy enablers

- Bolivia has set a target to achieve 183 MW through RE sources by 2025.⁶
- In March 2021, the Bolivian government introduced a net metering scheme for rooftop PV.⁶
- Bolivia has set a target to set up 8 isolated hybrid systems with RE sources in its power system by 2030.⁷
- As per NDC (2021-2030), Bolivia has set a target to attain an annual growth of 10% in the share of electric vehicles in the Bolivian public transportation by 2030.⁷



Technological Feasibility

- Bolivia receives high solar irradiation (GHI) of 5.4 kWh/m²/day and specific yield 4.9 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁸
- Bolivia has planned to make the country a global battery industrial hotspot.⁹
- In Feb 2021, Bolivia connected 100 MW Oruro Solar Plant to its main grid, a major step towards clean energy future.¹⁰
- Bolivia with the assistance of the World Bank has lightened up its rural area through solar power lights.¹¹



Market Maturity

- 97.6% of the population in Bolivia had access to electricity as of 2020.¹²
- Electricity Law defines the principles, institutional organisation, operational structure, and economic model of the electricity sector in Bolivia.¹³
- Bolivia's National Electricity Company (Empresa Nacional de Electricidad)-ENDE controls majority of the power sector in the country having 80% share in Generation & Transmission and 51% share in Distribution sector.¹⁴



Infrastructure

- Bolivia has a transmission system comprising of lines operating at 69 kV, 115 kV, 230 kV.¹⁵
- Bolivia has seven existing distribution companies having monopoly in operating areas.¹⁶
- Bolivia has two transmission companies Transportadora de Electricidad (TDE), and ISA Bolivia that are responsible for operation and maintenance of the network.¹⁶
- Bolivia has connected all major cities to main national grid except Tarija and Trinidad while transmission line for Tarija is under construction.¹⁶





Financing

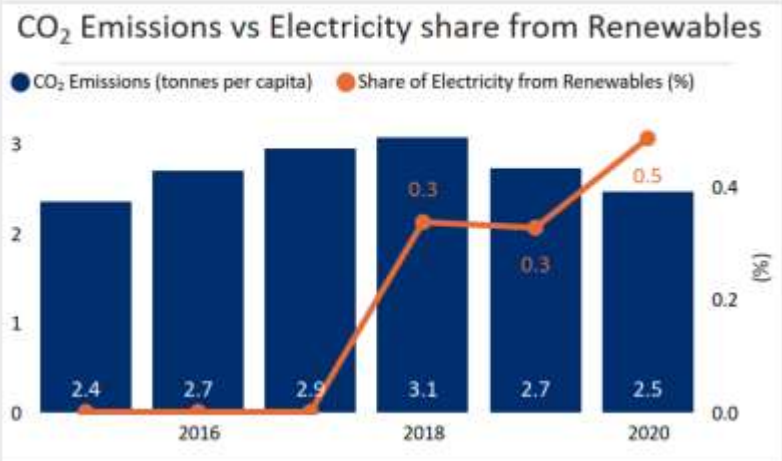
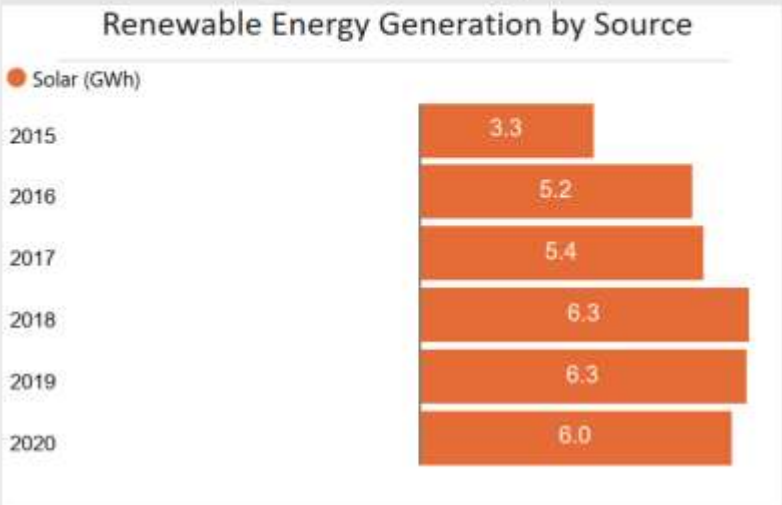
- CAF, Development Bank of Latin America has extended fund to all energy efficient and RE projects in Bolivia.¹⁷
- In 2018, Inter-American Development Bank (IDB) had approved USD 51.6 Mn loan to boost electricity sector in Bolivia.¹⁸
- The Green Climate Fund (GCF) has approved a funding of USD 1.1 Mn towards clean energy.¹⁹



Energy Imperatives

- In 2020, the per capita electricity consumption of 0.825 MWh in Bolivia is significantly lower in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of solar PV witnessed a CAGR of 118.0% reaching 170.33 MW in 2021 from 7.54 MW levels in 2017.²¹
- In 2021, the total installed capacity in the country stood at 3.58 GW²² with a significant share coming from gas (68.65%) followed by hydro (20.47%), solar (4.6%), wind (3.56%), biofuels (1.7%), biogas (0.14%), oil (0.88%).²²

| | | | | |
|--|-------|----------|--|------------|
|  | | Botswana |  | Influencer |
| | | Africa | | |
| Electricity Consumption in kWh/capita (2020) | 871.7 | | Average PVout in kWh/kWp/day (2020) | 5.1 |
| Getting Electricity Score (2020) | 59.5 | | Cumulative Solar Capacity in MW (2021) | 5.9 |
| | | | NDC Target by 2030 in % (base year 2010) | 15.0 |
| | | | Human Development Index (2021) | 0.7 |



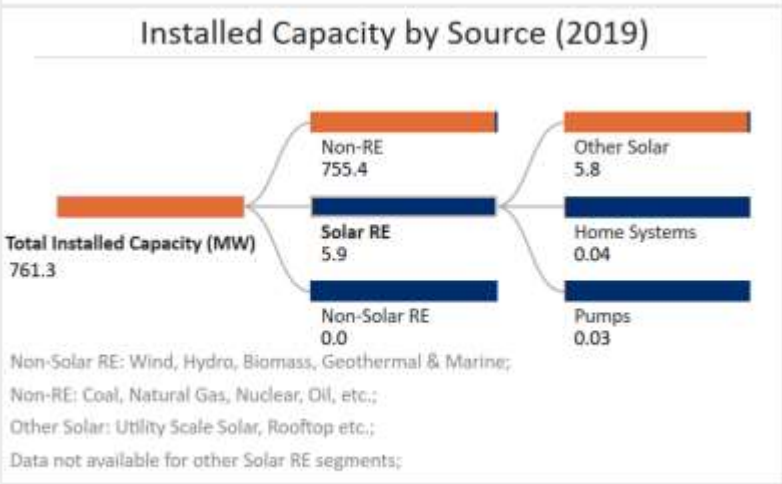
Fiscal Incentives & Public Financing for Renewables (2020)

Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

Yes



Support for Renewables (2020)

Feed-in-Tariffs for renewable energy supply to the grid?

No

Net metering/Gross metering policies and regulations?

Yes

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Botswana is an upper middle-income country¹ having GDP per capita (PPP) of USD 16,304 as of 2021.²
- GDP (Real) grew at an annual rate of 12.5% in 2021 and it is estimated to grow by 4.3% in 2022.³
- Inflation rate in the country increased to 6.7% in 2021 from 2.0% levels in 2020.⁵
- Total public debt is estimated at 18.6% of GDP as of 2021⁴ while the current account deficit narrowed to 1.9% of GDP in 2021 from 10.6% levels in 2020.



Policy enablers

- The country aims to meet 15% of its energy from RE by 2030, 36% by 2036, and 50% by 2040.⁶
- In 2020, the Government promulgated a 20-year Integrated Resource Plan (IRP) for electricity generation covering RE technologies such as solar PV, wind, concentrated solar thermal, and battery energy storage.⁶
- Botswana has strengthened climate finance resource mobilization through mechanisms such as the 2021 GCF program for RE and clean technology.⁴



Technological Feasibility

- The country receives high levels of solar irradiation of 6 kWh/m²/day and specific yield of 5.1 kWh/kWp/day, indicating a strong technical feasibility for solar in the country.⁸
- Government of Botswana through the Ministry of Investment, Trade, and Industry (MITI) aims to develop the local e-mobility industry to contribute towards reducing GHG emissions.¹⁰
- According to Africa Solar Industry Association (AFSIA), plans for green hydrogen projects in Botswana and Namibia have been quadrupled, from 1 GW to 5 GW of generation capacity.¹¹



Market Maturity

- Botswana Energy Regulatory Authority (BERA) is responsible for providing an efficient energy regulatory framework for Electricity, Gas, Coal, Petroleum products, Solar and all forms of RE.¹²
- The overall energy policy framework is overseen by the Ministry of Minerals, Green Technology and Energy Security (MMGE).⁶
- The Botswana Power Corporation (BPC), the national utility, has a monopoly over large-scale power generation, imports, transmission, and distribution.⁶



Infrastructure

- Botswana relies heavily on fossil fuels for its electricity generation depending on two major coal-fired power plants (Morupule A and B) and a number of diesel plants.¹⁵
- Botswana imports power from the Southern Africa Power Pool (SAPP) mainly from South Africa.¹⁵
- Botswana's power system is facing key challenges like unreliable power supply, lack of investment, poor maintenance, and high service costs.¹⁵



Financing

- The Sustainable Energy Fund for Africa (SEFA), managed by the AfDB, has approved a \$1 Mn grant to facilitate Botswana's transition to clean energy.¹⁶
- The AfDB contributes to enhance the policy, regulatory and institutional environment and enables investment in RE generation through the Botswana Renewable Energy Support Project.⁶
- The World Bank partners with the Government of Botswana to promote private sector-led jobs-intensive growth besides strengthening human and physical assets and supporting effective resource management.¹⁷



Energy Imperatives

- As of 2022, coal fired generating stations dominate the total installed capacity with a share of 99% in the mix. Botswana is in the process of rebalancing the power mix by involving the private sector to develop RE generating capacities.⁶
- The total installed capacity of solar PV witnessed a CAGR of 15% between 2017-2021 reaching 5.94 MW in 2021 from 3.40 MW levels in 2017.¹⁸
- In 2020, the per capita electricity consumption of 0.871 MWh is significantly lower in comparison to the global average of 3.31 MWh.¹⁹
- The price of electricity in the country is 14.4 US Cents/kWh as of 2019.²⁰



Brazil

Latin America & Caribbean

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

2922.7

Average PVout in kWh/kWp/day
(2020)

4.4

Cumulative Solar Capacity in MW
(2021)

13054.9

Getting Electricity Score (2020)

72.8

NDC Target by 2030 in %
(base year 2005)

50.0

Human Development Index (2021)

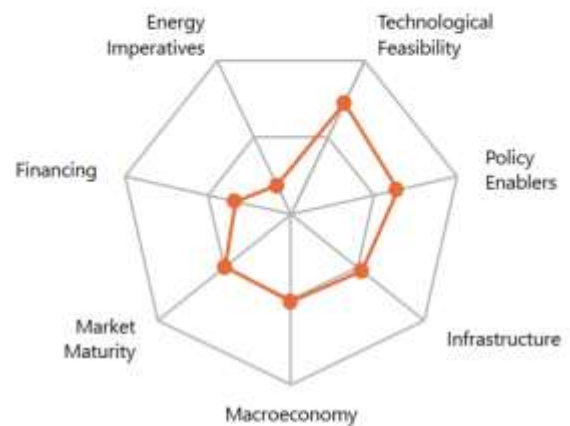
0.8

Renewable Energy Generation by Source

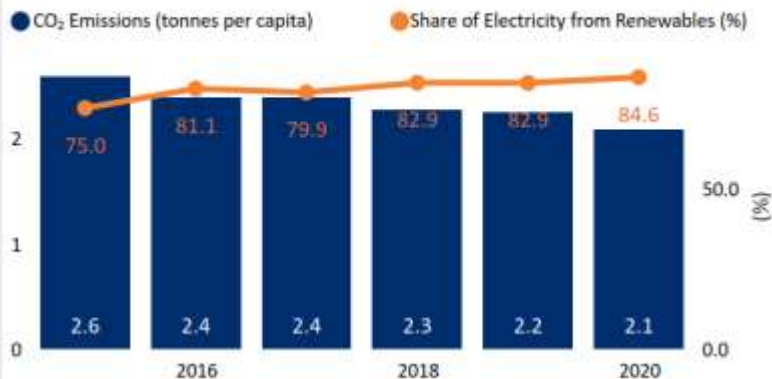


Non Solar RE includes Wind and Hydro;

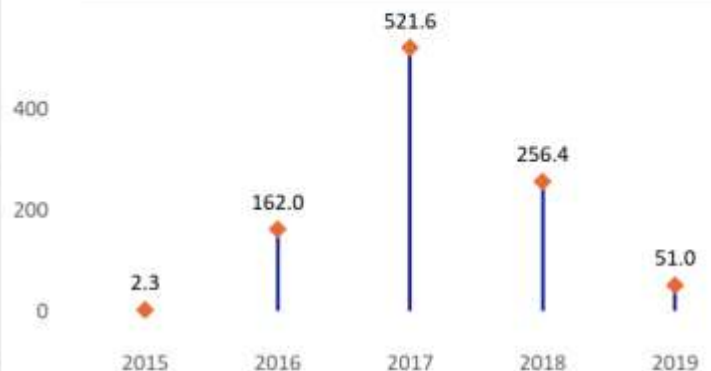
Performance against 7 Drivers



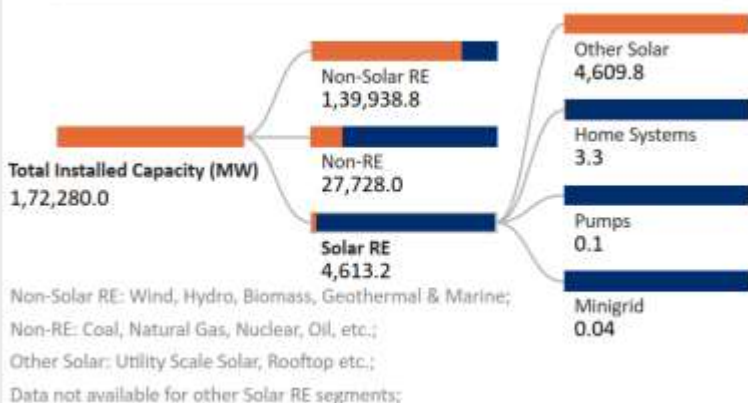
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

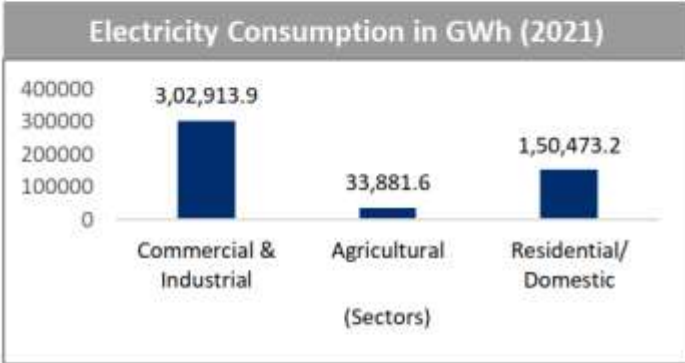
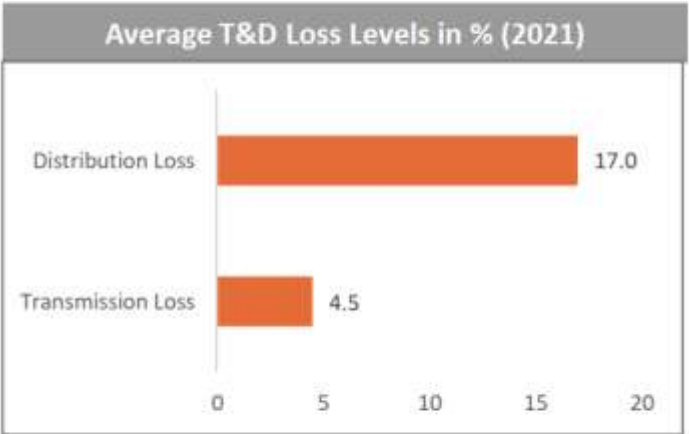
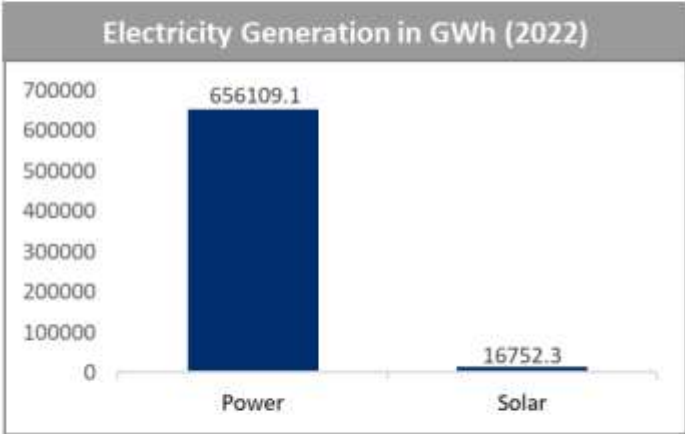
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

| Peak Demand/Load in MW (2021) | Electricity Consumption CAGR in % (2022 - 2026) | Average Capital Cost of Solar PV in USD/MW (2022) |
|-------------------------------|---|---|
| 87.2 | 4.4 | 3,23,466.0 |

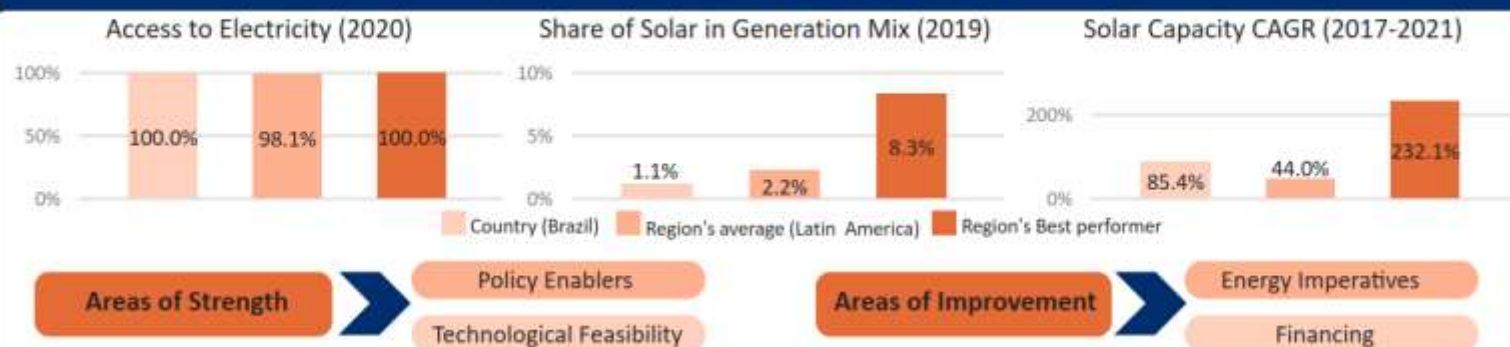


| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | Yes |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |

| Policies/Schemes for Solar segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | Yes | No | No | No | No | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Brazil is an upper middle-income country with a GDP per capita (PPP) of USD 16,031 in 2021.^{1,4}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 3.9% in 2020. However, in 2021 it has bounced back growing at a rate of 4.6%.¹
- The inflation rate (CPI) of the country has increased to 8.3% in 2021 from 3.2% levels in 2020.¹
- The general government gross debt to GDP has slightly reduced to 93.0% in 2021 from 98.7% levels in 2020.¹



Policy enablers

- In April 2021, the country has set its target for net-zero carbon emissions by 2050 which is a decade earlier than its previous target of 2060.⁷
- To promote development of RE in the country several incentives/mechanisms like RE auctions, import tax incentives, net metering and VAT incentives are available in the country.¹²



Technological Feasibility

- Brazil receives high levels of solar irradiation (GHI) of 5.3 kWh/m²/day and specific yield 4.4 kWh/kWp/day indicating very strong technical feasibility for solar in the country.³
- In 2021, 21.1% of the country's power demand was met through RE sources (excluding large hydro).⁴



Market Maturity

- 100% of the population in Brazil had access to electricity as of 2020.²
- Agência Nacional de Energia Elétrica (Aneel) is the designated agency that regulates the energy sector in the country.⁸
- Brazil is an associate state under the Southern Common Market "MERCOSUR" which aims to encourage the competitive integration of national economies into the global market thus creating commercial and investment opportunities.⁹
- The power sector in the country is unbundled into generation, transmission, and distribution with high level participation from private companies.⁹



Infrastructure

- Brazil's power infrastructure has been divided between National Interconnected System (Sistema Interligado Nacional (SIN)) and isolated Amazon region.
- The length of total transmission lines reached 1,66,641 ckm in 2021 and it is expected to reach 1,88,566 ckm by 2025.⁹
- Brazil has more than 102 power distribution companies with a total network length growing at a CAGR of 1.7% reaching 37,38,824 ckm in 2021 from 31,00,000 ckm in 2010. It is expected to reach 3,91,316 ckm by 2025.⁹
- The national grid of the country is interconnected with Argentina, Uruguay, Paraguay and Venezuela.³
- Between 2022 – 2026, the country plans to invest USD 14.71 Mn for the upgradation of the transmission and distribution sector in the country.¹⁴



Financing

- According to BNEF's climate scope report 2021, Brazil is the region's 2nd choice for investments in clean energy space.⁶
- In 2021, the Brazilian Economy attracted investments worth USD 85 Bn in the energy sector.¹⁰
- In March 2022, the European Investment Bank has signed a EUR 200 Mn loan to finance RE projects in Brazil including construction of 566.5 MW of wind power and 149 MW of solar power plant.¹¹



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 2.92 MWh which is relatively lower in comparison to the global average of 3.31 MWh.⁶
- The total installed capacity of solar PV witnessed a CAGR of 85.4% reaching 13,055 MW in 2021 from 1104 MW levels in 2017.⁷
- The peak demand for electricity in the country has increased to 702.25 TWh in 2021 from 627.88 TWh levels in 2020.⁴
- In 2021, the total installed capacity in the country stood at 677.53 GW with a significant share coming from hydro (56.2%), gas (13.4%) and wind (10.6%).⁴



Burkina Faso

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

76.5

Average PVout in kWh/kWp/day
(2020)

4.6

Cumulative Solar Capacity in MW
(2021)

62.4

Getting Electricity Score (2020)

29.4

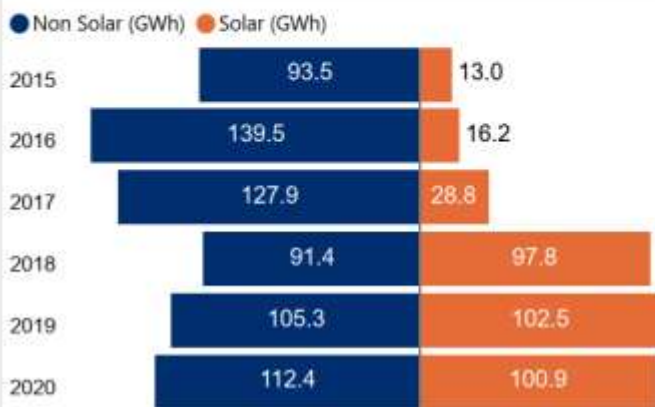
NDC Target by 2030 in %

18.2

Human Development Index (2021)

0.4

Renewable Energy Generation by Source

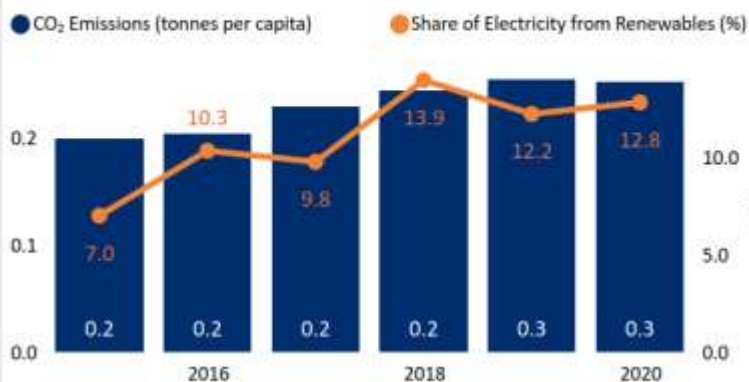


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



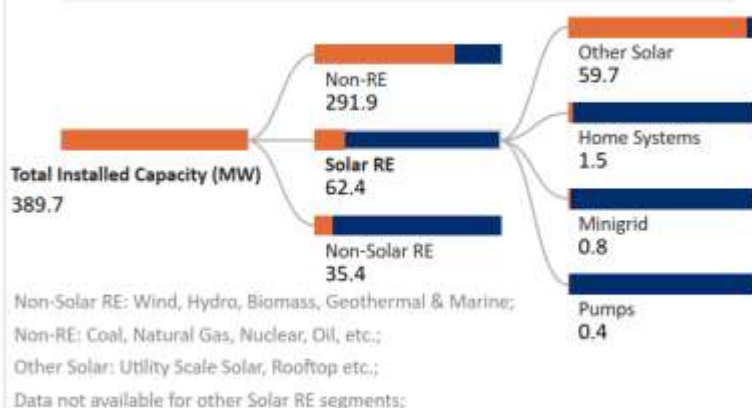
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

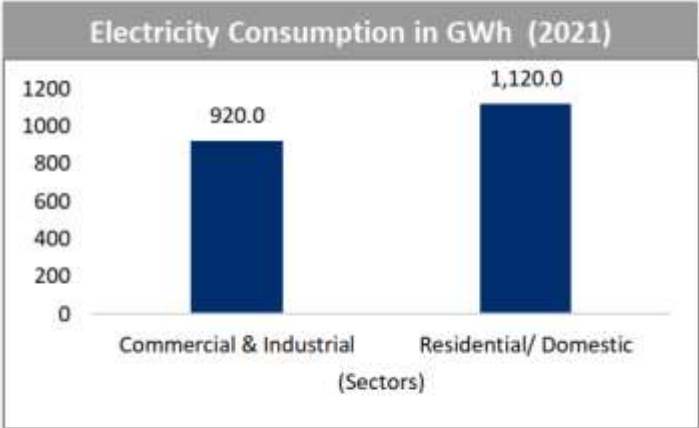
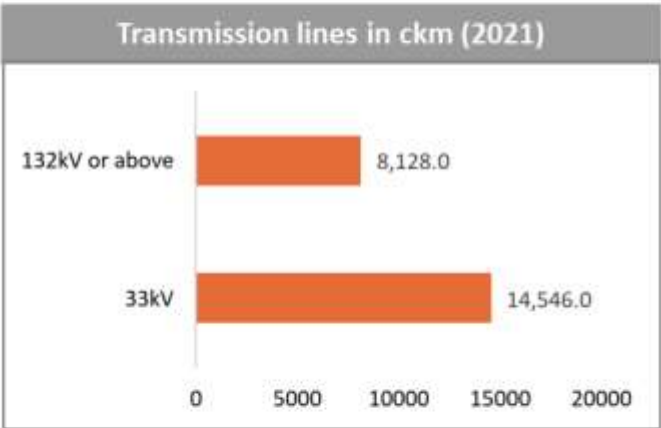
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

| Peak Demand/Load in MW (2021) | Electricity Consumption CAGR in % (2022 - 2026) | Threshold for licensing Solar in MW (2017) |
|-------------------------------|---|--|
| 419.0 | 13.0 | 1.0 |

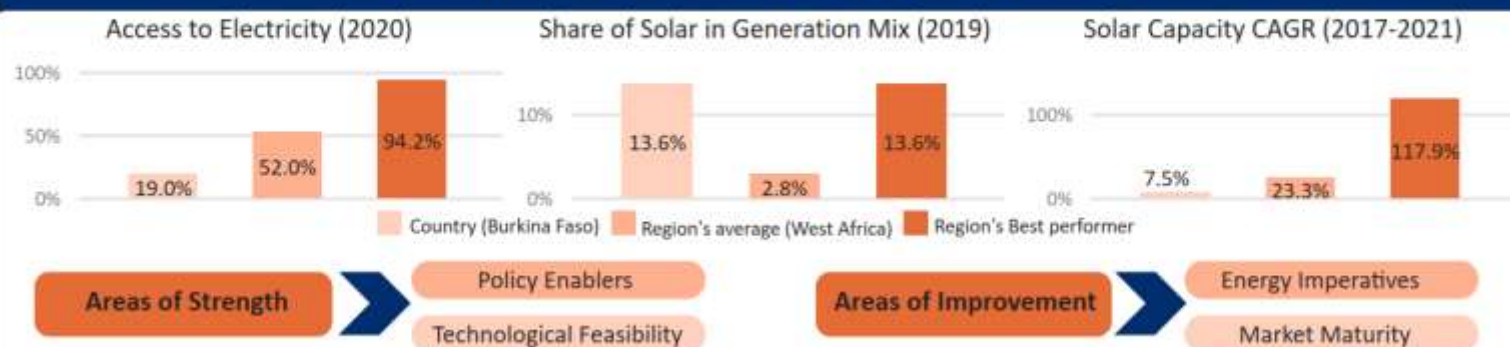


| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | No | Yes | No | No | No | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | No |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Burkina Faso is a low-income country¹ having GDP per capita (PPP) of USD 2,395 as of 2021.²
- GDP (Real) grew at an annual rate of 6.9% in 2021 and it is estimated to increase by 4.7% in 2022.³
- The public debt is estimated at 51.4% of GDP in 2021⁴ while the inflation rate reached 3.9% in 2021.⁵
- The budget deficit widened to 5.6% of GDP in 2021, a reflection of high expenditure while tax revenues remained low.⁴



Policy enablers

- National Agency for Renewable Energy and Energy Efficiency (ANEREE) has the mandate to promote the use of RE.⁶
- The country initiated an energy transition plan with the development of SPV as part of its Desert-to-Power initiative.⁴
- The country is on track to achieve SDG 13 on climate action by 2030 as it has accomplished about 90% of the goal.⁴
- Climate funding remains low in the country with the financial needs for the 2021–2025 NDC amounting to \$4.12 Bn of which only 39% has been acquired.⁴



Technological Feasibility

- The country receives high levels of solar irradiation of 5.8 kWh/m²/day and specific yield of 4.6 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁸
- The country typically receives 10 hours of sunlight per day.²⁴
- Yeleen Rural Electrification Project in Burkina Faso aims to install 100 mini-grids and improving the regulatory framework to mobilise private sector capital in RE.⁹
- The 'Beyond the Grid Fund for Africa (BGFA)' is providing \$2.5 Mn in funding to Off-grid solar system provider Oolu to install solar home systems and to expand its operations in rural areas.¹⁰



Market Maturity

- 19% of the population in the country had access to electricity as of 2020.¹¹
- National Electricity Utility (SONABEL), the vertically integrated state-owned utility is responsible for producing, transporting and distributing electricity in Burkina Faso.¹²
- Electricity Sector Regulatory Authority (ARSE) is the energy regulator responsible for regulating the activities of production, operation, transport, distribution, import, export, and sale of electricity throughout the national territory.¹³
- Burkina Faso is a member of West African Power Pool (WAPP).¹⁴



Infrastructure

- In Burkina Faso, electrical energy is transported at 90 kV, 132 kV and 225 kV and the capacity of transmission infrastructure is 1137 MVA.^{15,24}
- As part of the West Africa Power Pool program, the construction of the Ghana-Burkina Faso Interconnector is estimated to reduce the cost of electricity supply to Burkina Faso.¹⁴
- Burkina Faso has set up a solar panel manufacturing unit with a production capacity of 30 MW of solar panels/year.¹⁷
- The country's average Transmission and Distribution loss levels are 3.15% and 11.53% respectively in 2021.²⁴



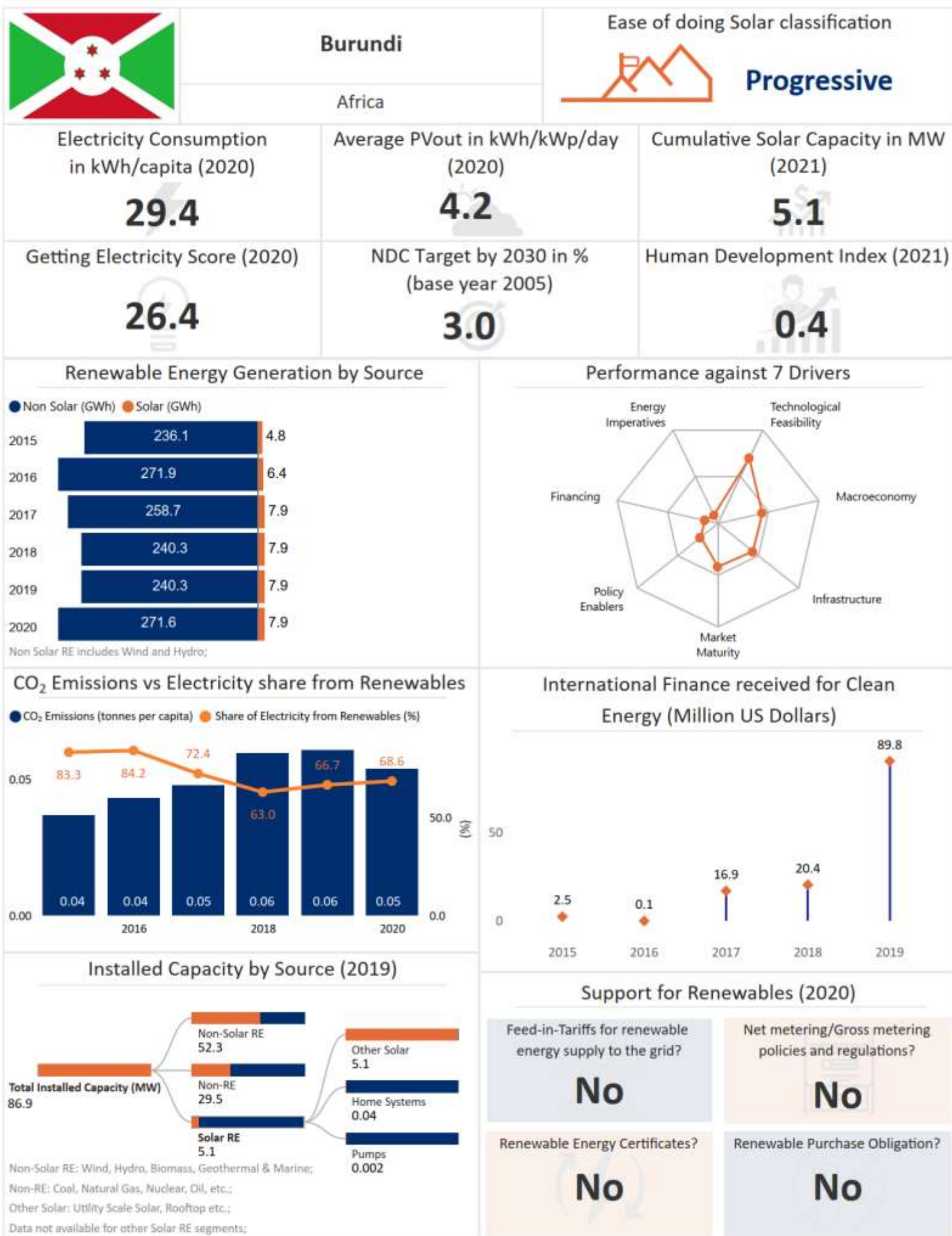
Financing

- In 2022, AfDB approved the Desert to Power G5 Sahel Financing Facility covering Burkina Faso, Chad, Mali, Mauritania, and Niger.¹⁸
- The AfDB supported Electrification Project for semi-urban areas of Ouagadougou and Bobo-Dioulasso has resulted in 32,449 new connections to the electric power network in 2022.¹⁹
- The Sustainable Energy Fund for Africa (SEFA), managed by the AfDB, has approved a \$1 Mn grant to facilitate transition to clean energy.²⁰

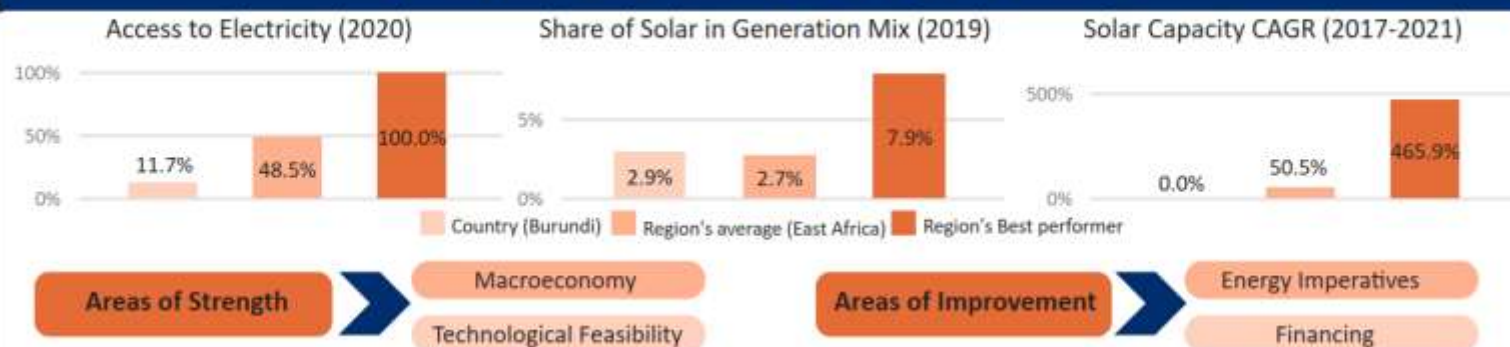


Energy Imperatives

- Of the total electricity generation of 8,72,126 MWh, solar electricity generation contributed 58,274 in 2021.²⁴
- The total installed capacity of solar PV witnessed a CAGR of 7.5% between 2017-2021 reaching 62.4 MW in 2021 from 46.8 MW levels in 2017.²¹
- The off-grid capacity of solar PV and installed capacity of solar mini grids stood at 1.2 MW and 2.1 MW as of 2020.²⁴
- In 2020, the per capita electricity consumption stood at 0.076 MWh which is significantly lower in comparison to the global average of 3.31 MWh.²²



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Burundi is a low-income country¹ with GDP per capita (PPP) of USD 775 as of 2021.²
- GDP (Real) grew at an annual rate of 2.4% in 2021 and it is estimated to grow by 3.6% in 2022.³
- Total public debt in the country increased to 71.9% of GDP in 2021 from 67% level in 2020.⁴
- Inflation Rate in the country increased to 8.3% in 2021 from 7.3% levels in 2020.⁵



Policy enablers

- Ministry of Hydraulics, Energy and Mines (MINHEM) is responsible for developing and implementing the energy sector policies.⁶
- ABER (Burundian Agency for Rural Electrification) is the designated agency that is responsible for the development and implementation of rural electrification programs and projects.⁶
- In 2020, Burundi revised its NDCs focusing on conserving carbon sinks, adopting climate-resilient seeds and crops, and developing non-motorized transport infrastructure.⁴



Technological Feasibility

- The country receives high levels of solar irradiation of 5.0 kWh/m²/day and specific yield of 4.2 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁷
- Average hours of direct sunshine typically vary between 4 to 5 hours daily regardless of the season.⁸
- The UN Environment program is currently active in Burundi and is working on the introduction of electric vehicles (two and three wheelers).⁹
- The penetration of quality-verified off-grid solar products in Burundi is very low with only an estimated 50,000-100,000 products sold to date across the country.¹⁰



Market Maturity

- 11.7% of the population in Burundi is having access to electricity since 2020 indicating a huge scope for electrification.¹¹
- Burundian National Authority for Regulating the Electricity and Water Sector (AREEN) is the designated regulatory agency responsible for the electricity and water sector in Burundi.⁶
- REGIDESO is a state-owned, vertically integrated power utility responsible for the supply and distribution of electricity in Burundi.¹²
- Burundi is a member of Eastern Africa Power Pool.¹³



Infrastructure

- Burundi imports electricity from neighbouring countries such as Democratic Republic of Congo (DRC) and Rwanda through a cross-border hydropower complex.¹⁴
- The country's transmission and distribution network of (30 kV-110 kV) are not in a good shape and require investments to improve the operations.¹⁵



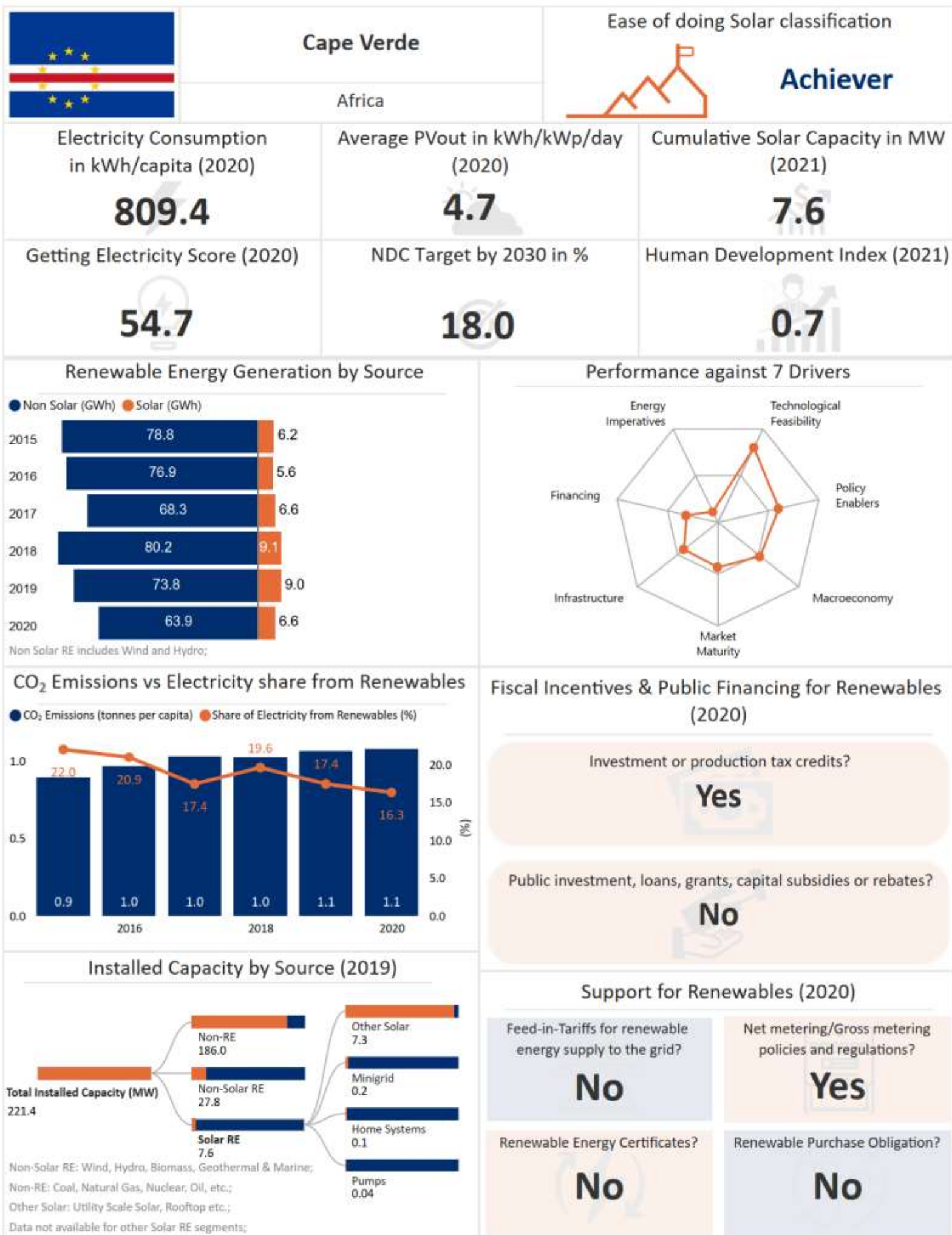
Financing

- The AfDB, through its Sustainable Energy Fund for Africa (SEFA), is providing \$990,000 grant to support the development of a 9 MW Solar-Hydro hybrid project in Burundi.¹⁶
- The AfDB's debt funding platform-Facility for Energy Inclusion attracts nearly \$160 Mn for small-scale renewable energy projects.¹⁷
- The AfDB and the Government of Burundi signed a \$29 Mn grant agreement to finance Phase 1 of the Access to Energy Project, which is part of the country's infrastructure development program.¹⁸

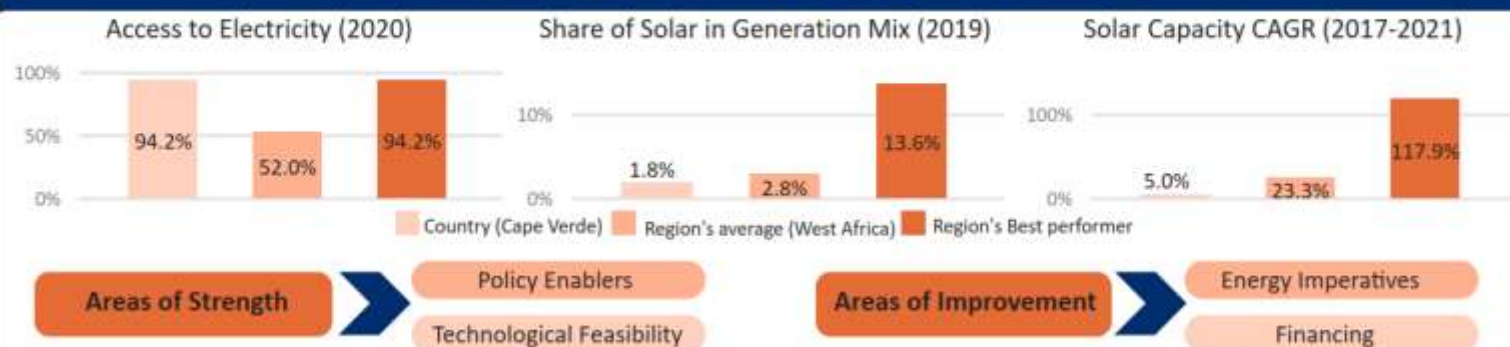


Energy Imperatives

- In 2020, the per capita electricity consumption of 0.03 MWh is significantly lower in comparison to the global average of 3.31 MWh.¹⁹
- The price of electricity in the country was 15.70 US Cents/kWh as of 2019.²⁰



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Cabo Verde is a lower middle-income country¹ with GDP per capita (PPP) of USD 6,717 as of 2021.²
- GDP (Real) grew at an annual rate of 6.9% in 2021 and it is estimated to grow by 5.2% in 2022.³
- Total public debt in the country increased to 156.7% of GDP in 2021 from 155% of GDP levels in 2020.⁴
- Inflation rate in the country increased to 1.8% in 2021 from 0.6% levels in 2020.⁴



Policy enablers

- General Directorate of Energy (DGE) is the designated agency for framing the renewable energy policies in the country.⁵
- The government is promoting energy transition through renewable energy investments, notably a 10 MW wind farm and 150 MW of solar farm by 2030.⁴
- Cabo Verde aims to increase the RE share in the electricity generation mix from 18.4% in 2020 to 30% in 2025 and to 50% by 2030.⁴
- National Energy Policy aims to promote energy conservation, energy efficiency and strengthening of the regulatory framework in the country.⁵



Technological Feasibility

- The country receives very high levels of solar irradiation of 5.7 kWh/m²/day and specific yield of 4.7 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁶
- The government has set a target of having a quarter of its national vehicle fleet comprising of electric vehicles by 2026.⁷
- The ECOWAS (Economic Community of West African States) Centre for Renewable Energy and Energy Efficiency (ECREEE) inaugurated a solar PV mini grid in Planalto Norte with the capacity of 45 kWp.⁸
- Small-scale solar power systems in rural Cabo Verde islands were installed which were funded by the Global Environment Facility (GEF).⁹



Market Maturity

- 94.2% population in the country had access to electricity as of 2020.¹⁵
- ELECTRA-SARL is the national power utility company, which is the sole generator, transmitter, and distributor of electricity in the country.¹⁰
- The Ministry of Tourism, Industry and Energy (MTIE) is the nodal ministry responsible for managing the energy sector in the country.¹⁰
- Cabo Verde is a member of the West African Power Pool.¹⁰



Infrastructure

- The transmission network consists of 1,570 km of transmission lines in the country operational in NORTE and SUL regions.¹¹
- Cabo Verde is heavily dependent on imported petroleum products and diesel for electric power generation.¹²
- The absence of reliable, adequate, and affordable power are recognised as major barrier for economic growth and social development in the country.¹¹



Financing

- In 2021, the World Bank approved an International Development Association (IDA) credit of \$3.5 Mn for the Improved Utility Performance Project (REIUP) in Cabo Verde.¹³
- In Cabo Verde, the World Bank has shown keen interest in sustaining high levels of growth and reducing unemployment, poverty and inequality.¹⁴



Energy Imperatives

- The total installed capacity of solar PV witnessed a CAGR of 5.01% between 2017-2021 reaching 7.58 MW in 2021 from 6.24 MW levels in 2017.¹⁶
- In 2020, the per capita electricity consumption stood at 0.81 MWh which is significantly lower in comparison to the global average of 3.31 MWh as of 2020.¹⁷
- The price of electricity in the country was 28.90 US Cents/kWh as of 2019.¹⁸



Cambodia

Asia & Pacific

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

457.6

Average PVout in kWh/kWp/day
(2020)

4.1

Cumulative Solar Capacity in MW
(2021)

427.9

Getting Electricity Score (2020)

57.5

NDC Target by 2030 in MtCO₂e

34.4

Human Development Index (2021)

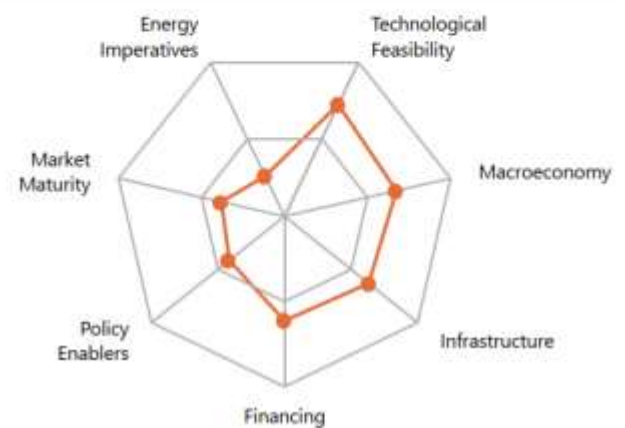
0.6

Renewable Energy Generation by Source

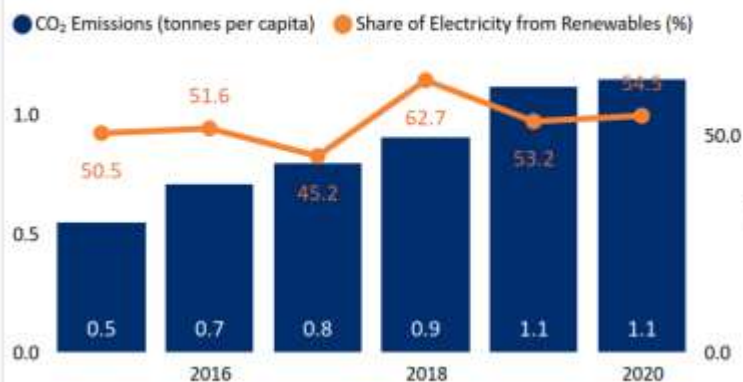


Non Solar RE includes Wind and Hydro;

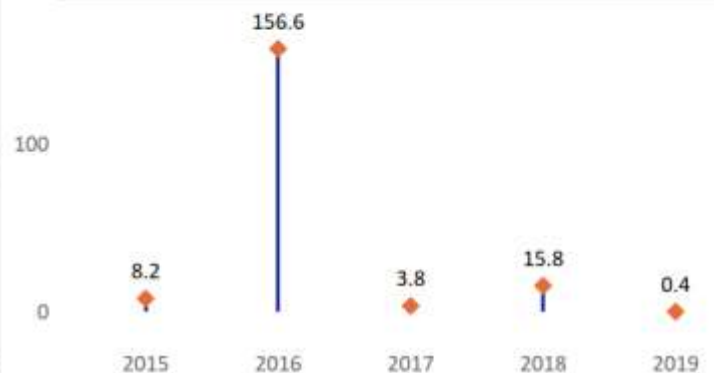
Performance against 7 Drivers



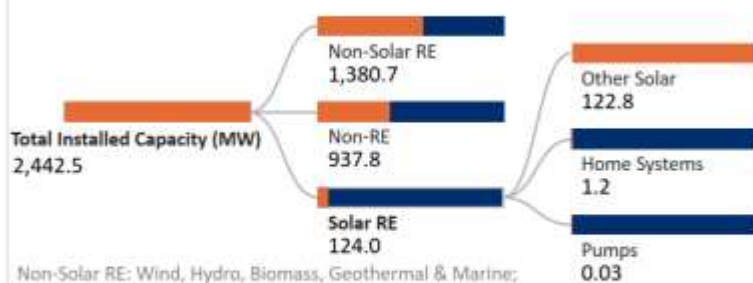
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Cambodia is a lower middle-income country with a GDP per capita (PPP) of USD 4,784 in 2021.¹
- Due to COVID-19 Pandemic the GDP (Real) had declined by 3.1% in 2020. However, in 2021, the GDP has bounced back registering an annual growth rate of 2.2%.²
- The inflation rate (CPI) of Cambodia had increased to 3.0% in 2021 from 2.9% levels in 2020.³
- The general government gross debt to GDP has reached 38.7% in 2021 from 34.3% levels in 2020.⁴



Policy enablers

- In 2019, the Ministry of Mines and Energy (MME) came up with Cambodia Basic Energy Plan (BEP) to ensure affordability, accessibility, security, safety, and transparency in energy supply.⁵
- Cambodia has set a target to achieve an energy mix of coal (35%), hydro power (55%) and other RE (10%) by 2030.⁵
- The Environmental Code of Cambodia is currently in its 11th draft. Once it is promulgated, it will provide a host of additional incentives for green energy producers.⁵
- Cambodia in its Long-Term Strategy for Carbon Neutrality (LTS4CN) has outlined a vision to achieve carbon neutral economy by 2050.⁶



Technological Feasibility

- Cambodia receives very high levels of solar irradiation (GHI) of 5.01 kWh/m²/day and specific yield 4.1 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁷
- The Ministry of Mines and Energy in collaboration with UNDP is planning to have SMG systems and SHS at villages that have not been electrified.⁸
- Total Solar Distributed Generation in partnership with Canopy Power has been developing 1.25 MW ground mounted solar with 2 MWh BESS in Koh Rong Samloem island.⁹



Market Maturity

- The Electricity Authority of Cambodia is responsible for issuing service licenses, and implementing operational standards for licensees to ensure the quality of supply and service to consumers.¹¹
- Cambodia in association with Agence Francaise De Developpement (AFD) are targeting to strengthen the electricity connectivity of 100% villages by 2020 and 90% of households by 2030.¹²
- Electricite Du Cambodge (EDC) is a government-owned power utility company that transmits, generates, supplies, and distributes electric power to distribution systems and bulk power consumers in Cambodia.¹³



Infrastructure

- Cambodia Power Transmission Lines (CPTL) of 115 kV transmit power from Thailand to the province of Banteay Mancheay, Siem Reap, Battambang.¹⁴
- The government of Cambodia has signed an agreement with the French Government for USD 70 Mn concessional loan and USD 1 Mn grant from the European Union for capacity building of EDC staff through AFD.¹⁵



Financing

- Climate investment funds have invested USD 30 Mn for Scaling Up Renewable Energy Program (SREP) to support solar energy development program.¹⁷
- ADB has approved a USD 127.8 Mn loan to support the construction of transmission lines and substations in Cambodia.¹⁸
- Multilateral Investment Guarantee Agency (MIGA), a member World Bank Group, has funded for many transmissions infrastructure projects in Cambodia.¹⁹



Energy Imperatives

- In 2020, the per capita electricity consumption of 0.46 MWh is lower than the global average of 3.31 MWh.²⁰
- The peak demand for electricity in the country stood at 7.65 TWh remaining same in 2021 and 2020.²²
- In 2021, the total installed capacity in the country has reached over 3.1 GW²³ with a significant share coming from coal (45%) and hydro (45.62%) followed by other fossil (5.36%), and bioenergy (2.88%).²²



Cameroon

Africa

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

329.2

Average PVout in kWh/kWp/day
(2020)

4.3

Cumulative Solar Capacity in MW
(2021)

14.4

Getting Electricity Score (2020)

61.3

NDC Target by 2030 in %
(base year 2005)

35.0

Human Development Index (2021)

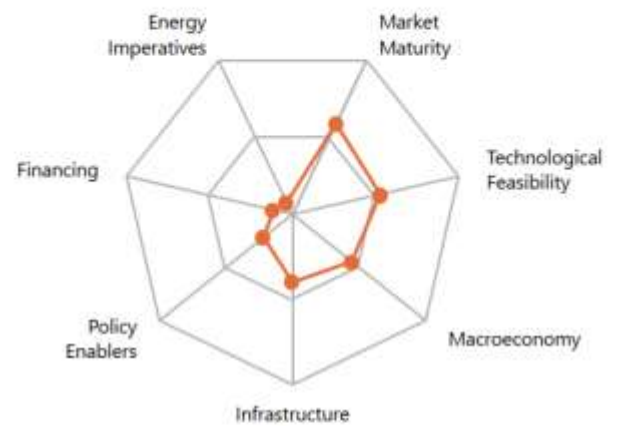
0.6

Renewable Energy Generation by Source

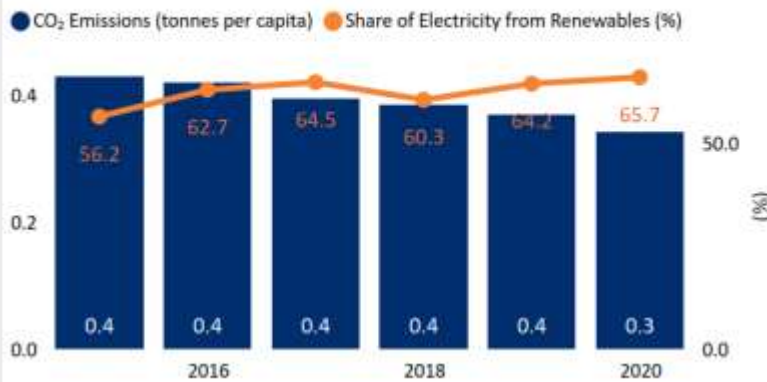


Non Solar RE includes Wind and Hydro;

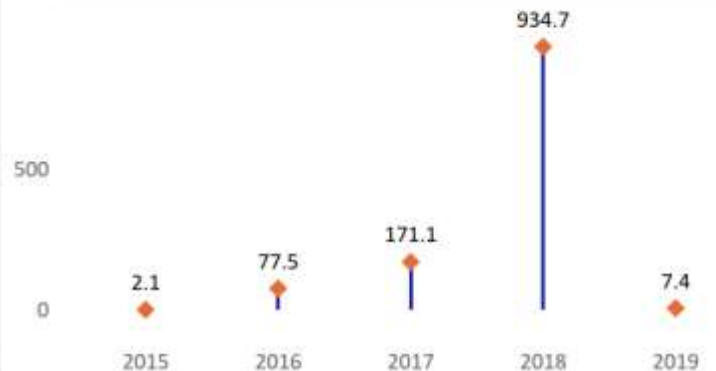
Performance against 7 Drivers



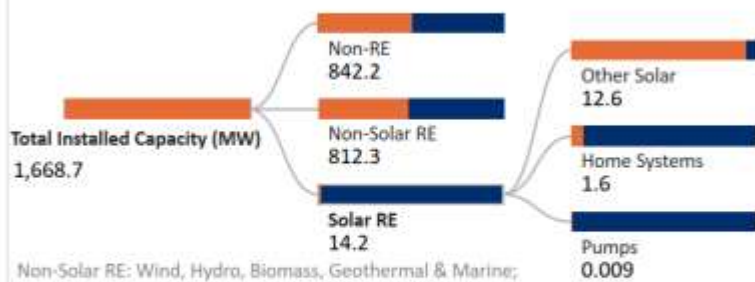
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

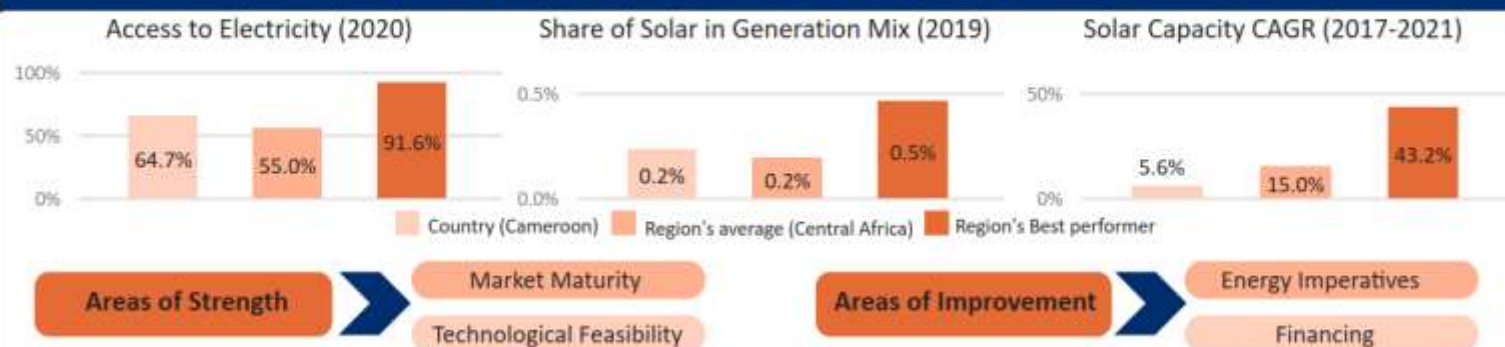
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Cameroon is a lower middle-income country ¹ with GDP per capita (PPP) of USD 4,065 as of 2021.²
- GDP (Real) grew at an annual rate of 3.5% in 2021 and it is estimated to grow by 4.3% in 2022.³
- Total public debt in the country increased to 46% of GDP in 2021 from 28.8% of GDP levels in 2015.⁴
- Inflation rate in the country has slightly risen to 2.5% in 2021 from 2.4% levels in 2020.⁴



Policy enablers

- Ministry of Water and Energy (MINEE) is responsible for the design, development, implementation and monitoring of government policies in the energy sector.⁵
- In 2021, the country submitted its NDC with an aim to reduce emissions to 35% by 2030.⁴
- The Rural Electrification Agency (AER) is responsible for promoting rural electrification throughout the country.⁵



Technological Feasibility

- The country receives high levels of solar irradiation of 5.07 kWh/m²/day and specific yield of 4.3 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁶
- In Cameroon, 36 MW of solar generation capacity and 20 MW/19 MWh of battery storage will be leased to power company ENEO, which is controlled by London-based investor Actis. The Cameroon government also holds a 44% stake.⁷
- In 2022, Aptech Africa commissioned a PV-hybrid system in Cameroon including a 18.36 kWp of roof-mounted PV generation with 25.2 kWh of lithium-ion battery storage.⁸



Market Maturity

- 64.7% population in the country had access to electricity as of 2020.¹²
- The Electricity Regulatory Agency (ARSEL) is responsible for the regulation, control and monitoring the performance of operators in the electricity sector.⁵
- The Electricity Development Corporation (EDC) is the designated agency for managing the public assets in the electricity sector.⁵
- National Electric Energy Transport Company (SONATREL) is responsible for managing the transport of electricity.⁵
- Cameroon is a member of the Central Africa Power Pool.⁹



Infrastructure

- In Cameroon, electricity is transmitted at 225 kV, 110 kV and 90 kV voltage levels and distributed at 30 kV, 15 kV, 0.38 kV and 0.22 kV.⁵
- Cameroon's electricity network is made up of three interconnected regional networks: Réseau interconnecté Sud (RIS), Réseau interconnecté nord (RIN) and Réseau Est (RIE).⁵
- The construction of the Chad - Cameroon Interconnection and the South-North Backbone is jointly financed (USD 750 Mn) by the AfDB and the WB.⁵
- The country plans for medium and long-term network expansion of 2,420 km of power lines by 2030 at an investment of USD 1.76 Bn.⁵



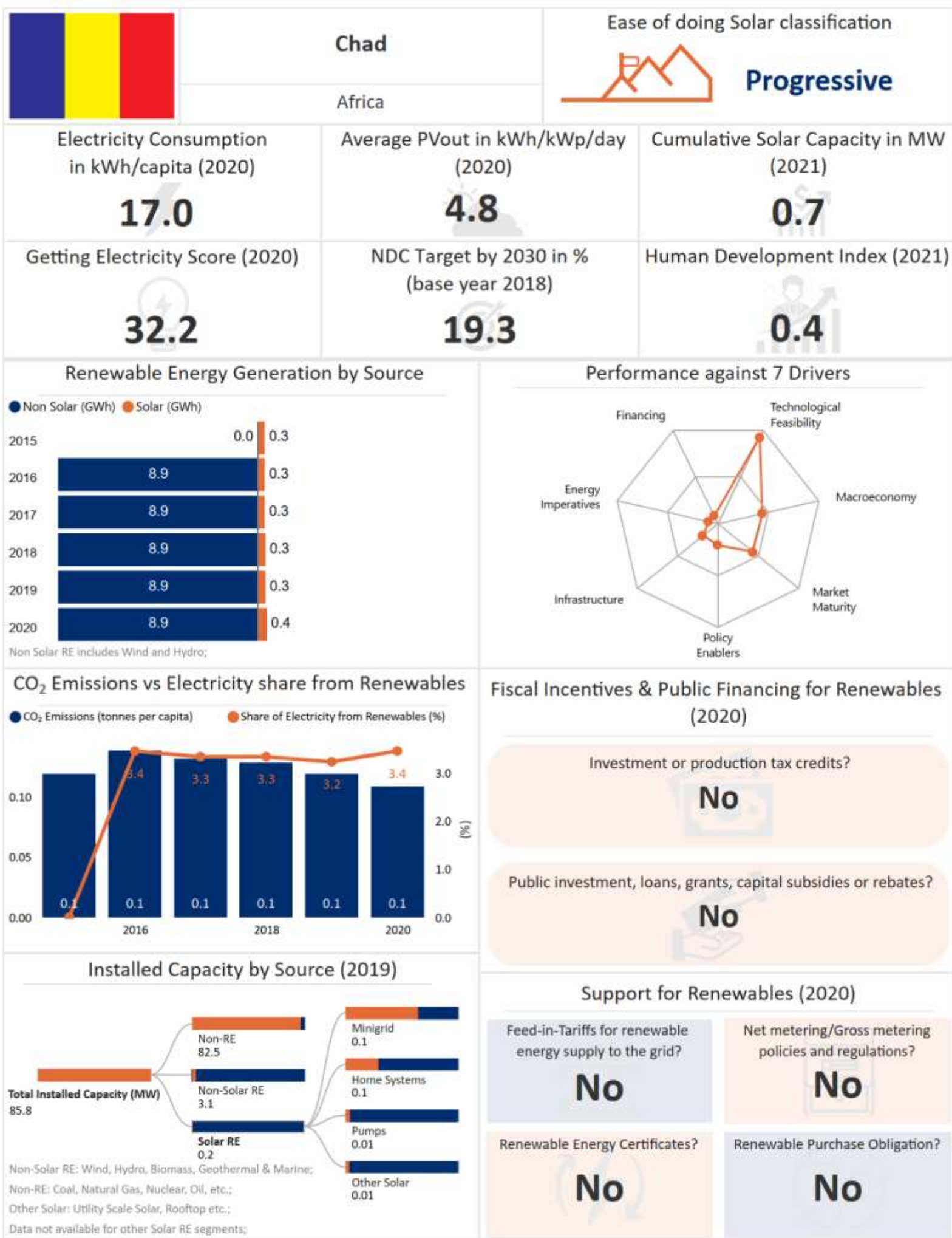
Financing

- In 2020, the AfDB and the multi-donor Fund for African Private Sector Assistance (FAPA) launched an initiative to bolster the deployment of electricity metering services in the country.¹⁰
- AfDB has approved a loan of €150 Mn to finance the construction of 420 MW Nachtigal hydroelectric project.¹¹
- In Cameroon, the AfDB has shown keen interest in developing a flagship forum, Africa Energy Market Place ("AEMP") to showcase investment opportunities in the energy sector.⁵



Energy Imperatives

- The total installed capacity of solar PV witnessed a CAGR of 5.64% between 2017-2021 reaching 14.4 MW in 2021 from 11.6 MW levels in 2017.¹³
- In 2020, the per capita electricity consumption stood at 0.33 MWh which is significantly lower in comparison to the global average of 3.31 MWh as of 2020.¹⁴
- The price of electricity in the country was 14.10 US Cents/kWh as of 2019.¹⁵



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Chad is a low-income country¹ having GDP per capita (PPP) of USD 1,566 in 2021.²
- GDP (Real) declined at an annual rate of 1.1% in 2021, however, it is estimated to grow by 3.3% in 2022.³
- The current account deficit narrowed down to 3.9% in 2021 from 8.1% levels in 2020.⁴
- Total public debt in the country reduced to 48.2% of GDP in 2021 from 51.5% levels in 2020.⁴



Policy enablers

- Agency for Renewable Energy Development (ADER) is responsible to promote renewable energy in the country.⁵
- In 2020, exemption from duties and taxes on all imports of solar components was granted in the country.⁴



Technological Feasibility

- Chad receives very high levels of solar irradiation of 6.3 kWh/m²/day and specific yield of 4.8 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁶
- In Chad, Djermaya solar power plant became the first renewable power generation project in the country⁷ with 4 MWh battery energy storage system (BESS).⁸
- Chad government along with energy company 'Savannah Energy' is planning to develop 400 MW of solar-plus-battery projects in the country.⁹



Market Maturity

- Only 11.1% population in Chad is having access to electricity as of 2020.¹⁰
- The Ministry of Energy and Petroleum is responsible for the design, coordination, implementation and monitoring of government policies in the energy sector.¹¹
- Electric Energy Authority is the energy regulator in the country.¹¹
- The Société Nationale d'Electricité (SNE) is the sole generator, transmitter, and distributor of electric energy.¹¹



Infrastructure

- Cameroon-Chad Power Interconnection Project consists of 1,024 kms of HV transmission lines (786 kms in Cameroon and 238 kms in Chad).¹²
- Only 10% of the population in Chad has reliable electricity; the percentage falls to about 1% in rural areas.¹³



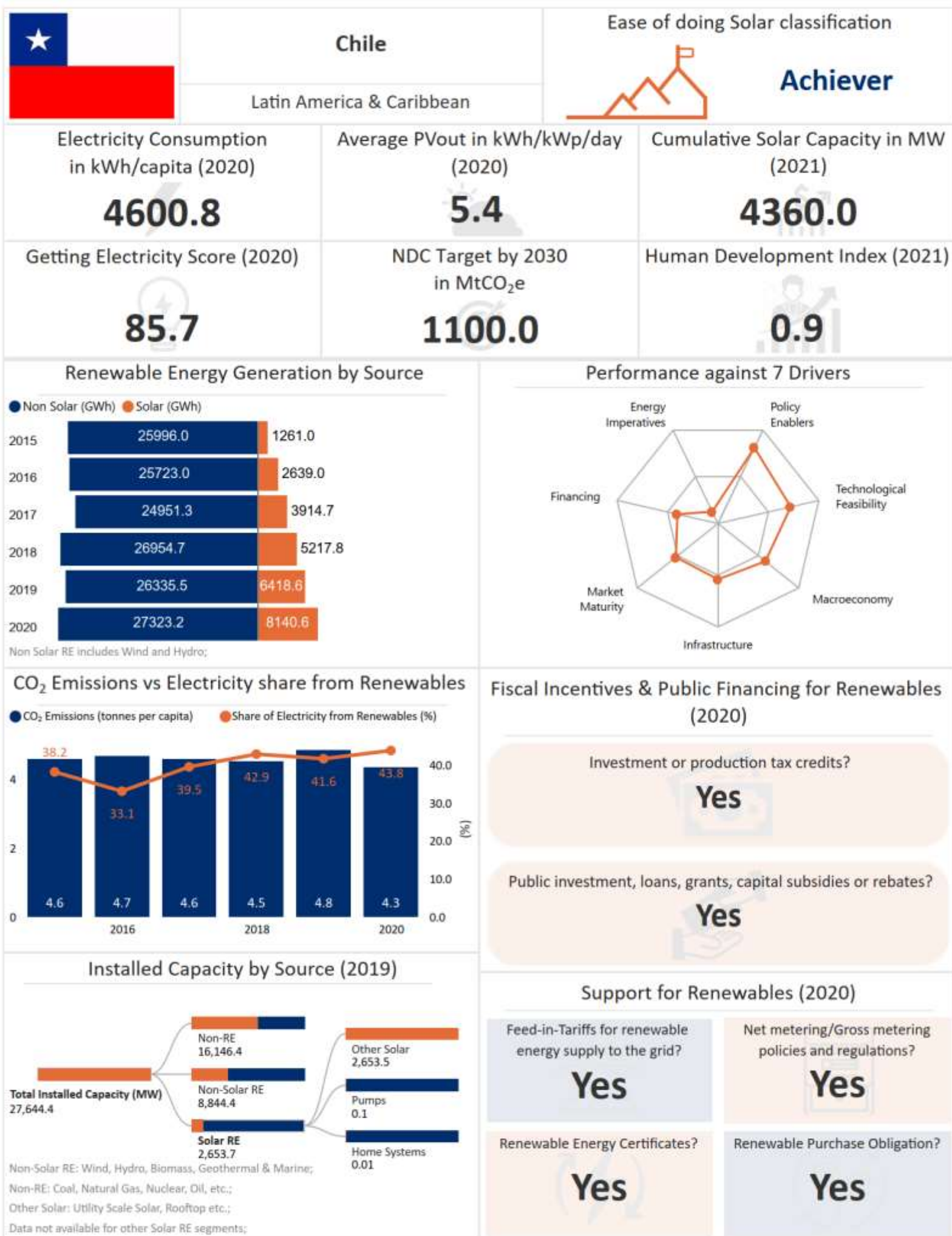
Financing

- In 2022, the World Bank approved a USD 295 Mn grant from the International Development Association (IDA) to help Chad expand its access to energy.¹⁴
- In 2022, the AfDB approved USD 379.6 Mn Desert to Power financing facility for Chad and committed to provide technical assistance over the next seven years.¹⁵
- The Sustainable Energy Fund for Africa (SEFA) approved a USD 780,000 grant for the development of a first phase 40 MW of Starsol solar PV plant in Chad.¹⁶

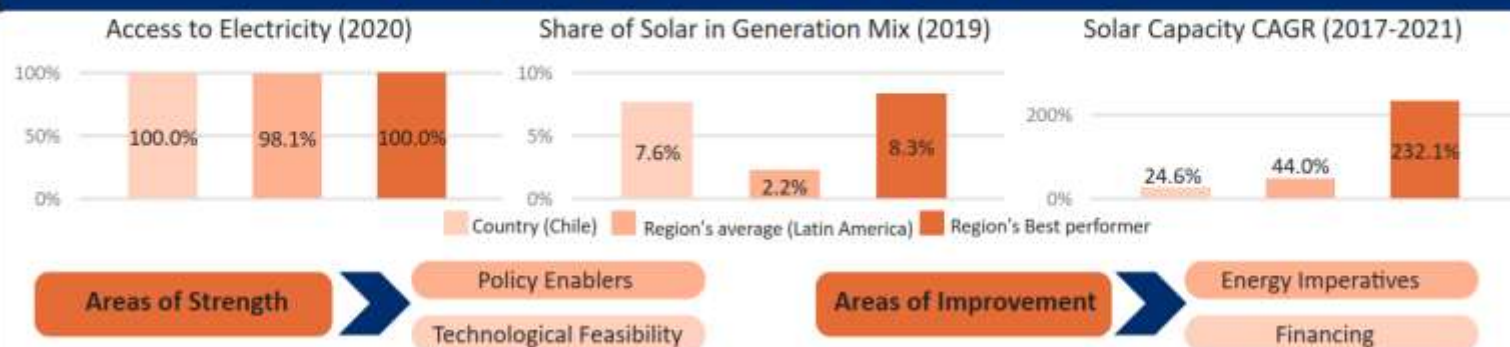


Energy Imperatives

- The total installed capacity in the country stood at 85.8 MW in 2019.¹⁷
- The total installed capacity of solar PV witnessed a CAGR of 43.2% between 2017-2021 reaching 0.73 MW in 2021 from 0.17 MW levels in 2017.¹⁸
- In 2020, the per capita electricity consumption stood at 0.02 MWh which is significantly lower in comparison to the global average of 3.31 MWh.¹⁹
- The price of electricity in the country was 20.5 US Cents/kWh as of 2019.²⁰



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Chile is a high-income country with a GDP per capita (PPP) of USD 28,372 in 2021.^{1,4}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 6.1% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 11.7% which is one of the fastest recoveries in the world.¹
- The inflation rate (CPI) of Chile has increased to 4.5% in 2021 from 3.0% levels in 2020.¹
- The general government gross debt to GDP has reached 36.3% in 2021 from 32.6% levels in 2020.¹



Policy enablers

- In 2022, the Chilean government has announced the Climate Change Framework Law ("the Climate Act"), which aims to achieve net zero emissions by 2050.²
- By 2030, the country targets to achieve 70% share from RE in the generation mix. Alongside, it has set an ambitious target to have 16 GW installed capacity of hydropower and 20 GW of solar and wind power by 2050.¹¹
- The government has launched a plan in 2020 which seeks to phase out the coal-based power plants by 2040 accelerating the net zero emission transition.¹⁰
- To promote the development of RE, mechanisms such as RE auctions, net metering, import tax & vat incentives have been implemented.⁸



Technological Feasibility

- Chile receives high levels of solar irradiation (GHI) of 5.8 kWh/m²/day and specific yield 5.4 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁵
- In 2021, 22.49% of the country's power demand was met through RE sources.¹³
- The green hydrogen strategy, introduced in 2020, intends to create 2,00,000 tonnes of green hydrogen by 2030 and targets to make Chile as the lowest-cost green hydrogen producer in the world.¹¹



Market Maturity

- The National Energy Commission (CNE), a decentralised public institution, regulates the power sector in the country.¹⁴
- The power sector in the country was unbundled, in 1980's, into generation, transmission and distribution and has also been privatised with high level participation from private companies.³
- Chile is an associate state under the Southern Common Market "MERCOSUR", which aims to encourage the competitive integration of national economies into the global market thus creating commercial and investment opportunities.¹⁵



Infrastructure

- The Sistema Eléctrico Nacional (SEN), a single interconnected grid, makes up the majority of Chile's electrical transmission infrastructure. The southern regions are covered by the minor isolated grids- the Sistema Eléctrico de Aysén (SEA) and the Sistema Eléctrico de Magallanes (SEM).²⁰
- The transmission network operates on voltages level ranging from 66 kV to 500 kV with the total transmission line length reaching 35,919 ckm in 2021.^{3,20}
- To upgrade the transmission infrastructure, a total of 210 projects worth USD 2.7 Bn are expected to be tendered between 2020-24.²⁰



Financing

- According to BNEF's climate scope report 2021, Chile is the region's top choice for investments in clean energy space. Furthermore, it has also ranked 12th in the EY Renewable Energy Country Attractiveness Index (RECAI) in 2022.^{9,19}
- In 2021, the Chilean Economy has attracted investments worth USD 3.4 Bn in the renewable energy sector.¹¹
- IDB has sanctioned USD 300 Mn loan to the Chilean government in 2022 for accelerating transition towards clean and sustainable energy.¹⁸

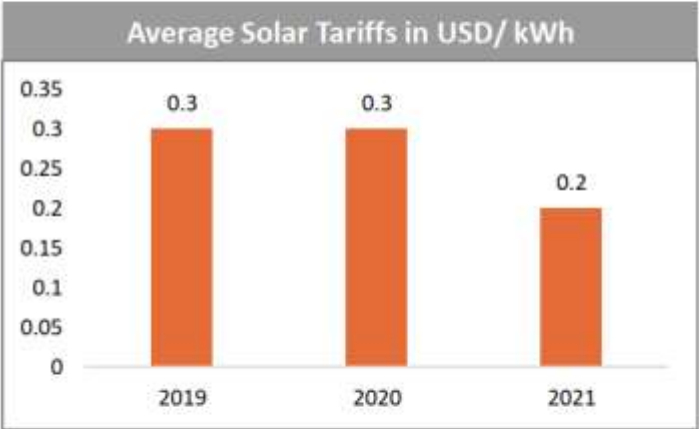
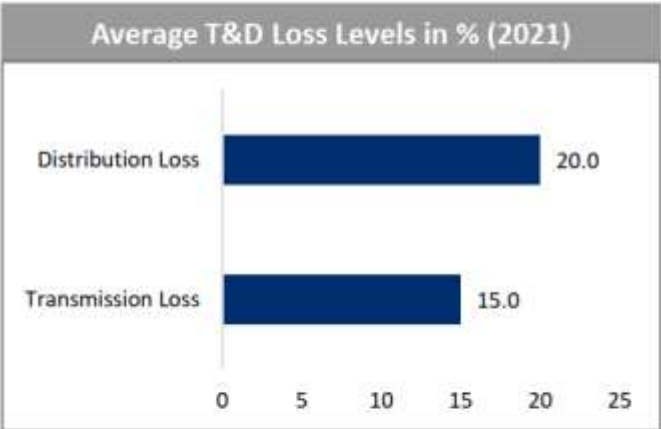


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 4.6 MWh which is relatively higher in comparison to the global average of 3.31 MWh.⁶
- The total installed capacity of solar PV witnessed a CAGR of 24.6% between 2017-2021 reaching 4,360 MW in 2021 from 1,809 MW in 2017.⁷
- In 2021, the total installed capacity in the country reached 28.3 GW with a significant share coming from renewable hydropower (24.8%), coal (16.9%), solar PV (16%), oil (14.7%), natural gas (14.1%), wind (11.4%) and rest from other sources.⁶



| Electricity Consumption CAGR in % (2022 - 2026) | Average term of Solar PPAs in years (2021) | Cheapest Source of Power (2021) |
|---|--|---------------------------------|
| 95.0 | 25.0 | Solar |

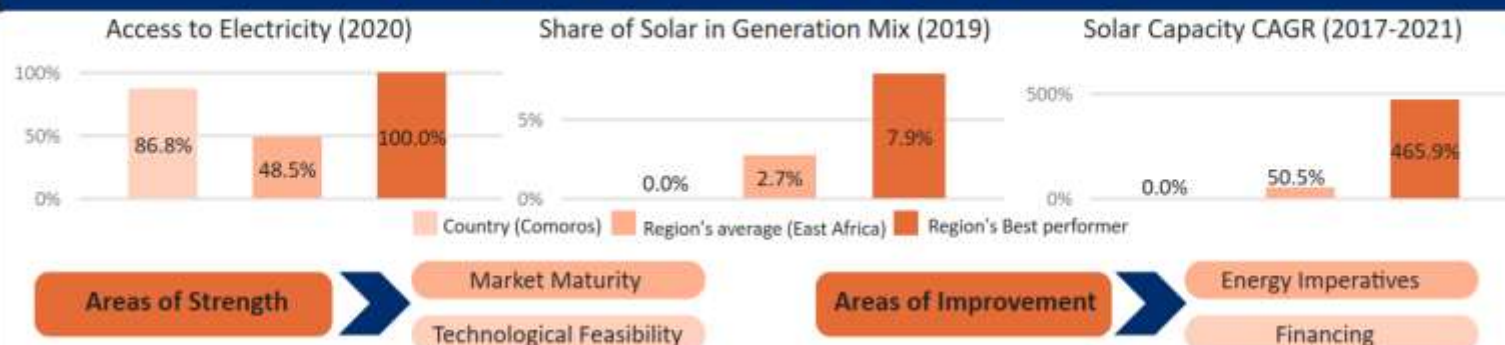


| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | Yes |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| Yes | Yes | Yes | Yes | No | No | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Comoros is a lower middle-income country¹ with GDP per capita (PPP) of USD 3,547 as of 2021.²
- GDP (Real) grew at an annual rate of 2.2% in 2021 and it is estimated to grow by 3.5% in 2022.³
- Inflation rate in the country increased to 1.4% in 2021 from 0.9% levels in 2020.⁴
- The current account deficit widened to 3.6% of GDP in 2021 from 2% levels in 2020.⁴



Policy enablers

- The Energy, Mines, and Water Directorate (Direction Générale de l'Energie, des Mines et de l'Eau, DGEME) is the agency responsible for managing the energy sector in the country.⁵
- National Energy Sector Strategy and Poverty Reduction and Growth Strategy Paper (PRGSP) aims for an ambitious target for access to energy and electricity.⁶
- The 'document de politique de l'énergie électrique et des produits pétroliers de l'Union des Comores' adopted in 2012 prioritizes RE for electricity generation.⁷
- Comoros aims to reduce its GHG emissions up to 23% and increase its net CO₂ absorption sink of 47% by 2030.⁴



Technological Feasibility

- Comoros receives high levels of solar irradiation of 4.9 kWh/m²/day and specific yield of 4.3 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁸
- The country typically receives 12 hours of sunlight per day.⁹
- Two 3 MW PV plus battery storage IPP projects are currently under development by private developers, one in Grande Comore ('Innovent') and the other in Anjouan ('VIGOR').⁵



Market Maturity

- 86.8% population in Comoros is having access to electricity since 2020.¹⁰
- Société Nationale de l'Electricité des Comores (SONELEC) is responsible for Production, Transmission, Distribution and Marketing of Electrical Energy in the Union of the Comoros.¹¹
- The Gestion de l'Eau et de l'Electricité aux Comores (MAMWE) and Electricité d'Anjouan (EDA) are the energy regulator across islands of Grand Comore and Moheli and Anjouan islands in Comoros.⁶



Infrastructure

- In Comoros, the capacity of the Transmission Infrastructure is 20 MVA at an voltage level of 22 kV.⁹
- The country's average Transmission and Distribution loss levels are 15% and 20% respectively.⁹
- The expected investment in the Transmission & Distribution Infrastructure over next 5 years is USD 37 Mn.⁹



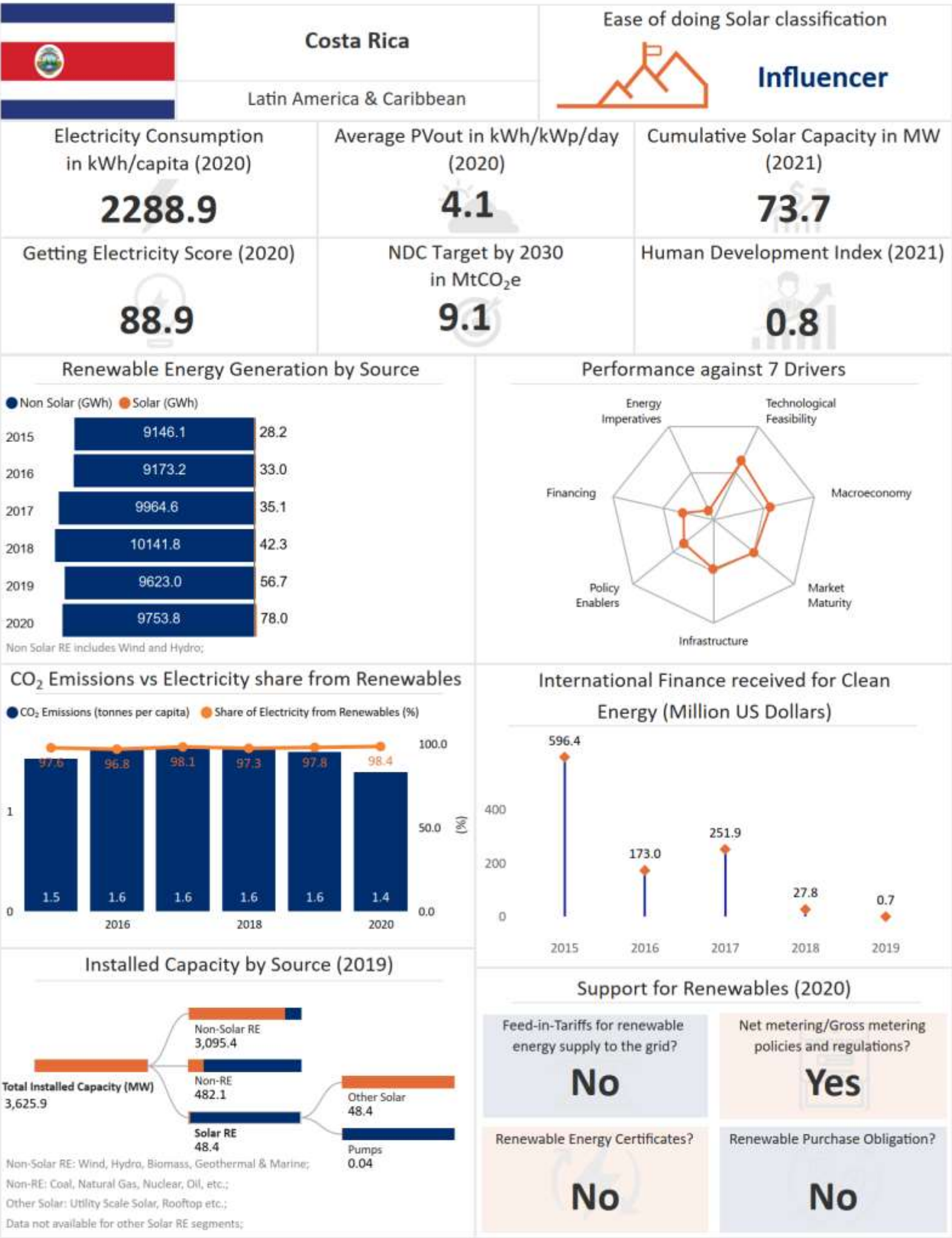
Financing

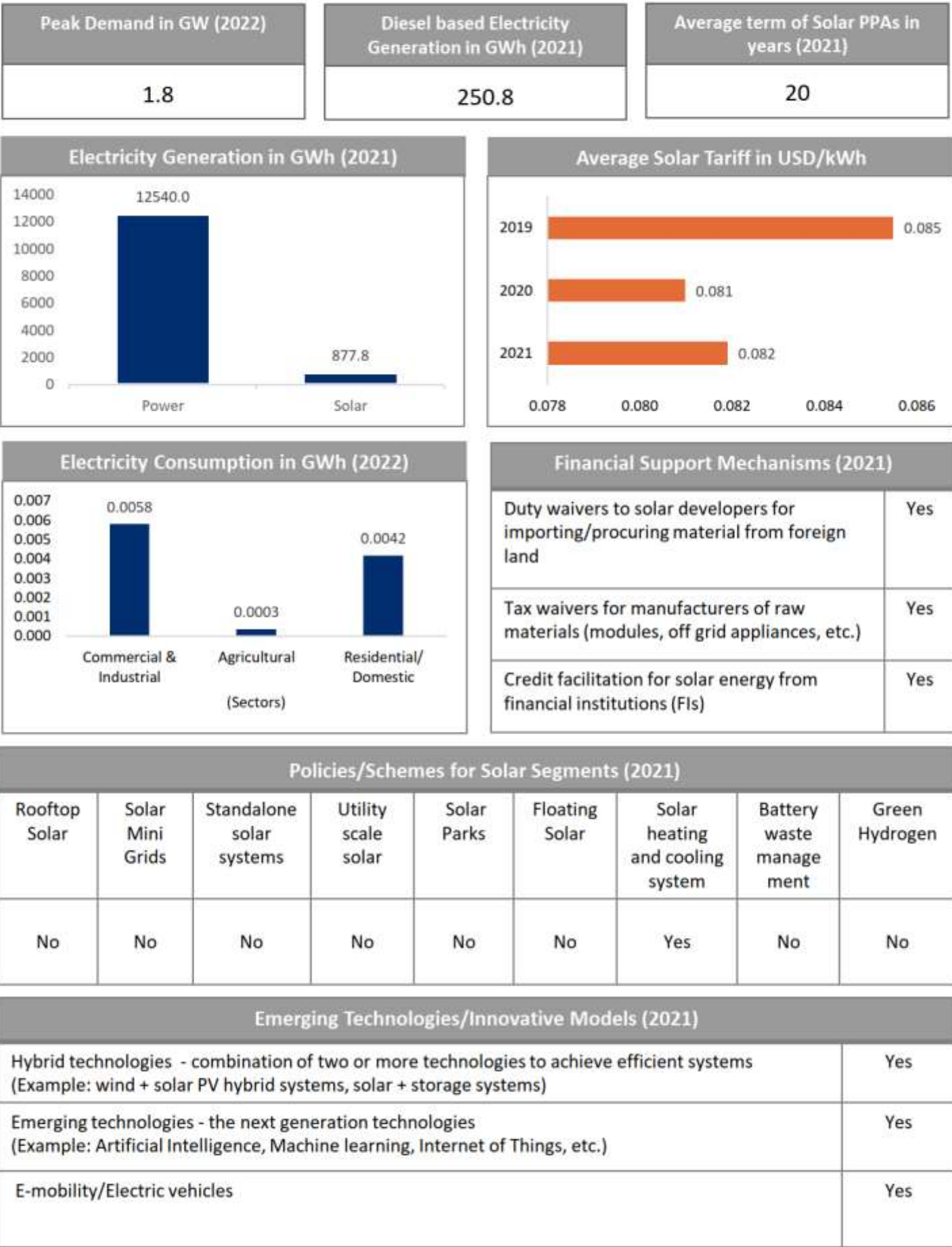
- In 2014, Sustainable Energy Fund for Africa (SEFA) approved a USD 480,000 grant to Comoros to facilitate private sector participation in RE sector.¹²
- The EU is supporting the country through a grant of EUR 2 Mn with an objective to install 6 grid connected micro power stations with a combined capacity of 300 kW.¹³
- The World Bank has invested USD 28.6 Mn in Power Storage, Pilot PV, and System upgrades of which USD 2.6 Mn will come from SIDS DOCK trust fund.⁵



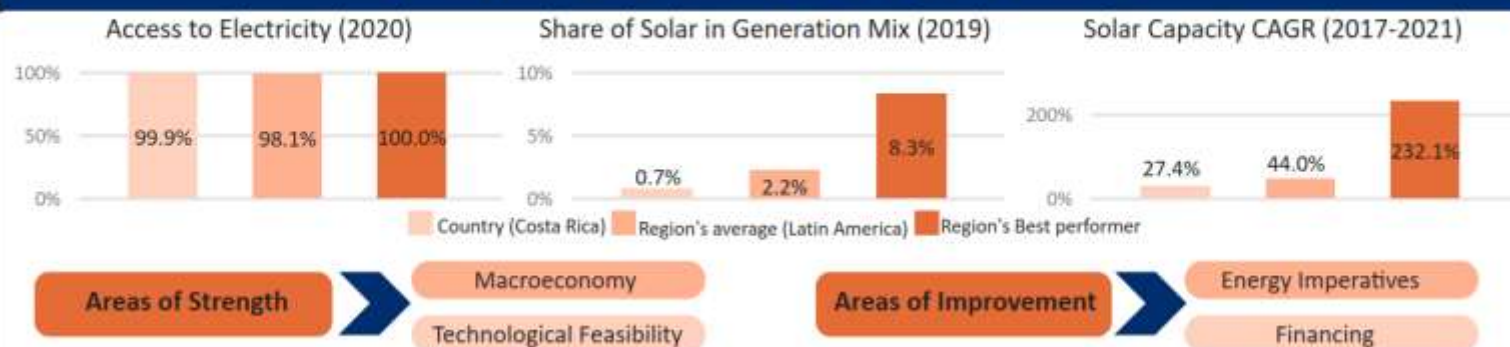
Energy Imperatives

- The total installed capacity in the country stood at 35.3 MW in 2019.¹³
- The total installed capacity of solar mini grids is 0.225 MW as of 2021.¹⁴
- In 2020, the per capita electricity consumption stood at 0.15 MWh which is significantly lower in comparison to the global average of 3.31 MWh.¹⁵
- The price of electricity in the country was 26.8 US Cents/kWh as of 2019.¹⁶





Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Costa Rica is an upper-middle income country with a GDP per capita (PPP) of USD 22,614 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 4.1% in 2020. However, in 2021, it has bounced back by growing at a rate of 7.8%.¹
- The inflation rate (CPI) of the country has increased to 1.7% in 2021 from 0.7% levels in 2020.¹
- The general government gross debt to GDP had marginally increased to 68.2% in 2021 from 67.2% levels in 2020.¹



Policy enablers

- By 2030, the country aims to achieve 100% share of RE in the electricity generation mix.⁶
- The National Decarbonization Plan 2018-2050 aims to make Costa Rica zero emission country by 2050. The plan envisions investing in clean initiatives for various sectors such as transportation, agriculture, energy, industry, waste management etc.⁷
- To promote development of RE several incentives such as net metering, feed-in tariff, import duty and tax exemptions are being implemented in the country.^{7,8}
- To encourage the adoption of solar energy, the government has been actively conducting trainings and providing certifications. In 2021 alone, 8 trainings sessions has been conducted.¹²



Technological Feasibility

- Costa Rica receives high levels of solar irradiation (GHI) of 4.9 kWh/m²/day and specific yield 4.1 kWh/kWp/day indicating very strong technical feasibility for solar in the country.³
- In 2021, 26.1% of the country's electricity demand was met through RE sources (excluding large hydro).⁴



Market Maturity

- As of 2020, 99.9% of the population in the country had access to electricity.²
- The Public Utilities Regulatory Authority is the designated agency that regulates the energy sector in the country.⁷
- The Institute of Electricity is responsible for the generation, transmission, and distribution of electricity in the country. Besides this, a few public institutions and cooperatives are also allowed to generate and distribute electricity.⁷



Infrastructure

- In August 2022, the US Trade and Development Agency (USTDA) extended support for developing a monitoring and diagnostic system to enhance the utility's management of its power generation, transmission, and distribution assets.¹¹
- The transmission and distribution of the country operates at 60 Hz frequency and voltages ranging from 220 V to 230 kV, with the total transformation capacity of transmission system reaching 12,116 MVA in 2022.^{7,12}
- In 2021, the country has reported transmission losses of 1.52% and distribution losses of 7.77%, indicating efficient power infrastructure.¹²
- Between 2022 to 2026, the country aims to spend USD 89.75 Mn for upgrading its transmission and distribution infrastructure.¹²




Financing

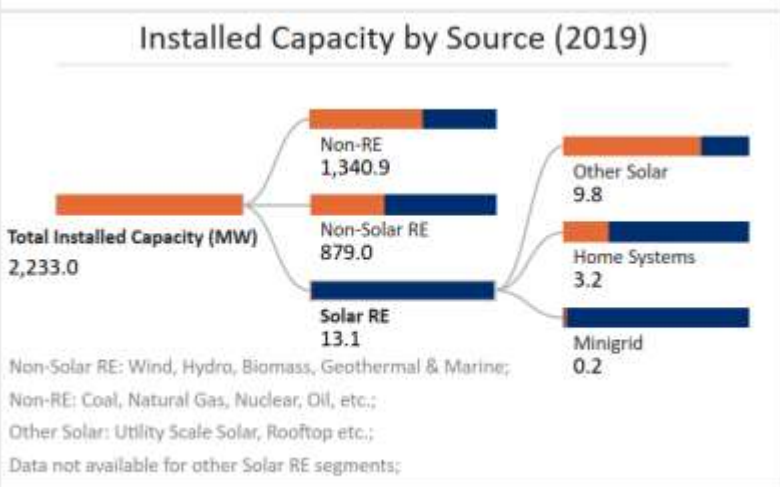
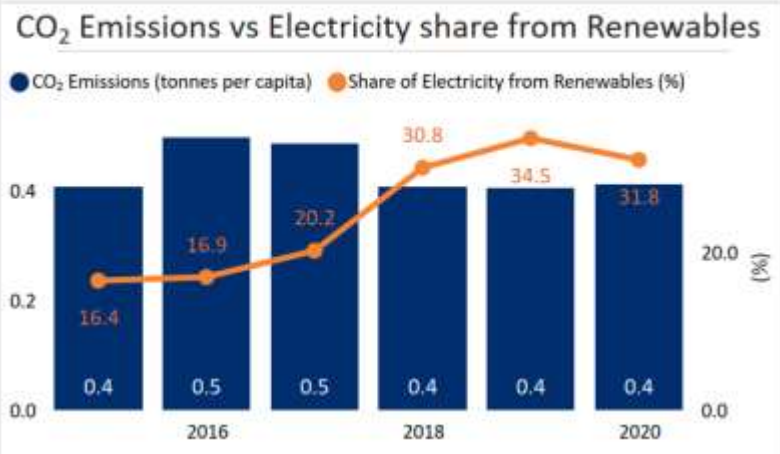
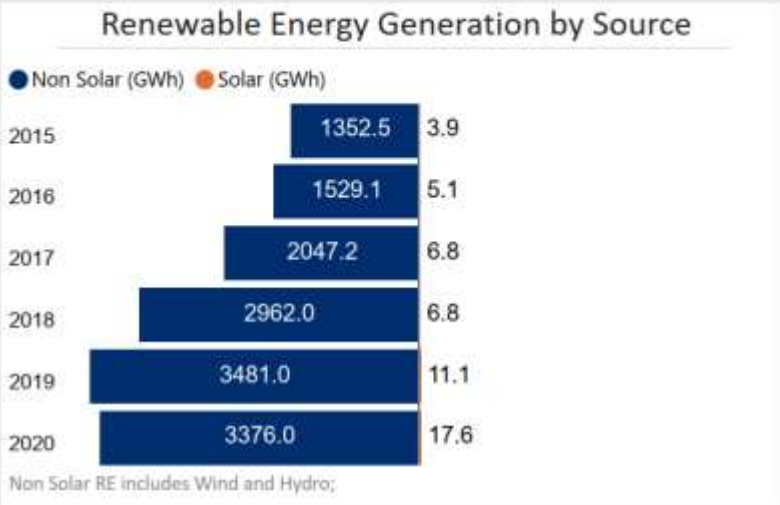
- The Inter-American Development Bank in June 2022 has approved a USD 300 Mn loan to support country's decarbonization plan, which aims to achieve net zero carbon emissions by 2050.¹⁰
- The IFC, to accelerate development of renewable energy in the country, had sanctioned a USD 35 Mn loan in 2019 to support and incentivize the issuance of a green bond by Davivienda Costa Rica.⁹
- To promote the use of solar energy, the country has credit facilitation for solar energy sector from the FIs.¹²



Energy Imperatives

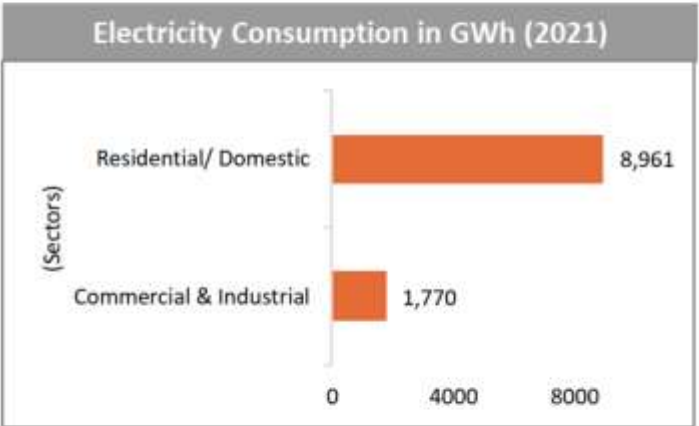
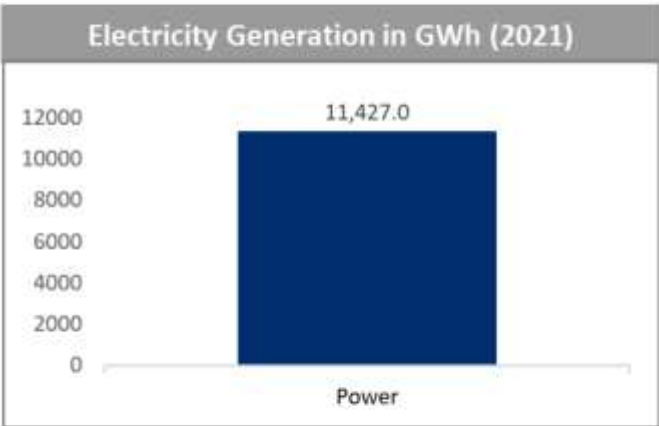
- In 2020, Costa Rica's per capita electricity consumption stood at 2.28 MWh which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The total installed capacity of solar PV witnessed a CAGR of 27.4% reaching 73.7 MW in 2021 from 28 MW in 2017.⁵
- The peak demand for electricity in the country has increased to 12.11 TWh in 2021 from 11.54 TWh levels in 2020.⁴
- In 2021, the total installed capacity in the country stood at 3.65 GW with a significant share coming from hydro (65.2%) followed by oil (12.9%) and wind (10.7%).⁴

| | | | | |
|--|--|-------------------------------------|--|--|
| <div> <div></div> <div></div> </div> | | Côte d'Ivoire | Ease of doing Solar classification | |
| | | Africa |  Influencer | |
| Electricity Consumption in kWh/capita (2020) | | Average PVout in kWh/kWp/day (2020) | | Cumulative Solar Capacity in MW (2021) |
| 361.7 | | 4.0 | | 13.1 |
| Getting Electricity Score (2020) | | NDC Target by 2030 in % | | Human Development Index (2021) |
| 59.2 | | 30.4 | | 0.6 |



| Support for Renewables (2020) | | | |
|--|----|--|--|
| Feed-in-Tariffs for renewable energy supply to the grid? | No | | |
| Net metering/Gross metering policies and regulations? | No | | |
| Renewable Energy Certificates? | No | | |
| Renewable Purchase Obligation? | No | | |

| Peak Demand/Load in MW (2021) | Diesel based Electricity Generation in GWh (2021) | Solar PV project Capital Cost in USD/MW (2021) |
|-------------------------------|---|--|
| 1645.0 | 5.0 | 750.0 |

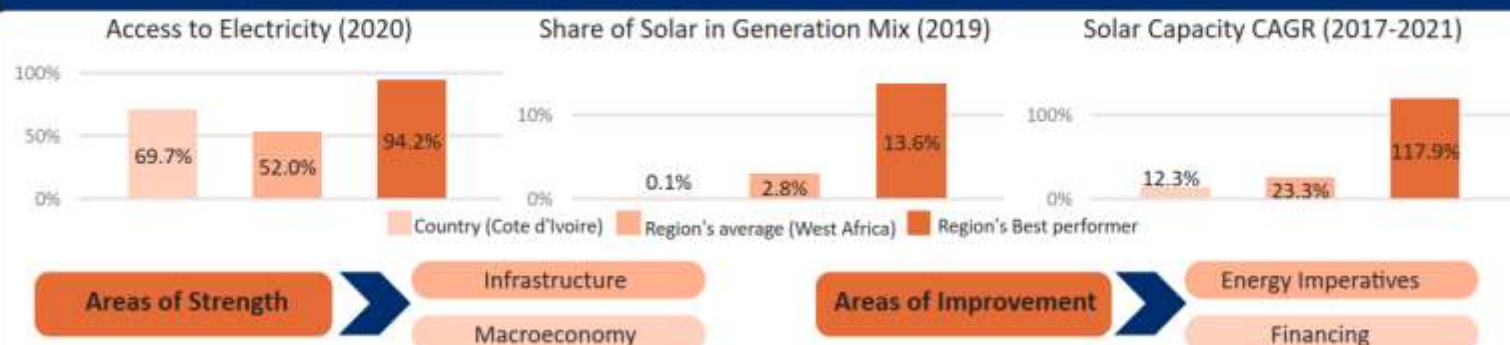


| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | Yes | Yes | Yes | Yes | Yes | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Côte d'Ivoire is a lower middle-income country¹ with GDP per capita (PPP) of USD 5,850 in 2021.²
- GDP (Real) grew at an annual rate of 6.5% in 2021 and it is estimated to increase by 6% in 2022.³
- Inflation rate in the country increased to 4.2% in 2021 from 2.4% levels in 2020.⁴
- The budget deficit in the country reduced to 5.0% of GDP in 2021 from 5.6% levels in 2020.⁴



Policy enablers

- The Ministry of Petroleum, Energy, and Renewable Energy is responsible for promoting off-grid solar in the country.⁵
- The Ministry of the Environment and Sustainable Development is responsible for implementing and enforcing environmental and sustainable development policies in the country.⁵
- Ivorian Association of Renewable Energies (AIENR) is responsible for promoting renewable energy and energy efficiency in Côte d'Ivoire.⁵
- Rural Electrification Master Plan (Plan Directeur d'Electrification Rurale [PDER]) has been created to strengthen electrification in rural areas of the country.⁵



Technological Feasibility

- Côte d'Ivoire receives high levels of solar irradiation of 5.0 kWh/m²/day and specific yield of 4.0 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁶
- The UN Environment program is currently active in Côte d'Ivoire and is working on the introduction of electric light duty vehicles and zero/low-emissions buses.⁷
- The project 'Promoting RE Based Grids in Rural Communities for Productive Uses in Côte d'Ivoire' aims to develop a market-based approach for improving the access to PV-based minigrids in rural areas.⁸



Market Maturity

- 69.7% population in Côte d'Ivoire had access to electricity as of 2020.⁹
- National Authority for the Regulation of the Electricity Sector (ANARE) is the energy regulator in the country.⁵
- The Ivorian Electricity Company (Compagnie Ivoirienne d'Electricité, CIE) handles the generation, transmission, and distribution of electricity.⁵
- Côte d'Ivoire is the member of the West African Power Pool (WAPP), which aims to integrate the national power systems into a unified regional electricity market.¹⁰



Infrastructure

- The country's average Transmission and Distribution loss levels are 8.3% and 10.4% respectively.¹¹
- The country is a net exporter of electricity to neighbouring countries such as Benin, Burkina Faso, Ghana, and Togo.⁵
- CIE operates an electricity network of more than 50,000 kms and it distributes electricity to more than 1.9 Mn customers in the Ivory Coast.¹²



Financing

- In Côte d'Ivoire, the AfDB is providing €50 Mn for development of RE projects in the country.¹³
- In 2018, the AfDB mobilized over CFAF 15 Bn to finance pay-as-you-go solar home systems in Côte d'Ivoire.¹⁴
- The AfDB approved USD 324 Mn to support two RE projects in Côte d'Ivoire and Morocco that are expected to significantly increase power supplies and keep economic growth on track.¹⁵

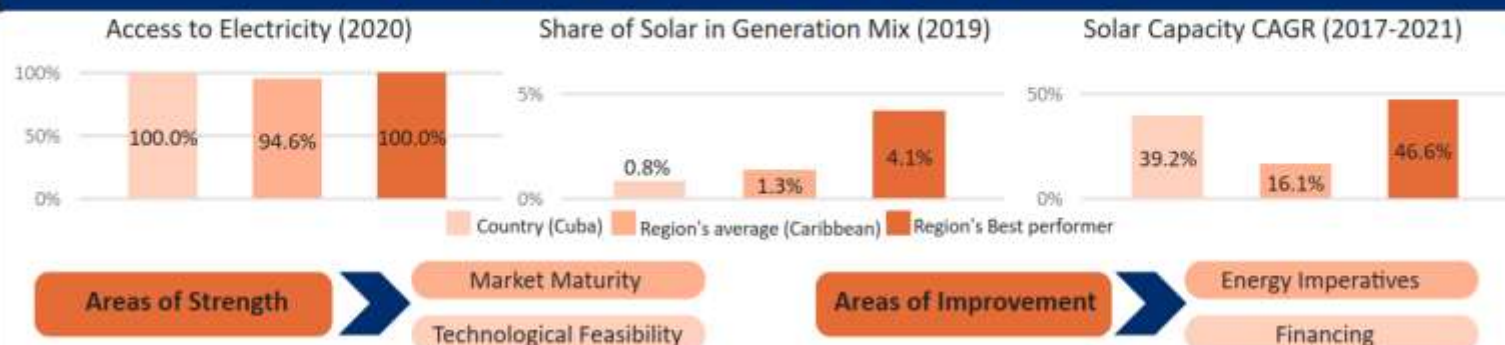


Energy Imperatives

- The total installed capacity in the country stood at 2,233 MW in 2019.¹⁶
- The total installed capacity of solar PV witnessed a CAGR of 12.3% between 2017-2021 reaching 13.14 MW in 2021 from 8.28 MW levels in 2017.¹⁷
- In 2020, the per capita electricity consumption stood at 0.36 MWh which is significantly lower in comparison to the global average of 3.31 MWh.¹⁸
- The price of electricity in the country was 11.8 US Cents/kWh as of 2019.¹⁹



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Cuba is an upper middle income¹ country with a GDP per capita (PPP) of USD 9,478 in 2020.²
- Due to COVID-19 Pandemic, the GDP (Real) declined by 10.9% in 2020. However, in 2021 it has bounced back growing at a rate of 0.5%.³
- The inflation rate (CPI) of Cuba was expected to increase by 500% in 2021 from 18.3% levels in 2020.³
- The general government gross debt to GDP has marginally increased to 24.5% in 2021 from 22.1% levels in 2020.³



Policy enablers

- Cuba has a plan, Plan Nacional de Desarrollo Económico y Social (the National Social and Economic Development Plan), which targets to increase share of clean energy output to 37% by 2030.⁴
- The Government of Cuba has published new rules that introduce incentives, import tariff exemptions, and tax benefits for distributed generation, in order to facilitate the installation and purchase of renewable electricity.⁵



Technological Feasibility

- Cuba receives high levels of solar irradiation (GHI) of 5.4 kWh/m²/day and specific yield 4.5 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁶
- In July 2022, India's Public Sector Utility NTPC has sought global bids on behalf of Unión Eléctrica de Cuba (UNE) for 1,150 MW of grid-connected solar PV and 150 MW/150 MWh battery energy storage system (BESS) projects in Cuba.⁷



Market Maturity

- 100% of the population in Cuba had access to electricity as of 2020.⁸
- The Ministry of Energy and Mines (MINEM) regulates the power sector in the country.
- In Cuba the Power generation is handled by independent power producers while the transmission and distribution of electricity is handled by state run entity named Unión Eléctrica (UNE).⁹



Infrastructure

- Cuba's transmission grid operates at 220/110 kV. In total, the country has 2,833 km of 220 kV lines and 4,188 km of 110 kV lines.¹⁰
- Cuba has state run company Cubaelectrónica (the import company for CCE - Empresa de Componentes Electrónicos) with a capacity of manufacturing 16,000 solar panels per year.¹¹



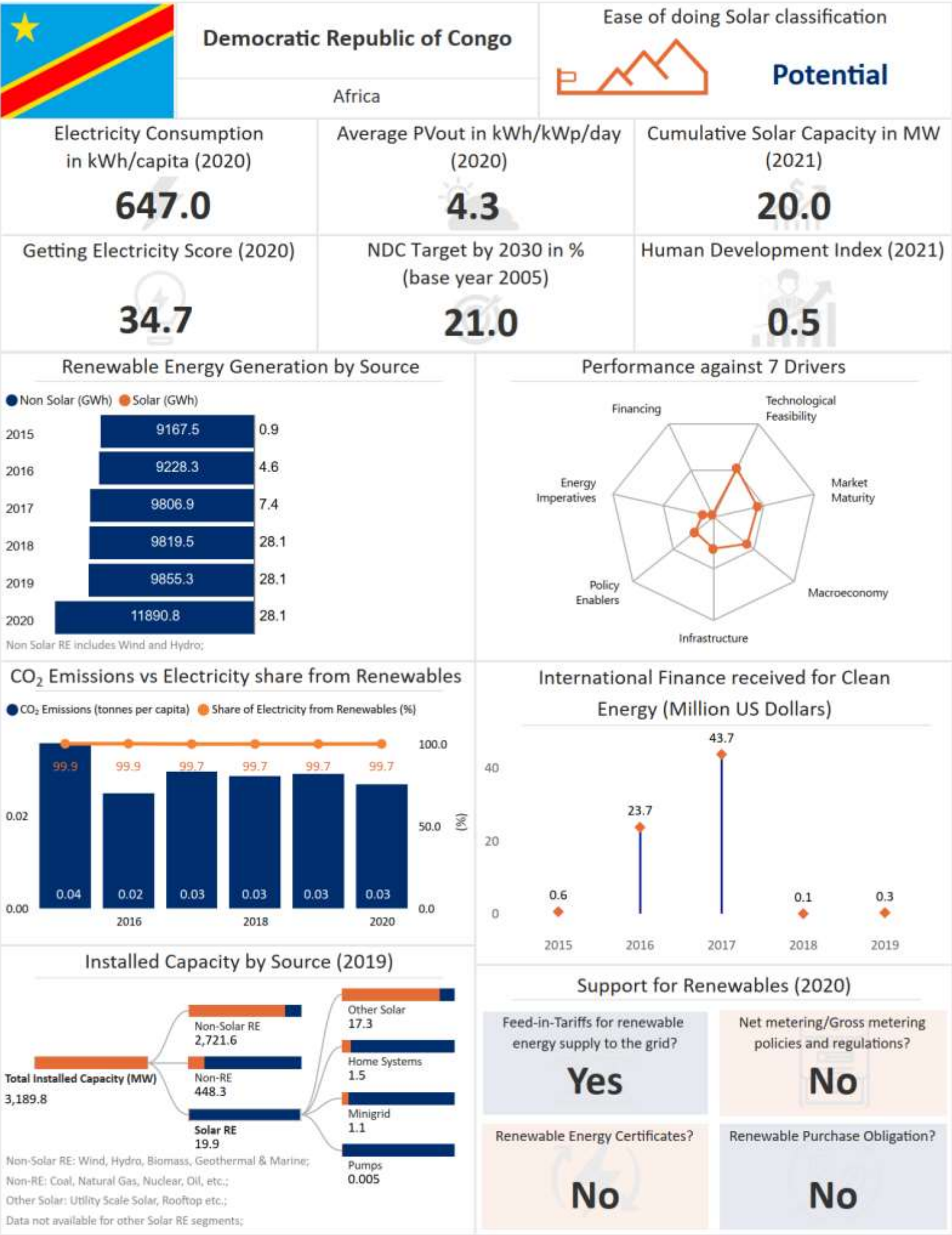
Financing

- In 2019, the Opec Fund for International Development (OIFD) extended a loan of USD 45 Mn to develop Cuba's Renewable energy.¹²
- Cuba has planned to invest more than USD 3.5 Bn in the RE sector to bring RE share in the energy mix to approximately 25% by 2030.¹²
- The Green Climate Fund (GCF) has allocated USD 62.1 Mn to Cuba to mitigate climate challenges.¹³



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 1.63 MWh which is significantly lower in comparison to the global average of 3.31 MWh.¹⁴
- The total installed capacity of solar PV witnessed a CAGR of 39.22% reaching 245.95 MW in 2021 from 65.5 MW levels in 2017.¹⁵
- The peak demand for electricity in the country stood at 18.45 TWh remaining similar in 2021 and 2020.¹⁶
- In 2021, the total installed capacity in the country stood at 6.58 GW¹⁷ with maximum share coming from oil (72%), solid fuels (14%), gas (9%), solar (4%) and hydro (1%).¹⁶



| Cumulative Power Generation in GWh (2022) | Cheapest Source of Power (2021) | Average term of Solar PPAs in years (2021) |
|---|---------------------------------|--|
| 13,148.0 | Hydro | 30.0 |

| Power Sector - Structure | |
|--|-----|
| Unbundling Generation, Transmission and Distribution (G-T-D) | Yes |
| Regulatory bodies | Yes |
| Load Dispatch centres | Yes |
| Technical Standards pertaining to Power equipment | Yes |
| Access to Power Exchange | No |
| Access to spot power market | Yes |
| Green Energy Trading plan/Strategy | No |
| Availability of Third-party procurement regulations | No |

| Support for Renewables (2021) | |
|---|-----|
| Feed-in-Tariffs for Renewable Energy Supply to the Grid | Yes |
| Renewable-cum-storage based tenders | No |
| Carbon Taxation | Yes |
| Manufacturing facility for solar equipment (inverters and balance of systems) | No |

| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | Yes |

| Policies/Schemes for Solar Segments (2021) | | | |
|--|--------------------------|-------------|----------------|
| Solar Mini Grids | Standalone solar systems | Solar Parks | Floating Solar |
| Yes | Yes | Yes | No |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Democratic Republic of Congo is a low-income country¹ with GDP per capita (PPP) of USD 1,179 in 2021.²
- GDP (Real) grew at an annual rate of 5.7% in 2021 and it is estimated to grow by 6.4% in 2022.³
- Inflation rate in the country declined to 9.3% in 2021 from 11.4% levels in 2020.⁴
- The budget deficit in the country reduced to 1.6% of GDP in 2021 from 2.1% levels in 2020.⁴



Policy enablers

- The country targets to achieve 30% share of solar in the energy mix by 2030.⁵
- In 2020, the Ministry of the Environment revised the Climate Change Policy, Strategy and Action Plan and developed its National Adaptation Plan (2020–2024) to reinforce resilience.⁴
- The country targets to reduce its GHG emissions to 21% by 2030.⁴



Technological Feasibility

- Democratic Republic of Congo receives high levels of solar irradiation of 5.1 kWh/m²/day and specific yield of 4.3 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁶
- The Green Mini-Grid Program serves as the pilot to an innovative private-led electrification approach to deploy renewable-based mini-grid solutions in the country.⁷



Market Maturity

- 19.1% population in Democratic Republic of Congo has access to electricity as of 2020.⁸
- The Ministry of Mines, Energy and Hydrocarbons is responsible for managing the energy sector.⁹
- Electricity Regulation Authority (ARE) is the energy regulator in the country.⁹
- The Société National d'Electricité (SNEL) is the sole generator, transmitter, and distributor of electric energy.⁹



Infrastructure

- The West-Southern transmission grid operated by SNEL consists of high voltage lines with a length of 6,937 km (including 1,827 km HVDC lines).¹⁰
- The West-Southern transmission grid is interconnected with Congo Brazzaville and Zambia (with respective transit capacities of 150 MW and 500 MW).¹⁰
- The Eastern transmission grid covers the Kivu provinces and is interconnected with Rwanda and Burundi.¹⁰



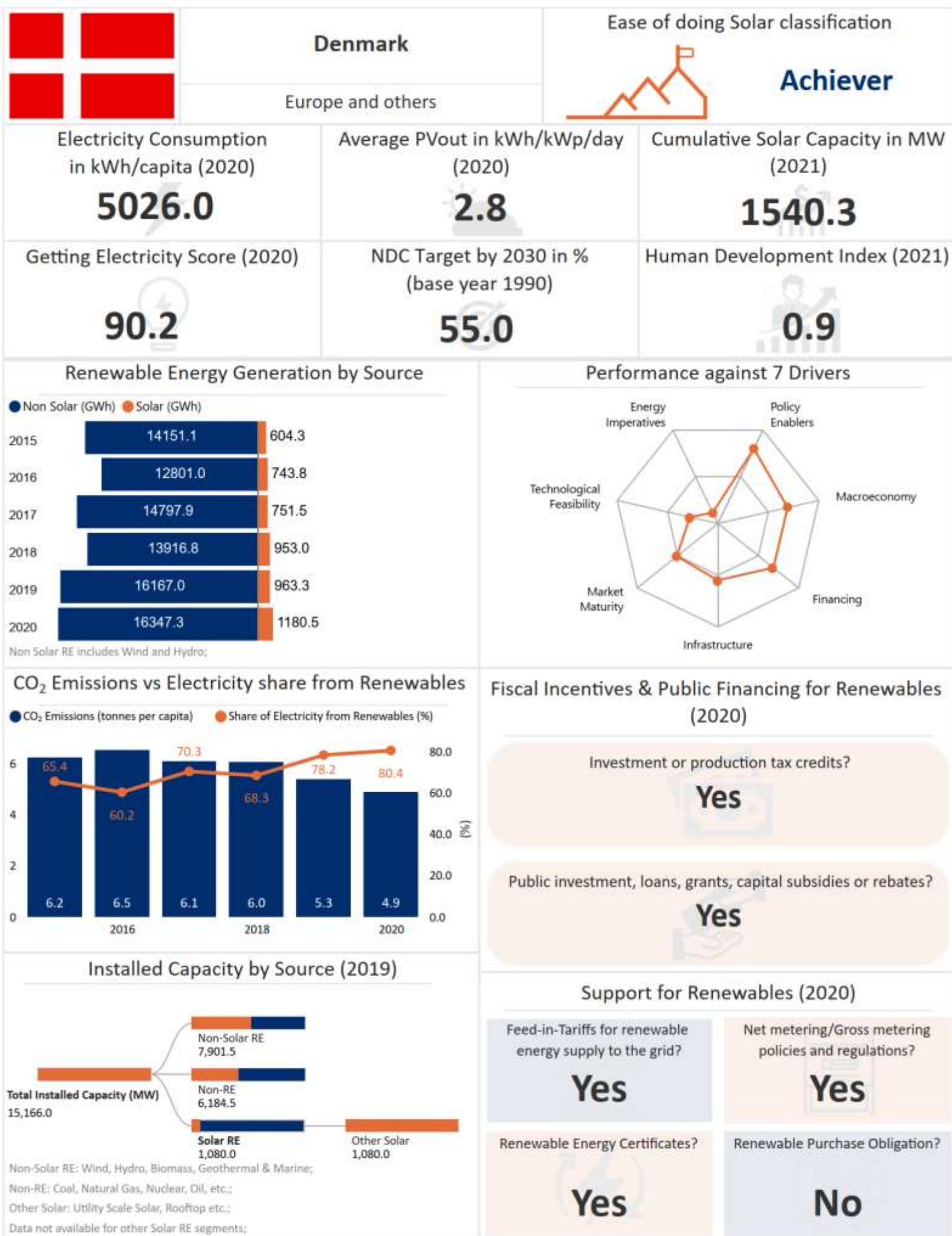
Financing

- In 2019, the AfDB approved the allocation of USD 20 Mn for Green Mini-Grid Program in Democratic Republic of Congo.¹¹
- The AfDB is providing USD 1 Mn under Sustainable Energy Fund for Africa (SEFA) grant to provide advisory services to the government of the Democratic Republic of Congo for the procurement of solar PV mini-grid systems.¹¹
- In DR Congo, the World Bank is providing USD 145 Mn for improving Electricity Access and Service Expansion project (EASE).¹²

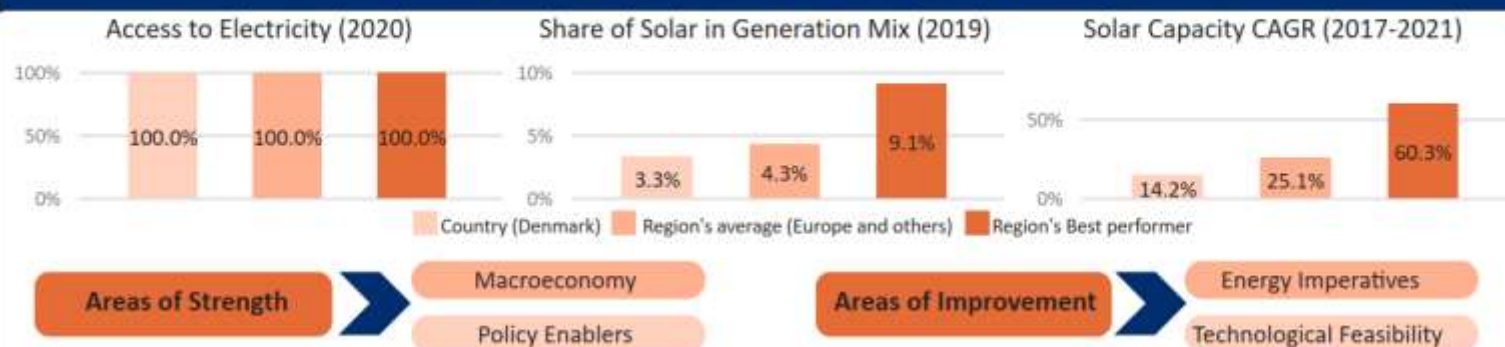


Energy Imperatives

- The total installed capacity in the country stood at 3,189.83 MW in 2019.¹³
- The total installed capacity of solar PV witnessed a CAGR of 39.7% between 2017-2021 reaching 19.93 MW in 2021 from 5.24 MW levels in 2017.¹⁴
- In 2020, the per capita electricity consumption stood at 0.64 MWh which is significantly lower in comparison to the global average of 3.31 MWh.¹⁵
- The price of electricity in the country was 10 US Cents/kWh as of 2019.¹⁶



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Denmark is a high-income country¹ with a GDP per capita (PPP) of USD 64,672 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 2% in 2020. However, in 2021, the GDP has bounced back recording an annual growth rate of 4.9%.³
- The inflation rate (CPI) of Denmark has increased to 1.9% in 2021 from 0.3% levels in 2020.⁴
- The general government gross debt to GDP has reached 36.6% in 2021 from 42.2% levels in 2020.⁵



Policy Enablers

- Denmark has set a target to achieve 100% renewable energy-based electricity generation by 2050.⁸
- Denmark has targeted to cut GHG emissions by 70%, from 1990 levels, by 2030.⁶
- In 2021, Denmark announced its plans to allocate funds for energy renovation projects and digital solutions that can monitor and optimise energy consumption.⁷
- Denmark has issued its first green bond, a zero-coupon bond, in 2022 with maturity on 15 November 2031 depending on stable market conditions.⁹



Technological Feasibility

- Denmark receives low solar irradiation (GHI) of 2.8 kWh/m²/day and specific yield 2.8 kWh/kWp/day indicating a very low technical feasibility for solar in the country.¹¹
- In Jan 2022, Denmark's Arla Food in association with Better Energy has announced setting up of four solar parks which will meet almost one third of Arla's electricity consumption.¹²
- Denmark has installed an off-grid hybrid project in Middelfart which can provide 20-25 household with 100% renewable energy 24/7, all year around.¹⁴



Market Maturity

- The Danish Utility Regulator (DUR) is the independent regulator that performs monitoring and regulation of the infrastructure of the Danish electricity network.¹⁶
- Denmark is part of the Nordic electricity spot market (Nord Pool Spot).¹⁷
- Energinet is the Danish national transmission system operator for electricity and natural gas. It is an independent public enterprise owned by the Danish state under the Ministry of Climate and Energy.¹⁸



Infrastructure

- Denmark's transmission network is divided into two separate transmissions grids: West Danish grid is connected to the European continental grid and the East Danish grid is connected to the Nordic grid.¹⁹
- Denmark has a well-connected transmission grid with its neighbouring countries including Sweden, Netherlands, Norway and Germany.²⁰
- Energinet transmission network comprises of 132 kV, 150 kV and 400 kV AC lines and 250 kV–500 kV DC lines handling 40,668 MVA of transformation capacity and 187 substations.²¹



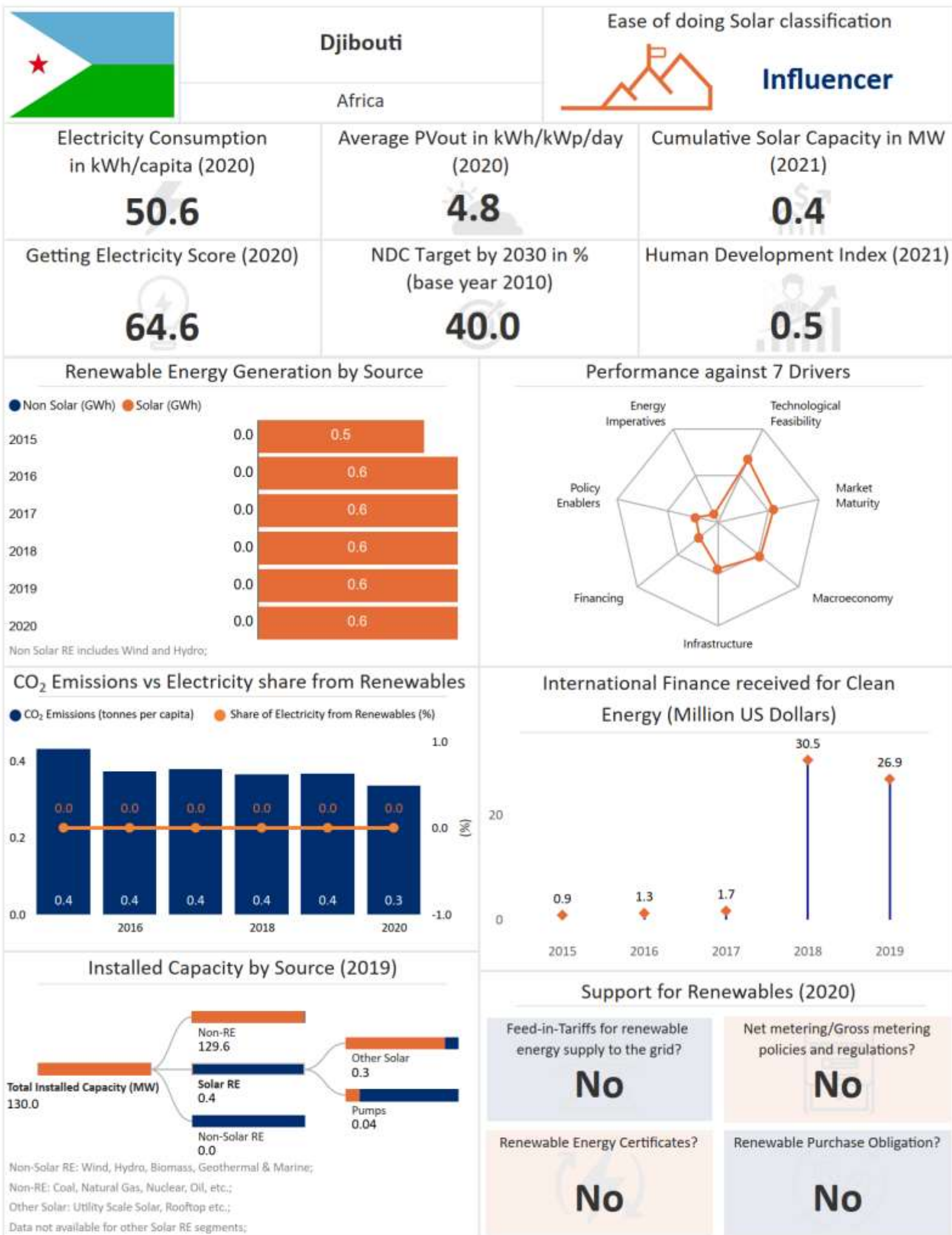
Financing

- Denmark has Danish Cooperation Fund for Renewable Energy and Energy Efficiency which has an aim to increase the use of RE in rural areas.²²
- Danish Green Investment Fund was set up with a corpus of USD 261 Mn to finance all green projects.²³
- The Danish Climate Investment Fund (KIF) is a public-private partnership with total corpus of USD 170 Mn and invests in climate projects in Asia, Africa, Latin America and in Europe.²⁴

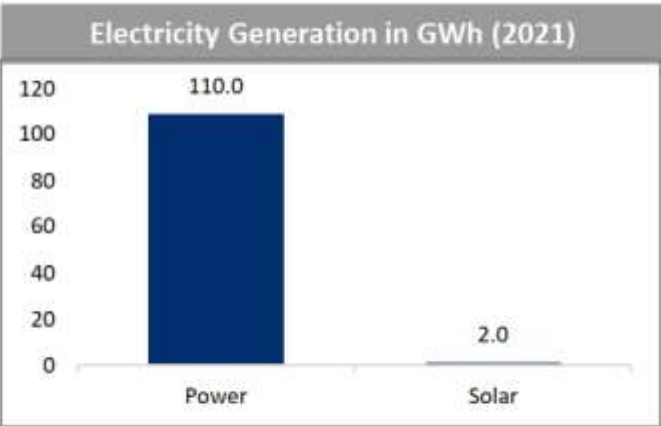


Energy Imperatives

- In 2020, Denmark's per capita electricity consumption stood at 5.02 MWh, which is significantly higher than the global average of 3.31 MWh.²⁵
- In 2021, the total installed capacity in the country has reached 16.17 GW²⁷ with a significant share coming from onshore-offshore wind and other fossil fuels.²⁷
- The cost of electricity per kWh is US Cent 45.9 for households and US Cent 25.8 for businesses.²⁸



| Peak Demand in MW (2021) | Electricity Consumption CAGR in % (2022 - 2026) | Average term of Solar PPAs in years (2021) |
|--------------------------|---|--|
| 132.1 | 7.5 | 25 |

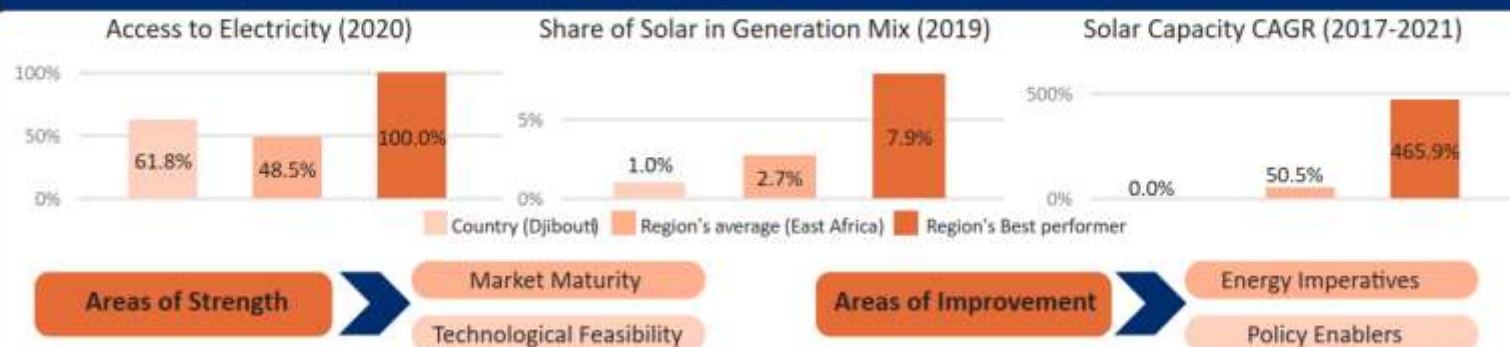


| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | No | No | No | No | No | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Djibouti is a lower middle-income country ¹ with GDP per capita (PPP) of USD 5,398 in 2021. ²
- GDP (Real) grew at an annual rate of 4% in 2021 and it is estimated to grow by 3% in 2022. ³
- Inflation rate in the country increased to 1.2% in 2021 from 0.3% levels in 2020. ⁴
- Total public debt in the country declined to 67.7% of GDP in 2021 from the levels of 73.1% in 2020. ⁴



Policy enablers

- The country aims to reduce its GHG emissions to 40% by 2030 and to achieve a 100% green energy mix by 2025. ⁴
- Djibouti has set a target to increase the share of solar to 10% in the energy mix by 2024. ⁵
- Djiboutian Agency for Energy Management (ADME) is responsible to promote energy efficiency and renewable energy in the country. ⁶
- The National Energy Commission is responsible to implement and monitor the Djibouti National Energy Master Plan. ⁶



Technological Feasibility

- Djibouti receives very high levels of solar irradiation of 5.9 kWh/m²/day and specific yield of 4.8 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁷
- The country typically receives 12 hours of sunlight per day indicating a strong potential of Solar. ⁵
- The project 'Promotion of better access to modern energy services through sustainable mini-grids and hybrid technologies in Djibouti' focuses on improving access to modern energy services through sustainable mini-grids in the country. ⁸



Market Maturity

- 61.8% population in Djibouti is having access to electricity since 2020. ⁹
- Ministry of Energy and Natural Resources (MERN) is responsible for designing and developing government policies on energy and natural resources. ⁶
- Electricity of Djibouti (EdD) is a state-owned utility and has a monopoly on electricity generation, transmission and distribution. ⁶
- On a regional level, the country is a member of the East African Power Pool. ¹⁰



Infrastructure

- The expected investment in the Transmission & Distribution Infrastructure over (2022-2026) is USD 28.9 Mn. ⁵
- In 2021, the construction of 230 kV double circuit transmission line from Semera (Ethiopia) to Nagad (Djibouti) with line length of 292 km (102 km in Ethiopia and 190 km in Djibouti) has been initiated in the country. ¹¹



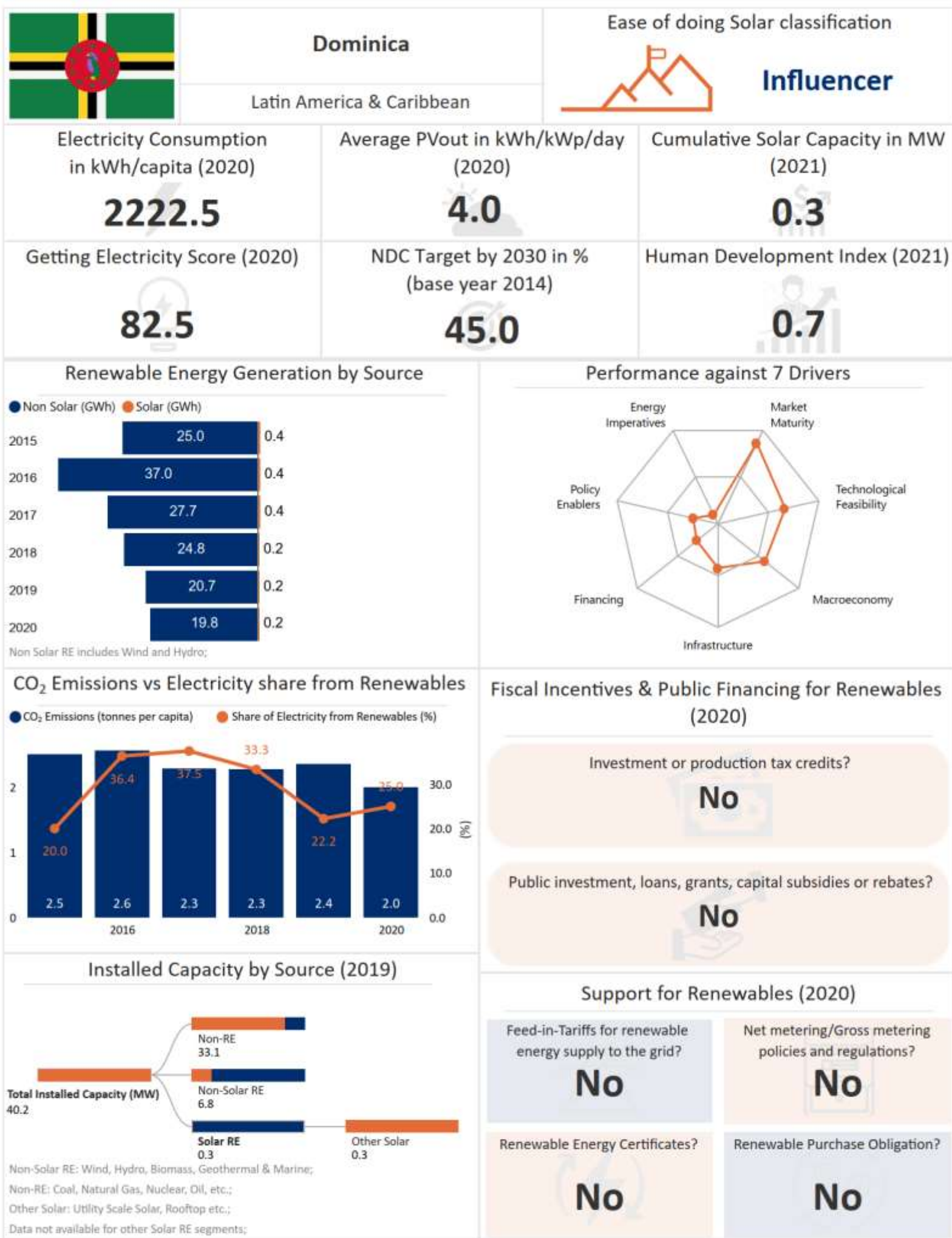
Financing

- In 2022, the African Development Fund has approved USD 5.5 Mn grant to initiate the flagship 'Desert to Power initiative' in Djibouti. ¹²
- In 2021, the AfDB approved USD 83.6 Mn to boost cross-border trade in electricity between Ethiopia and Djibouti. ¹³
- In 2022, the World Bank approved the 'Djibouti-Power System Interconnection Project', which aims to enhance regional connectivity through improved low-cost and clean electricity transmission between Ethiopia and Djibouti. ¹⁴

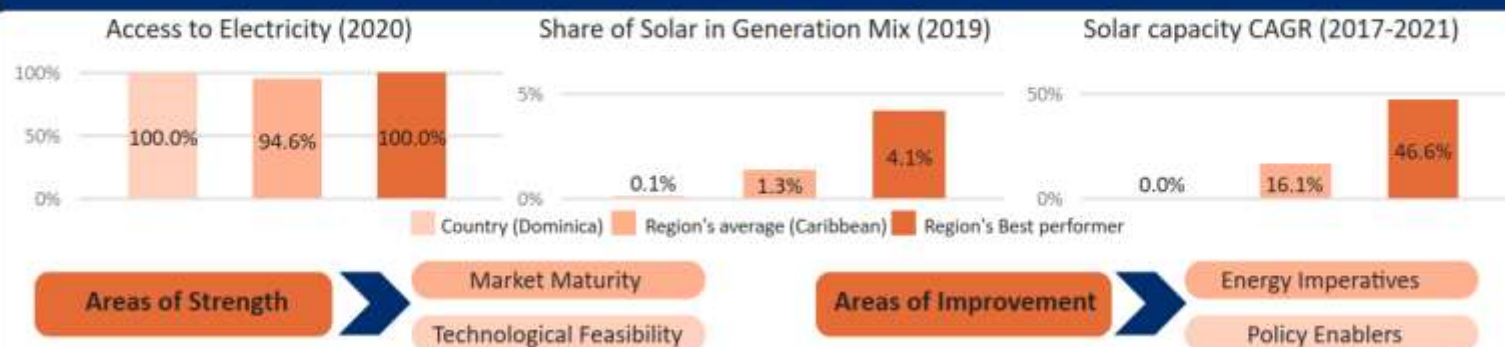


Energy Imperatives

- The total installed capacity in the country stood at 130 MW in 2019. ¹⁵
- The installed capacity of solar mini grids is 0.6 MW as of 2021. ⁵
- In 2020, the per capita electricity consumption stood at 0.05 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁶
- The price of electricity in the country was 25.5 US Cents/kWh as of 2019. ¹⁷



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Dominica is an upper middle income¹ country with a GDP per capita (PPP) of USD 11,951 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) declined by 16.6% in 2020. However, in 2021, the GDP has bounced back growing at a rate of 4.8%.³
- The inflation rate (CPI) of Dominica has increased to 1.6% in 2021 from -0.7% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 102.7% in 2021 from 114.5% levels in 2020.⁵



Policy enablers

- Dominica, through its National Energy Policy, has set a target to achieve an electricity generation mix with 100% share from RE by 2030.⁶
- The Electricity Supply Act 2006 regulates the generation, transmission, distribution, and supply of electricity services in the country.⁷
- Dominica's National Resilience Development Strategy 2030 aims to achieve affordable and clean energy through RE sources.⁸



Technological Feasibility

- Dominica receives high levels of solar irradiation (GHI) of 4.9 kWh/m²/day and specific yield 4.0 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁹
- In May 2021, Dominica had announced a 5 MW/2.5 MWh battery energy storage system (BESS) to provide necessary reserve power from existing RE sources during the time of calamities and emergencies.¹⁰
- In July 2021, Rocky Mountain Institute floated Request for Proposals (RfP) for Dominica School Microgrids Project on turnkey EPC mode.¹¹



Market Maturity

- 100% of the population in Dominica had access to electricity as of 2020.¹²
- The Independent Regulatory Commission (IRC) was established under the Electricity Supply Act, 2006 aimed at complete overhaul of electricity services in Dominica.¹³
- Dominica Electricity Services Limited (DOMLEC) has exclusive license to transmit, distribute and supply electricity within Dominica.¹⁴



Infrastructure

- Dominica has a transmission and distribution (T&D) network comprising of 403 kms of 11 kV and 922 kms of 230/400V overhead lines.¹⁴
- DOMLEC has an Advanced Metering Infrastructure (AMI) for energy accounting.¹⁴
- In Aug 2022, the Dominica Geothermal Development Company released an EoI to construct a new transmission network of 69 kV for its geothermal power project.¹⁵



Financing

- The Dominican government expects an investment of more than USD 2 Bn in the next three years across ~35 renewable energy projects.¹⁶
- The Caribbean Development Bank (CDB) has invested in RE and EE solutions in the Dominica's public sector.¹⁷
- The World Bank Group has extended support to Dominica in accelerating clean energy transition through investments and technical assistance.¹⁸



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 2.2 MWh which is significantly lower in comparison to the global average of 3.31 MWh.¹⁹
- The total installed capacity of Solar PV witnessed an annual decline of 15.91% reaching 0.32 MW in 2021 from 0.63 MW levels in 2017.²⁰
- In 2021, the total installed capacity in the country stood at 28.70 MW with major share coming from oil (75.26%) followed by hydro (22.85%), solar (1.10%) and wind (0.80%).²¹



Dominican Republic

Latin America & Caribbean

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

1578.2

Average PVout in kWh/kWp/day
(2020)

4.6

Cumulative Solar Capacity in MW
(2021)

490.0

Getting Electricity Score (2020)

68.0

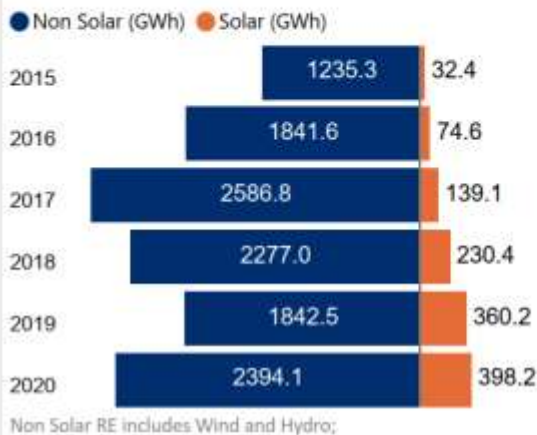
NDC Target by 2030 in %

27.0

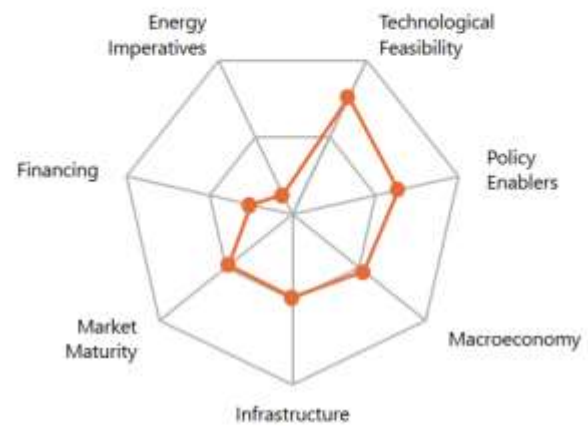
Human Development Index (2021)

0.8

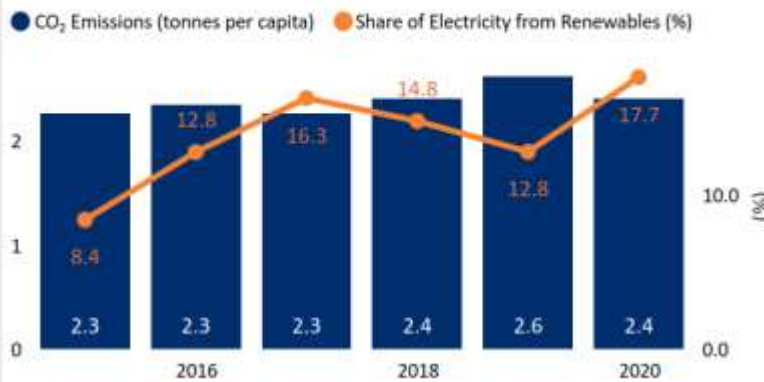
Renewable Energy Generation by Source



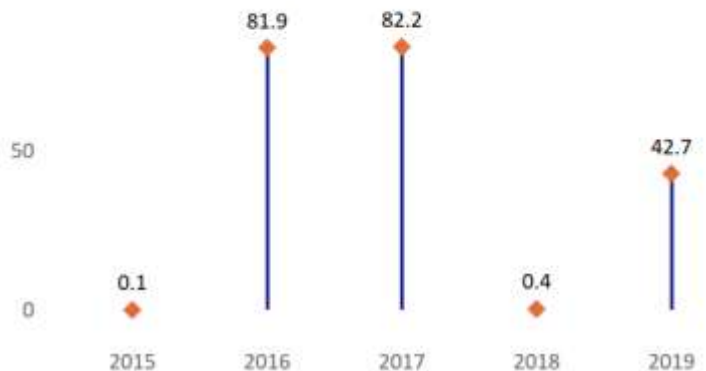
Performance against 7 Drivers



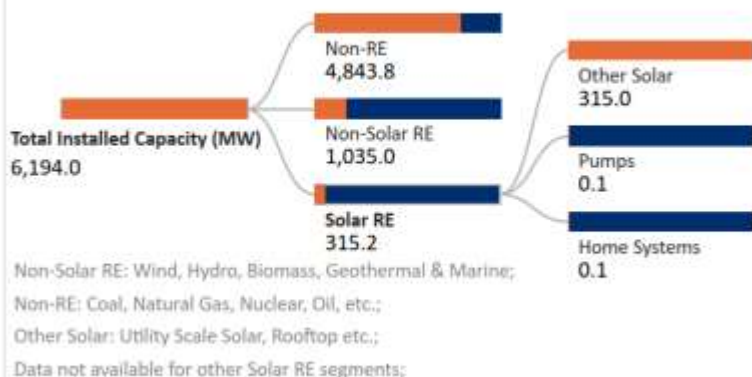
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable energy supply to the grid?

No

Net metering/Gross metering policies and regulations?

Yes

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Dominican Republic is an upper middle income¹ country with a GDP per capita (PPP) of USD 20,462 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) declined by 6.7% in 2020. However, in 2021, the GDP has shown signs of improvement recording an annual growth of 12.3%.³
- The inflation rate (CPI) of Dominican Republic has increased to 8.2% in 2021 from 3.8% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 63.1% in 2021 from 71.5% levels in 2020.⁵



Policy enablers

- In Oct 2022, Dominican Republic has set a target to achieve 25% of RE by 2025 and 30% by 2030 in the respective years' electricity generation mix.⁶
- Dominican Republic Net-Metering Regulation 2011 emphasises on encouraging use of RE sources and prosumer concept.⁷
- Dominican Republic has a law "Incentives for Development of Renewable Energy Sources and its Special Regimes" that facilitates diversification of energy sources, promotion of community investment in RE, and decentralisation of power and biofuel production.⁸



Technological Feasibility

- Dominican Republic receives high levels of solar irradiation (GHI) of 5.4 kWh/m²/day and a specific yield 4.6 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁹
- US Trade Development Agency (USTDA) has extended technical assistance to conduct Battery energy storage systems analysis to support the deployment of battery storage throughout the country's power system.¹⁰



Market Maturity

- 100% of the population in Dominican Republic had access to electricity as of 2020.¹¹
- General Electricity Law outlines the regulatory framework for the electricity sector in the Dominican Republic.¹²
- The Dominican Corporation of State Electric Companies (CDEEE) is the regulatory body for generation, transmission, distribution of electricity. CDEEE also act as an administrator for all companies in the energy sector.¹³
- The Consorcio Energético Punta Cana - Macao, S.A (CEPM), and its subsidiary Compañía de Electricidad de Bayahibe (CEB) generates, distributes, and markets electricity in the east of the Dominican Republic.¹⁴



Infrastructure

- Dominican Republic transmission system comprises of lines operating at 12.5 kV, 34.5 kV, 69 kV, 138 kV voltage levels.¹⁵
- In 2016, ZIV has been awarded a contract to upgrade 7 transmission substations of Dominican Republic Transmission Utility ETED (Empresa de Transmisión Eléctrica Dominicana).¹⁶



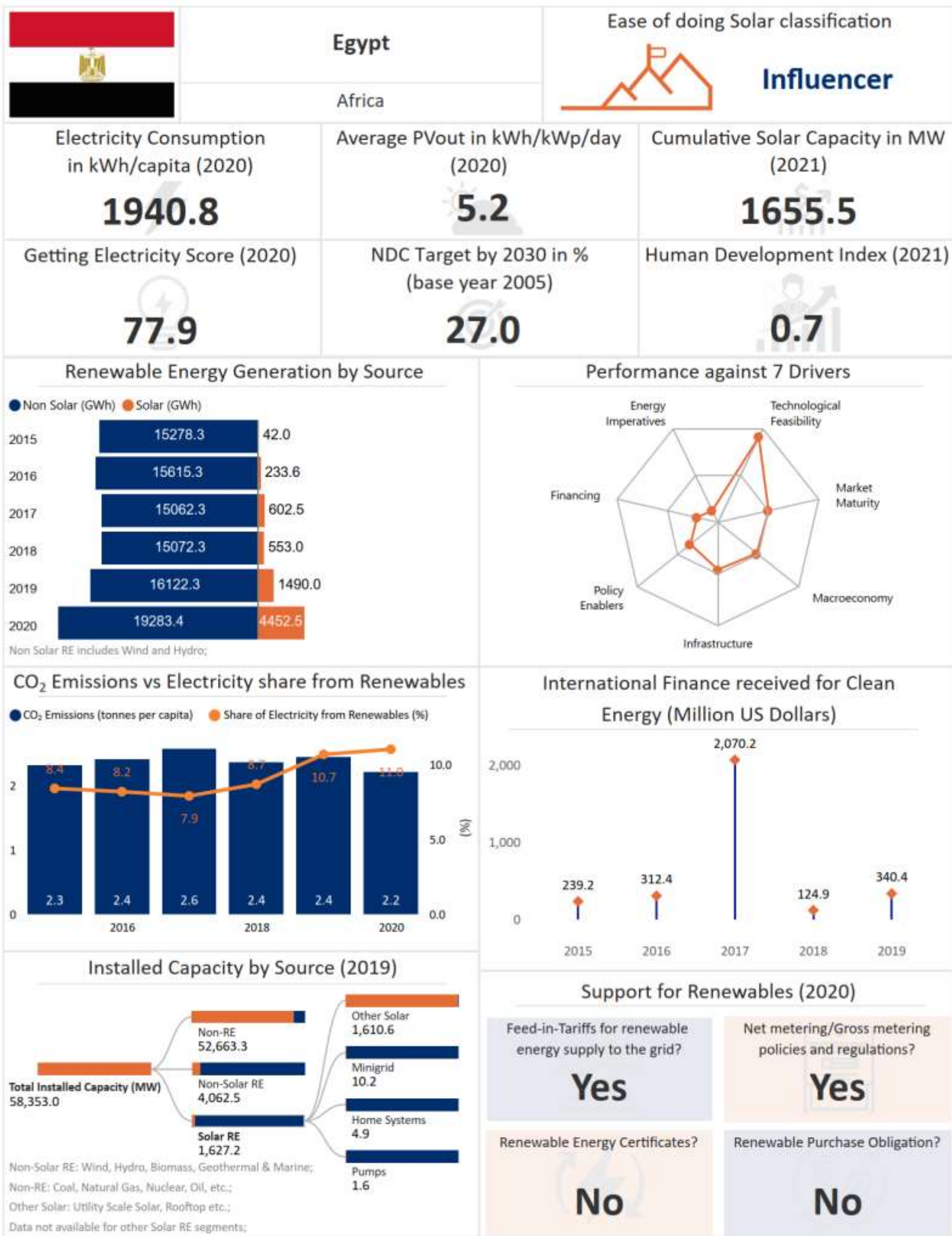
Financing

- In 2016, the European Investment Bank (EIB) has signed a loan agreement of USD 100 Mn with the country to improve the electricity distribution system and availability of power supply in the country.¹⁷
- In 2022, the World Bank has extended support to the Dominican Republic's pursuit of clean energy and high-quality jobs with USD 1.8 Bn for next five years.¹⁸
- The Dominican Electricity Transmission Company (ETED) has invested USD 19.9 Mn in upgrading substations that will provide stability, quality, and greater transmission capacity.¹⁹

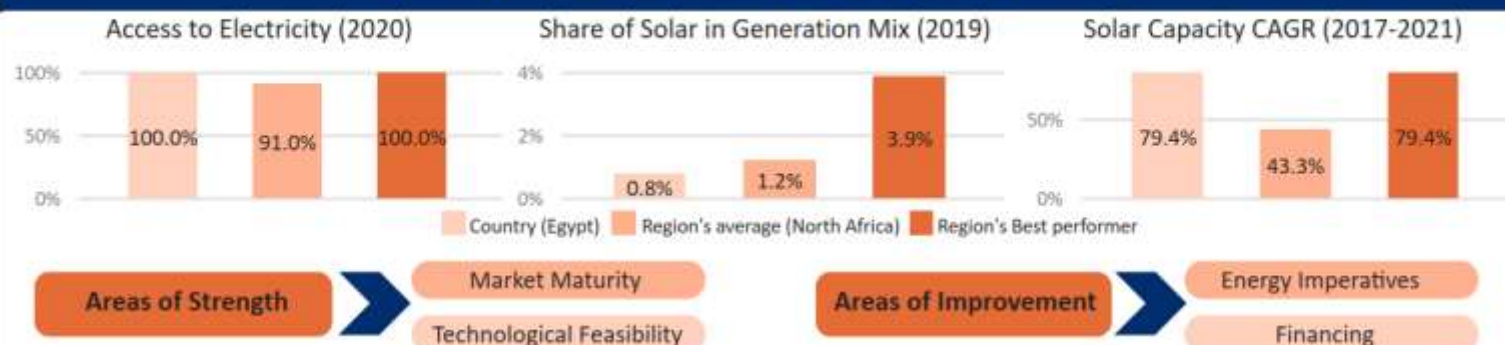


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 1.58 MWh which is significantly lower in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 46.6% reaching 489.60 MW in 2021 from 106.03 MW levels in 2017.²¹
- The peak demand for electricity in the country stood at 17.12 TWh remaining similar in 2021 and 2020.²²
- In 2021, the total installed capacity in the country stood at 493 MW with major share coming from gas (30.43%) followed by coal (21.5%), fossil fuel based (17.04%), hydro (12.58%), solar (9.94%), wind (7.51%) and bioenergy (1.29%).²²



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Egypt is a lower middle-income country ¹ with GDP per capita (PPP) of USD 12,706 as of 2021. ²
- GDP (Real) grew at an annual rate of 3.3% in 2021 and is estimated to increase by 5.9% in 2022. ³
- Total public debt in the country increased to 92% of GDP in 2021 from the levels of 87.9% in 2020. ⁴
- The fiscal deficit in the country narrowed down to 6.7% of GDP in 2021 from the levels of 7% in 2020. ⁴



Policy enablers

- Egypt aims to increase the share of renewables in the electricity mix to 42% by 2035. ⁵
- New and Renewable Energy Authority (NREA) is responsible for the development of renewable energy and implementation of energy conservation programs in Egypt. ⁶
- The National Climate Change Council (NCCC) is responsible for addressing the impact of climate change into national development plan. ⁷
- National Climate Strategy 2050 aims to plan and manage climate change with a low-emissions approach. ⁷



Technological Feasibility

- Egypt receives very high levels of solar irradiation of 6.1 kWh/m²/day and specific yield of 5.2 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁸
- Egypt targets to facilitate the installation of at least 4 MWp of new decentralized PV capacity to mitigate 66 kilotons of CO₂. ⁹
- In 2022, Egyptian government signed an MOU with an Australian Green Energy Company to explore the development of a green hydrogen production project with 9.2 GW of installed capacity. ¹⁰



Market Maturity

- 100% population in Egypt is having access to electricity since 2020. ¹¹
- Egyptian Electric Utilities and Consumer Protection Regulatory Agency (Egypt ERA) is the energy regulator responsible for implementing policy decisions, administering licences, and setting tariffs. ¹²
- Egyptian Electricity Holding Company (EEHC) owns 90% of Egypt's generation capacity and the entire state-owned T&D network comprising one transmission and nine distribution companies. ¹²
- Egyptian Electricity Transmission Company (EETC) is the TSO responsible for management, operation, and maintenance of electric power transmission system in the country. ¹³



Infrastructure

- Egypt's transmission network consists of overhead transmission lines and underground cables with a total length of 44,200 kms and a total transformer capacity of 99,600 MVA. ¹²
- Egypt's distribution network constitutes 460,897 km of low-voltage and medium-voltage lines and cables with a total transformation capacity of 71,103 MVA. ¹²
- Egypt has electricity interconnections with its neighbours, Jordan and Libya, for the import/export of electricity. ¹²



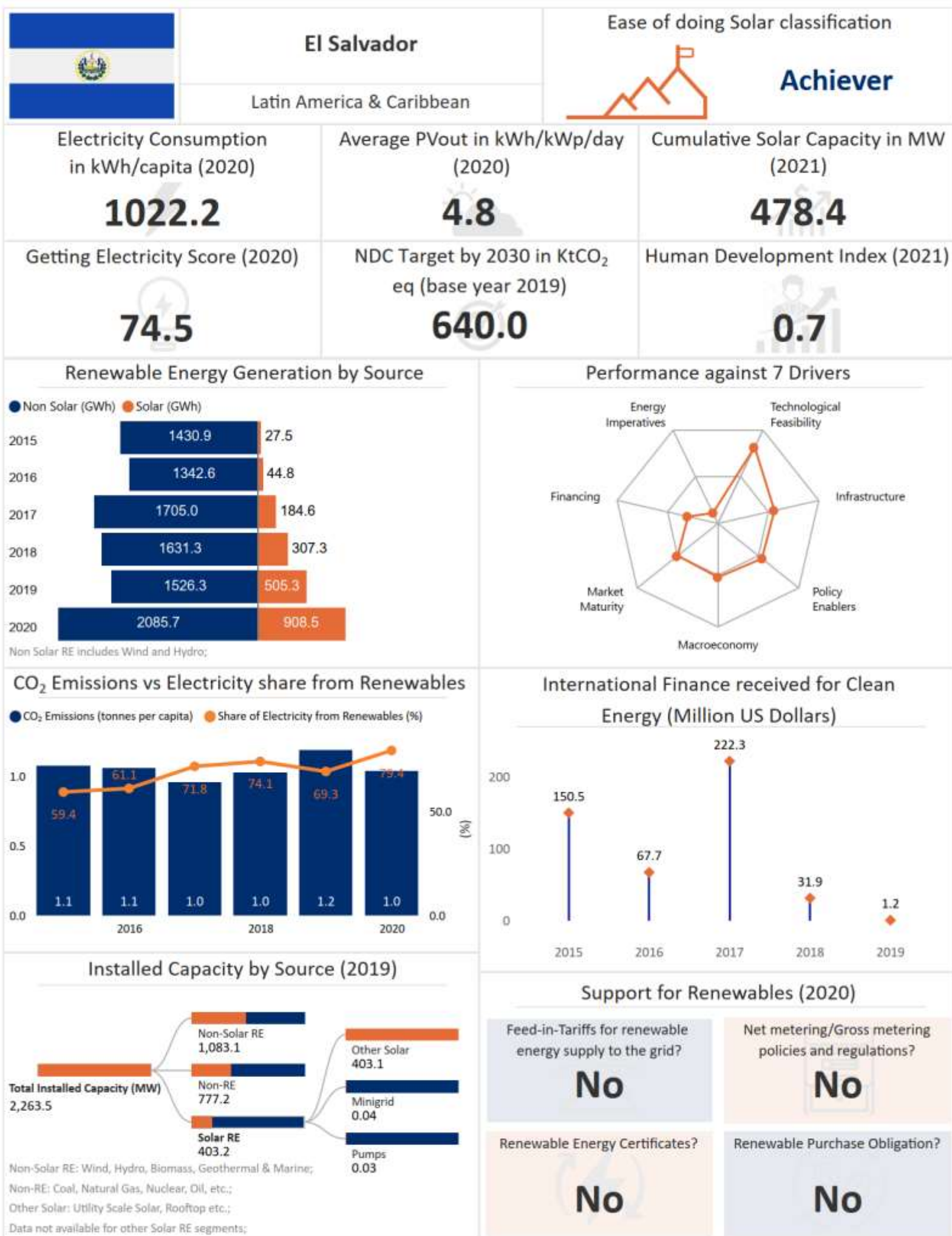
Financing

- In 2021, the AfDB approved USD 27.2 Mn for the design, construction, and operation of a 200 MW PV solar power plant at Kom Ombo in Upper Egypt on the river Nile. ¹⁴
- In 2021, the AfDB approved €83 Mn to finance the second phase of Egypt's Electricity sector and Green Growth Support Program. ¹⁵
- In 2017, the AfDB approved USD 55 Mn to finance three solar PV Projects under the Feed-in-Tariff (FIT) Program in Egypt. ¹⁶

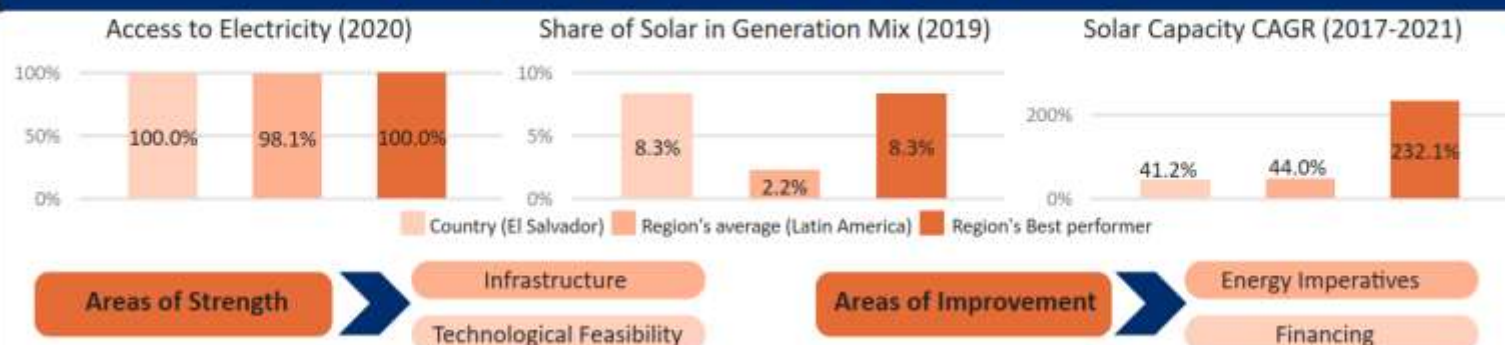


Energy Imperatives

- The total installed capacity in the country stood at 58,353 MW in 2019. ¹⁷
- The total installed capacity of Solar PV witnessed a CAGR of 79.4% between 2017-2021 reaching 1,655.5 MW in 2021 from 160 MW levels in 2017. ¹⁸
- In 2020, the per capita electricity consumption stood at 1.94 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁹
- The price of electricity in the country was 8 US Cents/kWh as of 2019. ²⁰



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- El Salvador is a lower-income country with a GDP per capita (PPP) of USD 9,982 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) had contracted by 4.1% in 2020. However, in 2021 it has bounced back growing at a rate of 7.8%.¹
- The inflation rate (CPI) of the country has increased to 3.5% in 2021 from -0.4% levels in 2020.¹
- The general government gross debt to GDP has reached 82.4% in 2021 from 89.4% levels in 2020.¹



Policy enablers

- To promote the development of RE the government provides several fiscal incentives such as income tax exemptions and import duty exemptions in the country.⁶
- The master plan for renewable energy 2012-2026 aims to increase the RE capacity in three tranches i.e., 250 MW in first phase, 192 MW in second phase and 182 MW in third phase.⁷
- To catalyse the growth of RE in the country, the country held RE auctions in 2014, 2017 and 2019 with a total of 272 MW capacity tendered.⁶



Technological Feasibility

- El Salvador receives very high levels of solar irradiation (GHI) of 5.9 kWh/m²/day and specific yield 4.8 kWh/kWp/day indicating very strong technical feasibility for solar in the country.³
- In 2021, 44.3% of the country's power demand was met through RE sources (excluding large hydro).⁴



Market Maturity

- 100% of the population in El Salvador had access to electricity as of 2020.²
- Superintendencia General de Electricidad y Telecomunicaciones (SIPRT) is the designated agency that regulates the energy sector in the country.⁶
- The power sector is unbundled with generation, transmission, and distribution sector seeing participation from different companies. The major companies in generation space are CEL, LaGeo, Duke Energy, INE etc, while transmission distribution sector is majorly operated by ETESAL and AES corporation.⁶



Infrastructure

- The transmission and distribution system of the country operates at 60 Hz frequency and voltages ranging from 220 V to 230 kV.⁶
- The country's national grid is connected to Central American Electrical Interconnection System (SIEPAC) through a single circuit line with a capacity of 300 MW ensuring energy security in the country.^{9,10}



Financing

- In 2018, Finnfund (Finnish Fund for Industrial Cooperation Ltd) granted USD 15 Mn loan for the construction of 10 solar plants with a cumulative capacity of 100 MW.⁶
- IRENA and the El Salvador's government has joined hands in January 2022 to support its decarbonization plan, to tap the geothermal potential and to provide financing for the RE projects in the country.⁸



Energy Imperatives

- In 2020, El Salvador's per capita electricity consumption stood at 1.02 MWh which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The total installed capacity of Solar PV witnessed a CAGR of 41.2% reaching 478 MW in 2021 from 120 MW in 2017.³
- The peak demand for electricity in the country has decreased to 7.88 TWh in 2021 from 7.92 TWh levels in 2020.⁴
- In 2021, the total installed capacity in the country stood at 2.45 GW with a significant share coming from oil (31.4%), hydro (23.3%) and solar (19.6%).⁴



Equatorial Guinea

Africa

Ease of doing Solar classification



Potential

Electricity Consumption
in kWh/capita (2020)

805.4

Average PVout in kWh/kWp/day
(2020)

3.7

Cumulative Solar Capacity in MW
(2021)

0.1

Getting Electricity Score (2020)

54.3

NDC Target by 2030 in %
(base year 2019)

35.0

Human Development Index (2021)

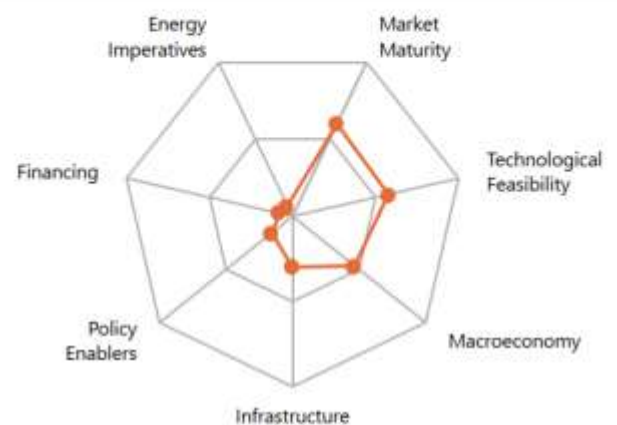
0.6

Renewable Energy Generation by Source

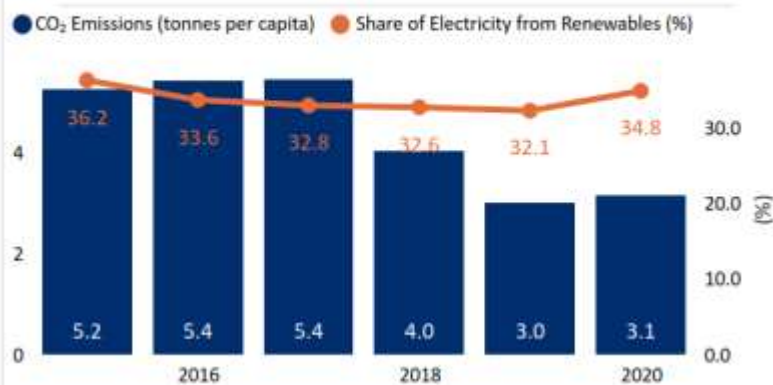


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

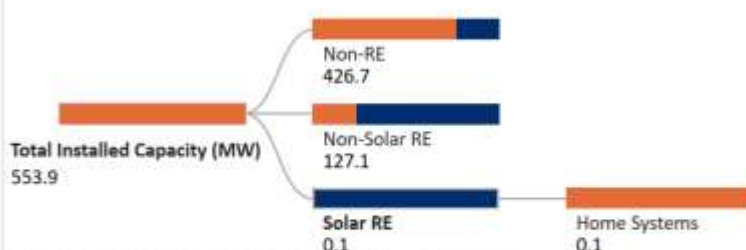
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Equatorial Guinea is an upper middle-income country ¹ with GDP per capita (PPP) of USD 16,080 in 2021. ²
- GDP (Real) declined at an annual rate of 3.5% in 2021, however, it is estimated to increase by 6.1% in 2022. ³
- Inflation rate in the country declined to 2.1% in 2021 from 4.8% levels in 2020. ⁴
- The budget deficit in the country reduced to 1% of GDP in 2021 from 1.7% levels in 2020. ⁴



Policy enablers

- The National Investment Plan REDD+ 2020 proposes a green economy model that aims to protect the forest and contribute to sustainable development in the country. ⁴
- Ministry of Mines, Industry and Energy (MMIE) is responsible for framing policies related to generation, transmission, and distribution of electricity. ⁵
- Equatorial Guinea has developed plans to ensure national resource management compatible with economic development. ⁶



Technological Feasibility

- Equatorial Guinea receives moderate levels of solar irradiation of 4.3 kWh/m²/day and specific yield of 3.7 kWh/kWp/day indicating a moderate technical feasibility for solar in the country. ⁷
- Equatorial Guinea has installed a self-sufficient solar microgrid system with 5 MW solar modules for a reliable power supply in the country. ⁸



Market Maturity

- As of 2020, 66.7% population in Equatorial Guinea had access to electricity. ⁹
- Electricity Energy Regulatory Agency is the energy regulator in the country. ¹⁰
- The Electricity sector is managed by Electricity Company of Equatorial Guinea (SEGESA) having several subsidiaries- SEGESA Generation, SEGESA Transmission and SEGESA Commercial. ¹⁰
- On a regional level, the country is a member of the Central Africa Power Pool. ¹⁰



Infrastructure

- SEGESA operates the country's two electricity transmission networks, which comprise approximately 80 miles of high voltage lines. ⁵
- The project 'Sustainable Energy for All' focuses on increasing reliability in power supply in regions where hydropower technologies will be located and increasing availability where the grid cannot be extended. ⁵



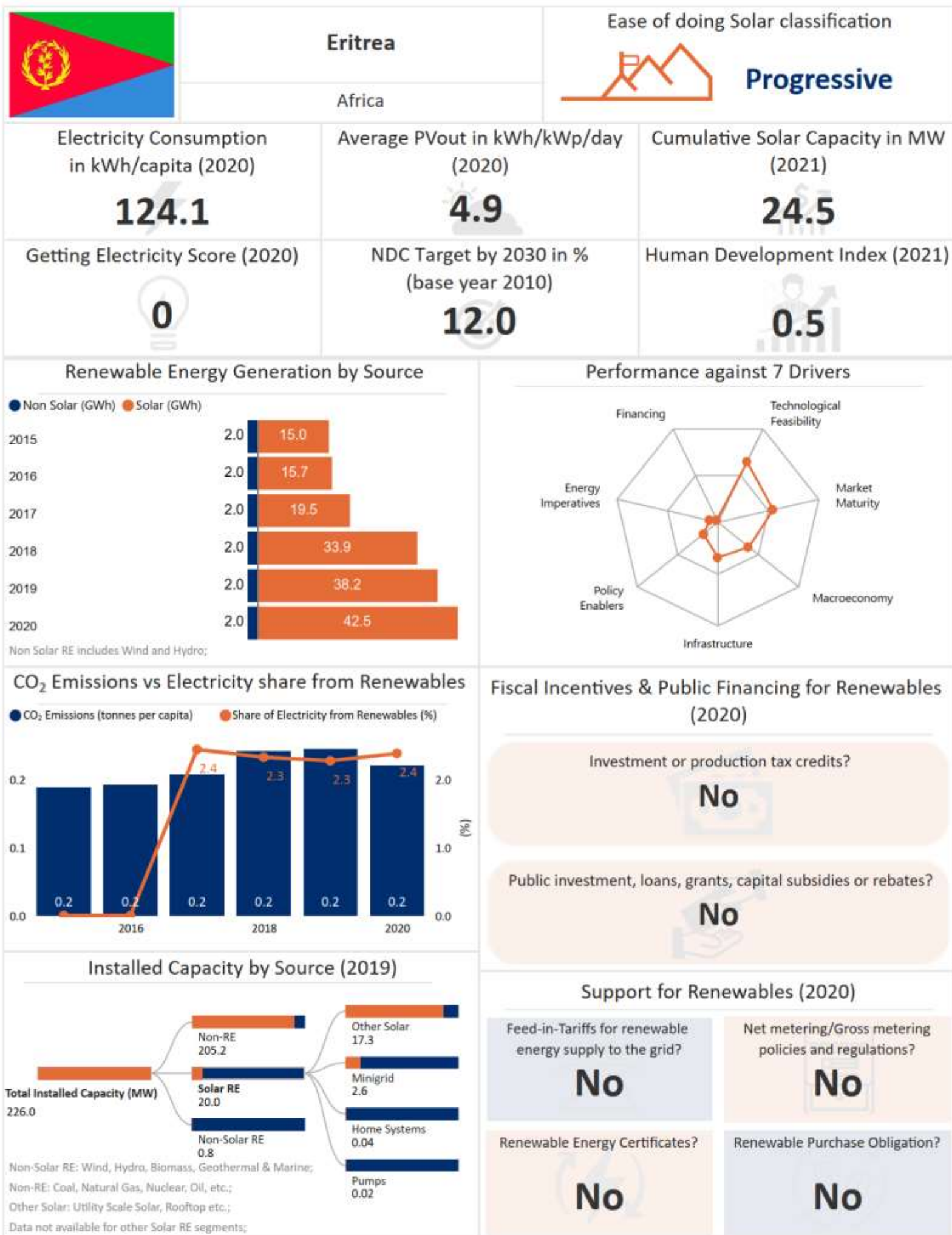
Financing

- In Equatorial Guinea, the World Bank has shown keen interest in providing financial support across agriculture, law, health, mining, and energy. ¹¹
- In Equatorial Guinea, the UNDP has shown keen interest in promoting small-scale hydropower in Bioko and other clean energy solutions for remote islands. ⁵

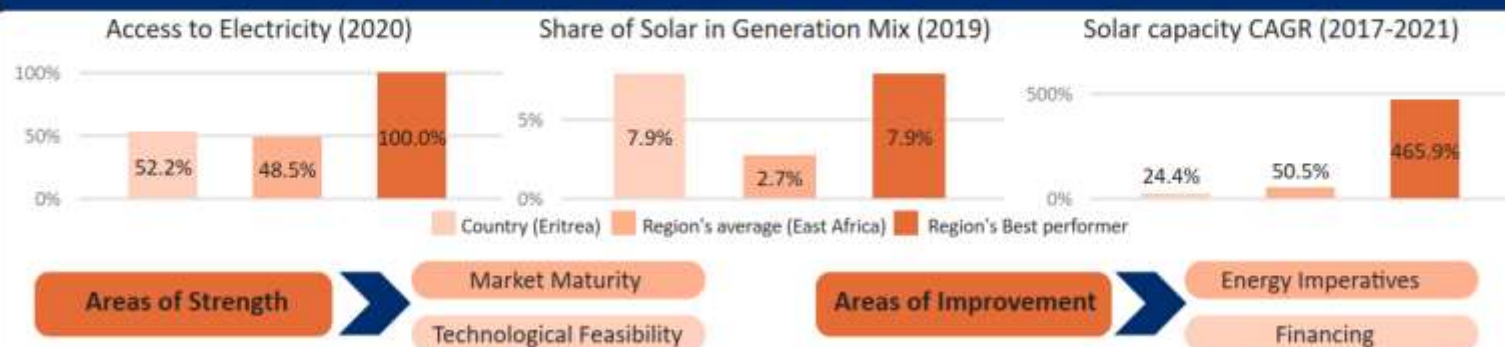


Energy Imperatives

- The total installed capacity in the country stood at 553.8 MW as of 2019. ¹²
- In 2020, the per capita electricity consumption stood at 0.81 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ¹³
- The price of electricity in the country was 17 US Cents/kWh as of 2019. ¹⁴



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- GDP (Real) grew at an annual rate of 2.9% in 2021 and is estimated to grow by 4.7% in 2022. ¹
- The fiscal deficit in the country narrowed down to 4.0% of GDP in 2021 from 4.4% levels in 2020. ²
- Inflation rate in the country declined to 4.5% in 2021 from 4.8% levels in 2020. ²
- The current account surplus widened to 13.5% of GDP in 2021 from 11.4% levels in 2020. ²



Policy enablers

- The Ministry of Energy and Mines is responsible for designing and refining policies, strategies, and regulatory issues in the energy sector. ³
- Eritrea aims to reduce its GHG emissions to 12.6% unconditionally and to 38.5% through international support by 2030. ²
- Renewable Electricity Fund is the national fund for the promotion and support of RE through private and public sector participation. ⁴
- Under the "Renewable Energy Policy and Development Framework 2010", the government has set a target to have 50% share of RE in the generation mix by 2030. ⁴



Technological Feasibility

- Eritrea receives very high levels of solar irradiation of 5.8 kWh/m²/day and specific yield of 4.9 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁵
- In 2021, Eritreans were provided affordable, 24/7 accessible solar powered energy through 2.25 MW capacity solar PV mini grids. ⁶



Market Maturity

- As of 2020, 52.2% population in Eritrea had access to electricity. ⁷
- The Eritrean Electricity Corporation (EEC) is the sole generator, transmitter, and distributor of electricity. ⁸
- Department of Energy (DoE) is the energy regulator responsible for tariff setting, drafting and enforcing laws, regulations, and standards for the energy sector. ⁹
- Eritrea is a member country of the East African Power Pool. ⁸



Infrastructure

- The transmission network consists of HV lines with a length of 71 km operating at 132 kV voltage level. ⁴
- The distribution network consists of MV lines with a length of 320 km operating at 33 kV and 66 kV. LV lines operate at 400 V and have an estimated length of 2,880 km. ⁴
- Eritrea is not interconnected to any of its neighbours. Bilateral discussions are expected to commence with Djibouti, Yemen, and Ethiopia to examine the possibility for interconnections. ⁴



Financing

- In 2022, the African Development Fund approved a USD 5.5 Mn grant to initiate the flagship 'Desert to Power initiative' in Eritrea. ¹⁰
- Eritrea, with a grant support from AfDB, is planning to set up Solar PV Power Project with a capacity of 25 MW at Village-Hadamu, Dekemhare Subzoba, of the Zoba Debub. ¹¹



Energy Imperatives

- The total installed capacity in the country stood at 226 MW in 2019. ¹²
- The total installed capacity of Solar PV witnessed a CAGR of 24.4% between 2017-2021 reaching 24.5 MW in 2021 from 10.2 MW levels in 2017. ¹³
- In 2020, the per capita electricity consumption stood at 0.12 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁴



Ethiopia

Africa

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

123.1

Average PVout in kWh/kWp/day
(2020)

4.7

Cumulative Solar Capacity in MW
(2021)

21.2

Getting Electricity Score (2020)

60.1

NDC Target by 2030 in %
(base year 2010)

68.8

Human Development Index (2021)

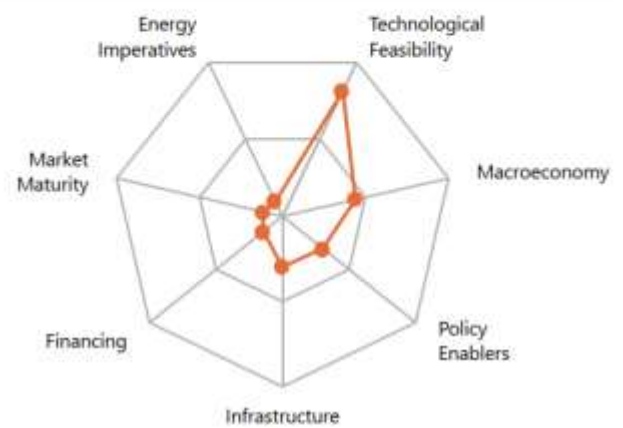
0.5

Renewable Energy Generation by Source

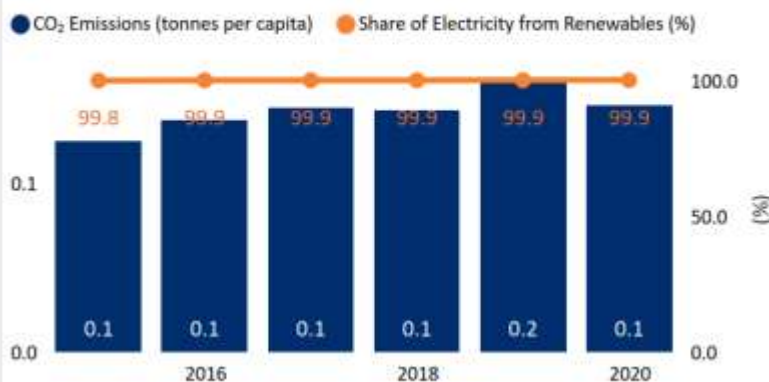


Non Solar RE includes Wind and Hydro;

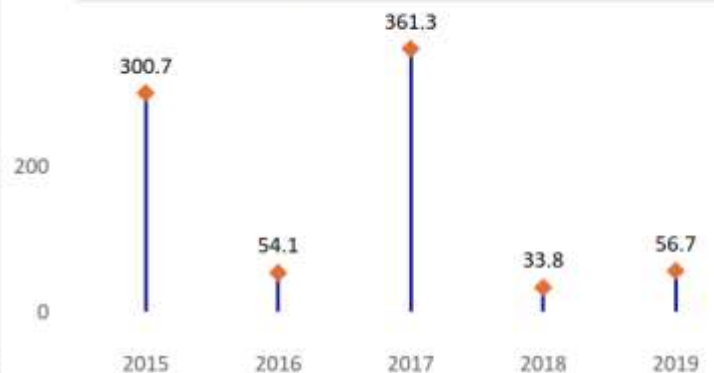
Performance against 7 Drivers



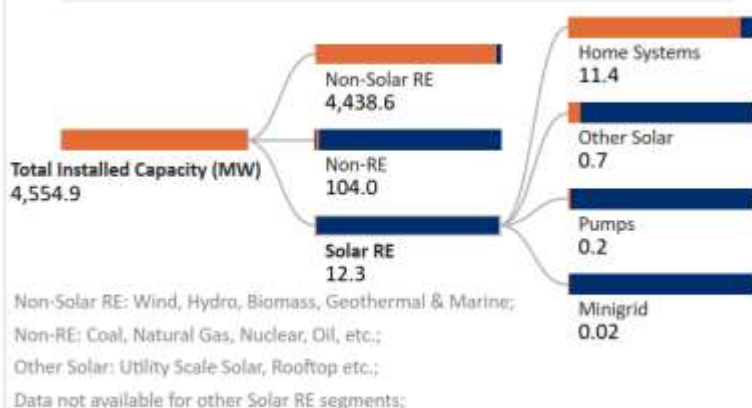
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable energy supply to the grid?

No

Net metering/Gross metering policies and regulations?

No

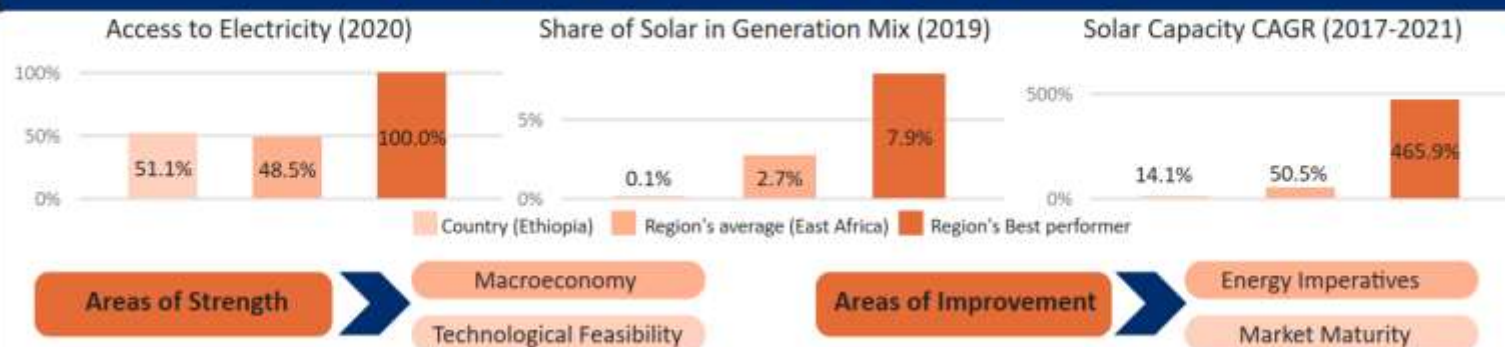
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Ethiopia is a low-income country with GDP per capita (PPP) of USD 2,548 in 2021. ^{1,2}
- GDP (Real) grew at an annual rate of 6.3% in 2021 and it is estimated to grow by 3.8% in 2022. ³
- Inflation rate in the country increased to 26.7% in 2021 from 20.4% levels in 2020. ⁴
- The fiscal deficit in the country declined to 2.6% of GDP in 2021 from 2.8% levels in 2020 due to expenditure reprioritization and growth in tax revenue. ⁴



Policy enablers

- Ministry of Water, Irrigation and Electricity (MoWIE) is responsible for energy operations and in framing energy policies in the country. ⁵
- SE4ALL National Action Plan includes the focus area for diversification of RE through installation of wind farms and solar systems. ⁶
- Ethiopian Rural Energy Development and Promotion Centre (EREDPC) is responsible to carry out rural energy policy formulation and promotion of RE technologies in rural areas. ⁵
- Rural Electrification Fund (REF) finances projects related to decentralised electricity generation and decentralised RE sources in the country. ⁶



Technological Feasibility

- Ethiopia receives very high levels of solar irradiation of 6.2 kWh/m²/day and specific yield of 4.7 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁷
- The UN Environment program is currently active and working on the introduction of electric two and three wheelers. ⁸
- In 2022, The Ethiopian Ministry of Finance announced the implementation of tax reform intended to encourage investment and the importation of electric vehicles. ⁹



Market Maturity

- In 2020, 51.1% population in Ethiopia had access to electricity. ¹⁰
- Ethiopian Energy Authority (EEA) is the energy regulator responsible for regulating the electricity sector and energy efficiency & conservation. ⁶
- Ethiopian Electric Power (EEP) is responsible for generation, transmission, and system operation in the country. ⁶
- Ethiopian Electric Utility (EEU) is responsible for power distribution in the country. ⁶



Infrastructure

- In 2021, the construction of 230 kV double circuit Transmission Line from Semera (Ethiopia) to Nagad (Djibouti) having line length of 292 km (102 km in Ethiopia and 190 km in Djibouti) has been initiated in the country strengthening the regional grid. ¹¹
- The power system of Ethiopia is interconnected to Sudan and Djibouti with 230 kV lines. ⁶
- The transmission network consists of 10,308 kms of 400 kV, 230 kV and 132 kV high voltage lines. ⁶
- The distribution network consists of 2,154 km of medium voltage lines at 66 kV and 1,54,687 km of low voltage lines at 400 V. ⁶



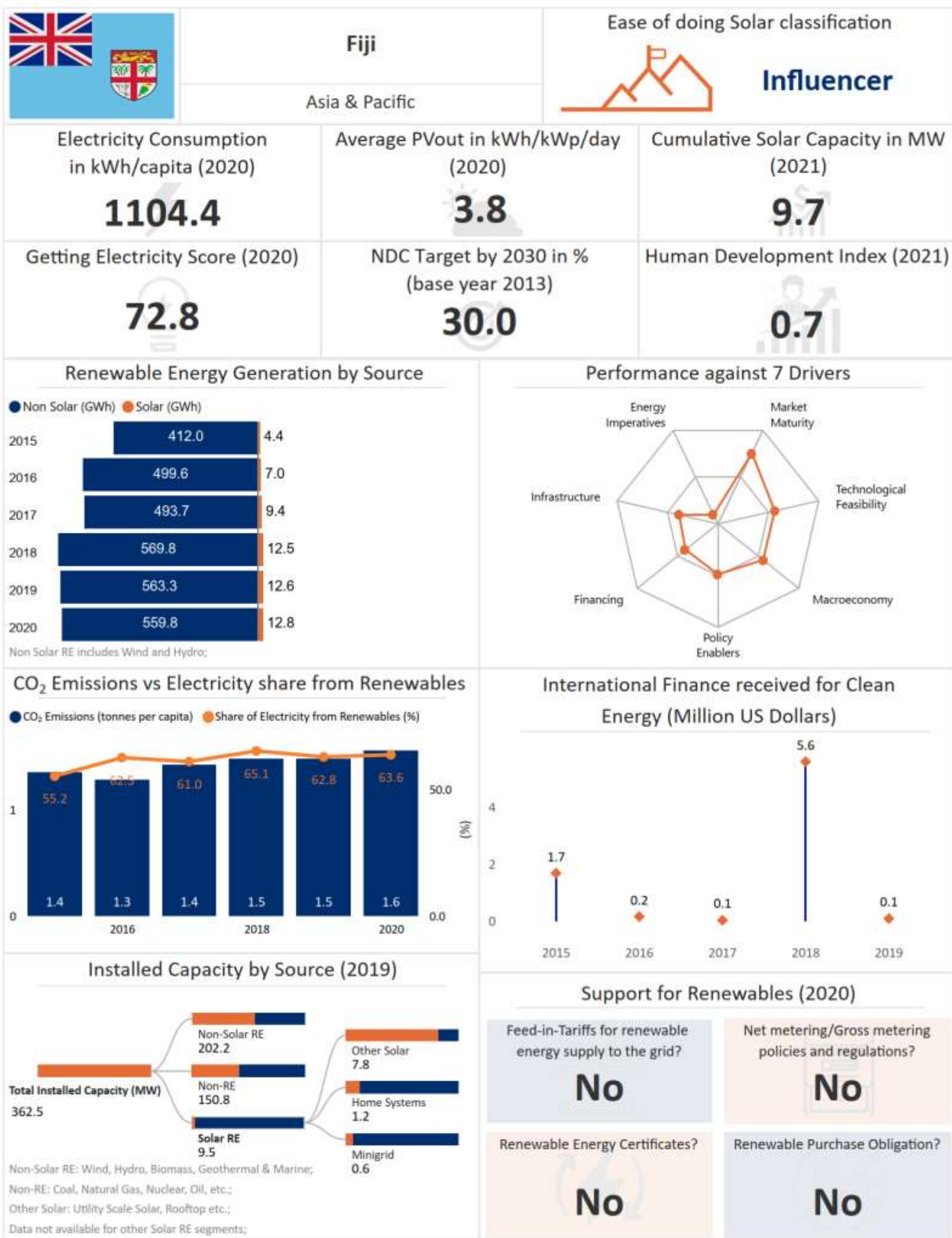
Financing

- In 2022, the AfDB approved the Leveraging Energy Access Finance Framework (LEAF) under which the Bank will commit up to USD 164 Mn to promote decentralized RE in Ethiopia. ¹²
- In 2022, the African Development Fund approved USD 5.5 Mn grant to initiate 'Desert to Power initiative' in Ethiopia. ¹³
- In 2022, the World Bank approved the 'Djibouti -Power System Interconnection Project' which aims to enhance regional connectivity through improved low-cost and clean electricity transmission between Ethiopia and Djibouti. ¹⁴



Energy Imperatives

- The total installed capacity in the country stood at 4,555.9 MW in 2019. ¹⁵
- In 2020, the per capita electricity consumption stood at 0.12 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁵



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Fiji is a middle-income country with a GDP per capita (PPP) of USD 11,381 in 2021. ^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 17% in 2020. However, in 2021, the GDP is showing signs of bouncing back with an annual growth rate of -5.1%, a recovery of almost 12 percentage points. ¹
- The inflation rate (CPI) of Fiji has increased to 0.2% in 2021 from -2.6% levels in 2020. ³
- The general government gross debt to GDP has reached 83% in 2021 from 63.1% levels in 2020. ⁴



Policy enablers

- Fiji's 20-year National Development Plan aims to generate all power from RE sources by 2030. ⁵
- Fiji has a Fiji National Policy in place to target rural electrification, grid-based power supply and R&D in promotion of new technology in RE. ⁶
- The Fijian government in its NDC commitment has reaffirmed its net zero GHG emissions by 2050. ⁷
- Fiji has enacted its Climate Change Act, 2021 as per the commitment in NDC to enable country's mitigation, adaptation, and disaster risk management. ⁸



Technological Feasibility

- Fiji receives moderate levels of solar irradiation (GHI) of 4.3 kWh/m²/day and specific yield 3.8 kWh/kWp/day indicating a moderate technical feasibility for solar in the country. ⁹
- Fiji Electricity Authority (FEA) and the Korean International Cooperation Agency (KOICA) has developed a 1.55 MW solar PV project on the island of Taveuni. ¹⁰
- Fiji is coming up with Energy Fiji Solar PV Park of 15 MW which is expected to start its commercial operation in 2023. ¹¹



Market Maturity

- 100% of the population in Fiji is having access to electricity since 2020. ¹²
- Energy Fiji Ltd (EFL) has sole statutory authority for the generation, transmission, distribution, retail of electricity. ¹³
- The Department of Energy (DOE) is responsible for energy policies and plans, energy efficiency and conservation, RE and rural electrification. ¹⁴
- Energy Fiji Ltd (EFL) has set out a process for regularly reviewing the cost of electricity supply and setting tariffs and making all forms of electricity subsidies transparent to energy consumers. ¹⁵



Infrastructure

- Fiji's power network comprises of 11 kV, 33 kV, 132 kV lines. ¹⁶
- In budget 2021-2022, Fiji government has allocated over USD 11 Mn for grid extension and house wiring for communities that have been relocated to due to rising sea levels. ¹⁷
- ADB has provided a loan of USD 20 Mn to finance expansion of transmission network for 11 kV, 33 kV, 132 kV lines. ¹⁸



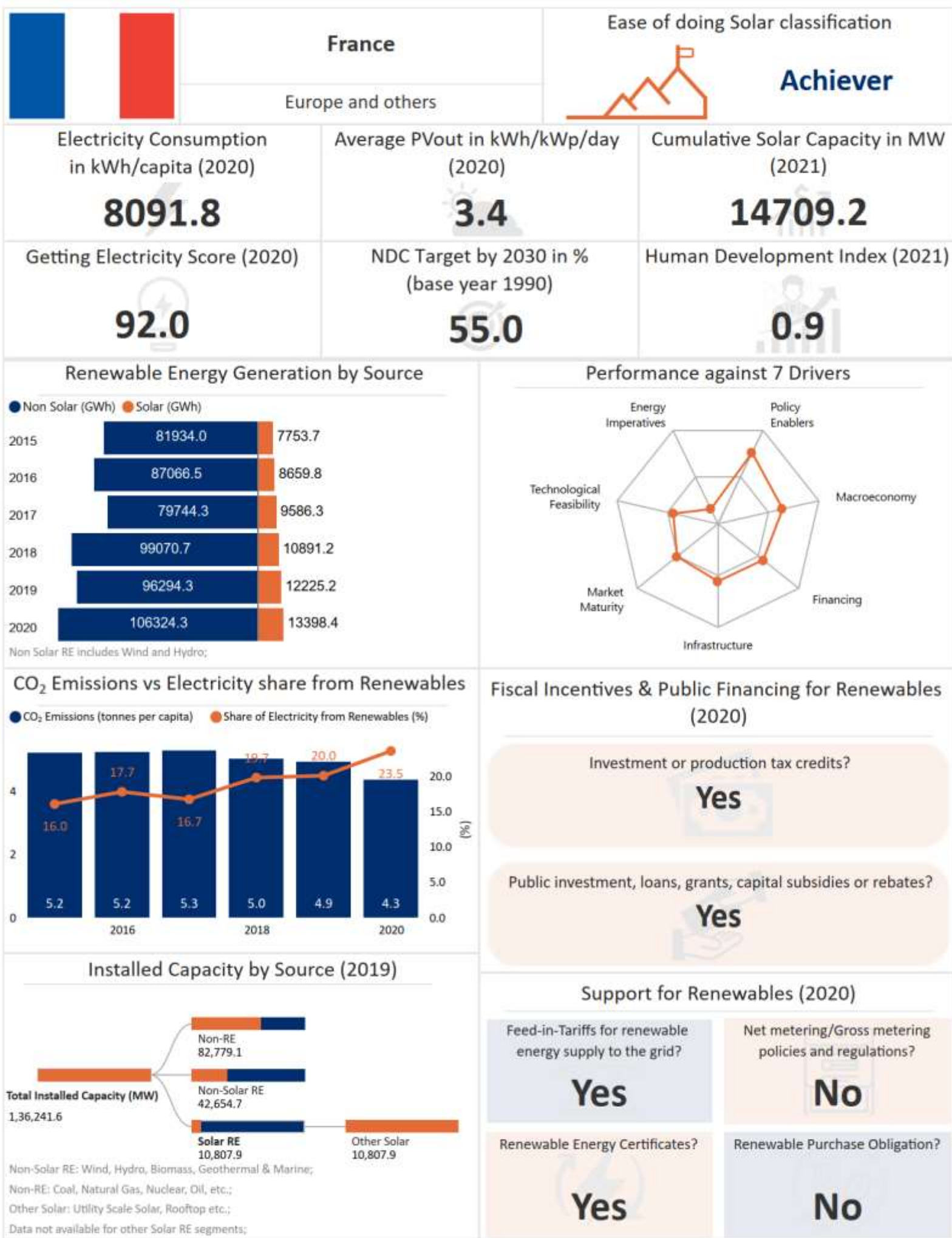
Financing

- A risk sharing fund administered by ANZ Bank and funded by the Global Environment Facility is established to allow participation of Fiji Development Bank and ANZ Fiji – to share the risk of lending for renewable projects. ¹⁹
- Private Financing Advisory Network (PFAN) with its result-based concept is funding private distributed energy service companies (DESCOs) for co-financing and developing off-grid solar projects in Fiji. ²⁰
- EFL and IFC have signed an agreement for Pacific's largest solar project worth USD 15 Mn. ²¹

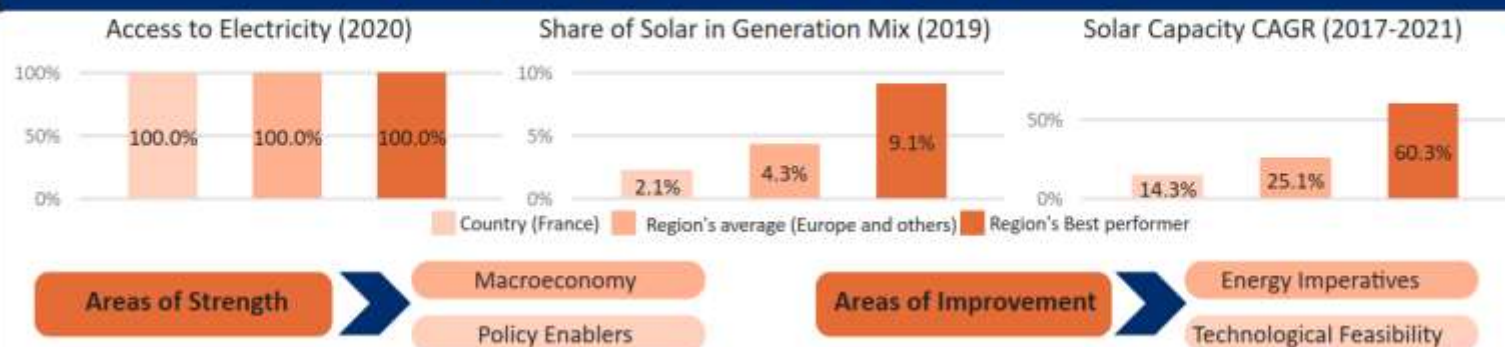


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 1.10 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ²²
- The total installed capacity of Solar PV witnessed a CAGR of 8.0% between 2017-2021 reaching 9.7 MW in 2021 from 7.1 MW levels in 2017. ²³
- The peak demand for electricity in the country is 0.99 TWh as of 2021 which has remained same as the last year's demand. ²⁵
- In 2021, the total installed capacity in the country has reached over 0.25 GW ²⁶ with a significant share coming from hydro (50.51%), other fuels (36.36%) followed by bioenergy (11.11%) and solar (2.02%). ²⁵



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- France is a high-income country with a GDP per capita (PPP) of USD 50,996 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 7.9% in 2020. However, in 2021, the GDP has bounced back recording an annual growth rate of 6.8% which is one of the fastest recoveries among similar economies in the world.³
- The inflation rate (CPI) of France has increased by 2.1% in 2021 from 0.5% levels in 2020.⁴
- The general government gross debt to GDP has slightly reduced to 112.6% in 2021 from 114.7% levels in 2020.⁵



Policy enablers

- France as an EU member has targeted to achieve a GHG emission reduction of at least 40% across the different sectors of the economy by 2030.⁹
- France has planned to reduce the share of nuclear from 70% to 50% in its electricity mix by 2035.⁶
- France legislated a net zero emissions target for 2050 in its 2019 Energy and Climate Act.⁶
- France has a feed-in-tariff policy, which gets updated by the France regulator Commission de Régulation de l'Énergie (CRE) depending upon the market.⁷
- France's energy regulator has released tenders in 2021 for the development of solar and other renewable energy projects.⁸



Technological Feasibility

- France receives moderate solar irradiation (GHI) of 3.5 kWh/m²/day and specific yield 3.4 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.¹⁰
- In 2021, France has come up with 55 MW solar power plant located northeast of Gien (Loiret), which would be catering to the electricity demand of close to 38,000 customers.¹¹
- Total Energies in France has installed a power capacity of 61 MW with a storage capacity of 61 MWh in 2021.¹²
- France's Enedis, a power grid operator in France, has achieved rank one in Smart Grid Index 2021.¹³



Market Maturity

- 100% of the population in France had access to electricity as of 2020.¹⁴
- The Commission de régulation de l'énergie is a regulatory body that regulates the electricity markets in France.¹⁵
- France's Enedis manages 95% of the electricity distribution network which is around 1.4 Mn Kms of power line.¹⁶
- Réseau de Transport d'Électricité (RTE) is the electricity transmission system agency operating in the country.¹⁸



Infrastructure

- The electricity transmission system comprises voltage levels ranging from 440 kV, 220 kV and low voltage of 63 and 90 kV covering almost 100,000 kms.^{17, 18}
- France's transmission system is interconnected with Belgium, Germany, Italy, Spain, Switzerland and Great Britain.¹⁹
- Réseau de Transport d'Électricité (RTE) is developing its offshore transmission network to generate 10-15 GW offshore wind power under a new scheme "schéma décennal de développement du réseau" (SDDR) by 2035.²⁰



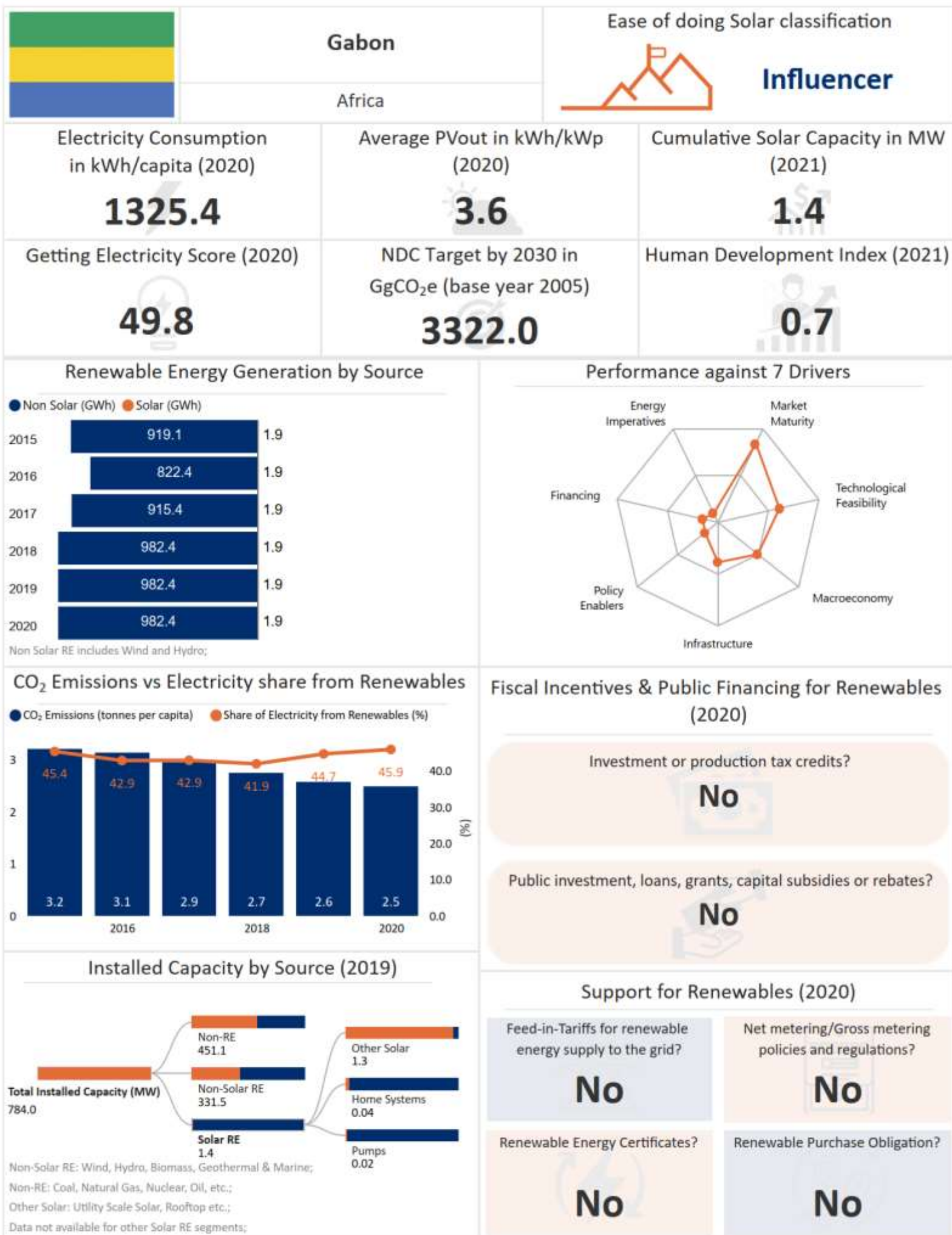
Financing

- Under the SDDR scheme, RTE has approximately invested USD 1.27 Bn towards development of transmission system.²⁰
- European Commission has approved USD 6.7 Bn support for renewable power generation from rooftop solar in France.²¹
- France has become one of the key contributors to Green Climate Fund (GCF) with a contribution of USD 1.7 Bn.²²

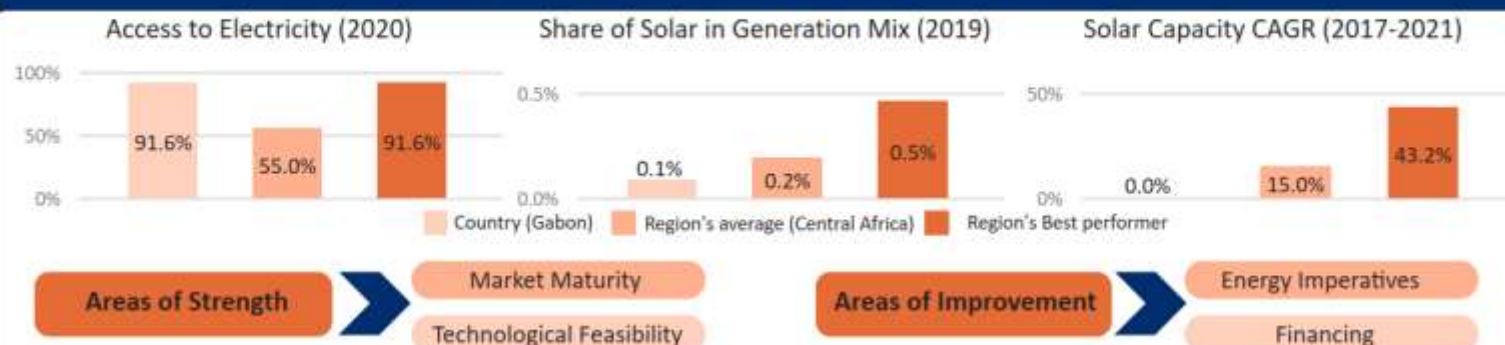


Energy Imperatives

- In 2020, France's per capita electricity consumption stood at 8.09 MWh which is significantly higher in comparison to the global average of 3.31 MWh.²³
- The total installed capacity of Solar PV witnessed a CAGR of 14.3% between 2017-2021 reaching 14,709 MW from 8610 MW between the years.²⁴
- In 2021, the total installed capacity in the country reached 139.07 GW²⁵ with a significant share coming from nuclear (72.17%) followed by hydro (10.84%), gas (6.95%), wind (6.68%), solar (2.67%), bioenergy (1.65%), other fossil (1.81%), coal (0.59%).²⁶
- The Cost of electricity per kWh is US Cent 18.2 for households and US Cent 17.0 for business.²⁷



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Gabon is an upper middle-income country with GDP per capita (PPP) of USD 15,176 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 0.9% in 2021 and is estimated to increase by 2.7% in 2022. ³
- Total public debt in the country increased to 74.7% of GDP in 2021 from 77.4% levels in 2020. ⁴
- Inflation rate in the country declined to 1.1% in 2021 from 1.3% levels in 2020. ⁴



Policy enablers

- Gabon aims to monetize its carbon credits that are estimated at USD 5 Bn in 2021. ⁴
- Gabon's Energy Policy aims to reduce its dependence on fossil fuels for electricity generation by promoting RE in the country. ⁵
- The PSGE (Emerging Gabon Strategic Plan) focuses on the green growth and aims to transform the country into an emerging economy by 2025. ⁶



Technological Feasibility

- Gabon receives high levels of solar irradiation of 4.5 kWh/m²/day and specific yield of 3.6 kWh/kWp/day indicating a strong technical feasibility for solar in the country. ⁷
- The Gabonese Minister of Energy has plans to construct a 120 MWp solar power plant at Ayémé Plaine equipped with a 15-hour BESS. ⁸
- In 2022, the Ministry of Energy had set out a plan to electrify off-grid households across the country through solar home systems. ⁹



Market Maturity

- 91.6% population in Gabon had access to electricity as of 2020. ¹⁰
- Ministry of Mines, Petroleum and Hydrocarbons and Ministry of Energy and Hydraulic Resources is responsible for providing electricity services in the Gabonese Republic. ¹¹
- Water and Energy Sector Regulatory Agency is the energy regulator in the country. ¹¹
- The Société d'Electricité et d'Eaux du Gabon (SEEG) is the sole generator, transmitter, and distributor of electric energy. ¹¹



Infrastructure

- The electricity produced in the country is transported at various voltage levels (Libreville 255 kV and 90 kV; Franceville 63 kV and Bongolo 63 kV) to various sub-stations across the nation. ¹²
- The sub-transmission network consists of 30 kV, 20 kV and 5.5 kV medium voltage levels. ¹²



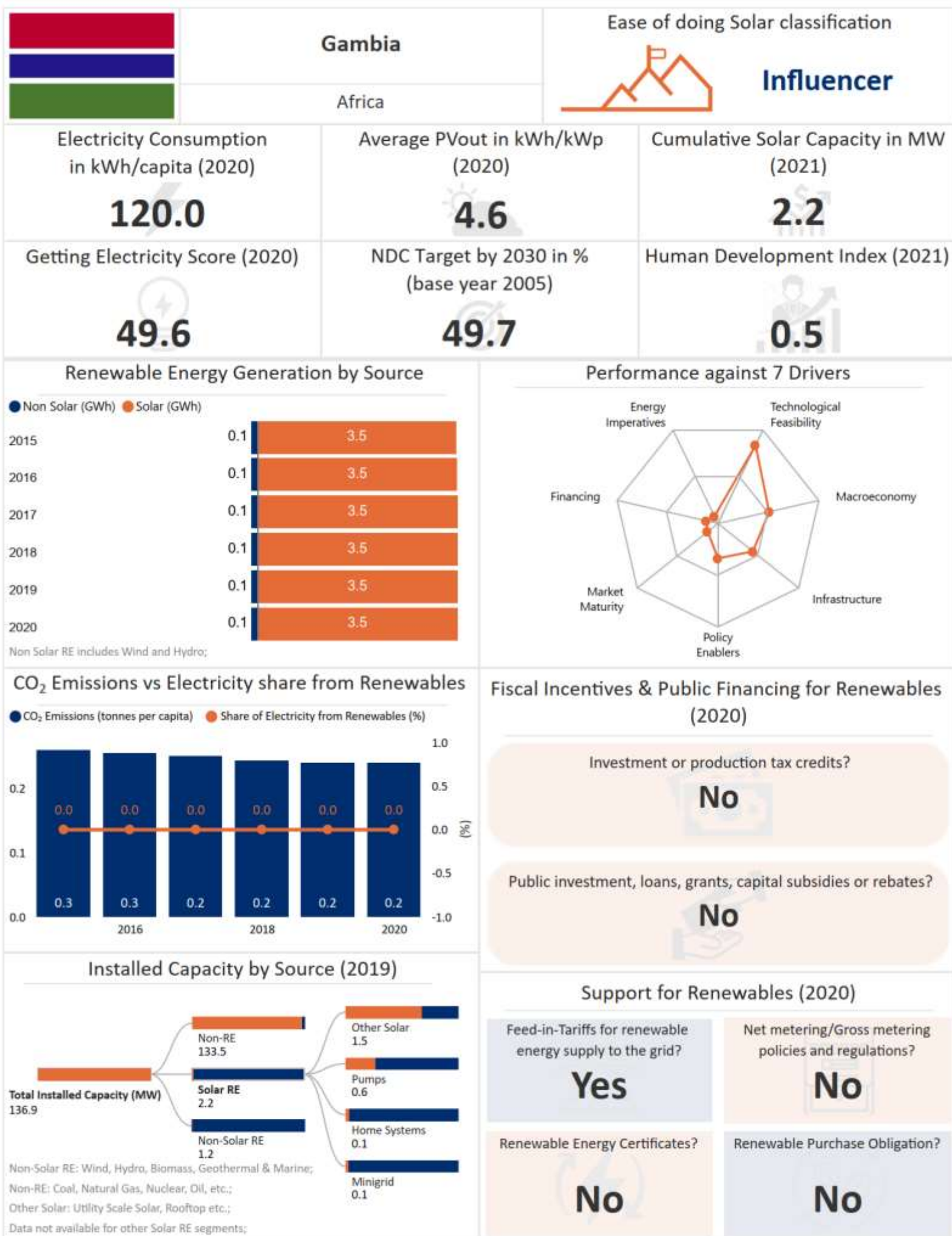
Financing

- In 2021, the AfDB approved €39 Mn for the construction of the Kinguéle Aval hydroelectric project in Gabon. ¹³
- The AfDB approved €57.5 Mn to the Coder Hydropower Project for the design, construction, and operation of two run-of-river hydro projects in Ngounie Province and North Gabon. ¹⁴
- In Gabon, the World Bank has shown keen interest in providing support through financing of more than 20 projects in a variety of sectors. ¹⁵



Energy Imperatives

- The total installed capacity in the country stood at 784 MW in 2019. ¹⁶
- In 2020, the per capita electricity consumption stood at 1.32 MWh which is lower in comparison to the global average of 3.31 MWh. ¹⁷
- The price of electricity in the country was 18.9 US Cents/kWh as of 2019. ¹⁸



| Threshold for licensing Solar Power in MW (2013) | Average Term of Solar PPAs in years (2021) | Testing Facility/R&D Availability for Solar (2021) |
|--|--|--|
| 1.5 | 20.0 to 25.0 | No |

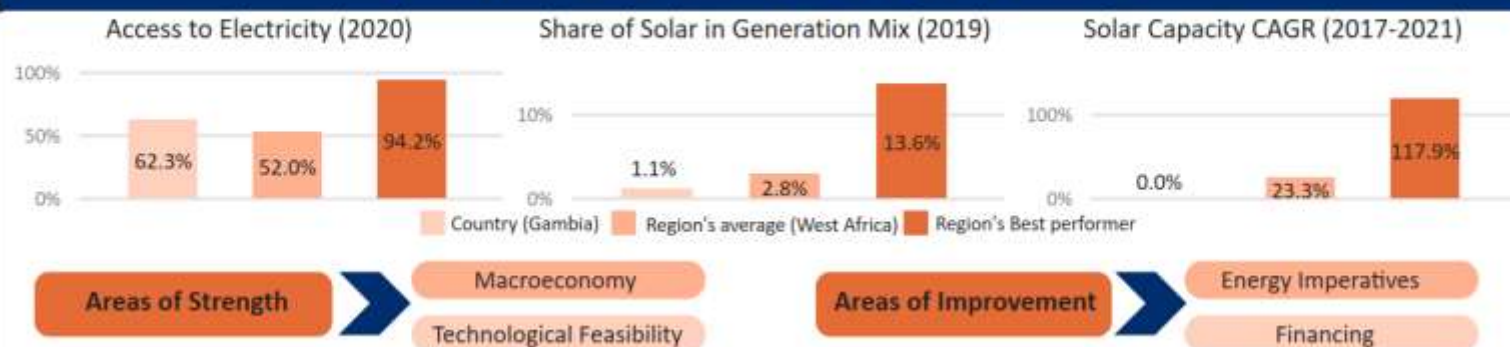
| Support for Renewables (2021) | |
|---|-----|
| Renewable Generation Obligations (RGO) i.e. Mandate for Non Renewable energy generators to produce electricity from Renewable sources | No |
| Franchising for solar business | Yes |
| Manufacturing facility for solar equipment (inverters and balance of systems) | No |

| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | Yes |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| Yes | Yes | Yes | Yes | Yes | No | Yes | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |
| E-mobility/Electric vehicles | No |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Gambia is a low-income country with GDP per capita (PPP) of USD 2,281 as of 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 5.6% in 2021 and it is estimated to increase by 5.6% in 2022. ³
- Inflation rate in the country increased to 7.5% in 2021 from 5.9% levels in 2020 due to high energy prices and freight charges. ⁴
- The fiscal deficit in the country increased to 4.0% of GDP in 2021 from 2.2% levels in 2020. ⁴



Policy enablers

- The Ministry of Energy (MOE) is responsible for establishing the policy and strategies for the energy sector. ⁵
- Power-up Gambia (PUG) has a net metering arrangement where in a utility dispatches excess solar power to the grid and draws it back at night. ⁶
- Renewable Energy Association of The Gambia (REAGAM) is responsible for promoting RE projects like small solar PV installations and solar thermal. ⁵
- The National Electricity Road Map 2017-2021 has set plans to improve power generation and transmission capacity and to reduce T&D losses. ⁷



Technological Feasibility

- Gambia receives very high levels of solar irradiation of 5.7 kWh/m²/day and specific yield of 4.6 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁸
- Gambia receives 6-7 hours of sunlight per day and on an average, 2,630 hours of sunlight per year indicating strong solar potential. ^{9, 18}



Market Maturity

- As of 2020, 62.3% population in Gambia had access to electricity. ¹¹
- Public Utilities Regulatory Authority (PURA) is responsible for regulating the electricity, water, and telecommunication sectors. ⁵
- The National Water and Electricity Company (NAWEC) operates the transmission and distribution network and is responsible for setting electricity tariffs, administering PPAs and implementing rural electrification projects. ⁵
- Gambia is the member of the West African Power Pool (WAPP), which aims to integrate the national power systems into a unified regional electricity market. ¹²
- The average duration or term of Power Purchase Agreements (PPAs) for solar PV projects is (20 to 25) years. ¹⁸



Infrastructure

- The transmission network consists of 250 km of 30 kV lines installed in the provincial grids plus 135 km of MV/LV lines and 94 km of LV overhead lines. ⁵
- Gambia plans to construct three 30 kV Transmission Lines and Distribution Networks in the North Bank and Upper River Regions. ⁷
- National Agricultural Research Institute (NARI) is responsible for research, development, and dissemination of RE technologies, mainly solar and biomass. ⁵



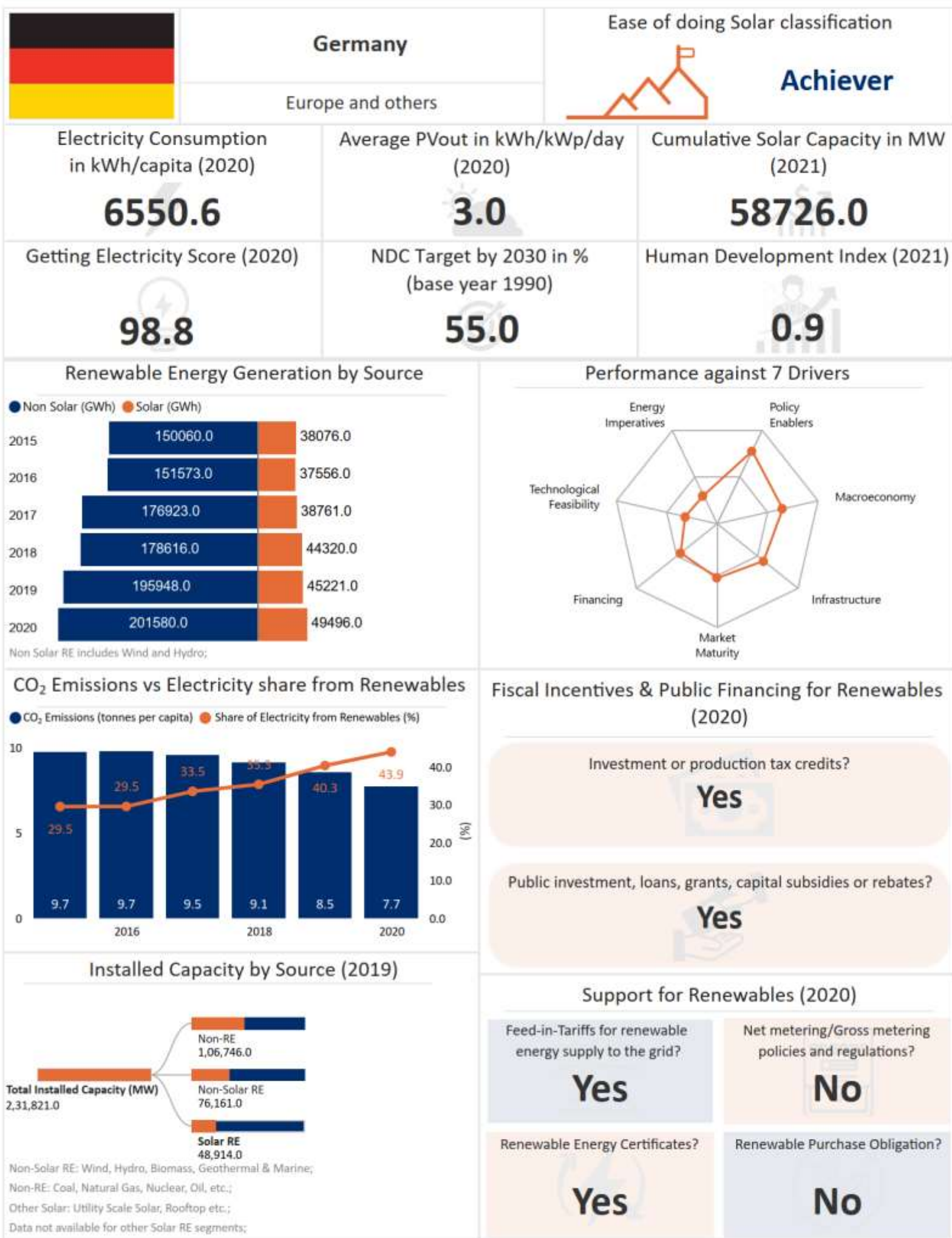
Financing

- The AFDB-managed Sustainable Energy Fund for Africa (SEFA) approved a USD 995,000 grant to The Gambia to implement a programme to facilitate private investments in Green Mini-Grids (GMG). ¹³
- In 2021, the World Bank approved 'The new Regional Electricity Access and Battery-Energy Storage Technologies' (BEST) Project for \$465 Mn to strengthen the WAPP's network operation with battery-energy storage technologies infrastructure. ¹⁴



Energy Imperatives

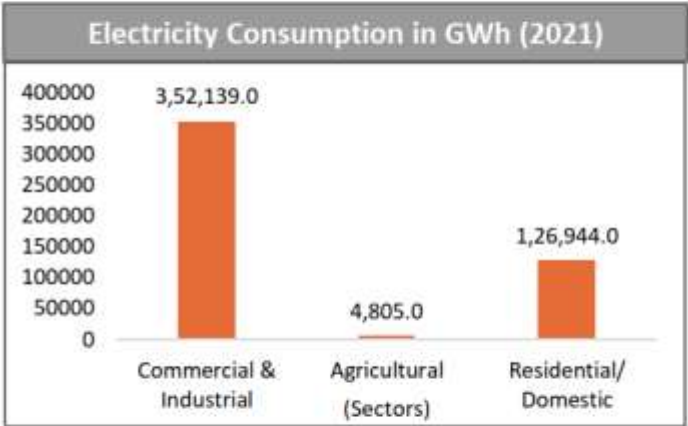
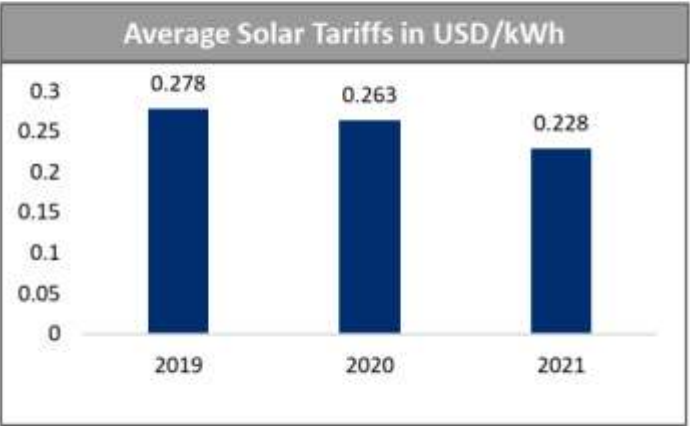
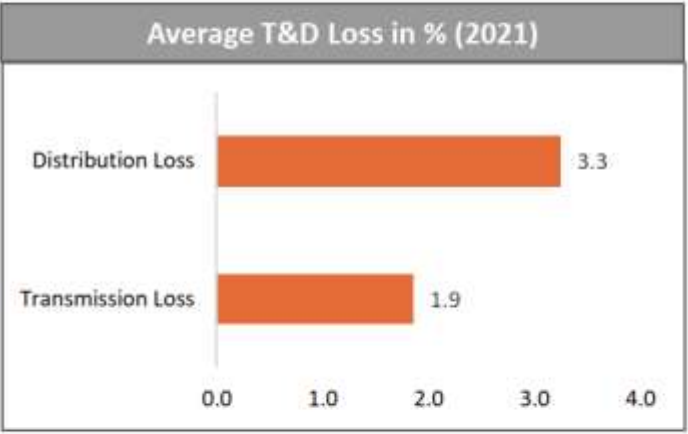
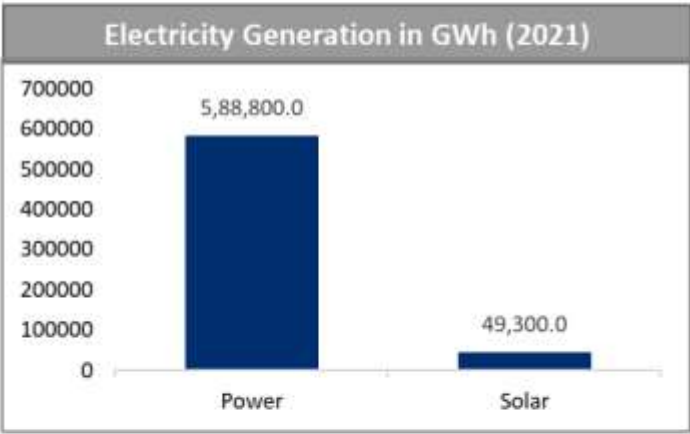
- The total installed capacity in the country stood at 136.9 MW in 2019. ¹⁵
- The total installed capacity of Solar mini-grids stood at 0.2 MW in 2021. ¹⁸
- In 2020, the per capita electricity consumption of 0.12 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁶
- The price of electricity in the country was 20 US Cents/kWh as of 2019. ¹⁷



| Solar Investment in Million US Dollars (2021) |
|---|
| 4,570.0 |

| Peak Demand/Load in MW (2021) |
|-------------------------------|
| 81,079.0 |

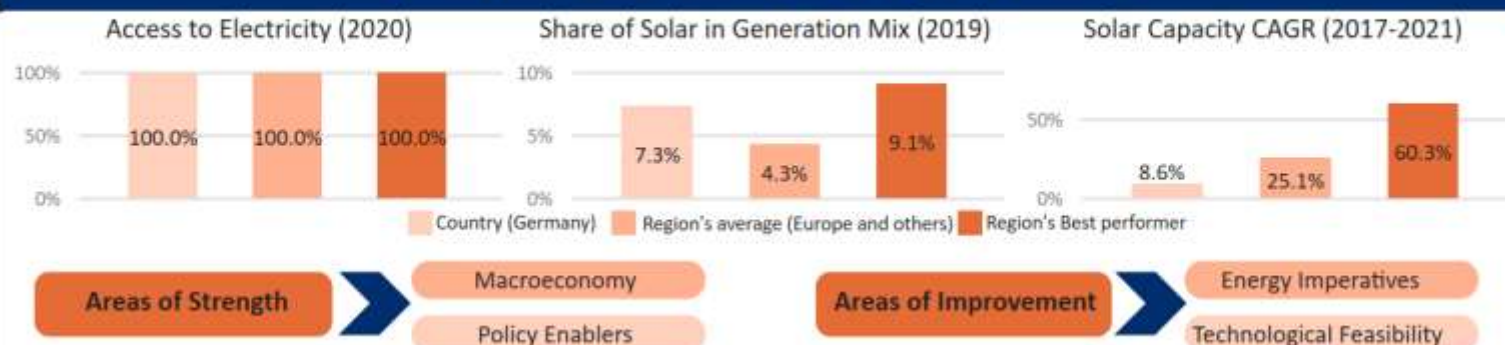
| Solar Tariff (Feed in Tariff mechanism) in USD/kWh |
|--|
| 0.228 |



| Policies/Schemes for Solar Segments (2021) | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system |
| Yes | No | No | Yes | Yes | Yes | Yes |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| E-mobility/Electric vehicles | Yes |
| Green Hydrogen | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Germany is a high-income country with a GDP per capita (PPP) of USD 58,276 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 3.7% in 2020. However, in 2021, the GDP has bounced back recording an annual growth rate of 2.6%.³
- The inflation rate (CPI) of Germany has increased to 3.2% in 2021 from 0.4% levels in 2020.⁴
- The general government gross debt to GDP has marginally grew to 69.6% in 2021 from 68% levels in 2020.⁵



Policy enablers

- Germany has aimed to become GHG neutral by 2045. It has set the preliminary targets of cutting emissions by at least 65 % by 2030 compared to 1990 levels, and 88% by 2040.⁸
- Germany's Federal Council has passed a law in 2022 which enshrines the commitment of sourcing 80% of electricity through renewables by 2030.⁶
- Germany has targeted to achieve onshore wind power of 115 GW, solar power of 215 GW by 2030. Further, the offshore wind is set to reach 40 GW by 2035, and 70 GW by 2045 respectively.⁶
- EU NDC target applies to reach climate neutrality by 2050.²⁵



Technological Feasibility

- Germany receives low solar irradiation (GHI) of 2.9 kWh/m²/day and specific yield 3.0 kWh/kWp/day indicating a low technical feasibility for solar in the country.⁹
- Germany has installed 300,000 battery energy storage systems by 2020 with an average capacity of 8.5 kWh which is about 2.3 GWh capacity.¹⁰
- Germany's utility Westnetz ranks 25th in Smart Grid Index 2021.¹¹



Market Maturity

- Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (Bundesnetzagentur (BNetzA)) serves as the regulatory authority for regulating transmission and distribution networks in Germany.¹³
- RWE, LEAG, Uniper, Vattenfall and EnBW are the main power generating companies in Germany.¹³
- Germany has four transmission system operators (50 Hertz Ltd, Amprion, TenneT, and TransnetBW).¹³
- Germany has 900 distribution system operators (DSOs) registered with BNetzA.¹³
- Germany has 890 energy supply companies which are active in the German Electricity Market.¹³



Infrastructure

- Germany's transmission system comprises of 35,000 kms of lines with a maximum voltage of 380 kV.¹⁴
- The total length of Germany's distribution grid is 1,679,000 kms operating at 60 kV, 6 kV, 440 V, 230 V and 94,800 kms operating at 110 kV.¹⁴
- Germany has cross border transmission network with Norway, Denmark, Sweden, Poland and Czech Republic, Austria, Switzerland, Belgium, Luxembourg, France and Netherlands.¹⁵
- Germany has planned to install new transmission lines between northern and southern territory using HVDC technology by 2025.¹⁶



Financing

- Germany has planned to invest an amount of USD 216 Bn to foster renewable energy to ease their reliability on gas.¹⁷
- KfW has financed renewable energy projects of the German Federal Ministry for Economic Cooperation and Development (BMZ). The project included large-scale German Indian solar partnerships.¹⁸
- European Investment Bank (EIB) has provided USD 391.6 Mn to support energy link connecting Germany and UK.¹⁹



Energy Imperatives

- In 2020, Germany's per capita electricity consumption stood at 6.5 MWh which is significantly higher than the global average of 3.31 MWh.²⁰
- In 2021, the total installed capacity in the country had reached 228.35 GW with a significant share coming from coal (29.04%) followed by gas (15.73%), nuclear (11.84%), wind (23.4%), solar (8.62%), bioenergy (9.01%), other fossil (3.48%), hydro (2.91%).^{22, 23}



Ghana

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

647.2

Average PVout in kWh/kWp/day
(2020)

4.0

Cumulative Solar Capacity in MW
(2021)

107.9

Getting Electricity Score (2020)

77.4

NDC Target by 2030 in
MtCO₂e (base year 2019)

64.0

Human Development Index (2021)

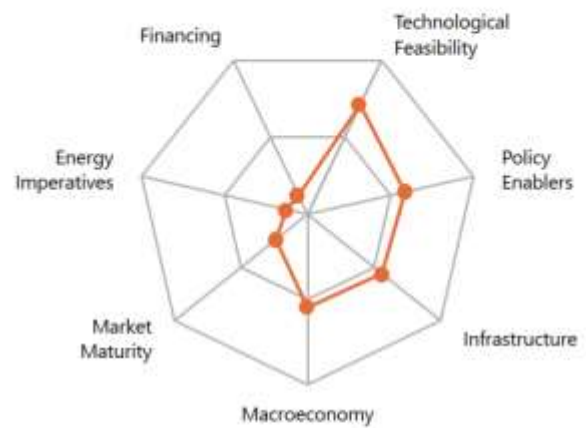
0.6

Renewable Energy Generation by Source

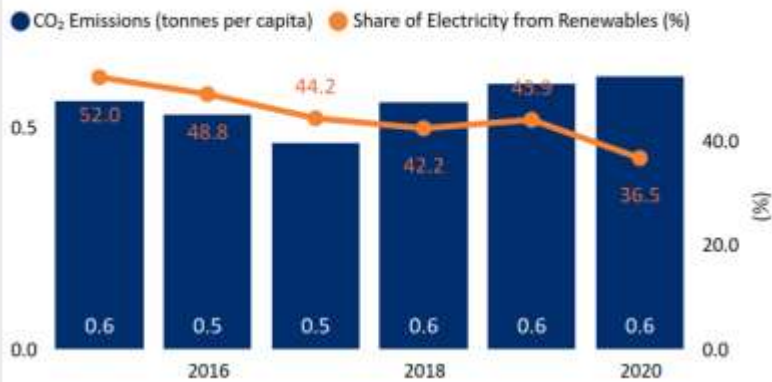


Non Solar RE includes Wind and Hydro;

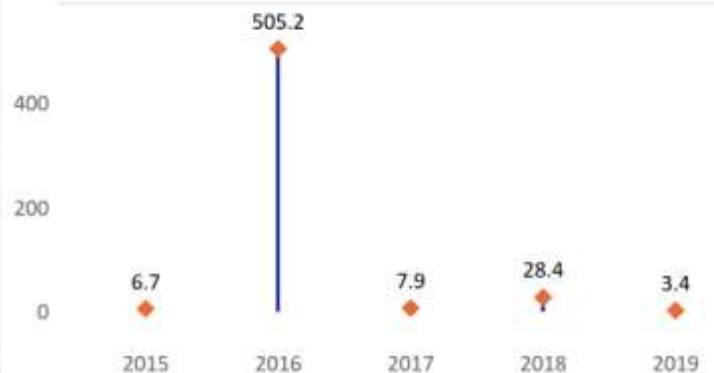
Performance against 7 Drivers



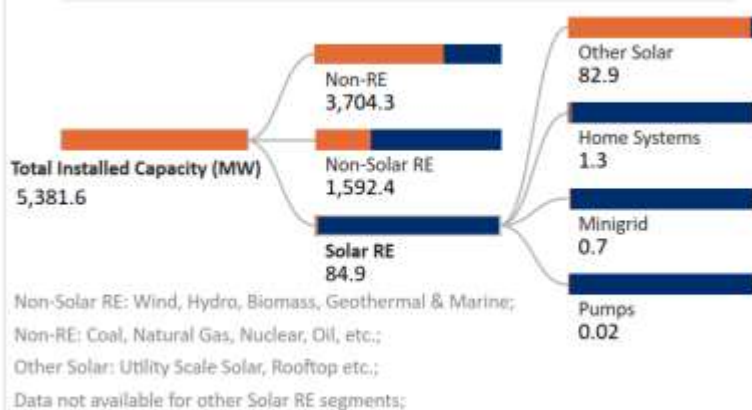
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable energy supply to the grid?

Yes

Net metering/Gross metering policies and regulations?

Yes

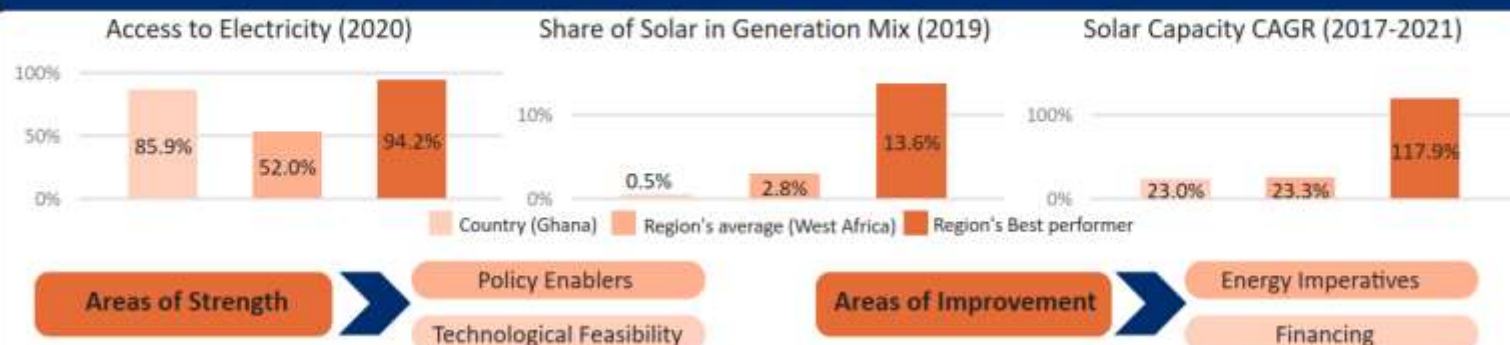
Renewable Energy Certificates?

Yes

Renewable Purchase Obligation?

Yes

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Ghana is a lower middle-income country with a GDP per capita (PPP) of USD 5,971 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 4.2% in 2021 and it is estimated to increase by 5.2% in 2022. ³
- The inflation rate in the country marginally increased to 10.0% in 2021 from 9.9% levels in 2020. ⁴
- The fiscal deficit in the country narrowed down to 12.1% of GDP in 2021 from 15.2% levels in 2020. ⁴



Policy enablers

- The Ministry of Energy is responsible for energy policy formulation and coordination of activities in the energy sector. ⁵
- The Government of Ghana enacted the Renewable Energy Act of 2011 to provide an enabling environment and foster the development of RE resources in the country. ⁶
- Ghana Public Utilities Regulatory Commission established feed-in tariff rates for electricity generated from RE sources. ⁷
- The 2010 Ghana National Energy Policy encompasses that RE development shall mainly focus on the vast mini hydro potential available in the country. ⁸



Technological Feasibility

- Ghana receives high levels of solar irradiation of 5.1 kWh/m²/day and a specific yield of 4.0 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁹
- Ghana receives, on an average, 2,377 hours of sunlight per year indicating a strong potential of solar. ¹⁰
- The UN Environment program is currently active in Ghana and is working on the introduction of Electric Light Duty Vehicles. ¹¹



Market Maturity

- 85.9% population in Ghana had access to electricity as of 2020. ¹²
- The Public Utilities Regulatory Commission (PURC) is a multi-sector regulator to regulate the provision of electricity and water utility services in Ghana. ¹³
- Ghana Grid Company (GRIDCo) is responsible for the transmission of electricity from generating companies to bulk customers, which include the Electricity Company of Ghana (ECG) and Northern Electricity Distribution Company (NEDCo). ¹⁴
- Ghana is a member of the West African Power Pool (WAPP), which aims to integrate the national power systems into a unified regional electricity market. ¹⁵



Infrastructure

- GRIDCo's transmission system comprises approximately 4,000 ckm of lines and 38 sub-stations. There are 75 kms of 225 kV lines and 100 km of 69 kV line in the Volta Region of Ghana. ¹⁶
- NEDCo's distribution network consists of 5,488 km of medium voltage lines and 7,832 km of low voltage (415 V) lines connecting 24 Bulk Supply Points. ¹⁷
- A 161 kV double circuit line and a single circuit 225 kV transmission line provide interconnection to Togo and Benin in the east and Cote d'Ivoire to the west. ¹⁶



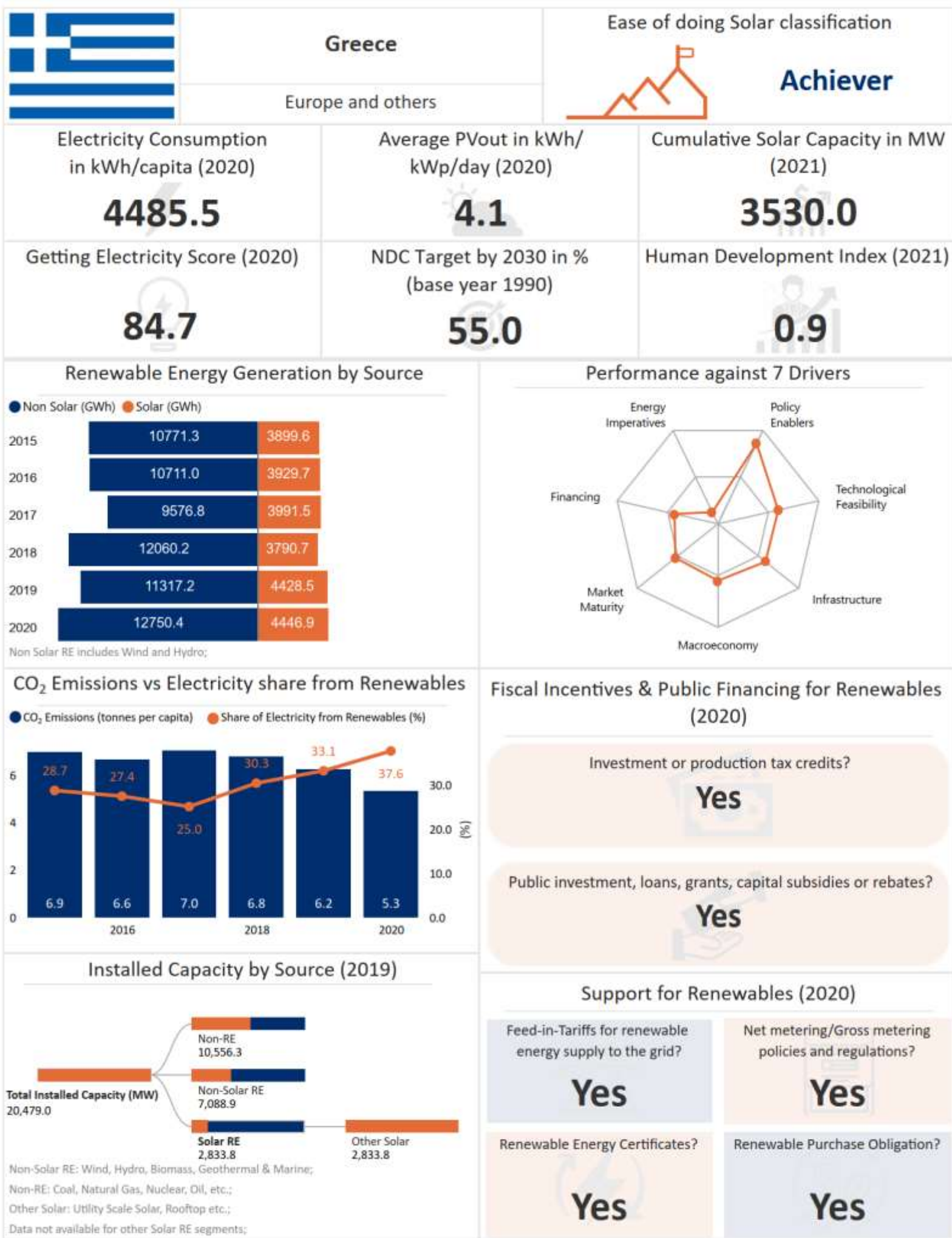
Financing

- In 2022, the AfDB approved the Leveraging Energy Access Finance Framework (LEAF) under which the bank will commit up to USD 164 Mn to promote decentralized RE in Ghana. ¹⁸
- The AfDB has approved a USD 1.5 Mn grant from its Sustainable Energy Fund for Africa (SEFA) to give thrust to Ghana's RE investment drive. ¹⁹
- The Government of Ghana has received financing from the African Development Bank in the form of a loan to cover the cost of the Electricity Distribution System Reinforcement and Extension Project (EDSREP). ²⁰

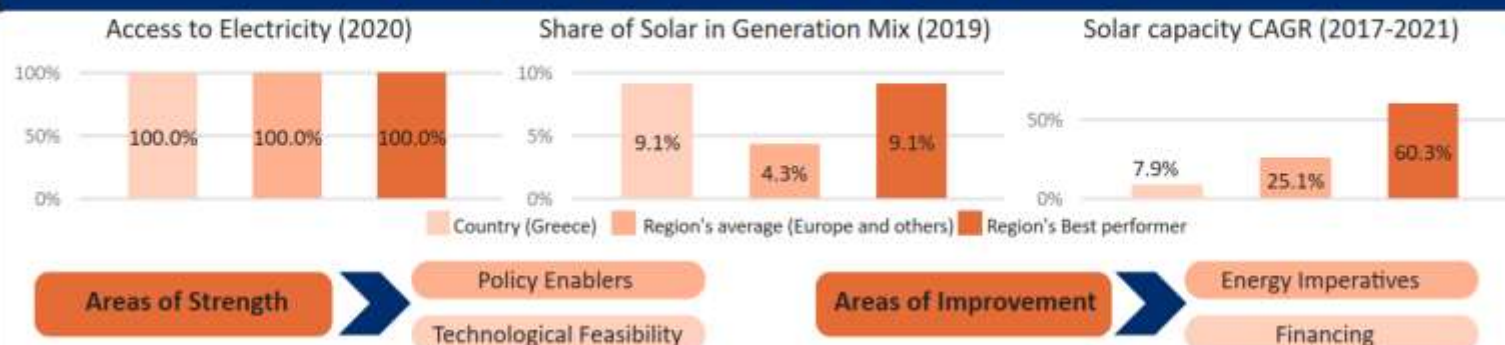


Energy Imperatives

- The total installed capacity in the country stood at 5,381.6 MW in 2019. ²¹
- In 2020, the per capita electricity consumption of 0.65 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ²³
- The price of electricity in the country was 22.2 US Cents/kWh as of 2019. ²⁴



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Greece is a high-income country with a GDP per capita (PPP) of USD 31,486 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 1.3% in 2020. However, in 2021 it has bounced back by growing at 8.3%.³
- The inflation rate (CPI) of Greece has increased to 0.6% in 2021 from -1.3% levels in 2020.⁴
- The general government gross debt to GDP has reduced to 199.4% in 2021 from 212.4% levels in 2020.⁵



Policy enablers

- Greece has targeted to accelerate its green energy capacity so as to increase the RE contribution in the generation mix to about 70% by 2030.⁷
- The country is promoting solar PV through many policy interventions such as feed-in-tariff and net metering policy for both solar and wind.⁸
- In Greece, the grid operators are mandated to connect RE generation plants to the grid and purchase electricity from such RE sources.⁸



Technological Feasibility

- Greece receives moderate solar irradiation (GHI) of 4.4 kWh/m²/day and specific yield 4.1 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.⁹
- The European Commission has approved a package of USD 337.8 Mn for the commissioning of BESS facilities up to 900 MW.¹⁰
- Greece has installed a hybrid mini-grid comprising 462 kW of solar PV capacity with six racks of lithium-ion batteries, a capacity of 553.8 kWh of DC storage capacity.¹¹



Market Maturity

- 100% of the population in Greece had access to electricity as of 2020.¹²
- Regulatory Authority for Energy (RAE) is an independent body that oversees the energy markets in Greece.¹³
- Protergia is the Electricity and Natural Gas Unit of MYTILINEOS, the largest independent electricity producer company in Greece.¹⁵
- Hellenic Electricity Distribution Network Operator (HEDNO) oversees operation, maintenance, and development of the power distribution network in Greece.¹⁶



Infrastructure

- The total length of HEDNO's network stands at 241,569 kms as of 2021.¹⁷
- The transmission network consists of 400 kV, 150 kV, 20 kV along with 165,290 sub-stations.¹⁷
- Greece has cross country transmission network and has been exporting electricity to Albania, North Macedonia, Italy, Bulgaria.¹⁸



Financing

- European Investment Bank (EIB) has provided USD 4.9 Bn to support Greece in moving towards clean energy.¹⁹
- Greece Government and the private investors have aimed to invest USD 9.94 Bn towards clean energy transition.²⁰
- A grant of USD 1.36 Bn has been extended to Greece under Just Transition Phase of EU Cohesion Policy Fund for the period (2021-2027) for climate change mitigation and energy transition.²¹



Energy Imperatives

- In 2020, Greece's per capita electricity consumption stood at 4.48 MWh which is higher in comparison to the global average of 3.31 MWh.²²
- The total installed capacity of Solar PV witnessed a CAGR of 7.9% reaching 3,530 MW in 2021 from 2,605 MW levels in 2017.²³
- In 2021, the total installed capacity in the country stood at 21.14 GW with a significant share coming from gas (40.61%), coal (11.29%), hydro (9.91%), solar (8.89%), bioenergy (8.69%) followed by fossil fuel based (3.48%) and hydro (2.91%).^{24, 25}
- The cost of electricity per kWh is US Cent 18.5 for households and US Cent 11.6 for business.²⁶



Grenada

Latin America & Caribbean

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

1777.5

Average PVout in kWh/kWp/day
(2020)

4.5

Cumulative Solar Capacity in MW
(2021)

3.6

Getting Electricity Score (2020)

73.4

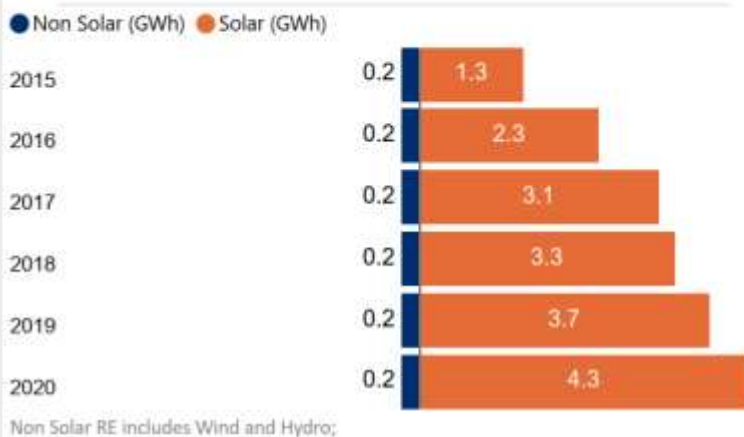
NDC Target by 2030 in %
(base year 2010)

40.0

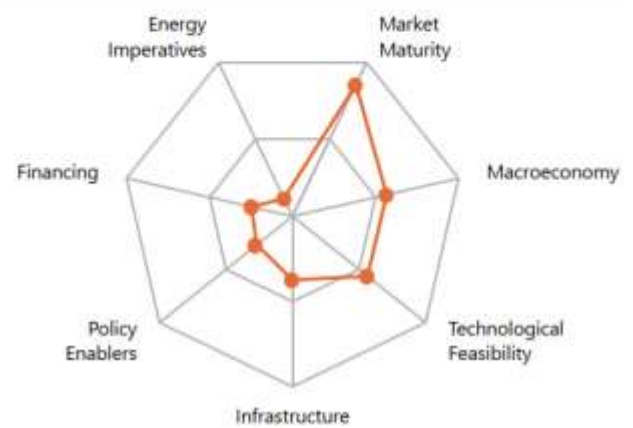
Human Development Index (2021)

0.8

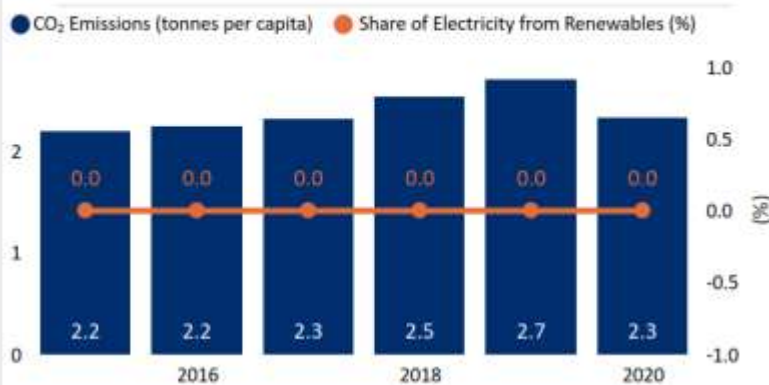
Renewable Energy Generation by Source



Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

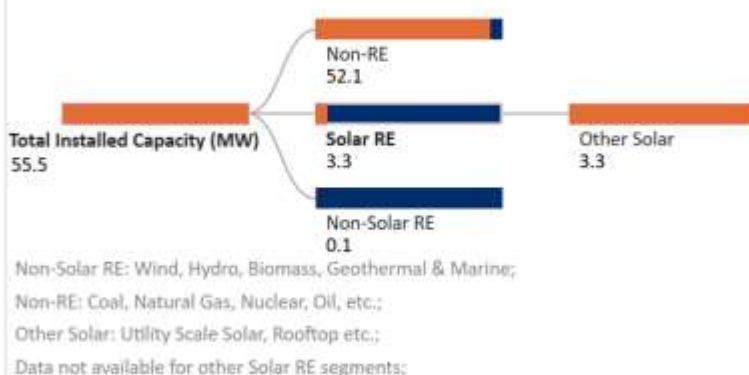
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Grenada is an upper middle-income country with a GDP per capita (PPP) of USD 15,038 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) had contracted by 13.8% in 2020. However, in 2021 it has bounced back growing at a rate of 5.6%.¹
- The inflation rate (CPI) of the country has increased to 1.2% in 2021 from -0.7% levels in 2020.¹
- The general government gross debt to GDP has reached 70.3% in 2021 from 71.4% levels in 2020.¹



Policy enablers

- To promote the development of RE in the country several incentives like tax reductions/exemptions, availability of interconnection standards and net metering are already implemented in the country.⁸
- The "Grenada Vision 2030" has set a target to achieve 100% RE for both the electricity and transport sectors by 2030.⁹



Technological Feasibility

- Grenada receives high levels of solar irradiation (GHI) of 4.9 kWh/m²/day and specific yield 4.5 kWh/kWp/day indicating a strong technical feasibility for solar in the country.³
- The country is highly dependent on imported fossil fuels for generation of electricity, making it vulnerable to fluctuating oil prices.⁴



Market Maturity

- As of 2020, 93.6% of the population in Grenada had access to electricity.²
- The Public Utilities Regulatory Commission is the designated agency that regulates the energy sector in the country.⁶
- Grenada Electricity Services Limited (GRENLEC) is the agency responsible for the generation, transmission, and distribution of electricity in the country.⁷



Infrastructure

- In 2021, the network losses stood at 6.61% indicating an efficient power infrastructure in the country.⁷
- The GRENLEC has been taking necessary steps to improve infrastructure and enhance customer experience through development of mobile application and multi-layered Geographical Information System (GIS).⁷



Financing

- The World Bank in May 2022 has sanctioned USD 25 Mn for Grenada's First Recovery and Resilience Programmatic Development Policy Credit that will help promote a greener and climate-resilient economy, improving sustainability, and greater accountability of fiscal management.¹⁰
- The government has created a dedicated fund to provide loans for solar PV under Nationally Appropriate Mitigation Action (NAMA) project.¹¹



Energy Imperatives

- In 2020, Grenada's per capita electricity consumption stood at 1.78 MWh which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The total installed capacity of Solar PV witnessed a CAGR of 12.1% reaching 3.6 MW in 2021 from 2.3 MW in 2017.⁵
- The peak demand for electricity in the country in 2021 stood at 1.78 TWh remaining similar to 2020 levels.⁴
- In 2021, the total installed capacity in the country stood at 0.06 GW with a major share coming from oil.⁴



Guinea

Africa

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

243.7

Average PVout in kWh/
kWp/day (2020)

4.4

Cumulative Solar Capacity in MW
(2021)

13.4

Getting Electricity Score (2020)

55.3

NDC Target by 2030 in
ktCO₂/year (base year 2020)

2000.0

Human Development Index (2021)

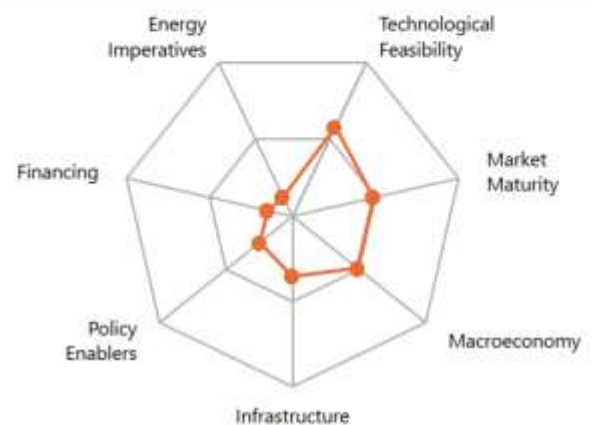
0.5

Renewable Energy Generation by Source

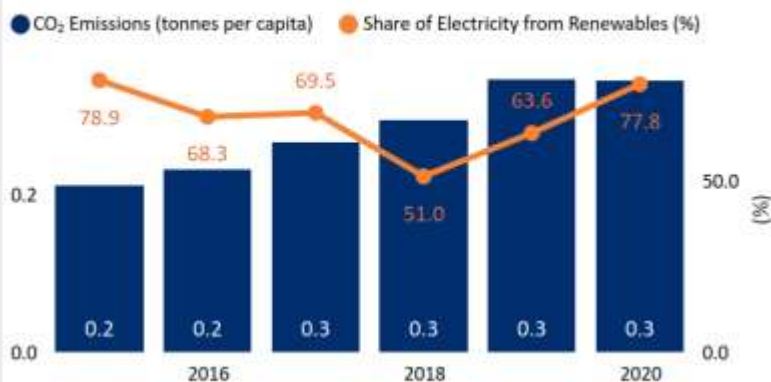


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



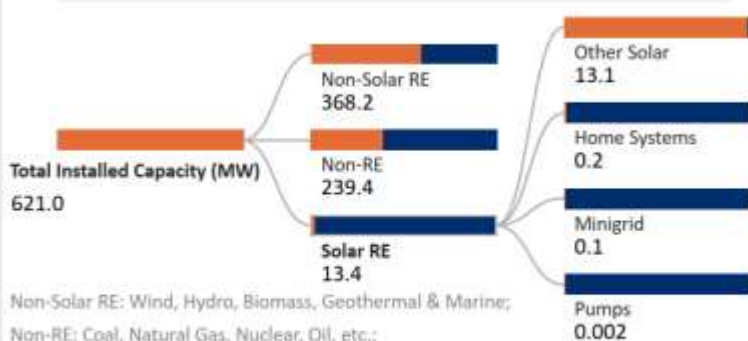
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

| Peak Demand in MW (2017) | Electricity Consumption CAGR in % (2022 - 2026) | Solar PV Capital Cost in USD/MW (2022) |
|--------------------------|---|--|
| 50.0 to 200.0 | 30.0 to 50.0 | 50.0 |

| Support for Renewables (2021) | |
|---|-----|
| Feed-in-Tariffs for Renewable Energy Supply to the Grid | Yes |
| Renewable-cum-storage based tenders | Yes |
| Carbon Taxation | No |
| Manufacturing facility for solar equipment (inverters and balance of systems) | No |

| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | Yes |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | Yes |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|--------------------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Battery waste management |
| No | Yes | No | No | No | No | Yes |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Guinea is a low-income country with a GDP per capita (PPP) of USD 2,901 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 4.2% in 2021 and it is estimated to increase by 4.8% in 2022. ³
- The budget deficit in the country reduced to 2.3% of GDP in 2021 from 2.9% levels in 2020. ⁴
- Total public debt in the country remained similar at 43.3% of GDP in 2021 in comparison to 43.4% levels in 2020. ⁴



Policy enablers

- The Ministry of Energy and Hydraulics (MEH) is responsible for preparing energy policies and the National Directorate of Energy (DNE) is responsible for facilitating energy access planning. ⁵
- Guinea has set a target to increase the share of solar to 11% - 15% of the energy mix by 2035. ⁶
- Agence d'Electrification Rurale (AGER) is responsible for the development of rural electrification programs including off-grid projects. ⁵



Technological Feasibility

- Guinea receives high levels of solar irradiation of 5.4 kWh/m²/day and a specific yield of 4.4 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁸
- The country typically receives 8 hours of sunlight per day. ⁶
- The government is planning to develop a mini-grid regulatory framework to improve electrification rates in the country. ⁵



Market Maturity

- 44.7% population in Guinea had access to electricity as of 2020 indicating a strong growth potential for electric power. ⁹
- ARSEE is responsible for regulating the electricity sector including reviewing and setting tariffs for the national utility. ⁵
- Electricity Corporation of Guinea (EDG) is the sole generator, transmitter, and distributor of electricity. ¹⁰
- Guinea is a member of the West African Power Pool (WAPP), which aims to integrate the national power systems into a unified regional electricity market. ¹¹



Infrastructure

- Guinea's transmission infrastructure comprises two separate grid systems- the Grid of Greater Conakry (known as RIC) and the central zone grid (known as the Tinkisso system). ⁵
- Conakry's system connects four main cities in Maritime Guinea and four other cities in Middle Guinea with an infrastructure comprising 116 km of 225 kV lines, 601 km of 110 kV lines, and 82 km of 60 kV lines. ⁵
- Guinea's expected investment in the Transmission & Distribution Infrastructure over the next 5 years (2022-2026) is USD 480 Mn. ⁶
- The country's average Transmission and Distribution loss levels are 46.9% and 34.8% respectively in 2021. ⁶



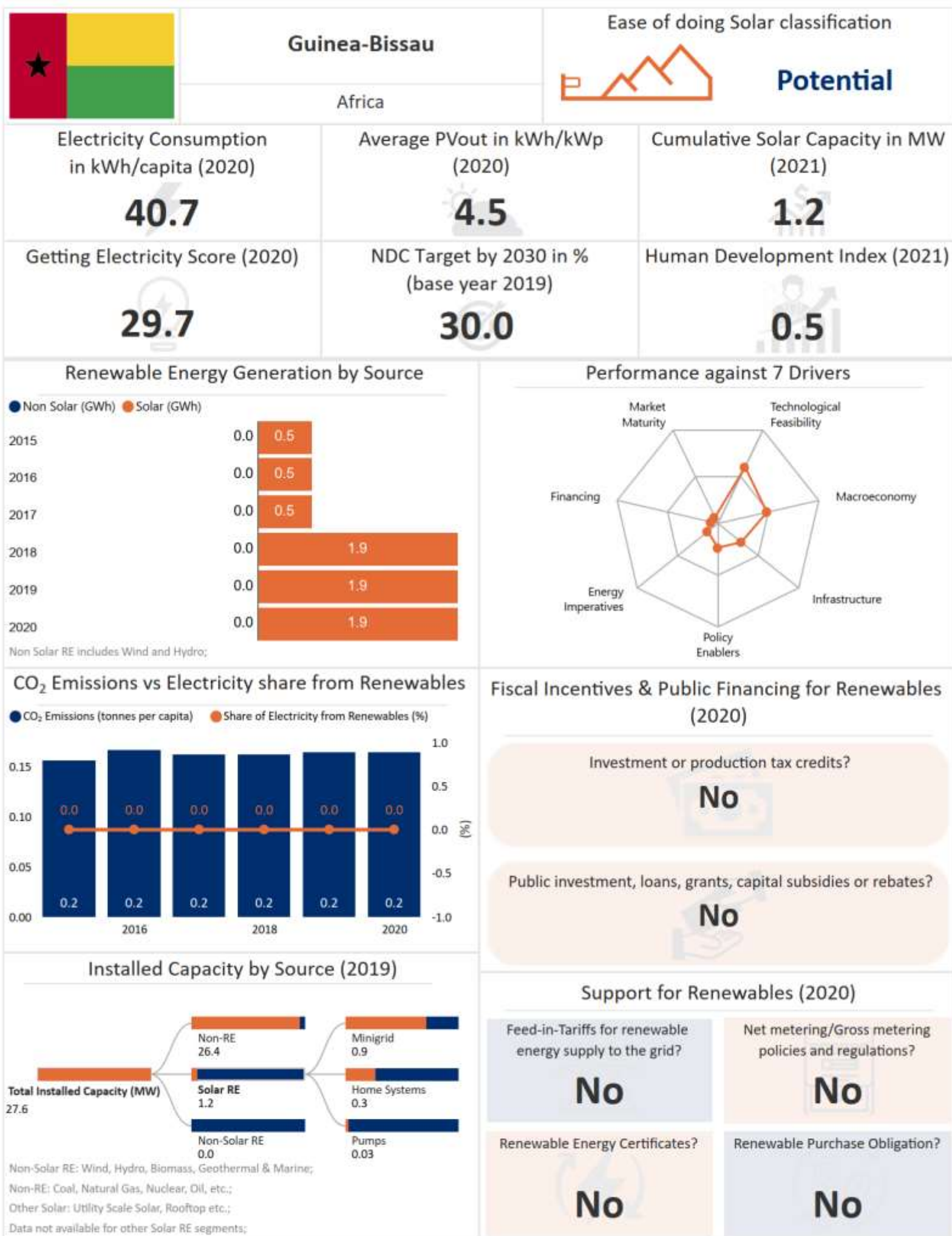
Financing

- In 2022, the AfDB approved the Leveraging Energy Access Finance Framework (LEAF) under which the bank will commit up to USD 164 Mn to promote decentralized renewable energy in Guinea. ¹²
- In 2019, the World Bank approved USD 50 Mn International Development Association (IDA) financing for the Guinea Electricity Access Scale Up Project to help increase access to electricity in selected areas of the country. ¹³
- The Green Climate Fund approved USD 170.9 Mn in financing for AfDB's Leveraging Energy Access Finance Framework (LEAF) program. Guinea is among the six countries where LEAF aims to unlock commercial and local-currency financing for decentralized renewable energy (DRE) projects. ¹⁴

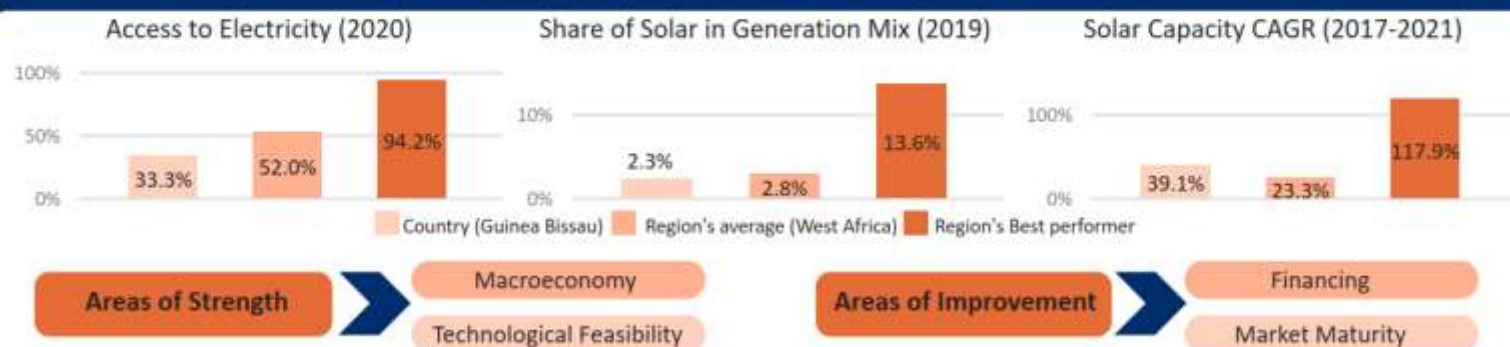


Energy Imperatives

- The total installed capacity of Rooftop Solar and Solar mini-grids are (45-50) MW and 10 MW respectively as of 2021. ⁶
- The total installed off-grid capacity of Solar PV in the country is between 100 KW to 1 MW as of 2021. ⁶
- The total installed capacity of Solar PV witnessed a flat CAGR of 0.1% between 2017-2021 reaching 13.4 MW in 2021 from 13.3 MW levels in 2017. ¹⁵
- In 2020, the per capita electricity consumption stood at 0.24 MWh which is significantly lower in comparison to the global average of 3.31 MWh in 2020. ¹⁶
- The price of electricity in the country was 19.6 US Cents/kWh as of 2019. ¹⁷



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Guinea-Bissau is a low-income country with a GDP per capita (PPP) of USD 2,012 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 3.8% in 2021 and it is estimated to increase by 3.8% in 2022. ³
- The inflation rate in the country increased to 3.3% in 2021 from 1.5% levels in 2020 driven by higher pandemic-related food and fuel prices. ⁴
- The fiscal deficit in the country narrowed down to 5.6% of GDP in 2021 from 9.8% levels in 2020. ⁴



Policy enablers

- The Ministry of Energy and Industry is responsible for implementing and regulating policies in the energy sector. ⁵
- The National Renewable Energy Action Plan (NREAP) serves as a RE plan and policy for Guinea-Bissau. ⁶
- Solar Panels are exempted from VAT while other components (inverters, batteries, controllers, etc.) of a solar kit are not exempted. ⁷



Technological Feasibility

- Guinea-Bissau receives very high levels of solar irradiation of 5.6 kWh/m²/day and a specific yield of 4.5 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁸
- Guinea-Bissau is planning to construct a 20 MW solar PV power plant near Bissau and two 1 MW hybrid mini-grid systems in Gabu and Cachungo. ⁹
- By 2030 around 9% of the population will be served by renewable energy-based hybrid mini-grids and stand-alone systems. ⁹



Market Maturity

- 33.3% population in Guinea-Bissau had access to electricity as of 2020. ¹⁰
- The National Electricity and Water Corporation (EAGB) is responsible for generation, transmission, and distribution of electricity in the country. ⁵
- Guinea-Bissau is a member country of the Western African Power Pool (WAPP). Its grid is interconnected with its neighbours and is an important reason for improving the reliability of the power supply in the country. ⁵



Infrastructure

- The 225 kV Guinea-Mali Electricity Interconnection Project entails the construction of a double-circuit transmission line over 714 km and associated substations between the town of N'zérékoré in Guinea and Sanankoroba (Bamako) in Mali. ¹¹
- Guinea-Mali Electricity Interconnection Project will interconnect Zone A countries (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Nigeria, Niger, and Togo) to Zone B countries (The Gambia, Guinea, Guinea-Bissau, Mali, Liberia, Senegal, and Sierra Leone) of the WAPP. ¹¹



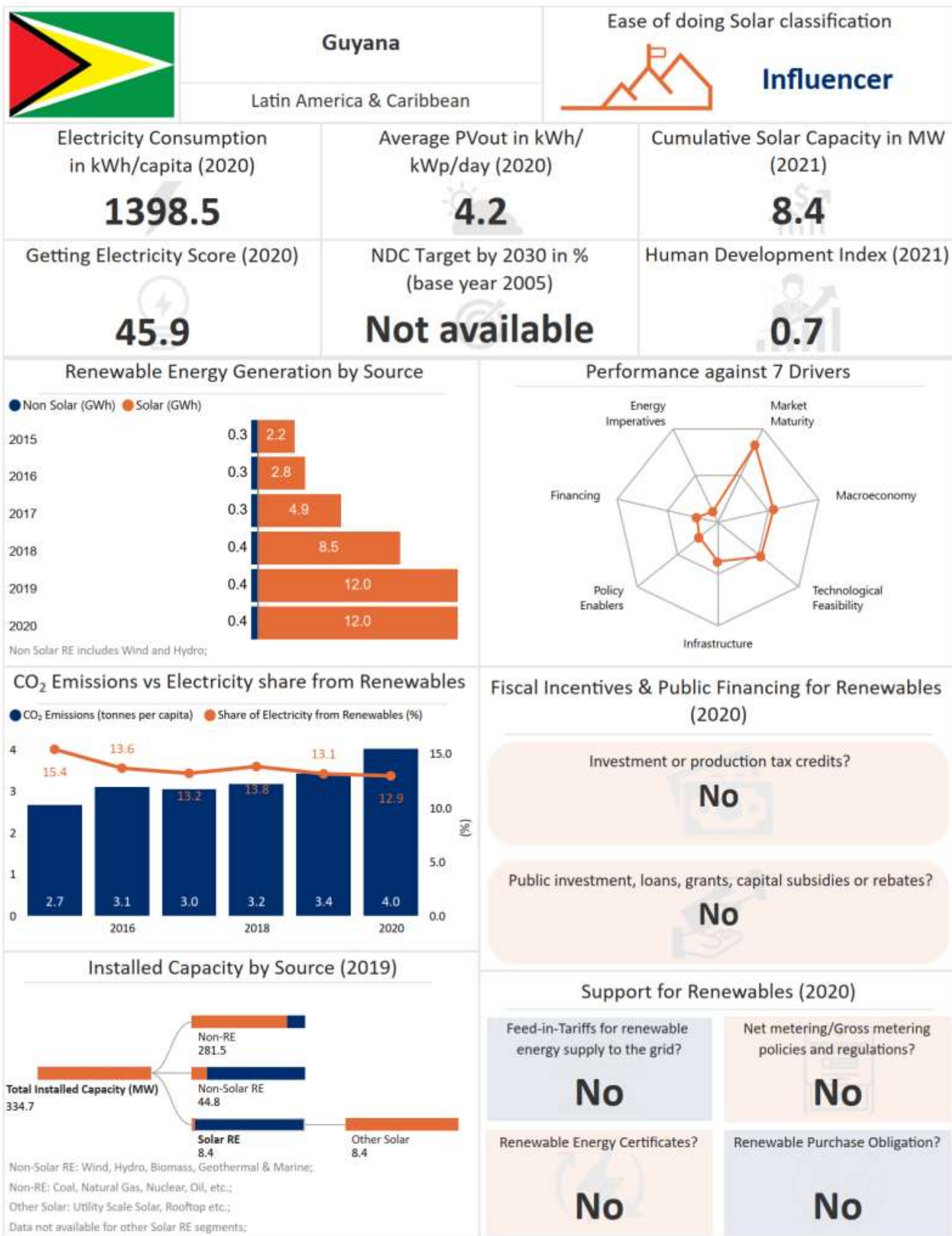
Financing

- Guinea-Bissau Sustainable Energy Investment plan aims to attract USD 700 Mn investments to bring in energy transformations by 2030. ¹²
- In 2018, the AfDB sanctioned USD 20.2 Mn to the Guinea-Bissau government intending to improve the reliability of power infrastructure in the country. ¹³

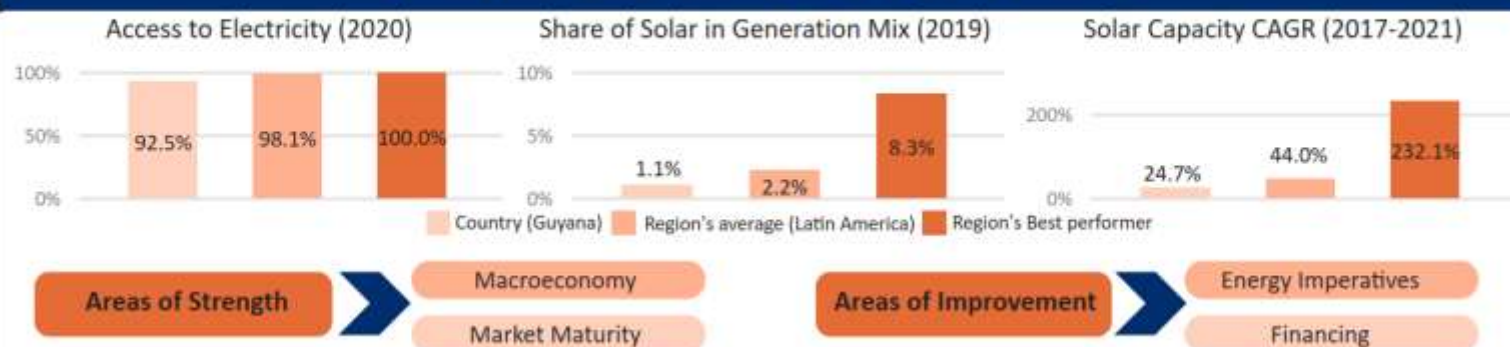


Energy Imperatives

- The total installed capacity in the country was 27.6 MW in 2019. ¹⁴
- The total installed capacity of Solar PV witnessed a CAGR of 39.1% between 2017-2021 reaching 1.169 MW in 2021 from 0.312 MW levels in 2017. ¹⁵
- In 2020, the per capita electricity consumption stood at 0.04 MWh which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁶
- The price of electricity in the country was 24.9 US Cents/kWh as of 2019. ¹⁷



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Guyana is an upper middle-income country with a GDP per capita (PPP) of USD 24,087 in 2021.^{1,2}
- In 2021, the GDP (Real) has increased by 23.8% and it is expected to grow with an annual rate of 57.8% in 2022.¹
- The inflation rate (CPI) of the country has increased to 3.3% in 2021 from 1.2% levels in 2020.¹
- The general government gross debt to GDP has decreased to 42.9% in 2021 from 51.1% levels in 2020.¹



Policy enablers

- By 2040, the country aims to achieve a 100% share of RE generation in the overall generation mix.¹¹
- To promote the development of RE, the government has established a Grid Code for the integration of distributed generation and establishment of the commercial and technical frameworks for grid connected renewable system providing fiscal incentives such as VAT and import duty, net metering and reverse auctions.^{7,9,10}



Technological Feasibility

- Guyana receives high levels of solar irradiation (GHI) of 5.2 kWh/m²/day and specific yield 4.2 kWh/kWp/day indicating strong technical feasibility for solar in the country.³
- In 2021, 13.6% of the country's power demand was met through RE sources (excluding large hydro).⁴
- The country is highly dependent on imported fossil fuels for generation of electricity making it susceptible to fluctuating oil prices.⁴



Market Maturity

- As of 2020, 92.5% of the population in Guyana had access to electricity.²
- The Public Utilities Commission is the designated agency that regulates the energy sector in the country.⁶
- Guyana Power & Light Company Limited (GPL) is the agency responsible for generation, transmission, and distribution of electricity in the country.⁷



Infrastructure

- Guyana Power & Light Company Limited had reported high system losses of 25% indicating a lot of scope for improvement.¹²
- GPL intends to expand its infrastructure to integrate a total of 29 MW of Solar PV generation capacity into its network by 2025.¹³



Financing

- Guyana has implemented provisions for tax concessions and capital write offs for investments in solar and wind projects.¹⁴
- Guyana REDD+ Investment Fund (GRIF) was created in 2010 to channelize international financing for renewables.¹⁵



Energy Imperatives

- In 2020, Guyana per capita electricity consumption stood at 1.4 MWh which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The total installed capacity of Solar PV witnessed a CAGR of 24.7% reaching 8.4 MW in 2021 from 3.5 MW levels in 2017.⁴
- The peak demand for electricity in the country has remained constant at 1.1 TWh in 2021 and 2020.⁴
- In 2021, the total installed capacity in the country stood at 360 MW with a significant share coming from oil (86.1%) followed by bioenergy (11.4%) and solar (2.8%).⁴



Haiti

Latin America & Caribbean

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

82.4

Average PVout in kWh/
kWp/day (2020)

4.7

Cumulative Solar Capacity in MW
(2021)

2.6

Getting Electricity Score (2020)

57.2

NDC Target by 2030 in %
(base year 2000)

32.0

Human Development Index (2021)

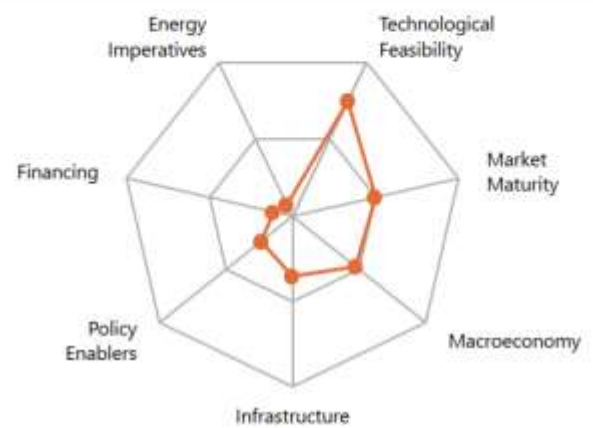
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Renewable Energy Generation by Source

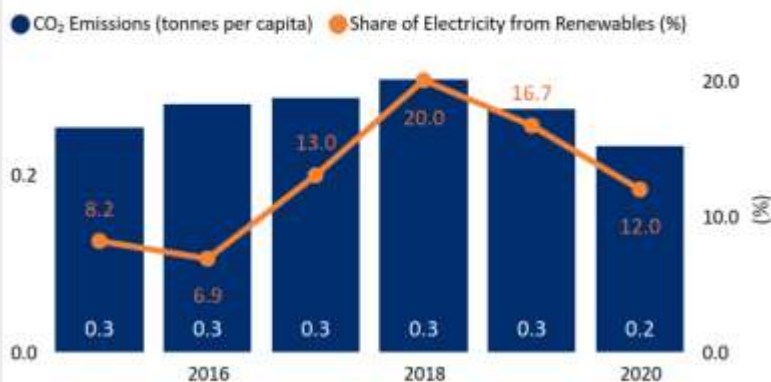


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



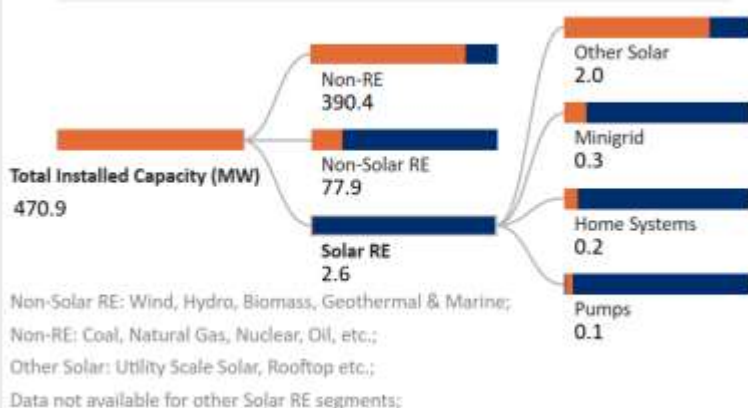
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable energy supply to the grid?

No

Net metering/Gross metering policies and regulations?

No

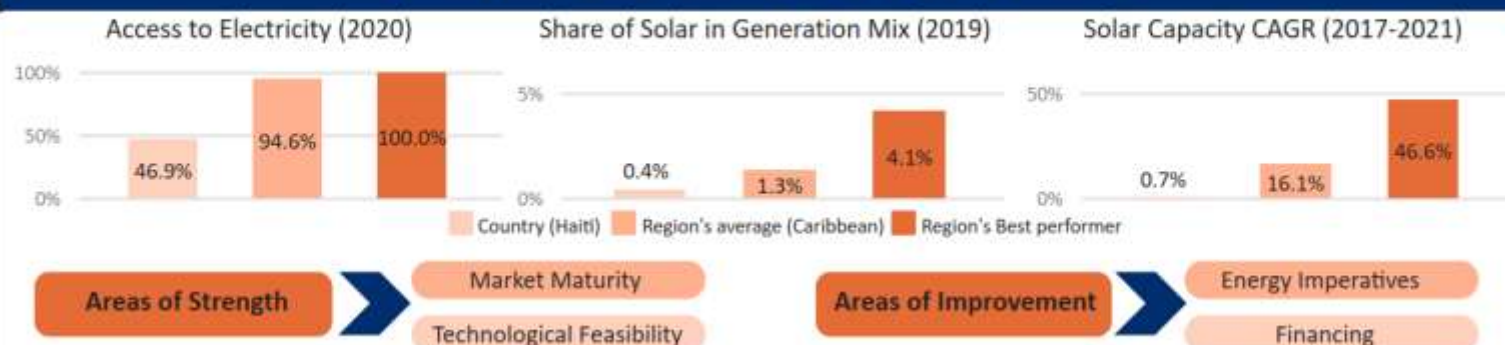
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Haiti is a lower-middle income country with a GDP per capita (PPP) of USD 3,153 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) declined by 3.3% in 2020. However, in 2021 it has slightly improved recording a rate of -1.8%.³
- The inflation rate (CPI) of Haiti has decreased to 15.9% in 2021 from 22.9% levels in 2020.⁴
- The general government gross debt to GDP has increased to 24.2% in 2021 from 21.3% levels in 2020.⁵



Policy enablers

- Haiti has set a target to achieve 47% of the electricity generation from RE sources by 2030.⁶
- Haiti has an unconditional target of installing an additional 37.5 MW of hydro by 2030.⁶
- Haiti has feed-in tariff and net-metering policy in place to promote electricity generation through RE.⁶



Technological Feasibility

- Haiti receives very high levels of solar irradiation (GHI) of 5.5 kWh/m²/day and a specific yield 4.7 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁷
- Haiti's largest solar plant of 12 MW, funded by the IDB and USAID, is planned to be commissioned by 2023.⁸



Market Maturity

- 46.9% of the population in Haiti had access to electricity as of 2020.⁹
- The National Authority for the Regulation of the Energy Sector (ANARSE) ensures the promotion and development of the energy sector by regulating generation, transmission, and distribution of electricity.¹⁰



Infrastructure

- In 2017, Haiti planned to augment its National Transmission Network by constructing 1,079 kms of high voltage power lines with extension of 12 sub-stations and a National Energy Control Centre.¹²
- Haiti has also planned to upgrade 1,920 kms of MV/LV lines and construction of 1,350 kms of MV/LV lines of their electricity distribution network.¹²



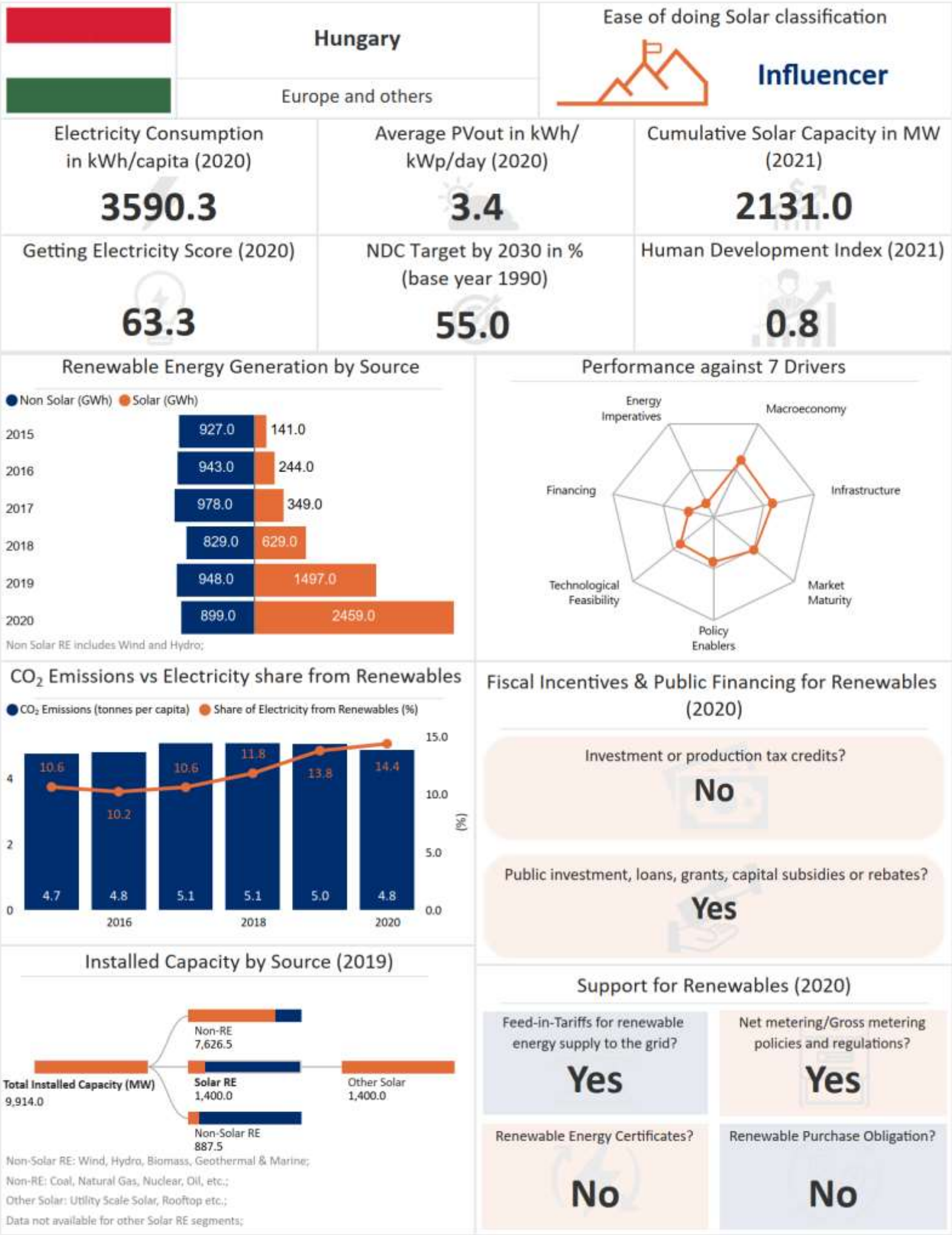
Financing

- In 2020, Taiwan extended a loan of USD 150 Mn to Haiti to repair and upgrade the metropolitan grids with USD 20 Mn set aside for rural electrification projects.¹¹
- In 2020, The World Bank extended an additional loan of USD 6.9 Mn for the Renewable Energy for All Project. This financing is aimed at scaling RE to improve accessibility of electricity for all.¹³
- The Green Climate Fund (GCF) has funded the government of Haiti with an amount of USD 13.9 Mn to support mitigating climate challenges and scaling smart solar energy access and microgrids.¹⁴

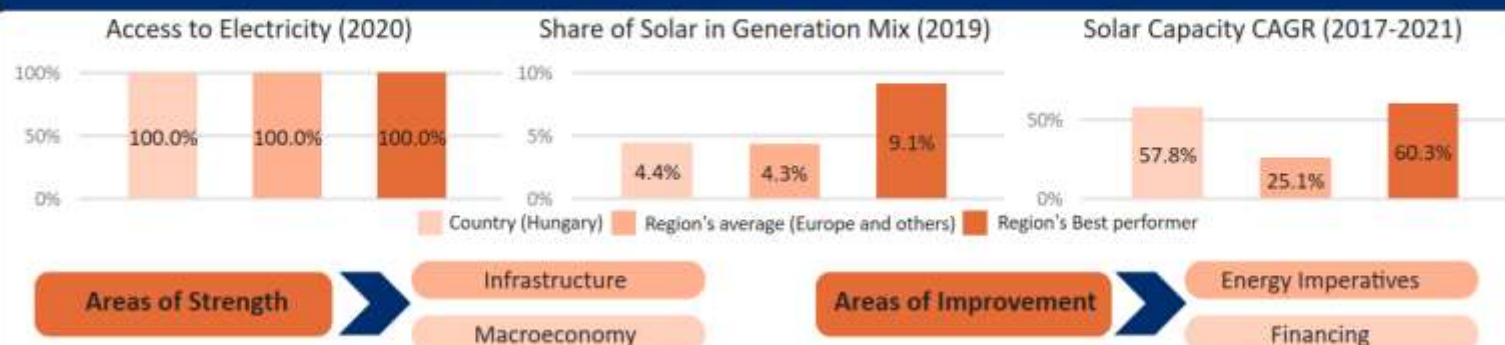


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.082 MWh in Haiti which is significantly lower in comparison to the global average of 3.31 MWh.¹⁵
- The total installed capacity of Solar PV witnessed a CAGR of 0.7% reaching 2.6 MW in 2021 from 2.5 MW levels in 2017.¹⁶
- The peak demand for electricity in the country stood at 0.91 TWh remaining similar in 2021 and 2020.¹⁷
- In 2021, the total installed capacity in the country stood at 469.37 MW with major share coming from fossil fuel (86.17%) followed by hydro (13.83%).^{17, 18}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Hungary is a high-income country with a GDP per capita (PPP) of USD 36,765 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 4.5% in 2020. However, in 2021 the GDP has bounced back by growing at 7.1%.³
- The inflation rate (CPI) of Hungary has increased to 5.1% in 2021 from 3.3% levels in 2020.⁴
- The general government gross debt to GDP has reduced to 76.8% in 2021 from 79.6% levels in 2020.⁵



Policy enablers

- Hungary has set an ambitious target to achieve a share of 90% coming from clean sources in the generation mix electricity by 2030.⁶
- Hungary has targeted to reach its solar capacity to nearly 6,500 MW by 2030 and almost to 12,000 MW by 2040.⁷
- Renewable energy Support Scheme (METÁR) -2021 aims to support for total electricity production of 300 GWh of electricity using RE sources.⁸
- To support RE in the country, Hungary has implemented feed-in-tariff policy for consumers that have installed RE capacity in the range of 50 kW-500 kW.⁹



Technological Feasibility

- Hungary receives moderate solar irradiation (GHI) of 3.5 kWh/m²/day and specific yield 3.4 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.¹⁰
- Hungary has got 3 Tesla MegaPack energy storage systems installed by MET Group with capacity of 7.68 MWh each.¹¹
- Hungarian firm "ILST-Hungary Ltd." are the leading manufacturers of solar and public lighting system and have been rendering services in central Europe.¹²
- Hungary's Tázlár Solar Park has an integrated capacity of 63 MWp providing electricity to more than 36,000 households.¹⁷



Market Maturity

- 100% of the population in Hungary had access to electricity as of 2020.¹³
- Hungarian Energy and Public Utility Regulatory Authority (HEA) is the regulatory body for energy and public utility market in the country.¹⁴
- Hungarian Independent Transmission Operator Company Ltd. (MAVIR Ltd.) is the agency responsible for providing reliable, efficient, and secure operation of the Hungarian electricity system.¹⁵



Infrastructure

- The length of the Hungarian transmission grid is 3,821 kms.¹⁵
- Hungarian MAVIR Ltd. owns 17 transmission grid sub-stations.¹⁵
- Hungary has a cross border transmission network with Slovenia to exchange electricity between the two countries.¹⁶
- Hungary has a double circuit 400 kV overhead line between Hévíz (Hungary) – Žerjavinec (Croatia).¹⁶



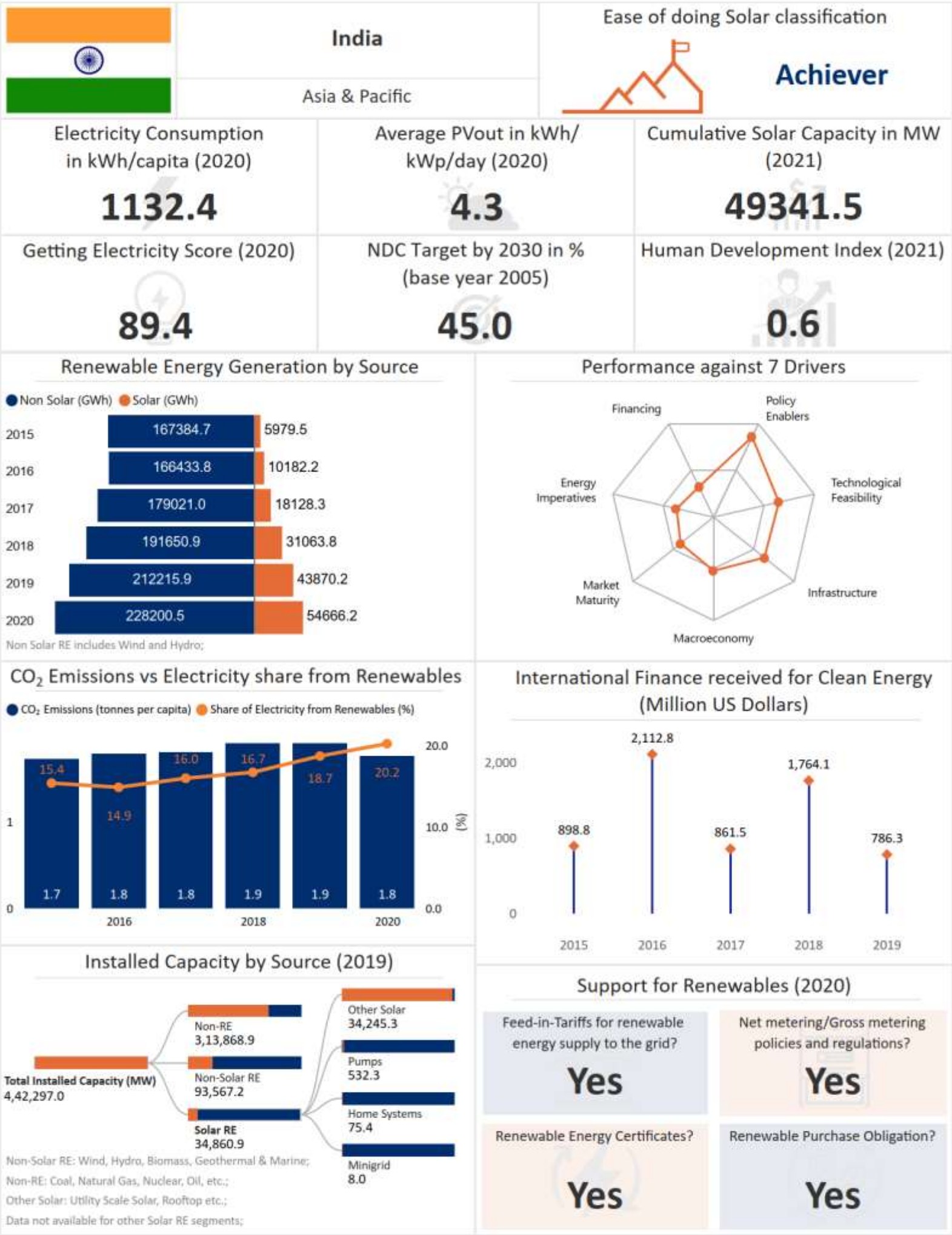
Financing

- The European Commission has approved an investment of USD 1.98 Bn to support sustainable growth in Hungary.¹⁸
- Hungary's Investment bank Berenberg has financed a 65 MW solar power project development in the country.¹⁹
- Photon Energy Group has invested in Hungary under Green Financing Framework for sustainable investments in 1.3 MWp solar plant in Tolna, Hungary.²⁰



Energy Imperatives

- In 2020, Hungary's per capita electricity consumption stood at 3.59 MWh which is comparatively higher to the global average of 3.31 MWh.²¹
- The total installed capacity of Solar PV witnessed a CAGR of 57.8% reaching 2,131 MW in 2021 from 344 MW levels in 2017.²²
- In 2021, the total installed capacity in the country stood at 26.88 GW with a significant share coming from nuclear (46.18%), gas (26.14%), coal (8.39%), solar (9.18%), bioenergy (6.34%), followed by fossil fuel based (1.15%), wind (1.89%) and hydro (0.56%).^{24, 23}
- The cost of electricity per kWh is US Cent 9.1 for households and US Cent 11.3 for business.²⁵



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- India is a lower middle-income country having GDP per capita (PPP) USD 7,242 as of 2021². Services, Agriculture and Industry sectors accounted for 47.69%, 16.77% and 25.87% of GDP respectively.¹
- GDP (Real) grew at an annual rate of 8.9% in 2021, further it is expected to grow by 8.2% in 2022.³
- Inflation rate in the country decreased to 5.5% in 2021 from earlier levels of 6.2% in 2020, while the total public debt was at 86.76% of GDP as of 2021.^{4,5}



Policy enablers

- MNRE is the nodal agency that is responsible for developing policy and regulations for all RE related aspects.⁶
- India aims to attain 500 GW of generation capacity through RE resources by 2030 and to reach net zero by 2070.⁷
- FDI up to 100% is permitted in the renewable energy sector with no prior Government approval required.⁸
- National Hydrogen Mission was launched in 2022 to meet climate targets and make India a green hydrogen hub.⁹
- Gol approved Rs 19,500 Cr PLI scheme for manufacturing of high efficiency solar PV modules in 2022.¹⁰



Technological Feasibility

- The country receives high levels of solar irradiation (GHI) of 5.1 kWh/m²/day and specific yield 4.3 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.¹¹
- Solar Energy Corporation of India (SECI) is a nodal body which implements the National RE related schemes and has issued tenders for 10,100 MW of hybrid/RTC/Peak power capacity of which 5,350 MW has already been awarded.¹²
- World's largest FSPV of 600 MW capacity is to be constructed at Omkareshwar dam in Khandwa district of MP.¹³
- MoP has come up with a scheme where existing Thermal/Hydro power stations will be bundled with RE and storage power.¹⁴



Market Maturity

- 99% of the population in the country is having access to electricity as of 2020.¹⁵
- The power sector is vertically unbundled and there are separate (public and private) entities for Generation, Transmission and Distribution.¹⁶
- CERC is the regulatory commission responsible for regulating the grid tariff, interstate electricity transmission and electricity grid code.¹⁷
- Power trading company such as India Energy Exchange (IEX), Power Exchange India Ltd (PXIL) offer open platforms for selling and purchasing of electricity in the country.¹⁸



Infrastructure

- Central Electricity Authority (CEA) mainly prepares the transmission network expansion plan.¹⁹
- India has Cross Border Electricity Trade (CBET) with Nepal, Bangladesh, and Bhutan.²¹
- MNRE partnered with the United States to create the Solar Energy Training Network (SETNET) of India to establish greater consistency and collaboration among India's solar energy training programs.²²
- The manufacturing capacity for solar PV cells and modules are around 3 GW/year and 10 GW/year.²³



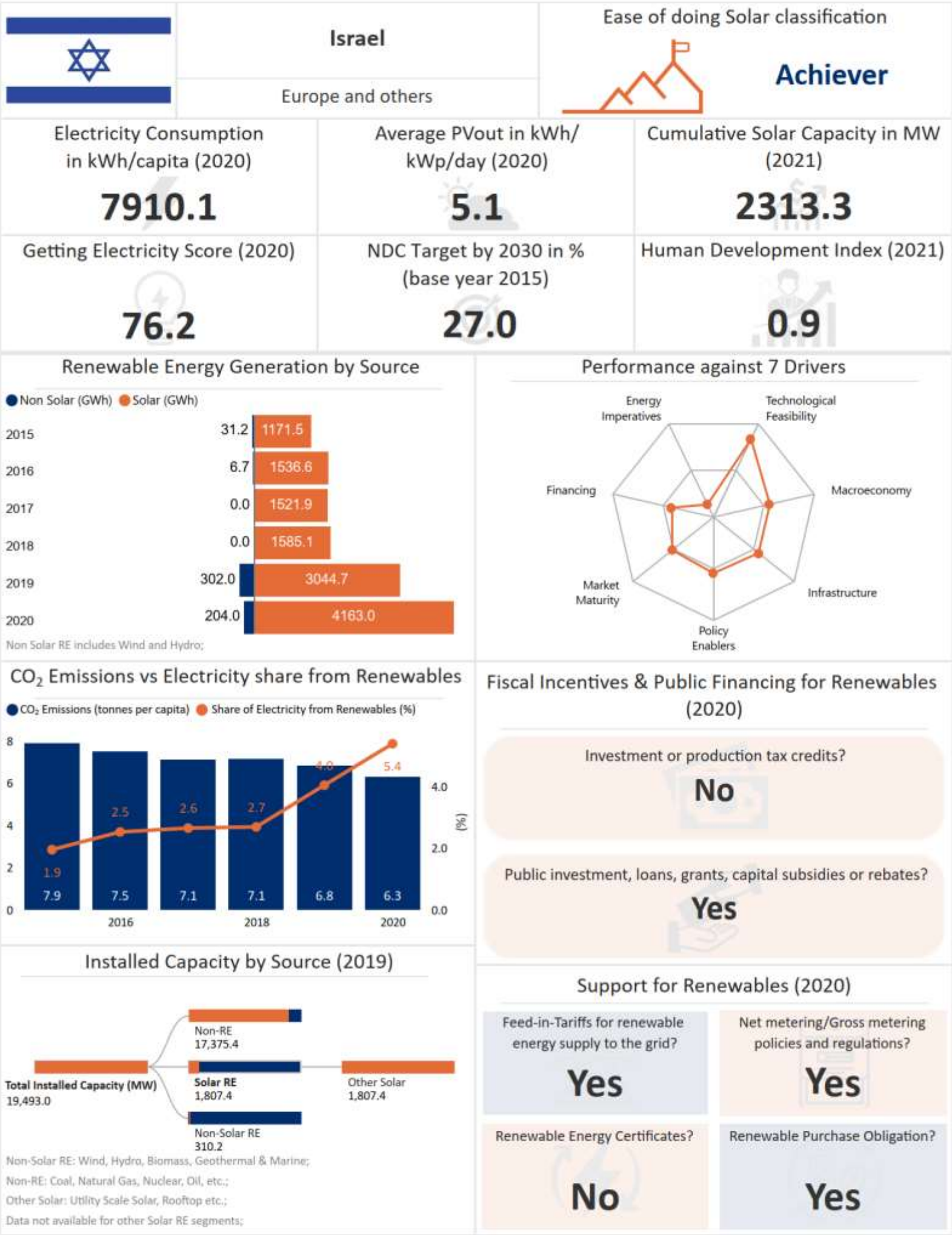
Financing

- The Asian Development Bank (ADB) has signed an agreement to invest USD 15 Mn in Avaada Energy Private Limited (AEPL) to help the company to scale up PV solar energy generation capacity in India.²⁴
- The World Bank Board approved USD 165 Mn in additional financing to support India's residential sector to adopt rooftop solar systems and make solar energy more affordable in 2022.²⁵
- IREDA has achieved the highest-ever loan sanction of Rs. 23,921.06 Cr in FY 2021-2026 and foreign investments in India stood at USD 1.6 Bn in the RE sector.²⁷



Energy Imperatives

- As of 2021, coal dominates the total installed capacity of with a share of 56%, followed by solar and hydropower having 10.33% and 10.06% share respectively.²⁸
- The total installed capacity in the country stood at 466 GW as of 2021.²⁸
- The peak demand for electricity in the country reached 1.37 TWh in 2021.²⁹



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Israel is a high-income country with a GDP per capita (PPP) of USD 43,451 in 2021.¹
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 2.2% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 8.2%.²
- The inflation rate (CPI) of Israel has increased to 1.5% in 2021 from -0.6% levels in 2020.³
- The general government gross debt to GDP has declined to 68.9% in 2021 from 71.7% levels in 2020.⁴



Policy enablers

- Israel launched Israel 2030 Energy Goals, which focusses on the country's plan to stop using coal as an energy source by 2030 and replace it with natural gas and solar with a share split of 70% and 30% respectively.⁵
- In 2018, the Israel government came up with a scheme for rooftop solar under which ~1.6 GW capacity is estimated to be deployed over a period of 3 years with a net metering facility up to 15 KW.⁷



Technological Feasibility

- Israel receives very high levels of solar irradiation (GHI) of 5.7 kWh/m²/day and specific yield 5.1 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁹
- The BIRD Energy program of Israel and US have awarded a grant to Fright Energy of Hod Hasharon, Israel and Solaria of California, USA to develop a solution to optimize process of energy storage and consumption and trading through local grid.¹⁰
- Israeli Public Utility Authority had come up with two tenders held in 2020 for solar-plus-storage. The first one was of 168 MW with 672 MWh of battery storage and the other 600 MW with ~2,400 MWh of battery energy storage system.¹²



Market Maturity

- 100% of the population in Israel is having access to electricity since 2020.¹³
- Israel's National Electricity Authority (PUA) regulates the provisions and supervises public services in the field of electricity distribution.¹⁴
- The Israel Electric Corporation Ltd (IECL) is a public and government-owned company that carries out the generation, transmission, distribution, sale and supply of electricity in the country.¹⁵



Infrastructure

- In Israel, transmission network comprises of about 760 ckm of 400 kV, 4,525 ckm of 161 kV and about 100 ckm of 115 kV with 147 sub-stations and around 48,100 transformers.¹⁶
- IECL, in its five-year (2022-2026) procurement plan, is planning to spend USD 2.5 Bn across transformers, switchgear, protection systems, zero-point earthing equipment, D.C. equipment, power cables, towers, insulators etc.¹⁷



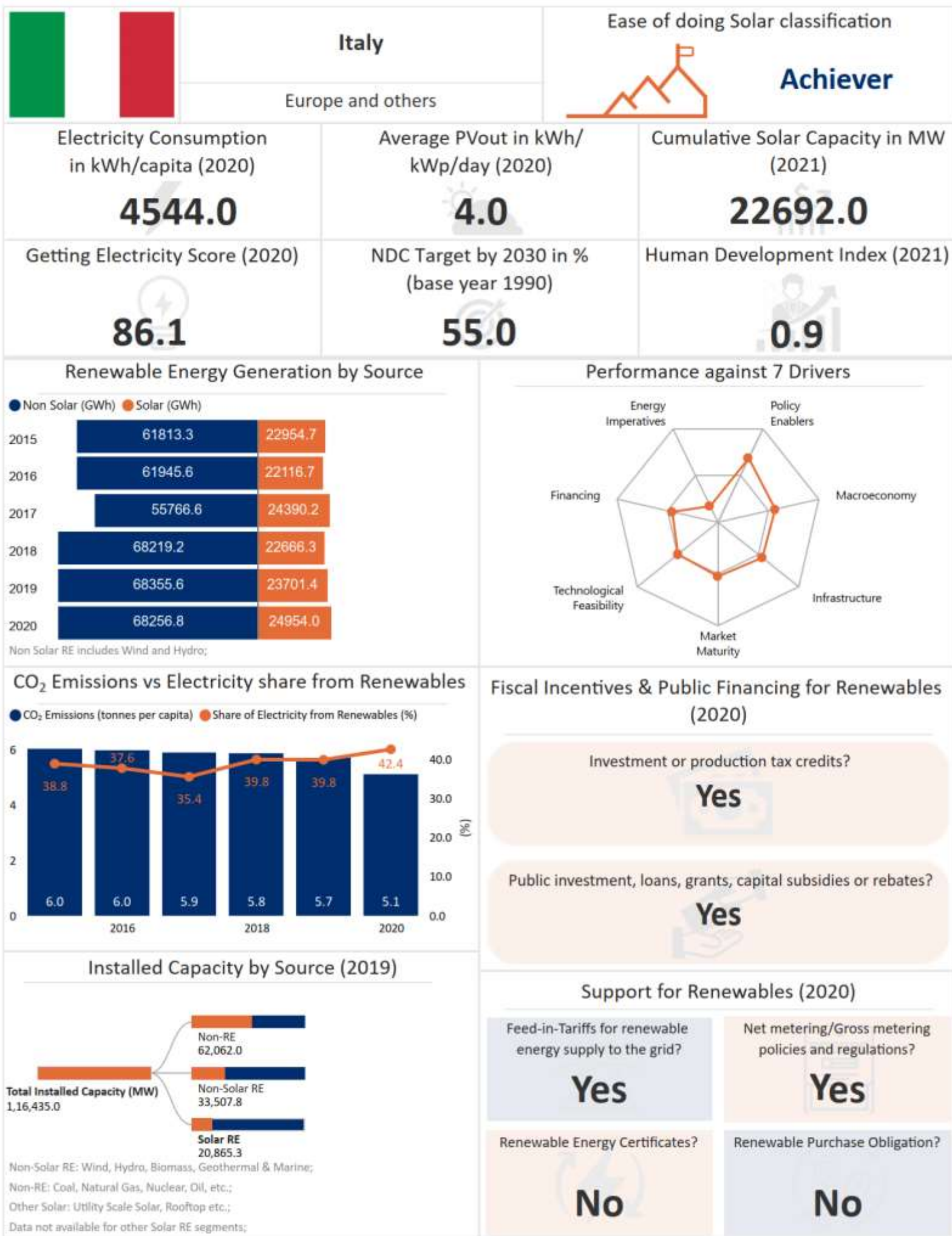
Financing

- Israel's finance and energy ministries are investing about USD 29 Mn to fund energy efficiency and renewable energy projects in government assets.¹⁸
- The U.S. Department of Energy (DOE) and Israel's Ministry of Energy (MoE) along with the Israel Innovation Authority is planning to invest USD 5.48 Mn in six clean energy projects.¹⁹
- In 2021, an Israeli venture capital fund launched a USD 100 Mn sustainability fund to meet the SDG goals.²⁰

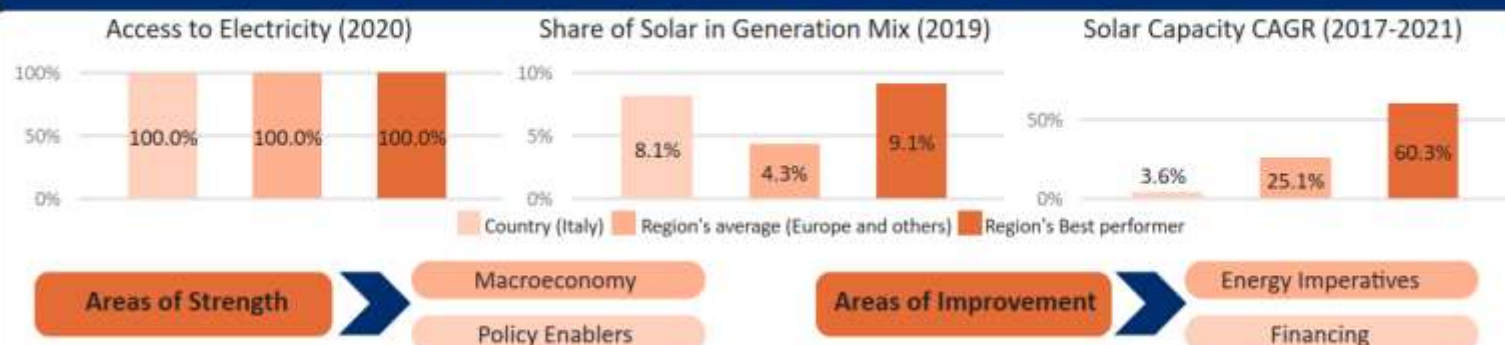


Energy Imperatives

- In 2020, Israel's per capita electricity consumption stood at 7.91 MWh which is more than 2 times higher in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 23.9% between 2017-2021 reaching 2,313 MW in 2021 from 982 MW in 2017.²¹
- The peak demand for electricity in the country has increased to 68.43 TWh in 2020 from 67.87 TWh levels in 2019.²²
- In 2021, the total installed capacity in the country reached 20 GW with a significant share coming from gas (65.98%) and coal (27.44%).²²
- The cost of electricity per kWh is US Cent 16.6 for households and US Cent 16.9 for business.²³



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Italy is a high-income country with a GDP per capita (PPP) of USD 46,374 in 2021. ^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 9% in 2020. However, in 2021 it has bounced back by growing at 6.7%. ³
- The inflation rate (CPI) of Italy has increased to 1.9% in 2021 from -0.1% levels in 2020. ⁴
- The general government gross debt to GDP has slightly reduced to 150.9% in 2021 from 155.3% levels in 2020. ⁵



Policy enablers

- Italy has targeted to reduce its carbon emissions to around 60% by 2030 from 1990 levels. ⁶
- Italy's National Energy and Climate Plan has set targets to achieve renewable energy contribution to 30% in total energy consumption by 2030. ⁷
- Italy's National Recovery and Resilience Plan (2021) has set 5 objectives: increase energy from renewable sources, improvement in digitalisation of the electricity grid, production-distribution of hydrogen, sustainable transport and R&D in clean transition. ⁸



Technological Feasibility

- Italy receives moderate solar irradiation (GHI) of 4.1 kWh/m²/day and specific yield 4.0 kWh/kWp/day indicating a moderate technical feasibility for solar in the country. ⁹
- Italy's Battery energy storage system (BESS) capacity has reached 1,227 MWh in 2022, of which 977 MWh is part of distributed energy storage. ¹⁰
- Triggiano Solar Park in Italy, with a capacity of 99.17 MW developed by Winch Energy, supplies electricity to rural areas through solar mini grids. ¹¹



Market Maturity

- The Italian Regulatory Authority for Energy, Networks and Environment (ARERA) is the agency responsible for carrying out regulatory and supervisory activities for electricity, gas, and water sector. ¹²
- Terna is responsible for transmission of electricity through high and extra-high voltage power grid all over Italy. ¹³
- Gestore dei Mercati Energetici S.p.A (GME) is the Italian Power Exchange (IPEX) which operates through a forward physical market (MTE), a market for the trading of daily products (MPEG) with continuous trading mode, a day ahead auction market (MGP), and an intraday auction market (MI). ¹⁴



Infrastructure

- Italy has set a target to expand 40 GW grid connected renewable energy by 2030. ¹⁵
- Italy's transmission network operates at 132 kV/150 kV, 220 kV and 380 kV voltage levels. ¹⁵
- Italy has a total transmission line length of 74,855 kms with 26 cross border interconnection lines. ¹⁶
- Italy has cross border transmission lines with Switzerland, Austria, Slovenia, and France. ¹⁷



Financing

- The Italian government has proposed to invest USD 5.86 Bn in RE projects which is a part of its National Resilience and Recovery Plan. ¹⁸
- For the expansion of transmission lines in Italy, Terna would invest Euro 18 Bn. ¹⁵
- The EIB has invested USD 48.9 Mn in RE under its Green Developer Financing Programme in Tuscany, Italy. ¹⁹
- The Council of Europe Development Bank (CEB) and Italy's multi-utility company IREN S.p.A. have signed a USD 79.9 Mn loan to augment the use of green energy in metropolitan area of Turin in Italy. ²⁰



Energy Imperatives

- In 2020, Italy's per capita electricity consumption stood at 4.54 MWh which is comparatively higher to the global average of 3.31 MWh. ²¹
- The total installed capacity of Solar PV witnessed a CAGR of 3.6% reaching 22,692 MW in 2021 from 19,682 MW levels in 2017. ²²
- In 2021, the total installed capacity in the country reached 116.98 GW with a significant share coming from gas (49.68%), followed by hydro (15.8%), solar (8.94%), wind (7.38%), bioenergy (7.01%), coal (5.01%), fossil fuel based (4.39%) and other renewables (2.08%). ^{23, 24}



Jamaica

Latin America & Caribbean

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

1565.7

Average PVout in kWh/
kWp/day (2020)

4.4

Cumulative Solar Capacity in MW
(2021)

92.5

Getting Electricity Score (2020)

65.0

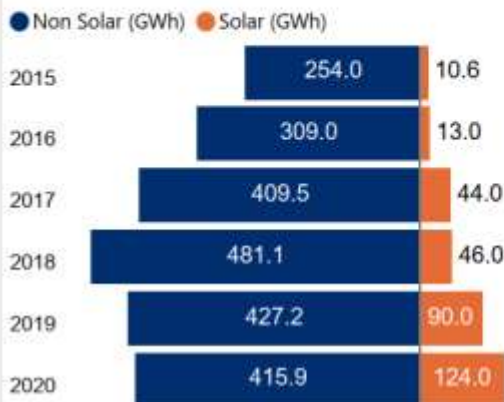
NDC Target by 2030 in %
(base year 2005)

25.4

Human Development Index (2021)

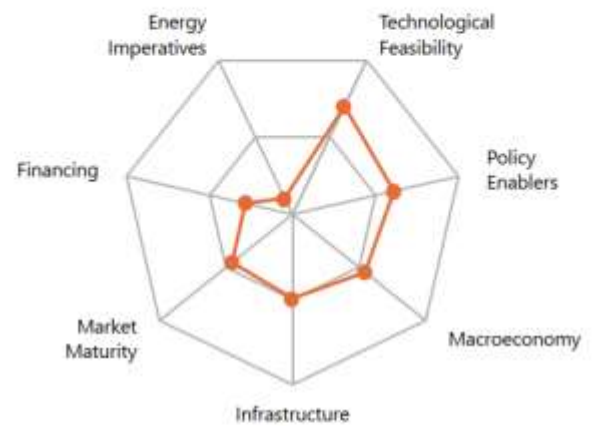
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Renewable Energy Generation by Source

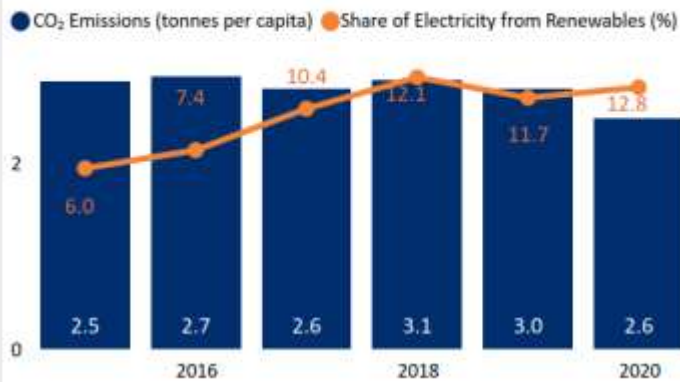


Non Solar RE includes Wind and Hydro;

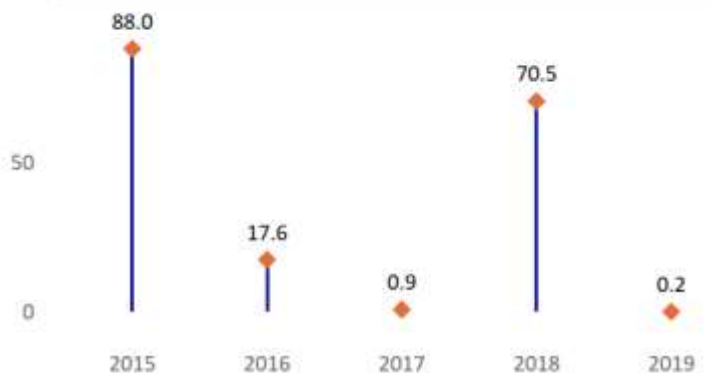
Performance against 7 Drivers



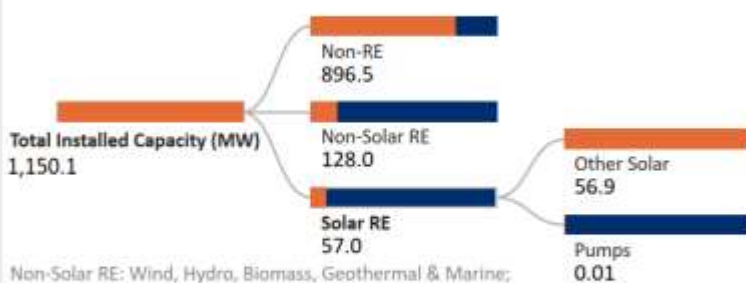
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Jamaica is an upper middle-income country with a GDP per capita (PPP) of USD 10,543 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) contracted by 10.0% in 2020. However, in 2021 it has bounced back recording an annual growth rate of 4.6%.¹
- The inflation rate (CPI) of the country has increased to 5.9% in 2021 from 5.2% levels in 2020.¹
- The general government gross debt to GDP has eased to 92.3% in 2021 from 108.1% levels in 2020.¹



Policy enablers

- By 2030, the country aims to achieve a 50% share of RE based electricity in the generation mix.⁸
- To promote the development of RE in the country several incentives such as tax exemptions, interconnection standards, net metering and green public procurement have been implemented in the country.⁶



Technological Feasibility

- Jamaica receives high levels of solar irradiation (GHI) of 5.2 kWh/m²/day and specific yield 4.4 kWh/kWp/day indicating high technical feasibility for solar in the country.³
- In 2021, 10.7% of the country's power demand was met through RE sources (excluding large hydro).⁴
- The country is highly dependent on imported fossil fuels for generation of electricity thus making it susceptible to fluctuating oil prices.⁴



Market Maturity

- 97.5% of the population in Jamaica had access to electricity since 2020.²
- The Office of Utilities Regulation (OUR) regulates the energy sector in the country.⁶
- Jamaica Public Services Company Limited is responsible for the generation, transmission, and distribution of electricity in the country.⁷



Infrastructure

- The national grid operates at a frequency of 50 Hz with voltage levels ranging from 110 V to 69 kV.⁷
- For Jamaica, challenges associated with RE variability can be minimized by upgrading the grid infrastructure with higher-voltage transmission lines and better operating & forecasting.¹⁰



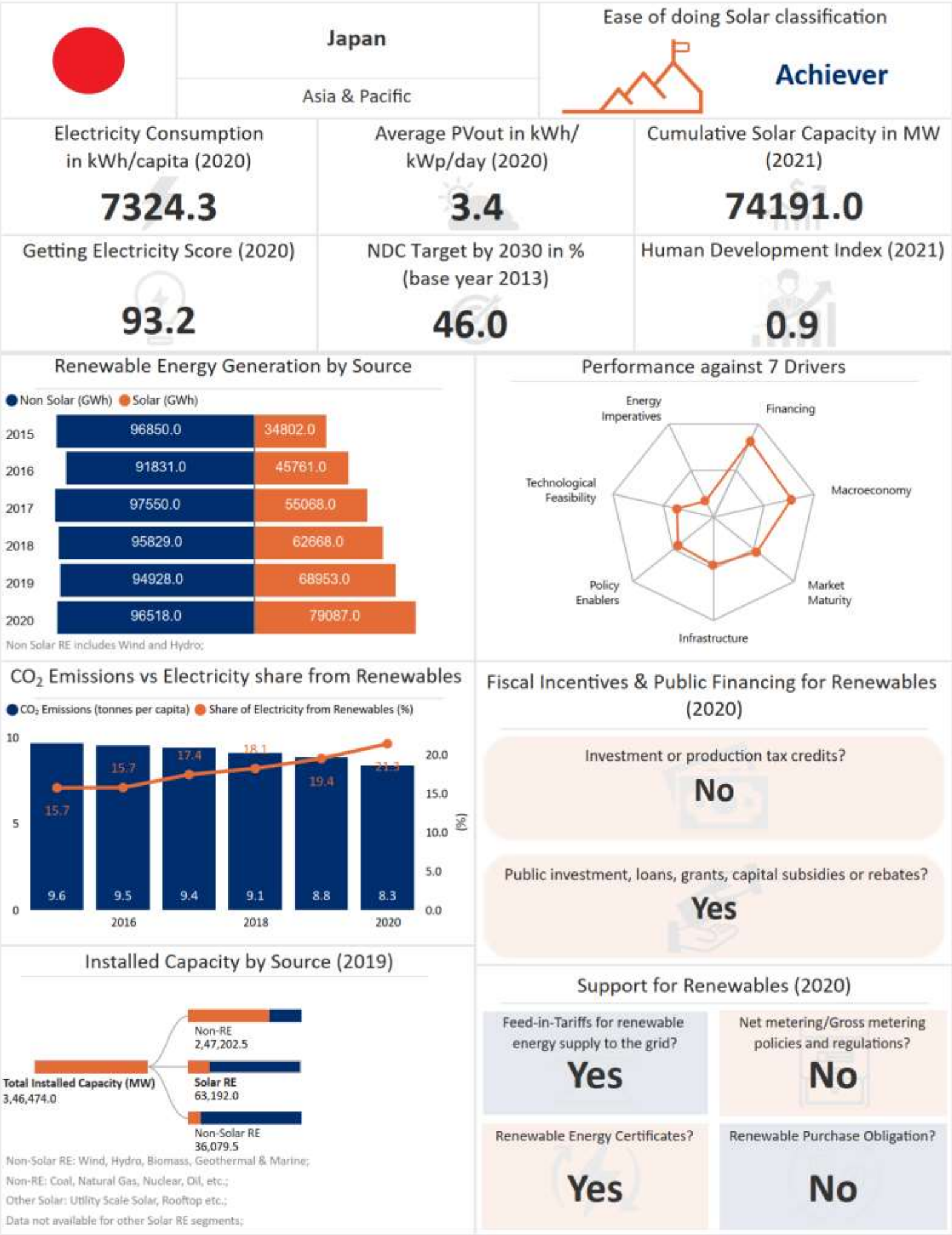
Financing

- The Development Bank of Jamaica (DBJ) maintains many credit lines to enable private banks to provide funding for RE projects.⁷
- The Inter-American Development Bank in 2021 has provided USD 24.3 Mn loan to Soleco Energy Limited for development of solar PV power plant in the country.⁹



Energy Imperatives

- In 2020, Jamaica's per capita consumption stood at 1.36 MWh which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The total installed capacity of Solar PV witnessed a CAGR of 13.6% reaching 92.5 MW in 2021 from 55.5 MW levels in 2017.⁴
- The peak demand for electricity in the country has remained constant at 4.02 TWh in 2021 and 2020.⁴
- In 2021, the total installed capacity in the country stood at 1.26 GW with a significant share coming from oil (47.6%), gas (32.5%) followed by wind (7.9%) and solar (7.1%).⁴



| Threshold for licensing Solar Power in MW (2021) | Solar PV Project Capital Cost in USD/MW (2021) | Daylight hours/day |
|--|--|--------------------|
| < 1.0 | 1.7 Million | 5.0 |



| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | No |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | Yes |
| Generation based incentives for Renewable energy generation | Yes |
| Revenue Based Incentives for Renewable energy generation | No |

| Policies/Schemes for Solar Segments (2021) | | | Support for Renewables (2021) | |
|--|---------------------|--------------------------|---|-----|
| Rooftop Solar | Utility scale solar | Battery waste management | Renewable Generation Obligations (RGO) | No |
| | | | Manufacturing facility for solar equipment (inverters and balance of systems) | Yes |
| Yes | Yes | No | Government Trainings/certifications for Human Resource focusing on Solar industry | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Japan is a high-income country with a GDP per capita (PPP) of USD 42,140 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 4.6% in 2020. However, in 2021, the GDP has bounced back recording an annual growth rate of 1.7%.³
- The inflation rate (CPI) of Japan has decreased by 0.2% in 2021 from 0% levels in 2020.³
- The general government gross debt to GDP has reached 262.5% in 2021 from 259.4 % levels in 2020.⁴



Policy enablers

- According to Japan's country report 2021, renewable energy contributes to 6% of its total energy supply.⁵
- Japan has set a target to achieve an energy mix by 2030 with 36%-38% share from RE, 1% from hydrogen, 20-22% from nuclear (no change), 20% from LNG (down from 26%), and 2% from oil (down from 3%).⁶
- Japan aims to move towards hydrogen economy. It is one of the key factors for decarbonization and is listed as one of the 14 key sectors of Japan's Green Growth Strategy.⁷



Technological Feasibility

- Japan receives moderate solar irradiation (GHI) of 3.6 kWh/m²/day and specific yield 3.4 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.⁸
- Japan has shown significant momentum in the EV charging space with more than 29,885 charging stations.¹⁰
- The Nishi-Sendai Substation Battery Energy Storage System (BESS) is a 40 MWh energy storage project located in Sendai, Miyagi and is based on lithium-ion storage technology.¹¹



Market Maturity

- 100% of the population in Japan is having access to electricity since 2020.¹³
- The Ministry of Economy, Trade, and Industry (METI) is responsible for developing and enforcing Japan's renewable energy laws and regulations, including the Feed-in Tariff system (FIT) to encourage RE development.¹⁴
- Japan Electric Power Exchange (JEPX) provides three types of markets, i.e., a spot day-ahead market, a forward fixed-form market to trade electricity and a forward bulletin board market as a place for free transactions.¹⁵
- TEPCO Power Grid is responsible for handling nearly one-third of all the power supplied in Japan.¹⁶
- In 2020, a cabinet decision was taken in the Electricity Business Act for procurement of electricity from RE.¹⁹



Infrastructure

- Japan's transmission network comprises about 38,315 km of transmission lines ranging between the 110 kV to 500 kV and 250 kV DC voltage levels.¹⁷
- Japan operates at two frequency that is 50 Hz and 60 Hz in eastern and western Japan respectively.¹⁸
- The Japanese government has partnered with the Japan International Cooperation Agency (JICA) to implement a USD 200 Mn electricity transmission expansion programme in Lagos and Ogun states.¹⁹
- Fujitsu and Chugoku Electric Power T&D has done a joint trial to expand the use of RE and improve maintenance of power transmission infrastructure.²⁰



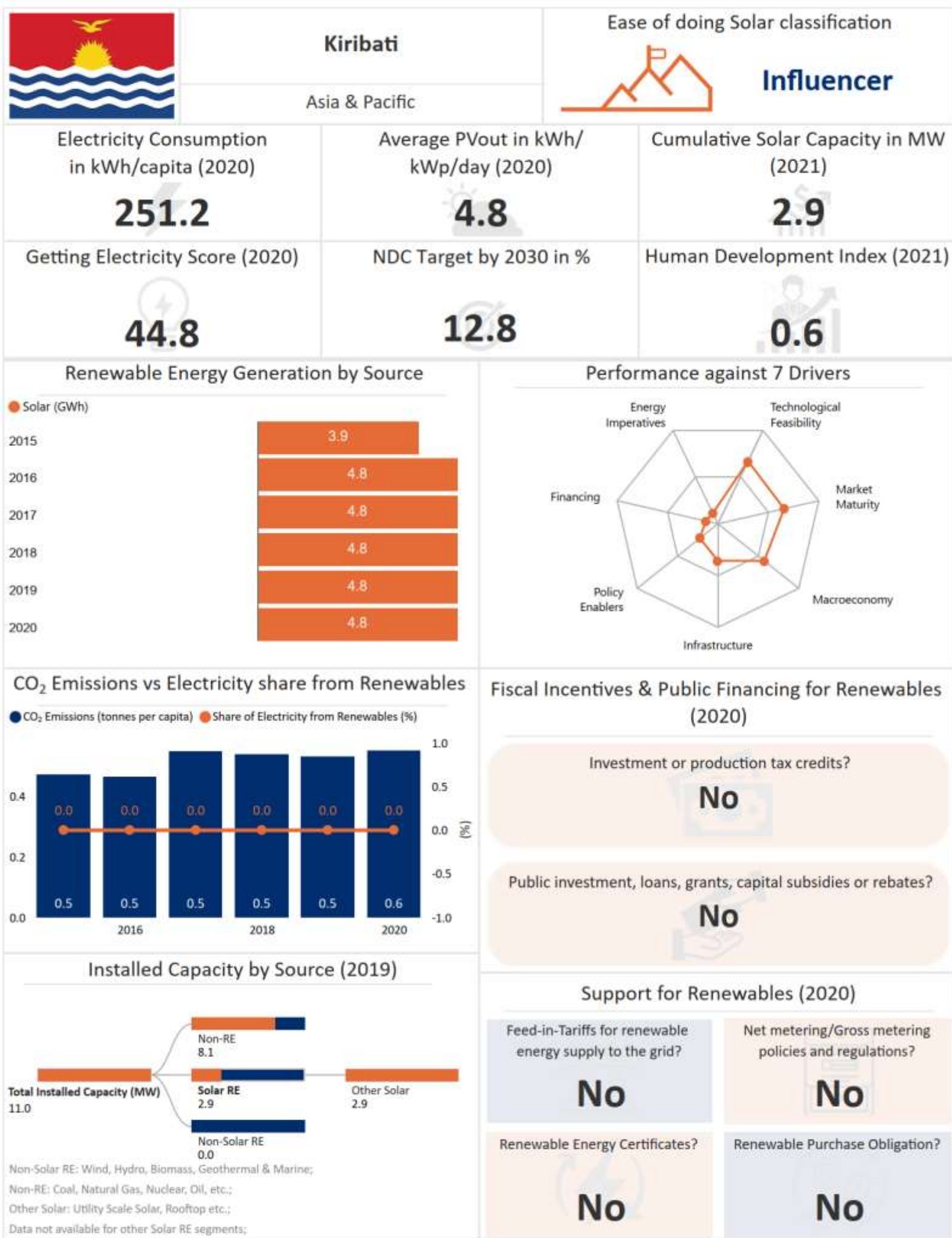
Financing

- Renewable Energy Investment Japan is the investment agency for renewables in the country.²¹
- Shinsei Bank is among the licensed financial institutions in Japan for arranging finance in solar power generation.²²
- The Asian Development Bank (ADB) and Japan's Ministry of Economy, Trade, and Industry (METI) have signed a Memorandum of Cooperation (MOC) to enhance their joint efforts to promote clean energy in Southeast Asia.²³



Energy Imperatives

- In 2020, Japan's per capita consumption stood at 7.32 MWh which is more than 2 times higher in comparison to the global average of 3.31 MWh.²⁴
- The total installed capacity of Solar PV witnessed a CAGR of 10.7% between 2017-2021 reaching 74,191 MW in 2021 from 49,500 MW in 2017.²⁵
- In 2021, the total installed capacity stood at 360 GW with a significant share coming from coal (32.77%), gas (35.40%), nuclear (6.02%), hydro (8.32%), solar (8.98%) and wind (0.94%).^{26, 27}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Kiribati is a lower middle-income country with a GDP per capita (PPP) of USD 2,128 in 2020.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 0.5% in 2020. However, in 2021, the GDP bounced back with an annual growth rate of 1.5%.³
- The inflation rate (CPI) of Kiribati has increased to 3% in 2021 from 2.5% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 17.6% in 2021 from 19% levels in 2020.⁵



Policy enablers

- Kiribati government in association with Global Environment Fund is promoting RE through "Promoting Outer Island Development through the Integrated Energy Roadmap" (POIDIER) Project.⁶
- The government of Kiribati in its Kiribati Integrated Energy Roadmap (KIER) has envisaged their goal of reducing usage of fossil fuels by 2025 in South Tarawa, Kiritimati and outer islands by a share of 23%, 40% and 40% respectively.⁷
- Kiribati's Energy Efficiency-Supply Side Management (EESM) initiatives has projected to reduce auxiliaries, technical and non-technical losses by 1.81%, 3.12% and 4.75%, respectively by 2025 with estimated saving of 2,033 MWh.⁷



Technological Feasibility

- Kiribati receives very high levels of solar irradiation (GHI) of 6.1 kWh/m²/day and specific yield 4.8 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁸
- Under Kiribati's Kiritimati Renewable Energy Program a 150 kW of ground mounted solar plant was commissioned in 2018.⁹
- Kiribati with its project on "Scaling-up Renewable Energy Program Investment Plan" has set up solar micro grid with a capacity 36.5 kW and coupled with battery storage of 346 kWh.¹⁰



Market Maturity

- 92% of the population in Kiribati had access to electricity as of 2020.¹¹
- The Ministry of Public Works and Utilities (MPWU) is responsible for the planning, management and coordination of the energy sector.¹²
- The Kiribati Solar Energy Company (KSEC), an incorporated company majority owned by the Government, is responsible for renewable energy, particularly sale or lease of solar PV systems and relevant components.¹²
- The Ministry of Lines and Phoenix is responsible for all government services including the development of power, electrification and transmission in Kiritimati Island.¹²
- The Energy Planning Unit (EPU) is responsible for coordinating the implementation of energy policies and providing necessary advice and assistance to all energy activities and energy-related matters.¹²



Infrastructure

- The Kiribati Electricity system is operated by the Ministry of Line and Phoenix Island Development which is divided into 3 parts, i.e., South Tarawa, Kiritimati Island and Outer Islands having several isolated grids under operation.¹³
- Kiribati Integrated Energy Road Map (KIER) has implemented installation of SCADA and Energy Management System to optimise the grid integration of RE.¹³



Financing

- The Climate Investment Funds (CIF) through its Scaling up Renewable Energy Program (SREP) has invested USD 0.5 Mn in the country.¹⁴
- The World bank had coordinated USD 1 Mn grant from GEF and USD 2.92 Mn grant from the Government of Australia through the Pacific Regional Infrastructure Facility (PRIF) for Kiribati Grid Connected Solar PV Project.¹⁵



Energy Imperatives

- In 2020, the per capita consumption of electricity is 0.25 MWh, which is significantly lower as compared to the global average of 3.31 MWh.¹⁶
- The demand for electricity in the country in 2021 stood at 0.03 TWh remaining the same as the previous year's.¹⁸
- In 2021, the total installed capacity in the country has reached 7 MW with almost 100% share coming from fossil fuels.^{18, 26}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Liberia is a low-income country with a GDP per capita (PPP) of USD 1,564 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 4.2% in 2021 and it is estimated to increase by 4.5% in 2022. ³
- The inflation rate in the country declined to 8.0% in 2021 from 17% levels in 2020. ⁴
- Total public debt in the country increased to 54.7% of GDP in 2021 from 47.9% levels in 2020 reflecting increased borrowing. ⁴



Policy enablers

- The Ministry of Mines & Energy (MME) is the statutory agency that is responsible for policy formulation in the energy sector of the country. ⁵
- The 2015 Electricity Law of Liberia established the legal and regulatory framework for the generation, transmission, distribution, and sale of electricity within Liberia. ⁶
- The Rural and Renewable Energy Agency (RREA) is responsible to accelerate the economic transformation of rural Liberia by promoting commercial development and supply of modern energy products and services to rural areas. ⁷



Technological Feasibility

- Liberia receives high levels of solar irradiation of 4.8 kWh/m²/day and a specific yield of 3.9 kWh/kWp/day indicating a strong technical feasibility for solar in the country. ⁸
- Liberia receives an average of 1,662 hours of sunlight per year. It is sunny 37.9% of daylight hours while 62.1% of daylight hours are likely cloudy or with shade, haze, or low sun intensity. ⁹
- In June 2017, five remote communities in Liberia that got solar minigrid as part of the project 'Light Up Our Futures' funded by EU. ¹⁰



Market Maturity

- 27.5% population in Liberia had access to electricity as of 2020. ¹¹
- The Liberia Electricity Corporation (LEC) is a public utility entity with a mandate to produce and supply electric power to the entire nation. ¹²
- Liberia Electricity Regulatory Commission (LERC) functions as the regulator that issue licenses, approve tariffs, ensure liberalization of the sector, and ensure a vibrant electricity sector. ¹³
- Liberia is a member of the West African Power Pool (WAPP), which aims to integrate the national power systems into a unified regional electricity market. ¹⁴



Infrastructure

- Liberia West Africa Power Pool (WAPP) transmission project plans to interconnect Ivory Coast, Liberia, Sierra Leone and Guinea through a 225 kV transmission line. ¹⁵
- Liberia Accelerated Electricity Expansion Project (LACEEP) entails the construction of 66/33 kV sub-station in Kakata, expansion of the existing 66/22 kV sub-station in Paynesville, and construction of distribution lines in communities in Paynesville and Kakata. ¹⁶




Financing

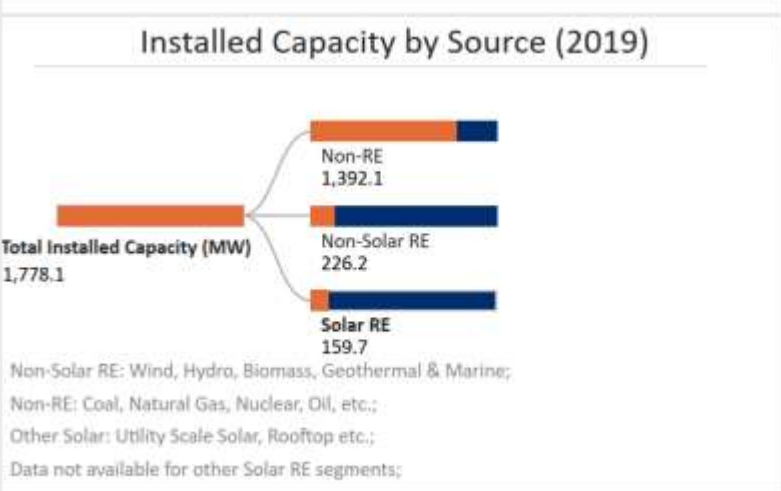
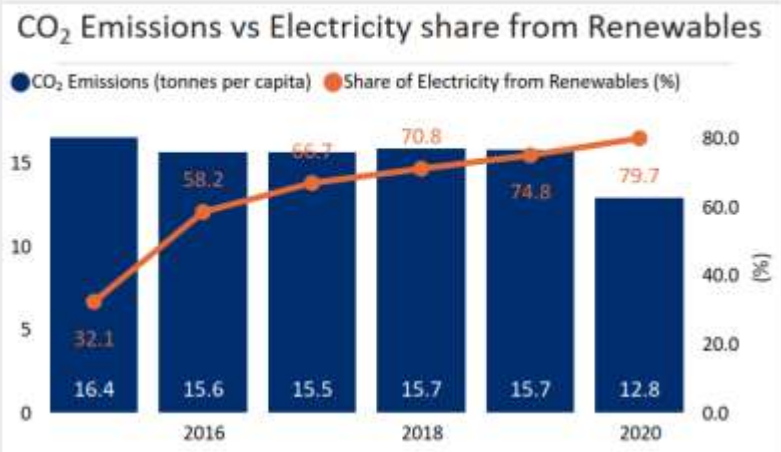
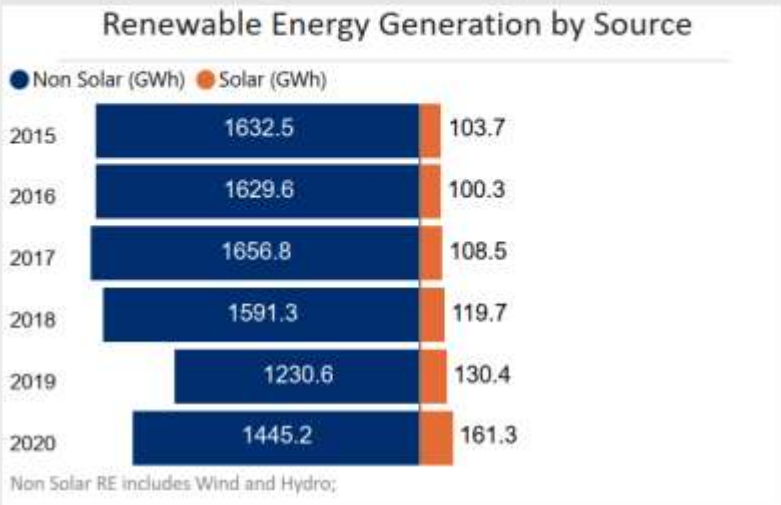
- The Liberia Electricity Sector Strengthening and Access Project (LESSAP) is the first project of a Multi-phase Programmatic Approach (MPA) where USD 180 Mn in IDA support is planned. ¹⁷
- The Climate Investment Funds (CIF) awarded Liberia a grant of USD 23.25 Mn to help transform country's RE sector. ¹⁸



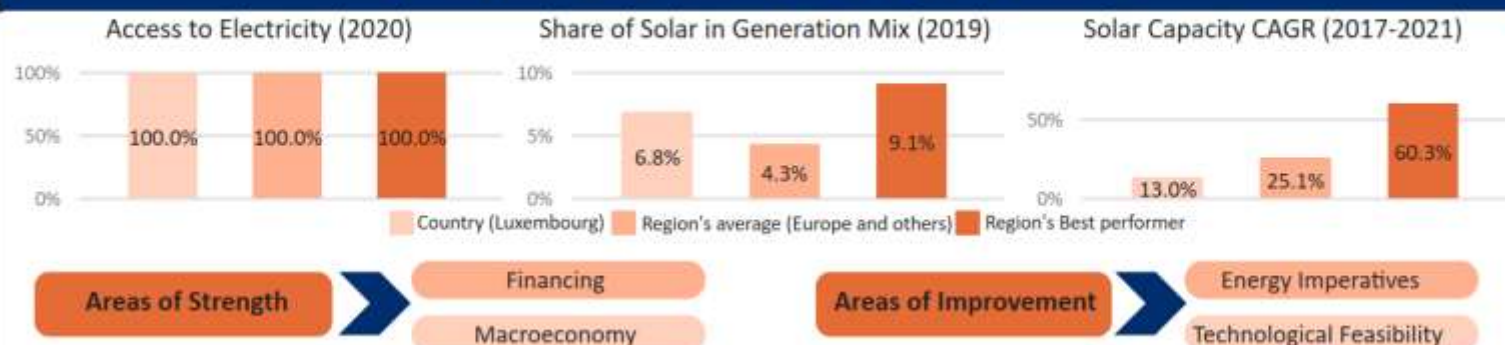
Energy Imperatives

- The total installed capacity in the country stood at 195 MW in 2019. ¹⁹
- The total installed capacity of Solar PV witnessed a CAGR of 1.8% between 2017-2021 reaching 2.6 MW in 2021 from 2.4 MW levels in 2017. ²⁰
- In 2020, the per capita electricity consumption stood at 0.18 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ²¹
- The price of electricity in the country was 39 US Cents/kWh as of 2019. ²²

| | | |
|---|--|---|
| <div> <div></div> <div>Luxembourg</div> </div> | | Ease of doing Solar classification |
| <div> <div></div> <div>Europe and others</div> </div> | | <div>  <div>Influencer</div> </div> |
| Electricity Consumption in kWh/capita (2020) | Average PVout in kWh/kWp/day (2020) | Cumulative Solar Capacity in MW (2021) |
| 1958.4 | 2.9 | 208.6 |
| Getting Electricity Score (2020) | NDC Target by 2030 in % (base year 1990) | Human Development Index (2021) |
| 84.3 | 55.0 | 0.9 |



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Luxembourg is a high-income country with a GDP per capita (PPP) of USD 133,330 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 1.8% in 2020. However, in 2021 GDP has bounced back by growing rate at 6.9%.³
- The inflation rate (CPI) of Luxembourg has increased to 3.5% in 2021 from 0.1% levels in 2020.⁴
- The general government gross debt to GDP has marginally decreased to 24.3% in 2021 from 24.8% levels in 2020.⁵



Policy enablers

- Luxembourg has set an ambitious target to reduce GHG emissions to 50-55% by 2030 from 2005 levels, and achieve a carbon neutral economy by 2050.⁶
- Luxembourg has adopted a draft Grand-Ducal regulation extending the 'Clever fueren' financial aid scheme until March 2022 to promote e-vehicles, hydrogen fuel cells and hybrid vehicles.⁷
- Luxembourg's National Energy and Climate Plan (NECP) has set an objective of achieving a 23-25% contribution from RE in the gross energy consumption by 2030.⁸



Technological Feasibility

- Luxembourg receives moderate solar irradiation (GHI) of 3.0 kWh/m²/day and specific yield 2.9 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.⁹
- Firm ArcelorMittal Differdange has installed floating solar projects in Luxembourg capable of generating 3 GWh of electricity annually and catering the demand for about 3,200 people.¹⁰
- Luxembourg had targeted to achieve 95% of electricity meters to be smart meters by the end of 2019 to allow consumers to become a prosumer.¹¹



Market Maturity

- The Institut Luxembourgeois de Régulation (ILR) is Luxembourg's regulatory authority that regulates the transmission and distribution of electricity and natural gas.¹³
- In Luxembourg EPEX SPOT is the leading exchange for providing a platform to buy, sell, trade electricity, secure transactions, and facilitate auction services.¹⁴
- Luxembourg's Creos Luxembourg S.A. is the transmission system operator (TSO) and the largest distribution system operator (DSO) operating in the country.¹⁵



Infrastructure

- Luxembourg has a strong transmission network comprising a total length of 9,783 kms of transmission network with voltage levels (220 kV, 65 kV and 20 kV).¹⁶
- Luxembourg has 2,657 transformer sub-stations capable of handling almost 5,132 GWh of energy for approximately 2,70,000 customers.¹⁶
- Luxembourg has cross border electricity trading arrangements with Germany and Belgium.¹⁶



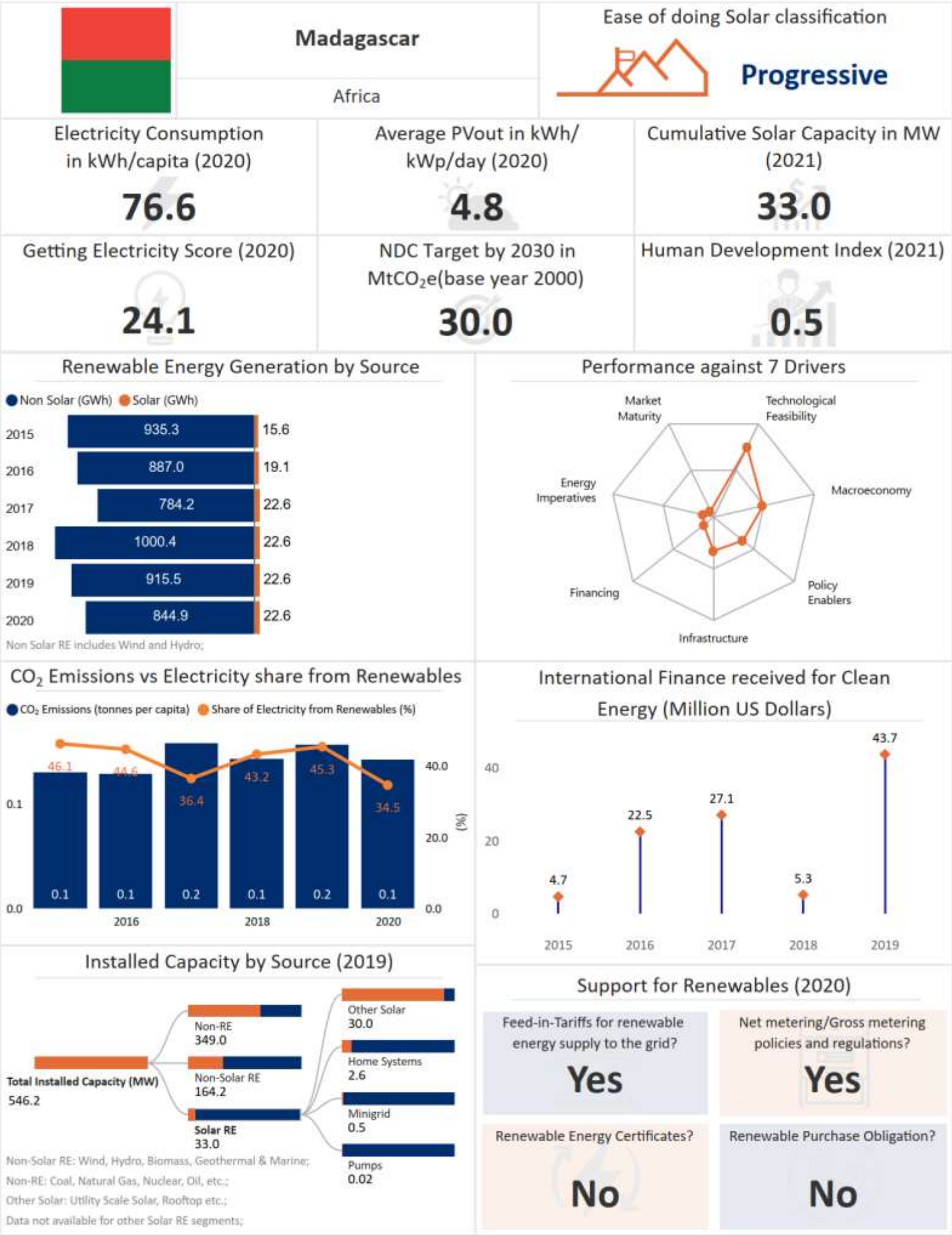
Financing

- Luxembourg Stock Exchange has 133 green bonds worth USD 62.9 Bn which are entirely dedicated to green, social, and sustainable financial instruments.¹⁷
- Luxembourg government and the EIB have created new channels of private investments to provide financing for the climate and environmental emergency.¹⁸

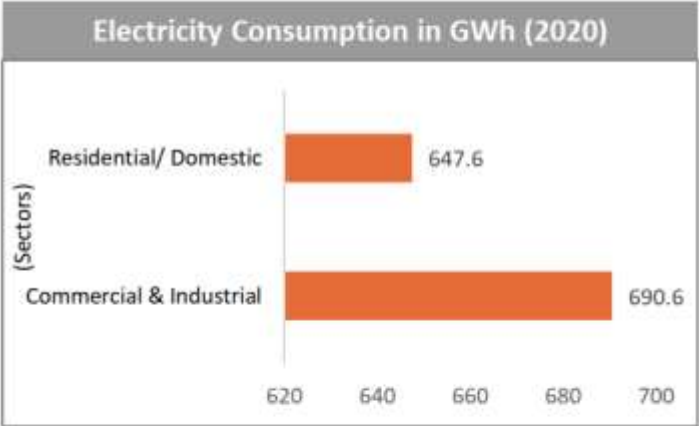
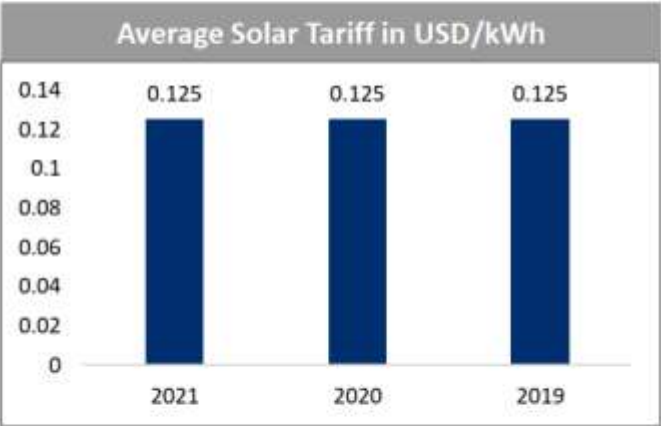


Energy Imperatives

- In 2020, Luxembourg's per capita electricity consumption stood at 1.95 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.¹⁹
- In 2021, the total installed capacity in the country stood at 1.83 GW with a significant share coming from bioenergy (27.61%) followed by wind (25.37%), solar (17.91%), gas (14.93%), hydro (8.96%) and fossil fuel based electricity (5.22%).^{21, 22}
- The cost of electricity per kWh is US Cent 21.8 for households and US Cent 12.9 for business.²³



| Peak Demand/Load in GW (2020) | Cheapest Source of Power (2021) | Generation Cost for Hydro Power in USD/kWh (2021) |
|-------------------------------|---------------------------------|---|
| 6.7 | Hydro | 0.04 |

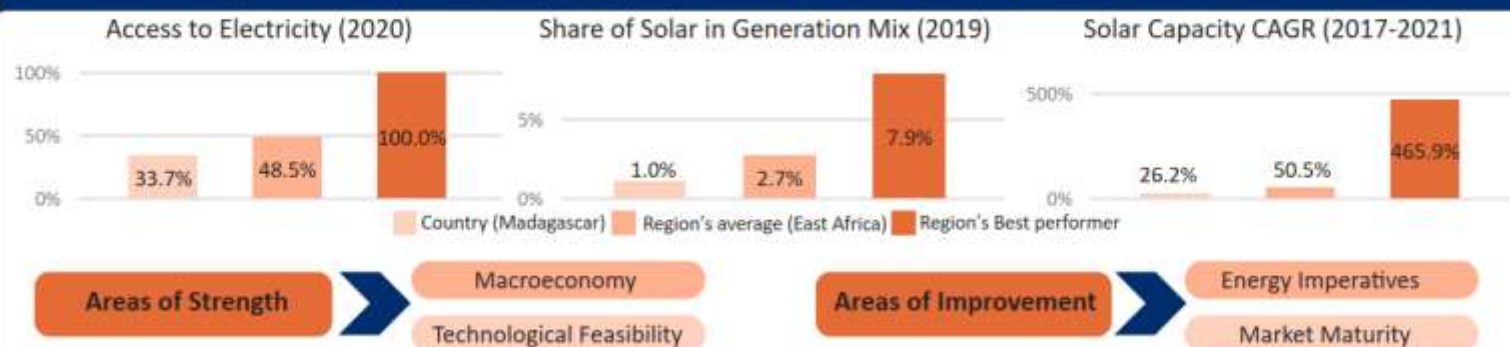


| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | Yes |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| Yes | Yes | Yes | No | Yes | No | Yes | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | No |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Madagascar is a low-income country with a GDP per capita (PPP) of USD 1,608 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 3.5% in 2021 and it is estimated to increase by 5.1% in 2022. ³
- The current account deficit increased to 5.5% of GDP in 2021 from 5.1% levels in 2020. ⁴
- The budget deficit in the country widened to 5.4% in 2021 from 4.0% levels in 2020. ⁴



Policy enablers

- Madagascar aims to achieve 85% of the total energy production from RE by 2030. ¹⁶
- Madagascar targets to increase the share of solar to 25% of the energy mix by 2023. ¹⁶
- National Sustainable Energy Fund (FNED) contributes to funding rural and suburban electricity infrastructure development projects based on RE and energy efficiency. ⁶
- The Rural Electrification Agency (ADER) is responsible for promoting access to electricity for the rural population primarily through RE sources. ⁷



Technological Feasibility

- Madagascar receives high levels of solar irradiation of 5.3 kWh/m²/day and a specific yield of 4.8 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁸
- The country typically receives 12 hours of sunlight per day. ¹⁶
- Madagascar receives an average of 2,690 hours of sunlight per year. It is sunny 61.4% of daylight hours and 38.6% of daylight hours are likely cloudy or with shade, haze, or low sun intensity. ⁹
- The UN Environment program is currently active and working on the introduction of electric two and three-wheelers. ¹⁰



Market Maturity

- 33.7% population in Madagascar is having access to electricity since 2020. ¹¹
- The Ministry of Water, Energy, and Hydrocarbons (MEEH) develops and implements policies for the provision of adequate and reliable power supply in Madagascar. ⁷
- The Electricity Regulatory Authority (ORE) is the regulatory body of the electricity sector. ⁷
- JIRAMA (Jiro sy rano Malagasy) is the vertically integrated state-owned water and electricity operator. ⁵
- The average duration or term of Power Purchase Agreements (PPAs) for Solar PV Projects is 15 to 25 years. ¹⁶



Infrastructure

- The Madagascan electrical system has 3 major HV interconnected grids (RI): Antananarivo-Antsirabe (RIA), Toamasina (RIT), and Fianarantsoa (RIF) operated by JIRAMA. ⁶
- Transmission grid coverage in Madagascar is very limited. The network is comprised mainly of 5 kV, 20 kV, 35 kV, 63 kV, 132 kV and 138 kV transmission lines. ^{7, 16}
- The Power Transmission Network Reinforcement and Interconnection Project in Madagascar (PRIITEM-II) entails the construction of a 135 km, 220 kV interconnection line between Antananarivo and Antsirabe. ¹²
- The country's average Transmission and Distribution loss levels are 4% and 10% respectively in 2021. ¹⁶



Financing

- The AfDB approved a USD 43 Mn loan to finance the second phase of the power transmission project (PRIITEM-II) in Madagascar. The financing comprises of a loan of USD 28.6 Mn from the African Development Fund (ADF), and a loan of USD 14.3 Mn from TSF, the Bank's financing mechanism for fragile and transition countries. ¹³
- In 2016, the World Bank approved an International Development Association (IDA) loan worth USD 65 Mn to help the Madagascan Government improve its electricity sector operations. ⁷



Energy Imperatives

- Of the total electricity generation of 18,36,382 MU, solar electricity generation contributed 38,340 MU in 2021. ¹⁶
- The total installed capacity of Solar PV witnessed a CAGR of 26.2% between 2017-2021 reaching 33 MW in 2021 from 13 MW levels in 2017. ¹⁵
- In 2020, the per capita electricity consumption stood at 0.08 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁶
- The average solar tariff in Madagascar is 0.125 USD/kWh in 2021. ¹⁶



Malawi

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

83.1

Average PVout in kWh/
kWp/day (2020)

4.6

Cumulative Solar Capacity in MW
(2021)

141.5

Getting Electricity Score (2020)

45.4

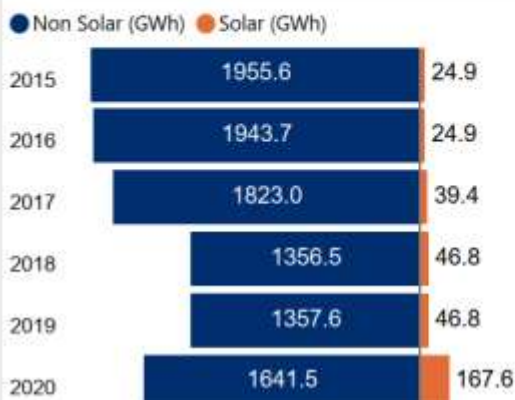
NDC Target by 2040 in %

51.0

Human Development Index (2021)

0.5

Renewable Energy Generation by Source

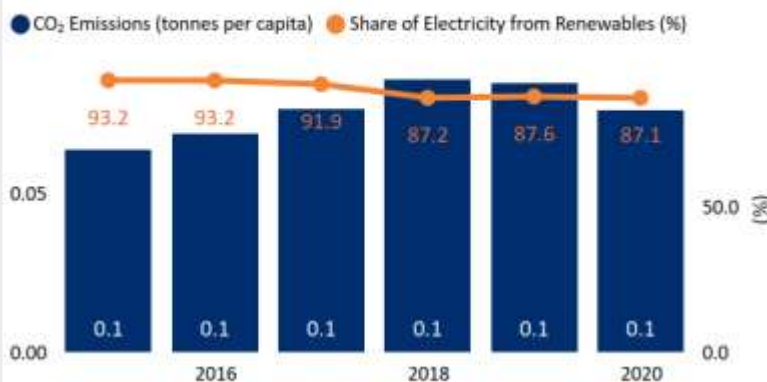


Non Solar RE includes Wind and Hydro;

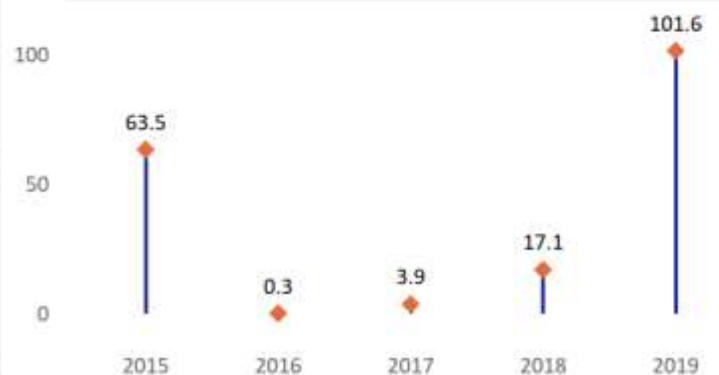
Performance against 7 Drivers



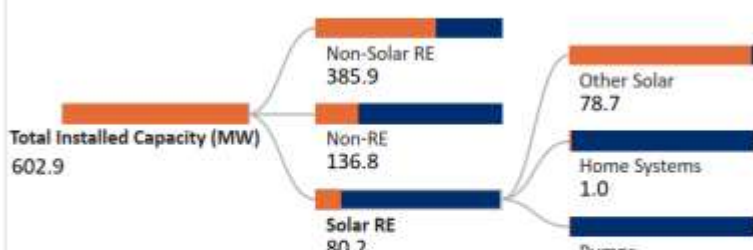
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

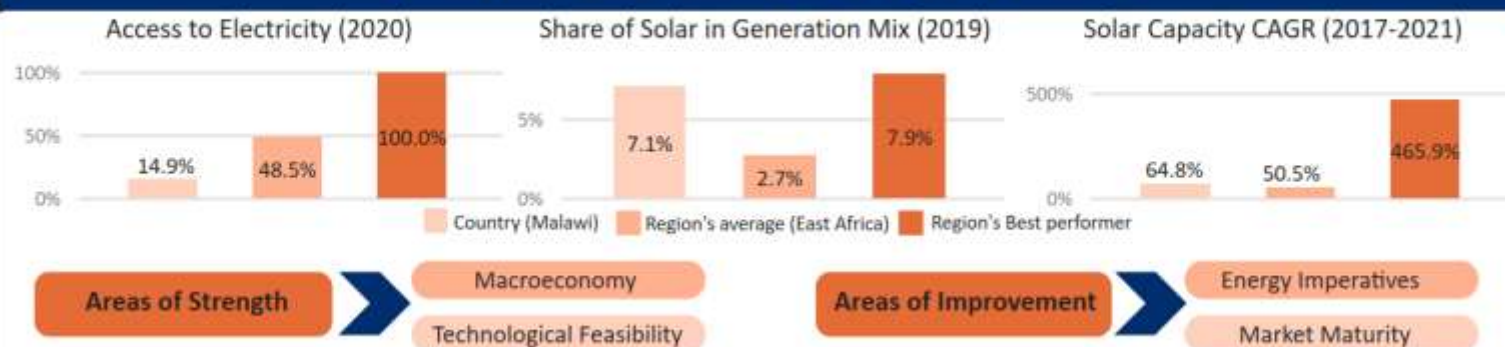
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Malawi is a low-income country with a GDP per capita (PPP) of USD 1,638 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 2.2% in 2021, and it is estimated to increase by 2.7% in 2022. ³
- The inflation rate in the country increased to 9.3% in 2021 from 8.8% levels in 2020. ⁴
- The fiscal deficit stabilized at 7.4% of GDP in 2021 from 9% levels in 2020 financed by debt and grants. ⁴



Policy enablers

- The Ministry of Natural Resources, Energy and Mining is responsible for framing policies, regulations and frameworks in the energy sector. ⁵
- As per the National Energy Policy, Malawi aims to promote electricity generation from RE and encourages IPPs to carry out feasibility studies on RE. ⁶
- To promote the development of RE, mechanism such as feed-in tariff have been implemented in the country. ⁶



Technological Feasibility

- Malawi receives high levels of solar irradiation of 5.5 kWh/m²/day and a specific yield of 4.6 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁷
- Minigrids are already a focus area for development in Malawi but are still not economically feasible compared to the regional benchmarks, and thus depend on high levels of subsidy. ⁵



Market Maturity

- Only 14.9% population in Malawi had access to electricity as of 2020. ⁸
- Malawi Energy Regulatory Authority (MERA) is responsible for regulating the energy sector in a transparent, efficient, and cost-effective manner for the benefit of the consumers and operators. ⁹
- The Electricity Supply Corporation of Malawi Limited (ESCOM) is a state-owned power transmission and distribution company in Malawi. ¹⁰
- Malawi is a member of the Southern Africa Power Pool (SAPP), which aims to integrate the national power systems into a unified regional electricity market. ¹¹



Infrastructure

- The transmission line length in the country span 2,395 kms of which 1,121 km are operated at 66 kV and 1,274 km are operated at 132 kV. ¹²
- The transmission network is currently isolated from neighbouring countries, besides supplying small cross-border towns through distribution networks in Mozambique and Zambia. ¹²
- Malawi is planning to construct a HV transmission line linking Malawi to Mozambique thereby enabling the two countries' power utilities to trade power on the regional power pool. ¹²



Financing

- To ease banking system liquidity constraints during the pandemic, the Reserve Bank of Malawi implemented several measures including lowering reserve requirements and a moratorium on debt service for small and medium enterprises (SMEs) until the end of 2020. ¹³
- The banking system remains well capitalized, liquid, and profitable but non-performing loans (NPLs) have risen from 4.8% in 2019 to 6.6% in 2020. ¹³



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.08 MWh, which is significantly lower in comparison to the global average of 3.31 MWh in 2020. ¹⁶
- The total installed capacity in the country stood at 602.9 MW in 2019. ¹⁴
- The total installed capacity of Solar PV witnessed a CAGR of 64.8% between 2017-2021 reaching 141.5 MW in 2021 from 19.2 MW levels in 2017. ¹⁵
- The price of electricity in the country was 11.5 US Cents/kWh as of 2019. ¹⁷



Maldives

Asia & Pacific

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

1054.5

Average PVout in kWh/
kWp/day (2020)

4.4

Cumulative Solar Capacity in MW
(2021)

30.8

Getting Electricity Score (2020)

55.6

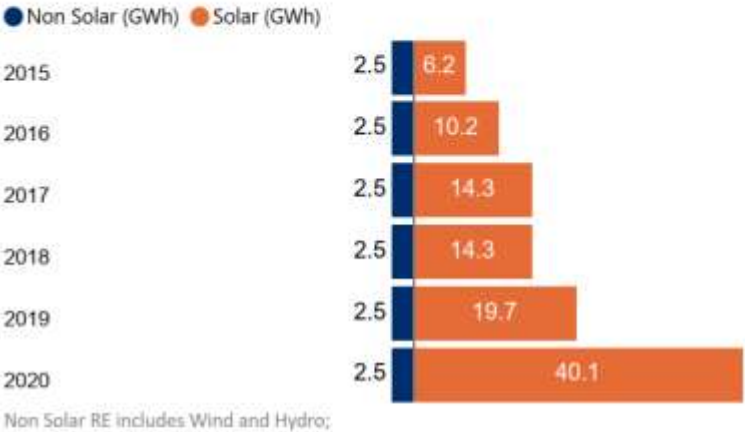
NDC Target by 2030 in %
(base year 2011)

26.0

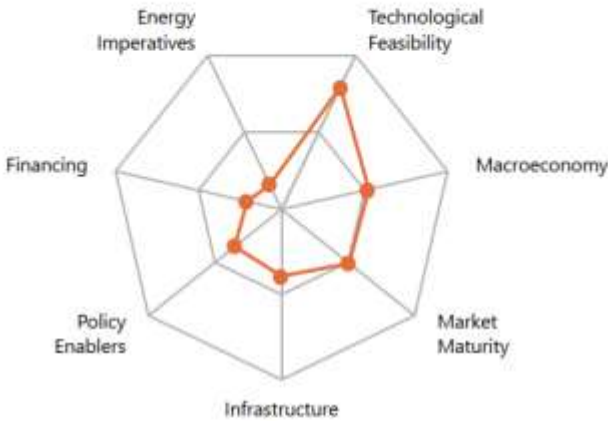
Human Development Index (2021)

0.7

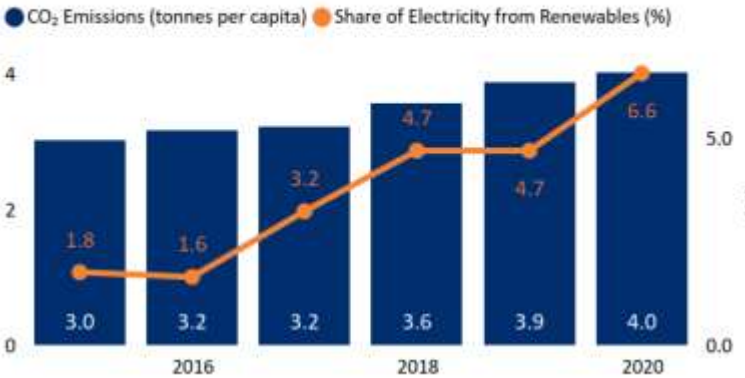
Renewable Energy Generation by Source



Performance against 7 Drivers



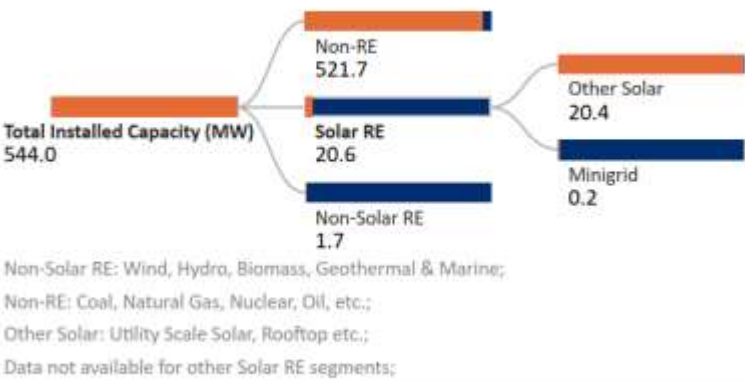
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy
(Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Maldives is a middle-income country with a GDP per capita (PPP) of USD 20,615 in 2021. ^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 33.5% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 37%.³
- The inflation rate (CPI) of Maldives has decreased to 0.2% in 2021 from -1.6% levels in 2020.⁴
- The general government gross debt to GDP has improved to 124.8% in 2021 from 154.4 % levels in 2020.⁵



Policy enablers

- ADB has prepared a roadmap "A brighter future for Maldives Powered by Renewables, 2020-2030" for Maldives in 2020 for promoting RE in Maldives.⁶
- The policy instruments supporting Maldives' vision for its energy sector are the Energy Policy and Strategy 2016 and the Strategic Action Plan (SAP) 2019–2023.⁶
- Maldives has set its agenda to reduce its GHG emissions by 10% compared to business as usual by 2030 unconditionally, and by 24% under the condition of sufficient availability of financial resources and international support for technology transfer and capacity building.⁶



Technological Feasibility

- Maldives receives very high levels of solar irradiation (GHI) of 5.9 kWh/m²/day and specific yield 4.4 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁸
- Maldives in its Greater Male region has installed a solar rooftop of cumulative capacity reaching 3 MWp in the beginning of 2020.⁹
- Maldives with its action plan called Preparing Outer Islands for Sustainable Energy Development (POISED) has conceptualised a hybrid system (Diesel generator, Solar PV, Energy Storage) resulting in an average fuel saving of 25%.⁹
- Maldives has floated a tender of 40 MWh for Battery Energy Storage System across its 19 islands/cities.¹⁰



Market Maturity

- 100% of the population in Maldives is having access to electricity since 2020.¹¹
- The Energy (electricity licensing) regulations 2012 regulates generation, transmission, and distribution in Maldives. ¹²
- The Maldives Renewable Energy Fund is positioned to channel sustainable investments into the country.¹³



Infrastructure

- Maldives' first HV power grid operating at 132 kV covers the Male Island ring network consisting of three 132 kV sub-stations on the Maldives' capital, Male Island, Hulhumale Island, and Hulhum Airport Island.¹⁴
- India and Maldives plan to set up a transmission interconnection for transfer of renewable power between the two countries.¹⁵
- Maldives has issued a grid upgradation tender for integration of Distributed Solar PV at 11 kV.¹⁶



Financing

- World Bank with its Accelerating Sustainable Private Investments in Renewable Energy (ASPIRE) has funded USD 107.4 Mn to bring in private investments for increasing RE capacity in Maldives.¹⁷
- The Asian Development Bank (ADB) has approved a USD 7.74 Mn concessional loan and a USD 2.73 Mn project grant to scale up the ongoing project for Preparing Outer Islands for Sustainable Energy Development (POISED).¹⁸
- The Asia Infrastructure Investment Bank (AIIB) has played a major role in Maldives by investing in solar PV, BESS and in grid upgradation.¹⁹



Energy Imperatives

- In 2020, Maldives per capita electricity consumption stood at 1.05 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²⁰
- The demand for electricity in 2021 in the country stood at 0.57 TWh remaining the same as the previous year's demand.²²
- In 2021, the total installed capacity in the country stood at 319.5 GW. ^{26,22}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Mali is a low-income country with a GDP per capita (PPP) of USD 2,330 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 3.1% in 2021 and it is estimated to increase by 2% in 2022. ³
- Total public debt in the country increased to 52.0% of GDP in 2021 from 47.3% levels in 2020. ⁴
- The current account deficit widened to 4.5% of GDP in 2021 from 2.3% levels in 2020. ⁴



Policy enablers

- Ministry of Energy and Water is responsible for policy formulation, promotion, co-ordination, and monitoring of the energy sector. ⁵
- Mali's National Energy Policy (NEP) aims to promote the widespread use of RE technologies in the country. ⁵
- Agency for Renewable Energies (AER) is responsible to promote large-scale use of RE in Mali. ⁶



Technological Feasibility

- Mali receives very high levels of solar irradiation of 5.9 kWh/m²/day and a specific yield of 4.7 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁷
- The government of Mali plans to increase the hybridization of its minigrids by adding PV capacity to diesel power plants. ⁸
- Mali Solar Rural Electrification Project aims to promote rural electrification through isolated solar photovoltaic (PV) minigrid systems. ⁹



Market Maturity

- 50.6% population in Mali had access to electricity as of 2020. ¹⁰
- The Electricity and Water Regulatory Commission is responsible for regulating the electricity sector in the country. ⁵
- National Water and Electricity Utility (EDM-SA) is the state-owned electricity utility responsible for the generation, transmission and distribution of electricity. ⁵
- Mali is a member of the West African Power Pool (WAPP) which aims to integrate the national power systems into a unified regional electricity market. ¹¹



Infrastructure

- Mali's electricity system includes an Interconnected Network (RI) which includes 150 kV, 63 kV, and 225 kV transmission lines and Isolated Centres (IC) with an installed capacity of 3.45 MW in solar. ¹²
- EDM-SA manages 35 isolated centres equipped with diesel generators and an autonomous distribution network in Bougouni and two centers (Kadiolo and Zégoua) supplied by the MV network of Côte d'Ivoire. ¹²



Financing

- In 2022, the AfDB approved USD 379.6 Mn Desert to Power financing facility for Mali and committed to providing technical assistance over the next seven years. ¹³
- The Green Climate Fund approved EUR 46.2 Mn to develop 50 solar-based mini-grids to promote rural electrification in Mali. ¹⁴
- The AfDB approved USD 25 Mn in Scaling Up Renewable Energy Program in Low Income Counties (SREP) funding to support Mali's projects for 20 MW solar PV Independent Power Producers (IPP) and 15 MW mini/micro hydro development. ¹⁵



Energy Imperatives

- The total installed capacity in the country stood at 1,014.6 MW in 2019. ¹⁶
- The total installed capacity of Solar PV witnessed a CAGR of 50.8% between 2017-2021 reaching 99.5 MW in 2021 from 19.3 MW levels in 2017. ¹⁷
- In 2020, the per capita electricity consumption stood at 0.158 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁸
- The price of electricity in the country was 13.6 US Cents/kWh as of 2019. ¹⁹



Marshall islands

Asia & Pacific

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

Not available

Average PVout in kWh/
kWp/day (2020)

4.2

Cumulative Solar Capacity in MW
(2021)

1.6

Getting Electricity Score (2020)

59.4

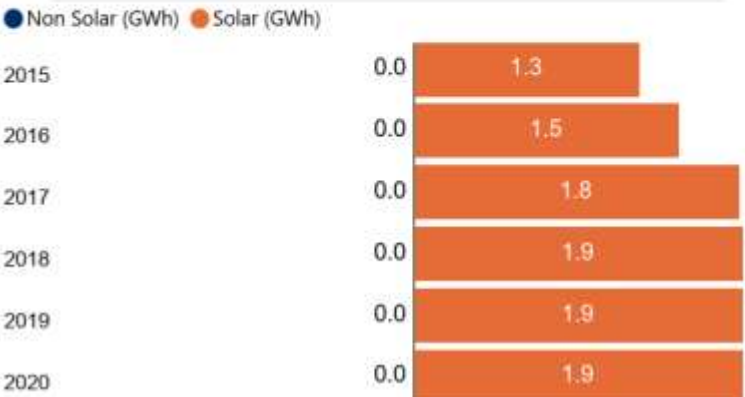
NDC Target by 2030 in %
(base year 2010)

40.0

Human Development Index (2021)

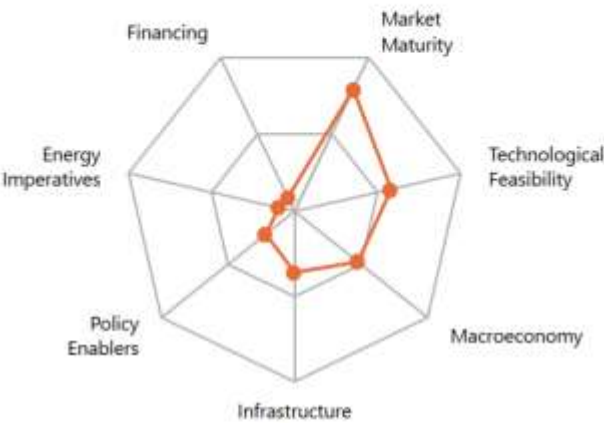
0.6

Renewable Energy Generation by Source

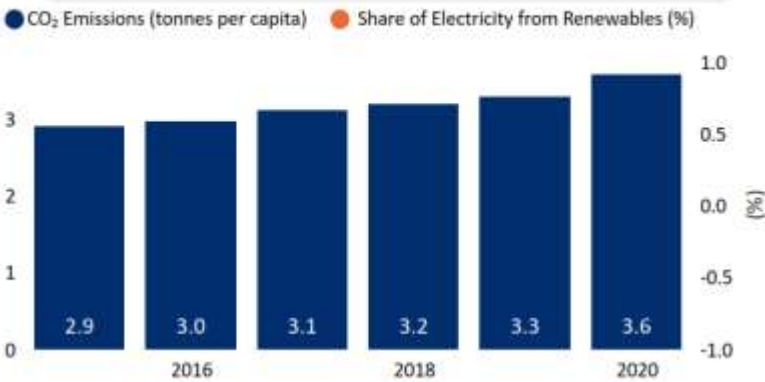


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables
(2020)

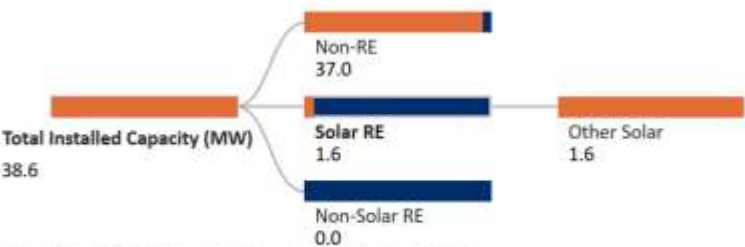
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;
Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;
Other Solar: Utility Scale Solar, Rooftop etc.;
Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Marshall Island is an upper middle-income country with a GDP per capita (PPP) of USD 6,550 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 1.6% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 1.7%.³
- The inflation rate (CPI) of Marshall Island has increased to 2.6% in 2021 from -0.7% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 19.8% in 2021 from 21.6% levels in 2020.⁵



Policy enablers

- Marshall Islands government in its NDCs has committed to reduce GHG emission and achieve net zero emissions by 2050.⁶
- Republic of Marshall Island (RMI) has targeted to achieve 100% renewable energy generation by 2050.⁷
- Marshall Island in its National Review Document, 2021 has prepared a roadmap to extend availability, affordability, and accessibility of electricity in accordance with SDG goal 7.⁸
- The World Bank through its Sustainable Energy Development Project has supported Marshalls Energy Company (MEC) to increase the share of RE in the generation mix, to improve EE and to enhance reliability of supply.⁹



Technological Feasibility

- RMI receives high levels of solar irradiation (GHI) of 5.4 kWh/m²/day and specific yield of 4.2 kWh/kWp/day, indicating a strong technical feasibility for solar in the country.¹⁰
- RMI, with distribution and installations of more than 3,100 Solar Home Systems in the rural communities, has increased its rate of extending clean energy to 100%.⁸
- RMI on its Meck Island has developed a microgrid with 2.4 MW solar photovoltaic (PV) system and a 2 MW/3 MWh Li-ion BESS.¹¹



Market Maturity

- 99.2% of the population in Marshall Islands had access to electricity as of 2020.¹²
- Kwajalein Atoll Joint Utility Resources (KAJUR) supplies 34% of the population from its grid network in Ebeye.¹³



Infrastructure

- MEC has three ways of supplying electricity through the main grid in Majuro, through off-grid SHS and mini-grid in the rest Island.¹²
- MEC's PV grid capacity includes 209 kW system supported by Japan International Cooperation Agency (JICA) and 600 kW system supported by the International Renewable Energy Agency (IRENA) and about 3,000 units that is 200 W of SHS supported by EU.¹³
- MEC operates at 13.8 kV, 4.16 kV and low voltage.¹³
- KAJUR has 600 kW of PV plants supported by JICA operating at 13.8 kV.¹³



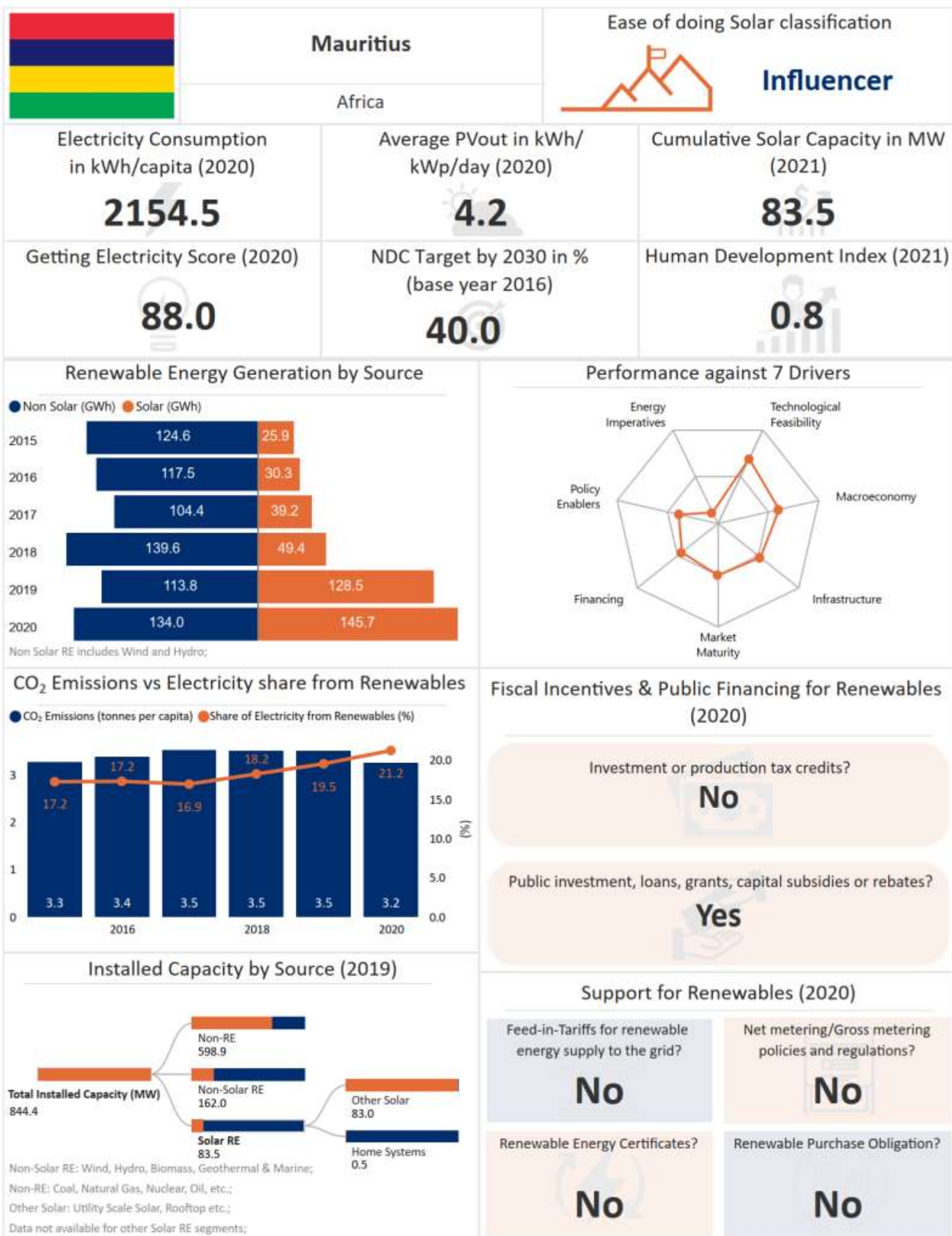
Financing

- Green Climate Fund covering Small Island Developing States (SIDS) includes RMI with a total investment of USD 55.5 Mn.¹⁴
- The Asian Development Bank (ADB) and RMI have an agreement for a USD 7 Mn grant to support the Marshalls Energy Company (MEC) in improving its energy network and to shift towards renewables.¹⁵
- The World Bank has extended an investment of USD 34 Mn for promoting renewable power generation in the country.¹⁶

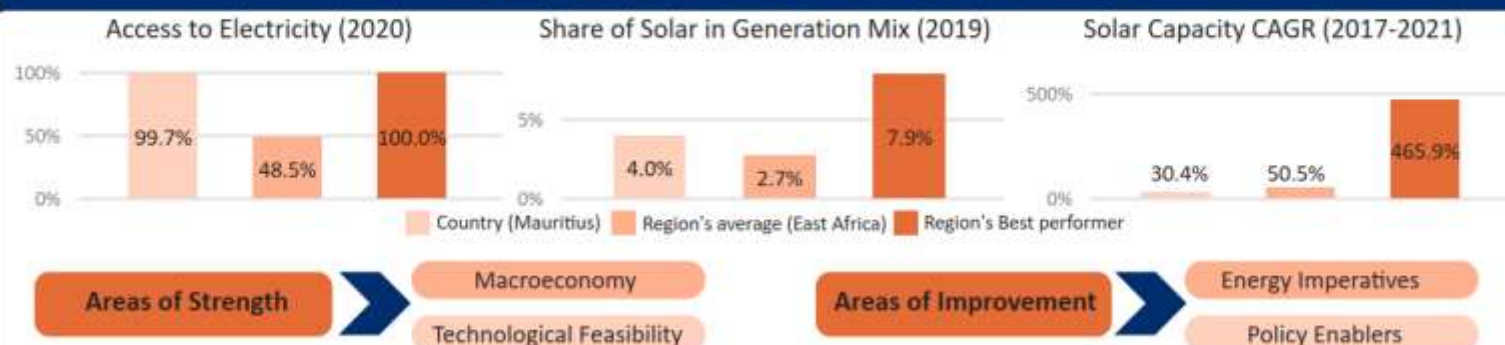


Energy Imperatives

- The total installed capacity of Solar PV witnessed a CAGR of 0.3% between 2017-2021, increasing to 1.63 MW from 1.61 between the years.¹⁸
- Per capita renewable capacity is 27.5 Watt/person in the country.¹⁹



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Mauritius is an upper middle-income country with a GDP per capita (PPP) of USD 23,035 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 3.9% in 2021 and it is estimated to increase by 6.1% in 2022. ³
- The public account deficit narrowed down to 9% of GDP in 2021 from 15.7% levels in 2020. ⁴
- The public debt-to-GDP ratio increased to 89% in 2021 from 73.4% levels in 2020. ⁴



Policy enablers

- The Ministry of Renewable Energy and Public Utilities (MPU) is responsible for energy policy and its portfolio includes energy, water, and wastewater. ⁵
- The Mauritius Energy policy emphasizes the development of RE, reduction of dependence on imported fossil fuel and promotion of energy efficiency in the country. ⁵
- Mauritius provides incentives for RE projects which includes VAT exemption for Solar PV projects and Accelerated Income Tax Depreciation provision for Green Investments in green technology equipment (50% straight line). ⁶



Technological Feasibility

- Mauritius receives high levels of solar irradiation of 5.1 kWh/m²/day and a specific yield of 4.2 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁷
- Mauritius receives an average of 2,889 hours of sunlight per year. It is sunny 65.9% of daylight hours while 34.1% of daylight hours are likely to be cloudy or with shade, haze, or low sun intensity. ⁸
- The UN Environment program is currently active in Mauritius and is working on the introduction of electric light duty vehicles. ⁹



Market Maturity

- 99.7% population in Mauritius had access to electricity as of 2020. ¹⁰
- The Mauritius Renewable Energy Agency (MARENA) creates an enabling environment for the development of RE to increase RE's share in the national energy mix. ¹¹
- The Utility Regulatory Authority (URA) is an independent body set up by the Government of Mauritius that regulates utility services, i.e., electricity, water, and wastewater. ¹²
- The Central Electricity Board (CEB) is responsible to prepare and carry out developmental schemes for improving the generation, transmission, distribution, and sale of electricity in the country. ¹³



Infrastructure

- The transmission network comprises of 66 kV lines, which interconnect power plants and major 66/22 kV sub-stations. ¹⁴
- The 22 kV outgoing lines from the sub-stations either supply the rural regions or are used for sub-transmission feeding 22/6.6 kV sub-stations. ¹⁴
- The CEB is investing hugely in the replacement of bare conductors with insulated cables to minimize power outages and targets to achieve 50% of underground 22 kV and low voltage network by 2025. ¹⁵



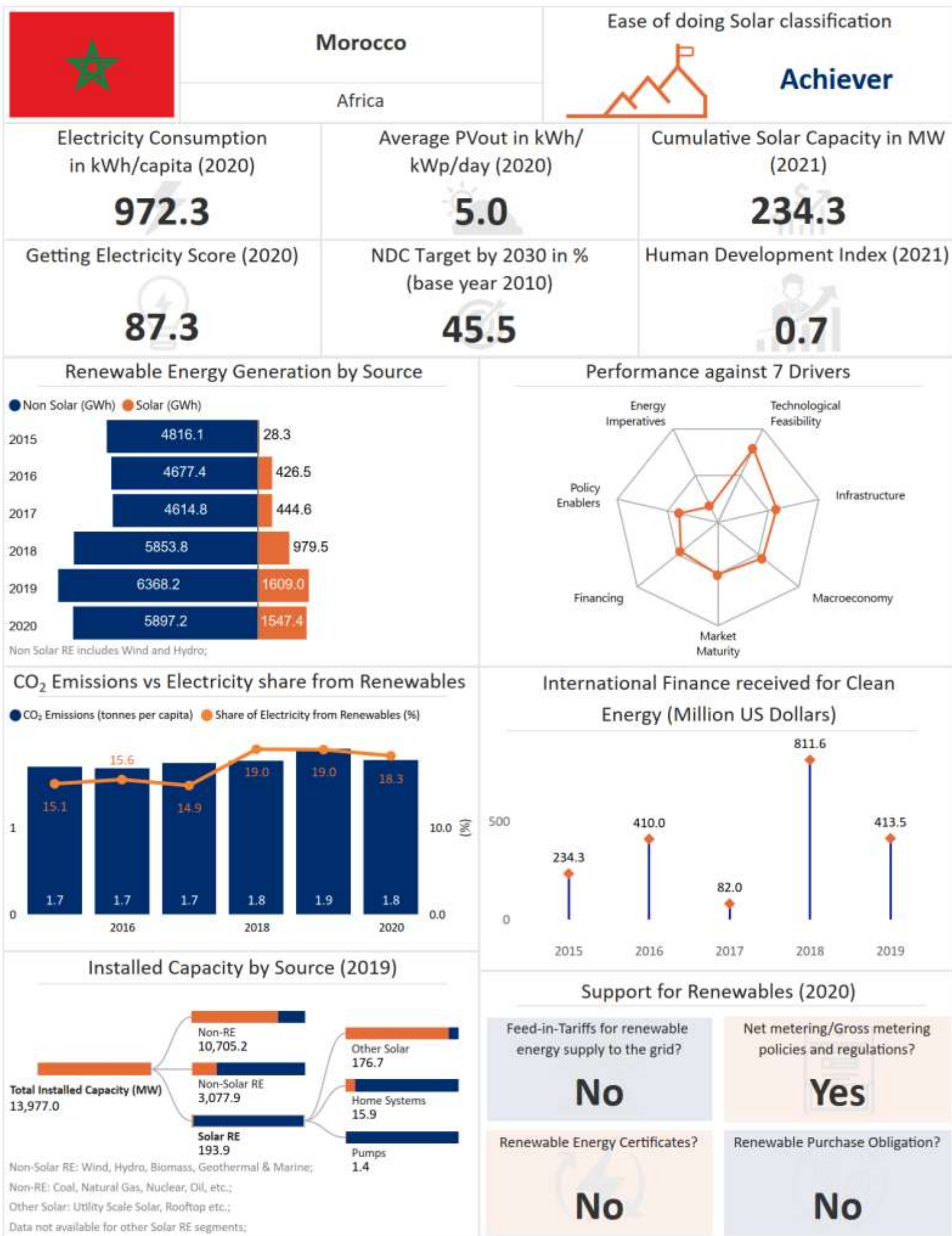
Financing

- In Mauritius, the Abu Dhabi Fund for Development (ADFD) loan of USD 10 Mn supported the Central Electricity Board in installing solar PV systems on rooftops of 10,000 households. ¹⁷
- The USD 28 Mn grant (coupled with more than USD 162 Mn of co-financing) is assisting Mauritius to meet its target of using renewables to supply 40% of the country's energy needs by 2030. ¹⁸

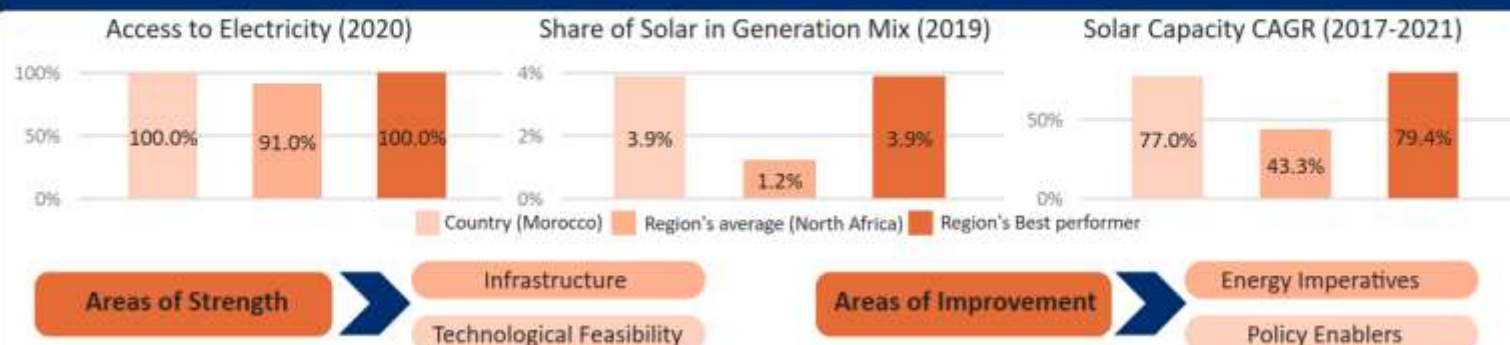


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 2.15 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ²¹
- The total installed capacity in the country stood at 844.38 MW in 2019. ¹⁹
- The total installed capacity of Solar PV witnessed a CAGR of 30.4% between 2017-2021 reaching 83.49 MW in 2021 from 28.84 MW levels in 2017. ²⁰
- The price of electricity in the country was 19.6 US Cents/kWh as of 2019. ²²



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Morocco is a lower middle-income country with a GDP per capita (PPP) of USD 8,853 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 7.2% in 2021 and the growth in 2022 is estimated to remain sluggish at 1.1%. ³
- The budget deficit is estimated at 6.4% of GDP in 2021, whereas the inflation rate in the country is estimated at 1.2% in 2021. ⁴
- Total public debt in the country marginally increased to 76.9% of GDP in 2021 from 76.4% levels in 2020. ⁴



Policy enablers

- The Department of Energy and Mining of the Ministry of Energy, Mining, and Environment is responsible for implementing policies in the areas of energy, mining, and geology. ⁵
- The government of Morocco aims to achieve a 52% share of RE in the energy mix by 2030. ⁴
- Morocco does not offer any fiscal incentives like tax or duty benefits (except for tax deductions for solar water heating appliances). ⁶



Technological Feasibility

- Morocco receives high levels of solar irradiation of 5.5 kWh/m²/day and a specific yield of 5.0 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁷
- In 2017, Morocco had around 128,000 homes powered by solar home systems taking it to among the top 3 countries in Africa for the adoption of this technology. ⁶
- Noor Midelt Phase 1 multi-technologies solar project operating with hybrid technology (CSP + PV) with a capacity of 800 MW is the world's first advanced hybridization of CSP and PV technologies. ⁸



Market Maturity

- 100% population in Morocco is having access to electricity since 2020. ⁹
- Moroccan Energy Authority (ANRE) is the energy regulator responsible for ensuring proper functioning of the national electricity sector. ¹⁰
- The ONEE (Office National de l'Electricité et de l'Eau Potable) is the sole generator, transmitter, and distributor of electricity in the country. ¹¹
- On a regional level, the country is a member of the Maghreb Electricity Committee (COMLEC) Power Pool. ¹¹



Infrastructure

- The transmission system of Morocco operates at voltage levels ranging from 60 kV to 400 kV AC. The transmission network has grown at a CAGR of 3.2% in the last decade reaching 28,693 ckm in 2020. ¹²
- Distribution of electricity in the country is managed by National Office for Electricity and Potable Water (ONEE) with presence of a few private distributors. ¹²
- The National grid of Morocco is interconnected with Spain and Algeria. Morocco was an importer of electricity; the country clocked 3,787.7 GWh of imports against 395.2 GWh exports during 2019. ¹²



Financing

- The AfDB approved USD 324 Mn investment to support two RE projects in Morocco and Côte d'Ivoire that are expected to significantly increase power supplies and keep economic growth on track. ¹³
- The Green Value Chain (GVC), developed by EBRD and designed for SMEs, has offered a credit line of EUR 90 Mn for providing technical support and financing of green technologies in the country. ¹⁴
- In 2018, the World Bank sanctioned funding of USD 125 Mn to support Morocco's aim of reducing its dependence on fossil fuels by developing solar energy resources. ¹⁵



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.97 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁸
- The total installed capacity in the country stood at 13,977 MW in 2019. ¹⁶
- The total installed capacity of Solar PV witnessed a CAGR of 77.0% between 2017-2021 reaching 234.3 in 2021 from 23.9 MW levels in 2017. ¹⁷
- The price of electricity in the country was 12.3 US Cents/kWh as of 2019. ¹⁹



Mozambique

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

569.5

Average PVout in kWh/
kWp/day (2020)

4.4

Cumulative Solar Capacity in MW
(2021)

55.0

Getting Electricity Score (2020)

71.7

NDC Target by 2025
in MtCO₂e

40.0

Human Development Index (2021)

0.4

Renewable Energy Generation by Source

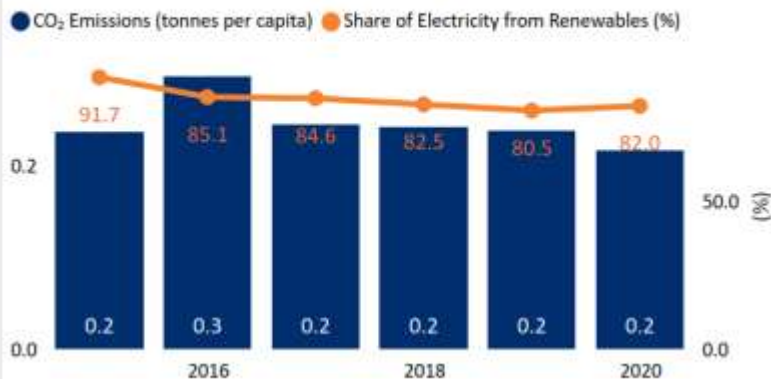


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



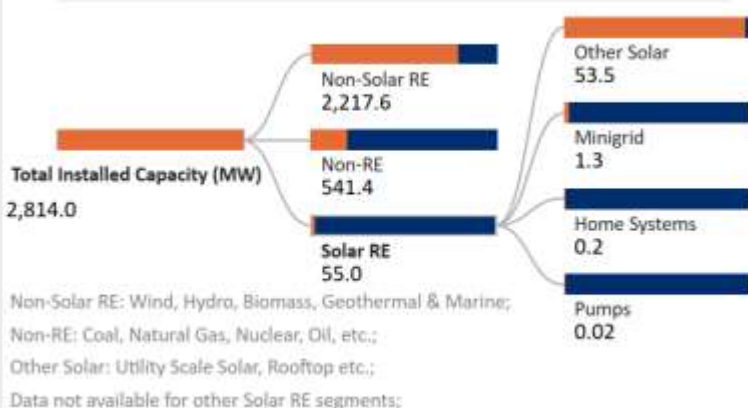
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

| Average term of Solar PPAs in years (2021) | Cheapest Source of Power (2021) | Testing Facility/R&D Availability for Solar (2021) |
|--|---------------------------------|--|
| 20.0 | Hydro | Yes |

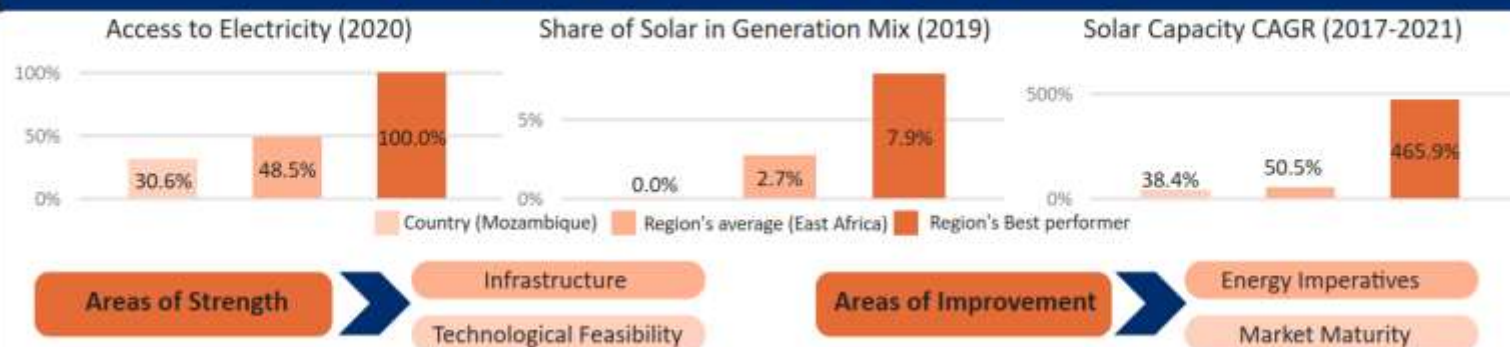
| Support for Renewables (2021) | |
|---|-----|
| Renewable Generation Obligations (RGO) i.e. Mandate for Non Renewable energy generators to produce electricity from Renewable sources | No |
| Franchising for solar business | No |
| Presence of regulatory framework for integrating solar generation to grid-powered electricity | Yes |
| Manufacturing facility for solar equipment (inverters and balance of systems) | No |

| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | Yes |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | Yes | No | No | No | No | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | No |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |
| E-mobility/Electric vehicles | No |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Mozambique is a low-income country with a GDP per capita (PPP) of USD 1,348 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 2.2% in 2021 and it is estimated to grow by 3.8% in 2022. ³
- The inflation rate in the country increased to 5.7% in 2021 from 3.1% levels in 2020. ⁴
- The fiscal deficit in the country narrowed down to 6.0% of GDP in 2021 from 7.0% levels in 2020. ⁴



Policy enablers

- The Ministry of Mineral Resources and Energy (MIREME) is responsible for planning the national energy strategy and policy for supervising the operation and development of the energy sector. ⁵
- The National Directorate of Energy (DNE) is the central technical body within the MIREME responsible for the analysis, preparation, roll-out of energy policies and licensing of electrical installations. ⁵
- The National Energy Fund (FUNAE) aims to grant financial loans for energy production, equipments, and techniques related to the production, distribution, and conservation of energy. ⁵
- Mozambique provides specific policies/schemes for Solar Mini Grids in the country. ¹⁸



Technological Feasibility

- Mozambique receives high levels of solar irradiation of 5.3 kWh/m²/day and a specific yield of 4.4 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁷
- The UN Environment program is currently active in Mozambique and is working towards introduction of electric light duty vehicles. ⁸



Market Maturity

- 30.6% population in Mozambique had access to electricity as of 2020. ⁹
- The ARENE, is the Energy Regulatory Authority functioning as a regulator for the generation, transmission, and sale of electricity. ⁵
- Electricidade de Moçambique (EDM), a state-owned and vertically integrated utility, is responsible for the generation, procurement, transmission, distribution, and sale of electricity. ⁵
- The average duration or term of Power Purchase Agreements (PPAs) for Solar PV Projects in Mozambique is 20 years. ¹⁸



Infrastructure

- As of 2019, Mozambique's transmission network comprised of about 8,310 km of lines and 77 sub-stations ranging between the 66 kV to ±533 kV high voltage direct current (HVDC) levels. ¹⁰
- Mozambique has cross-border interconnections with South Africa, Zimbabwe, and Swaziland. The interconnections with South Africa are established via ±533 kV HVDC, 400 kV, 275 kV, and 110 kV lines. ¹⁰
- In the distribution segment, EDM owns 19,495 km of medium voltage lines, 24,311 km of low voltage lines, and 12,277 transformer stations. ¹⁰



Financing

- International Finance Corporation (IFC) announced a financing package of USD 55 Mn to build Mozambique's first utility-scale solar PV plant, which will help increase the country's climate resilience and deliver power to rural areas. ¹¹
- In Mozambique, AfDB finances UA 25.9 Mn for Mozambique Energy for ALL (MEFA) program that aims to increase the stability of the Mozambican power system. ¹²
- The Sustainable Energy Fund for Africa (SEFA) has approved a USD 740,000 technical assistance grant to enhance the private investments in the RE sector. ¹³



Energy Imperatives

- In 2020, Mozambique per capita electricity consumption stood at 0.57 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ¹⁶
- The total installed capacity in the country stood at 2,814 MW in 2019. ¹⁴
- The total installed capacity of Solar PV witnessed a CAGR of 38.4% between 2017-2021 reaching 55 MW in 2021 from 15 MW levels in 2017. ¹⁵
- The price of electricity in the country was 10.4 US Cents/kWh as of 2019. ¹⁷



Myanmar

Asia & Pacific

Ease of doing Solar classification



Potential

Electricity Consumption
in kWh/capita (2020)

427.1

Average PVout in kWh/
kWp/day (2020)

4.1

Cumulative Solar Capacity in MW
(2021)

80.4

Getting Electricity Score (2020)

56.7

NDC Target by 2030
in MtCO₂e

414.8

Human Development Index (2021)

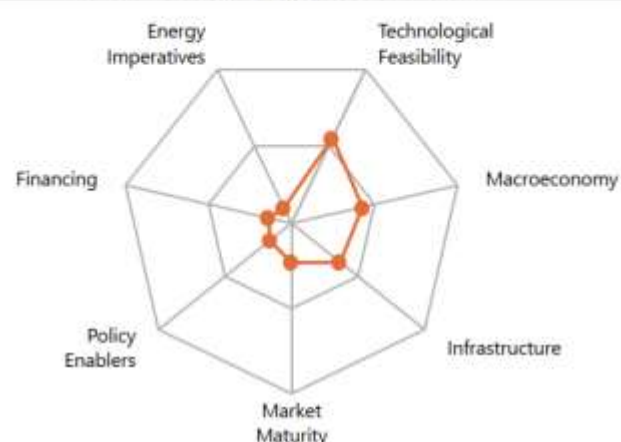
0.6

Renewable Energy Generation by Source

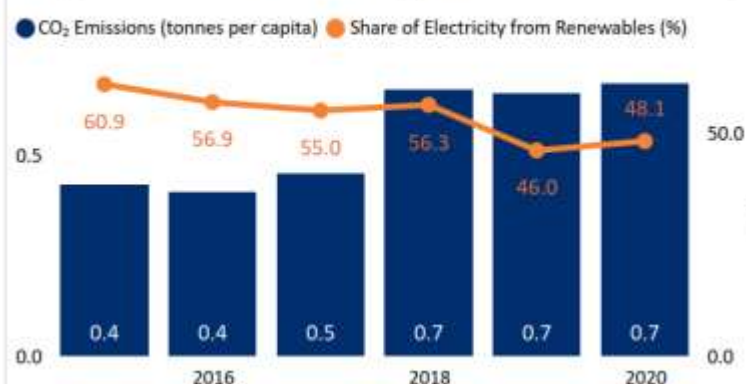


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



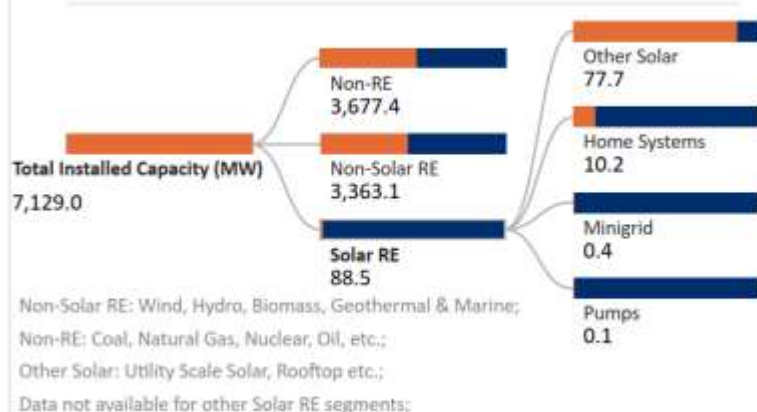
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Myanmar is a lower middle-income country with a GDP per capita (PPP) of USD 4,430 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) was 3.2 % in 2020. However, in 2021, the GDP further declined to a negative growth rate of 17.9%.³
- The inflation rate (CPI) of Myanmar has decreased to 3.6% in 2021 from 5.7% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 62.3% in 2021 from 39.3% levels in 2020.⁵



Policy enablers

- Myanmar Energy Master Plan has envisioned to achieve an energy generation mix with 57% hydropower, 30% coal, 8% natural gas and 5% solar and wind by 2030.⁶
- World Wildlife Fund (WWF) report on Myanmar has envisioned 100% renewable power by 2050.⁷
- Myanmar's Ministry of Electricity and Energy (MOEE) issued an invitation to bid in Aug'21 for the construction of ground-mounted 1 GW solar power projects on an independent power producer (IPP) and build-operate-own (BOO) basis.⁸



Technological Feasibility

- Myanmar receives moderate levels of solar irradiation (GHI) of 4.7 kWh/m²/day and specific yield 4.1 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.⁹
- Myanmar has one utility-scale solar power project, the 170 MW Minbu solar project in Magwe Region which is fully operational and has been producing 350 MU annually providing electricity to 2,10,000 households.¹⁰
- Myanmar has a storage system with an integration of 231 kWp PV, 160 KVA/ 624 kWh BESS and 150 KW DG which aims to supply electricity to unelectrified villages in Myanmar.¹¹



Market Maturity

- 70.4% of the population in Myanmar had access to electricity as of 2020.¹²
- Myanmar's Ministry of Electricity and Energy has different departments for electricity power planning, electricity generation, transmission & distribution.¹³
- Myanmar has three major Distribution enterprise i.e, Yangon Electricity Supply Corporation (YESC), Mandalay Electricity Supply Corporation (MESC) and Electric Supply Enterprise (ESE).¹³



Infrastructure

- Myanmar's transmission system comprises of a network of 230 kV, 132 kV, and 66 kV transmission lines and sub-stations.¹³
- To improve efficiency of transmission system, Myanmar has planned to replace the 6.6 kV systems with 11 kV network, and to expand the 33 kV systems.¹³



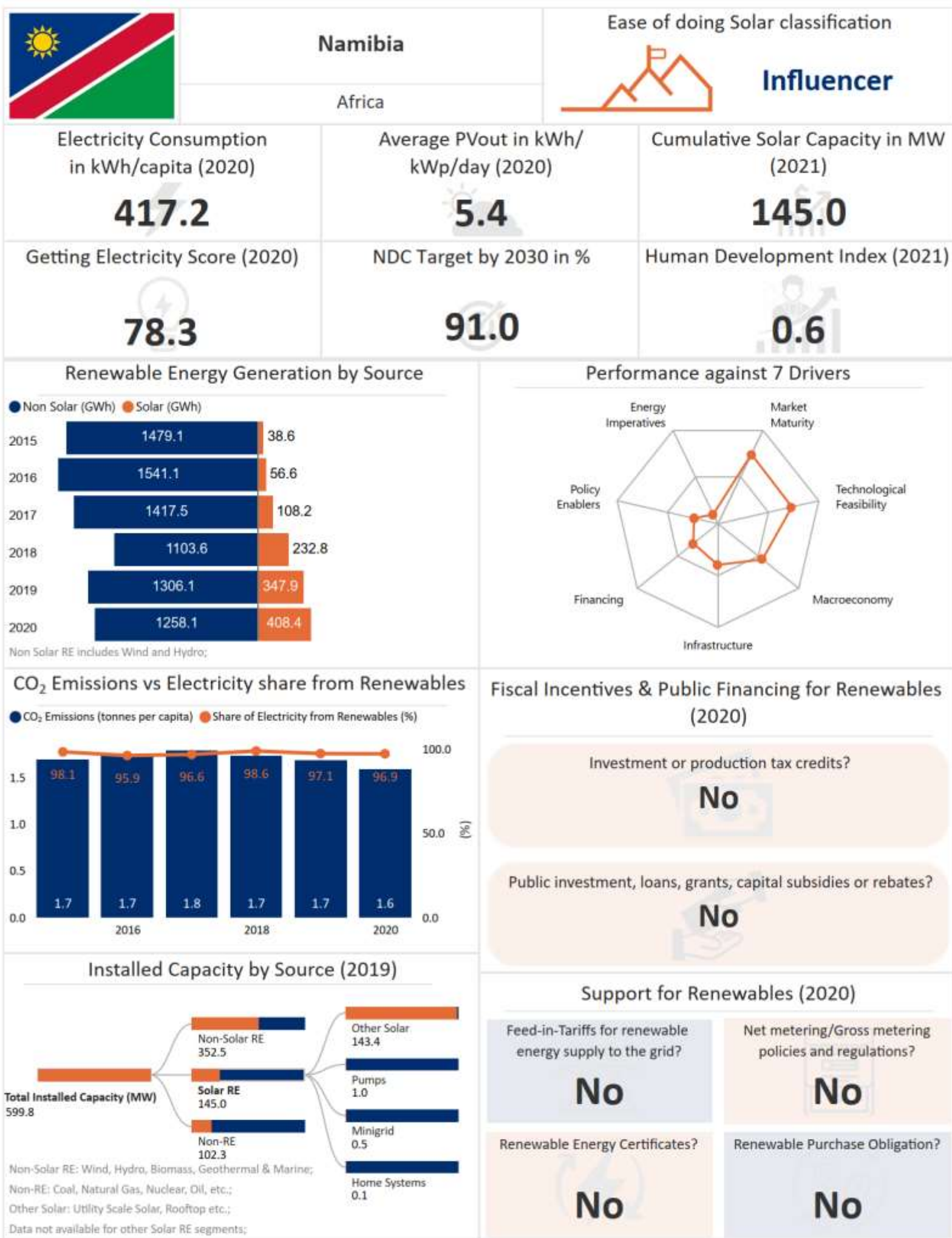
Financing

- The World Bank has approved a USD 350 Mn credit from the International Development Association (IDA) to improve efficiency of power in Myanmar.¹⁴
- The Asian Development Bank (ADB) has approved a USD 171.27 Mn loan in 2020 to help Myanmar in constructing 44 medium-voltage sub-stations and 1,006 km of distribution lines across Kayin state and the Ayeyarwady, east Bago, and Magway regions.¹⁵
- World Bank has funded with USD 3.45 Mn to support solar projects in Myanmar, focussing on the rural areas.¹⁶

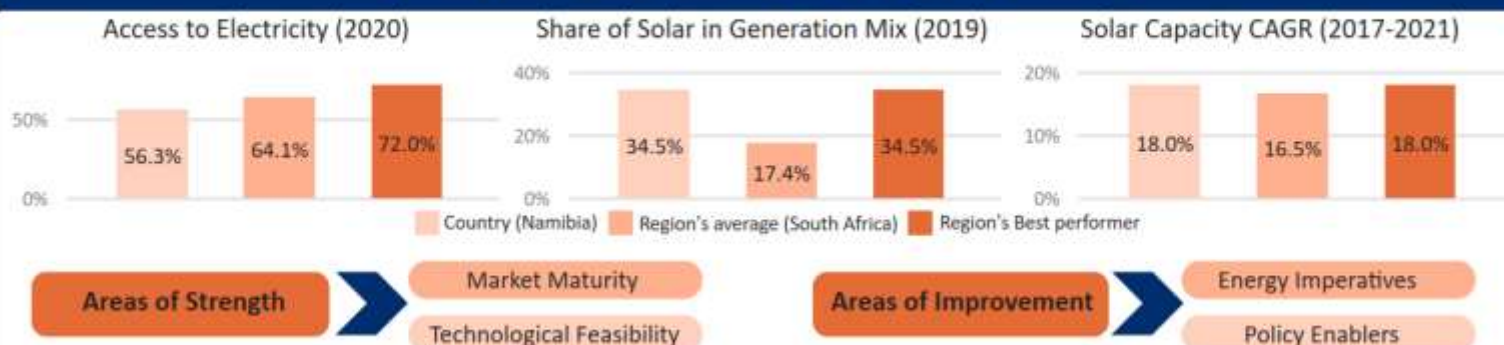


Energy Imperatives

- In 2020, the per capita consumption of electricity stood at 0.42 MWh, which is significantly lower as compared to the global average of 3.31 MWh.¹⁷
- The total installed capacity of Solar PV witnessed a CAGR of 16.4% between 2017-2021 wherein in 2017 the installed capacity was 43.8 MW and in 2021 it became 80.4 MW.¹⁸
- The peak demand for electricity in the country stood at 23.24 TWh in 2021 which remained similar to that in 2020.¹⁹
- In 2021, the total installed capacity in the country reached 6.03 GW with a significant share coming from hydro (54%), natural gas (41%) followed by smaller contributions coming from coal (2%) and solar (1%).^{20, 26}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Namibia is an upper-middle-income country with a GDP per capita (PPP) of USD 10,039 in 2021.^{1, 2}
- GDP (Real) grew at an annual rate of 0.9% in 2021 and it is estimated to grow by 2.8% in 2022.³
- The fiscal deficit is estimated at 8.1% of GDP in 2021 due to COVID-19 related spending and lower revenues.⁴
- Total public debt in the country is estimated at 57.8% of GDP in 2021.⁴



Policy enablers

- The Ministry of Mines and Energy (MME) is responsible for developing energy policy and approving licenses as recommended by the Electricity Control Board (ECB).⁵
- NamPower, the country's power utility, has set an ambitious target of generating 70% of the country's electricity from renewable sources by 2030.⁶
- In 2015, Namibia started the RE FIT programme for biomass, solar PV, and wind projects.⁷



Technological Feasibility

- Namibia receives very high levels of solar irradiation of 6.3 kWh/m²/day and a specific yield of 5.4 kWh/kWp/day indicating strong technical feasibility for solar in the country.⁸
- Namibia receives an average of 3,876 hours of sunlight per year. It is sunny 88.4% of daylight hours, and 11.6% of daylight hours are likely cloudy or with shade, haze, or low sun intensity.⁹
- The United Nations Development Programme (UNDP) in Namibia in collaboration with UNICEF Namibia launched the Vehicle-Grid-Integration (VGI) and Electric Vehicle (EV) project.¹⁰



Market Maturity

- 56.3% population in Namibia had access to electricity as of 2020.¹¹
- NamPower, the national electricity utility, is a state-owned company with a mandate to generate, trade, transmit, import, export, and distribute electricity.¹²
- The Electricity Control Board (ECB) is a statutory regulatory authority to exercise control over the electricity supply industry with the main responsibility of regulating electricity generation, transmission, and distribution.¹³
- Regional Electricity Distributors (REDs) are autonomous companies that manage the distribution of power to electricity consumers in a specified region of the country.⁵



Infrastructure

- NamPower owns a world-class transmission system and network of 132 kV to 400 kV of overhead power lines spanning more than 25,000 km.¹⁴
- A twin-circuit 220 kV transmission line from Walmund near Swakopmund to Rossing has been recently commissioned.¹⁵
- A 400 kV line will be built from Kunene to the existing Omatando substation that will significantly increase the power supply capacity to Oshakati, Ondangwa.¹⁶



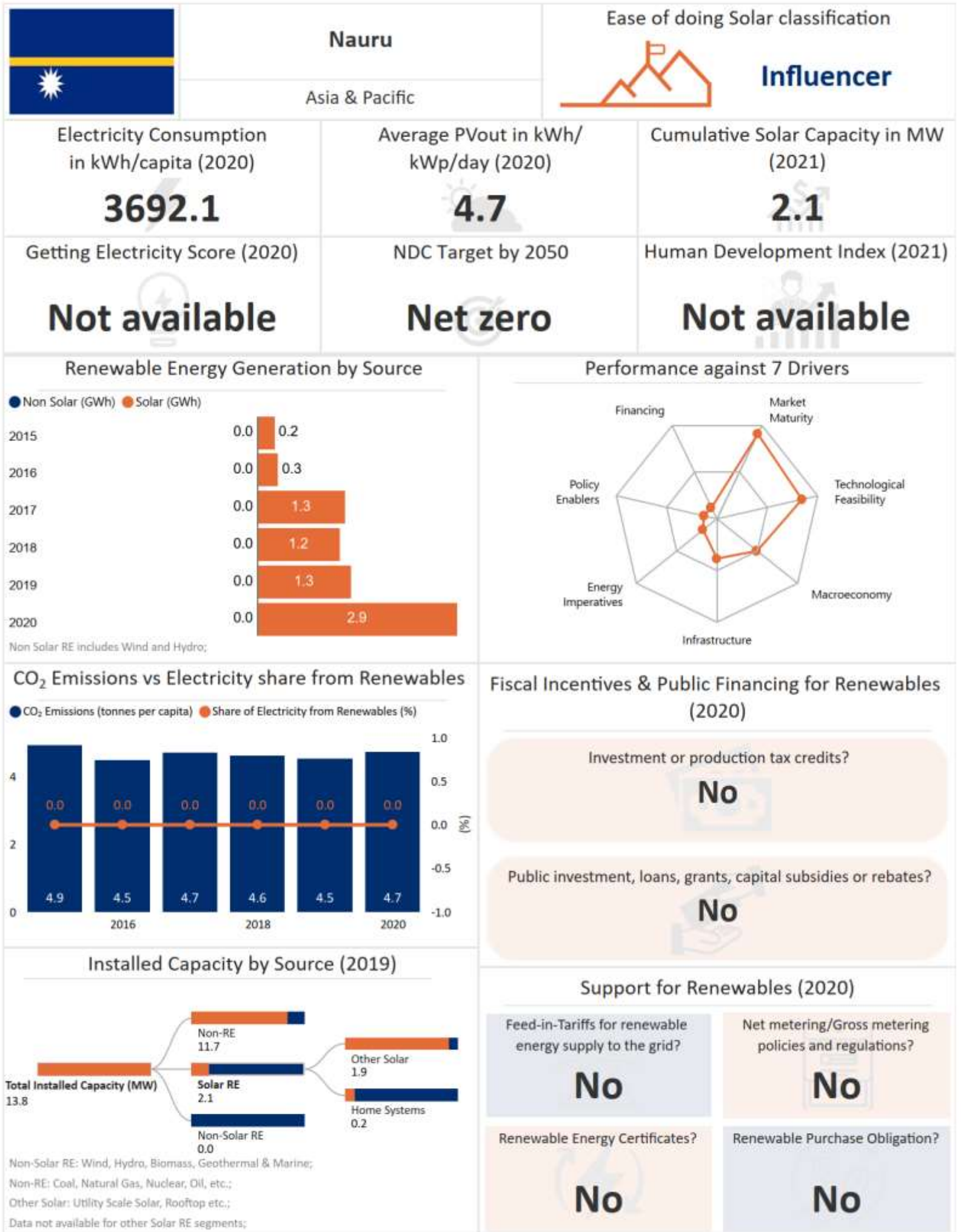
Financing

- The AfDB Group's Country Strategy Paper (CSP) 2020-2024 for Namibia lays out the strategy that will guide the bank to support the country for the achievement of sustainable and inclusive growth.¹⁷
- The AfDB approved USD 129.4 Mn loan to finance the Namibia Economic Governance and Competitiveness Support Programme.¹⁸

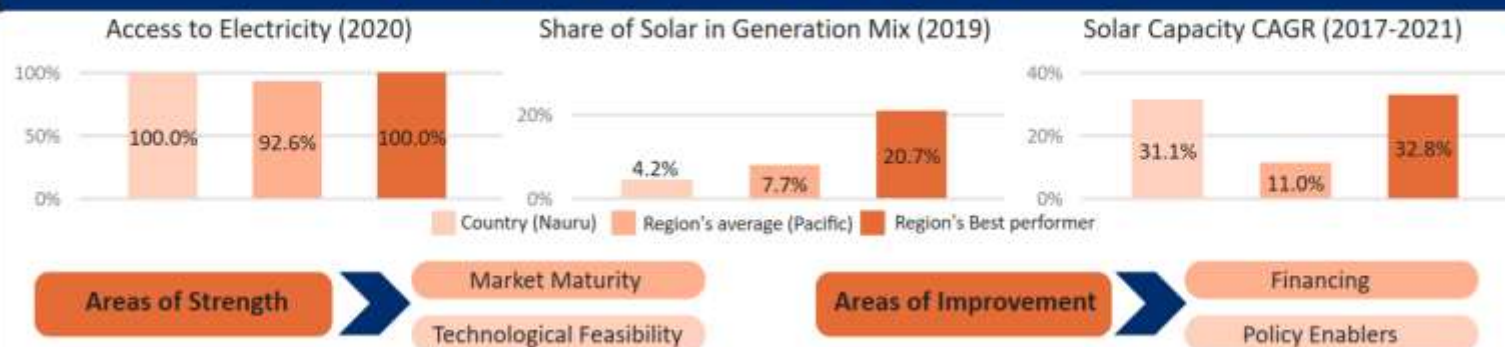


Energy Imperatives

- In 2020, Namibia's per capita electricity consumption stood at 0.42 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²¹
- The total installed capacity in the country stood at 599.73 MW in 2019.¹⁹
- The total installed capacity of Solar PV witnessed a CAGR of 18% between 2017-2021 reaching 144.9 MW in 2021 from 74.8 MW levels in 2017.²⁰
- The price of electricity in the country stood at 13.5 US Cents/kWh as of 2019.²²



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Nauru is a high income country with a GDP per capita (PPP) of USD 13,125 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) grew at only 0.7% in 2020. However, in 2021, the GDP has shown signs of improvement recording an annual growth rate of 1.6%.³
- The inflation rate (CPI) of Nauru has increased to 1.2% in 2021 from -6.6% levels in 2020.⁴
- The general government gross debt to GDP has significantly decreased to 27.1% in 2021 from 61.4% levels in 2020.⁵



Policy enablers

- Nauru's NDC has a target to achieve net zero greenhouse gas emissions by 2050.⁶
- The Nauru National Energy Policy Framework (NEPF) policy framework has prescribed guidelines for development of the energy sector for immediate future, mid and long-term goals.⁷
- Nauru, in collaboration with project executor IUCN and implementing agency UNEP, has established a low carbon fund (LCF) of USD 80,000 to promote RE and EE in private sector.⁸



Technological Feasibility

- Nauru receives very high levels of solar irradiation (GHI) of 5.9 kWh/m²/day and specific yield 4.7 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁹
- The Nauru Solar Power Development Project of capacity 2,500 kW with 5,000 kWh Battery Energy Storage System was announced in 2019 indicating a traction in RE and storage space.¹⁰
- Pacific Islands Greenhouse Gas Abatement through Renewable Energy (PIGGAREP) has extended training to Nauru Renewable Energy Staff and has facilitated successful installation of 150 solar powered street lights in Nauru college.¹¹



Market Maturity

- 100% of the population in Nauru had access to electricity as of 2020.¹²
- Nauru Utility Corporation (NUC) owns and operates power generation and distribution as well as water desalination and supply.¹³
- Nauru Utilities Corporation (NUC) Act 2011 defines responsibilities of the utilities corporation and doesn't legislate or regulates for everyday operations.¹⁴



Infrastructure

- NUC distribution system has a main ring configuration system which includes 11 kV, 3.3 kV and 415 V lines.¹⁴
- Nauru's interruption duration and interruption frequency indexes have improved from 67,500 minutes to 8,600 minutes and from 490 to 96 between 2015 and 2017.¹⁵



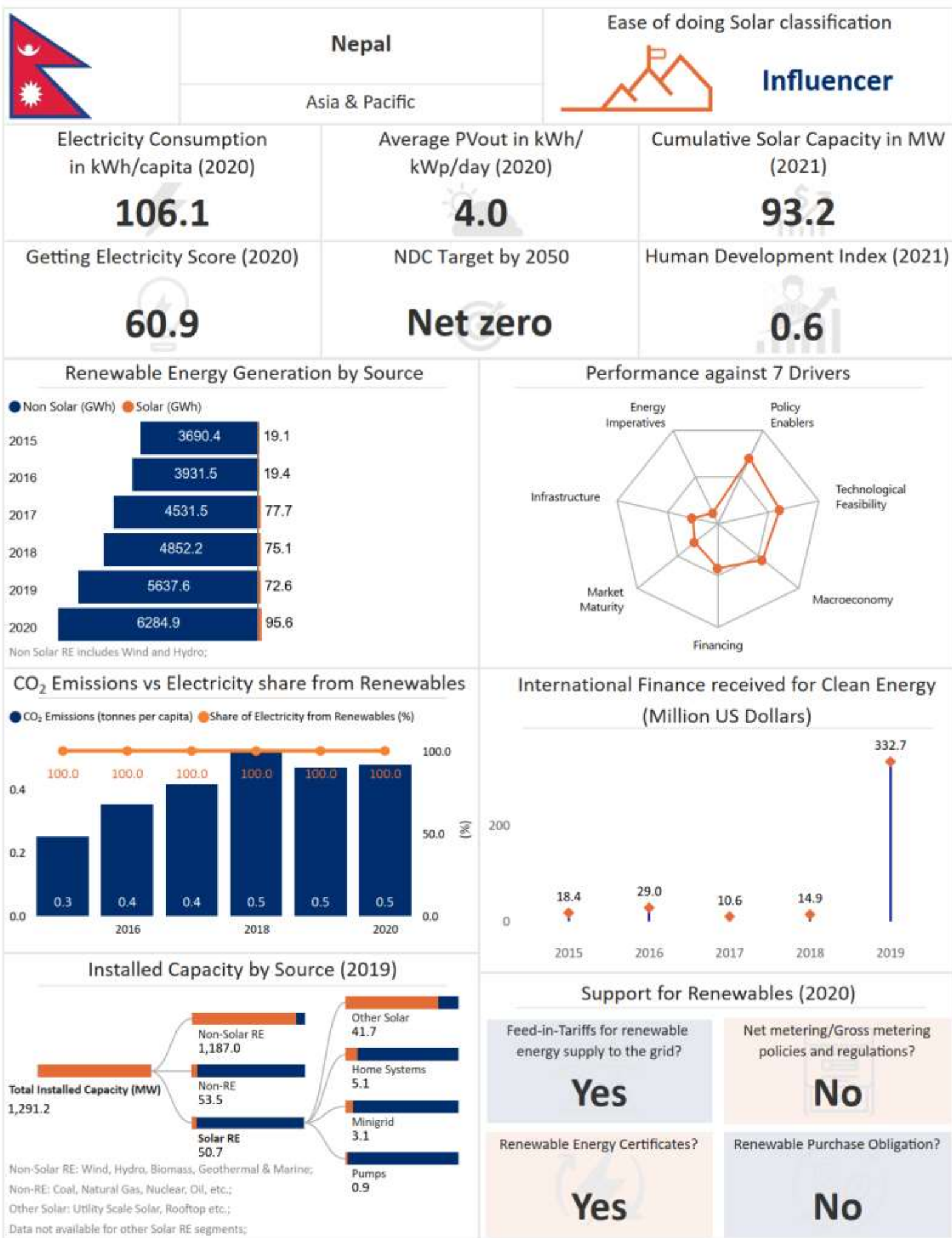
Financing

- In 2019, ADB and the Government of Nauru had signed a USD 22 Mn grant for solar projects with an objective to deliver reliable, affordable, secure and sustainable solar energy.¹⁶
- Pacific Environment Community (PEC) has invested an amount of USD 4 Mn to install a solar power generation system in Nauru.¹⁷



Energy Imperatives

- In 2020, the per capita consumption of electricity stood at 3.7 MWh, which is higher as compared to the global average of 3.31 MWh.¹⁸
- The total installed capacity of Solar PV witnessed a CAGR of 31.1% between 2017-2021 reaching 2.1 MW in 2021 from 0.7 MW levels in 2017.¹⁹
- The peak demand for electricity in the country is 0.04 TWh and has remained similar in 2021 and 2020.²⁰
- In 2021, the total installed capacity in the country has reached 0.014 GW with close to 100% share coming from fossil fuel.^{20, 21}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Nepal is a lower middle-income country with a GDP per capita (PPP) of USD 4,210 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 6.6% in 2020. However, in 2021, the GDP bounced back recording an annual growth rate of 4.2%.³
- The inflation rate (CPI) of Nepal has decreased to 3.6% in 2021 from 6.1% levels in 2020.⁴
- The general government gross debt to GDP has increased to 45.8% in 2021 from 42.4% levels in 2020.⁵



Policy enablers

- Nepal, in its NDC, has committed to reduce GHG emission to achieve net zero emissions by 2050.⁶
- Nepal has committed to expand clean energy generation from approximately 1,400 MW to 15,000 MW out of which 5,000 MW will be built using national resources.⁶
- Nepal has prepared a roadmap to achieve universal access to electricity by 2024 which is 3 years earlier than the timeline mentioned in the Sustainable Development Goals Status and Roadmap 2016-2030.⁷
- Nepal government with its initiative Green, Resilient, and Inclusive Development (GRID) has primarily focussed on RE and sustainable development.⁸



Technological Feasibility

- Nepal receives high levels of solar irradiation (GHI) of 4.5 kWh/m²/day and specific yield 4.0 kWh/kWp/day indicating a high level of technical feasibility for solar in the country.⁸
- Alternative Energy Promotion Centre (AEPIC) in Nepal has launched Mini Grid Special Programme to implement solar mini grid projects.¹⁰
- Nepal has established a Green Hydrogen Lab with a vision to enable Nepalese industries specialized in producing, storing, transporting, and using green hydrogen energy at a commercial level.¹¹



Market Maturity

- 90% of the population in Nepal had access to electricity as of 2020.¹²
- Nepal Electricity Authority is responsible for generation, transmission, and distribution of electricity.¹³
- Nepal Electricity Regulatory Commission is responsible for formulating regulations across generation-transmission-distribution, protecting rights of consumer, tariff etc.¹⁴



Infrastructure

- Power Transmission Company of Nepal Limited (PTCN) maintains and operate transmission system between Nepal and India for the purpose of export and import of electricity.¹⁵
- Electricity transmission lines in Nepal operate at 11 KV, 33 KV, 66 KV and 132 kV voltage levels.¹⁶
- A 400 KV D/C, 120 km long line will be laid connecting India and Nepal of which 20 km will fall in Nepal and the remaining 100 Km is in Indian territory (from Butwal in Nepal to Gorakhpur in UP, India). This line will have the capacity to handle a load of up to 2,000 MW.¹⁷




Financing

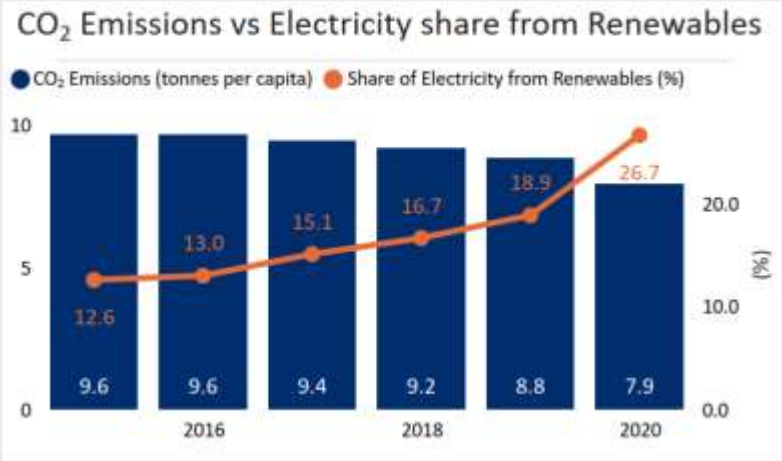
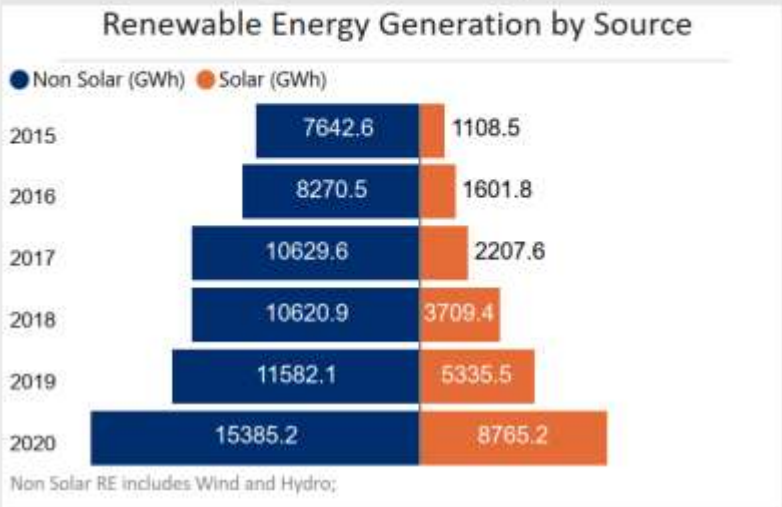
- Asian Development Bank (ADB), with a corpus of USD 150 Mn, is funding Nepal to enhance its power transmission and distribution efficiency.¹⁸
- The Government of Nepal and the World Bank has signed a concessional financing agreement for USD 100 Mn toward a green, climate-resilient, and inclusive development.¹⁹



Energy Imperatives

- In 2020, the per capita consumption of electricity is 0.106 MWh, which is significantly lower as compared to the global average of 3.31 MWh.²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 14.5% between 2017-2021 growing from 54.3 MW in 2017 to 93.2 MW in 2021.²¹
- The demand for electricity in the country was recorded as 3.09 TWh in 2021 remaining similar to that in 2020.²²
- In 2021, the total installed capacity in the country has reached 2.03 GW with a significant share coming from hydro (~95%).²³

| | | | |
|--|--|---|--|
| <div></div> <div></div> <div>Netherlands</div> | | <div>Ease of doing Solar classification</div> <div>  <div>Achiever</div> </div> | |
| Europe and others | | | |
| Electricity Consumption in kWh/capita (2020) | Average PVout in kWh/kWp/day (2020) | Cumulative Solar Capacity in MW (2021) | |
| 6925.2 | 2.9 | 14249.0 | |
| Getting Electricity Score (2020) | NDC Target by 2030 in % (base year 1990) | Human Development Index (2021) | |
| 82.5 | 55.0 | 0.9 | |



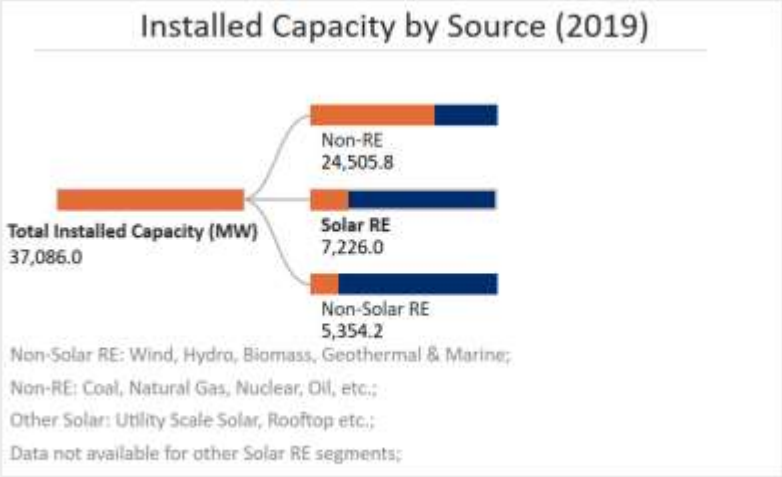
Fiscal Incentives & Public Financing for Renewables (2020)

Investment or production tax credits?

Yes

Public investment, loans, grants, capital subsidies or rebates?

Yes



Support for Renewables (2020)

Feed-in-Tariffs for renewable energy supply to the grid?

Yes

Net metering/Gross metering policies and regulations?

Yes

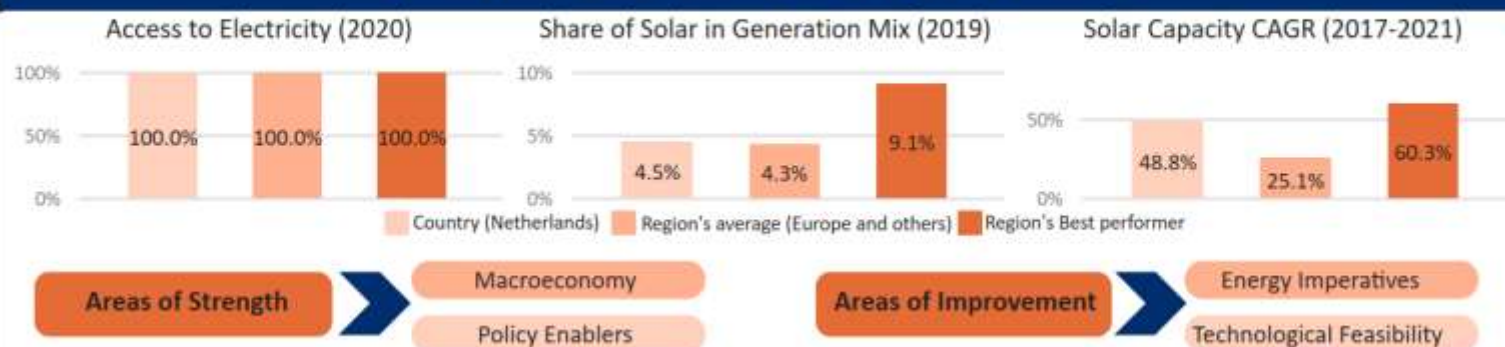
Renewable Energy Certificates?

Yes

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Netherlands is a high-income country with a GDP per capita (PPP) of USD 63,742 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 3.9% in 2020. However, in 2021, the GDP bounced back recording an annual growth rate of 4.9%.³
- The inflation rate (CPI) of Netherlands has increased to 2.8% in 2021 from 1.1% levels in 2020.⁴
- The general government gross debt to GDP has slightly reduced to 52.3% in 2021 from 54.6% levels in 2020.⁵



Policy enablers

- Netherlands has set a target to reduce GHG emissions to 49% by 2030 and 95% by 2050 (compared to 1990 levels).⁶
- Netherlands's Sustainable Energy Transition Scheme (SDE+) has provisions of expanding subsidy to renewable sector.⁷
- Netherlands has a net-metering scheme for small-scale PV to drive the growth of residential PV deployment.⁸



Technological Feasibility

- Netherlands receives low solar irradiation (GHI) of 2.9 kWh/m²/day and specific yield 2.9 kWh/kWp/day indicating a low technical feasibility for solar in the country.⁹
- Netherlands has installed its largest Battery Energy Storage System (BESS) with a capacity of 24 MW/48 MWh.¹⁰
- Netherlands's floating solar installations are expected to reach 200 GWp by 2050.¹¹



Market Maturity

- 100% of the population in Netherlands had access to electricity as of 2020.²
- Netherlands's Electricity Act (E-Act) 1998 is an important legislation for the creation of the electricity market for producers and suppliers of electricity.¹²
- Netherlands's Authority for Consumers and Markets (ACM) regulates the transmission and distribution operators of electricity and gas.¹³
- TenneT is a leading European electricity transmission system operator (TSO) that manages operations in Netherlands and Germany.¹⁴
- In Netherlands, EPEX SPOT is the leading exchange for providing market spot to buy, sell, and trade electricity, secure transactions, and auctioning services.¹⁵



Infrastructure

- Netherlands's TenneT, the TSO, owns and operates over 24,500 kms of high-voltage lines and cables and catering to 42 Mn customers.¹⁴
- Netherlands's TenneT operates 110 kV, 380 kV and 220 kV high voltage grid throughout the country.^{14, 16}
- Netherlands's TenneT has planned its expansion by constructing 40 new onshore high voltage substation.¹⁶
- Netherlands has an arrangement for cross border trading of electricity with Germany through TenneT as its TSO.¹⁴



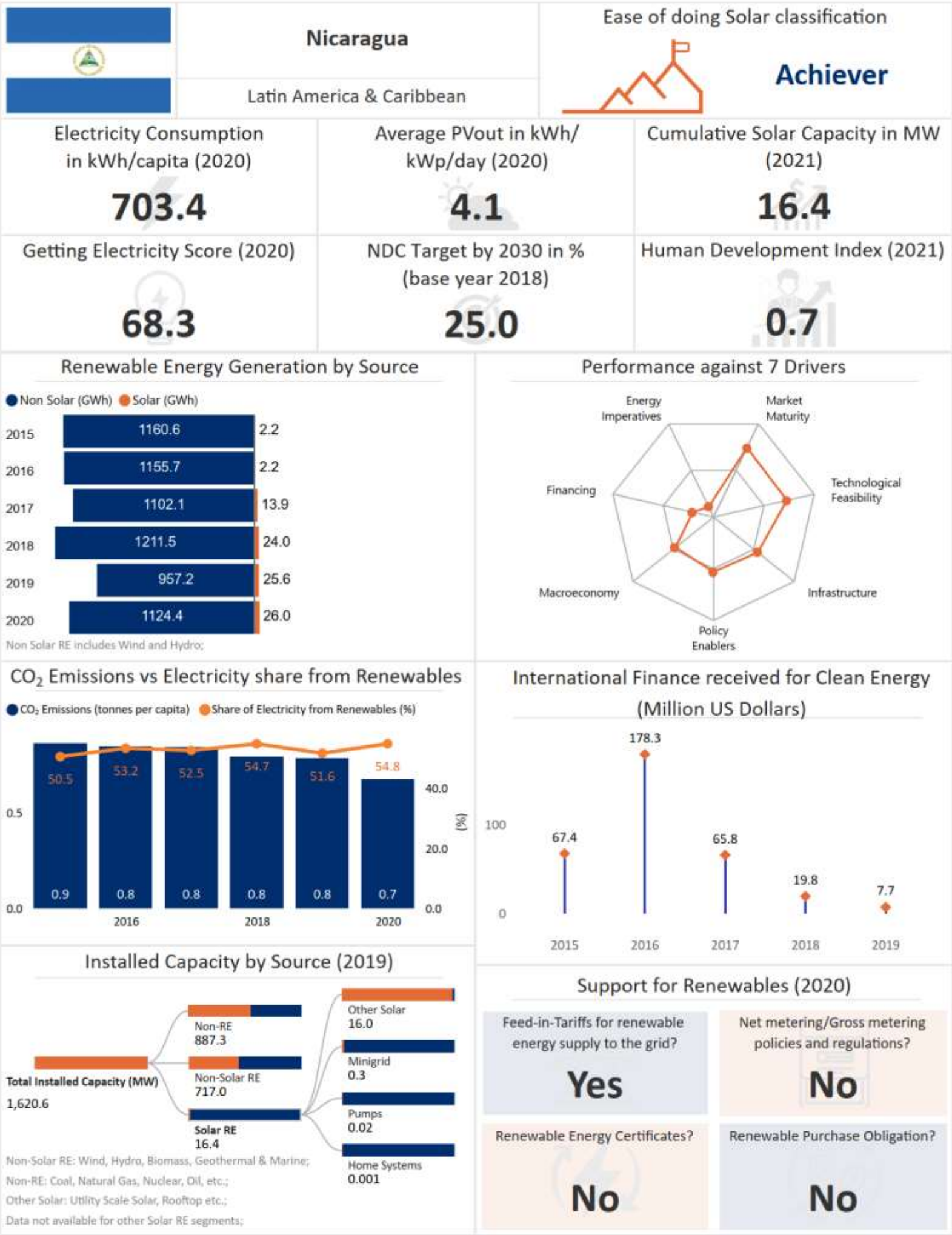
Financing

- The Government of Netherlands has announced its budgetary support of USD 13.09 Bn to SDE++ program for large scale RE projects.¹⁷
- In 2021, European Investment Bank (EIB) signed an agreement of USD 503 Mn with Orsted A/S in support of the commitment towards RE.¹⁸
- The Dutch Fund for Climate Fund (DFCF) is a consortium of Climate Fund Managers (CFM), World Wide Fund for Nature Netherlands (WWF-NL) and SNV Netherlands Development Organisation led by the Dutch Entrepreneurial Development Bank for extending financial support to climate resilient economic growth.¹⁹

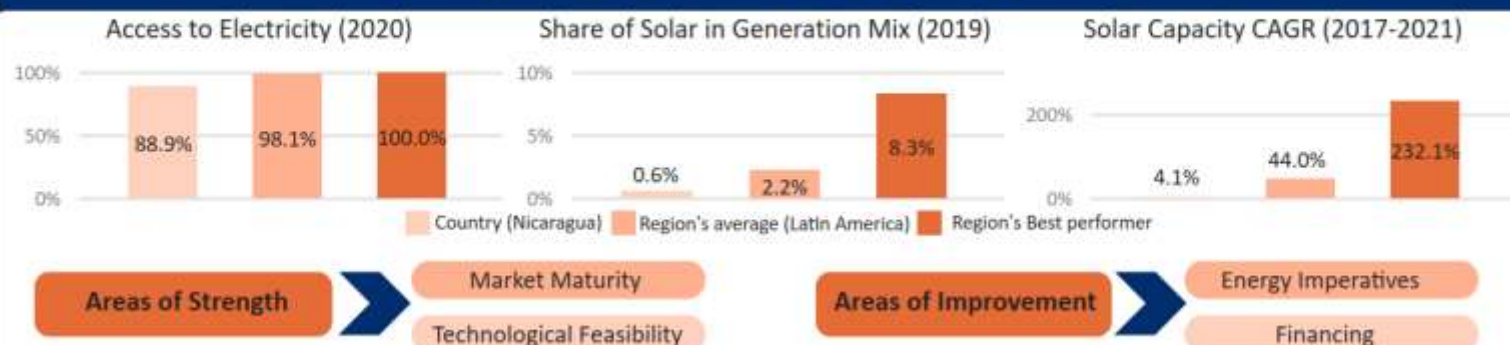


Energy Imperatives

- In 2020, Netherlands's per capita electricity consumption stood at 6.92 MWh, which is significantly higher in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 48.8% reaching 14,249 MW in 2021 from 2,903 MW levels in 2017.²¹
- In 2021, the total installed capacity stood at 46.73 GW with a significant share coming from gas (46.95%) followed by coal (12.02%), wind (14.91%), solar (9.40), fossil fuel based (4.65%), and hydro (0.07%).^{22,23}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Nicaragua is a lower-middle income country with a GDP per capita (PPP) of USD 6,195 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) declined by 1.8% in 2020. However, in 2021, it has bounced back growing at a rate of 10.3%.³
- The inflation rate (CPI) of Nicaragua has increased to 4.9% in 2021 from 3.7% levels in 2020.⁴
- The general government gross debt to GDP has marginally increased to 49.4% in 2021 from 48.1% levels in 2020.⁵



Policy enablers

- Nicaragua has set a target to achieve 60% of RE share in its electricity generation mix by 2030.⁶
- The Ministry of Energy and Mines had developed an Indicative Electricity Generation Plan (2013-2027) to analyse power generation capacity from RE sources.⁷
- Nicaragua's National Sustainable Electrification and Renewable Energy Program (PNESER) has supported the government to promote efficient and sustainable electricity service.⁸



Technological Feasibility

- Nicaragua receives high levels of solar irradiation (GHI) of 5.04 kWh/m²/day and specific yield 4.1 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁹
- The Central American Bank for Economic Integration (CABEI) has signed a technical cooperation agreement with Nicaragua to carry out a study on adoption of Battery Energy Storage System Applications (BESS).¹⁰



Market Maturity

- 88.9% of the population in Nicaragua had access to electricity as of 2020.¹²
- Nicaragua's state owned Empresa Nicaraguense de Electricidad (ENEL) was unbundled in 1998-99 and private participation in generation and distribution business were allowed in the country.¹³
- Nicaragua has four generation companies (GEMOSA, GEOSA, HIDROGESA, GECSA), one transmission company (ENATREL) and two distribution companies (DISNORTE and DISSUR).¹³



Infrastructure

- Nicaragua transmission system comprises of lines operating at 230 kV, 138 kV and 69 kV, 24.9 kV and 13.8 kV.¹⁴
- The national transmission system is spread out with 2,404.87 kms of circuit and 91 sub-stations in operation.¹⁴



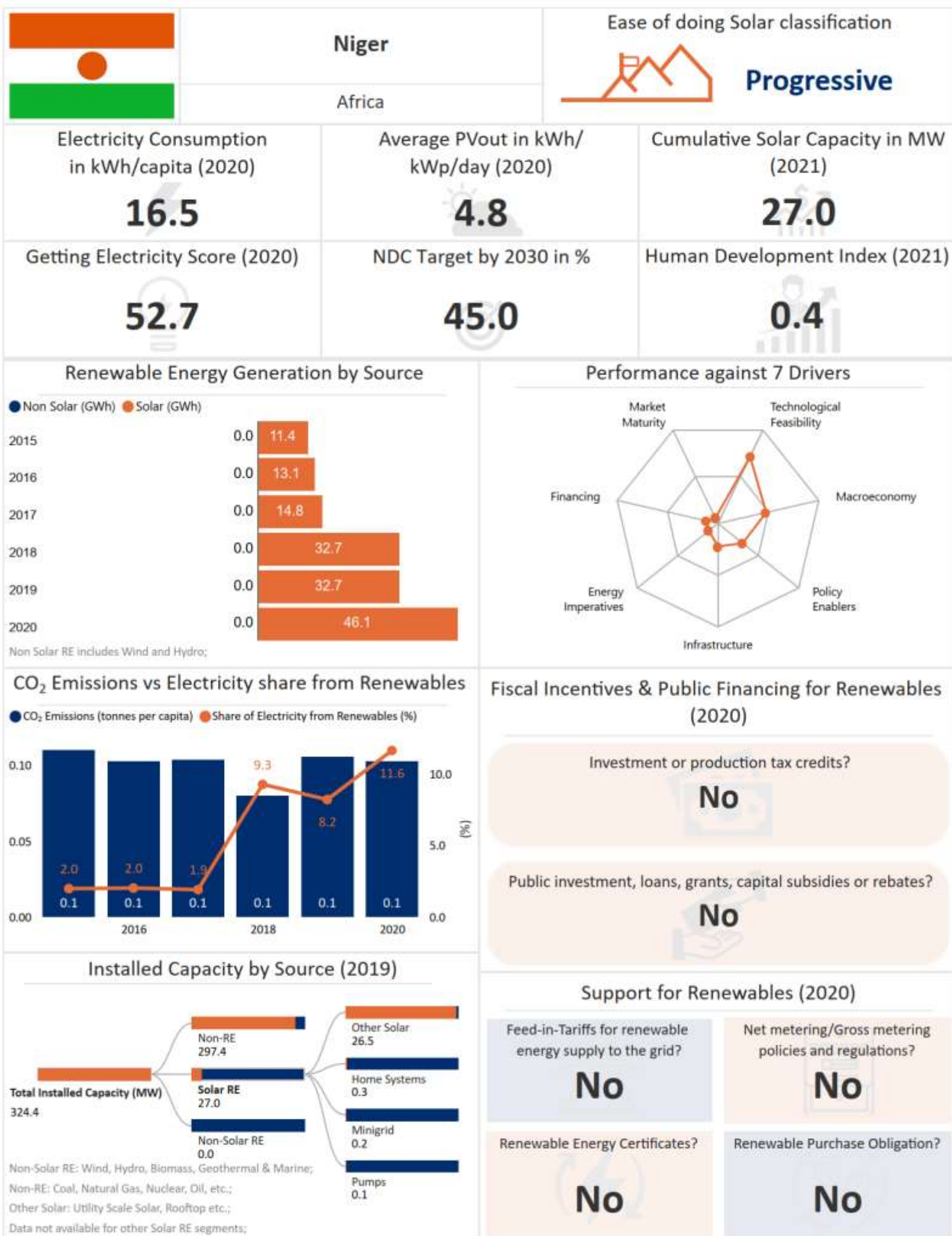
Financing

- In 2020, the Central American Bank for Economic Integration (CABEI) had approved a loan of USD 143 Mn to the Republic of Nicaragua to finance its National Program for Sustainable Electrification and Renewable Energy (PNESER).¹⁵
- In 2018, the Inter-American Development Bank had extended a loan of USD 20 Mn to finance RE projects managed by small and medium enterprises.¹⁶
- The Climate Investment Funds (CIF) has invested in Nicaragua through its Scaling up Renewable Energy Program (SREP) and Clean Technology Fund (CTF).¹⁷



Energy Imperatives

- In 2020, the per capita electricity consumption of 0.703 MWh in Nicaragua, which is lower in comparison to the global average of 3.31 MWh.¹⁸
- The total installed capacity of Solar PV witnessed a CAGR of 4.1% reaching 16.4 MW in 2021 from 14 MW levels in 2017.¹⁹
- The demand for electricity in the country stood at 5.09 TWh remaining similar in 2021 and 2020.²⁰
- In 2021, the total installed capacity in the country stood at 1.9 GW with major share coming from other fossil fuel (43.99%) followed by other renewables (16.74%), wind (15.67%), hydro (12.23%), bioenergy (10.94%), solar (0.43%).^{20, 21}



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Niger is a low-income country with a GDP per capita (PPP) of USD 1,304 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 1.3% in 2021 and it is estimated to grow by 6.9% in 2022. ³
- The inflation rate in the country declined to 3.2% in 2021 from 4.4% levels in 2020. ⁴
- Total public debt in the country increased to 50.9% of GDP in 2021 from 43.6% levels in 2020. ⁴



Policy enablers

- The Ministry of Energy is responsible for defining, implementing, monitoring and evaluating electricity policy in Niger. ⁵
- The Department for the Promotion of Renewable Energies is responsible for promoting and developing RE sector in the country. ⁵
- The Government of Niger created a Nigerien Agency for the Promotion of Rural Electrification (ANPER) to design, implement, and monitor rural electrification programs. ⁶
- Lighting Africa worked with the Niger Ministry of Energy and Ministry of Finance to exempt taxes on imports of solar and other RE products that came into effect in 2017. ⁷



Technological Feasibility

- Niger receives very high levels of solar irradiation of 6.2 kWh/m²/day and a specific yield of 4.8 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁸
- Niger's Solar Home Systems sales recorded the largest percentage increase in the region (with an impressive 325%) and reached record volumes of 14,000 units sale from July 2019 to December 2019 period. ⁹
- ANPER launched a nationwide feasibility study on mini-grid development with the support of USAID and Power Africa in 2019. ⁶



Market Maturity

- 19.3% population in Niger had access to electricity as of 2020. ¹⁰
- The Société Nigérienne d'Electricité (NIGELEC) is responsible for electricity production, transmission, and distribution. ¹¹
- Autorité de Régulation du Secteur de l'Energie au Niger (ARSE) is the energy sector regulatory authority of Niger. ¹²
- Niger is a member of the West African Power Pool (WAPP), which aims to integrate the national power systems into a unified regional electricity market. ¹³



Infrastructure

- The Nigeria-Niger-Benin-Burkina Faso power interconnection project of one 330 kV double-circuit line over 842 kms allows power exchange among the Countries in the WAPP. ¹⁴
- In 2022, the Economic Community of West African States (ECOWAS) started to build the "North Backbone" ("Dorsale Nord"), a 330 kV transmission line worth USD 568 Mn between Nigeria, Niger, Burkina Faso, Benin, and Togo. ¹⁵
- The AfDB approved a USD 550 Mn investment for the construction of a 330 kV transmission line from Birnin Kebbi (Nigeria) to Ouagadougou (Burkina Faso) through Niamey (Niger). ¹⁶



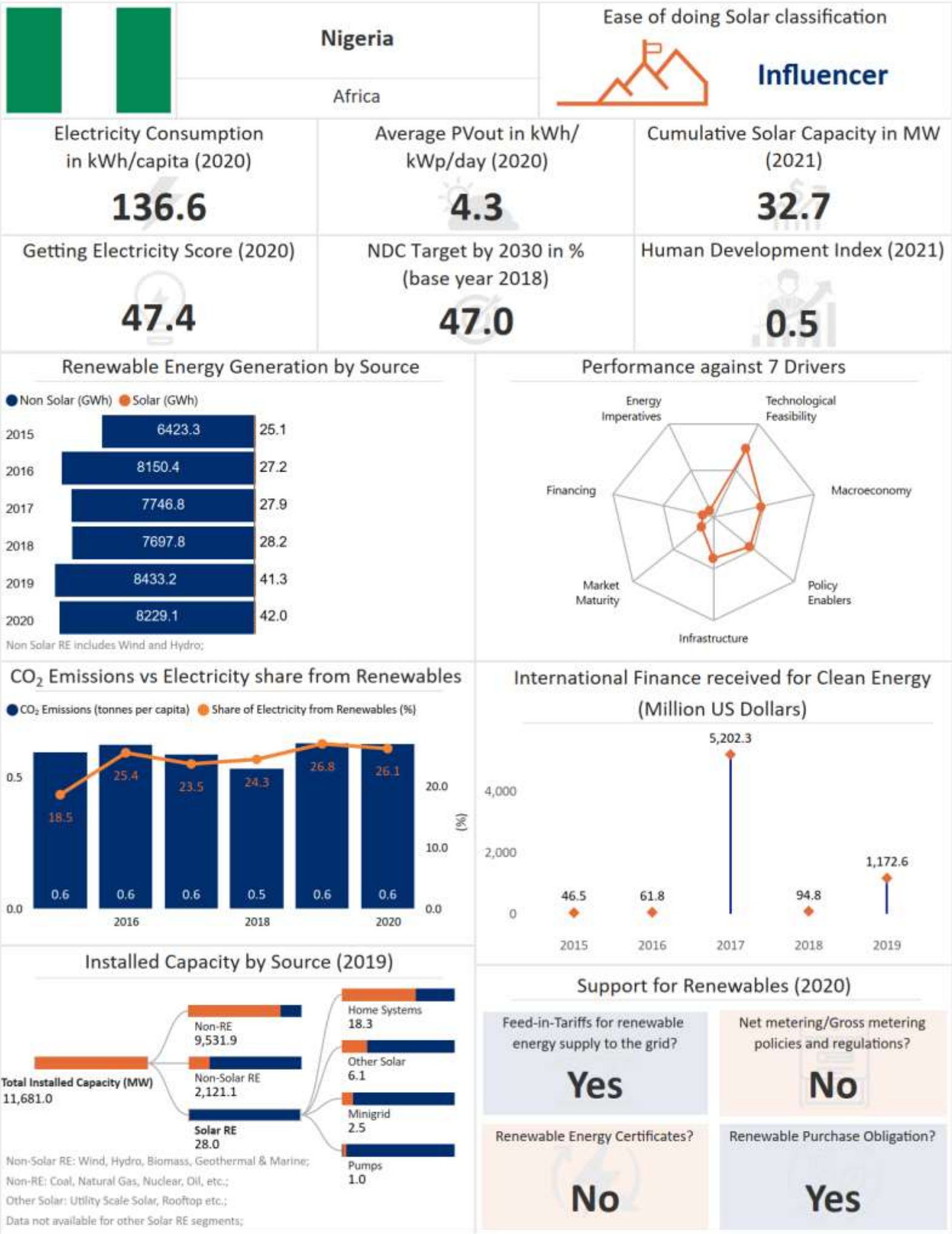
Financing

- In 2022, AfDB approved USD 379.6 Mn Desert to Power financing facility for Niger and committed to providing technical assistance over the next seven years. ¹⁷
- International fund flow in 2018 was USD 29.2 Mn (in PPP terms) to support clean energy and RE deployment. ¹⁸
- In Niger, the World Bank has shown keen interest in providing finance for 22 national and 10 regional projects valued at USD 2.98 Bn. ¹⁸



Energy Imperatives

- In 2020, Niger's per capita electricity consumption of 0.016 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ²¹
- The total installed capacity in the country stood at 324.43 MW in 2019. ¹⁹
- The total installed capacity of Solar PV witnessed a CAGR of 31.5% between 2017-2021 reaching 27.04 MW in 2021 from 9.04 MW levels in 2017. ²⁰
- The price of electricity in the country stood at 19.3 US Cents/kWh as of 2019. ²²



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Nigeria is a lower middle-income country with a GDP per capita (PPP) of USD 5,408 in 2021. ^{1, 2}
- GDP (Real) grew at an annual rate of 3.6% in 2021 and it is estimated to grow by 3.4% in 2022. ³
- The fiscal deficit narrowed down to 4.8% of GDP in 2021 from 5.4% levels in 2020 due to a modest uptick in revenues. ⁴
- Total public debt in the country stood at 22.5% of GDP in 2021. ⁴



Policy enablers

- The Federal Ministry of Power is the policy-making arm of the Federal Government with the responsibility for the provision of power in the country. ⁵
- The Government of Nigeria approved feed-in tariff regulations in 2015 that mandate electricity distribution companies to source at least 50% of their electricity requirements from renewables. ⁶
- In 2016, Nigeria adopted the Mini-Grid Policy to regulate mini-grids and speed up the electrification process in the country. ⁷



Technological Feasibility

- Nigeria receives high levels of solar irradiation of 5.2 kWh/m²/day and a specific yield of 4.3 kWh/kWp/day indicating strong technical feasibility for solar in the country. ⁸
- Stand-alone solar photovoltaic (PV) systems offer pay-as-you-go (PAYGo) business models for mini-grids that are not sustainable. ⁹
- The Nigeria Automotive Design and Development Council (NADDC) inaugurated the first Electric Vehicle Charging Station in Nigeria. ¹⁰



Market Maturity

- 55.4% population in Nigeria had access to electricity as of 2020. ¹¹
- Nigerian Electricity Regulatory Commission (NERC) is an independent regulatory body with the authority for regulating electric power industry in Nigeria. ¹²
- Transmission Company of Nigeria (TCN) is responsible to operate, expand/upgrade transmission facilities for efficient and effective wheeling of generated electricity. ¹³
- There are 11 Electricity Distribution Companies in Nigeria namely- Abuja, Benin, Eko, Enugu, Ibadan, Ikeja, Jos, Kaduna, Kano, Port Harcourt, and Yola. ¹⁴



Infrastructure

- Nigeria's transmission network comprises of high voltage substations with a transmission wheeling capacity of 7,500 MW and over 20,000 km of transmission lines. ¹⁵
- The transmission losses stand at 7.4% across the network and is high as compared to emerging countries benchmark of 2-6%. ¹⁵
- The transmission network system requires a significant amount of investment for increasing wheeling capacity, improving reliability, and stability, and reducing transmission losses. ¹⁵



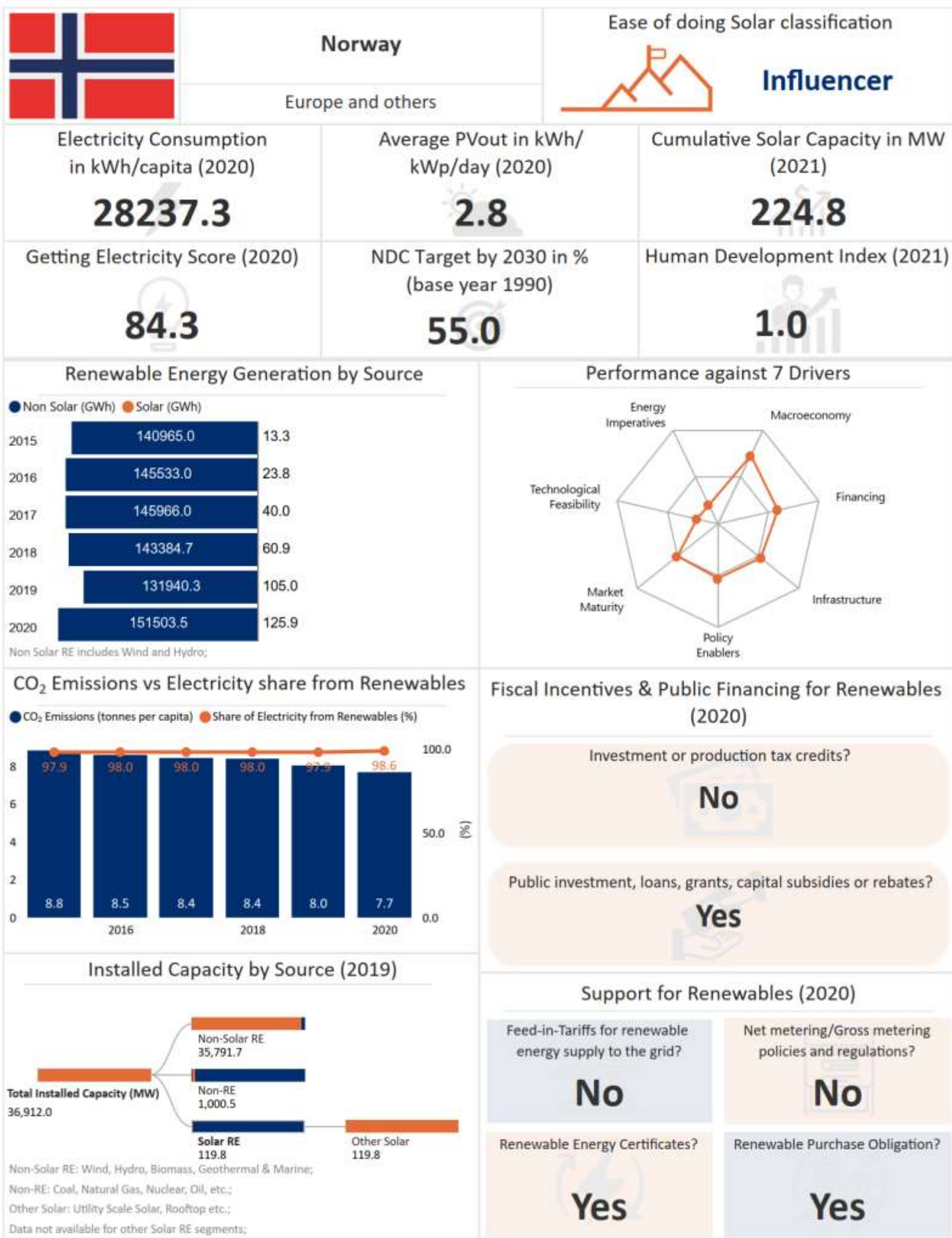
Financing

- In 2022, the AfDB approved the Leveraging Energy Access Finance Framework (LEAF) under which the bank will commit up to USD 164 Mn to promote decentralized RE in Nigeria. ¹⁶
- The Nigeria Energy Access Fund (NEAF), a climate impact fund of USD 50-60 Mn, will undertake equity/quasi-equity investments in small- to medium-scale sustainable energy projects. ¹⁷
- The AfDB approved a USD 1.5 Mn grant from the Sustainable Energy Fund for Africa (SEFA) to support the Nigerian Government's implementation of Phase 1 of the Jigawa 1-GW IPP Solar Procurement Program. ¹⁸

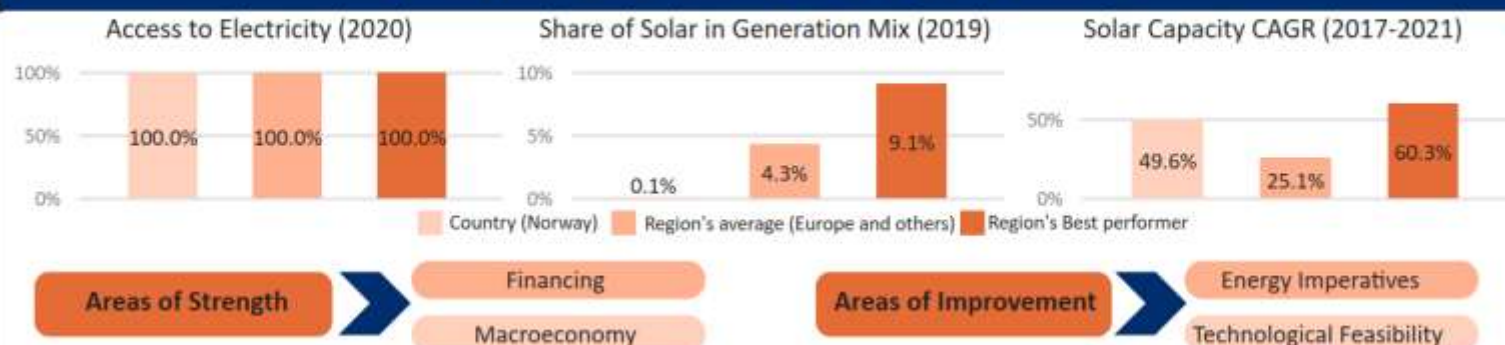


Energy Imperatives

- In 2020, Nigeria's per capita electricity consumption stood at 0.14 MWh, which is significantly lower in comparison to the global average of 3.31 MWh in 2020. ²¹
- The total installed capacity in the country stood at 11,681 MW in 2019. ¹⁹
- The price of electricity in the country stood at 13.6 US Cents/kWh as of 2019. ²²



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Norway is a high-income country with a GDP per capita (PPP) of USD 80,535 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) had declined to 0.7% in 2020. However, in 2021 the GDP bounced back growing at rate of 3.9%.³
- The inflation rate (CPI) of Norway has increased to 3.5% in 2021 from 1.3% levels in 2020.⁴
- The general government gross debt to GDP has reduced to 43.4% in 2021 from 46.8% levels in 2020.⁵



Policy enablers

- Norway has set a target to cut down its carbon emissions by around 40% (from 1990 levels) by 2030.⁶
- Norway's Electricity Certificates Act, 2011 aims to increase generation of electrical energy from RE sources.⁷
- The Government of Norway has taken an initiative to promote and develop offshore wind power at par with the total amount of electricity currently produced in Norway.⁹



Technological Feasibility

- Norway receives low solar irradiation (GHI) of 2.6 kWh/m²/day and specific yield 2.8 kWh/kWp/day indicating a low technical feasibility for solar in the country.¹⁰
- In 2021, almost 100% of the country's power demand was met through RE sources.¹¹
- Norway has installed ~220 MW solar PV capacity of installations as of 2021.¹²



Market Maturity

- 100% of the population in Norway had access to electricity as of 2020.²
- Norwegian Energy regulatory Authority (NVE-RME) is the national regulator for the Norwegian electricity and downstream gas markets.¹³
- Statnett SF is the Transmission System Operator (TSO) operating through a license for system operation under regulation of Norwegian Energy Act of 1990.¹³
- In Norway, EPEX SPOT is the leading exchange that provides a platform to buy, sell, and trade electricity, secure transactions, and auctioning services.¹⁴



Infrastructure

- The Norwegian electricity network comprises of transmission part (132 kV to 400 kV) and distribution part (33 kV and below).¹³
- Statnett, the TSO is responsible for maintaining the instantaneous balance of the power supply system and ensuring the quality of electricity supply in the country.¹⁵
- Norway has cross border transmission lines with Denmark, Sweden, Lithuania, Netherlands and recently it also got connected with United Kingdom and Germany.¹⁵



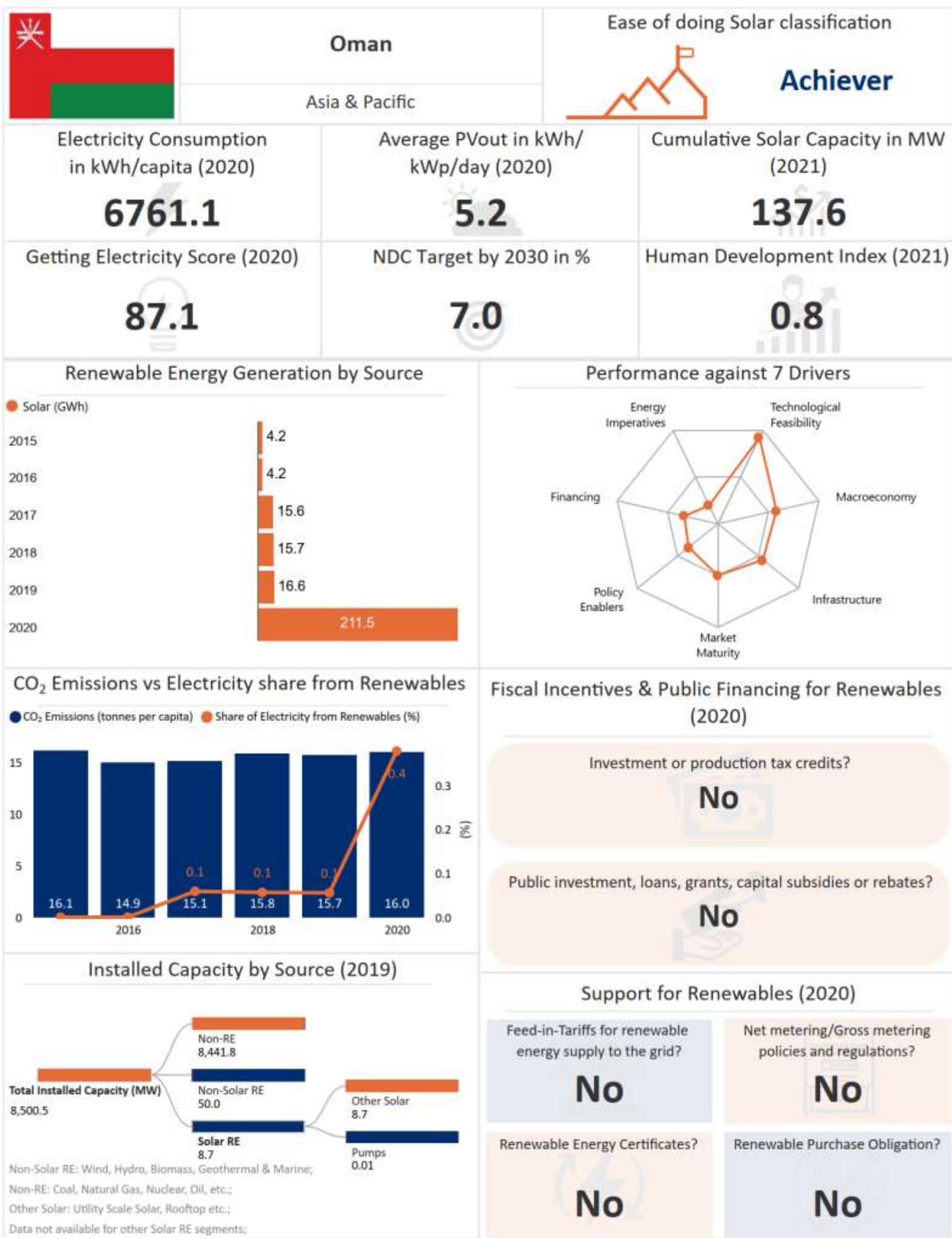
Financing

- Norway has Norfund with a corpus of USD 967.75 Mn which invests in Clean Energy to increase energy access and supply in developing countries.¹⁶
- In 2022, the Government of Norway launched a large-scale investment plan aiming at sea areas to develop 30 GW of offshore wind capacity by 2040.¹⁷
- The Norwegian Agency for Development Cooperation has signed an agreement with the Green Climate Fund to contribute a corpus of USD 39 Mn for climate led ini a ves in the country.¹⁸



Energy Imperatives

- In 2020, Norway's per capita electricity consumption stood at 28.23 MWh, which is significantly higher in comparison to the global average of 3.31 MWh.¹⁹
- The total installed capacity of Solar PV witnessed a CAGR of 49.6% reaching 224.8 MW in 2021 from 44.9 MW levels in 2017.²⁰
- In 2021, the total installed capacity in the country stood at 40.77 GW with a significant share coming from hydro (91.73%) followed by wind (6.46%), solar (0.02%) and other renewables (0.15%).^{21, 22}
- The cost of electricity per kWh is US Cent 13.5 for households and US Cent 14.2 for business.²³



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- The Sultanate of Oman is a high-income status country with GDP per capita (PPP) of USD 37,676. Oil and gas sector is the dominant contributor to the economy.^{1, 2, 3}
- Due to COVID-19 pandemic, the GDP (Real) had declined by 2.8% in 2020, but the economy has bounced back by growing at 2% in 2021.³
- In 2021, agriculture contributed 2.38% to the GDP while 52.2% share came from the industry and 50.67% from the service sector.⁴



Policy enablers

- The country is determined to reduce their absolute GHG emissions by 7% relative to a business-as-usual (BAU) scenario by 2030.⁵
- The country is planning to expand its electricity-generation capacities through RE independent power projects (IPP) and has planned to derive at least 30% of electricity from RE by 2030.⁶
- SAHIM is a renewable initiative taken up by Oman's Authority of Public Services Regulation.⁷



Technological Feasibility

- Oman receives high levels of solar irradiation (GHI) of 6.3 kWh/m²/day and specific yield of 5.2 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁸
- Oman's energy supply is entirely generated by nationally produced natural gas and oil products.⁹
- Oman's state-owned Rural Electricity Company (Tanweer) tendered 11 solar-diesel-storage hybrid projects (in 2019) with a combined capacity of 146 MW for non-interconnected areas.¹⁰



Market Maturity

- The Authority for Electricity Regulation Oman is responsible for regulating the electricity and related water sector in Oman.¹²
- The Oman Power and Water Procurement Company (OPWP) is the sole buyer of power and water for all IPP/IWPP projects within Oman.¹³
- Muscat Electricity Distribution Company SAOC, Majan Electricity Company SAOC, Mazoon Electricity Company SAOC and Dhofar Energy Company are the electricity distribution companies operating in Oman.¹⁵



Infrastructure

- The Oman Electricity Transmission Company SAOC (OETC) owns and operates the 132 kV, 220 kV and 400 kV interconnected transmission systems.¹⁶
- The transmission grid network of Dhofar operates at 132 kV level with 8 grid stations and 520 km length of power circuit lines.¹⁶
- The transmission system is interconnected with the transmission system of UAE (Abu Dhabi Transco) at Mahdah (Al Wasit) grid station through a 220kV interconnector.¹⁶
- Oman has achieved 99.99% of network reliability with an interruption time of 0.95 min.¹⁷



Financing

- The Asian Infrastructure Investment Bank (AIIB) approved a USD 60 Mn loan to increase Oman's renewable power generation capacity and reduce the country's dependence on gas and other fossil fuels for electricity generation.¹⁸
- AIIB has approved financing of up to USD 60 Mn for the Ibrill 500 MW Solar PV Independent Power Plant Project.¹⁹



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 6.76 MWh, which is almost twice in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 102.3% between 2017-2021 reaching to 137.59 MW in 2021 from 8.2 MW levels in 2017.²⁰
- The demand of electricity in Oman in 2021 stood at 34.21 TWh with no change observed from the 2020 levels.²¹
- Oman is dominated by gas based thermal power station comprising 99.2% and rest 0.88 % is from renewables.²³



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Palau is a middle-income country with a GDP per capita (PPP) of USD 15,145 in 2020.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 8.9 % in 2020 and in 2021, the GDP further declined by 13.4%.³
- The inflation rate (CPI) of Palau has declined to 0.4% in 2021 from 0.7% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 19.8% in 2021 from 21.6% levels in 2020.⁵



Policy enablers

- Palau has a policy on tax credits, feed-in-tariff, green public procurement, tax reduction and exemptions to facilitate RE in the country.⁶
- IRENA and Palau's government have come up with "Republic of Palau: Renewable Energy Roadmap 2022-2050" outlining country's ambition to attain an RE share of 92.1% in the generation mix.⁷



Technological Feasibility

- Palau receives high levels of solar irradiation (GHI) of 4.9 kWh/m²/day and specific yield 4.0 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁸
- Palau has accelerated deployment of solar PV and battery storage systems (BESS) through a continuous patronage from the Palau Public Utilities Corporation (PPUC).⁹



Market Maturity

- 100% of the population in Palau had access to electricity as of 2020.¹¹
- Palau's Palau Public Utilities Corporation (PPUC) is a public corporation established to manage and operate the electrical power and the water and wastewater systems.¹²
- Palau Energy Administration (PEA), under the Ministry of Public Infrastructure, Industries, and Commerce acts as the project management unit for several RE and EE projects in Palau.¹³



Infrastructure

- The country is divided into four interconnected electricity grids with 114 linear miles of 13.8 kV distribution lines and is interconnected by 47 linear miles of 34.5-kV undersea transmission lines.¹⁴
- Sharp and Western Caroline Trading Company (WCTC) in Palau has introduced 0.4 MW rooftop PV system in a supermarket and a hotel in Koror, Palau, for self consumption.¹⁵



Financing

- The ADB has invested USD 9.19 Mn in energy projects to strengthen energy security.¹⁶
- The ADB's Disaster Resilient Clean Energy Financing Project will facilitate access of clean energy financing amongst the low-income households and female borrowers.¹⁷



Energy Imperatives

- The total installed capacity of Solar PV witnessed a CAGR of 8.1% between 2017-2021 increasing to 1.7 MW from 1.3 MW between the years.¹⁸
- The electricity generation mix of Palau is dominated by diesel (97.5%) followed by solar (2.5%).¹⁹
- In 2021, the total installed capacity in the country has reached 33.5 MW with maximum share coming from oil (diesel).

20



Papua New Guinea

Asia & Pacific

Ease of doing Solar classification



Potential

Electricity Consumption
in kWh/capita (2020)

473.9

Average PVout in kWh/
kWp/day (2020)

3.7

Cumulative Solar Capacity in MW
(2021)

3.0

Getting Electricity Score (2020)

65.5

NDC Target by 2030 in %

50.0

Human Development Index (2021)

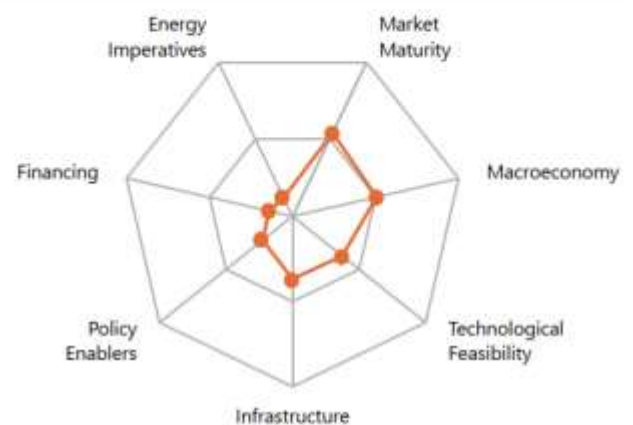
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Renewable Energy Generation by Source

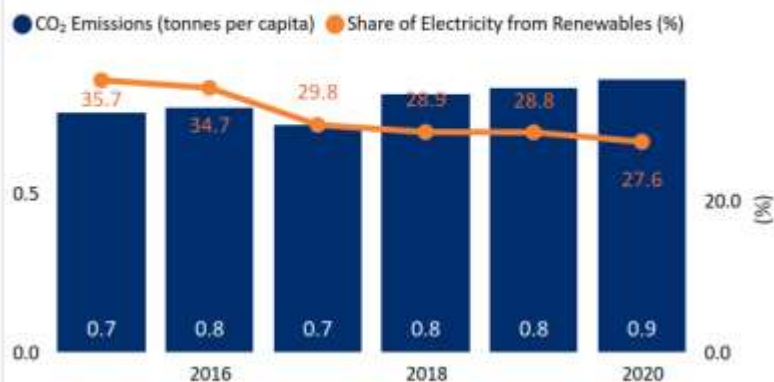


Non Solar RE includes Wind and Hydro;

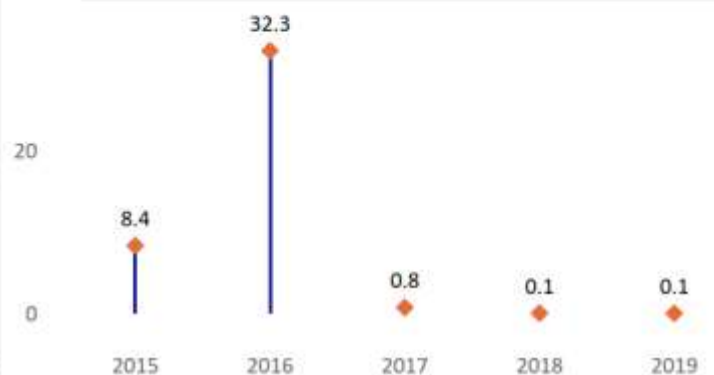
Performance against 7 Drivers



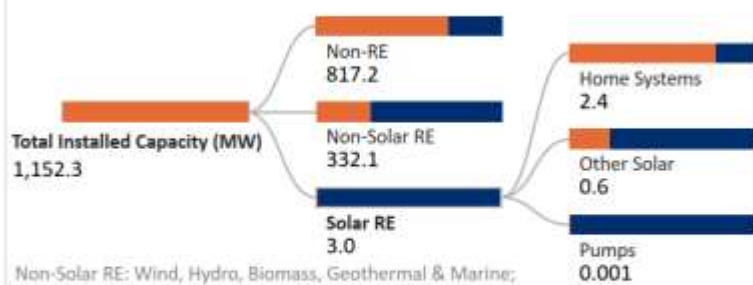
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Papua New Guinea (PNG) is a lower middle-income country with a GDP per capita (PPP) of USD 4,040 in 2021.^{1, 2}
- Due to COVID-19 Pandemic, the GDP (Real) has declined by 3.5% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 1.2%.³
- The inflation rate (CPI) of Papua New Guinea has declined to 4.5% in 2021 from -4.9% levels in 2020.⁴
- The general government gross debt to GDP has increased to 50.9% in 2021 from 47.1% levels in 2020.⁵



Policy enablers

- The government of Papua New Guinea, with its National Energy Policy, has set the ambitious goal of reaching 70% access to electricity by 2030 and to become carbon-neutral by 2050.⁶
- The Government of PNG and UNDP's Facilitating Renewable Energy and Energy Efficiency Applications for Greenhouse Gas Emission Reduction (FREAGER) project has worked closely to create awareness about application of mini grids using hydro and solar resources to improve livelihoods in rural areas.⁷
- PNG electricity sector is governed by Electricity Industry Act 2002.⁸



Technological Feasibility

- Papua New Guinea receives moderate levels of solar irradiation (GHI) of 4.5 kWh/m²/day and specific yield 3.7 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.⁹
- Papua New Guineans are embracing mobile pay-go (PAYG) solar which is improving energy access, rural electrification, renewable energy use and sustainable development.¹⁰



Market Maturity

- 60.4% of the population in Papua New Guinea had access to electricity as of 2020.¹¹
- National Energy Authority (NEA) oversees the implementation of energy regulations in the country.¹²



Infrastructure

- The ADB's Power Sector Development Project has supported government in expanding and upgrading transmission lines for both low and medium voltage.¹³
- A 130 km of overhead transmission line of 132 kV has been installed from Taraka to Singing Substation.¹⁴



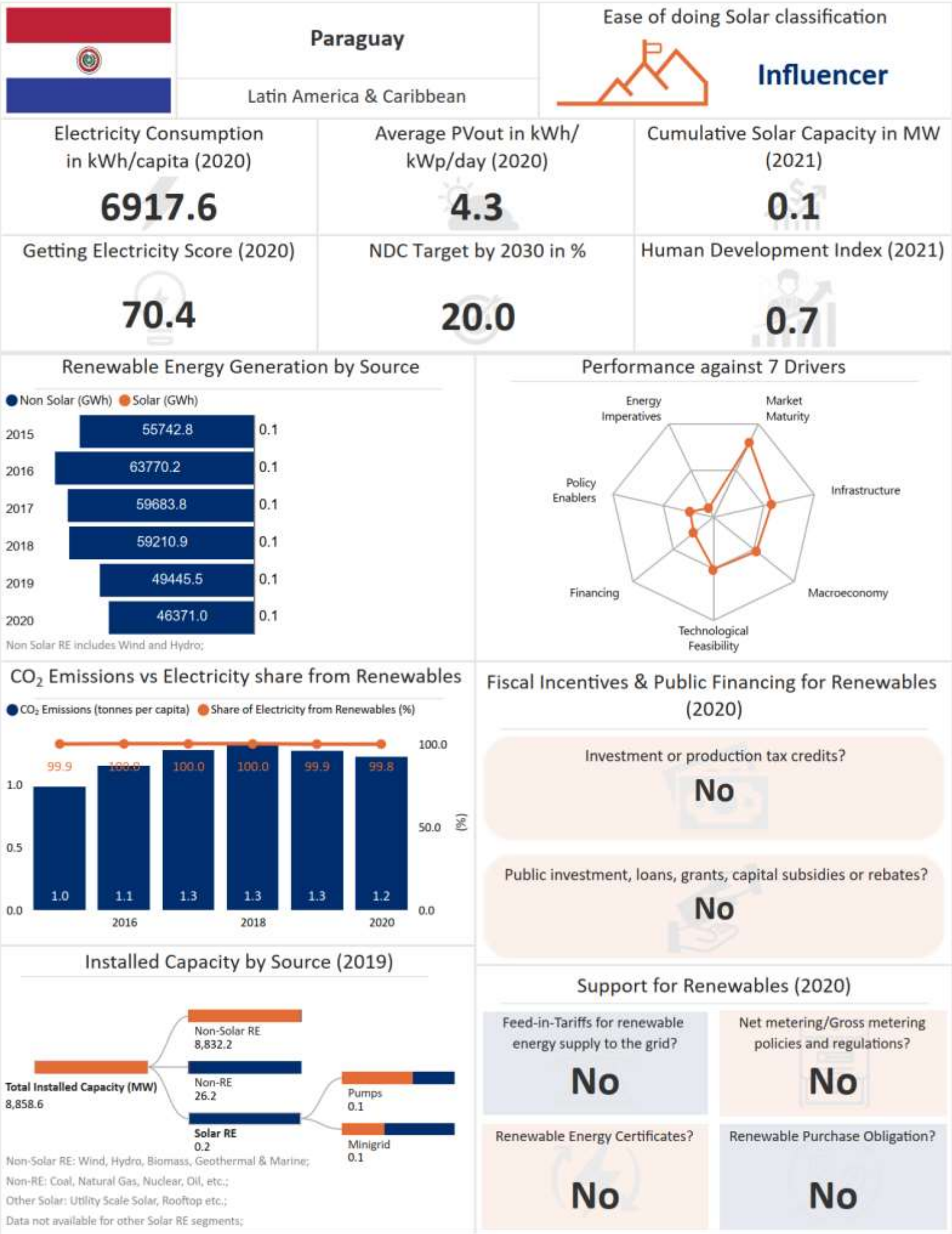
Financing

- Japan International Cooperation Agency (JICA) had extended a loan to PNG government for transmission network upgradation.¹⁴
- ADB's Power Sector Development Investment Program has invested in the country to develop PNG's power sector (Generation, Transmission, Distribution, rural electrification etc.).¹⁵
- World Bank has invested USD 8.35 Mn in PNG's Energy Sector Development Project to strengthen strategic framework for RE and rural electrification.¹⁶

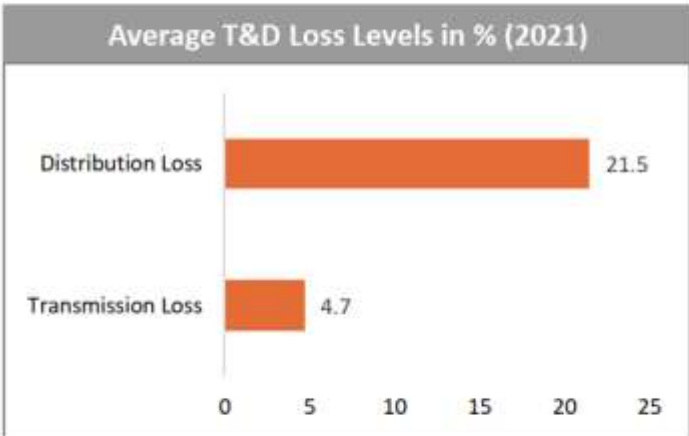
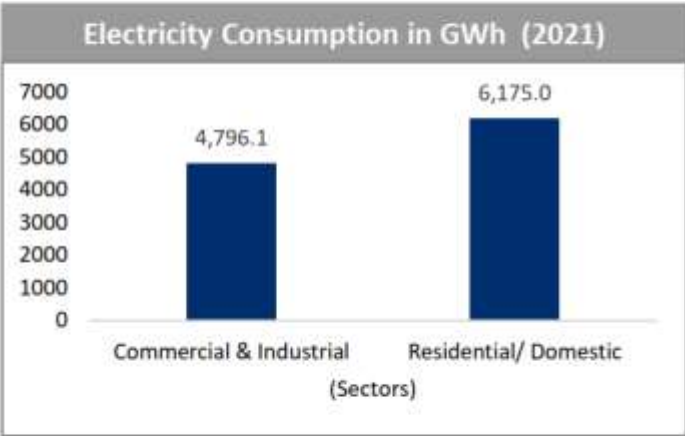


Energy Imperatives

- In 2020, the per capita electricity consumption of 0.473 MWh, which is significantly lower as compared to the global average of 3.31 MWh as of 2020.¹⁷
- The total installed capacity of Solar PV witnessed a CAGR of 25.8% between 2017-2021 reaching 3 MW in 2021 from 1.2 MW levels in 2017.¹⁸
- The peak demand for electricity in the country is 4.24 TWh remaining same in 2020 and 2021.¹⁹
- In 2021, the total installed capacity in the country reached 563.74 GW with a significant share coming from fossil fuels (79.25%) followed by hydro (18.87%).¹⁹



| Peak Demand/Load in GW (2021) | Electricity Consumption CAGR in % (2022 - 2026) | Diesel based Electricity Generation in GWh (2021) |
|-------------------------------|---|---|
| 3.7 | 31.0 | 2.0 |



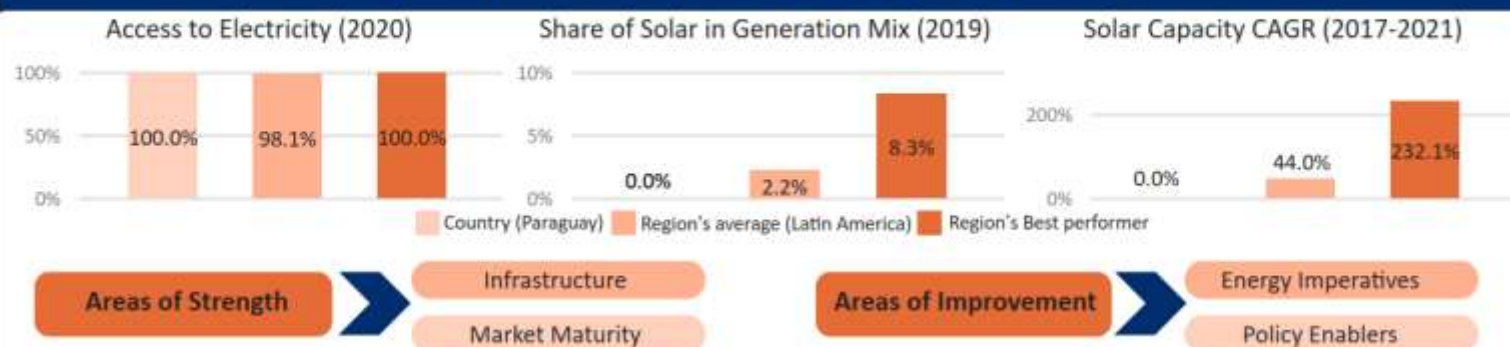
| Accessibility to Payment Mechanisms for purchase of Solar Products (2021) | |
|---|-----|
| Mobile application based online transactions | Yes |
| Digital E-wallets | Yes |
| Cash-on-delivery | Yes |

| Financial Support Mechanisms (2021) | |
|---|----|
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | No | No | No | No | No | No | No | Yes |

| Emerging Technologies/ Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | No |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Paraguay is an upper middle-income country with a GDP per capita (PPP) of USD 15,037 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 0.8% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 4.2%.¹
- The inflation rate (CPI) of the country has increased to 4.8% in 2021 from 1.8% levels in 2020.¹
- The general government gross debt to GDP has reached 37.0% in 2021 from 36.9% levels in 2020.¹



Policy enablers

- By 2030, the country aims to have a 5% share of solar energy in the generation mix.⁶
- The Vice Ministry of Mines and Energy (VMME) has released a conceptual framework in 2021 outlining guidelines for encouraging green hydrogen development for the country's long-term socio-economic growth.⁹
- Duty waivers for solar developers importing/purchasing material are available in the country to support the growth of solar projects.⁶



Technological Feasibility

- Paraguay receives high levels of solar irradiation (GHI) of 5.1 kWh/m²/day and specific yield 4.3 kWh/kWp/day indicating a strong technical feasibility for solar in the country.³
- In 2021, 100% of the country's power demand was met through RE sources.⁴



Market Maturity

- 100% of the population in Paraguay is having access to electricity since 2019.⁴
- The energy mix of the Republic of Paraguay is dominated by clean energy sources, where hydropower accounts for the largest share of the country's power generation representing ~99.5% of the installed power capacity.⁷
- The power sector is vertically integrated but lacks an independent regulator. The nation's street lighting and electricity generation, transmission, and distribution are all under the jurisdiction of National Electricity Administration (ANDE).⁷



Infrastructure

- Between 2022 and 2026, Paraguay plans to invest USD 2,940.63 Mn in the transmission and distribution sector for its upgradation to meet future demand and enhance quality of electricity supply.⁶
- The nation has reported distribution losses of 21.48% and it intends to boost the distribution infrastructure by constructing additional feeders and increasing sub-station capacity to 1,752 MVA by 2025.^{6,9}
- The country's transmission network operates at voltage level of 66 kV and higher with installed line lengths totalling 6,901 ckm operating at loss levels of 4.72%.^{6,7}



Financing

- The IDB approved a USD 260 Mn loan in March 2022 supporting Paraguay's National Development Plan 2030 by expanding the electrical transmission infrastructure thus enhancing the reliability and quality of electricity supply.⁸
- Since 2017, the nation has received more than USD 1.12 Bn in grants and loans from numerous international lending institutions including JICA, IDB, CAF, UNDP, and GCF.⁷



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 6.92 MWh, which is significantly higher in comparison to the global average of 3.31 MWh.⁴
- The demand for electricity in the country has increased to 49.34 TWh in 2021 from 17.59 TWh levels in 2020.⁴
- In 2021, the total installed capacity in the country stood at 8.86 GW with a significant share coming from hydro (99.4%) followed by fossil fuels (0.3%) and bioenergy (0.2%).⁴



Peru

Latin America & Caribbean

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

1632.0

Average PVout in kWh/
kWp/day (2020)

4.9

Cumulative Solar Capacity in MW
(2021)

336.0

Getting Electricity Score (2020)

74.5

NDC Target by 2030
in MtCO₂e

179.0

Human Development Index (2021)

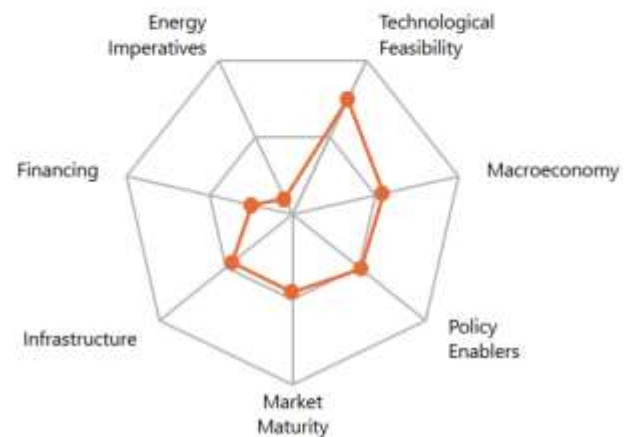
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Renewable Energy Generation by Source

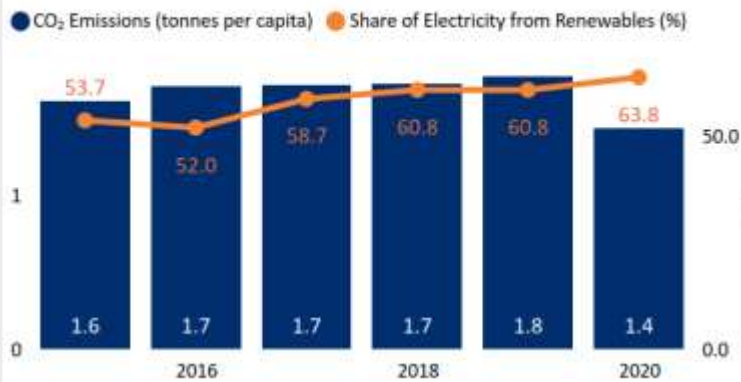


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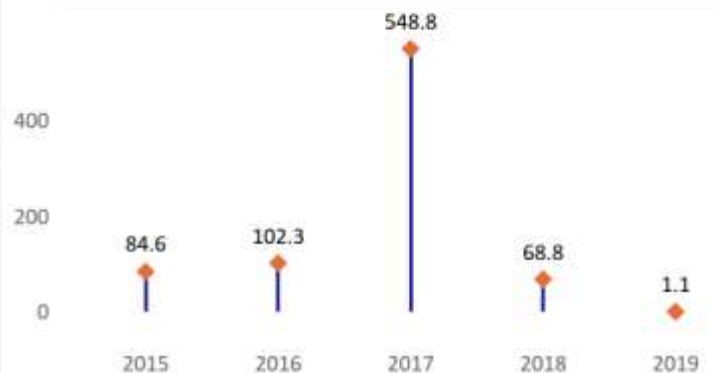
Performance against 7 Drivers



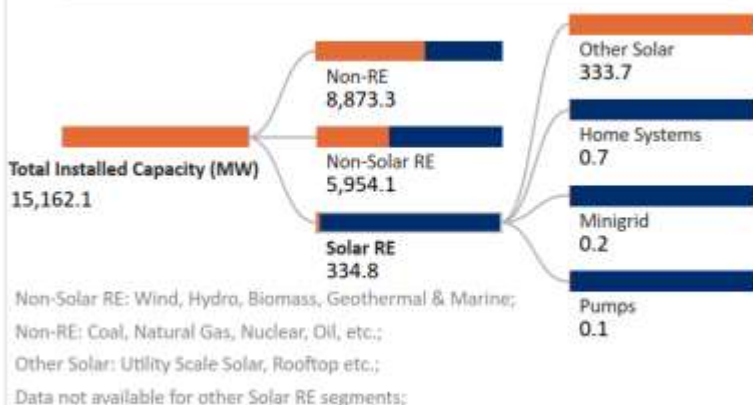
CO₂ emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

Yes

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

Yes

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Peru is an upper middle-income country with a GDP per capita (PPP) of USD 13,749 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 11.0% in 2020. However, in 2021, the GDP has bounced back registering an annual growth rate of 13.3% which is one of the fastest recoveries in the world.¹
- The inflation rate (CPI) of the country has increased to 4.0% in 2021 from 1.8% levels in 2020.¹
- The general government gross debt to GDP has reached 35.9% in 2021 from 35.1% levels in 2020.¹



Policy enablers

- The National Rural Electrification Plan 2016-25 aims to provide electricity access to 3.3 Mn people in rural regions through an investment of USD 1,280 Mn in rural electrification systems of which USD 294 Mn is for solar PV installations.⁷
- Various incentives such as priority dispatch to clean energy plants and 20% accelerated depreciation for renewables projects and net metering are being implemented in the country to promote the development of renewable energy.^{7,10}



Technological Feasibility

- Peru receives high levels of solar irradiation (GHI) of 5.2 kWh/m²/day and specific yield 4.9 kWh/kWp/day indicating a strong technical feasibility for solar in the country.³
- In 2021, 58.93% of the country's power demand was met through RE sources.⁴
- The country's solar PV generation capacity is underutilised with 800 GWh of power generated in 2019 out of a potential of 559,000 GWh/year.^{4,9}



Market Maturity

- 99.3% of the population in Peru had access to electricity as of 2020.⁴
- OSINERGMIN (Organismo Supervisor de la Inversión en Energía y Minería), an independent public institution, regulates the power sector in the country.⁶
- The utilities for generation, transmission, and distribution are unbundled with various private companies operating in these areas.⁸
- The country has a vibrant electricity market with bilateral contracts and open access legislation that provides a high level of transparency in procedures, market pricing, quantities and payment settlements.⁸



Infrastructure

- The transmission sector is privatised and handled by corporations such as Red de Energía del Perú S.A. (REPSA), Consorcio Energético Huancavelica (CONENHUA), Eteselva S.R.L., and others.
- The network operating voltage levels range from 30 kV to 500 kV and by 2025, the total length of their transmission lines is anticipated to reach 31,841 ckm.⁷
- Key private corporations dominate the distribution sector with major participants including Enel, Edelnor, and Luz del Sur.⁷
- The country's national grid is linked to Ecuador by a 220 kV interconnector with trade volumes reaching 33 GWh in 2020.⁷



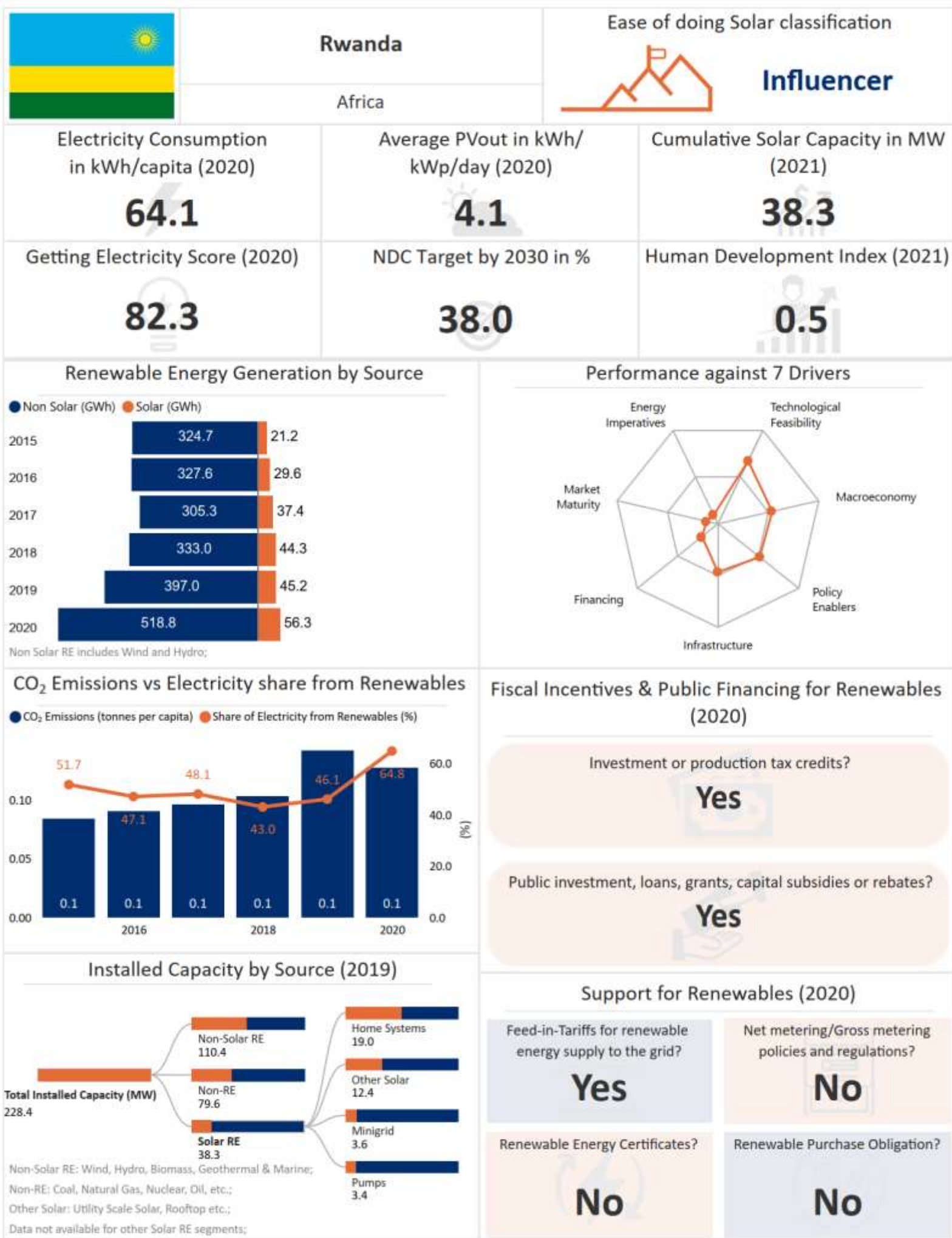
Financing

- In 2017, European Investment Bank (EIB) has sanctioned a loan of USD 150 Mn to ENEL for development of wind farm and solar power plant with a capacity of 312 MW.¹¹
- The CAF (development bank of Latin America) and the Official Credit Institute (ICO) have signed a USD 40 Mn financing agreement for the development of two wind plant with a total capacity of 36.8 MW.¹²
- The climate change law 2017 targets to promote funding for RE in the country thus mitigating climate change.¹³

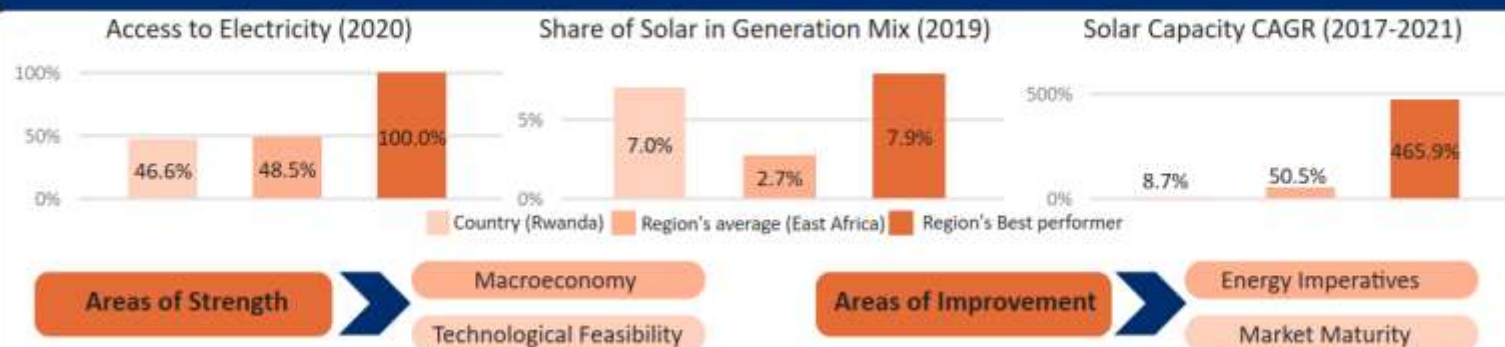


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 1.63 MWh, which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The peak demand for electricity in the country has increased to 52.49 TWh in 2021 from 57.35 TWh levels in 2020.⁴
- In 2021, the total installed capacity in the country stood at 12.53 GW with a significant share coming from hydro (43.8%) and gas (38.1%) followed by wind (3.3%).⁴
- The total installed capacity of solar PV witnessed a CAGR of 3.1% between 2017-2021 reaching 336 MW in 2021 from 297 MW levels in 2017.⁵



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Rwanda is a low-income country¹ with a GDP per capita (PPP) of USD 2,460 in 2021.²
- GDP (Real) grew at an annual rate of 10.2% in 2021 and it is estimated to grow by 6.4% in 2022.³
- The current account deficit widened from 12.2% of GDP in 2020 to 13.5% levels of GDP in 2021 due to higher oil prices and increased imports of capital goods.⁴
- The debt-to-GDP ratio in the country climbed from 71.2% in 2020 to 74.6% levels in 2021.⁴



Policy enablers

- The Ministry of Infrastructure (MININFRA) is responsible for initiating programs to increase the access to affordable energy and the development of policies and strategies in the country.⁵
- The Rwanda Energy Policy highlights measures that need to be undertaken to promote energy efficiency through a combination of approaches such as regulations, new codes, and standards, and the introduction of economic incentives such as subsidies for installation of solar water heaters.⁶
- Rwanda Utilities Regulatory Agency (RURA) regulates the electricity sector, sets the tariff and has recently published the National Renewable Energy Feed in Tariff in Rwanda.⁷



Technological Feasibility

- Rwanda receives high levels of solar irradiation of 4.9 kWh/m²/day and a specific yield of 4.1 kWh/kWp/day indicating strong technical feasibility for solar in the country.⁸
- Power Africa advises the Rwandan government on the design and implementation of its rural electrification strategy, which supports the roll-out of solar home systems and mini-grids.⁹
- The UN Environment program is currently active in Rwanda and is working on the introduction of electric two and three wheelers.¹⁰



Market Maturity

- 46.6% population in Rwanda had access to electricity as of 2020.¹¹
- The Energy Utility Corporation Limited (EUCL) is responsible for the generation, transmission, and distribution of electricity to end-users.¹²
- Rwanda is a member of the Eastern African Power Pool (EAPP) which aims to optimize the available energy resources and reduce electricity costs.¹³



Infrastructure

- Rwanda's transmission network comprises of 3 main voltage levels: 70 kV, 110 kV, and 220 kV transmission lines.¹⁴
- Of the total network, 648.28 km (66.6%) are 110 kV and 324.85km (33.4%) are 220 kV. Many 70 kV lines were upgraded to 110 kV to improve network reliability and power supply stability.¹⁴
- The distribution network suffers from poor reliability, resulting from underinvestment due to lack of clear plans in the distribution part of the network.¹⁵



Financing

- In 2022, the AfDB approved two loans amounting to USD 180 Mn to co-finance a major energy project, which will extend electricity access to rural areas and reduce greenhouse gas emissions in Rwanda.¹⁶
- The Government of Rwanda signed a €229.20 Mn funding agreement with the AfDB to support the country's program to improve electricity supply and expand access to electricity under the Scaling Up Electricity Access Program Phase II (SEAP II).¹⁷
- In 2021, the AfDB approved USD 84.22 Mn in loans and grants to electrify nearly 80,000 rural households.¹⁸



Energy Imperatives

- In 2020, Rwanda's per capita electricity consumption stood at 0.06 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity in the country stood at 235.61 MW in 2021.¹⁵
- The price of electricity in the country stood at 13.9 US Cents/kWh as of 2019.²¹



Saint Kitts and Nevis

Latin America & Caribbean

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

3948.0

Average PVout in kWh/
kWp/day (2020)

4.6

Cumulative Solar Capacity in MW
(2021)

2.0

Getting Electricity Score (2020)

70.2

NDC Target by 2030 in %
(base year 2010)

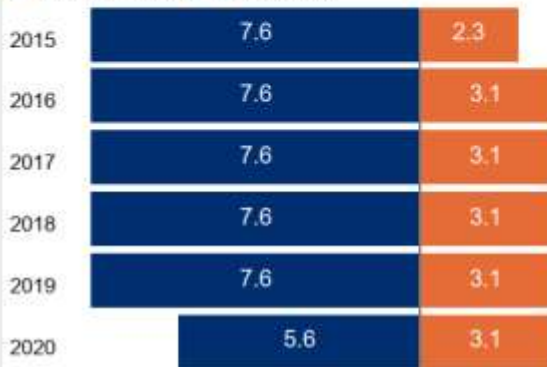
61.0

Human Development Index (2021)

0.8

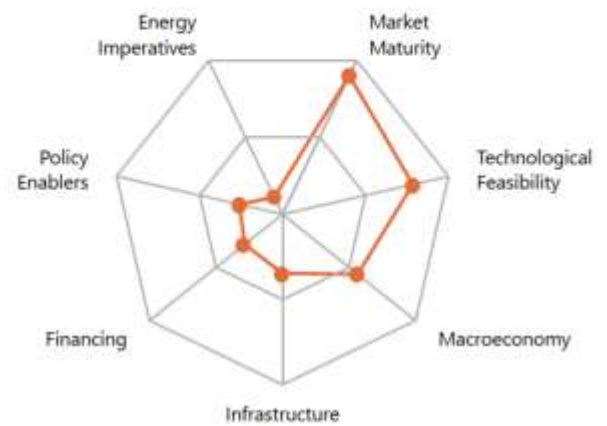
Renewable Energy Generation by Source

● Non Solar (GWh) ● Solar (GWh)



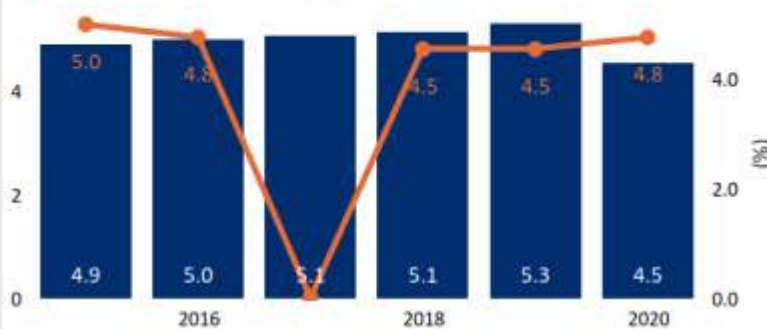
Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables

● CO₂ Emissions (tonnes per capita) ● Share of Electricity from Renewables (%)



Fiscal Incentives & Public Financing for Renewables (2020)

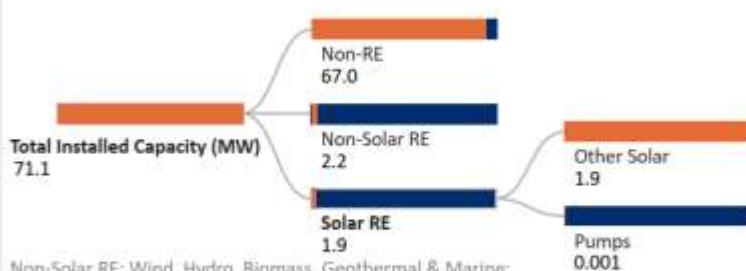
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Saint Kitts and Nevis is a high-income country with a GDP per capita (PPP) of USD 29,097 in 2021.^{1,2}
- In 2021, the GDP (Real) has contracted by 3.6%. However, in 2022, it is expected to bounce back with an annual growth rate of 10.0%.¹
- The inflation rate (CPI) of the country has increased to 0.2% in 2021 from -0.6% levels in 2020.¹
- The general government gross debt to GDP has reached 63.4% in 2021 from 56.8% levels in 2020.¹



Policy enablers

- By 2023, the country aims to achieve a 50% share from renewables in the electricity generation mix.⁵
- To promote the development of RE in the country, the government offers incentives such as tax credits and tax reductions/exemptions on imports of RE related materials in the country.⁶



Technological Feasibility

- Saint Kitts and Nevis receives very high levels of solar irradiation (GHI) of 5.6 kWh/m²/day and specific yield 4.6 kWh/kWp/day indicating very strong technical feasibility for solar in the country.³
- In 2021, only 4.76% of the country's power demand was met through RE sources.⁴



Market Maturity

- 100% of the population in the country had access to electricity as of 2012.⁴
- The Ministry of Public Works, Utilities, Transport and Port oversees the policy formation in the energy sector.⁷
- St. Kitts Electricity Company Limited (SKELEC) and Nevis Electricity Company Limited (NEVELEC), both public utilities, are responsible for the generation, transmission, and distribution of electricity in the country.⁸



Infrastructure

- The transmission and distribution of the country operates on 60 Hz frequency and on voltage levels ranging from 230 V to 11 kV.⁸
- The absence of an interconnected national grid for connecting two islands is a major challenge the country's power sector faces.¹¹



Financing

- In 2019, the government signed the Sector Budget Support Programme worth EUR 5 Mn in partnership with the European Union to facilitate integration of RE in the country.⁹
- Under the Sustainable Energy Facility for the Eastern Caribbean, the Green Climate Fund has provided USD 16.0 Mn financing support in the country.¹⁰



Energy Imperatives

- In 2020, Saint Kitts and Nevis's per capita electricity consumption stood at 3.9 MWh, which is relatively higher in comparison to the global average of 3.31 MWh.⁴
- The peak demand for electricity in the country has remained constant at 0.21 TWh in 2020 and 2021.⁴
- In 2021, the total installed capacity in the country reached 0.07 GW with a significant share coming from oil (94.0%) followed by wind (3.2%) and solar (2.8%).⁴
- In the last 5 years, the total installed capacity of solar PV has remained constant at 1.94 MW.⁵



Saint Lucia

Latin America & Caribbean

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

1797.1

Average PVout in kWh/
kWp/day (2020)

4.5

Cumulative Solar Capacity in MW
(2021)

3.8

Getting Electricity Score (2020)

83.0

NDC Target by 2030 in %
(base year 2010)

7.0

Human Development Index (2021)

0.7

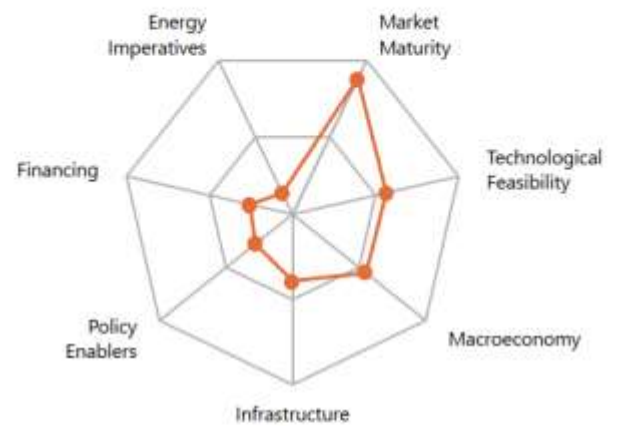
Renewable Energy Generation by Source

● Non Solar (GWh) ● Solar (GWh)



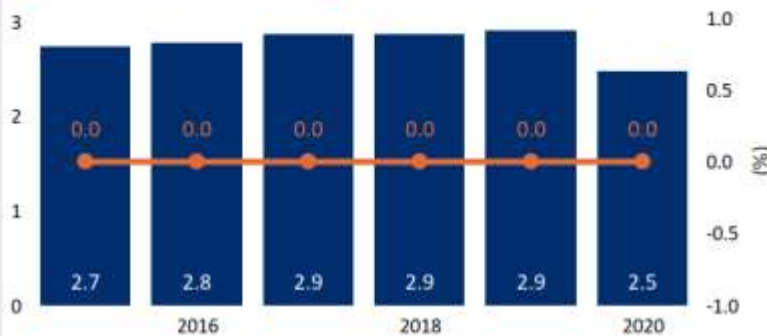
Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables

● CO₂ Emissions (tonnes per capita) ● Share of Electricity from Renewables (%)



Fiscal Incentives & Public Financing for Renewables (2020)

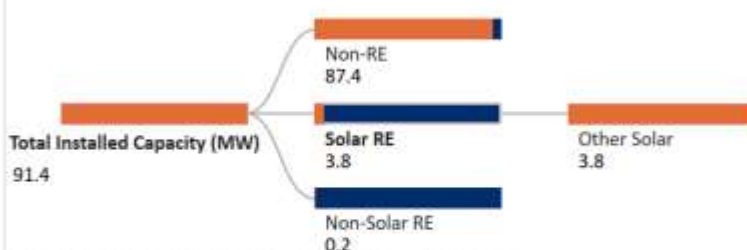
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Saint Lucia is an upper-middle income country with a GDP per capita (PPP) of USD 14,332 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 20.4% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 6.8%.¹
- The inflation rate (CPI) of the country has increased to 2.4% in 2021 from -1.8% levels in 2020.¹
- The general government gross debt to GDP has marginally increased to 95.5% in 2021 from 95% levels in 2020.¹



Policy enablers

- As per the NDC submitted by the government to UNFCCC, the country aims to achieve a 50% share of RE in the electricity generation mix by 2030.³
- To promote the development of RE in the country incentives such as net metering, import duty exemptions and income tax deductions for RE projects are being implemented in the country.⁸



Technological Feasibility

- Saint Lucia receives high levels of solar irradiation (GHI) of 5.4 kWh/m²/day and specific yield 4.5 kWh/kWp/day indicating very strong technical feasibility for solar in the country.³
- The country is highly dependent on imported fossil fuels for generation of electricity, thus making it susceptible to fluctuating oil prices.⁴



Market Maturity

- 100% of the population in Saint Lucia has access to electricity since 2020.⁴
- The country's power sector is governed by the National Utilities Regulatory Commission (NURC), an independent mul sector regulatory authority.⁶
- The power sector is bundled and controlled by the privately owned St. Lucia Electricity Services Ltd. (LUCELEC).⁷



Infrastructure

- The electricity transmission and distribution sector in the country operates at a frequency of 50 Hz with voltage levels ranging from 240 V to 66 kV.⁸
- In 2021, the system losses of LUCELEC stood at 6.3%.¹⁰
- As of March 2022, the total length of transmission and distribution lines stood at 78 miles (66 kV) and 2,767 miles (11 kV).¹⁰



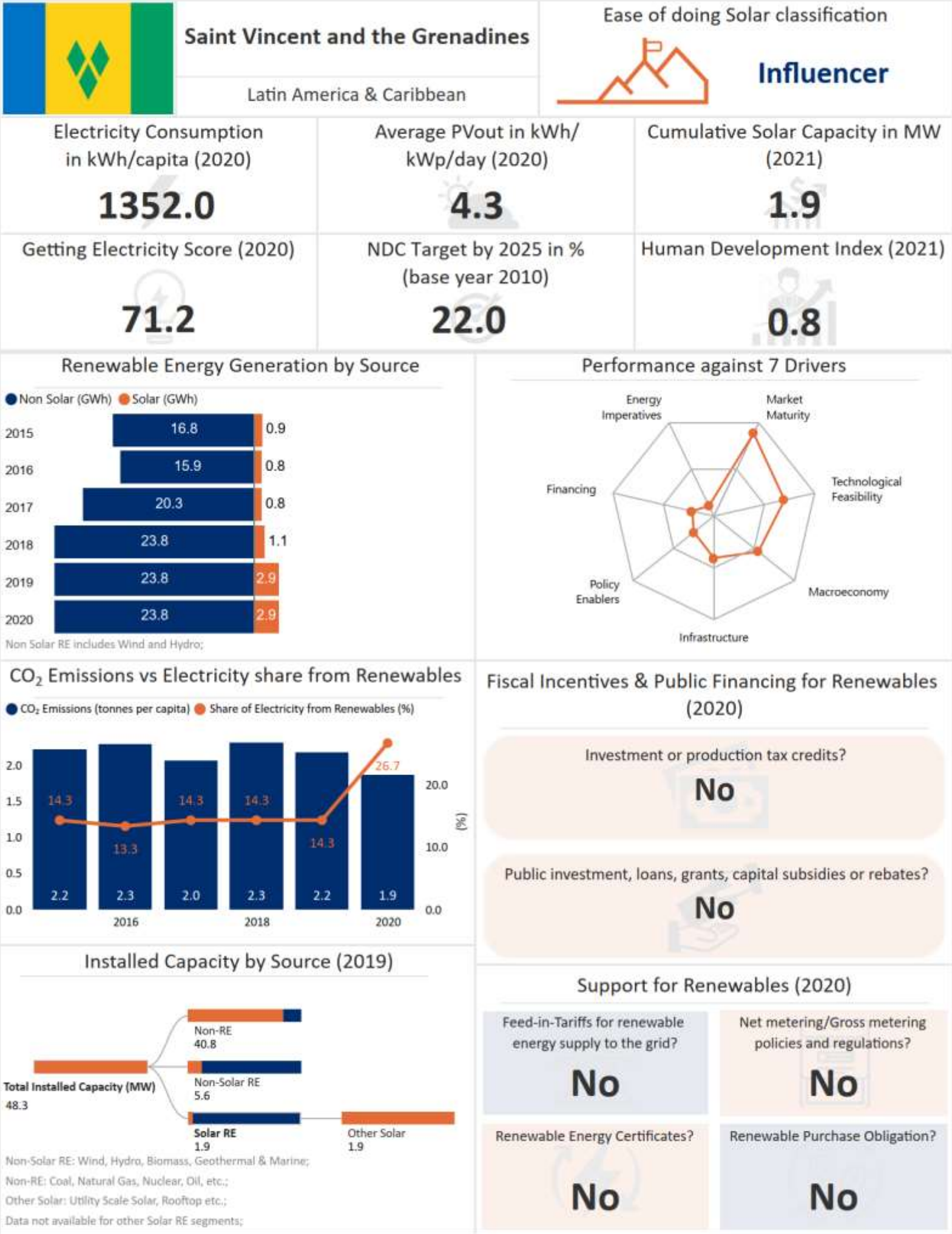
Financing

- In 2021, the Bank of Saint Lucia has started a re-financing programme that supports the consumers to buy solar PV systems and hybrid vehicles at 100% financing.¹¹
- The World Bank sanctioned USD 21.9 Mn to the government of St. Lucia in July 2021 with the goal of developing a favourable business climate for sustainable energy, improving the reliability of power infrastructure, and exploring the country's geothermal potential.¹²

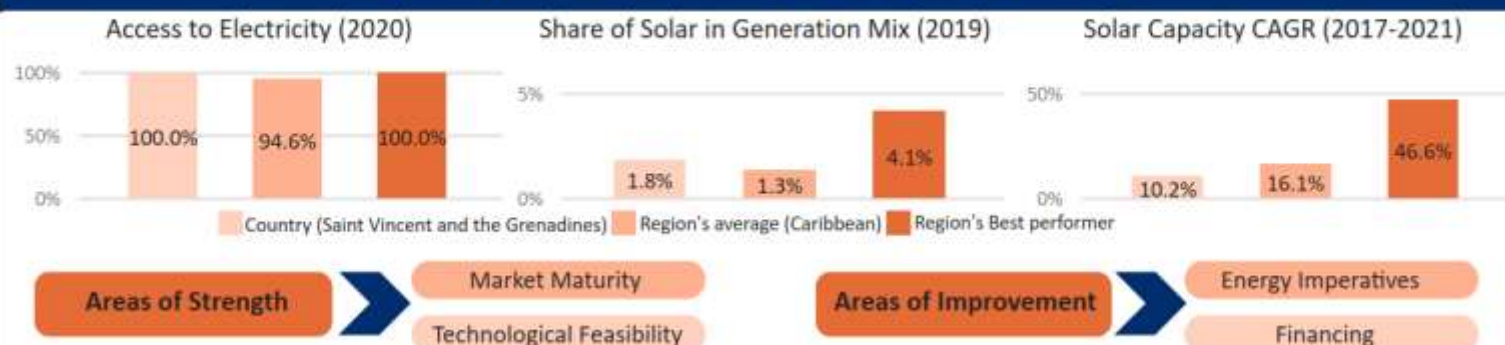


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 1.8 MWh, which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The peak demand of electricity in the country has remained constant at 0.33 TWh in 2020 and 2021.⁴
- In 2021, the total installed capacity in the country reached 0.09 GW most of which is based on oil fired generation.⁴
- The total installed capacity of solar PV witnessed a CAGR of 46.4% between 2017-2021, reaching 3.84 MW in 2021 from 0.83 MW levels in 2017.⁵



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Saint Vincent and Grenadines is an upper-middle income country with a GDP per capita (PPP) of USD 15,045 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) has contracted by 5.3% in 2020. However, in 2021, the GDP has bounced back clocking an annual growth rate of 0.5%.¹
- The inflation rate (CPI) of the country has increased to 1.6% in 2021 from -0.6% levels in 2020.¹
- The general government gross debt to GDP has reached 88.4% in 2021 from 79.2% levels in 2020.¹



Policy enablers

- To promote development of RE in the country, various incentives such as net metering, green public procurements, tax exemptions and interconnection standards are available in the country.⁷
- The National Economic and Social Development Plan 2013-2025 aims to improve physical infrastructure, preserve the environment and build resilience to climate change.⁶



Technological Feasibility

- Saint Vincent and Grenadines receives high levels of solar irradiation (GHI) of 5.2 kWh/m²/day and specific yield 4.3 kWh/kWp/day indicating strong technical feasibility for solar in the country.³
- In 2021, 26.67% of the country's power demand was met through renewable sources.⁴



Market Maturity

- 100% of the population in Saint Vincent and Grenadines is having access to electricity since 2018.²
- The power sector in the country is bundled and Saint Vincent Electricity Services Limited (VINLEC) is the nodal agency responsible for the generation, transmission, and distribution of electricity in the country.⁶
- Cabinet of the Government of St. Vincent and the Grenadines and VINLEC regulates the power sector in the country.⁸



Infrastructure

- Absence of an interconnected national grid for connecting two islands is a major challenge that the power sector faces.⁶
- In 2020, the system losses stood at 7.16% indicating a reasonably efficient infrastructure.⁸
- 800 kW solar PV with battery energy storage system was installed in the country in 2019 helping the country march towards its clean transition ambitions.⁹



Financing

- In 2020, the Caribbean Development Bank has sanctioned a USD 8.6 Mn financing for installation of solar PV panels and battery energy storage system in the country.¹⁰
- In 2020, the Abu Dhabi Fund for Development has sanctioned USD 104.5 Mn to eight RE initiatives in different countries, which also includes development of 600 kW solar PV project in the country.¹¹



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 1.35 MWh, which is relatively lower in comparison to the global average of 3.31 MWh.⁴
- The peak demand for electricity in the country has remained constant at 0.15 TWh in 2020 and 2021.⁴
- In 2021, the total installed capacity in the country reached 60 MW with a significant share coming from oil (83.3%) followed by hydro (16.7%).⁴



Samoa

Asia & Pacific

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

705.6

Average PVout in kWh/
kWp/day (2020)

4.1

Cumulative Solar Capacity in MW
(2021)

13.7

Getting Electricity Score (2020)

79.7

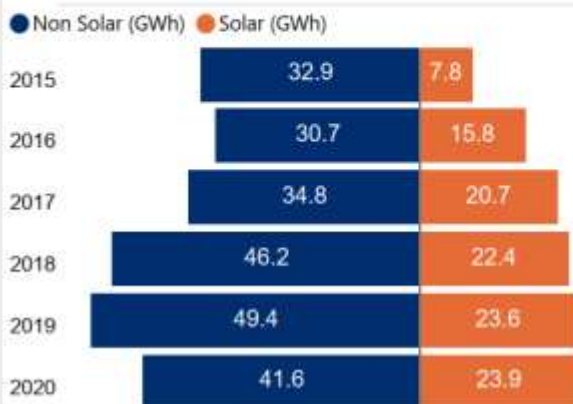
NDC Target by 2030 in %
(base year 2007)

26.0

Human Development Index (2021)

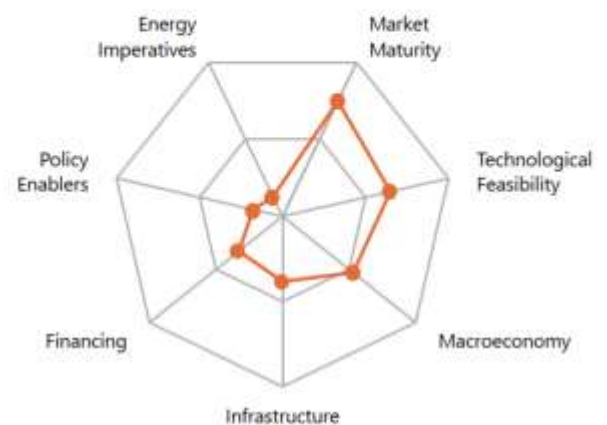
0.7

Renewable Energy Generation by Source

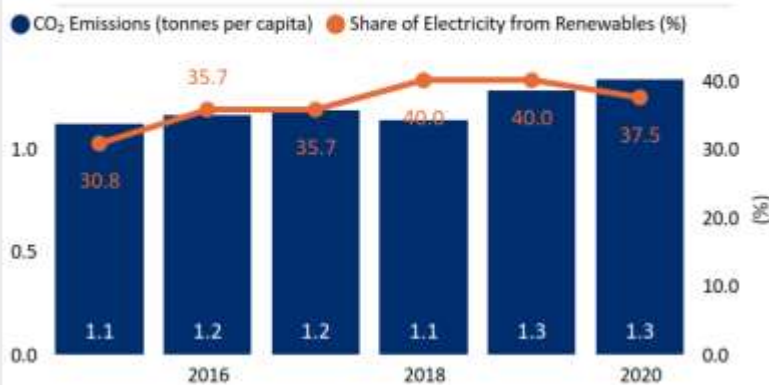


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

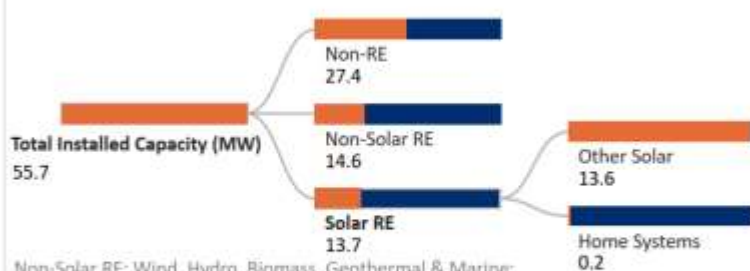
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Samoa is a lower middle-income¹ country with a GDP per capita (PPP) of USD 6,080 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 3.1% in 2020 and it further declined by 7.1% in 2021.³
- The inflation rate (CPI) of Samoa has declined by 3% in 2021 from 1.5% levels in 2020.⁴
- The general government gross debt to GDP has reached 46.3% in 2021 from 43.2% levels in 2020.⁵



Policy enablers

- Samoa has set a goal to generate 100% of its electricity from Renewable Energy by 2025.⁶
- Samoa in its Samoa Energy Sector Plan (2017-22) has prepared a framework to achieve affordable energy for all.⁷
- Samoa has a Feed-in-Tariff policy to support the development of new renewable energy projects by offering long-term power purchase agreements for the sale of RE electricity.⁸



Technological Feasibility

- Samoa receives high levels of solar irradiation (GHI) of 4.8 kWh/m²/day and specific yield 4.1 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁹
- Samoa RE sources includes wind, biomass, biogas, hydro, solar and municipal waste energy.⁸
- Samoa's Fiago Power Station has a battery storage system which is about 6 MW capacity and another at the Faleolo International Airport is of 2MW capacity.¹⁰



Market Maturity

- 100% of the population in Samoa had access to electricity as of 2020.¹¹
- The Electric Power Corporation (EPC) is responsible for the generation, transmission, distribution, and sale of electricity in Samoa.¹²
- EPC is regulated by Electric Power Corporation Act, 1980.¹⁴



Infrastructure

- Samoa's transmission network comprises of 22 kV and 33 kV voltage levels.¹³
- Samoa has upgraded its 4 sub stations by installing of SCADA monitoring system.¹³



Financing

- ADB has supported Samoa in the past with a loan up to USD 2 Mn to develop solar energy capability.¹⁵
- Small Island Developing States (SIDS) program of Green Climate Fund covers Samoa, one out of seven small Asia-Pacific islands, for moving to RE based generation from diesel based with a funding of USD 60.1 Mn.¹⁶



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.71 MWh in Samoa, which is significantly lower in comparison to the global average of 3.31 MWh.¹⁷
- The total installed capacity of solar PV witnessed a CAGR of 0.3% between 2017-2021 reaching 13.71 MW in 2021 from 13.55 MW levels in 2017.¹⁸
- The peak demand for electricity in the country stood at 0.14 TWh remaining similar in 2021 and 2020.¹⁹
- In 2021, the total installed capacity in the country reached 60.37 MW²⁰ with maximum share coming from fossil fuels (71.43%) followed by hydro (28.57%).¹⁹



Sao Tome and Principe

Africa

Ease of doing Solar classification



Potential

Electricity Consumption
in kWh/capita (2020)

456.3

Average PVout in kWh/kWp
(2020)

3.5

Cumulative Solar Capacity in MW
(2021)

0.3

Getting Electricity Score (2020)

62.1

NDC Target by 2030 in %

27.0

Human Development Index (2021)

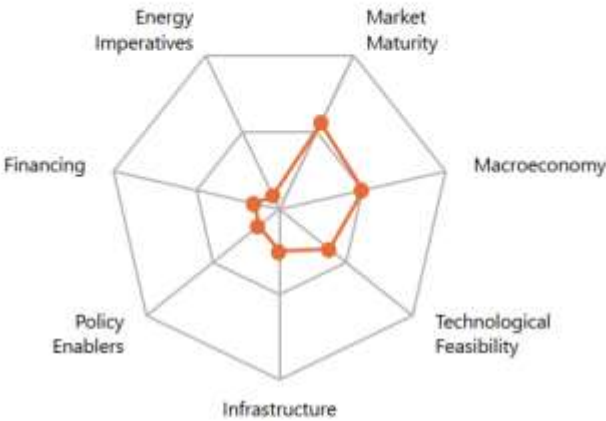
0.6

Renewable Energy Generation by Source

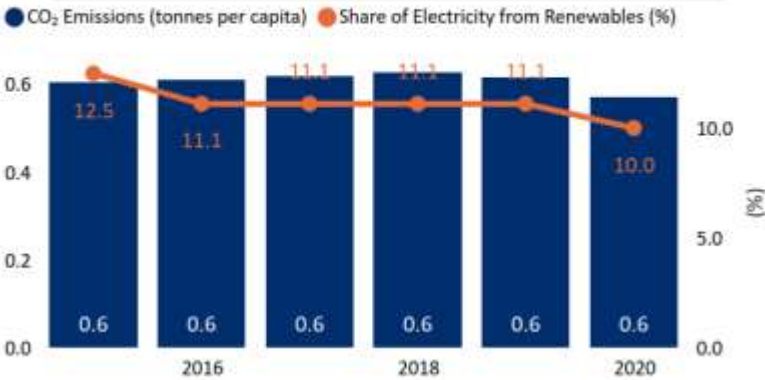


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

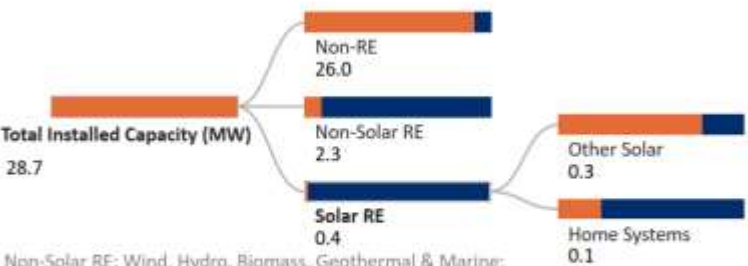
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

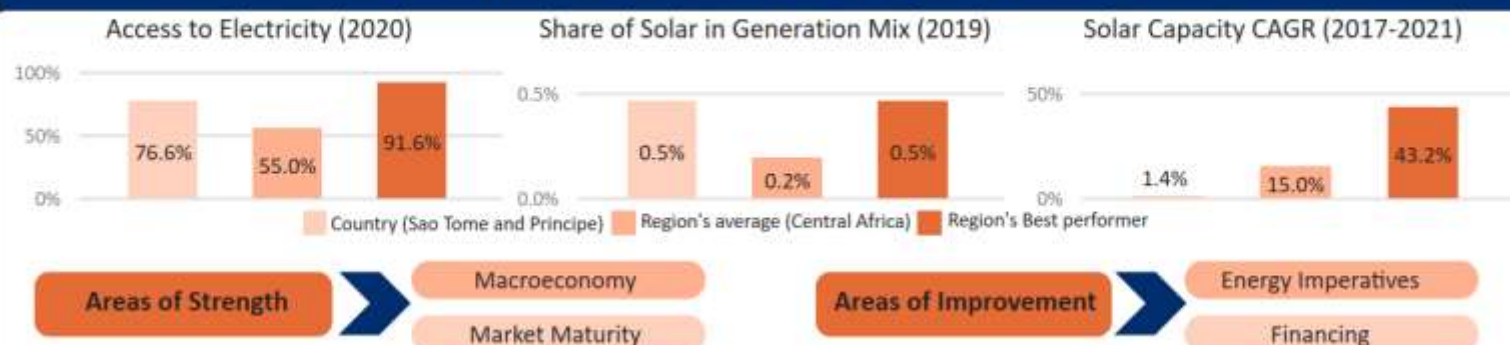
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- The inflation rate in the country increased to 9.5% in 2021 from 9.4% in 2020.²
- GDP (Real) grew at an annual rate of 1.8% in 2021 and it is estimated to grow by 1.6% in 2022.¹
- The current account deficit declined marginally to 10.1% of GDP in 2021 from 11.6% levels in 2020.²
- Total public debt in the country declined to 87.9% of GDP in 2021 from 99.9% levels in 2019.²



Policy enablers

- Sao Tome and Principe aims to increase RE generation from 26 MW to 49 MW and to reduce its CO₂ emissions to 27% by 2030.²
- The Directorate General of Natural Resources and Energy (DGRNE) is responsible for the design, promotion, and evaluation of strategic policies on water, energy, and geological resources.³
- The Energy Transition and Institutional Support Programme (ETISP) is designed to promote green growth, sustainable development of the power system, and strengthening public financial management in Sao Tome and Principe.⁴



Technological Feasibility

- Sao Tome and Principe receive high levels of solar irradiation of 4.9 kWh/m²/day and a specific yield of 3.5 kWh/kWp/day indicating strong technical feasibility for solar in the country.⁵
- As of 2020, the Government of Sao Tome and Principe is planning for the hybridization of one of the main thermal power plants (Santo Amaro) with solar photovoltaic technology through the Energy Transition and Institutional Support Programme (ETISP).⁴



Market Maturity

- 76.6% population in Sao Tome and Principe had access to electricity as of 2020.⁶
- Autoridade Geral de Regulação (AGER) is responsible for regulating and supervising the electricity sector in the country.⁷
- Empresa de Água e Eletricidade (EMAE) is a public entity responsible for the production, transport, and distribution of electric energy in the country.⁸
- Sao Tome and Principe is a member of the Central Africa Power Pool, which aims to strengthen the regional border on access to electrical service.⁹



Infrastructure

- The MV network (<60 kV) comprises of about 203 linear km and is composed of overhead lines supported by more than 1,200 underground cable posts.¹⁰
- The LV network system comprises of more than 300 km, supported by 3,500 poles in Sao Tome.¹⁰
- The transformation system comprises 2 substations with a power of 30.7 MVA, six sectioning points, and 183 transformer substations with an installed transformation capacity of 47.5 MVA.¹⁰



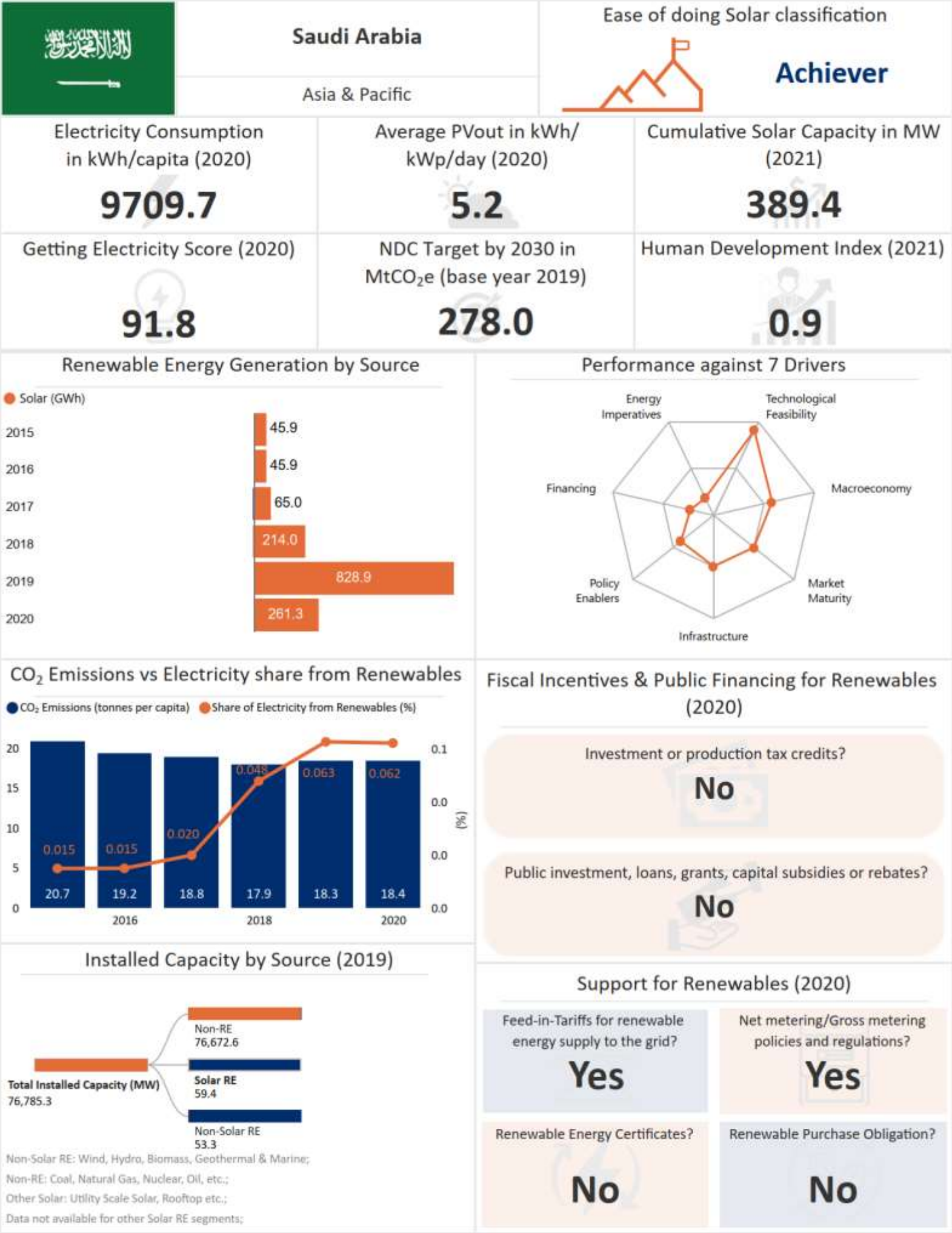
Financing

- Since 2020, the Global Environment Facility (GEF) in partnership with the country's Ministry of Public Works, Infrastructure, Natural Resources and Environment (MOPIRINA) has been working to promote RE and EE investments in the electricity sector.¹¹
- In 2020, African Development Fund approved USD 10.44 Mn for initiating the energy transition towards RE and for providing institutional support while strengthening financial governance and the business climate.⁴
- The Sustainable Energy Fund for Africa (SEFA) managed by the AfDB approved a USD 1 Mn grant to support the Republic of São Tomé & Príncipe for unlocking private investments in the development of mini hydropower projects.¹²



Energy Imperatives

- In 2020, Sao Tome and Principe's per capita electricity consumption stood at 0.46 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.¹⁵
- The total installed capacity in the country stood at 28.7 MW in 2019.¹³
- The total installed capacity of solar PV witnessed a CAGR of 1.4% between 2017-2021 reaching 0.334 MW in 2021 from 0.316 MW levels in 2017.¹⁴
- The price of electricity in the country stood at 17 US Cents/kWh as of 2019.¹⁶





Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Saudi Arabia is a high-income country¹ with a GDP per capita (PPP) of USD 48,711 in 2021.¹
- Due to COVID-19 Pandemic, the GDP (Real) has declined by 4.1% in 2020. However, in 2021, the GDP has bounced back with an annual growth rate of 3.2% which is one of the fastest recoveries among similar sized economies.²
- The inflation rate (CPI) of Saudi Arabia has declined to 3.1% in 2021 from 3.4% levels in 2020.³
- The general government gross debt to GDP has declined to 30% in 2021 from 32.4% levels in 2020.⁴



Policy enablers

- The Saudi Government launched the Renewable Energy Program under the framework of the Custodian of the Two Holy Mosques Renewable Energy Initiative to deliver the country target of around 50% of electricity achieving energy mix balance with the compliance to the Kingdom's emissions commitments in line with the Kingdom's Vision 2030.²⁴
- In 2021, the country announced its goal to reach net zero by 2060.⁵
- Saudi Arabia has planned a total of 15 GW to be tendered in 2022 and 2023, of which 5.36 GW were tendered in 2022.
- In October 2021, during the Saudi Green Initiative (SGI), Saudi Arabia announced a net zero target to be achieved by 2060. It also upgraded its NDC under the Paris Agreement.²⁴



Technological Feasibility

- Saudi Arabia receives very high levels of solar irradiation (GHI) of 6.2 kWh/m²/day and specific yield 5.2 kWh/kWp/day indicating a strong technical feasibility for solar in the country.¹¹
- The government of Saudi Arabia will be installing 1300 MWh BESS in Neom.²⁵
- The Ministry of Energy, through its NREP, has pre-developed and tendered 2,170 MW of RE capacity in the Kingdom. It has commissioned 700 MW of wind and solar out of which 300 MW is solar PV.²⁴
- Saudi Arabia is currently developing the Helios green hydrogen project in Neom, with a production capacity of 600 tonnes/day of clean hydrogen with power capacity of 4 GW utilizing the combined capacity from onshore solar (2.5 GW), wind and storage.²⁴



Market Maturity

- SEC is the holding company which maintains a monopoly over transmission and distribution across the Kingdom and owns and operate majority of generation units.¹⁴
- The Water and Electricity Regulatory Authority (WERA) is co-operating with SEC and Saudi Principle buyer to ensure agile and transparent regulatory framework of the power sector.²⁴



Infrastructure

- Saudi Arabia has four interconnections with the neighbouring countries of Kuwait, Bahrain, Qatar, and UAE through the Gulf Cooperation Council (GCC) interconnection project.¹⁵
- In 2020, Saudi Arabia's transmission network comprised of about 89,100 ckm of line length and 1,150 substations at voltage levels varying from 110 kV to 380 kV.¹⁵
- In 2021, the existing network was expanded by 2,372 ckm and 40 new transmission substations.¹⁶
- Saudi Arabia investment plans in power, water, infrastructure, tourism estimated to be USD 21 Bn for the coming years.¹⁷



Financing

- Saudi Arabia Government through Renewable Energy Program aims to attract 100 Bn USD for renewable investment by 2030.²⁴
- Saudi Arabia is planning to generate 50% of electricity from renewables by 2030 in which kingdom's Public Investment Fund (PIF) would contribute 70% of the total investment to develop GW scale projects.¹⁹



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 9.7 MWh, which is significantly higher in comparison to global average of 3.31 MWh.²⁰
- The peak demand for electricity in the country has increased to 356.62 TWh in 2021 from 338.03 TWh levels in 2020.²²
- In 2021, the total installed capacity in the country reached 105.21 GW with a significant share coming from gas (52.4%) and other fossil fuels (47.3%).²³
- Saudi Arabia has achieved the lowest LCOE globally for 600 MW utility scale project solar PV at 1.04 cent/kWh in 2019.²⁴



Senegal

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

296.2

Average PVout in kWh/
kWp/day (2020)

4.6

Cumulative Solar Capacity in MW
(2021)

237.5

Getting Electricity Score (2020)

65.2

NDC Target by 2030 in %

7.0

Human Development Index (2021)

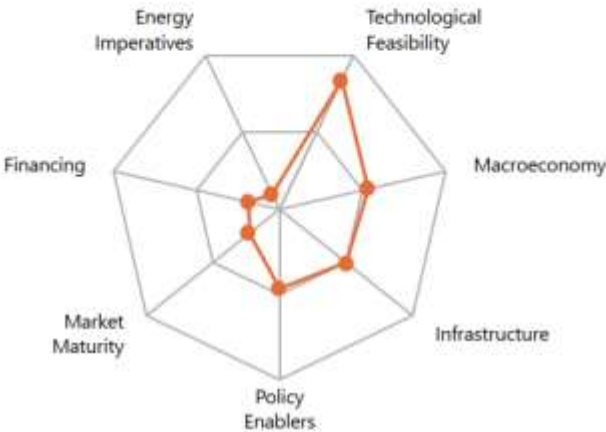
0.5

Renewable Energy Generation by Source

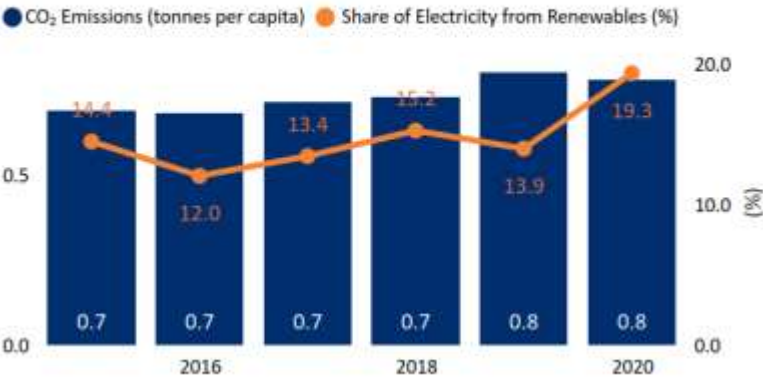


Non Solar RE includes Wind and Hydro;

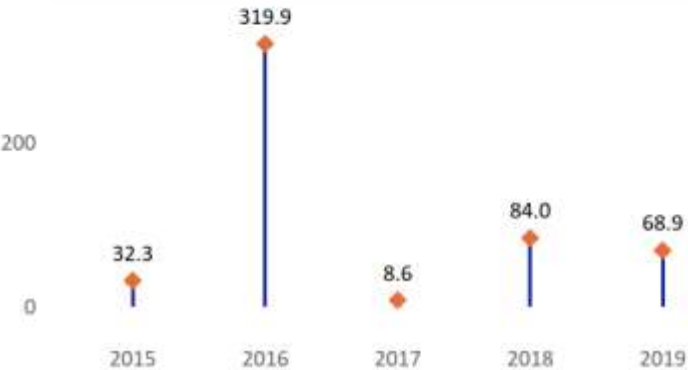
Performance against 7 Drivers



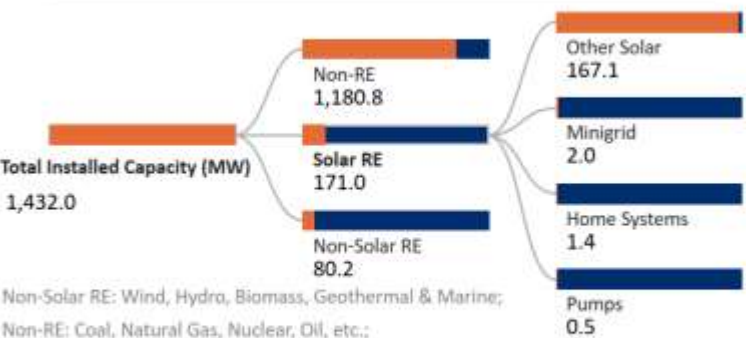
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;
Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;
Other Solar: Utility Scale Solar, Rooftop etc.;
Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

Yes

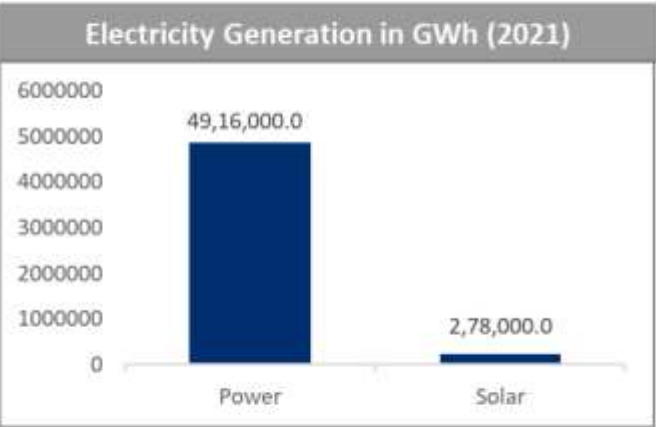
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

Yes

| Peak Demand/Load in MW (2021) | Electricity Consumption CAGR in % (2022 - 2026) | Average term of Solar PPAs in years (2021) |
|-------------------------------|---|--|
| 805.0 | 8.2 | 25.0 |



| Accessibility to Payment Mechanisms for purchase of Solar Products (2021) | |
|---|-----|
| Mobile application based online transactions | Yes |
| Digital E-wallets | No |
| Cash-on-delivery | Yes |

| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | Yes |
| Credit facilitation for solar energy from financial institutions (FIs) | Yes |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | Yes |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| Yes | Yes | Yes | Yes | Yes | No | No | Yes | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | Yes |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | No |
| E-mobility/Electric vehicles | No |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Senegal is a lower middle-income country¹ with a GDP per capita (PPP) of USD 3,840 in 2021.²
- GDP (Real) grew at an annual rate of 6.1% in 2021, and it is estimated to grow by 5% in 2022.³
- The fiscal deficit in the country narrowed down to 17.6% of GDP in 2021 from 16.7% levels in 2020.⁴
- Total public debt in the country increased to 73% of GDP in 2021 from 68.8% levels in 2020.⁴



Policy enablers

- The Ministry of Energy and Renewable Energy Development is responsible for preparing and implementing the policy in the production and distribution of energy and promoting RE in Senegal.⁵
- The National Agency for Renewable Energies (ANER) is responsible for the promotion and development of solar energy, wind energy, biomass, tidal power, and small hydraulics.⁶
- Senegal targets to increase the share of solar to 11.59% of the energy mix by 2023.⁷
- The tariff for solar power under the Feed-in-Tariff mechanism is 0.076 USD/kWh.⁷



Technological Feasibility

- Senegal receives very high levels of solar irradiation of 5.8 kWh/m²/day and a specific yield of 4.6 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁸
- The country typically receives 8 hours of sunlight per day.⁷
- The UN Environment program is currently active in Senegal and is working on the introduction of zero/low-emissions buses.⁹
- The average cost of electricity storage in Senegal is 0.052 USD/ kWh.⁷



Market Maturity

- 70.4% population in Senegal had access to electricity as of 2020.¹⁰
- The Electricity Sector Regulatory Commission (CRSE) is an independent authority responsible for regulating the production, transmission, distribution, and sale of electrical energy in Senegal.¹¹
- The National Electricity Company of Senegal (SENELEC) is responsible for the production, transport, distribution, purchase, wholesale/retail sale, and import/export of energy.¹¹



Infrastructure

- There are two grid systems: the 90 kV national grid and the 225 kV supranational grid comprising of 13,000 km which are managed by SENELEC.¹²
- In Senegal, reserve capacity is insufficient resulting in frequent (scheduled or unscheduled) outages while transmission losses, old thermal power plants, and increasing oil prices result in high average production costs.¹²
- The seasonal/yearly peak demand or load that has been met during 2021 is 805 MW.⁷
- The expected investment in the T&D Infrastructure over the next 5 years (2022-2026) in Senegal is USD 799.05 Mn.⁷



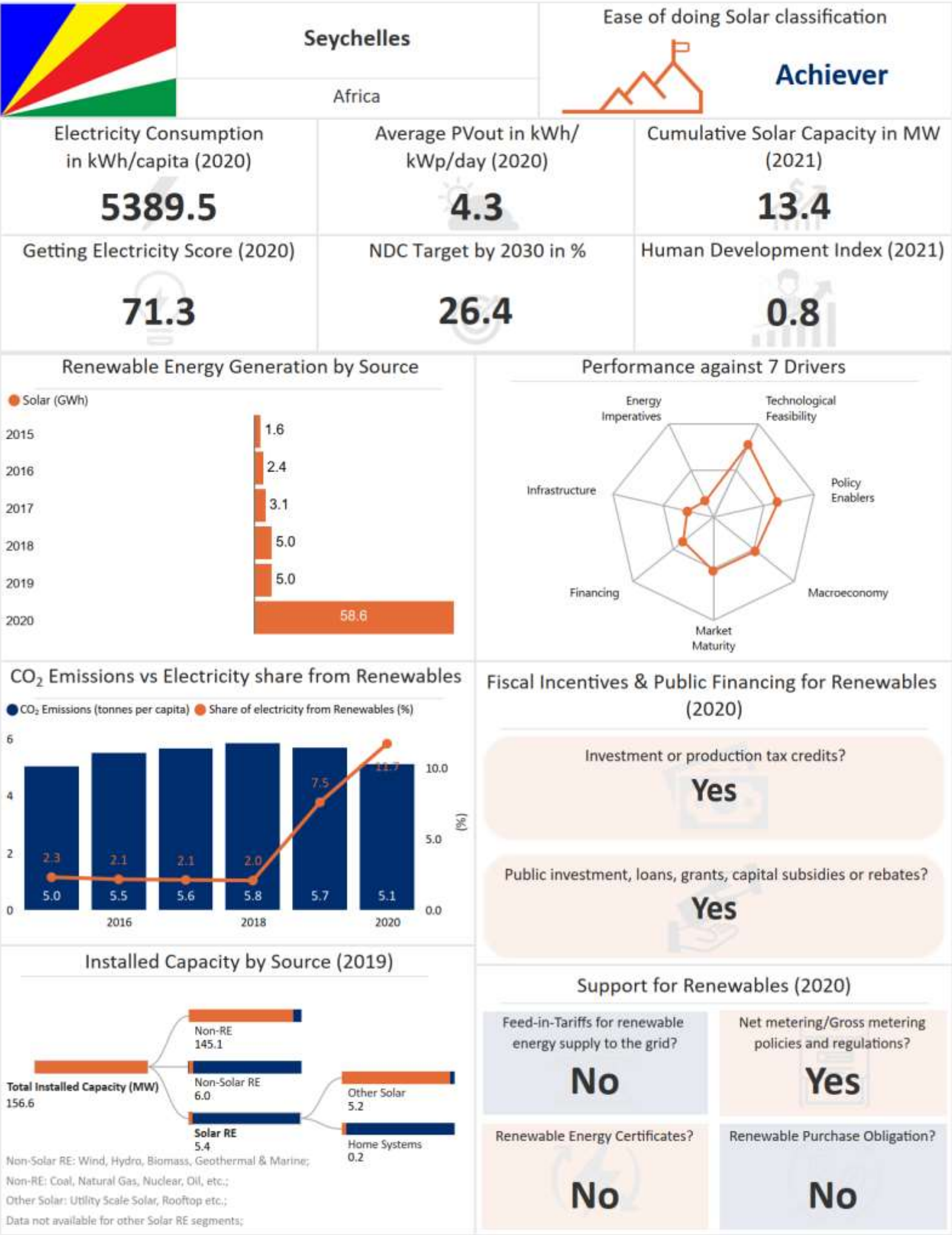
Financing

- The Export-Import Bank of the United States (EXIM) board approved USD 91.5 Mn in loan guarantee financing that supports U.S. exports of design engineering and construction services to the Republic of Senegal.¹³
- The International Finance Corporation (IFC) approved €38 Mn financing for two solar plants that will provide 60 MW AC low-cost power.¹⁴
- In 2021, the Multilateral Investment Guarantee Agency (MIGA) issued €6.9 Mn in guarantee to support two solar PV plants, providing protection against non-commercial risks for a duration of up to 15 years.¹⁵

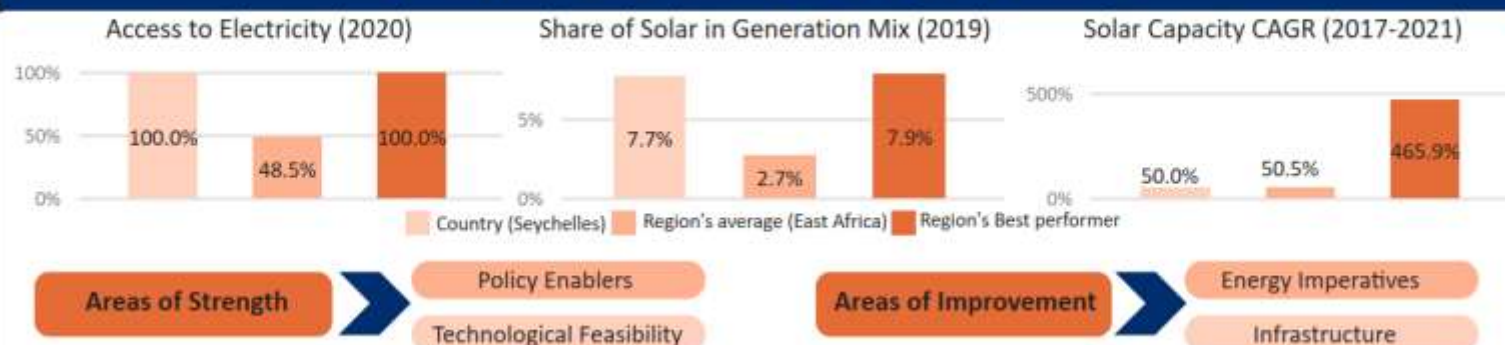


Energy Imperatives

- In 2020, Senegal's per capita electricity consumption stood at 0.29 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.¹⁷
- The total installed capacity in the country stood at 4,916 BUs in 2021.⁷
- The total installed capacity of solar PV witnessed a CAGR of 22.1% between 2017-2021 reaching 237.5 MW in 2021 from 107 MW levels in 2017.¹⁶
- The installed capacity of rooftop solar is 2.09 MW in 2021.⁷
- The average solar tariff in Senegal is 0.049 USD/kWh in 2019.⁷



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- GDP (Real) grew at an annual rate of 8% in 2021 and is estimated to grow by 4.6% in 2022.¹
- The inflation rate in the country increased to 9.7% in 2021 from 1.8% levels in 2020.²
- The fiscal deficit in the country narrowed down to 6.0% of GDP in 2021 from 18.9% levels in 2020.²
- The current account deficit narrowed down to 19.8% in 2021 from 23.1% levels in 2020.²



Policy enablers

- The Ministry of Environment, Energy, and Climate Change is responsible for developing, implementing, and monitoring various policies in the energy sector.³
- Seychelles aims to achieve 15% of RE share in the generation mix by 2030² and to reduce its economy wide GHG emissions to 21.4% by 2025 and 29.0% in 2030.⁴
- In Seychelles, the tariff arrangement is based on a net tariff where the energy produced by a customer offsets the energy consumed leading to a price reduction in the utility bill.⁵
- Seychelles targets to switch 30% of vehicles from fossil fuels to EVs by 2030.²



Technological Feasibility

- Seychelles receives very high levels of solar irradiation of 5.5 kWh/m²/day and a specific yield of 4.3 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁶
- The UN Environment program is currently active and working on the introduction of zero/low-emissions buses.⁷
- In Seychelles, the installation of a 14 MW grid-scale battery energy storage system (BESS) was supported by UNDP with a budgeted cost of Rs 270 Mn in 2021.⁸



Market Maturity

- 100% population in Seychelles had access to electricity as of 2020.⁹
- Seychelles Energy Commission is the energy regulator responsible for the oversight and planning of energy issues.¹⁰
- The Public Utilities Company (PUC) is the sole generator, transmitter, and distributor of electric energy in Seychelles.¹⁰
- Seychelles is a member of the Southern African Development Community (SADC)¹¹, which aims towards enhancing the seamless flow of intra-regional trade.¹²



Infrastructure

- The existing transmission network comprising of 33 kV overhead transmission line to South Mahe is now saturated and operating beyond its rated capacity during peak hours and will not be able to safely supply the projected electrical demand growth for the coming years.¹³
- PUC is carrying out major works to improve the 33 kV underground electricity distribution network to the South of Mahe.^{13,14}
- The 33 kV underground transmission line to South Mahe Project focuses on improving the reliability and quality of electricity supply in south Mahe, thereby contributing towards the socio-economic development of the country.¹³



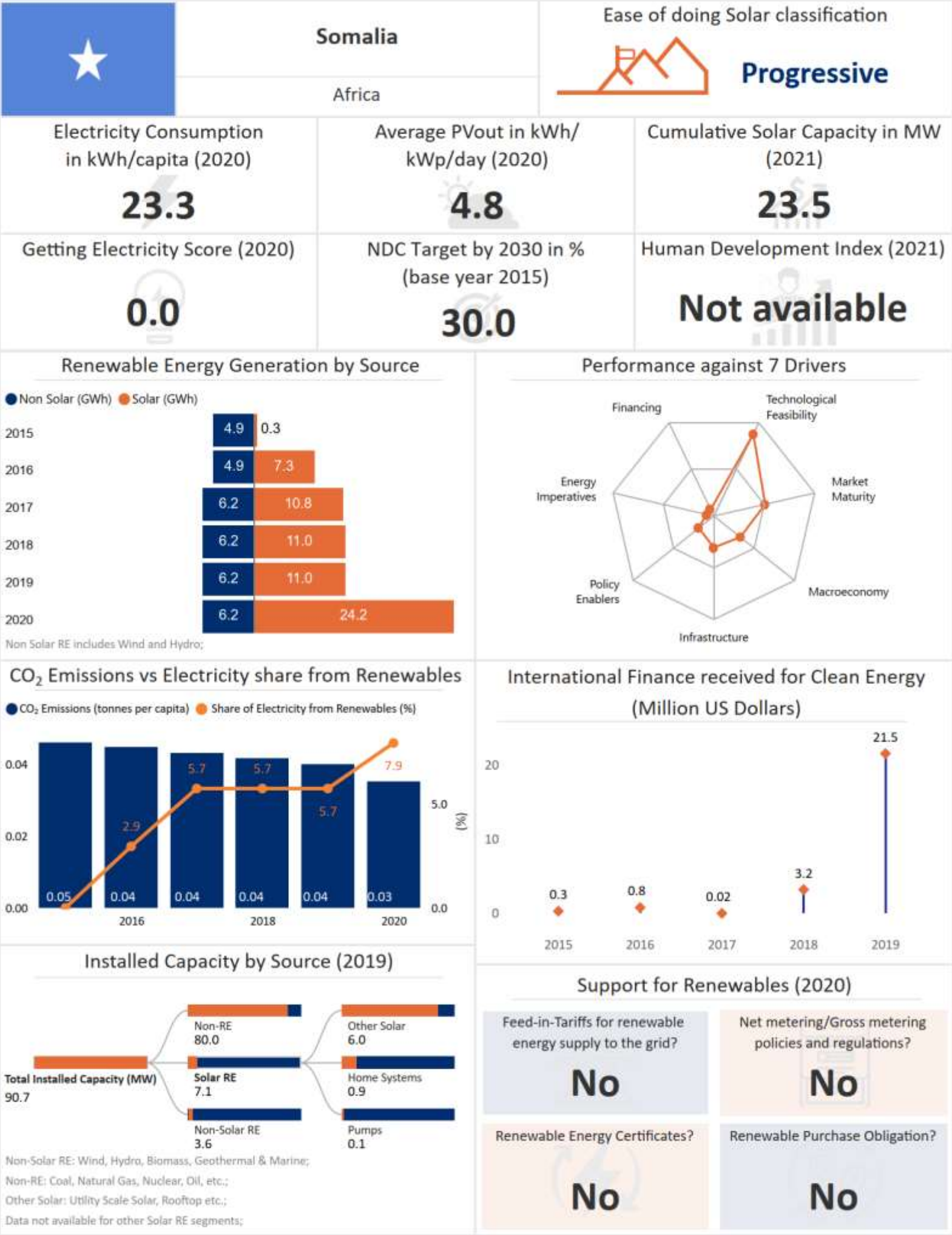
Financing

- In 2022, the AfDB approved for providing technical assistance and capacity building for the Ministry of Agriculture, Climate Change and Environment (MACCE) to develop an Integrated Plan (IRP) that will define the long-term vision for the power sector of Seychelles.¹⁵
- In 2021, the AfDB approved a USD 20 Mn flexible loan to finance Seychelles Governance and Economic Reforms Support Program to help drive the nation's macroeconomic stability.¹⁶
- In Seychelles, the World Bank has shown keen interest in supporting projects with a focus on environmental and transportation issues.¹⁷

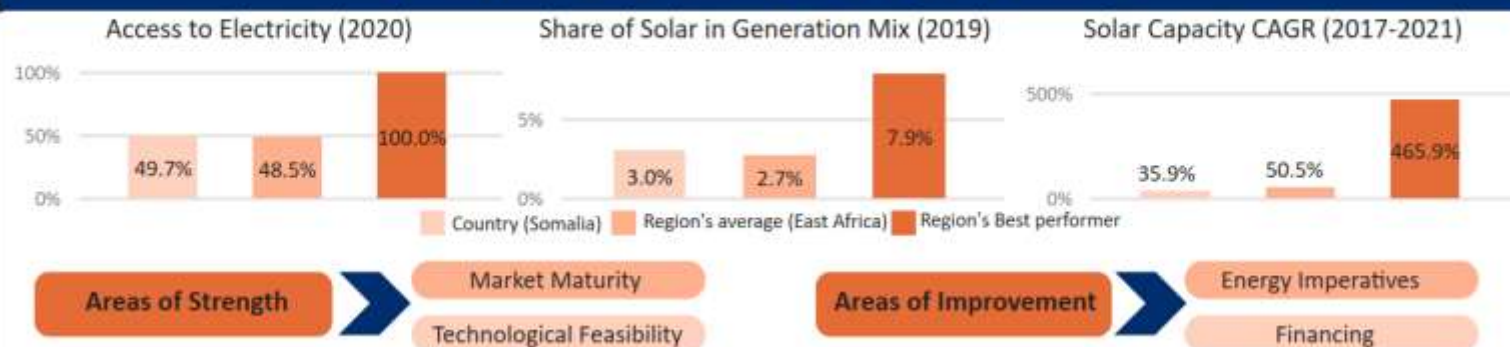


Energy Imperatives

- In 2020, Seychelles' per capita electricity consumption stood at 5.39 MWh, which is significantly higher in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity in the country stood at 156.6 MW in 2019.¹⁸
- The total installed capacity of solar PV witnessed a CAGR of 50.0% between 2017-2021 reaching 13.39 MW in 2021 from 2.64 MW levels in 2017.¹⁹



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Somalia is a low-income country¹ with GDP per capita (PPP) of USD 1,249 in 2021.²
- GDP (Real) grew at an annual rate of 2% in 2021 and it is estimated to grow by 3% in 2022.³
- Inflation rate in the country increased to 4.6% in 2021 from 4.3% levels in 2020.⁴
- The current account deficit marginally widened to 10.8% of GDP in 2021 from 10.4% levels in 2020.⁵



Policy enablers

- The Ministry of Energy and Water Resources is responsible for the formulation, direction and coordination of the national energy policies and water resources.⁶
- In 2021, Somalia updated its NDCs with focus on RE investments and targets to reduce its GHG emissions to 30% by 2030.⁵
- The Somali Business Catalytic Fund (SBCF) strengthened the private capital into the financing of solar energy solutions in Somalia.⁷



Technological Feasibility

- Somalia receives very high levels of solar irradiation of 6.1 kWh/m²/day and specific yield of 4.8 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁸
- In 2017, the UN Development Agency (UNDP) installed 298 solar panels—a 76 KVA hybrid solar system which allows a saving of 35% on fuel consumption in Somalia.⁹



Market Maturity

- 49.7% population in Somalia had access to electricity as of 2020.¹⁰
- Somaliland Energy Regulatory Commission is responsible for regulating and managing the development and utilization of energy resources in Somaliland.¹¹
- Banadir Electric Company (BECO) is responsible to generate, transmit and distribute electricity throughout Somalia at cost effective tariffs.¹²
- Somalia is a member of the Eastern African Power Pool (EAPP), which aims to optimize the available energy resources and reduce electricity cost in the region.¹³



Infrastructure

- The existing transmission network comprises of medium-voltage (33 kV/11 kV/415 Vs) power lines, substations and ground mounted transformers.¹⁴
- BECO is the major distribution company which supplies over 80% of electricity to Banadir and surrounding regions.¹⁵
- The current electricity situation in Somalia faces numerous challenges mainly due to lack of standardization in terms of installation of distribution network for households and commercial building.¹⁵



Financing

- In 2022, the Federal Government of Somalia has received financing from the AfDB towards technical assistance (TA) and capacity building for the establishment of the Regulatory Authority for energy sector (ERA).¹⁶
- The World Bank supported Somali Core Economic Institutions and Opportunities Project (SCORE) with a USD 13 Mn grant through the Somali Business Catalytic Fund (SBCF).¹⁷
- Currently the Federal Government of Somalia (FGS) is implementing households access to renewable energy and advancing cooking technologies project with a grant funding from the AfDB.¹⁸



Energy Imperatives

- In 2020, Somalia's per capita electricity consumption stood at 0.02 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²¹
- The total installed capacity in the country stood at 90.7 MW in 2019.¹⁹
- The total installed capacity of solar PV witnessed a CAGR of 35.9% between 2017-2021 reaching 23.538 MW in 2021 from 6.894 MW levels in 2017.²⁰



South Sudan

Africa

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

47.3

Average PVout in kWh/
kWp/day (2020)

4.5

Cumulative Solar Capacity in MW
(2021)

1.3

Getting Electricity Score (2020)

0

NDC Target by 2030 in %
(base year 2017)

18.0

Human Development Index (2021)

0.4

Renewable Energy Generation by Source

● Non Solar (GWh) ● Solar (GWh)



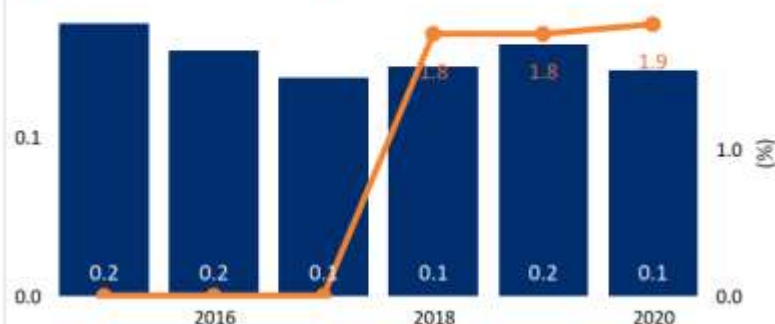
Non Solar RE includes Wind and Hydro:

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables

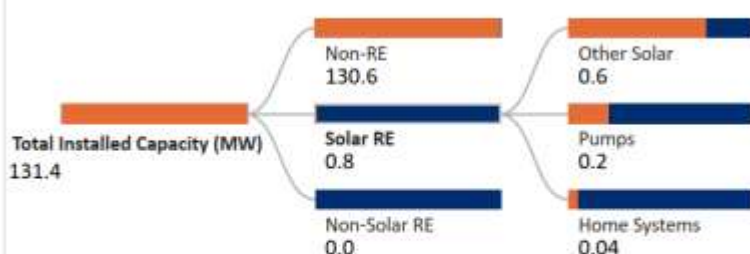
● CO₂ Emissions (tonnes per capita) ● Share of Electricity from Renewables (%)



International Finance received for Clean Energy
(Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine:

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.:

Other Solar: Utility Scale Solar, Rooftop etc.:

Data not available for other Solar RE segments:

Support for Renewables (2020)

Feed-in-Tariffs for renewable energy supply to the grid?

No

Net metering/Gross metering policies and regulations?

No

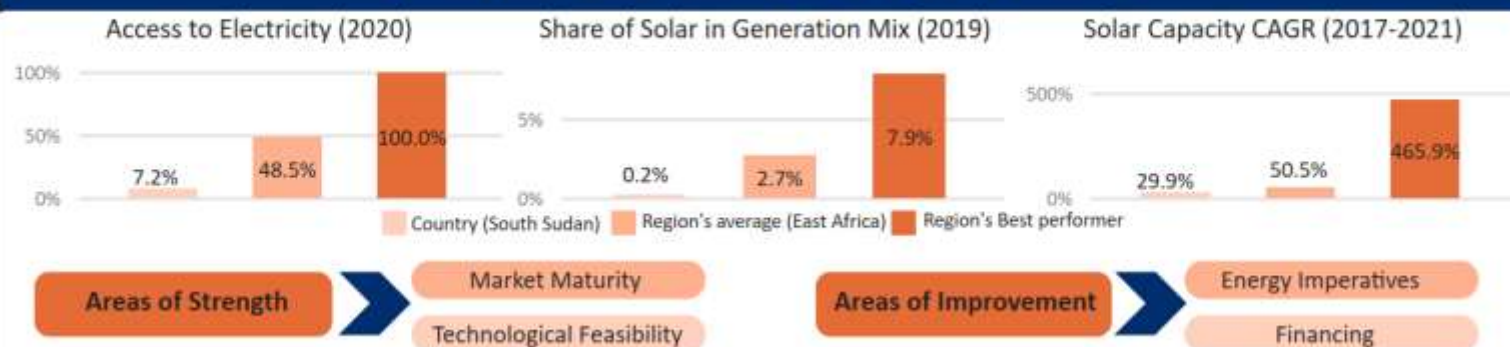
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- South Sudan is a low-income country¹ with the oil sector as the dominant contributor to the economy.²
- GDP (Real) grew at an annual rate of 5.3% in 2021 and it is estimated to increase by 6.5% in 2022.³
- The inflation rate in the country reduced to 5.3% in 2021 from 24% levels in 2020.⁴
- The fiscal deficit in the country narrowed to 6.7% of GDP in 2021 from 9.8% levels in 2020.²



Policy enablers

- In 2021, South Sudan prepared second Nationally Determined Contribution (NDC) which prioritizes the country's transition to a low-carbon economy and framing policies/incentives for private investments in RE generation.²
- South Sudan National Electricity Policy (SSNEP) outlines the framework for the development and operation of the Electricity Supply Industry (ESI) and defines the scope for Public-Private Partnerships (PPPs).⁵



Technological Feasibility

- South Sudan receives very high levels of solar irradiation of 5.7 kWh/m²/day and a specific yield of 4.5 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁶
- Variable Renewable Electricity (VRE) plus-storage projects are in the planning phase in South Sudan including a 20 MW solar park coupled with a 35 MWh storage system.^{7,8}
- In 2021, South Sudan installed a solar rooftop-diesel system for the Upper Nile University of Malakal in the country.⁹



Market Maturity

- 7.2% population in South Sudan had access to electricity as of 2020.¹⁰
- South Sudan Electricity Regulation Authority is the energy regulator in the country.¹¹
- The South Sudan Electricity Corporation (SSEC) is responsible for the generation, transmission and sale of electricity to distributors.¹¹
- South Sudan is a member of the Eastern African Power Pool (EAPP) which aims to optimize the available energy resources and reduce electricity costs in the region.¹²



Infrastructure

- Nile Equatorial Lakes Subsidiary Action Program (NELSAP) is planning to construct a 222 km power transmission line at 220 kV from Malakal to Bentiu in South Sudan.¹³
- As of 2020, South Sudan is planning to construct a 400 kV Juba –Nimule transmission line with a network length of 170 km and associated substations in the country.¹⁴
- Power Distribution System Rehabilitation and Expansion Project (PDSRE) aims to strengthen the distribution networks in Juba to provide a reliable electricity supply in the country.¹⁵



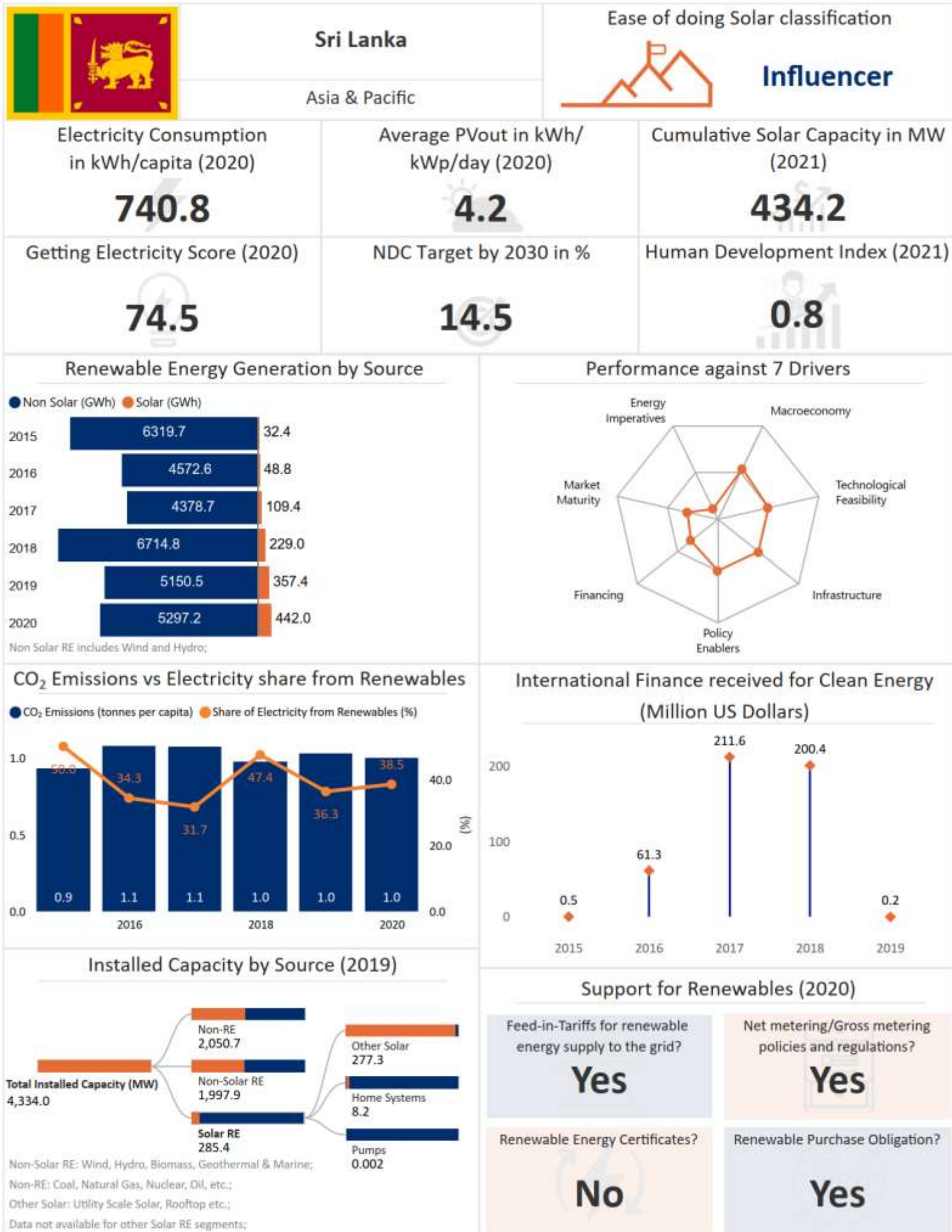
Financing

- In 2020, the AfDB approved financing for the Republic of South Sudan towards the cost of the Juba Power Distribution System Rehabilitation and Expansion Project.¹⁴
- In 2019, the African Export-Import Bank financed USD 45 Mn to build the country's first large-scale PV power project.¹⁶



Energy Imperatives

- In 2020, South Sudan's per capita electricity consumption stood at 0.05 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.¹⁹
- The total installed capacity in the country stood at 131.4 MW in 2019.¹⁷
- The total installed capacity of Solar PV witnessed a CAGR of 29.9% reaching 1.278 MW in 2021 from 0.449 MW levels in 2017.¹⁸



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Sri Lanka is a lower middle-income country¹ with a GDP per capita (PPP) of USD 14,707 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) declined by 3.5 % in 2020. However, in 2021 it has bounced back by growing at 3.3%.³
- The inflation rate (CPI) of Sri Lanka has increased to 6% in 2021 from 4.6% levels in 2020.⁴
- The general government gross debt to GDP has slightly increased to 103.1% in 2021 from 95.7% levels in 2020.⁵



Policy enablers

- Sri Lanka's energy policy has set an ambitious target of generating 70% of power from renewables by 2030.⁶
- Sri Lanka's Renewable Energy Resource Development Plan was made for 2021-2026 to implement large scale RE projects.⁷
- Net Metering mechanism in Sri Lanka has facilitated the solar business wherein consumers are encouraged for becoming prosumers.⁷
- The "Rooftop Solar PV Power Generation Project" in Sri Lanka has provided consumers with long-term debt financing for installation of rooftop solar PV systems.⁷



Technological Feasibility

- Sri Lanka receives high levels of solar irradiation (GHI) of 5.3 kWh/m²/day and specific yield 4.2 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁸
- The Sri Lankan government in association with DHYBRID (a German company) has initiated a pilot project to connect stand-alone grids to ensure safe supply of renewable power.⁹
- The Ceylon Electricity Board Hybrid Power System of capacity 5 MW has a battery energy storage system of 10 MWh.¹⁰



Market Maturity

- 100% of the population in Sri Lanka had access to electricity as of 2020.¹¹
- The role of Ministry of Power, Energy and Business Development (MOPE&BD) is to improve the country's power distribution network to ensure 100% household electrification.¹²
- The Public Utilities Commission of Sri Lanka (PUCSL) is the technical and safety regulator of the electricity industry.¹³
- The Ceylon Electricity Board (CEB) is a state-owned utility which is engaged in power generation, transmission, distribution, and collection of revenue.¹⁴



Infrastructure

- Sri Lanka's transmission network is well spread across the geography and comprises of 11 kV, 33 kV, 132 kV, 220 kV lines.¹⁵
- The National Transmission & Distribution Network Development and Efficiency Improvement Project (NTDND & EIP) entails construction of 132 kV/220 kV/400 kV transmission lines and 11 kV network along with SCADA integration.¹⁶



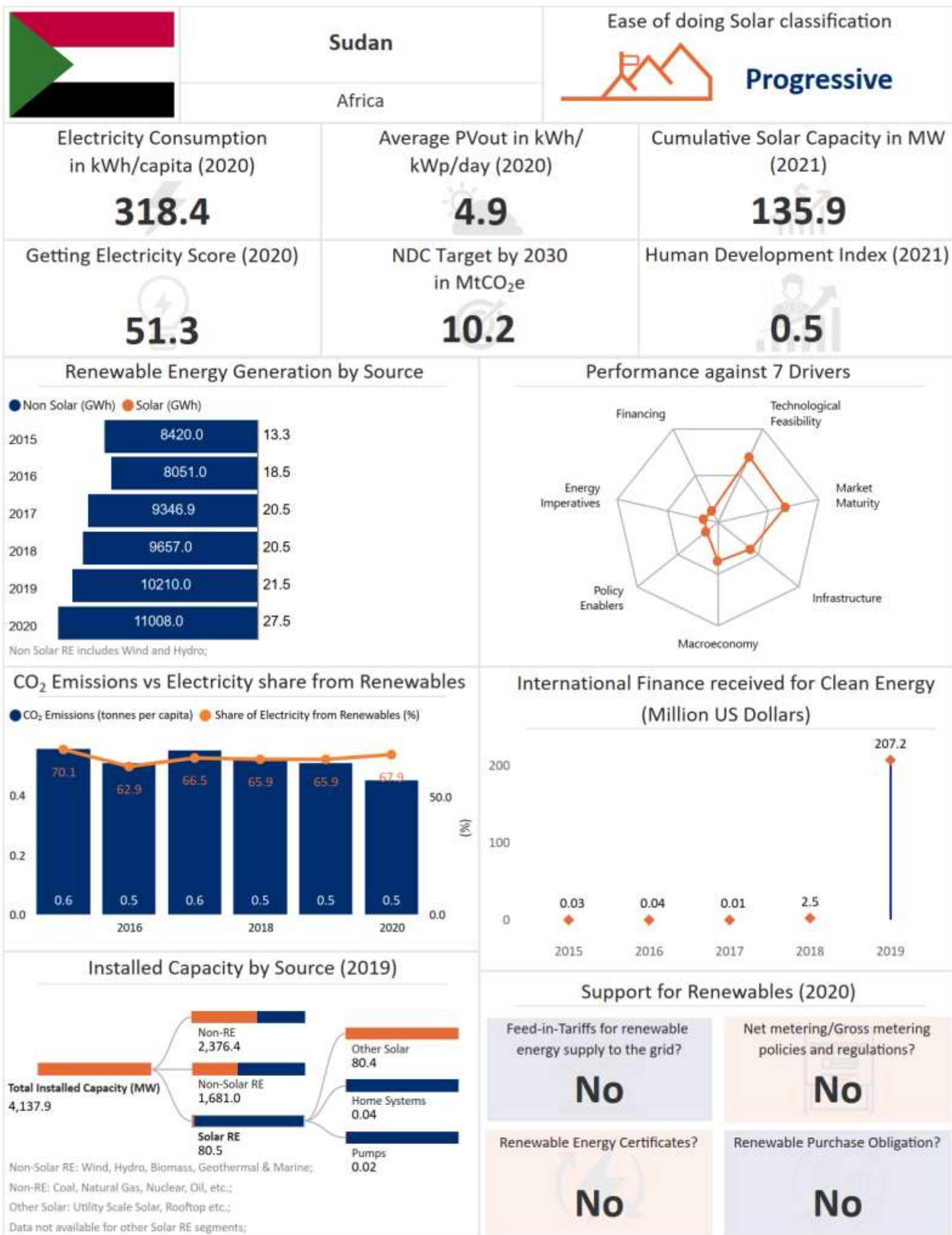
Financing

- The ADB had sanctioned a loan of USD 200 Mn in 2017 to Ceylon Electricity Board (CEB) to finance the wind power generation project in Mannar Island.¹⁷
- The Japan International Cooperation Agency (JICA) has actively extended loan to expand the transmission network.¹⁸
- The IFC is planning for an investment of more than USD 800 Mn, specifically in supporting growth-enabling sustainable infrastructure.¹⁹

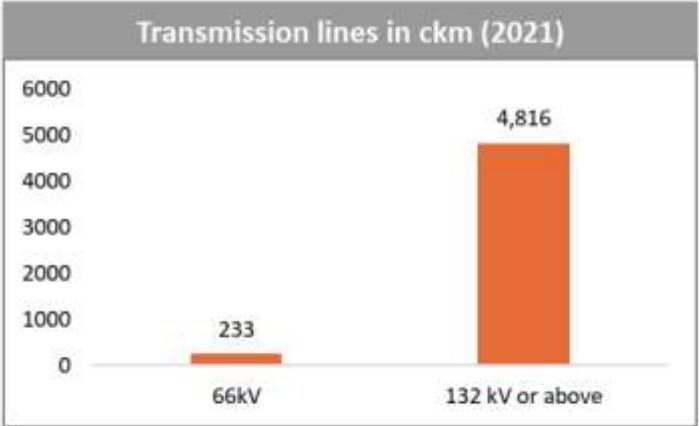
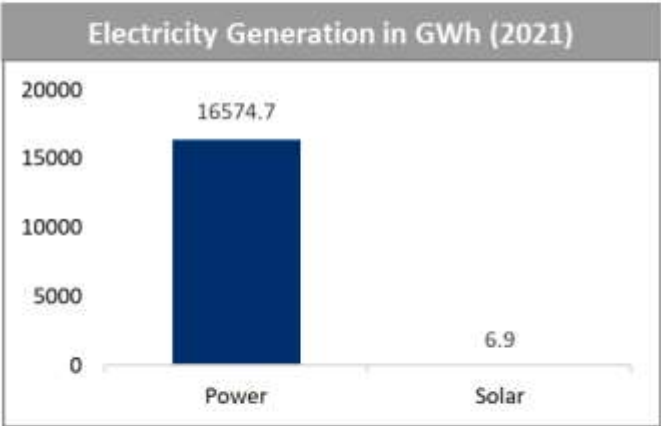


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.74 MWh in Sri Lanka, which is lower in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of solar PV witnessed a CAGR of 35% between 2017-2021 reaching 434.21 MW in 2021 from 130.82 MW levels in 2017.²¹
- The peak demand for electricity in the country stood at 15.21 TWh remaining same in 2021 and 2020.²²
- In 2021, the total installed capacity in the country reached 4.7 GW with a significant share coming from other fossils (36.95%), coal (26.23%), and hydro (32.22%) followed by bioenergy (1.58%), solar (0.72%) and wind (2.3%).²²



| Peak Demand/Load in GW (2021) | Cheapest Source of Power (2021) | Generation Cost for Hydro Power in USD/ kWh (2021) |
|-------------------------------|---------------------------------|--|
| 13.3 | Hydro | 0.035 |



| Financial Support Mechanisms (2021) | |
|---|----|
| Duty waivers to solar developers for importing/procuring material from foreign land | No |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | Yes | Yes | Yes | No | No | No | No | No |

| Emerging Technologies/Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | No |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Sudan is a low-income country¹ with a GDP per capita (PPP) of USD 4,066 in 2021.²
- GDP (Real) grew at an annual rate of 0.5% in 2021 and it is estimated to grow by 0.3% in 2022.³
- The inflation rate in the country has drastically increased to 358.9% in 2021 from 163.3% levels in 2020.⁴
- The fiscal deficit in the country reduced to 4.5% of GDP in 2021 from 5.6% levels in 2020.⁴



Policy enablers

- Ministry of Water Resources, Irrigation and Electricity (MoWRIE) is responsible for approving policies and regulations for power generation, transmission, and distribution.⁵
- Sudan targets to increase the share of solar in the overall generation mix to about 15% by 2026.⁶
- According to Sudan's strategic plan (2021-2035), the targeted renewable energy installed capacity is slated to reach 4.405 GW by 2030.⁶
- In Sudan, the National PV Fund aims to finance 400 solar pumps and it is planned to scale up the financing further in the near future.⁷



Technological Feasibility

- Sudan receives very high levels of solar irradiation of 6.1 kWh/m²/day and a specific yield of 4.9 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁸
- The country typically receives 9 hours of sunlight per day.⁶



Market Maturity

- 55.4% population in Sudan had access to electricity as of 2020.⁹
- Sudanese Electricity Transmission Company (SETCO) is responsible for the management, maintenance, and operation of the power transmission system and for supervising the construction of transmission infrastructure.⁵
- Sudanese Electricity Distribution Company (SEDC) is responsible for power distribution, managing the national distribution grid and some isolated grid systems.⁵
- Sudan is a member of the Eastern African Power Pool (EAPP) which aims to optimize the available energy resources and reduce electricity costs in the region.¹⁰



Infrastructure

- SETCO operates the transmission network of 33 kV Mono and Dual Circuit lines and Sub-Stations of 33/11 kV.¹¹
- As of 2021, the transmission network in Sudan comprises of 922.7 of 110 kV lines, 4196 kms of 220 kV lines and 619 kms of 500 kV lines.⁶
- SEDC constructs and supervises the distribution networks of less than 1.5 MVA loads and distributes electricity at 33 kV, 11 kV, and 415 V voltage levels.¹¹
- As of 2019, Sudan is an active member of EAPP and has 200 MW of operational interconnections with Ethiopia at 220 kV and Eritrea at 66 kV levels.⁵



Financing

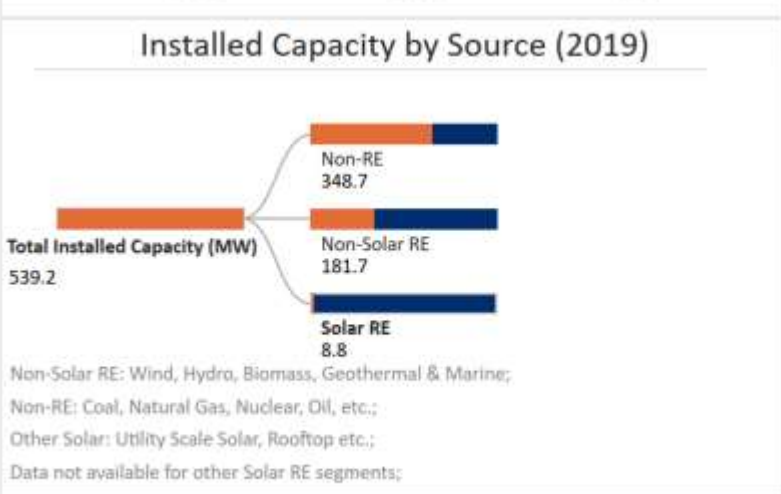
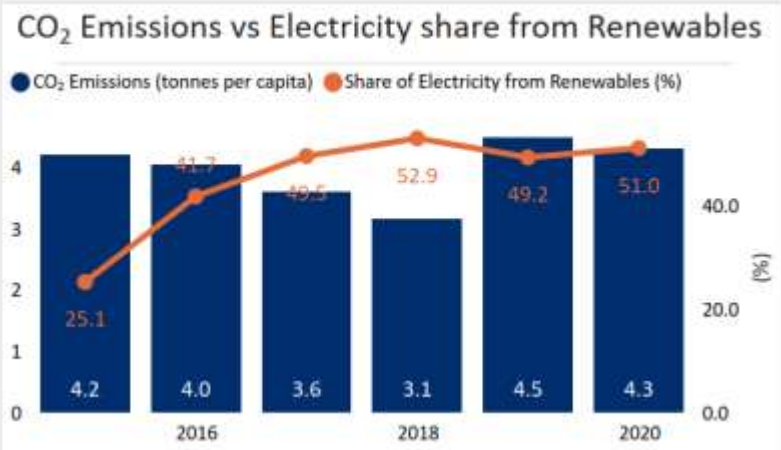
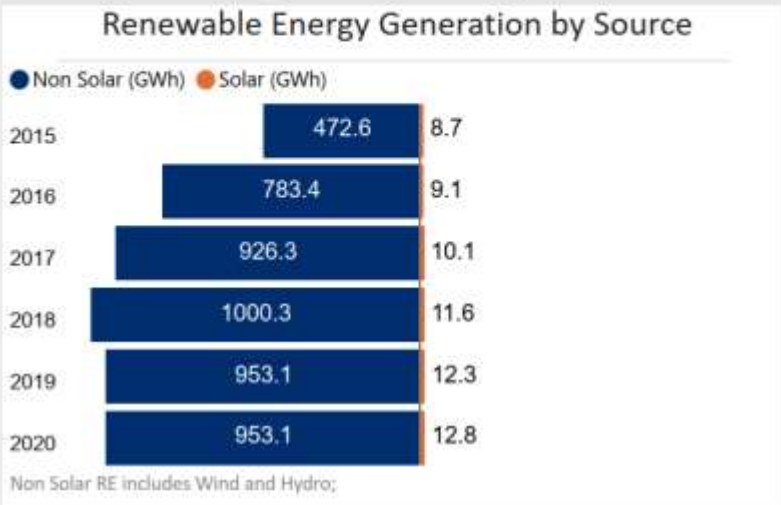
- In 2022, the African Development Fund approved a USD 5.5 Mn grant to initiate the flagship 'Desert to Power initiative' in Sudan.¹²
- The AfDB approved a USD 21.78 Mn grant to the government of Sudan to promote the adoption of solar-powered irrigation pumps in the country.¹³



Energy Imperatives

- In 2020, Sudan's per capita electricity consumption stood at 0.32 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.¹⁵
- Out of the total electricity generation of 16,574 MUs, solar electricity generation contributed only 6.85 MU in 2021.⁶
- The total installed capacity of solar PV witnessed a CAGR of 39.6% reaching 135.86 MW in 2021 from 35.8 MW levels in 2017.¹⁴
- As of 2021, the installed capacity of solar mini grids in the country stood at 5 MW.⁶
- The average solar tariff in Sudan is 0.038 USD/kWh in 2021.⁶

| | | | |
|--|---|---|--|
|  | | Suriname | Ease of doing Solar classification  Influencer |
| Latin America & Caribbean | | | |
| Electricity Consumption in kWh/capita (2020) 3937.7 | Average PVout in kWh/ kWp/day (2020) 4.3 | Cumulative Solar Capacity in MW (2021) 9.4 | |
| Getting Electricity Score (2020) 57.7 | NDC Target by 2030 in % (base year 2005) Not available | Human Development Index (2021) 0.7 | |



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Suriname is an upper-middle income¹ country with a GDP per capita (PPP) of USD 16,223 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) declined by 15.9% in 2020. However, in 2021, it has shown signs of recovery with GDP declining by only 3.5%.³
- The inflation rate (CPI) of Suriname has increased to 59.1% in 2021 from 34.9% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 125.7% in 2021 from 146.1% levels in 2020.⁵



Policy enablers

- Suriname has set a target to achieve a 35% share of RE in the electricity generation mix by 2030.⁶
- The Electricity Act 2016 facilitates private consumers to install solar panels for self-consumption and to use the electric grid to exchange energy by using net metering scheme.⁷
- The Electricity Act 2016, also facilitates tendering process by provision of signing PPAs with energy company and the owner of the solar and wind power plants.⁷



Technological Feasibility

- Suriname receives high levels of solar irradiation (GHI) of 5.4 kWh/m²/day and a specific yield 4.3 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁸
- Suriname's gold mine company site has battery energy storage system (BESS) of capacity 7.8 MW/7.8 MWh.⁹
- In Oct 2022, SINOSOAR, a Chinese firm was awarded a work to develop 500 KWp solar micro-grid project in Suriname.¹⁰



Market Maturity

- 98.2% of the population in Suriname had access to electricity as of 2020.¹¹
- The Electricity Act of 2016 regulates the power market including technical and financial situations and floating tenders for RE and private participation in Suriname.¹²
- Energie Bedrijven Suriname (EBS) is the state-owned energy generation, transmission, and distribution company of Suriname.¹³
- Suriname has four electricity suppliers- Suralco L.L.C, N.V. Energy Bedrijven Suriname (N.V. EBS), Staatsolie Power Company Suriname and Dienst Electriciteits Voorziening (DEV).¹⁴



Infrastructure

- In July 2019, through its NV Energie Bedrijven Suriname (EBS) which is the executing agency, Suriname has invited bids for upgrading its transmission system by augmenting 33 kV, 110 kV overhead lines and 110/12.3 kV, 33/6.15 kV and 110/33 kV substations.¹⁵
- The IDB has financed Suriname to digitally transform its transmission network using SCADA system, Energy Management System (EMS), Information and Communication Technologies (ICT), Geographic Integration System (GIS), Enterprise Resource Planning System (ERP) and an Outage Management System (OMS).¹⁶



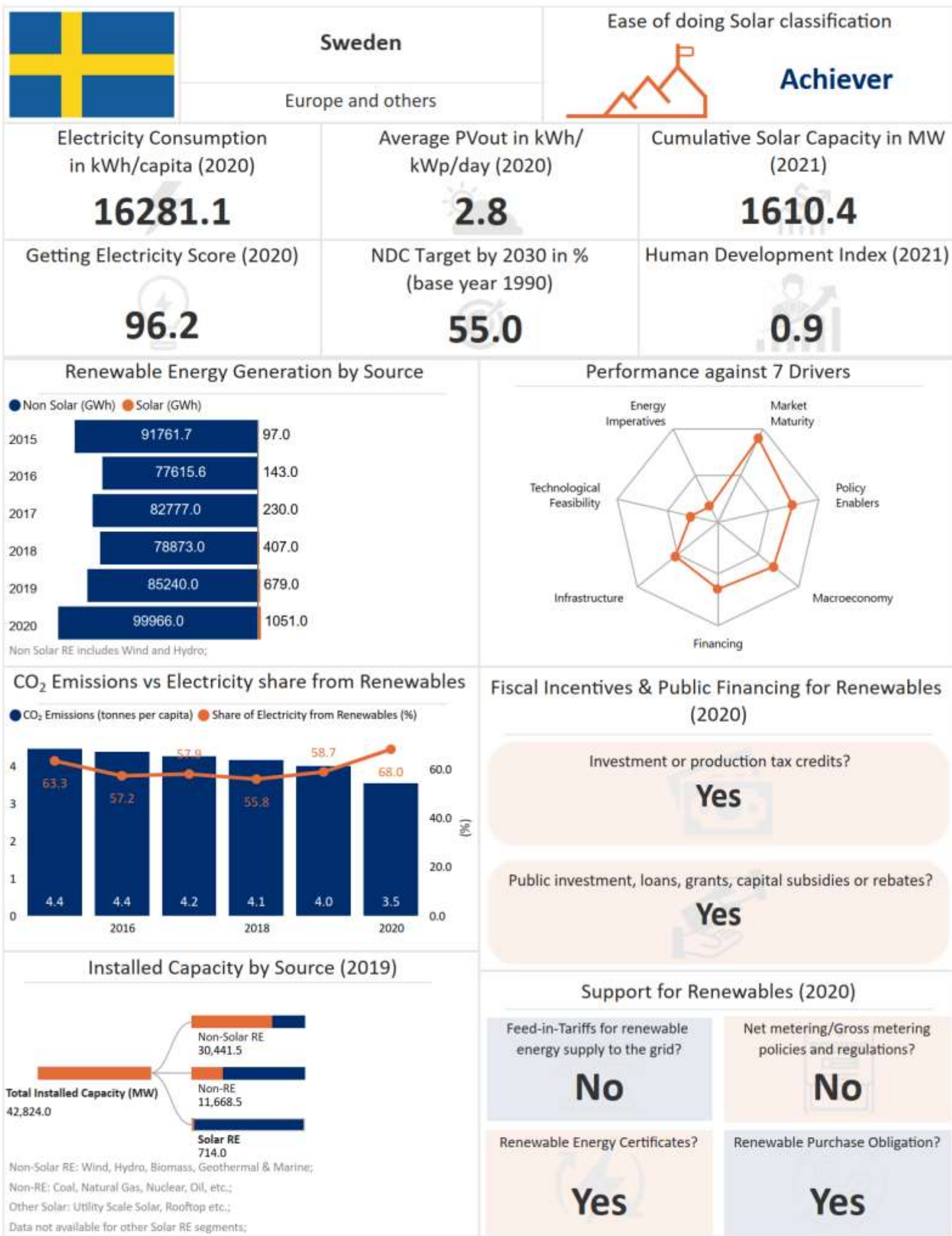
Financing

- In 2019, the Government of Suriname (GOS) has received financing from the Caribbean Development Bank (CDB) for the Power Projects Suriname to upgrade its transmission network.¹⁵
- The Government of Suriname with its "Discover Suriname" program has taken an initiative to invite investors to fund RE projects.¹⁶

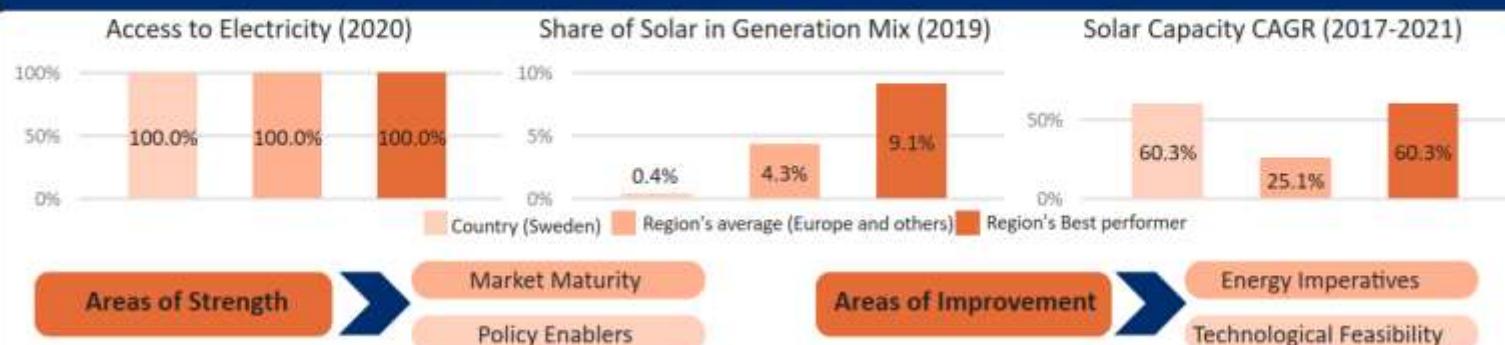


Energy Imperatives

- In 2020, the per capita electricity consumption stood at 3.94 MWh in Suriname, which is significantly higher in comparison to the global average of 3.31 MWh.¹⁷
- The total installed capacity of solar PV witnessed a CAGR of 5.3% reaching 9.43 MW in 2021 from 7.68 MW levels in 2017.¹⁸
- The peak demand for electricity in the country stood at 2.31 TWh remaining same in 2021 and 2020.¹⁹
- In 2021, the total installed capacity in the country stood at 566.5 MW²⁰ with major share coming from hydro (58.87%) followed by other fossils (40.69%) and solar (0.43%).¹⁹



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Sweden is a high-income country¹ with a GDP per capita (PPP) of USD 59,223 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 2.2% in 2020. However, in 2021, the GDP has bounced back recording an annual growth rate of 5.1%.³
- The inflation rate (CPI) of Sweden has increased to 2.7% in 2021 from 0.7% levels in 2020.⁴
- The general government gross debt to GDP has reduced to 36.8% in 2021 from 39.2% levels in 2020.⁵



Policy enablers

- Sweden has set a target to reduce its GHG emissions 59% by 2030 from 2005 levels and to have a net-zero carbon economy by 2045.⁶
- Sweden has targeted to generate 100% of its electricity from RE sources by 2040.⁷
- Sweden's Feed-in tariff policy provides access for small independent generators to be connected to the grid and mandates utilities to purchase electricity from small generators at agreed prices.⁸
- Sweden's Guaranteed Power Purchase Contract, 1997 policy mandates local distribution companies to purchase electricity from projects having less than 1,500 kW capacity within their territories.⁹



Technological Feasibility

- Sweden receives low solar irradiation (GHI) of 2.7 kWh/m²/day and specific yield 2.8 kWh/kWp/day indicating a low technical feasibility for solar in the country.⁹
- Sweden has set plans to operationalise battery energy storage system (BESS) of 70 MW/70 MWh by 2024.¹⁰
- Sweden has planned to build a 500 MW solar park which would cater to the demands of ~32,000 households.¹¹



Market Maturity

- 100% of the population in Sweden had access to electricity as of 2020.²
- The Electricity Act, 1997:857 regulates the connection of renewable electricity plants, the distribution of electricity from renewable sources and the obligation to expand the grid.¹⁵
- The Swedish Energy Agency (SEA) is the government agency responsible for matters related to the electricity supply and use of energy in Sweden.¹²
- The Swedish government has assigned Svenska kraftnät as the TSO that owns and operates the national electricity grid.¹³
- In Sweden, EPEX SPOT is the leading exchange for providing market spot to buy, sell, and trade electricity, secure transactions, and auctioning services.¹⁴



Infrastructure

- Sweden's national grid for electricity comprises of approximately 17,000 km of power lines and about 200 substations and switching stations.¹⁶
- Sweden's transmission network operates at 400 kV, 275 kV and 220 kV voltage levels.¹⁶
- Sweden has 16 cross border transmission lines with Denmark, Finland, and Norway (known as the Nordic Market).¹⁷



Financing

- The Swedish Government has invested USD 790.03 Mn towards renewable energy, efficient energy use and energy and climate advisory services in 2018 followed by additional funding in 2019 and 2020.¹⁸
- Sweden's largest municipal funding agency, Kommuninvest, has issued green bonds to institutional investors to fund green loans for investment projects undertaken by local and regional governments and about USD 1.1 Bn towards RE projects.¹⁹



Energy Imperatives

- In 2020, Sweden's per capita electricity consumption stood at 16.28 MWh, which is significantly higher in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of solar PV witnessed a CAGR of 60.3% reaching 1,610.43 MW in 2021 from 244 MW levels in 2017.²¹
- In 2021, the total installed capacity in the country stood at 45.2 GW²² with a significant share coming from hydro (42.96%) followed by nuclear (31.24%), wind (15.97%), bioenergy (7.79%), solar (0.61%) and gas (0.06%).²³



Country's regional performance and characteristics



Key Insights

Drivers

Insights



- Syria's economic crisis deepened to unprecedented levels in 2021. The international organizations have warned of the worst humanitarian conditions in Syria since the beginning of the conflict a decade ago.¹
- 60% of Syrians are now deemed food insecure as the cost of basic food items has more than doubled and purchasing power has rapidly diminished.¹



- In 2019, the Syrian government announced the National Renewable Energy Strategy 2030 to address its energy security concerns.³
- Syrian Law on Energy Conservation 2009 aims to fulfil the sustainable development requirements of the country and deploy various renewable energy applications.⁴
- The Syrian government, in its RE study report released in 2021, has targeted different renewable projects across domestic and private sector covering public sector entities, water and agriculture sector, industry and trade sector and places of worship.⁴



- Syria receives high levels of solar irradiation (GHI) of 5.5 kWh/m²/day and specific yield 4.9 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁵
- Syrian government has forecasted that electricity generation is set to grow from 20 BUs in 2021 to 60 BUs in 2030 through conventional electricity sources.⁴
- Syrian government has recently come up with PV power plant of 33 MW capacity in Aleppo.⁷
- A pilot project of 127 kWp with 720 kWh battery storage capacity was installed at a Hospital in Syria in 2016.¹⁹



- 89.1% of the population in Syria had access to electricity as of 2020.⁶
- The Ministry of Electricity regulates the generation, transmission, distribution of electricity within the country.⁷
- The operations related to of transmission and distribution is handled by General Organisation for Electricity Transmission and Distribution.⁹
- The Syrian government has constituted a RE fund to encourage consumers to stop using hydrocarbons by providing products such as interest-free loans or subsidized loans to the households, agriculture projects, manufacturer sector etc.⁸



- Syria is connected through electricity interconnections (at 400 kV levels) project which cover countries such as Turkey, Lebanon, Iraq, Libya, Egypt, Jordan, and Palestine.¹⁰
- The Syrian government is bringing up a major investment in the grid expansion by investing USD 10.5 Bn in generation, transmission and distribution.¹¹



- The Credit and Monetary Council (CMC) of the Central Bank of Syria (CBS) has set out new criteria for banks to provide financing for industrial and renewable energy projects.¹²
- DUBAI- Syria's Monetary and Credit Council has given banks the go-ahead to provide industrial and renewable energy projects with credit facilities without any lending ceilings.¹³
- UNDP has financed Syrian government for "Electricity and Renewable Energy Program" and has contributed almost USD 46 Mn.¹⁴



- In 2020, the per capita electricity consumption stood at 0.90 MWh, which is lower in comparison to the global average of 3.31 MWh.¹⁵
- The total installed capacity of solar PV witnessed a CAGR of 109.4% between 2017-2021 reaching 2.47 MW in 2021.¹⁶
- The peak demand for electricity in the country has remained same at 15.81 TWh for 2021 and 2020.¹⁷
- In 2021, the total installed capacity in the country reached 10 GW with a significant share coming from gas (61.29%) and other fossils (33.33%) followed by hydro (4.74%) and bioenergy (0.06%).¹⁷
- The price of electricity is USD Cent 1.4 for households and USD Cent 3.9 for business in Syria.¹⁸



Tanzania

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

120.2

Average PVout in kWh/
kWp/day (2020)

4.5

Cumulative Solar Capacity in MW
(2021)

23.6

Getting Electricity Score (2020)

74.9

NDC Target by 2030 in %
(base year 2000)

30.0 to 35.0

Human Development Index (2021)

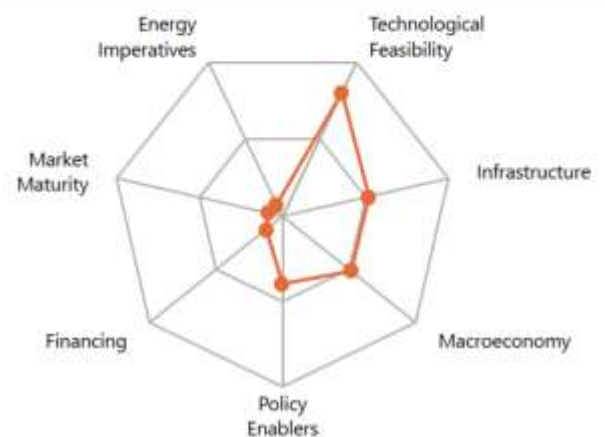
0.5

Renewable Energy Generation by Source

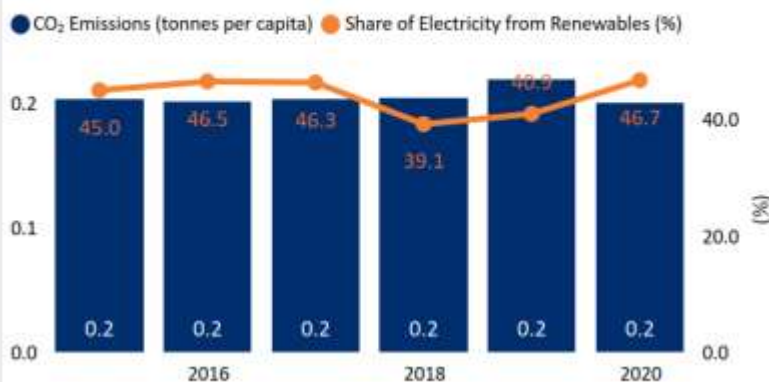


Non Solar RE includes Wind and Hydro;

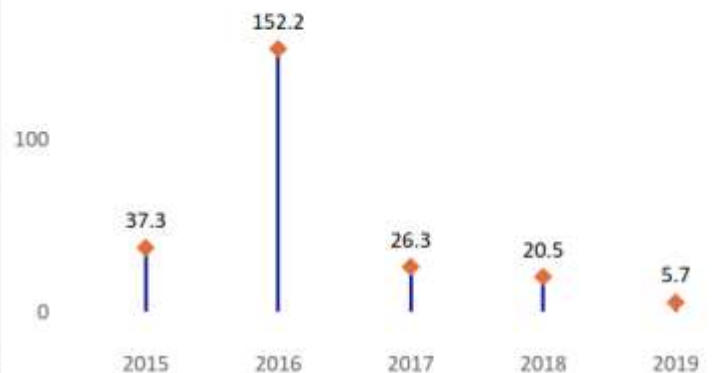
Performance against 7 Drivers



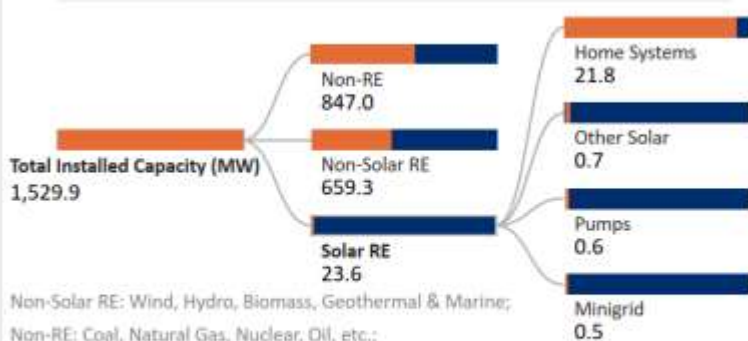
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

Yes

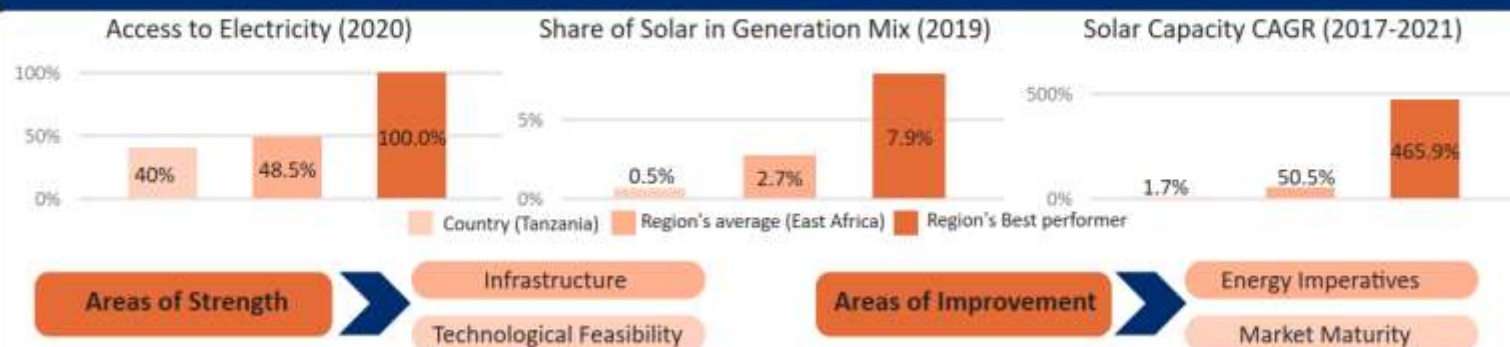
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Tanzania is a lower middle-income country¹ with a GDP per capita (PPP) of USD 2,836 in 2021.²
- GDP (Real) grew at an annual rate of 4.9% in 2021 and it is estimated to grow by 4.8% in 2022.³
- The inflation rate in the country increased to 3.7% in 2021 from 3.3% levels in 2020.⁴
- The fiscal deficit in the country increased to 3.4% of GDP in 2021 from 0.8% levels in 2020.⁵



Policy enablers

- Tanzania aims to reduce its GHG emissions to 10-20% by 2030, relative to the projected 2030 business-as-usual emissions of 138-153 MtCO₂e, through the promotion of clean technologies and RE sources.⁵
- The Ministry of Energy and Minerals is responsible for developing policies, plans, and programs related to electricity and renewable energy in the country.⁶
- National Energy Policy (NEP) aims at scaling up the RE utilization and diversifying the country's energy mix using solar, biomass, wind, small-scale hydro, and geothermal energy.⁷
- Feed-in-tariff (FIT) provisions are established to attract private investors to set up small power plants (SPPs) using RE.⁸



Technological Feasibility

- Tanzania receives very high levels of solar irradiation of 5.6 kWh/m²/day and a specific yield of 4.5 kWh/kWp/day indicating a very strong technical feasibility for solar in the country.⁹
- The UN Environment program is currently active in Tanzania and is working towards the introduction of electric vehicles (two and three-wheelers) and zero/low-emissions buses.¹⁰
- During the Covid-19 crisis, Tanzanian mini-grid company JUMEME provided free electricity to the 10 healthcare facilities that were connected to its mini-grids.¹¹



Market Maturity

- 40% population in Tanzania had access to electricity as of 2020.¹²
- The Energy and Water Utilities Regulatory Authority (EWURA) is responsible for regulating energy and water utilities transparently and efficiently that ensures quality, availability, and affordability.¹³
- Tanzania Electric Supply Company Limited (TANESCO) is responsible for the transmission and distribution of electricity, promotion of services, and customer service matters in the country.^{14, 15}
- Tanzania is a member of the Eastern African Power Pool (EAPP) which aims to optimize the available energy resources and reduce electricity costs in the region.¹⁶



Infrastructure

- Tanzania's transmission network comprises 3010 km of 220 kV lines, 1672 km of 132 kV lines, 543 km of 66 kV lines, and 670 km of 400 kV lines totalling to around 5896 km of lines and 57 substations.¹⁵
- TANESCO's transmission network expansion plan includes the construction of 414 km of 400 kV Singida – Arusha - Namanga transmission line.¹⁵
- Tanzania is planning to spend USD 1.9 Bn to upgrade its power transmission and distribution network to end electricity outages.¹⁷



Financing

- To promote investment in RE projects Tanzania, in collaboration with the World Bank's Carbon Partnership Facility, designed an innovative financing instrument that monetized carbon credits from private RE projects.¹⁸
- The AfDB has shown keen interest in improving RE investments to increase electricity access rates and RE generation.¹⁹
- As of 2020, the AfDB approved a USD 120 Mn loan to fund the construction of a 50 MW hydropower plant in Western Tanzania.²⁰



Energy Imperatives

- In 2020, Tanzania's per capita electricity consumption stood at 0.12 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²³
- The total installed capacity in the country stood at 1,529.9 MW in 2019.²¹
- The total installed capacity of solar PV witnessed a CAGR of 1.7% reaching 23.64 MW in 2021 from 22.07 MW levels in 2017.²²



Togolese Republic

Africa

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

62.8

Average PVout in kWh/
kWp/day (2020)

4.1

Cumulative Solar Capacity in MW
(2021)

57.2

Getting Electricity Score (2020)

72.6

NDC Target by 2030 in %
(base year 2018)

20.5

Human Development Index (2021)

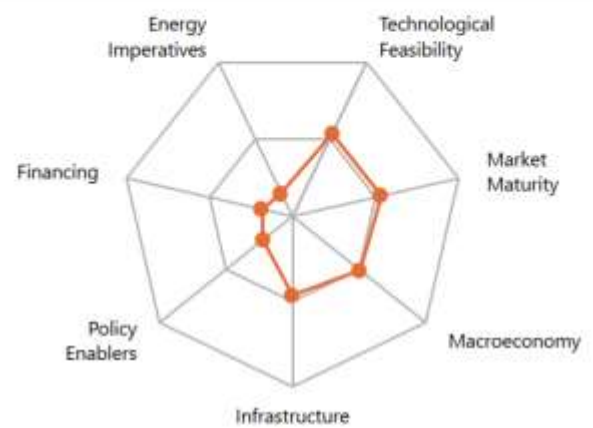
0.5

Renewable Energy Generation by Source

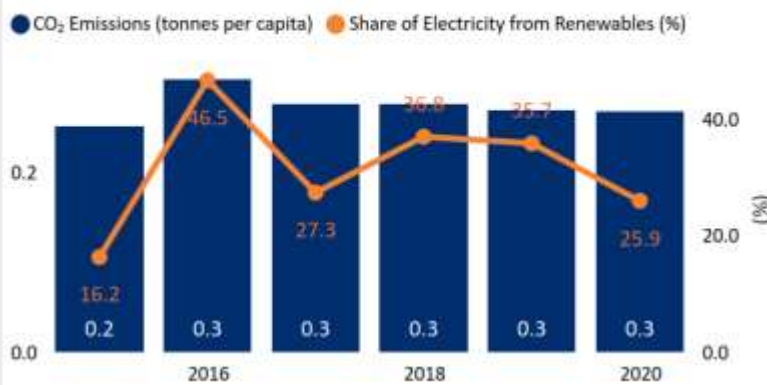


Non Solar RE includes Wind and Hydro;

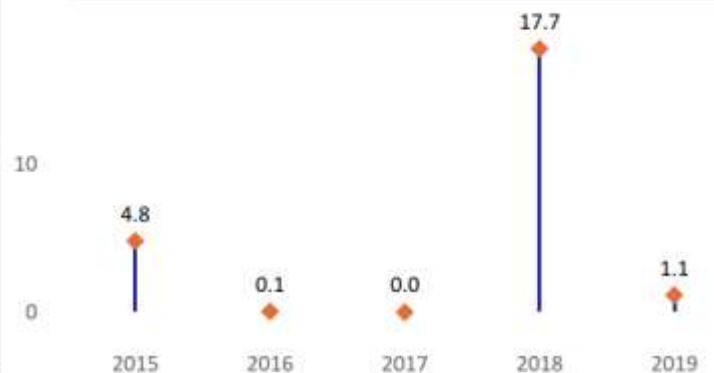
Performance against 7 Drivers



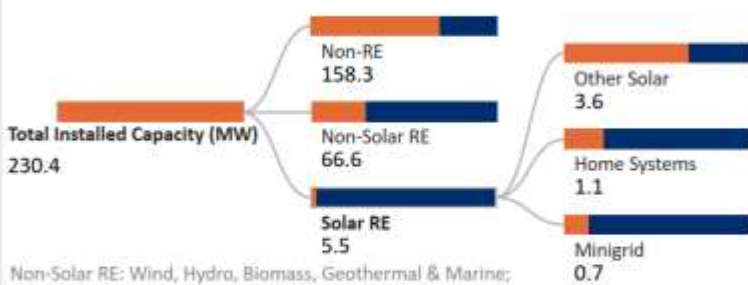
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



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Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

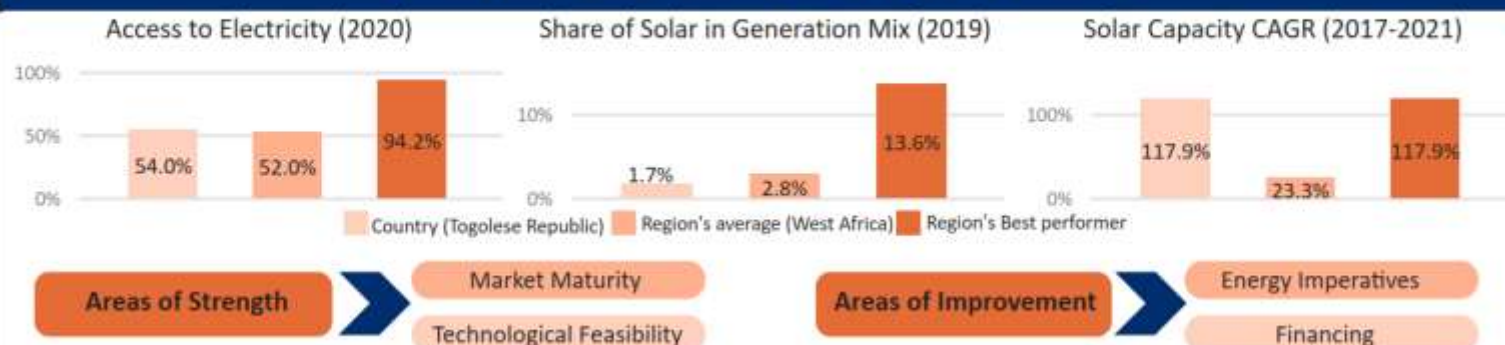
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Togo is a low-income country¹ with a GDP per capita (PPP) of USD 2,334 in 2021.²
- GDP (Real) grew at an annual rate of 5.1% in 2021 and it is estimated to grow by 5.6% in 2022.³
- The inflation rate in the country increased to 4.3% in 2021 from 1.8% levels in 2020.⁴
- Total public debt in the country increased to 61% of GDP in 2021 from 58.6% levels in 2020.⁵



Policy enablers

- The Ministry of Mines and Energy (MME) is responsible for planning, organizing, coordinating the energy sector policies, and promoting research and use of RE in Togo.⁶
- Togolese Agency for Rural Electrification and Renewable Energies (AT2ER) is responsible for implementing the country's rural electrification policy and developing RE sector in Togo.⁷
- The Government of Togo is showing interest in increasing private sector investment in the power sector and attracting companies (in off-grid domain) to increase access to electricity in rural areas.⁸



Technological Feasibility

- Togo receives high levels of solar irradiation of 5.2 kWh/m²/day and a specific yield of 4.1 kWh/kWp/day indicating strong technical feasibility for solar in the country.⁹
- The UN Environment program is currently active in Togo and is working on the introduction of electric vehicles (two and three-wheelers).¹⁰
- Currently, the Government of Togo is planning to accelerate rural electrification through the deployment of solar home systems (SHS).¹¹



Market Maturity

- 54% population in Togo had access to electricity as of 2020.¹²
- The Regulatory Authority for Electricity Sector (ARSE) is responsible for regulating tariffs and monitoring and managing potential conflicts between distributors and consumers.¹³
- The Compagnie Energie Electrique du Togo (CEET) is the agency responsible for the distribution and sale of electrical energy.¹⁴
- The Communauté Electrique du Benin (CEB) was created in 1968 through the Benin-Togo electricity code to import, produce and transmit electricity for the benefit of the two countries.¹³



Infrastructure

- The Nigeria-Benin Interconnection Reinforcement Project aims at the construction of a 330 kV double circuit HV transmission line for power exchange between Nigeria and Togo/Benin.¹⁵
- The proposed interconnections such as the Ghana-Togo-Benin transmission line of 338 kV is slated to increase transmission capacity and enable the flow of energy between countries.¹⁶
- Togo imports electricity from Ghana, Nigeria, and Cote d'Ivoire to meet the country's electricity demand.⁷



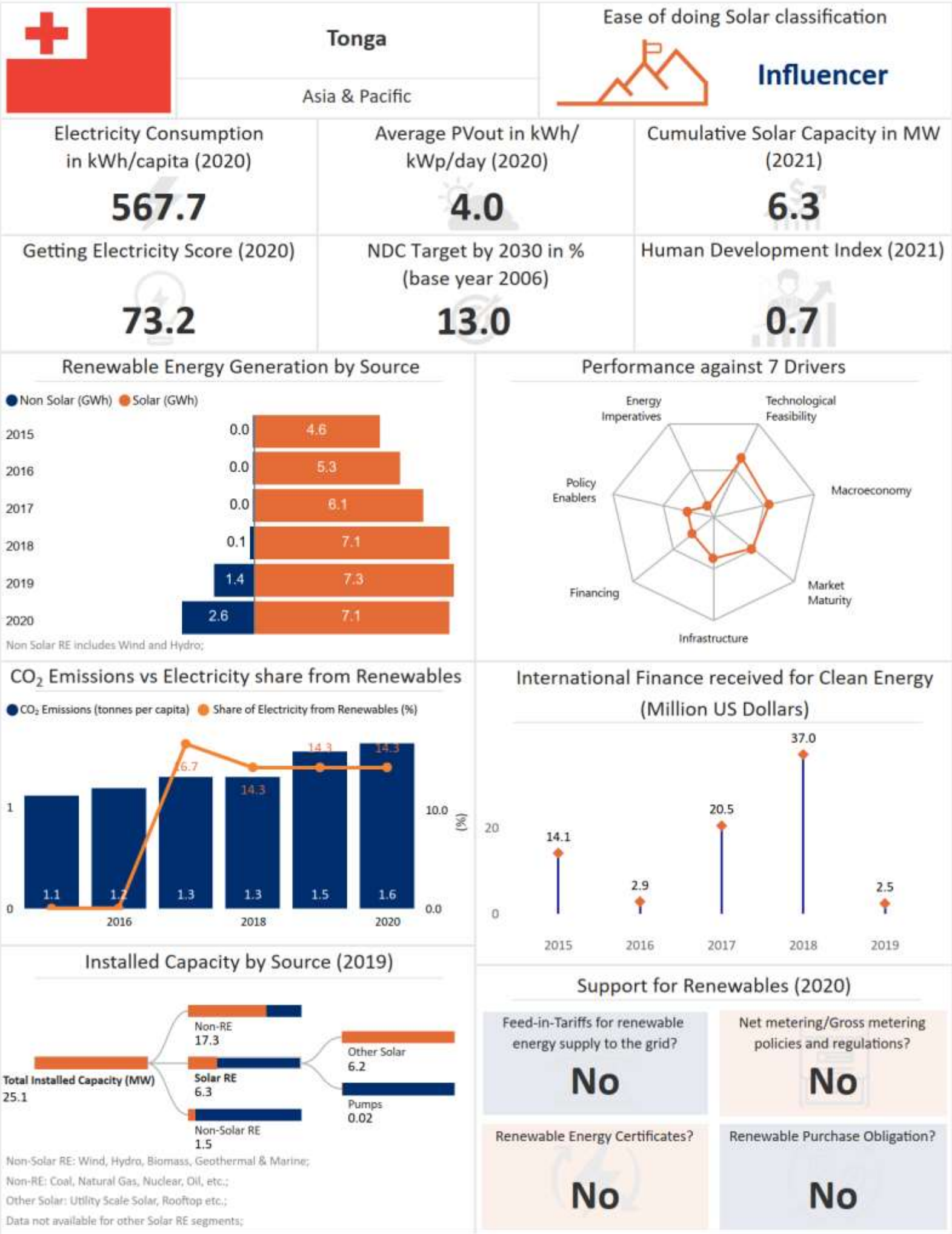
Financing

- The World Bank approved a USD 150 Mn International Development Association (IDA) financing that aims to improve fiscal and debt management, reduce the cost of electricity, and promote the use of RE in Togo.¹⁷
- In Togo, the EU has ramped up its financial and technical support, and the AfDB has prepared and implemented a new country strategy for 2016–2020.¹⁸



Energy Imperatives

- In 2020, Togo's per capita electricity consumption stood at 0.06 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²¹
- The total installed capacity in the country stood at 230.4 MW in 2019.¹⁹
- The total installed capacity of solar PV witnessed a CAGR of 117.9% reaching 57.23 MW in 2021 from 2.54 MW levels in 2017.²⁰
- The price of electricity in the country stood at 17 US Cents/kWh as of 2019.²²



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Tonga is a middle-income¹ country with a GDP per capita (PPP) of USD 6,749 in 2020.²
- Due to COVID-19 Pandemic, the GDP (Real) declined to 0.5% in 2020 and it further declined by 2.7% in 2021.³
- The inflation rate (CPI) of Tonga has increased to 1.4 % in 2021 from 0.4% levels in 2020.⁴
- The general government gross debt to GDP has reached 47.5% in 2021 from 43.6 % levels in 2020.⁵



Policy enablers

- Tonga has committed to achieve a share of 70% from renewables in the generation mix by 2030.⁶
- Tonga has also been working to achieve its energy efficiency target by 2030.⁷
- Tonga Climate Change Policy is focused towards building a resilient Tonga by 2035 envisioning an integrated approach to adaptation, disaster risk reduction and mitigation.⁷



Technological Feasibility

- Tonga receives high levels of solar irradiation (GHI) of 4.9 kWh/m²/day and specific yield 4.0 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁸
- Tonga Renewable Energy Project (TREP) entails electricity generation from renewable sources and grid technologies.⁹
- In March 2021, Energy Department of the Ministry of MEIDECC conducted a procurement for solar PV/BESS based micro-grid in 'O'ua, Tungua, Kotu and Mo'unga'one and for the island of Niuafo'ou.¹⁰



Market Maturity

- 100% of the population in Tonga is having access to electricity since 2020.¹¹
- The Electricity Commission regulates the power sector in the country. The state-owned Tonga Power Ltd (TPL) generates, transmits, and distributes electricity to the four islands in Tonga.¹²
- Tonga has developed the Renewable Energy Act, 2016 that promotes the development of renewable energy industry in the country.¹³



Infrastructure

- Nuku'alofa Network Upgrade Project (NNUP) has helped in reducing network losses and provide safe and reliable electricity supply to approximately 8,472 households and businesses.¹⁴
- Tonga is changing the existing electricity meters with the new smart meters to improve electricity services to the consumers.¹⁵



Financing

- ADB has financed Tonga's renewable energy project with an estimated cost of USD 750 Mn.¹⁶
- The Green Climate Fund (GCF) has given a grant of USD 29.9 Mn to emphasis on a climate-resilient battery energy storage system and renewable energy systems.¹⁷
- Australian Government and Government of Tonga has funded Tonga Renewable Energy Project with amounts of USD 2.50 Mn and USD 5.60 Mn respectively.¹⁸



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.567 MWh in Tonga, which is lower in comparison to the global average of 3.31 MWh.¹⁹
- The total installed capacity of solar PV witnessed a CAGR of 0.08% between 2017-2021 reaching 6.3 MW in 2021 from 6.2 MW levels in 2017.²⁰
- The peak demand for electricity in the country stood at 0.06 TWh remaining same in 2021 and 2020.²¹
- In 2021, the total installed capacity in the country reached 25 MW²² with almost 100% share coming from fossil fuel based electricity.²¹



Trinidad and Tobago

Latin America & Caribbean

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

5862.6

Average PVout in kWh/
kWp/day (2020)

4.3

Cumulative Solar Capacity in MW
(2021)

3.6

Getting Electricity Score (2020)

84.3

NDC Target by 2030 in %
(base year 2013)

15.0

Human Development Index (2021)

0.8

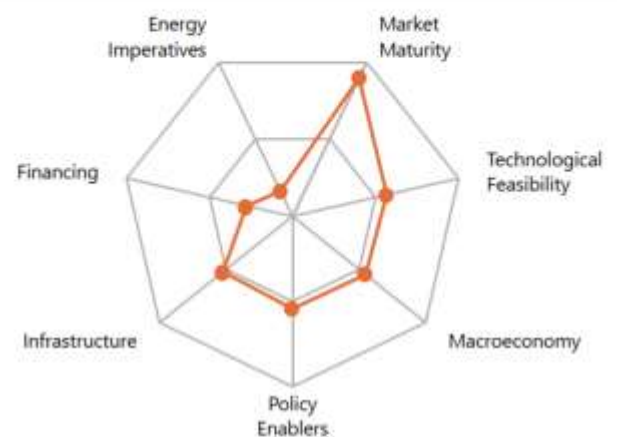
Renewable Energy Generation by Source

● Non Solar (GWh) ● Solar (GWh)



Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables

● CO₂ Emissions (tonnes per capita) ● Share of Electricity from Renewables (%)



Fiscal Incentives & Public Financing for Renewables (2020)

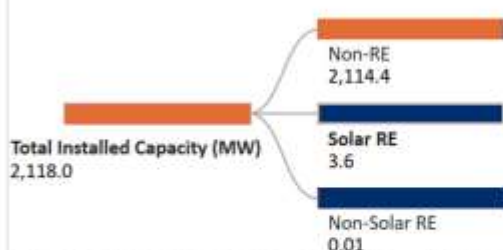
Investment or production tax credits?

Yes

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Trinidad and Tobago is a high-income country with a GDP per capita (PPP) of USD 25,309 in 2021.^{1,4}
- In 2021, the GDP (Real) has contracted by 0.7%. However, in 2022, it is expected to bounce back with an annual growth rate of 4.0%.¹
- The inflation rate (CPI) of the country has increased to 1.5% in 2021 from 0.6% levels in 2020.¹
- The general government gross debt to GDP has marginally increased to 60.6% in 2021 from 59.3% levels in 2020.¹



Policy enablers

- To promote development of RE in the country, various incentives such as tax credits, import duty exemptions, wear and tear allowances and interconnection standards have been introduced.^{10, 11}
- By 2030, the country aims to reduce cumulative emissions from its three main carbon-emitting sectors- power generation, transportation, and industry- by 15% compared to a business-as-usual baseline. The country intends to achieve this through increasing the use of RE, E-mobility, and other measures.¹²



Technological Feasibility

- Trinidad and Tobago receives high levels of solar irradiation (GHI) of 5.4 kWh/m²/day and specific yield 4.3 kWh/kWp/day indicating strong technical feasibility for solar in the country.³
- The country is highly dependent on imported fossil fuels for generation of electricity thus making it's economy susceptible to fluctuating oil prices.⁴



Market Maturity

- 100% of the population in Trinidad and Tobago is having access to electricity since 2006.²
- The Regulated Industries Commission (RIC), a statutory body, regulates the power sector in the country.⁶
- While the Trinidad and Tobago Electricity Commission (T&TEC) is the sole operator of electricity transmission and distribution, independent power producers also contribute to the electricity generation sector.⁷



Infrastructure

- Absence of an interconnected national grid for connecting two islands is a major challenge that the country's power sector faces.⁸
- In 2020, the system losses stood at 6.0% indicating a reasonably efficient infrastructure.⁹



Financing

- Under the Green Guarantee Company & CRAFT project, the green climate fund has provided USD 21.7 Mn financing support in the country.¹³
- In 2019, IRENA has sanctioned USD 3 Mn funding for the development of RE power plants in the country.¹⁴



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 5.86 MWh, which is significantly higher in comparison to the global average of 3.31 MWh.⁴
- The peak demand for electricity in the country has remained constant at 8.2 TWh in 2020 and 2021.⁴
- In 2021, the total installed capacity in the country reached 2.33 GW with a significant share coming from gas (85.4%) followed by oil (14.6%).⁴



Tunisia

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

1653.3

Average PVout in kWh/
kWp/day (2020)

4.7

Cumulative Solar Capacity in MW
(2021)

94.9

Getting Electricity Score (2020)

82.3

NDC Target by 2030 in %
(base year 2010)

45.0

Human Development Index (2021)

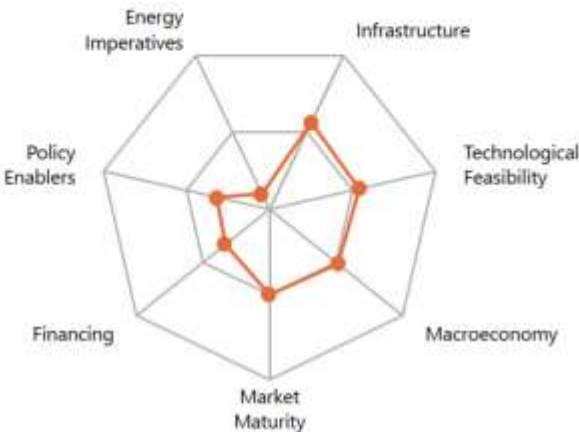
0.7

Renewable Energy Generation by Source

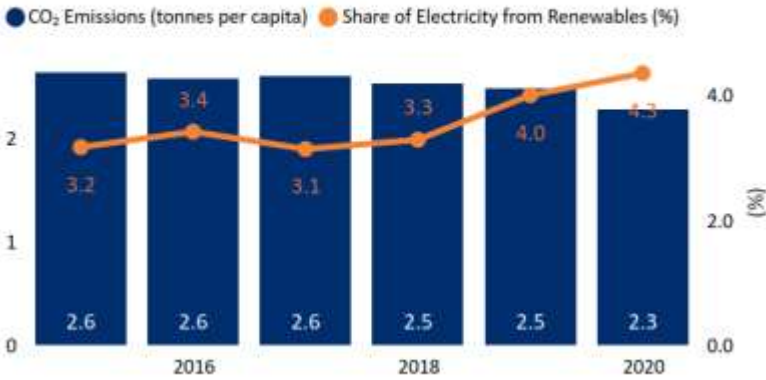


Non Solar RE includes Wind and Hydro;

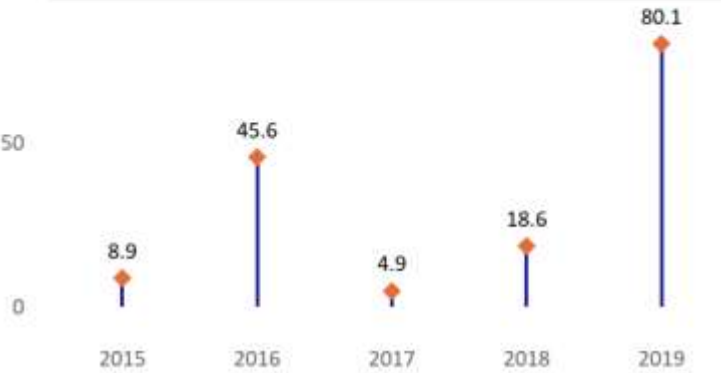
Performance against 7 Drivers



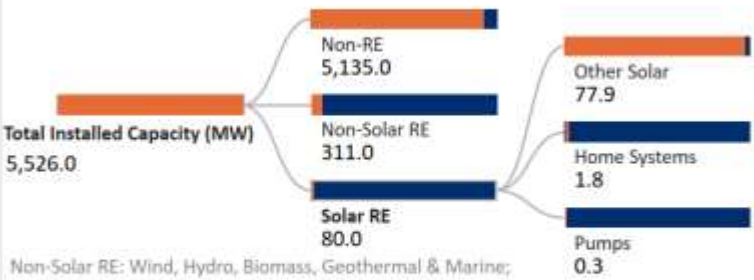
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy
(Million US Dollars)



Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;
Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;
Other Solar: Utility Scale Solar, Rooftop etc.;
Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Tunisia is a lower middle-income country¹ with a GDP per capita (PPP) of USD 11,283 in 2021.²
- GDP (Real) grew at an annual rate of 3.1% in 2021 and it is estimated to grow by 2.2% in 2022.³
- The inflation rate in the country marginally increased to 5.7% in 2021 from 5.6% levels in 2020.⁴
- The total public debt in the country stood at 91% of the GDP in 2021.⁵



Policy enablers

- The National Agency for Energy Management (ANME) is responsible for implementing policies and promoting RE sources and energy efficiency in the country.⁶
- The 'Tunisian Solar Plan' aims to reduce carbon intensity by 41% relative to 2010 levels and to attain a 30% share of RE in the energy mix by 2030.⁵
- The incentive mechanism 'Prosol' is a net-metering scheme in which the household receives a loan for the purchase of the PV plant and has the provision to repay the loan through periodic electricity bills. This scheme also offers a subsidy equal to 30% of the investment to the participating households.⁷



Technological Feasibility

- Tunisia receives high levels of solar irradiation of 5.4 kWh/m²/day and a specific yield of 4.7 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁸
- The UN Environment program is currently active in Tunisia and is working towards the introduction of electric light duty vehicles.⁹
- The Government of Tunisia is working on establishing a new legal framework to promote the production and use of green hydrogen.¹⁰



Market Maturity

- 100% population in Tunisia is having access to electricity since 2020.¹¹
- Tunisian Company of Electricity and Gas (STEG) is responsible for the production and distribution of electricity across the country.¹²
- The Directorate-General of Energy is responsible for regulating the electricity sector in the country.¹³
- Tunisia is a member of Comité Maghrebien de L'électricité (COMEELEC), the power pool of the Magreb region.¹⁴



Infrastructure

- STEG manages about 6,906 km of transmission lines of which 208 km is at 400 kV level, 2,910 km is at the 225 kV level, 2,382 km is at the 150 kV level, and 1,406 km is at the 90 kV level.¹⁵
- Tunisia's electricity distribution network length stands at 175,389 km including 59,691 km of MV lines and 115,698 km of LV lines.¹⁵
- Tunisia has a well-developed transmission network and it is already interconnected with Algeria and Libya, although these interconnectors are only used during specific situations and not for regular energy trade.⁷



Financing

- In 2022, the AfDB approved the Leveraging Energy Access Finance Framework (LEAF) under which the Bank will commit up to USD 164 Mn to promote decentralized RE in Tunisia.¹⁶
- Climate Investment Fund (CIF) aims at providing energy security and climate change mitigation through the USD 490 Mn Middle East and North Africa (MENA) region's concentrated solar power (CSP) initiative.¹⁷
- The AfDB approved a non-sovereign guarantee corporate loan of USD 75 Mn for an energy project in Southern Tunisia.¹⁸



Energy Imperatives

- In 2020, Tunisia's per capita electricity consumption stood at 1.65 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²¹
- The total installed capacity in the country stood at 5,526 MW in 2019.¹⁹
- The total installed capacity of solar PV witnessed a CAGR of 19.2% reaching 94.89 MW in 2021 from 47.076 MW levels in 2017.²⁰
- The price of electricity in the country stood at 9.70 US Cents/kWh as of 2019.²²



Tuvalu

Asia & Pacific

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

Not available

Average PVout in kWh/
kWp/day (2020)

4.3

Cumulative Solar Capacity in MW
(2021)

2.3

Getting Electricity Score (2020)

Not available

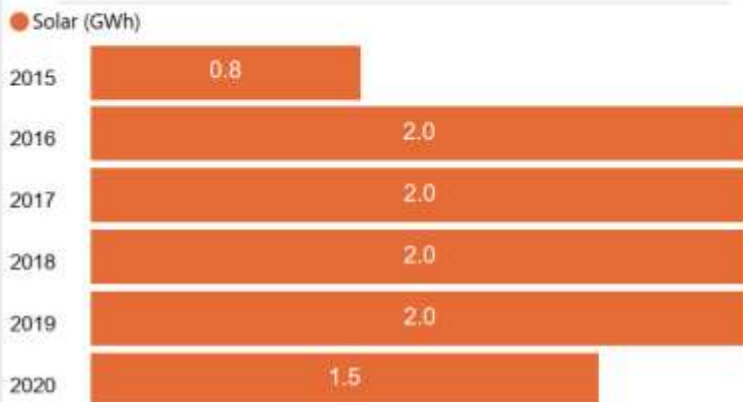
NDC Target by 2025

Net zero

Human Development Index (2021)

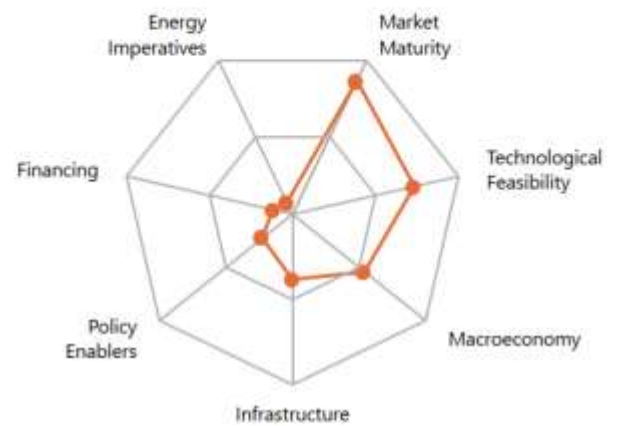
0.6

Renewable Energy Generation by Source

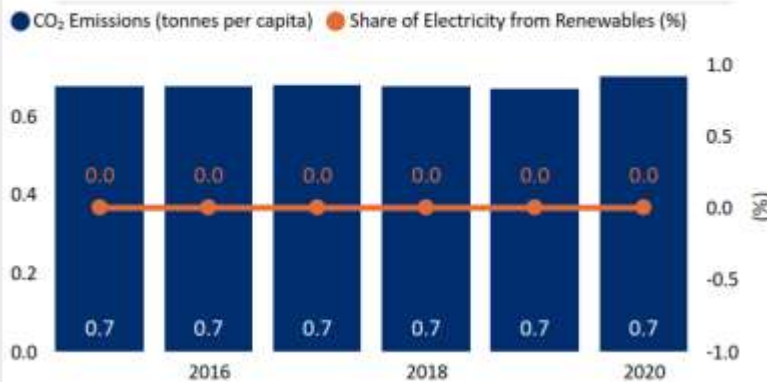


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

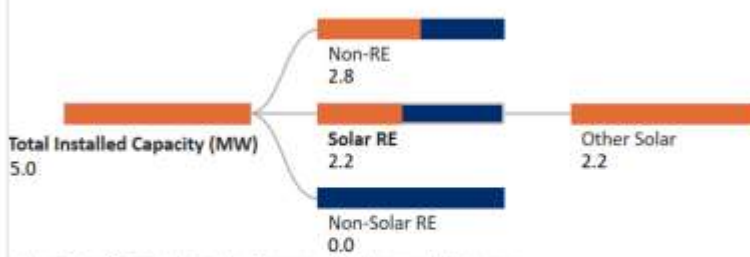
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Tuvalu is a middle-income¹ country with a GDP per capita (PPP) of USD 5,410 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 1% in 2020. However, in 2021 the GDP has bounced back by growing at 2.5%.³
- The inflation rate (CPI) of Tuvalu has increased to 2.9% in 2021 from 1.6% levels in 2020.⁴
- The general government gross debt to GDP has reached 6% in 2021 from 7.4% levels in 2020.⁵



Policy enablers

- Enetise Tutumau 2012-2020, a master plan for RE and EE in Tuvalu, has visioned achieving 100 % electricity through renewable energy by 2020.⁶
- Tuvalu Renewable Energy Project has updated its roadmap for Funafuti to achieve 100% electricity generation through renewable energy by 2025.⁷



Technological Feasibility

- Tuvalu receives high levels of solar irradiation (GHI) of 5.3 kWh/m²/day and specific yield 4.3 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁸
- Tuvalu with the support of The World Bank had added additional capacity of 750 kWp with 1000 kWh battery energy storage system (BESS), to an existing solar-diesel hybrid system, which was operationalised in 2021.⁷
- As per Tuvalu Funafuti roadmap 2019, various government and community buildings were identified for solar rooftop installations to enable economies of scale.⁷



Market Maturity

- 99.7% of the population in Tuvalu had access to electricity as of 2020.⁹
- Tuvalu Electric Corporation (TEC) is the state-owned power utility which plans, operates, and maintains the generation, distribution, and sales of electric power.¹⁰



Infrastructure

- Tuvalu's Funafuti power transmission operates using 11 kV cables from the Fongafale power plant and via substations (with 11 kV/415V-240 V) at 14 locations on the island.¹⁰
- Tuvalu has been focussing on building institutional, human, and technical capacity for the implementation of solar power systems.¹⁰
- As per Tuvalu Infrastructure Strategy and Investment Plan-2017, an investment of 12 Mn AUD was estimated for battery replacement of the solar PV systems.¹¹



Financing

- The World Bank through International Development Association (IDA) has approved a USD 7 Mn grant to enhance Tuvalu Energy Security.¹²
- The ESMAP has given a grant of USD 2.1 Mn grant under Small Island Developing States (SIDS) category to support Tuvalu to achieve energy security through clean energy.¹²
- The Asian Development Bank (ADB) has approved a USD 6 Mn grant to the Government of Tuvalu to expand its access to modern energy services, improve quality, reliability, and climate resilience.¹³

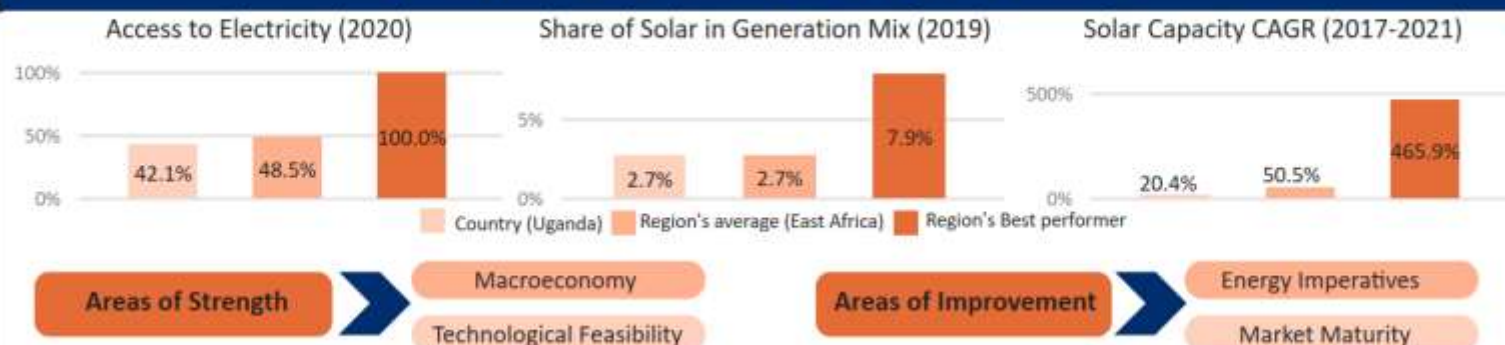


Energy Imperatives

- The total installed capacity of solar PV witnessed a CAGR of 0.94% reaching 2.31 MW in 2021 from 2.23 MW levels in 2017.¹⁴
- 70% of the population in Tuvalu have access to clean energy fuel.¹⁵
- In 2021, the total installed capacity in the country had reached 2.8 MW¹⁷ with a majority share coming from oil.¹⁸



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Uganda is a lower-income country¹ with a GDP per capita (PPP) of USD 2,468 in 2021.²
- GDP (Real) grew at an annual rate of 5.1% in 2021 and it is estimated to grow by 4.9% in 2022.³
- The inflation rate in the country has eased to 2.2% in 2021 from 2.8% in 2020.⁴
- The fiscal deficit in the country has reduced to 7.5% of GDP in 2021 from 9.5% in 2020.⁵



Policy enablers

- The Ministry of Energy and Mineral Development (MEMD) is responsible for developing and implementing policies in the electricity sector.⁶
- The Ugandan REFIT program is aimed at fast-tracking RE projects and reducing tariffs for new projects on an annual basis within the limits of the maximum installed project capacity.⁷
- The Electricity Connection Policy aims at increasing Uganda's electricity access to 60% by 2027 through connection subsidies for consumers located close to the existing network.⁸



Technological Feasibility

- Uganda receives high levels of solar irradiation of 5.3 kWh/m²/day and a specific yield of 4.5 kWh/kWp/day indicating strong technical feasibility for solar in the country.⁹
- The UN Environment program is currently active in Uganda and is working towards the introduction of electric two and three-wheelers.¹⁰
- The National Development Plan III aims to install 1,500 mini-grids in the next five years, and the current National Electrification Strategy has plans to install about 2,700 mini-grids in the country by 2030.¹¹



Market Maturity

- 42% population in Uganda had access to electricity as of 2020.¹²
- The Electricity Regulatory Authority (ERA) is responsible for regulating the Generation, Transmission, Distribution, Sale, Export, and Import of Electricity in Uganda.¹³
- Uganda Electricity Transmission Company Limited (UETCL) owns, operates and develops the High Voltage (above 33 kV) Transmission Grid.¹⁴
- Uganda Electricity Distribution Company Limited (UEDCL) distributes and supplies electricity to consumers in Uganda.¹⁵



Infrastructure

- UETCL's transmission network consists of 2,989 km of HV lines with 1,008 km of 220 kV, 1,946km of 132 kV, and 35km of 66 kV transmission lines. The length of the transmission network has more than doubled over the past 20 years.¹⁴
- UETCL's transmission network consists of 25 substations with a total transformation capacity of 2,829 MVA.¹⁴
- UETCL is implementing new power transmission projects for strengthening Power Evacuation, Regional Interconnection, and Grid Expansion and Reinforcement in Uganda.¹⁴



Financing

- The Climate Investment Fund (CIF) through its Scaling up Renewable Energy Program (SREP) has set an aim to enhance investments in solar photovoltaic net-metering, mini-grids, and wind power.¹⁶
- The AfDB approved USD 2.3 Mn to kick-start future investments in decentralized power systems in rural and urban areas in Uganda.¹⁷
- The AfDB approved an African Development Fund (ADF) loan of USD 78.13 Mn to finance the 'Mbarara-Nkenda & Tororo-Lira Power Transmission Lines Project' in Uganda.¹⁸



Energy Imperatives

- In 2020, Uganda's per capita electricity consumption stood at 0.1 MWh, which is significantly lower in comparison to the global average of 3.31 MWh.²¹
- The total installed capacity in the country stood at 1255.6 MW in 2019.¹⁹
- The total installed capacity of solar PV witnessed a CAGR of 20.4% reaching 91.72 MW in 2021 from 43.61 MW levels in 2017.²⁰
- The price of electricity in the country stood at 17.10 US Cents/kWh in 2019.²²



United Arab Emirates

Asia & Pacific

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

14047.4

Average PVout in kWh/
kWp/day (2020)

5.0

Cumulative Solar Capacity in MW
(2021)

2477.6

Getting Electricity Score (2020)

100.0

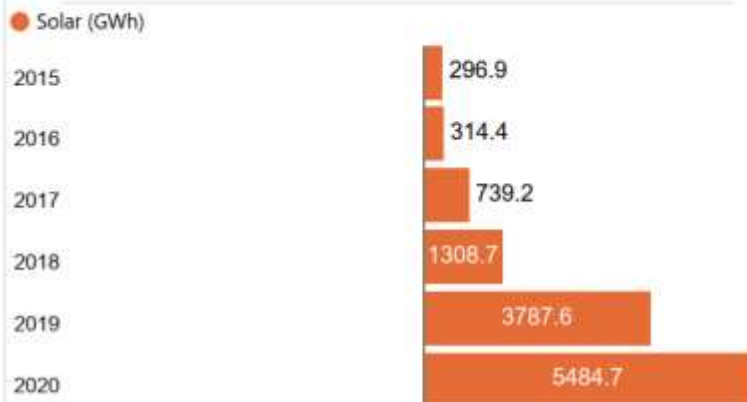
NDC Target by 2030 in %
(base year 2016)

31.0

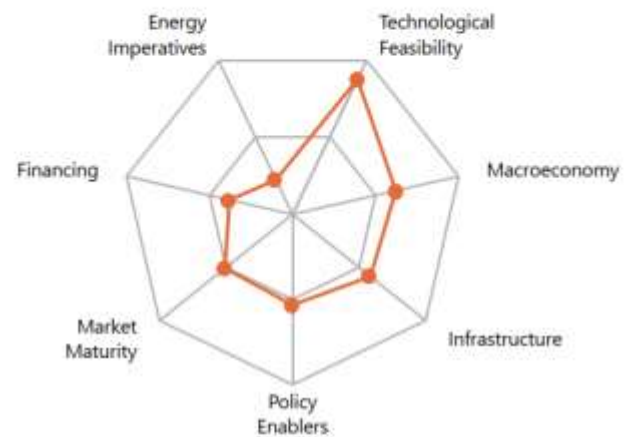
Human Development Index (2021)

0.9

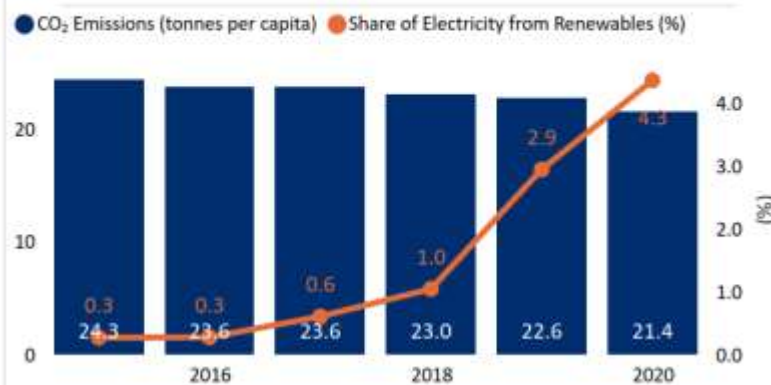
Renewable Energy Generation by Source



Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

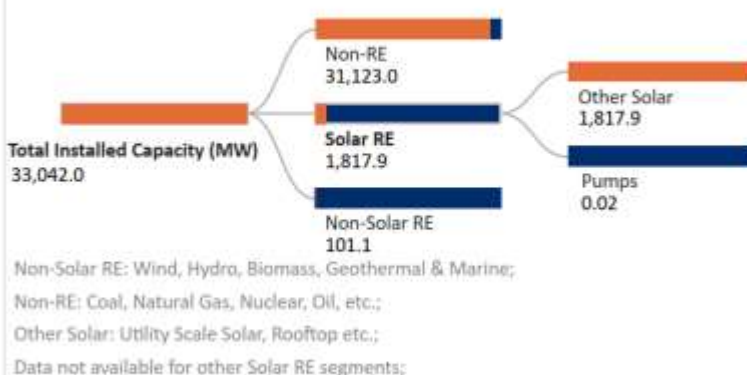
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

Yes

Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

Yes

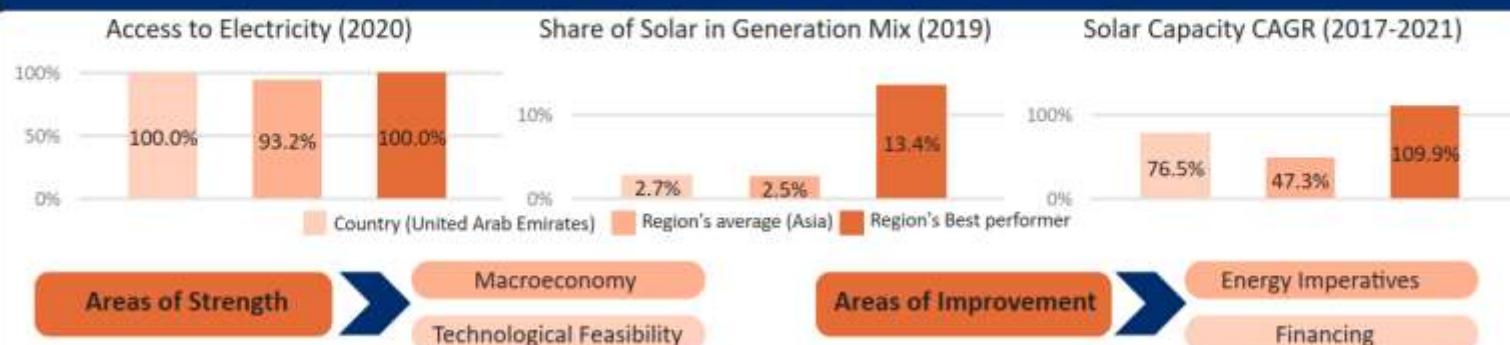
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

Yes

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- UAE is a high-income country with a GDP per capita (PPP) of USD 76,609 in 2021.¹
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 6.1% in 2020. However, in 2021, the GDP has bounced back recording an annual growth rate of 2.3%.²
- The inflation rate (CPI) of UAE had increased by 0.2% in 2021 from -2.1% levels in 2020.³
- The general government gross debt to GDP has reached 38.3% in 2021 from 40.4% levels in 2020.⁴



Policy enablers

- The UAE Energy Strategy 2050 has set a target to have an energy mix of 44% clean energy, 12% coal, 6% nuclear.⁵
- The Ministry of Climate Change and Environment (MOCCA) have launched National Dialogue for Climate Ambition (NDCA) platform to have an inclusive participation in the UAE Net Zero by 2050 Strategic Initiative.⁸
- The Dubai Electricity and Water Authority (DEWA) under its Distributed Renewable Resources Generation Programme has come up with first smart initiative to connect solar energy to buildings.⁶



Technological Feasibility

- UAE receives very high levels of solar irradiation (GHI) of 6.05 kWh/m²/day and specific yield 5.0 kWh/kWp/day indicating a strong technical feasibility for solar in the country.¹⁰
- Shams-1 in Abu Dhabi was the World's largest Concentrated Solar Power (CSP) plant when launched in 2013 with an area covering 2.5 sq. km and has a production capacity of 100 MW.¹¹
- Energy Service Companies (ESCOs) in Dubai are retrofitting 30,000 households with rooftop PVs.¹¹



Market Maturity

- Ministry of Energy & Infrastructure is the regulator of the power sector in UAE.¹⁵
- Etihad Water and Electricity (EWE) is the dominant participant in the northern emirates and engages in all segments of the market including generation, transmission, and distribution.¹⁶
- Abu Dhabi Water Electricity Authority (ADWEA) operates through Abu Dhabi Water and Electricity Company (ADWEC), Abu Dhabi Transmission and Despatch Company (TRANSCO), Abu Dhabi Distribution Company (ADDC), Al Ain Distribution Company (AADC) and Al Mirfa Power Company (AMPC) for its generation, transmission and distribution (T&D) assets.¹⁷



Infrastructure

- UAE's TRANSCO is the largest grid owner with 68% share of UAE's line network, DEWA has a 26% share and SEWA accounts for 6% of the network.¹⁷
- Majority of the substations in UAE operates at 132 kV voltage level with DEWA accounting for over 70% of those substations. Only TRANSCO owns and operates substations at a voltage level of 220 kV.¹⁷
- TRANSCO has set a plan for 2020-2026 period to expand its transmission network across 132 kV, 220 kV and 400 kV.¹⁷
- DEWA is anticipating an investment of worth USD 0.27 Bn in electricity transmission projects between 2021 and 2024 of which 80% is for 132 kV projects and the rest is for 400 kV projects.¹⁸



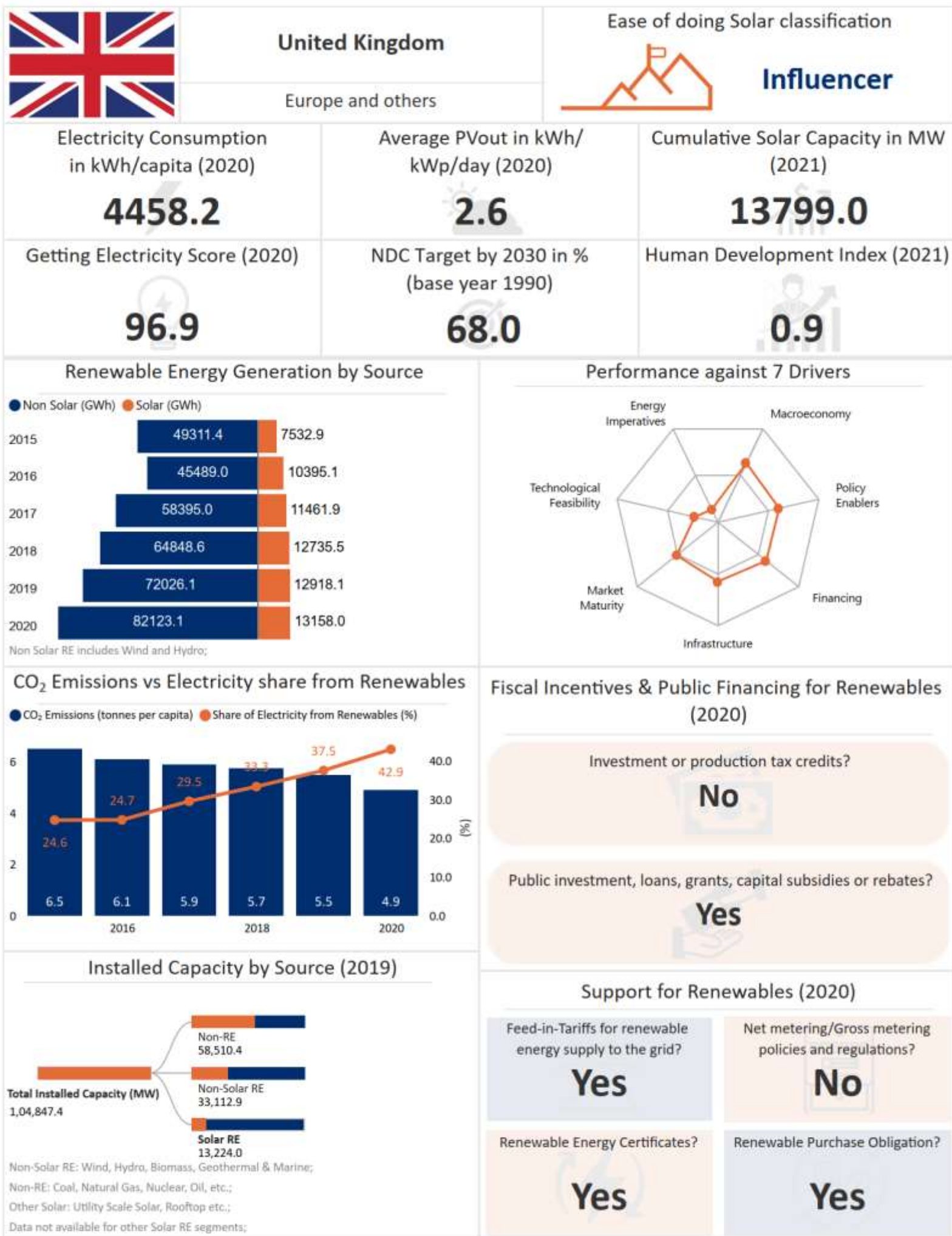
Financing

- The Arab Petroleum Investments Corporation (APICORP), an investment agency for all energy related projects, has recently extended USD 50 Mn to Yellow Door Energy for financing solar projects.²⁰
- The Abu Dhabi Fund for Development (ADFD) in association with IRENA is funding USD 400 Mn toward the Energy Transition Accelerator Financing (ETAF) platform for securing a minimum of USD 1 Bn in total funding towards transition to RE in developing countries.²¹

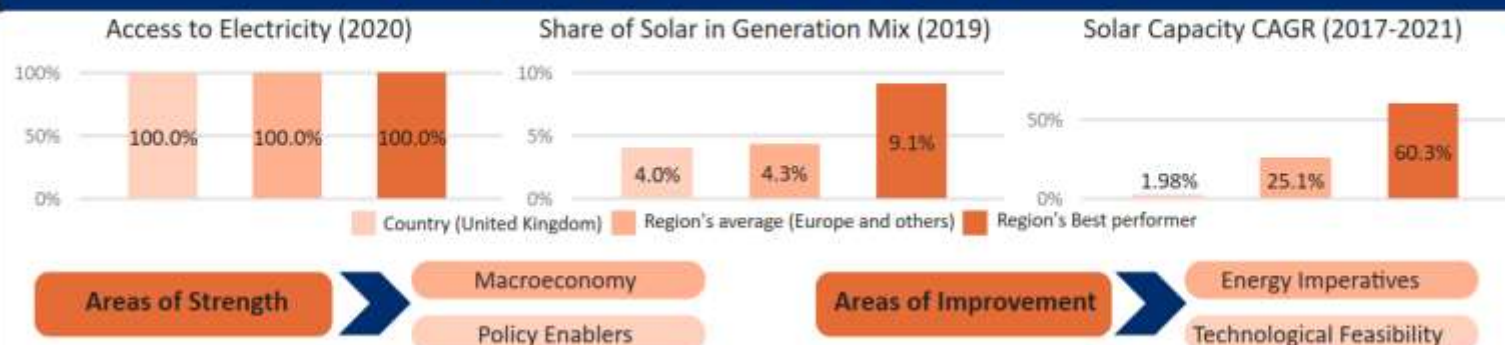


Energy Imperatives

- In 2020, UAE's per capita electricity consumption stood at 14.04 MWh, which is more than four times higher in comparison to the global average of 3.31 MWh.²³
- The peak demand for electricity in 2021 stood at 123.8 TWh remaining same as the previous year's demand.²⁵
- In 2021, the total installed capacity in the country has reached over 27 GW¹¹ with a significant share coming from gas (95.54%) followed by solar (3.02%), nuclear (1.43%) and bioenergy (0.01%).²⁵



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- United Kingdom is a high-income country¹ with a GDP per capita (PPP) of USD 50,810 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 9.3% in 2020. However, in 2021 it has bounced back growing at a rate of 7.4%.³
- The inflation rate (CPI) of United Kingdom has increased to 2.6% in 2021 from 0.9% levels in 2020.⁴
- The general government gross debt to GDP has slightly reduced to 95.3% in 2021 from 102.6% levels in 2020.⁵



Policy Enablers

- The Association for Renewable Energy & Clean Technology has extended support to United Kingdom (UK) in policy making for RE and associated clean technologies.⁶
- UK has set a target to cut its carbon emissions by around 68% by 2030 from 1990 levels.⁷
- UK has targeted to achieve offshore wind energy projects capacity to 50 GW by 2030.⁹
- UK has Feed-in Tariffs (FIT) policy to promote RE and low-carbon electricity generation.⁸



Technological Feasibility

- United Kingdom receives very low solar irradiation (GHI) of 2.6 kWh/m²/day and a specific yield 2.6 kWh/kWp/day indicating a week technical feasibility for solar in the country.¹⁰
- In November 2022, UK's NextEnergy Solar Fund has financed battery energy storage system (BESS) capacity of 250 MW/500 MWh in eastern England.¹¹
- Renewable UK figures from April show that the total pipeline of battery projects in the country has doubled from 16.1 GW a year ago to 32.1 GW at present.¹²



Market Maturity

- 100% of the population in United Kingdom had access to electricity as of 2020.²
- The Office of Gas and Electricity Markets (Ofgem) is the regulator of the UK gas and electricity networks and is governed by the Gas and Electricity Markets Authority.¹³
- Eastern Power Networks (EPN), London Power Networks (LPN) and Southeastern Power Networks (SPN) are the three licensed Distribution Network Operators (DNOs) regulated by Ofgem.¹³
- The European Power Exchange EPEX SPOT SE and its affiliates operate short-term electricity markets in Central Western Europe and the UK.¹⁴



Infrastructure

- UK's transmission network comprises of 7,000 kms of overhead lines, 2,800 kms of underground cable and 350 sub-stations.¹⁵
- UK's National Grid has two electricity transmission systems- Scottish Electricity Transmission System and English and Welsh Electricity Transmission System.¹⁵
- UK has set a target to reach 500 MW of rooftop solar capacity by 2022.¹⁶
- UK has cross border transmission lines with France, Interconnexion France-Angleterre (IFA) link.¹⁷



Financing

- The Asian Development Bank (ADB) and the Government of the United Kingdom has signed an MoU to develop a USD 134 Mn trust fund to support Association of Southeast Asian Nations (ASEAN) countries to scale up green financing.¹⁸
- In May 2022, British Oil and Gas Company (BP) has intended to invest up to USD 20.4 Bn in the UK's energy system by 2030.¹⁹



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 4.46 MWh in United Kingdom, which is significantly higher in comparison to the global average of 3.31 MWh.²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 1.98% reaching 13,799 MW in 2021 from 12,760 MW levels in 2017.²¹
- In 2021, the total installed capacity in the country stood at 108.07 GW with a major share coming from gas (40.23%) followed by nuclear (15.26%), wind (21.17%), bioenergy (12.73%), solar (4.06%), Coal (1.93%).^{23,22}
- The cost of electricity per kWh is US Cent 32.2 for households and US Cent 25.1 for business.²⁴



United States of America

Europe and others

Ease of doing Solar classification



Achiever

Electricity Consumption
in kWh/capita (2020)

12904.1

Average PVout in kWh/
kWp/day (2020)

4.4

Cumulative Solar Capacity in MW
(2021)

93713.0

Getting Electricity Score (2020)

82.2

NDC Target by 2030 in %
(base year 2005)

50.0 to 52.0

Human Development Index (2021)

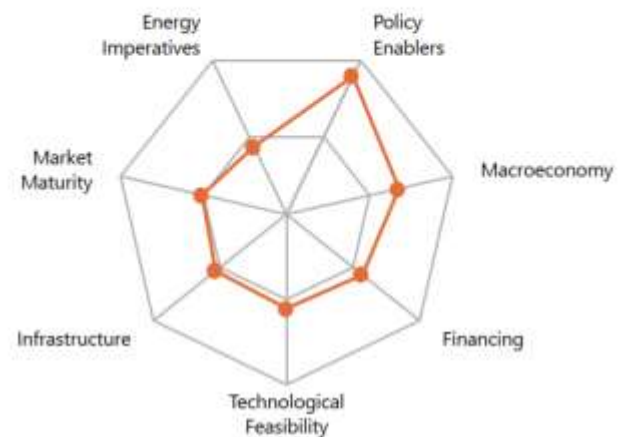
0.9

Renewable Energy Generation by Source

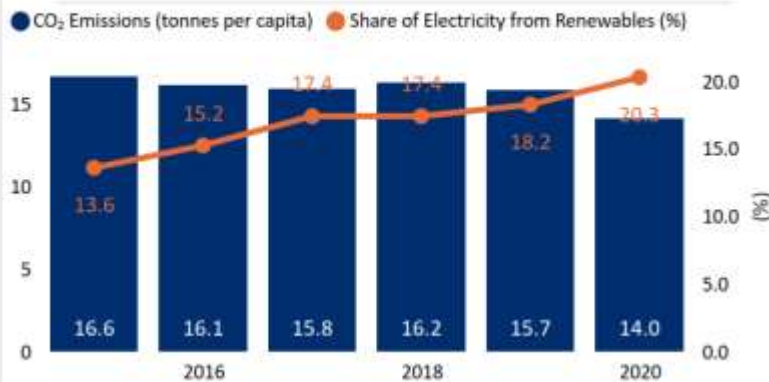


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

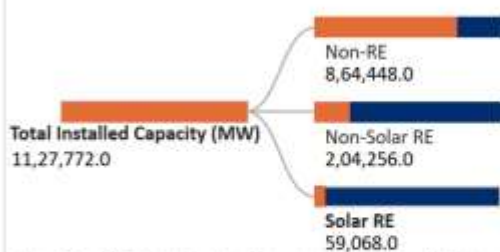
Investment or production tax credits?

Yes

Public investment, loans, grants, capital subsidies or rebates?

Yes

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

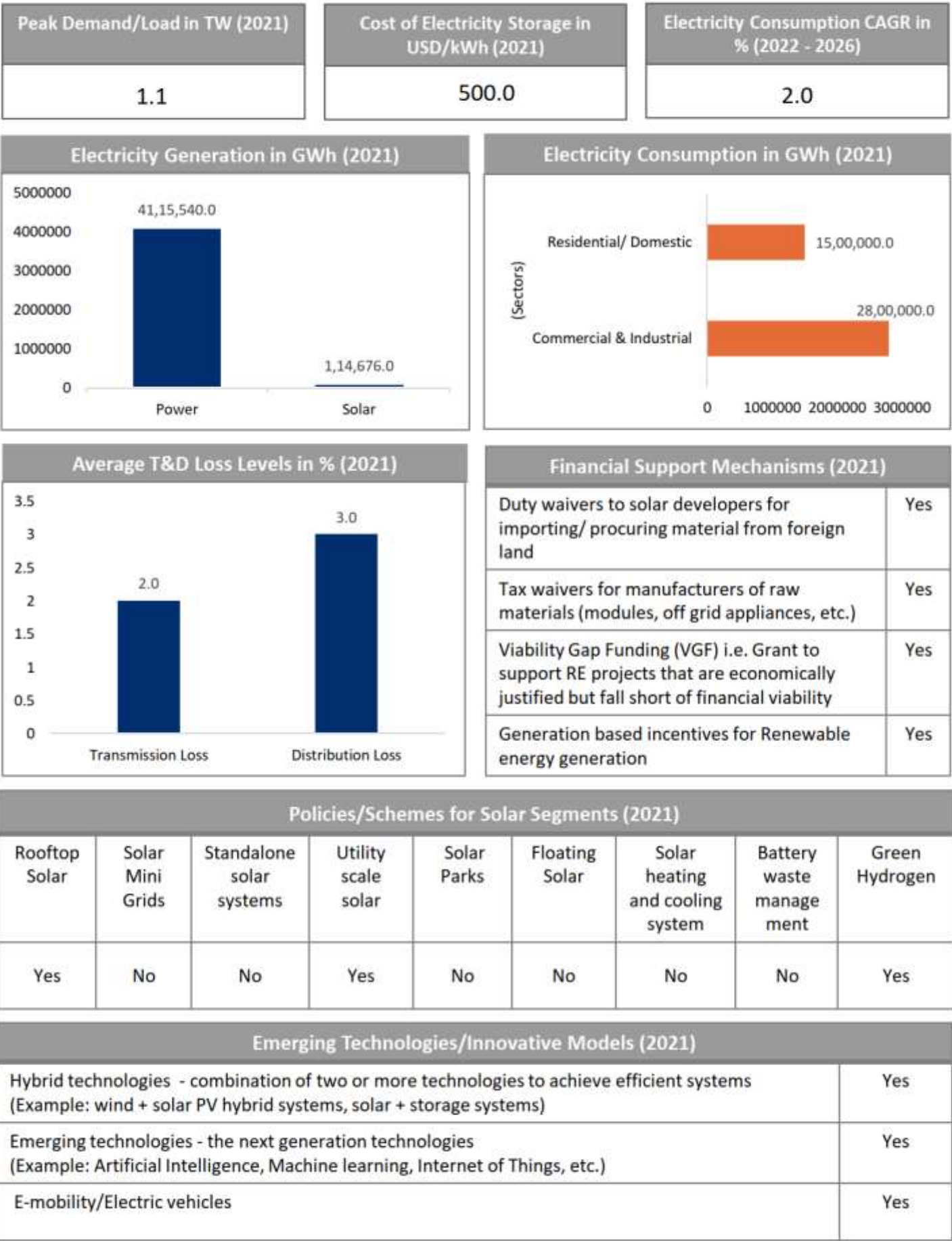
Yes

Renewable Energy Certificates?

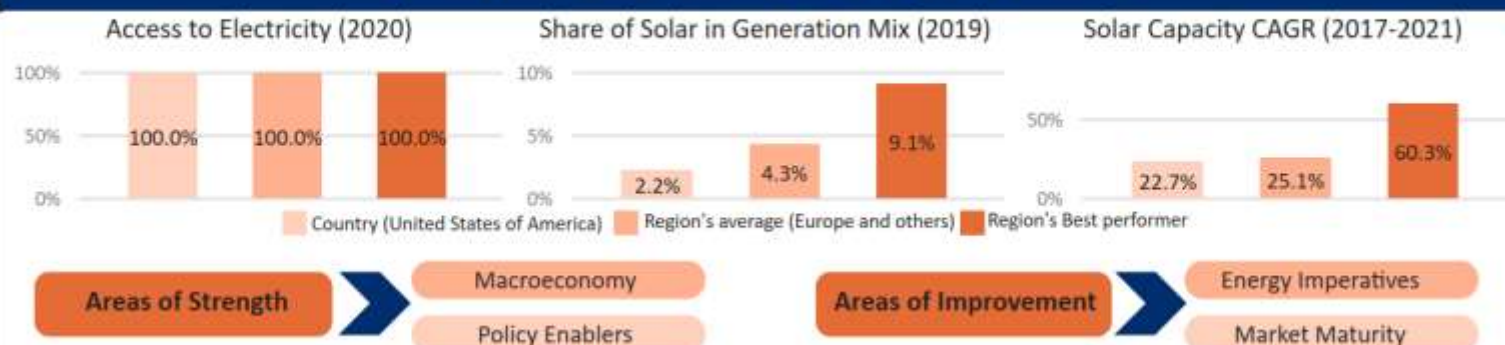
Yes

Renewable Purchase Obligation?

Yes



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- The United States of America (USA) is a high-income country ¹ with a GDP per capita (PPP) of USD 69,288 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 3.4% in 2020. However, in 2021, it has bounced back growing at a rate of 5.7%.³
- The inflation rate (CPI) of the USA has increased to 4.7% in 2021 from 1.2% levels in 2020.⁴
- The general government gross debt to GDP has slightly reduced to 128.1% in 2021 from 134.5% levels in 2020.⁵



Policy enablers

- The country has targeted to cut its carbon emissions by 50-52%, below 2005 levels, by 2030.⁶
- The country has set an ambitious target to install an average of 30 GW of solar capacity per year between 2022 and 2025 and 60 GW per year from 2025-2030.⁷
- The country has arrangements for feed-in-tariff policy in place to encourage deployment of RE sources.⁸
- USA also has policy on rebates for purchasing RE equipment, and tax incentives for RE sources.⁸



Technological Feasibility

- USA receives high solar irradiation (GHI) of 4.5 kWh/m²/day and a specific yield 4.4 kWh/kWp/day indicating a high technical feasibility for solar in the country.⁹
- The country typically receives 12 hours of sunlight per day.¹²
- USA has a Battery energy storage system (BESS) capacity of 4.6 GW mostly used for services like arbitrage, load management, and reducing power losses from curtailment.¹⁰
- In Nov. 2021, Doral Renewables announced USA's largest solar park in Indiana spreading across 13,000 acres with a capacity of ~1.3 GW which is planned to be operational by 2024.^{11, 28}



Market Maturity

- The Federal Energy Regulatory Commission (FERC), that has been empowered by the Federal Power Act, regulates interstate transmission of electricity, natural gas, and oil, and regulates hydropower projects and natural gas terminals.¹⁴
- FERC had issued an order 2000 which calls for power utilities to form Regional Transmission Organization (RTO) to manage and operate the country's power transmission system.¹⁶



Infrastructure

- USA's transmission network increased from 601,031 ckms to 672,898 ckms over the decade and it is expected to reach 706,044 ckms by 2025.¹⁸
- USA's transmission system operates at 600 kV, 400-599 kV, 300-399 kV, 200-299 kV and 100-199 kV voltage levels.¹⁸
- USA's distribution network spread has increased from 9,381,835 ckms to 10,830,658 ckm over the decade and it is expected to reach 11,962,156 ckm by 2025.¹⁸
- USA has cross border trading of electric power from Canada and Mexico.¹⁹



Financing

- The U.S. Department of Energy (DOE) and Solar Energy Technologies Office (SETO) supports funding opportunities on photovoltaics, concentrated solar-thermal power, systems integration, technology to market, and solar costs projects.²⁰
- In 2021, the USA government has passed a USD 550 Bn fund for Clean Energy Investment.²¹
- USA's Energy Efficiency & Renewable Energy (EERE) has a dedicated investment to support decarbonization across all sectors.²²
- In 2021, the USA invested USD 8 Bn to support the development of clean hydrogen.²³



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 12.90 MWh in USA, which is significantly higher in comparison to the global average of 3.31 MWh.²⁴
- The peak demand for electricity in the country stood at 4149.86 TWh in 2021 and 4,009.27 TWh in 2020.²⁷
- In 2021, the total installed capacity in the country stood at 1229 GW with a significant share coming from gas (43%) followed by coal (18.35%), wind (10.80%), nuclear (8.12%), hydro (6.50%) and solar (7.74%).^{27, 26}



Vanuatu

Asia & Pacific

Ease of doing Solar classification



Progressive

Electricity Consumption
in kWh/capita (2020)

227.9

Average PVout in kWh/
kWp/day (2020)

3.5

Cumulative Solar Capacity in MW
(2021)

4.4

Getting Electricity Score (2020)

72.2

NDC Target by 2030 in %
(base year 2005)

Not available

Human Development Index (2021)

0.6

Renewable Energy Generation by Source

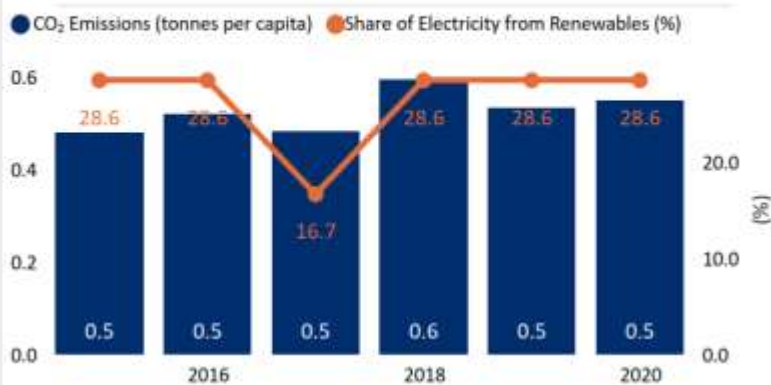


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

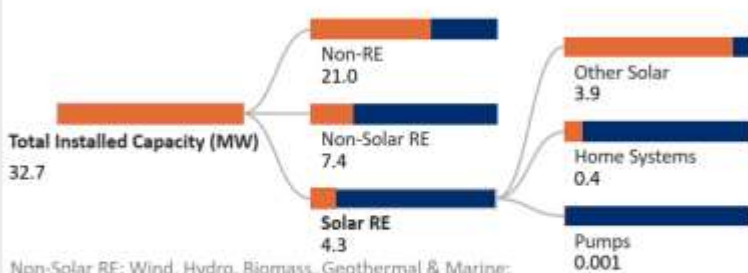
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

No

Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macroeconomy

- Vanuatu is a lower middle-income¹ country with a GDP per capita (PPP) of USD 3,057 in 2021.²
- Due to COVID-19 Pandemic, the GDP (Real) had declined by 5.4% in 2020. However, in 2021, the GDP has bounced back by growing rate at 0.4%.³
- The inflation rate (CPI) of Vanuatu has decreased to 2.3% in 2021 from 5.3% levels in 2020.⁴
- The general government gross debt to GDP has marginally increased to 48.2% in 2021 from 47.5% levels in 2020.⁵



Policy enablers

- Vanuatu National Energy Road Map (2016-30) envisions to have affordable, secure, accessible, high quality, clean energy services.⁶
- Vanuatu has launched an ambitious climate policy with a commitment of achieving 100% RE share in electricity generation by 2030.⁷
- Vanuatu has targeted to install 10 MW grid connected solar PV by 2025 and additional 10 MW grid connected solar by 2030.⁸



Technological Feasibility

- Vanuatu receives moderate levels of solar irradiation (GHI) of 4.3 kWh/m²/day and specific yield 3.5 kWh/kWp/day indicating a moderate technical feasibility for solar in the country.⁹
- Vanuatu's Department of Energy has set up a solar mini grid that caters to the electricity demand of almost 2,800 people in a remote island of Malekula.¹⁰
- National Advisory Board (Government of Vanuatu) has proposed an RE project with BESS (capacity of 11.5 MW/6.75 MWh) under PPP model on Efate Island.¹¹



Market Maturity

- 67.3% of the population in Vanuatu had access to electricity as of 2020.¹²
- The power sector in Vanuatu is regulated by Utilities Regulatory Authority (URA). UNELCO and VIU are the utilities operating in the country through Electricity Concession Contracts.¹³
- Nationally Appropriate Mitigation Action (NAMA) has extended its support to Vanuatu in achieving 100% access to electricity to all by 2030.¹⁴



Infrastructure

- Vanuatu's transmission lines comprises of Malekula transmission line of 20 kV and low voltage lines of 400 V for distribution grids.¹⁵
- The Government of Vanuatu has increased its energy access to households through expansion of existing distribution grids and development of low-cost RE.¹⁵



Financing

- In 2021, the Asian Development Bank (ADB) and Government of Vanuatu announced to provide USD 6 Mn and USD 1.2 Mn grant respectively towards development of RE.¹⁶
- In 2017, the World Bank had approved USD 4 Mn to provide electricity to 45,000 people in Vanuatu through RE sources.¹⁷
- In 2021, the Climate Investment Funds (CIF) invested in Vanuatu through its Scaling up Renewable Energy Program (SREP) with an amount of USD 14 Mn.¹⁸



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.23 MWh, which is lower in comparison to the global average of 3.31 MWh.¹⁹
- The total installed capacity of Solar PV witnessed a CAGR of 13.2% reaching 4.4 MW in 2021 from 2.7 MW levels in 2017.²⁰
- The peak demand for electricity in the country is 0.07 TWh remaining same in 2021 and 2020.²¹
- In 2021, the total installed capacity in the country stood at 32 MW with maximum share coming from fossil fuel based (71.43%) followed by bioenergy (14.29%) and solar (~15%).^{21,22}



Venezuela

Latin America & Caribbean

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

3270.4

Average PVout in kWh/
kWp/day (2020)

5.2

Cumulative Solar Capacity in MW
(2021)

5.3

Getting Electricity Score (2020)

39.8

NDC Target by 2030 in %

20.0

Human Development Index (2021)

0.7

Renewable Energy Generation by Source

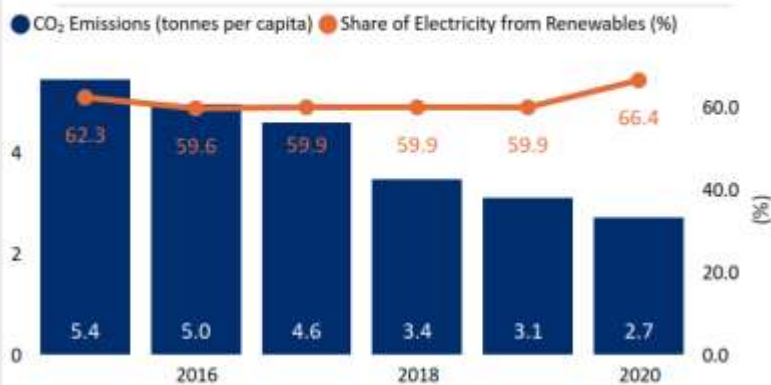


Non Solar RE includes Wind and Hydro;

Performance against 7 Drivers



CO₂ Emissions vs Electricity share from Renewables



Fiscal Incentives & Public Financing for Renewables (2020)

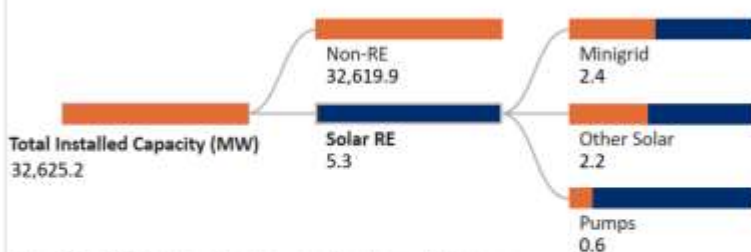
Investment or production tax credits?

No

Public investment, loans, grants, capital subsidies or rebates?

No

Installed Capacity by Source (2019)



Non-Solar RE: Wind, Hydro, Biomass, Geothermal & Marine;

Non-RE: Coal, Natural Gas, Nuclear, Oil, etc.;

Other Solar: Utility Scale Solar, Rooftop etc.;

Data not available for other Solar RE segments;

Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

No

Net metering/Gross metering
policies and regulations?

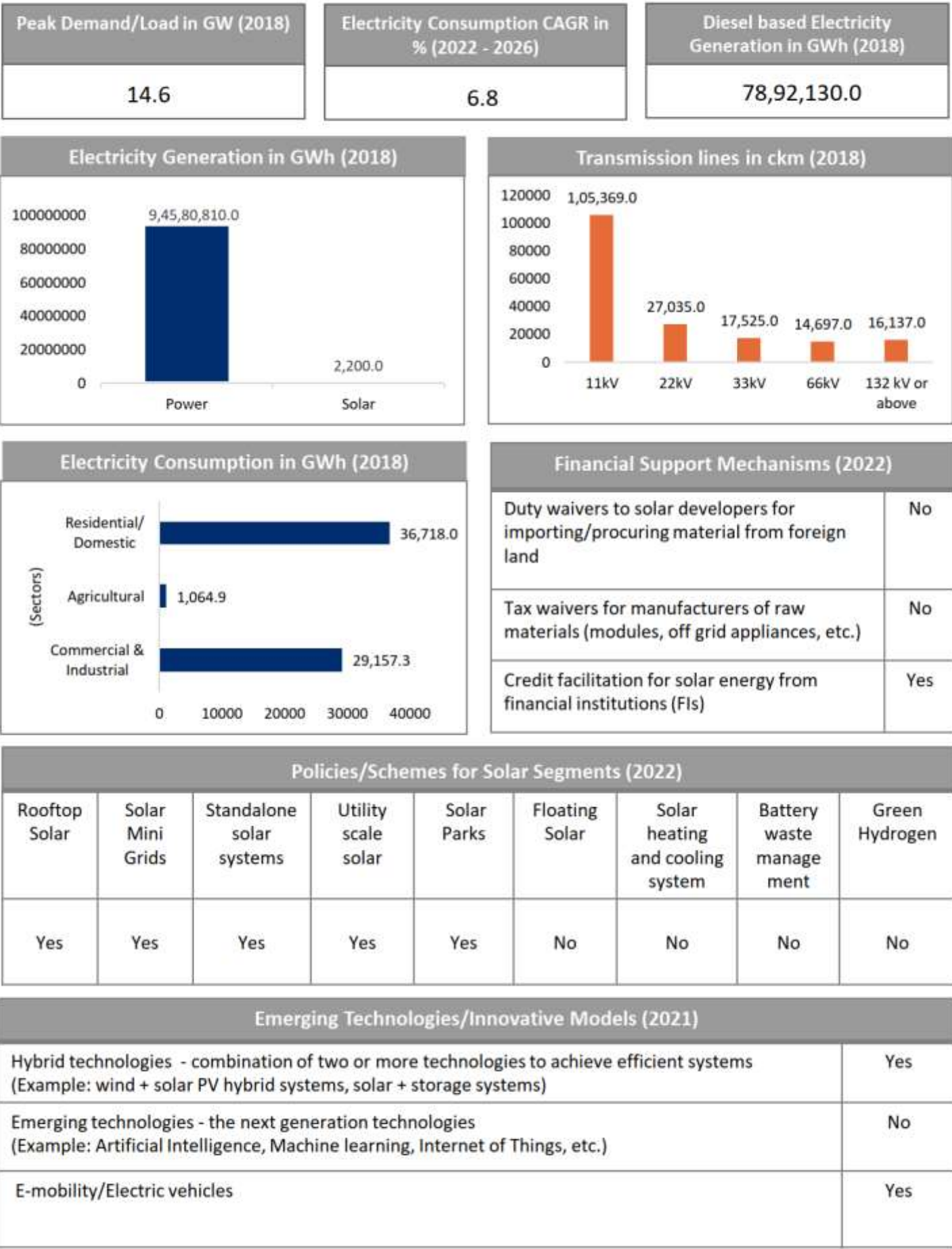
No

Renewable Energy Certificates?

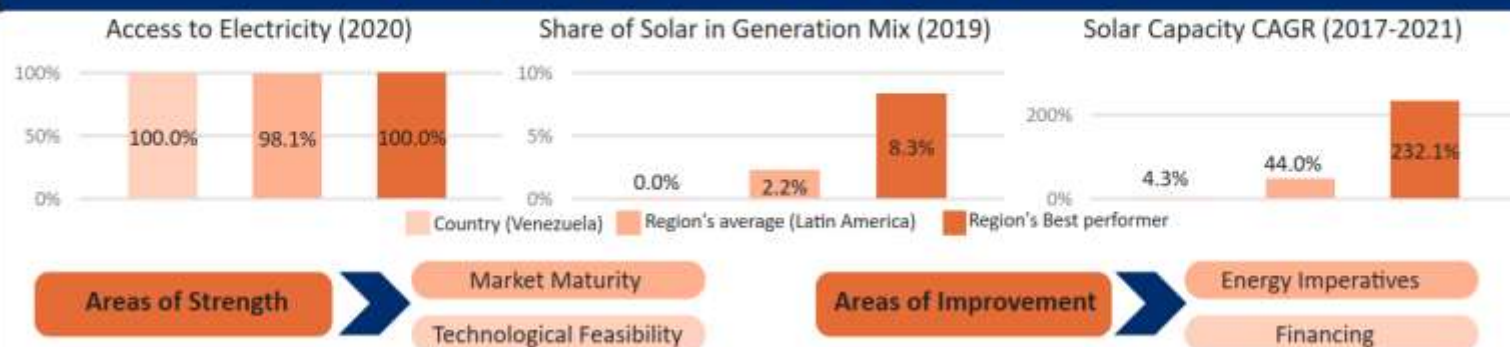
No

Renewable Purchase Obligation?

No



Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Venezuela is a lower middle income country with a GDP per capita (PPP) of USD 1,690 (estimated) in 2020. ^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) declined by 30% in 2020. However, in 2021 it has bounced back growing at a rate of 0.5%. ³
- The inflation rate (CPI) of Venezuela has decreased to 1590% in 2021 from 2360% levels in 2020. ⁴
- The general government gross debt to GDP has decreased to 240.5% in 2021 from 319.1% levels in 2020. ⁵



Policy enablers

- Venezuela Country Development Plans 2013-2019 ("Plan de la patria") had aimed at increasing energy efficient and RE technology in all sectors of economy. ⁶
- Venezuela has set a target to generate 85% electricity from RE sources by 2030 under the UN 2030 Agenda for Sustainable Development. ⁷
- Venezuela Development Plan for the National Electric System aims to integrate RE by including it in both the medium-term (2013-2019) and long-term (2014-2033) strategy. ⁸



Technological Feasibility

- Venezuela receives high levels of solar irradiation (GHI) of 5.4 kWh/m²/day and specific yield 5.2 kWh/KWp/day indicating a high technical feasibility for solar in the country. ⁹
- In 2021, Venezuela had commissioned its first grid connected solar pv system to ensure continuous power to broadband transport networks. ¹⁰
- Venezuela has a rooftop solar installed capacity of 0.05 MW. ²²



Market Maturity

- 100% of the population in Venezuela had access to electricity as of 2020. ¹²
- CORPOELEC is an integrated state-owned operating company responsible for carrying out activities of Generation, Transmission, Distribution and Marketing of power. ¹³



Infrastructure

- In Aug 2022, the Government of Venezuela has announced to invest USD 1.5 Bn to rebuild the country's 9,000 MW generation system by 2025. ¹⁴
- The IDB's 2020 report, A Look to the Future for Venezuela, estimates the cost of improvement of electricity sector for first five-year period at USD 7.1 Bn. These costs would include provision for activities aimed at improving generation, transmission, and distribution. ¹⁵
- Venezuela's transmission network operates at 765 kV, 400 kV, 230 kV, 138 kV and 115 kV and 69 kV voltage levels. ²²



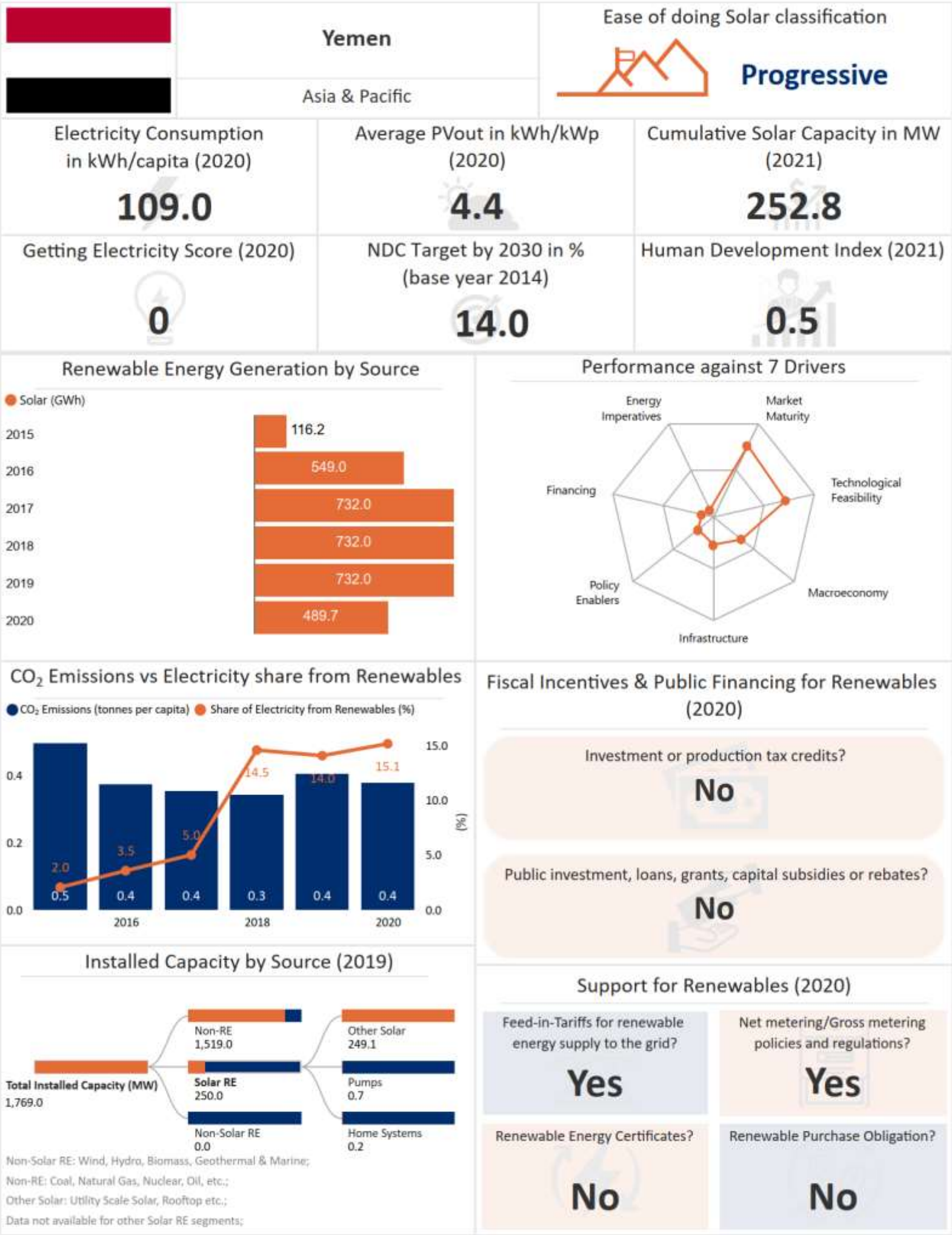
Financing

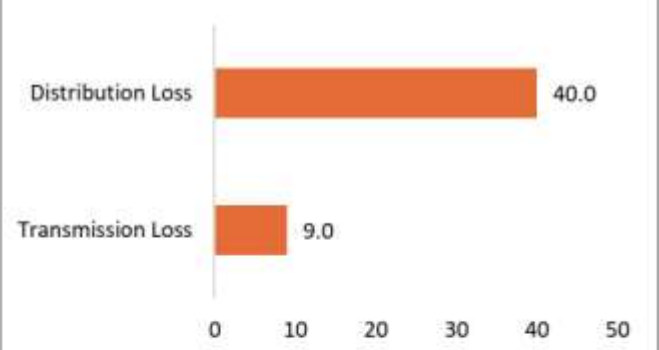
- Foreign investments are encouraged in Venezuela and are protected by a new legal framework enabled through the dispositions stipulated in the Decree 2095. ¹⁶
- Venezuela have fully private model, community-based model and public-private mode for off-grid solar products. ²³



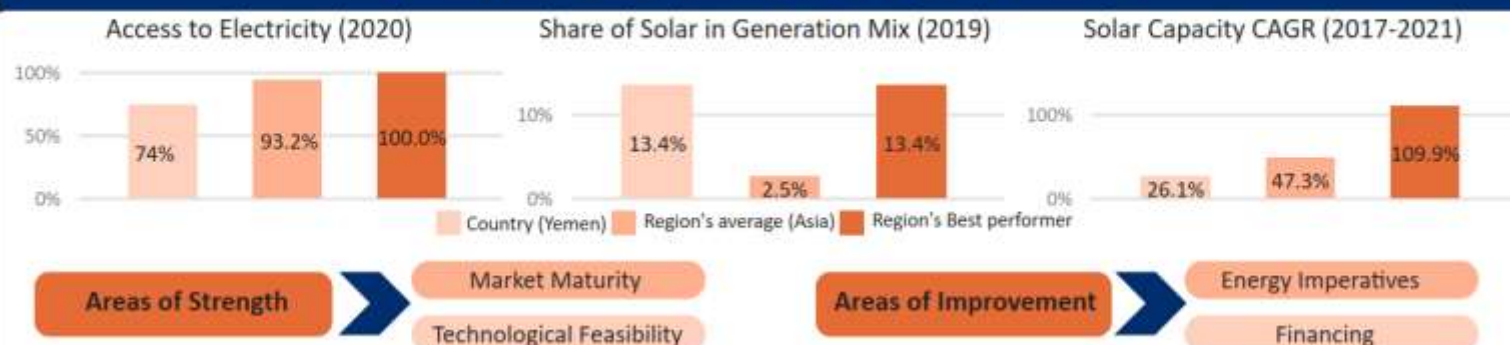
Energy Imperatives

- In 2020, the per capita electricity consumption stood at 3.27 MWh, which is slightly lower in comparison to the global average of 3.31 MWh. ¹⁸
- The total installed capacity of Solar PV witnessed a CAGR of 4.3% reaching 5.3 MW in 2021 from 4.5 MW levels in 2017. ¹⁹
- The peak demand for electricity in the country stood at 103.62 TWh remaining same in 2021 and 2020. ²⁰
- In 2021, the total installed capacity in the country stood at 33.31 GW ²¹ with maximum share coming from hydro (69.42%) followed by gas (30.49%), solar (0.01%). ²⁰



| Peak Demand/Load in GW (2022) | Cheapest Source of Power (2022) | Generation Cost for Solar Power in USD/kWh (2022) | | | | | | | | |
|---|---------------------------------|--|--|-------------|--------------------------------|----------------------------------|---|----------------|---|-----|
| 1.5 | Solar | 0.09 | | | | | | | | |
| Average T&D Loss Levels in % (2022) | | Support for Renewables (2022) | | | | | | | | |
|  | | <table><tr><td>Renewable Generation Obligations (RGO)</td><td>No</td></tr><tr><td>Franchising for solar business</td><td>No</td></tr><tr><td>Manufacturing facility for solar equipment (inverters and balance of systems)</td><td>No</td></tr><tr><td>Research & development facilities for solar systems</td><td>Yes</td></tr></table> | Renewable Generation Obligations (RGO) | No | Franchising for solar business | No | Manufacturing facility for solar equipment (inverters and balance of systems) | No | Research & development facilities for solar systems | Yes |
| Renewable Generation Obligations (RGO) | No | | | | | | | | | |
| Franchising for solar business | No | | | | | | | | | |
| Manufacturing facility for solar equipment (inverters and balance of systems) | No | | | | | | | | | |
| Research & development facilities for solar systems | Yes | | | | | | | | | |
| Financial Support Mechanisms (2022) | | | | | | | | | | |
| Duty waivers to solar developers for importing/procuring material from foreign land | | Yes | | | | | | | | |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | | Yes | | | | | | | | |
| Credit facilitation for solar energy from financial institutions (FIs) | | No | | | | | | | | |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | | Yes | | | | | | | | |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | | No | | | | | | | | |
| Policies/Schemes for Solar Segments (2022) | | | | | | | | | | |
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen | | |
| No | Yes | No | Yes | Yes | Yes | No | No | No | | |
| Emerging Technologies/Innovative Models (2022) | | | | | | | | | | |
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | | No | | | | | | | | |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | | Yes | | | | | | | | |
| E-mobility/Electric vehicles | | No | | | | | | | | |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Yemen is a low-income country with a GDP per capita (PPP) of USD 690.8 in 2021.^{1,2}
- Due to COVID-19 Pandemic, the GDP (Real) has declined by 8.5% in 2020. In 2021, the GDP has contracted by only 2% showing signs of recovery.³
- The inflation rate (CPI) of Yemen has increased to 63.8% in 2021 from 23.1% levels in 2020.⁴
- The general government gross debt to GDP has decreased to 63.1% in 2021 from 84.2% levels in 2020.⁵



Policy enablers

- Yemen targets to increase the share of solar to 0.06% of the energy mix by 2024.²⁶
- In 2009, the Yemen government has announced National Strategy for Renewable Energy and Energy Efficiency to promote RE and energy efficiency in the country.⁶
- The Enhanced Rural Resilience in Yemen (ERRY) which is a UNDP programme, facilitated around 3,200 households with solar energy application in 20 rural communities to improve their energy access.⁷
- United Nations' office in Yemen has installed a solar carport system with 310 kWh Lithium Energy Storage System.²⁵



Technological Feasibility

- Yemen receives very high levels of solar irradiation (GHI) of 6.5 kWh/m²/day and specific yield 4.4 kWh/kWp/day indicating a strong technical feasibility for solar in the country.⁹
- In 2020, 86% of power demand was met through fossil fuels and the balance 14% was met from renewables.¹⁰



Market Maturity

- 74% of the population in Yemen had access to electricity as of 2020.¹¹
- The Ministry of Electricity and Energy (MoEE) has monopoly over generation, transmission, and distribution of electricity.¹²
- Yemen is in the process of preparation of its first Power Purchase Agreement for two 20 MW PV projects.¹²
- The average duration or term of Power Purchase Agreements (PPAs) for Solar PV Projects in Yemen is 25 years.²⁶



Infrastructure

- The capacity of transmission Infrastructure in Yemen is 800 MVA as of 2022.²⁶
- The installed generation capacity of Yemen is 1.5 GW of which oil fueled electricity dominates the share with 95%.¹³
- The Government of Yemen represented by Minister of Electricity and Energy and Ministry of Oil and Minerals have signed an MoU with Siemens Energy to create sustainable development in field of electricity and energy.¹⁴
- The country after its war conflict have limited access to electricity infrastructure and 6 out of 10 cities assessed had no electricity according to Dynamic Damage and need Assessment (DNA).¹⁶
- Saudi Development and Reconstruction Program will develop medium and low-voltage electrical distribution network and solar-powered lighting systems for roads in Aden.¹⁷



Financing

- World Bank has disbursed a USD 150 Mn loan to Yemen through Emergency Electricity Access Project to support off grid Solar and to ensure basic supply of electricity to critical facilities.¹⁸
- Kuwait Fund for Arab Economic Development is financing USD 2.5 Mn into a new UNDP project called Renewable Energy Improve Access to Health Services and Livelihood Opportunities (HEAL).¹⁹
- Yemen's Al Kuraimi Islamic Bank has financed 824 solar projects that include 406 water pumping stations on farms and is now expanding to provide solar and hybrid solar-diesel systems to small businesses.²⁰



Energy Imperatives

- In 2020, the per capita electricity consumption stood at 0.11 MWh, which is considerably lower in comparison to global average of 3.31 MWh.²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 26.1% between 2017-2021 reaching 252.8 MW in 2021 from 100 MW levels in 2017.²²
- The peak demand for electricity in the country has remained same at 3.25 TWh in 2021 and 2020.²³
- Electricity generation in Yemen is dominated by other fossil fuels with a share of 55.38% followed by gas based thermal comprising 29.23% and 15.38% from solar.²⁴



Zambia

Africa

Ease of doing Solar classification



Influencer

Electricity Consumption
in kWh/capita (2020)

869.2

Average PVout in kWh/
kWp/day (2020)

4.8

Cumulative Solar Capacity in MW
(2021)

96.4

Getting Electricity Score (2020)

62.1

NDC Target by 2030 in %
(base year 2010)

25.0

Human Development Index (2021)

0.6

Renewable Energy Generation by Source

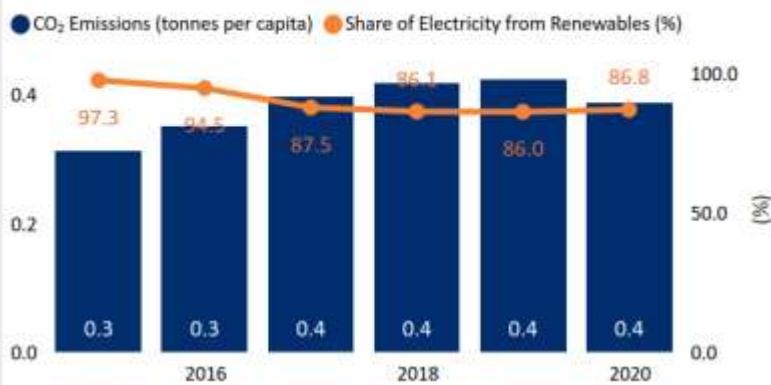


Non Solar RE includes Wind and Hydro;

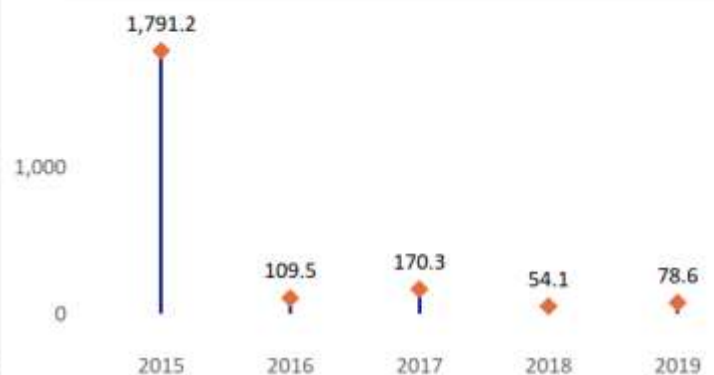
Performance against 7 Drivers



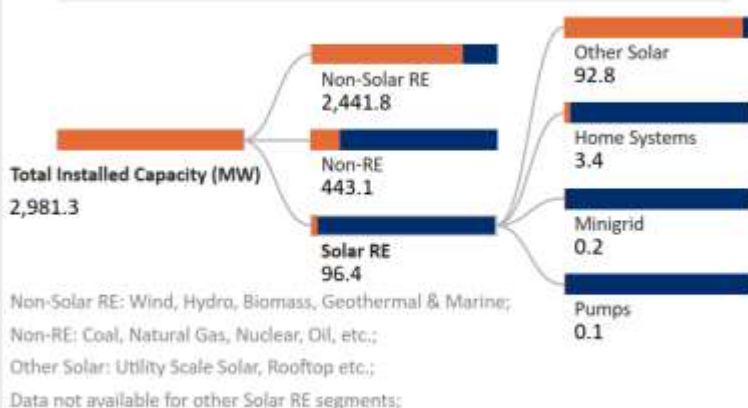
CO₂ Emissions vs Electricity share from Renewables



International Finance received for Clean Energy (Million US Dollars)



Installed Capacity by Source (2019)



Support for Renewables (2020)

Feed-in-Tariffs for renewable
energy supply to the grid?

Yes

Net metering/Gross metering
policies and regulations?

No

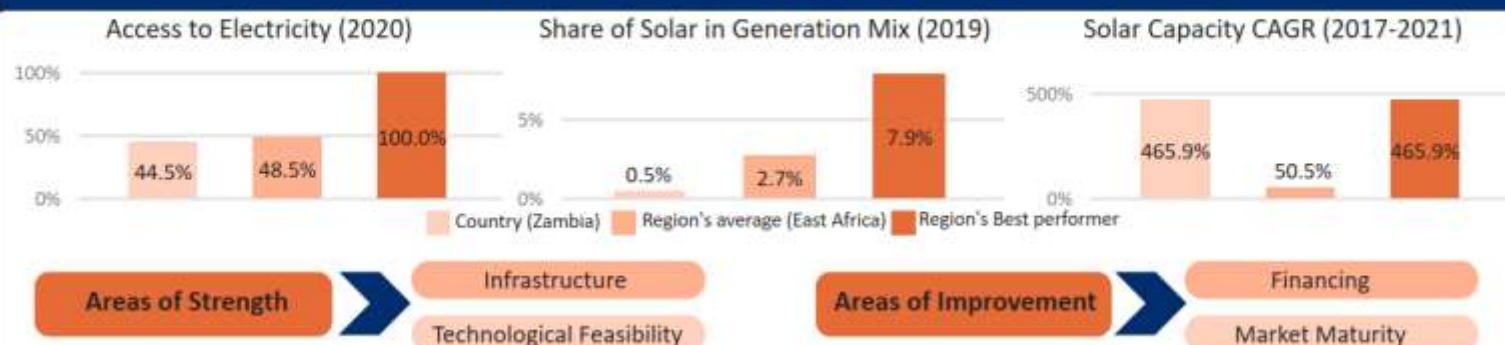
Renewable Energy Certificates?

No

Renewable Purchase Obligation?

No

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Zambia is a lower middle-income country ¹ with a GDP per capita (PPP) of USD 3,556 in 2021. ²
- GDP (Real) grew at an annual rate of 4.3% in 2021 and it is estimated to grow by another 3.1% in 2022. ³
- The inflation rate in the country increased to 22.1% in 2021 from 15.7% levels in 2020. ⁴
- The fiscal deficit narrowed down from 13.2% in 2020 to 8.4% levels in 2021 despite a surge in COVID-19-related spending and revenue shortfalls. ⁴



Policy enablers

- The Ministry of Energy is responsible for framing energy policies and development of renewable energy sources in Zambia. ⁵
- Ministry of Green Economy and Environment is responsible for formulating and reviewing policies that promote investment towards low carbon, resource-efficient, and socially inclusive interventions. ⁶
- The National Energy Policy 2019 aims for an optimal energy resource utilization to meet Zambia's domestic and non-domestic needs at the lowest cost and to establish Zambia as a net exporter of energy. ⁷



Technological Feasibility

- Zambia receives very high levels of solar irradiation of 5.9 kWh/m²/day and a specific yield of 4.8 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁸
- The UN Environment program is currently active in Zambia and is working on the introduction of electric light duty vehicles. ⁹



Market Maturity

- 44.5% population in Zambia had access to electricity as of 2020. ¹¹
- ZESCO Limited is a vertically integrated electricity utility responsible for the generation, transmission, and distribution of electricity in Zambia. ¹²
- The Energy Regulation Board (ERB) is a statutory body responsible for regulating the energy sector in Zambia. ¹³
- Zambia is a member of the Southern African Power Pool (SAPP), which aims to be a fully integrated, competitive energy market and a provider of sustainable energy solutions in the region. ¹⁴



Infrastructure

- ZESCO consists of 56,000 km of distribution network with 3,779 km of 66 kV, 8,922 km of 33 kV, 23,667 km of 11 V, and 19,713 km of 400 V. ¹⁵
- 'Tanzania - Zambia Interconnector project' links the Tanzanian grid to Zambia's grid and includes a 620 km of 400 kV double circuit transmission line. ¹⁶
- The Distribution and Customer Services Directorate of Zambia aims at providing continuous and reliable service to over one million customers providing a 24/7 platform for the customer to report faults and other non-fault-related complaints. ¹⁵



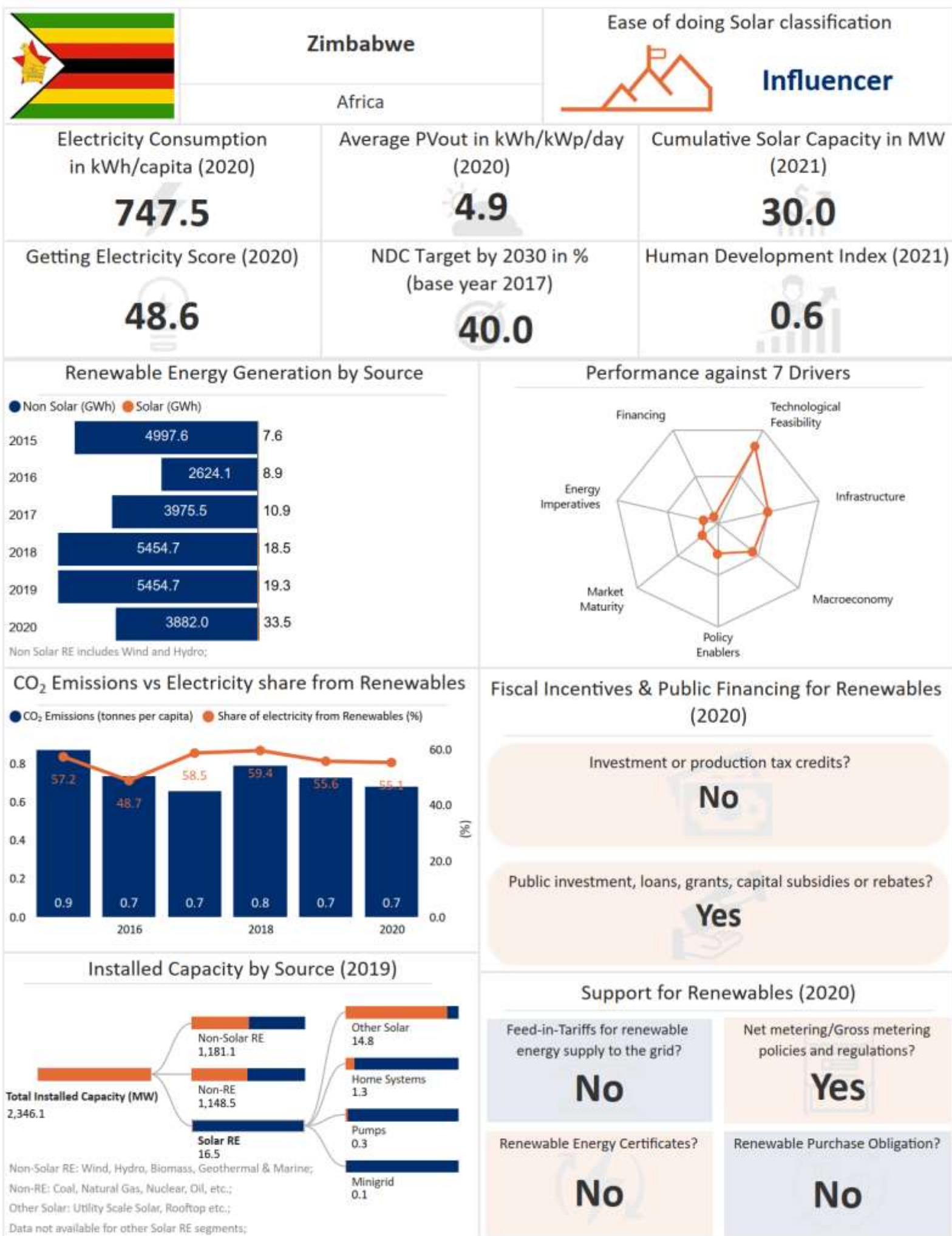
Financing

- The AfDB-GCF framework includes technical assistance which seeks to support the Government of Zambia in its efforts to catalyze private investment for small-scale RE projects. ¹⁷
- The Government of Zambia received financing from the AfDB through the Sustainable Energy Fund for Africa (SEFA) and the Green Climate Fund (GCF) towards the RE Financing Framework. ¹⁸
- In 2018, the AfDB approved a USD 50 Mn for financing small-scale RE projects in Zambia to diversify Zambia's energy generation which is heavily reliant on hydroelectricity. ¹⁹

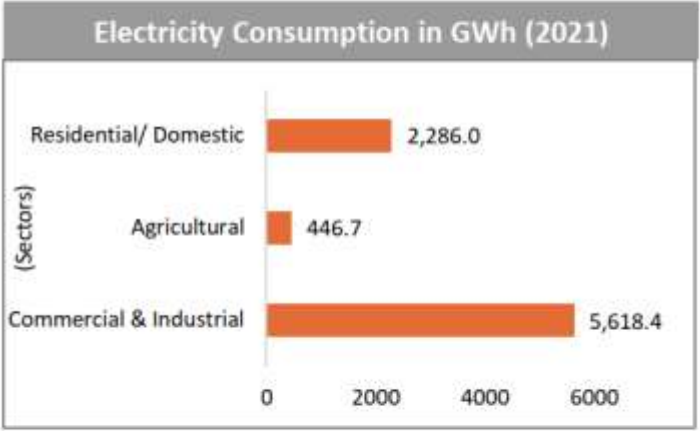
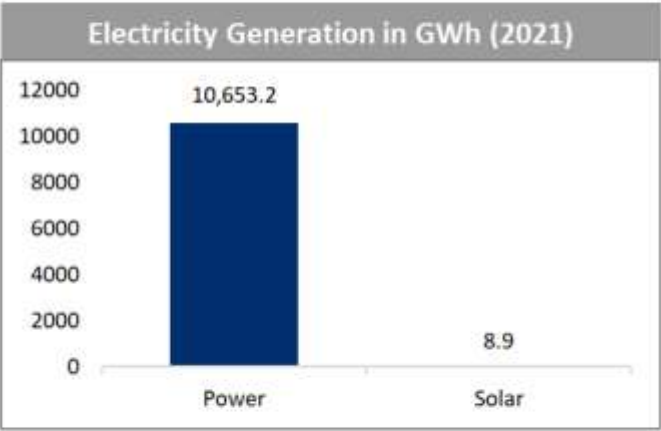


Energy Imperatives

- In 2020, Zambia's per capita electricity consumption stood at 0.87 MWh, which is significantly lower in comparison to the global average of 3.31 MWh. ²²
- The total installed capacity in the country stood at 2,981.3 MW in 2019. ²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 465.9% between 2017-2021 reaching 96.424 MW in 2021 from 0.094 MW levels in 2017. ²¹
- The price of electricity in the country stood at 4.70 US Cents/kWh in 2019. ²³



| Threshold for licensing Solar in MW (2021) | Cheapest Source of Power (2021) | Generation Cost for Hydro Power in USD/kWh (2021) |
|--|---------------------------------|---|
| 0.1 | Hydro | 0.04 |

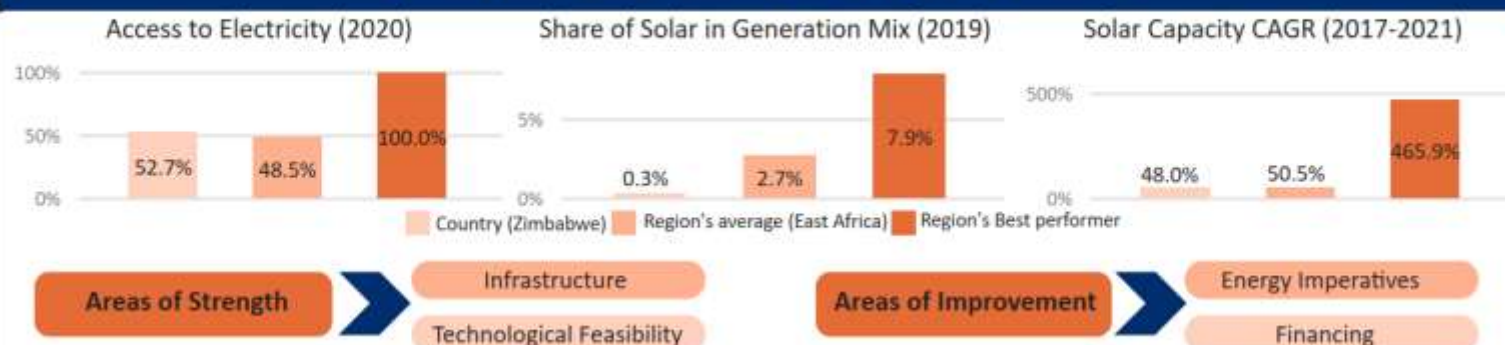


| Financial Support Mechanisms (2021) | |
|---|-----|
| Duty waivers to solar developers for importing/procuring material from foreign land | Yes |
| Tax waivers for manufacturers of raw materials (modules, off grid appliances, etc.) | No |
| Credit facilitation for solar energy from financial institutions (FIs) | No |
| Viability Gap Funding (VGF) i.e. Grant to support RE projects that are economically justified but fall short of financial viability | No |
| Accelerated Depreciation benefit for Industrial/commercial users of Solar Power | No |

| Policies/Schemes for Solar Segments (2021) | | | | | | | | |
|--|------------------|--------------------------|---------------------|-------------|----------------|----------------------------------|--------------------------|----------------|
| Rooftop Solar | Solar Mini Grids | Standalone solar systems | Utility scale solar | Solar Parks | Floating Solar | Solar heating and cooling system | Battery waste management | Green Hydrogen |
| No | No | No | No | No | No | No | No | No |

| Emerging Technologies/ Innovative Models (2021) | |
|---|-----|
| Hybrid technologies - combination of two or more technologies to achieve efficient systems (Example: wind + solar PV hybrid systems, solar + storage systems) | No |
| Emerging technologies - the next generation technologies (Example: Artificial Intelligence, Machine learning, Internet of Things, etc.) | Yes |
| E-mobility/Electric vehicles | Yes |

Country's regional performance and characteristics



Key Insights

Drivers

Insights



Macro-economy

- Zimbabwe is a lower middle-income country ¹ with a GDP per capita (PPP) of USD 2,324 in 2021. ²
- GDP (Real) grew at an annual rate of 6.3% in 2021, and is estimated to grow by another 3.5% in 2022. ³
- General government gross debt to GDP significantly decreased to 67.6% in 2021 from 102.6% levels in 2020. ⁴
- The inflation rate in the country decreased to 98.5% in 2021 from 557.3% levels in 2020. ⁵



Policy enablers

- The Ministry of Energy and Power Development (MoEPD) is responsible for formulating and implementing energy and power development policies in the country. ⁶
- Zimbabwe targets to increase the share of solar to 25% in the electricity generation mix by 2030. ⁷
- Solar panels, inverters, solar lights, energy-saving light bulbs, and electricity generators are exempted from import duty but a 15% VAT charge is applied. ⁸



Technological Feasibility

- Zimbabwe receives very high levels of solar irradiation of 5.7 kWh/m²/day and a specific yield of 4.9 kWh/kWp/day indicating a very strong technical feasibility for solar in the country. ⁹
- The country typically receives 6 hours of sunlight per day. ⁷
- In Zimbabwe, Mini-grids below 100 kW are regulated by light-handed regulations and do not require a license and are usually developed by NGOs with donor fundings. ¹⁰
- Zimbabwe is constructing an off-grid 0.5 MW hybrid solar-diesel project in Mashonaland East province. ¹¹



Market Maturity

- 52.7% population in Zimbabwe had access to electricity as of 2020. ¹²
- The Zimbabwe Electricity Transmission and Distribution Company (ZETDC) is responsible for the transmission, distribution, and supply of electricity to the end users. ¹³
- Zimbabwe Energy Regulatory Authority (ZERA) is responsible for regulating the procurement, production, transportation, transmission, distribution, importation/exportation of energy. ¹⁴
- The average term of Power Purchase Agreements (PPAs) for solar PV projects in Zimbabwe is 25 years. ⁷



Infrastructure

- The transmission system consists of 420 kV, 330 kV, 220 kV, 132 kV, 88 kV, and 66 kV lines with a total circuit length of over 7,274 km. ¹⁵
- Zimbabwe has over 119,784 km of distribution lines serving approximately 600,000 customers. ¹⁵
- The country's average Transmission and Distribution loss levels stood at 4% and 12.76% respectively in 2021. ⁷



Financing

- The United Nations SDG-Fund has approved Zimbabwe's USD 45 Mn program on catalyzing investments in RE for the acceleration of the attainment of the Sustainable Development Goals (SDGs) in the country. ¹⁶
- The AfDB-managed Sustainable Energy Fund for Africa (SEFA) approved a USD 965,000 grant to support the development of a 20 MW off-grid solar PV rooftop project in Zimbabwe. ¹⁷
- The Energy Sector Reform Support Technical Assistance Project funded by the AfDB aims to improve the availability of reliable electricity supply by promoting IPPs in Zimbabwe. ¹⁸



Energy Imperatives

- In 2020, Zimbabwe's per capita electricity consumption stood at 0.75 MWh, which is lower in comparison to the global average of 3.31 MWh. ²⁰
- The total installed capacity of Solar PV witnessed a CAGR of 48% reaching 30.02 MW in 2021 from 6.25 MW levels in 2017. ¹⁹
- The price of electricity in the country stood at 11.90 US Cents/kWh in 2019. ²¹



5. Appendix 1

Regional outcomes

Regional outcomes

Africa (44 countries)

Countries are arranged in alphabetical order under each classification.

| EoDS 2022 classification | ISA member countries | EoDS 2022 classification | ISA member countries |
|--------------------------|----------------------|--------------------------|------------------------------|
| Achiever | Cabo Verde | Progressive | Burundi |
| Achiever | Morocco | Progressive | Cameroon |
| Achiever | Seychelles | Progressive | Chad |
| Influencer | Algeria | Progressive | Comoros |
| Influencer | Botswana | Progressive | Eritrea |
| Influencer | Burkina Faso | Progressive | Ethiopia |
| Influencer | Côte d'Ivoire | Progressive | Guinea |
| Influencer | Djibouti | Progressive | Madagascar |
| Influencer | Egypt | Progressive | Mali |
| Influencer | Gabon | Progressive | Niger |
| Influencer | Gambia | Progressive | Somalia |
| Influencer | Ghana | Progressive | South Sudan |
| Influencer | Malawi | Progressive | Sudan |
| Influencer | Mauritius | Progressive | Togolese Republic |
| Influencer | Mozambique | Potential | Democratic Republic of Congo |
| Influencer | Namibia | Potential | Equatorial Guinea |
| Influencer | Nigeria | Potential | Guinea-Bissau |
| Influencer | Rwanda | Potential | Liberia |
| Influencer | Senegal | Potential | Sao Tome and Principe |
| Influencer | Tanzania | | |
| Influencer | Tunisia | | |
| Influencer | Uganda | | |
| Influencer | Zambia | | |
| Influencer | Zimbabwe | | |
| Progressive | Benin | | |

Asia & Pacific (25 countries)

Countries are arranged in alphabetical order under each classification.

| EoDS 2022 classification | ISA member countries | EoDS 2022 classification | ISA member countries |
|--------------------------|----------------------|--------------------------|----------------------|
| Achiever | Australia | Influencer | Nepal |
| Achiever | Bahrain | Influencer | Palau |
| Achiever | India | Influencer | Samoa |
| Achiever | Japan | Influencer | Sri Lanka |
| Achiever | Oman | Influencer | Tonga |
| Achiever | Saudi Arabia | Influencer | Tuvalu |
| Achiever | United Arab Emirates | Progressive | Marshall islands |
| Influencer | Bangladesh | Progressive | Syria |
| Influencer | Cambodia | Progressive | Vanuatu |
| Influencer | Fiji | Progressive | Yemen |
| Influencer | Kiribati | Potential | Myanmar |
| Influencer | Maldives | Potential | Papua New Guinea |
| Influencer | Nauru | | |

Europe and others (13 countries)

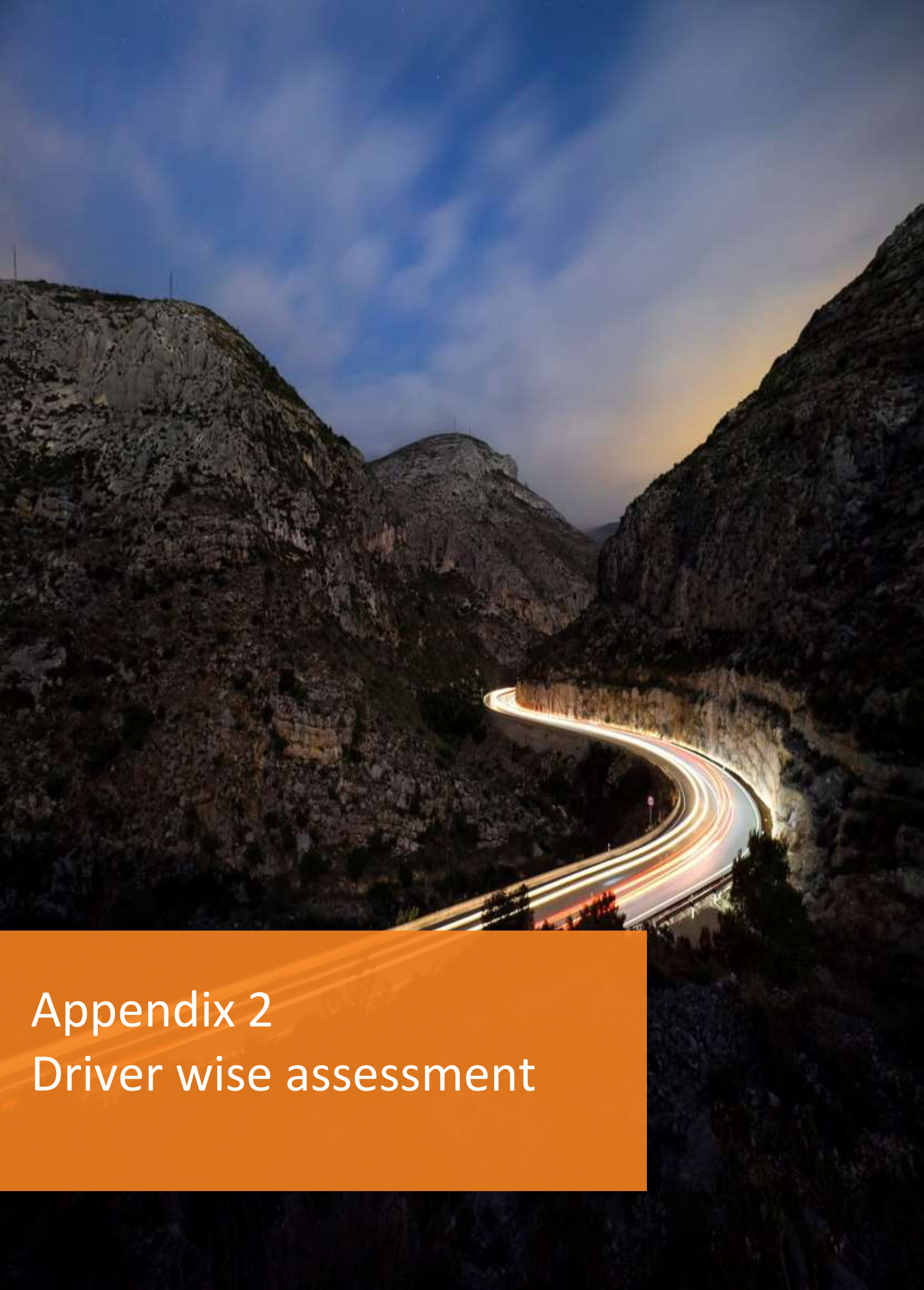
Countries are arranged in alphabetical order under each classification.

| EoDS 2022 classification | ISA member countries | EoDS 2022 classification | ISA member countries |
|--------------------------|----------------------|--------------------------|--------------------------|
| Achiever | Denmark | Achiever | Sweden |
| Achiever | France | Achiever | United States of America |
| Achiever | Germany | Influencer | Hungary |
| Achiever | Greece | Influencer | Luxembourg |
| Achiever | Israel | Influencer | Norway |
| Achiever | Italy | Influencer | United Kingdom |
| Achiever | Netherlands | | |

Latin America & Caribbean (25 countries)

Countries are arranged in alphabetical order under each classification.

| EoDS 2022 classification | ISA member countries | EoDS 2022 classification | ISA member countries |
|--------------------------|----------------------|--------------------------|----------------------------------|
| Achiever | Antigua & Barbuda | Influencer | Jamaica |
| Achiever | Argentina | Influencer | Paraguay |
| Achiever | Barbados | Influencer | Peru |
| Achiever | Brazil | Influencer | Saint Kitts and Nevis |
| Achiever | Chile | Influencer | Saint Vincent and the Grenadines |
| Achiever | Dominican Republic | Influencer | Saint Lucia |
| Achiever | El Salvador | Influencer | Suriname |
| Achiever | Nicaragua | Influencer | Venezuela |
| Achiever | Trinidad and Tobago | Progressive | Belize |
| Influencer | Bolivia | Progressive | Cuba |
| Influencer | Costa Rica | Progressive | Haiti |
| Influencer | Dominica | | |
| Influencer | Grenada | | |
| Influencer | Guyana | | |



Appendix 2

Driver wise assessment

1. Macroeconomy

| S.no./ | ISA member countries | S.no. | ISA member countries |
|--------|----------------------------------|-------|------------------------------|
| 1 | Luxembourg | 55 | Cape Verde |
| 2 | Norway | 56 | India |
| 3 | Denmark | 57 | Côte d'Ivoire |
| 4 | Sweden | 58 | El Salvador |
| 5 | Australia | 59 | Uganda |
| 6 | United States of America | 60 | Zambia |
| 7 | Germany | 61 | Tanzania |
| 8 | Netherlands | 62 | Tunisia |
| 9 | France | 63 | Belize |
| 10 | Japan | 64 | Brazil |
| 11 | United Kingdom | 65 | Togolese Republic |
| 12 | United Arab Emirates | 66 | Gambia |
| 13 | Hungary | 67 | Papua New Guinea |
| 14 | Mauritius | 68 | Cambodia |
| 15 | Botswana | 69 | Sao Tome and Principe |
| 16 | Chile | 70 | Nauru |
| 17 | Dominica | 71 | Bolivia |
| 18 | Saudi Arabia | 72 | Suriname |
| 19 | Oman | 73 | Gabon |
| 20 | Kiribati | 74 | Madagascar |
| 21 | Italy | 75 | Bangladesh |
| 22 | Antigua & Barbuda | 76 | Guinea |
| 23 | Grenada | 77 | Guinea-Bissau |
| 24 | Costa Rica | 78 | Benin |
| 25 | Saint Kitts and Nevis | 79 | Comoros |
| 26 | Israel | 80 | Palau |
| 27 | Fiji | 81 | Nigeria |
| 28 | Morocco | 82 | Mozambique |
| 29 | Nepal | 83 | Egypt |
| 30 | Saint Lucia | 84 | Niger |
| 31 | Tonga | 85 | Algeria |
| 32 | Guyana | 86 | Marshall islands |
| 33 | Namibia | 87 | Haiti |
| 34 | Saint Vincent and the Grenadines | 88 | Nicaragua |
| 35 | Vanuatu | 89 | Burkina Faso |
| 36 | Greece | 90 | Liberia |
| 37 | Trinidad and Tobago | 91 | Equatorial Guinea |
| 38 | Peru | 92 | Cameroon |
| 39 | Barbados | 93 | Burundi |
| 40 | Ghana | 94 | Chad |
| 41 | Jamaica | 95 | Ethiopia |
| 42 | Sri Lanka | 96 | Zimbabwe |
| 43 | Bahrain | 97 | Myanmar |
| 44 | Tuvalu | 98 | Democratic Republic of Congo |
| 45 | Argentina | 99 | Mali |
| 46 | Rwanda | 100 | Eritrea |
| 47 | Dominican Republic | 101 | South Sudan |
| 48 | Malawi | 102 | Sudan |
| 49 | Senegal | 103 | Yemen |
| 50 | Paraguay | 104 | Venezuela |
| 51 | Samoa | 105 | Somalia |
| 52 | Maldives | 106 | Syria |
| 53 | Djibouti | 107 | Cuba |
| 54 | Seychelles | | |

2. Policy enablers

| S.no. | ISA member countries | S.no. | ISA member countries |
|-------|--------------------------|-------|----------------------------------|
| 1 | United States of America | 55 | Egypt |
| 2 | India | 56 | Mali |
| 3 | Greece | 57 | Botswana |
| 4 | Chile | 58 | Gambia |
| 5 | Netherlands | 59 | Malawi |
| 6 | Denmark | 60 | Tunisia |
| 7 | Germany | 61 | Barbados |
| 8 | France | 62 | Belize |
| 9 | Argentina | 63 | Cambodia |
| 10 | Sweden | 64 | Zambia |
| 11 | Nepal | 65 | Niger |
| 12 | Italy | 66 | Ethiopia |
| 13 | Brazil | 67 | Zimbabwe |
| 14 | Seychelles | 68 | Saint Lucia |
| 15 | Dominican Republic | 69 | Mozambique |
| 16 | Jamaica | 70 | Grenada |
| 17 | Australia | 71 | Comoros |
| 18 | United Kingdom | 72 | Tonga |
| 19 | Cape Verde | 73 | Vanuatu |
| 20 | Ghana | 74 | Antigua & Barbuda |
| 21 | Burkina Faso | 75 | Saint Kitts and Nevis |
| 22 | Bahrain | 76 | Saint Vincent and the Grenadines |
| 23 | El Salvador | 77 | Guinea |
| 24 | Israel | 78 | Dominica |
| 25 | Trinidad and Tobago | 79 | Namibia |
| 26 | United Arab Emirates | 80 | Haiti |
| 27 | Syria | 81 | Guinea-Bissau |
| 28 | Nicaragua | 82 | Paraguay |
| 29 | Norway | 83 | Guyana |
| 30 | Rwanda | 84 | Democratic Republic of Congo |
| 31 | Peru | 85 | Tuvalu |
| 32 | Sri Lanka | 86 | Papua New Guinea |
| 33 | Fiji | 87 | Kiribati |
| 34 | Bolivia | 88 | Togolese Republic |
| 35 | Japan | 89 | Djibouti |
| 36 | Senegal | 90 | Cameroon |
| 37 | Côte d'Ivoire | 91 | Marshall islands |
| 38 | Luxembourg | 92 | Liberia |
| 39 | Nigeria | 93 | Burundi |
| 40 | Hungary | 94 | Chad |
| 41 | Saudi Arabia | 95 | Yemen |
| 42 | Tanzania | 96 | Venezuela |
| 43 | Mauritius | 97 | Somalia |
| 44 | Morocco | 98 | Eritrea |
| 45 | Uganda | 99 | Samoa |
| 46 | Costa Rica | 100 | Myanmar |
| 47 | Madagascar | 101 | Gabon |
| 48 | Oman | 102 | Sao Tome and Principe |
| 49 | Algeria | 103 | Equatorial Guinea |
| 50 | Bangladesh | 104 | Cuba |
| 51 | Palau | 105 | Sudan |
| 52 | Maldives | 106 | Nauru |
| 53 | Benin | 107 | South Sudan |
| 54 | Suriname | | |

Note: Countries are arranged based on the scores (high to low) in each driver category

3. Technological feasibility

| S.no. | ISA member countries | S.no. | ISA member countries |
|-------|----------------------------------|-------|------------------------------|
| 1 | Chad | 55 | Rwanda |
| 2 | Oman | 56 | Kiribati |
| 3 | Egypt | 57 | Dominica |
| 4 | Saudi Arabia | 58 | Zambia |
| 5 | Mali | 59 | Bolivia |
| 6 | Somalia | 60 | Samoa |
| 7 | United Arab Emirates | 61 | India |
| 8 | Botswana | 62 | Eritrea |
| 9 | Bahrain | 63 | Burkina Faso |
| 10 | Nauru | 64 | Tonga |
| 11 | Senegal | 65 | Costa Rica |
| 12 | Gambia | 66 | Bangladesh |
| 13 | Israel | 67 | Nepal |
| 14 | Antigua & Barbuda | 68 | Gabon |
| 15 | Zimbabwe | 69 | Guinea-Bissau |
| 16 | El Salvador | 70 | Venezuela |
| 17 | Barbados | 71 | Greece |
| 18 | South Sudan | 72 | Marshall islands |
| 19 | Ethiopia | 73 | Guinea |
| 20 | Tanzania | 74 | Equatorial Guinea |
| 21 | Cape Verde | 75 | Trinidad and Tobago |
| 22 | Maldives | 76 | Syria |
| 23 | Morocco | 77 | Saint Lucia |
| 24 | Saint Kitts and Nevis | 78 | Fiji |
| 25 | Seychelles | 79 | Grenada |
| 26 | Malawi | 80 | Myanmar |
| 27 | Suriname | 81 | United States of America |
| 28 | Mozambique | 82 | Cambodia |
| 29 | Dominican Republic | 83 | Tunisia |
| 30 | Benin | 84 | Togolese Republic |
| 31 | Uganda | 85 | Vanuatu |
| 32 | Madagascar | 86 | Guyana |
| 33 | Haiti | 87 | Cameroon |
| 34 | Peru | 88 | Democratic Republic of Congo |
| 35 | Cuba | 89 | Côte d'Ivoire |
| 36 | Nigeria | 90 | Paraguay |
| 37 | Tuvalu | 91 | Sri Lanka |
| 38 | Namibia | 92 | Italy |
| 39 | Nicaragua | 93 | Comoros |
| 40 | Brazil | 94 | Belize |
| 41 | Chile | 95 | Liberia |
| 42 | Yemen | 96 | France |
| 43 | Australia | 97 | Japan |
| 44 | Niger | 98 | Hungary |
| 45 | Ghana | 99 | Sao Tome and Principe |
| 46 | Jamaica | 100 | Papua New Guinea |
| 47 | Sudan | 101 | Germany |
| 48 | Saint Vincent and the Grenadines | 102 | Luxembourg |
| 49 | Argentina | 103 | Netherlands |
| 50 | Burundi | 104 | Denmark |
| 51 | Mauritius | 105 | Sweden |
| 52 | Algeria | 106 | United Kingdom |
| 53 | Palau | 107 | Norway |
| 54 | Djibouti | | |

Note: Countries are arranged based on the scores (high to low) in each driver category

4. Market maturity

| S.no. | ISA member countries | S.no. | ISA member countries |
|-------|----------------------------------|-------|------------------------------|
| 1 | Nauru | 55 | Egypt |
| 2 | Barbados | 56 | Tunisia |
| 3 | Antigua & Barbuda | 57 | Argentina |
| 4 | Palau | 58 | Mauritius |
| 5 | Saint Kitts and Nevis | 59 | Algeria |
| 6 | Sweden | 60 | Saudi Arabia |
| 7 | Trinidad and Tobago | 61 | Haiti |
| 8 | Venezuela | 62 | Norway |
| 9 | Saint Vincent and the Grenadines | 63 | Oman |
| 10 | Saint Lucia | 64 | Bahrain |
| 11 | Cuba | 65 | El Salvador |
| 12 | Tuvalu | 66 | Brazil |
| 13 | Dominica | 67 | Guinea |
| 14 | Grenada | 68 | Tonga |
| 15 | Gabon | 69 | Suriname |
| 16 | Guyana | 70 | Dominican Republic |
| 17 | Paraguay | 71 | Syria |
| 18 | Marshall islands | 72 | Bolivia |
| 19 | Yemen | 73 | Peru |
| 20 | Fiji | 74 | Jamaica |
| 21 | Samoa | 75 | Belize |
| 22 | Nicaragua | 76 | Liberia |
| 23 | Namibia | 77 | Democratic Republic of Congo |
| 24 | Sudan | 78 | Cape Verde |
| 25 | Kiribati | 79 | Chad |
| 26 | Equatorial Guinea | 80 | Burundi |
| 27 | Comoros | 81 | India |
| 28 | Cameroon | 82 | South Sudan |
| 29 | Vanuatu | 83 | Botswana |
| 30 | Sao Tome and Principe | 84 | Sri Lanka |
| 31 | Djibouti | 85 | Nepal |
| 32 | Eritrea | 86 | Cambodia |
| 33 | Papua New Guinea | 87 | Côte d'Ivoire |
| 34 | Togolese Republic | 88 | Bangladesh |
| 35 | Australia | 89 | Ghana |
| 36 | Greece | 90 | Myanmar |
| 37 | Germany | 91 | Senegal |
| 38 | Italy | 92 | Zimbabwe |
| 39 | Seychelles | 93 | Nigeria |
| 40 | Chile | 94 | Gambia |
| 41 | Luxembourg | 95 | Ethiopia |
| 42 | Japan | 96 | Zambia |
| 43 | Netherlands | 97 | Rwanda |
| 44 | Hungary | 98 | Mali |
| 45 | Israel | 99 | Benin |
| 46 | United Kingdom | 100 | Tanzania |
| 47 | Somalia | 101 | Uganda |
| 48 | Denmark | 102 | Burkina Faso |
| 49 | Maldives | 103 | Guinea-Bissau |
| 50 | United States of America | 104 | Madagascar |
| 51 | United Arab Emirates | 105 | Mozambique |
| 52 | Costa Rica | 106 | Niger |
| 53 | France | 107 | Malawi |
| 54 | Morocco | | |

Note: Countries are arranged based on the scores (high to low) in each driver category

5. Infrastructure

| S.no. | ISA member countries | S.no. | ISA member countries |
|-------|--------------------------|-------|----------------------------------|
| 1 | India | 55 | Djibouti |
| 2 | Bahrain | 56 | Algeria |
| 3 | Argentina | 57 | Palau |
| 4 | Greece | 58 | Gambia |
| 5 | Hungary | 59 | Burundi |
| 6 | United Arab Emirates | 60 | Dominica |
| 7 | Morocco | 61 | Bangladesh |
| 8 | Paraguay | 62 | Cape Verde |
| 9 | Germany | 63 | Suriname |
| 10 | United Kingdom | 64 | Sudan |
| 11 | Mozambique | 65 | Saint Vincent and the Grenadines |
| 12 | Tunisia | 66 | Tonga |
| 13 | Barbados | 67 | Cameroon |
| 14 | Netherlands | 68 | Nigeria |
| 15 | El Salvador | 69 | Namibia |
| 16 | Venezuela | 70 | Maldives |
| 17 | Ghana | 71 | Saint Lucia |
| 18 | Israel | 72 | Benin |
| 19 | Oman | 73 | Gabon |
| 20 | France | 74 | Fiji |
| 21 | Italy | 75 | Nauru |
| 22 | Denmark | 76 | Samoa |
| 23 | Nicaragua | 77 | Tuvalu |
| 24 | Chile | 78 | Syria |
| 25 | Zambia | 79 | Guyana |
| 26 | United States of America | 80 | Grenada |
| 27 | Brazil | 81 | Papua New Guinea |
| 28 | Norway | 82 | Myanmar |
| 29 | Mauritius | 83 | Botswana |
| 30 | Sweden | 84 | Marshall islands |
| 31 | Trinidad and Tobago | 85 | Kiribati |
| 32 | Tanzania | 86 | Guinea |
| 33 | Côte d'Ivoire | 87 | Haiti |
| 34 | Luxembourg | 88 | Saint Kitts and Nevis |
| 35 | Antigua & Barbuda | 89 | Eritrea |
| 36 | Zimbabwe | 90 | Liberia |
| 37 | Senegal | 91 | Cuba |
| 38 | Sri Lanka | 92 | Madagascar |
| 39 | Malawi | 93 | Vanuatu |
| 40 | Saudi Arabia | 94 | Democratic Republic of Congo |
| 41 | Jamaica | 95 | Somalia |
| 42 | Dominican Republic | 96 | Equatorial Guinea |
| 43 | Japan | 97 | Ethiopia |
| 44 | Bolivia | 98 | Guinea-Bissau |
| 45 | Costa Rica | 99 | Yemen |
| 46 | Cambodia | 100 | Seychelles |
| 47 | Belize | 101 | South Sudan |
| 48 | Uganda | 102 | Nepal |
| 49 | Rwanda | 103 | Sao Tome and Principe |
| 50 | Burkina Faso | 104 | Mali |
| 51 | Togolese Republic | 105 | Niger |
| 52 | Australia | 106 | Comoros |
| 53 | Egypt | 107 | Chad |
| 54 | Peru | | |

Note: Countries are arranged based on the scores (high to low) in each driver category

6. Financing

| S.no. | ISA member countries | S.no. | ISA member countries |
|-------|----------------------------------|-------|------------------------------|
| 1 | Luxembourg | 55 | Algeria |
| 2 | Denmark | 56 | Guyana |
| 3 | Japan | 57 | Maldives |
| 4 | Sweden | 58 | Nicaragua |
| 5 | United Kingdom | 59 | Egypt |
| 6 | Norway | 60 | Botswana |
| 7 | Australia | 61 | Rwanda |
| 8 | United States of America | 62 | Côte d'Ivoire |
| 9 | France | 63 | Senegal |
| 10 | Cambodia | 64 | Togolese Republic |
| 11 | Netherlands | 65 | Mali |
| 12 | Morocco | 66 | Suriname |
| 13 | Italy | 67 | Burkina Faso |
| 14 | Germany | 68 | Gabon |
| 15 | Mauritius | 69 | Mozambique |
| 16 | Greece | 70 | Sao Tome and Principe |
| 17 | Nepal | 71 | Guinea |
| 18 | Israel | 72 | Ethiopia |
| 19 | Barbados | 73 | Palau |
| 20 | Chile | 74 | Papua New Guinea |
| 21 | Fiji | 75 | Myanmar |
| 22 | Bolivia | 76 | Benin |
| 23 | United Arab Emirates | 77 | Zambia |
| 24 | Seychelles | 78 | Burundi |
| 25 | Bahrain | 79 | Sudan |
| 26 | Vanuatu | 80 | Uganda |
| 27 | Brazil | 81 | Madagascar |
| 28 | Oman | 82 | Tanzania |
| 29 | Sri Lanka | 83 | Ghana |
| 30 | Tunisia | 84 | Kiribati |
| 31 | Samoa | 85 | Nauru |
| 32 | India | 86 | Tuvalu |
| 33 | Cape Verde | 87 | Liberia |
| 34 | Namibia | 88 | Yemen |
| 35 | Costa Rica | 89 | Gambia |
| 36 | El Salvador | 90 | Malawi |
| 37 | Belize | 91 | Cameroon |
| 38 | Saint Kitts and Nevis | 92 | Haiti |
| 39 | Jamaica | 93 | Niger |
| 40 | Antigua & Barbuda | 94 | Nigeria |
| 41 | Trinidad and Tobago | 95 | Comoros |
| 42 | Dominica | 96 | Marshall islands |
| 43 | Tonga | 97 | Venezuela |
| 44 | Saint Lucia | 98 | Syria |
| 45 | Dominican Republic | 99 | Chad |
| 46 | Grenada | 100 | Zimbabwe |
| 47 | Hungary | 101 | Equatorial Guinea |
| 48 | Peru | 102 | Cuba |
| 49 | Paraguay | 103 | Somalia |
| 50 | Bangladesh | 104 | Guinea-Bissau |
| 51 | Saudi Arabia | 105 | Democratic Republic of Congo |
| 52 | Djibouti | 106 | Eritrea |
| 53 | Argentina | 107 | South Sudan |
| 54 | Saint Vincent and the Grenadines | | |

Note: Countries are arranged based on the scores (high to low) in each driver category

7. Energy Imperatives

| S.no. | ISA member countries | S.no. | ISA member countries |
|-------|--------------------------|-------|----------------------------------|
| 1 | United States of America | 55 | Denmark |
| 2 | India | 56 | Nepal |
| 3 | Zambia | 57 | Grenada |
| 4 | Japan | 58 | Guyana |
| 5 | Germany | 59 | Kiribati |
| 6 | Argentina | 60 | Syria |
| 7 | United Arab Emirates | 61 | Suriname |
| 8 | Australia | 62 | Cape Verde |
| 9 | Bahrain | 63 | El Salvador |
| 10 | Norway | 64 | Niger |
| 11 | Oman | 65 | Saint Kitts and Nevis |
| 12 | Cambodia | 66 | Sri Lanka |
| 13 | Brazil | 67 | Saint Vincent and the Grenadines |
| 14 | Saudi Arabia | 68 | Nicaragua |
| 15 | Netherlands | 69 | Malawi |
| 16 | Seychelles | 70 | Democratic Republic of Congo |
| 17 | Italy | 71 | Burkina Faso |
| 18 | Nauru | 72 | Jamaica |
| 19 | Sweden | 73 | Namibia |
| 20 | Morocco | 74 | Peru |
| 21 | Antigua & Barbuda | 75 | Myanmar |
| 22 | Trinidad and Tobago | 76 | Tunisia |
| 23 | Maldives | 77 | Costa Rica |
| 24 | France | 78 | Paraguay |
| 25 | Togolese Republic | 79 | Uganda |
| 26 | Bolivia | 80 | Madagascar |
| 27 | Hungary | 81 | Senegal |
| 28 | Comoros | 82 | Fiji |
| 29 | Saint Lucia | 83 | Palau |
| 30 | United Kingdom | 84 | Ethiopia |
| 31 | Sudan | 85 | Gabon |
| 32 | Israel | 86 | Chad |
| 33 | Zimbabwe | 87 | Dominica |
| 34 | Venezuela | 88 | Rwanda |
| 35 | Barbados | 89 | Marshall islands |
| 36 | Mozambique | 90 | Algeria |
| 37 | Samoa | 91 | Burundi |
| 38 | Dominican Republic | 92 | Sao Tome and Principe |
| 39 | Luxembourg | 93 | South Sudan |
| 40 | Vanuatu | 94 | Djibouti |
| 41 | Chile | 95 | Eritrea |
| 42 | Belize | 96 | Yemen |
| 43 | Ghana | 97 | Tanzania |
| 44 | Egypt | 98 | Nigeria |
| 45 | Guinea | 99 | Gambia |
| 46 | Guinea-Bissau | 100 | Tuvalu |
| 47 | Greece | 101 | Cameroon |
| 48 | Liberia | 102 | Benin |
| 49 | Côte d'Ivoire | 103 | Cuba |
| 50 | Mali | 104 | Botswana |
| 51 | Tonga | 105 | Haiti |
| 52 | Papua New Guinea | 106 | Somalia |
| 53 | Bangladesh | 107 | Equatorial Guinea |
| 54 | Mauritius | | |

Note: Countries are arranged based on the scores (high to low) in each driver category



Appendix 3 - Annexure

Driver 1: Macroeconomy

| S.No | Indicators | Description | Parameter |
|------|--|--|----------------------|
| 1 | GDP (Current prices) | The Current Prices measures GDP/ inflation/asset prices using the actual prices in the economy. Economic development is generally measured in terms of gross domestic product (GDP) because it is easier to quantify the production of goods and services than a multi-dimensional index can measure other welfare achievements. High GDP signifies economic strength and development in the country | Economic Development |
| 2 | GDP growth in % terms, annual | The annual average rate of change of the gross domestic product (GDP) at market prices based on constant local currency, for a given national economy, during a specified period of time. This indicator is to understand how the economy is performing in the near term/ currently. GDP is an accurate indicator of the size of an economy and the GDP growth rate is the single best indicator of economic development | Economic Development |
| 3 | GDP growth (current prices) in % terms, 5 years | This indicator is to understand how the economy of the country is performing in the long term. High GDP is a sign of economic strength and development in the country | Economic Development |
| 4 | Gross domestic product per capita, constant prices | GDP at constant price is the GDP adjusted for the effects of inflation. GDP at constant price is also referred to as real GDP.GDP is expressed in constant national currency per person. Data are derived by dividing constant price GDP by total population. Annual percentages of constant price GDP are year-on-year changes; the base year is country-specific | Economic Development |
| 5 | GDP based on purchasing-power-parity (PPP) | Gross domestic product (GDP) in purchasing power standards measures the volume of GDP of countries or regions. it is calculated by dividing GDP by the corresponding purchasing power parity (PPP), which is an exchange rate that removes price level differences between countries. | Economic Development |
| 6 | General government gross debt to GDP | The indicator to compare a country's public debt to its gross domestic product (GDP). A high debt-to-GDP is undesirable for a country, as a higher ratio indicates a higher risk of default. | Country Risk |

Driver 1: Macroeconomy

| S.No | Indicators | Description | Parameter |
|------|---|---|---------------------|
| 7 | Equity Risk Premium | An equity risk premium is an excess return earned by an investor when they invest in the stock market over a risk-free rate. This return compensates investors for taking on the higher risk of equity investing in the country. | Country Risk |
| 8 | Fiscal deficit | A fiscal deficit is a shortfall in a government's income compared to its spending. Large and long-term deficits will increase country risk. | Country Risk |
| 9 | Inflation | Inflation refers to an environment of generally rising prices of goods and services within an economy. The indicator subjects to the risk that inflation will undermine an investment's returns through a decline in purchasing power. Lower inflation will have lower country risk. | Country Risk |
| 10 | Change in Inflation over the past 5 years | This indicator is to understand how the economy of the country is performing in the long term | Country Risk |
| 11 | Political stability Index | Institutional indicator that shows the stability in political and governmental issues in the countries. The uncertainty associated with an unstable political environment may reduce investment and the speed of economic development. | Political stability |
| 12 | Total Investment | Expressed as a ratio of total investment in current local currency and GDP in current local currency. Investment or gross capital formation is measured by the total value of the gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables for a unit or sector. | Investment |
| 13 | Net FDI Inflow | FDI net inflows are the value of inward direct investment made by non-resident investors in the reporting economy, including reinvested earnings and intra-company loans, net of repatriation of capital and repayment of loans. Higher FDI inflow is a good sign for overall economic development of a country | Investment |
| 14 | Protecting Minority Investor Interest | The protecting minority investors indicators focus specifically on equity investors who acquire common shares of companies, not bondholders. | Investor Protection |

Driver 1: Macroeconomy

| S.No | Indicators | Description | Parameter |
|------|------------------------------|--|---------------------|
| | | The indicator measures the strength of minority shareholder protections against misuse of corporate assets by directors for their personal gain as well as shareholder rights, governance safeguards and corporate transparency requirements that reduce the risk of abuse | |
| 15 | Enforcing contracts score | The enforcing contracts indicator measures the time and cost for resolving a commercial dispute through a local first-instance court (competent court), and the quality of judicial processes index, analysing whether the country has adopted a series of good practices that promote quality and efficiency | Investor Protection |
| 16 | Ease of Doing Business score | The Ease of Doing Business (EoDB) index is a ranking system were higher rankings indicate better, usually simpler, regulations for businesses and stronger protections of property rights. | Doing Business |
| 17 | Logistics performance index | Logistics Performance Index overall score reflects perceptions of a country's logistics based on efficiency of customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments, and frequency with which shipments reach the consignee within the scheduled time. The index ranges from 1 to 5, with a higher score representing better performance. | Doing Business |
| 18 | Trading across borders-Score | Doing Business measures the time and cost associated with three sets of procedures of exporting and importing goods —documentary compliance, border compliance and domestic transport—within the overall process of exporting or importing a shipment of goods. The score for trading across borders is the simple average of the scores for the time and cost for documentary compliance and border compliance to export and import. | Doing Business |

Driver 2: Policy enablers

| S.No | Indicators | Description | Parameter |
|------|--|---|------------------------|
| 1 | Schemes for Renewable Energy | Presence of schemes for RE signifies improvement of the generation as well as the adoption of solar energy in the country | Support for Renewables |
| | <ul style="list-style-type: none"> Feed-in-Tariffs for Renewable Energy Supply to the Grid (Existing National/ Sub-National) | Availability of Tariff for Solar Power under the Feed-in-Tariff mechanism in the country | Support for Renewables |
| | <ul style="list-style-type: none"> Presence of Net metering/ Gross metering policies and regulations | Net metering policies supports renewable energy technologies which allow end-users to receive a credit or payment for the net excess electricity that is generated and exported to the grid. Net metering policies in place would help in attracting rooftop prosumers to opt for solar | Support for Renewables |
| | <ul style="list-style-type: none"> Subsidy provisions for Renewable Energy | Support for renewables can be ascertained through provision of policies, incentives and schemes directed for the development of Solar. Public investment, loans, grants, capital subsidies or rebates provided by the governments, are studied here to capture this support. | Support for Renewables |
| | <ul style="list-style-type: none"> Regulatory framework for integrating solar generation to grid-powered electricity | Presence of Regulatory framework for integrating solar generation to grid-powered electricity | Support for Renewables |
| | <ul style="list-style-type: none"> Regulatory guidance for off-grid solar business | Regulatory guidance for off-grid solar business in the country | Support for Renewables |
| | <ul style="list-style-type: none"> Single window approval system for solar projects | Single window approval system for solar projects in the country | Support for Renewables |
| | <ul style="list-style-type: none"> Requirement for inclusion of Solar PV in the design of new public buildings in law/policy/regulation | The country’s law/policy/regulation requires solar photovoltaics be considered in the design of new public buildings | Support for Renewables |
| | <ul style="list-style-type: none"> Franchising for solar business | The country’s legal framework provide for Franchising for solar business | Support for Renewables |
| | <ul style="list-style-type: none"> Accelerated depreciation benefit | The accelerated depreciation benefit allows the commercial and industrial users of solar power to depreciate their investment in a Solar Power Plant at a much higher rate than general fixed assets. This in return allows the user to claim tax benefits on the value depreciated in a given year | Support for Renewables |

Driver 2: Policy enablers

| S.No | Indicators | Description | Parameter |
|------|--|---|------------------------|
| 2 | Schemes for Solar segments <ul style="list-style-type: none"> ▪ Rooftop Solar ▪ Solar Mini Grids ▪ Standalone solar systems ▪ Utility scale solar ▪ Solar Parks ▪ Floating Solar ▪ Solar heating and cooling system ▪ Battery waste management ▪ Green Hydrogen | Availability of specific policies/ schemes for the following Solar segments in the country | Support for Renewables |
| 3 | Carbon Taxation | Under a carbon tax, the government sets a price that emitters must pay for each ton of greenhouse gas emissions they emit. Businesses and consumers will take steps, such as switching fuels or adopting new technologies, to reduce their emissions to avoid paying the tax. Higher carbon tax will facilitate more focus on RE in the country | Support for Renewables |
| 4 | Renewable Generation Obligation | Mechanism to promote RE by stipulating generation of a percentage of the power by the generating companies or generators from RE sources. Presence of RGO policy in the country will support more deployment of RE sources | Support for Renewables |
| 5 | Renewable Purchase Obligations | Mechanism to promote renewable energy by stipulating purchase of a percentage of the power procurement by distribution utilities from renewable energy sources. Presence of RPO policy in the country will support more deployment of RE sources | Support for Renewables |
| 6 | Renewable Energy Certificates | Market-based instrument to promote renewable sources of energy and development of the market in electricity. One REC is created when one megawatt hour of electricity is generated from an eligible renewable energy source. Presence of REC in the country will support more deployment of RE sources | Support for Renewables |
| 7 | RE tendering | Existing national or subnational policy or tender framework | Support for Renewables |

Driver 2: Policy enablers

| S.No | Indicators | Description | Parameter |
|------|---|--|------------------------|
| 8 | Submissions to COP/UNFCCC | The Conference of the Parties guide the efforts of the countries that are parties to act against climate change. The submissions for COP/UNFCCC will help understand the commitment from the country. | Sustainability Targets |
| 9 | Emission Reduction Targets | Targets to reach zero-carbon economy, boost innovation and drive sustainable growth by setting ambitious, emissions reduction targets. | Sustainability Targets |
| 10 | NDC target | The NDC target refers to the country's National Determined Contribution (NDC) Target measured in percentage | Sustainability Targets |
| 11 | RE Targets in the NDC | Mandatory renewable energy targets are part of government legislated schemes which require electricity retailers to source specific proportions of total electricity sales from renewable energy sources according to a fixed time frame. The presence of Renewable energy targets will help understand the country's commitment. RE targets will act as a key driver for a favourable policy ecosystem. | Sustainability Targets |
| 12 | RE Targets by 2030 | The indicator refers to the Renewable energy Targets by 2030 measured in MW/GW | Sustainability Targets |
| 13 | CO2 emissions per capita | The total amount of carbon dioxide emitted by the country as a consequence of all relevant human production and consumption activities, divided by the population of the country. Higher emissions will drive the countries to make sustainable decisions. | Sustainability Targets |
| 14 | Nitrous oxide emissions in energy sector (thousand metric tons of CO2 equivalent) | Nitrous oxide emissions from energy processes are emissions produced by the combustion of fossil fuels and biofuels | Sustainability Targets |
| 15 | Provisions for meeting energy needs of women and/or marginalised groups | The indicator refers to the provisions for meeting the energy needs of women and/or marginalised groups in the country's renewable energy policies and targets | Sustainability Targets |

Driver 2: Policy enablers

| S.No | Indicators | Description | Parameter |
|------|--|---|------------------------------|
| 16 | Incentives for Solar Developers | Presence of following incentive/ support schemes will help in assessment of the level of support for solar developers | Financial Support Mechanisms |
| | <ul style="list-style-type: none"> Investment or production tax credits | <p>Investment Tax Credit - An investment tax credit provides a direct tax rebate of a certain percentage of the investment in a qualified asset or business</p> <p>Production Tax Credit - A production tax credit provides a tax rebate based on the amount of production by a certain business</p> | Financial Support Mechanisms |
| | <ul style="list-style-type: none"> Import duty waivers for Solar Developers | A waiver on duty and tax on specified imported goods exempts the solar developers from paying duty and tax on the goods. Main reason for the exemption is that the concerned goods or products are of strategic importance to the country and the economy and taxing them may prohibit wide access to them by the intended customers due to high prices | Financial Support Mechanisms |
| | <ul style="list-style-type: none"> Tax waivers for manufacturers of raw materials | Tax waivers provided in the country for manufacturers of raw materials | Financial Support Mechanisms |
| | <ul style="list-style-type: none"> Generation based incentives for RE generators | Generation based incentive (GBI) promotes electricity generation and provides incentive to reduce capex while ensuring sustained performance of the plant during its operation phase. | Financial Support Mechanisms |
| | <ul style="list-style-type: none"> Revenue Based Incentives for RE generators | Revenue based incentive (RBI) promotes electricity generation and provides incentive based on the revenues for Renewable energy generators. | Financial Support Mechanisms |
| | <ul style="list-style-type: none"> Subsidy provisions for Renewable Energy | Subsidies provided in the country for Renewable energy generation | Financial Support Mechanisms |
| | <ul style="list-style-type: none"> Viability Gap Funding | <p>Viability Gap Funding (VGF) is an incentive scheme in which a certain percentage of total capital cost is paid by the government to make the project economically viable.</p> <p>In case of renewable energy projects, “VGF” is the fraction of capital cost required to achieve the target APPC (Average Power Purchase Cost).</p> | Financial Support Mechanisms |

Driver 2: Policy enablers

| S.No | Indicators | Description | Parameter |
|------|---|--|------------------------------|
| | ▪ Presence of Energy service companies (ESCOs) | Presence of Energy service companies (ESCOs) in the country | Financial Support Mechanisms |
| | ▪ Credit facilitation for solar energy sector from financial institutions (FIs) | The credit facilitation for solar energy sector from financial institutions (FIs) in the country | Financial Support Mechanisms |
| | ▪ Mechanism for credit policy | Mechanism for credit policy in the country | Financial Support Mechanisms |
| 17 | Regulatory Quality Index | Regulatory Quality Index captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote renewable energy development. Higher Regulatory quality Index represents higher quality of Regulatory ecosystem in the country. | Regulatory Quality Index |

Driver 3: Technological Feasibility

| S.No | Indicators | Description | Parameter |
|------|---|--|----------------------------------|
| 1 | Average Solar Capacity Utilisation Factor | For a Solar Photovoltaic (SPV) project, Capacity Utilisation Factor (CUF) is the ratio of actual energy generated by SPV project over the year to the equivalent energy output at its rated capacity over the yearly period. Higher average CUF represents higher generation from SPV plant in the country. | Solar Technology/ Irradiation |
| 2 | Average Global horizontal irradiation | Global Horizontal Irradiance (GHI) is the total amount of shortwave radiation received from above by a surface horizontal to the ground. The Solar Irradiation is preferable to photovoltaic installations and includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DIF). High GHI represents higher solar potential in the country | Solar Technology/ Irradiation |
| 3 | Average Direct normal irradiation | Direct Normal Irradiation (DNI) is the amount of solar radiation received per unit area by a surface that is always held perpendicular (or normal) to the rays that come in a straight line from the direction of the sun at its current position in the sky. The Solar Irradiation is preferable to concentrating solar thermal installations and installations that track the position of the sun. | Solar Technology/ Irradiation |
| 4 | Average Diffuse horizontal irradiation | Diffuse Horizontal Irradiance is the amount of radiation received per unit area by a surface (not subject to any shade or shadow) that does not arrive on a direct path from the sun but has been scattered by molecules and particles in the atmosphere and comes equally from all directions. | Solar Technology/ Irradiation |
| 5 | Average Ambient Temperature | Ambient temperature is the air temperature around the solar panel or environment where solar pv plant is operated. Standard ambient temperature is 25 °C. Low Ambient temperature is preferred as it directly affects the output of SPV plant | Solar Technology/ Irradiation |
| 6 | Average tilted irradiation | Global Tilted Irradiation/Irradiance (GTI), or total radiation received on a surface with defined tilt and azimuth, fixed or sun-tracking. This is the sum of the scattered radiation, direct and reflected. It is a reference for photovoltaic (PV) applications, and can be occasionally affected by shadow. | Solar Technology/ Irradiation |

Driver 3: Technological Feasibility

| S.No | Indicators | Description | Parameter |
|------|--|---|----------------------------------|
| 7 | Daylight hours | The intensity distribution of light over the visible spectrum generated by the Sun under various conditions or by other light sources intended to simulate natural daylight. The indicator refers to the total duration, the country typically receives the sunlight during the day | Solar Technology/ Irradiation |
| 8 | Presence of emerging technologies/ innovative models | Presence of emerging technologies signifies the maturity and penetration of technologies in the power sector 1. Hybrid technologies - combination of two or more technologies to achieve efficient systems (Eg: wind + solar PV hybrid systems, solar + storage systems) 2. New generation technologies - the next generation technologies (like Artificial Intelligence, Machine learning, Internet of Things, etc.) 3. E-mobility 4. Green Hydrogen | Hybrid Technology |
| 9 | Existence of Storage Projects | Presence of storage projects signifies the development of the solar projects in the country. The solar-plus-storage system is a battery system that is charged by a connected solar system, such as a photovoltaic (PV). The indicator refers to the availability of storage projects in the country. | Storage Projects |
| 10 | Average Cost of Electricity Storage | The cost associated with storing the electricity produced by solar pv or concentrated solar. | Storage Projects |
| 11 | Renewable-cum-storage based tenders | The indicator refers to the tenders for Round-the-Clock Supply of Renewable Energy (Storage-based) introduced in the country | Storage Projects |

Driver 4: Market Maturity

| S.No | Indicators | Description | Parameter |
|------|---|---|---|
| 1 | Institutional Structure in the Power sector | Institutional structure in the power sector signifies the regulatory framework in the country 1.Unbundling GTD 2.Load Dispatch centres 3.Nodal Agency for RE 4.Regulatory bodies 5.Technical Standards 6.Pre-determined standards for procurement 7.Grid Codes | Institutional Structure in the Power sector |
| 2 | Share of population with access to electricity | The indicator refers to the percentage share of the total population with access to electricity in the country | Access to Electricity |
| 3 | Electricity Generation | The Electricity Generation in the country for the year 2021 in Million units | Operational Solar Projects |
| 4 | Share of solar in generation mix | The percentage share of the solar in the overall generation mix signifying the penetration and adoption of solar | Operational Solar Projects |
| 5 | Share of solar in the energy mix | The percentage share of the solar in the overall energy mix for 2021 signifying the penetration and adoption of solar | Operational Solar Projects |
| 6 | Target year pertaining to increase the share of solar | Target year pertaining to increase in the share of solar | Operational Solar Projects |
| 7 | Average Duration of PPAs(Solar pv) | The average duration/ term of Power Purchase Agreements for Solar PV Projects. Longer duration signifies lower risk for solar producers | Operational Solar Projects |
| 8 | Project Capital Cost | The average Capital Cost per MW to bring a Solar PV project to a commercially operable status | Operational Solar Projects |
| 9 | Status of solar technologies | The current status of Floating Solar PV, Solar Mini Grid, Solar Park, Standalone Solar System, Rooftop Solar projects in the country based on the level of activity and options mentioned below. A. No Projects executed/ envisaged B. Project(s) under Feasibility assessment stage C. Project(s) under construction D. Project(s) Operational | Operational Solar Projects |

Driver 4: Market Maturity

| S.No | Indicators | Description | Parameter |
|------|---|---|--------------|
| 10 | Competitive bidding | Tariff based competitive bidding is a bidding mechanism for long term power procurement in power sector. The price discovery mechanism in which various developers(generator) bids and one with the lowest bid gets the contract. The indicator refers to the presence of competitive bidding for power procurement in the country | Power Market |
| 11 | Power Market | Power Market signifies the trading of electricity products and enhances the speed and efficiency of trade execution | Power Market |
| | <ul style="list-style-type: none"> Competitive bidding for large scale RE projects (> 10 MW) | Presence of competitive bidding for large scale Renewable energy projects in the country | Power Market |
| | <ul style="list-style-type: none"> Access to Power Exchange | The indicator refers to the presence of trading platform for the physical delivery of electricity, renewables, and certificates. It signifies the presence of additional avenue for solar generators to sell electricity in the power trading platform | Power Market |
| | <ul style="list-style-type: none"> Access to spot power market | Accessibility to the spot market where the electrical energy is traded for immediate physical delivery to match the supply of electricity from power stations with real time consumption by households and businesses. | Power Market |
| | <ul style="list-style-type: none"> Green Energy Trading plan/Strategy | Strategy to implement separate trading segment focused only on Renewable energy sources in the country | Power Market |
| | <ul style="list-style-type: none"> Solar energy vision/roadmap | Presence of solar energy vision or roadmap in the country | Power Market |
| 12 | Threshold for licensing Solar power (< 1MW or higher) | Threshold for licensing of Solar power in the country (< 1MW or higher) in MW | Power Market |
| 13 | Open Access segment <ul style="list-style-type: none"> Availability of Third-party procurement regulations Group Captive/ collective self-consumption | Non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission. The indicator refers to the availability of Open Access regulations and Group Captive/ collective self-consumption in the country. | Open Access |

Driver 4: Market Maturity

| S.No | Indicators | Description | Parameter |
|------|--|--|---------------------|
| 14 | Live Products in the Market <ul style="list-style-type: none">Solar LanternsSolar Home systemsSolar PumpsPico-scale Solar PV appliancesSolar Cookers | The indicator refers to the number of the solar products available in the country’s market. Number of products signifies the adoption of mentioned solar sub-segments in the market. | Sub-segments Market |
| 15 | Accessibility to payment mechanisms <ul style="list-style-type: none">Mobile application based online transactionsDigital E-walletsCash-on-delivery | Accessibility to the following payment mechanisms for purchase of Solar Products. It signifies digital penetration that facilitates procurement of solar products. | Sub-segments Market |
| 16 | Availability of Business Models for Off-Grid Solar Products | Availability of Business Models available in the Off-Grid Solar Products Market. It signifies the products or services the business plans to sell, its identified target market, and any anticipated expenses. | Sub-segments Market |
| 17 | Name of the business model for Off-Grid Solar Products | Business model for Off-Grid Solar Products | Sub-segments Market |
| 18 | Access to Clean Fuels | The indicator refers to the percentage of the population with access to clean fuels | Sub-segments Market |

Driver 5: Infrastructure

| S.No | Indicators | Description | Parameter |
|------|---|---|-------------------------|
| 1 | Installed Generation Capacity per GDP (constant prices) | The indicator refers to the Installed Generation Capacity based on the GDP constant prices in the country. It is calculated by dividing the Installed Generation Capacity by GDP (current prices). Higher value signifies the development of better Power Infrastructure in the country | Power Infrastructure |
| 2 | Installed solar Generation Capacity | The indicator refers to the Installed solar Generation Capacity in the country measured in MU | Power Infrastructure |
| 3 | Expected solar generation projects capacity | The capacity of solar projects that are in the pipeline (MW) to facilitate deployment of solar generation in the country | Power Infrastructure |
| 4 | Transmission Capacity (MVA) | The overall Capacity (in MVA) of the Transmission Infrastructure in the country | T&D Grid Infrastructure |
| 5 | Voltage of transmission lines | The indicator signifies the present network voltage of transmission lines in the country – At 11kV, 22kV, 33kV, 66kV and 132 kV or above | T&D Grid Infrastructure |
| 6 | Expected investments over next 5 years (in T&D) | Expected investment in T&D Infrastructure over next 5 years in the country | Prospective Investments |
| 7 | Investment mobilised or deployed in for solar | The investment mobilised or deployed in 2021 for solar in Million USD | Prospective Investments |
| 8 | T&D losses | Electric power transmission and distribution losses refer to the losses that occur in transmission between the sources of supply and points of distribution. Having lower T&D losses will increase the overall efficiencies of utilities | Utility Efficiency |
| 9 | Getting electricity Score | The score for getting electricity is the simple average of the scores for each of the component indicators: the procedures, time, cost for a business to obtain a permanent electricity connection and supply for a standardized warehouse, as well as the reliability of supply and transparency of tariffs index. | Getting electricity |
| 10 | Getting electricity: Regulatory monitoring (0-1) | The regulatory monitoring index analyses whether a regulator—that is, an entity separate from the utility—monitors the utility’s performance on reliability of supply. A score of 1 is assigned if the regulator performs periodic or real-time reviews. | Getting electricity |

Driver 5: Infrastructure

| S.No | Indicators | Description | Parameter |
|------|--|--|---------------------|
| 11 | Getting electricity: Financial deterrents aimed at limiting outages (0-1) | The financial deterrents index analyses whether financial deterrents exist to limit outages. A score of 1 is assigned if the utility compensates customers when outages exceed a certain cap, if the utility is fined by the regulator when outages exceed a certain cap or if both these conditions are met. | Getting electricity |
| 12 | Getting electricity: Mechanisms for monitoring outages (0-1) | The mechanisms for monitoring outages index analyses what tools are used by the distribution utility to monitor power outages. A score of 1 is assigned if the utility uses automated tools, such as an Outage/Incident Management System (OMS/IMS) or Supervisory Control and Data Acquisition (SCADA) system. | Getting electricity |
| 13 | Mechanisms for restoring service (0-1) | The mechanisms for restoring service index analyses what tools are used by the distribution utility to restore power supply. A score of 1 is assigned if the utility uses automated tools, such as an OMS/IMS or SCADA system. | Getting electricity |
| 14 | Getting electricity: Cost to get electricity (% of income per capita) - Score | The score for cost benchmarks economies with respect to the regulatory best practice on the indicator. The score ranges from 0 to 100, where 0 represents the worst regulatory performance and 100 the best regulatory performance | Getting electricity |
| 15 | Getting electricity: Communication of tariffs and tariff changes (0-1) | The communication of tariffs and tariff changes index analyses whether electricity tariffs are transparent. A score of 1 is assigned if effective tariffs are available online and customers are notified of a change in tariff a full billing cycle (that is, one month) ahead of time. | Getting electricity |
| 16 | Getting electricity: Total duration and frequency of outages per customer a year (0-3) | The total duration and frequency of outages per customer a year index analyses the quality of the power supply. If SAIDI and SAIFI are 12 (equivalent to an outage of one hour each month) or below, a score of 1 is assigned. If SAIDI and SAIFI are 4 (equivalent to an outage of one hour each quarter) or below, 1 additional point is assigned. If SAIDI and SAIFI are 1 (equivalent to an outage of one hour per year) or below, 1 more point is assigned. | Getting electricity |

Driver 5: Infrastructure

| S.No | Indicators | Description | Parameter |
|------|--|---|---------------------|
| 17 | Level 1 practical potential, excluding land with identifiable physical obstacles to utility-scale pv | The indicator refers to the Solar Potential in percentage excluding physical obstacles in the country. It signifies the land resource availability for solar deployment | Solar Potential |
| 18 | Mean Schooling Years | Average number of completed years of education of a country's population aged 25 years and older, excluding years spent repeating individual grades. It signifies the quality of human resource in the country. | Capacity Building |
| 19 | Population ages 15-64 (% of total population) | Total population between the ages 15 to 64 as a percentage of the total population. | Capacity Building |
| 20 | Human development Index | The Human Development Index (HDI) is a summary measure of human development. It measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living. The HDI is the geometric mean of normalized indices measuring achievements in each of the three dimensions and embodies imperfect substitutability across all HDI dimensions. | Capacity Building |
| 21 | Government Training/ certification | Government Trainings/ certifications/ academic programs for human resource focusing on Solar industry in the country | Capacity Building |
| 22 | Number of trainings | Number of trainings for human resource in country focusing on Solar industry | Capacity Building |
| 23 | Testing facility/ R&D availability | Testing/ research & development facilities for solar systems/ solutions in the country | Capacity Building |
| 24 | Manufacturing facility | The facilities in the country to manufacture original equipment including inverters and balance of systems ecosystem | Domestic capability |
| 25 | Auxiliary capacity | The domestic capacity for Installation, Operation & Maintenance by EPC Companies/system Integrators | Domestic capability |

Driver 6: Financing

| S.No | Indicators | Description | Parameter |
|------|---|--|-----------------------|
| 1 | No. of commercial banks per 100,000 adult population | The total number of commercial bank access in the country reported annually by the central bank or the main financial regulator of the country | Accessibility |
| 2 | Domestic credit to private sector (% of GDP) | Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. | Accessibility |
| 3 | Domestic credit to private sector by banks (% of GDP) | Domestic credit to private sector by banks refers to financial resources provided to the private sector by other depository corporations (deposit taking corporations except central banks), such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises | Accessibility |
| 4 | Bank Deposits to GDP (%) | The total value of demand, time and saving deposits at domestic deposit money banks as a share of GDP | Quality of the System |
| 5 | Private Credit by Deposit Money Banks to GDP (%) | The amount of outstanding credit extended by banks to the non-financial private sector by deposit money banks measured relative to a country's GDP is a measure of the size of the financial sector. | Quality of the System |
| 6 | Bank Z-Score | Z-Score captures the probability of default of a country's banking system. Z-score compares the buffer of a country's banking system (capitalization and returns) with the volatility of those returns. | Quality of the System |
| 7 | Resolving insolvency - Score | The score for resolving insolvency is the simple average of the scores for each of the component indicators: the recovery rate of insolvency proceedings involving domestic entities, as well as the strength of the legal framework applicable to judicial liquidation and reorganization proceedings. | Quality of the System |

Driver 7: Energy Imperatives

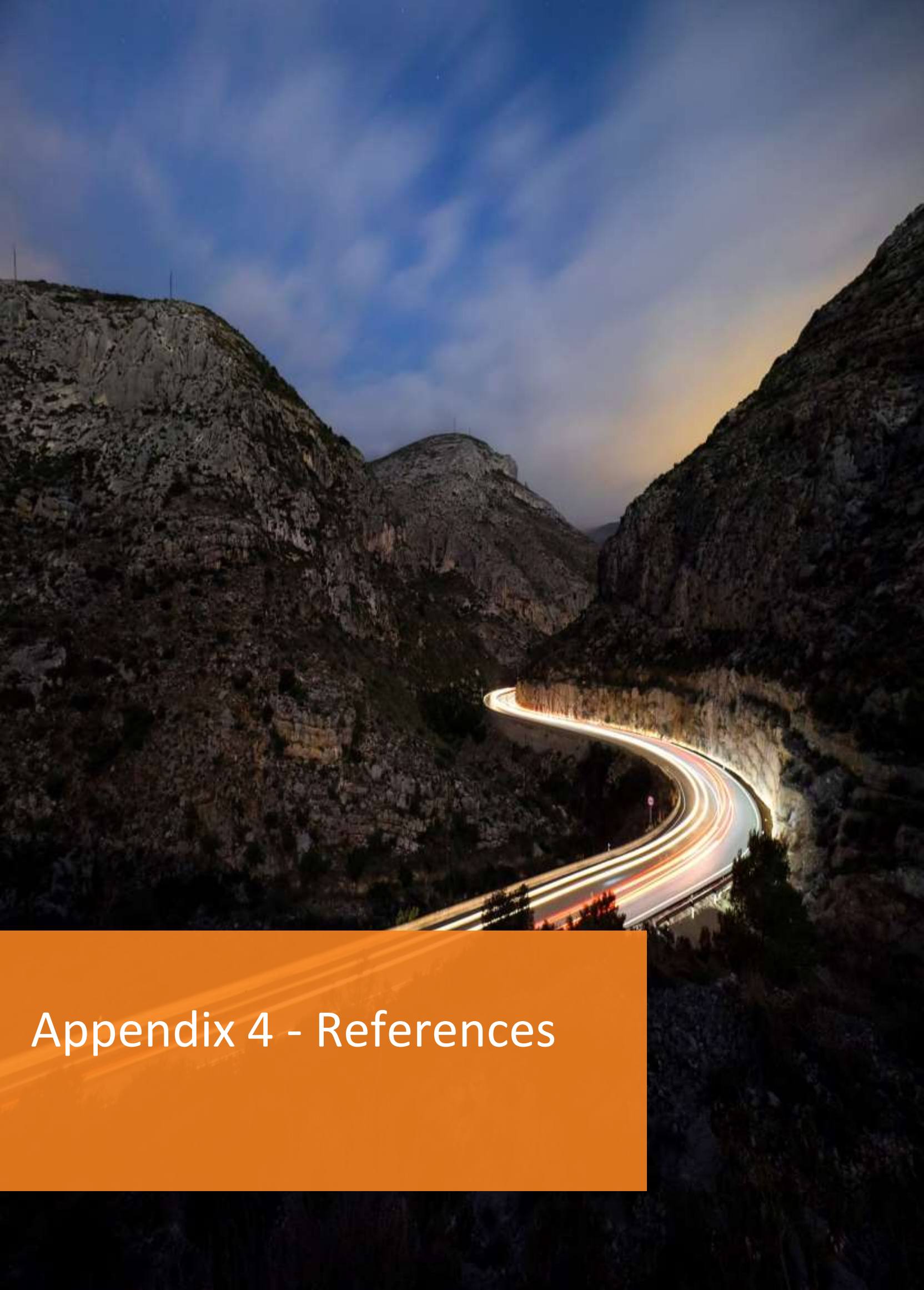
| S.No | Indicators | Description | Parameter |
|------|---|---|---------------------|
| 1 | Consumption per Capita | The per capita consumption indicates the average consumption by a person belong to a particular nation calculated from the known total consumption of that nation and the total population. | Electricity Outlook |
| 2 | Growth in Electricity Consumption (last 4 years) – 2015 to 2019 | The growth rate in electricity consumption of the country for the last four years | Electricity Outlook |
| 3 | Overall Electricity Consumption - 2020 | The electricity consumption in the country for 2020 measured in Million Units | Electricity Outlook |
| 4 | Overall Electricity Consumption - 2021 | The electricity consumption in the country for 2021 measured in Million Units | Electricity Outlook |
| 5 | Growth in Electricity Consumption (2022-2026) | The expected growth rate (CAGR) for electricity consumption from 2022 to 2026 in the country | Electricity Outlook |
| 6 | Cumulative Solar PV Capacity (2021) | The cumulative solar installed capacity (in MW) in the respective country | Electricity Outlook |
| 7 | Growth in Solar PV Capacity last 4 years – 2017 to 2021 | The growth rate in Solar PV Capacity of the country for the last four years measured in percentage | Electricity Outlook |
| 8 | Cumulative Solar off-Grid Capacity - 2021 | The cumulative off-grid solar installed capacity (in MW) in the respective country | Electricity Outlook |
| 9 | Cumulative Rooftop Solar capacity | The cumulative rooftop solar installed capacity (in MW) in the respective country | Electricity Outlook |
| 10 | Cumulative solar mini grids capacity | The cumulative solar mini grids capacity (in MW) in the respective country | Electricity Outlook |
| 11 | Peak demand/load | Peak demand on an electrical grid is the highest electrical power demand that has occurred over a specified time period. | Electricity Outlook |
| 12 | Peak demand/load occurrence time in a day | Peak demand is the time when consumer demand for electricity is at its highest in a day. Occurrence of peak demand during the day means the solar power is more purposeful. | Electricity Outlook |

Driver 7: Energy Imperatives

| S.No | Indicators | Description | Parameter |
|------|---|---|---------------------|
| 13 | Electricity-GDP elasticity | Electricity-GDP elasticity is the percentage change in electricity consumption to achieve one per cent change in national GDP. High Electricity-GDP elasticity indicates that an economy is more effective and productive in extracting value-i.e. by generating goods and services-from the electricity it consumes. | Electricity Outlook |
| 14 | Average solar tariff (last 3 years) - (2019-2021) | The average Solar tariff in the market (in USD per kWh) for last three years in the country | Solar Tariff |
| 15 | Solar Tariff (Feed-in Tariffs mechanism) | Feed in tariff refers to a policy mechanism developed for the support of renewable energy technologies, through the award of a certain payment per kWh for electricity produced by a renewable resource and fed into the grid. The policy designed to support the development of renewable energy sources by providing a guaranteed, above-market price for producers. High feed-in-tariffs support RE development in the country | Solar Tariff |
| 16 | Price of electricity | Electricity pricing can vary widely by country or by locality within a country. Electricity tariff are dependent on many factors, such as the price of power generation, government taxes or subsidies, local weather patterns, transmission and distribution infrastructure, and multi-tiered industry regulation. | Electricity Tariff |
| 17 | Diesel shares in overall electricity generation/supply | Diesel replacement is one of the key drivers for countries to move towards renewable energy. This indicator signifies the total percentage share of Diesel based electricity in the generation mix. | Alternate Sources |
| 18 | Subsidy for fuels <ul style="list-style-type: none"> ▪ Subsidy for kerosene ▪ Subsidy for diesel ▪ Subsidy for petrol ▪ Subsidy for LPG ▪ Subsidy for softcoke | Availability of subsidy provisions for fuels in the country. Subsidies for kerosene and other fuels will create higher resistance for households to shift to solar-based home solutions. | Alternate Sources |
| 19 | Cheapest source of Power and associated cost | The cheapest source of power generation in the country | Alternate Sources |
| 20 | Consumer Mix | Share of Commercial & Industrial/ Residential/Domestic/ Agricultural electricity consumption in Million Units | Consumer Mix |

Driver 7: Energy Imperatives

| S.No | Indicators | Description | Parameter |
|------|--|---|--------------|
| 21 | % share of solar lighting and home systems | The percentage share of solar lighting & home systems in the country pertaining to 2021 | Sub-segments |
| 22 | % share of solar pumps | The percentage share of solar pumps in the country pertaining to 2021 | Sub-segments |



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