GENERACIÓN Sole



The business opportunity of

Distributed Solar Generation in Colombia

Financial mechanisms for the commercial banking sector

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National Context and Growth Factors for Distributed Solar Generation

National potential of investment in distributed solar generation

Conclusions and recommendations

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About Generación Sole

“GENERACIÓN SOLE” is a platform created by the United Nations Environment Program to promote distributed solar generation and distributed energy resources in Latin America and the Caribbean**.**

This platform provides the dialogue for the regulation of self-generation of renewable energy, promote the adoption of distributed energy resources and constitute a community of practice for interested parties in the region.

Generación Sole is a necessary action in the fight against climate change.



www.generacionsole.org

About this Report

This document forms part of the regional Generación Sole initative implemented by the Office for Latin America and the Caribbean for the (UNEP), in collaboration with the the Ministry of Mines and Energy of Colombia (MME), the Association of Banking and Financial Entities of Colombia (ASOBANCARIA), the Renewable Energy Association (SER Colombia), the Colombian Association of Solar Energy (ACOSOL), and relies on the support of the Spanish Agency for International Development Cooperation (AECID).

This initiative is envisioned to become to a catalyst for private finance for climate initiatives corresponding to National Determined Contributions (NDC) of Colombia and other countries in Latin America and the Caribbean, contributing to ongoing regional work on the objectives established by the Paris Agreement and the United Nations Sustainable Development Goals (SDG).

The results of this project are expected to become a useful tool and support for the design and execution of more financial programs for distributed solar energy, collaborating with the implementation of the Green Protocol of the Association of Banks and Financial Entities of Colombia (ASOBANCARIA) and other initiatives in the Mission of Energy Transformation. Accompanied by the public initiative for energy innovation, the investment and private finance will lead a paradigm shift in the energy system of Colombia, in line with the transformation of the society in a more resilient, sustainable and equitable.

Complete version of the study available at:
https://www.generacionsole.org/financiamiento-gsd-colombia/



Objectives

- Evaluate the market investment potential of distributed solar photovoltaic generation for the private sector, with special focus on the banking sector (commercial banks), for the residential, commercial and industrial segments.
- Identify main barriers, risks, challenges and opportunities to catalyze private investment in the market for distributed solar generation systems.
- Analyze existing mechanisms of finance (national and international) and make recommendations for the design of financial products for DSG systems.

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National Context and Growth Factors for Distributed Solar Generation

Distributed Solar Generation (DSG) systems provide significant economic, social and environmental benefits to the general population and the national electricity system.

DSG systems are solar photovoltaic systems connected to the distribution grid that generate electricity for self-consumption in homes, businesses, industries, and public buildings.

Figure 1. Main characteristics, economic, social and environmental benefits of DSG

Main characteristics

- **Local generation,** near the point of consumption;
- **Automatic exchange with the electricity grid** (surplus generation injected to the grid for a compensation);
- **Simple and secure installation,** through a qualified professional;
- **Multiple installation possibilities** on roofs, decks or on the ground;
- Investment with a **lifespan of more than 25 years;**
- **Simple, secure and inexpensive maintenance;**
- **Scalable system,** from small residential systems to large industrial installations.

Socioeconomic benefits

- **Economic savings** for the electricity user, enabling an essential role to the consumer in the electricity sector;
- **Encourage private investment, boosting economic growth and job generation** (direct and indirect);
- **Support the creation of a national solar industry** throughout the value chain;
- **Improved electricity system,** diminishing losses in transport and distribution;
- **Reduce electricity subsidies,** redistributing public resources in other areas like education, health, housing and natural spaces;
- **Deferral of public investments** to improve and expand the transmission grid;
- **Diversification of the energy matrix,** and reduced dependence on imported fossil fuels

Environmental benefits

- **Avoided GHG emissions** by replacing electricity generation from fossil fuels.
- **Savings in water use** on large hydroelectric plants.
- **Avoided air pollution** near to large fossil fuel power plants.
- **Improve the adaptation of the electricity system** reducing the impacts of natural disasters on the electricity infrastructure.

Energy, environmental and financial education

The installation of DSG systems converts to the consumer into a new actor in the electricity system, fostering conscious use of economic resources and a more rational use of energy.

DSG as a strategic sector to attract investment, economic growth and job creation.

The decarbonization of the energy sector, the cornerstone for the fulfilment of the objectives of Paris Agreement.

A 51% reduction of GHG emission by 2030, an ambitious objective already underway.

According to the update of the Nationally Determined Contribution, carried out in 2020, various goals of mitigation and adaptation to climate change have been adopted, including a 28% reduction of GHGs with respect to the baseline by 2030.

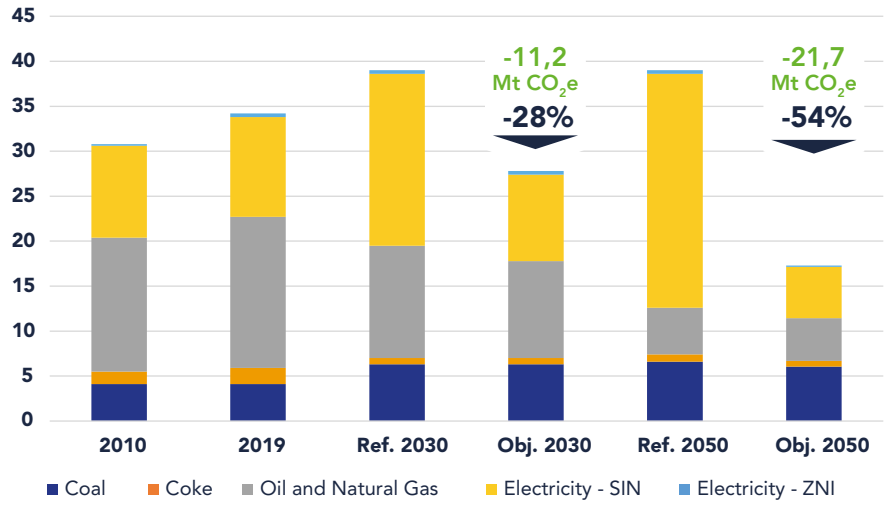
Additionally, the Colombian government has published its Comprehensive Climate Change Management Plan for the Mining and Energy Sector which aims to make the national energy sector carbon neutral by the year 2030.

Distributed Energy Resources as a pillar of transformation in the Colombian energy system.

The Mission of Energy Transformation, an initiative of the Ministry of Mines and Energy already **under implementation, aims to foster the incorporation of DER** in the grids through the design of flexible markets and tariffs, promoting the participation of the user in the electricity market.

In the framework of the MTE, a regulatory roadmap has been presented with concrete proposals to modernize the energy system and promote private investment for the installation of DSG systems in the residential, commercial and industrial sectors across the country

Graph 1. Objectives to reduce CO_2 emissions in the mining-energy sector set out in the updated NDC from Colombia for 2030 and 2050



Source: Own elaboration based on data from the Ministry of Mines and Energy (2020, 2021)

The current regulatory framework for DSG assures long-term certainty for investments.

The regulation established for small scale self-generation (AGPE) and distributed generation offers conditions which anticipate a massive market take-off.

Figure 2. Main aspects of the regulatory framework that supports DSG

Economic compensation schemes

- The photovoltaic system reduces consumption from the grid through self-generation, without limit and at the same retail rates;
- Through bidirectional measurement, surplus energy is injected and used to compensate consumption at a different time (with charges);
- If more energy is generated than consumed on any billing period, the energy retailer purchases it and compensates the user (at market price).

Compensations and incentives for distributed generation

- Simplified connection processes for small installations;
- No distribution and transmission charges for AGPE generators;
- Tax benefits of Laws 1715 of 2014 (exemption of import taxes and VAT for equipment, accelerated depreciation);
- Fiscal compensations allows partial deduction of investment from income tax.

Quality and safety standards

- Govern the regulation of electrical installations (RETIE);
- Technical requirements defined for bidirectional metering and quality of service;
- Solar installers adhere to international standards of the solar industry (IEC).

Source: UNEP, based on information of the Law no. 1715 of 2014, the decrees MME no.2469 (2014), 1073 (2015) and 348 (2015), the Resolution CREG 030-2018, its annexes and amendments.

Law N° 2099 of 2021

Through this law, tax benefits for renewable energy and energy efficiency are extended for 30 years.

Strengthening development funds for the sector

In 2021, the Unconventional Energy and Energy Efficiency Fund (FENOGE) was re-launched and provided with new operating instructions which widen its reach to create new financing and collateral mechanisms.

Additionally, FONENERGIA was created to unify existing electric sector development initiatives and make them more efficient.

The characteristics of the Colombian electricity market are very favorable for disruptive growth of DSG.

98% of users correspond to small residential and commercial consumption, representing more than 62% of the energy sold annually. **Large opportunity for small-scale self-consumption.**

A favorable solar resource for the development of solar energy across the country.

The average PV potential is greater than the global average and additionally a large potential is concentrated in the north and west of the country where the most populated departments are located.

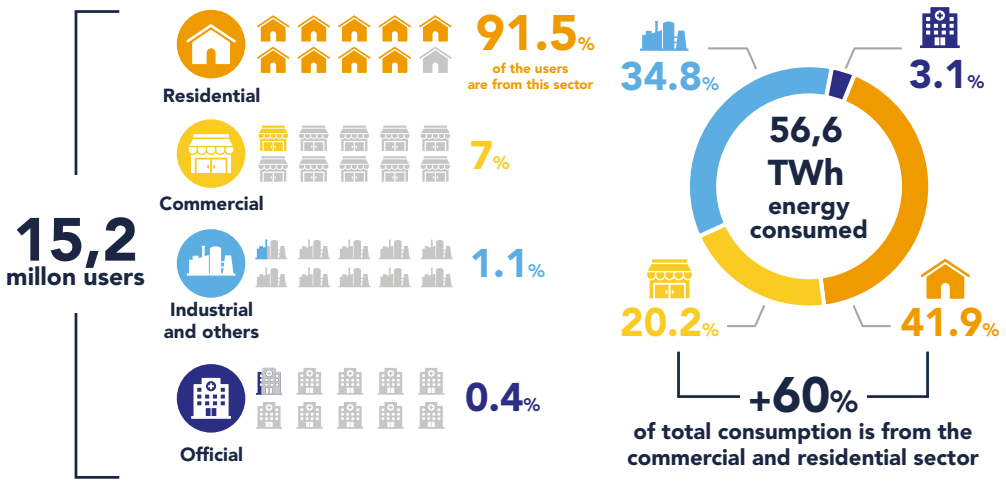
The cost of DSG systems has fallen up to 85% globally in the last 10 years. The Colombian market follows the same trend.

A continued reduction of the costs of DSG systems is projected, reaching an additional 15% to 35% reduction by 2024, which will attract even more investment.

The DSG systems have reached, in some cases, grid parity.

The cost of energy generated by DSG systems is currently lower than electricity tariffs for certain types of users.

Graph 2. Matrix of electricity consumption by regulated users in Colombia, 2019



Source: Own production from data of the SUI (MME and SSPD)

Concentration in electricity consumption and geographic distribution of consumers.

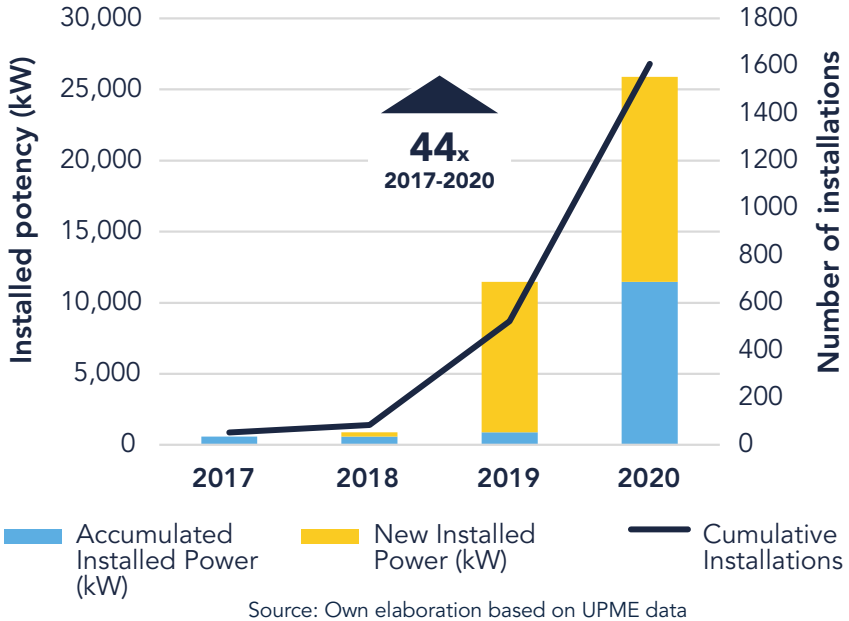
The departments of Antioquía, Bogotá (DC) and Valle del Cauca account for 43% of the national electricity consumption. The Caribbean region accounts for 25% of consumption and the Andean and Orinoco regions account for almost 30%.

Building characteristics, mostly single story, make many houses and businesses suitable for the installation of DSG systems on rooftops.

DSG shows firm growth thanks to the current regulatory framework, a decrease in the cost of the technology, and national development of the solar industry.

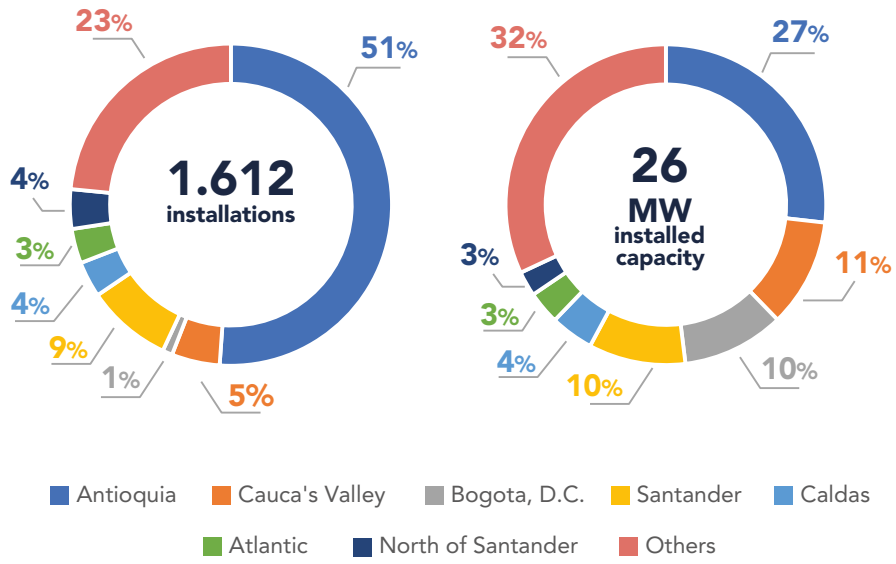
In February 2021, more than 3.500 connection requests and 1.612 DSG system installations with a capacity of 26 MW existed.

Graph 3. Number of installation and potential of DSG systems in Colombia (only AGPE and DG from solar source)



Source: Own elaboration based on UPME data

Graph 4. Distribution of DSG installations by department



Source: Own elaboration based on UPME data

Despite the COVID-19 pandemic, the number of new installations tripled in 2020 in comparison to 2019.

Large predominance of solar photovoltaic technology for AGPE and GD

Almost all (99,2%) of the connection requests for small-scale self-generation and distributed generation systems correspond to solar photovoltaic technology. 84% of the requests correspond to AGPE with surplus sales; 6% AGPE without surplus, and only 10% to the GD scheme.



National potential of investment in distributed solar generation

To estimate the market potential of DSG in Colombia, the sector has been analyzed in detail using a proven methodology.

Generación SOLE has carried out an exhaustive analysis of the electricity market, the regulatory framework, the current costs and tariffs to project attractive profitable investments.

Methodology adapted to analyze the current potential of distributed generation for self-consumption

Based on proven methodology (used by NREL* and other national and international organizations), adapted to optimize the analysis of information available in the country.

The analysis carried out is at the user level (bottom-up) and considers the current conditions of the market as well as housing which allows for information disaggregated by segment, tariff or department to be obtained.

Technical Potential

The total installation potential is considered as a function of the natural conditions of the country (temperature and irradiation), the number of electricity consumers by type and department, as well as their monthly and annual electricity consumption. Lastly, the building suitability for the installation of a GSD system.

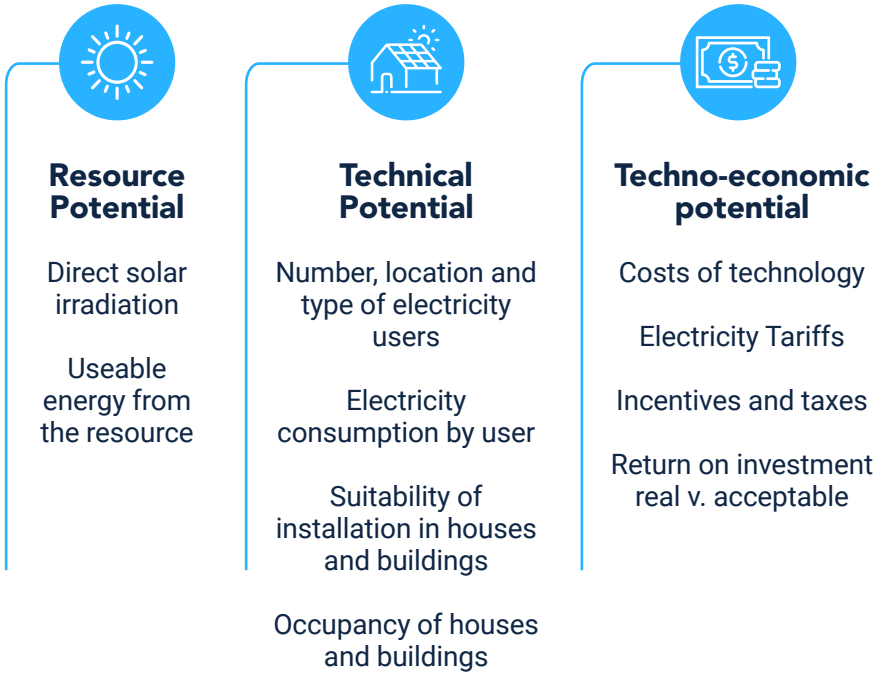
Techno-economic Potential

The market investment potential of DSG is shown (in Colombian pesos and USD by type of user and region). It is calculated based on Technical Potential, considering the economic feasibility of the DSG systems by type of user. It is calculated using the electricity tariffs by type of user, DSG incentives and the associated costs for the installation and maintenance of a DSG system (CAPEX and OPEX).

Payback Period

A simple payback period of up to 7 years has been established to consider economic viability of the projects, in line with international standards and the financial conditions of the national market.

Figure 3. Types of potential renewable systems installation



Own elaboration adapted from NREL, 2016.

*Brown et al., Estimating Renewable Energy Economic Potential in the United States: Methodology and Initial Results, NREL, revised version, August 2016

The market investment potential of DSG in Colombia is over 34 billion Pesos or 9.600 million dollars.

More than 471.000 DSG systems for a total 7.424 MWp are technically and economically viable in the current market conditions.

The opportunity to decarbonize the electricity sector, with many economic benefits

This number of systems will generate, on average, 10 TWh of distributed electrical energy annually, corresponding to 17,9% of energy sold by distributors in 2019.

Distributed investments potential in all segments

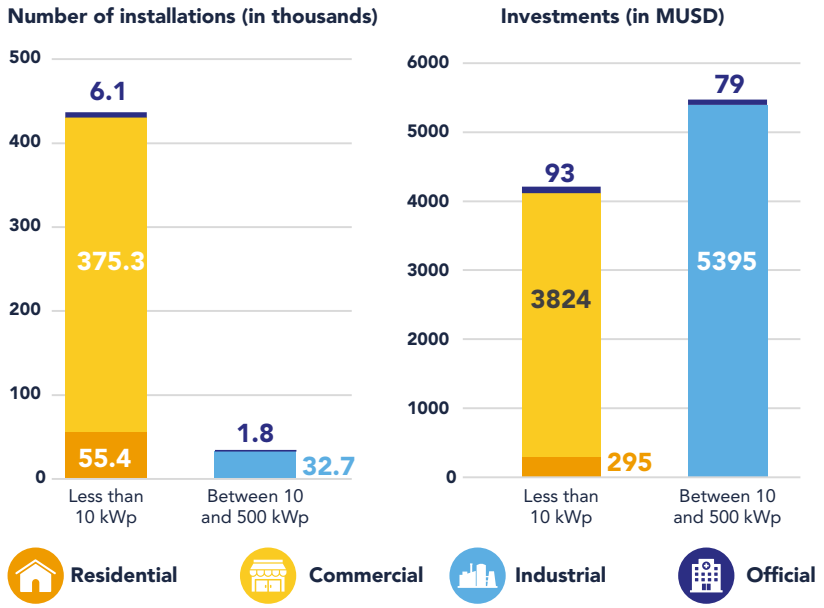
More than 90% of the technically and economically viable installations are small-scale (less than 10kWp), which illustrates a huge business opportunity for homes and small businesses. However, **large industrial installations capture 50% of investments** owing to the greater size of installations

Table 1. Techno-economic Potential of installation of DSG systems in Colombia

Segment	Number of installations	Investment range for DSG system	Total investments
Residential	55.421	**11 a 19 MCOP** (3k – 5,3k USD)	**1,1 billion COP** (294,5 MUSD)
Commercial	375.263	**29 a 55 MCOP** (8,3k – 15,4k USD)	**13,6 billion COP** (3.823,8 MUSD)
Industrial	32.651	**240 a 1.780 MCOP** (67.5k a 500k USD)	**19,2 billion COP** (5.395,1 MUSD)
Official	7.879	**55 a 155 MCOP** (15,4k a 43,4k USD)	**0,7 billion COP** (172,1 MUSD)
Total	**471.214**		**34,4 billion COP** (9.685,6 MUSD)

Source: Own production

Graph 5. Technically and economically viable DSG systems by size and segment



Source: Own production

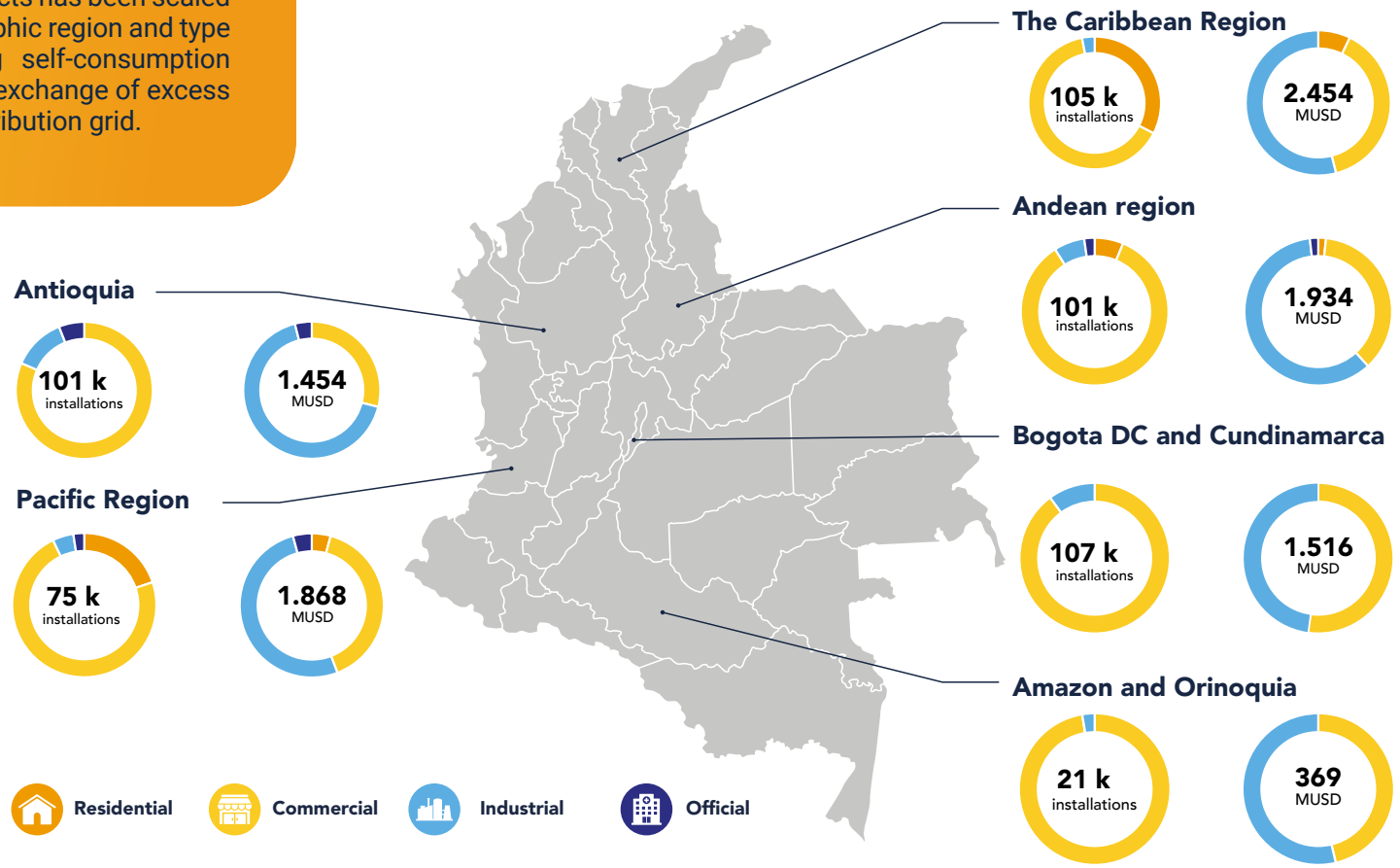
All regions and departments of the country present an important investment potential.

The installation of GSD systems is attractive to different types of users in all studied segments.

Prioritizing self-consumption

The size of the projects has been scaled by segment, geographic region and type of user, prioritizing self-consumption and minimizing the exchange of excess energy with the distribution grid.

Figure 4. Geographic distribution of technically and economically viable DSG installations (number of installations and investment potential in millions of USD)



Source: Own production

The investment potential could grow up to 12.700 MUSD in the near term, continuing current trends in the solar photovoltaic industry.

469.000 additional installations, totaling 1.900 MW (mostly residential), have a payback period of 8 and 9 years, for which the potential investment could increase by 3.006 MUSD (over 31%) compared to the current potential.

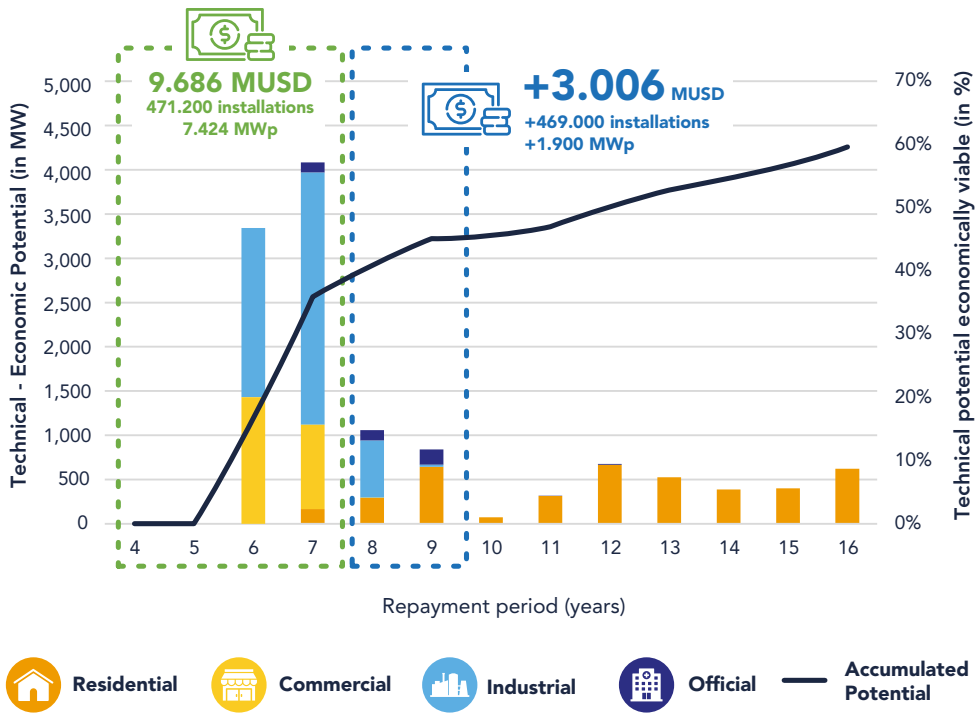
Opportunity for more installations to become economically and financially viable

The continuity of current trends and cost reduction of the technology, could reduce the payback periods in the installations of DSG. The technically viable installations, mainly in the residential and commercial sectors, that have returns between 8 and 9 years, could have economic viability with additional incentives.

The financing availability and feasibility to obtain fiscal benefits directly impacts in the payback period and is key to increase investments

A large number of users with potential to install DSG systems compare future credit payments with the monthly electricity bill savings before deciding to purchase a system. **An improvement in current financial conditions (interest rates or rebates) should have a significant impact on energy consumers' decision-making.**

Graph 6. Return periods of DSG systems in Colombia (in MW, by segment)



Source: Own production (30.5% of the installations show a payback of 17 years or more, corresponding mainly to residential users of strata 1 and 2)

55,400 residential installations show repayment periods of up to 7 years, and 504,000 show repayment periods of up to 9 years



Conclusions and recommendations

The financial sector, and in particular, commercial banking, can be a key actor in the deployment of DSG systems.

A large interest from banks to finance DSG systems has been detected. However, there are challenges to resolve.

The characteristics of the investment make access to financing important

The capital needed for this type of installation prevents many users from accessing their system, given the significant disbursement required at the start of the project for the purchase and installation of the system. Then, the costs of operation and maintenance are very low.

Currently, financing of this type of system is addressed through traditional products

Colombian banks have experience financing solar energy projects, mostly utility-scale, whose owners are generally energy sector companies.

DSG system installations are mainly financed with the user's own resources, or with regular consumer loans (persons), corporations (entities), mortgages (both segments), and in smaller measure through financial leasing.

The offer of specific financial products is still in the early phase. **However, commercial banks are beginning to outline strategies to take advantage of the detected business opportunity.**

Main detected challenges



Creditworthiness of electricity user-generator (difficult to access collateral, insufficient guarantees or credit history).



Quality of the installations.



Lack of **track-record** of DSG integrators and installers.



Bank's limited capacity to perform project technical risk analysis, and high cost (associated with the number and total amount of the projects).



Lack of experience and knowledge from banks and potential.

A commitment towards sustainable finance

The Green Protocol, signed in 2012 and renewed in 2017, between the Colombian government and the Colombian Banking Association, is aimed at boosting the financing of programs that promote sustainable development, internal energy efficiency practices and education, in addition to introducing the impacts of environmental and social risks in their portfolios.

Simplifying and standardizing risk analysis processes will allow banks to create scalable products for quick adoption of DSG systems.

Proposals and recommendations to address detected challenges and capture the opportunities in distributed solar generation that the Colombian market offers (I).

1. Optimize the evaluation process of project technical risk to facilitate credit issuance, while diminishing perceived risk for the bank.

- The **availability of aggregated and reliable information**, with respect to the track-record of installers and performance of the systems at the national and regional level, will increase confidence from end-users and financial institutions.
- The **association with external evaluators** with experience in the industry will allow the bank to focus solely on credit risk evaluation, enabling the financing of viable projects and quality systems only. This association could be individual for each institution, or collectively through the ABP or other organizations.
- Establishment of a **guide of good practices** for DSG installations accepted nationally that serves to carry out an objective evaluation of the installations and avoid differences in interpretation by evaluators.
- Creation of a **quality certification for suppliers and installers**, issued by an independent institution respected among all actors, for banks to use as a reference when evaluating the sector.



The use of existing tools will allow the rapid creation of new financial products, diminishing the cost of implementation.

Proposals and recommendations to address detected challenges and capture the opportunities in distributed solar generation that the Colombian market offers (II).

2. Create new sale channels and optimize existing ones to increase reach to end-users, diminishing risk and transaction costs of projects.

- Use of existing technological tools to **simplify and standardize risk evaluation processes** (technical and financial) and ensure rapid adoption of the products.
- Alliances with other market participants to **finance projects indirectly** (installers, distributors, energy companies), additionally transferring installation associated risks (design and performance).
- The presence of a **secondary market of assets** (equipment) will allow financial institutions to improve the profile of risk and collateral requested for the credits.





3. Take advantage of synergies with existing financial products improving credit conditions while maintaining a solid collateral structure.

- **Introduce the financing of DSG systems leveraging existing credit lines,** with low perceived risk, for example: external commercial lines of the agricultural sector and the agroindustry, mortgage credits.
- These credit lines generally have better financial conditions due to knowledge of these clients and their collateral, often having limits which are greater than the capital required to purchase a DSG system.

Awareness about the benefits of DSG will diminish perceived risk for banks and generate interest of potential users.

Proposals and recommendations to address detected challenges and capture the opportunities in distributed solar generation that the Colombian market offers (III).



4. Diminishing the risk exposure of banks through implementation of proven tools, incorporating mechanisms used in other markets.

- Creation of **specific funds and innovative financing** can help users with low access to traditional banking finance. The development multilateral banks, and international organizations could collaborate with the local banking sector to adapt successful cases in other countries.
- Specific **solar industry insurance mechanisms** for the bank and installer (security of design or performance) are successfully used in other countries in the region to minimize the main project risks.
- **Use of credit repayment mechanisms used in other sectors** like loans with portfolio collection (credits for reward) or use of the utility bill.
- The **creation of investment funds** to group projects and liabilities (within a bank or between banks), could be a valuable tool to diminish the exposure of a bank. incorporating other types of actors such as private funds and minor investors can also liberate funds for new projects.

5. Collaborate with generating awareness and education of users about the economic, environmental and social benefits of the DSG system.

- The **existing capacity of commercial bank executives** in risk assessment and commercial areas (personal and commercial banking) will improve the capacity to absorb future demand of this specific type of credit.
- An increase of **visibility of projects and successful cases to the general public**, can help disseminate knowledge on the economic, environmental and social benefits of the projects.
- The **creation of pilot projects** by actors in the industry (bank, government, private sector) as proof of technical and financial viability will accelerate the development and implementation of products at a commercial scale.



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