The Government of Colombia is interested in structuring a proposal to modernize the institutional and regulatory framework that facilitates the incorporation of new agents, technologies and transactional schemes in the energy markets. The advances in information technology, telecommunications, control, supervision and the trend towards greater decentralization of energy production activities and their associated transactions require an institutional and regulatory framework favorable to innovation and technical change.

As pointed out by the International Energy Agency (IEA, 2019), electricity markets have been adjusted as a result of: (i) the use of variable resources such as low cost wind and solar energy, (ii) deployment of decentralized resources such as photovoltaic generation and electric vehicles, and (iii) digitization, which facilitates measurement, supervision and new ways to trade energy. It is important to bear in mind that the objectives of decarbonization set by economies and societies have found a clear compliance option for the goals outlined in the clean electrification use of energy.

In the IEA report, it is pointed out that the flexibility in the electrical system, in the short, medium and long term, has become a priority, in order to facilitate the reliable and efficient management of new technological developments and business opportunities; and that those responsible for formulating policies, regulatory frameworks and the structure of markets are key to achieving the benefits derived from them.

In Colombia, Laws 142 and 143 of 1994 established an operating framework for public services and the electrical industry, respectively. The liberalization of the market, the introduction of a competitive price formation in generation, the regulation by incentives in transmission and distribution, and the institutional advances have allowed a reliable supply, even in times of reduction and variation of water resources.

Notwithstanding the above, and given the technological and market advances that have occurred in the world in the last ten years, there are still efforts to be made to guarantee a supply with efficient prices, achieve higher quality and service coverage, increase resilience to climatic phenomena and improve energy management (i.e., energy efficiency and demand response). In addition, the aforementioned changes in the industry offer opportunities to increase competition, diversify the generation portfolio, increase the demand participation, automate distribution networks and take advantage of local resources embedded in distribution networks, which make it necessary to modernize the market architecture and regulation. It is also necessary to take advantage of the development opportunities represented by decentralization and digitalization to develop new value chains, jobs, and combat climate change.
While progress is being made in solving the current challenges of the electricity market which, in the words of the Ministry of Mines and Energy (Ministerio de Minas y Energía, MME by its Spanish acronym), are the high level of concentration in some segments of the electricity market, the vulnerability of the sector to hydro-climatic events and the greater intensity and frequency of these, the low participation of demand, and the need for better quality conditions in the provision of the service and a better formation of rates that benefit the final user, the Government of Colombia has convened the Mission of energy transformation and modernization of the electrical industry: road map for the energy of the future (Misión de transformación energética y modernización de la industria eléctrica: hoja de ruta para la energía del futuro).

To carry out the Mission, the Energy Division of the Inter-American Development Bank has been given the task to contract a consultancy in order to “determine the frame of reference, scope and main activities of the Mission”. This consultancy must:

1. Establish the objectives, priorities and the scope of the Mission
2. Establish the main activities and deliverables of the Mission
3. Define the operation of the Mission
4. Convene the experts that are going to be part of the Mission and coordination
5. Estimate the costs and delimitate the work schedule

This document corresponds to the second report of this consultancy. This report contains the general objectives of the Mission and the scope of each of the Focus to work.

Through the development of the Mission, the MME identified different study topics that were discussed with this consultancy to finally select the following:

(i) Competition, participation and structure of the electricity market
(ii) The role of gas in energy transformation
(iii) Decentralization, digitalization and efficient management of demand
(iv) Closing gaps, improvement of quality and design and efficient formulation of subsidies
(v) Review of the institutional and regulatory framework

Also, in this document we present a proposal of the methodology for the development of the Mission, the list of international and national experts identified with the Ministry, as well as an estimate of costs.

The Minister of Mines and Energy states that the Mission must identify public policy actions and the institutional and regulatory framework that contributes to the general purposes of this administration: greater competitiveness, reliability, and environmental and social responsibility.

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1 In this document will be used, generally, the Spanish acronyms.
With this in mind, the consultant (BID) proposes that Mission experts center their studies on the generation of concrete policy, regulatory and supervisory proposals to achieve the modernization of the industry and advance in the energy transformation required by the country according to the challenges and commitments acquired. The products and main actions proposed for each team of consultants are:

(i) Deliver a Position Paper (or several) by each Focus for discussion and analysis of the entities and agents of the sector, as well as by the other work teams of this Mission. For the third Focus it is requested a Preliminary Report moreover than a Position Paper.

(ii) Participate in meetings and workshops organized to discuss and analyze the problems identified, the vision prepared with consideration of international trends, and the gaps and action plans to overcome them.

(iii) Deliver a final document of the work done (White Paper) with the road map for the implementation of the actions identified. This document should take into consideration the recommendations of the selected Peer Reviewers.

The total length of the Mission is estimated to be six (6) months. The schedule attached to this document was prepared by the Ministry, according to their expectations and the operating guidelines of the work teams suggested by this consultancy.

The present report mainly includes the comments made by the IDB the different instances of the Technical Secretariat, and some experts who have collaborated with the review of the proposed scope. Inputs from the discussions held with the MME with the participation of the IDB and World Bank were also considered.

A. Study Focuses of the Mission

This section describes the scope of each Mission Focus. The requirements respond to the review of the problem, the identification of proposals in the National Development Plan (Plan Nacional de Desarrollo, PND by its Spanish acronym) of the current government, the actions underway in the MME, the Energy and Gas Regulation Commission (Comisión de Regulación de Energía y Gas, CREG by its Spanish acronym), the Energy and Mining Planning Unit (Unidad de Planeación Minero Energética, UPME by its Spanish acronym), the Superintendence of Public Services (Superintendencia de Servicios Públicos Domiciliarios, SSPD by its Spanish acronym), XM (the system operator and market administrator), in other entities of the sector and in multilateral banking, and to a long-term vision of this consultancy. The third Focus has a little more detail, given the few diagnostic studies that have been conducted in the country.  

2 In addition to the Reference Terms (MME-IDB, 2018), for this work have been used: a study conducted for Fedesarrollo (Benavides et al., 2018) and other for the MME with the support of the IDB (Cadena et al., 2017), the Bases del Plan Nacional de Desarrollo 2018-2022 (DNP, 2019), the National Development Plan (Plan Nacional de Desarrollo, PND by its Spanish acronym – Law 1955 of 25, 2019), CREG circulars and resolutions and documents prepared by Naturgas (2017) and PHC for Asocodis (2019). Several works provided by the DNP are mentioned. MME, CREG and DNP made remarks to this document.
It is important to note that different studies have been developed in the country, which consultants must consider in order to analyze the proposals made and identify the barriers that have not allowed the implementation of the suggested recommendations. A summary of the corresponding work carried out in the country is presented in the annex.

Likewise, and as is to be expected, the Energy and Gas Regulatory Commission (CREG) advances in the solution of different issues in the electrical and natural gas markets, and recognizes the changing environment of these industries by proposing a new regulatory attitude, which must be characterized by: (i) Light-handed regulation, (ii) greater ex-post control, (iii) more flexible marketing rules (eventual gradual release of markets), (iv) supervised self-regulation of the agents, (v) principles and conditions that define the playing field for the marketing of products, (vi) rules of market behavior, and, in our case, (vii) differential regulation for agents vertically integrated and with a dominant position (CREG, 2018).

Needless to say, the consulting team must explore different alternatives and evaluate their advantages and disadvantages so that the MME has a wide menu of options to guide the sector. In this work, it is sought that the consultants leave concrete proposals to advance in the required transformations.

1. Competence, participation and structure of the electricity market

Since the issuance of Laws 142 and 143 of 1994, the operation of the Colombian electricity sector was reformed. During these 25 years it has been possible to guarantee electricity supply and increase its coverage. The difficulties implied by the hydro-climatic phenomena that are characteristic of the country's geographical location have been confronted. Despite the characteristics of this industry, in the country there is a high concentration of few agents in the generation and commercialization activities of the public electricity service, a low deployment of Non-Conventional Renewable Energy Sources (NCRES, Fuentes No Convencionales de Energía Renovables) to a large and small scale, and limited use of financial instruments and new transactional schemes. Some companies remain vertically integrated. Entry barriers are reported for new competitors, which has resulted in inefficient price signals that impact the rate paid by end users.

It is important to point out that one of the actions of the reform was to create the figure of the retailer, which was supposed to look after the interests of the users and "rival" with the other agents of the chain (Generation and Distribution), specifically the retailer should always be looking for better prices and conditions for users. This has not happened. The retailer-distributor does not really face any competition and in many cases his work does not add much value nor represents the interest of the final consumer.

The above implies a principal-agent problem. The user as principal "delegates" the retailer as an agent to manage their energy purchase portfolio in the wholesale market. The retailer, being

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3 The comments and contributions of Julián Rojas, Lina Escobar and Fernando Barrera are gratefully acknowledged.
integrated with the distributor and sometimes with generators, faces several conflicts of interest within the company, which reduce the incentives to carry out efficiently managed purchases.

On one hand, vertical integration with the distributor enables blocking potential competitors in the competitive segment (the commercialization) either by limiting access to the essential goods (input foreclosure), that is, the distribution network, or by delaying the processes of costumer foreclosure, so that it can ensure a dominant position in the market and retain less elastic users as captive demand.

Now, if the retailer is also integrated with a generator, new conflicts of interest arise that may go against the representation of the user's interests. Since it is the best interest of the generator to maximize profits and try to market its energy at the highest possible price, the issue of having a retailer with a captive market, and the possibility of carrying out transactions within the company without any competition, would allow transaction prices that are not representative of the market.

With technological changes in the making, the role of this figure is crucial for the incorporation of distributed generation, self-generation, demand response figures, the creation of hedges and financial products that are suited to the consumers’ appetite for risk, and, in general, for proper market function.

The Energy and Gas Regulatory Commission (CREG) advances in creating a solution for a large part of the problems identified at the level of the Wholesale Electricity Market. In the Regulatory Agenda for 2019 (CREG, 2018), CREG proposes to define, among others, the binding clearance, the complementary service market, the demand response and the adequacy of the network code. In this context and taking into account the studies carried out in the country, partially summarized in Cadena, Chahín, Benavides, and Betancur et al. (2017), as well as the developments in Benavides Cadena, González, Hidalgo, and Piñeros (2018), the objectives detailed below are proposed for this Focus: improvements in the contractual schemes and in guarantees and risk coverage; an analysis of the investment signals, in particular the reliability charge; identification of barriers and proposals that facilitate the entry of new agents and technologies as well as the availability of connection and transmission infrastructure; and adjustments in the functional structure of the market considering the availability of clear and transparent information.

1.1. **Contractual schemes, guarantees and risk coverages**

The consultant should examine different alternatives to have a standardized and anonymous market for contracts with due guarantees and risk coverage schemes. The scope of the contract must not only cover the option of reducing exposure to the volatility of the spot market price, but the options of mechanisms and financial instruments to coordinate the entry of new investments and promote competition within the market. It should include the description, structure, operation and articulation with the regulation and market agents of the proposed mechanisms and instruments.

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An alternative is to examine what mechanisms or incentives are required for integrated and dominant agents to participate in these schemes instead of intra-firm transactions. In the world almost all intra-firm transactions must be done by anonymous and representative markets under the principle of *arm’s length* to avoid discriminatory practices and price determinations that do not represent market conditions. This way crossed subsidies could be avoided and undesirable behaviors against the end users are mitigated. In Article 316 of the National Development Plan (*Plan Nacional de Desarrollo*, PND by its Spanish acronym – Law 1955 of May 25, 2019), vertical integration (generation, distribution and commercialization) of companies in the sector (or companies with a same governance or in which control situations exists) is eased, before restricted by Article 74 of Law 143 of 1994, and it is allowed to increase the participation and commercialization limit of the energy distributors in the national market from 25% to 35%.

In this sense, CREG is working in two fronts. The first one concentrates in improving the call schemes by means of which the commercial agents subscribe coverage contracts for the regulated market. With the expedition of CREG Resolution 080 of 2018, the CREG proposes greater information disclosure on calls and to rely on centralized information systems concerning these transactions. The objective is to give this mechanism transparency and: (I) to facilitate the control on the call processes of both authorities and agents and users, (II) to have traceability of the processes and power to obtain data on the prices of these contracts at the moment in which they take place, (III) to promote competition, and (IV) to facilitate the search of information that makes the entrance of new competitors possible. It is expected that the changes to the calls for the regulated market would be in place for the third trimester of 2019.

The second work axis is the creation of market mechanisms proposed by interested third parties that fulfill a series of principles and conditions and that offer signs of more efficient pricing being transferred in a cost benefit relation to the final regulated user. In this direction, the CREG published Resolution 114 of 2018, which points out the possibility of designing transactional mechanisms by third parties and define principles and general conditions to transfer prices of these mechanisms of commercialization of electrical energy.

In its document 106 of 2017, CREG carries out a diagnosis of the market of bilateral electric power contracts, identifies the convenience of third parties developing alternative energy marketing mechanisms to those established in the current regulation and establishes a series of guiding principles and characteristics that should be met by the market contracts developed by these third parties, so that the prices resulting from the transactions that are given there can be transferred in the tariff formula to the regulated users.

In this regard, it is important that the consultant analyze why a Standardized Anonymous Market (MAE, by its Spanish acronym) has not been introduced in Colombia or what other alternatives exist to encourage the entry of more agents into de wholesale market.
CREG recognizes that the technological changes that are presented and will be presented in the electricity markets can result in a wide range of mechanisms of energy commercialization that go beyond the Commission's regulatory capacity and that, therefore, a general regulatory framework is required, where the principles are determined as well as the conditions that they must fulfill to guarantee their integrity.

In summary, the consultant should identify the main barriers and propose the strategies and precise instruments so that the country can "improve medium and long-term contracting [and the] development of mechanisms such as future energy transactions and platforms of standardized transactions, which achieve transparency, anonymity, liquidity and efficient risk management", as indicated in the *Bases del Plan Nacional de Desarrollo 2018-2022* (DNP, 2019).

It is necessary to identify the actions and milestones that will ensure that the regulatory proposal will result in the promotion of competition and reduction of generation prices to the final consumer. Colombia has had two experiences of boosting contract markets. The first one, the Organized Regulated Market (*Mercado Organizado Regulado*, MOR by its Spanish acronym), was proposed by CREG in 2011, and its design was never implemented after multiple changes. A study for the DNP by EY-Enersin (2016) indicated that one of the reasons for this was that the market was not comfortable with the proposed guarantee scheme. The second experience in Colombia is Derivex, a centralized, standardized and anonymous platform for trading electricity futures, that has been operating without success for several years. The amounts traded in Derivex are considerably lower than those negotiated in the bilateral market (it does not represent even 1% of the national demand).

The problems derived from the absence of a standardized and anonymous market for contracts have been discussed by various studies, including those developed by CREG. Ausubel and Cramton (2010, cited also in Benavides *et al.*, 2018) summarized almost a decade ago the deficiencies of the OTC (Over The Counter) contract scheme in the electricity market in Colombia: "Unfortunately, the existing contract market has high transaction costs, as a result of non-standardized contracts, poor price formation, localized contracting, lack of transparency and other factors. The problem is evidenced by the frequent occurrence of higher prices to regulated users compared to non-regulated...

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5 As indicated in the Fedesarrollo study (Benavides *et al.*, 2018), the central synthesis of the international literature on the interaction between the market contracts and the spot market is the following: open competition in contracts (unlike the bilateral contracting), followed by competition in quantities in the spot market, forces each generator to offer higher quantities in the spot market than in the case of competition without contracts. In equilibrium, both the spot price and the price of contracts fall in comparison to the situation where there are no contracts (or there are only bilateral contracts).

6 In this market, uniform energy futures would be traded for unregulated demand and with differentiated time blocks for regulated demand. The allocation of the contracts had to be carried out through a centralized auction in which the demand curve was constructed from the purchase offers of the retailers. The participation of retailers of regulated users was mandatory, but the amounts contracted depended on the offers of the generators.

7 Valentiera and Cadena (2017) associate the low depth of this platform to: (i) lack of knowledge of the futures market by agents, (ii) its complexity compared to bilateral contracts, (iii) low volume of offers, (iv) tariff problems that prevent retailers from transferring purchases to regulated users, and (v) high costs of guarantees to participate in the system.
users, which are not explained by the form of charges, credit risks or other factors. It is necessary to identify the signals and incentives required to improve the liquidity of the market.

In this direction, Jara (2016) identifies the following problems of contracts in the Colombian electricity market: opacity in the price formation, illiquidity, price discrimination according to the agent concerned and differentiation between the price of contracts for the regulated market and the non-regulated one. It also points out the absence of strict guarantees (there are agents that can not participate because they do not meet credit conditions and the credit costs are implicitly incorporated into the contracts).

The consultant must make concrete proposals to remedy this identified problem and that does not yet have a definitive solution. These should include an analysis of the current guarantee scheme and possible improvements in the value to be hedged and the allocation of risks.

Likewise, the consultant should review the recommendation of supervision and publicity outlined in Cadena et al. (2017) that include the approaches of several previous consultants:

Power purchase agreements are contracts of a financial nature and because they are an intermediation, the regulations on the matter issued by the Financial Superintendency [Superintendencia Financiera, SF by its Spanish acronym] must be accepted. In this way, the requisites of those who participate in this market will be those defined or come to define by this entity. It is also proposed that XM, in coordination with the SF, develop a transactional platform in which agents wishing to participate have the obligation to publish their position (long or short) on that market on a daily basis. Sellers must publish quantities, conditions and prices. Undeveloped positions may not be traded on that market.

1.2. Investment, reliability charge and contracts

The Ministry considers that the current rules that remunerate the reliability of the system should be reviewed. The probable evolution of the generation facilities, the operation of the market and the current regulation must be taken into account. This is the generation variability based on NCRES and hydropower, financing and ease of entry for new competitors, as well as the rules that regulate the operation of markets, complementary services and the heterogeneity of consumption nodes and generation that exist in different areas of the country. Similarly, there is concern about the impact of how payments are collected and transferred to agents on the stock and the contracts price.

Likewise, it has been conceptualized in several works (for example, that of EY-Enersic mentioned) and other instances that the promotion of competition should be considered as the main alternative to the sale of standardized contracts backed by a counterparty risk chamber and the in depth use of financial instruments. McRae and Wolak (2017) have argued that it is feasible to substitute the reliability charge for a contract entry mechanism, highlighting regulatory simplification and eliminating the perverse incentives that manipulate declarations to the spot market during drought events. The elimination of the reliability charge requires that the contract market have the volumes and liquidity needed to generate interest from project developers and have contracts with the
appropriate support from the financial sector. It is necessary to evaluate the costs that this option would have for the users and to propose what would be required for the transition of the facilities that have Firm Energy Obligations (*Obligaciones de Energía Firme*, OEF by its Spanish acronym) assigned. It must be ensured that the scheme of contracts is transparent, neutral, reliable and characterized by an efficient formation of prices so that retailers can transfer said prices to users.

The consultant should evaluate the advisability of maintaining the charge for reliability in their current scheme, review other options such as strategic reserves, pure energy markets with mechanisms of *scarcity pricing*, and make the adjustment recommendations necessary for its evolution. Likewise, it should evaluate the convenience or inconvenience of the coexistence of two simultaneous entry mechanisms (reliability charge and auctions for long-term contracts) for existing and new generation technologies, including NCREs. The consultant must take into account the regulatory adjustments underway when examining these aspects in detail.

In a previous study carried out for IDB (Cadena *et al.*, 2017) a proposal was made to adjust the CxC mechanism, defining three categories of plants for the CxC assignment based on which relationship would be applied in each case for the premium, the scarcity price and the allocation periods. The following table (Table 1) summarizes the proposal.

**Tabla 1. Proposal to adjust the CxC mechanism**

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>Past Tenders</th>
<th>New Tenders*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prime</strong></td>
<td>Value equivalent to the monthly fixed cost of efficient generation technology with lower capital cost (12% discount rate, 20 Years investment recovery period, 6 months financial cost during construction).</td>
<td>Closing prices of the corresponding tender.</td>
<td>Both the Premium and the Scarcity Price are defined by a &quot;Multiple Attributes Tender&quot;, in which the participants submit bids for each of these two variables. The remuneration of the selected plants corresponds to the &quot;Pay-as-Bid&quot; principle.</td>
</tr>
<tr>
<td><strong>Shortage Prices</strong></td>
<td>Incremental Operational Cost of Energy Rationing (Threshold, CRO1) calculated by the UPME.</td>
<td>Calculated in accordance with the provisions of Section 1.4 of Annex 1 of Resolution CREG-071 of 2006.</td>
<td></td>
</tr>
</tbody>
</table>

*8 A first proposal of this idea can be found in Bushnell and Oren (1994). Then Oren in conjunction with Barroso and other authors (2006) propose the same for Brazil.*
Assignment Period | Annual. | As foreseen in the corresponding tenders. | 10 years.
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In regard to the practice rules of the OEF, the consultants say that “this would remain unchanged, that is, for each of the plants allocated by the OEF, the latter will be required when the price of the market price exceeds the scarcity price of the respective plant”. The authors recommend to:

> [...] let the MME be responsible for defining: (i) when tenders are started, (ii) how many tenders will take place, if you choose to split the tenders by type of technology, and (iii) how much new ENFICC will be acquired in the respective tender(s). The UPME will present a report to the MME annually with suggestions and recommendations on the decisions that the Ministry should adopt.

Likewise, they recommend:

> [...] to deepen the participation in the demand for the security of the voluntary disconnection ring, through the retailers or the "aggregators", which represent decentralized production and demand management in the market; and even to think about direct offers to disconnect non-regulated users (a kind of demand bidding and buy-back program). Finally, it was recommended, "to review the reconfiguration of the tenders, establishing a bottom (to be defined) and study the validity of the last instance resort plants."

### 1.3. Diversification of generation assets, participation of NCRES and greater number of agents

Electricity generation in Colombia is supported by the use of water resources and the inclusion of thermal sources (coal, natural gas or some proportion of liquids) to guarantee the firmness required by the regulation. The market, like many others, is oligopolistic. The regulatory mechanisms have reinforced the participation of hydro sources and conventional thermal generation. Although the diversification of the resources has been a permanent determination of public policy (see different National Energy Plans – *Planes Energéticos Nacionales*), new technologies and agents have not been attained and the generation portfolio moves away from the efficient frontier (Benavides *et al.*, 2018).

The consultant should discuss how to resolve the tension between indicative planning and the options for correcting the course when the results of expansion tenders, in particular those with the reliability charge, moves away from the vision of optimal long-term goals. The consultant should analyze the planning options used in the country to assess their possibilities for improvement. The consultant should also consider the opportunity of different non-conventional renewable technologies, for instance offshore wind power and geothermal energy, and non-renewable sources, for example nuclear energy, for a country such as Colombia.
In particular, the consultant should analyze the use of a mechanism like the long-term contract proposed for NCRES introduction, evaluate the optimal participation of these energies in the energy matrix, the periodicity of future auctions and the number of optimal achievements, and make recommendations on the case to ensure that the Colombian market and consumers can take advantage of the low costs of energy generation of these technologies and stability offered by lower carbon content resources and take advantage of their contribution in the reduction of vulnerability, complementarity improvement and reduction of emissions.

In the Bases del Plan Nacional de Desarrollo 2018-2022 (DNP, 2019), it is established that "MME, UPME and CREG will develop the necessary actions to carry out the long-term hiring tenders that will facilitate the incorporation of NCRES into the National Interconnected System [Sistema Interconectado Nacional, SIN by its Spanish acronym] ". Article 296 of the law of the Plan (Law 1955 of May 25, 2019) established that marketers must buy between 8% and 10% of renewable energy in their total portfolio. The consultant should analyze the recommended timing for the implementation of this measure and the possible consequences that should be regulated by the breach of the goal.

In the Reliability Charge tender that took place in February 28, 2019, 1,398 MW of NCRES projects (6 wind projects and 2 solar projects) were awarded OEF (2,51 GWh / day for 1,160 MW and 0,76 GWh / day for 238 MW solar). These and other additional projects aspire to receive energy contracts in long-term contracting tenders. The first tender, which had an objective demand of 1,183 GWh-year in 12-year contracts, resulted in not awarding any contracts despite the competitive participation of the generation projects that were presented. According to the conditions of participation, with a significant part of non-conventional renewable energy, "the government seeks to reduce the high country's dependence on hydroelectric power." There is an indicative target of 1,500 MW of non-conventional renewable energies in 2030 (NDP). Now, the government aims to award 1,500 MW for an energy goal of 3,443 GWh-year before the end of 2022. Other studies set this target between 3,500 MW - 5,000 MW in 2030-2050.

In the Bases del Plan Nacional de Desarrollo 2018-2022 (DNP, 2019), it is also stated that the MME will promote mechanisms of financial support and credit enhancement for NCRES projects. The consultant, given the advances in this field, and the recommendations on the mechanisms and their optimal number of fulfillments, should also analyze the implications of having non-dispatchable generation of low variable costs in the recovery of the investment costs of dispatchable technologies, so that the agents interested in the development of generation with NCRES manage to overcome the

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9 Likewise, they will advance the necessary actions to consolidate the electric transmission infrastructure and the regulatory framework that promotes and makes the entry of the NCRES viable into the Colombian energy matrix (Pact for Sustainability). The second phase of the electrical interconnection of renewable energies from the La Guajira peninsula to the rest of the country will be promoted and the development of technologies that facilitate their insertion in the Colombian energy matrix will be endorsed.

10 It is important to note that article 298 of the Law established that generation with NCRES with capacity greater than 10 MW must pay 1% of gross sales at the rate established by CREG as support to ethnic communities (60%) and the growth of the regions where these projects are carried out (40%)
barriers to enter. The consultant should analyze the implications of including or not NCRES plants on the merit order dispatch. This means, if these technologies are going to be on the base of the dispatch or are going to make a price and quantity offer to be included in the dispatch.

It is important to note that the connection of these projects to the SIN is a concern, since the number of requests has exceeded the forecasts and, what is more important, the availability and capacity of the network to host them in the short term is not enough. DNP recognizes these limitations when it states that the MME will adjust the technical regulations and CREG regulation to facilitate the connection of projects and energy delivery of the NCRES by modifying the network codes, the market operation regulations, and the technical regulation of electrical installations. Additionally, it is necessary to evaluate the allocation criteria “first in time, first in the right” and its effect in the hoarding of the transport capacity in both the National Transmission System (Sistema de Transmisión Nacional, STN by its Spanish acronym) and the Regional Transmission System (Sistema de Transmisión Regional, STR by its Spanish acronym). Therefore, it is necessary to review which are the best regulatory practices for a proactive expansion of the networks that guarantee the fundamental principle of access to all generation (and demand) agents without primarily distinguishing by type of technology, but understanding that new technologies require a more expeditious, intelligent and efficient development of the transmission networks.

On Focus 5, with respect to the institutional framework and corporate governance, when analyzing the organization of responsibilities for the operation of the system and market administration, the consultant should evaluate the possibility of eliminating the responsibilities of the network expansion analysis and of carrying out the transmission call process from UPME. Without those responsibilities, with free human capital and more time available, connection studies should flow more expeditiously. However, it must be taken into account that Article 21 of the National Development Plan (Law 1995 of 2019) empowers UPME to charge for the services provided, which increases the revenues and institutional capacity of this entity.

The penetration of variable sources and the options of demand participation in the energy market require an adaptation of the dispatch and the organization of complementary services markets. The Energy and Gas Regulatory Commission (CREG) advances in this task. The consultant should review these developments, that are decisive for a good integration of non-conventional renewable energies in the electricity market, mainly the non-controllable or variable ones. Two studies have been contracted: one on binding clearance, intraday market and balance sheet mechanisms; and the other on the remuneration of complementary services. In both studies there is the option of moving from a uninodal system to a multinodal system. There is no convergence in the chosen proposals and the study of this matter should be extended (see objective 1.4).

The participation of demand in the wholesale market or in the market for reliability services must be studied. Mechanisms of participation in capacity markets are a reality in several system operators. In our case, the consultant should consider the principal-agent problems (moral hazard) that could arise when a Non-Regulated User (Usuario No Regulado, UNR by its Spanish acronym) obtains a reliability claim and cannot comply with their OEF. Likewise, the consulting team must study other
mechanisms to encourage demand from the wholesale market to participate in reduction programs under the expected conditions of supply or emergency limitations. Similarly, the demand could participate in complementary services programs.

Likewise, the consultant should review the role of international interconnections to facilitate the operation of variable sources of energy.

Finally, the Commission has considered the option of installing battery storage systems to alleviate network restrictions. Storage analysis need to be expanded in order to consider new services such as the integration of renewables, the improvement of energy supply, and the quality of service as well as the delay of investments at all tension levels. As stated in Objective 1.5, it is necessary to develop a regulatory framework that eliminates barriers for different technologies to participate in the delivery of products in the market (energy, reliability) or the delivery of different services, whether regulated or not (including regulation, frequency or even services associated with transmission and distribution).

1.4. Restrictions and Nodal Prices and Transmission Infrastructure

A recent and very heartfelt concern of the market is the cost of restrictions\textsuperscript{11} and its allocation. According to a study hired by Asocodis (PHC, 2019), "the cost of the restrictions from April 2016 to date, range in values from around $ 5 / kWh to values of the order of $ 35 / kWh". The over cost derived from the use of more expensive generation is transferred uniformly to the national demand.

After a detailed analysis of the fundamentals (prices and magnitude), critical factors and their regulation, the consultants propose short, medium and long term measures throughout the life cycle of the restrictions: "definition of policies, expansion planning, regulation, execution of expansion projects, operational planning, operation and maintenance of transport assets, economic dispatch, real-time operation and settlement and billing of restrictions". Specifically, the improvements refer to:

the architecture of the market, the reliability and quality criteria, the signals for generators, transporters and network operators, the rules of dispatch, the declaration of fuel prices, the publication of information to guarantee transparency, the liquidation, the supervision and surveillance of the market, as well as the criteria, responsibilities and procedures for the expansion of the STN, STR and SDL networks that are determining factors for the costs of restrictions and their evolution. (PHC, 2019)

Among the specific recommendations are the construction of transmission projects (STN) and subtransmission projects (STR), required in the shortest time possible, the delivery and the formation of a complementary service markets, the gradual allocation of the cost of the restrictions from the STR and SDL to the Network Operators (NO, Operadores de Red), taking into account that

\textsuperscript{11} Limitations that arise in the operation of power systems caused by capacity limitations in electricity grids or in the application of safety and reliability criteria in electricity supply.
they are responsible for the expansion plan of their networks, and the evaluation for setting a nodal pricing system that reports on generation costs in the different nodes or zones of the system.

In this sense, an inter-institutional group formed by the MME, the CREG, the SSPD, the UPME and XM was organized in order to elaborate and agree on a short, medium and long-term action plans to solve the problem. Within this plan of action, it is worth noting actions such as the revision of dispatch schemes and configuration of the plants, supervision of the costs reported by the agents, evaluation of the increases in maximum levels of exchanges with the Caribbean Coast, improvements in coordination of the testing and maintenance periods of the generators and follow-ups to the expansion plans of the Network Operators, among others.

As a tangible product of these action plans, CREG Resolution 034 of 2019 was issued for comments, containing a package of measures to solve the problem of restrictions and addressing issues such as the configuration of the plants, the costs of fuel generation, the testing declaration of the units, and a costs of restrictions report.

The consultant should review all these recommendations and prepare a proposal for short, medium or long-term actions on the premises of regulation in Colombia that are the promotion of competition and regulation in cases where this is not possible. It is important to check whether the regulation should emphasize availability as a product of the service and the quality signals that must be given.

Regarding nodal prices, the Colombian electricity market currently uses a single price scheme in all the nodes of the network to liquidate the generation transactions. Other countries have implemented nodal pricing schemes or zonal prices (which average prices in neighboring nodes). The temporary resolution of these prices is useful to establish demand response through prices, although this can still occur in our uninodal system if the signal of reconciliation is transferred in the restricted nodes. The spatial resolution is relevant to encourage conventional investments and distributed energy resources (DER) (MIT Energy Initiative 2016).

Several studies recommend a transition to more granular (zonal or nodal) price schemes in Colombia. The DNP contracted a study to examine this option whose recommendations should be taken into account by the consultant to propose the system road map to migrate from uninodal to zonal or nodal pricing with the appropriate strategies, instruments and actions for its implementation, if it concludes it’s a benefit for the country. Otherwise, it must justify the decision to maintain a uninodal system. This recommendation should be the result of an evaluation of the impact of migrating to this scheme and of the identification of its effects in the different zones of the country.

Some studies have already estimated the nodal or zonal costs for Colombia (UPME, 2016; Vega and Velasco, 2010; Zambrano, Olaya and Velásquez, 2014 cited in Piñeros, Cadena and Morillo, 2018).12

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12 Recently, Piñeros, Cadena and Morillo (2018) estimate the impacts of implementing nodal costs for Colombia during 2015-2024. The results of this analysis cited in (Benavides et al., 2018) are: (i) The costs of the Caribbean region are 18% higher than the uninodal price in the first 3 years of the study while the costs of San Carlos (Antioquia) are 30% lower than the uninodal price during the same time horizon. (ii) Zonal costs depend on
which confirm that the system costs in Colombia vary in space and time. In Cadena et al. (2017) an analysis is made of the evolution of the transmission charges in Colombia and the aspects to be taken into account if it is decided to migrate to granular signals.\(^\text{13}\)

If there is a proposal from the consultant in the direction of moving towards greater spatial and temporal granularity of prices in the system nodes, in addition to the road map, a proposal should be made to deploy efforts of dissemination and training of market participants. The definition of a path towards nodal prices should, where appropriate, also include a definition of the mechanisms for managing price difference risks that must be established. That is, the convenience or lack of introducing a scheme of financial transmission rights, which is a key element for the operation of a nodal price mechanism. The practice has shown that it is complex to implement this type of mechanism, but the consultant should therefore assess in which way these risks will be handled, if through a legal financial scheme executed by the market operator or if it is expected that the participants find financial instruments to do so, or a combination of both. Likewise, the consultant should evaluate how these prices are assigned among agents. The EY-Enersinc study proposed a water-pricing scheme to avoid affecting end user prices, while the U. de Comillas study (2017) proposed a downstream scheme.

On the other hand, the construction of transmission (and sub-transmission) infrastructure and the connection of new agents face delays due to the administrative burden of the entity in charge of technical analysis and execution of tenders, and due to the granting of environmental licenses and the execution of social consultations by each agent selected for each identified project. Transmission is a facilitator of the competition. The consultant must evaluate the expansion and remuneration scheme of the network and recommend the adjustments of the case to reduce the restrictions that arise in the system due to problems relating to delays in the start-up of these projects. The current methodologies of transmission expansion must be reviewed in sight of the current results and consider structural adjustments, such as making a more proactive and anticipated expansion that considers the costs of delay and its effects on congestion.

In the same way, the participation of NCRES in the national energy market could benefit from new international interconnections or the expansion of the existing ones to take advantage of complementary climate regimes. National policy objectives and different regulatory frameworks

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\(^{13}\) Colombia changed from a scheme of zonal charges to one of stamp charge. The reasons that were invoked at the time for this change, the summary of the recommendations to adopt the scheme of Nodal Charges, aside from simplified versions like the one that was implemented and was in place between 1995 and 2000 with few and dubious results, but in its integral version is summarized in the annex to this document.
have delayed this option. The consultant must elaborate a concept about the main barriers faced and actions to take in order to advance in this direction.

1.5. New services and agents: storage systems and aggregators

The development of storage systems has accelerated in recent years in an important way. Costs have been reduced as a result of a significant increase in installed capacity (between 15% to 21% due to a doubling of the capacity). These systems (ESS) provide numerous (and different) services to an energy system. International references report between eleven and nineteen services in different categories. The main applications of storage systems are the regulation of frequency and the provision of other auxiliary services, the integration of renewables, the supply of energy and an increase in capacity, the delay of transmission and distribution investments, and the reduction of congestion and improvements with regards to the energy quality. It is worth mentioning that ESS can provide different services at the same time, given that their operation, their technical characteristics and their regulatory framework allow for it.

The Colombian regulator has considered the use of storage systems to alleviate the restrictions on the electrical grid. The consultant should make a proposal for the incorporation of these systems considering the provision of different services and in this way improve their competitiveness in the market. This proposal will start with an analysis of the possible services in Colombia and the barriers that these systems face for their installation and operation in the current market. As a result, it should propose the best form of participation in the Colombian market, either in the different links of the chain or as a convergence asset providing different services, and the necessary adjustments for its dissemination. All barriers must be removed so that this new technology can offer all the products for markets or all the auxiliary services that it can provide. Within the regulated services, the value as a network asset should be included, and market products include, for example, the purchase and sale of energy, as well as reliability products. It is also necessary to define whether this new technology requires the designation of a new player in the wholesale market or whether the current state of players (agents) is enough. It should also be discussed if the separation of activities or the regulation of the activities are necessary.

Another modification to the market comes from the need to have aggregators to facilitate the participation of DER in the market. This new agent would be responsible for grouping the flexibility offered by prosumers and converting it into services for the electrical market. This point will be developed in Focus 3.

In Article 290 of the PND (Law 1955 of 2019), the National Government empowered CREG to define new activities, links in the supply chain of public services for gas, electric power and liquid fuels, as well as the regulations applicable to the agents that develop them. In this sense, the possibility opens up to incorporate new agents and activities quickly in the service chain while new technologies are developed and adopted in the national market.

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14 Acronym for the fusion of the words “producer” and “consumer” (see Wikipedia:
https://es.wikipedia.org/wiki/Prosumidor
In this setting, new paradigms for the commercialization of energy at a distributor level should also be studied. Given the reduction of generation scales, installations a few MW, or several tens of kW, can have very competitive costs facilitating innovation in the commercialization of their energy. That means additional schemes from sales in the wholesale and contract markets must be studied such as simplifying markets at the distribution level for organized markets or facilitating markets where both users and generators can directly transfer energy (peer to peer). This will require analyzing the current legal barriers that limit the participation of small-scale generators, as well as the legal limitations so that users can at the same time choose to generate their electricity and participate in these markets. This aspect is also being studied in the fifth focus.

1.6. Open and transparent information

Information is essential in a market to promote competition and guarantee free access. In Colombia there is insufficient information on quantities, prices and contractual modalities offered by sellers in the market. The consultant should analyze and propose a system where agents and the public in general can have access in real time to market data and transactions, in order to be able to optimize their decisions. It should also review the international experience in terms of best available information practices in advanced markets and system operators, contrasting with the information and periodicity which is currently made public, and determining the existing gaps that must be breached in terms of availability of information that is essential to achieve transparency, confidence in market mechanisms, and equality conditions. It must describe justifiably, what information should be reserved or confidential, which information is open to all public, and which will have restricted access to different types of participants in the market.

It is recommended that the consultant review the proposal for mechanisms to monitor the wholesale energy and gas markets in which monitoring indicators are proposed for this purpose, work led by the SIC (2016), as well as the study conducted by PSR and PHC for the DNP and the SSPD on market monitoring (PSR-PHC, 2018).

1.7. Market structure

In addition to the aspects discussed in the previous points relating to the design of market contracts within the electricity sector and the current legal framework, the consultant should study other structural alternatives to the issue of competition and concentration in the sector and propose this to focus team 5. The consultant should review international experience in terms of structural measures, such as imposing legal limits on horizontal and vertical concentration from the electricity sector; analyze procompetitive measures in wholesale markets and describe this option, as well as the transition mechanisms for compliance; and examine the functional separation in cases of vertical integration. In addition to legal mechanisms that limit concentration, consultants should study what opportunities are offered by reforms to the legal framework of general economic competition in

15 https://www.sic.gov.co/herramienta-para-el-monitorio-del-mercado-electrico
Colombia. That is, to study the legal mandate of current economic competition in Colombia, how it contributes or hinders competition in the electricity sector and propose appropriate measures for control concentration based on coordination between the general competition laws and the framework applicable to the electric sector. Thus, the consultant should evaluate the possibility of having a market supervisor that, as in the US markets, daily reviews the generators offers and has the faculty to intervene the offers when he considers it pertinent.

Another problem that exists in the electricity markets is that market power is exert in different markets and not only in the spot market. In Colombia, the results of McRae and Wolak (2017) show that the exercise of dominance can be done in more than one market.

Other countries, notably the US in the wake of the California crisis and the European Directive on REMIT (Regulation on Energy Market Integrity and Transparency) following the market investigation of 2006-7, use a softer standard than the excessive price standard. This standard seeks to apply legislation on market manipulation or theories of fraud to the comprehensive analysis of market positions. The consultants will analyze if it is necessary to introduce a competition standard associated with price manipulation, as this is common in financial and securities markets, to cover the interaction between different markets of the Wholesale Energy Market (Mercado de Energía Mayorista, MEM by its Spanish acronym): reliability, contracts, stock market, complementary services, etc.

Likewise, the consultants of this Focus group, aside from summarizing the recommendations and adjustments to the market in topics like market entry, participation of new agents, technologies, contractual schemes, reliability options, facilitators signals of the competition as nodal positions, and enabling measures such as improvements in the quality and availability of information, must also make recommendations related to the role of marketing in the retail market which feeds the work of the consultants in focus groups 3 and 5.

The integration of competitive activities with monopolistic activities reinforces the monopolistic interests that block the entrance of third parties to the market. In Cadena et al (2017) it was pointed out that "in the particular case of the agents who jointly develop distribution and retailing activities, the following is presented: (i) Resistance to change, as the company restricts Free Network Access, as far as possible, to its competitor's; and (ii) Resistance to connection given that the company interposes obstacles to connect self-producers and distributed resources, or the company interposes obstacles to the migration of loads at voltage levels higher than the voltage level where it is located". In addition, there are few incentives to design efficient portfolios or new products for clients.

On the other hand, the emergence of distributed generation and storage systems leads one to think of the technical and economic convenience of the distributor being able to provide these activities. In fact, Law 143 incorporates the technological developments presented at this level into the definition of the distribution activity. The consultant should discuss the pros and cons of increasing vertical disintegration of activities in the face of this reality. The separation of retail and distribution activities is more important when the generation scales have been reduced and therefore energy producers
and consumer-producers can carry out generation and consumption activities at the same time. The role of distributors while serving users at regulated rates must be examined by proposing in its case a complete separation of activities based on international experience in markets where competition at the user level has broadened. The review should be focused on the user as the last beneficiary and payer of all services, in such a way that the benefits that technological development and scale reduction represent can be facilitated.

In the *Bases del Plan Nacional de Desarrollo 2018-2022* (DNP, 2019), it is stated that "the national Government will facilitate the participation of more players in the provision of public services and complementary activities and will consider those companies that carry out activities other than the provision of public services, as long as there are no conflicts of interest and possible dominant positions". The consultant should make recommendations to move in this direction.

It is important to note that the CREG has proposed a document on vertical and horizontal integration for discussion in order to evaluate the relevance of the current rules on vertical integration and concentration for public services of electric power and gas used for fuel. For this purpose, it is essential to make an exhaustive identification of the relevant trade-offs to evaluate the impacts that these limits might have on the other links in the chain, as well as the possible intersectorality effects (gas-electricity) that may arise. Likewise, the discussion seeks to identify intervention alternatives “which include the possibility of keeping the current rules”.

Following the new regulatory attitude proposed by the Commission and described above, "the analysis objective is to define general rules, having in mind that the problems to be solved through the establishment of vertical integration limits and the participation in markets are closely linked and therefore cannot be treated in isolation. Of course, one of such general rules can result, and probably will result, in prescriptions for the different activities, and when collecting the current state of each public service, they might be different in each case".

This discussion should help the consultant’s work. The recommendations that the consultant can make will be of great importance.

2. The role of natural gas in energy transformation: supply and demand16

Natural gas has had what is considered a positive development in recent decades at the international and national level. Production and transport techniques have been diversified, increasing the available supply in different regions, and technological advances have been incorporated to increase flexibility on the use of this resource at different scales (Benavides *et al*., 2018). The share of this fuel in the global energy markets has been increasing and expectations predict greater growth in different sectors such as consumption and transformation.

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16 We thank Carmenza Chahín and the staff of CREG, DNP, MME and Naturgas for their comments.
In Colombia, after many years of continuous growth, in the last five years there has been a developmental stagnation. In contrast to this situation, the growth of other energy resources in the country, although moderate, exhibit positive rates (Anaya, 2019), even more with the current and expected participation in the global energy markets.

In recent years the country has faced a gradual and sustained reduction in production and natural gas reserves, which has significantly affected the price of thermal generation using natural gas as a fuel. For this reason, there is a clear need to have a sustainable and long-term natural gas supply plan that ensures supply for reliable thermal generation, given the complementarity that it provides to the system during low hydrological periods. Natural gas today is a more tradable product, thanks mostly to the proliferation of liquefaction and regasification plants around the world, after the NCRES it has the highest growth rate among the energy resources destined for electricity generation. The flexibility offered by this technology is an important complement to the penetration of variable sources of electrical generation. Naturgas (2017) points out that it is “imperative to develop a broad, diverse, competitive and stable natural gas supply base to allow market players to make informed long-term decisions”.

The Bases del Plan Nacional de Desarrollo 2018-2022 (DNP, 2019) establishes guidelines on the promotion of this energy competition, determining that "CREG will promote tools and mechanisms to improve liquidity, price formation at different terms, short term contracting flexibility, price coverage and the coordination of the supply and transport contracting times". Likewise, it defines that "CREG will evaluate the convenience of migrating to a different remuneration system from the one in place for the transportation of natural gas, seeking to consolidate a national gas market and stimulate the incorporation of a larger quantity of natural gas reserves for the supply of the demand, considering current and future service needs".

It is important to note that in the 2019 Regulatory Agenda (CREG, 2018) CREG is expected to define the remuneration methodology for gas transportation in the first semester, and the commercialization aspects of the pacific regasification plant services in the second semester. Likewise, in the current year the distribution charges will be determined using the approved methodology, which has received positive comments from agents due to its suitability to recognize the differences in cost structures of the different companies derived from the heterogeneity of the markets and their geographical and economic conditions.

On the other hand, due to the lower carbon content and other pollutant characteristics attributed to this fuel and with an adequate management in the chain of production and use, one should expect a higher growth rate compared to other energy resources with fewer relative advantages. It is necessary to review demand growth constraint and find the right incentives so that, having assured a reliable supply at efficient prices, participation in end-use sectors can be increased, starting with transportation, continuing with trade and industry and ending in residential use, which must be maintained.
The objectives and scope proposed for this Focus, consist in reviewing and identifying proposals to have a secure supply infrastructure that provides the required reliability, a better gas to electricity coordination and the necessary information to identify demand growth opportunities while making recommendations for regulatory adjustments to have a more dynamic industry and a more efficient and flexible market.

2.1. Supply scheme.

The consultant should propose a strategy, with its respective instruments, to guarantee a wide offer of natural gas that includes agents and production zones (new and existing) to have a more competitive market and better prices to meet demand, which should grow as a result of the environmental quality and management of this resource.

The National Hydrocarbons Agency (ANH) and the MME have been encouraging higher levels of exploration in new fields, both continental and offshore, that should yield positive results in the coming years. In the Bases del Plan Nacional de Desarrollo 2018-2022 (DNP, 2019) it is established that "the ANH will designate the zones for exploration and production of unconventional deposits and the MinEnergía and the MinAmbiente will update, if necessary, the specific technical and environmental regulations for the exploration and production process." In addition, the recently issued finance law introduced important tax incentives for capital intensive industries, such as energy and hydrocarbons: gradual reduction of income tax rate from 33% to 30% between 2019 and 2022, credits against income tax for total VAT paid on capital goods, as well as 50% of the ICA (Impuesto de Industria y Comercio, Industry and Commerce Tax) and the GMF (Gravamen a los Movimientos Financieros, Tax on financial transactions) for the next 2 years and 100% as of 2021. These incentives have already been translated into a 68% increase in foreign direct investment in the first quarter of 2019 compared to the same period of the previous year and are expected to cause higher reserves in the medium term. Finally, the mission that evaluated the feasibility of exploring unconventional deposits delivered a detailed report suggesting a series of technical, environmental and social conditions prior to and concomitant with the development of Integrated Pilot Research Projects (Proyectos Piloto Integrales de Investigación) before determining commercial viability of this type of deposits through hydraulic fracturing and horizontal drilling (Comisión Interdisciplinaria Independiente, 2019).

On the other hand, the UPME has been studying the installation of regasification terminals in the Pacific Coast to meet the electricity generation in the wholesale market and consumption in the west and south of the country. In the Bases del Plan Nacional de Desarrollo 2018-2022 (DNP, 2019) it is stated that "The process of preparing and publishing the final terms for the development of this project [the plant] will continue, including the allocation of risks in each of its phases. In the same way, interinstitutional articulation will be sought at national and territorial scales, so that the start of these projects takes place in the year 2023."

A long-term option to examine is Power to Gas, usually abbreviated P2G, which is a technology that converts electrical energy into gas fuel (if the surplus energy from wind generation is used, the concept is sometimes referred to as wind gas). Given the wide range of wind resources (and solar) in
La Guajira, it is wise to consider the country’s options in the application of this technology and consequently the actions that must be taken to have the required capabilities.

If the share of natural gas in the wholesale generation portfolio is to be maintained and increased, it is necessary that the supply and transportation of natural gas guarantee the electric reliability that the National Government desires. The gas-electricity coordination must be studied in order to harmonize the supply and allocation of the transport capacity so that the resource is available effectively and efficiently.

2.2. Retail production, transport infrastructure and remuneration.
The consultant should analyze aspects related to the commercialization of gas production, the planning and construction of transport infrastructure and its correct remuneration. At the same time that the government is concerned about the supply, it understands that it is necessary to count on an infrastructure that guarantees the offer in consumption hubs.

In this regard, the *Bases del Plan Nacional de Desarrollo 2018-2022* (DNP, 2019) established that UPME "will develop the necessary analysis to determine the additional or complementary transportation infrastructure that allows for the incorporation of continental, offshore and imported resources (crude, gas, liquid fuels, among others) from different zones of supply to demand. Also, it will evaluate the storage and transport network reconfiguration to ensure greater reliability of supply".

Supply and reliability investments are determined in the planning methodology used by UPME. The consultant should analyze the best practices (criteria, methodologies) at the international level and make the necessary recommendations. The Supply Plan is based on an estimate of the demand to be met and that available and planned, according to the agents’ production statements, based on which a balance is made. However, market agents systematically question this balance. UPME indicates that it has developed the most reliable information. The consultant should analyze the existing information problem and propose alternatives to make this process clear.

Another aspect to consider in the gas - electricity coordination is the contribution of gas to energy-distributed resources. Also, industry competitiveness opportunities should be evaluated through the use of natural gas at competitive prices, for which a policy signal is needed to allow the entire natural gas chain to have flexible tariffs and give commercial incentives to new demand projects (similar to those granted to NGV in Decree 802 of 2004). The option of relying on imported gas to supply the final demands at the vehicular, residential and industrial levels should be considered.

From the contract’s perspective, remuneration and commercialization, the PND (DNP, 2019), has already mentioned and established that:

[…] CREG will promote tools and mechanisms to improve liquidity, efficient price formation at different terms, flexibility of short term contracting, price coverage and the coordination of the contracting supply and transport times. The entity must evaluate the convenience of
migrating to a remuneration different from the one in force for the transportation of natural gas, seeking to consolidate a national gas market, stimulate the incorporation of a greater quantity of natural gas reserves, and consider current and future service needs. [...] Naturgas proposes to increase the flexibility of gas supply and transportation contracting model.

Each of the possible transport tariff schemes (common carrier, contract carrier and entry-exit) present a series of advantages and limitations that must be weighed according to the needs of the system. It is important to evaluate alternatives such as: (i) common carrier model with stamping, (ii) stamping only additional connections, (iii) stamping only by transport system, and (iv) the entry-exit model. The consultant is expected to define which model allows the best expansion of the system, the development of new demand, a greater viability of the offer and a better overall competitiveness of gas as a fuel.

In the roadmap, the consultant must contemplate the periods foreseen by CREG for the establishment of these tariffs.

2.3. **Storage and free access to regasification plants.**

In the PND (DNP, 2019), it is established that:

MinEnergia, or the entity it designates, will study the need to have storage infrastructure for liquid fuel and gas fuel to determine, among other conditions, its location and capacity. Considering the above, CREG will issue a regulatory framework that encourages the participation of agents in the provision of new storage services. On the other hand, MinEnergia will review and, if necessary, establish or modify the strategy of demand and supply in case of a shortage of liquid fuel and / or gas fuel.

The effect, in terms of flexibility, of having storage infrastructure that guarantees reliability in the supply, as well as a reduction in time between nomination and delivery of fuel, should be analyzed.

In the same order of ideas, recommendations should be made to guarantee free access to the regasification infrastructure of the country, the possibilities of cost remuneration and the conditions that should be fulfilled in order to eventually prolong the use of the regasification infrastructure in the Cayao Terminal on the Caribbean Coast.

2.4. **Operation and information coordination.**

The natural gas market is a short-term (daily) contract market with nominations for both supply and transport. In the case of thermal plants demand, their nominations in the gas market are made once they know their expected energy dispatch. Up to four re-nominations can be made, both for supply and transportation of natural gas during the day of the operation, which must be communicated six hours in advance. In order to provide greater flexibility, the consultant should examine the possibility of reducing time between nominations and deliveries according to the proposals of the intraday markets in the electricity market. If the gas thermal plants are going to participate in the auxiliary
services market and offer flexibility, it is also necessary that the two operations are coordinated, and their interaction is facilitated.\textsuperscript{17}

The process of re-nominations could lead to a secondary gas market (U. Comillas et al. – CREG, 2018, 58; ver anexo). Consultants should recommend how to stimulate a secondary natural gas market. This market, in addition to presenting "very limited liquidity, is not a centralized market and there is no predefined timetable." (59) Achieving better coordination between the two markets is essential to take advantage of the flexibility and support that these plants can offer in the presence of renewable energies.

Finally, it is necessary for the consultant to review the responsibilities and duties of the Market Manager to guarantee access to the operational information needed to monitor the system and to develop the national natural gas market, as established in the PND (2019). The Natural Gas Market Manager, who resides on the Mercantile Exchange since January 2015, "is responsible for the management of the market information platform and the management of platforms for gas supply and transport capacity negotiations in the primary and secondary markets". This manager is in charge of offering information and manage virtual platforms for the purchase and sale of natural gas and its transport capacity, the registration of supply contracts and the publication of monthly and annual reports on the behavior of the main wholesale market variables. Colombia’s Mercantile Exchange considers that it has built a highly useful transactional platform and expects to be able to offer better services "for the benefit of the producers, traders, transporters, distributors, retailers and final users of the natural gas service".

The CREG in Resolution 136 of 2018 establishes the criteria and procedures that will be considered in the selection of the Natural Gas Market Manager for the period 2020 – 2025, and the conditions under which this entity will provide its services and remuneration. The consultant should conceptualize the possibilities of expanding and improving these services and contrast these responsibilities and services with those offered in the electricity market.

For market monitoring, it is recommended that the consultant review the proposal for monitoring mechanisms of the energy and gas wholesale markets in which indicators are proposed for this purpose, work led by the SIC (SIC, 2016), as well as the study conducted by PSR for the DNP and the SSPD on market monitoring (PSR, 2018).

2.5. Natural gas demand. System Integration.

Natural gas is essential for the energy supply of the country and the energy transformation that the MME wants to promote. The demand for this energy resource has not grown significantly in previous years. One of the reasons noted is low confidence in its safety, reliability and competitive offer. It is necessary to identify alternatives to break this vicious cycle.

\textsuperscript{17} Proposal made in the second document of the report on the definition of the operating characteristics of the binding firm, the intraday markets and the balance sheet mechanism (U. Comillas \textit{et al.}-CREG, 2018).
The residential market is a market with vegetative growth, even though it shows an increase in connected users, it has also shown an important consumption decrease by households. Options that offer greater comfort to consumers, implementing better retailing strategies, should achieve better penetration of this fuel.

The demand in the industry has increased with the growth of the manufacturing sector, which has not been very high in recent years, and the relative better prices of coal which still does not face a carbon tax. The demand of the commercial, tourism and service sectors could increase significantly. Integrated strategies and efficient offers of natural gas and electrical services, even water, should help the growth of demand for this energy resource. The possibility of installing thermal districts can be an opportunity to increase gas demand.

Transport sector is the most attractive option that companies foresee for increasing demand of this fuel. The price advantages compared to those of liquids and electricity as well as less emissions of particulate material compared to liquids that do not use the latest technologies are important to seek greater participation in the cargo, mass and non-mass public transportation sectors. The consultant should identify the combination of energy, fiscal and regulatory policy instruments to facilitate the participation of this energy resource in the Colombian market (see Objective 2.6). It is worth noting that the Committee for Customs, Tariffs and Foreign Exchange (Comité de Asuntos Aduaneros, Arancelarios y de Comercio Exterior – Comité Triple A), lead by the Vice Minister of Commerce, recently approved the permanent reduction of 15% to 5% in the tariff of heavy cargo and passengers’ vehicles operating with cleaner technologies. Similarly, the Ministry of Environment and Sustainable Development (MADS) achieved the approval of the Higher Council for Fiscal Policy (CONFIS) of a reduction in the hybrid vehicles tariff (electric and fossil fuels), electric, and those that operate exclusively with natural gas. "These measures are part of a prevention and control policy for air pollution in Colombia led by the Ministry of Environment." (Legis, 2011)

Another aspect to evaluate is the deployment of intelligent measurement and its service integration, since it raises opportunities for integrated management of consumer information and may become a provided service (see IEEE - PES Magazine, January / February, 2017), in line with the purpose of modernizing the sector and the revenues discussed in Focus 5.

2.6. Institutional and regulatory aspects
The consultant will review market schemes in this industry and recommend legal or regulatory adjustments (style and practice), if appropriate, to have a more open and dynamic environment that encourages innovation and incorporation of changes in the energy industry under an efficient scheme.

With regard to the regulation of energy and gas, Naturgas (2017) points out that the "complexity and regulatory inflexibility limits the expansion and adoption of new uses or new supply quantities. Additionally, a more direct contact with the reality of the industry is needed as well as a regulatory impact analysis (AIR) that is valid at an international level". CREG is moving in this direction, this is
an aspect that will be reviewed in Focus 5. Any input that can be contributed from this perspective will be of great value.

With regards to environmental regulation, although up to now the carbon tax for natural gas and coal has not been contemplated in Colombia,\(^{18}\) neither is the price allocation for the use of water resources used in electricity generation, these payments will be a reality sooner rather than later, and we must take into account their impact on the formation of prices and the formation of the long-term generation market. The payment of the tax and/or the purchase of emission quotas (if the emission trade scheme, ETS is implemented in the country), plus the alternatives for offsetting emissions as contemplated in MADS decree 926 of 2017 in relation to "neutral carbon" certifications, are alternatives that should be considered to examine the competitiveness of the primary energy resources portfolio.

Likewise, the viability of a tax on particulate material must be considered in accordance with the health costs derived from the use of other, more polluting fuels. The document from the National Council for Economic and Social Policy (CONPES) on air quality has different proposals and commitments related to sustainable mobility, although not directly with the use of this type of instruments.\(^{19}\)

In the case of both taxes, it is necessary to take into account the emission of pollutants throughout the production and utilization chain. The consideration of all costs and benefits (and externalities) must give clear market signals of how the objective energy matrix is achieve.

3. Decentralization, industry digitalization and efficient demand management.

In the National Development Plan for 2018-2022, the National Government of Colombia, through the National Planning Department, explicitly recognizes the relevance of the global context of the electricity sector and establishes objectives aligned with that context. As the plan describes it, the three global trends that are currently transforming the sector are the electrification of the economy, the adoption of distributed energy resources and digitalization. These trends, if adopted appropriately, promise benefits for the country, including the increase in the diversification of

\(^{18}\) At the time of writing this report, the Ministry of Finance is contemplating the introduction of the carbon tax for coal.

\(^{19}\) Among the recommendations contained in CONPES document are: (i) modernizing the fleet through the addition of clean technologies and the disintegration of polluting vehicles. (ii) continue to improve the quality of petrol and diesel. (iii) implement tools to improve mobility in the cities through the use of tags on vehicles based on their technology. (iv) to reduce evasion of techno mechanical tests. (v) encourage the technological restructuring and innovation in the industry. (vi) improve the procedure of access to tax incentives for the purchase of less polluting technologies and emission control systems, as well as other funding mechanisms. (vii) increase the implementation of plans of prevention, reduction and control of pollution of the air, as well as strengthen the generation of information on emissions and air quality (https://www.dnp.gov.co/Paginas/CONPES-de-calidad-del-aire-contribuir%C3%A1-a-mejorar-la-salud-y-el-ambiente-de-los-colombianos.aspx ).
generation, competition, the "active participation of users and more players in the chain", and the impulse of "entrepreneurship, and innovation in the productive sectors and in the energy sector".

This Focus of the Mission will concentrate particularly on the adoption of these relevant trends for the players involved in electricity distribution and commercialization activities. In particular, the most technical issues associated with the distribution transformation and retail activities will be addressed in this Focus. On the contrary, issues more related with the structure, role and regulation of the institutions involved in the distribution and commercialization activities will be addressed in Focus 5.

In particular, the Energy guideline from the National Development Plan describes nine strategies, of which at least four will be addressed directly or indirectly by this Focus, including:

- the digitalization of sectoral data, ESCOS (energy services companies), advanced measurement infrastructure (AMI) and complementary services,
- enabling measures for the promotion of distributed energy resources (DER),
- efficient management of energy resources, and
- promotion of competition and development of decentralized businesses.

The digitalization of sectoral data, ESCOS, AMI and complementary services involve progress in:

[...] the definition of the sectoral data governance approach facilitates a harmonious data market between the user and other players, which is linked to the penetration of the advanced measurement infrastructure (AMI), as it is to the digitalization of the other uses that derive from this new market (Pact for Digital Transformation). (DNP, 2019)

From its part, the National Government "will support the development of energy services companies known as ESCO and will promote access to financial resources to implement Energy Efficiency (EE) measures in these sectors of the economy (Pact for Sustainability) ". (DNP, 2019)

In order to implement enabling measures for the promotion of distributed energy resources, the National Plan describes some measures of a more technical than institutional nature that will be addressed in this Focus. In particular, the following are measures to be considered by the MME, the CREG, and the UPME within its relevant competences for this Focus:

- Promote "the participation of the DER in the energy markets, through mechanisms that can group the flexibility offered by the prosumers and turn it into services for the electricity market". (DNP, 2019)
- "Incorporate energy storage systems into the National Interconnected System (SIN), increase the participation of distributed generation, the development of micro-grids, the participation of aggregating agents as new agents in the supply chain of electric power service, as well as the active participation of the demand ". (DNP, 2019)
• The CREG should "introduce mechanisms that promote decentralization and digitalization, as well as participation of demand response and hourly tariff schemes to promote price formation and competition in energy markets." (DNP, 2019)
• The CREG should analyze and implement changes such as price schemes that send signals of location of investment in Unconventional Renewable Energy Sources (NCRES), the promotion of distributed resources, and the remuneration of distribution networks with binomial rates (for example, that remunerate separately the energy components in kWh and power in kW).
• The MME will develop the studies and the review of the results against the tariff policy of distribution areas (ADD), taking into account, among other aspects, its articulation with DER promotion policy.

The National Plan clarifies the importance of implementing these measures in a coordinated manner and avoiding practices that harm users. To achieve this, the plan highlights the importance of coordinating the technical and commercial operations of the local distribution of electricity with those of the wholesale electricity market.

In relation to the efficient management of energy resources, the plan indicates that the UPME:

[...] will be in charge of identifying the necessary measures to manage the information associated with the use, saving and conservation of energy, with the aim of advancing actions in energy efficiency and focusing the saving efforts and technological substitution of the different sectors of the economy. This information will be public and will serve as an input to access resources for the development of energy efficiency projects. (DNP, 2019)

Finally, for the promotion of competition and the development of decentralized businesses, the National Plan stipulates that the National Government will have a role of possible relevance to this Focus in the development of the market for contracts and transactional platforms to lead the CREG:

In the PND (DNP, 2019), it is stated that "the national Government will facilitate the participation of more players in the provision of public services and complementary activities and will consider those companies that carry out activities different from the provision of public services, as long as there are no conflicts of interest and possible dominant positions " (DNP, 2019)

This mission shares the responsibility of determining the ways in which the National Government can play this role of facilitator effectively.

The advances in digitalization and decentralization of the sector mentioned above suppose a highly electrified economy with high levels of electricity consumption. This cannot be possible if the elements needed to migrate to an economy that consumes electricity efficiently and with the intensity required by the country’s economic and industrial development are not created. In this sense, the country also established mechanisms that until now are indicative, but which must be strengthened
to obtain financing and issue regulatory signals so that companies that are part of the provision service chain can implement new services aimed at the efficient management of demand (for example, hourly rates, energy efficiency schemes such as equipment replacement and voltage loss reduction, etc.) and users can make use of them because they represent real benefits.

Likewise, it is necessary to consider the gradual diffusion of embedded generation in the distribution networks and the connection of electric vehicles and storage systems to the network. The adoption of these technologies, which is already occurring massively in some systems around the world, possibly requires a new agent in the market or an extension of commercialization to fulfill the function of aggregation of distributed energy resources. Thus, this adoption requires a new regulatory framework that encourages an adequate transformation of Network Operators. Examples of important questions to consider for this transformation towards a more decentralized system include:

- What should be the role of distribution companies in the task of enabling improvements in the overall efficiency of the system and the competitive deployment of distributed energy resources and efficient demand management schemes?
- What changes can and should be made to the current regulatory framework (regulatory schemes, tariffs, retail market and incentives) to allow the agile introduction of new technologies and innovation, and to better align the distribution companies interests with the current administration energy policy objective of offer better prices for users?

These questions were a central guideline to focus the regulatory transformation in New York, called Reforming the Energy Vision (REV) that started in 2014. Similar questions raised in other markets will be addressed in this mission, as will be seen below.

Resolution 40072 of 2018 of the MME and its amendment "by which mechanisms are established to implement the Advanced Measurement Infrastructure in the public electric power service", as well as Resolution CREG 030 of 2018, "by which regulates the activities of small-scale self-generation and distributed generation in the National Interconnected System", are a sample of the recent initiatives aimed at promoting the digitalization and decentralization of the electricity sector in Colombia. These actions will continue in 2019, particularly with guidelines for the implementation of intelligent measurement infrastructure, which will be regulated by the CREG in 2019\textsuperscript{20} (according to the published Regulatory Agenda) in accordance with Resolution 40072 and Modifying Resolution 40483 of May 30 of 2019, both from the MME.\textsuperscript{21}

\textsuperscript{20} In fact, CREG has been working on the issue of AMI and published a technological analysis status report in the document CREG 077 of 2018.
\textsuperscript{21} In this last resolution, the MME: (i) extends the term CREG has for regulation of the implementation of AMI until April 15, 2020, (ii) establishes Network Operators (NO) as the first option responsible for the implementation of AMI (however, if the CREG finds that it must be another agent, it must support this decision for each case), and (iii) change the gradual implementation so that by 2030 75% of the users of each market are connected to an AMI system without making any difference between urban or rural users.
Despite the existence of these initiatives, privately and at the energy policy level of the National Government, there is a lag in the systematic, coordinated and efficient adoption of digital technologies and distributed resources with respect to global trends, which represents a valuable opportunity for the country. These trends have been driven by technological advances within and outside the sector, both in distributed energy generation and storage resources, and in digital information storage and management technologies.

In this context, it is necessary to establish policies and regulatory measures that encourage efficient adoption and facilitate the financing of technologies and services that enable digitalization and decentralization of the sector and encourage frequent and informed participation in the decision-making process in the short term (in consumption) and in the long term (in the adoption of technologies for consumption management, storage, or distributed generation). The policy, regulatory and legal measures should be reviewed. The participation of demand as an energy producer, the integration of distributed resources and new business models is a considerable departure from the legal frameworks developed in the 1990s. The new paradigm, which already facilitates technological development, is largely blocked by a legal and regulatory framework designed for large generation plants and the flow of energy in one direction. Hence, the consultant should review the legal adjustments necessary to structurally reflect that the industry of the future can no longer be compartmentalized in generation, transmission and distribution. Clear definitions of user protection, such as their right to produce energy, access to distribution services and different forms of market participation (both retail and wholesale) are fundamental rights. In particular, the consultant should review whether an incremental regulatory review scheme is sufficient to enable these new business forms, or if it is necessary to make profound legal changes.

As the MME points out, some of these enabling technologies or decentralized energy resources are platforms and applications of Big Data analysis, Internet of Things (IoT), intelligent measurement (AMI), energy storage systems, electric vehicles, load infrastructure, microgrids, distributed generation and blockchain. Other technologies that some distribution companies are considering and adopting globally to modernize and digitalize their distribution systems, improve the reliability of the service and facilitate the decentralization of the system include:

- Monitoring and data acquisition control systems (SCADA)
- Distribution management systems (DMS)
- Control systems and optimization of voltage and reactive power (VVC / VVO)
- Distributed energy resource management systems (DERMS)
- Interruption management systems (OMS)
- Fault location, isolation and service restoration systems (FLISR).

Due to the enabling role of these technologies and their cost, as illustrated in Figure 1 (below), the mission must also establish a methodology to determine the advantages of investing in these technologies for the final consumers, the distribution companies and for the country. Following the trend of other regions (Kristov, 2019), this methodology could be based, for example, on a [22] The CREG is working on defining specific penetration goals of some technologies by Network Operators (NO).
standardized cost and benefit analysis tool applicable to these technologies and designed specifically for the Colombian context. Likewise, the enabling framework that allows anyone who wants to use these technologies for the development of different and new business forms should be studied.

In accordance with the objectives and priorities established by this government in the National Development Plan and for this mission, the following is described below:

- **Goals:** The totality of the objectives (general and specific) of Focus 3.
- **The scope of Focus 3,** separated into two stages to be contracted sequentially:
  - A First Stage to be carried out during the first 2 months of the mission focused on (i) consolidating issues of this Focus with precedents in Colombia, and (ii) preliminary analysis of issues of this Focus without precedents in Colombia.
  - A Second Stage to start in July focusing on the integral execution of the topics (discussed upon the delivery of the First Stage and preparation for the delivery of the Second Stage) plus the resulting roadmap.
- **The experts will deliver the work plan for the execution of the activities associated with the two stages of this consultancy at the beginning of the contract.**

**Goals:**
The objectives proposed for this Focus can be categorized into topics to be consolidated and exploratory topics, based mainly on the existence or inexistence of considerable precedents in Colombia, respectively. The objectives to consolidate with significant precedents are the following four:

- 3.1 Modernization of distribution systems
- 3.2 Comprehensive planning of distribution systems (the least developed)
- 3.5 Streamline the process of distributed energy resources interconnection
- 3.6 Promote the efficient management of demand (specifically, demand response mechanisms)

The objectives in exploratory issues without significant background are the three remaining:

- 3.3 Increase visibility and transparency of distribution systems
- 3.4 Creation of a network service exchange platform
- 3.7 Reformulation of distribution tariffs to reflect the costs of the distribution system

The details of these objectives and their activities are described below (after the scope).

**Scope of the First Stage**
- **Short-term measures:** Document that reports the execution of all activities in objectives 3.1, 3.5 and 3.6. These activities are in particular a first series of recommendations and measures associated with the objectives of Focus 3, whose background in Colombia is considerable and therefore it is expected that they may be proposed, reviewed, and implemented in the short term (in a year or less). In particular, it is suggested that this report be developed by some of the members of the consultancy team and reviewed by others (*peer-reviewed*).
• **Partial analysis of exploratory topics**: Document that reports the partial execution of objective 3.2. In particular, activities 3.2.1 and 3.2.2 must be executed and reported with regards to the description of the legislative/regulatory framework and the current practical problems/barriers.

• **Report on previous topics** consolidates the generalities\(^2\) of the topics associated with objectives 3.1, 3.2, 3.5, and 3.6 and discusses their relevance in relation to the general objectives of this administration (greater competitiveness, reliability and environmental and social responsibility) with the objective of informing those who will implement the policies to be followed in the subject matter and the parties involved.

**Scope of the Second Stage**

• **Medium-term measures**. Document that reports on the execution of all the activities in objectives, in particular objectives 3.2, 3.3, 3.4, 3.6 and 3.7 (review of First Stage delivery and complete treatment of these objectives). This work will result in a series of recommendations and measures associated with the objectives of Focus 3.

• **White Paper with Focus Report 3.** Includes a *Peer Review*.

• **Road map for short- and medium-term measures**. Document that recommends a plan with approximate implementation terms for the short-term measures resulting from the First Stage and for the execution of the activities deferred from this Focus for the Second Stage, considering (and describing) possible dependencies among the different activities, objectives, and focuses.

In that order of ideas, the consultant should draw and deliver a **Work Plan** that describes the activities that will be developed in the two stages. It must include, at least, a description of the distribution of the issues, deliverables and tasks to be carried out among the members of the consultant team and the expected delivery times.

**3.1 Distribution System Modernization**

The consultancy should propose a policy to institutionalize and encourage the investment of distribution companies in the modernization of their systems in accordance with the following specific objectives:

3.1.1. Describe concisely the legislative and regulatory framework that currently governs investment in the modernization of distribution systems in Colombia and the way in which it promotes or hinders such investment.

• Compile and summarize the conclusions relevant to the topic and all pertinent studies that have been carried out in this area, especially those hired by official entities of the Colombian state.

• Identify the state of development of the network infrastructure and its technological deployment.

\(^2\)These generalities may include, for example, potential benefits, costs, enabling technologies, challenges, and associated lessons learned.
3.1.2. Accurately describe the practices employed and problems currently faced by distribution companies in Colombia to plan, execute, document, report and monitor investments in the modernization of distribution systems.

- Identify and document the practices employed and problems currently faced by distribution companies in Colombia to plan, execute, document, report and monitor investments in the modernization of distribution systems through surveys, interviews, meetings, or an alternative primary research methodology that covers a representative sample of distribution companies in Colombia. The DNP contracted a study with EY on behavioral and differentiating aspects of the service providers.

a) Propose a categorization of distribution companies registered with regulatory entities in groups that share similar intrinsic characteristics that result in similar conditions (for example, challenges) for investment in modernization. This categorization could, for example, consider and prioritize differences among the distributors according to:
   - its ownership model (public, private, mixed),
   - its size measured by the number of distribution customers (for example, less than 100 thousand, between 100 thousand and one million, and more than one million) and its urban and rural composition,
   - its territorial coverage (municipal, intra-departmental, multi-departmental, national),
   - the destination of their benefits (with or without profit),
   - its majority ownership,\textsuperscript{24}
   - the state of their finances, and
   - their collection risks.

b) Propose a representative sample of distributors that includes at least two companies of each identified category.

c) Propose a list of relevant questions about distributors for primary research identifying which ones require closed answers (quantitative or multiple choice), which are open and which a mixture of both. The questions should help identify the practices currently used by the distributors to plan, execute, document, report and track investment modernization.

d) Propose and execute a primary research methodology that responds to the questions identified for each of the distributors in the representative sample. The methodology proposed by default is completing surveys, telephone or personal interviews, but the consultant can propose some alternative methodology of primary investigation in case of considering it more convenient.

e) Analyze the responses obtained from each distributor identifying a list of sufficiently differentiable practices used in the planning, execution, monitoring, documentation, and reporting of investments for the modernization of distribution systems.

\textsuperscript{24}Try not to interview affiliates that share the same individual as a majority owner to obtain a more diverse sample of distribution companies.
are considered, especially those contracted by official entities of the Colombian state.

- Add, discern, tabulate (to the extent possible) and describe concisely all the practices identified in the previous activities, detailing the ways (similar or different) in which distributors of various categories use them.

- Discuss the possible causal relationships between the type or condition of the distributors (their category) and the practices employed by them.

3.1.3. Propose a series of methodological requirements, different for each of the categories of identified distribution companies, which guide the development of the distributors toward a modernization plan of the distribution system consider: (a) the energy sector vision outlined by the current administration in the "Pact for the quality and efficiency of public services" in the National Development Plan (DNP, 2019), (b) the global trends of the electric power industry there referenced (electrification, decentralization and digitization), (c) the general purposes of this administration (greater competitiveness, reliability and environmental and social responsibility), (d) the general regulatory objectives of the CREG, (e) the prioritization of such purposes and objectives, (f) the existing problems faced by distributors to modernize distribution systems (particularly those identified in section 3.1.2), (g) modernization of existing practices of distribution systems, (h) the financial feasibility and economic convenience of the changes proposed, (i) the technological advances for the modernization of distribution systems, including automation and network monitoring, and its maturation stages, (j) best practices and lessons learned internationally in terms of methodology and planning of investments in the modernization of said systems, and (k) the possibility of new technological requirements associated to new agents and business models proposed in this focus (such as aggregators and serial measurement points).

- Use lessons learned in other jurisdictions to elaborate a Guide of stages, processes and minimum requirements to be fulfilled by the distributors in the elaboration of a Modernization Plan of the distribution system. For this, it is suggested to use as a base the decision process described in the three volumes of the series Modern Distribution Grid of the US Department of Energy where seven stages are described for the elaboration and implementation of a modernization plan: (i) define objectives and attributes, (ii) identify functions of the network, (iii) develop an architecture of the network, (iv) develop the design, (v) select solutions (technologies), (vi) develop the plan, and (vii) implement the plan.

- Consider the work carried out in national initiatives (Smart Grids Colombia Vision 2030 and Colombia Inteligente), which has been focused more on the deployment of technologies and infrastructure than on regulatory aspects and market design. The Mission must recognize and build on these advances, incorporating them where appropriate and convenient in the seven stages described, applied to the Modernization Plan of the distribution system.

- Propose the planning period to be considered and the frequency with which the plan must be updated.

3.1.4. Formulate requirements and mechanisms that standardize and encourage the elaboration of plans for the cost-effective deployment of advanced measurement technologies (AMI), the
preparation of business plans that maximize the net benefit of the investment and the accelerated deployment of the measurement infrastructure to the extent that said acceleration generates added value for consumers (for example, in the form of additional savings).

3.1.5. Determine how the process of automation, supervision and control of operations in distribution systems should be given, considering the increase in the availability and flow of operational information.

3.2 Comprehensive planning of distribution systems (the least developed)

Specify a policy to institutionalize and effectively incentivize the use of efficient and comprehensive planning practices of distribution systems and networks by distributors.25

3.2.1. Describe concisely the legislative and regulatory framework that currently governs the planning of the expansion of distribution networks in Colombia and the way in which it considers non-traditional alternatives to mitigate the deficiencies or needs identified in the planning process.

- Compile and summarize the conclusions applicable to all relevant studies that have been carried out in this area, especially those hired by official entities of the Colombian state.

3.2.2. Accurately describe the practices employed and problems currently faced by distribution companies in Colombia to plan, execute, document, report and monitor investments in the modernization of distribution systems.

- Identify and document the practices employed and problems currently faced by distribution companies in Colombia to plan, execute, document, report and monitor investments in the modernization of distribution systems through surveys, interviews, meetings, or an alternative primary research methodology that covers a representative sample of distribution companies in Colombia. For this activity the same steps (a) - (d) specified for activity 3.1.2 must be followed.
- Conduct secondary research that complements primary research in such a way that all the relevant studies that have been carried out on the subject for Colombia are considered, especially those contracted by official entities of the Colombian state.
- Add, discern, tabulate (to the extent possible) and describe concisely all the practices identified in the previous activities, detailing the ways (similar or different) in which distributors of various categories use them.
- Discuss the possible causal relationships between the type or condition of the distributors (their category) and the practices employed by them.

3.2.3. Develop a guide to comprehensive planning of distribution systems that propose requirements (possibly differentiated for distributors in different categories) for the planning processes of distribution networks that standardize (or require) and encourage (or promote) the effective use of advanced practices that consider in a comprehensive, neutral and efficient way all kinds of solutions (traditional, non-traditional, own and external),

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25 Efficient and comprehensive planning refers to the neutral and indiscriminate consideration of all types of technologies, resources, practices and solutions (traditional, non-traditional and DER) as competing alternatives to meet the needs and deficiencies of the system and the distribution network identified in the planning cycles.
including those from DER, to supply all the needs and deficiencies of the distribution network identified in the planning process.

- An example is the guide for the elaboration of the *Distributed Implementation System Guidance Plan* that the regulators of the state of New York ordered to follow the six distribution companies that it regulates. This guide, available in NYPSC (2016), includes general requirements of administrative and technical processes for the specific distribution systems planning requirements and necessary content to include in each distributors plan.

- Highlight the need of improving the planning practices of distribution companies so that they incorporate different technological solutions (like storage) in their expansion plans.

3.2.4. Include in the previous guide a road map of requirements (possibly differentiated for distributors in different categories) for the processes of interconnection of DER that standardize, speedup, and encourage the cost-effective interconnection of DER in the distribution networks.

- These requirements must be coordinated with the existing requirements delineated by the UPME and the territorial agencies so that, altogether, all the requirements respond suitably to the local and national necessities of the electrical system.

- For the elaboration of these requirements, the consulting team must consider the advances of the international standards and must develop a road map of regulatory and technical actions to achieve the transition to integral planning.

3.3 Increase visibility and transparency of distribution systems

Propose a policy to institutionalize and to encourage the appropriate publication of detailed information regarding distribution systems (including the use of assets, the operation of the systems and the planning of infrastructure investment) that facilitates the generation of opportunities to invest in DER, the establishment of trade markets and the production of new business models. This policy must consider criteria for the protection and use of information that considers and balances the rights to privacy of the users of the distribution system and the infrastructure security that can be considered critical.

3.3.1. Expose in a concise way the legislative and regulatory framework that at the moment governs the report, publication of descriptive and performance geo-referenced distribution systems indicators on behalf of the distributors in Colombia.

- Include a description of the legal and/or regulatory framework that governs the treatment of information from the system agents, including companies deprived from information which can jeopardize the privacy of end users and critical infrastructure security.

- It is noted that Resolution CREG 030-18 includes excellent elements in this regard like, for example, to publish the state of the transformers on a page Web.

3.3.2. Synthesize and present/display the used practices and problems faced today by the distribution companies in Colombia for the report and publication of detailed descriptive indicators (at level of transmission, subtransmission, substations, circuits, assets of distribution of average and low tension, etc.) and of performance.
• Include used practices for collection, publication, use and commercialization of information of the distribution systems and consumption of the end users.

3.3.3. Propose and justify a list of descriptive and performance indicators (along with a spatial and temporary granularity) of the distribution systems that the distributors would have to collect and to report (access controlled if deemed necessary, by questions of privacy or security) with a specified regularity to encourage the investment and efficient adoption of DER and the creation of trade markets and new business models.

3.3.4. Evaluate the convenience of requiring the possible elaboration of interactive maps of DER hosting capacity and a plan of implementation of these maps through a pilot project that demonstrates the technological and economic feasibility of the practice.

3.3.5. Evaluate the convenience of requiring the possible elaboration of interactive maps that indicate the net benefits of DER location in the distribution network and a plan of implementation of these maps that begins with a pilot project demonstrating the technological and economic feasibility of the practice.

3.3.6. Study the convenience of establishing a confidential data treatment policy in the creation of planning data and an operation of the distribution systems that balance the access to free information with the purpose of favoring, among other aims, the development of the retail competition.

• As discussed in a decision of the California state regulator (CPUC, 2018), there are valid arguments for publishing limited information and data on the operation and planning of distribution systems. Based on the previous items (3.3.1 in particular), the consultant should analyze the convenience of establishing criteria for the confidential treatment and generation of information to be published, discussed in this section (3.3). These criteria should attempt to balance the potential costs and benefits (quantifiable or not) of acquiring and publishing such information with potential legal considerations. Some arguments discussed by the CPUC in the cited document include: (i) the individual energy use treatment by users of these distribution system as private information, (ii) the identification of data that may compromise electrical infrastructure considered critical, and (iii) the protection of information that may be considered a commercial secret.

3.4 Creation of a network service exchange platform

Draw up the preliminary design of a market for short and long-term network services - traditionally provided by the distributors through improvements to the distribution infrastructure in the long term and practices in the short term - that can be acquired from DER (through market mechanisms or regulated tariffs) located in the distribution network or behind the meters (in the consumers' facilities). This market should serve as a platform for exchanging these services between the established market administrator (regardless of whether or not this is the distribution company), DER, aggregators, prosumers, and even consumers, thus facilitating the creation of transaction markets and the innovation of business models in the network boundary (as in the grid’s edge).

3.4.1. Describe concisely the legislative and regulatory framework that currently defines the distribution services provided by distributors in Colombia.
3.4.2. Establish and define a set of distribution services that can be quantified and valued (through prices), which are associated with needs or regularly deficiencies identified by Network Operators and planners, and that have the potential to be supplied by DER (including measures of demand management).

3.4.3. Analyze the role and responsibilities of the operator of said distribution service market, the compatibility (or lack of compatibility) of this market operator with the multiple current roles of the distribution companies in Colombia, and discuss alternatives to make these roles compatible (including cases in which the roles are kept separate and cases in which they are combined in a single entity).

3.4.4. Analyze the advantages and disadvantages of allowing or prohibiting distribution companies from owning DER, and propose a policy to regulate the conditions under which distributors could be owners of DER.

3.5 Streamline the process of distributed energy resource interconnection
Propose a policy that reforms and encourages the simplification of the interconnection process of distributed energy resources.

3.5.1. Present in a concise way the legislative and regulatory framework that currently governs the process of interconnection of distributed generation and storage systems at all levels of the distribution systems in Colombia, and the way in which this framework facilitates or hinders the interconnection process.

3.5.2. Describe in a concise way the practices employed and problems faced today to execute said interconnection processes and the way in which these practices facilitate or hinder the interconnection process.

3.5.3. Propose a reform to the current regulation of the interconnection processes of distributed energy resources, possibly differentiated by the type and scale of the resource, that simplifies said processes and that encourages the streamlining of the distributor, considering the use of indexed incentives to performance indicators or some alternative mechanism.

3.5.4. Review best practices in terms of attention time and level of studies, or not, required for different types of facilities. Propose obligations in the interconnection regulations that use online computer systems to attend interconnection requests and that expedite the attention of different requests depending, among others, on their size characteristics.

3.5.5. Propose an articulation between the electrical industry and the National Electric Mobility Strategy (ENME), especially in the components of charging stations, regulations and batteries. The Annex summarizes this strategy, which seeks to accelerate the transition to this type of mobility in order to generate fewer emissions and use energy efficiently improving the quality of life for Colombians.

3.6. Promote efficient demand management
Propose a policy to institutionalize and effectively promote the implementation of an efficient level of demand resources management.
3.6.1. Present concisely the legislative and regulatory framework that currently governs the implementation or contracting of demand management programs by distributors in Colombia, including demand response and energy efficiency resources.

3.6.2. Accurately describe the practices employed and barriers currently faced by distribution companies in Colombia for the implementation or contracting of demand management programs, including demand response and energy efficiency programs.

3.6.3. Formulate a scheme or regulatory mechanism that regulates the deployment of demand management resources by distributors and effectively encourages the participation of demand response resources and investment in energy efficiency measures, considering the use of incentives indexed to performance indicators or some alternative mechanism.

3.6.4. Propose a regulatory mechanism to determine one or more quantifiable objectives that can be assigned to each distributor of demand management resources to be deployed, differentiated by resource type and by attribute (such as conserved energy and reduced peak demand) in the case that said differentiation is appropriate.

3.6.5. Examine the convenience of considering, in an integral and indiscriminate manner, traditional and non-traditional demand management measures (including efficiency measures of the distribution system) as possible substitute resources using appropriate methodologies to fully quantify the net benefits received by the distributor, its customers and society.

3.6.6. Delineate diverse channels to obtain, directly or indirectly through third parties, resources for demand management and mechanisms to compensate them, including, possibly, competitive bids, tenders, or other competitive mechanisms and programs administered by the distributors and dedicated regulated tariffs.

3.6.7. Consolidate the problems and inefficiencies that demand response resources may face in their participation in the Colombian wholesale market (including those analyzed in Annex 1 of CREG Circular 087-2018).

3.6.8. In order to mitigate the problems and inefficiencies identified in the previous activity, the consultant should propose and describe possible solutions to enable the participation of demand response resources in the wholesale market. These can be new or adapted solutions from other markets applicable for the Colombian case.

- A particular interest is to analyze when it is acceptable or convenient (or not) that the forms of participation and settlement of demand response resources are asymmetric with respect to those of the generators (for example, with respect to the prices used for settlement and the socialization of reconciliations).

3.7 Reform of distribution tariffs to reflect the costs of the distribution system

Present a reform and diversification of the distribution tariffs established for the different users of the distribution system that align with the principle of efficient cost distribution (that is, according to the causation) and with the prioritized principles of this reform.

3.7.1. Describe concisely the legislative and regulatory framework that currently governs the elaboration of regulated distribution tariffs to remunerate distributors in Colombia.
3.7.2. Examine tariff alternatives for the recovery of reform costs that will not be financed with external funds.

3.7.3. Based on the principles of tariff design, international experiences and current conditions of distribution systems in Colombia, propose adequate rates for the remuneration of distributed energy resources based on the net benefits generated and differentiated according to the location in the distribution network and the voltage level of the interconnection.

3.7.4. Propose a reform to the flat rates currently used in Colombia, a set of differentiated or appropriate dynamic rates for regulated users, and recommendations for the adoption of dynamic rates on a voluntary or mandatory basis in the short, medium and long term.

3.7.5. In the case of voluntary dynamic rates, consider the convenience of using incentives indexed to performance indicators or an alternative mechanism for distributors to encourage the adoption of such rates.

4. Closing gaps, quality improvement and efficient subsidy design and formulation

Although electricity service coverage is currently over 97% in the country, there are more than 400,000 homes without electric power service (431,137 in 2017, according to the Indicative Plan for the Expansion of Coverage, Plan Indicativo de Expansión de la Cobertura, PIEC by its Spanish acronym; UPME, 2018). The reduction of this service deficit with adequate quality levels has always been one of the purposes of public policy and is an indispensable element to fulfill the purposes of the Development Plan of the current Government, as well as the Sustainable Development Goals (SDG). The estimated cost to achieve a total basic coverage of the electric power service is 5 trillion pesos, and to have standardized networks and adequate quality levels, another similar amount is needed (UPME, 2014).

To efficiently move forward increasing coverage, as established in the PND (DNP, 2019), it must be taken into account, in addition to an energization approach (and not only the network extension, that has not managed to transform the conditions of production and quality of life of the populations), the new technological developments available, such as microgrids with energy services, water pumping and irrigation. In addition, communication systems to monitor the microgrid and facilitate self-repair, detection and reporting of operational problems, and sustainable business schemes, are required.

The UPME has developed a regional approach through the Sustainable Rural Energization Plans (Planes de Energizacíón Rural Sostenibles, PERS by its Spanish acronym), which include agreements with local managers and strategic alliances, as well as national and international cooperation. To date, 6 PERS have been completed in Nariño, La Guajira, Tolima, Chocó, Cundinamarca and Putumayo,

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26 The information provided by the DNP and UPME, the comments of the Institute of Planning and Promotion of Energy Solutions for Non-Interconnected Areas (Instituto de Planeación y Promoción de Soluciones Energéticas para la Zonas No Interconectadas, IPSE by its Spanish acronym) and the suggestions of Catalina Rueda, Laura Ruiz, Jose Camilo Manzur, Edwin Cruz, Marcela Bonilla and Rutty Paola Ortiz are gratefully acknowledged.
and 3 PERS are in execution in the Orinoquia (Vichada, Casanare, Meta, Arauca), Cesar and in Norte de Santander (UPME, 2019).

The coverage of combustible gas in 2017, according to the Gas Coverage Expansion Plan (Plan Indicativo de Expansión de Cobertura de Gas Combustible, PIECGC by its Spanish acronym; UPME 2017), was of 9.3 million users connected by natural gas networks, 2.1 million Liquefied Oil Gas users (LPG) per cylinder and 90 000 users connected to LPG through network. Increasing this coverage requires focused efforts on resources investment so that they are oriented according to the needs of the territories and the population that still does not have public energy and gas services.

It is noteworthy that currently about 982,000 households cook with firewood or charcoal (see document CONPES 3934, 2018), the vast majority in the rural sector. Cooking with wood or charcoal, especially in the way it is carried out (inadequate conditions, very low levels of combustion efficiency and without emission control), has negative effects on the health of the exposed population. According to data from the study on health effects and costs associated with air pollution, conducted by the World Bank in 2012, it is estimated that the average annual cost of health impacts from indoor air pollution associated with the use of traditional fuels (mainly firewood) in rural areas of Colombia is 1.129 billion pesos (0.22% of GDP in 2009) (Ministerio de Ambiente y Desarrollo Sostenible, 2015). In order to mitigate this situation, among other actions, it has been proposed to implement more efficient cooking systems to improve ash emission evacuation and control systems. Likewise, it is necessary to carry out programs of firewood substitution with other energy sources, such as gas or electricity.

The PND (DNP, 2019) establishes, among other actions, that "MinAmbiente, in coordination with the environmental authorities, will establish a national program to replace wood stoves for more efficient ones". In the same document, in the "Pact for the quality and efficiency of public services: water and energy to promote the competitiveness and well-being of all", it is said that "Through FENOGE, MinEnergía [...] will structure a wood and coal substitution program for LPG, together with the program for more efficient stoves and wood-burning orchards led by the MinAmbiente (Pact for Sustainability)."

The UPME is carrying out a study to design a firewood substitution strategy as an energy source for the residential areas of Colombia. The aim is to reduce energy poverty and the impact on health and the environment because of the use of firewood as an energy source.

Regarding the quality of the service, a report from the Superintendency of Public Services (2017) indicated that: "[...] the results shown in the Diagnostic of the Quality of the Electric Power Service in Colombia [2016] made by the Superintendency, evidenced that there are significant opportunities for improvement in terms of quality". The regulation has been modified in the direction of giving better signals and incentives to achieve these opportunities, identified in Resolution CREG 015 of

\[\text{Within these costs, infant mortality represents 6%; female mortality, around 78%; acute respiratory disease (ARD) in children and adult women and COPD morbidity in adult women, 16%} \] (Ministerio de Ambiente y Desarrollo Sostenible, 2015).
2018, which establishes the methodology for distributing electricity in the SIN. The consultant should verify if this regulatory proposal is sufficient and adequate to improve the quality of the service. The consultant is asked to evaluate regulatory schemes based on results and their possible favorable effects. In Focus 5 the difficulty of disseminating innovative schemes in the distribution companies will be analyzed and proposals for regulatory schemes will be made to facilitate them.

In the Colombian electricity market, there are two (2) funds that have the objective of granting subsidies to the demand (FSSRI and FOES) and three (3) funds that have the purpose of granting subsidies to the offer (FAZNI, FAER, PRONE). This proliferation of subsidy funds has been exercising, from the side of the demand, a growing and probably unsustainable fiscal pressure on the Nation’s General Budget (PGN). On the supply side, there is lack of efficiency in the price conformation assumed by the end user because the FAZNI, the FAER and the PRONE are financed with cross subsidies by charging fees paid by SIN users. These funds were created on a temporary basis and have been extended without pause. The National Development Plan (PND, by its Spanish acronym) extended the validity of the FAZNI, the FAER and the PRONE until 2030, when it is planned to reach service universalization.

In the case of combustible gas, there is the Special Fund for the Promotion of Natural Gas (Fondo Especial Cuota de Fomento de Gas Natural, FECF by its Spanish acronym), which promotes the development of natural gas distribution networks in areas of influence of the main gas pipelines and contributions of PGN for the construction of LPG (Liquified Petroleum Gas) distribution networks.

Other resources that are not exclusively destined for energization projects, but are available sources destined to finance offer, are added to these funds, such as the General Royalties System (Sistema General de Regalías, SGR by its Spanish acronym), FENOGE, works for taxes, work for royalties and the fund Plan Todos Somos PAZcífico. The multiplicity of sources is accompanied by a diversity of criteria, decision instances and access mechanisms.

According to the problem identified and what is established in the PND (DNP, 2019) in this Focus the consultants will face two main challenges that will be advanced according to the scope described below.

The first challenge is to assess the status of the energy supply policy (electricity and combustible gas) in terms of coverage, quality and the achievements or difficulties to advance in the goals set. The incentives provided by the regulation for private initiatives, the scope of existing funds for public initiatives, and the effectiveness and efficiency in reaching its objectives to achieve the goal of universal service and international quality standards in 2030 will be reviewed. Additionally, the consultant team should consider in their analysis the new technological trends and their impact on the distribution at the urban level and the possible elimination of the pre-established limits between what are called rural areas of the SIN and the Non-Interconnected Zones (Zonas No Interconectadas, ZNI by its Spanish acronym). Similarly, the energy complementarity should be analyzed seeking to optimize investments in the same zone or community. From there, the team must propose an update and adaptation of the policies required.
The final goal of this challenge is to find new schemes and proposals to improve universal coverage and meet the objectives set out in the SDGs.

The second challenge is to evaluate the contribution balance and subsidies from the Solidarity Fund for Subsidies and Incomes Redistribution (Fondo De Solidaridad Para Subsidios y Redistribución de Ingresos, FSSRI by its Spanish acronym), analyze the best way to focus the subsidies, in agreement with support given to other services, and analyze the impact of dismantling the contributions and the trajectory proposals of the subsidy dismount. The FOES and their application to the Special Areas must be taken into account. The subsistence consumption must be evaluated to determine the reasonable levels and to evaluate the possibility of granting a unique subsidy to the energy consumption.

4.1. Coverage increase for gaps closure
In the country, important efforts have been made to expand the supply of energy and electricity to all households and improve the quality and continuity of the service. Different strategies have been conceived to achieve an increase in the coverage of energy services, which are mentioned in: (i) the National Energy Plan (Plan Energético Nacional, PEN), (ii) the Indicative Electric Power Expansion Plan (Plan Indicativo de Expansión de Cobertura, PIEC, de energía eléctrica), (iii) the Indicative Plan for the Expansion of Combustible Gas Coverage, (iv) the Sustainable Rural Energization Plans (Planes de Energizacín Rural Sostenible, PERS), (v) the Plan Todos Somos PAZcífico (PTSP), and (vi) the National Rural Electrification Plan (Plan Nacional de Electrificación Rural, which is a post-conflict plan). These planning instruments are mostly issued by the UPME, which ensures the consistency of the lines of action of each proposed plan and strategy.

At the financing level, there is also a diversity of funds and financing schemes to achieve the coverage goals, among which we can mention: (i) the Financial Support Fund for Energization of the Interconnected Rural Areas of the SIN (Fondo de Apoyo Financiero para Energización de las Zonas Rurales Interconectadas del SIN, FAER), (ii) the Financial Support Fund for the Energization of Non-Interconnected Zones (Fondo de Apoyo Financiero para la Energización de las Zonas no Interconectadas, FAZNI), (iii) the Special Development Fee Fund (Fondo Especial Cuota de Fomento, FECF) for gas, and (iv) the General Royalty System (Sistema General de Regalías, SGR). There is also the possibility to access resources from: (v) PTSP, (vi) from Findeter, and (vii) from the program for LPG (PGLP, by its Spanish acronym). And there are resources that remain to be mentioned: (viii) from the PRONE, (ix) from the Social Energy Fund (Fondo de Energía Social, FOES), and (x) from the Nonconventional Energy Fund and Efficient Energy Management (Fondo de Energías No Convencionales y Gestión Eficiente de la Energía, FENOGE). In the same way as in the case of planning instruments, there is a diversity of funding sources and, therefore, criteria to gain access to these

28 The National Rural Electrification Plan was formulated in coordinated work by the Ministry of Mines and Energy, the UPME and the IPSE (Instituto de Planeación y Promoción de Soluciones Energéticas para las Zonas No Interconectadas. Institute of Planning and Promotion of Energy Solutions for Non-Interconnected Zones). The information that was taken as the basis for the formulation of the PNER was from the Indicative Expansion Plan for Electric Power Coverage, PIEC 2016-2020 of the UPME. This Plan establishes universal electricity service coverage by 2030, being fully aligned with the Sustainable Development Goals (SDG).
different resources. Applications for approval are not submitted to the same entity, although the UPME and the IPSE (Instituto de Planeación y Promoción de Soluciones Energéticas para las Zonas No Interconectadas, Institute for Planning and Promotion of Energy Solutions for Non-Interconnected Areas) play a significant role in the process of study and viability of the projects.

The consultant should verify the progress in terms of electricity and combustible gas coverage at the urban and rural levels and identify the main obstacles to reach the increase coverage goals that have been raised in the different plans. The group should analyze the goals established by this Government in the PND Basis (DNP, 2019) and propose the tools and resources necessary to achieve them, including the alarms of the case regarding possible difficulties, or indicate if technically they are not possible goals for the stipulated time.

Regarding electrical coverage, the consultant should evaluate new mechanisms to reach universalization of the electric power service by or before 2030, the date on which, in accordance with the articles of the Plan, the FAER and the PRONE expire (FAZNI remains in effect) or propose a coverage goal for 2030 if universalization is not feasible. The consultant should also identify the impact on subsidies by increasing coverage.

With regard to natural gas, it is gradually expanding towards rural areas as users of urban areas connect to this service. The distribution of natural gas to these rural area municipalities is done through virtual gas pipelines, which are trucks that transport compressed natural gas. The goal is to continue connecting users to the extent that it is an efficient alternative to the LPG option, which would be available in small and/or distant locations, as well as in rural areas of low population concentration. Notwithstanding the foregoing, according to the calculations made by UPME, the number of LPG users has an evolution contrary to natural gas, which shows a 25% decrease between 2005 and 2016, going from 2.83 to 2.12 million residential users nationwide. For the year 2016, it is recorded in the SUI-SSPD that LPG was consumed in 1043 municipalities distributed in the 31 departments of the country and Bogotá. 37.6% of users are concentrated in the departments of Antioquia, Nariño and Cundinamarca (not including Bogotá).

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29 The IPSE states that, although the criteria established in technical and financial requirements for the formulation of projects to access resources of the FAZNI, FAER and SGR funds have similar characteristics in general terms, particularities are given by the type of solution alternative and the intervention zones (environmental, social, economic, financial and technical restrictions). The Ministry of Mines and Energy, UPME and IPSE, are working on the standardization of these requirements for the presentation of projects that seek to be financed with FAZNI and FAER funds. Regarding the prioritization criteria for allocation of resources, they are defined, for each fund, seeking alignment with the expanding coverage public policy, and thus comply with the Government’s Plans.

30 For projects that have a favorable technical and financial viability concept, the resources are approved by the Management Committee of each Fund. In the case of the FAER, the Committee is made up by the Minister of Mines and Energy, who presides it or his delegate, the Vice Minister of Energy or his delegate, and the Energy Director of the Ministry of Mines and Energy. In the case of FAZNI, the Committee is made up by the Minister of Mines and Energy, who will preside it or his delegate, the Vice Minister of Energy or his delegate, and the Director of UPME or his delegate.
The consultant should also evaluate the efficiency in the use of funds applied to gas and the effectiveness of these schemes to improve the living conditions of the population.

In all cases, a monitoring scheme should be recommended accompanied by an information system that records the different investments made, operating and maintenance expenses, and that facilitate the management of the assets. It should be verified, according to what is established in the regulation, the scope of private participation (ASE, new models such as APP and adjustment in the regulation to incorporate decentralized assets in the remuneration of the Network Operators –NO—, among others).

The team should also review the regulatory barriers for the implementation of energy solutions that make use of new technologies and supply schemes that do not correspond with traditional technological and commercial systems and propose solutions to remove them. In addition, if the public offer contemplates the provision of different services in a coordinated manner, it is necessary to adapt the regulations. There are a significant number of requirements to organize the provision of a service that could be excessive or inflexible when it comes to individual solutions. These solutions or others of greater importance cannot receive support from the funds if they are not organized as Public Service Companies (Empresas de Servicios Públicos, ESP). Today there are providers that serve users in business schemes without fulfilling requirements such as ESP; they are viable schemes (as they say), but they lack sufficient capital (in some cases) to continue their expansion. It is important to review what the scope of the regulation should be (if it should establish rules for all types of services offered, or if it should be limited to the tariff regulation that serves as a basis for the determination of subsidies —efficient levels— when companies submit applications).

The consultant should evaluate the possibility of including the investments required to expand coverage (and normalize networks, subject of objective 4.2) in distribution remuneration methodologies based on long-term average costs and take into account the elements of the tariff methodology for the ZNI. In particular, the consultant will evaluate the alternative of allowing Network Operators to contribute to the coverage expansion through isolated centralized or individual solutions and micro-grids, in the area of influence of the retail markets of the SIN, which would contribute, in the context of the Pact for Equity of the PND, to gradually eliminate the pre-established limits between the SIN and the ZNI in a sustainable energy solutions framework. The foregoing must be in accordance with what is defined in the PND Basis (DNP, 2019): "It will promote the use of energy and meet the needs of remote areas, the development of micro-grids and other schemes that allow inclusion within the positions recognized by the CREG expansion of coverage projects with or without connection to the network." Likewise, it should evaluate the pertinence of continuing with the scheme of the Distribution Areas (ADD) in a context of benefit/cost analysis and in accordance with an adequate transition.

In the PND, it is proposed to do:

[...] a reengineering of the existing funds to support the expansion of coverage, like FAZNI, FAER and FECFGN [Fondo Especial Cuota de Fomento de Gas Natural, Natural Gas...
Development Fee Special Fund], so that they are oriented to the development of the extension of coverage with a new concept of covering energy needs with an integral vision and sub-regionalization, which incorporates the particularities of indigenous territories, Afro-Colombian communities and stabilization zones, among others.

The FOES and its application to the Special Areas must be taken into account. The consultant will recommend the criteria to gain access to the resources of the different Funds.

The IDB has contracted two studies to examine the policy, resource management, information and sustainability aspects of the solutions for the ZNI. The final report of the first study, that included the first three topics (Ortiz et al., 2019), did an integral analysis of the institutional framework that governs the Colombian electricity sector for the ZNI in order to propose a road map of the adjustments necessary for the State to comply with the objective of guaranteeing the reliability of the supply of electric power in these areas, the sustainability of the proposed solutions and the incorporation of NCRES and new schemes for providing the service. In this work it was found that: "the energy coverage increase will be achieved through infrastructure projects and sustainable delivery schemes, for which institutional capacities are needed in accordance with the development of these projects. In this sense, it is proposed to strengthen and specialize the entities of the sector."

The study recommends three types of actions. The first one is to concentrate the planning and feasibility of projects in UPME in order to maintain a sectoral integral activity for planning, and to guarantee the adequacy between what has been planned and what will be executed. It is stated that "having an exclusive viabilizer guarantees the uniformity of criteria regarding the universe of projects to be executed, gives clarity and transparency to the interested parties and facilitates the risk control system of the sector." The consultant should review the integration of UPME's coverage plans and their coordination with other agencies to improve the supply of other public services and goods in rural areas and ZNI.

The second major recommendation is to restructure and strengthen the IPSE31 to be the entity responsible for structuring and executing projects of high technical levels and with a broad understanding of the challenges of working with communities, using local sources, estimating potential lawsuits, designing of business schemes and of performance monitoring programs for energy solutions. IPSE has been making efforts to move in this direction. In addition to these results, the consultant should evaluate the possibility that the projects structured in the renewed IPSE will not be strictly for electricity supply but will consider other energy sources such as natural gas and LPG that, although they are not local sources, would improve the energy supply to meet different uses efficiently. It must also make recommendations to coordinate the development of other public services projects and improve the local offer of public goods in these areas.

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31 The function of the IPSE is to identify, promote, encourage, develop and implement energy solutions through efficient business schemes, being financially viable and sustainable in the long term, seeking the satisfaction of the energy needs of the Non-Interconnected Zones (ZNI) and technically supporting the entities defined by the MME.
The third recommendation refers to the creation of an Information Manager that provides reliable information on: calculating coverage rates, investing in assets and their status to facilitate their management, evolving the demand for electric power and energy efficiency actions, and advancing in the reduction of the unmet indices needs for improving the living conditions of the population in these areas. The consultant should review the scope of this manager and consider if the integration of these services is feasible as well as the expansion of the proposed functions.

The second study contracted by the IDB, in progress, will make a proposal on the sustainability of energy projects with non-conventional sources of renewable energy in non-interconnected areas. It should seek to recommend aspects and criteria to ensure sustainability of the solutions after coming into operation. The sustainability schemes, as indicated by the PND, should consider training the local community in accordance with the provisions of the Plan for Framework Implementation (Plan Marco de Implementación, PMI by its Spanish acronym). After reviewing the aforementioned studies, the consultant must make any adjustments or recommendations that are considered pertinent. The consultant should review the proposed options, as well as any interesting international experiences that are applicable to the Colombian context and situation.

In the PND (DNP, 2019) it is established that the National Government will seek to increase coverage (and improve quality) in the provision of public services to "close the gaps and aid the development of territories with a comprehensive energy vision of the available resources and the long-term sustainable provision of the service". In particular for the ZNI, according to what is established in the PND, the consultant will have to review the World Bank studies\textsuperscript{32} for ZNI\textsuperscript{33} and, if it is the case, it will have to suggest the levels and “benefit service ranks in agreement with the conditions of the population, their necessities, the number of beneficiaries and the installed capacity required to supply in a sustainable form these service benefits.” (DNP, 2019)

4.2. Improvements in service quality

Technological change has turned the quality of electric power service into a fundamental component of electricity as a productive factor. Therefore, the energy service quality indicators and its behavior become an early indicator of the electric power provision service within the framework of productivity, on the one hand, and on efficiency in the signals of economic regulation, on the other.

The consultant should evaluate the reasons for the service quality lag in different markets in the country. This evaluation must incorporate an effect analysis of the regulatory signals given on service quality in the current regulation and analyze whether with the incentives offered in CREG Resolution 015 of 2018, the SAIDI and SAIFI indicators can be improved and made comparable with

\textsuperscript{32} Beyond Connections: Energy Access Redefined (2015) and Action Plan to complete electrification in the department of La Guajira (Plan de Acción para completar la electrificación en el departamento de La Guajira, 2018).

\textsuperscript{33} It is also suggested to review the Investment Banking study carried out in 2016 for the structuring of business schemes to expand the coverage of electricity in Non-Interconnected Areas.
international values. In the aforementioned Resolution 015, a change was made in the distribution of asset remuneration methodology when going from a Net Replacement Value (NRV) scheme to a Depreciated Optimized Replacement Cost Model (DORC), which includes an investment plan with a limit to the annual increase.

The consultant should also verify to what extent it is possible to improve the quality in rural, non-interconnected and special areas. This must be done in accordance with: (i) what is established in the regulation, (ii) the scope of private participation (adjustment in the regulation to incorporate decentralized assets in the remuneration of Network Operators, among others) and (iii) the resources available in the funds (FAZNI, PRONE and FAER).

In order for the SAIDI and SAIFI indicators to be comparable at the international level, the consultant must estimate the Colombian indicators in an equivalent way to how it is done in other countries. The service quality analysis in different regions of Colombia from the perspective of the SAIDI and SAIFI indicators must be carried out taking into account groups of companies with similar characteristics regarding the quality of service of electricity distribution companies in the country. Thus, it is appropriate for the consulting team to review and deepen the quality analysis among companies, considering groups of comparable companies and the characteristics of the markets they serve. Among other features, the consultant should check:

- Market size and user dispersion
- Topology and type (aerial or underground) of networks
- Correlation between quality and underground networks
- Level of Rurality
- Geography
- Market commercial characteristics (willingness to pay, accessibility, management difficulty, %NBI, etc.)

The consultant should also propose a goal for 2022 (e.g., quality of service indicators compared to the levels of the countries in our regional environment, as is the case of Brazil and Chile) and another by 2030 and evaluate the costs of reaching the proposed goals. The team should also propose a monitoring and verification scheme for achieving these goals taking into account the problems and the warning signs to identify, according to the case. The information relating to Resolution CREG 015 of 2018 must be met, where quality goals are established according to reasonable budgets.

The Scheme to monitor the service quality of electrical energy proposed should help to verify the fulfillment of the quality goals within the investment plans framework for Network Operators to develop. In this way, service quality will become the main inductor to encourage investments and replacement of assets within the framework of the new regulation, and for the following tariff periods.
In the context of a follow-up to the quality of the service provided by supply companies, current information systems (case of the SUI) should be evaluated as tools for control and surveillance of service quality features.

From the statistical analysis of data, the consultant’s proposals should contribute to establishing a scheme of competition by comparison, if deemed reasonable. That is, finding a set of “groups of comparable companies” where homogeneity criteria among peers allows the use of a monitoring tool for service quality in the country which contributes, subsequently, to establish the regulatory settings needed to close the gaps between groups where it is technically and economically feasible. The comparison of SAIDI or SAIFI indicators by similar company groups according to the composition of markets between urban and rural areas, among other things, can be good information for regulation, supervision and the implementation of a control scheme.

Finally, in the context of international referencing, in the English market, for example, the initial ceiling price mechanism for natural monopolies (T&D) evolved into the model of income RIIO (Revenue = Incentives + Innovation + Outputs), which balances the objectives of achieving low costs and introducing new network services with sufficient income. The consultant shall assess, in the context of designing incentives for distribution companies, if a scheme like this would achieve that by 2030, quality results should be consistent with international standards of OECD member countries.

4.3 Design and efficient subsidy formulation

Taking into account the role that demand subsidies have had, on the one hand, to ensure the effective enjoyment of utilities by all consumers and, on the other hand, for the financial viability of the companies, it is necessary to review the current design for effectiveness and sustainability of demand subsidies that exist in the sector, in particular subsidies from the Fund for Subsidies and Incomes Redistribution (FSSRI) and the Social Energy Fund (FOES).

The International Monetary Fund (IMF), through its Department of Public Finance, undertook a mission in Colombia between March 27 and April 9 this year in relation to subsidies in the energy sector. The mission evaluated impact on coverage, tax savings and escalation of several proposals for targeting and recommended, among others things to: (i) reduce 10% of additional subsidies for strata 1 and 2 and eliminate the subsidy to the stratum 3 (low tax savings, mildly progressive, high coverage); (ii) cross stratification with SISBEN or other socio-economic indicators (mid tax savings, progressive and mid coverage with the best focus); or (iii) migrate to a monetary support mechanism, like Familias en Accion (high tax savings, progressive, low coverage with better focalization).

If these recommendations of the IMF are taken into account, the DNP identifies it is necessary to advance the following actions:

(i) analysis of the enterprise architecture of the Superintendency, including water and sanitation. (ii) adaptation of the SISBEN form to include the mechanism for measurement and establishment of the

34 We are grateful for comments from the DNP and MinHacienda.
score that should be applied to public services. (iii) analysis of technical requirements and a pilot exercise of SISBEN - SUI database intersection. (iv) adaptation/modification of technology platforms to facilitate interoperability. (v) amendment of regulation required for energy and gas billing to begin to capture information from the inhabitants (basically include the identity card of the person living there, not the landlord), for it to be cross-referenced with the SISBEN. (vi) design a socialization campaign for users and companies.

In Law 1955 of 2019, PND 2018-2022, incorporated the subsidies article that keeps an additional 10% subsidy on levels 1 and 2, but additionally included a clause that gives the Government the faculty to cross-reference the stratification variable with an income indicator, like SISBEN.

4.3.1 Subsidy Targeting

From the previously raised and given the vision of the Government, it is necessary to analyze three phases when granting of subsidies: (i) subsidies by strata while in junction with the SISBEN, (ii) subsidies to beneficiaries determined by SISBEN managed by service companies, and (iii) subsidies granted directly to consumers. It is important that the analysis take into account the issues raised for the targeting of subsidies in public services, that is, assign public resources to those who really need them. Also, it is necessary that the recommendations are accompanied by an impact analysis (tax, users through rates, companies) and that these recommendations do not affect the outsourcees if they continue as a vehicle in the delivery of subsidies.

For the settlement of home utilities, the PND (DNP, 2019), in the two initial stages recommended the "use the official billing report of the SUI as the only means of information for the conciliation of grants coming from the Solidarity and Redistribution Income Fund (FSSRI)." This recommendation should also extend to the FOES. The consultant shall review the viability of this reporting scheme as the sole source of information for the allocation of subsidies, taking into account studies on quality of information of the SUI by M&Q, hired by the IDB, and propose actions of monitoring and verification, for which the SSPD, before December 31 in 2022, should carry out the adjustments that are necessary in such a way to ensure reliability, traceability and timeliness of the information. Equally, the consultant shall recommend additional channels to provide the information necessary for the evaluation of granted subsidies.

Here, the consultant it is required to provide an analysis of the recommendations of the different studies, in particular of the recommendations of the Mission of the IMF, and studies conducted by DNP (REDI subsidies, 2014; analysis of subsidies - ) Marcela Melendez, 2017) and recommendations on public policy of subsidies (ECSIM, 2018).

**Information crossing**

The consultant shall propose a roadmap so that the Government can adopt the cross-reference stratification methodology elaborated by the DANE in 2010 with SISBEN (some indicators of

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35 Consulting services for the structuring and formulation of the strategical and methodological framework for the management of quality of information reported to the single information system (SUI) for electricity and combustible gas services. (In course)
household income) for the definition of beneficiaries. As established by the PND, "measures allowing crossing of information between strata and other indicators will measure the level of poverty or low income, extending this methodology to users of irrigation districts and other subsidies allocated to the consumption of public utilities" will be proposed.

PND considers an adaptation of the SISBEN form necessary to include the measurement mechanism to establish the score that should be applied to public services. So far, information crosses have been made with an approximate SISBEN score relating to health and education, but with the implementation of the strata, it should have its own score. Is also necessary to assess required regulatory settings so that the billing of energy and gas begins to capture information from the inhabitants of the household (basically include the identity card of the people living there, not that of the owner of the property) so that it can be cross with SISBEN.

It is necessary to evaluate the options for crossing data with the SISBEN-SUI database. Following the text in bill 186 of 2016, filed in a parliamentary procedure in Congress, a consultancy was contracted with the IDB to advance an analysis of the SUI data quality of the energy and gas sectors. The purpose of this consultancy is to advance in the interoperability of the SISBEN and SUI systems.

Pilot exercises
The new proposed subsidy allocation scheme should contemplate the implementation of pilot projects in some markets that consider the operational changes in the company processes and in the user's culture, as well as take into account transition mechanisms for adapting to a new subsidy allocation scheme. The above with adjustments that the MME and the consultant consider relevant to improve subsidy targeting.

4.3.2. Subsidies to energy consumption
The consultant should examine the feasibility of granting a single subsidy to energy consumption in households, according to possible market supply (electricity, natural gas and LPG) and integral subsistence consumption, which UPME would estimate. Additionally, for this proposal the consultant should consider trends in terms of demand participation, new energy generation technologies and business schemes (for example, self-consumption, mini-grids or integral solutions), versus the design of a single subsidy. Likewise, it is essential to recommend how to 'pass' energy efficiency signals and actions (equipment with compliance standards, etc.) to avoid inefficient subsidies.

In the same way, and considering the role that demand subsidies have played in the provision of financial sustainability as a determining factor in the viability of operators, the consultant should analyze the implications of a transition from traditional subsidies to an energy consumption subsidy aimed at users and whose administration will depend exclusively on them.

Delivery and subsidy administration
The consultant should examine the options for granting subsidies directly to consumers, as is the case with Familias en Acción, as opposed to delivery through distribution companies, or other delivery mechanisms. Having a comprehensive subsidy for energy consumption will challenge this
alternative. It is necessary to evaluate the impact of any of these alternatives on companies. A good example of a pilot to review is the LPG subsidy program conceived and implemented by the MME.

The proposal should ensure that users that are not organized through (ESP), but in energy communities or other forms, can receive energy consumption support.

**Amounts and subsidy temporality**
The consultant should recommend subsidy percentages to be granted for the different income levels and strata and their temporality. It is necessary to evaluate all options to reduce the fiscal burden and to be fiscally sustainable.

**Use of monitoring and subsidy impact**
The consultant should propose a methodology to evaluate the use of subsidies that are granted and their impact on improving the living conditions of the population. The consultant should analyze the effectiveness of current subsidies in terms of design, targeting, distribution, and from this analysis and the analysis of the market studies recommend a reformulation of subsidy policy (or the alternative mechanism proposed), and regulation in case it is required, in order to achieve financial viability while providing the service throughout the national territory, as well as the quality of life of users and their access to services within a fiscal sustainability framework. It would be advisable to comment on the option of ensuring (for each fiscal period on behalf of the Nation) the FSSRI resource deficit that would cover companies providing the public electric power and natural gas services. The possibility of gradually dismantling the stratum 3 electricity subsidy and the elimination of the additional 10% subsidy to strata 1 and 2 should be evaluated.

The consultant should propose ways to overcome quality and completeness information difficulties that exists and the methodology for their application, monitoring and subsidy evaluation, or any alternative mechanism that is proposed.

4.4. **Strengthening the institutional and regulatory framework**
Consultants covering the first part of this Focus (coverage and quality) should, from the analysis carried out and the objectives set out in Focus 3, provide elements to advance in the distribution modernization activity and analyze the retail market in detail taking into consideration the current state of the distribution system and its challenges. This topic will be in charge of the international consultant.

Currently there is a study underway to conduct a comprehensive analysis of the institutional framework that governs the Colombian electricity sector for the ZNI in order to propose adjustments that allow the State to meet the objectives of ensuring energy reliability, supply power to the ZNI, sustain the incorporation of non-conventional Renewable Energy Sources projects (NCRES) and formulate new service provision schemes, within the framework of Laws 142 and 143 of 1994, and reviewing the latest public policy guidelines (Law 1715 of 2014 and Decree 1623 of 2015, among others). This study is being financed by the IDB.
The consultant must provide elements to structure a monitoring system that allows for verification, good project structure for those projects to be financed with public resources, implementation and administration of business schemes, and information management of any assets financed with public resources. What is presented in Objective 4.1 may be sufficient.

Likewise, it should recommend the necessary institutional adjustments for implementation, monitoring and evaluation of the proposed subsidy scheme. The information presented in point 4.3 of the report may be sufficient.

5. Institutional and regulatory framework review

The need for a transition towards an industry that is more open to innovation, a more flexible market that encourages the entry of new agents, technologies and transactional schemes, and a more diverse and resilient energy matrix, requires a comprehensive review of the institutional and regulatory framework. In this sense, it becomes necessary, on the one hand, to review the structure and architecture of the electricity and natural gas markets, and, on the other hand, to review the institutional design referring to these markets, which are, the Ministry of Mines and Energy (MME), the Mining and Energy Planning Unit (UPME), the Energy and Gas Regulatory Commission (CREG), the Institute of Power Planning and Promotion Solutions for the Non-Interconnected Zones (IPSE) and other governmental institutions involved, in order to reach an effective coordination among them and that their functions are in line with the management trends of the sector.

As it is indicated in Benavides et al. (2018), the English market, upon which the Colombian market was based, has changed several times. Adjustments have been made to improve identified problems and to adapt to new technological and transactional possibilities. In this document, it is pointed out, that the first lesson learned from the British experience was:

[...] an electricity market instrument is fallible and may fall short in the promotion of competition and the entry of new technologies investment, [due] in part to technical complexity, uncertainty in supply and demand, difficulties in real time demand adjustments, external factors and the fundamentally incomplete and imperfectly competitive character of electricity markets [...].

As a second lesson learned, is indicated:

[...] the limitations or unexpected consequences of electricity markets can be remedied. The energy policy, in representation of general interests, should guide the regulation to this effect and give independent system operators the leadership while searching for better alternatives.

Fernando Barrera made an operative analysis of the Wholesale Energy Market (MEM) in which he raises some adjustments to the institutional framework mentioning, among others: (i) an improved energy policy based on risk analysis and the definition of clear goals and monitoring indicators and
(ii) a better regulatory framework through the creation of an Agency of Economic Regulators that could be independent or operate as part of the Superintendence of Industry and Commerce (SIC) as well as greater independence and a CREG operational improvement by means of a normative impact analysis and MME regulation in regards to sectoral policy. It also raises the need for supervision, coordination and inspection between the Superintendency of Public Services (SSPD), the SIC and the Financial Superintendency (which would act on contractual issues), where the SSPD would be the sole information repository.

It is then necessary to review the way of establishing this regulation. The CREG and SSPD have raised a new regulatory attitude in line with the mentioned changes and analyses. In particular, CREG has proposed a lighter hand regulation, with greater freedom of action and innovation. To this end, it points out a general principles definition and macro criteria that define the playing field for business and the identification of rules and behavioral guidelines. There would be greater self-regulation by agents monitored by the SSPD, which should strengthen their control \textit{ex post}. The proposal is for the consultant to review if it is best to continue regulating by activities or, rather, by services. This type of scheme should be considered for less regulated segments, or those with greater competition, where light hand regulation is more effective.

On the other hand, in order to implement "enabling measures for the promotion of distributed energy resources", the National Plan stipulates that the CREG will review "the chain of public service supply of energy and gas, in order to assess the possibility of including new activities and agents, and promoting the expansion scope of unregulated users and the liberalization of regulated ones". To achieve this, the National Plan indicates that the CREG "will evaluate the electric and gas service model to determine if it is necessary to adopt new market participants and incorporate them into the new chain structure" (DNP, 2019).

In accordance with objectives and priorities established by this government in the National Development Plan and for this Mission, the main themes that derive from this Focus and its scope are those listed and detailed below: analysis of the recommendations made in Focus 1 to 4; adjustments to the structure and architecture of the electricity market (integration and concentration); monopoly regulation options and market contestability with an analysis of the possibilities for innovation in each proposed scheme; separation and function restructuring, regulation, and a business model of distributors and retailers to facilitate the entry of new agents and technologies with a more flexible operation; restructuring and definition of the retailer’s role as well as aggregators and communities of prosumers (prosumers) regulation to facilitate new energy schemes and business transactions; improvements to the governance of the electricity and natural gas sector and its relations with the telecommunications sector.

5.1 \textbf{Analysis of previous Focus recommendations}

The consultants should take into consideration the advances and recommendations relating to specific objectives involving institutional and regulatory reforms of the previous four parts. In Focus 1 and 3, measures should be proposed regarding the role of distributors, retailers and new agents in
a new, more open, and flexible market, the way in which they interact with free agents in the market, the role of the System Operator and their interaction with Network Operators in a more or less centralized architecture, among others. In Focus 2, the consultants will make recommendations on the adjustments required to achieve better function and coordination of the electricity and gas markets and on aspects relating to vertical and horizontal integration, complementary and excluding activities, among others.

5.2 Structure and architecture of the electricity market (integration and concentration)

In the PND (DNP, 2019), it is stated that:

"the national Government will facilitate the participation of more players in the provision of public home services and complementary activities and will consider companies that carry out activities different from the provision of public home services, as long as there are no conflicts of interest or possible dominant positions that arise".

The consultant should make recommendations to move in this direction.

To be able to comment on the necessary market architecture, the most important thing is to first analyze if it is necessary to have a system of service competition (with freedom of integration) or a system of competition/regulation of activities. This will be needed to determine the existence of essential infrastructure for any service provision.

As it was noted in the introduction of this Focus, the consultant should consider the possibility of migrating from the current activity regulation to one that is service based, focusing on the telecommunications experience where there is vertical integration and competition is sought in the horizontal segment, as proposed by Cadena et al. (2017):

Distributed generation, accumulation systems, demand participation, monitoring control methodologies and devices, telecommunications, information and their management strategies and expressions of consumer preference provide the basis for a new scheme that is more open, flexible and competitive.

Once defined whether the service competition is total or partial, it is necessary to determine which functions can be integrated into the service chain provision and which are the most convenient regulations among activities if there is no market integration. In this first phase of determining market architecture it is necessary to analyze activities/services and their advantages/disadvantages for allowing the integration of said activities/services. In the second phase (topic 5.3) the applied regulation should be analyzed.

To conceptualize about the integration of functions/services, the consultants should take into account:
The current market structure.
- The asymmetry that arises from non-integrated firms.
- The scale economies or scope of current activities (including transaction costs).
- The challenges posed by new technologies and their effect on these economies, in new or consolidated markets.

The consultant must identify and propose the agents that will participate in the retail market (distributors, retailers, distributors-retailers, aggregators, market aggregators, prosumers, communities of prosumers, etc.), their role, activities to be performed, and operating criteria.

Likewise, the consultant should review the challenges that the new transactional schemes impose on the sector and the telecommunications infrastructure. The operation of smart networks in a smart cities framework, the operation of micro-grids and the integration of systems raises some questions (CREG, 2019) that consultants should explore:

- How can ICT (Information and Communications Technology) connectivity (wired and wireless) be fostered for innovative energy services and be articulated with the Internet of Things (IoT)? How will the efforts of the Nation be articulated with those of the territories and regions?
- What will be the dedicated spectrum for smart grid operation? Under which conditions? How to facilitate a joint deployment that optimizes the country’s resources?
- What will be the appropriate regulatory framework for ICT to facilitate and promote the use of smart energy networks?
- Will the energy regulatory framework of ICT be applied to smart energy network providers? Will a qualifying title or compensation be required for universal service?
- What will be the obligations of the suppliers? What are the users’ rights?
- Will the interconnection standards between operators apply?

It is worth mentioning that Congress recently approved an ICT Law that seeks, among other things, to modernize the sector and strengthen connectivity mechanisms that close existing gaps.

5.3 Monopoly regulation options, market disputability in the proposed structure and innovation promotion

The decision to separate the activities of the sector (generation, transmission, distribution and commercialization) should be based on the cost of using markets or regulation for the coordination between separate activities. It is easier to separate activities if market regulation reduces transactional costs. In this sense, it is necessary to develop the type of regulation that should be used in the chosen architecture. The topic should be oriented towards analyzing a way to regulate activities and services suggested by the consultants of the other Focus groups.

The CREG has proposed a document on vertical and horizontal integration to discuss in order to:

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evaluate the relevance of current rules on vertical integration and concentration of public services for electric power and combustible gas. For this purpose, it is essential to make an exhaustive identification of the relevant trade-offs to evaluate the impact that these limits might have on the other links of the chain, as well as the possible intersectoral gas-electricity effects that may arise. Likewise, the discussion seeks to identify intervention alternatives, which include the possibility of keeping the current rules”.

Following the new regulatory attitude proposed by the CREG and described above:

“analysis points to the definition of general rules, taking into account that the problems to be solved through the establishment of vertical integration limits and market participation are closely linked and therefore cannot be treated in an isolate manner. Of course, the definition of these general rules can result - and probably will result - in different activity prescriptions that, when collecting the current state of each public service, would be different in each case.

Considering that public service progress is being made toward an integration that provides an optimal and efficient supply, the convenience and opportunity of deregulating or relaxing the regulation of monopolistic activities should be evaluated, proposing and discussing the effectiveness of new approaches, such as regulation based performance (PBR), and new ways increasing market contestability. It is important that the consultant analyze the effect of the regulatory approach on the promotion of innovation in regulated companies.

In Article 316 of the PND (Law 1955 of 2019) vertical integration (generation, distribution and commercialization) of sector companies (or companies with the same controlling agent where a control situation exists), was previously limited in article 74 of Law 143 of 1994, it now allows for an increase from 25% to 35% in the participation and commercialization limit of distributors in the national energy market. It is convenient to review the implications of these proposals working against the promotion of future innovation in the sector.

Finally, it must be taken into consideration that, according to what is established in the legislation, the regulator must determine tariff methodologies, which are valid for five years. These periods have been systematically infringed. In addition, a tariff definition is presented based on activities that does not coincide over time and that in some way raise questions about the application effects of some methodologies on others and on final prices. It is necessary for the consultant to propose alternatives so that the regulator can, in a more coordinated and effective way, establish methodologies to calculate resulting charges.

5.4 Function and regulation separation and restructuring for business model distributors and retailers

Due to the importance that the consumer will have in the future vision of the electricity market and the sector, there is a fundamental role to be played by distribution models, it is necessary to reserve
a separate point to talk about the distributor/retailer relationship in the new context and the evolution of this role in the distributor's business model.

For this topic, the consultant should discuss, for example, the separation of activities required to allow the entry of new agents, technologies and transaction schemes that are more flexible, mainly at the retail market level. In the same sense, the team should conceptualize the degree of centralization or decentralization necessary at the operative level of the system and the market.

As it is pointed out in objective 1.8, the emergence of distributed generation and storage systems leads us to think about the technical and economic convenience for the distributor to be able to provide these services. In fact, Law 143 incorporates technological developments presented at this level into the definition of distribution activity. The consultant should discuss the pros and cons of deepening vertical disintegration of activities facing his reality. The separation of retail and distribution activities is more important when generation scales are reduced and therefore energy producers and consumer-producer users can carry out generation and consumption activities at the same time. The consultant must define the role of the distributor in detail to serve users at regulated rates, proposing in its case a complete separation of activities based on international experience in markets where competition at the user level has broadened. The review should be focused on the user, as the last beneficiary and payer of all services, in such a way that the technological development benefits of scale reduction represented here can be granted.

5.4.1 Retail competition analysis and the user’s right to choose a retailer

For DER to flourish, a profound revision of the legal framework applicable to the final sale of electricity to users and the distribution relationship is required. The consultant should evaluate limitations of the current regulation that makes users of a certain size have to exclusively opt for a regulated service, locking them in a captive distributor market. The modern legal framework should have a clear separation between distribution business, the final sale and the right of users to opt for any form of supply, including self-production, the supply of their energy could come from distributed markets, wholesale markets, or purchases made by distributors. That is, it is necessary to review the entire framework applicable to the retail competition to eliminate any retail competition barriers with new technologies.

The consultant should expose the convenience and challenges of restructuring the current vertical integration model of operation, planning and ownership of distribution systems by companies and the concomitant regulatory model to facilitate an efficient transition to a decentralized sector model.

This activity is a fundamental part of this Mission and, therefore, requires a broad discussion of the different alternatives to follow and a deep and detailed justification of the consultant's final recommendation. Other jurisdictions that have gone through this same process, among others, include New York, Hawaii, California and Denmark, where the regulator, guided by consultancies and discussions with interested parties, has selected a restructuring distribution form for companies and their business model.
Three clear examples of similar restructuring processes that have been carried out in recent years are highlighted. The order to adopt a regulatory policy framework of New York’s regulator (NYPSC, 2015) determines and argues the decision to require distribution companies to serve as distributed system platforms (DSP). This is a defined model within the same REV transformation process with functions classified into 3 general categories: i) integrated planning of the distribution system, ii) network operation, and iii) market operations. One of the conclusions of the analysis that led to this decision was that, because the basic functions of the DSP would be highly integrated with the planning of public services and the operations of the system, assigning them to an independent entity would be redundant, inefficient and unnecessarily expensive. (NYPSC, 2015, page 45).

In Hawaii, in compliance with state law SB 2939, the state energy office commissioned a study to evaluate the costs and benefits of various ownership models of electric distribution companies, as well as the feasibility of several regulatory approaches of such companies to help Hawaii to achieve its state energy goals (London Economics International LLC, 2019). The preliminary results of this analysis in Hawaii suggest that a change in the current ownership model of distribution systems (regulated private companies) would not necessarily be convenient; however, it suggests that the benefits of changing the traditional regulatory model (cost-of-service regulation) to a model based on performance indices (that is, performance-based regulation or PBR) generally outweigh the costs. A preliminary analysis briefly describes the options analyzed by the contracted study.

Although the scope of this Mission does not necessarily include fundamental changes to the ownership model of the distribution systems, it does include consideration of profound changes to the regulatory or business model and the functions carried out by the distributors, retailers, and aggregators.

Finally, the Danish case was analyzed and recommended for Colombia in Benavides et al. (2018) and described in more detail by Energinet (2015). This case, briefly described in section 3.8.1 of this document, essentially proposes a series of electricity market models that integrate a new type of participant, the aggregators (of DER), which are not necessarily distribution or commercialization companies.

It is then necessary to:

- Analyze the advantages and disadvantages in the Colombian context of a separation of main functions of the current distribution companies (1. the operation and planning of the distribution system, 2. the ownership and maintenance of the distribution infrastructure, and 3. the administration of the regulated distribution service "market") in different structures that have been proposed in literature and established in other geographies.

- Propose an appropriate restructuring or separation of distribution companies for the Colombian sector based on the qualitative analysis of advantages and disadvantages with respect to their suitability to achieve the vision established by the Mission.
• Propose a restructuring of the distribution company’s business model under the new institutional model that seeks a transition to a regulated alternative earnings model different from regulated capital investment.

• Propose an articulation between the electrical industry and the National Electric Mobility Strategy (ENME), especially with respect to charging station components, regulations and batteries.

• Present the pricing model for this network service and the other services that the distributor can offer, verifying an adequate remuneration for the activity.

• Design a policy to encourage innovation in regulated distribution and marketing business models for companies, considering, for example, the use of pilot projects. This activity should be carried out consulting the proposals of the other Focuses.

5.5 Restructuring and role definition for retail regulation, aggregators and prosumer communities

The commercialization of energy should turn into an activity that encourages retail competition. This function will be developed through existing agents, separate from other activities, or new agents that add surplus energy that can be commercialized in the market. These agents should encourage the use of distribution networks for different transactions that can be carried out in the retail market or to the wholesale market.

Retailers or aggregators should facilitate the participation of DER in the market. New agents would be responsible for grouping up the flexibility offered by prosumers and converting it into services for the electricity market. Currently, regulatory bodies in some markets around the world have advanced in the incorporation of an aggregating agent that fulfills this role. The consultant will have to revise international institutional advances referring to aggregation that are relevant for the Colombian case, as well as the conformation and performance of virtual plants.

As mentioned at the PND (DNP, 2019) for the “promotion of competition and the development of decentralized businesses” the National Government will promote contract market development and transactional platforms that should be managed by the CREG. This role will be:

36 According to Benavides et al. (2018), in the United States the Federal Energy Regulation Commission (FERC) approved in 2016 the entrance of a new Distributed Energy Resource Provider (DERP) that is in charge of gathering offers from several DER and taking them to market to offer complementary services. In the United Kingdom, OFGEM (energy and gas regulator) has granted a license to the Flexitricity company to provide its services as an aggregator. This company is responsible for managing demand response in the energy and gas market and offers flexibility and energy supply services; that is, it plays the roles of aggregator and retailer. In the Nordic countries, the organization of energy regulators (Nordreg) proposes a focus on service ‘aggregation’, rather than on defining strict roles and relationships between entities ‘retailer’, ‘aggregator’ or ‘independent aggregator’. Nordreg highlights that it is necessary to allow competition and suggests that promoting an independent aggregator can lead to inefficiencies because, on the one hand, there can be an inappropriate allocation of costs and benefits among market participants and, on the other hand, there may be a distortion in efficient price formation. Additionally, there is an increase in administrative costs due to the establishment of a new regulatory framework that allows for the inclusion of independent aggregators, costs that end up being assumed by customers. Finally, in Germany, Next Kraftwerke operates as a virtual plant.
"facilitate the participation of more players in the provision of public home services and complementary activities considering companies that carry out activities different from the provision of public home services, as long as there are no conflicts of interest or possible dominant positions that arise".

5.5.1 Analysis and DER aggregator model proposal

In a coordinated manner referring to the reforms proposed in Focus 1 of this Mission (objective 1.5 in particular), the consultant will have to examine the international institutional advances in aggregation and possible agent aggregator models for increasingly more decentralized architectures, including in particular models that have been considered in other jurisdictions world-wide.

- Based on this analysis, the consultant must propose an aggregator model of commercialization adapted for the Colombian context and the long-term vision of a more decentralized system.
- It is necessary to consider and conclude on the convenience of a provisional commercialization / aggregator model that facilitates the transition from the current institutional and regulatory structure of the sector to the more decentralized structure foreseen by this Mission.
- As part of this analysis, the consultant must evaluate the convenience of the initial aggregator/commercial model proposed to the CREG in Benavides et al. (2018), in which one hopes that “initially the commercial agent is in charge of adding prosumer offers and make these services available to balance authorities, that in a decentralized system are distribution system operators (DSO)”. This proposal, which "is inspired by the role of aggregators in the electricity market present in Danish regulation" (Energinet, 2015), could be implemented, for example, as a mandatory service for regulated consumers or as an optional opt-in or opt-out service.
- Also, the consultant must approach the other recommendations made in Benavides et al. (2018) to qualify for a commercial agent/aggregator role in the Colombian electrical market. In section 4.6.D, among others, the authors comment on qualifying measures taken by the US, the United Kingdom and Nordic countries. Also, two fundamental challenges are emphasized that the consultant will have to study to select the aggregator model: “the first challenge is the necessity to differentiate between classic consumption and flexible consumption, for which it is essential to install serial measurement points which allow to make this consumption differentiation. This may lead to additional costs”. If this model is found advisable, the consultant must analyze the allocation of the responsibility to assume these costs and the convenience of transferring them to the end user. The second challenge "is the necessity to avoid the market power exercise, that

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37 According to Benavides et al. (2018), an advantage of this market structure is that it is not necessary to establish contractual links between a new agent and the system operator, which provides simplicity at the time of implementation. The commercial agent- aggregator, and further on the aggregator, can group offers made by several distributed generators and participate in tenders that take place in the wholesale market, to sell it by means of contracts or to sell it to the end users directly. Equally, it can group flexibility from several consumers by means of demand response programs, where clients are compensated to modify their consumption patterns adapting them to the network needs. Lack of balance caused by the aggregator at flexibility activation time can be handled with the same agreement that the commercial agent has with the authority in charge of the balance.
may appear due to the integration of distributor-commercial agent-aggregator in a single agent, the owner of the distribution network infrastructure. This market power can be harmful for DER expansion”.

5.5.2 Aggregator roll analysis, entrance barriers and other associated topics

For DER to flourish, the existence of market aggregators is required to represent them before Market Operators (DSO and ISO). It is necessary to review the entire framework applicable to retail competition and eliminate any retail competition barriers with new technologies. It is necessary to study the coordination of commercialization activity with new potential agents such as Service Aggregators and Virtual Power Plants and to conceive prosumer or prosumer community participation in the market. The consultant must:

- Discuss service measurement and who should offer this service. This discussion must include the investment responsibility in the operation not only of intelligent measurement, but also the investment in all advanced measurement infrastructure (AMI) necessary for the adequate operation of the equipment. This analysis must consider the legal framework (including resolution 40072-18 of MME, “By which mechanisms to implement the advanced measurement infrastructure are established for electrical energy public service”) and the existing work that CREG has advanced to implement AMI technology (including document 077-18 which contains an initial technological revision and analysis of relevant elements for the development of a suitable regulatory framework).
- Examine activity remuneration and payment of new technologies.
  - Analyze the need to invest in measurement technologies (additional or not, to AMI infrastructure) associated to commercialization and aggregation activities.
  - In coordination with the proposals of section 3.1 (Modernization of distribution systems), clarify the allocation of investment responsibilities of new technologies between existing agents (Network Operator, commercial agents, end users) and the new agents (aggregators).
- Evaluate information management and income derived from consumer behavior.

5.5.3 Distributor, retailer and aggregator participation in the wholesale market

The consultant should discuss the role of existing agents and new agents in DER participation for the wholesale market.

- Specifically, and contemplating the proposals resulting from Objective 1.5, the role of existing agents (for example, Network Operators) and new agents (for example, those proposed by this Mission, including aggregating agents) in aggregation, representation and participation of DER should be discussed connected to the distribution system, that is, in front/behind the meter, and in the wholesale market, as demand response resources (i.e., efficient demand management), and more generally as DER.
• In particular, in relation to forms of resource demand participation response in the wholesale market, previously proposed in activity 3.6.8, the consultant must define in detail what would be the role of said agents (including Network Operators, retailers, and aggregators) regarding said resources. A specific question to answer by the consultants is which agents could or should be able to represent DER in the wholesale market directly or indirectly.

5.5.4 Alternative electrical retail paradigms

The consulting team will study new paradigms for the commercialization of energy at the distribution level and will offer proposals on the role that the different agents involved (distributors, retailers, aggregators) would have in the new market schemes. Given the scale generation reduction, installations of dozens or few MW, or of several tens of kW can have very competitive costs to facilitate innovation in energy commercialization. That is, it is imperative to study additional schemes to wholesale markets and contracts sales, such as distribution market facilitation, in organized markets, or facilitate markets where both users and generating users can transfer energy directly (peer-to-peer). This will require analyzing the current legal barriers that limit the participation of small-scale generations, as well as the legal limitations so that users can at the same time choose to generate their electricity and participate in these markets. This aspect is also requested from the consultants of Focus 1.

5.6 State governance and market functions

Due to the characteristics of our electrical service, it is necessary to delimit specific functions for its provision. Some of them are carried out by governmental institutions and others can be entrusted to market agents. In this part of the study you must define functions that will be carried out in the sector and establish a methodology to assign them to different institutions.

5.6.1 Coordination and capacity of Government entities in the electric sector

The MME wants to improve coordination instances between the different entities of the sector. The consultant should review coordination instances and conceptualize their pertinence and necessary adjustments needed to improve the effectiveness and efficiency of the Executive's work. Specifically, among others, you should evaluate these points:

• Energy policy, monitoring and goal compliance
• Functioning and participation of government bodies in the CREG
• New challenges of the SSPD
  o Market monitoring
  o Elements proposed in information objectives of previous focuses
• The role of the SIC and the Financial Superintendency in the promotion of competition and control supervision of the contractual agent agreements
• Gas - electricity coordination
  o Follow-up and monitoring
As summarized in the Annex, Fernando Barrera, in a study for the IDB (Barrera, 2019), makes proposals to improve the governance of the Colombian Wholesale Energy Market (MEM). In summary, this author proposes: (i) the creation of a model of coordination and expansion of the transport network based on an Independent Operator model, ISO type, through the creation of a new institution, mixed ESP, with a majority of contributions of the Nation and with shareholding of the agents of the sector; (ii) create an independent CREG without members of the Government, to solve "the slowness in the regulatory decisions and the lack of elements of competitive analysis in the decision making"; and (iii) an instance of appeal handled by the SIC.

The consultants should, among other tasks, analyze the feasibility of these proposals that have been on the table for a significant time. Regarding the appeals instance, many agents are concerned with the judicialization of sector decisions.

5.6.2 Adjustments to the natural gas sector

The consultant should review the proposals in Focus 2, focusing on the coordination of electricity and gas service provision, and integrate their recommendations relating to proposals made here with respect to electricity markets.

5.6.3 Information technology and telecommunications (ICT) sector coordination

As already mentioned, new measurement technologies, automation, supervision and control will provide a considerable volume of information that demands, in addition to the support from ICT infrastructure, the harmonization of the policy and regulation of both sectors, which are established autonomously and independently.

The consultant should propose institutional and regulatory adjustments that allow: (i) greater competition in different markets (short and long term), (ii) entry possibilities (and exit) of new agents, and (iii) technological and transactional schemes. It is important to review what is proposed and defined in the results of objective 5.2.

Congress of Colombia approved the ICT Law, which seeks, in addition to the modernization of the sector and the strengthening of connectivity mechanisms, the establishment of a modern independent regulatory body. The consultant should analyze the harmonization between the communication sector and the electricity sector for facilitating the introduction of new technologies.

5.6.4 Environmental system coordination

The coordination difficulties from the energy sector with the environmental system and social management are widely known (see document CONPES 3762 of August 2013). Likewise, there are coordination problems with the National Mining Order Plan (UPME, 2014) within the environmental
system and of the Nation with its territories. These difficulties affect the execution of infrastructure projects and their contemplated and established deadlines.

Based on the different diagnoses and proposals made in the country, one of which led to the definition of guidelines for the development of national interest projects or PINES is the aforementioned CONPES, the consultant should make institutional and regulatory adjustment proposals that allow to overcome these problems, improve the efficiency in work execution and the effectiveness in the sectorial coordination. Some experts agree on the need to weigh identification and preparation of possible expansion executions (projects) with sufficient information to facilitate decision making in the face of the administrative burden that the entities responsible for such work would face. In particular, the Environmental Licensing Authority (ANLA) has indicated the need to improve new development planning to ensure adequate project structuring and response from the entities involved.

5.6.5 Other coordination

In the country, energy efficiency actions are being developed, which is a fundamental program of efficient energy management and electric mobility, a key element of distributed resources. The consultant must make recommendations that he considers necessary to integrate the strategies and actions developed there with the resulting proposals of this Mission.

B. Definition of the scope and Mission work.

The production of a road map that advances the market adjustments required will be carried out by different teams of international and national consultants, experts in these issues and knowledgeable about the situation of the industry and the Colombian market. It is required, that the Ministry and other Government entities, elaborate proposals of sectorial vision to be discussed and validated with the selected consultants and sector agents.

As has been said, the consultants must take into account the studies carried out and those underway in the country. This consultancy will organize a file with these documents. The teams must propose a set of public measures relating to energy, legal and regulatory policy and articulate them in decrees or resolutions to be implemented by the National Government and the MME and its ascribed entities after contextualizing the problem in a clear and concise manner and analyzing the international experience standards appropriate to the study subject. The risks and barriers for the implementation of the recommendations made will be identified. That is, the revision will not be restricted to work under the current legal framework, but must expose changes that are necessary to implement the best solutions identified. It will be up to the Ministry to define and select the best options within the proposals made by the consultants.

The priority in the implementation of the recommendations will be stipulated. That is, it will stipulate the order in time and the regulatory measures to be proposed, which can be short, medium or long
term, based desirably on a qualitative analysis of interdependence between measures and cost-benefit or effort-reward. It is foreseen, for example, that short-term measures are those that are urgent, pilots, enablers of other measures, or those that involve low effort and high reward. In other words, safe measures to implement given their high probability of success. The medium-term measures may be those necessary to make less abrupt transitions, controlled demonstrations of schemes or measures that involve low effort and low reward. Finally, long-term measures can be definitive, consistent with the vision established by the Mission, or measures that involve high effort and high reward. The figure below (extracted from Martini, 2015) illustrates the evolution by stages of a distribution system. These stages can illustrate the scope of the Mission in Focus 3 and serve as an example for other Focuses.

Keep in mind that it is possible that the five studies are not developed simultaneously, which would be desirable.

C. Conformation of work teams.

As noted at the beginning, five teams composed of international and national experts will be formed, according to the experience necessary to carry out this work.

In the work meetings mentioned above, some consultants were identified preliminarily for each of the Focus groups. This list has been supplemented by this consultancy. The results are summarised in the following table (Table 2):
Table 2. Proposed consultants for the five work teams

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<th>International Expert</th>
<th>National Expert</th>
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<td><strong>Competition, participation and structure of the electricity market</strong></td>
<td>Frank Wolak</td>
<td>Diego Jara</td>
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<td>Jaime Millán</td>
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<td><strong>The role of gas in energy transformation</strong></td>
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<td>Carmenza Chahín</td>
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<td>Miguel Vázquez</td>
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<td>(To be defined)</td>
<td>Luisa Lafourie</td>
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<td><strong>Decentralization, digitalization and efficient management of demand</strong></td>
<td>Carlos Battle</td>
<td>Andrei Romero Grass</td>
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<td><strong>4. Closing gaps, improvement of quality and design and efficient formulation of subsidies</strong></td>
<td>Ignacio Pérez-Arriaga</td>
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<td>Juan Ricardo Ortega</td>
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<td><strong>5. Review of the institutional and regulatory framework</strong></td>
<td>Fernando Barrera (Frontier Economics)</td>
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<td>Hugh Rudnick</td>
<td>Manuel Maiguashca</td>
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We propose to make use of an additional international consultant to support work consolidation, to guarantee the coherence of the final road map proposal and to consider the use of legal support advisers to evaluate the implementation of institutional proposals and legal/regulatory modifications that come from the different Focuses. A candidate to examine is Ross Astoria.

It has been suggested to the MME to organize a Technical Secretariat with the participation of the attached entities, whose conformation has already been carried out.

D. Work methodology

The hiring of Position Papers on behalf of experts is proposed, seminars to discuss the proposals and identify gaps and actions to be taken, work instances and coordination between groups, and the delivery of a final document with a road map. The methodology is described below:

(i) The consultants selected for each Focus should prepare an article that (a) summarizes the current situation of the topic, (b) states the vision that has been discussed with the Ministry of Mines and Energy and its entities, and (c) proposes actions that must be undertaken. Each team will hold prior discussions with the entities and agents directly involved in the subject, including guilds and the academy (for and against). Minimum requirements of interested parties to be contacted will be established, possibly by a minimum number (for example, in cases where the total sample is wide and varied, as is in the case of distribution companies).

(ii) These Position Papers will be discussed in seminars with broad industry and the Government participation. These seminars will evaluate policy, planning, regulation and other actions necessary to achieve the proposed vision based on the initial state and international trends.

(iii) The consultants will deliver a final document “White paper” with the road map. An independent industry and academy peer-review is suggested to examine the final documents from each team in addition to traditional sector comments. Also a final revision of the work on behalf of international peers and Government organizations is suggested.

(iv) It is proposed that the consultants carry out coordination meetings among work teams to achieve the consistency of different proposals on at least three occasions: in the beginning, in the middle of work development and before presenting the final report. These meetings will be coordinated by the designated team.

(v) Finally, it is proposed to carry out analysis and consolidation work within Government entities with the coordination of team leadership. It is suggested to have a minimum permanent team
to accompany the work done and to have under its guidance, the designated consultants, that will help draft the final proposal and all of its details.

(vi) We suggest to hold an initial launch Mission seminar, with the participation of inspiring experts who present a new and modern vision of the industry and illustrate the challenges faced in order to achieve this transformative design.

(vii) The results of all this work will be presented in a final seminar, if the Ministry considers this necessary.

E. Mission schedule

The following is the Mission schedule prepared by the coordination of the Technical Mission Secretariat (Mónica Gasca, Advisor to the Office of the Viceminister of Energy, and Ángela Inés Cadena Monroy, with suggestions from this consultancy). This schedule takes into account the functional particularities of expert groups in each Focus, the bank’s financial availability and the expectations of the Ministry for the work completion. In general terms, there will be a period of six (6) weeks for the preparation of the Position Papers, three (3) weeks of consultations and discussions with the interested agents and with experts from other focuses, four (4) weeks for the preparation of the final document and roadmap, and three (3) additional weeks for the Peer Review process and final presentation. In total, there would be a 4-month deadline for the final delivery. In the case of Focus 3, two to three (2 to 3) additional weeks are added. Focus 5 will begin three (3) weeks after the other Focuses, since it depends on them.
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