Draft TC ABSTRACT

I. Basic project data

▪ Country/Region:	Colombia
▪ TC Name:	Analysis, assessment and recommendations for the successful implementation of the Smart Grid infrastructure in Colombia
▪ TC Number:	CO-T1337
▪ Team Leader/Members:	José Ramón Gómez (ENE/CCO),Team Leader; Mauricio Bouskela (IFD/CTI), Co-team Leader; Arnaldo Vieira de Carvalho (INE/ENE) Juan Roberto Paredes (INE/ENE); Alberto Levy (INE/ENE); Laura Rojas (INE/ENE); Yolanda Valle (INE/ENE); Joonkyung Seong, (INE/ENE); Jiyoon Son (IFD/CTI); Matteo Grazzi (CTI/CCO); Andrea Giraldo (CAN/CCO); Javier Bedoya (LEG/SGO); under the supervision of Leandro Alves, Chief (INE/ENE)
▪ Indicate if: Operational Support, Client Support, or Research & Dissemination.	Client support
▪ If Operational Support TC, give number and name of Operation Supported by the TC:	n/a
▪ Reference to Request: (IDB docs #)	IDBDOCS-#37452096-Min energia - CO-T1337 - No objeción IDBDOCS-#37452097-Mincom -CO-T1337 - No objeción
▪ Date of TC Abstract:	March 13, 2013
▪ Beneficiary (countries or entities which are the recipient of the technical assistance):	Ministry of Mines and Energy of Colombia Ministry of Information and Communication Technologies
▪ Executing Agency and contact name (Organization or entity responsible for executing the TC Program) {If Bank: Contracting entity} {If the same as Beneficiary, please indicate}	IDB (INE/ENE)
▪ IDB Funding Requested:	US$850,000
▪ Local counterpart funding, if any:	US$255,000 (in kind)
▪ Disbursement period (which includes execution period):	24 months
▪ Required start date:	May 2013
▪ Types of consultants (firm or individual consultants):	Firm and individual consultants
▪ Prepared by Unit:	INE/ENE and IFD/CTI
▪ Unit of Disbursement Responsibility:	CAN/CCO
▪ Included in Country Strategy (y/n); ▪ TC included in CPD (y/n):	Yes
▪ GCI-9 Sector Priority:	Yes

II. Objective and Justification

Justification

Smart Grid (SG) is the convergence of a modern electrical power grid with the application of Information and Communication Technologies (ICT), allowing bidirectional data flow and information management. SG enables active participation of consumers, provides support for improved power quality and energy efficiency and seamless integration of renewable energy and energy storage. It anticipates and responds to system disturbances (self-heal) and enables new products, services, and markets around an evolved electrical sector. According to the SG workshop in Korea carried out by the IDB (RG-T2058: "Smart Grid and Its Application in Sustainable Cities"), SG refers to "Next-generation network that integrates information technology into the existing power grid to optimize energy efficiency through two-way exchange electricity information between suppliers and consumers in real time."

In this order, "*Colombia Inteligente*" is an initiative that has been created to establish the strategy for a successful evolution towards a SG in Colombia and has been formed by several entities and utilities that, in cooperation with and based in the world's best practices and the national framework, aim to promote the development of appropriate SG policies, regulation and technology solutions, for the benefit of the Colombian electrical sector, in order to manage energy production and use efficiently. In this sense, the initiative is a non-governmental and collaborative program that, as a first goal, has succeeded to establish a knowledge network supported by the main actors in the Electric and ICT Sectors in Colombia: CIDET, CINTEL, XM, CNO, CAC, COCIER, EPM, CODENSA, ELECTRICARIBE, EMCALI, EPSA and CELSIA[1].

A critical factor in the success of the *Colombia Inteligente* Program is to identify the drivers for SG implementation based on the country needs and expectations. Environmental concerns, increasing electricity consumption, interconnection between networks, the integration of renewable energy, security of energy supply, aging infrastructure and significant advances in information and communication technologies have been identified as major drivers for SG deployments worldwide.

In Europe and Asia, smart meters, or Advanced Metering Infrastructure (AMI), are being actively deployed. The market of Demand Response technologies is expanding, and the importance of data management capabilities is growing. For instance, the National Smart Grid Roadmap of Korea illustrates five domains[2]. Investment plan for technology development under

[1] CIDET (Centro de Investigación y Desarrollo Tecnológico del Sector Eléctrico), CINTEL (Centro de Investigación de las Telecomunicaciones), XM (filial de ISA especializada en la Gestión Inteligente de Sistemas de Tiempo Real), CNO (Consejo Nacional de Operación), CAC (Comité Asesor de Comercialización), COCJER (Comité Colombiano de la Comisión de Integración Energética Regional), EPM (Empresas Públicas de Medellín), CODENSA (Empresa de servicios de energía eléctrica domiciliario de Bogotá), ELECTRICARIBE (Empresa distribuidora de energía eléctrica, filial de la española Unión Fenosa), EMCALI (Empresas Municipales de Cali), EPSA (Empresa de Energía del Pacifico S.A), CELSIA (Empresa de servicios públicos).

[2] The vision for National Smart Grid Roadmap of Korea is that 'the SG will establish a platform for Low carbon Green growth'. The roadmap illustrates three phases and five domains. The five domains are Smart Consumer, Smart Transportation, Smart Renewable, Smart Power Grid, and Smart Electricity Service. Phase 1 will focus on demonstration and commercialization from 2012 to 2013, which includes the Jeju test-bed and

Smart Consumer, which is one of five domains, is 673 million US dollar for AMI Technology Development, AMI System Establishment and Bi-directional Electricity Trade from 2012 to 2030. In this sense, according to lessons learned from international experiences, several energy traders have executed pilot projects in SG in Colombia that include: installation of smart meters, AMI and prepaid systems, among others.

Along this line, the Ministry of Mines and Energy of Colombia and the Ministry of Information and Communication Technologies have requested a Technical Assistance (i.e., the Project) to the IDB with the objective to identify the best suitable framework to implement SG in Colombia. The Project is framed in the dialogue areas *(vi) energy efficiency and renewable energy and (viii) information and communication technologies,* established in the IDB Country Strategy with Colombia 2012-2014 (GN-2648-1). In addition, The Project is aligned with the IDB's institutional priorities as outlined in the Ninth General Capital Increase in Resources for the IDB Report (GCI-9) which considers as priorities areas: (i) infrastructure for competitiveness and social welfare, as the Project seeks to assess the benefits and necessary infrastructure of SG in Colombia; and (ii) protecting the environment, responding to climate change, renewable energy, and enhancing food security by promoting an energy efficiency and the integration of renewable energy and energy storage into the grid.

The general objective of the TC is to identify the best-suitable solutions, standards and regulations needed to develop and implement SG in Colombia, benchmark of ICT, sharing knowledge with countries which have introduce SG solutions, and to complement an existing smart grid pilot project that will integrate several associated technologies for its use as test bed of some of the developments of the Project. The Project addresses the SG functionality required from the ICT and energy perspectives, thus providing important planning elements that are essential for any SG deployment.

III. Description of activities

The Project is structured in five components:

Component I. Analysis of SG solutions for the Colombian Power Sector: Component I will identify feasible SG solutions in Colombia based on the development of three scenarios for 2030 regarding technological, economic and regulatory aspects. The SG solutions to identify may include for instance: Advanced Metering Infrastructure (AMI), Demand Side Management (demand response and energy efficiency), Distribution Automation, Home Area Networks, electric vehicles, etc. For this purpose, Component I will also identify the ICT requirements of each of the identified SG solutions: data volume, data periodicity, latency, availability, security, management systems, etc. Component I will include a characterization of the Colombian Power

smart pilot cities, such as the one in Jeju City, and various selected cities in Korea from 2013 to 2016. Phase 2 will focus on spreading SGs to other urban areas in Korea until 2020. Phase 3 will focus on the nationwide deployment of SGs until 2030. The Jeju test-bed the Jeju Island SG test-bed in Korea is a large-scale project with a total investment of US$239.5 million. The Korean government invested US$69.5 million and the private sectors US$ 170 million. This test-bed includes a fully integrated SG system with existing electricity infrastructure.

Sector including power loads, communications, infrastructure, markets, and other aspects related to the deployment of SG solutions; and it will take into consideration an analysis based on a Smart Grid Maturity Model (SGMM) of a group of national electric operators. The output of Component I will be one (1) document with the identified SG functions with their communication and ICT requirements. The expected result of Component I is the ICT requirements incorporated in the design of architectural and other technical aspects of the SG solutions.

Component II. Benchmarking of information and communication technologies: Component II will analyze: national and international experiences on SG, lessons learned and best practices related with the development of information and communication technologies for SG. Component II will include the following activities: (i) inventory of present and planned communication infrastructure in Colombia that could be used to support the identified SG communication needs; (ii) analysis of selected national and international experiences related to SG deployment, including those related to the development of Smart Cities (combined use for health, safety and other purposes); and (iii) definition of the best practices applicable to Colombia. The National Smart Grid Roadmap of Korea can be analyzed as an International Best Practice for benchmarking the SG in Colombia. The output of Component II will be 1 (one) document with the benchmarking plan for SG strategies, policies, technologies, applications and ICT solutions that are being used in specific countries. The expected result of Component II is knowledge exchange of successful experiences and lessons learned by the development of ICT in the context of SG, with at least one additional country (most likely to be Korea).

Component III. ICT and SG infrastructure and architecture design: Component III will develop the basic design of the infrastructure, based on the technological requirements for an interoperable, secure and scalable ICT for current and future SG solutions. The design will include the analysis of different communications protocols and standards used in throughout the electricity chain (production, transmission, distribution and consumption). Component III will include the following activities: (i) architectural design for selected SG solutions: SG solutions may be grouped to use a common communication solution; (ii) technical requirements and standards related to each of the main architectural components; and (iii) definition of ICT implementation details required to define costs and schedule. The output of Component III is 1 (one) document describing the infrastructure and the basic engineering at the level required to assess the associated financial aspects of the SG and ICT solutions. The expected results of Component III are the recommended architecture of the ICT infrastructure (equipment, connectivity, bandwidth, software) for SG applications and a comparative matrix of different communications protocols, technologies and standards used in the stages mentioned.

Component IV. Costs and financial aspects for a SG solution deployment: Component IV will develop a financial analysis for the deployment of the technological infrastructure for proposed SG solutions in Colombia, through an economic extrapolation and cost/benefit analysis. Component IV will include the following activities: (i) determine the cost of implementing the ICT architecture selected in Component III and define the cost (CAPEX and OPEX) and the benefits to implement the SG solutions infrastructure mentioned in Component III above to show decision makers if there are advantages to implement SG in Colombia, considering different

scenarios about economic and regulatory aspects; (ii) calculate the NPV, and the financial and economic rates of return of the proposed investments in SG; (iii) carry out sensitivity analysis on the major cost factors; and (iv) propose financing alternatives for its deployment. The output of Component IV will be 1 (one) document with a high level cost estimate and a cost/benefit analysis of the project for three different scenarios. The expected result of Component IV is the adoption of an economic model to analyze the required infrastructure for ICT and SG.

Component V. Regulatory and policies recommendations: Component V will provide recommendations of the relevant communications and energy sectors policies and regulatory measures to foster the deployments of the proposed SG technological infrastructure model in the sector. Component V will develop the analysis of regulatory and policies requirements to be recommended to the government and regulatory entities and to the different stakeholders in the SG value chain. The output of Component V is 1 (one) document containing a detailed analysis of the regulatory and policy for the SG and ICT deployment in Colombia. The expected result of Component V is the diffusion of the regulatory and policies recommendations with the different stakeholders, in order to raise the awareness of the SG implementation and to foster the development of the required ICT infrastructure.

Component VI. Test Bed Pilot Project (Test Bed): Component VI consists in the implementation of a pilot project in SG solutions. The Test Bed will complement an existing smart grid pilot project in Colombia. The Test Bed will integrate several associated technologies such as distributed generation, advanced metering infrastructure, two way communications, demand response, advanced distribution automation and control schemes, electric vehicles, etc. The Test Bed will be built-up from a developed platform in which some of the smart grid technologies are already integrated. The output of Component VI is the ICT and SG technologies and methodologies tested. The expected result of Component VI is the established feasibility of some of the project developments, considering the conditions of the Colombian electricity and communications sectors.

Component VII. Dissemination and socializing: Component VII will finance several workshops and seminars for the dissemination of the Project results, as well as technical visits to the Test Bed in order to involve the majority of stakeholders in the electricity and communications sectors with the development of ICT and SG. Component VII will include the following activities: (i) Workshops and seminars to discuss and disseminate the acquired knowledge; (ii) Guided visits from national entities and utilities to the Test Bed Pilot Project. The output of the Component VII is at least 2 (two) workshops /seminars developed and at least 1 (one) visit to the Test Bed by the national entities and utilities. The expected result of Component VII is the diffusion of the knowledge with the different stakeholders, including end-users, in order to raise the awareness of the SG implementation and to foster the development of the required ICT infrastructure.

IV. Budget

Indicative Budget (US$)

Component	Description of the activities	Duration (months)	IDB	Counterpart Funding[3]	Total Funding
Component I. SG solutions analysis for Colombia	Consultancy services	10	160,000	30,000	190,000
Component II. Benchmarking of ICT communication	Consultancy services	6	100,000	30,000	130,000
Component III. ICT SG Infrastructure and architecture design	Consultancy services	5	70,000	20,000	90,000
Component IV. Costs and Financial aspects	Consultancy services	4	50,000	15,000	65,000
Component V. ICT Regulatory and Policies Recommendations	Consultancy services	6	100,000	50,000	150,000
Component VI. Test Bed Pilot project	Goods and works	18	150,000	50,000	200,000
Component VII. Dissemination and socializing	Goods and services		50,000	15,000	65,000
Contingencies	--		32,000	0	32,000
Project Management	Individual consultant	24	108,000	45,000	153,000
Evaluation	Individual consultant		30,000	0	30,000
TOTAL			**850,000**	**255,000**	**1,105,000**

Schedule of the project

The project will be executed in a 24-month period

Component	Set of activities	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
I	Act. i																								
	Act. ii																								
	Act. iii																								
II	Act. i																								
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IV	Act. i																								
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	Act. iv																								
V	Act. i																								
VI	Act. i																								
VII	Act. i																								
	Act. ii																								
Project management																									

[3] In kind contribution

V. Executing agency and execution structure

The IDB's Energy division (INE/ENE) and the Competitiveness, Technology and Innovation (IFD/CTI) division (the IDB team) will be in charged to execute the Project. For coordination purposes a Steering Committee will be established in order to oversee the activities of the Project. The Steering Committee will be formed by the Ministry of Mines and Energy of Colombia, the Ministry of Information and Communication Technologies, the Mining and Energy Planning Unit (UPME), the Energy and Gas Regulatory Commission (CREG), the National Planning Department (DNP) in Colombia, and the IDB.

VI. Project Risks and issues

There are not major risks in the implementation of the Program. A Project Manager will be hired as part of the Project to execute the components in a timely manner.

VII. Environmental and Social Classification

There are no envisioned environmental or social risks associated with this operation. We expect a C classification.

Vo.Bo.

Leandro Alves,
Energy Division Chief