U.S. - COLOMBIA SMART GRID WORKSHOP

Partnering to Power the Future

FEBRUARY 11 - 12, 2014
BOGOTÁ, COLOMBIA

Sponsored by the U.S. Trade and Development Agency in partnership with

Colombia inteligente

WORKSHOP HANDBOOK

U . S . TRADE AND DEVELOPMENT AGENCY

February 11, 2014

Dear Workshop Participant:

On behalf of the U.S. Trade and Development Agency, I am pleased to welcome you to the U.S.-Colombia Smart Grid Workshop. Our goal for the workshop is to foster U.S.-Colombian partnerships for state-of-the art electricity transmission and distribution projects throughout the country. We will explore the technologies, equipment and services, as well as associated policies, regulations and financing mechanisms that can support the implementation of smart grid projects. It is our pleasure to sponsor such an important event along with *Colombia Inteligente*, and we hope that your attendance will be both professionally rewarding and personally enjoyable.

Included in the workshop itinerary are panel discussions focusing on a variety of important issues, such as: an overview of the smart grid in Colombia; key technical issues such as microgrids, transmission systems and demand response; and project funding and export finance. There will also be frequent opportunities for you to get to know your fellow workshop participants.

If there are any specific topics that you would like to address during the workshop or any particular participants with whom you would like to meet, please let us know and we will do our best to accommodate your request. Our contractors, the MFM Lamey Group, will be directing the logistics of the workshop, and you may count on them to ensure that things run smoothly throughout the program.

Thank you for your participation in this important event, and I look forward to meeting you in person during our time here in Bogotá. We hope that this workshop strengthens the partnership between our countries so that we can accomplish our shared objective of ensuring reliable, affordable electricity for all.

Sincerely,

Leocadia I. Zak
Director

1000 WILSON BOULEVARD, SUITE1600, ARLINGTON, VA 22209-3901 • 703.875-4357 • Fax: 703.875.4009 • WWW.USTDA.GOV

Workshop Handbook – Table of Contents

ACKNOWLEDGEMENTS

The U.S. Trade and Development Agency would like to acknowledge the support and assistance of the following partner, sponsors and supporting organizations whose invaluable assistance contributed to the success of this workshop.

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Smart Grid Interoperability Panel (SGIP)

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USTDA

United States Trade and Development Agency

AN OVERVIEW

USTDA PROGRAMS AND ACTIVITIES

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The U.S. Trade and Development Agency (USTDA) helps companies create U.S. jobs through the export of U.S. goods and services for priority development projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding project planning activities, pilot projects, and reverse trade missions while creating sustainable infrastructure and economic growth in partner countries.

USTDA Programs

USTDA promotes economic growth in emerging economies by facilitating the participation of U.S. businesses in the planning and execution of priority development projects in host countries. The Agency's objectives are to help build the infrastructure for trade, match U.S. technological expertise with overseas development needs, and help create lasting business partnerships between the United States and emerging market economies.

USTDA advances these objectives through its two key programs, the International Business Partnership Program and the Project Development Program.

The International Business Partnership Program

In support of the National Export Initiative, USTDA launched the International Business Partnership Program (IBPP) designed to connect foreign buyers with U.S. manufacturers and service providers in order to open new export markets and commercial opportunities around the world for U.S. companies through the following activities:

Reverse Trade Missions

As part of the IBPP, USTDA increased its investment in reverse trade missions, which bring foreign buyers to the United States, pending upcoming procurements, in order to observe the design, manufacture and demonstration of U.S. products and services that achieve their development goals. These strategically planned missions also present excellent opportunities for U.S. businesses to establish or enhance relationships with prospective overseas customers.

Conferences and Workshops

USTDA organizes worldwide conferences and workshops to connect U.S. firms with foreign project sponsors. These sector or project-specific events are designed to showcase U.S. goods, services and technologies to foreign buyers. U.S. firms also have the opportunity to meet one-on-one with overseas project sponsors. These events also provide U.S. companies with an understanding of U.S. government programs and the role they can play in supporting increased exports, from advocacy support to export financing options.

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AN OVERVIEW

USTDA PROGRAMS AND ACTIVITIES

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Project Development Program

USTDA provides grants directly to overseas sponsors who, in turn, select U.S. companies to perform Agency-funded project development activities. An overseas sponsor is a local entity, public or private, with the decision-making authority and ability to implement a project. USTDA's priority sectors include: clean energy and energy efficiency, transportation, and information and communications technology.

Key project development program activities include:

Feasibility Studies and Pilot Projects

USTDA-funded and U.S.-led feasibility studies link foreign project sponsors with U.S. businesses at the critical early stage when technology options and project requirements are being defined. These studies provide the comprehensive analysis required for major infrastructure investments to achieve financing and implementation. In some cases, export opportunities depend on a demonstration of the U.S. seller's goods, services or technologies in the foreign buyer's setting. USTDA-funded pilot projects demonstrate the effectiveness of commercially proven U.S. solutions and provide the analysis, evaluation, and empirical data needed for potential foreign projects to secure funding.

Technical Assistance

USTDA advances economic development in partner countries by funding technical assistance that supports legal and regulatory reform related to commercial activities and infrastructure development, the establishment of industry standards, and other market-opening activities. These technical assistance programs facilitate favorable business and trade environments for U.S. goods and services.

Training Programs

In support of U.S. businesses, USTDA also provides training for foreign decision makers to support the sale of U.S. equipment and services overseas. Training can take place in either the United States or host country and it typically focuses on technology or regulatory requirements in order to give project sponsors a better understanding of U.S. capabilities and expertise related to a procurement.

Supporting Small Businesses

USTDA has served as a catalyst for U.S. small businesses to expand their international markets. The Agency partnered with the Small Business Administration (SBA) to increase small business participation in USTDA-sponsored events in order to raise their profile with international buyers, which has yielded significant results. Additionally, USTDA draws extensively on the expertise of small consulting and engineering firms across the country to provide a variety of services related to project definition and evaluation.

USTDA by the Numbers

73:1 For every $1 invested in its programs, USTDA has generated $73 in U.S. exports

$45.8 Billion Since its establishment, USTDA's programs have contributed to over $45.8 billion in U.S. exports

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USTDA

United States Trade and Development Agency

Partnering with Colombia

Traditional and Clean Energy Sectors

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USTDA advances these objectives through its two key programs, the International Business Partnership Program and the Project Development Program.

U.S. study tours are the mainstay of USTDA's International Business Partnership Program (IBPP). Created in 2010, the IBPP is USTDA's signature program for linking U.S. technologies and expertise to priority development projects. These visits are carefully planned to enable overseas project sponsors to meet with U.S. businesses, technical experts and policymakers and financiers that can help them achieve their development goals. These study tours also provide delegates with an opportunity to tour industrial development sites in the United States and to observe the manufacture and demonstration of state-of-the-art technologies first-hand.

Through feasibility studies, technical assistance, pilot projects and other forms of project planning assistance, USTDA's Project Development Program helps overseas project sponsors identify technological solutions and sources of financing for priority infrastructure projects.

USTDA in Colombia

Over the past thirty years, USTDA has invested in activities that have supported priority development projects with both public and private sector sponsors in Colombia. The Agency's program is instrumental in engaging U.S. companies in Colombia's infrastructure development and modernization by facilitating technology transfer in key sectors including transportation, energy, and information and communication technology

Smart Grid Reverse Trade Mission

In October 2012, USTDA sponsored a reverse trade mission to the United States to familiarize 14 Colombian public and private officials with the U.S. smart grid regulatory environment and advanced U.S. smart grid technologies and equipment. The delegation visited Washington, DC; Atlanta, GA; and San Francisco, CA.

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Traditional and Clean Energy Sectors

Promoting Economic Development and Commercial Cooperation

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Clean Energy

Power Market Management System

This Reverse Trade Mission will bring up to eight high-level Colombian public and private sector power utility organization representatives to Washington, DC; Raleigh, North Carolina; Austin, Texas; and San Francisco, California in March 2014 to meet with U.S. companies with expertise in Market Management Systems (MMS) and settlements. The RTM will provide Colombia opportunities to learn about suitable MMS technologies that will assist them with reducing grid supply issues and optimizing investment in the electric power market of Colombia.

Intelligent Supervision and Advanced Control System (iSAAC) for the Colombian Transmission Grid

USTDA is providing a grant to XM Compañía de Expertos en Mercados S.A. E.S.P., the system operator and market administrator of the Colombian power grid, to fund a sole-sourced technical assistance to design a conceptual Wide Area Measurement System (WAMS) for the Colombian power grid and to define a road map for its implementation. The iSAAC project will involve the use of synchronized phasor measurement units and associated hardware at substations, along with system design work to improve the ability to monitor and control the national electrical grid in Colombia.

20 MW Hybrid Solar and Wind Park

USTDA is providing a grant to Celsia for a feasibility study to determine the technical, economic and financial viability of a 20 MW grid-connected, hybrid solar and wind park in the department of Atlántico. Celsia is a publicly listed utility and Colombia's fourth largest power producer. Solar and wind generation will allow Colombia to diversify its energy portfolio, currently highly reliant on hydropower and subject to long arid season caused by swings in international weather patterns.

U.S.-Colombia Smart Grid Workshop

USTDA is sponsoring a Smart Grid workshop to be held in Bogotá February 11-12, 2014 and will co-host the event with Colombia Inteligente, the local industry coalition. The event, which aims to foster U.S.–Colombian partnerships for electricity transmission and distribution projects, will include topics such as microgrids, distribution automation and the applicability of demand response programs in Colombia.

Traditional Energy

Ecopetrol Barrancabermeja and Cartagena Refinery Modernization

USTDA provided two feasibility study grants: one to expand and modernize the Cartagena Refinery to meet product standards and environmental requirements and another to Ecopetrol to develop an integrated master plan for the modernization of operations at its refinery in Barrancabermeja. In 2002, USTDA sponsored an RTM for four executives from the Cartagena Refinery and two officials from the Sebastopol Refinery to participate in a business briefing in Houston and financing roundtable in D.C., among other meetings with U.S. industry.

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Heather Connell – Research Analyst, Contractor

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USTDA in Latin America and the Caribbean

Promoting Economic Development and Commercial Cooperation

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The U.S. Trade and Development Agency (USTDA) advances sustainable infrastructure and economic growth in emerging economies by funding project planning activities, pilot projects, and U.S. study tours. USTDA activities promote the use of U.S. goods and services for priority development projects that help build the infrastructure for trade.

USTDA Programs

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Through feasibility studies, technical assistance, pilot projects and other forms of project planning assistance, USTDA's Project Development Program helps overseas project sponsors identify technological solutions and sources of financing for priority infrastructure projects.

USTDA in Latin America and the Caribbean

USTDA places a high priority on Latin America and the Caribbean, and works with qualified project sponsors to facilitate the implementation of priority infrastructure and development projects.

USTDA focuses its activities in strategic sectors that offer the greatest opportunity for developmental and commercial impact. These strategic sectors include clean energy, transportation, and telecommunications. Other sectors of interest include agribusiness and water and environment.

The following page provides a representative sample of USTDA initiatives and activities in the region.

Photo Credit: Jeff Hager

*As the result of a feasibility study and associated reverse trade mission funded by USTDA, the **Cartagena Refinery** (REFICAR) has thus far concluded over $1.5 billion in contracts with U.S. companies for this refinery upgrade. These contracts include a $1.4 billion engineering, procurement, and construction contract for the refinery expansion that will increase processing capacity to 165,000 barrels per day.*

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USTDA in Latin America and the Caribbean

Promoting Economic Development and Commercial Cooperation

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Clean Energy

Intelligent Supervision and Advanced Control System for the Colombian Transmission Grid: USTDA is providing a grant to XM Compañía de Expertos en Mercados, the system operator and market administrator of the Colombian power grid, to fund a technical assistance to design a conceptual Wide Area Measurement System (WAMS) for the Colombian power grid and to define a road map for its implementation. The iSAAC project will involve the use of synchronized phasor measurement units to improve the ability to monitor and control the national electrical grid in Colombia.

Baja California Wind Power Project: In support of the Energy and Climate Partnership of the Americas (ECPA) and the U.S.-Mexico Bilateral Framework on Clean Energy and Climate Change, USTDA is funding a feasibility study for the State Government of Baja California to enable the supply of wind power to state government office buildings and facilities.

Transportation

Caribbean Airport Certification Process: USTDA provided a technical assistance grant to the Executive Secretariat of the Caribbean Aviation Safety and Security Oversight System to assist selected member countries, including Jamaica, with their airport certification processes. The technical assistance consultancy developed or updated master airport safety plans for eligible CASSOS member countries to ensure compliance with current International Civil Aviation Organization requirements.

Intelligent Transportation System (ITS) Technologies: USTDA is providing technical assistance grant to the Ministry of Transport of the Government of Colombia for assistance with the implementation of the intelligent transportation system (ITS) technologies. The Technical Assistance will conduct analysis of ITS technologies and their applicability in Colombia and define two pilot programs using different ITS applications in the effort to facilitate their implementation by the Colombian government.

Master Plan Update for Bogota International Airport: This technical assistance grant to the Special Administrative Unit for Civil Aeronautics (Aerocivil) addresses planning for phased development at Bogota International Airport over the next 30 years. The technical assistance includes a workshop regarding terminal technology and security improvements that highlighted U.S. sources of supply.

Telecommunications

Rio de Janeiro State Government Information Technology Modernization and Integration: USTDA is providing a grant to the Rio de Janeiro State Information Technology Company for technical assistance that will design the road map and implementation plan for a new data center. The grant also fund an information technology infrastructure review for the state government.

Contact us for more information:

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ELECTRICITY TRANSMISSION AND DISTRIBUTION

PROMOTING ECONOMIC DEVELOPMENT AND COMMERCIAL COOPERATION

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USTDA's reverse trade missions (RTM) are the mainstay of its International Business Partnership Program (IBPP). Created in 2010 in response to President Obama's National Export Initiative, the IBPP is USTDA's signature program for linking the U.S. private sector to foreign buyers. These visits are carefully planned to enable foreign decision makers to meet with U.S. businesses and to observe the manufacture, and demonstration of U.S. goods and services that can help them achieve their development goals. These RTMs also include meetings with financial institutions to observe financing options and technical and regulatory bodies that can assist with strengthening the project sponsor's technical capacity.

Through feasibility studies, technical assistance and pilot projects, USTDA's Project Development Program helps overseas project sponsors identify technological solutions and various sources of financing for priority infrastructure projects.

Recent Activities

USTDA sponsored a visit to the United States for senior officials from the Vietnam National Power Transmission Corporation (NPT) to connect them with U.S. electric power transmission technology providers. Having identified $5 billion worth of upgrades and investments that are needed for their network, NPT delegates had the opportunity to visit U.S. power transmission companies and equipment manufacturers as well as meet with consulting companies that could assist with service capabilities and construction management.

Shortly after the RTM, NPT and GE signed a memorandum of understanding to work together on a pilot to install GE's relay system on NPT's network. Thus far, NPT has purchased $11 million worth of GE equipment, and NPT and GE are currently working with the U.S. Export-Import Bank to purchase additional equipment valued at $36 million.

Delegates from NPT tour Georgia Power's substation facility.

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eThekwini Smart Metering Feasibility Study in South Africa

In order to address concerns over South Africa's declining electricity reserve margin, USTDA awarded a grant to eThekwini Municipality to support the rollout of advanced electricity metering, or smart meters. USTDA's assistance promotes the application of innovative U.S. technologies that will enable South African electricity distributors to integrate energy-intensive users into a smart metering system.

Demand Response System Pilot Project in China

In support of the U.S.-China Energy Cooperation Program's efforts to open China's market to U.S.-manufactured technologies as the country continues to develop its energy infrastructure, USTDA funded a feasibility study and pilot project on the implementation of a smart grid demand response management system for the China State Grid Electric Power Research Institute (SGEPRI). U.S. companies provided the equipment for the pilot, and the results will assist SGEPRI in designing a national smart grid implementation strategy.

CESC Smart Grid Feasibility Study in India

USTDA is funding a feasibility study grant to CESC Ltd. for the implementation of smart grid technologies and practices across their electricity supply and distribution network in Kolkata, India. The study would develop requirements and specifications for a smart grid implementation roadmap for CESC and would address a range of improvements, including integrating smart meters and automated meter reading into CESC's distribution system.

Eastern Transmission Line Feasibility Study in Ghana

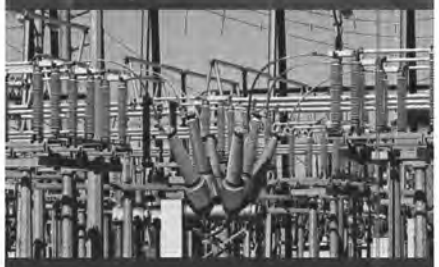
USTDA is funding a feasibility study to assist the Ghana Grid Company Limited, a state-owned power transmission company, in determining the technical and economic viability of reinforcing Ghana's electricity transmission network with new power transmission lines. The new lines would makes the electrification of unserved rural communities more affordable and accessible in the northern and eastern regions of Ghana.

Smart Grid Applications in Power Distribution in Turkey

USTDA is providing funding for a feasibility study that will introduce upgraded control systems and smart grid technology to the Başkent Elektrik Company in Turkey. The study will include a gap analysis, strategy proposal, estimate of investment requirements, and system integration recommendations for this newly privatized company.

Smart Grid Regulatory Framework Project in Mexico

USTDA is providing a grant to the Comisión Reguladora de Energía to provide technical assistance that will outline the key components of a regulatory framework to support smart grid deployment in Mexico.



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Colombia inteligente

Colombia Inteligente is a **nation committed to a sustainable energy program**, where all the sectors use efficiently high quality energy resources, preserving the environment. All in line with policies, strategies, action plans and services that integrate different energy sources, electrical grids and information and communication technologies with an active demand participation.

Colombia Inteligente is also a strategic body that promotes the integral development of smart grids in Colombia, to contribute with the main focus areas, which are, **universal access, security & quality, competitiveness and environment sustainability**.

The initiative is meant as a **Collaborative Network** comprised of working groups, which are active elements that seek to achieve the objectives through different actions, studies, or projects.

Organizations and member companies of the initiative are:

More Information: www.colombiainteligente.org email: info@colombiainteligente.org

I. WORKSHOP AGENDA

Workshop Agenda

Day 1 – February 11, 2014

TIMING	SESSION DESCRIPTIONS
0800 – 0900	**REGISTRATION AND CONTINENTAL BREAKFAST** *Sponsors Expo Opens in the Santafe Foyer with Breakfast in the Santafe 3*
0900 – 0930 *Santafe 1 & 2*	**WELCOME AND OPENING REMARKS** • Hon. Leocadia I. Zak, Director, U.S. Trade and Development Agency • Chargé d' Affaires Benjamin Ziff, U.S. Embassy, Colombia • Vice Minister Orlando Cabrales, Ministry of Mines and Energy • Alberto Olarte, President of Colombia Inteligente and Technical Secretary of the National Operations Council *Introduced by Nathan Younge, Regional Director – Latin America and the Caribbean, U.S. Trade and Development Agency*
0930 – 1000 *Santafe 1 & 2*	**OVERVIEW OF THE SMART GRID IN COLOMBIA** Colombia Inteligente (Smart Colombia) is a multi-stakeholder industry coalition promoting smart grid innovation throughout the country. Its objective is to ensure that Colombia reaches high levels of energy efficiency by implementing best practices and advanced technologies for energy usage in key subsectors. In this session, representatives from Colombia Inteligente will discuss the implementation of smart grid in Colombia's electric power delivery sector, including a review of current and future smart grid programs and projects. Dr. Renato Céspedes, Technical Coordinator, Colombia Inteligente

1000 – 1030

Santafe 1 & 2

OVERVIEW OF SMART GRID INVESTMENT GRANTS IN THE UNITED STATES AND LESSONS LEARNED

To support the development of a smart grid in the United States, the Department of Energy provided funding for the distribution of Smart Grid Investment Grants (SGIGs) as part of the American Recovery and Reinvestment Act of 2009 (ARRA). Under a competitive process, U.S. utilities received grant money and provided matching funds to develop smart grid projects. There were 99 SGIG projects ranging in scope from the deployment of advanced metering infrastructure to advanced distribution automation technologies to wide area measurement systems (WAMS) with synchrophasors.

This session will discuss the ARRA grant process, lessons learned and next steps for the further development of a smart grid in the United States. Several projects relevant to potential projects in Colombia will be highlighted.

Dan Ton, Program Manager, Smart Grid R&D, U.S. Department of Energy

1030 – 1100 **NETWORKING BREAK** *in the Santafe Foyer*

1100 – 1200

Santafe 1 & 2

SMART GRID FOR DISTRIBUTION UTILITIES: BENEFITS AND CHALLENGES

Each of the panelists for this session has successfully deployed smart grid solutions for distribution systems in the United States. The speakers will review various technologies and case studies where the introduction of a smart grid has contributed to improvements in operations and reliability.

Moderator and speaker: Glenn Pritchard, Technology Lead, Smart Grid/Smart Meter Project, PECO

- Neal Bartek, Smart Grid Projects Manager, SDG&E
- Sandra Ospina Arango, Manager of Quality and Innovation Projects, EPSA
- Fernan Izquierdo, Manager Global Solutions, Latam, Silver Spring Networks

1200 – 1330 **LUNCHEON** *Sponsored by* ORACLE UTILITIES

Santafe 3

Luncheon Speaker:

John R. Norris, Commissioner,
Federal Energy Regulatory Commission

1330 – 1445 | **MICROGRIDS FOR RELIABLE AND RESILIENT POWER SUPPLY**

Santafe 1 & 2

Microgrids are complete power systems on a small scale. They include most smart grid technologies for distribution systems, and oftentimes renewable energy (solar). Microgrids have a role in power markets and are major contributors to a reliable and resilient grid. They are the focus of much smart grid activity in the United States in 2014.

This session will provide an overview of advanced microgrid applications in the United States. After a brief introduction on the topic, panelists will address: the siting of microgrids in a variety of locations, including rural and urban, industrial and commercial and university settings; the relationship of building energy management systems to microgrids; and the tools and resources available to plan microgrid investments, installations, and operations. This panel will conclude with a panel discussion of possibilities for microgrid development in Colombia.

Microgrid – "Smart Grid" Connected to the Distribution Grid
Speaker and Moderator: Jim Reilly, Reilly Associates

Microgrid Energy Efficiency and Economic Operations in a Campus Environment
Speaker: Ted Borer, Energy Plant Manager, Princeton University Microgrid

Utility-Scale Microgrids in Remote Areas
Speaker: Neal Bartek, Smart Grid Projects Manager, SDG&E

Microgrid Development in Colombia
Speaker: Nicanor Quijano, Department of Electrical Engineering, Universidad de Los Andes, Colombia

1445 – 1545 | **LEADING TECHNOLOGIES TO ENABLE THE SMART GRID**

Santafe 1 & 2

This session will be an opportunity for U.S. companies to discuss relevant technologies that enable the smart grid, including metering and communications infrastructure; data and outage management; and distribution automation.

Moderator:
Dr. Renato Céspedes, Technical Coordinator, Colombia Inteligente

- Steve Meissel, Vice President, International Business Development, Aclara
- Claudia Vasquez, Principal Sales Consultant, Oracle Utilities
- Germán Eduardo Hernández, Sales Manager, S&C Electric, Colombia

1545 – 1615 | **NETWORKING BREAK** *in the Santafe Foyer*

1615 – 1715

Santafe 1 & 2

TRANSMISSION SYSTEMS IN COLOMBIA - PHASOR MEASUREMENT UNITS (PMUS) IMPROVE RELIABILITY

Wide Area Measurement Systems – XM Case Study: This panel will provide an opportunity for XM Compañía de Expertos en Mercados S.A. E.S.P. (XM Company of Experts in Markets or "XM), the Colombian project sponsor, and Quanta Technology, the U.S. contractor, to describe the USTDA-funded technical assistance program that is enabling XM to refine its design of an advanced Wide Area Measurement System (WAMS) and support the development of an Intelligent Supervision and Advanced Control System (iSAAC) for the Colombian transmission grid. The WAMS will utilize synchronized phasor measurement units (PMUs) and associated hardware and software at the control center and substations to improve the ability to monitor and control the national electrical grid in Colombia. This session will address benefits of deploying phasor measurement units (PMUs) in wide area measurement to improve the situational awareness of the power grid, making it more reliable and self-healing.

Moderator: Jacob Flewelling, Country Manager – Colombia and the Dominican Republic, U.S. Trade and Development Agency

- Ramon Leon, Senior Executive, New Business Development, XM
- David Elizondo, PhD, Principal Advisor, Quanta Technology
- Diogenes Quintero, Manager for Latin America and the Caribbean, Arbiter Systems Exclusive Distributor

1715 – 1815

Santafe 1 & 2

GAINING INTELLIGENCE FROM "BIG DATA"

Smart grid and bulk energy markets have brought terabytes of data to utilities. This data ranges from customer usage to field assets to real-time pricing. These massive amounts of data need to be presented in a concise, actionable manner to enable decision making, i.e. grid operations and engineering, network design, asset strategy, budget planning, settlements, financial risk management, etc. This requires advanced data management and analytics. This session will describe how utilities can use "big data" throughout the enterprise through data access and integration, enhanced visualization and analysis in a collaborative environment enabling accurate operational and market decision making and expansion planning.

Moderator: E. David Ellington, President, GridSpeak Corporation

- Claudia Vasquez, Principal Sales Consultant, Oracle
- James L. Connaughton, Executive Vice President, C3 Energy
- Jake Levine, Senior Manager Market Development and Regulatory Affairs, Latin America, Opower

1900 – 2030

Santafe foyer

NETWORKING RECEPTION *Sponsored by*

Colombia Inteligente

Day 2 - February 12, 2014

TIMING	SESSION DESCRIPTION
0800 – 0830	**CONTINENTAL BREAKFAST** *in Santafe 3*
0830 – 0835	**WELCOME**
Santafe 1 & 2	Clark Jennings, Chief of Staff, U.S. Trade and Development Agency
0835 – 0945	**DEMAND RESPONSE MARKETS: REGULATORY VIEWS**
Santafe 1 & 2	This session will introduce demand response as a major part of the smart grid from a regulatory and market perspective. The Federal Energy Regulatory Commission (FERC) has jurisdiction over wholesale markets and for monitoring demand response programs in the United States. The Electric Reliability Council of Texas (ERCOT) market has the closest resemblance to the Colombian market and is facing similar challenges introducing demand response. The Energy and Gas Regulatory Commission (CREG) is Colombia's technical regulatory body for electricity and gas. Moderator: Jim Reilly, Consultant, Reilly Associates • Michael Tita, Policy Group Manager, Federal Energy Regulatory Commission (FERC) • Joel Mickey, Director, Market Design and Development, Electric Reliability Council of Texas (ERCOT) • Mauricio Gomez, Commissioner, Energy and Gas Regulatory Commission (CREG)
0945 – 1015	**DEMAND RESPONSE IN THE UNITED STATES**
Santafe 1 & 2	Curtailment service providers are aggregators that contract with customers for load and, in turn, sell the load into the market. This session will explain the role of aggregators in the market and explore approaches for implementing smart metering and demand response programs in Colombia. Vince Faherty, Principal, International Market Development, EnerNOC
1015 – 1045	**NETWORKING BREAK** *in the Santafe Foyer*

1045 – 1145 | **STRATEGIES FOR IMPLEMENTING DEMAND RESPONSE IN COLOMBIA**

Santafe 1 & 2

This panel discussion will review the possibilities for implementing demand response programs in Colombia.

Moderator: Angela Cadena, Director, Mining and Energy Planning Unit, UPME

- Mauricio Gomez, Commissioner, Energy and Gas Regulatory Commission (CREG)
- Michael Tita, Policy Group Manager, Federal Energy Regulatory Commission (FERC)
- Joel Mickey, Director, Market Design and Development, Electric Reliability Council of Texas (ERCOT)
- Olga Cecilia Pérez, Technical Secretary, Electricity Marketing Advisory Committee (CAC)
- Vince Faherty, Principal, International Market Development, EnerNOC

1145 – 1230 | **INDUSTRIAL ENERGY EFFICIENCY AND DEMAND RESPONSE IN COLOMBIA**

Santafe 1 & 2

This session will introduce the applicability of energy efficiency to demand response programs for industrial companies in Colombia. The speakers represent key stakeholders in the energy sector, including the Mining and Energy Planning Unit (UPME), which is the planning and development organization under the Ministry of Mines and Energy for the mining and energy sectors in Colombia; an industrial energy end-user; and member of the National Business Association of Colombia (ANDI). UPME formulates state policies and decision-making for the benefit of the country through independent research and analysis.

Moderator: Anne McKinney, Deputy Director, Colombian American Chamber of Commerce

- Carlos Garcia, Sr. Advisor, Demand Division, Mining and Energy Planning Unit – UPME
- Karen Schultt, Director, Energy, Ministry of Mines and Energy
- Daniel Romero, Director, Chamber of Large Energy and Gas Consumers, National Business Association of Colombia (ANDI)

1230 – 1345 | **LUNCHEON** *Sponsored by*

Santafe 3

ACLARA C3 Energy

1345 – 1445 | **PROJECT FUNDING AND EXPORT FINANCE**

Santafe 1 & 2

This panel discussion will review financing resources and case studies for financing smart grid projects. Panelists will include representatives from U.S. government and international funding organizations as well as private financing organizations.

Moderator: Nathan Younge, Regional Director – Latin America and the Caribbean, U.S. Trade and Development Agency

- José Ramón Gomez, Senior Regional Energy Specialist, Inter-American Development Bank
- Luis Carlos Herrera, Senior Associate, Energy and Natural Resources, Investment Banking, Bancolombia Investment Banking
- Kristtian Rada, Operations Officer, International Finance Corporation
- Luis Eduardo Niño, Business Development Manager, National Development Finance Agency (Financiera de Desarrollo Nacional)
- Juan Antonio Sefair, Bogotá-Based Broker, Export Import Bank of the U.S.

1445– 1545 | **TECHNOLOGIES TO IMPROVE RELIABILITY**

Santafe 1 & 2

Meter data can be used to identify the locations of outages, plan restoration, and dispatch crews to exact locations. In the past, utilities relied on calls from customers to identify outage locations. Combining data from meters (AMI) with outage management systems (OMS), response times can result in significant improvement in reliability indices (SAIDI, SAIFI and CAIDI), thus increasing customer satisfaction. The suite of tools depends on the interoperability of smart grid technologies and the sharing of data between the enterprise, engineering, and operations departments of utilities. The panelists will describe how to improve reliability through these methods.

Moderator: Gustavo Domínguez Poó, Director for Latin America, NEMA

- Carlos A. Nicolini, Regional Director – LatAm, Apex CoVantage
- Nic Wilson, Energy Regional Segment Manager, Americas, Vaisala, Inc.
- Juan Jacobo Rodriguez, Planning Officer, T&D Planning Department, EPM
- Juan Sarmiento, Regional Sales Manager, GE Digital Energy

1545 – 1615 | **NETWORKING BREAK** *in the Santafe Foyer*

1615 – 1700 | **ENERGY EFFICIENCY AND LOAD CONTROL**

Santafe 1 & 2

Energy efficiency and load control are major benefits of utilizing smart grid technologies. This is important for commercial and industrial customers, as well as residential customers. It is a prerequisite for participation in demand response markets, by identifying loads that are available for commitment to markets. The speakers will discuss the benefits of increasing energy efficiency and load control and the technologies that can successfully achieve these dual goals.

Moderator: Nathan Younge, Regional Director – Latin America and the Caribbean, U.S. Trade and Development Agency

- **Colombian View on Energy Efficiency**
  Omar Eduardo Arango, Director of Energy Management, EMCALI
- **Technology and Process Solutions**
  Chris Hickman, CEO, Innovari

1700– 1730 **CONSUMER INTERACTION WITH THE SMART GRID**

Santafe 1 & 2

The smart grid enables consumers to play a large role in managing load and energy efficiency. This session will discuss the role of consumers in implementing a smart grid.

- Angel Sustaeta, Director of Sales, Latin America, Opower

1730– 1800 **WORKSHOP WRAP UP AND DISCUSSION**

Santafe 1 & 2

This roundtable will focus on key themes and topics captured throughout the two-day workshop and discuss next steps for moving forward. Roundtable participants will be selected according to the topics of greatest interest as they emerge during the workshop.

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II. Officials, Speakers and Moderators

Officials, Speakers and Moderators

Featured Speakers

Hon. Leocadia I. Zak
Director
U.S. Trade and Development Agency

Leocadia I. Zak serves as the Director of the U.S. Trade and Development Agency where she leads an agency dedicated to encouraging economic growth in emerging markets and the export of U.S. goods and services to those markets. After being nominated by President Obama in November 2009, Ms. Zak was confirmed by the U.S. Senate on March 10, 2010. She had served as Acting Director of the agency since January 20, 2009 and before that was the General Counsel (2000 – 2006) and Deputy Director (2006 – 2009) of USTDA.

Prior to joining USTDA, Ms. Zak was a partner in the Washington, D.C. and Boston offices of Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C. practicing in the areas of corporate, municipal and international finance. She served as counsel in connection with a variety of project finance transactions for energy, transportation, health care, telecommunications and tourism projects.

Ms. Zak was also an Adjunct Professor of Law and has taught "International Project Finance" at the Boston University School of Law, Morin Center for Banking and Financial Law Studies and at the Georgetown University Law Center.

Ms. Zak received her B.A. from Mount Holyoke College and her J.D. from Northeastern University School of Law.

Doctor Orlando Enrique Cabrales Segovia
Vice-Minister of Energy
Ministry of Mines and Energy
Colombia

Doctor Orlando Cabrales serves as Vice Minister of Energy in the Ministry of Mines of Colombia. Prior to assuming his current role at the Ministry, he served as President of the National Hydrocarbon Agency (ANH) of Colombia – the nation's hydrocarbon resource manager and promoter.

Before his duties at ANH and the Ministry, Doctor Cabrales held several high ranking executive positions at British Petroleum Company over a fifteen year period. This included serving as the Legal Vice President for Latin America, and also as Legal Director and Senior Lawyer. Doctor Cabrales also served as Executive Assistant and Political Analyst for the BP Colombia

President. At Ecopetrol – the Colombian Oil company – he was an assistant to the Director between 1988 and 1990. Doctor Cabrales has acted as a member of the Board of Directors at several companies in Colombia, including Malterias de Colombia, Aluminio Reynolds, Astilleros Vikingos, BP Gas Colombia, Central Oil Pipeline, El Tiempo, and Corporación Excelencia a la Justicia. He holds degrees from Unviersidad Javeriana and a Master of Philosophy from Boston College.

Mr. Benjamin Ziff
Charge d'Affaires
U.S. Embassy, Colombia

Benjamin Ziff is the Chargé d' Affaires at the U.S. Embassy in Bogota, Colombia. He recently completed a one-year assignment as Minister Counselor for Public Affairs at the U.S. Embassy in Baghdad, Iraq.

After joining the Foreign Service in 1988, he began his Foreign Service career in Canberra, Australia in the U.S. Embassy's press section. He subsequently served as Assistant Cultural Attaché at the U.S. Embassy in Tel Aviv, Israel, moved on to be the Press Attaché at the U.S. Embassy in Panama City, and returned to the Middle East as the Director of the American Center in Jerusalem.

Mr. Ziff then served at the U.S. Embassy in Lima, Peru, before spending a year at the National War College in Washington, DC. After a tour in the Department of State as Deputy Director of the Office of Central American Affairs, Mr. Ziff served in Caracas, Venezuela as Counselor for Public Affairs at the U.S. Embassy. He then transferred to Rome, Italy where he spent three years as Counselor for Public Affairs.

Mr. Ziff received his B.A. in Political Science from the California State University at Long Beach, his M.A. from the Fletcher School of Law and Diplomacy, and an M.S. in National Security Studies from the National War College.

Dr. Alberto Olarte
President
Colombia Inteligente

In his role at Colombia Inteligente, Dr. Alberto Olarte serves as Technical Secretary of the National Operation Council, covering the technical aspects to ensure that the integrated operation of the national grid is safe, reliable and economical. Dr. Olarte also has duties as the Chairman of the Steering Committee of Colombia Inteligente, leading a broad discussion forum for the electricity sector that promotes finding solutions for the entire chain from generation to final consumption based on better performance and better service to users, utilizing wherever technically and economically justifiable, new technological proposals that exceed the benefits of conventional technologies.

Dr. Olarte has extensive experience in the areas of electricity dispatch planning of the Colombian Electrical System, production and economic dispatch of generation and supply of energy, Energy Resources Management and managerial skills and experience in energy companies. He received degrees in Electrical Engineering from Universidad de Los Andes, a Masters in Power Systems from the University of London and a specialization in Management of Power Systems from Swedish Power in Stockholm, Sweden.

Hon. John R. Norris
Commissioner
Federal Energy Regulatory Commission

John R. Norris was nominated by President Barack Obama to the Federal Energy Regulatory Commission in 2010 and reconfirmed by the U.S. Senate in 2012 for a full term expiring in June 2017.

Commissioner Norris, a lawyer, has years of experience in energy policy and regulatory affairs. He most recently served as Chief of Staff to Secretary Tom Vilsack of the U.S. Department of Agriculture. Prior to joining the USDA, he served as Chairman of the Iowa Utilities Board (IUB) from 2005 to 2009. During his tenure as IUB Chairman, Commissioner Norris served on the National Association of Regulatory Utility Commissioners (NARUC) Electricity Committee and was Co-Chair of the 2009 National Electricity Delivery Forum.

During his IUB tenure, Commissioner Norris also served as a Board Member, Secretary and President of the Organization of Midwest Independent System Operator (MISO) States as well as Chairman of the MISO Demand Response Working Group. He also was a member of the FERC/NARUC Demand Response Collaborative. Commissioner Norris also has served on the Board of Directors of the National Regulatory Research Institute, as a member of the Board of Trustees of the Iowa Power Fund and on the Advisory Councils of the Iowa Energy Center, the Financial Research Institute for the University of Missouri College of Business and the Center for Global and Regional Environmental Research at the University of Iowa.

In 1999 and 2000, Commissioner Norris was Chairman of the Iowa Electric Restructuring Task Force while serving as Chief of Staff for then-Iowa Governor Tom Vilsack. He also served as Chief of Staff for U.S. Representative Leonard Boswell (IA-3rd) from 1997 to 1998. From 1989 to 1993 he owned and managed a restaurant in Greenfield, Iowa, and he was State Director of the Iowa Farm Unity Coalition during the Farm Crisis of the 1980s.

Commissioner Norris graduated with distinction from the College of Law at the University of Iowa in 1995 and earned his undergraduate degree in 1981 from Simpson College in Indianola, Iowa.

Colombian Government Participants

Doctor Germán Castro Ferreira
Executive Director
Regulatory Commission for Energy and Gas (CREG)

Germán Castro Ferreira serves as Executive Director of the Regulatory Commission for Energy and Gas of Colombia (CREG). He assumed the position of Executive Director in 2010 and recently had his term extended an additional four years by President Juan Manuel Santos. Doctor Castro Ferreira has 30 years experience in the energy sector and was named as an Expert Commissioner in 2009.

Doctor Castro Ferreira studied Electrical Engineering and later earned a Masters of Business Administration at La Universidad de Los Andes and undertook advanced studies in Global Strategies at Esade Business School in Madrid, Spain. He has also served as an instructor at several institutions, including Universidade La Salle, Externado de Colombia and Politécnico Gran Colombia.

Doctor Ángela Inés Cadena Monroy
Director General
Mining and Energy Planning Unit (UPME)

Angela Inés Cadena Monroy was appointed by President Juan Manuel Santos as the new Director General of the Mining Planning Unit Energy – UPME, according to Decree 1708 of August 15, 2012. Doctor Cadena is a graduate of the Universidad de Los Andes, where she received undergraduate and graduate degrees in Electrical Engineering. She also holds a Ph.D. in Economics and Social Sciences from the University of Geneva, Switzerland. Doctor Cadena has over 10 years experience in academia, and served as Director of UPME from 1998 to 1999 and as Deputy Director for Energy Resources from 1996 to 1997. Prior to returning to UPME, she was engaged in teaching and research activities in the department of Electrical Engineering at the Universidad de Los Andes, where she coordinated joint projects with organizations such as the Inter-American Development Bank. Doctor Cadena has also led studies on future energy scenarios for Colombia and on measures to reduce greenhouse gas emissions on the energy system and the Colombian economy.

Ms. Karen Shultt
Director, Energy
Ministry of Mines and Energy

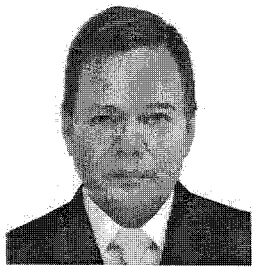
In her role at the Ministry of Mines and Energy, Karen Shultt's duties include actively participating in the restructuring and privatization processes of generation and distribution state-owned companies, the supervision of investment bank contractual obligations and the correspondent deliverables, and assisting the Vice Minister on the economic and regulatory decisions taken at the Board of the Regulatory Commission of Energy and Gas (CREG).

Additional duties include the coordination of the regulatory agenda between the Energy Regulatory Commission and the Ministry of Mines and Energy. Ms. Shultt organizes industry and government workshops and energy forums to discuss in a constructive way, the market's problems and foresee potential opportunities. She also is involved in the design of institutional policies and the implementation of strategic industry reforms focused, particularly, on the regulatory framework and proper economic signals and in strategic consulting in the structuring and development of infrastructure projects and public utility services programs for the energy and gas sectors.

Ms. Shultt received her undergraduate degree from Pontifica Universidad Javeriana in Colombia and has taken post graduate and continuing education courses at Georgetown University, Universidad Industrial de Santander, University of Calgary, and the London School of Economics. She received an MBA with a concentration in International Business from the University of East London.

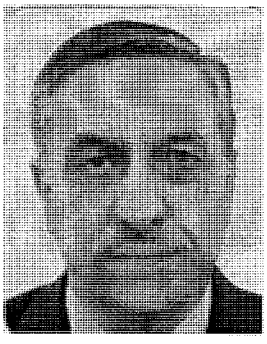
Additional Colombian Participants

Ing. Omar Arango
Director of Energy Management
Empresas Municipales de Cali E.I.C.E. (EMCALI)



As Director of Energy Management at EMCALI, Mr. Omar Arango develops the initiatives for the strategic plan for energy business, manages the human resource, technical, financial and operational aspects of the Directorate, identifies business opportunities, markets the energy business policies and holds additional duties.

Mr. Arango is an Electrical Engineer by training and is currently pursuing a Masters in Business Administration at Universidad del Valle in Cali. He has significant experience in the coordination and management of comprehensive technical and commercial projects, auditing the design and construction of electrical networks and low voltage and home installations, planning, control and monitoring of investment projects and the design and construction of electrical distribution networks.



Doctor Renato Céspedes
Technical Coordinator
Colombia Inteligente

Dr. Renato Céspedes is the Technical Director for Colombia Inteligente, the main innovation activity for smart grid in Colombia for the electrical sector. He is also an associate professor of the National University of Colombia in the Graduate Department of Electrical Engineering and a Senior Member of IEEE. Dr. Céspedes has been invited as a speaker to major conferences throughout the world, has published more than 65 papers and has been expert for the World Bank, the Inter-American Development Bank (IDB), and the Organization of Energy in Latin America (OLADE).

Dr. Céspedes holds a doctorate in Electrical Engineering from the National Polytechnique Institute of Grenoble, France and has experience in the areas or operation and analysis of Power Systems, SCADA and Energy Management Systems (EMS) including the associated communications systems, Distribution Management Systems (DMS), Market Management Systems (MMS) and Power System Strategic decisions and planning. He has been project manager or consultant for a number of projects worldwide including countries such as Unites States, Spain, Netherlands, Poland, Brazil, Mexico, Costa Rica, Saudi Arabia, Vietnam, Thailand, India, Pakistan, South Africa, Togo, Colombia, Peru, Ecuador, Venezuela, and Chile.

At the present Dr. Céspedes is also CEO & General Manager of RConsulting Group in Bogotá, Colombia specializing in the areas of Intelligent Networks (Smart Grid) with an emphasis on the most appropriate technological tools businesses. Previously he served for twenty years as Director for the Latin American office of KEMA Inc., during which time he acted as a consultant and project engineer for the implementation of systems throughout the world.

Mr. Jose Ramón Gómez
Senior Energy Specialist
Inter-American Development Bank

Mr. Jose Ramón Gómez is a Senior Energy Specialist at the Inter-American Development Bank. His areas of expertise are in Rural Electrification with an emphasis in electricity access; renewable energy, and power generation and transmission. Among many other activities, he is leading several energy programs in Colombia, Panama and Honduras, and he also led the energy division activities for the reconstruction of Haiti. During his career at the Bank he has worked in Argentina, Jamaica, Guatemala, Guyana, Suriname, and led the outreach and partnership activities of the energy division, which included the identification and development of several co-financing opportunities. Prior to joining the IDB in 2005, he worked in the Environmentally & Socially Sustainable Development Division of the Latin America & Caribbean Region in the World Bank Group (IBRD). He holds a B.S. Sanitary and Environmental Engineering from the Universidad de la Salle, Bogotá, Colombia and two Master of Science degrees in Environmental and Civil Engineering and Engineering Management both from the George Washington University.

Ing. Luis Carlos Herrera
Senior Associate, Energy and Natural Resources
Banco de Inversión Bancolombia (Bancolombia Investment Banking)

Luis Carlos Herrera serves as Senior Associate for Energy and Natural Resouces for Banco de Inversión Bancolombia (Bancolombia Investment Banking). He has served in this capacity since September 2013. From February 2009 to February 2012 he was a Business Analyst for Interconexión Eléctrica ISA. Mr. Herrera has over seven years experience in investment banking, including more than three years in the financial structuring and financial offer of power transmission lines and international tenders for government concessions, covering several countries, including Colombia, Peru, Brazil and Chile. Mr. Herrera received a Bachelor of Science degree in Civil Engineering and Business Management from EAFIT University in Colombia, a Postgraduate Specialization in Finance from EAFIT University, and a Masters in Finance from the University of New South Wales.

Ing. Ramón León
Senior Executive, New Business Development
XM S.A.

Ramon Leon is currently Senior Executive for new business development at XM S.A. (an affiliate of Grupo ISA), in charge of the design and structuring of new business opportunities for the company, based on the advanced management of real-time systems and market platforms. He has 16 years of experience in the strategic planning of energy systems, the management of research and development projects, and the structuring of corporate entrepreneurship projects based on innovation. Mr. León is also a member of the Advisory Board of the Colombia's National Research Program on Energy and Mining.

Mr. León is an Electrical Engineer from Universidad Tecnológica de Bolívar and has a Masters Degree in Electrical Engineering from Iowa State University. He also has a Certificate in Modern Power System Protection from the University of Wisconsin-Madison and a Certificate in Operations Research from Universidad Nacional de Colombia. He is a Fulbright-Colciencias scholarship recipient and a senior member of the Power and Energy Society of the IEEE.

Doctor Daniel Vicente Romero Melo
Director, Chamber of Large Consumers of Energy and Gas
National Business Association of Colombia (ANDI)

Daniel Romero Melo is a Mechanical Engineer with a specialization in Information Systems and Finance. He has worked with Financiera Energética Nacional, the Ministry of Mines and Energy, and the Superintendent of Public Services. His current role is as Director, Chamber of Large Consumers of Energy and Gas for National Business Association of Colombia (ANDI), which is a non-profit organization whose main purpose is to expand and promote economic, social and political principles within a free enterprise system, based upon beliefs that include human dignity, political democracy, social justice, private property and liberty.

Ing. Olga Cecilia Pérez
Technical Secretary
Electricity Marketing Advisory Committee

Olga Pérez serves as Technical Secretary of the Electricity Marketing Advisory Committee of Colombia. She has extensive experience in the Colombian electricity sector both in the private sector and in academia. Ms. Pérez has worked with Energy Group Bogotá, Codensa, Chivor and the Power Corporation of Cundinamarca. In her experience in the electricity sector, Ms. Pérez has actively participated in various forums such as ASOCODIS, ANDESCO, CNO, CAC and COCIER. She has also served as professor at Universidad de La Salle and has been involved in management training programs of INALDE, IDIME and Universidad de La Sabana. Ms. Pérez is a graduate of the faculty of

Electrical Engineering from Universidad Nacional de Colombia and holds Masters Degrees in Finance, Business Management, and Technical and Economic Management of the Electrical Sector.

Doctor Nicanor Quijano
Associate Professor
Department of Electrical and Electronic Engineering
Universidad de Los Andes

Nicanor Quijano (IEEE Senior Member) received his B.S. degree in Electronics Engineering from Pontificia Universidad Javeriana (PUJ), Bogotá, Colombia, in 1999. He received M.S. and Ph.D. degrees in Electrical and Computer Engineering from the Ohio State University in 2002 and 2006, respectively. In 2007 he joined the Electrical and Electronics Engineering Department, Universidad de Los Andes (UAndes), Bogotá, Colombia as an Assistant Professor. In 2008 he obtained the Distinguished Lecturer Award from the School of Engineering at UAndes. He is currently an Associate Professor, the Director of the Research Group in Control and Automation Systems (GIAP, UAndes), the Chair of the IEEE Control Systems Society (CSS), Colombia, and a member of the Board of Governors of the IEEE CSS. His research interests include hierarchical and distributed optimization methods, using bio-inspired and game-theoretical techniques for dynamic resource allocation, applied to problems in energy, water, and transportation. For more information and a complete list of publications see: http://wwwprof.uniandes.edu.co/~nquijano

Mr. Juan Antonio Sefair
General Manager
Recursos Corporativos
Colombia

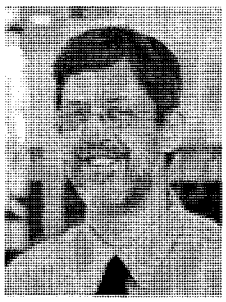
Juan Antonio Sefair serves as General Manager of Recursos Corporativos, providing procurement and commercial management for mergers and acquisitions, financial advisory, corporate and trade finance and political risk guarantees for the World Bank, the Multilateral Investment Guarantee Agency and the Overseas Private Investment Corporation. Mr. Sefair has over twenty years experience in the financial sector, with a focus on creating value with extensive experience in finance, strategic planning, marketing, commercial and administrative management. His experience is focused on export credit agencies, particularly for programs of the Export-Import Bank of the U.S. as well as in financial advisory and debt restructuring.

Mr. Sefair is a former independent consultant for PNC Bank for structured trade finance on EX-IM Bank programs. He is currently working on the same program with Huntington Bank. Prior to his current role with with Recursos Corporativos he held positions at ABN AMRO Bank and at the Ministry of Finance of Colombia. Mr. Sefair received his degree in Business Administration from Colegio de Estudios Superiores de Administración (C.E.S.A.), and in Financial Law from Universidad de Los Andes.

U.S. Company Speakers, U.S. Government Speakers and Additional Speakers

Mr. Neal Bartek
Smart Grid Projects Manager
San Diego Gas & Electric

During his 15 years in the electric industry, Mr. Bartek has held numerous positions with both Florida Power & Light and San Diego Gas & Electric (SDG&E). His breadth of experience includes various aspects of the design, evaluation, application, and implementation of electrical power equipment and the electric grid. His present responsibilities as Smart Grid Projects Manager for SDG&E include leading a team of project managers in the development and implementation of innovative projects in support of SDG&E's Smart Grid Deployment Plan. Mr. Bartek has a Bachelors of Science degree in Operations Research and Industrial Engineering from Cornell University in Ithaca, NY.



Mr. Ted Borer
Manager
Princeton University Microgrid

Edward T. Borer is the energy plant manager for Princeton University. He is actively involved in campus energy and carbon emissions reduction efforts. He has 30 years of experience in the power industry, is a registered professional engineer, and holds both undergraduate and graduate degrees in Mechanical Engineering as well as the CEM, CEP, and LEED-AP Certifications. He has leadership roles in the International District Energy Association and New Jersey Higher Education Partnership for Sustainability. He is founding co-chairman of the Microgrid Resources Coalition and has provided energy resiliency briefings to US House Representatives, FERC Commissioners, and various state level legislators. He speaks regularly on energy topics, has published articles in trade magazines, an energy 'blog, and peer-reviewed journals as well as a book chapter on combined heat and power.

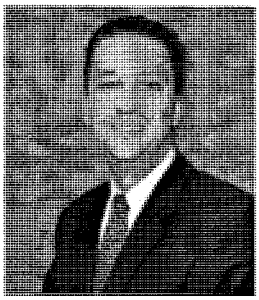
Mr. Jim Connaughton
Executive Vice President
C3 Energy

James L. (Jim) Connaughton is the Executive Vice President at C3 Energy, a utility analytics software provider offering smart grid solutions that enable energy companies and utilities to realize the full economic value of their investments in grid, product, and service modernization. Mr. Connaughton was formerly the Executive Vice President and Senior Policy Advisor of Exelon Corporation and served on the company's Executive Committee.

From 2001 to 2009, Mr. Connaughton was Chairman of the White House Council on Environmental Quality, a Senate-confirmed position, where he served as senior energy, environment, and natural resources advisor to President George W. Bush. During his service

with the federal government, Mr. Connaughton led a wide variety of cabinet-level policy and management committees, resulting in new market-based energy programs, incentives, technology initiatives, and public-private partnerships. These results included bipartisan energy legislation in 2005 and 2007, and nearly $90 billion for energy technology research and incentives to accelerate the commercial deployment of advanced technologies. Internationally, Mr. Connaughton led work for G8 leaders related to energy issues. He helped establish a broad series of international energy technology initiatives; the public-private Asia Pacific Partnership on Clean Development and Climate Change; and the Major Economies Meetings on Energy and Climate, in which he served as the President's personal representative.

Mr. Connaughton serves on the Board of Governors of the US Department of Energy's Argonne National Laboratory, on the Board of Advisors to the University of Maryland Energy Research Center, and on the U.S. Commission to the United Nations Education, Science, and Cultural Organization (UNESCO). Mr. Connaughton earned his law degree, magna cum laude, from Northwestern University School of Law and received his bachelor's degree from Yale University.



Mr. David Elizondo, Ph.D.
Managing Consultant, Latin American Business
Quanta Technology

David Elizondo, PhD, has a wide range of experience in the transmission and distribution of electrical energy, including 15 years of experience in electric power transmission and distribution which includes: extensive experience in power system analysis and simulations such as load flow, short circuit, transient angular stability, contingency analysis, transient voltage stability, and reactive power compensation. Dr. Elizondo has recent experience in the integration of renewable energy sources in the power system, the integration of technology Synchrophasors for wide area monitoring systems energy control and the application of robotic technology to work in energized electrical installations.

Dr. Elizondo has worked as a consultant for power systems over the past ten years in Latin American countries such as Colombia, Ecuador, Chile and Mexico as well as in the U.S. From 2012 to 2013, he managed projects for XM Technical Consultancy in the area systemic protection and flexible energy systems. In Ecuador and in conjunction with CENACE, he was in charge of research for the definition of systemic protection nationwide.

Dr. Elizondo earned his Masters and PhD degrees in Electrical Engineering at Virginia Tech and his Mechanical and Electrical Engineering Bachelor degree from the ITESM in Mexico. He is a member of the society of energy and power of the IEEE and a member of the working group in Latin America. Dr. Elizondo has published numerous technical papers in various forums in Latin America and the United States of America.

Mr. E. David Ellington
Co-Founder and President
GridSpeak Corporation

E. David Ellington is Co-Founder and President of GridSpeak Corporation. GridSpeak Corporation was conceived to integrate 21st-century financial services, processes, methodologies, technology and innovation to the wholesale electricity trading market. As such, GridSpeak Corporation is an energy services company that leverages market research, analytics, and proprietary technology to provide liquidity into the electricity markets. GridSpeak's proprietary technology, the GridSpeak Platform, is a comprehensive, web-based solution providing real-time and historical market information and analytical tools that convert data and information into market opportunities.

Mr. Ellington is a Partner at Emory Capital Group, LLC (ECG). ECG is an advisory firm providing confidential counsel to entrepreneurs, CEOs, policy makers and boards of directors in a variety of fields including technology and technology transfer, SI/VAR arrangements and agreements, Internet strategy, international business transactions and partnerships, private equity, seed and venture capital, institutional investing and asset allocation, government policy, corporate governance and philanthropy.

Mr. Ellington received his Bachelor of Arts in History from Adelphi University and a Master of Arts in Comparative Politics and Government from Howard University. He received his Juris Doctor from Georgetown University Law Center, where he concentrated on international, corporate and tax law.

Mr. Jacob Flewelling
Country Manager for Colombia and the Dominican Republic
U.S. Trade and Development Agency

Jacob Flewelling has been Country Manager for the Andean Region and the Caribbean Basin at the U.S. Trade and Development Agency (USTDA) since June 2010. In this capacity, he is responsible for business development, project preparation and evaluation, and supervision of USTDA activities in his assigned countries, notably Colombia and the Dominican Republic. Previously he was Country Manager for South Asia, beginning in December 2008. Prior to joining USTDA, Jacob served as an Investment Insurance Officer in the Latin America and Africa regions at the Overseas Private Investment Corporation (OPIC), where he started on a full-time basis in May 2005. Before that, he worked for three years as an analyst in the Global Financial Operations group of a major consulting firm. Jacob earned a Master's degree in International Commerce and Policy from George Mason University and a Bachelor's degree in International Relations from the School of International Service at American University.

Mr. Germán Eduardo Hernández
Sales Manager
S&C Electric Company

Germán Eduardo Hernández is the Sales Manager for S&C Electric Company, covering the Colombian market. Mr. Hernandez has worked in the fields of specialized consulting for industrial processes automation, power generation and substations automation in power transmission and power distribution systems and is responsible for commercial strategies and business development related to technological solutions for the energy sector at important multinational manufacturing companies. He is a graduate in Electronics Engineering from the University of Antioquia (Colombia) and holds a Master of Science in Electrical Engineering from the University of Texas.

Mr. Chris Hickman
CEO
Innovari

Chris Hickman serves as CEO for Innovari. In this role, he provides the utility-centric vision for the company's unique value proposition and strategy. Chris has over two decades of utility industry experience ranging from power generation to regulation to end-use customer services and technologies. His current role at Innovari furthers his efforts to improve the electric energy enterprise by leveraging new technologies and ideas.

Chris has been a frequent contributor at a variety of utility industry events and leadership conferences, as well as having spoken before Congress, the Federal Energy Regulatory Commission (FERC) and other influential policy groups. He has served on the boards of the IEEE Power Engineering Society, the GridWise Alliance and Avistar (an unregulated subsidiary of PNM), along with several non-profit organizations and participated as a member of the DOE regulatory assistance project team, helping provide a utility industry perspective to state and federal regulators regarding current policy issues.

Prior to his current role at Innovari, he held a variety of positions over a 13 year period in engineering, federal and state policy development, infrastructure planning and budgeting, IT and billing systems, and environmental management systems for coal and natural gas generation plants and T&D assets at PNM Resources. At PNM, he was also responsible for the communications architecture, fiber, telecommunications, and SCADA deployment and systems. During his tenure at PNM, Chris (in partnership with two other PNM employees) received three patents for new technology and systems developed to help optimize utility grid performance. Chris has also served in senior positions at Ice Energy, SureGrid, and Cellnet Technology.

Ms. Anne McKinney
Deputy Director
Colombian American Chamber of Commerce

Anne McKinney is the Deputy Director of the Colombian American Chamber of Commerce (AmCham Colombia). She is involved with member advocacy, supervises the delivery of business development services, coordinates activities with the U.S. Embassy and U.S. government agencies, and manages special projects and corporate social responsibility programs, among other responsibilities. Prior to joining AmCham in April 2009, Anne worked as a consultant to Cisco Systems as part of the Strategic Funding and Government Advocacy team. Based in Bogotá, Anne generated sales prospects for Cisco public sector sales teams in Latin America, identified and qualified projects funded by multilateral development banks, participated in the LATAM strategic planning process, and strengthened relations with key government customers and multilateral development bank staff. From April 1995 to November 2007, Anne worked at the U.S. Trade and Development Agency (USTDA), where she served as Country Manager for Latin America and the Caribbean and was later promoted to Regional Director. At USTDA, she identified and managed projects designed to position U.S. companies in the implementation of infrastructure and other priority projects that contribute to sustainable development in Latin America. Anne worked closely with other U.S. Government agencies to promote U.S. exports and to further U.S. policy objectives in the region. Anne has an M.A. from the Johns Hopkins University School of Advanced International Studies (SAIS) and a B.A. from American University.

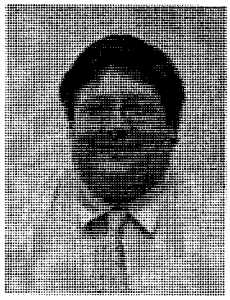
Mr. Joel Mickey
Director, Market Design and Development
Electric Reliability Council of Texas, Inc. (ERCOT)

Joel Mickey is Director of Market Design and Development for the Electric Reliability Council of Texas (ERCOT). His team is tasked with providing technical and business expertise in support of stakeholder, IMM, and PUCT activities related to strategic market design initiatives. Currently this includes Resource adequacy issues, redesign of the ancillary services market, demand response, and development of pilot projects. Mr. Mickey's previous roles at ERCOT include: Director of Grid Operations 2009-2012, Director, Wholesale Market Operating Systems 2006-2009, and Manager, Market Operations Support 2000 to 2006.

Prior to joining ERCOT, Mr. Mickey worked as a staff consultant at a software development firm specializing in energy Trading and Risk management systems for restructured electric and gas markets. He started his career in the power industry as a graduate of a power line installer program at Northwest Iowa Technical College in Sheldon, Iowa, in 1981.

In 1981 he joined Houston Lighting and Power (now CenterPoint Energy, and Reliant) where he worked for 15 years in various positions including underground network tester, system controller, and staff consultant.

Mr. Mickey received a Bachelor of Science in Economics and Political Science from Houston Baptist University in Houston, Texas, in 1996. He served on various committees for the North American Electric Reliability Council (NERC) including Definition of Bulk Electric System, the Standards Development team for Interchange, and the Electronic Scheduling Committee. He currently is a board member on the North American Energy Standards Board (NAESB). He is a board member of OUs College of computer and electrical engineering steering committee. At ERCOT, Mr. Mickey served as the co-chair of the Texas Nodal Team's market operations concept group and chaired the Nodal Transition Plan Task Force.



Mr. Glenn A. Pritchard, PE
Principal Engineer
Exelon/PECO

Glenn Pritchard graduated from Clemson University in 1990 with a B.S. Degree in Electrical Engineering. He is a registered professional engineer in Pennsylvania. He has been with Exelon/PECO in Philadelphia for nineteen years. He is a Principal Engineer and is responsible for developing new applications that leverage AMI Systems and metering data. Glenn is currently the Technology Lead for PECO's Smart Grid/Smart Meter Project. This project includes the system-wide replacement of 1.8M electric meters, the associated integration and application redesign and the installation of a Smart Grid communications backbone Glenn has recently received the 2010 IEC Grid Vision and the 2008 Utilimetrics' Utility Best Practices Awards for his work in the Smart Grid and AMI fields.

Other areas of experience include distribution & transmission, substation automation and communications. Pritchard specializes in finding new applications of existing and emerging technologies.

Glenn has taught pre-symposium classes at Autovation in 2009 and 2010, at T&D World University in 2008 & 2009, and has been a regular speaker/panelist at key industry venues. Furthermore, Glenn has authored numerous papers on AMI systems and the use of the data generated by such platforms.

Mr. James T. Reilly
Consultant
Reilly Associates

Jim Reilly, principal of Reilly Associates, has worked in the energy sector as an independent consultant in the U.S. and internationally for more than 25 years. He has completed numerous projects in smart grid and microgrids for clients in North America, Japan, and Europe.
Jim initiated and facilitated the development process for *Use Cases* for smart grid projects involving the integration of renewable energy to distribution systems and microgrids in the U.S. and Japan. He is the co-author of *The Sendai Microgrid Operational Experience in the Aftermath of the Tohoku Earthquake: A Case Study*.

Jim provides consulting services to the U.S. Department of Energy Office of Electricity on research and development planning for smart grid, microgrid operations and control. He is a contributor to the DOE white paper on *The Advanced Microgrid, Integration and Interoperability.*

Jim is a member of the working groups for the IEEE 1547 standards on the integration of renewables into distribution systems and the IEEE 2030 standards on the *Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure.*

Jim serves as Lead for the NIST/SGIP working group on *Microgrids and Hierarchical Distributed Control.* Jim regularly interfaces with stakeholders in the regulatory, industry, and the research communities. He is the author of numerous papers and articles, and is a speaker and panelist at workshops on microgrids. He holds degrees from Georgetown University and Columbia University.

Mr. Jeff Renaud
Senior Director for Market Development
EnerNOC

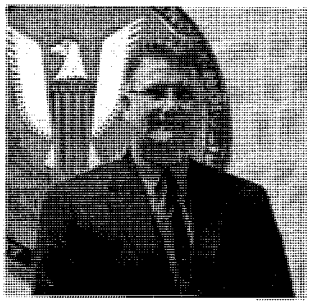
Jeff Renaud is Senior Director for Market Development, at EnerNOC. In this capacity, he leads EnerNOC's efforts to evaluate and develop new global markets for the company.

Prior to his current position, Mr. Renaud was Director for Australia & New Zealand. In that role, he led EnerNOC's operations in Western Australia's Wholesale Electricity Market, Australia's National Electricity Market, and in the New Zealand Electricity Market. Prior to that, Mr. Renaud served as Director, Corporate Development for EnerNOC. Before joining EnerNOC, Mr. Renaud served as Director, Ecomagination at General Electric. At GE, he worked closely with GE's Infrastructure, Industrial, and Capital businesses on key strategic marketing and business development initiatives related to GE's clean technology product and service portfolio.

Mr. Renaud has an MBA from the University of California at Berkeley, and a BS in Chemical Engineering and Mathematical Economics from Tulane University.

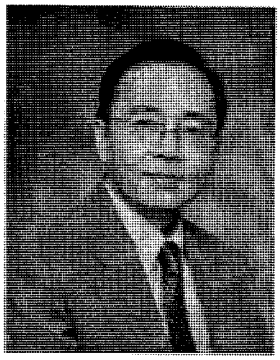
Mr. Michael Sachse
Senior Vice President, Regulatory Affairs
Opower

Michael Sachse leads Opower's legal and regulatory teams. An experienced negotiator and strategist, Michael's efforts have been instrumental to Opower's success closing deals with eight of the ten largest utilities in the United States as well as developing the regulatory strategy that has led to the widespread acceptance of information-based efficiency by public utility commissions. Prior to joining Opower, Michael was a litigator at Patterson Belknap Webb & Tyler. Michael received his BA in History from Amherst College and his law degree from Harvard Law School.



Mr. Michael Tita
Policy Group Manager
Federal Energy Regulatory Commission

Michael Tita is a Policy Group Manager for the Federal Energy Regulatory Commission's Office of Energy Policy and Innovation and has more than 30 years experience in the energy industry. Mr. Tita develops and employs analytical techniques, and leads a team of professionals to develop policy and other regulatory recommendations to address emerging issues affecting wholesale and interstate energy markets. Mr. Tita and his team address policy, market and regulatory issues for a number of functional areas including smart grid interoperability standards, demand response, natural gas and electric industry coordination, integration of variable energy resources and distributed energy resources. Mr. Tita provided direction and made significant contributions to numerous Commission products including the July 16, 2009 Smart Grid Policy Statement, FERC staff's 2010 National Action Plan on Demand Response and the Commission's annual demand response reports required by the Energy Policy Act of 2005. Prior to joining FERC in 2008, Mr. Tita was the Manager of the Natural Gas Practice and a Senior Energy Analyst for the Energy Solutions Operation of Science Applications International Corporation (SAIC). Prior to joining SAIC, Mr. Tita was vice-president of the public utilities consulting firm of Baker G. Clay & Associates, Inc. and previously was employed as a field engineer supervising natural gas drilling and production operations for Devon Energy Corporation. Mr. Tita has more than 30 years experience in policy, regulatory, financial, economic, and operational analyses and modeling of the energy industry. Mr. Tita holds a Master of Business Administration from Loyola College in Maryland and a Bachelor of Science in Petroleum Engineering from Marietta College.



Mr. Dan Ton
Program Manager for Smart Grid
U.S. Department of Energy
Office of Electricity Delivery and Energy Reliability

Dan Ton is Program Manager of Smart Grid R&D within the U.S. Department of Energy (DOE) Office of Electricity Delivery and Energy Reliability (OE). He is responsible for developing and implementing a multi-year R&D program plan for next-generation smart grid technologies to transform the electric grid in the United States, through public/private partnerships.

Previously, Dan managed the Renewable Systems Integration program within the DOE Solar Energy Technologies Program.

Dan holds a Bachelor of Science in Electrical Engineering and a Master of Science in Business Management, both from the University of Maryland.

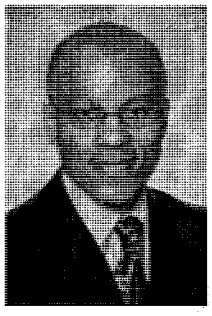
Mr. Cameron Werker
Senior Commercial Officer
U.S. Foreign Commercial Service
Bogotá, Colombia

Cameron Werker serves as the Senior Commercial Officer for the U.S. Department of Commerce's Foreign Commercial Service in Bogota, Colombia.

Prior to Colombia, Mr. Werker most recently served as the Regional Senior Commercial Officer in the U.S. Commercial Service office in Belgrade, Serbia with regional responsibilities for both Serbia and Montenegro. His tour of duty in Belgrade ended August 2010.

Mr. Werker joined the Department of Commerce in 1993. For six years, he worked in Import Administration as an International Trade Specialist administering the U.S. anti-dumping duty law. Mr. Werker joined the Commercial Service in 1999. His first assignment was to the U.S. Export Assistance Center in Boston, MA. While there he assisted U.S. companies with all matters relating assisting U.S. companies to export their products. He served as a board member of the New England Environmental Business Council, as well as a regional team leader for the Commercial Service's Rural Export Team. Immediately prior to his assignment in Belgrade, Mr. Werker served as a Commercial Officer at the U.S. Embassy in Beijing, China for 4 years covering the IT Sector. Prior to joining the Department of Commerce, Mr. Werker worked as the Marketing Manager of an Indian agricultural company in New Delhi, India. Prior to that, he served as a trade analyst at the International Trade Commission in Washington, DC.

Mr. Werker holds a BA in International Marketing from Colorado State University.



Mr. Nathan Younge
Regional Director for Latin America and the Caribbean
U.S. Trade and Development Agency

Nathan Younge is USTDA's Regional Director for Latin America and the Caribbean. In this capacity, Mr. Younge is responsible for developing and implementing USTDA's economic development program throughout the region.

Mr. Younge acquired nearly a decade of experience in the political risk insurance industry. Prior to USTDA, he worked for Zurich Emerging Markets Solutions, where he served as an Assistant Vice President for Underwriting and Risk Management and as an Assistant Vice President for Political Risk Insurance. Previously, Mr. Younge worked for the Overseas Private Investment Corporation, where he served as a Senior Investment Insurance Officer for Latin America and as the agency's Acting Chief of Staff.

Earlier in his career, Mr. Younge worked for USTDA as a Country Manager for Latin America and the Caribbean and as a Country Manager for Africa and the Middle East.

Mr. Younge holds a BA from American University, an MA from Old Dominion University and an MA from George Mason University. He is fluent in Portuguese and Spanish.

III. COLOMBIA SMART GRID INFORMATION

filial de isa

COLOMBIAN ELECTRICITY SECTOR

Alejandro Gutiérrez Gómez
Juan Diego Gómez Vélez
XM Compañía de Expertos en Mercados S.A. E.S.P.
September 2012

Summary

Colombia is a country with 45 million inhabitants, with coverage of over 95% and approximately nine (9) million subscribers to the electrical service (including residential, commercial and industrial end users). The installed capacity is approximately 14,4 GW, 63.7% of which is hydroelectric generation, 31,5% thermoelectric and 4,8% of plants below 20 MW and co-generators. In Colombia's institutional framework, it is remarkable that regulation and surveillance are separated and that there is an entity where the participants in the market have a say or are represented; this entity is in charge of defining the technical aspects of the operation through agreements. Transmission[1] expansion is achieved through public auctions organized by a branch of the Ministry of Mines and Energy; Distribution[2] expansion is the responsibility of each distributor. The Colombian electrical sector has a company that assumes the roles of System Operator and Market Administrator, in charge of planning, coordinating, monitoring and controlling the operation of the National Interconnected System and the settlement of all trades in the short term market (energy pool).

There is not an Exchange in Colombia but an energy pool with a single country price for each hour as a reference for the settlement of bilateral contracts, commercial generation and demand of generators and retailers. Transmission and Distribution are paid for by a regulated income methodology and use of system charges applied to the demand through the retailers and centrally settled.

In 2006 a charge was designed to incentivize investment in future generation and to hedge the volatility of the pool price paid by consumers. This charge is called the Reliability Charge and is paid by consumers to ensure reliability of supply in the long term including extreme hydrologic conditions and to cap the pool price to a scarcity price fixed by the regulator and calculated on a monthly basis. Before 2006 a former mechanism named the Capacity Charge was in place, without long term signals or a price hedge.

Colombia is interconnected to the south with Ecuador and to the north east with Venezuela under different trade rules. With Ecuador there is a Market Coupling under the regulation of the Andean Community of Nations where the direction of the electricity flow is decided based on the comparison of the import and export prices of the two countries which depend on the marginal prices of each country. Exports to

[1] Voltage levels equal or above 220 kV
[2] Voltage levels below 220 kV

and imports from Venezuela are represented in the Colombian market by a domestic agent as a generator or retailer.

Retail sales in Colombia consider two kinds of end users: regulated users, whose tariffs are defined by the regulator, and non-regulated users, who are allowed to freely negotiate the price of the energy they buy from their retailer of choice. Non-regulated users are those with a peak demand higher than 0,1 MW or a minimum monthly demand of 55 MWh.

The future of the Colombian electricity market tends towards the integration with the gas market and towards the creation of new markets of financial derivatives led by the market operator, XM, in association with the Colombian Stock Exchange, who have created DERIVEX, the administrator of the new market of standard derivatives of energy commodities. This market is supported by the Colombian Clearinghouse.

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1 Introduction

The development of electricity markets, which was characteristic of the 90s, has had diverse consequences in the countries that have implemented the models designed by the pioneers of that time. Colombia was no exception to this trend. In 1994 the Wholesale Electricity Market was implemented, based on the tools established by the new political constitution of 1991 and in part motivated by the 1992 rationing, which was the trigger for a movement towards the denationalization of the electricity public service, concluding in the implementation of a price based market with a centralized dispatch and the separation of the responsibilities for regulation, surveillance, expansion planning and operation coordination.

Since the creation of this market there have been many changes in its regulatory framework, nevertheless it retains its essence and it can be said that it has fulfilled its purpose of extending coverage and achieving reliability levels that were unthinkable in 1992.

This paper aims to give a glimpse of the Colombian electricity sector, with emphasis on the wholesale electricity market. It has a top-down approach, starting with the main characteristics of the sector and the description of the energy pool transaction process and concluding with the understanding of what happens with each kind of participant in the market.

2 Electricity Sector Figures

Colombia is a country with an estimate of 45 million inhabitants, with coverage of over 95% and approximately nine (9) million subscribers[3,4] to the electrical service (including residential, commercial and industrial end users). It has an area of 1.141.748 m^2.

The power sector in Colombia is highly dependent on hydro resources. On December 31st, 2011, it had a net effective capacity of 14.420 MW, comprising 9.185 MW of hydroelectric generation capacity (63,7% of the total installed capacity), 4.545 MW of thermoelectric generation capacity, 635 MW of generation capacity of resources below 20 MW (hydro, thermal and wind) and 55 MW of cogeneration capacity[5].

[3] A subscriber is a single household or business or industrial premise.
[4] Source: www.asocodis.com.co
[5] Source: XM, December 31st, 2011

	Capacity (MW)	Share
Hydroelectric	**9,185**	**63,7%**
Thermoelectric	**4.545**	**31,5%**
Natural Gas	3.053	
Coal	991	
Fuel Oil	314	
Other liquid fuels	187	
Below 20 MW	**635**	**4,4%**
Hydroelectric	533	
Thermoelectric	83	
Wind turbines	18	
Cogeneration	**55**	**0,4%**
Interconnected System Total	**14.420**	

Source: XM S.A. E.S.P.

Thermal generation is mostly gas-based generation (3.053 MW) exploiting gas reservoirs located in the Northwestern region. Coal-based generation (991 MW), on the other hand, is expected to increase over time because new coal reserves have recently been found in the Northeast region (Cesar and Boyacá). It has been estimated that Colombia has roughly 100 GW of potential hydropower. However, most of the hydro projects face serious development constraints due to the evolution of the environmental laws.

The energy demand of the National Interconnected System in the year from August 2011 to July 2012 was 57,2 TWh, with a peak power demand of 9.295 MW in early December.

In Colombia, there are four major wholesale market participants, i.e., generators, distributors, transmission companies, and retailers. No new companies created after the Electricity Act of 1994 are allowed to participate in the four activities, yet the retail activity may be combined either with generation or distribution. Companies created before 1994 were allowed to retain their vertical integration, but they must keep separated accounting.

The four largest generators have 65% of the total installed capacity. Generators can participate in the day-ahead market or establish bilateral contracts with retailers. They are obligated to provide ancillary services and are paid for it. The only current

ancillary service market in Colombia is that of secondary frequency control. The following table includes the names and installed capacity of the largest generators:

Generator	Installed capacity (MW)
Empresas Públicas de Medellín	3.257
EMGESA	2.879
ISAGEN	2.254
GECELCA	1.214

By the end of 2011 there were 41 generators and 69 Retailers with commercial activity in the Colombian electricity market, as well as 29 Distributors and 9 National Transmission Companies[6].

On December 31st, 2011, the National Interconnected System had 24.405,8 km of high voltage lines, as follows:

Transmission Network length [km]	
110-115 kV	10.089,4
138 kV	15,5
220-230 kV	11.654,6
500 kV	2.646,3
TOTAL	**24.405,8**

Source: XM

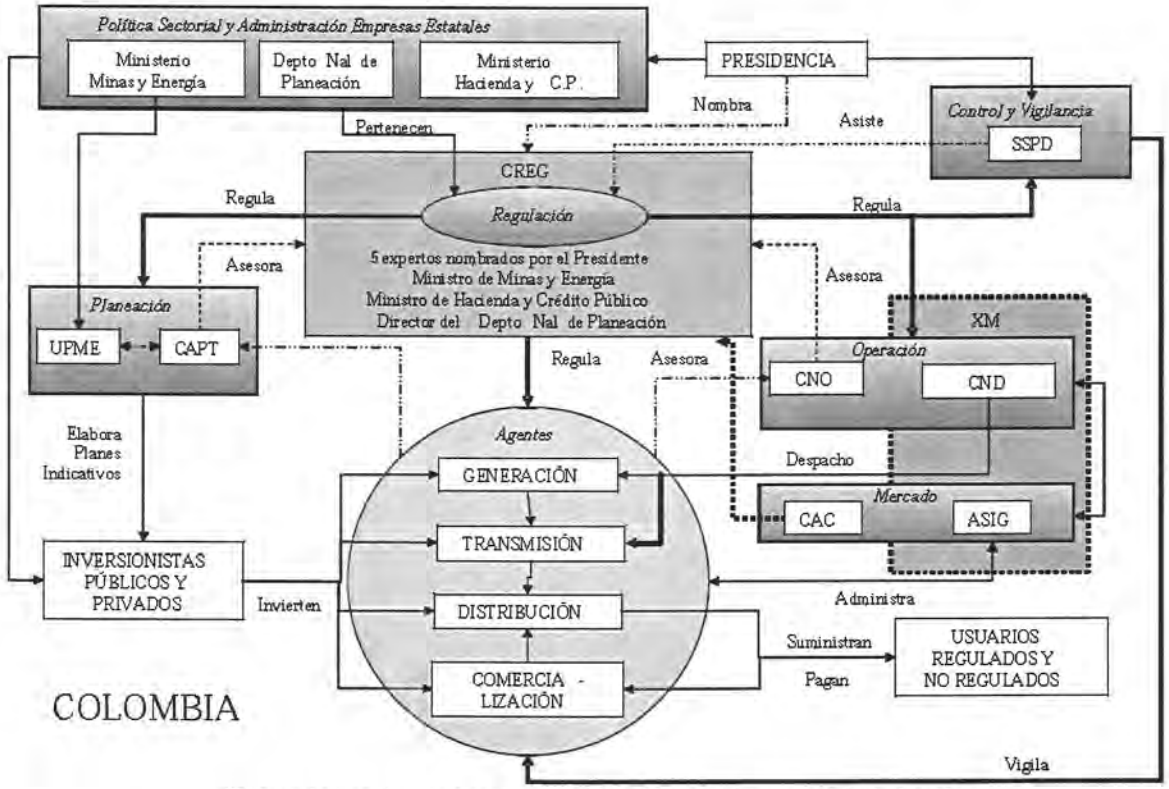
The largest Transmission Company in Colombia is Interconexión Eléctrica S.A. -ISA, a company in which the government owns 52,94% of the total shares. ISA owns 73,87% of the national transmission system. ISA also has operations and owns transmission assets in Ecuador, Peru, Bolivia and Brazil.

There are two main categories of end users in the retail market: Regulated Users are those whose tariff is established by the CREG, and Non-Regulated Users are those who are allowed to purchase their energy at freely negotiated prices with their retailers. The minimum requirement to be a Non-Regulated User is to have a

[6] Transmission is defined in Colombia for voltages equal or above 220 kV and Distribution for voltages below that threshold.

maximum demand greater than 0,1 MW or a monthly energy demand greater than 55 MWh.

3 Institutional Framework



Graph 1. Institutional Layout of the Colombian Electricity Sector.
Source: Energy and Gas Regulation Commission. www.creg.gov.co

Acts 142 and 143 of 1994 define the role of the different agents and institutions in the market, as follows:

The Ministry of Mines and Energy is in charge of establishing sector policies, defining the technical standards for service and defining the coverture and universal service policies.

Expansion planning is the responsibility of the state through the Mines and Energy Planning Unit (UPME), an entity attached to the Ministry of Mines and Energy. This entity is supported by the Transmission Planning Advisor Committee, which is composed of representatives of the Large Consumers and the generation, retail, transmission and distribution companies. Expansion of the Transmission system is made through a mechanism of auctions, based on the Reference Expansion Plan

produced by UPME. The Generation Expansion Plan produced by UPME is just a reference plan.

The Energy and Gas Regulation Commission – CREG – produces the norms for the electricity and gas sectors and is established as a special administrative unit of the Ministry of Mines and Energy. Its members are the Minister of Mines and Energy (president of the commission), the Minister of Treasury and Public Credit, the Director of the National Planning Department, five (5) independent energy experts, appointed by the President of the Republic for four (4) year periods. The Public Services Superintendent attends the CREG's meetings as a non-voting member.

The Superintendence of Public Services is in charge of Control and Surveillance. This institution controls and surveys that the public service providers obey the laws and administrative acts they are subject to. Surveillance against anti-competitive practices is done by the Superintendence of Industry and Commerce.

The Electricity Act (act 143 of 1994) created the National Operations Council– CNO -, whose main function is to define through agreements about the technical aspects of the system operation in order to ensure that the integrated operation of the National Interconnected System is done with safety, reliability and economic efficiency. The members of this council are representatives of the generators, distributors, national transmission companies (Transcos voting only in matters related to interconnection), and the Director of the National Dispatch Center –CND-, the System Operator, with voice but no vote[7].

XM Compañía de Expertos en Mercados S.A. E.S.P. –XM- is designated by law as the System Operator and Market Administrator. XM is also in charge of the settlement and clearing of the charges for the remuneration to the network owners. XM is a subsidiary company of ISA, the largest transmission company in Colombia. The creation of XM was authorized by the Decree 848 of 2005. Until 2005 these functions were a responsibility of ISA (TSO) for more than 30 years.

[7] Art. 36, Act 143 of 1994

XM is a public service utility of mixed capital, subject to the Public Services Act (Act 142 of 1994), the Electricity Act (Act 143 of 1994) and the regulation for private enterprises. Its Board of Directors has five members with their own surrogates. Three of the members are fully independent of ISA, the owner company. Decisions are made with a positive vote of at least four members, which requires the agreement of at least two of the three independent members.

Acts 142 and 143 of 1994 designate responsibilities for the National Dispatch Center of planning, coordination, supervision and control of the operation of the resources in the National Interconnected System, as well as the Administration of the System for Commercial Trades (Market Administration), functions that must be accomplished subject to CREG regulation and CNO agreements.

4 Colombian Electricity Market

The Wholesale Electricity Market in Colombia is defined as the market of large blocks of electrical energy, within which generators and retailers sell and buy energy in the long term (contract market) or in the short term (energy pool):

- **Short term (spot) market:** Its design is based on that of the U.K. before the reform. Generators place their price offers and availability declarations every day to a day-ahead market for each of their plants or generation units. The Price offers are the same for each of the 24 hours, but availability may vary with the time of day due to technical reasons.

  The demand, represented here by retailers, is a price taker of the pool price, which is a unique price for the whole interconnected system for each hour of the day. The pool price is established through the Ideal Dispatch, a coupled optimization process, which minimizes total cost including offer price for every dispatched plant and the starting costs of thermoelectric plants taking into account the technical constraints of the generation resources, but not the constraints of the network.

  In other words, the pool price is given by the intersection of the forecasted hourly demand and the supply curve. Locational marginal prices are not currently implemented in Colombia.

- **Long term market:** Generators and retailers sign bilateral contracts to buy or sell energy. These contracts must be registered with the Market Administrator –ASIC, who calculates for each hour the net transactions in the short term market (the pool).

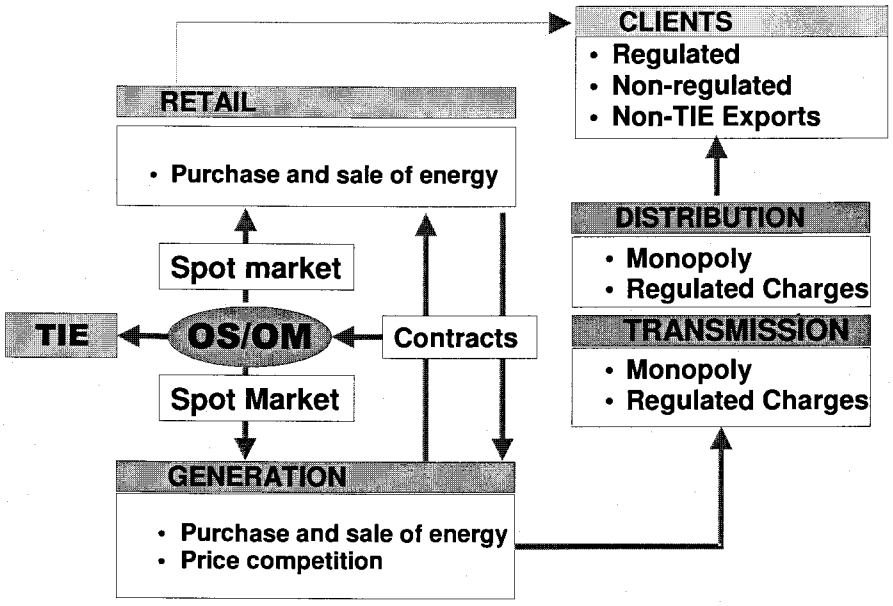
Net transactions consider contract purchases, end user demand, contract sales and dispatched generation. Billing, payments and collaterals of the long term transactions (bilateral contracts) are the responsibility of the parties to the contracts, not the Market Administrator. Bilateral contracts do not establish the physical operation of engines.

There are many kinds of bilateral contracts, but all of them fall into two main categories: "pay as demanded" and "take or pay". Pay as demanded is a contract in which the buyer buys what it is consumed. On the other hand, take or pay is an agreement in which the buyers are committed to pay regardless of what is demanded.

The product traded in the Wholesale Electricity Market is the energy flowing through the National Interconnected System. The regulatory framework has established that the energy to be paid for is the active energy, the MWh produced by the generators. There are proposals for the creation of a reactive energy market, with technical challenges such as the identification of the Mvar actually produced or consumed by the generation engines and the transmission and distribution assets.

It shall also be noted that the price assigned to energy in the Colombian market is a monomic price, be it the pool price, the contract price or the reconciliation price. The monomic price includes the costs of energy as well as the costs of power or capacity.

4.1 Market Participants



Graph 2. Colombian market structure

Ever since Acts 142 (public utilities act) and 143 (electricity act) of 1994 were signed, the Colombian electricity sector has experienced considerable changes. It has gone from being a centralized, state-owned and planned sector to being one with clearly defined institutions, where efficiency and private investment is encouraged and the market has a stronger role in giving the necessary signals for investment.

The Colombian system has been broken up into those activities where competition is feasible, to those which are natural monopolies. There are four main activities in the Colombian electricity sector:

1. Generation: It is carried out by those agents who produce the electricity.

2. Transmission: It is the activity of transporting energy from the locations where it is produced to the places where it is demanded. It is a natural monopoly and is paid according to the rules set forth by the Colombian Regulator.

3. Distribution: It is the activity of taking the electricity to the end user. As with transmission, it is a natural monopoly and paid according to the rules set forth by the regulator.

4. Retailing: It is in charge of the commercial aspect of the sector, including billing, collecting and buying the energy in the spot market. Users can choose their retailer, making it a competitive activity.

The activities where there is a competitive market are Generation and Retail. Generators compete in the spot market through their day-ahead offers and in the long term through the prices they propose for bilateral contracts. Retailers are price takers in the spot market but compete through the prices they can offer to the end users.

Transmission and Distribution companies are distinguished by the voltage level of their networks. Transmission is for networks equal of above 220 kV, and Distribution is for networks below that voltage level. These agents do not have a participation in the purchase or sale of electricity; their incomes are collected from demand through the retailers via post-stamp charges. Distributors are charged with the cost of constraints associated to the congestion in their networks because they are fully responsible for the planning and execution of their expansion.

Transmission companies are charged with the cost of constraints associated to the delays in their expansion projects. Expansion of Transmission is a centralized responsibility of the UPME, which produces the National Transmission Expansion Plan and executes the projects through public auctions where the domestic transmission companies and foreign investors compete for the right to build, operate and own the new infrastructure.

There is a market coupling with Ecuador in place since 2003 through a regulated mechanism known as the Short Term International Electricity Transactions –TIE, based on an international agreement of the Andean Community on Nations. Exports and Imports with Venezuela are not under these agreement rules and are represented in the Wholesale Electricity Market by a domestic agent which acts as generator on retailer. There are no current interconnections with other countries.

4.2 Market Operation

4.2.1 Economic Dispatch

The National Dispatch Center –CND- in XM is responsible for the system operation. The CND calculates a centralized dispatch, which takes into account the price offers of the generators, their declared availability, the network constraints (including programmed resource maintenances, which are coordinated by XM) and the technical characteristics of the generators, to attend the forecasted demand with the quality, reliability and safety criteria established by the regulation. Inside this process, the operation of international interconnections is coordinated as well.

This dispatch is known as the Economic Dispatch and is calculated through a 24-hour optimization process, considering also the start-up costs of thermoelectric units, which is declared by the generators on a quarterly basis. The economic dispatch may be updated during the operation day due to changes in availability of generation, demand and transmission or distribution assets.

The formulation for the Economic Dispatch is as follows[8]:

$$Min \sum_t \sum_i (Pof_{it} \times Q_{it}) + Par_{it}$$

Subject to:

$$D_t \leq \sum_i Q_{it}$$

$$Technical\ characteristics$$

Electricity and Voltage constraints

Operation Constraints

where:

i Index for Generation plants or units
t Index for the hours of the day
Pof Offer Price in the day-ahead market
Par Offer Price for the start-up of thermoelectric units required for the ideal dispatch.
Q Generation
D Demand

The assignment of Secondary Frequency Reserve is made through an optimization process before the calculation of the Economic Dispatch, so that the cost for attending the needs of the National Interconnected System is minimized for the 24 hours of the dispatch horizon. The formulation for this process is as follows[9]:

$$Min \sum_t \sum_i (Pof_{it} \times D_{AGC\,it}) + Par_{it}$$

Subject to:

[8] CREG 051 Resolution of 2009
[9] CREG 051 Resolution of 2009

$$R_{AGC\,t} \leq \sum_{i} D_{AGC\,it}$$

Operation Constraints

where:

i Index for generation units or plants
t Index for the hours of the day
Pof Offer Price in the day-ahead market
Par Offer Price for the start-up of thermoelectric units required for the AGC reserve
D_{AGC} Reserve for the secondary frequency regulation
R_{AGC} Required reserve for regulation

4.2.2 Ideal Dispatch

After the operation of the system and considering the demand of energy and losses, XM makes another centralized dispatch due to its responsibilities as the Administrator of the Commercial Trade System –ASIC. For this purpose XM takes into account the price offers of the generators, their commercial availability, the offer prices of Ecuador if at any hour there was an electricity import, and the technical characteristics of the generators, but without considering the constraints of the transmission network. This dispatch is called an Ideal Dispatch and is produced by an optimization process with a 24-hour horizon.

The resulting dispatch program identifies the lowest price available resources required to meet total demand, considering the technical characteristics of generation units but not the network constraints.

The formulation is similar to that of the economic dispatch[10]:

$$Min \sum_{t} \sum_{i} (Pof_i \times Q_{it}) + Par_i$$

Subject to:

$$D_t \leq \sum_{i} Q_{it}$$

Technical characteristics

where:

i Index for Generation plants or units

[10] Resolución CREG 011 de 2010

t Index for the hours of the day
Pof Offer Price in the day-ahead market
Par Offer Price for the start-up of thermoelectric units required for the ideal dispatch.
Q Generation
D Demand

As a result of this dispatch, the Pool Price is calculated for every hour of the operation day, which is the offer price of the required flexible plant[11] with the highest offer price for each hour, plus an additional value (ΔI) calculated as the per unit value of the difference between the actual operation value of the thermoelectric plants and the value that would result as their income if paid the highest offer price (hourly marginal price) [12]. This additional value provides the pool price with the uncovered costs for the start-up of thermoelectric plants and for the ideal generation in inflexibility.

There is a Pool Price in Colombia for each market according to the demand that is met (price discrimination):

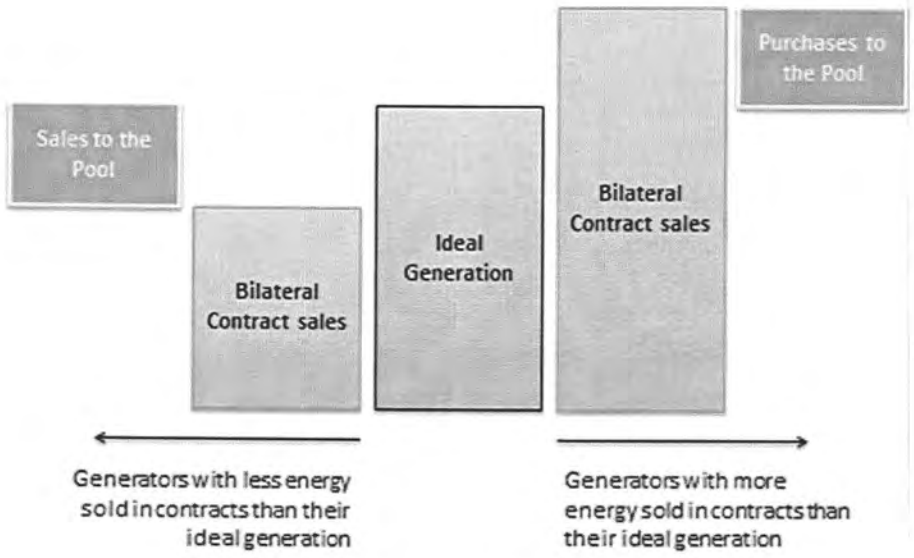
- National Demand or Domestic Demand
- National Demand plus TIE Demand[13]
- National Demand plus TIE Demand plus exports outside the TIE regulation[14]

The Pool Price includes the Equivalent Cost of Energy of the Reliability Charge and the value of the tax destined to the Fund for the Financial Support for the Electrification of Non-interconnected Zones– FAZNI -[15]

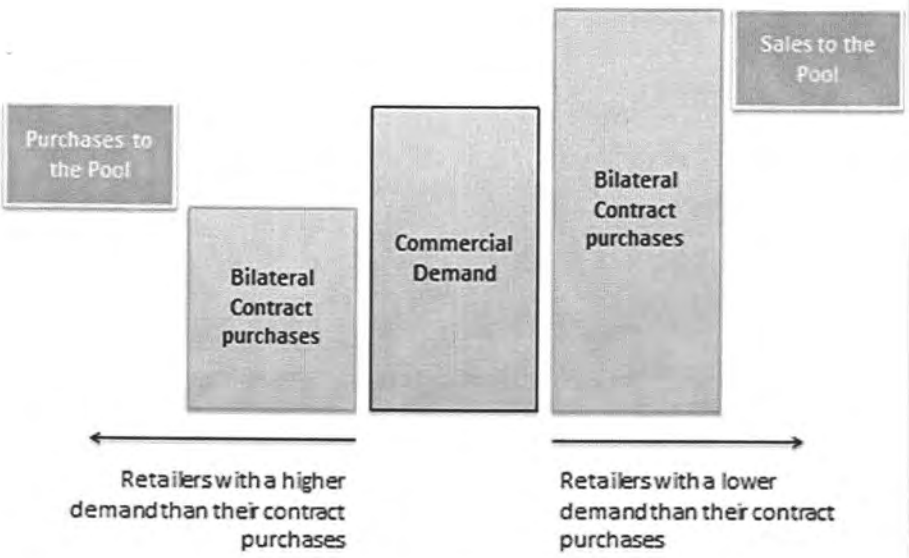
4.2.3 Pool Energy Settlement

The difference resulting from comparing the quantities of energy traded for every hour in contracts and those generated or demanded are sold or purchased to the Pool. This rule is illustrated in the following graphs:

[11] A plant is inflexible if it is programmed so that it is unable to change its generation output to supply additional incremental demand (positive or negative variation). CREG Resolution 24 of 1995.
[12] This rule intends to eliminate the uncertainty in the payment of start-up costs for thermoelectric resources.
[13] Total Domestic Demand plus International Demand of the Coordinated Economic Dispatch (exports to Ecuador)
[14] Total Domestic Demand plus International Demand of the Coordinated Economic Dispatch (exports to Ecuador) plus Non-Domestic Demand (exports to Venezuela)
[15] CREG Resolution 102 de 2006. $1/kWh, indexed by the Colombia PPI (base: December 2006)



Graph 3. Pool Purchases or sales of Generators



Graph 4. Pool Purchases or sales of Retailers

As you can see, Generators sell and buy energy from the Energy Pool for the difference between the generation as calculated in the Ideal Dispatch and their Bilateral Contract sales (signed with retailers or other generators). Retailers, on the other hand, trade Pool Energy for the difference between their end users' demand and their Bilateral Contract purchases signed with generators of other retailers.

4.2.4 Settlement of the Network Constraints

Because it includes the constraints of the transmission network, the Economic Dispatch is more expensive than the Ideal Dispatch used to obtain the Pool Price and the Pool Settlement. This difference in costs is due to the network constraints.

The valuation of Constraint Costs is made through the difference between Ideal Dispatch Generation and the generation that actually occurred for every generation asset. This difference is the base for a concept known as Reconciliation, the value of which may be positive (in case the generator has actually delivered energy to the system but has not been dispatched by the Ideal Dispatch[16]). A negative value for this concept indicates that the generator could not deliver energy to the network due to a constraint in it (trapped energy). The valuation of the reconciliation payment is different when it is positive than when it is negative. When it is positive, the generator is paid its offer price capped to a regulated operations cost.

A negative reconciliation results when the generator was dispatched in the ideal dispatch but not in the real dispatch, which means there was no actual delivery of energy to the network. The pool settlement of this generator is a credit for the ideal energy valued at pool price or at the bilateral contract price. Because there was no actual delivery of energy, the generator is to pay back the difference between real generation and ideal generation at the pool price.[17]

Who pays for network constraints? In general, those constraints derived from operative situations of the National Transmission System (above 220 kV) are paid by the whole demand through the retailers (the costs are socialized along the whole National Interconnected System) and those attributable to each Distributor are paid by them[18]. Transmission companies are to pay for constraints when they are caused by a delay in their new projects.

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[16] As a general rule, it can be said that when this happens the generator has produced energy to alleviate a network constraint.
[17] Valuation of negative reconciliation (Negative Reconciliation Price) was modified by CREG Resolution 121 of 2010, valid since August of that year.
[18] CREG Resolution 063 of 2000 established the attribution criteria.

There is another reconciliation associated to the Secondary Frequency Regulation. The cost of this service is paid for by all the generators dispatched in the Economic Dispatch, pro rata of their programmed generation[19].

4.2.5 Reliability Charge

Since the inception of the wholesale electricity market in Colombia, the need for a mechanism to promote generation expansion was identified. As the market developed, there was also the problem for additional mechanisms to handle the volatility of the Pool Price, taking into account the vulnerability of the system to the El Niño phenomenon, which increases the Pool Prices and makes it more difficult to ensure reliability due to the decrease in hydro inflows.

Consequently, the CREG established the so called Capacity Charge[20] in December, 1996, which was in place until November 30th, 2006, when it was replaced by the Reliability Charge[21].

The Reliability Charge's objective is produce the long term economic signals to make the expansion of new generation installed capacity possible, as well as to establish incentives to minimize the seasonality of the Pool Price.

Essential to the Reliability Charge is the definition of the product it pays: Firm Energy Obligations (OEF) are a commitment of the generators that is backed up by physical generation assets able to produce firm energy during critical supply conditions. This new mechanism attempts to ensure energy supply reliability in the long term at efficient prices.

The OEF required to cover the system demand are auctioned among the generators. The generator with an awarded OEF receives a known and stable payment during a given term. In exchange, the generator is committed to deliver a specific amount of energy when the Pool Price exceeds a CREG established threshold called the Scarcity Price. Such payment is settled and cleared by the ASIC and paid for by the end users of the National Interconnected System through the tariffs the retailers charge.

The OEF establish a legal commitment between the wholesale electricity market demand and the generators, which provides both parties with the benefits of a stable mechanism in the long term which gives signals and incentives for investment in new

[19] CREG Resolution 064 of 2000
[20] CREG Resolution 116 of 1996
[21] CREG Resolution 071 of 2006

generation resources, ensuring in consequence the supply of electrical energy required by the country's growth[22].

The Reliability Charge is collected by the generators through their sales in contracts and in the Energy Pool. Therefore, there is a floor to the price offers made by the generators to the Pool. This floor is known as the Equivalent Energy Cost and is included in the resulting Pool Price.

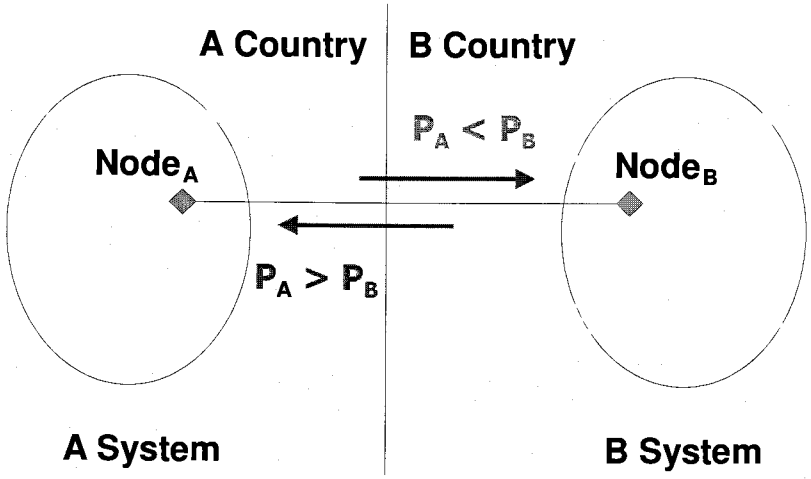
4.2.6 International Short Term Electricity Transactions with Ecuador[23]

CAN Decision 536 of 2002 and later CAN Decisions 720 of 2009 and 757 of 2011 issued by the Andean Community of Nations, have established the rules for a mechanism known as International Short Term Electricity Transactions –TIE, through which it has been possible to couple the short term markets of Ecuador and Colombia.

Under this framework there is a main rule: the flows through the international interconnections are originated in the market coupling of the two countries, considering the export offers and import bids in the frontier nodes. Although CAN Decision 536 provided for financial contracts between agents of the two countries (which without a doubt would enhance both markets), there is no regulation today under which those contracts could be made.

As it is established in the regulation of the two countries[24], the implemented model requires the calculation of both export offer prices and import bid prices. They are used to identify the direction and the magnitude of the energy flows.

[22] Source: http://www.creg.gov.co/cxc/secciones/que_es/que_es.htm. CREG.
[23] Congestion Rents in the Ecuador – Colombia Interconnection. Diego Felipe García G., Alejandro Gutiérrez G. 2006.
[24] Colombia: CREG Resolution 004/2003, 014/2004. Ecuador: CONELEC Regulation 002/2004



Graph 5. Definition of the flow direction.
The flow goes from the country with the lowest price to the country with the highest price.

After establishing the required generation to attend domestic demand, the dispatch of each country considers the export offers of the other country, which are shaped as incremental steps. The electricity transaction is decided when the export price of the other country is lower than the import price of the country that will import.

Colombia is currently exploring in association with Panama the different alternatives to interconnect both countries. This would give Colombia access to the Central American market. The CREG in Colombia and the National Authority of Public Services in Panama have issued regulation proposing the bases for the interconnection and the development of the transactions between the two countries.

4.2.7 Transmission and Distribution Remuneration

Electrical energy Transmission (voltages equal of above 220 kV) is paid for with the regulated income methodology. The CREG approves every five years the asset inventory to be recognized to each National Transmission Agent, based on which the income is calculated. This cost is passed through to end users via a stamp charge, pro rata of the consumed energy. New transmission assets built because the investor was awarded the project in one of UPME's auctions are paid a regulated income approved by the CREG according to the yearly income offer they made for the auction.

Transmission companies are charged with the cost of constraints associated with the delays in their expansion projects. Expansion of Transmission is a centralized responsibility of the UPME, which produces the National Transmission Expansion Plan and executes the projects through public auctions where the domestic

transmission companies and foreign investors compete for the right to build, operate and own the new infrastructure.

Distribution has a Revenue Cap mechanism for voltage levels between 57,5 and 220 kV and Price Cap methodology for lower voltage levels. End users pay stamp charges according to the voltage level of connection to the system and pro rata of the quantities consumed.

Both Transmission and Distribution Charges are paid by the retailers, who pass the costs through the tariff to the end users. XM is in charge of the settlement and clearing of the incomes and charges that remunerate the transmission owners, as well as of the settlement[25] of the charges for distribution[26], but the billing and clearing is a responsibility of each distributor. In the near future, XM will also be responsible for the calculation and settlement of the charges for the non-technical losses reduction plans of the SDLs.

4.2.8 Collateral

To secure the debts resulting from the transactions in the Wholesale Electricity Market, as well as the payment for the services of system operation and market administration delivered by XM, the participant agents are required to provide collateral to XM[27] or use alternative mechanisms like the monthly or weekly prepayments and the transferal of Credit Rights. The calculation of prepayments is completely regulated by the CREG and executed by XM.

A coaxing mechanism for the opportune payment of debts with the market and among the participant agents has been established. It comprises two different procedures for different kinds of agents: i) Suspension: Retailers in default who are not also distributors are suspended from the market until they pay all their debts or reach a payment agreement with all their creditors (so that they are able to produce a certificate of good standing), their end users are to be served by another retailer of their choice or by the incumbent retailer by defect; ii) Supply Curtailment: Retailers in default who are also distributors and who are therefore the incumbent retailer for a group of end users have the supply of electricity to their users interrupted for a few hours every day until they pay their debts or reach a payment agreement with their creditors; a supply curtailment in the pool is also applied, suspending the effects of

[25] Distribution settlement includes the calculation of quality of service indexes, with which monitoring of the behavior of the network can be monitored.
[26] Distribution includes the Regional Transmission Systems – STR (voltages between 57,5 and 220 kV) and the Local Distribution Systems –SDL (voltages below 57,5 kV).
[27] Elegible guarantees are: bank guarantee, bank endorsement or standby letter of credit (SLOC).

their sale contracts in order to avoid the increase in their debt with the short term market.

4.2.9 End user tariff

There are in Colombia two kinds of end users: Regulated End Users, for whom the CREG establishes a tariff formula, and Non-Regulated End Users, who are allowed to freely negotiate their tariff with the Retailer they choose. For the Regulated End Users, the basis of the tariff is the Service Provision Unitary Cost[28], which is calculated according to the following general formula:

A variable component:

$$CUv = G + T + D + Cv + PR + R$$

Where:

- **G:** Maximum energy purchase cost
- **T:** Use of National Transmission System cost
- **D:** Use of Distributions Systems cost
- **Cv:** Variable component of the Retailing cost
- **PR:** Cost of purchasing, transporting and reducing losses
- **R:** Constraints Cost

A fixed component (CU_f), the fixed component of the Retailing cost (cost per bill).

This unitary cost is charged to the users on a monthly basis, depending on the voltage level they are connected (different values for D). For low income users the tariff includes a subsidy over the unitary cost. The subsidy is paid for in part by explicit taxes in the tariffs of high income residential users, commercial users and industrial users.

5 A market prospective

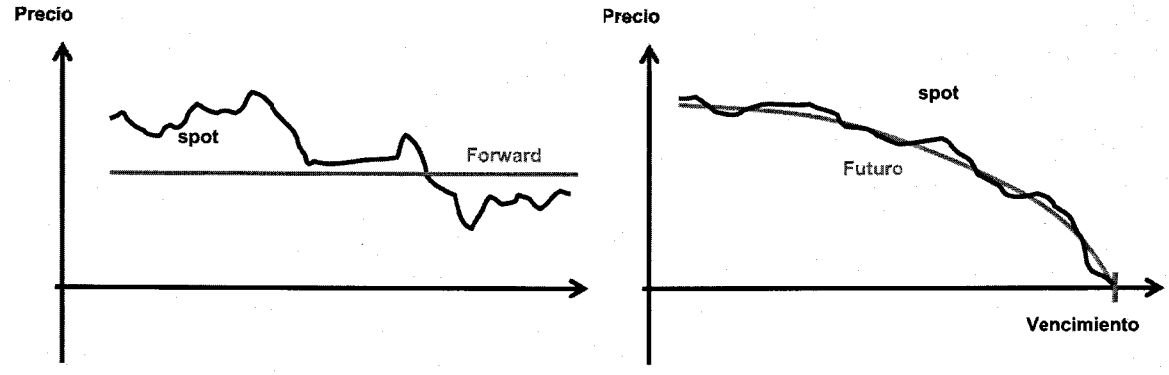
Retailers and Generators are exposed to risks derived from the nature of the operations in the market. They have to deal with the volatility of the Pool Price (which is ten times as high as that of the bilateral contracts) and to exogenous risks, such as changes in the peso-dollar exchange rate, taxes, credit risk, regulation changes and new technological developments, to mention a few.

[28] CREG 119 Resolution of 2007

Because the electricity market offer only two alternatives for supplying demand and hedging the risks mentioned above, the portfolio of a given agent is limited to define the financial hedge through bilateral contracts and assume the Pool Price risk.

Because the bilateral contracts do not have a standard (current situation) the collateral design to be implemented is very complex and does not completely protect against credit or counterpart risks. Furthermore, the bilateral contract market isn't liquid enough, making it difficult to reconfigure the portfolios (non-standard contracts ought to be negotiated to close a position), which brings higher transaction costs, low leverage and limits the speculation the market needs.

On the other hand, standard contracts in the form of futures or options backed up by a Clearinghouse bring along indisputable advantages like a reliable hedge for the volatility in the Pool Price, the counterpart and credit risk elimination, high liquidity, low transactions costs, ease to reconfigure portfolios (position closure) and high leverage (a larger market with speculation). Because there is a mark to market, the price of the futures contract converges with the pool price on delivery.



Graph 6. Behavior of forward contract prices and future contract prices compared to the pool price

There is in Colombia a market for standard derivatives on energy commodities and it is managed by DERIVEX S.A., a company that is in operation since late 2010. DERIVEX is a joint venture between XM and the Colombian Stock Exchange created to provide the electricity market participants and end users with an organized market for the trade and registry of instruments to hedge their market risk as well as their credit risk through the clearing of the negotiated derivatives in the Colombian Clearinghouse –CRCC.

As the derivatives market matures, it is expected that the value chain of the electricity sector will be extended to include other investors and financial institutions optimizing and diversifying their portfolios. All of this will promote the formation of fair prices and the synergic development of the energy and financial markets.

Conclusions

An outline of the workings of the Wholesale Market of the electricity sector in Colombia has been presented, including all the activities in the production line (e.g. Generation, Transmission, Distribution and Retail), dealing with some topics with the required depth to achieve a basic understanding. There's still an open question about the future of the Colombian electricity sector, considering the strategic location of our country for the interconnection between South and Central America and the ongoing development of financial derivatives by the Colombian Stock Exchange and XM through their joint venture DERIVEX, which will surely promote regional integration. This is a challenge we ought to face with cooperative spirit in order to reach the global economic welfare.

References

EL SECTOR ELÉCTRICO COLOMBIANO; V Seminário Internacional do Setor de Energia Elétrica: Integração com Energia Renovável. Alejandro Gutiérrez Gómez. 2010

Regulation issued by the Energy and Gas Regulation Commission– CREG –.

The Congestion Rents in the Ecuador – Colombia Interconnection. Diego Felipe García, Alejandro Gutiérrez. 2006

Governance and independence of the System Operator and the Market Administrator. Pablo Hernán Corredor A., Sonia Margarita Abuchar A., Alejandro Gutiérrez G.

www.creg.gov.co – Energy and Gas Regulation Commission – CREG -

www.xm.com.co – XM S.A. E.S.P.

www.asocodis.com.co – Colombia Association of Distributors

Information from Doing Business in Colombia: 2013 Country Commercial Guide for U.S. Companies, U.S. & FOREIGN COMMERCIAL SERVICE AND U.S. DEPARTMENT OF STATE

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Doing Business in Colombia

Market Overview

The Republic of Colombia is the fourth largest economy in Latin America, after Brazil, Mexico, and Argentina, and has the third largest population with approximately 46 million inhabitants. It is the only country in South America with two seacoasts (Pacific and Caribbean), which provides tactical shipping advantages in today's global market. Aided by major security improvements, steady economic growth, and moderate inflation, Colombia has become a free market economy with major commercial and investment ties to the United States, Europe, Asia, and Latin America. With the implementation of the U.S.-Colombia Free Trade Agreement on May 15, 2012, Colombia is the third largest market for U.S. exports in Latin America.

The reality is that the past 10 years have brought extraordinary change to the country in terms of economic development due to improvements in the security situation. Strong political stability, a growing middle class (35.3% of the population), and improved security has created an economic boom in Colombia that, coupled with the government's conservative fiscal policies, lessened the impact of the global economic crisis. Key economic indicators demonstrating the positive long-term effect of Colombia's political and economic policies include: GDP growth of 5.5 percent in 2011 and 4 percent in 2012; foreign direct investment of USD 15.8 billion in 2012, a record for Colombia, which is an increase over the previous record of USD 14.8 billion in 2011, and inflation of 4 percent in 2012 and 4.3 percent in 2011. These are all signs of a strong and growing economy.

Due to Colombia's close ties to the United States and Colombians' appreciation for the quality and reliability of U.S products, consumers in Colombia often favor U.S. products and services over those of our foreign competitors. The United States is Colombia's largest trading partner and Colombia is the 22nd largest market for U.S. exports in 2012. U.S. exports to Colombia in 2012 topped USD 16 billion, an increase of more than 14 percent over 2011.

Colombia is unique in that there are five bona fide commercial hubs in the country: Bogota, Medellin, Barranquilla, Cali, and Cartagena. As opposed to the majority of Latin American countries that have one or two major cities, Colombia offers U.S exporters access through multiple commercial hubs, each of which has its own American Chamber of Commerce. While these cities, and many other secondary cities, offer unique market opportunities, they are close enough via air routes that is common to have one partner (agent, distributer, or representative) to cover the whole country.

Regarding foreign direct investment by U.S. companies, coal mining and oil and gas exploration/production are the principal areas of U.S. investment, followed by the consumer goods, high-tech and tourism/franchising sectors. A sample of the major U.S. companies in Colombia include: 3M , Citibank, ChevronTexaco, Chicago Bridge and Iron , Drummond, ExxonMobil, Goodyear, General Electric, General Motors, Johnson and Johnson, Kimberly Clark, Kraft, Microsoft, Marriott, Marriott International, Occidental Petroleum, Sonesta Collection Hotels and Unisys.

2013 will bring greater investment in infrastructure projects ranging from roads (USD 26 billion allocated over the next 4 years), airport modernizations, port construction, and railway projects. New FDI will begin to be reflected in major hotel (Hilton and Hyatt) and infrastructure (highway, mass transportation, ports and airport) projects.

The Colombian government has implemented bilateral or multilateral trade agreements with most countries in North and South America, including the United States and Canada. The European Union ratified a Free Trade Agreement with Colombian in December 2012, but must be passed by each member country before being implemented. Colombia has an ambitious trade agenda and has initiated FTA negotiations with South Korea, Panama, Japan, and Turkey.

Regarding the U.S.-Colombia FTA, on May 15, 2012, the agreement went into force, immediately eliminating import tariffs on 80 percent of U.S. exports of consumer and industrial products to Colombia, with remaining tariffs phased out over one to ten years. Other provisions include strong protection for U.S. investors (legal stability), expanded access to service markets, greater intellectual property rights protection, market access for remanufactured goods, increased transparency and improved dispute settlement mechanisms (arbitration).

Market Challenges

As with any market, there are numerous challenges to doing business in Colombia (some of which were eliminated with implementation of the Free Trade Agreement):

- Only firms licensed under Colombian law may provide legal services. Foreign law firms can operate in Colombia by forming a joint venture with a Colombian law firm and operating under the licenses of the Colombian lawyers in the firm.
- Economic needs tests are required when foreign providers of professional services operate temporarily; and residency requirements restrict transborder trade of certain professional services, such as accounting, bookkeeping, auditing, architecture, engineering, urban planning, and medical and dental services.

• A commercial presence is required to provide information processing services or to bid on Colombian government contracts.
• Telecommunications barriers to entry include cross subsidies, the requirement for a commercial presence in Colombia, and an economic needs tests.
• For firms with more than ten employees, no more than 10 percent of the general workforce and 20 percent of specialists may be foreign nationals.
•International banking institutions are required to maintain a commercial presence in Colombia through subsidiary offices.
• Insurance companies are restricted from offering policies to underwrite risk on government sponsored infrastructure projects due to Colombian regulations that do not recognize insurance policies as equivalent to bank guarantees.
• Customs duties have been consolidated into four tariff levels: 0 to 5 percent on capital goods, industrial goods and raw materials not produced in Colombia, 10 percent on manufactured goods with some exemptions, and 15 to 20 percent on consumer and "sensitive" goods. Exceptions include automobiles, which are subject to a 35 percent duty (except Sports Utility Vehicles). A group of agricultural products is protected by a price band mechanism that offers variable duties as high as 100 percent, but will eventually decrease to zero over the next xx to 19 years.

Market Opportunities

Despite market challenges, Colombia provides significant opportunities for U.S. exporters:

• Colombia's extensive planned infrastructure projects will require: project financing, public works subcontracting, logistics, construction equipment for public roads and airports; water treatment, water supply, electric power generation, oil and gas exploration and pollution control equipment, air navigational and port security aids, railway construction, transportation equipment, security and defense items and services, and mass transit systems.
• Awarded to the OPAIN company in 2006, Bogota's El Dorado International Airport still requires massive upgrades. The Medellin/Rio Negro airport upgrade is underway and the Northeast airports concession has been awarded. All concessionaires are seeking equipment to modernize their facilities.
• The United States Trade and Development Agency (USTDA) and EXIM Bank support U.S. companies as they craft solutions to development challenges and make inroads in key sectors such as oil and gas, petrochemicals, renewable energy, telecommunications, and ports. USTDA grants have resulted in big U.S. company wins at the country's two newest refineries. EXIM's preliminary commitment of USD 1 billion to Colombia's major oil company Ecopetrol and USD 2.8 billion to the Reficar refinery project will provide a myriad of export opportunities for U.S. exporters of oil and gas equipment and services. USTDA grants for customs security and

operational enhancements at the ports in Cartagena, Buenaventura, and Puerto Salgar should also increase prospects for U.S. exporters.

• Significant U.S. export opportunities not already mentioned include: cotton, wheat, corn soy products, automotive parts and accessories, tourism, computer hardware and software services, IT equipment and services, plastics materials and resins, electrical power systems, safety and security equipment, food and beverage processing and packaging equipment and medical equipment.

Market Entry Strategy

Market entry strategies are as follows:

• Secure an agent, representative, or distributor in Colombia, which requires a contract that meets the provisions of the Colombian Commercial Code.

• Focus on formality, personal relationships, and trust when negotiating agreements and contracts.

• Communicate with the U.S. Commercial Service and the Economic sections of the U.S. Embassy in Bogotá regarding specific concerns.

• Offer excellent after-sales service arrangements and maintain the sales relationship. Warranties or guarantees on imports are critical for supporting after sales service in Colombia.

• Provide high quality products and/or services, affordable financing and competitive pricing.

• Support your local partner's marketing efforts with advertising campaigns or by participating in trade shows. Do not be hands off; visit often.

• Spanish-language sales collateral and service manuals are essential, and may be required in certain sectors, like medical products. U.S.-based staff with a strong knowledge of Spanish is certainly helpful.

Electrical Power Systems (ELP) Sector Focus

Overview Return to top *(in U.S. $ millions)*	**2011**	**2012pry**	**2013est**
Total Market Size	1,193	1,282	1,435
Total Local Production	258	270	285
Total Exports	190	208	210
Total Imports	1,125	1,220	1,360
Imports from the U.S.	382	415	418

The above statistics are unofficial estimates Sources: Association of Power Generation Companies, National Planning Department, Energy and Gas Regulatory Commission, Mining and Energy Planning Unit and World Trade Atlas

The Electrical Power Systems market continues to represent an important opportunity for U.S. exporters. The significance will increase as Colombia's continues to expand its economy, which in turn will drive the demand for more electricity across all industrial sectors.

At the end of 2012, Colombia's installed electric power generation capacity reached 14,524 MW, up from 13,420 MW in 2011, with a 63.6 percent hydro power share and the remainder 36.4 percent (gas, coal-fired power plants, wind power, and cogeneration facilities). By 2019, the government has forecasted the installed capacity to reach 18,671 MW, with an increased reliance on large-scale hydro.

The Energy and Gas Regulatory Commission (CREG) enacted a "Reliability Charge" that recognizes the availability of generation assets to insure "firm generation capacity - OEF" under critical conditions, becoming a major incentive to develop new power projects in Colombia. Recent power auctions under this new market-oriented mechanism, generated new power plant commitments, mostly hydro-based plants and increasing the share of hydro-based generation (to reach 72 percent) with the incorporation of Porce III and IV, El Quimbo, HidroSogamoso and Pescadero-Ituango, totaling more than 4,000 MW.

Several large Colombian power companies, including Interconexión Eléctrica (ISA), Empresas Públicas de Medellín (EPM), ISAGEN S.A., and Empresa de Energía de Bogotá (EEB) are evaluating expansion projects to other Andean Countries (Bolivia, Ecuador, and Perú) and Central American countries. The proposed power interconnection with Panama could lead to new power projects in Central America.

The Colombian Government is also promoting the use of renewable energy sources, especially for off-grid and isolated areas. Also under development is a regulatory framework to expand the use of energy efficient systems and create awareness for the rational use of energy, including building more cogeneration facilities.

Efforts are underway to promote private ventures in the areas of solar, wind, geothermal, and small-hydro systems. If successful, these projects will allow for the use of energy in sustainable community projects. EPM owns the country's sole wind power plant (Jepírachi) located in La Guajira. This is a 19.5 MW facility, with financial support from the World Bank's Prototype Carbon Fund's greenhouse gas reduction credits. Other electric utilities are interested in pursuing renewable energy projects (mainly wind). Another non-traditional project is the Amoyá run-of-river hydro project that is expected to produce some 80 MW of electricity and additional environmental benefits aimed at protecting the peak areas in the surrounding mountains.

Imports of electric power generation equipment benefit from a favorable peso-U.S. dollar exchange rate; relative proximity of Colombia to the U.S.; and with the implementation on May 12, 2012, of the U.S.-Colombia Trade Promotion Agreement (U.S.-CTPA), Colombia will eliminate import duties for equipment, spare parts, and accessories for this sector.

Best Products/Services

Electrical power equipment opportunities include:
- Power, distribution, and specialty transformers
- Switchgears
- Motors
- Generators
- Industrial controls
- Steam, gas, and hydraulic turbines
- Turbine generator sets.

The outlook for the Colombian electricity sector is promising since the government is planning to develop several new power generation projects, mostly hydro, to accommodate the expanded demand through 2018. Additionally, the government is exploring prospects to become a major exporter of electricity (including goods and services) to the Andean region and Central America.

Some solid business prospects exist as a result of this trend to continue using hydroelectric plants with gas-fueled thermal energy generators, including cogeneration systems. Also,

electricity trading and distribution companies are focusing on reducing losses by acquiring leading-edge management and control systems technologies.

Another promising business opportunity is the Rural Energy Program aimed at providing electrical power to off-grid areas using renewable energy systems such as solar, wind, and small and medium scale hydro plants. This program calls for new generation systems and improving existing systems. The government has taken steps to secure funding for the program. This sector will continue to consolidate.

To assist with these government efforts, the U.S. Trade and Development Agency has awarded feasibility study grants for a 50 MW geothermal power plant (ISAGEN), for a 20 MW landfill waste-to-energy facility, and for a proposed solar-wind power project. In addition, USTDA is also supporting the Colombian government's interest in using Smart Grid technologies.

Resources

CS Bogotá contact: Julio Carbó, Commercial Specialist
Email: Julio.Carbo@trade.gov
Tel: (571) 275-27-23

U.S. Trade and Development Agency (TDA): www.ustda.gov

Association of Power Generation Companies (ACOLGEN): www.acolgen.org.co

Energy and Gas Regulatory Commission (CREG): www.creg.gov.co

Empresas Públicas de Medellín (EPM): www.eeppm.com

Interconexión Eléctrica S.A. (ISA): www.isa.com.co

ISAGEN: www.isagen.com.co

Mining and Energy Planning Unit (UPME): www.upme.gov.co

National Planning Department (DNP): www.dnp.gov.co

Ministry of Mines and Energy (MME): www.minminas.gov.co

Transelca: www.transelca.com.co

Trade and Project Financing

How Do I Get Paid (Methods of Payment)

Most products are imported through letters of credit or time drafts. Soft and long-term financing is an important sales tool, especially for government imports or public tenders. Foreign suppliers, financial intermediaries in Colombia, or foreign financial institutions, may finance Colombian Imports.

Colombian importers may freely negotiate payment terms with their suppliers, but importers must list the agreed payment terms on the import documents and may not subsequently change them. These are generally between one and six months for imported products for immediate consumption, including raw materials, intermediate goods, and consumer goods, with almost no term limitations for capital goods, which are payable within the timetables set on the import documentation, plus a grace period of three additional months. Foreign payments may be authorized in installments, but in no case can the original terms listed on the import documents be changed.

General trade finance is freely available and letters of credit are widely used in Colombia. Methods, terms, and conditions of payment vary with the type of credit. Most imports of equipment are paid via irrevocable 180-day letter of credit (L/C), payable on sight against shipping documents. Normal payment term is 60 days. There are transactional cases in which suppliers may extend terms to 120 days by time draft, but this is not common practice. When a satisfactory trading relationship has been established, terms are those generally applied in international trade. Short-term is considered any term less than one year; medium-term is from one to four years; and, long-term ranges from five years up to 20 years.

How Does the Banking System Operate

Colombia's financial system operates under the supervision of the Financial Superintendent, created in 2005 from the merger of the Banking Superintendent and the Stock Exchange Superintendent. The financial system is relatively large in comparison with the nation's gross domestic product. It has many highly sophisticated institutions with state-of-the-art technology. However, financial services are still very costly and intermediation remains the most important financial activity.

Following the 1998-1999 financial crises, almost half of banking and non-banking institutions were closed, taken over, or forced to merge. Many weaker financial institutions merged or are now affiliated with more experienced and financially sound owners. Still, experts consider that

the sector has not reached its ideal size. The presence of foreign banks has intensified competition and investment in advanced technologies and government authorities have made significant efforts to improve the health of the financial sector. In January 2012, Scotia Bank of Canada acquired Colpatria Bank for about $1 billion. The most recent investment, valued at $1.3 billion, was the acquisition of Helm Bank by the Chilean group Corpbanca in October 2012.

Commercial banks are allowed to complete all authorized credit operations, with the exception of leasing operations and real sector investments. Only commercial banks provide checking accounts. Within this group, some institutions specialize in housing and construction financing (mortgage banks). Commercial banks dominate the financial market, accounting for over 80 percent of the financial system's assets.

In 2009 a new law reforming the financial sector was passed. The reforms increased protection for financial customers, including requirements that financial institutions properly disclose the costs associated with their operations. They also forbid agreements in which consumers waive their rights and provisions shifting the burden of proof to consumers. The reforms create Advocate for Financial Consumers positions, which every financial institution must have and who are responsible for ensuring that financial institutions do not violate consumers' rights. The new law also introduces greater flexibility to the pension fund system by creating the multi-fund structure to allow for various risk investment profiles. It allows foreign banks and foreign insurance companies to operate locally without having to incorporate a Colombian entity, although they do have to set up a branch in Colombia, subject to all relevant legal requirements. Finally the law establishes mechanisms to promote microfinance, securitization and the development of capital markets.

Foreign-Exchange Controls

Colombia imposes no foreign exchange controls on trade. However, exchange regulations require that the following transactions be channeled through intermediaries (i.e. banks or other recognized financial institutions) authorized for such purposes, and must be declared to the Central Bank:

- Imports and exports of goods
- External loans and related financing costs
- Investment of capital from abroad and remittances of profits thereon
- Investment of Colombian capital abroad, as well as remittances of yields
- Investment in foreign securities and assets and their associated profits
- Endorsements and guarantees in foreign currency
- Derivative or secondary financial operations, e.g. forwards, swaps, caps, floors, or collars.

Colombia has reduced foreign exchange controls significantly in recent years. External Resolution No. 6 of 2000 abolished prior deposit requirements with the Central Bank for public and private external loans as well as for foreign financing of imports into Colombia. Also, Resolution 11 allows residents to make payments to other residents in U.S. dollars through checking accounts held abroad, and Resolution 8 authorizes stock brokerage firms to act as intermediaries in the foreign exchange market. The Colombian peso is convertible and investors report no untoward restrictions on access to hard currency.

Projects performed by companies with foreign capital in special sectors such as the exploration and production of oil, natural gas, coal, nickel, and uranium are subject to a special foreign exchange policy. Under the special policy, investors are not bound to repatriate export-generated foreign currency. Companies devoted to technical services related to hydrocarbon exploration and production activities may carry out operations in a foreign currency with no repatriation obligation. Furthermore, foreign investors are not obligated to reimburse Colombia with foreign currency obtained from the sale of products from these operations. Expenses incurred abroad that are related to the development of these projects must be paid in foreign currency. Companies interested in being covered by these special provisions must notify the central bank.

The Ministry of Finance issued Decree 4145 on November 5, 2010 reinstating a withholding tax of 33 percent on interest paid on foreign debt. This decree will raise the cost of capital for local borrowers. The purpose of the decree is to reduce the inflow of foreign currency, which has appreciated the Colombian peso by about six percent since the beginning of 2010. Decree 4145 does not supersede a lower rate of withholding tax provided for in Colombia's tax treaties with Spain and Chile.

U.S. Banks and Local Correspondent Banks

Virtually all-Colombian banks have correspondent banks in the United States. The following are major Colombian banks and U.S. banks with which they have correspondent relationships:

Davivienda:
Davivienda Internacional
JP Morgan Chase
Citibank
Bank of New York Mellon
BanColombia:
Citibank
Bank of New York Mellon
Deutsche Bank
Bank of America
CoBank
JP Morgan Chase
American Express Bank
Lloyds TSB Bank
International Bank of Miami
Regions Bank
Banco de Occidente:
Citibank
Bank of America
Bank of New York Mellon
American Express Bank
Banco Popular:
Bank of America
Dressner Bank
Bayerische Hypound-Vereins Bank
Citibank
Bank of New York Mellon
TD Bank
HCBC Bank
ING Bank
Regions Bank
Banco de Bogotá
Citibank
Bank of America
Deutsche bank
JP Morgan
Bank of New York Mellon
AV Villas
Banco de Occidente USA
Colpatria Bank
Bank of America
BBVA Colombia
BBVA Bank, New York
BBVA Bank, Miami

Project Financing

The government and the Central Bank are important sources of funding for the financial system. The Central Bank, in addition to providing the usual discount facilities to support system liquidity, manages several special government funds to promote lending into a number of sectors that have been determined to be important to national development or economically essential. The funding comes from government capital, bonds, and current fiscal appropriations, if needed to cover deficits. Access to the funds tends to require considerable paperwork; applicants must qualify and margins are limited. Their importance as a funding resource has diminished in recent years.

Leasing, and domestic and international (both operating and capital) financing are becoming popular, mainly because of tax benefits. Factoring and international credit insurance is available. Transactional financing is more associated with trade in consumer goods, while equity-based financing is more commonly used for project financing.
Colombian exporters have access to credit offered by the Colombian Foreign Trade Bank (Bancoldex). This credit is also extended to Colombian importers for industrial imports.
Foreign investors have full access to local credit. While the Colombian Government still directs credit to some areas (notably agriculture), credit is mostly allocated by the private financial market. Loans of foreign origin or foreign financing of imports are permitted.

EX-IM: The Export-Import Bank of the United States (Ex-Im) provides a full range of services in Colombia. Ex-Im offers a range of loan, insurance, and loan guarantee programs to facilitate exports of U.S. goods and services to Colombian governmental and private companies. For additional information visit: www.exim.gov

OPIC: OPIC is a U.S. government agency that supports, finances and insures projects that have a positive effect on U.S. employment, are financially sound and promise benefits to the social and economic development of the host country. OPIC assistance is available for new investments, privatization, and for expansion and modernization of existing plants sponsored by U.S. investors. Access OPIC programs at: www.opic.gov

Multilateral Funding Agencies and Financial Markets: Multilateral agencies such as the World Bank through the International Finance Corporation (IFC), the Inter-American Development Bank (IDB), the Andean Development Corporation (CAF), the Export Import Bank of Japan, and USAID (and development agencies of Japan and Canada) are active in providing financing for projects in Latin America and the Caribbean.

The Andean Development Corporation (Corporacion Andina de Fomento) is the only organization to provide major direct financing for greenfield projects in Colombia. The CAF has provided direct financing to the private sector for the development of greenfield projects in various infrastructure sectors.

IADC: The Inter-American Development Corporation provides development capital to export oriented companies in the agricultural business through "Corfisura Fondo de Desarrollo de Empresas," Colombia's first development capital fund in, manufacturing, mining, and emerging technology sectors.

World Bank: In 1994, Colombia approved through Law 149, its adherence to the Multilateral Investment Guarantee Agency (MIGA), created in 1985 by the World Bank to stimulate the flow

of resources for productive ends between member countries and in particular toward developing countries.

Web Resources

Export-Import Bank of the United States: http://www.exim.gov
Country Limitation Schedule: http://www.exim.gov/tools/country/country_limits.html
OPIC: http://www.opic.gov
U.S. Trade and Development Agency: http://www.ustda.gov/
SBA's Office of International Trade: http://www.sba.gov/oit/
USDA Commodity Credit Corporation: http://www.fsa.usda.gov/ccc/default.html
U.S. Agency for International Development: http://www.usaid.gov
U.S. Embassy Website in Bogotá, Colombia: http://bogota.usembassy.gov
Colombian Banking Association: http://www.asobancaria.com
Colombian Customs and Income Tax Offices: http://www.dian.gov.co
Colombian Ministry for Foreign Affairs: www.minrelext.gov.co

Contacts

Andean Development Corp. (CAF): www.caf.com
Andean Community (CAN): www.comunidadandina.org
ANDI (National Industries Association): www.andi.com.co
ANIF (Financial Entities Association): http://anif.co/
Association of Automotive Importers and Exporters: www.asopartes.com
Association of Flower Exporters: www.asocolflores.org
Banco de la República (Central Bank): www.banrep.gov.co
Bancoldex (Foreign Trade Bank) www.bancoldex.com
Banking Association: www.asobancaria.com
Banking Superintendence: www.superfinanciera.gov.co
Bivac de Colombia S.A.: www.bureauveritas.com.co
Bogotá Chamber of Commerce: www.ccb.org.co
Cambio Magazine: www.cambio.com.co
CNTV (National TV Commission): www.cntv.org.co
Colombian Agricultural Institute- ICA: www.ica.gov.co
Colombian Association of Airlines (ALAICO): www.alaico.org Colombian Association of Travel and Tourism Agencies (ANATO): www.anato.org Colombian Hotels Association (COTELCO): www.cotelco.org Colombian Special Administrative Unit for Civil Aeronautics (UAEAC): www.aerocivil.gov.co
Colombian Association of Hospitals and Clinics: www.achc.org.co Colombian Association of Medical Business: www.acemi.org.co
Colombian Association of Systems Engineers: www.acis.org.co
Colombian Association of Banks:
http://www.asobancaria.com/portal/page/portal/Asobancaria/inicio
Colombian Coffee Growers Federation: www.cafedecolombia.com
Colombian Construction Chamber: www.camacol.org.co
Colombian Customs and Income Tax Offices (DIAN): International Commerce Bulletin:
http://www.dian.gov.co/dian/14cifrasgestion.nsf/e7f1561e16ab32b105256f0e00741478/a02b47038628e5610525733e0059549a?OpenDocument
Colombian Customs and Income Tax Offices (DIAN): www.dian.gov.co
Colombian Engineers Society: www.sci.org.co
Colombian Export Promotion Bureau: Colombia Sector Profile Agro-industry:
http://www.inviertaencolombia.com.co/Adjuntos/087_Perfil%20Sector%20Agroindustrial.pdf
Colombian Export Promotion Bureau: www.proexport.com.co
Colombian Government: Citizens, Economy and Commerce:
http://www.gobiernoenlinea.gov.co/web/guest/informate?ref=link23#pr=_TaxonomyBrowser_WAR_taxonomybrowserportlet_profiletabs-citizen&au=_TaxonomyBrowser_WAR_taxonomybrowserportlet_audience0

Colombian Government: Companies, Economy and Commerce
http://www.gobiernoenlinea.gov.co/web/guest/informate?ref=link23#pr=_TaxonomyBrowser_WAR_taxonomybrowserportlet_profiletabs-enterprise
Colombian Government: http://www.gobiernoenlinea.gov.co/web/guest
Colombian Grain Growers Federation: www.fenalce.org.co
Colombian Infrastructure Chamber (CCI): www.infraestructura.org.co
Colombian Petroleum Association: www.acp.com.co
Colombia Stock Exchange: http://www.bvc.com.co/pps/tibco/portalbvc
Colombian Tele-Informatics Chamber: www.ccit.org.co
Colombian-American Chamber of Commerce: www.amchamcolombia.com.co
Council of American Companies (CEA): http://www.ceacolombia.com/es/
CREG (Energy and Gas Regulatory Commission): www.creg.gov.co
CRT (Telecommunications Regulatory Commission): http://www.crcom.gov.co/
DANE (Statistics Bureau): www.dane.gov.co
Dinero Newspaper: www.dinero.com
Economic Commission for Latin America and the Caribbean (ECLAC): www.eclac.org
El Espectador Newspaper: www.elespectador.com
El Tiempo Newspaper: www.eltiempo.com.co
Export-Import Bank of The United States (EXIMBANK): www.exim.gov
FENALCO (Merchants Association): www.fenalco.com.co
Health Colombia Online Magazine: www.saludcolombia.com
Industry And Commerce Superintendence: www.sic.gov.co
Instituto Nacional de Vigilancia de Medicamentos y Alimentos (INVIMA): www.invima.gov.co
International Airport Operator (OPAIN): www.elnuevodorado.com
Inter American Development Bank: www.iadb.org
International Packaging Exhibition, 2011, Bogota-Colombia: http://www.andinapack.com/
Intertek Testing Services (Customs validation): www.intertek.com
La Nota Económica Magazine: www.lanota.com
La República Newspaper: www.larepublica.com.co
Latin-American Integration Association (ALADI) http://www.aladi.org
Medellín Chamber of Commerce/Trade Point: www.camaramed.org.co
Ministry of Agriculture and Rural Development: www.minagricultura.gov.co
Ministry of Information and Communications Technologies: http://www.mintic.gov.co/
Ministry of Environment, Housing and Territorial Development: www.minambiente.gov.co
Ministry of Health (Ministerio de la Protección Social):
http://www.minproteccionsocial.gov.co/Paginas/default.aspx
Ministry of Mines and Energy: www.minminas.gov.co
Ministry of Trade, Industry and Tourism: www.mincomercio.gov.co
Ministry of Transportation: www.mintransporte.gov.co
National Association of Exporters: www.analdex.org

National Cattlemen's Federation: www.fedegan.org.co
National Health Care Superintendence: www.supersalud.gov.co
National Planning Department: www.dnp.gov.co
Overseas Private Investment Corporation (OPIC): www.opic.gov
Plastic Industries Association: www.acoplasticos.org
Portafolio Newspaper: www.portafolio.com.co
Pharmaceutical Laboratories Association (AFIDRO): www.afidro.or
Presidencia de la República (Office of the President of Colombia): www.presidencia.gov.co
Scientific Association for Health: www.sociedadescientificas.com Semana magazine: www.semana.com
Small Business Association-Acopi: www.acopi.org.co
State Controller's: www.contraloriagen.gov.co
State Contracting Information System (SICE): www.sice-cgr.gov.co
Superintendent of Corporations: www.supersociedades.gov.co
Trade and Development Agency: www.ustda.gov
Visit USA Committee Colombia: www.visitusacol.com
World Bank: http://www.worldbank.org/

Market Research

To view market research reports produced by the U.S. Commercial Service please go to the following website: http://www.export.gov/marketresearch.html and click on Country and Industry Market Reports.

Please note that these reports are only available to U.S. citizens and U.S. companies. Registration to the site is required, but free of charge.

Trade Events

Please use the link below for information on upcoming trade events.
http://export.gov/ibp/ibp.asp?ReportID=IBP

Colombia Unveils 2013-27 Electricity Plan

Source: http://www1.upme.gov.co/sala-de-prensa/fotonoticias/plan-de-expansion-de-referencia-generacion-transmision-2013-2027

Colombia's mining and energy planning unit, UPME, recently revealed its 2013-27 electricity plan. Key highlights include:

- The addition of roughly 3.1GW of capacity as well as more than US $2 billion in transmission works.
- The completion of the mega hydro project Ituango's second phase, two new hydro plants, two gas-fired combined-cycle thermo plants and one coal plant.

In terms of the key areas of study in the plan, key points included:

- The plan analyzed the impact of connecting major users to the national transmission network (STN) including hydro projects Río Ambeima (45MW) and San Miguel (42MW), coal-plant project Termotasajero II (160MW) and mega hydro project Ituango (2.4GW)
- Analysis of the connection needs for coal producer and major electricity consumer Drummond.

Transmission works, for planned and reconfigured projects and additional developments noted in the plan include:

- The 230kV Tuluní substation (expected operation date August 2016);
- The 220kV Río Córdoba substation (September 2016);
- The 500kV La Loma substation (November 2016)
- Reconfiguring the 230kV Guavio - Tunal line and the 220kV Barranquilla - Tebsa line
- Installation of a second 500/220kV transformer at Copey (November 2015)
- Connection of the Ituango project to the STN (June 2018)

The planning unit also expects 500kV lines to be constructed to facilitate power transfer to and from Colombia's Caribbean, southwest and eastern regions. In total the transmission works involve more than US$2bn of investment and should be completed in the next five years, UPME said.

UPME also studied two alternative plans to increase renewable generation and diversify Colombia's energy matrix. One included adding 540MW of capacity through wind, geothermal and cogeneration, while the other consisted of adding 300MW of wind capacity in northern coastal Guajira department.

Executive Summary – National Energy System Bill

The following pages contain the text for the National Congress of Colombia's final text adopted on the first reading at the fifth commission of the senate of the republic. Congress enacted several general provisions summarized in the document and briefly noted below:

Article 1. Object: The bill aims at encouraging savings and efficiency energy, and promoting the development and use in the Colombian energy market energy from renewable sources such unconventional means necessary for sustainable economic development, reducing emissions of greenhouse gases and energy security and the establishment of a legal regime and economic activity generation and sale of electricity through the non-conventional renewable sources.

Article 2. Purpose of the bill: It aims to establish the tools and strategies governing the use of non-conventional renewable energy, energy conservation and promote investment, research and development of clean technologies to generate electricity, in the context of energy policy and commitments in Colombia energy-saving, renewable energy and reducing emissions of greenhouse emissions. These objectives form the basis of the plans for saving, efficiency energy and the development of non-conventional renewable energy. Among the key details included in this is the guiding of public policy and definition of tax, tariff and financial instruments for participation in the Colombian energy market, the encouragement of the penetration of non-conventional renewable energy, and the promotion of energy efficiency and use of non-conventional renewable energy sources in all sectors and activities.

Article 3. Scope: The scope of this bill applies to all public and private actors involved in the definition of sectoral policies and provision of electricity.

Article 4. Declaration of Public Utility and Social Interest

Article 5. Definitions that aid in the interpretation and application of this Act.

Article 6. Administrative Powers: The government declared the following administrative powers as subject to the act's provisions:

- Ministry of Mines and Energy
- Ministry of Finance
- Ministry of Environment
- Regional Autonomous Corporations

Article 7. Promoting savings and energy efficiency of generation sources energy through the use and exploitation of non-conventional renewable energy.

Article 8. The savings and energy efficiency are the instrument of government to promote energy saving and efficiency.

Article 9. Method of making savings plans and energy efficiency sources of power generation through the use and exploitation of nonconventional renewable energy.

Article 10. Content of savings and energy efficiency sources power generation through the use and exploitation of non-renewable conventional energy.

Article 11. Financing of savings and energy efficiency sources power generation through the use and exploitation of non-renewable energy conventional.

Articles 12-15. The instruments for the promotion of renewable energies:

- Tax incentives
- Incentive tariff
- Accounting incentive, accelerated depreciation of assets
- Secure pricing regime

Articles 16-22. Actions to be undertaken for the development on non-conventional renewable energy:

- Development of energy from forest biomass
- Energy reforestation
- Agricultural biomass
- Energy from waste
- Development of solar energy sector
- Development of wind energy

Articles 23-26. Methods for the promotion and protection of non-conventional renewable energy:

- Measures to promote the solar energy sector
- Evaluation of the potential of geothermal energy
- International cooperation in the area of non-conventional renewable energy
- Fund for Renewable Energy and Energy Efficiency to fund programs for renewable energy and energy efficiency in the islands of San Andrés, Providencia and Santa Catalina - FERES.

Article 27. Electricity generation from non-conventional renewable energy

Article 28. Obligations and rights of energy producers

Articles 29-33. Exemplary actions of government and public administration

- Exemplary actions
- Best practices

- Savings and energy efficiency
- Buildings belonging to the government: Establishing a target global minimum energy savings for all government buildings 9% 2016, to be achieved through energy management measures.
- Governance of buiildings. The government will extend the criteria on energy efficiency requirements and renewable energy facilities and publicly owned buildings to facilities or buildings governance, even if the ownership is private.

Articles 34-35

- Promotion of reseach in renewable energy and energy efficiency and an energy impact assessment of plans and programs

Articles 36-38. Environmental considerations

- Harmonization of environmental requirements for energy development.
- Monitoring of emissions and discharges from energy facilities
- Statistical monitoring and assessment of compliance of the bill's objectives

TEXTO DEFINITIVO APROBADO EN PRIMER DEBATE EN LA COMISIÓN QUINTA DEL SENADO DE LA REPÚBLICA

PROYECTO DE LEY 278 DE 2013 SENADO - 096 DE 2012 CÁMARA.

"Por medio de la cual se regula la integración de las energías renovables no convencionales al Sistema Energético Nacional"

EL CONGRESO DE COLOMBIA
DECRETA:

CAPÍTULO I

Disposiciones generales

Artículo 1. Objeto. La presente ley tiene por objeto el fomento del ahorro y la eficiencia energética; la promoción del desarrollo y utilización en el mercado energético colombiano de la energía procedente de fuentes renovables no convencionales como medio necesario para el desarrollo económico sostenible, la reducción de emisiones de gases de efecto invernadero y la seguridad del abastecimiento energético; y el establecimiento de un régimen jurídico y económico de la actividad de generación y comercialización de energía eléctrica a través de la fuentes renovables no convencionales.

Artículo 2. Finalidad de la ley. Tiene por objeto establecer los instrumentos y las estrategias que regulen el aprovechamiento de las energías renovables no convencionales, el ahorro energético y la promoción para la inversión, investigación y desarrollo de tecnologías limpias para generar electricidad, en el marco de la política energética, y los compromisos asumidos por Colombia en materia de ahorro energético, energías renovables y reducción de emisiones de gases de efecto invernadero. Dichos objetivos constituirán la base de los planes para el ahorro, la eficiencia energética y para el desarrollo de las energías renovables no convencionales.

a) Orientar las políticas públicas y definir los instrumentos tributarios, arancelarios, contables y de participación en el mercado energético colombiano que garanticen el cumplimiento de los compromisos y obligaciones señaladas en el párrafo anterior;

b) Incentivar la penetración de las energías renovables no convencionales en el sistema energético colombiano, con criterios de eficiencia y sostenibilidad económica;

c) Impulsar la eficiencia energética y el uso de las energías renovables no convencionales en todos los sectores y actividades, con criterios de sostenibilidad medioambiental, social y económica;

d) Establecer mecanismos de cooperación y coordinación entre el sector público, el sector privado y los usuarios en el fomento del ahorro, la eficiencia energética y el desarrollo de las energías renovables no convencionales;

e) Establecer el deber a cargo del Estado a través de las entidades del orden nacional, departamental, distrital y/o municipal de desarrollar programas y políticas para asegurar el impulso y uso de mecanismos de fomento de la eficiencia energética y de la penetración en el mercado energético colombiano de la energías renovables no convencionales;

f) Estimular la inversión, la investigación y el desarrollo en la generación y comercialización en el mercado energético colombiano de las energías renovables no convencionales, mediante el establecimiento de incentivos tributarios, arancelarios y contables y demás mecanismos que permitan el estímulo del desarrollo de las energías renovables no convencionales en Colombia;

g) Fijar los criterios y principios que deben ser observados por el Gobierno Nacional para adaptar y complementar el marco jurídico actual, otorgando certidumbre y estabilidad al fomento de la eficiencia energética y al desarrollo sostenible de las energías renovables no convencionales con criterio de eficiencia económica y desarrollo social;

h) La supresión gradual de las barreras de tipo jurídico, económico y de mercado que obstaculizan el uso de las energías renovables no convencionales en Colombia, y conceder la garantía jurídica suficiente a los potenciales inversores en nuevas tecnologías de ahorro y eficiencia energética y de aprovechamiento de las energías renovables no convencionales;

i) La creación de las condiciones para el desarrollo y el fomento de un mercado de servicios energéticos y para la aportación de otras medidas de mejora de la eficiencia energética y promoción de las energías renovables destinadas a los consumidores finales;

j) Proporcionar certeza a los inversores privados, alentar el desarrollo continuo de tecnologías destinadas al aprovechamiento de las energías de origen renovable y crear un mercado de la eficiencia energética;

k) Fijar las bases legales para establecer una estrategia nacional para la actuación internacional en el ámbito de la energía, especialmente en lo que se refiere a la disponibilidad de recursos suficientes de energías renovables no convencionales para asegurar los objetivos fijados en este artículo.

Artículo 3. Ámbito de aplicación. El ámbito de aplicación de la presente ley cobija a todos los agentes públicos y privados que intervengan en la definición de políticas sectoriales y en la prestación del servicio de energía eléctrica y sus actividades complementarias conforme a lo dispuesto las Leyes 142 y 143 de 1994 y demás normas complementarias.

Artículo 4. Declaratoria de utilidad pública e interés social. La promoción, estímulo e incentivo al desarrollo de las actividades de generación y comercialización de energías renovables no convencionales se declara como un asunto de utilidad pública e interés social, público y de conveniencia nacional, fundamental para asegurar la diversificación del abastecimiento energético pleno y oportuno, la competitividad de la economía colombiana, la protección al medio ambiente, el uso eficiente de la energía y la preservación de los recursos naturales no renovables.

Esta calificación de utilidad pública o interés social tendrá los efectos oportunos para su primacía en todo lo referente a ordenación del territorio, urbanismo, planificación ambiental, fomento económico, valoración positiva en los procedimientos administrativos de concurrencia y selección, así como a efectos de expropiación forzosa.

Artículo 5. Definiciones. Para efectos de interpretar y aplicar la presente ley se entiende por:

1. Desarrollo Sostenible. Se entiende por desarrollo sostenible el que conduzca al crecimiento económico, a la elevación de la calidad de vida y al bienestar social, sin agotar la base de recursos naturales renovables en que se sustenta, ni deteriorar el medio ambiente o el derecho de las generaciones futuras a utilizarlo para la satisfacción de sus propias necesidades.

2. Energía Renovable No Convencional (ERNC): Es aquella energía generada por medio de aquellas fuentes de energía disponibles a nivel mundial que son ambientalmente sostenibles, pero que en el país no son empleadas o son utilizadas de manera marginal y no se comercializan ampliamente.

3. Eficiencia Energética: Es la relación entre la energía aprovechada y la total utilizada en cualquier proceso de la cadena energética, dentro del marco del desarrollo sostenible y respetando la normatividad vigente sobre medio ambiente y los recursos naturales renovables.

4. Uso eficiente de la energía: Es la utilización de la energía, de tal manera que se obtenga el mayor provecho de la energía utilizada en cualquier proceso de la cadena energética, bien sea de una forma original de energía y/o durante cualquier actividad de producción, transformación, transporte, distribución y consumo de las diferentes formas de energía, dentro del marco del desarrollo sostenible y respetando la normatividad vigente sobre medio ambiente y los recursos naturales renovables.

5. Energía biomasa: es la energía renovable no convencional obtenida de la degradación espontánea o inducida de cualquier tipo de materia orgánica que ha tenido su origen inmediato como consecuencia de un proceso biológico y toda materia vegetal originada por el proceso de fotosíntesis, así como de los procesos metabólicos de los organismos heterótrofos.

6. Energía Eólica: Llámese energía eólica, a la energía que puede obtenerse de las corrientes de viento.

7. Geotérmica: Es la energía que puede obtenerse del calor del subsuelo terrestre.

8. Energía Solar: Llámese energía solar, a la energía transportada por las ondas electromagnéticas provenientes del sol.

9. Fuentes de energías no renovables. Son aquellos recursos que se encuentran en la naturaleza, que requieren para su formación un largo período de tiempo y su disponibilidad es limitada. Su uso requiere **de** la ejecución de diversos procesos para la generación de energía.

10. Fuentes convencionales de energía: Para efectos de la presente ley son fuentes convencionales de energía aquellas utilizadas de forma intensiva y ampliamente comercializadas en el país.

11. Contador Bidireccional: Contador que acumula la diferencia entre los pulsos recibidos por sus entradas de cuenta ascendente y cuenta descendente.

12. Proceso de Cogeneración: Producción combinada de energía eléctrica y energía térmica que hace parte integrante de una actividad productiva.

13.Autogeneración: Aquella actividad realizada por personas naturales o jurídicas que producen energía eléctrica a partir de la y el uso de energías renovables no convencionales, para atender sus propias necesidades y que usan la red pública tanto para obtener energía de respaldo del Sistema Interconectado Nacional como para la venta de sus excedentes.

14. Venta de excedentes de energías renovables no convencionales: Acción que puede ser realizada por cualquier autogenerador o cogenerador de energías renovables no convencionales el cual podrá vender sus excedentes de energía según las normas de mercado especial dispuestas por la Comisión Reguladora de Energía y Gas en cumplimiento de lo dispuesto en la presente Ley.

Artículo 6°. Competencias administrativas. Corresponde al Gobierno Nacional, el ejercicio de las siguientes competencias administrativas con sujeción a lo dispuesto en la presente ley, del siguiente modo:

1. **Ministerio de Minas y Energía**

a) Planificar a nivel nacional, a través de la Unidad de Planeación Minero-Energética (UPME) los mecanismos que harán posible el ahorro y eficiencia energética y el uso de energías renovables en los términos establecidos en la presente ley, en particular, la elaboración y aprobación de los Planes Quinquenales de Ahorro y Eficiencia Energética y los Planes Quinquenales de Energías Renovables.

b) Fijar los objetivos nacionales en materia de ahorro, eficiencia energética y de participación de las energías renovables en el mercado energético nacional, en el marco de lo establecido en la presente ley y de la política y de los compromisos y obligaciones asumidas por Colombia a nivel

interno e internacional en materia de ahorro energético, energías renovables y reducción de emisiones de gases de efecto invernadero;

c) Promover la participación de Colombia a nivel internacional en aquellos foros o grupos de trabajo relacionados con la eficiencia energética y el desarrollo de las fuentes de energías renovables no convencionales;

d) Definir y desarrollar una estrategia internacional para asegurar el suministro de fuentes de energías renovables necesarias para el cumplimiento de los objetivos fijados en la presente ley;

e) Sancionar, en el ámbito de su competencia, la comisión de las infracciones establecidas en la ley, decretos que la reglamenten y otras disposiciones que las desarrollen;

f) Expedir dentro de los seis (6) meses siguientes a la entrada en vigencia de la presente ley, el marco regulatorio a través del cual se defina el régimen económico de la retribución y estímulo a la generación de energía eléctrica a partir de energías renovables no convencionales y cogeneración de las mismas; el esquema en que se llevará a cabo la comercialización de este tipo de energía en el mercado regulado y no regulado nacional; y la incorporación en la regulación de los incentivos fijados para estas actividades; dicho marco regulatorio deberá estar en un todo conforme a lo dispuesto en la presente ley;

g) Regular la organización y funcionamiento del mercado de generación de energía a partir de energías renovables no convencionales y cogeneración de las mismas, con sujeción a lo dispuesto en la presente ley;

h) Regular la organización y funcionamiento de la actividad de comercialización de energías renovables no convencionales, definiendo los modelos contractuales, derechos de los usuarios, niveles de eficiencia, deberes de los prestadores y demás aspectos relevantes, con sujeción a lo dispuesto en la presente ley;

i) Establecer los requisitos regulatorios de calidad y seguridad que han de regir la generación y comercialización de energía eléctrica basada en la explotación de energías renovables no convencionales.

j) Determinar los derechos y obligaciones de los sujetos públicos y/o privados encargados de la generación y comercialización de energía eléctrica basada en la explotación de energías renovables no convencionales en el mercado energético nacional;

k) Inspeccionar con la colaboración de los servicios técnicos de la Corporación Autónoma con jurisdicción en el lugar en donde se ubiquen las instalaciones de generación eléctrica basada en energías renovables no convencionales, las condiciones técnicas, económicas y el cumplimiento de las condiciones establecidas en las autorizaciones otorgadas;

l) Establecer los procedimientos necesarios para asegurar la prioridad en la concesión de la conexión de las instalaciones de generación de energía eléctrica a partir de fuentes de energías renovables no convencionales y de cogeneración o autogeneración frente al resto de instalaciones;

m) Establecer los criterios de prelación entre las distintas tecnologías, dando preferencia a aquellas que supongan una mayor eficiencia energética y económica para el sistema, y valorando la contribución de cada una de ellas al autoabastecimiento energético y su incidencia positiva socio ambiental;

n) Regular que la prioridad en la concesión de las instalaciones de generación de energía eléctrica a partir de fuentes de energías renovables no convencionales, de cogeneración y autogeneración de las mismas quedará condicionada a la garantía de suministro;

o) Regular los procedimientos simplificados para la conexión de pequeñas instalaciones a las redes de distribución;

p) Establecer mecanismos técnico-económicos regulatorios para incentivar la gestión de la demanda, la mejora de la eficiencia energética, el desplazamiento de los consumos en periodos punta y el aplanamiento de la curva de demanda posibilitando así una mayor penetración de la generación de origen renovable no convencional, de su cogeneración y autogeneración;

q) Realizar programas de divulgación masiva acerca de los beneficios y oportunidades que ofrecen las energías renovables;

r) Diseñar guías de información acerca del procedimiento requerido para adquirir abastecimiento energético a través de energías renovables no convencionales;
s) Reglamentar el uso de contadores bidireccionales e incluirlos dentro del sistema de medición de energía que contempla la Resolución número 25 del 13 de julio de 1995;

t) Reglamentar la operación del Sistema Interconectado Nacional incluyendo el modelo energético de generación distribuida a través de energías renovables no convencionales.

2. **Ministerio de Hacienda y Crédito Público**
a) Otorgar subvenciones y otras ayudas para el fomento de investigación y desarrollo en energías renovables y ahorro y eficiencia energética a las universidades públicas y privadas, ONG y fundaciones sin ánimo de lucro que adelanten proyectos en este campo debidamente avalados por Colciencias, según lo establecido en la Ley 29 de 1990 y el Decreto número 393 de 1991;

b) Reglamentar el cumplimiento de los requisitos fijados para el otorgamiento de incentivos, incluidos los fiscales, a la producción, transformación y consumo de energías renovables y cogeneración; así como al ahorro y eficiencia energética conforme a lo dispuesto en la presente ley;

c) Participar conjuntamente con los Ministerios de Minas y Energía y de Medio Ambiente, en la elaboración y aprobación de los Planes Quinquenales de Ahorro y Eficiencia Energética y los Planes Quinquenales de Energías Renovables.

3. **Ministerio de Medio Ambiente**
a) Definir las políticas sectoriales ambientales para el fomento del desarrollo de proyectos de generación de energías renovables no convencionales, cogeneración y autogeneración de las mismas y de impulso a la eficiencia energética a nivel nacional a partir de la utilización de energías renovables no convencionales;

b) Cooperar en la ejecución de proyectos relativos a la ampliación, mejora y adaptación de las redes e instalaciones eléctricas y de hidrocarburos, en procura de contribuir a garantizar una adecuada calidad y seguridad en el suministro de energía, con un mínimo impacto ambiental y de manera económicamente sostenible para lograr las finalidades señaladas en esta ley;

c) Participar conjuntamente con los Ministerios de Minas y Energía y de Hacienda y Crédito Público en la elaboración y aprobación de los Planes Quinquenales de Ahorro y Eficiencia Energética y los Planes Quinquenales de Energías Renovables;

d) Evaluar de manera quinquenal los avances obtenidos por Colombia a partir de la generación y comercialización de energías renovables no convencionales respecto del uso y conservación de sus recursos naturales, menores emisiones de CO_2 y verificación de adopción indicadores de desarrollo sostenible en el servicio de energía;

e) Velar porque en el desarrollo de las actividades de generación y comercialización de energías renovables no convencionales se cumplan los principios generales ambientales establecidos en la Ley 99 de 1993.

4. **Corporaciones Autónomas Regionales**
a) Con independencia de las competencias del Gobierno Nacional, fomentar el desarrollo de proyectos de generación de energías renovables no convencionales, cogeneración de las mismas y de la eficiencia energética en el territorio de su Comunidad;

b) Cooperar en la ejecución de proyectos relativos a la ampliación, mejora y adaptación de las redes e instalaciones eléctricas y de hidrocarburos en el ámbito de su jurisdicción, en procura de contribuir a garantizar una adecuada calidad y seguridad en el suministro de energía, con un mínimo impacto ambiental, económicamente sostenible para lograr las finalidades señaladas en esta ley;

c) Coordinar sus actuaciones con las acciones previstas en el Plan Quinquenal de Ahorro y Eficiencia Energética y en el Plan Quinquenal de Energías Renovables y cooperar con el Gobierno Nacional en aras al cumplimiento de los objetivos señalados en los mismos, informando sobre las acciones adoptadas y logros conseguidos en el ámbito de su jurisdicción.

CAPÍTULO II

Promoción del ahorro y la eficiencia energética a través del uso y aprovechamiento de energías renovables no convencionales

Artículo 7. Promoción del ahorro y la eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales. En desarrollo del Programa de Uso Racional y eficiente de la energía (PROURE) y demás formas de energía no convencionales diseñado por el Ministerio de Minas y Energía, según lo dispuesto en la Ley 697 de 2001 y en cumplimiento de las finalidades y principios establecidos en la presente ley, el Ministerio de Minas y Energía, conjuntamente con los Ministerios de Medio Ambiente y Hacienda y Crédito Público deberán desarrollar una serie de instrumentos técnicos, jurídicos, económico-financieros, de planificación y de información, entre los que deberán contemplarse:

a) Planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales;

b) Incentivos fiscales y/o financieros para la generación y comercialización de las energías renovables no convencionales;

c) Incentivos a la Inversión, investigación y desarrollo de técnicas para la generación y comercialización de las energías renovables no convencionales;

d) Reglamentaciones técnicas;

e) Sistemas de etiquetado e información al consumidor sobre la eficiencia energética de los procesos, instalaciones y productos y sobre el contenido energético de los productos manufacturados;

f) Campañas de información y concientización.

Artículo 8. Objeto y finalidad de los planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales. Los planes de ahorro y eficiencia energética son el instrumento del Gobierno para la promoción del ahorro y la eficiencia energética.

Los planes de ahorro y eficiencia energética serán el instrumento para la concreción de las actuaciones en esta materia, el establecimiento de plazos temporales para la ejecución de las mismas, la atribución de responsabilidades en el ámbito de las Entidades Públicas y la identificación de las diferentes formas de financiación y necesidades presupuestarias.

Artículo 9. Procedimiento de elaboración de los planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales. Los planes de ahorro y eficiencia energética de las fuentes de

generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales se elaborarán con la participación de una Comisión Interministerial presidida por el Ministro de Minas y Energía y/o su delegado y con el concurso del Ministro del Medio Ambiente y/o su delegado, el Ministro de Hacienda y Crédito Público y/o su delegado, el Ministro de Desarrollo y el Ministro de Comercio Exterior y/o su delegado.

Artículo 10 Contenido de los planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales. Como mínimo los Planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales deberán desarrollar el siguiente contenido:

1. Los planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales responderán a una estructura sectorial que permita fijar objetivos separados para los diferentes sectores o consumidores finales y, de manera particular, para el sector generador de la energía, y contendrán una relación de medidas e instrumentos para su ejecución en cada uno de los sectores identificados. Dichos planes establecerán programas de renovación de equipos por otros de alto rendimiento energético, que se llevarán a cabo de manera periódica en todos los sectores consumidores finales, definiendo el alcance de los mismos y atribuyendo las responsabilidades y competencias para su puesta en marcha a los Departamentos u organismos correspondientes del Gobierno Nacional.

2. Los planes de ahorro y eficiencia energética podrán contemplar, como mecanismo de apoyo necesario para el cumplimiento de los objetivos propuestos, la suscripción de acuerdos voluntarios con los diferentes agentes intervinientes en el mercado energético. Estos acuerdos deberán incorporar compromisos medibles, verificables y vinculantes en materia de puesta en marcha de medidas de mejora de la eficiencia energética y estarán sujetos a requisitos de control e información por parte de los organismos de control. Para garantizar la transparencia, los acuerdos voluntarios se pondrán a disposición del público y se publicarán antes de su aplicación, en la medida en que lo permitan las disposiciones relativas a la confidencialidad.

Artículo 11.Financiación de los planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales. Los planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y aprovechamiento de las energías renovables no convencionales se dotarán adecuadamente de los medios financieros necesarios para la consecución de los objetivos aprobados, ya sea con cargo a impuestos, a asignación de partidas dentro de los presupuestos públicos y/o a través de mecanismos fiscales que permitan estimular las actividades de generación, cogeneración y autogeneración de las energías renovables no convencionales, sin exclusión de otros posibles mecanismos de financiación.

El Gobierno se asegurará, en todo caso, de que la financiación aprobada para los planes de ahorro y eficiencia energética de las fuentes de generación de energía a través del uso y

aprovechamiento de las energías renovables no convencionales sea adecuada y suficiente para alcanzar los objetivos concretos contenidos en los planes de ahorro energético previstos en esta ley.

Para la financiación de los programas de apoyo a la cogeneración y autogeneración, y sin perjuicio de que se articulen otros mecanismos que faciliten la rápida adopción de tecnologías eficientes y, en especial, de la cogeneración de alta eficiencia, se estará a lo dispuesto en relación con el régimen retributivo de la producción de energía eléctrica en régimen especial.

CAPÍTULO III

Promoción de las energías renovables no convencionales

Artículo 12. Instrumentos para la promoción de las energías renovables. Incentivo tributario. Como fomento a la investigación, desarrollo e inversión en el ámbito de la generación y comercialización de energías renovables no convencionales, el ahorro y la eficiencia energética, los obligados a declarar renta que realicen directamente inversiones en este sentido, tendrán derecho a reducir anualmente de su renta, por los 5 años siguientes al año gravable en que hayan realizado la inversión, el cincuenta por ciento (50%) del valor total de la inversión realizada.

El valor a deducir por este concepto, en ningún caso podrá ser superior al 50% de la renta líquida del contribuyente determinada antes de restar el valor de la inversión.

Para los efectos de la obtención del presente beneficio tributario, la inversión causante del mismo deberá ser debidamente certificada como tal por el Ministerio de Medio Ambiente.

Artículo 13. Instrumentos para la promoción de las energías renovables. Incentivo arancelario. Las personas naturales o jurídicas que a partir de la vigencia de la presente ley sean titulares de nuevas inversiones en nuevos proyectos de instalación de centrales para la generación de energía eléctrica, utilizando para ello fuentes renovables de energía gozarán de exención del pago de los Derechos Arancelarios de Importación de maquinaria, equipos, materiales e insumos destinados exclusivamente para labores de preinversión y de inversión en la construcción de las obras de las centrales para la generación de energía eléctrica. Este beneficio arancelario será aplicable y recaerá sobre maquinaria, equipos, materiales e insumos que no sean producidos por la industria nacional y su único medio de adquisición esté sujeto a la importación de los mismos.

La exención del pago de los Derechos Arancelarios a que se refiere el inciso anterior se aplicará a proyectos de generación de energía eléctrica con fuentes no convencionales y deberá ser solicitada a la DIAN en un mínimo de 15 días hábiles antes de la importación de la maquinaria, equipos, materiales e insumos necesarios y destinados exclusivamente a desarrollar los proyectos de energías renovables, de conformidad con la documentación del proyecto avalada

en la certificación emitida por el Ministerio de Minas y Energía o la entidad que este faculte para este fin.

Artículo 14. Instrumentos para la promoción de las energías renovables. Incentivo arancelario. Incentivo contable, depreciación acelerada de activos. La actividad de generación de energía eléctrica a base de recursos renovables no convencionales, gozará del régimen de depreciación acelerada.

La depreciación acelerada será aplicable a las maquinarias, equipos y obras civiles necesarias para la instalación y operación de la generación de energía renovable no convencional, que sean adquiridos y/o construidos, exclusivamente para ese fin, a partir de la vigencia de la presente ley. Para estos efectos, la tasa anual de depreciación será no mayor de veinte por ciento (20%) como tasa global anual. La tasa podrá ser variada anualmente por el titular de generación, previa comunicación a la DIAN, sin exceder el límite señalado en este artículo, excepto en los casos en que la ley autorice porcentajes globales mayores.

Artículo 15. ***Instrumentos para la promoción de las energías renovables. Régimen de Precios garantizados***. Todos aquellos usuarios regulados y no regulados que estén en capacidad de Cogenerar o Autogenerar a través de la explotación de fuentes no convencionales de energía FNCE y cumplan con los requisitos estipulados en esta ley, podrán comercializar la energía excedente de su producción a través de un mercado especial de energía, complementario al mercado existente, en el cual concurrirán los generadores y comercializadores públicos privados y mixtos para la evacuación de energía eléctrica de forma preferente y en condiciones especiales que permitan la comercialización, garantizando la libre competencia de la energía generada con fuentes no convencionales, estableciendo como mínimo que el 1% de la energía transada por los agentes que concurren al mercado sea generada con fuentes no convencionales de energía, estableciendo como meta global para el 2020 un incremento en la participación de las FNCE en la canasta energética total del 1% en energía eléctrica del país.

Parágrafo: La Comisión de Regulación de Energía y Gas CREG deberá reglamentar lo dispuesto en el presente artículo, máximo dentro los seis (6) meses siguientes a la expedición de la presente ley de acuerdo a lo previsto en el artículo 21 de la ley 143 de 1993.

CAPÍTULO IV

Del desarrollo de las energías renovables no convencionales

Artículo 16. Desarrollo de la energía procedente de biomasa forestal.

1. Las zonas de selvicultura que cuenten con proyecto de ordenación, o instrumentos de gestión forestal equivalentes y las incluidas en el ámbito del Plan Nacional de Desarrollo Forestal (PNDF)

deberán incluir entre sus instrucciones o contenidos la utilización de todos los subproductos y residuos obtenidos en los aprovechamientos o tratamientos de las masas forestales, no admitiéndose la posibilidad de su abandono en éstas zonas.

2. En el caso de no existir instrumentos de gestión forestal o (PNDF) que recoja lo indicado en el punto anterior, los planes de aprovechamiento y los tratamientos silvícolas deberán incluir entre sus instrucciones o condiciones la utilización de todos los subproductos y residuos obtenidos en los aprovechamientos o tratamientos.

3. Se incluirán entre las actividades con acceso preferente a incentivos, la realización de planes plurianuales de aprovechamientos o tratamientos que incorporen la aplicación energética de los productos, subproductos o residuos. Estos planes se definirán de acuerdo a los periodos necesarios para realizar una selvicultura y aprovechamiento energético adecuados que desarrolle una estructura productiva y garantizar el suministro de biomasa a los potenciales usuarios durante un periodo de tiempo idóneo para el desarrollo de proyectos energéticos.

4. El gobierno, en coordinación con las Corporaciones Autónomas, dictará las disposiciones necesarias para establecer un mecanismo de fomento para la realización de planes plurianuales de aprovechamientos o tratamientos que incorporen la aplicación energética de los subproductos o residuos.

Artículo 17. Repoblaciones forestales energéticas.

1. Tendrán la consideración de repoblaciones forestales energéticas aquellas en las que se establezcan marcos de plantación o siembra y se realice una selvicultura orientados a maximizar el rendimiento en peso y a favorecer la corta, extracción y procesado económico. El destino de los productos maderables y leñosos deberá ser única y exclusivamente energético.

2. El Gobierno, en coordinación con las Corporaciones Autónomas, dictará las disposiciones necesarias para establecer instrumentos de fomento de la realización de repoblaciones forestales energéticas, según las cuales para determinadas especies, características de la temporada climática y otros factores, las repoblaciones forestales serán energéticas.

3. El Gobierno en coordinación con las Corporaciones Autónomas dictará las disposiciones necesarias para establecer instrumentos de fomento de repoblaciones forestales energéticas.

Artículo 18. Biomasa Agrícola. El Gobierno, en coordinación con las Corporaciones Autónomas, establecerá planes de actuación con el fin de fomentar la valorización energética de biomasa agrícola y evitar el abandono, la quema incontrolada en la explotación o el vertido de los residuos agrícolas.

Artículo 19. Energía de Residuos.

1. Será considerado fuente renovable el contenido energético de la fracción biodegradable, tanto de los residuos, como de los combustibles recuperados.

2. Se considera como fracción combustible de los residuos aquella que se oxide sin aporte de energía una vez que el proceso de combustión se ha iniciado.

3. El Gobierno, en colaboración con las Corporaciones Autónomas, fijará objetivos de reutilización, reciclado y valorización energética para algunas tipologías concretas de residuo de interés energético a partir de determinados umbrales de generación. Para ello, establecerá reglamentariamente un mecanismo que indicará los sujetos obligados e incluirá un sistema que permita la supervisión y certificación y un régimen de pagos compensatorios.

4. Se faculta al Ministerio de Minas y Energía para reglamentar normas técnicas que definan los parámetros de calidad que han de cumplir los combustibles sólidos recuperados obtenidos a partir de diferentes residuos. Además, El Ministerio de Ambiente, Vivienda y Desarrollo Territorial en conjunción con el Ministerio de Agricultura y Desarrollo Rural, podrá determinar que los combustibles sólidos recuperados que alcancen los parámetros que en dichas normas se consideren necesarios, salgan del ámbito de aplicación de la normativa sobre residuos. Dichas normas técnicas, teniendo en cuenta las directrices comunitarias, incluirán, entre otros aspectos, categorías, calidades y ámbitos de aplicabilidad así como un sistema que permita la supervisión y control.

Artículo 20. Desarrollo del sector de la Energía Solar.

1. La energía solar se considerará como fuente de energía no convencional.
2. El Gobierno Nacional a través del Ministerio de Minas y Energía fomentará el uso de las instalaciones de aprovechamiento del recurso solar en los proyectos de urbanización municipal y/o distrital, en las edificaciones institucionales y/o gubernamentales nacionales departamentales, distritales y municipales y en la industria.
3. El Ministerio de Minas y Energía directamente o a través de la entidad que designe para este fin determinará las condiciones de competencia de este tipo de energía en el mercado energético colombiano; establecerá los condicionamientos técnicos y de calidad a cumplir por las instalaciones que utilicen la energía solar como fuente de generación.
4. El Gobierno Nacional, por intermedio del Ministerio de Ambiente, Vivienda y Desarrollo Territorial Unidad, determinará los parámetros ambientales que deberán cumplir los proyectos desarrollados con la utilización de dicha fuente renovable no convencional, así como la mitigación de los impactos ambientales que puedan presentarse en su implementación.

Artículo 21. Desarrollo de la energía eólica.

1. La energía eólica se considerará como fuente de energía no convencional.

2. El Gobierno Nacional a través del Ministerio de Minas y Energía fomentará el uso de las instalaciones de aprovechamiento del recurso eólico en proyectos de generación en zonas aisladas o interconectadas al sistema interconectado nacional.
3. El Ministerio de Minas y Energía, directamente o a través de la entidad que designe para este fin, determinará las condiciones de competencia de este tipo de energía en el mercado energético colombiano; establecerá los condicionamientos técnicos y de calidad a cumplir por las instalaciones que utilicen el recurso como fuente de generación.
4. El Gobierno Nacional, por intermedio del Ministerio de Ambiente, Vivienda y Desarrollo Territorial Unidad, determinará los parámetros ambientales que deberán cumplir los proyectos desarrollados con la utilización de dicha fuente renovable no convencional, así como la mitigación de los impactos ambientales que puedan presentarse en la implementación.

Artículo 22. Evaluación del potencial de la geotermia. El Gobierno pondrá en marcha instrumentos para fomentar e incentivar los trabajos de exploración e investigación del subsuelo para el conocimiento del recurso geotérmico y fomentar su aprovechamiento de alta, baja y muy baja temperatura.

CAPÍTULO V

Promoción y protección de las energías renovables no convencionales

Artículo 23. Medidas de promoción del sector de la Energía Solar. El Gobierno Nacional a través del Ministerio de Minas y Energía fomentará el uso de instalaciones con el aprovechamiento del recurso solar en los proyectos municipal y/o distrital, en las edificaciones institucionales y/o gubernamentales nacionales departamentales, distritales y municipales y en la industria.

El Gobierno Nacional incentivará el uso de la generación fotovoltaica como esquema de respaldo de energía avalando la cogeneración y la autogeneración con fuentes renovables no convencionales.

Con el apoyo del Ministerio de Hacienda y Crédito Público otorgarán los incentivos arancelarios, contables y tributarios de tal forma que se viabilice la inversión y la participación en el desarrollo de estos proyectos.

El Gobierno Nacional determinará el esquema de comercialización y tarifas, y sus condiciones de despacho en el mercado energético colombiano, así como los aspectos relacionados con la conexión al Sistema Interconectado Nacional.

El Gobierno Nacional determinará el esquema de medición para todas aquellas edificaciones oficiales y/o privadas, industrias, comercios y residencias que utilicen o muestren interés en la utilización de fuentes de generación fotovoltaica. El esquema de medición contemplará la posibilidad de la medición en doble vía, de forma que se habilite un esquema de cogeneración para dichas instalaciones.

Artículo 24. Evaluación del potencial de la geotermia. El Gobierno pondrá en marcha instrumentos para fomentar e incentivar los trabajos de exploración e investigación del subsuelo para el conocimiento del recurso geotérmico y fomentar su aprovechamiento de alta, baja y muy baja temperatura.

Artículo 25. Cooperación Internacional en Materia de Energías Renovables No Convencionales.

1. En la puesta en marcha de acciones de cooperación internacional tendrán ámbito preferencial las encaminadas a:

a) El desarrollo conjunto entre países limítrofes de proyectos de generación y comercialización de energías renovables no convencionales;
b) Impulsar la transferencia de tecnología;
c) Cooperación en materia de investigación, desarrollo e innovación.

2. Adicionalmente, en este contexto, y dentro de la política energética de abastecimiento energético, el posterior desarrollo de esta ley deberá sentar las bases para disponer de una estrategia nacional de generación de energías renovables no convencionales con el objeto de optimizar las fuentes, tanto nacionales como internacionales, de las materias primas más apropiadas, con criterios de sostenibilidad y eficiencia, contribuyendo así de una manera significativa a los objetivos nacionales de participación de las energías renovables no convencionales en el consumo energético contemplados en esta ley.

3. El Gobierno fomentará la internacionalización de la actividad de las empresas colombianas del sector de las energías renovables no convencionales.En ese esfuerzo se enmarcará la elaboración de programas de acción específicos que prestarán especial atención a los aspectos relativos a la transferencia de tecnología y al acceso a las materias primas y medios de producción precisos para el desarrollo del sector nacional de las energías renovables no convencionales.

4. Asimismo, el Gobierno fomentará la cooperación internacional en el ámbito de las energías renovables no convencionales, en especial en lo relativo a la participación de los sectores público y privado en el desarrollo de los Mecanismos de Desarrollo Limpio y Mecanismos de Aplicación Conjunta establecidos en el Protocolo de Kyoto.

Artículo 26: – Fondo de Energías Renovables y Eficiencia Energética para financiar programas de energías renovables y eficiencia energética en las islas de San Andrés, Providencia y Santa Catalina - FERES. Créase el Fondo de Eficiencia Energética para financiar programas de energías renovables y eficiencia energética para los usuarios de menores recursos. Los recursos que nutran este fondo podrán ser aportados por la Nación, el departamento de San Andrés, Providencia y Santa Catalina, así como organismos de carácter multilateral e internacional. Dicho Fondo será reglamentado por el Ministerio de Minas y Energía y administrado por la Fiduciaria La Previsora S.A.

Parágrafo 1. Con los recursos del Fondo de Energías Renovables y Eficiencia Energética se

podrán financiar programas y proyectos para la implementación de energías renovables, así como para la mejora de eficiencia energética mediante la sustitución de electrodomésticos y artefactos de uso residencial.

Igualmente estudios, auditorias energéticas, adecuaciones locativas, disposición final de equipos sustituidos y costos de administración e interventoría de los programas y/o proyectos.

CAPÍTULO VI

Integración de la generación, cogeneración y autogeneración de energías renovables no convencionales al Sistema Interconectado Nacional

Artículo 27. Generación de energía eléctrica a partir de energías renovables no convencionales.

1. La generación de energía eléctrica a partir de fuentes de energías renovables no convencionales o de cogeneración o autogeneración podrá realizarse en instalaciones aisladas o conectadas al sistema eléctrico nacional.
2. La actividad de generación de energía eléctrica en instalaciones conectadas al sistema eléctrico, a partir de fuentes de energía renovable no convencional o de cogeneración o autogeneración, tendrá la consideración de generación en régimen especial, así reglamentado por el Ministerio de Minas y Energía y la Comisión de Regulación de Energía y Gas.

CAPÍTULO VII

Obligaciones y derechos de los productores de energía eléctrica a partir de fuentes de energía renovable no convencionales y de la cogeneración y autogeneración de las mismas

Artículo 28. Obligaciones y derechos de los productores de energía eléctrica a partir de fuentes de energías renovables no convencionales y de la cogeneración y autogeneración de las mismas.
1. Las obligaciones y derechos de los productores de energía eléctrica a partir de fuentes de energías renovables no convencionales y de la cogeneración y autogeneración de las mismas para las instalaciones conectadas al sistema eléctrico serán los establecidos en la Ley 142 de 1994.

2. Serán obligaciones de los productores de energía eléctrica a partir de fuentes de energía renovables y de cogeneración, para las instalaciones aisladas:
a) El desarrollo de todas aquellas actividades necesarias para producir energía eléctrica para su propio consumo y, en especial, en lo que se refiere a seguridad y al cumplimiento de las condiciones medioambientales exigibles;
b) Estar dotados de los equipos de medida que permitan determinar la energía producida por la instalación, en los términos que reglamentariamente se establezcan;
c) La remisión a la Administración de la información acerca de su producción, en los términos que reglamentariamente se establezcan;

d) Todas aquellas que puedan derivarse de la aplicación de la presente ley y sus normas de desarrollo.

3. Los productores de energía eléctrica a partir de fuentes de energía renovables y de cogeneración, para las instalaciones aisladas, gozarán de las ayudas o incentivos fiscales que reglamentariamente se establezcan.

CAPITULO VIII

Acciones ejemplares del gobierno y la Administración Pública

Artículo 29. Acciones ejemplares. El Gobierno Nacional y el resto de administraciones públicas, en el ámbito de sus respectivas competencias, adoptarán acciones ejemplares tendientes a la supresión de barreras técnicas, administrativas y de mercado para el desarrollo de las energías renovables y la promoción del ahorro y eficiencia energética. En particular, las medidas tendrán por objeto la consecución del ahorro de energía y la introducción de energías renovables en los distintos sectores, el establecimiento de requisitos mínimos de eficiencia para los equipos que consumen energía, la concienciación de los consumidores de energía para un comportamiento racional y eficiente, la mejora de la eficiencia en la producción, el transporte y la distribución de calor y de electricidad, así como el desarrollo de tecnologías energéticas y para la eficiencia energética de los edificios. Para ello, se prestará especial atención a la formación del personal al servicio de las Administraciones públicas, especialmente en el ámbito local y regional, donde se encuentran los órganos competentes para la tramitación y autorización de instalaciones.

Artículo 30. Buenas prácticas. El Ministerio de Minas y Energía, con la colaboración de otros Ministerios y de las Entidades Territoriales, posibilitará y facilitará un intercambio de buenas prácticas entre los organismos del sector público, especialmente, sobre prácticas de contratación pública eficientes energéticamente, y pondrá a disposición de todas las administraciones las experiencias de que tenga conocimiento sobre buenas prácticas a nivel internacional.

Artículo 31. Planes de ahorro y eficiencia energética. El Gobierno Nacional, y el resto de administraciones públicas, en el ámbito de sus respectivas competencias adoptarán planes de ahorro y eficiencia energética, así como de uso de fuentes renovables. Las administraciones públicas, en sus ámbitos territoriales, adoptarán planes de ahorro y eficiencia energética y de utilización de fuentes de energía renovables para los edificios y equipos consumidores de energía de titularidad pública con análogos objetivos al del Gobierno Nacional.

Artículo 32. Edificios pertenecientes a las administraciones públicas. Se establece un objetivo de ahorro energético mínimo global para todos los edificios de las administraciones públicas del 9% en el 2016, a conseguir mediante medidas de gestión energética. Este objetivo se incrementará hasta un 20% en 2020 y hasta un 40% en 2024, mediante medidas de ahorro y eficiencia energética a realizar dentro de los procesos de mantenimiento y rehabilitación habituales en cada edificio, en función de su viabilidad técnica.

Artículo 33. Edificios de gestión pública. Las administraciones públicas harán extensivos los criterios referidos en los artículos anteriores sobre exigencias de eficiencia energética y energías renovables en instalaciones y edificios de titularidad pública a aquellas instalaciones o edificios de gestión pública, aun cuando la titularidad sea privada.

CAPÍTULO IX

Ciencia y tecnología

Artículo 34. Fomento de la investigación en el ámbito de las energías renovables y el ahorro y la eficiencia energética.

1. Las administraciones públicas, cada una en el ámbito de sus competencias fomentarán las actividades de investigación científica, desarrollo tecnológico e innovación de interés en el campo de las energías renovables y del ahorro y la eficiencia energética potenciando el desarrollo e innovación industrial y la colaboración entre los diferentes agentes del Sistema Nacional de Ciencia, Tecnología e Innovación (SNCTI).

2. El fomento al que hace referencia el apartado anterior, se llevará a cabo dentro del marco de referencia que constituyan los sucesivos Planes Nacionales de Desarrollo. Las Corporaciones Autónomas y entes locales, en el ámbito de sus respectivas competencias, podrán adoptar medidas de fomento de la innovación que, en el caso de estar relacionadas con la energía, deberán incluir objetivos relacionados con el ahorro y la eficiencia energética y las energías renovables. Asimismo, los planes de fomento de la investigación, desarrollo e inversión elaborados por el Gobierno Nacional o de innovación elaborados por el resto de administraciones públicas, cuando afecten al ámbito de las energías renovables o al del ahorro o eficiencia energética, deberán inscribirse dentro de los marcos vinculantes sobre política energética que se establezcan en planes o programas nacionales.

3. Los planes de fomento a los que hace referencia el apartado anterior, establecerán las medidas concretas que serán de aplicación para la incentivación y apoyo del ahorro y la eficiencia energética y de las energías renovables y los indicadores adecuados para su seguimiento.

4. Los sistemas de fomento de la investigación, desarrollo e inversión en el campo de las energías renovables no convencionales o del ahorro o la eficiencia energética deberán orientarse a:
a) Potenciar la investigación, desarrollo e inversión en áreas clave para conseguir una alta penetración de tecnologías eficientes y limpias, y el empleo de recursos de origen renovable a medio y largo plazo;
b) Facilitar y maximizar la penetración de energías renovables en el sistema energético nacional, particularmente en lo que respecta a su contribución a la seguridad del suministro y estabilidad del sistema;
c) Impulsar la implantación comercial de tecnologías que se encuentran en fase de demostración y/o comercial;

d) Explorar el potencial a medio y largo plazo de tecnologías limpias que se encuentran en fases poco avanzadas de investigación y/o desarrollo;
e) Reducir los costes asociados a la utilización de las fuentes de energía renovables no convencionales más acordes con el potencial natural del país. Para ello, estos sistemas de fomento deberán establecer líneas prioritarias de acción en tecnologías o campos concretos.

5. Las medidas concretas para el fomento de la investigación, desarrollo e inversión en el ámbito de las energías renovables no convencionales y el ahorro y la eficiencia energética podrán ser de carácter económico-financiero, fiscal o tributario, así como de impulso a la cooperación y colaboración entre los agentes del SNCTI. En el caso de las medidas de carácter económico-financiero, los mecanismos de apoyo modelarán las fuentes de financiación que se estimen necesarias para la consecución de los objetivos marcados, diferenciando entre fondos públicos y fondos privados.

6. Las medidas concretas a las que se refiere el apartado anterior, cuando estas sean aprobadas por una Administración Pública, se seleccionarán de entre aquellas alternativas más eficientes en la relación objetivo a conseguir/recursos empleados.

7. Los Planes Nacionales de Desarrollo, en lo que se refiere a energías renovables no convencionales y ahorro y eficiencia energética deberán tener en cuenta los resultados y la experiencia adquirida en planes anteriores, tomando como referencia, entre otros, los indicadores de seguimiento mencionados en el apartado 4, motivando razonadamente la elección de objetivos, prioridades y medidas.

8. En cualquier caso, la política de investigación, desarrollo e inversión en el ámbito de las energías renovables no convencionales y el ahorro y la eficiencia energética, cuando sea llevada a cabo por alguna Administración Pública, deberá inspirarse e integrar las orientaciones que se deriven de la política energética mundial, y más concretamente en lo que se refiere a desarrollo de tecnologías energéticas.

CAPÍTULO X

Evaluación del impacto energético de planes y programas

Artículo 35. Evaluación del impacto energético de planes y programas.

1. Los planes o programas elaborados por el Gobierno Nacional que deban ser sometidos a una evaluación ambiental estratégica, antes de su aprobación, deberán someterse igualmente a una evaluación de impacto energético que realice una correcta ponderación de los impactos energéticos y socioeconómicos asociados. Dicha evaluación incluirá la identificación, descripción y evaluación de sus implicaciones energéticas y socioeconómicas.

2. La evaluación del impacto energético contendrá, como mínimo, la siguiente información:

a) Implicaciones sobre la generación, transformación y consumo de energía y sobre la estructura energética nacional;
b) Su contribución al uso más racional de los recursos naturales existentes;
c) Impactos sobre la calidad y seguridad de suministro energético;
d) Su contribución a la generación de empleo y al desarrollo industrial y tecnológico, así como en las actividades económicas generales;
e) Análisis de alternativas energéticas.

3. En los planes o programas a aprobar por el Gobierno Nacional a que se refiere el apartado 1, el Ministerio de Minas y Energía realizará la evaluación del impacto energético a que se refiere el apartado anterior siguiendo el proceso que se determine reglamentariamente.

CAPÍTULO XI

Otras consideraciones relacionadas con aspectos medioambientales

Artículo 36. Armonización de requisitos ambientales para el desarrollo de las energías renovables no convencionales.

1. Se deberá elaborar un procedimiento para la realización de los estudios de impacto ambiental y de impacto energético de las instalaciones a partir de fuentes de energía renovables no convencionales, para su aplicación a aquellas sometidas a autorización por parte del Gobierno Nacional.

2. El procedimiento al que se refiere el apartado 1 diferenciará entre distintas tipologías de instalaciones, definiendo las características generales que deben cumplir cada una de ellas.

Artículo 37. Emisiones y vertidos de las instalaciones de energías renovables no convencionales. Los límites de emisiones o vertidos establecidos para las instalaciones de energías renovables no convencionales, en ningún caso podrán ser más rigurosos que los límites establecidos en el caso menos exigente aplicado a combustibles convencionales.

En particular, el Gobierno Nacional desarrollará una normativa específica que regule las emisiones y los vertidos de las instalaciones que utilicen recursos renovables de acuerdo a sus características específicas.

Artículo 38. Seguimiento estadístico y evaluación conjunta del cumplimiento de los objetivos.

1. Para el adecuado seguimiento y evaluación del cumplimiento de los objetivos de la presente ley, además de los informes periódicos de seguimiento de los diferentes planes y programas, cada cuatro años se realizará una evaluación de:
a) Los planes y programas de ahorro y eficiencia energética;
b) El Plan de Energías Renovables;
c) Los escenarios de evolución del escenario energético general;

d) La planificación de redes de transporte de electricidad y gas natural.

2. Las evaluaciones tendrán en cuenta las posibles desviaciones de la trayectoria prevista, el desarrollo de las distintas tecnologías de aprovechamiento de las energías renovables, así como la evolución del marco socioeconómico experimentada y previsible, e incorporará las medidas apropiadas para el cumplimiento de los objetivos globales del Plan y para una utilización eficiente de las distintas tecnologías y de los instrumentos para la promoción de las energías renovables.

3. El Gobierno Nacional, asegurará y articulará los mecanismos de colaboración necesarios con entidades públicas y privadas, para la captación y provisión de la información estadística requerida.

4. El Gobierno Nacional, a través de los Ministerios y los organismos responsables de la elaboración de estadísticas de consumo de energía por fuentes y sectores, garantizará la calidad de las mismas.

Artículo 39. Vigencia. La presente ley rige a partir de la fecha de su promulgación y deroga todas las disposiciones que le sean contrarias.

EN LOS ANTERIORES TERMINOS FUE APROBADO EN PRIMER DEBATE EL PROYECTO DE LEY NUMERO 278 DE 2013 SENADO – 096 DE 2012 CÀMARA "POR MEDIO DE LA CUAL SE REGULA LA INTEGRACIÒN DE LAS ENERGIAS RENOVABLES NO CONVENCIONALES AL SISTEMA ENERGÈTICO NACIONAL", EN SESIÓN DEL MIERCOLES TRECE (13) DE NOVIEMBRE DE DOS MIL TRECE (2013)

Ponente,

José David Name Cardozo
Senador Ponente.

Maritza Martínez Aristizabal
Presidenta Comisión Quinta

Delcy Hoyos Abad
Secretaria General

DIAGNÓSTICO DEL SISTEMA INTERCONECTADO NACIONAL

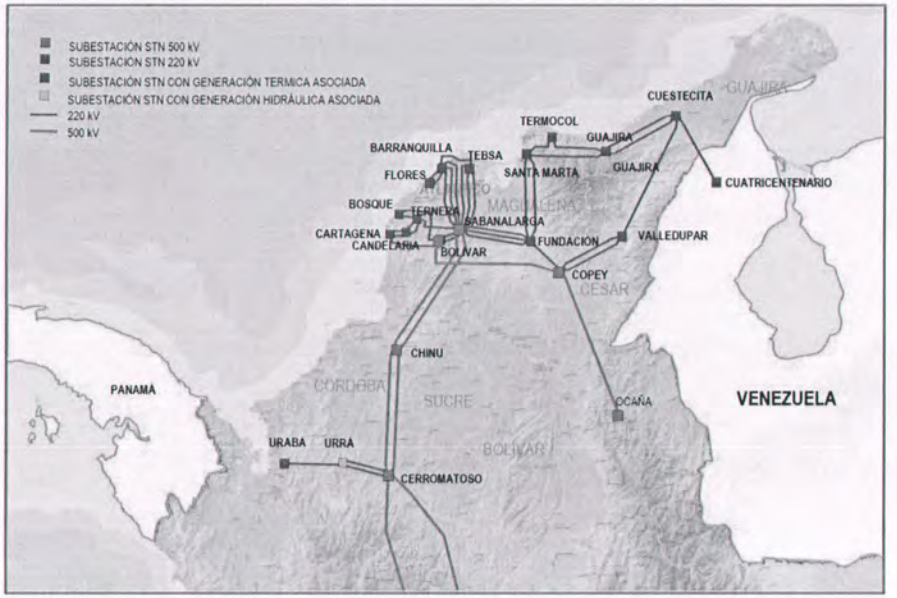
INTRODUCCIÓN

La unidad con el fin de dar cumplimiento a lo establecido por la resolución CREG 024 de 2013; la cual en su artículo 7, estableció:

"Artículo 7. Necesidades de expansión identificadas por la UPME. *Cuando en el Plan de Expansión del SIN se identifiquen necesidades de expansión en los STR, los OR del área de influencia deberán proponer un proyecto que sirva de solución a la necesidad e incluirlo dentro de su respectivo plan de expansión que entregará a la UPME al año siguiente, teniendo en cuenta lo establecido en el artículo 3.*
Si los OR no incluyen tales proyectos dentro de su plan de expansión, la UPME definirá el proyecto a ejecutar y lo incluirá en el Plan de Expansión del SIN. Los OR del área de influencia que no presentaron proyectos que atendieran las necesidades identificadas no podrán manifestar interés en ejecutar el proyecto que definió la UPME ni participar en los posibles Procesos de Selección para su ejecución en caso de que se tenga que recurrir a ellos".

A continuación se presenta para cada una de las áreas operativas las necesidades identificadas, con el fin de que hagan parte de estudio por cada uno de los OR's y puedan presentar a la Unidad las obras necesarias para la solución de las diferentes problemáticas presentadas en este documento.

ÁREA CARIBE - ATLÁNTICO



Problemáticas identificadas

El área presenta diferentes situaciones relacionadas en su mayoría con agotamiento de red a nivel de 110 kV y de la capacidad de transformación, las cuales se presentan a continuación:

- **Agotamiento en la capacidad de transformación 220/110 kV en Tebsa y Termoflores;** se observan sobrecargas ante condiciones de falla de uno de los transformadores de Tebsa y de Flores 220/110 kV para condiciones de mínimo despacho de generación en el área; por lo cual se ve la necesidad de tener generación de seguridad a nivel del STR, des-optimizando el despacho económico y posibilitando

desatención de demanda. Actualmente se tiene definido el proyecto Caracolí 220 kV y obras asociadas con fecha de entrada para el año 2015, que mitiga gran parte de esta problemática.

También se está presentando agotamiento de la capacidad del transformador de Sabanalarga 220/110 kV con posible desatención de demanda ante contingencia de este. El OR presentó la alternativa del segundo transformador en Sabanalarga con fecha de entrada 2014, para solucionar esta situación.

Agotamiento en la red de 110 kV de Atlántico; El agotamiento de la red del STR puede ocasionar desatención de demanda y despacho de generación fuera de mérito. Actualmente debe mantenerse generación de seguridad en el área para preservar el sistema ante contingencias sencillas. La UPME definió el proyecto Caracolí 220/110 kV con entrada en operación para el año 2015, que alivia en gran parte esta situación.

Niveles de corto circuito a nivel de valores de diseño en las subestaciones Tebsa y Termoflores 110 kV; Se presenta un aumento en el nivel de corto circuito, cercano a los límites de diseño, para las subestaciones Tebsa y Termoflores 110 kV. Con respecto a la subestación Termoflores se planteó por parte del OR, el seccionamiento de la barra de 110 kV para disminuir estos niveles.

Con respecto a la subestación Tebsa 110 kV, se recomienda verificar la posible reubicación de las máquinas de Termobarranquilla en la barra de 220 kV de TEBSA.

ÁREA CARIBE - BOLÍVAR

Problemáticas identificadas

Las situaciones observadas de esta área están relacionadas con el agotamiento de la red a nivel de 66 kV y de la capacidad de los transformadores de conexión, las mismas se presentan a continuación:

- **Agotamiento en la capacidad de transformación 220/66 kV y de la red a 66 kV;** Esta deficiencia puede producir desatención de la demanda y des-optimización del despacho económico en Bolívar; el OR planteó, la construcción del segundo transformador en la subestación Bosque 220/66 kV para el año 2015, un nuevo punto de inyección a 66 kV en la subestación Bolívar 220 kV para el año 2015 y el aumento de la capacidad de transformación en Ternera 220/66 kV pasando de 200 MVA a 300 MVA para septiembre de 2013. Sin embargo se observa un agotamiento progresivo de la red de 66 kV del STR, para lo cual la Unidad recomienda que se evalúe el cambio de nivel de tensión de 66 kV a 110 kV en el corto plazo.

- **Bajas tensiones;** se presentan bajas tensiones en la subestación El Carmen 110 kV y Zambrano 66 kV, que puede ocasionar desatención de demanda en el área. El OR planteó la necesidad de instalar nueva compensación capacitiva en la subestación el Carmen con fecha de entrada para el año 2014.

ÁREA CARIBE – CORDOBA – SUCRE

Problemáticas identificadas

Las diferentes situaciones observadas se presentan como consecuencia del agotamiento de la capacidad de transformación y bajas tensiones en los nodos del área, las cuales se presentan a continuación:

- **Agotamiento de capacidad de transformación;** Ante condiciones de falla de uno de los transformadores 500/110 kV de la subestación Chinú, se observa sobrecargas en el transformador que queda en servicio y posible desatención de la demanda existente y limitación en la atención de nuevas cargas. Para solucionar esta problemática se definió un tercer transformador en Chinú 500/110 kV que entraría en operación a finales del año 2013, adicional al nuevo proyecto línea Chinú – Montería – Urabá 220 kV y obras asociadas, con fecha de entrada en operación para el año 2015.

- **Bajas tensiones;** Se observan bajas tensiones en las subestaciones Montería y Rio Sinú 110 kV en condición normal de operación y ante contingencia, que puede producir desatención de la demanda existente y limitación en la conexión de nuevos usuarios. Para solucionar esta problemática se definió el proyecto línea Chinú – Montería – Urabá 220 kV y obras asociadas, con año de entrada 2015. Adicional a esto se tiene previsto la instalación de una compensación capacitiva en la subestación Montería 110 kV, solicitada por el OR, para entrar en operación en el año 2015.

ÁREA CARIBE – CERROMATOSO

Problemáticas identificadas

Las situaciones observadas, son consecuencia del agotamiento de la capacidad de la transformación, las cuales se presentan a continuación:

- **Agotamiento de la capacidad de transformación;** Ante condiciones de falla de uno de los transformadores 500/110 kV en la subestación Cerromatoso, se observa sobrecarga en los otros transformadores que quedan en servicio, lo que puede llevar a producir desatención de demanda y limitación para atender nuevas cargas. Además de la necesidad de generación de seguridad al interior de la Sub-área, para solucionar esta problemática, se definió un tercer transformador 500/110 kV en la subestación Cerromatoso, que entraría en operación en el año 2014.

ÁREA CARIBE – GUAJIRA - CESAR – MAGDALENA

Problemáticas identificadas

Esta área presenta diferentes dificultades relacionadas en su mayoría con el agotamiento de la capacidad de la transformación, agotamiento de red a 110 kV y la existencia de redes radiales en el STR, las cuales se presentan a continuación:

- **Agotamiento de la capacidad de transporte;** se tiene agotamiento de la capacidad de carga de la línea Fundación – Rio Córdoba 110 kV, debido al crecimiento de la demanda conectada en las subestaciones del enlace Santa Marta – Gaira – Rio Córdoba – Fundación 110 kV. Esta condición puede generar sobrecargas en el circuito y desatención de demanda; para solucionar esta problemática se está estudiando por parte de la UPME la viabilidad de un nuevo

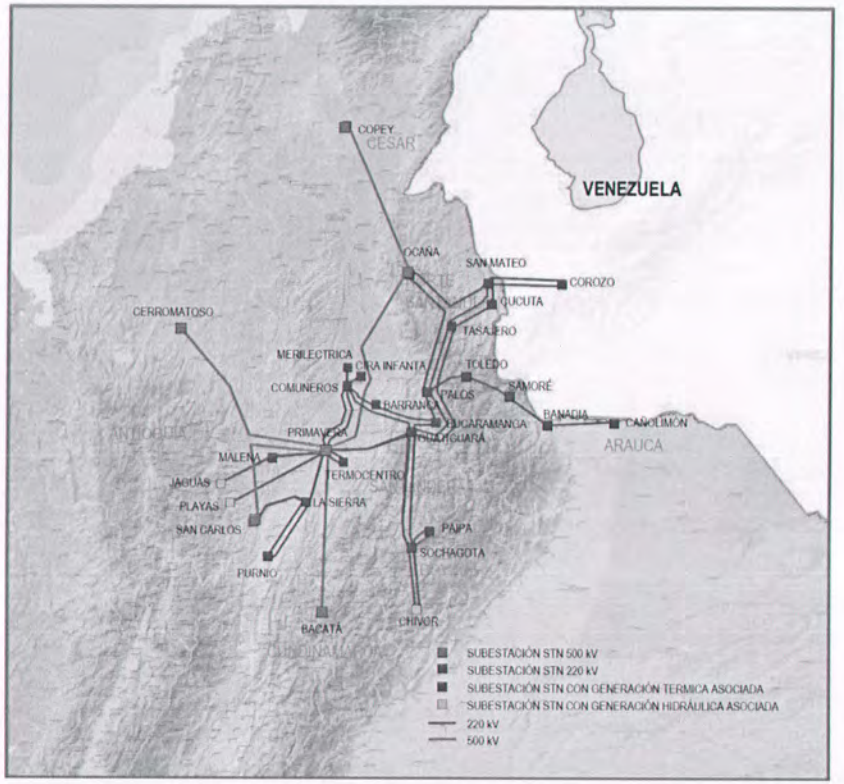
punto de inyección a 220 kV en la subestación Rio Córdoba 110 kV.

- **Agotamiento de la capacidad de trasformación;** Ante la contingencia de uno de los transformadores en la subestación Fundación 220/110 kV, se observa sobrecarga en el transformador que queda en operación, que puede provocar desatención de demanda en la zona. Se recomienda al OR estudiar la incorporación de un tercer transformado 220/110 kV en la subestación Fundación 220 kV. Adicional a lo anterior la necesidad del nuevo punto de inyección a 220 kV en la subestación Rio Córdoba 110 kV complementa la solución.

La contingencia de uno de los transformadores en Cuestecitas 220/110 kV, provoca sobrecarga en el transformador que queda en servicio y esto puede ocasionar desatención de demanda en el área. Como solución, el OR presentó la alternativa de instalación de un tercer transformado 220/110 kV – 100 MVA en dicha subestación, adicional al cambio de capacidad de los transformadores existentes de 60 MVA a 100 MVA.

La misma situación se presenta ante la falla del único transformador de Copey 220/110 kV que produce desatención total de la demanda de las subestaciones El Copey, El Paso y El Banco 110 kV. Se recomienda al OR tener en cuenta en sus planes de expansión, el nuevo punto de inyección a 500 kV, La Loma, para solucionar la problemática de esta zona.

ÁREA NORDESTE –SANTANDER



Problemáticas identificadas

En esta área se presentan diferentes situaciones, relacionadas en su mayoría como consecuencia de agotamiento de la capacidad de la transformación, agotamiento de red a 115 kV, que podrá ocasionar demanda no atendida.

Dentro de las problemáticas observadas están:

- **Agotamiento de la capacidad de transformación 230/115 kV;** como consecuencia del crecimiento de la demanda se observa agotamiento de la capacidad de transformación. Se recomienda al OR estudiar el fortalecimiento de los puntos de transformación (Palos, Bucaramanga y Barranca) o establecer nuevos puntos de conexión 230/115 kV.

- **Agotamiento de la red a 115 kV;** como consecuencia del crecimiento de la demanda se observa agotamiento de la red a 115 kV, que podría conducir a tener demanda no atendida. Se recomienda al OR reforzar la red del STR de todo el departamento de Santander.

ÁREA NORDESTE NORTE DE SANTANDER

Problemáticas identificadas

Actualmente el Norte de Santander presenta diferentes problemáticas, relacionadas en su mayoría al agotamiento de la capacidad de la transformación, agotamiento de red del STR que podrá conducir a tener demanda no atendida.

A continuación se presentan cada una de las problemáticas observadas y los impactos que estas tienen en el:

- **Agotamiento de la capacidad de transformación 230/115 kV;** Como consecuencia del crecimiento de la demanda se observa alta cargabilidad en los transformadores de conexión del área tales como Ocaña y San Mateo, y sobrecargas, que ocasionan bajas tensiones y colapso, ante la contingencia sencilla de alguno de ellos y mínima generación en el área. El OR planteó el refuerzo de capacidad de transformación 230/115 kV en la subestación Ocaña 115 kV con fecha de entrada enero de 2016 y en la subestación San Mateo 115 kV para diciembre de 2015. Estas obras ya fueron conceptuadas por la UPME.

- **Agotamiento de la red a 115 kV;** También se observa agotamiento de la red a 115 kV, que puede conducir a tener demanda no atendida ante contingencias sencillas. El OR planteo compensación capacitiva en la subestación Tibu 115 kV con fecha de entrada en operación en diciembre de 2015, compensación en Aguachica 115 kV con fecha de entrada en marzo de 2016 y en Ayacucho 115 kV con fecha de entrada en mayo de 2016.

  Adicionalmente a continuación se muestran la obras de expansión aprobadas por la UPME al Operador CENS cada una con la fecha de entrada:

Nombre del Proyecto	Fecha de Entrada
Repotenciación de la línea Ocaña - Convención 115 kV	jul-15
Segundo transformador en San Mateo 115 kV	dic-15
Compensación en la subestación Tibú 115 kV	
Repotenciación de la línea Belén - La Ínsula 115 kV	
Dos transformadores adicionales en Ocaña 115 kV	ene-16
Subestación Nueva Aguachica 115 kV	mar-16
Recofiguración de la línea Ocaña - Aguachica 115 kV	
Compensación en Aguachica 115 kV	
Línea Aguachica Nueva - Ayacucho 115 kV	abr-16
Normalización de la subestación Ayacucho 115 kV	may-16
Compensación en Ayacucho 115 kV	
Repotenciación línea Convención - Tibú 115 kV	jul-17
Repotenciación línea Tibú - Zulia 115 kV	

ÁREA NORDESTE – BOYACÁ - CASANARE

Problemáticas identificadas

Esta área presenta diferentes situaciones, relacionadas en su mayoría como consecuencia del agotamiento de la capacidad de la transformación y del agotamiento de la red a 115 kV, que puede llevar a presentar energía no suministrada ante contingencias sencillas y des – optimización del despancho.

Problemáticas observadas:

- **Sobrecarga de los transformadores de Paipa 230/115kV ante salida del Transformador paralelo de 180 MVA:** Se observa agotamiento de la capacidad de la transformación 223/115 kV, lo que puede producir colapso del área, demanda no atendida y des-optimización del despacho en Boyacá y Casanare. El OR EBSA planteó un nuevo punto de conexión al STN.

- **Agotamiento en la red a 115 kV.** Se observa posibilidad de demanda no atendida ante contingencias sencillas en la red del STR y desoptimización del despacho. Se recomienda a los OR's EBSA y ENERCA presentar proyectos que mitiguen la situación antes mencionadas.

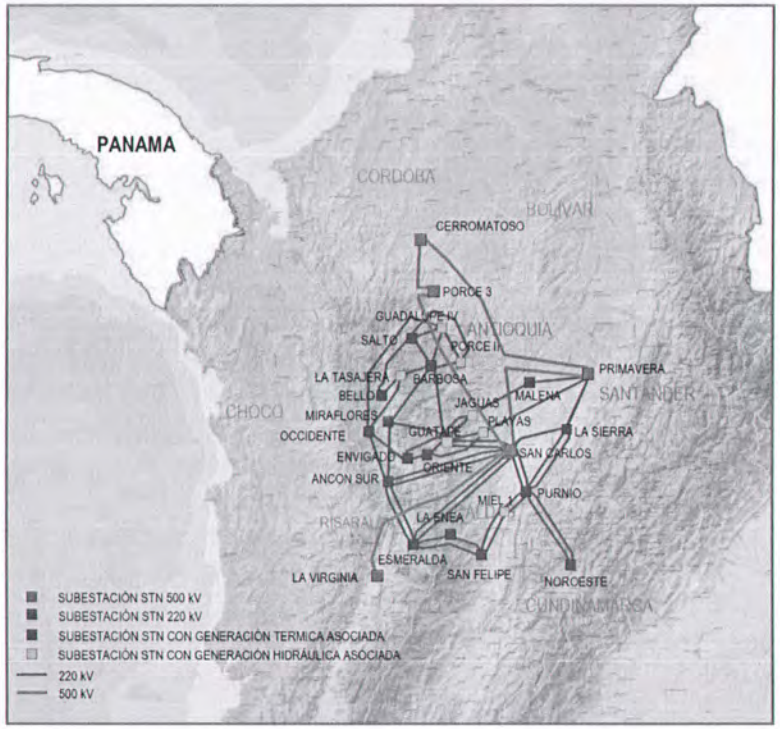
ÁREA NORDESTE – ARAUCA

Problemáticas identificadas

El área atiende su demanda de manera radial. A continuación se presenta la problemática observada:

- **Atención radial de la demanda;** La demanda del área está siendo atendida de manera radial, lo cual puede ocasionar, ante contingencias sencillas, que se presente demanda no atendida. El OR ELENAR plante una interconexión con el sistema de ENERCA a nivel de 115 kV; sin embargo se recomienda al OR, estudiar alternativas con nuevos puntos de conexión al STN.

ÁREA ANTIOQUIA



Problemáticas identificadas

Esta área presenta diferentes problemáticas, en su mayoría relacionadas con la gran capacidad de generación instalada en el STR y el STN. Se presentan bajas tensiones en algunas sub - áreas ante contingencia sencillas y probable desatención de demanda ante contingencias en redes del STR, que operan radialmente. A continuación se presentan las situaciones observadas:

- **Sobrecargas de transformadores;** ante falla de uno de los transformadores en Bello 220/110 kV, se presenta sobrecarga en el transformador en paralelo, lo que genera una limitación en la generación del norte de Antioquia; actualmente se tiene definido el proyecto Bello – Guayabal – Ancon 220 kV y obras asociadas con fecha de entrada 2015, que aliviará la situación mencionada.

- **Sobrecarga de circuitos;** se observa sobrecarga del enlace envigado – Guayabal 110 kV en estado normal de operación y contingencia sencilla, que genera limitación de la generación en el norte de Antioquia. El proyecto Bello – Guayabal – Ancon 230 kV y obras asociadas evitará dicha situación.

  Respecto a los problemas de congestión en el enlace Salto – Yarumal 110 kV la UPME aprobó la repotenciación del mencionado enlace con la nueva subestación Yarumal 2 - 2012 y el nuevo circuito Yarumal 2 – Riogrande 110 kV para diciembre de 2013.

- **Bajas tensiones;** Ante la contingencia de la línea Playas – Puerto Nare 110 kV, se presentan bajas tensiones en las subestaciones que quedan alimentadas aguas abajo de Calderas 110 Kv (Cocorná, Puerto Inmarco y Puerto Nare) con la consiguiente desatención de demanda. Actualmente se tiene definido un nuevo punto de inyección a nivel 230 kV denominado la Sierra 110 kV y un nuevo circuito la Sierra - Cocorná 110 kV, con fecha de entrada 2015. Adicionalmente la UPME definió la nueva subestación San Lorenzo 110 kV para la conexión de la Planta con OEF denominada San

Miguel junto con otras plantas menores para entrar en operación a finales de 2013.

Para los problemas de bajas tensiones y confiabilidad en el sur oriente de Antioquia la UPME definió el circuito San Lorenzo – Sonsón 110 kV que aliviará el riesgo de desatención de demanda y energía atrapada en el área mencionada.

- Atención radial de la demanda con bajas tensiones, ante la contingencia del transformador de Urabá 220/110 kV.

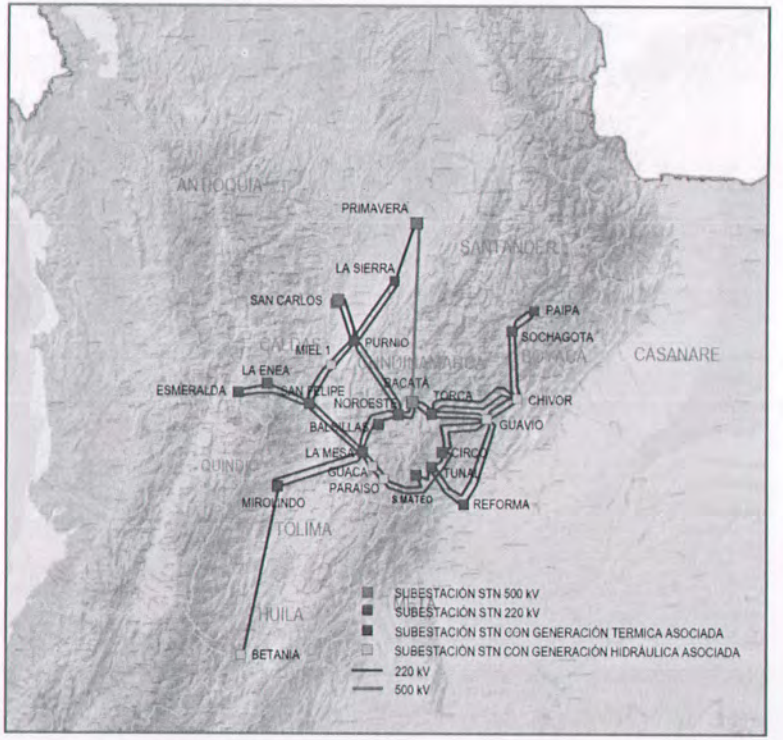
ÁREA ANTIOQUIA - CHOCÓ

Problemáticas identificadas

Esta área presenta diferentes problemáticas, relacionadas con atención radial de la demanda y bajas tensiones en las subestaciones, las cuales se presentan a continuación:

- **Atención radial de la demanda;** se observa que ante la topología actual, la contingencia del transformador de Virginia 230/115 kV o del circuito Virginia – Certegui 115 kV se presenta desatención de la demanda. Actualmente como solución a esta problemática el OR presento la normalización de la subestación El Siete 115 kV que permitiría cerrar el anillo y atender la demanda del Chocó mediante el enlace Bolombolo – Barroso – El Siete – Quibdó – Certegui – Virginia 115 kV. Se recomienda al OR estudiar y presentar alternativas de expansión que sean complementarias a las obras presentadas y que eviten bajas tensiones ante condiciones de contingencia en el mediano y largo plazo.

ÁREA ORIENTAL – BOGOTÁ



Problemáticas identificadas

Se presenta diferentes problemáticas en esta área, relacionadas en su mayoría como consecuencia del agotamiento de la

capacidad de la transformación, bajas tensiones ante contingencias simples que pueden causar demanda no atendida.

Problemáticas encontradas y algunas soluciones definidas.

- **Sobrecarga del transformador Bacatá 500/115 kV ante falla de transformador Bacatá 500/230 kV.** Se observa que ante la salida del transformador de Bacatá 500/230 kV, se sobrecarga el transformador 500/115 kV pudiéndose presentar demanda no atendida o des-optimización del despacho de generación. Actualmente se tienen definidos y adjudicados los proyectos Nueva Esperanza y obras asociadas y el proyecto Chivor – Chivor II – Norte – Bacatá 230 kV y obras asociadas, ambos con entrada en operación para el año 2015. Adicionalmente se definió el adelanto de la construcción del segundo transformador 500/115 kV en la subestación Bacatá para el año 2014.

- **Bajas tensiones en el norte de la sabana de Bogotá**; Ante contingencias en líneas del STR, como son Bacatá – Chía 115 kV, Noroeste – Tenjo 115 kV y Bacatá – El Sol 115 kV, se presentan bajas tensiones en el norte de la sabana, lo que puede producir demanda no atendida o generación fuera de mérito. Actualmente como solución a esta problemática se tiene definido el proyecto Chivor – Chivor II – Norte – Bacatá 230 kV para el año 2015 y la incorporación de una compensación capacitiva en Ubate de 50 MVAr para el año 2013 propuesta por el Operador de Red del área.

- **Sobrecargas en líneas:** En condición normal de operación se presenta alta cargabilidad del enlace Torca - Aranjuez 115 kV y sobrecarga de este ante contingencias sencillas. Actualmente no se tiene solución ante esta problemática y el operador de red no ha propuesto obras que la mitiguen.

ÁREA ORIENTAL – META

Problemáticas identificadas

Las diferentes problemáticas de esta área se relacionadas en su mayoría al agotamiento de la capacidad de la transformación y atención radial de la demanda.

Problemáticas encontradas y algunas soluciones:

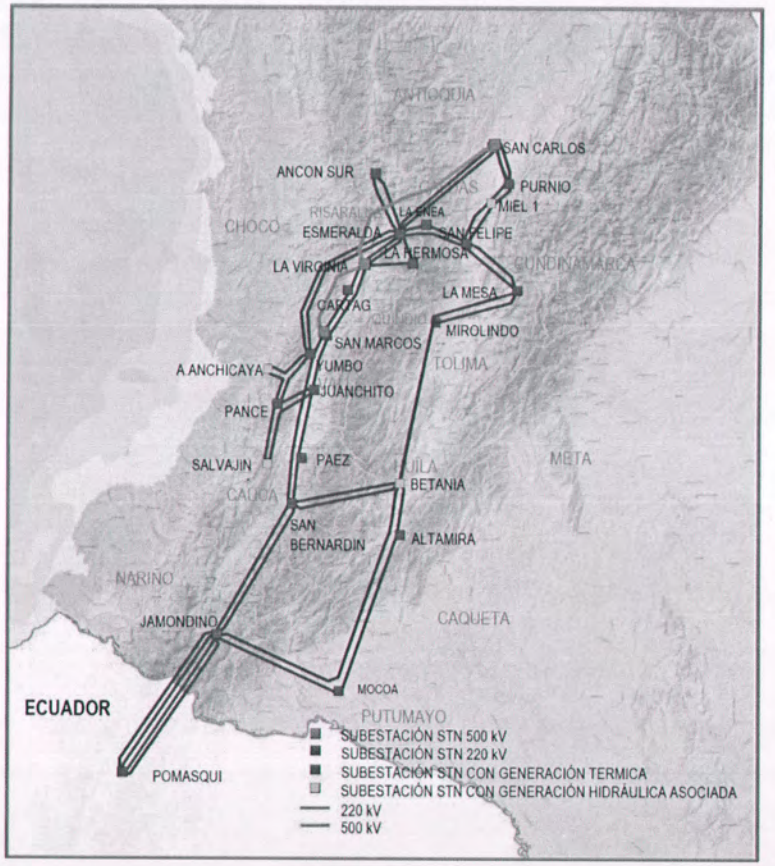
- **Agotamiento de la capacidad de transformación.** En la subestación la Reforma 230/115 kV, ante contingencia de uno de los bancos actuales, se produce sobrecarga en el que queda en servicio, provocando demanda no atendida y limitación de conexión de nuevas cargas en el STR del Meta. Actualmente se tiene definido el proyecto Súria 230 kV y obras asociadas, como solución a esta problemática con fecha de entrada para el año 2015. Adicionalmente se aprobó la construcción del tercer transformador en Reforma 230/115 kV para entrar en operación en diciembre de 2013.

- **Atención radial de la demanda;** se observa que debido a la topología actual, las subestaciones a 115 kV Súria, Puerto López y Puerto Gaitán son atendidas radialmente desde la subestación Ocoa, que ante alguna contingencias sencilla de alguno de estos enlaces se produce desatención de demanda. Actualmente está definido el proyecto Suria 230/115 kV y obras asociadas como solución a esta problemática con fecha de entrada en operación para el 2015. El Operador de Red del área presentó soluciones a nivel del STR, las cuales fueron aprobadas por la Unidad y corresponden a las mostradas en la siguiente tabla:

Nombre del Proyecto	Fecha de Entrada
Subestación Suria 115 kV	jun-12
Energización Ocoa - Suria - Subestación Puerto López 115 kV	
Energización Puerto López - Puerto Gaitán 115 kV	
Subestación Puerto Gaitán 115 kV	
Segundo Circuito Suria - Puerto López 115 kV	dic-13
Tercer transformador 230/115 kV 150 MVA Subestación La Reforma	
Segundo Circuito Puerto López - Puerto Gaitán 115 kV	
Subestación Ocoa 115 kV	
Transformadores 230/115 kV 2x150 MVA en la S/E Suria	sep-15

Las demandas asociadas a la subestación Granada y San José del Guaviare 115 kV son atendidas radialmente desde la subestación Ocoa 115 kV. Esta condición puede ocasionar demanda no atendida ante contingencias sencillas de los enlaces respectivos. Se recomienda a los ORs incumbentes, estudiar nuevas obras a nivel del STR que eliminen esta situacón.

ÁREA SUROCCIDENTAL – CALDAS- QUINDIO – RISARALDA



Problemáticas identificadas

Esta área presenta diferentes problemáticas, relacionadas especialmente con el agotamiento de la capacidad de la transformación, sobrecargas de elementos ante contingencia y

bajas tensiones. A continuación se presentan las diferentes situaciones observadas y algunas soluciones definidas.

- **Agotamiento de la capacidad de transformación;** Ante la condición de falla de uno de los transformadores en la subestación la Esmeralda 230/115 kV se provoca sobrecarga en el otro, con probable desatención de demanda o des-optimización del despacho de generación. Actualmente se tiene definido y adjudicado el proyecto Armenia 230/115 kV y obras asociadas como solución a esta problemática junto con la necesidad de instalación de un tercer transformador 230/115 kV en Esmeralda para el año 2014.

- **Sobrecargas de elementos;** se observa que ante la falla del transformador de la subestación Cartago 230/115 kV se presentan sobrecargas del enlaces Rosas – Dos Quebradas 115 kV, lo que puede producir desatención de demanda y des-optimización del despacho. Actualmente se tiene definida la entrada en operación de un segundo transformador Cartago 230/115 kV para el año 2014, obra que aliviaría la sobrecarga; sin embargo, se recomienda a los OR's incumbentes estudiar y presentar alternativas de expansión en el STR que mitiguen esta situación.

  Las contingencias sencillas del transformador de San Felipe 230/115 kV y de los enlaces San Felipe – Mariquita - La Victoria 115 kV, ocasionan violaciones de tensión y desatención de demanda. La UPME aprobó el Proyecto Purnio 230/115 kV y el enlace Purnio – La Dorada 115 kV para el año 2014, que da solución a estos inconvenientes.

ÁREA SUROCCIDENTAL – VALLE

Problemáticas identificadas

Están relacionadas en su mayoría con el agotamiento de la capacidad de la transformación y sobrecargas de circuitos del STR.

Problemáticas observadas y algunas soluciones:

- **Sobrecargas en estado estacionario;** se observan sobrecargas del anillo Yumbo - La Campiña - Chipichape 115 kV ante condiciones simultaneas, de alto despacho térmico en el área, bajo despacho en el Alto y Bajo Anchicaya y contingencia N-1 en líneas del STR. Actualmente el OR presento como solución a esta problemática la repotenciación del enlace Yumbo - La Campiña - Chipichape 115 kV.

- **Sobrecargas en contingencia;** se presenta la sobrecarga del enlace Rosa-Dosquebradas 115 kV del Área CQR, ante la contingencia del transformador 230/115 kV de Cartago, lo que puede llevar a que se presente demanda no atendida en CQR y Valle, bajas tensiones en el norte del Valle y generación fuera mérito. Actualmente se tiene aprobada la entrada del 2° transformador de Cartago para mediados del año 2014 como solución a esta problemática.

- **Agotamiento en la transformación;** ante condiciones de alta generación hidráulica en el área se presenta alta cargabilidad de la transformación y sobrecarga ante contingencia en los transformadores de San Marcos 230/115 kV o Yumbo 230/115 kV, produciéndose una des-optimización del despacho con generación fuera de mérito. Actualmente se tiene definido el proyecto Alférez 230/115 kV y obras asociadas como solución a esta problemática con fecha de entrada en operación para el 2013.

ÁREA SUROCCIDENTAL – CAUCA - NARIÑO

Problemáticas identificadas

La problemática de esta área se relaciona con el agotamiento de la capacidad de la transformación y de la red del STR. A continuación se presentan las diferentes situaciones observadas y algunas soluciones aprobadas:

- **Agotamiento de la red a 115 kV;** se observa que ante contingencias simples, se puede producir demanda no atendida debido a la radialidad de conexión de las subestaciones. Se recomienda al OR estudiar proyectos a nivel del STR que mejore las condiciones del sistema y considerar un nuevo punto de conexión al STN.

- **Agotamiento en la capacidad de transformación 230/115 kV;** se observa agotamiento de la capacidad de transformación en las subestaciones Jamondino y San Bernardino, lo que puede producir demanda no atendida en condiciones normales de operación y ante contingencia. Actualmente como parte de la solución el OR se encuentra en proceso de instalación de un segundo Transformador en la subestación Jamondino con fecha de entra en operación diciembre de 2013, se recomienda a los ORs incumbentes estudiar y presentar nuevos puntos de conexión al STN y/o repotenciar los actuales.

ÁREA SUROCCIDENTAL TOLIMA – HUILA- CAQUETA

Problemáticas identificadas

Esta área presenta diferentes problemáticas, relacionadas en su mayoría con el agotamiento de la capacidad de la transformación, de la red a 115 kV y bajas tensiones ante contingencias sencillas, las cuales se presentan a continuación:

- **Bajas tensiones;** se observa que ante contingencias sencillas a 115 kV y transformadores de conexión se presentan bajas tensiones en subestaciones del área, que puede ocasionar demanda no atendida. Se recomienda a los OR's incumbentes estudiar y presentar obras a nivel del STR que mitiguen la situación antes mencionadas.

- **Agotamiento de capacidad de transformación, sobrecargas y atención radial de la demanda;** se observa sobrecargas de circuitos y transformadores de conexión al STN en condiciones de falla de elementos que pueden llevar a presentar desatención de demanda debido a la topología radial de estas áreas. Se remienda a los ORs incúmbetes estudiar y presentar obras que mitiguen esta situación, tales como aumento de capacidad de transformación en Betania y Mirolindo, obras a nivel del STR, obras que eliminen la radialidad de Florencia y Doncello, así como aumento de la capacidad de transformación en Altamira. El OR – Electrocaquetá presentó el Plan de Expansión donde incluyó el segundo circuito Altamira – Florencia – Doncello 115 kV. Cabe anotar, que no tuvo en cuenta el segundo transformador en la subestación Altamira, por lo cual se le solicita al OR estudiar esta alternativa adicional.

- **Sobrecargas en contingencia;** se observan sobrecargas de circuitos de Enertolima y Electrohuila ante contingencias sencillas en las fronteras de las dos áreas, que puede causar

demanda no atendida. La UPME conceptuó la construcción de la nueva subestación Natagaima 115 kV para el 2014, que aliviará parte de la problemática de estas áreas.

ÁREA SUROCCIDENTAL PUTUMAYO

Problemáticas identificadas

El área de Putumayo presenta problemática relacionada con atención radial de la demanda.

- **Atención Radial de la demanda;** se observa que la demanda está alimentada radialmente mediante el transformador 230/115 kV de Mocoa, lo cual produce que ante la contingencia del mismo se produzca demanda no atendida. Se recomienda al OR, presentan alternativas de expansión relacionadas con la ampliación de la capacidad de transformación y/o estudiar nuevos puntos de inyección al STN.

IV. PRESENTATIONS

PROJECT FUNDING AND EXPORT FINANCE

EXPORT-IMPORT BANK of the UNITED STATES

RecursosCorporativos

Agenda

- Who is US Exim-Bank
- Pre-Export Financing
- Post-Export Financing
- Recent success Cases in Colombia

RecursosCorporativos

Who is the US Eximbank

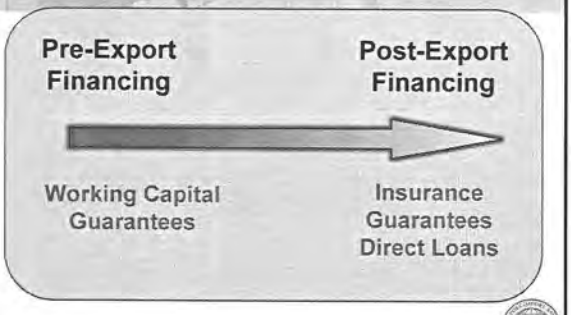
The Export-Import Bank of the United States (Ex-Im Bank) is the official export credit agency of the United States. Ex-Im Bank's mission is to assist in financing the export of U.S. goods and services to international markets. Ex-Im Bank enables U.S. companies — large and small — to turn export opportunities into real sales that help to maintain and create U.S. jobs and contribute to a stronger national economy. Ex-Im Bank does not compete with private sector lenders but provides export financing products that fill gaps in trade financing. We assume credit and country risks that the private sector is unable or unwilling to accept. We also help to level the playing field for U.S. exporters by matching the financing that other governments provide to their exporters. Ex-Im Bank provides working capital guarantees (pre-export financing); export credit insurance; and loan guarantees and direct loans (buyer financing). No transaction is too large or too small. On average, more than 85% of our transactions directly benefit U.S. small businesses.

RecursosCorporativos

- "...Double Exports Over the Next Five Years and Support the Creation of 2 Million American Jobs." – National Export Initiative 2010
- "Colombia is one of the nine countries in the world that Ex-Im Bank has identified as having the greatest potential for U.S. exporters and their workers," - Fred P. Hochberg, chairman and president of the Bank.

RecursosCorporativos

Ex-Im Bank Support Covers the Spectrum



RecursosCorporativos

PRE-EXPORT FINANCING:
WORKING CAPITAL GUARANTEE PROGRAM

RecursosCorporativos

Working Capital Guarantee

Guarantee to a commercial lender which makes a loan to an exporter to purchase or manufacture US goods and services for export

RecursosCorporativos

Working Capital Guarantee

- Assists small and mid-size companies in obtaining working capital to produce or purchase US goods and services for export
- Provides a 90% guarantee of repayment (principal and interest) on loans to exporters
- May be set up as "Transaction-Specific" or a "Revolving" Line of Credit
- No minimum or maximum amounts
- Loan supports advances made against export-related inventory (including WIP) and foreign receivables:
  - Up to 75% advance rate on inventory, and up to 90% on foreign receivables

RecursosCorporativos

WCG Increases Borrowing Power

		Your Working Capital Facility without Ex-Im Bank		Your Working Capital with Ex-Im Bank	
Collateral (Inventory)	Amount	Advance Rate	Borrowing Base	Advance Rate	Borrowing Base
Export Inventory					
Raw Materials	$200,000	20%	$ 40,000	75%	$ 150,000
WIP	200,000	0%	0	75%	150,000
Finished Goods	600,000	50%	300,000	75%	450,000
Export/Foreign Accounts Receivable					
Open Account/Foreign Account Receivable	$400,000	0%	0	90%	$ 360,000
L/C Backed A/R	600,000	70%	420,000	90%	540,000
Total Borrowing Base			$760,000	vs.	$ 1,650,000

RecursosCorporativos

Working Capital Guarantee: Program Initiatives

In November 2008, the board of Directors in response to the financial crisis approved three modifications to the program aimed at providing additional liquidity for US exporters

- Provide support for up to 100% of indirect exporters
- Increase support for warranty letters of credit from $500,000 to $1,500,000
- Reduce collateral requirement for performance letters of credit from 25% to 10%

Recursos

POST-EXPORT FINANCING:
SHORT-TERM
EXPORT CREDIT INSURANCE

Recursos

Short-Term Export Credit Insurance

Protects US exporters against non-payment by foreign buyers due to

- Commercial Risks
- Political Risks

Allows exporters to offer competitive credit terms to foreign buyers

- Generally up to 180 days, some products may qualify for 360 day terms

Obtain additional financing

- Insured foreign receivables may be added to your borrowing base by assignment of policy proceeds (claim payments) to lender

Recursos

Risks Covered

Commercial Risks

- Insolvency
- Bankruptcy
- Protracted default

Political Risks

- Transfer risk
- War, revolution, insurrection, expropriation
- Cancellation of an import or export license

Short-Term Export Credit Insurance

Coverage:

- 90%, 95%, or 98%, depending on policy selected and buyer classification
- Applies on credit terms of up to 180 days, exceptionally 360 days (for capital equipment and bulk, unprocessed agricultural products)

Exporter Policies:

- Multi-Buyer or Single-Buyer

Small Business Multi-Buyer Policy

- Coverage: 95% commercial and 95% political
- Exporter must qualify as "small business" by SBA definition, **and**
- No more than $7.5 million in export credit sales over the past 2 years
- In same line of business for at least 3 years (No material adverse issues)
- Must insure ALL export credit sales (L/C, CIA, CAD, SDDP, and Canadian sales may excluded)
- Refundable advance premium: $500
- No deductible, no application fee, "pay-as-you-ship," no minimum premium requirement
- Buyer credit limits endorsed to policy (requires minimal pre-approvals by Ex-Im Bank)

Small Business Multi-Buyer Premium Rates

(on March 11, 2010)

Term	Sovereign	Financial Institutions	Private
Sight L/Cs	$0.03	$0.03	N/A
1-60 days	$0.16	$0.20	$0.55
61-120	$0.27	$0.33	$0.90
121-180	$0.35	$0.43	$1.15
181-270	$0.43	$0.54	$1.45
271-360	$0.53	$0.65	$1.77

Per $100 of the gross invoice amount

25% rate reduction if used with Ex-Im Bank / SBA Working Capital Guarantee product!

Recursos Corporativos

Standard Multi-Buyer Policy

- For experienced exporters with over 500 employees and /or $7.5mm in annual export credit sales
- Must insure ALL export credit sales (L/C, CIA, CAD, SDDP and Canadian sales may be excluded)
  - On a case-by-case basis, exporter may request to exclude certain countries and/or buyers ("Reasonable Spread of Risk")

Coverage:

- 95% for both commercial and political risks
- No minimum premium, "pay-as-you-ship"
- Buyer credit limits endorsed to policy (requires minimal pre-approvals by Ex-Im Bank)

Recursos Corporativos

POST-EXPORT FINANCING SOLUTIONS:

... WHEN A FOREIGN BUYER NEEDS MEDIUM-TERM OR LONG-TERM FINANCING

Recursos Corporativos

Medium-Term Insurance and Guarantees

- Capital Equipment - Sales and Related Services
- Used Equipment – Can be considered
- Buyer criteria per Medium-term Credit Standards
  - Minimum 3 year history
  - Reliable financial statements (audited if credit exceeds $1 million)
  - Buyer must meet certain financial ratios

Medium-Term Insurance and Guarantees

- Minimum 15% down payment required (may be financed by the lender)
- 100% coverage on the remaining 85% financed portion (both principal and interest)
- 1 to 5 year repayment, exceptionally 7 years and < $10 million (up to 15 years for certain environmental exports)
- Generally limited to buyers in developing markets
- Ex-Im Bank can now support up to 30% of Local Cost

Medium-Term Insurance and Guarantees: Pricing Indications

(on March 11, 2010)

- Private-sector, corporate borrowers, 5 year tenor, single shipment, for transactions under $10 million

Country	Insurance Premium	Guarantee Exposure Fee
Mexico	3.62%	3.68 %
Brazil	2.82%	2.87 %
Russia	5.82%	5.92%

- Refer to "*Fee Calculator*" on **www.exim.gov**
- One-time (flat) fee (may be financed)
- Under Guarantee program, a 0.125% p.a. commitment fee applies (accrues 60-days from approval date)

Standard Finance Model

Single shipment ~ 5 year ~ private-sector Mexico

Net Contract Price:	US$1,000,000
Less: 15% Down payment:	150,000
Financed Portion:	850,000
Plus: Ex-Im Exposure Fee:	31,280 (3.68%)
Total Financed Amount:	$881,280

- Payable in 10 equal semi-annual principal payments of $88,128 plus accrued interest.
- Pricing Indication:
  - Lender's interest rate: 6-mo. Libor + 2.5%
  - Lender's facility fee: 1-2%
  - Ex-Im Commitment Fee: 0.125% (if "Guarantee")

Recursos

The Rules We Follow

- " The Three C's"
  - Content
  - Cover
  - Creditworthy Foreign Buyers

Recursos

Eligibility Criteria – Content

No Defense Articles or Services, or Military Buyers

Exceptions may be made for humanitarian purposes, drug interdiction, dual-use items

US Content

Each item must have more than 50% US content for short-term transaction eligibility

85% of the value of eligible goods and services in the US supply contract; or 100% of the US content in all eligible goods and services in the US supply contract

Services must be performed by US-based personnel, either in the US or in the "host" country

Recursos

Eligibility Criteria - Cover

- Country Eligibility
- Support available in over 155 countries
- Restrictions may apply for political or economic reasons
- Refer to the Country Limitation Schedule (CLS) at www.exim.gov, on the homepage under "Shortcuts"

Eligibility Criteria - Credit

Short-Term Performance Criteria

Ratio	Standard
Operating Profit	Positive for last 2 years
Net Income	Positive for last 2 years
Cash from Operations	Positive last year
Current Ratio	>1.25
Total Liabilities/Tangible Net Worth	< 250%
Ex-Im Exposure/Tangible Net Worth	< 50%

Medium-Term Performance Criteria

Ratio	Standard
Operating Profit	Positive for last 2 years
Net Income	Positive for last 2 years
Cash from Operations	Positive last year
EBITDA/Debt Service	>1.50x
Total Liabilities/Tangible Net Worth	< 175%
Ex-Im Exposure/Tangible Net Worth	< 40%

RECENT SUCCESS CASES IN COLOMBIA

Reficar Refinery in Colombia

- In FY 2011, Ex-Im Bank approved a $2.84 billion direct loan/loan guarantee to Colombia's Refinería de Cartagena S.A. (Reficar), an independent subsidiary of Ecopetrol S.A., Colombia's national oil and gas company.
- This financing is part of a $5 billion refinery and upgrade project in Cartagena, from which Reficar will supply petroleum products to the domestic and export markets.
- Ex-Im's financing will support the purchases of equipment and services from over 150 large and small U.S. engineering and design, equipment supply, contracting and process licensing firms, including CBI Americas Ltd. in Houston, Texas. Suppliers include small businesses in Louisiana, Texas, Colorado, New Jersey, New York, Missouri, Ohio, Oklahoma and Pennsylvania.
- Ex-Im Bank estimates that this transaction will create or sustain more than 15,000 American jobs for a total of four years.

RecursosCorporativos

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RecursosCorporativos

Universidad de los Andes

RESEARCH ON MICROGRID SOLUTIONS IN COLOMBIA

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José Lenin Morillo
Miguel A. Velásquez

Grupo SILICE

Universidad de los Andes

February 11, 2014

Outline

- Introduction
- SILICE Phase 3
- Education
- Conclusions and Other Projects

Introduction

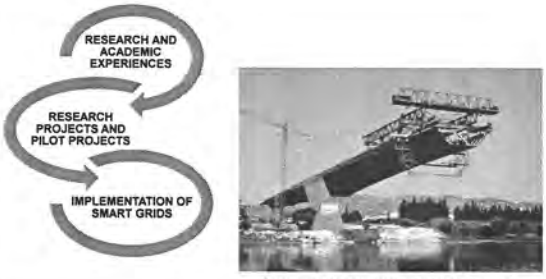

Image source: http://www.construcloud.com/tag/puentes/

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Introduction

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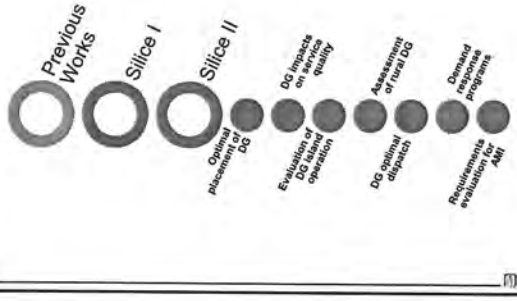

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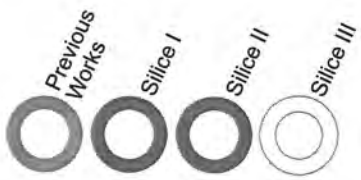
Introduction



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SILICE PHASE 3

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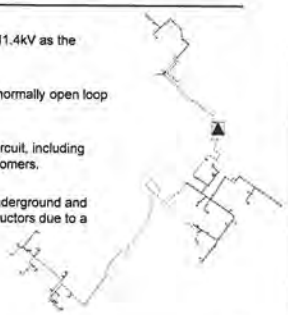
Project Goals

Design the conceptual and basic engineering of a smart microgrid on a distribution circuit, including:

- DG applications and energy storage
- Demand response program
- Energy efficiency
- Advanced metering
- Integration of electric vehicles

Distribution Circuit – Technical Features

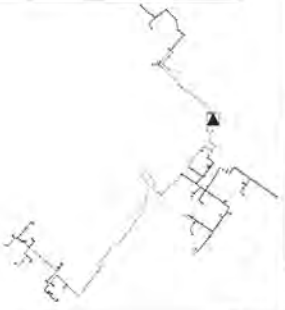
- 8 primary distribution circuits operating at 11.4kV as the nominal voltage.
- Expanded radial system operation, with a normally open loop system.
- 10 MVA average load connected in each circuit, including residential, commercial, and industrial customers.
- The main distribution feeders have both underground and overhead lines, and different types of conductors due to a disordered system expansion.
- Multiple switching devices installed along the feeder.



Distribution Circuit – Technical Features

New elements

- Reclosers – overhead lines
- Switchgears – underground lines
- RTUs
- Advanced metering
- Electric vehicles along with their charge stations
- Distributed generation composed by renewable sources.



Distribution Automation

- Optimal planning of recloser-based protection systems

Efficient placement of normally open reclosers (NOPs)

- Active power losses minimization.
- ENS minimization.
- Genetic Algorithm.

Efficient placement of normally closed reclosers (NCPs)

Economic efficiency optimization

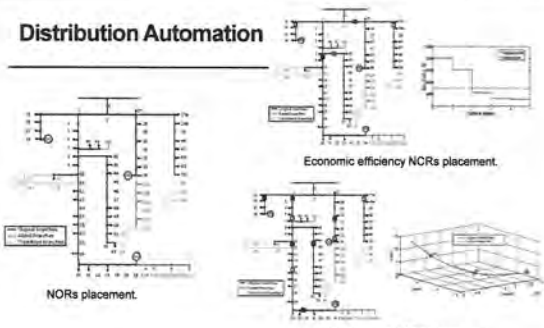
- ENS minimization.
- Caesar I Algorithm and Differential Evolution

Multiobjective optimization

- SAIFI,SAIDI, and costs minimization.
- Multiobjective metaheuristic: NSGS-II and IMODE.

M.A. Velásquez, J. L. Morillo, J. E. Barco & A. I. Cadena, "Pareto-based multi-stage and multi-objective planning of DG enhanced distribution System," International Journal of Electrical Energy, vol. 2. No. 1, pp. 45-52, Mar. 2014.

Distribution Automation



Economic efficiency NCRs placement.

NORs placement.

Multiobjective NCRs placement.

M. A. Velasquez, A. Cadena & C. Taultva, "Optimal planning of recloser-based protection systems applying the economic theory of the firm and evolutionary algorithms," *Innovative Smart Grid Technologies Europe (ISGT EUROPE), 2013 4th IEEE/PES*, vol., no., pp.1-5, 6-9 Oct. 2013

Electric Mobility

Electric mobility incentives in Colombia

Codensa
- 15 E-vehicles MITSUISHI iMIEV
- 26 E-motorbikes for internal operation
- 48 E-Bike to Work program

Bogotá
- 50 E-taxicab pilot program

Fig. E-vehicles MITSUISHI iMIEV *

The implementation of public transport with EVs mainly involves three challenges:

- Routing to meet transport demand.
- Coordinate energy recharge to ensure reliable operation, avoiding increases in the curve of peak demand .
- Battery care.

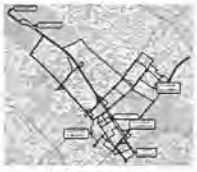
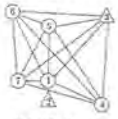


Fig. Operations area of EVs.

* Picture taken from Memoria Annual 2011. Codensa.

Electric Mobility

A centralized controller based on a program that minimizes the operation cost of all Evs is proposed, in which the objective function considers the recharging cost and the battery degradation cost because of routes assignment and recharging actions.



	1	2	3	4	5	6	7
1	0	0	0.25	0.09	0.34	0.45	0.17
2	0	0	0.23	0.09	0.34	0.45	0.17
3	0.25	0.28	0	0.26	0.13	0.54	0.28
4	0.17	0.17	0.30	0	0.37	0.59	0.23
5	0.29	0.29	0.53	0.48	0	0.11	0.41
6	0.38	0.38	0.56	0.46	0.15	0	0.40
7	0.15	0.15	0.45	0.22	0.47	0.58	0

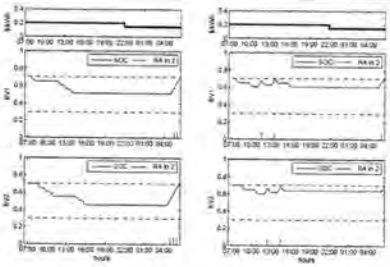
Simplified road graph and consumption energy matrix.

Routes	1	2	3	4	5
Paths	1, 5, 6, 7, 1	1, 5, 6, 4, 1	1, 3, 6, 7, 1	1, 3, 6, 4, 1	1, 2, 6, 7, 1
c^n[kWh]	1.01	1.10	1.01	1.10	1.01
$[s^n, r^n]$	[7 : 30, 8 : 21]	[8 : 30, 9 : 26]	[9 : 30, 10 : 21]	[10 : 20, 11 : 26]	[11 : 30, 12 : 21]

Optimal routing.

Barco J. Quijano N. (2013) **Routing and Scheduling of Recharge for Electric Vehicles.** *Virtual Control Conference on Smart Grid Modeling and Control*

Electric Mobility



Scheduling of recharge for EV1 and EV2 operating in 2 scenarios

Electric Mobility

New constraints to the expansion and operation planning of distribution systems when the optimal placement of charging stations is considered

- Power supply capacity.
- Energy losses and voltage profiles.
- Service quality.
- Station service area with traffic restrictions.

Fig. Charging station *

* Picture taken from Memoria Annual 2011. Codensa.

Distribution Network Reinforcement

- Optimal distribution network reinforcement considering load growth, losses, reliability and distributed generators

New substations

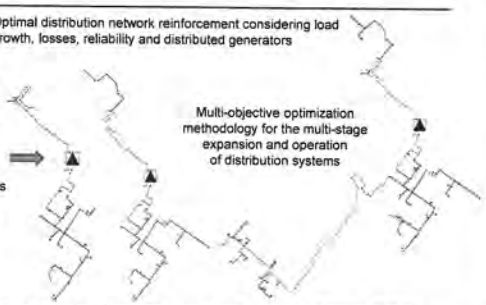
Repowering Substations

New lines

Rewiring lines

Distributed generation

Protection devices



J.L. Morillo, J.F. Perez & A.I. Cadena, "Dynamic multi-objective planning for distribution systems with distributed generation," *Innovative Smart Grid Technologies Europe (ISGT EUROPE), 2013 4th IEEE/PES* , vol., no., pp.1-5, 6-9 Oct. 2013

Telecommunication Systems and Advanced Metering

End to end architecture

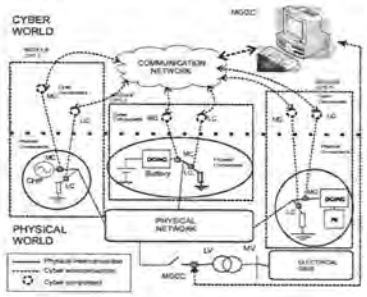
- **SM:** SW and HW implementation (SAGEMCOM, LANDIS + GYR, GE, KAMSTRUP, ZIV)
- **MDMS:** SW implementation (Toshiba, Oracle, Itron, eMeter)
- **AMI Communication network:** Wi-Fi, LTE, Fiber, Ethernet

Telecommunication Systems and Advanced Metering

Telecommunication Systems and Advanced Metering

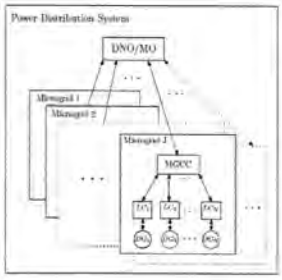
Communication systems for power system automation

Cyber Physical Microgrid Architecture



C. Macana, N. Quijano, and E. Mojica-Nava, "A survey on cyber physical energy systems and their applications on smart grids," in IEEE PES Conference on Innovative Smart Grid Technologies (ISGT Latin America), 2011

Distributed Generation and Microgrids
Hierarchical and Distributed Strategy

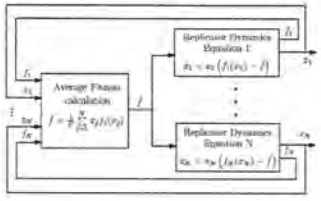


- DGs grouped in microgirds.
- Distributed Network Operator and / or market Operator (DNO/MO).
- Central controller for each Microgris (MGCC)
- Local controller for each DG (LC).
- A dispatch strategy for each DG.

Application of Replicator Dynamics
Centralized, Distributed - Implementation

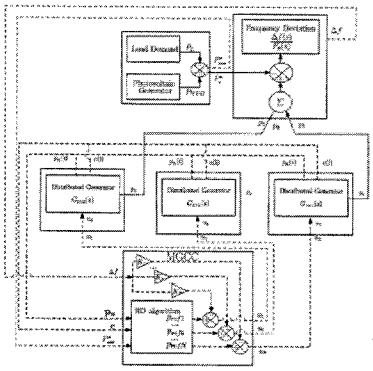
System with Global Information

System with Local Information



Pantoja A, Quijano N. (2011) A Population Dynamics Approach for the Dispatch of Distributed Generators. *IEEE Transactions on Industrial Electronics (ISSN 0278-0046)* 58(10), pp. 4559-4567

Load Frequency Control in Microgrids Replicator Dynamics Control Strategy



Mojica E, Quijano N, Pavas A. **Dynamic Population Games for Hierarchical Microgrid Management.** *In Proceedings of the 2013 IEEE ISGT Europe*

Macana C, Mojica E, Quijano N. (2013) **Time-Delay Effect on Load Frequency Control for Microgrids.** *Proceedings of the 2013 IEEE International Conference on Networking, Sensing And Control*

Demand Response and Frequency Syncronization

- We have designed economical and social incentives, which are able to modify the habits of the consumers. For that, we have used classical economical models and population dynamical concepts.
- We have designed a networked distributed control scheme, in order to guarantee the frequency syncronization between microgrids.

Giraldo J, Mojica E, Quijano N. **Synchronization of Dynamical Networks Under Sampling.** *Proceedings of the 2013 European Control Conference*

Carlos Barreto, Mojica E, Quijano N. (2013) **Design of Mechanisms for Demand Response Programs,** Proceedings of the 2013 IEEE CDC

Carlos Barreto, Mojica E, Quijano N. (2013) **A Population Dynamics Model for Opinion Dynamics with Prominent Agents and Incentives,** In *Proceedings of The 2013 American Control Conference*

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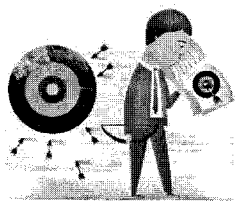
EDUCATION

IELE4114: Microgrids



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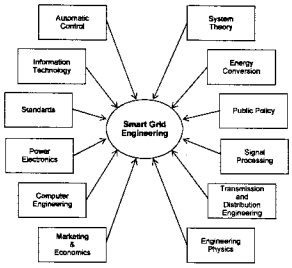
Challenges



M. Kezunovic, "Teaching the smart grid fundamentals using modeling, simulation, and hands-on laboratory experiments," in IEEE Power and Energy Society General Meeting, 2010, pp. 1-6, IEEE, 2010.

Objectives

- Understand the concepts associated with smart grids an distributed generation. This objective would satisfy criteria 3a) and 3k) from ABET.
- Integrate the different areas of the electrical engineering: Power and Energy, Control Systems, Telecommunications and Economics and Regulation. This objective would satisfy criterion 3d) from ABET.
- Design a Smart Grid with distributed generation for a region in Colombia. This objective would satisfy criteria 3a), 3b), 3c), 3d), 3e), and 3k) from ABET.
- Present the results of the proposed Smart Grid design. This objective would satisfy criterion 3g) from ABET.
- In order to meet these objectives, we gather some feedback from the students by means of different types of evaluations. In this case, the course is evaluated with two midterm exams (50%) and one final project (50%).

Universidad de los Andes

CONCLUSIONS

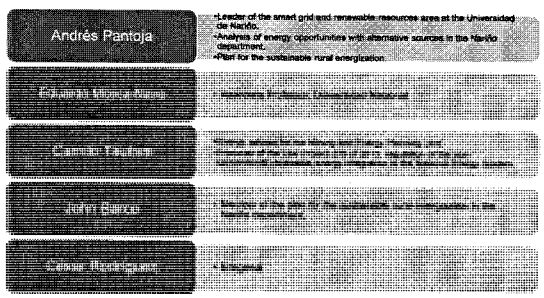
Conclusions

- We have made several contributions from a theoretical point of view, which we hope can be integrated in new smart grid projects that Codensa has (e.g., Salitre Inteligente, SILICE IV(?)).
- The knowledge acquired is presented in a master's level course, in order to show the students how different areas can work together in a real engineer problem.
- Silice was the first project that studied smart grid ideas. Today, there are other initiatives in Colombia (e.g., Colombia Inteligente, and other companies are developing there own microgrids).

International Standards Contributions

- **Quijano N, Cadena A, Mojica E**, Amin M, Annaswamy A, Callaway D, Caramanis M, Chow J, Dotta D, Farid A, Flikkema P, Genc S, Low S, Parisio A, Polis M, Qu Z, Samad T. (2013) Control-Enabled Smart Grids – Scenarios for 2030 – 2050. IEEE Vision For Smart Grid Controls: 2030 And Beyond (ISBN 978-0-7381-8459-3) pp: 53-84.

The present of some previous members



Other Projects

- **SGR Nariño (2014-2015)**
  - Identify alternative energy possibilities in 15 "*municipios*".
  - Desgin a possible solution that includes smart grids concepts and distributed generation
  - Design a microgrid in the ECE building in UdeNar
  - Use this knowledge to create a research group in energy at UdeNar.

Acknowledgements

- SILICE III is supported by Emgesa-Codensa-Endesa (Innovation Division) and Colciencias (Department of Science, Technology, and Innovation) under contract number 387-2012 (Sept 2012 - Sept 2014).

- The research group SILICE has included professors (14), post-docs (2), PhD students (9), masters students (26), and undergraduate students (10), who we would like to thank.

V. U.S. Smart Grid Information

Reference Documentation on U.S. Smart Grid Efforts

U.S. Federal Agencies

- National Institute of Standards and Technologies (NIST) at www.nist.gov/smartgrid and http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/WebHome
- US Department of Energy, at http://energy.gov/smart-grid and http://www.smartgrid.gov/ and http://www.sgiclearinghouse.org/
- Federal Energy Regulatory Commission, at http://www.ferc.gov/default.asp and http://www.ferc.gov/industries/electric/indus-act/smart-grid.asp

Regulatory

- Energy Independence and Security Act of 2007, Section 1305 – Smart Grid Interoperability Framework (see attachment.) Also, Title XIII – Smart Grid at http://www.ferc.gov/industries/electric/indus-act/smart-grid/eisa.pdf
- Federal Energy Regulatory Commission, Smart Grid Policy Statement, July, 2009 at http://www.ferc.gov/whats-new/comm-meet/2009/071609/E-3.pdf
- Federal Energy Regulatory Commission, Smart Grid Interoperability Standards Order, July 2011 (see attachment.) Also available at http://elibrary.ferc.gov/idmws/search/fercgensearch.asp by searching for Docket No. RM11-2-000

Consumer

- Southern California Edison, Rule 21: Generating Facility Interconnections at http://www.sce.com/NR/sc3/tm2/pdf/Rule21.pdf

Technical

- NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0, February, 2012 at http://nist.gov/smartgrid/upload/NIST_Framework_Release_2-0_corr.pdf
- Demand Response Potential Assessment at http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf
- Federal Energy Regulatory Commission report on Demand Response: http://www.ferc.gov/legal/staff-reports/12-20-12-demand-response.pdf
- Federal Energy Regulatory Commission 2013 report on Demand Response & Advanced Metering: http://www.ferc.gov/legal/staff-reports/2013/oct-demand-response.pdf

Stakeholders and Conceptual Design

- (Input from variety of stakeholders) http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPMembershipInfo and https://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/StakeholderCategories
- (Conceptual design) http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SmartGridArchitectureCommittee

Educational

- Power Systems Engineering Research Center (multi-university collaborative) at http://www.pserc.wisc.edu/home/index.aspx

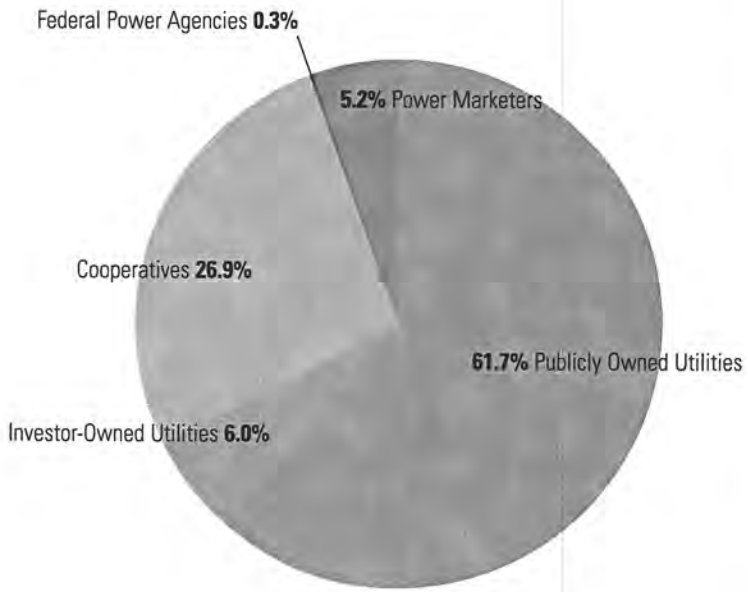
Institute of Electrical and Electronics Engineers (IEEE) Smart Grid Standards

- http://smartgrid.ieee.org/standards/ieee-approved-proposed-standards-related-to-smart-grid

U.S. Electric Utility Industry Statistics

Number of Electricity Providers

		% of Total
Publicly Owned Utilities	2,006	61.7%
Investor-Owned Utilities	194	6.0%
Cooperatives	874	26.9%
Federal Power Agencies	9	0.3%
Power Marketers	168	5.2%
TOTAL	**3,251**	**100.0%**



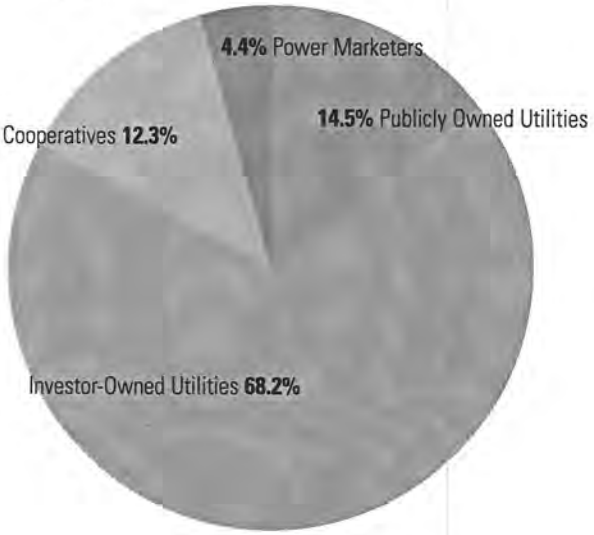
Number of Customers

	Full-Service Customers	Delivery-Only Customers	Total	% of Total
Publicly Owned Utilities	20,940,561	7,892	20,948,453	14.5%
Investor-Owned Utilities	93,187,386	5,169,747	98,357,133	68.2%
Cooperatives	18,497,708	13,338	18,511,046	12.8%
Federal Power Agencies	40,827	2	40,829	0.0%
Power Marketers	6,282,395	0	6,282,395	4.4%
Total	**138,948,877**	**5,190,979**	**144,139,856**	**100.0%**

Energy-only revenue represents revenue from a utility's sales of energy outside of its own service territory. Delivery-only revenue represents revenue the utility receives from the delivery portion of unbundled (retail choice) sales made to customers in the utility's service territory. Total revenue shows the amount of revenue each sector receives from both bundled (full-service) and unbundled (retail choice) sales to ultimate customers.

More than 99 percent of power marketers' full-service sales and revenues occur in Texas. Investor-owned utilities in the ERCOT region of Texas no longer report sales or revenue to ultimate customers. Their customers are counted as full-service customers of retail electric providers (REPs), which are classified by the Energy Information Administration as power marketers. The REPs bill customers for full service and then pay the IOU for the delivery portion.

Source: Energy Information Administration Form EIA-861, 2010. Does not include U.S. territories.

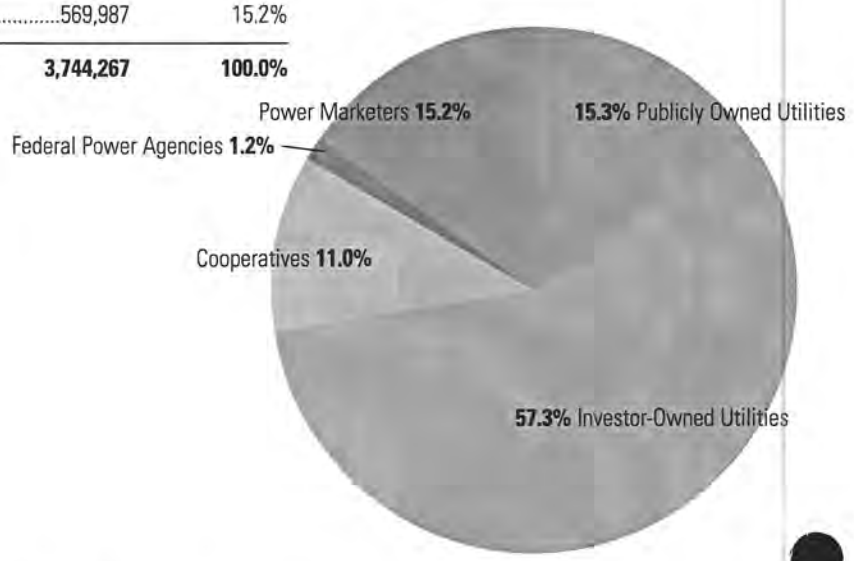


Sales to Ultimate Consumers

(in thousands of MWhs)

	Full-Service Sales	Energy-Only Sales	TOTAL	% of TOTAL
Publicly Owned Utilities	557,452	14,368	571,820	15.3%
Investor-Owned Utilities	2,134,857	10,756	2,145,613	57.3%
Cooperatives	411,939	1,198	413,137	11.0%
Federal Power Agencies	43,710	0	43,710	1.2%
Power Marketers	217,031	352,956	569,987	15.2%
TOTAL	**3,364,989**	**379,278**	**3,744,267**	**100.0%**

Energy-only sales represent a utility's sales of energy outside of its own service territory. The Energy Information Administration collects data on both the energy portion and delivery portion of unbundled (retail choice) sales. Delivery-only sales are not shown here as it would result in double counting. Total sales show how much energy, via either full service or energy-only sales, that each sector sells to ultimate customers.



Electric Revenues from Sales to Ultimate Customers

(in millions of dollars)

	Full-Service Sales	Energy-Only Sales	Delivery-Only Sales	Total	% of Total
Publicly Owned Utilities	$52,254	$1,079	$91	$53,424	14.5%
Investor-Owned Utilities	$210,339	$755	$13,168	$224,262	60.9%
Cooperatives	$39,788	$74	$14	$39,876	10.8%
Federal Power Agencies	$1,798	$0	$2	$1,800	0.5%
Power Marketers	$21,427	$27,410	$0	$48,837	13.3%
TOTAL	**$325,606**	**$29,318**	**$13,275**	**$368,199**	**100.0%**

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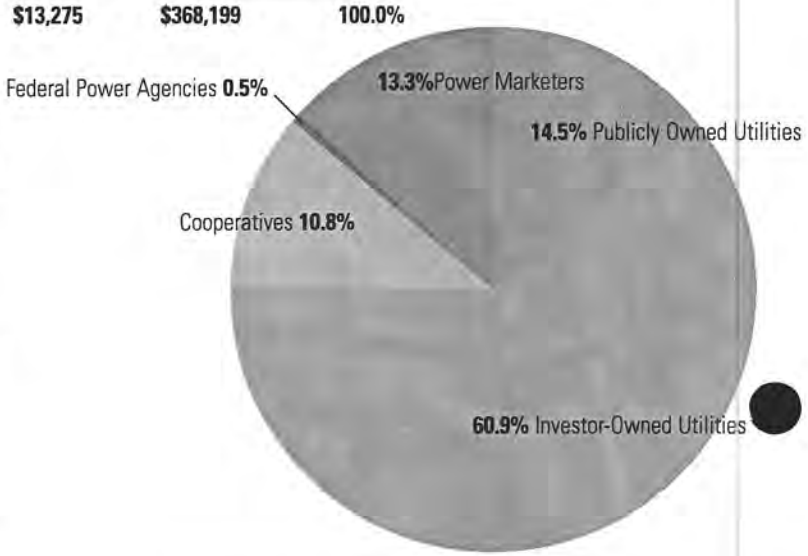
More than 99 percent of power marketers' full-service sales and revenues occur in Texas. Investor-owned utilities in the ERCOT region of Texas no longer report sales or revenue to ultimate customers. Their customers are counted as full-service customers of retail electric providers (REPs), which are classified by the Energy Information Administration as power marketers. The REPs bill customers for full service and then pay the IOU for the delivery portion.

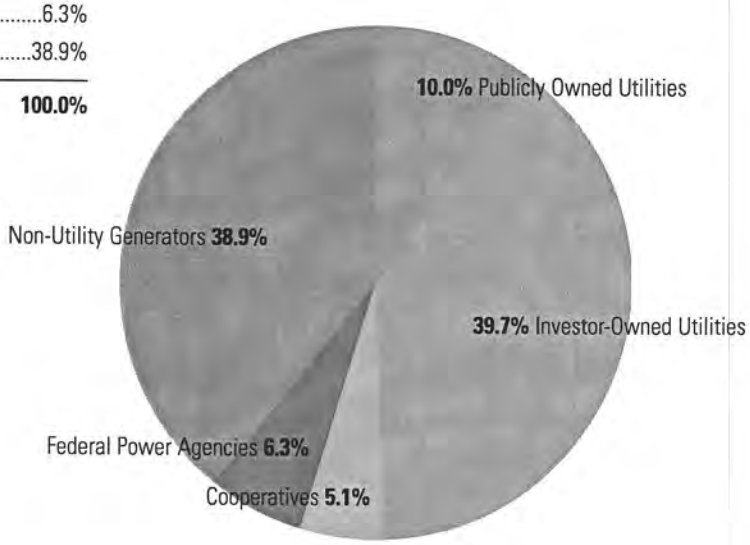
Source: Energy Information Administration Form EIA-861, 2010. Does not include U.S. territories.



Generation

(in thousands of MWhs)

		Percent of Total
Publicly Owned Utilities	416,082	10.0%
Investor-Owned Utilities	1,652,885	39.7%
Cooperatives	212,006	5.1%
Federal Power Agencies	260,630	6.3%
Non-Utility Generators	1,619,053	38.9%
TOTAL	**4,160,656**	**100.0%**

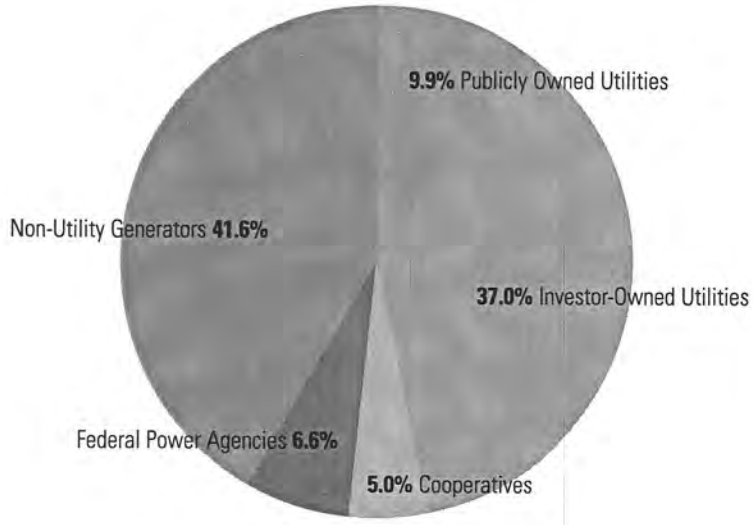


Nameplate Capacity

(in megawatts)

		Percent of Total
Publicly Owned Utilities	112,214	9.9%
Investor-Owned Utilities	421,399	37.0%
Cooperatives	56,687	5.0%
Federal Power Agencies	74,657	6.6%
Non-Utility Generators	473,681	41.6%
TOTAL	**1,138,638**	**100.0%**

Source: Energy Information Administration Forms EIA-861 and EIA-923 for generation, and Form EIA-860 for capacity, including adjustments for joint ownership. Data are for 2010 and do not include U.S. territories.



SMART GRID Maturity Model (SGMM)

Utility organizations:
use the SGMM to assess, guide, and improve your efforts toward a smart grid transformation

Utility service providers:
gain SEI certification to guide utilities in using the SGMM

ESSENTIAL ANSWERS
Getting started on charting smart grid transformation

How is the SGMM different from other maturity models?
The SGMM is different from other maturity models because it is not a process model. CMMI and the CERT® Resilience Management Model are process models. The SGMM is a management tool that utilities can use to plan their smart grid transformation and track progress against that plan.

Who created the SGMM?
The SGMM was created by the Global Intelligent Utility Network Coalition (GIUNC) and APQC. At the time, the GIUNC consisted of Alliander, CenterPoint Energy, Inc., Country Energy, CPFL Energia, DONG Energy, ERDF, IBM, North Delhi Power Limited, Oncor, Pepco Holdings, Inc., Progress Energy, and Sempra Energy.

What is the Software Engineering Institute's role in the SGMM?
The Software Engineering Institute (SEI) is a trusted, objective broker of best practices, methods, and tools to organizations worldwide. As steward of the SGMM, the SEI

- supports the model's widespread availability, adoption, and use
- ensures a reliable set of products and services for the SGMM user community
- develops and administers formal SEI Partner and Certification Programs
- administers quality control of the SGMM and its usage
- collects and analyzes data and best practices
- provides feedback on SGMM usage

How many organizations have adopted SGMM?
More than 150 utilities are using the model or have taken the first steps toward using it. Please review our latest update at www.sei.cmu.edu/library/abstracts/brochures/sgmm-2011.cfm.

What is the geographical breakdown of organizations using the SGMM?
A little more than half of SGMM community members are utilities in the United States. The others are distributed fairly evenly across Europe, Asia-Pacific, Canada, Mexico, and Central and South America.

How can I talk to other SGMM users?
We invite you to join the SGMM User Forum at www.linkedin.com/groups?home=&gid=3906519&trk=anet_ug_hm. On our website you can access a directory of licensed SGMM partner organizations at www.sei.cmu.edu/partners/sgmm.

What materials do I need to get started with the SGMM?
To facilitate easy and effective adoption of the SGMM, we offer these freely available materials on our website:

- SGMM Model Definition
- SGMM Matrix, a summary view of the model domains and expected characteristics
- SGMM Compass Assessment Survey, designed to characterize the status of a utility's smart grid implementation in the context of the SGMM
- SGMM Navigation Process, developed to help organizations chart a technical, organizational, and operational path through their grid modernization effort

Are SGMM product suite materials available for download?
Yes, you can download the materials from www.sei.cmu.edu/smartgrid/start/downloads.

Are there services available to help me adopt SGMM?
On our website, you can access a directory of licensed SGMM Partner organizations that have sponsored individuals for SGMM Navigator certification. Please see www.sei.cmu.edu/partners/sgmm.

ESSENTIAL ANSWERS
Getting started on charting smart grid transformation

If I complete the assessment survey, will the information be publicly available?
Survey data linked to an individual electric utility will not be released without the permission of that utility. Survey responses will be entered into the aggregated data that is reported for the good of the industry and for comparison to future SGMM survey participants, but individual responses will not be attributed to any particular utility. Only aggregated or blinded views of the data will be publicly available, to include use of the data via white papers and presentations, or as part of best practice and research activities.

What is an SEI Partner?
The SEI Partner Network disseminates trusted, leading-edge SEI methods and technologies throughout the worldwide SEI community. SEI Partners are organizations that are carefully licensed and monitored by the SEI to deliver official SEI courses, methods, and processes.

What SGMM-related training courses does the SEI offer?
We offer SGMM Navigator Training as preparation for leading the SGMM Navigation process. Sponsored SEI-certified SGMM Navigators deliver official licensed SEI SGMM Navigation process services on behalf of SEI Partner organizations. Navigators guide an organization toward determining its smart grid maturity.

Where do I get the most recent SGMM information?
We offer three good ways to stay current with SGMM developments:
1. Join the SGMM mailing list by sending an email with your request to info@sei.cmu.edu.
2. Join the SGMM User Forum on LinkedIn: http://linkd.in/OcMIuB.
3. Visit www.sei.cmu.edu/smartgrid.

Will the SGMM change? How?
Stakeholder needs and requirements will determine how the SGMM evolves. We provide a baseline that not only allows utilities and others to use the model effectively but also serves as a foundation to solicit model improvements.

How can I collaborate with the SEI in this work?
Start by joining the SGMM mailing list. Send an email with your request, as well as any questions, comments, or ideas for collaboration, to info@sei.cmu.edu.

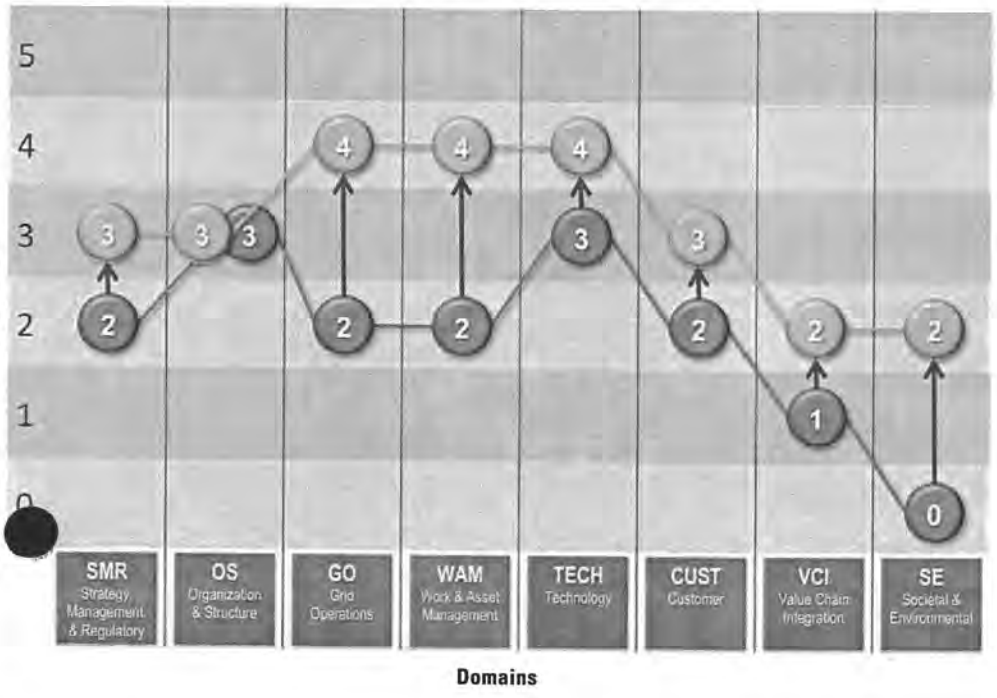
Related Websites
www.sei.cmu.edu/smartgrid
www.sei.cmu.edu/smartgrid/tools

For general information
For information about the SEI and its products and services, contact
Customer Relations
Phone: 412-268-5800
FAX: 412-268-6257
info@sei.cmu.edu
www.sei.cmu.edu

www.youtube.com/user/seicmu
www.linkedin.com/company/3146
https://twitter.com/SGMM_Navigator
www.facebook.com/SEICMU

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15313-2612

SGMM and our Navigation process help you decide

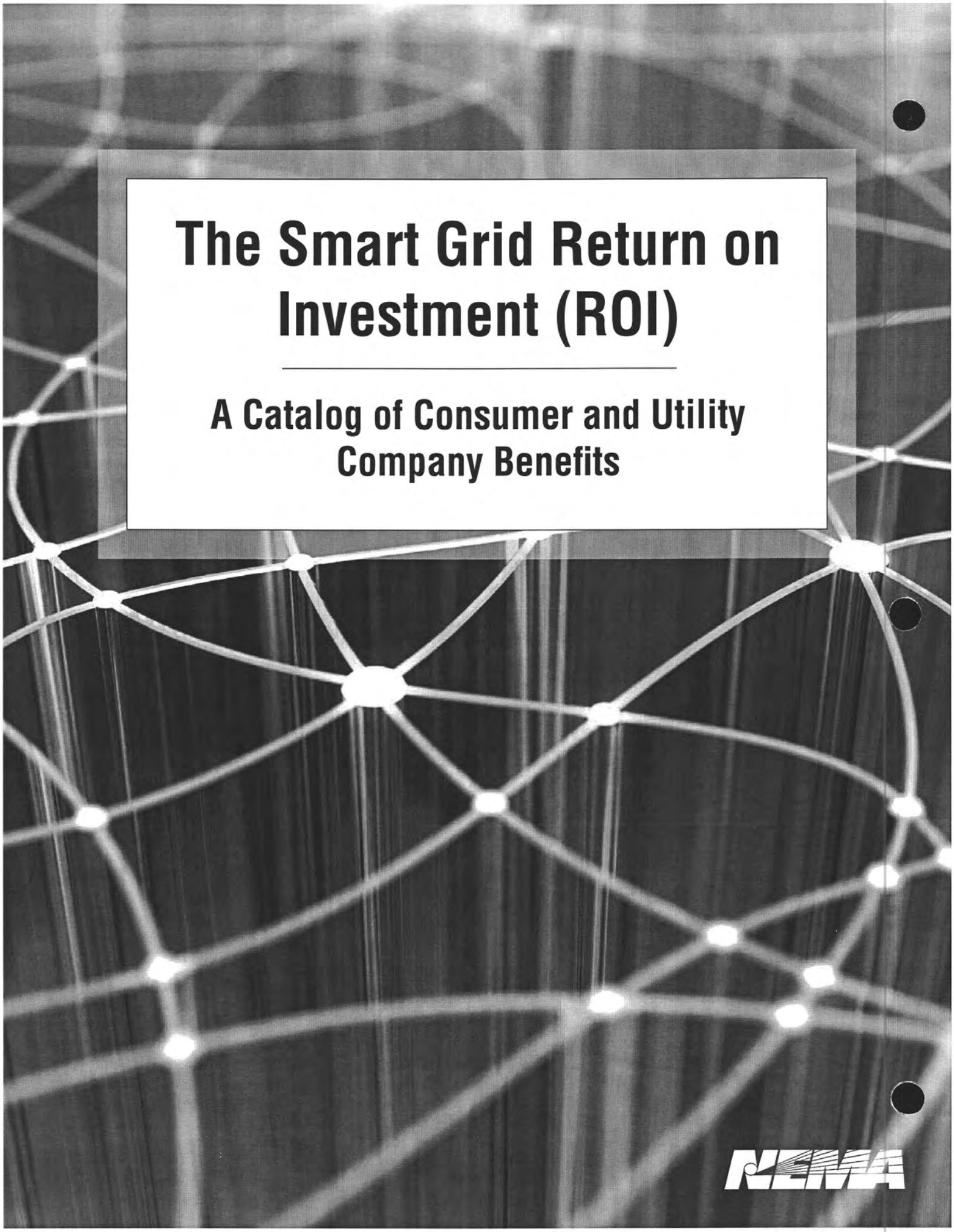


Where you aspire to be in X years

Where you are today

Applying the SGMM provides a view of where a utility is and where it wants to mature to achieve its smart grid vision

The Software Engineering Institute (SEI) is a federally funded research and development center sponsored by the U.S. Department of Defense and operated by Carnegie Mellon University.



The Smart Grid Return on Investment (ROI)

A Catalog of Consumer and Utility Company Benefits

NEMA

The Smart Grid Return on Investment (ROI)

A Catalog of Consumer and Utility Company Benefits

Executive Summary

> *"A smart grid uses digital technology to improve reliability, security, and efficiency (both economic and energy) of the electric system from large generation, through the delivery systems to electricity consumers..."*
>
> *U.S. Department of Energy, Smart Grid Systems Report*[1]

December of 2012 marks the fifth anniversary of the *Energy Independence and Security Act of 2007* (better known as EISA), the landmark piece of legislation that launched the U.S. government's effort to modernize the nation's electrical system and produce a "Smart Grid."[2] Aided by a grant program as part of the *American Investment and Recovery Act of 2009* (ARRA or the Stimulus Act)[3], federal and state agencies have come together with the electrical industry to design and install a variety of solutions aimed at achieving the objectives outlined in EISA. As the results from these investments start to become apparent, it is important to take a critical look at the value they are providing to utility companies and consumers alike.

As the examples in this whitepaper will show, financial, environmental, and societal benefits are all achievable from Smart Grid implementations:

- The Smart Grid plan adopted by Commonwealth Edison will generate immediate savings on customer's electric bills;
- Investments by Austin Energy promote a smarter, more efficient grid that also involves the consumer in energy consumption decisions;
- Virginia Dominion Power uses Smart Grid technologies to save thousands of megawatts in future generating capacity;
- Minnesota Power uses long-haul transmission and energy storage to incorporate the massive wind energy potential in the Midwest; and
- The Bonneville Power Administration implements an effective Conservation Voltage Reduction program saving generation costs that are shared by its members.

The key to achieving additional benefits from the Smart Grid is to continue to fortify and adapt the business model for utility companies based on the prospect of achieving a favorable return on investment. Whether a utility is municipal, cooperative, or investor-owned, the revolutionary technologies that make these benefits possible require structural changes in the utility operating environment that are equally as bold. Regulators and legislators will have a major hand in the success of this endeavor as they wrestle with a range of challenges necessary to the success of the Smart Grid. These may include financing mechanisms such as low-interest government-backed loans, technology considerations based on variations for the service life of Smart Grid products when compared to legacy predecessors, changes to the accounting rules to avoid stranded assets in utility operations, and rate schemes that take advantage of emerging technologies.

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[1] http://www.smartgrid.gov/sites/default/files/pdfs/sgsr_main.pdf

[2] U.S Congress, Public Law 110-140, *Energy Independence and Security Act of 2007*, Title XIII.

[3] U.S. Congress, Public Law 111-5

Background

"A penny saved is a penny earned"
Variation on a phrase in George Herbert's
Outlandish Proverbs *circa 1633*[4]

In some cases, the Return on Investment (ROI) argument is extremely obvious—money spent on Smart Grid technologies promote efficiencies that enable the consumer to directly and immediately save money on their electric bill. In other cases, the ROI is much more nuanced. A utility company may incur a Smart Grid expense today in exchange for some form of operational efficiency down the road. Regulatory filings will often express these benefits in terms of their "net present value" or NPV, making it very easy to show ROI as a percentage of the expense. However, when the utility states the benefits over a period of time, it's much more difficult to calculate an exact ROI.[5] Regardless of the interval, the savings expressed by the utility company still represent a real operational expense that would otherwise become part of the rate base, which is ultimately another financial benefit to the consumer. And finally, it's possible that in some cases a Smart Grid investment may yield a societal or environmental benefit that can't be measured in dollars and cents.

Historically, Benjamin Franklin has been credited as the source of the quote listed above, when actually he was born 73 years after it was published in its original form, "A penny spar'd is twice got."[6] In the context of the Smart Grid, the economic equivalent of the penny-saved saying is contained in the energy sector cliché, which states that the cheapest power plant is the one we don't have to build. A typical example illustrating this concept is Virginia Dominion Power, which announced that it intended to install $600 million of equipment to create a "smart" electric grid that "will produce environmental benefits while providing customers with substantial cost savings."[7] As a starting point, Dominion installed 30,000 smart meters with an additional $1.5 million in synchrophasor technologies which together provide dynamic, real-time information about the conditions on the grid.[8, 9] The operational efficiencies derived by the combination of a smart distribution and transmission system, in conjunction with Dominion's EDGE℠ Energy Efficiency program for consumers, provide the primary drivers for the utility's savings.[10] As a result, Dominion's Smart Grid implementation will produce customer savings of over $1 billion against the $600 million investment—an ROI of just under 67 percent. Environmental and societal benefits associated with the program include the ability to forgo the construction of two power plants, and delay the implementation of two more despite the fact that customer demand for electricity is expected to grow by more than 4,000 MW over the same period.[11]

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[4] http://www.phrases.org.uk/meanings/a-penny-saved-is-a-penny-earned.html
[5] NPV calculations include a factor for the time-based value of the investment.
[6] http://www.phrases.org.uk/meanings/a-penny-saved-is-a-penny-earned.html
[7] http://www.sustainablebusiness.com/index.cfm/go/news.display/id/16269
[8] http://www.dom.com/dimensions/customers/smart-grid-applications.jsp
[9] http://dom.mediaroom.com/index.php?s=43&item=812
[10] http://www.dom.com/business/dominion-voltage/edge-overview.jsp
[11] Ibid.

The Case for Sustained Utility Company Investment

"1. Electrification"
National Academy of Engineering,
Top Engineering Achievements of the 20th Century[12]

Collectively, we are faced with an aging, over-stressed electric grid—parts of which are dangerously antiquated. As many have noted relative to the quote from the National Academy of Engineering above, even as we complete the first decade of the 21st century, if Thomas Edison or George Westinghouse were alive today, they would recognize much of the technology as the same they had used to build electric grids in the late 1800s.

The blackout in August of 2003 that affected the northeastern United States and central Canada was an eye-opening event that resulted in a number of studies about the performance of the grid. The aftermath of the event included having an impact on two major pieces of federal legislation: the *Energy Policy Act of 2005* and the *Energy Independence and Security Act of 2007*. Portions of each law dealt with electricity reliability and the Smart Grid.

In July of 2004, the North American Electricity Reliability Council issued a report to the NERC Board of Trustees on the causes of the blackout.[13] Viewing the event from several perspectives, the report details the conditions (including weather and load) in the moments leading up to the event that triggered the outage, and then follows the behavior of multiple grid elements (including the operators) as the events of the day unfolded. In a moment of absolute clarity describing the cause of the blackout, the report states, "Simply put—blaming a tree for contacting a line serves no useful purpose." [14] The report then goes on to list a variety of deficiencies that include everything from a lack of situational awareness and poorly trained operators, to failed alarms and poor vegetation management practices.

ComEd
An Exelon Company

In December of 2011, Commonwealth Edison filed a "first-of-its-kind utility performance metrics program with financial penalties" with the Illinois Commerce Commission.[15] As part of a series of filings in its grid modernization program, the initial filing "triggered a process that should lead to a $44 million reduction in ComEd's current rates."[16] The metrics outlined in the filing focus on "improving system reliability, reducing estimated bills, reducing customer costs associated with unaccounted for energy consumption and theft, and increasing support for minority- and women-owned businesses. Among the performance standards are:[17]

- Reducing the frequency of outages by 20 percent over 10 years resulting in 700,000 fewer outages per year. This will save consumers a projected $100 million in outage-related costs.
- Reducing annual average outage duration by 15 percent over 10 years.
- Reducing ComEd's Southern Region frequency of outages by 20 percent over 10 years. This area includes the southern suburbs, which have traditionally lagged other regions in service reliability.

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[12] http://www.nationalacademies.org/greatachievements/Feb22Release.PDF, February 22, 2000.
[13] *Technical Analysis of the August 14, 2003 Blackout: What Happened, Why, and What Did We Learn?* North American Electric Reliability Corporation, Princeton, NJ, July 13, 2004.
[14] Ibid, pp. 94.
[15] http://www.smartenergyil.com/update/comed-files-historic-utility-accountability-standards-benefit-consumers
[16] Ibid
[17] Ibid

- Reducing ComEd's Northeastern Region frequency of outages by 20 percent. This area includes the north and northwest suburbs, which were devastated by storms this past summer. This metric assumes that HB 3036 (trailer bill) is signed by the Governor.
- Improvement in the total number of customers who exceed the service reliability targets by 75 percent over the 10 year period.
- Reducing the number of annual estimated electric bills by 90 percent over 10 years.
- Reducing consumption on inactive meters, a cost borne by all customers, by 90 percent over 10 years.
- Reducing electricity theft, a cost borne by all customers, by 50 percent over 10 years.
- Reducing bad debt expenses, a cost borne by all customers, by $30 million over 10 years.

Here again, in addition to the financial benefits enumerated above the ComEd announcement projects a societal benefit by "increasing opportunities for minority- and women-owned businesses by 15 percent over a 10 year period, representing millions in additional spending every year for these businesses."[18]

ComEd is one of many utilities taking an aggressive approach to its Smart Grid implementation plans. A number of other examples are available on the Smart Grid Information Clearinghouse website: http://www.sgiclearinghouse.org/businesscases.

The Case for Involving the Electricity Customer

> *"Improving consumers' understanding of and access to the electric energy usage information of the consumers will help consumers more effectively manage usage."*
> *S.1029, The Electric Consumer Right to Know Act or e-KNOW Act*[19]

Electricity customers come in a variety of sizes and types, but they are generally broken down into three categories: residential, commercial, and industrial. Some customers can occupy multiple categories as companies like Google and Boeing operate significantly large office buildings in addition to large data centers and manufacturing facilities. In the Department of Defense, base-level metering is not uncommon which means that a single military facility could operate residential (barracks and housing), commercial (exchanges, commissaries, and hospitals), and industrial (operational units and motor pools) facilities concurrently on an installation's electric bill.

	Number of Customers (Pct. of Total)	Thousand MWh (Pct. of Use)	Avg. Retail Price in cents per kWh
Residential	125.7 million (87.22%)	1,445,708 (38.51%)	11.54
Commercial	17.7 million (12.26%)	1,330,199 (35.43%)	10.19
Industrial	0.748 million (0.52%)	970,873 (25.86%)	6.77
All Sectors	*144.140 million*	*3,754,493*	*9.83*

Table 1. U.S. Retail Electricity Sales Data, 2010

[18] Ibid
[19] http://www.gpo.gov/fdsys/pkg/BILLS-112s1029is/pdf/BILLS-112s1029is.pdf

According to the U.S. Energy Information Administration's *Electric Power Annual (EPA) 2010* report, Table 1 represents the amount of electricity used by each of the three customer categories. It's amazing how close the breakdown in usage is across the three categories despite the vast differences in numbers of customers.[20]

In terms of getting the customer involved with his or her energy usage, the White House Policy Framework for the 21st Century Grid notes that, "Commercial and industrial (C&I) consumers enjoy powerful opportunities for energy efficiency and demand response, but generally experience fewer of the information and access barriers that affect residential consumers and small businesses."[21]

In June 2010, the American Council for an Energy-Efficient Economy (ACEEE) released a report that examined the results of 57 feedback studies "which had sufficient data on the energy savings from various feedback approaches."[22] In its analysis, the ACEEE cited a variety of customer feedback mechanisms that were categorized as either "indirect," meaning enhanced billing, websites, and daily or weekly reporting, or "direct" which included real-time and premise-level information down to the individual appliance. As the report states, "if broadly implemented in the United States using well-designed programs, residential sector feedback programs could provide the equivalent of 100 billion kilowatt-hours of electricity savings annually by 2030."[23]

The most successful implementation in terms of integrating the consumer into the Smart Grid is the Pecan Street demonstration project hosted by Austin Energy and the University of Texas in the historic Mueller neighborhood of Austin, Texas. The Pecan Street project is the very model of interoperability as a smart distribution system is fully integrated with renewable generation through solar panels, a local communication system, and consumer controls to implement an advanced electricity and water conservation environment.

The benefits of the fully-integrated environment in the Pecan Street project were summed up in a 2010 report which included a set of recommendations for Austin Energy. Some of the cost-saving benefits the report cites include "fuel savings, decreased line losses, and less need for transmission and distribution lines."[24] The report goes on to lay the groundwork for the changing relationship between the consumer and the utility company. In the future, the consumer cannot be simply considered a load to the utility company, but has to be seen as an integrated partner hosting renewable generation devices and participating in demand response programs. It goes on to detail rate structures and business models that will help to complete this transformation.

The Case for System Efficiency

In the mid-1970s, researchers at Lawrence Livermore National Laboratory in California began tracking and publishing an annual "Energy Flow Chart" based on the total energy inputs and points of

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[20] http://www.eia.gov/electricity/annual/pdf/tablees1.pdf

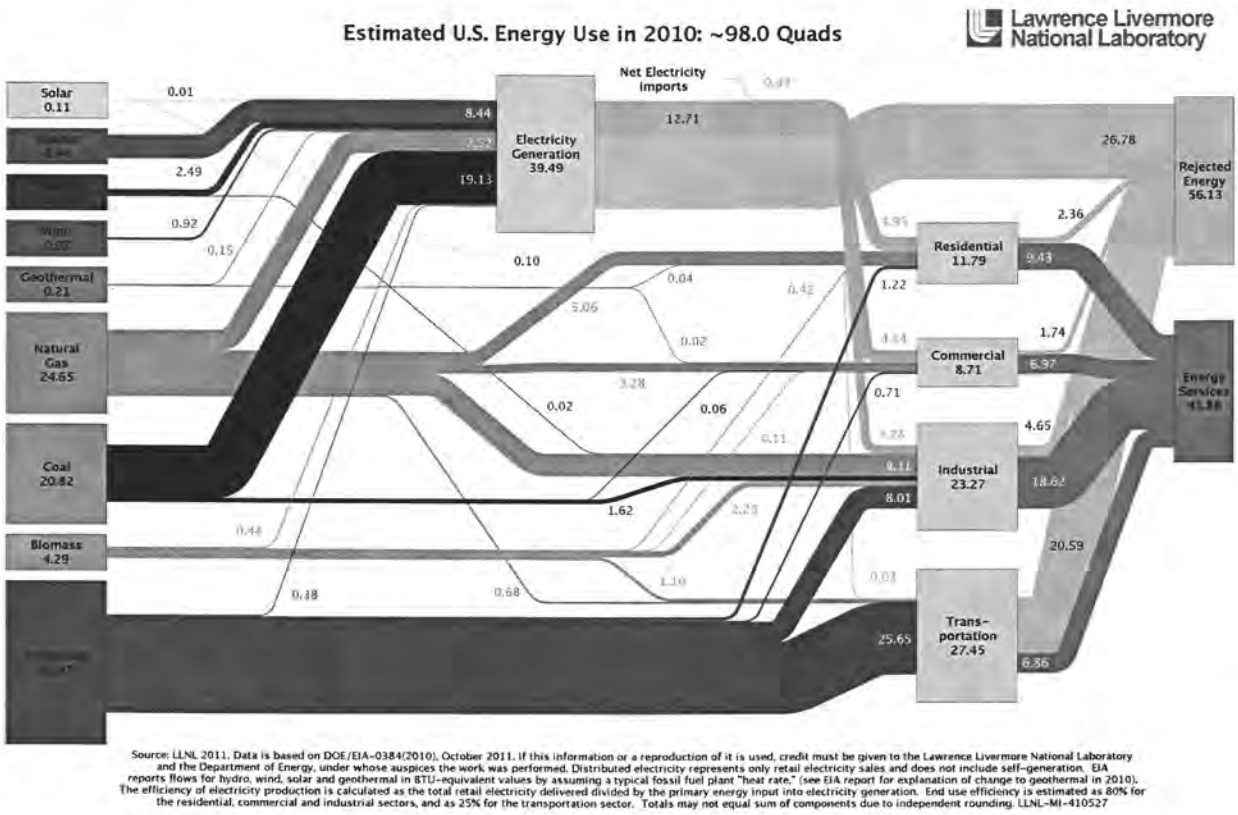
[21] Executive Office of the President, National Science and Technology Council, Washington, DC, 20502; June 13, 2011, pp37.

[22] Ehrhardt-Martinez, K., et. al., *Advanced Metering Initiatives and Residential Feedback Approaches: A Meta-Review for Household Electricity-Saving Opportunities*, © June 2010, ACEEE, Washington, DC 20045

[23] Ibid, pp.iii

[24] http://www.pecanstreet.org/wordpress/wp-content/uploads/2011/08/Pecan_Final_Report_March_2010.pdf

consumption in the U.S. economy.[25] Based on "vast quantities of data from the Department of Energy's Energy Information Administration (EIA)," perhaps the most telling detail in the chart is the area dedicated to electricity generation. As seen in Figure 1, for the estimated data in 2010 of the 39.49 quads (short for quadrillion BTU) that were committed to the process of electricity generation, some 26.78 quads or just over 67.8 percent of the total input ended up as "Rejected Energy."



Source: LLNL 2011. Data is based on DOE/EIA-0384(2010), October 2011. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for hydro, wind, solar and geothermal in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." (see EIA report for explanation of change to geothermal in 2010). The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 80% for the residential, commercial and industrial sectors, and as 25% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

Figure 1. 2010 Energy Flow Chart

From the perspective of the energy flow chart, there is room for improvement in the operation of the electric grid. But the question is, "How?" What's lacking in the Livermore diagrams is any level of granularity in the data that the observer can turn into actionable intelligence; that is where the Smart Grid provides value.

Voltage optimization is the holy grail of electric power for the distribution system. Utility companies strive to keep voltages within regulator-specified limits in order to provide a sustainable electrical current for devices connected to the grid. Meanwhile, manufacturers strive to produce devices that will tolerate the voltage fluctuations that are inherent within those limits. Too much voltage fed into a home, office, or factory (a condition called "overvoltage") is a waste of energy that might cause certain devices to produce excessive amounts of heat in their internal wiring. Too little voltage can result in a condition called a "brownout," where individual devices might trip on and off as the voltage continues to fluctuate below acceptable levels. Either way, too much or too little voltage could result in reducing the service life of the device.

[25] https://str.llnl.gov/Sep09/simon.html

In a three-year study called the Distribution Efficiency Initiative (DEI), the Northwest Energy Efficiency Alliance (NEEA) "studied and evaluated cost-effective methods of implementing DSE [distribution system efficiency] and voltage optimization (VO) on distribution systems."[26] Utilizing both a load research study and concurrent demonstration project, the outcomes were described in a February 2010 *Transmission & Distribution World* article as follows:[27]

> *"The overall results of the study conclusively show that operating a utility distribution system in the lower half of the American National Standards Institute (ANSI) C84.1 standards' acceptable voltage range of 120 V to 114 V saves energy, lowers demand and reduces reactive power requirements without negatively impacting customer service. By implementing both DSE and VO in concert, utilities can cost effectively achieve a 1% to 3% energy kilowatt-hour reduction, a 2% to 4% reduction in kilowatt demand, and a 4% to 10% reduction in reactive power demand. Computer models demonstrate that 10% to 20% of the energy savings can occur on the utility side of the meter."*

Seizing on the DEI results, the Bonneville Power Administration (BPA) has implemented an Energy Smart Utility Efficiency (ESUE) program focused on distribution efficiency and conservation voltage reduction (CVR). Established in 1937, the BPA markets wholesale electrical power from 31 hydroelectric sites located on the Columbia River and a transmission network that covers Washington, Oregon, and Idaho and extends into parts of Montana, California, Nevada, Utah, and Wyoming.[28] While they don't have a specific stake in the distribution grid, as a public service organization formed under the federal government, the BPA is committed to advancing a vision that includes responsible environmental stewardship and accountability to the region. [29]

Effective voltage optimization is a concept that relies on all of the capabilities of the Smart Grid. Simply lowering voltage at the substation may cause unacceptably low voltages at the tail-end of a distribution line. In a similar vein, raising the voltages at the substation could cause persistent overvoltage conditions at the head-end. In order to successfully implement voltage optimization, CVR systems require the assistance of the Smart Grid's most visible component—the advanced metering infrastructure (AMI) or so-called "smart meter." The first generations of electric meters simply had the capability of measuring (electromechanical) and/or reporting (automatic meter reading or AMR) the amount of electricity that passed through them. Modern AMI-based smart meters cannot only measure electricity usage, but they can also report system voltages at the customer end that would be necessary for a utility company to implement voltage optimization.

For two implementations in the BPA service region (the Clark and Cowlitz Public Utility Divisions), the ESUE's incentive program offered to pay the utility either twenty-five cents per kWh, or 70 percent of the project installed cost, whichever is less.[30] Either way it's a win-win situation for the consumers and utility companies alike. Utility companies win because they can leverage the existing investment in smart meters, see greater efficiency in the overall distribution system, and can recover their costs by

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[26] http://tdworld.com/overhead_distribution/distribution-system-efficiency-20100201
[27] Ibid, February 1, 2010
[28] http://www.bpa.gov/corporate/About_BPA
[29] Ibid
[30] http://tdworld.com/overhead_distribution/voltage-optimization-20101101, November 1, 2010

lowering their generation levels and/or power-purchasing burden. At the same time, consumers win because of the savings in future generation costs by the utility and the environmental benefits. According to one article, if we achieve an increase of only three percent across the board, it would be equivalent to "over twice the energy provided by solar power installations in the U.S. And, since we're talking demand reduction, benefits don't rely on weather or time of day, and you don't have to figure out how to store it."[31]

The Case for Integrating Renewable Generation

The physics of the power grid demand (and NERC rules require) that all electricity generation and consumption remain in balance at all times. Minor imbalances in the power grid can be cured by localized, automated corrections exercised by existing reactive-power grid technologies like capacitors, reactors, voltage regulators, reclosers and in more recent cases, energy storage solutions that have the ability to absorb excess power from the grid. Each of these devices performing their assigned duties compensate for spikes and sags in the available electric power and account for the reason your lights might flicker during a thunderstorm as various electrical sources and loads are impacted by the weather.

Major imbalances for which there is no adequate compensation in the grid (like the loss of a transmission line during the blackout in August 2003), can cause cascading failures, widespread outages, economic distress, and physical damage to the generation and transmission assets of grid operators. At its best, intermittency is merely a magnifier of imbalances on the grid; at its worst, it is also a source of them. Unfortunately, some of the more beneficial components of the 21st century power grid (in terms of their carbon footprints) introduce levels of intermittency to the grid that were previously unimaginable, namely wind and solar generation and electric vehicles. These trade-offs were the subject of a number of *Wall Street Journal* articles in the latter parts of 2011.[32]

In a pair of comprehensive studies, the U.S. Department of Energy (DOE) sponsored programs at the National Renewable Energy Laboratory (NREL) to examine the operational impacts of high penetrations of wind power in the eastern U.S., as well as wind coupled with solar power in the western U.S.[33] A finding that is common to both studies is that the grid could accommodate both the variability and uncertainty of a high-penetration of renewable power through a process that involves more dynamic management of generation reserves.

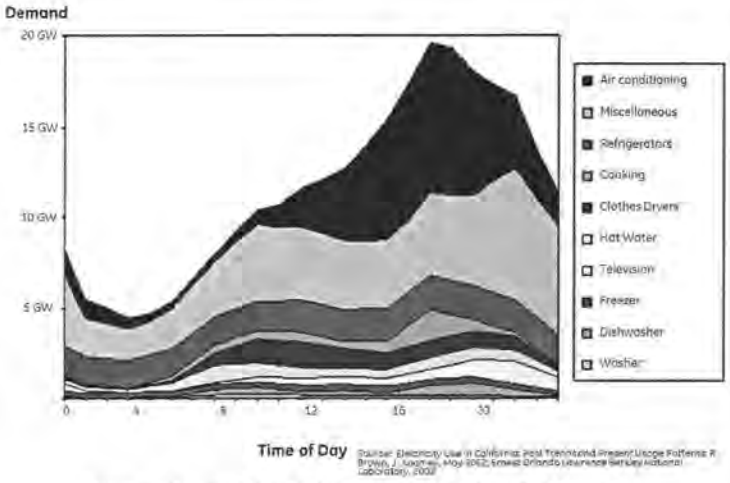

Figure 2. Residential Summer Loads - California

Today, generation reserves are deployed across several, fairly predictable bands of the demand curve such as the residential summer loads reflected in Figure 2. Utility company experience is applied to observable weather patterns and the reserve generation capacity is dispatched to follow the load as the

[31] http://smartenergyportal.net/article/conservation-voltage-reduction-no-brainer-smart-grid-benefit

[32] From online.wsj.com: *The EPA's Reliability Cover-Up*, November 15, 2011; and *If the Lights Go Out*, December 6, 2011

[33] http://www.nrel.gov/wind/systemsintegration/

curve moves from the nominal base load demand to the expected peak over the course of a day.[34] The key concepts in this description are the terms "predictable" and "dispatchable" as neither of them can be applied to wind and solar generation capabilities in the same operational sense that utility companies use them today.

In a study released in December 2011 by Alstom Grid, Inc. for the U.S. Department of Energy,[35] a variety of techniques for accommodating high penetrations of wind power were described based on the lessons learned from utility companies across the globe. Based on survey information, a key theme in the best practices presented in the report is flexibility: procuring flexible resources, managing congestion, economical dispatch, dispatchable loads, flexible generation, etc.[36] The report goes on to say "efficient integration of wind energy requires that the grid operator has access to the proper mix of flexible resources ranging from supply-side, delivery-side and the demand-side...several of the changes in operational processes, which respondents rank as having high value for wind integration, are related to measures that are known to provide flexibility to power systems."[37]

An interesting paradigm related to this concept is an arrangement that has been struck between Minnesota Power, a utility in the U.S., and Manitoba Hydro, a utility in Canada. In May 2011, Minnesota Power announced a deal that "includes a wind storage provision that allows Minnesota Power to transmit energy northward from its wind farms in North Dakota when wind production is high or electric loads are low. Manitoba Hydro will then absorb the wind power into its system—in essence storing the wind power, using the Manitoba system as a rechargeable battery."[38]

The "storage" referred to in this article is actually the backbone of Manitoba Hydro's system, a series of 14 hydroelectric systems scattered throughout the province. The electricity from Minnesota Power's wind farms is aggregated and incorporated into Manitoba Hydro's base load, and in order to keep its grid in balance, Manitoba Hydro will simply curtail their hydroelectric dams.

The Case for Supporting Electric Vehicles

In addition to the variability of renewable generation, electric vehicles (EVs) present a new and interesting challenge to grid operators: the idea of a mobile load. While a certain percentage of the electrical load has always been mobile, it has never approached the levels that could be possible with EVs. In the White House's policy statement for the 21st century grid, the Obama administration reiterated its goal of having one million electric vehicles on the road by 2015.[39] In an online search of Library of Congress documents, 57 pieces of legislation containing the phrase "electric vehicle," (many

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[34] Blume, Steven W., *Electric Power System Basics for the Nonelectrical Professional*, pp. 188-195, © 2007 by the Institute of Electrical and Electronics Engineers, Inc. Published by John Wiley & Sons Inc., Hoboken, NJ.

[35] Jones, Lawrence E., *Strategies and Decision Support Systems for Integrating Variable Energy Resources in Control Centers for Reliable Grid Operations*, U.S. Government Contract No. DE-EE0001375.

[36] Ibid, Section 5.4 and 5.5

[37] Ibid, pp. 30

[38] http://www.cbc.ca/news/canada/manitoba/story/2011/05/24/mb-hydro-sale-power-minnesota.html

[39] Executive Office of the President, National Science and Technology Council, *A Policy Framework for the 21st Century Grid: Enabling Our Secure Energy Future*, pp. 1.

targeted at incentivizing the EV or charging station purchases) had been introduced during the first session of the 112th U.S. Congress.[40]

In essence, a vast proliferation of EVs not only means additional overall electrical demand, but because the vast majority of EVs are targeted to the consumer market, the EVs that are charging in a residential area overnight will possibly appear in various retail, commercial, and industrial locations during the day. While a certain amount of the electricity load has always been mobile (following the commuter from home to work and back again), the amount of electricity involved with electric vehicle charging takes this challenge to a whole new level.

The *National Electrical Code* outlines specifications for electric vehicle charging requirements,[41] for which there are three charging levels being developed in the U.S. by the Society of Automotive Engineers (SAE):[42]

- **Level 1** uses the common 110-volt electrical supply in order to facilitate virtually ubiquitous access for EV charging—any functioning electrical outlet can be used to charge a vehicle;
- **Level 2** charging uses a 240-volt electrical supply and will require that a dedicated charging station be hard-wired to a fixed location. According to the Tennessee Valley Authority, Level 2 will likely be the charging level of choice for commercial EVs and public outlets;[43] and
- **Level 3** has not yet been defined, but could entail even higher voltage than Level 2 charging, as well as some form of direct current (dc) fast charging. (According to DOE sources[44], lower-voltage dc charging has been proposed for Level 1 (up to 20kW dc) and Level 2 (up to 80kW dc) charging standards).

Depending on how they are supported by the various utility companies and regulatory commissions, high penetrations of EVs could require substantial changes to the grid. In terms of the utility business model, it may be necessary to support special rates for EV charging, changes in metering and/or submetering technologies, and back office systems that support some form of roaming charge for EV owners that could potentially cross control area boundaries. It could also be necessary to create third-party classifications for parking providers, convenience stores, retailers, or employers who want to offer EV charging for their customers and employees. Once all of these issues are resolved, the utility company still needs to figure out how to incorporate the operational implications of these factors in their grid management system.

The conceptual design of a Smart Grid forms the ideal platform for accommodating both the variability and mobility of the load associated with electric vehicles. Two documents, the Federal Energy Regulatory Commission's (FERC) *Smart Grid Policy; Final Rule*[45] and the National Institute of Standards and Technology's *NIST Framework and Roadmap for Smart Grid Interoperability Standards*,[46] form the primary sources from which a vast majority of industry draw their direction. Together these publications list eight priority application areas for Smart Grid standardization:

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[40] Search conducted on www.thomas.loc.gov, December 30, 2011; the 112th Congress began on January 5, 2011.
[41] National Fire Protection Association, *NFPA 70®: National Electrical Code*, Article 625, 2011.
[42] https://www.tva.gov/environment/technology/car_infrastructure.htm
[43] Ibid.
[44] http://www1.eere.energy.gov/cleancities/toolbox/pdfs/ev_charging_requirements.pdf
[45] FERC 18 CFR, Chapter 1; July 27, 2009
[46] NIST Special Publication 1108; Release 1.0, January 2010

- Demand Response and Consumer Energy Efficiency
- Wide-Area Situational Awareness
- Energy Storage
- Electric Transportation
- Advanced Metering Infrastructure
- Distribution Grid Management
- Cyber Security
- Network Communications

Any grid operator who must address a high penetration of renewable generation and/or widespread adoption of electric vehicles would have to rely on the tools that deliver wide-area situational awareness, network communications, and distribution management in order to achieve the necessary levels of operational flexibility. Also, one of the greatest weapons for dealing with intermittency is the application of energy storage technologies, which also happens to be another of the eight priority application areas.

The Case for Transmission System Investments

The two major challenges confronting the nation's transmission system are reliability and efficiency. Unlike any other domain in the grid, there is also an international component to the transmission systems' operation. Generation, distribution, and customer resources exist only on one side or the other of the U.S. borders with Canada and Mexico. As shown in Figure 3 and illustrated in the Minnesota Power example in the previous section, the transmission system is an international resource.[47]

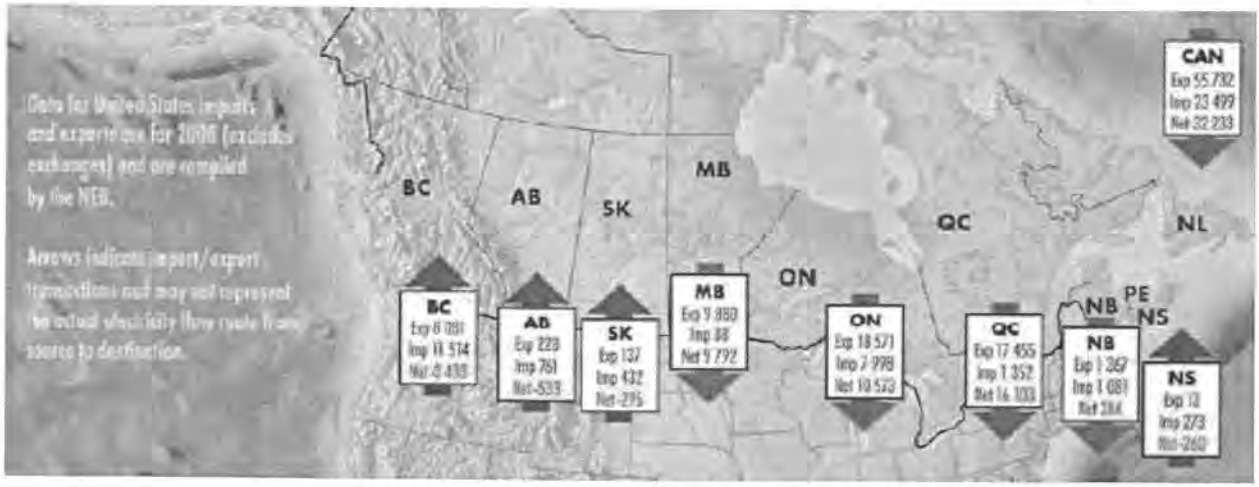

Figure 3. 2008 Canadian Transfers of Electricity

In April of 2004, the U.S.-Canada Power System Outage Task Force issued its final report on the August 14, 2003 blackout.[48] Not to be confused with the NERC final report that was published in July 2004, the

[47] National Energy Board of Canada; *Canada's Energy Future, Infrastructure Changes and Challenges to 2020*, October 2009, pp. 29.

[48] *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*, U.S.-Canada Power System Outage Task Force, April 2004.

U.S.-Canada Task Force was formed as a collaborative effort sponsored by the U.S. Department of Energy and the Canadian Ministry of Natural Resources. Because the failures of the August blackout were felt on both sides of the U.S.-Canadian border, the introductory remarks to the *Recommendations* section state that, "The interconnected nature of the transmission grid requires that reliability standards be identical or compatible on both sides of the Canadian/U.S. border."[49] The report then includes a collection of 46 recommendations, fourteen of which deal specifically with reliability. To this end, *Recommendation 4* states, "Clarify that prudent expenditures and investments for bulk system reliability (including investments in new technologies) will be recoverable through transmission rates."[50]

As previously mentioned, the impacts of the August 2003 outage influenced the development of the *Energy Policy Act of 2005*. Pursuant to this, in July of 2006 the Federal Energy Regulatory Commission (FERC) issued Final Rule 679 "for the purpose of benefiting consumers by ensuring reliability and reducing the cost of delivered power by reducing transmission congestion."[51] Attempting to quantify the hard costs of transmission congestion, one section of the ruling notes that:

> *"Many commenters agree that there is a significant need for new investment in transmission facilities. EEI states that, although increases in transmission investment are predicted over the 2004 to 2008 period, the industry still has not reached the optimal level of investment. International Transmission notes that growth in transmission capacity has lagged behind the growth in peak demand over the last three decades and this trend is projected to continue through at least 2012. International Transmission cites to studies estimating the cost of power interruptions and fluctuations to range from between $29 billion and $135 billion annually, the cost of the August 2003 Northeast-Midwest blackout to be between $4 billion and $10 billion, congestion costs of $4.8 billion in the ISO/RTO markets of California, New York, New England, the Midwest and PJM for 1999 to 2002, and increases in PJM congestion costs, from $499 million in 2003 to $808 million in 2004."*[52]

The benefits of the transmission investments spurred by FERC Order 679 are evident the U.S. Department of Energy's *Smart Grid System Report* issued in July 2009. In the three years following the FERC Final Rule, the System Report observed that "gross annual measures of grid operating efficiency have been steady or improving slightly as the amount of energy lost in generation...and transmission and distribution losses improved very slightly" as a percentage of net generation. While this is an encouraging trend, not every indicator is positive. Indices for Service Average Interruption Duration (SAIDI), Customer Average Interruption Duration (CAIDI), and System Average Interruption Frequency (SAIFI) have not improved. The report attributes that "the worsening trend in these indices suggests that a lack of investment in the delivery infrastructure is having an impact."[53]

A continuing challenge, especially with respect to large-scale renewable energy, is the ability to get electricity from the generation source to the point of consumption. This problem is especially

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[49] Ibid, pp. 143.
[50] Ibid, pp. 146.
[51] 18 CFR Part 35, Federal Energy Regulatory Commission, *Promoting Transmission Investment through Pricing Reform*, (Docket No. RM06-4-000; Order No. 679), Final Rule, Issued July 20, 2006.
[52] Ibid, pp. 8-9
[53] U.S. Department of Energy, *Smart Grid System Report*, July 2009, pp. 45.

noticeable when you compare a U.S. map showing the population density to those showing wind and solar potential.

Figure 4. U.S. Population Density by County

Figure 5. U.S. Wind Power Potential

Figure 6. U.S. Photovoltaic Solar Potential

In September of 2009, the National Energy Technology Laboratory of the U.S. Department of Energy published a document called *The Transmission Smart Grid Imperative.*[54] Because of advancements driven by the Smart Grid, the report states that, "new and emerging requirements find transmission in roles it was not designed to perform."[55] The stresses on the transmission system will not only increase because of wind and solar penetration, but will also be driven by more active wholesale markets as a result of TOU rates.

Section 1304 of the *Energy Independence and Security Act* states that the Secretary of Energy "shall seek to leverage existing Smart Grid deployments...to facilitate the commercial transition from the current power transmission and distribution system technologies to advanced technologies."[56] To this end, the *American Reinvestment and Recovery Act of 2009* included specific allocations for the incorporation of phasor measurement units (PMUs), better known as synchrophasors and other transmission system optimization technologies. As of December 2010, the Smart Grid Information Clearing House listed ten projects that will implement a total of 625 PMUs as part of the stimulus program.

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[54] http://www.netl.doe.gov/smartgrid/referenceshelf/whitepapers/The%20Transmission%20Smart%20Grid%20Imperative_2009_09_29.pdf

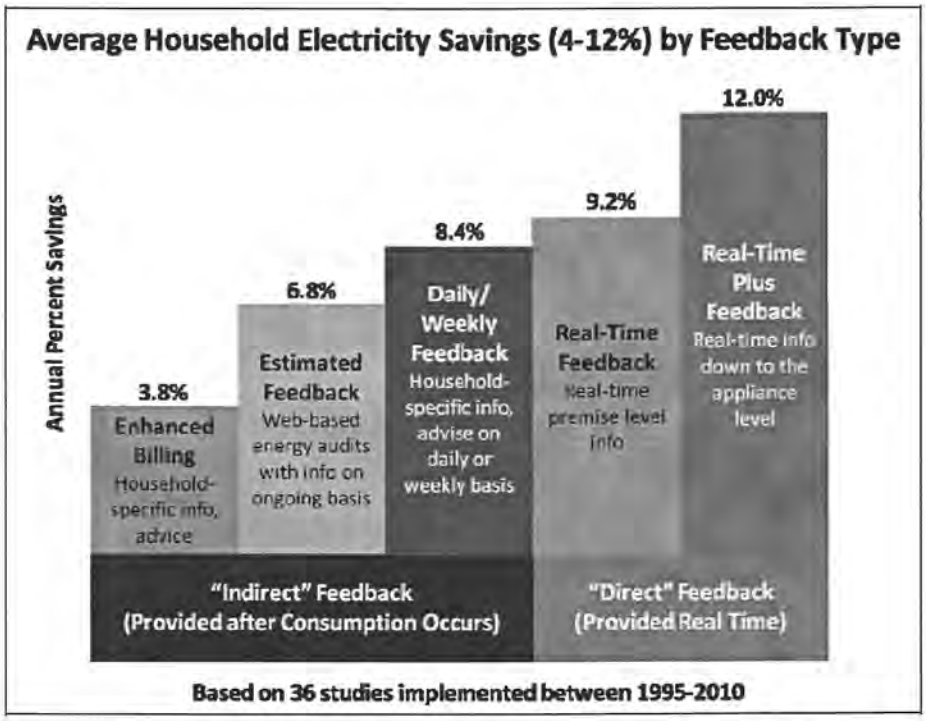
[55] Ibid, pp. 4

[56] PL 110-140, *Energy Independence and Security Act of 2007*, Title XIII, Section 1304(2)(B).

An example of what can be gained on the transmission system relative to the EISA objectives via Smart Grid is the Dynamic Line Ratings Demonstration Project being implemented by Oncor Electric Delivery Company, LLC in Texas. According to the Smart Grid Information Clearinghouse, the objective of this project is to "reduce transmission-line congestion and increase the carrying capacity of the transmission lines...so that transmission systems can be utilized to their full capacity, decreasing congestion and deferring upgrades and additional construction."[57] The demonstration project runs through 2013 with the results indicating that the smarter transmission system will deliver reduced electric costs, increased power reliability, and decreased greenhouse gas emissions.

The Case for Empowering Consumers for Capacity Management

Various studies have shown that a customer-controlled response to dynamic pricing can result in energy savings. Figure 7 (page 15) shows the data from a report by the American Council for an Energy Efficient Economy illustrating the fact that when customers are empowered with the right tools, dynamic pricing models can produce significant results in terms of annual energy savings.[58]



Source: ACEEE Report E105, *Advanced Metering Initiatives and Residential Feedback Programs*

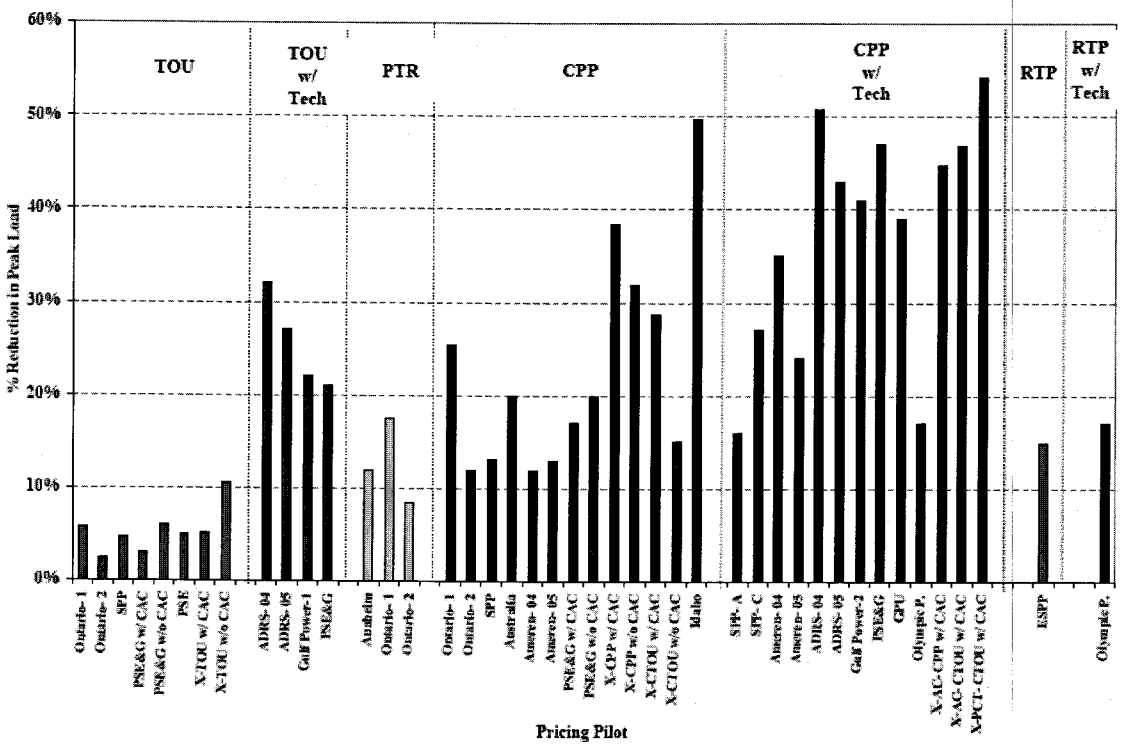
Figure 7. Aggregate Results of Residential Feedback Studies

[57] http://www.sgiclearinghouse.org/sites/default/files/projdocs/1739.pdf

[58] Ehrhart-Martinez, et. al., *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, American Council for an Energy-Efficient Economy, Washington, DC. June 2010.

Additional research for commercial/industrial customers using "automated" demand response built into devices (ADR, as opposed to manual customer response) provides both substantial savings and improved response times particularly in terms of peak load reduction. Pilot studies with residential customers have also indicated that increased information regarding their current energy usage and dynamic pricing results in a large number of customers responding either manually or via automatic responses from pre-programmed devices (e.g., programmable communicating thermostats, energy management controllers/systems).

Figure 8 (page 16)shows the effectiveness of various rate schemes such as time of use (TOU), peak-time rebate (PTR), critical peak pricing (CPP), and real-time pricing (RTP) as standalone measures and in combination with ADR and customer feedback technologies.[59]



Source: The Brattle Group, http://www.brattle.com

Figure 8. Household Response to Dynamic Pricing of Electricity

Based on AMI communication networks, utilities are establishing pilots and in some cases larger rollouts of energy information, monitoring, and control devices within individual buildings. Many utilities with severe summer weather offer peak- or direct-load control programs (DLC) for their customers, allowing them to interrupt air conditioning and other non-essential devices on the days with the greatest demand. In conjunction with smart meters and AMI systems, utilities are now working to identify the energy management systems and home/commercial networked devices that provide the greatest benefits in these programs.

[59] Faruqui, Amad and Sergicil, Sanem, *Survey of Experimental Evidence*, The Brattle Group, http://www.brattle.com/Experts/ExpertDetail.asp?ExpertID=164, January 10, 2009.

Ideal dynamic pricing solutions empower customers to make their own decisions and to install systems themselves. Home area network (HAN) and home energy management systems (HEMS) can empower residents to automatically control HVAC, lighting, and plug-loads based on the price of electricity. Technology enhancements are making it practical to implement customer control based on pricing signals and not just demand response signals. Although the customer energy cost-saving benefits may not be large enough to be a strong motivator, the same new technology also enhances home security, automation, fire safety, and power quality. The combinational benefits can motivate voluntary adoption and relieve utilities of risk and liability by not "owning" the solution.

New technology for plug-based load control uniquely identifies each plug-load and thus solves the 40-year-old problem of trying to control plug-based loads safely. For example, a window air conditioner is a typical plug-based ADR target. However, until recently the control system had no way to know if the unit had been unplugged during the middle of a DR event, or worse if it had been unplugged and replaced by a piece of medical equipment. Now, with unique appliance identification using plug RFID tags, the local receptacle controller only executes a DR signal or responds to a dynamic price signal if the correct target device is plugged in. Plug-load identification is key to demand and dynamic pricing response.

Devices that monitor and report status (energy usage, utilization voltage) are commercially available for use in home/building automation. In some cases, the current cost(s) to the customer, when compared to the short-term savings have not been adequate to motivate individual customers to install these items. However, based on the results cited earlier, any utility seeking to control peak loads, match load dynamics to renewable generation outputs, and/or optimize system resources, relatively small customer energy savings (e.g., 5 percent) could justify the utility subsidizing cost of direct load control, energy management systems, and home area networks for their customers.

Motivating customers to proceed with these efforts may require customer education, retail distribution of suitable devices (perhaps certified by the utility and/or national standards organizations), and customer incentives with support/approval from local or regional regulatory agencies. These regulatory agencies may also need information/support regarding the benefits of including voltage, as well as energy usage so that both customers and electric utilities can benefit from better information and control of those parameters at the individual building and device location.

Conclusions and Call to Action

A popular book on many business professionals' reading lists in the 1990's was *Crossing the Chasm* by Geoffrey A. Moore. The gist of the book is that there are multiple stages to the product adoption curve and that the most difficult transition (i.e., the chasm) was moving from the early adopters into the first stages of mass deployment. In terms of the Smart Grid, many feel that we are at exactly that point. The question then becomes, what would be necessary to maintain enough momentum for the industry to breach the chasm? In order to sustain the business case for utility companies and manufacturers in a way that is palatable for regulators and consumers, there are several options:

Legislative Actions

- **Low interest rate loans.** Capital investment is the life blood of the Smart Grid business case. In order for utility companies to reach the investment levels necessary for full deployment, they will have to borrow at favorable interest rates. Though a significant amount of stimulus was directed to the grid, the amount of spending to date has yielded only modest results as

evidenced by the Department of Energy *Smart Grid Systems Report*. While the ARRA certainly helped get things started, a lot more is necessary. When you consider that $3.4 billion was allocated to the Smart Grid Investment Grant program, it averages out to only about $1 million per electric utility in the U.S. With estimates ranging from $200 billion worldwide (Pike Research[60]) to $2 trillion just for the U.S. (Electric Light & Power Online[61]), it's obvious that a great deal of funding is going to be necessary for a long, long time. State and federal legislators need to promote government-backed loans as a low-interest option for utility companies.

- **Synchronization between service life and depreciation schedules.** If the service life of a device is shortened, the accounting rules for how a utility carries that device on their books must undergo a similar change. The very definition of a "stranded asset" is when the service life is less than the depreciated life of a device. Rip-and-replace strategies for under-depreciated electrical gear will be very expensive if the accounting rules don't keep up, and will provide mountains of frustration for regulators, customers, and utility companies. Legislators and regulators must work together to synchronize service life with utility company depreciation schedules.

Regulatory Actions

- **Adjustments in the effective service life and maintenance increments for power equipment systems.** In order to achieve the full benefit of a smart grid, a great deal of technology penetration is necessary. In developing areas of the country, this is more easily accomplished as the grid can be "built smart" from the ground up. Because utility companies exist under a regulatory model, in many cases the service life of a given piece of electrical gear is very tightly controlled. The underlying digital technologies simply don't have the same durability as their so-called "dumb grid" predecessors, and possible rapid advances in efficiency and security characteristics mandate a more forward-looking vision for devices on the grid. In order to facilitate the evolution of the grid, regulators are going to have to break from the decades-long service life models they've come to know and permit shorter service-life models for power equipment systems associated with Smart Grid. This must include additional allowances for maintenance of the smarter gear and provisions for routine replacements of those assets on a periodic basis.
- **Look for opportunities to implement well-structured pilot programs.** A favorite quote from Vint Cerf, one of the men considered to be the father of the internet, is that nothing sells like a working demo. Utility companies should be looking for opportunities to implement projects that will prove the value of Smart Grid implementations. At the same time they should work with their regulators to structure those projects and identify a business case that can also be embraced by legislators who want to incentivize them. A remarkable example is the Smart Grid City initiative that was implemented by Xcel Energy in Boulder, Colorado. The industry should observe the lessons learned from the Xcel experience and use those lessons to define the characteristics of a well-structured pilot. Utility companies need to work with regulators to define these pilots and consumer education must be permitted as a legitimate expense.
- **Embrace creative rate schemes.** Numerous studies have shown that the combination of Smart Grid technologies and creative rate schemes can create energy savings for consumers and

[60] http://www.pikeresearch.com/newsroom/smart-grid-investment-to-total-200-billion-worldwide-by-2015
[61] http://www.elp.com/index/allan-mchale-blog/blogs/elp-blogs/alan-mchale/post987_6042380411334018898.html

reduce peak demand for utility companies.[62] Regulators and legislators alike should consider creative pricing plans for Smart Grid programs that include time of use (TOU), real-time (RTP), and critical peak (CPP) pricing, as well as performance-based ratemaking and cost recovery. In doing so, models which include separate charges for infrastructure and service delivery need to be part of the rate structure. Also, rate mechanisms must be identified for third-party providers capable of delivering Smart Grid services, and a workable set of feed-in tariffs need to be fielded for consumer generated renewable energy. These rates must be designed to remove the disincentives for conservation and balance the risk and reward between the traditional ratepayer, the ratepayer as generator, and the regulated utility that would serve both of them. Encourage support for dynamic pricing information delivery to consumers in conjunction with in-building devices that provide measurement and control of load devices. Dynamic price ranges may need to become more aggressive to create a stronger incentive for adoption of Home Area Network solutions by customers.

- **Optimize the Transmission Network.** Current transmission planning practices focus entirely on static line ratings. As seen in the Oncor example discussed earlier, there is a variety of benefits to be gained by allowing optimization of the transmission system through dynamic line ratings. Recommendation 27 of the US-Canada task force report in April 2004 encourages the use of dynamic line ratings, citing that variations in ambient temperature, wind, and other environmental factors create "unnecessary and unacceptable uncertainties about the safe carrying capacity of individual lines on the transmission networks."[63] Making regulatory allowances for utilities to optimize their transmission system through the use of synchrophasors and dynamic line ratings will allow them to absorb additional capacity from renewable and distributed generation sources at a fraction of what it costs to either upgrade existing transmission corridors or build new lines.

[62] A catalog of such studies is available on the website of Dr. Amad Faruqui, a pillar of the Smart Grid community and employee of the Brattle Group: http://www.brattle.com/Experts/ExpertDetail.asp?ExpertID=164. Other examples are available via the U.S. Department of Energy website for the Smart Grid Information Clearinghouse: http://www.sgiclearinghouse.org/Project

[63] U.S.-Canada Power System Outage Task Force, *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*, April 2004, pp. 162.

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VI. Sponsors and Supporting Organizations

Oracle Applications and Technology: MANAGING INFORMATION & MAXIMIZING THE VALUE OF THE SMART GRID

ORACLE UTILITIES

ORACLE'S SMART GRID SOLUTIONS IMPROVE BUSINESS PROCESSES

Oracle's Smart Grid applications help utilities:

- Reduce field costs—and lower carbon footprint—by eliminating the vast majority of routine connect and disconnect tasks, routing field crews to emergencies via the most direct and lowest-cost route, and determining the nature and extent of a problem before trucks roll.
- Reduce the time and cost to develop and implement new rates.
- Speed bill payments from customers leaving the region by letting them receive and pay a final bill with a single phonecall.
- Reduce credit and collection costs by facilitating prepayment options.

ORACLE'S SMART GRID SOLUTIONS IMPROVE GRID EFFICIENCY

Oracle solutions help utilities to:

- Lower the cost to serve neighborhoods by more accurately sizing the equipment each requires.
- Improve reliability by speeding emergency repairs.
- Reduce the number of customers affected by an outage by automatically switching them to another feeder.
- Use microgrids to better use local renewable generation.

The Smart Grid is all about information. It's about using information to better accomplish utility goals: more efficient processes, empowered customers, and a sustainable environment.

Implementing the Smart Grid is a multi-step process. First, utilities must place highly sophisticated meters and sensors on power lines and at customer sites. Then they must gather and store the resulting terabytes of data while maintaining data integrity, auditability, and security.

Processing the data into information for multiple purposes is a third step; departments and customers must receive information in useful formats. Finally, each recipient must analyze the information and glean from it the insights that can help them bolster reliability, lower cost, enhance energy security, and reduce greenhouse gases.

The Oracle Difference

Oracle has the world's most complete solution for taking the huge volumes of Smart Grid data and turning them into information that solves problems.

Our database and middleware technologies are unmatched in their ability to rapidly process, route, and extract information from massive quantities of data.

Our mission-critical utility applications underpin billing, metering, asset, field, and network operations around the world.

Our analytic and business intelligence tools reach into every aspect of power delivery and use to determine better, cheaper, faster ways to conduct the utility business.

The Need for Change

The Smart Grid is not a complete break with the past. Electric utilities have always processed meter and sensor data into information. But organizational barriers and inflexible legacy information systems made it difficult to share information fully. Data from SCADA remained primarily with distribution engineers. Billing systems forwarded gross consumption figures to those responsible for supply, but not in enough detail to minimize waste in supply portfolios.

Keeping information primarily within operations (engineering), information (business), and customer technology silos worked well for utilities in the past. Departments performed assigned tasks with admirable efficiency. The result has been a reliability and cost record that remain the envy of other industries.

The 21st Century, however, has ushered in new concerns. Governments and customers are challenging utilities to help the world community reduce greenhouse gases, to empower customers to better understand and control their consumption, and to ensure that power quality and reliability meet demanding new standards.

ORACLE

ORACLE'S SMART GRID SOLUTIONS EMPOWER CUSTOMERS

Oracle's rapid processing and dissemination of information helps customers:

- Identify and eliminate waste.
- Better assess the impact their power use has on the environment.
- Control costs by switching to storage, on-site generation, or lower appliance settings when bottlenecks threaten or wholesale prices rise.

The Smart Grid is a vital tool in the quest to meet these emerging goals. The information it provides—shared, analyzed, and acted on—can increase the efficiency with which we use electricity and thus maintain productivity with less generation. Smart Grid information can help us increase the use of generation from renewables. It can dramatically reduce waste. It can cut the costs of doing business.

But it can do so only when the best applications, joined in a coherent and efficient information architecture, extract the full value of the data generated by each part of the business.

How Oracle Helps Maximize Smart Grid Data Value

Oracle helps utilities ensure that they receive and record every data point the Smart Grid produces. We work with Smart Grid partners to ensure that we capture and use data from grid sensors, AMI systems, and other communications and device providers. We ensure its integrity and guard it against intruders.

Oracle then provides that data to all the applications and business processes that need it. We replace the information silos of the past with an enterprise information structure that integrates Oracle and non-Oracle applications into a functional whole.

Oracle helps utilities identify the information most effective in improving business processes. We enhance information sharing. And we apply advanced analytics and business intelligence to help utility departments and customers better meet their goals.

Preparing Today for Tomorrow's Challenges

Today's Smart Grid is starting a long evolution. The ways utilities will use it will change. Oracle will be there every step of the way, helping utilities use Smart Grid innovations to maximize peak shaving, to unravel the complications of refueling electric vehicles, to handle distributed storage as an everyday fuel source.

Today, we're helping utilities put in place the information infrastructure and foundation applications that will make this larger future possible. We're helping them build on existing applications, enhance processes, and fill strategic holes with new products. We're dramatically decreasing the time required to turn data into action.

Helping utilities evolve at the speed of value. That's the pivotal role Oracle plays to ensure that utilities and customers can maximize the potential of the Smart Grid. And that is why Oracle is The Smart Grid Choice.

Contact Us

For more information about Oracle's Smart Grid solutions, please visit oracle.com or call +1.800.ORACLE1 to speak to an Oracle representative.

Oracle is committed to developing practices and products that help protect the environment

ORACLE

Big Data: Are Utilities Doing Enough?

THE DATA DELUGE

The latest Oracle research shows North American electric utilities are grappling with massive amounts of data from smart meters and other systems. They have significant opportunity to harness data to help improve grid performance and customer service.

Satisfied Customers
Operational Efficiency
Power Theft Prevention
Improved Reliability
Better Forecasting
Strategic Decisions • Minimized Outages • Lower Asset Maintenance Costs

UTILITY PREPAREDNESS

ONLY

17%

of utilities are completely prepared for the data influx. Up from 9% in 2012

JUST

20%

of utilities give themselves an "A+" for getting information to the people who need it. Up from 8% in 2012

CUSTOMER SERVICE

50%

of utilities are using smart grid data to increase customer satisfaction through forecasting, demand management and improved reliability

THE SKILLS GAP

62%

But 62% have a data analytics skills gap, which they are closing with hiring, training and third-party solutions

THE CLOUD

2 out of 3 are considering cloud-based solutions for smart grid data management and analysis

THE TIME IS NOW

Most utilities are not using their data as efficiently as possible. They need to accelerate analytics efforts to drive significant operational and customer service improvements and speed time to ROI.

Over the next 1 to 2 years, utilities plan to use smart grid data to identify trends and forecast demand, provide customers with usage information and use predictive analytics to improve reliability.

Download the comprehensive report, *Utilities and Big Data: Accelerating the Drive to Value,* at www.oracle.com/goto/utilities.

ORACLE

Gold Sponsor

C3 Energy

C3 Energy harnesses the power of big data, smart grid analytics, social networking, machine learning, and cloud computing to improve the safety, reliability, and efficiency of power delivery. C3 Energy's family of utility-tested and proven smart grid analytics products deliver end-to-end solutions across the entire smart grid, from energy grid capital asset allocation, transmission, distribution, and advanced metering, to the customer experience and energy efficiency programs. C3 Energy products enable utility operators to realize the full benefit of their smart grid and energy system investments. Learn more at C3Energy.com

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Aclara® represents the industry's leading Intelligent Infrastructure technologies for providing device networking, data-value management, and customer communications to electric, water, and gas utilities globally. Over 500 utilities in nine countries rely on proven Aclara solutions to connect with their customers. Aclara Technologies LLC is part of the Utility Solutions Group of ESCO Technologies Inc. (NYSE: ESE), St. Louis. Create Your Intelligent Infrastructure™ www.Aclara.com.

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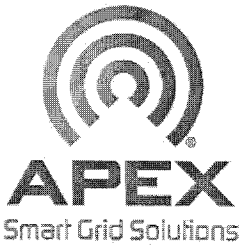

Apex works with water, gas, and electric utilities all over the world, delivering the most competitive solutions and technologies to address the complex requirements of today's Smart Grid initiatives. We specialize in Meter Replacement, Network Equipment Installation, Smart Grid Technology System Acceptance Testing, Consulting, and ROI-enhancing services. All of our end-to-end solutions are powered by ProField®, the Smart Grid industry's only integrated ERP system for Mobile Workflow Optimization.

On the web: http://www.apexcovantage.com/smartgridsolutions/solutions/

ENERNOC

EnerNOC is a leading provider of smart grid applications for commercial and industrial (C&I) end-users, electric utilities, and grid operators. Our suite of solutions includes comprehensive demand response (DR) and data-driven energy efficiency, as well as energy price and risk management. EnerNOC's world-class energy management applications provide system operators and planners with cost-effective alternatives to investments in traditional power generation, transmission, and distribution.

Since its founding in 2001, EnerNOC has focused on the application layer of the smart grid and the intersection of Information Technology (IT) and energy. Today, EnerNOC is the world's largest provider of C&I demand response solutions with commercial operations in Australia, Canada, Japan, New Zealand, the United Kingdom, and the United States. As of 2014, our company manages more than 9,000 MW of dispatchable demand response capacity from more than 14,000 participating customer sites. We provide demand response capacity to dozens of utilities and system operators around the globe, and participate in a wide variety of demand response programs and electricity markets, including capacity, energy, and ancillary services. As the global leader in AutoDR technology and solutions, EnerNOC is also at the forefront of developing cutting-edge demand response programs that are specifically designed to facilitate the integration of renewable resources into electrical systems.

Yet, EnerNOC provides much more than just demand response. By integrating our technology platform with meters, sensors, building management systems (BMS), and industrial control equipment, EnerNOC is also able to provide powerful visualization and analytical tools that deliver significant energy efficiency savings. EnerNOC's IP-based technology platform captures and presents real-time energy data to our customers through our Software as a Service (SaaS) offerings, including web portals and smartphone/tablet apps, available anywhere in the world. With between 24,000 and 27,000 MW of peak load under management, and more than one billion data points captured every month, EnerNOC's database of C&I energy information is unparalleled. Through our Big Data Analytics Platform (BDAP), we are making energy data available to both our internal data scientists as well as third parties over standard APIs, unlocking a massive analytics and optimization opportunity.

innovari

THE **INTERACTIVE ENERGY SOLUTION ™**

Innovari's leadership team is made up of energy industry professionals with deep experience directly applicable to understanding, developing and delivering solutions for utilities. This unique background allows our team to maintain a utility-centric mindset of safety, reliability, security, customer satisfaction and shareholder value in delivering solutions that can rapidly deliver benefits. Our motto is "Solutions Designed for Utilities", and we live by it. We are industry veterans who have over 100 combined years of experience running utility companies. We recognized and are now fulfilling our industry's need for the next generation of enabling solutions: delivering **Interactive Energy Solutions™** (IES) that are real, not hype.

Our IES includes real time monitoring, advanced analytics, control verification and two-way communications to cost-effectively solve some of our industry's most challenging problems. A key element to our solution is the **Energy Agent™,** which is packaged as a utility-owned and utility-branded capital asset.

Innovari's **Interactive Energy Solution™** provides:

- Dispatchable, two-way verifiable energy management across the grid;
- T&D optimization across the breadth of the distribution system;
- Revenue generation in the ancillary services markets;
- Enhanced end-user (typically commercial) customer engagement via a utility-owned, utility-branded capital asset; and
- Future extensibility and I/O functionality to enable integration of other Smart Grid systems and distributed energy resources (such as battery storage).

Improving your utility's relationship with your customers is part of our core business model. The **Energy Agent™,** which is installed on the end-use customer premises, is the key to unlocking the value hidden in the utility-customer relationship. It connects the customer in real time to your system constraints, and enables them to become part of the solution, fostering better service and a stronger industry for all of us.

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OPOWER

About Opower

Working with 90 utility partners and serving more than 20 million consumers across eight countries, Opower is a leading provider of cloud-based software to the utility industry. Opower's platform uses big data analytics and behavioral science to enable utilities to achieve energy outcomes, including energy efficiency, customer engagement and demand response. Founded in 2007 and privately held, Opower is headquartered in Arlington, Virginia, with offices in San Francisco, London, Singapore and Tokyo.

For more information, please visit www.opower.com and follow us on Twitter at @Opower.

S&C Electric Company is a leading manufacturer and an innovative trendsetter for electric power systems. Founded in 1911, the Company designs and manufactures solutions for electric power transmission and distribution with an emphasis in reliability, efficiency and power quality. In addition, S&C offers a wide range of engineering, laboratory, and testing services for electric utilities and commercial, industrial, and institutional power systems.

On the web: http://www.sandc.com

Silver Spring Networks (NYSE: SSNI) is a leading networking platform and solutions provider for smart energy networks. Silver Spring's pioneering IPv6 networking platform, with over 18 million Silver Spring enabled devices delivered, is connecting utilities to homes and businesses throughout the world with the goal of achieving greater energy efficiency for the planet. Silver Spring's innovative solutions enable utilities to gain operational efficiencies, improve grid reliability, and empower consumers to monitor and manage energy consumption. Silver Spring Networks' customers include major utilities around the globe such as Baltimore Gas & Electric, CitiPower & Powercor, Commonwealth Edison, CPS Energy, Florida Power & Light, Jemena Electricity Networks Limited, Pacific Gas & Electric, Pepco Holdings, Progress Energy, and Singapore Power, among others. To learn more, please visit www.silverspringnet.com.

Vaisala is a global leader in environmental and industrial measurement. Building on 75 years of experience, including 30 years of advanced lightning detection and data delivery services, Vaisala contributes to a better quality of life by providing a comprehensive range of innovative observation and measurement products and services for chosen weather-related and industrial markets.

On the web: www.vaisala.com

Supporting Organizations

AMCHAM
COLOMBIA
CÁMARA DE COMERCIO
COLOMBO AMERICANA

The Colombian American Chamber of Commerce (AmCham Colombia) was founded in 1955 to promote trade and investment between the United States and Colombia and with other countries in the region. AmCham members include U.S. and Colombian companies as well as companies from third countries. Today, AmCham has more than 1,000 member companies nationwide. In addition to the principal office in Bogotá, there are AmCham branches in Barranquilla, Cali, Cartagena, and Medellin. AmCham Colombia is a member of the Association of American Chambers of Commerce in Latin America (AACCLA) and is affiliated with the U.S. Chamber of Commerce. AmCham provides a number of services to non-member companies including market research, contact lists, business matchmaking services, and the organization of trade missions. For more information, please visit our website: www.amchamcolombia.com.co

EEI EDISON ELECTRIC INSTITUTE

The Edison Electric Institute (EEI) is the association of U.S. Shareholder-Owned Electric Companies. Our members serve 95 percent of the ultimate customers in the shareholder-owned segment of the industry, and represent approximately 70 percent of the U.S. electric power industry.

We also have more than 70 international electric companies as Affiliate Members, and more than 200 industry suppliers and related organizations as Associate Members.

Organized in 1933, EEI works closely with all of its members, representing their interests and advocating equitable policies in legislative and regulatory arenas. EEI provides public policy leadership, critical industry data, market opportunities, strategic business intelligence, one-of-a-kind conferences and forums, and top-notch products and services.

On the web: www.eei.org

NEMA is the trade association of choice for the electrical manufacturing industry. Founded in 1926 and headquartered near Washington, D.C., its approximately 450 member companies manufacture products used in the generation, transmission and distribution, control, and end-use of electricity.

These products are used in utility, medical imaging, industrial, commercial, institutional, and residential applications. Domestic production of electrical products sold worldwide exceeds $120 billion.

NEMA provides a forum for the development of technical standards that are in the best interests of the industry and users, advocacy of industry policies on legislative and regulatory matters, and collection, analysis, and dissemination of industry data. In addition to its headquarters in Rosslyn, Virginia, NEMA also has offices in Beijing and Mexico City.

On the web: www.nema.org

The Smart Grid Interoperability Panel (SGIP) orchestrates the work behind power grid modernization. SGIP was established to identify technical and interoperability standards harmonization that accelerates modernization of the grid. As a member-funded, non-profit organization, SGIP helps utilities, manufacturers and regulators address standards globally: utilities gain improved regulatory treatment for investment recovery and manufacturers obtain enhanced commercial opportunities worldwide. SGIP members stay competitive, informed and well-connected. To learn more about SGIP, visit http://sgip.org/.

UTC
UTILITIES TELECOM COUNCIL

The Utilities Telecom Council (UTC) is a global trade association dedicated to creating a favorable business, regulatory, and technological environment for companies that own, manage, or provide critical telecommunications systems in support of their core business. Founded in 1948 to advocate for the allocation of additional radio spectrum for power utilities, UTC has evolved into a dynamic organization that represents electric, gas, and water utilities; natural gas pipelines; critical infrastructure companies; and other industry stakeholders. From its headquarters in downtown Washington, DC, UTC provides information, products and services that help members: Manage their telecommunications and information technology more effectively and efficiently; voice their concerns to legislators and regulators; identify and capitalize on opportunities linked to deregulation worldwide; and network with other telecom and IT professionals.

On the web: www.utc.org