Renewable Energy in Colombia

Institute of the Americas Webinar

IPD Latin America

June 18, 2015
Colombia’s Potential

Overview
Colombia’s Electric System (2015)

**Areas Connected to the National Interconnected System (SIN)**
- Densely populated areas (strong population concentration)
- Installed power generation capacity: 15,513 MW (6th largest in Latin America)
- Heavy dependence on hydro:
  - 2nd in South America after Brazil
  - Installed capacity: 10,919 MW (@70% of total installed capacity)
  - Electricity produced (March 2015): 4,024 GWh (@71% includes large and small hydro)

**Non-Interconnected Areas (ZNI’s)**
- Remote areas; scattered population
- High presence of ethnic communities (indigenous, African-Colombian)
- High poverty rates
- Estimated installed generation capacity: 165 MW
- Intermittent service (4 to 8 hour service per day on average)

**Electricity demand per region**

- **Caribbean Coast**: 19.6%
- **Northwest**: 15.7%
- **Central**: 24.6%
- **Coffee R.**: 4.38%
- **Valle**: 12%
- **Tolima**: 4.26%
- **Sur**: 2.94%
- **East**: 9.45%
- **Caribbean Coast**: 19.6%

Source: Ministry of Mines and Energy, XM and UPME
Two Different Stories

**Average Electricity tariff (SIN)**

\[ CU = G + T + D + C + PR + R \]

- **Subsidies (2014):**
  - US$ 613 million (S1, S2, S3)
- **Contributions (2014):**
  - US$ 338 million (S4, S5, S6, Industrial, commercial and official sectors)

**Gov’t subsidies:**
- @US$ 275 MM to cover differential.
- **Actual contribution:**
  - @US$ 500 million (to cover companies’ deficits)

**ZNI’s**
- Heavy dependence on fossil fuels (diesel): US$ 3/gallon in average
- Subsidies around US$ 75.3 million in 2014: @7% of MinMinas budget for that year
- Low payment capacity: dependence on subsidies

**Average electricity cost in ZNI (non-subsidized)**

US\$ kWh

- **Average cost nationwide.** Includes generation, distribution and retail average costs. Does not include impact of government subsidies.

**Gov’t. subsidies electric sector 2014:**
- @US$ 580 million @65% of MinMinas budget
Renewable Energy Participation in Colombia’s Energy Basket

Installed Capacity by Technology
National grid 2015

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capacity (MW)</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>18.4</td>
<td>0.12%</td>
</tr>
<tr>
<td>Biomass</td>
<td>77.2</td>
<td>0.49%</td>
</tr>
</tbody>
</table>

Main factors for current limited renewables (other than hydro) share:

- Abundant water resources
- High cost vs. efficiency
- Reliability issues
- Limited to non-existent knowledge of market regarding renewables potential

*Includes mini-hydro
Source: IPD based on UPME
Wholesale Energy Market Dynamics

(Spot market)

Typical Dispatch Model:

- Plants to be dispatched
- P. not dispatched

Average Price by Technology:

- Spot Price
- Hydro
- Coal
- Scarcity Price
- Dual
- Diesel
- Gas

Source: IPD based on CREG

Source: XM-Approximate figures
Renewables Installed Capacity in Colombia’s Electric System

(Includes national grid and ZNIs)

- 760.2 MW installed capacity of renewable energy. This represents around 4.72% of the total installed capacity in the electric system

- Solar solutions mostly for ZNIs

- Only relevant wind generation project: Jepírachi (La Guajira, 2004)

- Most investment for research by the private sector: EPM and Isagen. Technical support of public entities: Colciencias, IDEAM, UPME.

Capacity by Technology (MW)

Includes national grid, non-connected areas –ZNIs-- and others
Source: UPME

- Mini-hydro (between 10-20MW) 296.0
- Mini-hydro (<10MW) 168.7
- Biomass 268.2
- Solar (telecommunications towers) 4.5
- Solar (ZNI) 4.5
- Wind 19.5

Includes national grid, non-connected areas –ZNIs-- and others
Source: UPME
Renewables Potential in Colombia

Current projects:
- Jepírachi Wind Farm (19.5MW Current) (EPM+WB)
- 3 projects registered in UPME (projected 474 MW)
  - Casa Eléctrica, Irrapia, Carrizal (Jemeiwaa Ka)

Wind potential

<table>
<thead>
<tr>
<th>Region</th>
<th>Potential (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>La Guajira Peninsula*</td>
<td>21,000</td>
</tr>
<tr>
<td>Caribbean Coast</td>
<td>20,000</td>
</tr>
<tr>
<td>Santander and N. Santander</td>
<td>5,000</td>
</tr>
<tr>
<td>Huila</td>
<td>2,000</td>
</tr>
<tr>
<td>Boyacá</td>
<td>1,000</td>
</tr>
<tr>
<td>Risaralda-Tolima</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Source: IPD based on UPME and IDB
*Potential in La Guajira remains throughout the year. In other regions, dependent on season.

Renewables Potential in Colombia

Solar

Largest existing project: Éxito Panorama solar project (508 kW), Barranquilla.

High irradiance levels throughout the year across the country (4.5 kWh/m² avg.)

Areas with highest potential located far away from the national grid: strong potential in ZNIs.

**Estimated potential (kWh/m²/year)**

- La Guajira Peninsula: 1,960 - 2,340
- Eastern Llanos: 1,440 - 2,160
- Caribbean Coast: 1,260 - 2,340

Position vis-à-vis other regions with significant irradiance in the world (in kWh/m²/per day in average):

- Tacna, Perú: 5.68
- La Guajira, Colombia: 5.77
- Luxor, Egypt: 5.98
- Geraldstown, Australia: 5.80
- Mexicali, Mexico: 5.90
- Arica, Chile: 6.78
Case Study: Exito Panorama, Barranquilla

- Largest solar plant in Colombia (online in March 2015)

- Exito moving towards efficient energy solutions: energy savings + reputation

- 508 kW installed at CO$ 2,000 million (@US$ 800,000)

- @US$ 1,570 per installed kW

- For self-consumption only, no plans to sell surpluses to the grid

- Not enough incentives to install more capacity and sell? Net metering system not attractive?

Source: IPD based on Google Maps
Very limited development of geothermal power potential in Colombia

Extremely little knowledge of this potential

Only one well drilled to date: Nereidas-1, Nevado del Ruiz volcano area; dry hole

Areas with identified high potential: Nariño, Cauca, Huila, Caldas, Risaralda

ISAGEN is taking the lead on research and potential studies. Two existing projects:

- **Nevado del Ruiz Volcanic Massif Project-Caldas-Risaralda depts. (ISAGEN)**
  - Pre-feasibility assessments concluded
  - Projected 50MW installed capacity

- **Tufiño - Chiles Binational Project, Nariño dept. (ISAGEN-CELEC EP, Ecuador)**
  - Cross-border agreements signed
  - Pre-feasibility assessments initiated

Policy and Regulation

Where We Stand
Turning to Renewables

System Reliability

• IDEAM projects less rain precipitation for: 2011-2040 (climate change)
• El Niño
• Increasing social and environmental licensing challenges for large-scale hydro-electric generation plants

Diversified Energy Basket

• Back-up system mainly based upon thermal fired plants (gas, coal and diesel). With appropriate incentives, renewables could become an economically feasible and environmentally friendly source of supply. Reliability is the issue.

ZNIs

• Need to reduce diesel use and fiscal burden (Back to slide 4)
• Increase electricity supply service hours in ZNIs
• Expand coverage
• Economic development in a post-conflict scenario

Politics?

• International agreements: IRENA membership (Law 1665/2013, Sentence C-332/2014)
• Lack of clear political champion, apart from UPME
• Not a priority in Congress
• Not all stakeholders want to see renewables succeed
Main Developments

2001
Efficient energy use / renewable energy declared as policy priority (Law 699/2001)

2003
PROURE* is created
Decree 3683/2003

2008
Co-generators allowed to sell energy surplus

2010
PROURE** Action Plan 2010-2015

May/2014
‘Renewables Law’ 1715/2014

2015
Regulation on incentives scheme
Targeted for May; Pending

Mar/2015
Regulation for self-generators
CREG resolution 024/2015


**Specific goals and objectives are established for the 2010-2015 period
The Renewables Law

- Promote power generation based on REs
- Integrate REs into the country’s power system (grid and ZNIs)
- Incentives to investment in RE projects
- Eliminate market barriers for RE’s
- Sustainable development
- Emissions reduction

Law 1715/2014
Looking Forward

Opportunities & Challenges
Scenarios of Law 1715’s Impact on Colombia’s Electric Sector

Total installed capacity:
- Optimistic: 23,150 MW, Renewables: @10-15%
- Moderate: 21,676 MW, Renewables: @6-7%
- Pessimistic: 21,402 MW, Renewables: @2%

*Hydro include small-scale generation plants (@3% of installed capacity)

Highlights
- Government views its projections as conservative
- Government expects Law 1715 to have a greater impact
- Will the system be prepared if expectations are fulfilled?
Opportunities and Challenges: National Grid

- Counter seasonal cycles
- Diversification of back up sources of supply
- Future incentives?
  - Tax
  - Reliability charge-type incentive being discussed

- Slow regulation development progress/enough political will?
- Incentives not enough for broad levels of activity
- Lobbying and opposition from traditional generators
- No political interest to offer up subsidies other than fiscal incentives
- Prior consultation/licensing (Jepírachi took 3 years)
Opportunities and Challenges: ZNIs

- Opportunity to boost economic activity in neglected areas
- Wind and solar more efficient and cheaper than diesel
- Counter seasonal cycles
- Potential use in economic activities (i.e. oil, gas & mining activities)
- Post-conflict strategy?

- Poor State presence in areas with highest potential: security, social issues
- Presence of ethnic communities: prior consultation issues
- Logistical challenges
- Who will pay?
- Government role in the future?
## Other regional experiences

<table>
<thead>
<tr>
<th>Country</th>
<th>Incentive scheme</th>
<th>Fiscal</th>
<th>Other</th>
</tr>
</thead>
</table>
| Peru             | -Income tax, import tariffs, early recovery of VAT / selective add’t’l taxes on contaminant fuels | -Biannual auction system  
- Accelerated depreciation  
- Long-term contracts |                                                                       |
| Chile            | -Bidding mechanisms provide access to subsidies, grants, and tax reductions       | -Electric utility quota obligation (5%)  
- Geo-referenced platform  
- Others |                                                                       |
| Brazil           | -Equipment exempted from Industrial Products Tax (IPI) VAT  
- Reinfia (under discussion) | -National Bank for Economic and Social Development offers favorable financing conditions  
- Long-term contracts |                                                                       |
| Mexico           | -Tax Deductions (state level)  
- Clean energy certificates | -100% accelerated depreciation  
- Estampilla postal”  
- Energy bank |                                                                       |
| Colombia (under discussion) | Income, VAT, tariffs | Accelerated depreciation |                                                                       |

### Regional highlights:
- Major interest in RE developments
- Net-metering schemes
- Issue of access to financing

**Colombia:**
- Ways to go to improve incentives
- Limited public/state commitment

*Sources: IPD based on KPMG and national legislation*
Financing options

• Local banks?
  – Little familiarity with renewable energy/energy efficiency projects
  – Difficult and costly to get financing
  – Government active role needed to incentivize local banking involvement

• Multilaterals?
  – No specific financing options identified for renewables in Colombia to date
  – Dependent on regulations and other developments

• Government support unlikely to assist/support financing in Colombia

• Little government/multilateral-bilateral discussions to date