LOOKING TO THE ANDES: LONG-TERM SCENARIOS OF OIL SUPPLY AND DEMAND FOR PERU, COLOMBIA AND ECUADOR

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OVERVIEW ON ANDEAN COUNTRIES: PERU, COLOMBIA AND ECUADOR

- High economic growth rates.
- Petroleum production has risen in the last decades.
- Oil and Oil Products are relevant to their economy.
- They are implementing oil consumption reduction policies.

Oil and Petroleum Products

Peru: 14.5% of total imports
   - Net Imports US$ 2.3 billions

Colombia: 44% of total exports
   - Net Exports US$ 27.3 billions

Ecuador: 55% of total exports
   - Net Exports US$ 11.1 billion

Source: PETROAMAZONAS
This work aims at estimating the oil supply-demand balance of these countries up to 2030, according to many programs and policies that governments are implementing.
<table>
<thead>
<tr>
<th>Sector</th>
<th>Perú</th>
<th>Colombia</th>
<th>Ecuador</th>
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</table>
| Residential Sector  | - Natural Gas Massification in households (by 2015, 400 000 new connections, and by 2020, 1200 000 new connections) (MINEM, 2013b)  
| Industrial, Public and Services Sector | | | |
| Transport Sector    | - Natural Gas Massification in Transport (250 NGV stations by 2015, and 400 NGV stations by 2020) (MINEM, 2013b)  
- PROURE- Improvement of the transport fleet as well as the establishment of better driving techniques (an estimated reduction of 1.29% in the energy intensity for all transport technologies) (MINMINAS, 2010).  
- Quito Subway.  
- 5 new Subway Lines in Lima.  
- Increase of biofuels blends: E-20, and B-20 by 2020 (MINMINAS, 2007).  
- Monorail in Arequipa. | | |
| Power Generation    | - Lighting Program (1.5 million and 0.5 million LCFs in households and public buildings by 2016; 100 000 LEDs in public lighting).  
- Replacement of 32 million incandescent lamps by LFC (MINMINAS, 2010).  
- Hydro Power Generation Expansion (more than 90% of electricity produced by hydro power plants in 2017).  
- NUMES Plan for Power Generation (Aims an energy mix for Power Generation in 2040: 40% NG; 40% Hydro; 20% Renewable Energy)  
- Substitution of 2 million old refrigerators by efficient refrigerators (MINMINAS, 2010). | | |
METHODOLOGY

OIL SUPPLY


• These works adopted 2P reserves as the Ultimate Recoverable Resources (URR) for the conservative scenario, and higher URR for optimistic scenarios.

• ECUADOR: New Multi-Hubbert. Based on production from OLADE (2014); Reserves data from MRNNR (2014).

<table>
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<tr>
<th>Country</th>
<th>URR-Conservative Scenario (MMBbls)</th>
<th>URR-Optimistic Scenario (MMBbls)</th>
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</thead>
<tbody>
<tr>
<td>Peru</td>
<td>3,885</td>
<td>8,637</td>
</tr>
<tr>
<td>Colombia</td>
<td>16,718</td>
<td>49,765</td>
</tr>
<tr>
<td>Ecuador</td>
<td>6,776</td>
<td>10,247</td>
</tr>
</tbody>
</table>

Source: (MINEM, 2013a), (MINEM, 2013), (OLADE, 2014), (MRNNR, 2014),
METHODOLOGY

OIL PRODUCTS DEMAND: BASE YEAR

- MODEL: LEAP Software.

- RESIDENTIAL SECTOR: Bottom-up approach. Activity: Households. Different disaggregation level according to information available.

- TRANSPORT SECTOR: The ASI methodology (Schipper et al., 2000) was used.

\[ E_i = \sum_{j=vehicle}^{vehicle type} A_{i,j} S_{i,j} I_{i,j,k} \]

Where:
- \( i \): Type of fuel.
- \( E_i \): Fuel consumption (gal, m³).
- \( A_i \): Activity (use of the vehicle – km/vehicle-year).
- \( S_i \): Structure (number of vehicles by modal – vehicles).
- \( I_i \): Energy intensity (average efficiency by vehicle – gal/km, m³/km).

- Industry, Public and Services Sectors: Energy intensities based on sectorial GDP.

- Power Sector: Effective capacity, energy production and the efficiency by technologies and type of fuel used by plants are taken from National agencies of Energy Regulation, Electric System National Operators and Ministries of Energy and Mines.

Example: Residential Sector modeling

Peru

Colombia
METHODOLOGY

FORECASTING OIL PRODUCTS DEMAND: Baseline and Policy Scenarios

• RESIDENTIAL SECTOR:
  – Policy: In Peru 1.2 millions households displaced LPG by NG by 2020 (NG Massification); 1 million household displaced firewood by LPG for cooking (Cocina Perú). In Ecuador 2.6 millions household displaced LPG by electricity for cooking (Cocción Eficiente)

• TRANSPORT SECTOR:
  – Baseline: Historical trend.
  – Policy: - In Peru increasing of NGV by NG Massification Program replacing diesel and gasoline vehicles. Colombia: Biofuel blends increases E-20, and B-20 by 2020
  – For metro projects passenger demand of viability studies were taken. Doll and Balaban (2013) a common criticism leveled against all subways is that they have experienced ridership far lower than what was predicted. We adopted a factor of 60%.
  – Distributed: 80% public transport users, and 20% particular vehicle users.

The assumed modal shift from public transport is higher than the reported by (Vuk, 2005) for the Madrid subway (50%), the new subway in Athens (56%), the Crydon Tramlink (69%) and the Manchester Subwaylink (50%), however it is lower than the considered for the Copenhagen Subway (72%) and the Quito Subway (85%).
**METHODOLOGY**

**FORECASTING OIL PRODUCTS DEMAND: Baseline and Policy Scenarios**

*INDUSTRY, PUBLIC AND SERVICES SECTORS:*
- Baseline: Future projections of sectorial GDP. Energy intensities maintained.
- Policy: In Peru a reduction of the energy intensity of 3.6% for NG and fuel oil (Boilers improvement). In Colombia a reduction of energy intensity of 11% and 10% for industrial and public/services respectively (PROURE program)

*POWER GENERATION:*
- Baseline: Same capacity structure.
- Demand side projects will reduce (efficient lighting) or increase (electric cookers) the electricity demand.

**Example: Power Generation Expansion in Ecuador**

Baseline

Policy
RESULTS

Oil Products, Biofuels and Natural Gas Consumptions in the Baseline Scenario

- Significant increase of Diesel and Gasoline.
- Peru: Driven by increase of truck and SUV fleet.
- Colombia: NG in baseline scenario mitigates diesel and gasoline consumption.
- Ecuador: Biofuels blends are not considered. Significant increase of consumption of fuel oil in power generation.
**RESULTS**

*Differences in Energy Consumptions by Source between the Baseline and Policy Scenarios*

- **Peru**: Metro projects reduced diesel and gasoline consumption. Gasoline impacted also by Massification of NG Program. Net Reductions of LPG (Trade-off “NG Massification and “Cocina-Peru”). NUMES impacted Diesel. Lighting program slightly impacts.

- **Colombia**: Ethanol and Biodiesel blends had major impacts in gasoline and diesel consumption. PROURE program also had significant impacts in many sectors.

- **Ecuador**: Major impacts in fuel oil consumption by the Hydro Power Generation Expansion. Significant reductions in LPG consumption by the “Cocccion Eficiente” Program.
RESULTS

Supply-Demand Curves for the Baseline and Policy Scenario

- Peru: Adverse outlook.

- Colombia: In a pessimistic scenario the country would become a net oil importer.

- Ecuador: Will it face a possible peak-oil in the following years?.
Our baseline projections show that the demand of oil products in 2030 will be nearly twofold the demand of 2012. The diesel and gasoline are the main fuels required driven by the transport sector demand. In Ecuador, in the baseline scenario there is a significant growth of fuel oil consumption for power generation if the major hydro power plants are not constructed.

Should the governmental programs are implemented, there would be accumulated savings of 121 Mboe, 142 Mboe, and 214 Mboe of oil products for Peru, Colombia and Ecuador, respectively. Remarkably are the reductions achieved by the Subway Lines program in Peru, the increasing of biofuels blends in Colombia and the Hydro Power expansion plan in Ecuador.

The simulated supply-demand scenarios show that Ecuador and Colombia could change the net exporter position to a net oil importer position before 2030. This highlights the importance of implementing the current policy programs and also addressing more aggressive actions to cope with the increasing oil products demand. Furthermore, it suggest the need of making investments to promote the diversification of the energy supply with other energy resources such as natural gas or biofuels.

Further studies are needed to assess the economic impact of these scenarios for these countries. Economic policies has to take into consideration that oil and oil products are the main exporting goods of Colombia and Ecuador, and there are probable scenarios that these net exports could be offset by the increasing demand. In addition, in the case of Peru the negative oil trade balance will increase and this could decelerate the expected economic growth.
Thank you for your attention!

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