OPTIMIZATION OF POWER GENERATION AND ENERGY EFFICIENCY (OGE&EE)

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The National Strategy on Climate Change (2012-2025) is a national policy that integrates de lines of action to fight climate changes up to 2025. This tool facilitates mainstreaming climate change in sector such as water resources, ecosystems, agriculture and energy. The current policy proposes the following approach:

1. **Mitigation focuses in reducing emissions of greenhouse gases and increase carbon sinks in strategic sectors.**
2. **Adaptation deals with strengthen the capacity of economic and environmental social systems to cope with the inevitable impacts of climate.**
INDC of Ecuador

Unconditioned Contribution

The Ecuador is committed to reduce between 20.4% to 25% of its GHG emissions by the year 2025.
(Uncertainty 10%)

NAMA – Hydropower Development
• Operation 8 hydroelectric projects by 2017 (2.827 MW installed capacity)

NAMA – Program of Efficient Cooking
• Replacement of 1’500.000 gas cookers for induction cookers

NAMA – Optimization of Power Generation and Energy Efficiency
• Partial implementation of OGE&EE Program (Petroamazonas flaring dimishing)

Conditioned Contribution

The Ecuador is committed to reduce between 37.5% to 45.8% of their GHG emission by the year 2025.
(Uncertainty 10%)

• Implementation of all the Master Plan Electrification more than 39 hydroelectric projects (7.661 MW installed capacity)

• 4'300.000 replacement of gas cookers for induction cookers

• Full implementation of OGE&EE

• Optimization of the transport sector
The existing Business Environment in the oil industry (still) shows high levels of gas flaring in the Ecuadorian Amazon Region.

**KEY INDICATORS**

- Only 15 MW of additional gas/crude power generation facilities was developed, which represents no more than 4.4% of the total power demand in the year 2023 (by means of the OGE&EE Program the State is developing over 300 MW).
- Over 100 million cubic feet of associated gas were burned per day whereby its value in BOE represents over USD 14 billion.
- Overall utilization factor in the range of 30-35% which means that for every 1 MW power demand it had to install ~3 MW (by means of the OGE&EE Program the overall utilization factor will increase to > 70%).
• The oil industry generally lacks an energy efficiency culture.
• For energy efficiency projects to be successful, objectives, conviction and passion have to trickle-down from top management to operators in the field.
• Most oil companies have not empowered a group of people, with resources and budget, to develop energy efficiency projects.

Energy Efficiency in most cases is NOT mandatory.
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Technical Barriers

Associated Gas Challenges:
UNSTABLE, UNRELIABLE and UNPREDICTABLE

1. Instability and uncertainty of associated gas in terms of volume, composition and trend.
2. Moving target: One solution does NOT fit all requirements given the fact that gas composition and volumes vary constantly.
3. Storing associated gas (to mitigate batches) comes with significant technical/economical challenges.
4. Transporting associated gas requires significant infrastructure with the risk of ending up as a stranded asset.
5. Limited fuel range (in terms of fuel composition) and fuel flexibility (ability to burn lowest cost and environmental impact available fuel) of most available power generation technologies generates a risk of ending up with a stranded asset in the event of fuel composition variations and or fuel volume restrictions.
6. It is very challenging (technically / economically) to optimize associated gas peaks (see charts).
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Economical Barriers

- Risk of stranded assets (low utilization) due to an uncertain operating environment. No guaranteed long term stable feedstock supply
- Energy efficiency project often face the challenge to overcome certain economical hurdles (monetizing stranded Associated Gas) lack of an economy of scale;
- Limited resources have a tendency to flow to “core business” projects (competing projects);
- Price distortion of competing fuels (crude oil and diesel used for power generation are either valued at zero cost or heavily subsidized (especially crucial at the beginning of the NAMA implementation));
- Energy efficiency implementation is not considered essential/has little or no impact on company financials (only the marketing aspect of energy efficiency is considered vital);
- Climate finance, CDM and other mechanisms have not delivered (THEY CREATED EXPECTATIONS BUT WITH NO DELIVERABLES so far)
1. **Optimize** up to 70 – 80 mmscfpd of Associated Gas for LPG production and power generation.

2. **NAMA boundaries:** NOT limited to one oil field and/or one operator but covers a national petroleum sector (multiple fields and operators – both state owned and private).

3. **NAMA key infrastructure:**
   - Associated Gas capture and Associated Gas handling facilities
   - Associated Gas transportation infra-structure
   - Power Generation facilities
   - Substations and power distribution facilities

4. **NAMA scope:**
   - Over 45 substations
   - Over 1000 km of transmission / distribution lines
   - Over 31 power plants – over 17 oil blocks
   - (Associated Gas, Gas / Crude and Crude Power Plants)
   - Over 100 km of gas pipelines
• **Fuel Flexibility**: Develop technology with the capability to burn either Crude Oil, Associated Gas and or Liquid Associated Gas (Condensates).

• **Waste Heat Recovery (WHR)**: Optimize exhaust gases for process facilities.

• **Monetizing Stranded Associated Gas (MSAG)**: Bring to market to monetize remote/limited volume of Associated Gas.
NAMA OGE&EE) Challenges (HOW)

- Develop small scale standardized/modular/redeployable (skid mounted / containerized) “plug and play” modules which can be fit together to form “phased in”/”phased out”/tailor made solutions.
- Building Block/LEGO solutions.
THE STATE OF ECUADOR HAS EMPOWERED TO THE STATE-OWNED OIL COMPANY TO EXECUTE THE OGE&EE PROGRAM
NOTES
1. The scenario "WITHOUT" the OGE&EE Project includes Gas and Crude Oil Power Generation Facilities installed by Private Oil Companies and Gas and Crude Oil Power Generation Facilities previously installed at Block 18 (Gas / Crude Oil vapor turbines and MAK Crude Oil power generator).
2. The power demand within the SEIP-E is based on the Scenario SHE 2014 which considers a peak volume of 570,000 bbl/d of crude oil more than the projected power demand needed for private companies contracted by PETROAMAZONAS EP (incremental volume of 130,000 bbl/d of crude oil).
3. Power demand forecast based on the Scenario Secretaría de Hidrocarburos (SHE) 2014 is different from the Scenario Low Investment Wood McKenzie - Ministerio de Recursos Naturales No Renovables (WM-MRNNR) due to: (i) The Scenario SHE 2014 includes ITT, the Scenario Low Investment WM-MRNNR does not, (ii) the Scenario SHE 2014 does not consider Improved Oil Recovery (IOR), the Scenario Low Investment WM-MRNNR does include IOR.
### NAMA OGE&EE

**Expected Outcomes: Transformational Impact**

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#### NOTES

1. The scenario "WITH" the OGE&EE Project assumes up to 200 MW of surplus Hydropower being imported from the National Grid as of 2017. According to CONELEC, for the SEIP-E has been considered a maximum of 100 MW on peak demand more an incremental power transfer depending on the hydrological conditions.

2. The scenario "WITH" the OGE&EE Project includes Gas and Crude Oil Power Generation Facilities installed by Private Oil Companies and Gas and Crude Oil Power Generation Facilities previously installed at Block 18 (Gas / Crude Oil vapor turbines and MAK Crude Oil power generator).

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NAMA OGE&EE

Expected Outcomes: Environmental Benefits

NAMA OGE&EE

NOTES
1. The emissions reduction within the SEIP-E is based on the Scenario of the Secretaría de Hidrocarburos (SHE) 2014.
2. The calculation includes CO2 emissions reduction due to fossil fuel displacement within the SEIP-E by surplus hydropower being imported from the National Grid.
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Ongoing Monitoring and Reporting

**INPUT**
- Power
- Investment
- Fuel Consumption
- Noise Level Measurement
- Fuel Cost
- CO2 Emission Factor
- Key Performance Indicators
- Energy Delivered to Communities

**OUTPUT**
- Economic Savings
- Savings vs. Investment
- Volume of Associated Gas Utilized
- Volume of Fuel Saved
- Power generated by fuel /source
- CO2 Emission reductions
- Short-Lived Climate Pollutants Reduction
- Energy for communities
- Noise Level Mitigation

**DATA PROCESSING**

The MRV System is so-called the Energy Efficiency Indicators Management System or SGI-EE
A brief summary of the Energy Efficiency Indicators is included in a company daily report (AG recovered and utilized, savings of diesel and CO₂ emission reductions).
The MRV System (SGI-EE) reports on a daily basis (as well as monthly and early).
OVERALL INVESTMENT *
USD 1,152,310,533

INVESTED UP TO JULY 2016
USD 654,226,589

* According to the Plan de Desarrollo OGE&EE 2013 – 2017
### NAMA OGE&EE

**Expected Climate Finance Support**

Some projects that would contribute to recover more associated gas and reduce CO\textsubscript{2} emissions:

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<th>Category</th>
<th>Project</th>
<th>Estimated Budget</th>
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<td><strong>TOTAL</strong></td>
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**NOTES**

2. The estimated budget could have slight changes based on updated KPIs.
Based on the Project Finance Structure, a financial mechanism so-called IPCOM-T has been proposed for gas and gas/crude power generation facilities at first. At present, a first agreement applying this mechanism is under negotiation for 52,1 MW (USD 100 million aprox.) between Petroamazonas EP, Private Sponsors and the Private Branch of a Multilateral Bank.
Thank You
Questions?
NAMA OGE&EE
Outcomes: Power Generation

Increase nominal installed capacity (distributed power with > 20 power generation facilities).

324.06 MW

Additional capacity installed up to July 2016

180.16 MW

Under negotiation

129.74 MW
NAMA OGE&EE
Outcomes: Power Distribution

13.8 / 35 / 69 kV of Distribution System to be developed
519.7 km

13.8 / 35 / 69 kV of Distribution System built up to July 2016
156.9 km

138 kV Transmission System to be developed
470 km
Gas pipelines to be developed under OGE&EE

+ 100 km
In September 2014, the OGE&EE Program put into operation a first power interconnection between the Petroleum Power Grid (also known as SEIP-E) and the community in Block 12. Petroamazonas EP deliver power to the community “Comunidad del Milenio Pañacocha” in the Amazon Rainforest through a 8.4 km. distribution power cable of 13.8 kV.

800 Beneficiaries of this interconnection

79 Households in the community
NAMA OGE&EE
Outcomes: Environmental Benefits

RESULT 2009 – 2015
VOLUME OF GAS RECOVERED: 15.9 thousand MMSCF
Associated gas recovery and utilization is national action included in the INDC of Ecuador.

RESULT 2009 – 2015
EMISSION REDUCTIONS: 848.5 thousand of ton CO₂