The Gambia: Renewable Energy Integration and Feed-In-Tariff Implementation

Matarr Touray
PURA
Presentation

- Electricity sub-Sector in The Gambia
- RE Law development and Regulatory Framework
- Feed – in – Tariffs Rules
- Tariff Model and Indexation Updates
- Challenges
National Electrification

- Network more developed along the coast
- Lack of national transmission backbone
  - Limits large scale RE integration
National Electrification

Electrification Rate by Region
2008 - 2012

Regions of The Gambia

- GBA
- WCR
- LRR
- NBR
- CRR
- URR

GBOS/NAWEC
Challenges for the power sector

- Insufficient transmission and distribution network
- Insufficient generation to meet demand (suppressed Demand)
- Lack of regional interconnection
- High T& D Losses (22%)
- Insufficient private sector investment
  - Financial credibility of off-taker
- Relatively high tariffs (opportunity)
  - Exposure to international fossil fuel prices
## Tariff increase June 2012

<table>
<thead>
<tr>
<th>Customer Category</th>
<th>2011 Tariff</th>
<th>New 2012 Tariff</th>
<th>% increase</th>
<th>US ¢ /kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic (prepayment flat)</td>
<td>7.20 D/kWh</td>
<td>9.10 D/kWh</td>
<td>26%</td>
<td>0.26</td>
</tr>
<tr>
<td>Commercial</td>
<td>8.60 D/kWh</td>
<td>9.70 D/kWh</td>
<td>13%</td>
<td>0.28</td>
</tr>
<tr>
<td>Hotel / Club / Industries</td>
<td>8.95 D/kWh</td>
<td>10.40 D/kWh</td>
<td>16%</td>
<td>0.30</td>
</tr>
<tr>
<td>Agriculture</td>
<td>8.00 D/kWh</td>
<td>9.10 D/kWh</td>
<td>14%</td>
<td>0.26</td>
</tr>
<tr>
<td>Area Councils</td>
<td>8.70 D/kWh</td>
<td>9.70 D/kWh</td>
<td>11%</td>
<td>0.28</td>
</tr>
<tr>
<td>Central Government</td>
<td>8.70 D/kWh</td>
<td>9.70 D/kWh</td>
<td>11%</td>
<td>0.28</td>
</tr>
</tbody>
</table>

US $1 = D35
Integrating Renewable

- Standard PPA just for Renewable
- Developed a Feed-in- Tariff Model
  - Using avoided cost of (Mixed HFO & LFO plant)
- Develop the RE interconnection Guideline
  - 4 yrs experience of Batakunku (150 kVA)
  - In 2012, 1MW of grid connected wind
    - GAMWIND Wind Farm Ltd
  - 20kW Net Metering pilot project
A regulatory framework

Hierarchy of requirements

- Renewable Energy Law
- FIT rules
- Electricity Act 2005
- Generation Licence
- Power Purchase Agreement
- Regular tariff announcements
- Grid code (will be needed as part of WAPP)
- Network connection agreement

Increasing detail and definition, PURA responsible
Increasing stability (slow to change, greater Ministerial scrutiny)
Grid Connected Renewable Energy
Community (cooperative)
Managed Wind Project 2009:
Model for small scale electrification
Net-metering (Renewable)

- Two meters installed
- Same tariff both ways (retail tariff or kWh/kWh)
  - Good for investors
- 2kW Pilot working
- 20kW solar PV installed @ Leo’s Hotel
  - www.leos.gm
  - Huge Solar potential
Role of PURA in new RE Law

- Implement the regulatory framework to support renewable energy
- Within the legal framework, define the rules for pricing renewable electricity
- Calculate FIT each year, including announcing the indexed level of existing PPAs.
- Ensure NAWEC implement the rules in practice
- Check that claiming generators are really renewable
- Monitor progress to ensure (1) costs to consumers are within acceptable levels and (2) investment framework is sufficiently stable and attractive
- Issue generation licences.
- Dispute resolution between NAWEC and generators.
- Check that the cap has not been reached, announce once the cap is reached.
Feed in Tariffs - Main Features

- No extra cost to consumers:
- The initial support level to be determined by the avoided cost methodology (LFO/HFO).
- Eligible technologies: solar PV, wind, biogas, biomass. (Subject to review)
- Automatically eligible scale: 20kW to 1.5MW.
- Below 20kW, net metering. NAWEC to offer decision. PURA can review
FiT- Rules - Main Features II

- Above 1.5MW, should negotiate traditional PPA.
- Certainty: PPA for 15 years from plant commissioning. Tariffs published 3 years in advance to give certainty to project developers, and thereafter only adjusted based on indexation.
- Simple benchmarking indexation formula linked to local inflation (for a deemed local component) and foreign exchange rate (US $, for a deemed international component).
Feed in Tariff Rules:

- PURA certifies “Eligible Renewable Plant”, that can receive the Feed In Tariffs.
  - Based on an “Eligible Renewable **Technology**” (Annual Authority Announcement)
  - On-Grid and eligible for connection to the grid under the Connection Agreement
  - **Capacity** is no greater than the “Specified Maximum Capacity” and no lower than the “Specified Minimum Capacity” (Annual Authority Announcement)
  - Operated in compliance with the FiT- Rules, the **Standard Power Purchase Agreement**, the terms of its Generation Licence and all pertinent laws
  - Complies with any “special requirements” which PURA impose.
Cap on overall level

- The system is not well placed to integrate large volumes of variable renewable generation.
  - Currently not stable and suffers from frequency disturbances (affects wind turbines).
  
- No central control system /dispatch

- Initially a cap of 10% of total available capacity until further technical studies are carried out.
  - Currently about 6 MW.

- The ultimate decision on the level of the cap is for PURA
Feed in Tariff Rules:

- FIT will be set in Dalasi/kWh of delivered electricity.
- Feed In Tariffs calculated in accordance with a methodology set out by the Authority and approved by the Minister of Energy.
- Generator and NAWEC shall enter into a Standard PPA.
- Generator invoices NAWEC according to the timescales set out in the PPA based on the metered generation.
- Annual Authority Announcement each year, including the adjusted FIT.
Tariff Setting Approach

- **Private avoided costs methodology** (a single tariff which represents the avoided cost of the alternative form of generation). 10MW Diesel

  - Simplest approach: single tariff based on existing technologies.
  - Might not be enough to foster the development of some renewable technologies.
  - High cost of current generation means renewables compete more easily
Feed in Tariff Rules:

- **Duration**
  - FIT cover fifteen (15) years from the date of commissioning. After this, if plants continue to operate, future tariffs may be freely negotiated... in compliance with any rules set by PURA.

- **Reviewing the Feed In Tariffs for existing projects:**
  - FIT for existing projects only reviewed based only on an index to inflation for the “Deemed Local Inflation Link” and an index to the dollar Exchange Rate for the “Deemed Foreign Link”, and not for any other reason

  - Announcement of the FIT levels for new projects three fiscal years in advance on a rolling basis, and once announced only reviewed based on indexation
Balanced ScoreCard Model

1) Define Technology

Technology

LFO

2) Define the portfolio mix

Mix - % LFO
30%
%

Mix - % HFO
70%

2) Define Project IRR

12%

3) Fill technology Inputs

Inputs

4) Outputs

LFO
HFO
Mix LFO-HFO
# Annual Tariff Announcements

<table>
<thead>
<tr>
<th>Year Zero</th>
<th>Year One</th>
<th>Year Two</th>
<th>Year Three</th>
<th>Year Four</th>
<th>Year Five</th>
</tr>
</thead>
<tbody>
<tr>
<td>PURA announces prices for years 1, 2 and 3 based on current avoided cost.</td>
<td>PURA adjusts prices for years 1, 2 and 3 for indexation (50% local inflation and 50% forex). Announces new prices for years 4, 5 and 6 based on current avoided cost.</td>
<td>PURA adjusts prices for years 1 to 6 for indexation (50% local inflation and 50% forex).</td>
<td>PURA adjusts prices for years 1 to 6 for indexation (50% local inflation and 50% forex). Announces new prices for years 7, 8 and 9 based on current avoided cost.</td>
<td>Projects commissioned in year 1 get the year 1 FIT adjusted for indexation for the full 15 year PPA.</td>
<td>Projects commissioned in year 2 get the year 2 FIT adjusted for indexation for the full 15 year PPA. Projects commissioned in year 3 get the year 3 FIT adjusted for indexation for the full 15 year PPA.</td>
</tr>
</tbody>
</table>
Example of indexation

The proposed formula will be:

\[ T_i = T_{(i-1)} \left[ (1 + \text{Inf}).LIL + \left( \frac{\text{ExRt}_i}{\text{ExRt}_{(i-1)}} \right).FL \right] \]

- **T** \(_i\) Tariff for period “i”
- **T** \(_{(i-1)}\) Tariff in previous period (i-1)
- Inf = Local inflation in percentage for the year (i.e. 5%)
- LIL = Deemed Local Inflation Link (in percentage)
- FL = Deemed Foreign Link (in percentage) (LIL + FLC = 1)
- ExRt\(_i\) = Exchange rate, GMD/Euro for period “i”
- ExRt\(_{(i-1)}\) = Exchange rate, GMD/Euro for previous period (i-1)

Adjust the “local” component for Gambia inflation

Adjust the “international” component for forex

\$/ Euro Index
Assumptions to calculate tariff

<table>
<thead>
<tr>
<th>Technology</th>
<th>Units</th>
<th>HFO</th>
<th>LFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>MW</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Net Thermal Efficiency</td>
<td>%</td>
<td>40</td>
<td>36</td>
</tr>
<tr>
<td>Internal consumption</td>
<td>%</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Calorific value</td>
<td>MKcal/sm³</td>
<td>7837.5</td>
<td>8662.5</td>
</tr>
<tr>
<td>Scheduled Maintenance</td>
<td>days/yr</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Forced Outage</td>
<td>%</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>CAPEX</td>
<td>USD/kW</td>
<td>1,400</td>
<td>1,100</td>
</tr>
<tr>
<td>Years under construction</td>
<td>yr</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Investment throughout yr</td>
<td>%</td>
<td>45-55</td>
<td>45-55</td>
</tr>
<tr>
<td>Useful life</td>
<td>yr</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>USD/MWh</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Fuel Costs</td>
<td>USD/toe</td>
<td>624</td>
<td>850</td>
</tr>
</tbody>
</table>

- Project Finance considering 25 years (assumed useful life).
- Depreciation period: 20 years.
- Income tax & VAT: 0%
- Debt-Equity structure: 50-50
- Loan tenor 6 yr, rate 12%
- Three scenarios are included based on different IRR: 10%, 12%, 15%
- Tariff D8.4/kWh
Feed in Tariff Rules:

Administration

- **Reporting:** PURA shall consolidate and report on renewable generation (information provided by NAWEC).

- **Certification:**
  - Must apply to PURA to get formal recognition as an Eligible Renewable Plant (rules set out minimum information required).
  - PURA will respond on a first come, first serve basis, within two months, based on compliance with the rules and technical suitability.
Settlement

- Paying renewable generators for their power
  - the payments would come from NAWEC as the single grid company and electricity supplier.

- Frequency of Payments
  - 20kW-100kW paid every 3 months.
  - 100kW to 1.5MW paid every month.

- Auditing the scheme to ensure that it is being followed correctly.
  - Where generation from a particular plant seems unusual or fraud is suspected, PURA will have the right to audit the site and ensure that the generation is from the source claimed.
Main Challenges

- Slow political process
  - 1.6 yrs to approve RE law
  - Ability of Utility to Pay Developers (Elec, Water and Sewerage), Political Directives.
  - Retail Prices increased since June 2012
    - Solar more competitive
    - FIT will be below retail tariff
  - Land allocation would continue to be difficult for wind projects