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ecosur afrique holding
9th Floor, Raffles Tower
19 Cybercity. Ebene. Mauritius
Tél. +230 404 6060
Fax +230 468 1616
Registration number : 086712 C1
www.ecosurafrique.com

UNFCCC Secretariat
Martin-Luther-King-Strasse 8
D 53153 Bonn
Germany

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Attn. CDM Executive Board and SSC WG
cdm-info@unfccc.int

Subject. Call for inputs on on the standardization of the off-grid component of the "*Tool to calculate the emission factor for an electricity system*"

Dear Members of the CDM Executive Board and Methodologies Panel,

This electronic submission is a contribution to the CDM EB call for public inputs in relation to the standardization of the off-grid component of the "*Tool to calculate the emission factor for an electricity system*".

In a number of situations, the identified national grid is limited to a few power plants with a seemingly high renewable origin share, although the vast majority of the region/country's electricity demand may notoriously rely on numerous unconnected thermal generation plants/sets. The current call for inputs is therefore highly welcomed in the hope that it could ease the inclusion of such significant off-grid thermal power capacity in the Combined Margin Emission Factor calculation, in order to more appropriately reflect the reality of the electricity mix and sources CDM projects may displace if allowed to account for them in a reasonably timely and uncostly manner.

Elements of response with regards to the questions raised by the Information note of the 56th CDM Methodologies Panel:

(a) In which countries is off-grid power generation relevant and significant for inclusion in the "Tool to calculate the emission factor of an electricity system"?

We believe most Sub-Saharan Africa's countries are confronted with significant off-grid power generation as a consequence of inaccessible or unreliable national/regional electricity systems.

In **Nigeria**, several sources confirm the trends highlighted in PDD "Afam Integrated Gas and Power (AIGP)" (submitted with NM0208[1]) regarding the relevance and significance of off-grid power generation. In 2010, "*Habitants spend about $13 billion on the importation and fuelling of generators althought this is greater than the $10 billion investment that will be required annually to achieve stable power supply in the country. An opinion poll sponsored by the World Bank has confirmed that Nigerians are willing to pay cost-reflective tariffs for electricity.This is hardly surprising given the fact that some of the poorest Nigerians, including artisans and small business people, spend considerable amounts on off-grid petrol-powered generators*".[2] "*In the first week of January 2012, Nigerian businesses spent a whopping $8.2 million (about N1.180 billion) on importation of power generating sets.*"[3]. "*Off-grid power capacity is estimated at about 4-8,000 MW which make up a substantial part of Nigeria's power supply*"[4]. "*Electricity demand in Nigeria far outstrips supply. Nigeria has a population in excess of 150 million people and currently generates approximately 3,800 MW of electricity with very high levels of suppressed demand in excess of 10,000 MW. While the Nigerian power sector is characterized by serious deficiencies in generation, transmission & distribution infrastructures, the confluence of high suppressed demand, dependable population growth and healthy increases in GDP highlight the excellent potential of the Nigerian power sector. There is a shortfall in each distribution region.*"[5]

In **Sierra Leone** for instance, "*the lack and cost of electricity is one of the most frequently cited challenges facing investors. One example is Leocem, a cement manufacturer, which has built its own 5 MW power house. Another example is Sierra Rutile, a mining company, which built a new power house containing four 7.5 MW generators at a cost of $29*

[1] NM0208: Afam Integrated Gas and Power (AIGP) project
http://cdm.unfccc.int/methodologies/PAmethodologies/pnm/byref/NM0208
[2] President Jonhatan, October 2010, http://www.ngex.com/news/public/newsinfo.php?nid=9050
[3] iWatch Live, June 27th 2012, http://blog.iwatchlive.org/2012/06/n1-1bn-spent-on-generator-imports-in-one-week/
[4] Anton Eberhard and Katharine Nawaal Gratwick, January 2012, http://www.gsb.uct.ac.za/files/LightInside.pdf
[5] AG Energy Partners Limited website, 2011,http://www.agenergypartners.com/general/2/_i_nigerian_energy_market_or_i_

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million. Celtel, a mobile phone operator, uses a generator to run the main switch 24 hours a day and places two generators for every tower site in order to maintain 24-hour service. The company also pays for security guards to protect against the theft of the fuel in the generators".[6]

In **Guinea Conakry**, the total National grid's power installed is about 226,8MW which 43% is thermal and 57% is from hydroelectricity. According to Muriel Devey in its book "*La Guinée*"[7] the power provision is completed by independent off-grid generators due to low operating ratio. Indeed due to maintenance operations and lack of investment in the power sector to repair actual equipment[8] people are pushed to use independent off-grid generators. Last news representing quite well the situation is the 22x1MW off-grid power generators's offer from China on July 26th 2012.

Many other countries in Sub-Saharan Africa do embrace the same problematic although not necessarily so obvious based on, say, the installed capacity per capita. In the **Democratic Republic of Congo** for example, the 1,775 MW installed at Inga hydropower complex only operate at a fraction of its size by lack of maintenance, and mostly supply the mining industry cluster of Katanga, 1,700 km away across the country and still short of 800 MW, while barely 7% of the Congolese population have access to electricity at all.[9]

Thus in order to define which countries off-grid power generation is deemed significant, several key performance indicators (technical indices and commercial indices) that are already used to monitor the performance of electrical systems[10] could be assessed:
- Capacity factor of the electricity grid
- Load factor of the electricity grid
- Number of outages per year
- Households electrification rate
- Connectivity potential

Amongst the key performance indicators outlined above, the first three, when combined, give a good overview of the system.

Capacity factor of the electricity grid: This performance indicator is calculated as a **ratio of average hourly generation to maximum possible generation at the installed capacity level (before losses)**. This capacity factor gives the percentage of installed capacity that is utilized. Thus it provides valuable information on how close is the power generation system is to its practical limit (the installed capacity). There is no right identical capacity factor for all countries since the ideal value for this indicator is specific to each national context however when the capacity factor is very high there is an obvious risk of system overload and blackout, while when it is too low it means that equipment usage is inefficient.

Load factor of the electricity grid: This performance indicator is calculated as a **ratio of the average annual load to maximum annual load**. It gives information about the variability of the demand and how efficiently the power system is managed. When the load factor is high (average demand is close to peak demand), the load variability is low and/or equipment usage is high and close to the capacity limits. Thus supply might be unsufficient to meet demand.

Operating ratio: This performance indicator is calculated as a **ratio of the operating capacity to the installed capacity**. It gives information on the condition of the power generation assets. And thus it gives context to the analysis of the other two indicators. When this indicator is low, it means that only a small percentage of the installed capacity is actually available for genera

By analyzing those three indicators together (particularly the capacity factor and the load factor), it is possible to get quite a good picture of the performance of an electrical system and in particular its capacity to meet the demand. For instance when both capacity factor and load factor are high, it means that capacity has to be increased in order to meet the growing demand and that supply level is likely to be unsufficient to meet the current demand, which leads to the adoption of alternative power sources (off-grid generators, isolated power plants) by the customers or is responsible for a suppressed demand.

Beyond these first three indicators:

Number of outages per year is a key indicator of service quality since blackouts, brownouts and load shedding are prejudiciable to businesses and housheolds from economic and soclal points of view. A high level of outages and service unreliability forces the customer to require to expensive emergency power system or even independant electricity

[6] UNCTAD fact-finding mission, June 2008, http://unctad.org/en/docs/diaepcb200914_en.pdf
[7] ISBN 978-2-8111-0076-6 Karthala Editions, 2009
[8] Le Magazine de l'Afrique, Spécial Guinée Energie, May-June 2012, http://content.yudu.com/A1wi7f/NAF26/resources/80.htm
[9] Earthzine essay, March 2010, http://www.earthzine.org/2010/03/08/power-potential-and-pitfalls-on-the-congo-developing-africa%E2%80%99s-cleanest-and-largest-hydropower-opportunity/
[10] Monitoring Performance of Electric Utilities, Indicators and Benhcmarking in Sub-Saharan Africa, The World Bank, 2009, http://www.esmap.org/esmap/sites/esmap.org/files/P099234_AFR_Monitoring%20Performance%20of%20Electric%20Utilities_Tallapragada_0.pdf

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generators using fossil fuel. It also reduces the amount of power that they are likely to consume given the higher cost of setting up such systems.

Household electrification rate: This performance indicator is a calculated as a ratio of population with access to electricity out of population in the country. Even though this indicator measures only households access to electricity it can be used as a proxy for commercial access especially for small businesses and thus is an important indicator of power sector performance. A low level means that an important part of the population is obliged to rely on independent power sources such as diesel generators.

Connectivity potential: This performance indicator is calculated as the difference between number of new households minus number of new connected households each year. A high level means that a growing part of the population does not have access to grid connected electricity.

Tresholds could be defined for the above indicators in order to select the countries in which off-grid power generation is deemed significant for inclusion in *the "Tool to calculate the emission factor of an electricity system".*

(b) What information required by the current off-grid procedure in the tool could be simplified or standardized?

The minimum data/information to be collected on each off-grid power plant as required in the current off-grid procedure in the tool may be seen as reasonable in the case of large countries such as Nigeria if we refer to the PDD "Afam Integrated Gas and Power (AIGP)". However we noticed that information used in this PDD comes from a study conducted by NEPA, the National Electric Power Authority during the period 1978-2002 that is to say five years before PDD has been published. This underlines the difficulty to gather recent data.

In many Sub-Saharan Africa countries, collection of grid data certified by relevant authorities for grid connected power plants remains a challenge. When some information is publicly available, most of the time, data are outdated[11]. This is disproportionately true for the additional data that may be collected on off-grid power generation. It is quite difficult to get access to such data which may give strategic information on the capacity and/or production of sensitive industrial sites. In the case of smaller-scale multi-location like SMEs and individual properties surveying may be even more difficult. This is evenmore true for CDM project developers than for government authorities.

(c) Have you tried to apply the off-grid component of the tool? If yes, describe your experience; and

(d) What barriers, if any, have prevented you from applying the off-grid calculation component of the grid tool?

Our past tentative to apply the off-grid component of the tool did stall by lack of information availability / data collection capacity. Inexistent publicly displayed data, let alone country officials/utility reluctance to share power-related information, singularly hampers the chances of gathering required off-grid details in sufficient quantity and/or quality, would it not be simplified/standardized for accrued DNA participation at government level and private sector accessibility.

(e) What data is typically available on off-grid power generation, in particular in least developed countries?

Very minimal information is available in some countries especially among the Least Developed; where it can already be complicated to retrieve exhaustive and accurate information on the grid from the utility company itself.

Elements of response with regards to the possible new approaches suggested by the Information note of the 56th CDM Methodologies Panel:

A. Inference from load characteristics

(a) Are data to derive a load curve readily available in locations with significant off-grid generation?

From our experience, chronological load data for each hour of a year are definitely not available (either not recorded or not willingly disclosed) in most of the Sub-Saharan Africa countries with significant off-grid generation (see the examples above) except maybe for some countries with a developed grid such as Nigeria (data for the year 2002 were used in 2007 in the PDD "Afam Integrated Gas and Power (AIGP)").

(b) Do load curves for grids in locations with significant off-grid generation actually demonstrate the characteristics illustrated in the figure below?

N/A

[11] Example: In Senegal the last publicly available annual report from SENELEC was published for the year 2008
http://www.senelec.sn/content/view/66/65/
In Mali, the last publicly available annual report from the Ministry of Energy was published for the year 2007
http://www.dnemali.org/upload_document/Rapport_SIE_2007.pdf

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(c) How would it be possible to account for the effect that the installed power capacity could not represent limitations on grid electricity generation, but rather, for example, that the grid could contain a significant amount of hydropower where water supply is variable (and limited) or that the grid has significant transmission constraints?

We believe that as a simplifying assumption it may be possible to disregard the limitation of supply due to transmission constraints since this information that is specific to each power plant may be quite difficult to gather for large countries due to important number of off-grid power plants and for small countries due to the lack of database. We think that it is possible to verify for large HPP if a low capacity factor is due to unsufficient water supply or to other issues. For small HPP and especially those operated by IPP this information may be difficult to obtain.

B. Use of data on the deficit in electricity supply

(a) How should the deficit in electricity supply be defined and quantified?

The deficit in electricity supply may be related to two causes:

- **Demand in electricity that is not met by the current level of supply.** As explained in the previous section when both the capacity factor and the load factor of the electrical grid are high, it is likely that the power generation assets are operating close to their maximum level and that a part of the demand is not currently met. In this situation it may be possible to estimate the related deficit in electricity supply by considering the household electrification rate and by calculating the amount of electricity that would have been supplied to all households who should have been connected to the grid and who may currently use off-grid power plants as an alternative. Furthermore it may be possible to define the quantity of electricity that should have been supplied to the customers if the operational power capacity was sufficient by using the minimum service level outlined in the « *Guidelines on the consideration of suppressed demand in CDM methodologies* » (Version 2.0)
- **Demand in electricity that is caused by the unreliability of the electrical grid.** As stated in the previous section a high level of unreliability (blackouts, brownouts and load shedding) in the electricity supply leads to increased use of diesel generators as a back up or even as independent power sources for customers in particular for businesses which need reliability in the electricity supply. Unfortunately it may be difficult to estimate the parameters of this relation using surveys, thus the use of publicly available database containing national/regional data should be preferred.

In countries in which the operating ratio is particularly low given to inadequate maintenance for example, the opportunity to meet the deficit in electricity supply by power plants that have a low operating factor shall be considered as well as the installation of new capacities on the grid.

(b) Does the grid operator collect and analyze information about the deficit in electricity supply?

Grid operator participation is indeed a valuable option, although DNA, Government and NGOs efforts and publications should also be granted acceptability.

(c) How can the type of fuels used by the off grid units be determined?

Given that the main appeal of off-grid generators is very often their increased reliability compared to grid generated electricity, non-dispatchable renewable sources such as wind power and solar power may be ruled out as possibilities for off-grid power plants. Amongst all fossil fuels that are commonly used to fuell electricity generators, gas/diesel oil has the lowest emission factor according to IPCC and thus it may be conservatively chosen as the default fuel.

(d) How can the percentage of the deficit that would be generated by off-grid power plants be determined?

Given that the deficit in electricity is related to two causes as outlined in section B. a), we came that for:

- the demand in electricity that is not met by the current level of supply, a combined approach considering also the « *Guidelines on the consideration of suppressed demand in CDM methodologies* » (Version 2.0) could be applied.
- the demand in electricity that is caused by unreliability of the grid, a value of 100% maybe applied seems it is obvious that all customers that are critically affected by this issue would use off-grid power plants as back-up or independent power generators.

In conclusion, we look forward to such standardization of the off-grid component of the "*Tool to calculate the emission factor for an electricity system*". We strongly recommend the use of publicly available information for all Sub-Saharan African countries (exemple of data base: World Bank, IEA, AfdB, UNDP,…) for the inclusion of off-grid power generation. This could be achieved by using some of the key performance indicators defined above. Finally we think that a better integration of the suppressed demand concept in the new version of the tool would help to promote the development of new CDM projects especially in Least Developped countries.

Yours sincerely,

ecosur afrique:

Aurelie LEPAGE	Alexandre DUNOD	Jean-Félicien BANNY
Chief Operating Officer	CDM Project Manager	CDM Project Manager
a.lepage @ecosurafrique.com	a.dunod@ecosurafrique.com	jf.banny@ecosurafrique.com