The Kuyasa Case Study: An effort towards climate justice and energy poverty alleviation (crediting suppressed demand for energy services under the CDM).

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Abstract

If development and poverty alleviation strategies directed at energy poor households succeed, their economic status and their ability to consume goods and services is bound to change. This is likely to lead to an increase “in their demand for energy services” which is usually ‘suppressed’ due to energy poverty and/or lack of modern energy infrastructure. Poor households may be able to access sustainable energy technologies and services through the climate mitigation project activities of the Kyoto Protocol with the development of “baselines” (that which would have happened in the absence of the project activity) which consider the case of suppressed demand. However, in order to successfully and sustainably implement such project activities, a viable financial structure is required.

This paper looks at how this case study has developed baselines which consider suppressed demand and also looks closely at the financing options which can be undertaken to ensure proper implementation of the whole project activity.

1. Introduction

At household level, energy poverty can be understood as limited access to energy services, which includes both access to fuels and appliances. Energy poverty thus affects the energy choices and consumption patterns of poor households. However, if development and poverty alleviation strategies are introduced and succeed, the economic status of the energy poor households and their ability to consume goods and services is bound to change\(^1\). Consequently, these households will increase their demand for energy services and acquire a similar variety of energy sources and energy consumption patterns (and hence emissions’ profiles) as that seen in their “energy well-off” counterparts who are, commonly, high consumers of energy. These households are thus referred to as experiencing a “suppressed demand” for energy services due to energy poverty which currently exists among low-income communities (Winkler and Thorne, 2002).

The Kuyasa Pilot CDM Project activity is a City of Cape Town initiative together with the community of Kuyasa and is facilitated by the SouthSouthNorth Project. This project activity showcases how disadvantaged communities in developing countries, can be included in the climate debate whilst attaining, in the long run, some degree of climate

\(^1\) A study of Economic trends embodies in the living standard measure (LSM) that approximates the Kuyasa inhabitants’ situation was undertaken. The LSM concluded that this segment of South African population is increasing the consumption of goods and services, including the future installation of hot water storage geysers.
justice. Thus, energy poverty, lack of appliances and hence suppressed demand for energy services in this community, is used to inform a baseline methodology. A baseline has been determined using the Kyoto Protocol’s small-scale modalities and procedures. Therefore, a suppressed demand baseline methodology interpretation is being explored in this case study and has been forwarded to the Methodologies Panel of the UNFCCC’s Executive Board for approval.

This case study\(^2\) shows how disadvantaged communities in the “South”, that have contributed the least to global climate change but will bear the largest burden, are influencing policies at both local and national levels, and are thus contributing to the climate justice debate. Failing to achieve justice in these instances would sentence Kuyasa residents to get dirty before they qualify to get clean. These households also continue finding it difficult to access the “finance” which can assist them in further contributing to the climate change debate. In this case study, different financing options are thus being explored to facilitate implementation of the project, the first, however, is to get the methodology right for the portion which could be covered by the Kyoto Protocol Clean Development Mechanism. The international portion can then be used to leverage the shortfall in required finance.

2. The Case Study: Kuyasa CDM Project Activity

In 1994, the first South African government of national unity introduced the Reconstruction and Development Programme (RDP) which is an integrated, coherent socio-economic policy framework. Within this framework a programme was proposed which included the building of a million houses by the year 2000 for all households with a monthly income of less than R3500 (US 437) or less, who had never owned property before and who resided in squatter camps close to urban areas. With this programme a maximum institutional subsidy of R16000 (US$ 2000) per beneficiary was pledged to be used for the building of standard Reconstruction and Development Programme (RDP)\(^3\) housing units.

The RDP housing units have electricity, but no hot water storage geysers (providing hot water on demand) they also have no ceiling insulation. These households are currently dependent on batch heating for hot water (pots on stoves) and inefficient methods for space heating, during the four coldest months of the year.

The scope of this project activity includes the retrofitting of each standard housing unit

\(^2\) The thrust of the case study is has been to build and calibrate theoretical models for energy service consumption so as to be able to use the model to predict an energy service baseline for the level of unsuppressed demand for energy services from day 1 using baseline fuels’ emissions intensities.

\(^3\) Each housing unit covers an area of 30m\(^2\); with one pre-paid electricity meter and plug point; a single roof cover layer (galvanised iron) with no insulating material or ceiling; and a partitioned toilet with a basin and one cold water tap. Energy service benchmarks such as thermal comfort and warm water on demand are not met.
with renewable and energy efficient technologies which reduce GHGs whilst promoting sustainable development. The renewable and energy efficient interventions include:

- Solar Water Heaters,
- Ceiling and ceiling insulation and,
- Compact fluorescent light bulbs. (The case study does not deal with the rather straightforward methodology dealing with CFLs.)

This project activity will be submitted as a Gold Standard\(^4\) CDM project activity because of its significant contribution to sustainable development.

3. **Energy poverty and suppressed demand for energy services**

In a suppressed demand case, it is assumed that as livelihoods improve, so an ability to consume goods and services is likely to grow, along with an increased demand for, as well as an increased availability of, energy services. Thus if these assumptions prove to be true, and with primary data suggesting that this is the case, it thus follows that without any of these renewable and energy-efficient technology interventions these households will acquire the technologies, fuels and overall energy services which will result in increased emissions.

Low-cost households use as much as 25% of their income on energy services. However, even with constraints such as low income and limited access to efficient fuel and appliance combinations, these households have been found to manage their energy services highly efficiently within these constraints (Cousins and Mahote, 2003). Therefore as these energy constraints are reduced, it can be assumed that their current good energy management practices will be eroded in favour of greater inefficiency with consequent increases in GHG emissions. The majority of the increased energy service consumption, however, will be used to fulfill the current shortfall in energy service requirements, diminishing the suppressed demand in favour of satisfying the service.

Thus, the baseline methodology for such cases should set out to establish how current suppressed demand can be incorporated into the design of emissions baselines in terms of the provisions of paragraph 46 of the Modalities & Procedures for Clean Development Mechanism project activities, which reads: “The baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host Party.” The rationale is that in future, households will tend to satisfy their energy service requirements.

In this case study, we will make an attempt to illustrate how to develop a baseline

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\(^4\) The “Gold Standard: Quality Standards for CDM and the JI” provides the first independent best practice benchmark for CDM (Clean Development Mechanism) and JI (Joint Implementation) greenhouse gas mitigation projects. It offers project developers a tool with which they can ensure that the CDM and JI deliver credible projects with real environmental benefits and, in so doing, give confidence to host countries and the public that projects represent new and additional investments in sustainable energy services. The Gold Standard Tool has been endorsed by members of Climate Action Network and by also a number of non-profit organisations around the world.
methodology which predicts the future (unsuppressed) emissions from the outset in terms of the demand for conventional energy services, in this case, for thermal energy services. Such an approach will require a balance between conservative baseline development and a correct interpretation of the aforementioned paragraph 46. Therefore, an additional challenge is to develop predictive baseline modelling approaches that are both conservative and transparent.

3.1 An example of a suppressed demand methodology: Thermal performance baseline methodology

The calibrated theoretical model employs empirical data to predict seasonal and diurnal heating requirement based on occupancy, and to understand when thermal comfort for the residents is reached temperature-wise by observing heating behavior.

The outcome has been to use a 4 month heating season with a heating in the morning and evening in which the households would reach a level of thermal comfort. This model is further refined, and calibrated incrementally, by comparing empirical performance (on indoor and outdoor temperatures, and real heat loads observed in both the behavioral study and measured using data loggers installed for monitoring purposes) with the predicted performance and adjusting parameters to achieve convergence or minimum deviation from the mean. Adjustments are then made for certain parameters such as air changes\(^5\) to ensure that the model can predict performance with acceptable accuracy to within 5% around the mean. The technical monitoring of the impacts of the interventions involved the installation of data loggers. A rich database has been established from frequent monitoring of all of these parameters over a six month period.

Using the calibrated model for houses with ceilings and ceiling insulation, the amount of energy required to reach thermal comfort without ceilings for the heating season can be predicted. The baseline for a CDM project activity that installs ceilings and ceiling insulation is the predicted emissions scenario in the houses in the absence of ceilings. Once fed into the model, these provide the following graphical interpretation (Figure 1.1) of the suppressed baseline emissions scenario.

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\(^5\) Air changes are difficult to measure and thus have to be assumed.
**Methodology:** In this case, the energy required to provide thermal comfort in the case of Kuyasa type houses for 4 months of the year between the times of, for illustration, 06h00 and 08h00 and 18h00 and 21h00, is predicted using the calibrated model.

The calculation of suppressed demand is based on the premise that over time the energy consumption will increase to a point where thermal comfort is reached during observed non-sleeping periods of occupation. The times are based upon real non-sleeping occupancy, approximated by observing lighting and other loads sensed by the data loggers and then conservatively refined. Thus for the purposes of illustration, the level of thermal comfort is reached for two periods of the day (06h00 to 08h00 and 18h00 to 21h00) for 4 winter months. The amount of energy required to heat the house without the ceiling is A and AI for the 4 months. The current level of energy utilized is C and CI for 4 months. The energy required heating the house with the ceiling and ceiling insulation is B and BI for 4 months.

**Results:**

**Suppressed demand** = (A-C)-(B-C) + (AI-CI)-(BI-CI)

A final assumption is that even with increasing income, the installation of ceilings would only have occurred once other necessities (such as increased space adding to the current 30m²) had been achieved and after the acquisition of electric hot water storage geysers.
Therefore, the degree to which the heating service is suppressed is expressed as the difference between the predictions with and without the ceiling and ceiling insulation in meeting thermal comfort expressed as emissions of CO₂ equivalent.

3.1.1. Results from the Kuyasa thermal performance suppressed demand baseline methodology

The average energy saved in the morning period (06h00 to 08h00) and evening (18h00 to 21h00) heating periods were found to be 837 and 508 kWh/annum respectively with energy savings of 21.1% and 18.3% respectively. Thus the total average energy per household was to be 1345 kWh/annum per house, representing an average of 19.4% saving on energy used for spacing heating.

The suppressed demand baseline methodology explained above has been submitted to the Methodologies Panel of the UNFCCC Executive Board to clarify if the interpretations given in Appendix B for small scale project activities are correct and consistent with paragraph 46 of the Modalities and procedures for the clean development mechanism in the Marrakech Accord (FCCC/CP/2001/13/Add.2).

The initial response from the CDM’s Methodology Panel has been inconclusive, as we feel that the Methodologies Panel have considered only the lack of infrastructure and not poverty as a pillar of suppressed demand. This is being followed up through correspondence. At the same time the Kuyasa project is being put forward for a pre-validation opinion following the CDM ‘small scale methodology’ approach. Once acceptance has been assured, a full scale methodology will be submitted. This will then be applicable to a potential regular housing project activity in South Africa, and for the retrofitting of the many low cost houses built over the past ten years.

3.1.2. Technical Status Quo of the CDM Project Activity

This project activity was initiated in July 2002 with a demonstration phase whereby 10 beneficiary households were selected by the local community to have their houses retrofitted with the three identified interventions. These demonstration houses serve a dual purpose, one being a demonstration to the local community on the performance and efficiency of the interventions, and two, as a means of establishing a baseline methodology as required by the Kyoto Protocol’s CDM’s Modalities and Procedures.

These households have also have been monitored over the period of six months for technical performance and efficiency of the interventions. This has been done by means of data loggers which have been installed in the houses, which record water temperatures, all electricity flows as well as indoor and outdoor temperatures. The change in behavior patterns of these households in terms of non-electrical energy use, energy consumption and overall impact of these technologies has also been monitored over the same period through an anthropological (behavioural) study.

Both the behavioral and technical monitoring studies have assisted in the development
and refinement of a suppressed demand thermal performance baseline methodology and a suppressed demand solar water heating methodology. Both methodologies have been established and refined by local technical energy experts, including the SouthSouthNorth Project Development Team.

4. Financial Status Quo of the CDM Project Activity

The carbon market is subject to a number of major uncertainties at this stage, primarily that of Kyoto ratification. Developed countries which have signed the Kyoto Protocol (termed Annex I countries) are busy with the process of devolving their country level targets to their various economic sectors. Once this is complete, it will stimulate private sector involvement in the market. At the moment the market can best be described as fragmented, immature and illiquid, however this is changing rapidly, particularly with the advent of the EU Emissions Trading Scheme at the beginning of 2005 and the start of the Kyoto First Compliance Period in 2008.

Purchasers in the carbon market include public buyers, private funds and project financiers, private companies and NGOs. These entities are interested in the market for reasons of compliance with regulatory targets, voluntary offsets of emissions, and to a lesser extent, speculation. The high level of risk surrounding Certified Emission Reductions (CERs) means that no purchaser is willing to pay for a future stream of CERs up front, and very few are buying credits post 2012, the end of the Kyoto First Compliance Period. This puts an implementation time pressure on CDM project activities to generate CERs as soon as possible. It also means that for project activities where the CER revenue is necessary for implementation, bridging finance is required. Whilst emission reductions can be monitored, verified and certified as regularly as the project participant chooses during the crediting period, there is a cost implication to this which will need to be assessed against project activity cash flow requirements.

Therefore, CDM project activities which have high sustainability characteristics can command the highest prices in the market at the moment. Currently the best realistic price for a project such as Kuyasa is estimated at €10/tCO2e (tonne of carbon dioxide equivalent). Indications are that this price may rise slightly as the market matures.

Presently there are three options which have been considered for the Kuyasa Case study whilst it must be ensured that each preferred financial structure must take into account the need for ongoing sustainability of the project activity to ensure the CER revenue and to ensure sustainable benefits for the community mostly in terms of energy services:

4.2.1 Option 1 (The CDM Project activity component)

The three interventions in the project activity have an up-front capital cost of approximately US$771 per housing unit. Also based on conservative assumptions, the CER revenue will cover 22 percent of this cost, and this represents a minimum revenue stream over an eight year period until 2012. As a result, bridging finance in year zero is still required for this amount.
However, investor interest in the Kuyasa project is high, although dependent on a viable financing structure in place to ensure delivery of CERs at least until 2012.

4.2.2 Option 2 (Replication of the case study to a regular project activity)

The Kuyasa case study holds an immense opportunity for replication at a national level. Currently, there are over 1.5 million RDP houses in South Africa which could benefit from this project design (which include technical and financial methodologies).

The case study and the extension of this case study to a regular CDM project activity inform each other in a number of ways, and they are as follows:

- A fully transacted Kuyasa project activity will demonstrate the viability of this project design to potential grant fund streams as it contains huge lessons for implementation processes;
- Establishing a sustainable and replicable financial model at the small-scale (case study) will hugely facilitate replicability; and
- Should the financial models for the small-scale and regular project activity differ substantially, negative comparisons may be made.

Therefore, given the context of a potential regular project activity, the small-scale project activity need not be restricted to being located in Kuyasa. The discussions so far with the project participant (City of Cape Town - local government) and other stakeholders have identified a number of other possibilities in order to overcome institutional barriers which should be given due consideration, but with acknowledgement of the CDM suppressed demand methodology objective, as a first step.

4.2.3 Option 3 (Community involvement)

These Kuyasa households are by definition very low income earners. However, some contribution for the purposes of ownership of the three interventions is a consideration, both for the sustainability of the project (the interventions have to be present and operating in order to have the credits certified) and potentially for the financing package.

Initial investigations show an amount in the region of R30 (US$5) to be the sum that homeowners spend currently on energy services per month. Therefore, if this amount were to be a monthly repayment on a loan from micro-lenders (who charge a minimum of 32 percent interest), this would enable the homeowners to borrow R1000 ($167) over a five year period.

The Net Present Value (NPV) for maintenance costs of these interventions is estimated to be R390 ($65) per household, plus a NPV of CER cost of R85 ($14) per housing unit. These costs have not been included in the upfront capital costs.
5. Conclusions.

This case study clearly illustrates that for societies, communities and households where energy poverty exists, suppressed demand for energy services exists and there should therefore be possibilities for CDM interventions using a suppressed demand baseline methodology. The methodology which has been used in this Kuyasa Case Study can be used and applied to other sectors and where infrastructure is limited such as in Least Developed Countries, where currently the energy service is unmet either due to lack of available quantity or quality. Results from this case study have indicated that there is a great possibility for replication of these kinds of interventions, whilst considering the case of suppressed demand for all the existing and future RDP housing in South Africa, as a start.

The use of calibrated models which we have presented above has not been introduced under the CDM’s modalities and procedures in defining and determining baselines where suppressed demand (i.e. increased future emissions due to development and decreased poverty) is anticipated and emissions are projected to rise. Therefore, this case study has argued that suppressed demand is a specific circumstance that justifies baseline scenarios that use calibrated models in which future emissions are most likely to increase. Anything less would perversely sentence the poor and undeveloped to become dirty before qualifying to get clean. Using suppressed demand baseline would facilitate technological leapfrogging now, through consciously avoiding future emissions and this is in keeping with the Convention and allows Multi-lateral Environmental Agreements to be used to directly address poverty alleviation.

In terms of financing such activities, especially in terms of the technologies in such poor communities, has also proven to be a great obstacle for sustainability of such project activities. The Kuyasa Case study has proven to be a real “learning by doing process” with each option outlined trying to ensure sustainability of the project activity where credible real CERs could be obtained. Stakeholders within this case study are still trying to analyze the financing options presented to them and hopefully will succeed in setting a precedent for such small-scale CDM project activities with high sustainable development benefits direct to communities in the “South”.

The replication of Kuyasa/suppressed demand type projects could use international funding dedicated to the purchase of CERs as a way of leveraging National and International resources, to, on one hand deliver climate mitigation and the other poverty alleviation – a certain global win-win.
6. References