SUPPRESSED DEMAND AND THE CARBON MARKETS

DOES DEVELOPMENT HAVE TO BECOME DIRTY BEFORE IT QUALIFIES TO BECOME CLEAN?

Three Case Studies of Suppressed Demand in CDM Projects

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Case Studies on Development Projects in the Carbon Market

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GERES - Group for the Environment, Renewable Energy and Solidarity

- is a non-profit association set up in 1976, which works to improve the living conditions of the poorest communities by implementing projects that reduce fuel poverty, conserve the environment and limit climate change and its consequences. The association deploys development engineering and specific technical expertise in partnership with local communities and stakeholders.

Its activities focus on energy-efficient techniques, extension of energy services to facilitate local economic development, promotion of renewable energy supply chains and waste recycling. At present, more than 200 people are running almost 50 innovative sustainable development projects in France and 12 countries in the South.

CDC Climat

– the subsidiary of the French financial organization Caisse des Dépôts set up in 2010 to combat climate change.

A committed player in carbon finance, CDC Climat supports the establishment of climate policies at international, regional and national level, adopting a three-pronged approach:

- development of services for the carbon markets;
- investment in carbon assets, directly or in the form of innovative carbon funds open to other long-term investors, with the aim of reducing CO_2 emissions by 60 Mt by the end of 2014;
- research into climate change economics, by conducting independent, unbiased studies aimed at the public authorities, market stakeholders and the general public.

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EXECUTIVE SUMMARY

Without supported low carbon development strategies, goals of limiting climate change obstreperously more challenging. It could also "lock in" developing regions to high carbon growth and development pathways.

Much of the world still languishes without a range minimum services that are able to meet basic human needs. Globally, the International Energy Agency (IEA) estimates that 20% of people live without access to electricity and 40% are reliant on biomass for cooking, more than 1 billion people are without access to safe drinking water and 2.6 billion without basic sanitation. **Lack of access to modern forms of energy tends to go hand-in-hand with a lack of provision of clean water, sanitation and healthcare.**

There is a staggering inequality in access to services and the quality of services between rich and poor societies - the poorer three quarters of the world's population use only 10 per cent of global energy[i]. **Lack of access to Minimum levels of basic services is a serious barrier to socio-economic development and progress toward the Millennium Development Goals.**

While imperative, cost-effective expansion of Minimum Services throughout the developing world is likely to carry with it a considerable increase in GHG emissions from poor regions. Expanding access enables increases in productivity, competitiveness and promotion of economic growth and poverty reduction and often results in increases in emissions. Over time there is an undeniable link between increases GDP, increases in energy usage and emissions; a relationship that is stronger among LDC's[ii].

Mitigation of GHG emissions and expansion of basic services are critical and immediate global imperatives. However, for societies that have yet to reach level of economic development that is emissions intensive, pure mitigation instruments that focus only on trying to reduce current levels of emissions are likely to have minimal impact.

Poor or under development regions tend to have low levels of emissions. The latent demand that exists for these basic services is "suppressed" due to barriers such as low income, weak infrastructure and inadequate access to technology or skills.

"Suppressed Demand" refers to a situation where current levels of access to services are inadequate for basic human needs – termed "Minimum Service Levels" (MSL).

Services are inadequate because of "income effects" and the "rebound effect". That is, because income/poverty or infrastructure barriers constrain access to services or when the demand of a service increases as a result of the decrease in the unit cost of a service.

The OECD predicts that **energy-related CO_2 emissions are forecast to grow even more rapidly, increasing by 78% between 2005 and 2050 if no new action is taken to curb them, largely as a result of increased demand for electricity[iii].** Even so, the IEA 2011 estimates that achieving universal access to 'modern energy services' by 2030 would marginally increase demand for fossil fuels and GHG emissions[iv].

Much debate is focused on how we can facilitate poverty alleviation and a massive expansion in the provision of basic and necessary services with comparatively low carbon methods that will, on the one hand, reduce emissions from current levels and on the other avoid future emissions as countries develop.

Carbon markets can also play a role in catalyzing low-carbon investment in developing countries - $27 billion have flowed to developing countries, catalyzing low carbon investments of over $100 billion[v]. The **CDM has been successful in channeling funds, and it has been an important element of EU and international climate policy**.

While certainly not without its limitations[vi], we could expect the **CDM to play a central role in a post 2012 climate agreement[vii]. Despite twin aims of promoting sustainable development and reducing emissions, the CDM has demonstrated its irrelevance to billions of people in LDC's.**

A reform of the CDM would be relevant for LDC's and poor regions not only from an equity perspective, but also to achieve goals of climate change mitigation. Given that offset flows so far have largely gone to a relatively small set of middle income countries, broadening access among developing countries is an important priority.

The challenge is how to reform the CDM and other emerging mechanisms such as Nationally Appropriate Mitigation Actions (NAMA)[2] plan, to create much greater participation from a wider range of developing countries post-2012 that can transit them to a low carbon development path.

Many factors contribute to the current low participation for LDC's, such as investment and political risk faced by projects: **LDC's are not typically the "low hanging - high volume - easy to pick fruit" that attracts investors**. **Add to that, another key obstacle is that the CDM focuses on historic levels of emissions**.

In many poor regions, the low level of historic emissions, with disregard for latent demand leads to such insignificant creditable emission reductions that carbon finance revenue has marginal or negligible impact"[viii]. In other words, projects that beneficiates poor populations, in terms of services, infrastructure, access and income, and do not already pollute significantly are generally unviable as CDM projects. **The CDM and development stakeholders have recognized this concern[ix].**

Considering the concept of suppressed demand and therefore, of "avoiding future emissions", alongside simplified and standardized approaches to project

[2] NAMAs, Country targets/pledges, MRV, and other decarbonising activities linked to energy access and basic services

development is one curative measure. While the potential developmental benefits of such an approach are persuasive, regulators have faced considerable challenges in terms of methods for baseline estimation of future emissions.

In that sense, during the period of this study the CDM Executive Board outlined:

(i) a standard on suppressed demand;
(ii) a work plan to explore the concept and operationalize it within methodologies[x].

This guidance recognizes and defines "Suppressed Demand" within the CDM and sets out a methodological framework for assessment and inclusion within methodologies.

Including "Suppressed Demand" in CDM project baselines involves making a "normative choice" about where emissions levels would be at the same point in the future, not where they are today or where they have been in the past.

This "choice" is a function of the technologies and fuels that will likely be deployed and the level of service that would be attained as countries develop and the barriers of low income, poor infrastructure skills and technological availability are removed or reduced. As with all CDM baselines, it is a counter factual baseline scenario used as a comparison to actual emissions achieved in the project.

Some of the current CDM methodologies do already account for suppressed demand. The potential ways of including suppressed demand are in the development of the baseline scenario, specifically:

- **Emissions intensity of services;**
- **Level of service.**

However, most of the current interpretations remain unclear and unrealistic**.** They are so far not field tested or proven to have an impact on project development.

Also, current CDM methodologies do not yet take fully into account the concepts of Minimum Service Levels. Basic human needs in the context of the CDM relate mainly to energy services. Others, such as access to food or housing are not yet relevant as CDM project types. Moreover, there is no definitive of exhaustive list of basic services for human needs or agreement on the adequate quantity or quality of services. In many cases those agreements require political consensus on acceptable levels of service. This process could then, help to bring back the sustainable development assessment to the top of the CDM agenda.

CASE STUDY FINDINGS

BASELINE FUELS AND EMISSIONS FACTORS

Emissions factors of CO_2 per unit of energy from fuel use are important to the viability of CDM projects. However, selecting or predicting 'the expected fuel(s) to be used' in the baseline can be challenging and be subject to numerous non-linear relationships. A **particularly important factor is the price and availability fuels**. However, there are other **unpredictable factors such as local barriers to access to types of fuel and the costs of different**

technologies over time. The current CDM methodologies propose a "Tier 1" approach where globally applicable emissions factors for expected fossil fuel use are used. **However, the CDM "Tier 1" default value does often not closely match field realities.**

In general, the lower level of aggregation the greater the accuracy, more complexity and scarcer the data required to inputs are likely to be. Bearing this in mind, new CDM methodologies could **also allow optional and conservative Tier 1 defaults or more tailored project/nationally specific data inputs, i.e. Tier 2 and Tier 3 factors.**

BARRIER ANALYSIS

The **CDM put forward a barrier analysis approach to technology and fuel selection.** This essentially ranks alternative fuels and technologies and eliminates those that face financial, infrastructure, market or skills barriers.

While simple and easy to use, it can too easily **lead to singular outcomes of fuels and technologies,** which is unrealistic and can lead to either over or under crediting depending on which fuel/technology is selected. **It can also transform technologies that normally were eligible to non-eligible (see scenario B of case study 2).** Add to that, it **does not allow for use of multiple of fuels, common in LDC's, and makes no reference to national, regional or local relevance.**

It is also **difficult to assess penetration rates as data is often proprietary or unavailable**. Moreover, looking at current barrier and penetration and does not assess potential changes in the future.

MINIMUM SERVICE LEVELS

Basic human needs in the context of the **CDM relate mainly to energy services**.

However, **there is no definitive of exhaustive list of basic services for human needs or agreement on the adequate quantity or quality of services to meet basic human needs.**

Minimum Service Levels for some basic services exist and can be easily identified. For example, drinking water requirements have specific recommendations from the World Health Organization (WHO).

However, others, such as cooking energy requirements, are inherently more difficult to identify, and integrate into methodologies.

Even **when internationally recognized MSL exist**, such as WHO recommendation for indoor temperature of 18^0C, these **may not be expressed in energy units**. Conversion of MSL's to CDM relevant energy units and GHG emissions then becomes more problematic.

Also, **the MSL's may not be relevant for extreme environments**. For example, Passive Solar Housing in extreme environments, while providing genuinely beneficial and significant increases in temperature, can often not provide a basic service level of 18^0C. Moreover, this level of service is not necessary for people who are adapted to the cold.

Potential Impacts

The **case studies provide methodological suggestions** and explore other potential approaches for accounting for suppressed demand.

The case studies reveal that changes will potentially **increase the CER issuance of the project between ~70% and 230% increase to CER volumes.** For example, a new approach to Passive Solar Home methodologies could increase the CER potential of the project considerably, from 1.4 CER/unit/year to 2.1 CER/unit/year.

Suppressed demand methods can maintain close environmental integrity by deriving Tier 2 and Tier 3 baselines. This, added to clear monitoring requirements, will allow ERs to be credible, transparently calculated and accurate.

Recommendations to the CDM EB

I. Publish a full list of relevant minimum services and provide further clarification on the quality and quantity of minimum services, based on accepted precedents.

II. Allow the optional use of derived values that reflect specific circumstance of the host country or project location. Emissions factors for expected fuel use should be allowed to be as specific as possible i.e. Tier 2 Nationally Specific and Tier 3 Location specific.

III. Draw up and make available, data on expected energy mix and technology mix (by 2030 or other agreed reference point) for both Tier 1 and Tier 2 emissions factors.

IV. Ensure the 'development value' of project by only crediting projects that can show significant either improvements in or provision of basic services through applicability requirements; and therefore, reconsidering sustainable development as an eligibility criteria for CDM projects.

SECTION 1 - SUPPRESSED DEMAND AND CARBON MARKETS

BACKGROUND

Access to modern forms of energy and other basic services, such as potable water, sanitation and housing, is central to development and poverty alleviation. There is almost unanimous agreement that energy services in particular play a pivotal role in national development and that, generally, there is a high degree of correlation between energy use, economic growth and level of development[3].

Over time there is an **undeniable link between increases in GDP, rate of poverty reduction and increases in energy usage[4] and CO_2 emissions**, a relationship that is stronger among lower-income countries[5].

The demand for minimum services in developing countries is expected to grow dramatically, and the increases in population and improvements in living standards are adding to the scale of the challenges. Therefore, there is an immediate need for 'headroom' or carbon space for LDC's to grow and overcome poverty and to provide basic services to their populations.

Developing countries have to be allowed 'space' – both on a temporal scale and in terms of emissions– to increase the provision of MSL's.

On the other hand, this has to be reconciled with the need for a rapid de-carbonization of our economies, developed and developing - in particular, energy systems that remain recalcitrant in their reliance on fossil fuels - in the face of destabilizing anthropogenic climate change.

Basic human needs in the context of the CDM relate mainly to energy services and other activities which are relevant as CDM project types. Yet, as previously mentioned, there is no definitive of exhaustive list of basic services for human needs or agreement on the adequate quantity or quality of services to meet basic human needs.

Basic Human needs

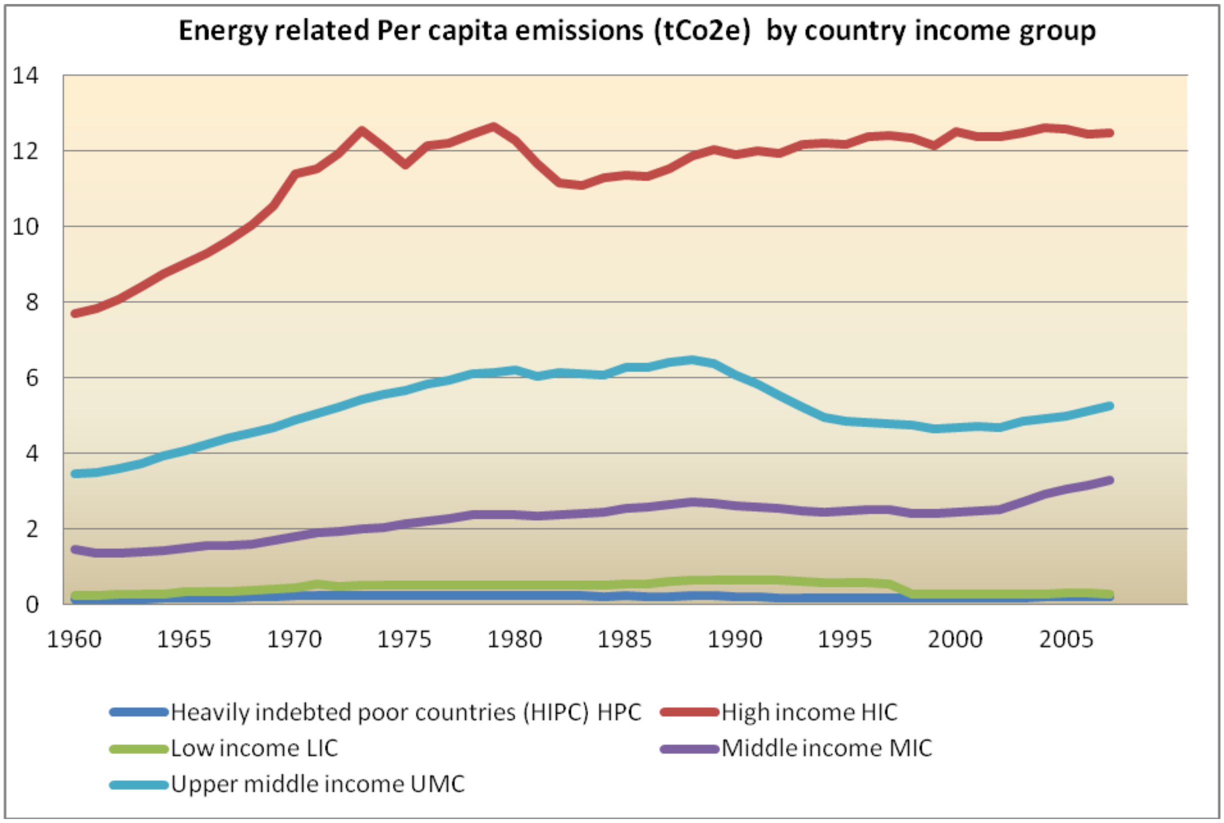
Article 25 of the UN declaration of Human rights states that *"***everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing** …" Access to and delivery of basic needs services is therefore a condition in which the population can obtain water, food, shelter and health services **in adequate quantity and quality** to ensure survival and satisfy their right to "life with dignity". The UN also notes that "**Energy services… provide cross-cutting influences on both social and economic development, thereby influencing a nation's ability to achieving Millennium Development Goals** (MDGs)". They stress the importance of "three types of services in particular: modern fuels for cooking and heating; electricity for public services; and motive power for productive uses in communities".

[3] Annual. Rev. Environ. Resources. 2005.30:117-144.

[4] Energy Climate Change and Poverty Alleviation. Global Network on Energy for Sustainable Development, UNEP, 2010.

[5] Bowen and Fankhause 2011: Low-Carbon Development for the Least Developed Countries - World Economics, Vol. 12, no. 1. January–March 2011

Figure 1 - Per capita emissions by country income groupings



Source: World Bank Development Indicators, 2011.

The **CDM interpret basic human needs** as "***services required to meet basic human needs for example, basic housing and basic energy services including lighting, cooking, and drinking water supply***".

In **this report, basic services refer to: "*Basic energy needs for clean cooking, treatment of drinking water supply and heating fuels, lighting, electricity (at home and in public services), motive power for productive uses, energy needs for cooling, information and communication*"**.

In many LDC's and poor regions the latent demand for basic services is currently not being met as the majority of the population languishes in income or service poverty. Moreover, with current trends, more people will be without modern energy access in 2030 than today.

In other words, our current actions in the provision of basic services such as energy are failing, both in terms of scale and pace[6]. In short, there is a wide inequality in energy/service access and quality between rich and poor societies - the poorer three quarters of the world's population use only 10 per cent of global energy[7].

[6] World Energy Outlook - UNDP, IEA, UNIDO 2010

[7] Summary conclusions of the Vienna Energy Forum – organized by UNIDO, the Austrian Government and the International Institute for Applied Systems Analysis (IIASA). June 2011

The magnitude of the change required in the global energy system will be huge. The challenge is to find a way forward that addresses simultaneously climate change, security, and equity and climate economics issues[8].**The immediate need is to secure affordable, clean and reliable MSL's at the household level**. In fact, domestic energy consumption tends to make up a far larger proportion of total energy demand in developing countries than in OECD nations[9].

The cost of providing MSL's also imposes a heavy financial burden on the majority of low-income households in developing countries[10]. In the Philippines for example, low income families often spend more than 20% of their total income on energy services[11].Concerning clean water and sanitation, access to such services normally requires considerable investments in infrastructure usually supported by governments.

Addressing climate change in developing countries poses a fundamentally different challenge. With income levels far below those of developed countries —and per capita emissions on average just one-sixth those of the industrialized world—developing countries will continue to increase their emissions as basic services are provided to the population[12].

[8]http://www.iiasa.ac.at/Research/ENE/GEA/index_gea.html

[9] INDIA Energy Handbook 2011: Demand Driven, Supply Chained. IECC 2010 http://www.psimedia.info/handbook/India_Energy_Handbook.pdf

[10] Global Network on Energy for Sustainable Development 2010: Achieving Energy Security in Developing Countries

[11]Battye: Household energy, biomass and vulnerability (Cebu island – Philippines). Unpublished report by GERES

[12] Chandler et al 2002 - Climate change mitigation in developing countries. Pew Center on Global Climate Change

WHAT IS SUPPRESSED DEMAND?

Un-met latent demand for basic services is termed 'suppressed demand': Income poverty, lack of infrastructure, high unit costs of energy and services and issues of physical access all suppress demand for services such as cooking energy, clean water or lighting. As these barriers are removed, i.e. people gain higher incomes and greater access to services (through government, private or other channels), people will certainly access higher level of service than they currently do.

Indeed, if current national and international development efforts eventually succeed in developing economies and LDC's, energy consumption and provision of basic services will have to increase substantially. If development goals are to be achieved, Minimum Service Levels should be universally achieved[13].

To achieve goals of limiting mean temperature changes, aside from rapid decarbonization of developed world emissions, most certainly requires that LDC's and other developing regions follow a development path that differs from both those already trodden by today's industrial countries. To do this, strategies that decouple emissions and service provision and economic output must be implemented large scale and over the long term[14].

[13] Such as the UN target to achieve universal access to modern energy services, and for a 40 per cent reduction in energy intensity by 2030, the Stockholm Statement (http://www.worldwaterweek.org/documents/WWW_PDF/2011/2011-Stockholm-Statement.pdf) and the Millennium Development Goal of reducing by half the proportion of the population without sustainable access to safe drinking water and basic sanitation.

[14] Bowen and Fankhause: Low-Carbon Development for the Least Developed Countries - World Economics, Vol. 12, no. 1. January–March 2011.

CARBON MARKETS AND THE POOR: A CONTRADICTION IN TERMS?

The single UNFCCC's Kyoto Protocol flexibility instrument that involves in developing countries is the Clean Development Mechanism (CDM). It has the twin objectives of reducing emissions and contributing to sustainable development objectives. International carbon markets have a crucial role to play in financing projects and providing innovative technology and fostering access to clean and renewable energy.

Carbon offset markets can play an important role in catalyzing low-carbon investment in developing countries but now face major challenges. Offset markets through the Clean Development Mechanism have resulted in $27 billion in flows to developing countries in the past 9 years, catalyzing low carbon investments of over $100 billion[15]. These flows and catalytic effects on technology and capability are essential for meeting the increasing energy demand and providing basic services[16].

Often framed as being directly and inherently linked, the CDM and sustainable development are concepts that are not always tightly woven together. The SD dimension is not merely a requirement of the CDM; it should be seen as a main driver for developing country interest in participating in CDM projects.

[15] World Bank 2011: Mobilizing Climate Finance - Paper prepared for G20 Sept 2011.

[16] The CDM Project Potential in Sub-Saharan Africa with Focus on Selected Least Developed Countries 2011: Published by: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)

Non-Annex 1 countries were supposed to define and monitor "Sustainable Development" in CDM projects. The reality is that, generally, relatively little attention is paid to the assessment of SD impacts of CDM projects and there are few suggestions on specific assessment methods[17]. **Projects can voluntary search for a differentiation in the market by adding a "quality" label, such as the Gold Standard.**

The concept of suppressed demand and avoided emissions has emerged in development and climate policy circles[18]. It is generally believed that by adequately addressing the issue of [suppressed demand] in the CDM and NAMA[19], can **drive access to energy and other essential services while decarbonising simultaneously. It is also thought to go some way to improving the regional distribution of the CDM and increase its relevance to the billions living in conditions of energy poverty and lacking basic services[20].**

[17] CDM Sustainable Development Impacts UNEP Risø Centre: http://cd4cdm.org/Publications/CDM%20Sustainable%20Development%20Impacts.pdf

[18] Winkler and Thorne 2002 - Baselines for suppressed demand: CDM projects contribution to poverty alleviation. Forum for Economics and Environment - 2002

[19] NAMAs, Country targets/pledges, MRV, and other decarbonising activities linked to energy access and basic services

[20] Suppressed Demand Working Group Interim Conclusions 2011: http://sdwg.wikispaces.com/

MARKET FAILURES

Despite the CDM aims, the mechanism has demonstrated its irrelevance to billions of people that lack access to MSL's, especially the LDCs:

- **LDC account for just 1.2% of all CDM projects[21] and just 0.5% of the CER volume issued;**
- **For small scale projects, LDC account for 45% of CDM projects[22] but only 9.3% of the CER volume issued;**
- **There are 31 LDC countries with no CDM projects.**

Although many factors contribute to this state of affairs, a key obstacle is that contemporary rule-making focuses on historic levels of carbon emissions when determining the volume of CER's a project can be issued.

In many Least Developed Countries (LDC) and Middle Income Countries (MIC), the low level of historic emissions leads to such insignificant creditable emission reductions that carbon finance revenue has a marginal or negligible impact. Moreover, assuming that a continued supply of low/poor quality services will continue throughout a crediting period does not align well with the development aims of CDM[23].

[21] At validation, Request Registration or Registered: Source UNEP RisoCenter CDM database (accessed September 2011)

[22] At validation, Request Registration or Registered. Source UNEP RisoCenter CDM database (accessed September 2011)

[23] The SSC WG notes that "particularly in the context of LDCs/SIDs and economically restricted regions of developing countries, over reliance on historical data results in very low emission baseline scenarios with consequent disregard for the latent demand for energy and other that exist...an assumption of continued supply of low/poor quality services throughout the 7 or 10 years of crediting period, as these countries/regions develop, may not align well with the development aims of CDM...such low baseline levels may result in such insignificant levels of emission reduction...that carbon credit revenue has a marginal or negligible impact." CDM SSC WG Twenty-seventh meeting report Annex 7: Treatment of increase in future anthropogenic emissions of host country

SUPPRESSED DEMAND WITHIN CDM

Considering the concept of suppressed demand, alongside simplified and standardized approaches, to CDM projects is one curative measure to the failures and imbalances of the CDM.

While factoring Suppressed Demand into CDM baselines involves normative choices, the approach is clearly supported by science. The IPCC24, finds that countries will need pursue differentiated sustainable development pathways, according to their specific circumstances. In order to support the 'clean development' of poor countries with extremely low baseline emissions, the CDM needs to incentivize "avoided emissions" [thereby harnessing the significant leapfrogging potential and avoiding future fossil lock-in].

Including suppressed demand would allow CDM crediting of projects for the avoidance of future emissions related to basic services. It could re-align the CDM as a development mechanism which is able to target the poorest and most vulnerable. **In this way the CDM project would 'leap-frog' to cleaner technologies and avoid emissions, without the scenario first being dirty.** The recent modalities and procedures of the CDM state that "*the baseline may include a scenario where future anthropogenic emissions are projected to rise above current levels*[25]". The CDM has also prepared guidelines[26], aiming to achieve consistency in the methods to address the situation of

[24] IPCC, 2007: Climate Change 2007: Impacts, Adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, C.E. Hanson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. - ch.12.2.1,2

[25] CDM Executive Board meeting report - EB 62 Report Annex 6

[26] CDM Executive Board meeting report - EB 62 Report Annex 6

suppressed demand in CDM baseline and monitoring methodologies where future emissions by sources may rise above current level. These guidelines aim to "*harmonize such approaches across CDM methodologies*" and provide approaches that "*can be used in baseline and monitoring methodologies to address situations of suppressed demand. They are applicable when a minimum service level, was unavailable to the end user of the service prior to the implementation of the project activity*."

In the CDM guidance[27], suppressed demand occurs when services for "Minimum Services", which are required to meet basic human needs, are inadequate. It defines the income effect, rebound effect and minimum services as mentioned previously.

It also suggests methodological approaches for two issues (see Annex 4 for more details):

(I) The identification of the **baseline technology/ measure** under a suppressed demand situation; and (barrier analysis),

(II) The identification of the **baseline service level** that should be used to calculate baseline emissions in a suppressed demand situation.

The two concepts, however, have different implications for how an alternative baseline scenario for the project could be constructed.

The CDM guidance aims to establish baseline fuels, technologies and the level of service for determining the Emissions Reductions of a project.

In simplified terms, it put forward a type of barrier analysis for alternative provisioning of service for the baseline. Each alternative (fuel or technology for example) is ranked in terms of the quality of service they provide.

A barrier analysis is then undertaken on each alternative in relation to its compliance with local regulation and if there are income, infrastructure or technology barriers to its adoption. Where available, a proxy of the penetration rate of each alternative is used. The first alternative that does not face barriers is taken as the baseline.

The traditional view on fuel switching in the household sector of developing countries has been that households gradually ascend an "energy ladder": there is a simple progression from relatively inefficient fuels and energy end-use equipment to more efficient fuels, electricity and equipment, with increasing income levels and urbanization.

However, the switch from inefficient to more efficient fuels and equipment is **not a linear or unidirectional process** as suggested by the simple energy ladder theory. Households tend to use multiple fuels, which correspond to a vector of energy services. Complete switching, where one fuel totally substitutes for another, is rare.

The reasons for multiple fuel use are varied and not dependent on economic factors alone, although the affordability or cost of the energy service also has an important bearing on the household's choice. In some cases, **households choose to use more than one fuel because they want to increase the security of supply. In other cases, the choice is dependent on cultural, social or taste preferences.**

[27] CDM Executive Board meeting report - EB 62 Report Annex 6

SECTION 2-

CASE STUDIES OF SUPPRESSED DEMAND IN THE CDM

This section of the paper presents the interpretation of the concepts described on the previous pages in **3 small scale projects case studies**. Firstly we assess the current CDM methodologies for the project and evaluate how Suppressed Demand is taken into account. We then apply the CDM guidance on suppressed to the project and determine an alternative baseline following this guidance. Finally, we compare and contrast the approaches and suggest alternatives.

Guidance on suppressed demand published by the CDM serves as an overarching framework[28]. However, these are not yet field tested, operationalized or harmonized across sectors or methodologies. Cases were selected on the basis of data availability, location of the project and impact.

Case study	Project technology and location	Methodology
Case 1	**Ceramic Water Purifiers in Cambodia**	**AMS III.AV/Version 02**
Case 2	**Improved Cooking stoves in Cambodia**	**AMS II.G/Version 03**
Case 3	**Passive Solar Homes in India**	**AMS I.E/Version 04**

The cases studies are presented following the structure below:

STEP 1: Outlines the project and its impacts

STEP 2: Applies the current CDM small scale methodologies to the project and estimates the CER potential of the project **(Scenario A)**

STEP 3: Evaluates how suppressed demand could be applied in methodologies

- Barrier analysis
- Specific Methodological changes

STEP 4: Compares the different **CERs scenarios** by considering **4 different methodological** approaches that are:

A. Current CDM methodology rules;

B. Including CDM recent guidelines on barrier analysis;

C. New Methodology revision with specific data;

D. New Methodology revision with defaults.

[28] http://cdm.unfccc.int/UserManagement/FileStorage/9D86VZY2RQTNUGOW7EKSCA4MHFLI05

CASE 1: CERAMIC WATER PURIFIERS IN RURAL CAMBODIA

STEP 1: PROJECT OUTLINE AND IMPACTS

Water-borne disease is a leading cause of illness in the developing world[29]. In Cambodia, 20% of under-5 children had experienced diarrhea in the preceding 2 weeks. Diarrheal diseases are the most prevalent cause of death in children under 5 years old[30].

The Ceramic Water Purifier (CWP) is a point-of-use microbial water treatment system intended for routine use in low-income household settings. The system can filter enough to supply a family of five (>30 liters per day) with clean drinking water. The usable lifetime of the filters is the field is 3 years[31], to maintain conservativeness. The project aims to disseminate over 70,000 units between 2011 and 2017, an average of **10,000 units per year in rural areas of Cambodia**.

CWP reduce the demand for conventional water treatment through boiling water with non-renewable biomass. Aside from this, the socioeconomic benefits of access to clean drinking water include reduced time spent provisioning water, reduced cost for families, reduced morbidity and mortality, improved attendance at school and increased productivity. Locally produced CWP have the advantages of being lightweight, portable, relatively inexpensive, chemical free, low-maintenance and easy to use.

STEP 2: CURRENT CDM POTENTIAL

The project is eligible as a CDM project type under methodology AMS **III.AV./Version 02**[32] applicable to the introduction of low greenhouse gas emitting water purification systems. The project is treated as Case 1 in the methodology[33], as less than 60% of the rural population have access to safe water sources. Case 2 refer to projects not falling into this category.

According to the current CDM methodology (**Scenario A**), the following CERs are expected:

Table 01: CPW CER Scenario A

	Current CDM - tCo2e
Total Years 1 to 7	280,565
Annual average	**40,081**

STEP 3: HOW ARE SUPPRESSED DEMAND APPROACHES APPLIED IN THE METHODOLOGY?

By doing a **barrier analysis** (for more details see Annex 1) on the project as defined by the CDM guidance it reveals that:

- The baseline fuel is charcoal.

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[29] UN 2010: http://www.un.org/News/Press/docs/2010/ga10967.doc.htm UNGA. Sixty-fourth General Assembly Plenary 108th Meeting

[30] Cambodian National Institute of Public Health and National Institute of Statistics, 2006

[31] Lantagne, D. 2001. "Investigation of the Potters for Peace Colloidal Silver Impregnated Ceramic Filter – Report 2: Field Investigations". Allston, MA: AlethiaEnvironmental.

[32] http://cdm.unfccc.int/methodologies/DB/7FU80N8RZB4M0XPH26OBEQLBJWYGZH

[33] The project is CASE 1[33], meaning that project activities implemented in rural areas of countries with proportion of rural population using an improved drinking-water source equal to or less than 50%.

- The baseline technology or practice is water boiling on a high efficiency Improved Cooking Stove using charcoal as a fuel.
- The service level would be set at 5.5 lppd as the minimum service level.

The **current methodology** already make provisions for suppressed demand by

(I) the type of fuel used in the baseline (baseline emission factor);

(II) demand for purified water in the baseline (minimum service level); and,

(III) assumption of water treatment in the baseline.

However, these provisions could be improved and so, **some considerations** are presented below**.**

(I) EMISSIONS FACTORS: TYPE OF FUEL USED FOR WATER BOILING

Cambodian households in rural areas typically use wood, charcoal or other types of biomass residue for water boiling. As such it is literally a poor fuel choice - a fuel chosen by the poor because they are limited alternatives available to them. The CDM apply an Emissions Factor for projected Fossil Fuel use. This essentially states that households, most of them currently not using fossil fuels, are expected to migrate "up the energy ladder" toward fossil fuels for water boiling. The methodology provides either a (Tier 1) globally applicable default Emissions Factor (EF) of 50% coal, 25% kerosene and 25% LPG, equal to 81.6 tCO2/TJ[34], or a singular fossil fuel emissions factor .i.e. coal, lpg or kerosene.

However, analysis of fuel trends in rural Cambodia and energy modeling[35] suggests that the fossil fuel most likely adopted in 2030 would be a mix of LPG gas (38%) and Charcoal (35%) - which is non renewable in Cambodia and has an extremely high emissions factor (see Table 2). Therefore, the figure that most reflects the project context is a weighted emission factor of 188.58 tCO2e/TJ.

Table 02: Specific Emission Factor for Tier 2 (National level)

EF Cambodia Rural Tier 2	tCo2e/ TJ	Rural - Cambodia	EF
Non forest wood and biomass residues (renewable)	**0**	**28%**	**0.00**
Charcoal (70% non-renewable with forest wood)	**470.4**	**35%**	**164.64**
Coal	**96**		
Kerosene	**71.5**		
LPG	**63**	**38%**	**23.94**
Weighted average tCo2e/TJ			**188.58**

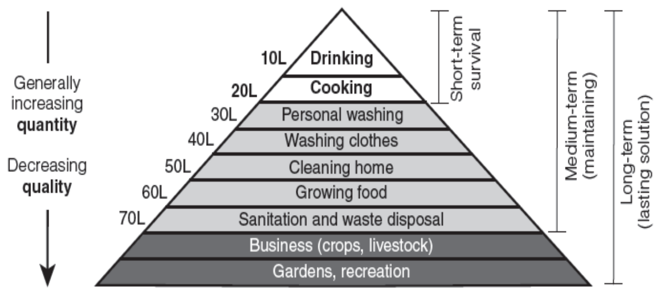
(II) MINIMUM SERVICE LEVEL

The level of service prior to the project is inadequate for basic human needs,

[34] "It is assumed that the mix of present and future fuels used would consist of a solid fossil fuel a liquid fossil fuel (and a gaseous fuel. Thus a 50% weight is assigned to coal a 25% weight is assigned to both liquid and gaseous fuels 71.5 tCO2/TJ for kerosene and 63.0 tCO2/TJ for Liquefied Petroleum Gas (LPG).This value represents the emission factor of the substitution fuels likely to be used by similar users, on a weighted average basis."

[35] UNDP 2009: Residential energy demand in Rural Cambodia.

approximately 2 liters of contaminated water per person per day. According to the WHO[36] water is required for a variety of uses. Simplified requirement for survival are summarized as follows:



Type of need	Quantity
Survival (drinking and food)	2.5 to 3 lpd
Basic hygiene practices	2 to 6 lpd
Basic cooking needs	3 to 6 lpd
Total	**7.5 to 15 lpd**

Note that this may be different from long term needs.

Suppressed demand for the quantity of water is accounted for in the CDM methodology through the application of the **project level of service** i.e. the water delivered in the project used for drinking purposes. This level is assessed through survey literature or expert testimony and capped at 5.5 Liters per Person per Day (lppd) in the methodology.

Studies in Cambodia show that users reported filling the filter an average of 2.2 times per day[37] and the capacity of the filter is 10 liters. For an average family of 4.8 people, this suggested a level **of 4.58 lppd consumed[38] if filters are filled fully each time**. This is also in line with expert views. 5.5 lppd is the minimum level of service recommended for drinking water, as stipulated by the WHO and health professionals. This could be used as a **default value in the methodology**.

The CDM guidance on suppressed demand also states that "[MSL] should be realistic and reasonable but not overly conservative" and they "should be so chosen that over a long time horizon, it will always be reached" and established through "national/international peer reviewed research or relevant studies or benchmarks that take into account that emissions will rise to achieve the international/national development goals".

Alternatively, a simple method of assessment of project service level is also suggested that would estimate consumption in terms of liters per person per day through a small survey every two years of **filter filling per household per day and use of filtered water consumption**. Use of water is treated as **consumption** (direct or indirect e.g. as vegetable washing and cooking needs or sale) and **non consumption**, (body washing/sale).

Only water used for consumption is creditable. A discount factor should also be applied (0.9) to account for sampling errors and insufficient filling of the filter. This data should be conservatively stated and cross checked with a controlled field test for exact measurement (in minimum 10 households). During this test, water use is monitored in a small sample of

[36] WHO 2011: TECHNICAL NOTES ON DRINKING-WATER, SANITATION AND HYGIENE IN EMERGENCIES How much water is needed in emergencies

[37] IDE 2003: CERAMIC WATER PURIFIER CAMBODIA FIELD TESTS IDE Working Paper No. 1 October 2003.

[38] However, it should be noted that the project level of service is difficult to accurately ascertain through surveys and observations. .

households (min. 10) for a period of 2 days. **A cap of 15 lppd is applied (this applies to creditable liters only and is not a cap on project service levels).**

(III) WATER TREATMENT PRACTICE

For projects in rural areas where improved sources are unavailable to more than 60% of the population i.e. Case 1 projects, the CDM assumes that all families boil water, or would have boiled water. This assumes that had fuel, knowledge and time been available to them they would have boiled water to treat it i.e. the demand for water boiling as a treatment practice is also suppressed[39]. Moreover, they assume that all water is boiled as a method of treatment, for at least 5 minutes[40]. Case 2, where improved water sources are available to more than 60% of the population, project must show evidence of water boiling is, or would have been, common practice.

In Case 1, an assumption that 100% boil or would have boiled is simplistic and unrealistic in some contexts as households can also use other treatment methods such as chlorination treatment, bio-sand filters or SODIS water treatment. These practices should form part of the baseline to avoid project over-crediting.

In Cambodia for example, prior to the project, surveys find that 86% of people boil water as a means of treatment[41]. Further, an estimated 8% of residents have no water treatment method, and an additional 4 % of people leave water to stand and to settle before drinking i.e. it is not treated[42]. So for case 1 the figure would be 100%. In case 2 the figure would be 86%. It is also not clear from the methodology how justification given to water that "would have been boiled".

An alternative is to combine **both case 1 and case 2 into one standardized approach**. The applicability of the methodology should be changed to all projects where **publically or privately provided safe, reliable and sufficient water (WHO defined safe and equivalent to 7.5 lppd for at least 12 hours per day) is provided to households via a tap.**

The % of people boiling water (either frequently or infrequently) and practicing no treatment or inadequate treatment is combined. The % of HH practicing non energy intensive alternative safe treatment (determined from a pre-defined list) practices such as chlorination is discounted.

For example, 80% boil water and 10% have no treatment, whereas 10% chlorinate water. 80% boil and 10% have inadequate treatment. 10 practice safe treatment and should be discounted. A discount factor of 0.9 would then be applied i.e. only 90% of filters/HH can claim carbon finance.

This type of information is available for most if not all LDC countries. Where it is not, or is thought inaccurate or outdated, a small survey should be undertaken to assess treatment practice.

Table 03 summarizes the methodological changes proposed in the previous paragraphs. To learn in details about the methodological changes, please refer to Annex 1.

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[39] Note that this only applied to CASE 1 project in rural areas.

[40] WHO guidelines for Emergency Treatment of drinking water at point of the use <http://www.searo.who.int/LinkFiles/List_of_Guidelines_for_Health_Emergency_Emergency_treatment_of_drinking_water.pdf>

[41] PATH 2010: Accelerating trial and adoption of POU HWTS among the middle to low income population: Market research report Cambodia

[42] PATH 2010: Accelerating trial and adoption of POU HWTS among the middle to low income population: Market research report Cambodia

Table 03: Specific methodological revisions/considerations: AMS III.AV

Applicability condition	Should be applicable to all point of use and small scale safe water provisioning projects where publicly provided safe, reliable and sufficient water (WHO defined safe and above 7.5 lppd for at least 12 hours per day cooking, drinking and basic hygiene needs) is not provided to households via a tap.
Service Level: **Quantity of water treated in the baseline** **QPW**	**Option A: a Minimum Service Level of 5.5 lppd** should be applied, in line with WHO recommendations for a basic minimum of daily potable drinking water need (currently treated as a cap by the CDM). **Option B: Small targeted surveys that assess project level of service,** in terms of liters per person per day should be conducted. A small survey should be done every two years of filter filling per household per day and use of filtered water consumption. Use of water is treated as consumption – direct or indirect e.g. as vegetable washing and cooking needs or sale - and non consumption, e.g. body washing etc, should be accounted for. Only water used for direct consumption is creditable. A **discount factor** should also be applied (0.9) to account for sampling errors and insufficient filling of the filter. A cap of 15 lppd is applied to creditable liters only, unless credible evidence is well documented and justified.
The method of water treatment in the baseline **WT**	**Literature or historical data showing the % of people boiling water or practicing no treatment of wate**r from:(i) Reliable literature or (ii) Survey to establish the water treatment practices in the target household. The % of people boiling water (either frequently or infrequently) and practicing no treatment or unsafe treatment is combined. The % of HH practicing alternative safe treatment (determined from a pre-defined list) practices is discounted.
Emissions factor: The fuels used for water treatment	**Option A: Tier 1 default weighted average emissions factor 81.6 tCO2/TJ**. **Option B: Tier 2 or Tier 3 calculated emissions factor (tC02e/TJ)** i.e. National or Regional specific default factor using a barrier analysis and/or of forecasting cooking energy mix in 2030. This fuel mix must be based on published and credible research or energy modeling and verified as being i) conservative and ii) credible. Therefore for this case study we consider the weighted EF of 188.58 tCO2e/TJ (as per table 02).

STEP 4: COMPARISON OF DIFFERENT CERS POTENTIAL SCENARIOS

Considering the different methodological approaches, the following CERs potential scenarios could be expected:

Graphic 01: Different scenarios with methodological revisions/considerations - AMS III.AV

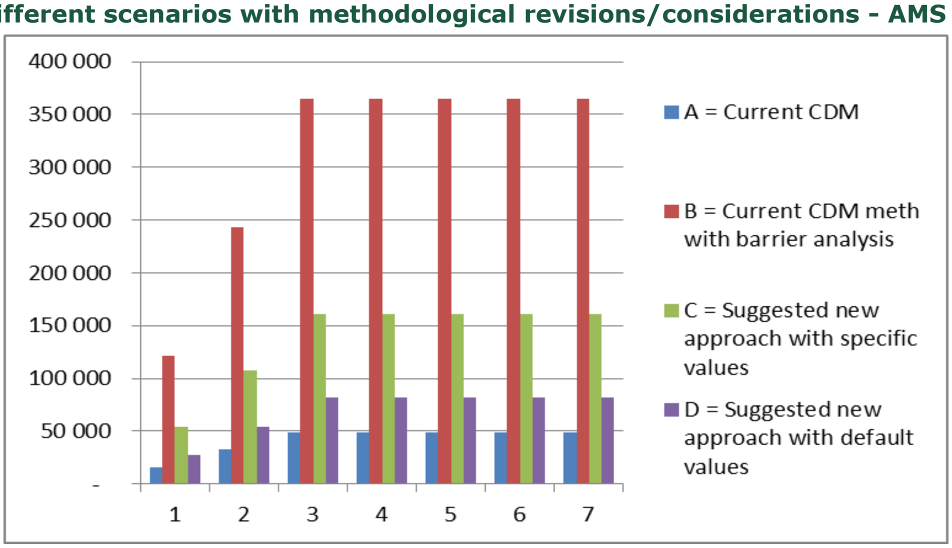

Table 04: Different scenarios with methodological revisions/considerations: AMS III.AV

Yr	Disseminated	In use	A	B	C	D
1	10,000	10,000	15,586.94	57,643.73	51,511.86	26,046.40
2	10,000	20,000	31,173.88	115,287.46	103,023.72	52,092.79
3	10,000	30,000	46,760.83	172,931.19	154,535.58	78,139.19
4	10,000	30,000	46,760.83	172,931.19	154,535.58	78,139.19
5	10,000	30,000	46,760.83	172,931.19	154,535.58	78,139.19
6	10,000	30,000	46,760.83	172,931.19	154,535.58	78,139.19
7	10,000	30,000	46,760.83	172,931.19	154,535.58	78,139.19
Total	**70,000**		**280,565**	**1,037,587**	**927,213**	**468,835**
Annual average			**40,081**	**148,227**	**132,459**	**66,976**

While suppressed demand is accounted for, there is scope for improvement in this methodology:

- Under current CDM methods (A) the project would yield 1.63 CER/unit/yr. By using the guidance on suppressed demand and barrier analysis (B) applied to the project, CER potential would increase to 12.7 CER/unit/yr. This is because fuel selected would be charcoal, which due to inefficient production and high non renewability has an extremely high emissions factor. This suggests that the current CDM methodology significantly under credits projects according to its own guidance or that the CDM barrier analysis can lead to extreme results.
- Using the new suggested approach with project specific data (C) would increase the CER potential of the project to 5.27 CER/unit/yr and using the new approach with suggested defaults would yield 2.72 CER/unit/Yr, a 230% increase.

KEY CHALLENGES

- ✓ Basic needs for water are for drinking, hygiene and cooking, are between 7.5 and 15 lppd in emergency situations. There is a range of basic needs presented and furthermore, basic needs for the longer term residency are likely to be higher and for more than just drinking water. The Minimum Service Level for drinking water for "basic human needs" has scientific recommendations but still requires political determination.
- ✓ Minimum service level is expressed in a non-energy unit which must be converted to energy/Co2e values.
- ✓ Assessing project level of service in the field is difficult with surveys or with physical monitoring due to remote locations and monitoring consumption in situ.
- ✓ Emissions factors are difficult to derive at Tier 2 (national level) and Tier 3 (regional level) where data is scarce and may require specialist skills. Moreover, Tier 2 national level factors may not reflect very local conditions.

CASE 2: IMPROVED COOKING STOVES IN CAMBODIA

STEP 1: PROJECT OUTLINE AND IMPACTS

Improved Cooking Stoves (ICS) refer to a wide variety of improved cooking appliances for domestic and institutional use. In Cambodia over 90 percent of energy used for cooking comes from wood and charcoal. The woodfuels used come from mostly non-renewable sources and are contributing to degradation and deforestation in Cambodia[43].

The poor spend about three to four hours a day on energy-related activities such as gathering fuel wood, boiling water, and cooking. Inadequate access to energy services has entrenched poverty, slowed improvements in health and education, and contributed to environmental degradation and socio-economic inequalities[44]. Due to the inefficiency of the commonly used energy technologies, the poor pay higher unit costs for energy than more affluent people. On average, rural families spend about 10 percent of their income on fuel and electricity[45].

This project involves the dissemination of ICS in Cambodia, the Improved New Laos Stoves (NLS). The project disseminates over 50,000 stoves per year in urban and peri-urban areas. ICS save energy, time and money for the users, and reduces indoor air pollution and green house gases emission. The New Laos Stoves is 20% more thermally efficient than the most efficient artisan traditional stoves and 60% more efficient than 'three stone fires' and can save families significant amounts of money and time. Because of the significant savings on charcoal and wood, payback time is about three months for the New Lao Stove. Each stove has a usable lifetime in the field of 2 years[46].

STEP 2: CURRENT CDM POTENTIAL

The methodology deployed in the project is **AMS II.G./Version 03**. This category comprises appliances involving the efficiency improvements in the thermal applications of non-renewable biomass. It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs.

According to the current CDM methodology (**Scenario A**), the following CERs are expected:

Table 05: ICS CER Scenario A

	Current CDM - tCo2e
Total Years 1-7	195,319
Annual average	**27,903**

STEP 3: HOW ARE SUPPRESSED DEMAND APPROACHES APPLIED IN THE METHODOLOGY?

The **barrier analysis** as per the CDM guidance on suppressed demand reveals that LPG would be the most likely alternative to be adopted.

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43 Buss etc al 2011: Biomass Renewability and baseline surveys in Cambodia. GERES Cambodia 2011.Unpublsihed.

44 Steele and Van Mansvelt: IMPROVED ENERGY TECHNOLOGIES FOR RURAL CAMBODIA. World Bank 2009

http://siteresources.worldbank.org/EXTEAPASTAE/Resources/ASTAE-IMPROVED-ENERGY-TECHNOLOGIES-Cambodia.pdf

45 Steele and Van Mansvelt: IMPROVED ENERGY TECHNOLOGIES FOR RURAL CAMBODIA. World Bank 2009

http://siteresources.worldbank.org/EXTEAPASTAE/Resources/ASTAE-IMPROVED-ENERGY-TECHNOLOGIES-Cambodia.pdf

46 In reality the stoves can last for longer but 2 years is assumed to maintain conservativeness.

The **current methodology** also make provisions for suppressed demand by:

(I) baseline emission factor;

However, these provisions could be improved and so, **some considerations** are presented below**.**

(I) Emissions factors: type of fuel used for energy

The methodology includes suppressed demand by considering an 'expected fossil fuel' use for meeting similar thermal energy needs. The methodology uses the same weighted emission factor from the previous case study, so a value of 81.6 tCO_2/TJ.

However, analysis of fuel trends and energy modeling in Cambodia suggests a mix of wood, charcoal and LPG will likely be adopted in the future. The fossil fuel most likely adopted would be LPG gas. No coal and no kerosene. Therefore the emissions factor suggested by the UNFCC looks unrealistic and overly simplistic as (Tier 1) global default emissions factor. An alternative would be a nationally specific (Tier 2) or location specific (Tier 3) default value that reflects local circumstance, based on either a barrier analysis or credible literature and energy modeling.

Energy modeling in Cambodia suggests an energy mix in 2030 that is 26% wood and biomass residue , 31% charcoal and 43% LPG. By using project specific data, the result is a higher EF for urban and peri-urban areas of Cambodia (see Table 06).

Table 06: Specific Emission Factor for Tier 3 (project level)

EF Cambodia Rural Tier 2	tCo2e/ TJ	% fuel mix	EF
Non forest wood and biomass residues (renewable)	**0**	**20%**	**0.00**
Charcoal (70% non-renewable with forest wood)	**470.4**	**15%**	**70.56**
LPG	**63**	**65%**	**40.95**
Weighted average tCo2e/TJ			**111.51**

Table 07 summarizes the methodological changes proposed in the previous paragraphs. To learn in details about the methodological changes, please refer to Annex 2.

Table 07: Specific methodological revisions/considerations: AMS III.G/version03

Applicability condition	Applicable to all ICS project of all sizes. ICS must comply with international benchmarks for cookstoves, meaning they are tested using an international standard, for thermal efficiency. For example: http://cleancookstoves.org/overview/what-is-a-clean-cookstove/ http://www.pciaonline.org/resources
Service Level	**Use project level of service measure in MJ (saved)/unit/day** as compared to the baseline, derived from controlled field test of cooking with improved appliances, compared to most prevalent alternative. **Minimum Service Levels is yet to be established: highly variable depending on diet/ cultural practices and requirements of cooking.**
Emissions Factor	**Option A: Tier 1 default weighted average emissions factor 81.6 tCO2/TJ**. **Option B: Tier 2 or Tier 3 calculated emissions factor (tC02e/TJ)** i.e. National or Regional specific default factor using a barrier analysis and/or of forecasting cooking energy mix in 2030. This fuel mix must be based on published and credible research or energy modeling and verified as being i) conservative and ii) credible.

STEP 4: COMPARISON OF DIFFERENT CERS POTENTIAL SCENARIOS

Graphic 02: Different scenarios with methodological revisions/considerations –AMS II.G V03

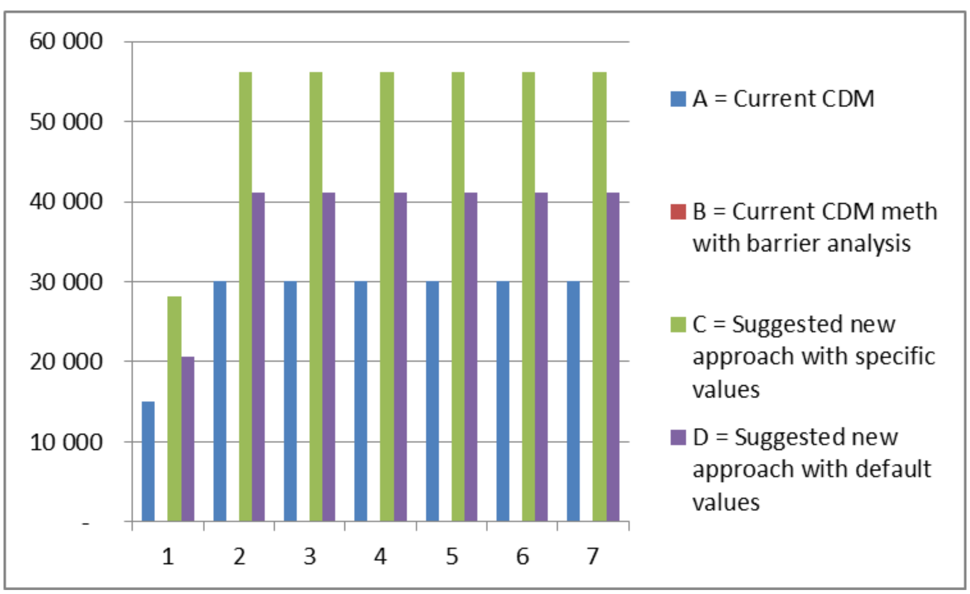

Table 08: Different scenarios with methodological revisions/considerations: AMS II.G –V3

Yr	ICS Disseminated	ICS in use	A	B	C	D
1	50,000	50,000	15,025	-	28,125.61	20,582
2	50,000	100,000	30,049	-	56,251.22	41,163
3	50,000	100,000	30,049	-	56,251.22	41,163
4	50,000	100,000	30,049	-	56,251.22	41,163
5	50,000	100,000	30,049	-	56,251.22	41,163
6	50,000	100,000	30,049	-	56,251.22	41,163
7	50,000	100,000	30,049	-	56,251.22	41,163
Total	**350,000**	**650,000**	**195,319**	**0**	**365,633**	**267,560**
Average per year	50,000	92,857	27,903	0	52,233	38,223

While suppressed demand is accounted for, the scope for improvement in this methodology are:

- Under current CDM methods (A) the CER from the project are **27,903** tCO2e/yr. Applying CDM guidance on suppressed demand to the project baseline (B), CER potential would result in 0 CER per year. This is because improved cooking stoves are already found commonly and would therefore be selected as the baseline technology. As such, the current CDM guidelines make some ICS projects in ineligible. In such case then the **CDM barrier analysis can lead to unrealistic results and would hamper project development**.
- Applying suppressed demand approaches with project specific data in (C) or using a standardized set of defaults (D) would increase the CER potential of the project. Compared to current CDM approaches (A) of 1,8 CER/unit/yr, new approaches (C) and (D) would result in 1,0-1,3 CER/unit/yr on average, a 72% increase.

KEY CHALLENGES

- ✓ There is a wide variety of basic needs for cooking energy. This has yet to be adequately explored by research and will vary from region to region, depending on habits, fuel, foods and culture.
- ✓ Emissions factors are difficult to derive at Tier 2 (national level) and Tier 3 (regional level) where data is scarce and may require specialist skills.
- ✓ Changes suggested here are likely to bring about more complication for project developers, for example, strengthening applicability requirements for ICS to meet international benchmarks. However the development impacts of interventions are secured as technologies will provide high level of service.
- ✓ If barrier analysis is used and selects high efficiency equipment, for example Improved Cooking Stoves, then this will exclude some projects and could prevent previously viable and beneficial project activities.

CASE 3: PASSIVE SOLAR HOMES IN NORTHERN INDIA

STEP 1: PROJECT OUTLINE AND IMPACTS

The project uses solar energy, harnessed through energy efficiency measures implemented in buildings. A combination of energy efficiency measures as: Improved Insulation (II) and one of the three passive solar technologies for solar gain: Trombe Wall (TW), Direct Gain (DG) or Attached Greenhouse (AGH), are installed.

The project is located in the high altitude desert of the Western Indian Himalayas. Winter temperatures in this area can be as low as -30°C, there is little precipitation and scarce vegetation. Villages are located between 2700 and 4600 meters above sea level and are often extremely geographically isolated. Due to the lack of natural resources and/or lack of financial means heating needs during the long winter period (from November to March) are high and indoor temperature fall well below basic minimums.

Because of the colder temperatures at high altitudes, mountain people – particularly women and children – often spend long hours near stoves within confined spaces.

In this environment, households use substantially more energy than do people living in warmer climates or at lower altitudes. To reduce their fuel consumption and costs, often close the doors and windows. This exacerbates the amount of smoke in the house and exposes people to greater risks associated with indoor air pollution, such as respiratory diseases.

Over the course of 7 years the project will integrate energy efficiency measures in 250 households per year in 100 rural and remote villages.

STEP 2: CURRENT CDM POTENTIAL

The CDM used methodology AMS I.E./Version 04. This category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies. Examples of these technologies include but are not limited to biogas stoves, solar cookers and passive solar homes.

Table 09: ICS CER Scenario A

	Current CDM - tCo2e
Total Years 1-7	9,653
Annual average	**1,379**

STEP 3: HOW ARE SUPPRESSED DEMAND APPROACHES APPLIED IN THE METHODOLOGY?

The **barrier analysis** focuses on one technology and one fuel rather than combinations, which is most likely to happen in the project context. It would also lead to the selection of wood as a baseline fuel as all fossil fuels face significant barriers, typically costs and import difficulties, within this region.

This current CDM methodology accounts of suppressed demand in terms of:

(I) the type of fuel used in the baseline (baseline emission factor);

(II) Service level: actual increases in level of thermal comfort attained in the project i.e. using the project level of service in terms of thermally energy produced by the intervention as a baseline.

(I) Emissions factors: type of fuel used for energy

In AMS I.E, the CDM approach uses the same weighted emission factor from the other cases presented before, that is for the substitution of non-renewable woody biomass by similar consumers, a value of 81.6 tCO_2/TJ.

The fuel used pre- project can be assumed to be biomass because globally biomass is the predominant fuel used for space heating. Because the poor people in rural areas lack access to electricity and modern fuels, they rely primarily on human and animal power for mechanical tasks, such as agricultural activities and transport, and on the direct combustion of biomass (wood, crop residues, dung) for activities that require heat. Biomass fuels are typically used for cooking (which dominates inanimate energy consumption in most warm regions), space heating, heating water for bathing, and meeting some industrial heating needs . The World Energy Outlook estimates that 54% of all people in Developing countries are dependent on biomass in 2009, moving to 51% in 2015 and 44% in 2030.

Space heating requires large amounts of fuel. A study TehriGarhwal (a district in Uttarakhand state in India) shows a marked increase in the use of biomass with increasing altitude, and fuel use was shown to be two to three times greater in winter than in summer. The firewood consumption was reported at around 1.07 kg/person/day below 500 m altitude, rising by an additional fuel requirement of about 0.8 kg/person/day per 1,000 m, to reach 2.8 kg/person/day above 2,000 m .

Looking forward, rafts of major studies conclude that “coal will be the predominant form of energy in future” and that imports of petroleum and gas will continue to increase substantially in absolute terms. Fossil fuels (coal, oil, and natural gas) are expected to contribute about 90% of the increase in primary energy consumption toward 2030. Primary coal demand is predicted to show the largest increase of all fossil fuels and account for 35% of the increase in primary energy consumption, followed by oil at 33%, and natural gas at 19% .

Looking at long term fuel trends in India suggests that the fossil fuel most likely adopted would be Coal and LPG gas and also grid connected electricity. Therefore the default (Tier 1) emissions factor (EF projected fossil fuel use) suggested by the UNFCCC looks realistic and balanced.

In that line, many studies suggest that, at the national level (Tier 2), commercial energy of a higher quality and efficiency such as LPG and Coal and electricity are steadily replacing the traditional energy resources being consumed in the rural sector. Sufficient data and analysis exists to develop a likely future energy mix.

However, looking at fuels is not enough. Using different fuels also means that different technologies will be used – comparatively more efficient electric heaters or LPG burners would be used.

The fuel and technology mix would have to be taken into account, through a comparatives efficiency factor. For example, LPG burners and electric heaters are assumed to be 50% more efficient than traditional devices and coal heater are assumed to have an equivalent efficiency.

Accounting for the fuel and technology mix that could be adopted can yield higher emissions factors in some instances. Table 10 presents the different values for emissions factors according to the levels of accuracy.

Table 10: Emission Factors in different Tiers

Tier	Level of aggregation	Emissions Factors
1	Global	**81.6 tCo2e/TJ** • 50% Coal, • 25%Kerose ne • 25% LPG)
2	National	**91.6 tCo2e/TJ** • 60% Coal • 20% LPG • 20% electricity
3	Local	**51 tCo2e/TJ** • 40% Coal • 40% LPG • 20% Electricity

The Tier 3 emissions factor while similar would have radically different make up, 40% Coal, 20% electricity (grid connection - hydro sources) and 40% LPG. The Emissions factor would in this case be lower than both Tier 1 and Tier 2 emissions factors.

(III) MINIMUM SERVICE LEVEL

The methodology does incorporate desired service levels by allowing the quantity of thermal energy generated by the project to be applied to the baseline scenario; however, in the case of projects that do not generate energy, such as PSH projects, minimum service levels are not recognized. There is a large inconsistency in the methodology with regard to this type of project.

If project measure the biomass saved in the project, the current CDM methodology does not account for suppressed demand in the service level achieved in the project or a Minimum Service level. It assumes that the pre-project, suppressed demand, level of service is the baseline.

Alternatively, consideration should be made of Minimum Service Levels or Project Service levels to be taken as the baseline.

Indoor thermal conditions are important for health and comfort, although individuals vary in their temperature requirements. The World Health Organization recommends a minimum indoor temperature for health of 18ºC, with up to 20-21ºC for more vulnerable groups, such as older people and young children.

According to Erlingsson et al. (2008)[47] the minimum comfortable temperature for dwelling-houses is 18°C and heating is usually required to sustain a temperature of 18°C indoors when outdoor temperatures fall under 15°C.

Conversely, Practical Action (2010) *Poor People's Energy Outlook* suggests a minimum standard or 12^{0}C.

The WHO explains the health impacts of temperature as follows:

[47]Erlingsson,et al., 2008: House heating with geothermal energy. Workshop for decision makers on direct heating use of geothermal resources in Asia

Table 11: WHO temperature health impacts

Temperature	Health effects
24°C	Top range of comfort
21°C	Recommended living room temperature
<20°C	Mortality rate begins to rise
18°C	Recommended bedroom temperature
16°C	Resistance to respiratory diseases becomes weakened
12°C	More than two hours at this temperature raises blood pressure and increases heart attack and stroke risk
5°C	Significant risk of hypothermia

Considering this range, a Minimum Service Level of an average of between 12 to 18°C indoor temperature would be an ideal minimum level of service provided to households.

However, in extreme conditions, where outdoor temperature could well reach -20 this may not be achievable, even if substantial temperature differentials (between indoor and outdoor temperatures) are achieved.

PSH project in Northern India for example achieve only a 9 Degree indoor temperature.

The project raises indoor temperatures to an average of 9 Degrees, whereas non PSH houses average below 5 Degree.

Using a Minimum Service level confers that the project technology actually provides this level of service. Therefore, to use MSL's in the methodology and maintain environmental integrity, PSH buildings should demonstrate and ability to achieve the specified indoor air

temperature levels. This is not the same as requiring buildings to actually be set at those temperatures. Setting performance requirements for thermal conditions must acknowledge the interactions between temperature (air, radiant), humidity and air velocity (draught), as well as how much clothing is worn and activity level.

Using a minimum service level in this case is problematic. The service level in this case is the indoor temperature achieved. This is a non energy unit. It is therefore difficult to make relevant for the CDM as this must be converted to an energy and emissions equivalent value.

There are two crucial factors that then become relevant:

1. The temperature difference between outdoors and indoors (pre-project)

2. The input energy required to generate the temperature difference.

Both these parameters can be used calculate the energy required for an increase of 10C thermal heating. The energy relevant unit is therefore MJ/°C of thermal heating.

N.B. This assumes a linear relationship between fuel use and temperature increase. The reality may be different but the complexity of defining dynamic energy input-thermal output relationships would make this type of calculation difficult for small scale developers.

Using the **project level of service** in this case **would be simpler**, **however direct measurement of the thermal energy generated by the project is difficult in rural areas.**

A simple comparison between pre project and project fuel use can easily be drawn. The fuel difference between non PSH households and PSH households can also be measured relatively simply. However, this does not account for suppressed demand.

PSH allows higher average indoor temperatures than traditional houses, with less than half the fuel use. Most notably, the average indoor temperature in PSH houses is more than **4°C higher** than that of traditional houses.

PSH houses generally reach a higher level of thermal comfort than traditional houses. The baseline emissions should reflect how much additional energy would be needed to heat traditional houses to the **same thermal performance as the project buildings** (buildings with PSH technology). The baseline includes current energy consumption for heating the additional energy that would be required to match the level of thermal performance provided by the project.

Table 12 summarizes the methodological changes proposed. To learn in details about the methodological changes in calculations, please refer to Annex 3.

Table 12: Different scenarios with methodological revisions/considerations: AMS I.E (V4)

Applicability condition	To ensure the integrity of the approach, **only PSH technologies that can demonstrated *to provide significant temperature difference (indoor and outdoor) in extreme environments. Defined as providing indoor temperature degrees higher than a comparative household.*** If project do not meet requirements, through a combination of interventions, projects should not be considered as CDM projects.
Service Level	**Option A: Minimum Level of Service (18^{0}C)** in line with WHO recommendations and the number of days heating required. **Option B: Temperature differentials** and to factor in the number of heating days required per year with an optional default value.
Biomass Savings	Change specific to PSH, to reflect temperature differentials and to factor in the number of heating days required per year
Emissions Factor	**Option A: Tier 1 default weighted average emissions factor 81.6 tCO2/TJ** **Option B: Tier 2 or Tier 3 calculated emissions factor (tC02e/TJ)** i.e. National or Regional specific default factor using a barrier analysis and/or of forecasting cooking energy mix in 2030 with comparative efficiencies for thermal devices. This fuel mix must be based on published and credible research or energy modeling and verified as being i) conservative and ii) credible.

STEP 4: COMPARISON OF DIFFERENT CERS POTENTIAL SCENARIOS

Graphic 03: Different scenarios with methodological revisions/considerations –AMS I.E V04

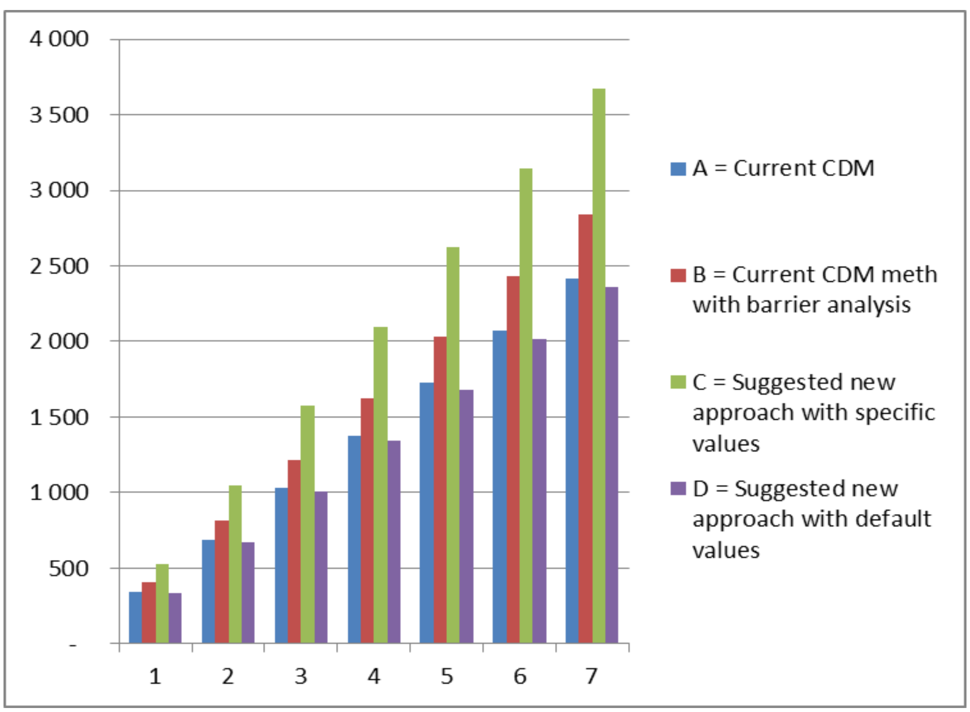

Table 13: Different scenarios with methodological revisions/considerations - AMS I.E –V4

Yr	Number of PSH in use	A = Current CDM	B = Current CDM meth with barrier analysis	C = Suggested new approach with specific values	D = Suggested new approach with default values
1	250	345	406	605	337
2	500	690	811	1,210	673
3	750	1,034	1,217	1,816	1,010
4	1,000	1,379	1,622	2,421	1,346
5	1,250	1,724	2,028	3,026	1,683
6	1,500	2,069	2,434	3,631	2,020
7	1,750	2,413	2,839	4,236	2,356
Total 7 years	7,000	**9,653**	**11,357**	**16,946**	**9,425**
Annual average		1,379	1,622	2,421	1,346

Under current CDM methods (A) the CER from the project are 1.4 CER/unit/yr. Applying CDM guidance on suppressed demand to the project baseline (B), CER potential would be 1.6 CER per year. In such case then the CDM barrier analysis can lead to extreme and unrealistic results and would hamper project development.

Applying suppressed demand approaches with project specific data in (C) would increase the CER potential of the project. Compared to current CDM approaches (A) of 1.4 CER/unit/yr, new approaches (C) would result in 2.1 CER/unit/yr on average – a 66% increase. Scenario (D), using tier 3 default value reduces the project potential to almost the same level than (A) with the current CDM methodology.

KEY CHALLENGES

- ✓ This methodology is consolidated for a basket of technologies and is not well adapted to PSH.
- ✓ MSL for indoor temperature, according to the WHO, is 18^{0}C. However, projects may not be able to achieve this level in extremely cold environments. Option 2 - Temperature differentials -, is most likely to consider the real achievements of the project.
- ✓ Using a MSL in this case is problematic, as the service level is the indoor temperature achieved. This is a non energy unit. It is therefore difficult to make relevant for the CDM as this must be converted to an energy and emissions equivalent value. This would require additional information on technologies used and temperature differentials achieved for example.
- ✓ Emissions factors are difficult to derive at Tier 2 (national level) and Tier 3 (regional level). Moreover, national trends may not apply to specific areas. In other worlds, Tier 2 macro trends in India may not accurately represent Tier 3 factors, in the project areas of remote and rural areas of Ladakh.

CONCLUSION OF CASES

Current CDM methodologies do already account for suppressed demand in some ways, but current interpretations may be unrealistic in some circumstances and unable potential projects to properly benefit from carbon finance. Moreover, the methods of including suppressed demand are new and not field tested or proven to have an impact of project development in these areas. As we could see, improving methodologies is possible, and the simple change in an emission factor could even double the CERs potential. All that maintaining the environmental integrity by deriving Tier 2 and Tier 3 baselines that are credible, transparently calculated and accurate, if deemed worthwhile by the project developer. Coupled with monitoring requirement the integrity of such an approach need not be compromised.

The case studies reveal that some clarifications and opening to other calculation possibilities that reflects the service level handled by the project can make a large and fundamental difference to the viability of projects. Unfortunately, CDM Methodologies do not yet take fully into account the concepts of Minimum Service levels required to meet basic human needs. They should be modified to do so where relevant to comply with its own guidance on the topic. Not only, the guidance should be improved so that simple and significant projects in terms of social development can see the light.

The barrier analysis method, as suggested by the CDM is a step forward, but it can lead to unrealistic outcomes if high efficiency technologies or emissions intensive fuels are selected, as shown by the case studies. It also does not easily allow for multiple use of fuels. It is also difficult to assess penetration rates once they are often proprietary or unavailable. This analysis also overlaps with the barrier analysis from the additionality test. It should be made clear that the options to be considered does not benefit from carbon finance, otherwise we'll have previous eligible activities to be considered as non-eligible.

Moreover, the CDM default value does not match field the realities of the case studies. Options should be made available to project developers to develop location or technology specific values that reflect local contexts; since, as shown by the previous case studies, they are not necessarily pushing the CERs potential to a higher level.

The tests of different tiers for EF raises some important questions:

- *How standardize weighted averages across the different regions of the world?*
- *Are fuels such as biomass included in this mix and which fNRB – Fraction of non renewable biomass (current or expected future) should be applied?*

If the benefit (perceived additional CER issuance) of calculation of factors is deemed worthwhile and within the skill set of project developers, Tier 2 and Tier 3 values may be derived from research or small surveys of target population. Surveys are designed to be 'lightweight' approaches (qualitative and quantitative sample size not bigger than 100 households) that can be determined once the project is underway. For example, default values could be considered for the PDD and validation stage; and the verified values could be established *ex-post* during verification. Among other things, this significantly shifts the costs burden of project development away from initial investments in data gathering and surveys and harmonizes these costs with project monitoring.

Finally, suppressed Demand methodologies should incorporate where possible Minimum Service Levels. In some cases the Minimum service level is easy to identify for example, in the case of water requirements. Minimum Service levels can easily be identified and integrated into methodologies in some circumstance such as Water filters in AMS II AV. However, other MSL's such as cooking fuel requirements are inherently more difficult to agree upon, but improvements have been made. The most complex case is the PSH technology, where the MSL standards, such as the WHO recommendation for average indoor temperature of 18^0C, are not expressed in energy units and are not always relevant for extreme environments. Passive solar housing in extreme environments can often not provide this service level and this level of service is not necessary for people who are adapted to the cold. Therefore, further research is needed in order to make robust recommendations for energy projects at household level, as it is the case of the PSH technology. Another considerable help would be to draw intelligent sustainable indicators for measuring the level of services achieved by the project during the monitoring.

ANNEXES

ANNEX 1. FULL CASE STUDIES

CASE 1: CERAMIC WATER PURIFIERS IN RURAL CAMBODIA

➢ BARRIER ANALYSIS - CDM GENERAL GUIDANCE ON SUPPRESSED DEMAND

By doing a barrier analysis on the project as defined by the CDM guidance it reveals that

- The baseline fuel is charcoal.
- The baseline technology or practice is water boiling on a high efficiency Improved Cooking Stove using charcoal as a fuel.
- The service level would be set at 5.5 lppd as the minimum service level.

Table 14- water treatment alternatives (technology and fuel) barrier analysis

Technology Alternatives	Compliance with local regulations	Income barrier	Infrastructure barriers	Skills barrier	Technological barrier	Penetration rate in project area
Piped clean water to home	✓	★	★	★	★	**0%**
Piped clean water to locality	✓	★	★	★	★	**0%**
Water filtration (CWP)	✓	★		★	★	**2%**
SODIS or 'Bio-sand'	✓	★		★		**2%**
Boiling - high efficiency stove	✓					**22%**
Boiling - low efficiency stove	✓					**64%**
Purchase bottled water	✓	★				**4%**
No treatment	✓					**12%**

Water boiling fuel Alternatives (ranked)	Compliance with local regulations	Income barrier	Infrastructure barriers	Skills barrier	Technological barrier	Penetration rate (<10% excluded)
Electricity	✓	★	★	★		**0%**
LPG	✓	★	★			**2%**
Kerosene	✓	★				**0%**
Charcoal	✓					**26%**
Wood	✓					**62%**
Biomass Residues	✓					**8%**
Dung and plastic	✓					**2%**

➢ SERVICE LEVEL

The service level is defined in liters per person per day (lppd) and derived from one of the following options:

Service level pre project	Service level in the project	Minimum service level
Approx. 2 lppd of often contaminated and untreated water.	4.58 lppd	7.5 lppd as per WHO guidelines, including cooking. Or, 5.5 lppd liters of drinking water per person per day for drinking[48].

- **METHODOLOGICAL CHANGES : AMS III. AV – V02**

A suggested new methodology for assessment should be as follows:

$$ERy = QPWy * WTcorrection * SEC * EFprojected\ fuel\ use * 10^9$$

Where:

ER = *Emissions reductions during the year y in (tCO2e) y*

QPW = *Quantity of purified water in year y (liters) . The total volume of drinking water per person per day applied to average HH occupancy rate. Defined through:*

Option A: default value set at 5.5 liters per person per day

Option B: Household surveys (n=100) to assess project level of service, in terms of liters per person per day through annual survey of filter filling per household per day and use of filtered water consumption. Use of water is treated as consumption – direct or indirect e.g. as vegetable washing and cooking needs or sale - and non consumption, e.g. body washing etc. Only water used for consumption is creditable.

This data cross checked with a controlled field test for measurement of 10 households. During this test, water use is monitored in a small sample of households (10) for a period of 2 days.

WT= *Water Treatment correction factor. To account for variation in water treatment practice use*

*Option A: **default value** of 0.9 i.e. assume that 90% of the population boil or practice no treatment*

Option B: Reliable literature or small survey (100 target households) to establish the water treatment practices in the household. Studies[49] suggest that this type of information is available for most if not all LDC countries. Where it is not, or is thought inaccurate or outdated, a small survey should be undertaken to assess treatment practice.

The % of people boiling water (either frequently or infrequently) and practicing no treatment or unsafe treatment is combined.The % of HH practicing non energy intensive alternative safe treatment practices

[48]WHO guidelines for Emergency Treatment of drinking water at point of the use <http://www.searo.who.int/LinkFiles/List_of_Guidelines_for_Health_Emergency_Emergency_treatment_of_drinking_water.pdf>

(determined from a pre-defined list from the CDM) such as chlorination or clean piped water to the households is discounted.For example, 80% boil water and 10% have no treatment, whereas 10% chlorinate water. The factor of 0.9 would then be applied i.e. only 90% of filters can claim carbon finance.

SEC *Specific energy consumption required to boil one litre of water (kJ/L).*

EF *Emission factor for expected fossil fuel use.*

*Option A: use a **default value**of 81.6 tCO2/TJ.*

Option B: Country or Regional specific emissions factor using barrier analysis and/or forecasting cooking energy mix in 2030. This fuel mix must be based on published and credible research or energy modeling (using historical data and factoring in national circumstances) and verified as being i) conservative and ii) credible.

fNRB biomass is used, the fraction of woody biomass used in the absence of the project activity in year y that can be established as no.If displaced fuel is fossil fuel use a default value of 1.0

N.B. a list of data should be drawn up and made publically available by the UN either by precedents used by project or by dedicated agency.

CERS POTENTIAL SCENARIOS CALCULATIONS PARAMETERS

As discussed, suppressed demand can be interpreted differently in this particular case. To compare the impact of methodological changes we calculate the potential CER issuance to the project under the following scenarios:

A – Current CDM methodology,

B – Current CDM adjusted with simplified barrier analysis,

C – CER calculated as per the suggested new methodology using project specific data,

D – CER calculated as per the suggested new methodology using default values.

Table 15- Different CERs scenarios parameters

Description	Parameter	A	B	C	D	Unit
Total quantity of purified water/liters/year	QPW	80,241,600	96,360,000	78,636,768	94,432,800	
Quantity of purified water/unit (based on manufactures specifications)	Qe/u	8,024	9,636	7,864	9,443	liters/unit
Members per CWP	P_i	4.8	4.8	4.8	4.8	
Number of units (y)		10,000.00	10,000.00	10,000.00	10,000.00	Units
Estimated usable lifetime		3	3	3	3	years
Lppd		4.58	5.5	4.58	5.5	lppd
SEC	SEC	3,574.80	1787.4	3574.80	3574.8	Kj/liter
Fraction of Non renewable biomass	fNRB	0.73	0.73	N/A	N/A	Fraction
WT		1	1	0.98	0.98	estimate or default
EF (tCo2/tj)	EF	81.60	470.4	188.58	81.60	tCO2/TJ
Be	BE	17,086.94	59,143.73	53,011.86	27,546.40	tCo2e
Le	Le	-	-	-	-	tCo2e
Pe	Pe	1,500.00	1,500.00	1,500.00	1,500.00	tCo2e
Emissions reduction year 1		15,586.94	57,643.73	51,511.86	26,046.40	tCo2e
ER per filter per year		1.56	5.76	5.15	2.60	tCo2e

CASE 2: IMPROVED COOKING STOVES IN CAMBODIA

➢ BARRIER ANALYSIS - CDM GENERAL GUIDANCE ON SUPPRESSED DEMAND

Table 16- Summary of barrier analysis

Fuel Alternatives (ranked)	Compliance with local regulations	Income barrier	Infrastructure barriers	Skills barrier	Technological barrier	Penetration rate (<10% eliminated)
Electricity	✓	★	★	★		15%
LPG	✓	In some areas/populations	In some areas/populations			13%
Kerosene	✓	★				9%
Charcoal	✓					35%
Wood	✓					60%
Biomass Residues	✓					
Dung and plastic	✓					

SERVICE LEVEL

The service level is defined in term of the energy required for cooking.

Service level pre project	Service level in the project	Minimum service level
1.76 kg wood per person per day 8.4 kg of wood equivalent per HH per day	Unkown.	None suggested. Found to be too variable and no international relevant level is yet available on the topic.

➢ METHODOLOGICAL CHANGES: AMS II.G V03

The proposed changes firstly **simplify the methodology**, by removing the Fraction of Non Renewable Biomass. This is because, by including suppressed demand, biomass fuels are not expected to feature in the baseline emissions scenario.

Secondly, proposed changes allow for a more relevant Tier 2 or Tier 3 *Emissions Factors* to be applied to the baseline that take into **account project specific factors, in addition to an optional default value**. This is referred to as Tier 2 (Country specific) or Tier 3 (Location/project specific) values.

$$\mathbf{ER} = \mathbf{By} * \mathrm{NCV}\mathit{biomass} * \mathrm{EF}\mathit{projected\ fuel\ use}$$

ER — *Emission reductions during the year y in tCO2e*

By — *Quantity of woody biomass that is substituted or displaced. Determined by Option a, b or c (see CDM methodology).*

NCVbiom — *Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tons)*

EF — *Emission factor*

***Option A**: use (Tier 1) default value of 81.6 tCO2/TJ*

Or

***Option B:** (Tier 2) nationally specific or (Tier 3) location specific emissions factor forecasting cooking energy mix in 2030. This fuel mix* *must be based on either a barrier analysis as per CDM guidelines, or published and credible research or energy modeling (using historical data and factoring in national circumstances) and verified as being i) conservative and ii) credible.*

➢ **CERs POTENTIAL SCENARIOS CALCULATIONS PARAMETERS**

Table 17- Different CERs scenarios parameters

		A = Current CDM	B = Current CDM meth with barrier analysis	C = Suggested new approach with specific values	D = Suggested new approach with default values	Unit
Emissions Reduction	ER	15,024.5	-	28,125.6	20,581.6	CER
ER per stove per year		0.3	-	0.6	0.4	CER
ER per stove (lifetime of stove)		0.6	-	1.1	0.8	CER
Biomass displaced in the project	B	16,815.0	-	16,815.0	16,815.0	Tons of biomass
Efficiency of the system being replaced	η	0.1	0.2	0.1	0.1	fraction
Fraction of Non renewable biomass	fNRB	0.7	0.7	N/A	N/A	fraction
Net Calorific Value of biomass	NCV	0.0	0.0	0.0	0.0	TJ/ton
Emission factors for expected fuel use	EF	81.6	63.0	111.5	81.6	tCo2e/tj
Number of appliance disseminated	I	50,000.0	50,000.0	50,000.0	50,000.0	units
Usable life time of stoves		2.0	2.0	2.0	2.0	years
Leakages		1.0	1.0	1.0	1.0	fraction
Total annual fuel consumption per HH		-	-	-	-	tons wood /hh per year
ICS comparative efficiency		1.8	1.8	1.8	1.8	%

CASE 3: PASSIVE SOLAR HOUSING: ENERGY EFFICIENT BUILDINGS IN COLD DESERTS OF THE WESTERN INDIAN HIMALAYAS

➢ **BARRIER ANALYSIS - CDM GENERAL GUIDANCE ON SUPPRESSED DEMAND**

Table 18- Barrier analysis

Technology Alternatives (ranked)	*Compliance with local regulations*	*Income barrier*	*Infrastructure barriers*	*Skills barrier*	*Technological barrier*	*Penetration rate (less than 10% excluded)[50]*
Electric heaters	✓	★	★			0%

[50] Estimates

LPG heaters	✓	★				2%
Kerosene heaters	✓	★				4%
Passive solar heating systems	✓	★		★		0%
High efficiency biomass heating stoves	✓	★		★	★	0%
Traditional heating device	✓					92%
3 stone fire used for space heating	✓					

Traditional heating devices do not face barriers and should therefore be selected as the baseline.

Fuel Alternatives (ranked)	Compliance with local regulations	Income barrier	Infrastructure barriers	Skills barrier	Technological barrier	Penetration rate (less than 10% excluded)[51]
Electricity	✓	★	★			0%
LPG	✓	★	★			3%
Kerosene	✓	★	★			9%
Coal	✓		★			1%
Wood	✓					40%
Biomass Residues	✓					9%
Dung and plastic	✓					69%

Barrier analysis would also lead to the selection of wood as a baseline fuel as all fossil fuels face significant barriers, typically costs and import difficulties, within this region.

➢ Service Level

Service level pre project	**Service level in the project**	**Minimum service level**
Approximately 4 Degrees Celsius Indoor air temperature with high fuel use	Approximately 9 Degrees Celsius average indoor air temperature, with 55% low fuel use.	18 Degrees Celsius average indoor air temperature based on WHO standards.

➢ Methodological changes : AMS I.E – V04

We suggest the following alternative equations (1) and (2).

$$ERy = By * EF\ expected\ fuel\ use\ (1)$$

Where:

ER = Emissions reduction in year

By= Heating energy need displaced per household by the intervention * number of installed units (see equation 2)

[51] Estimates

$NCV_{biomass}$= Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne)

EF = Option A: use default value of 81.6 tCO_2/TJ

Or

Option B: Country or Regional specific default factor forecasting cooking energy mix in 2030. This fuel mix must be based on barrier analysis as per the CDM guidelines, published and credible research or energy modeling (using historical data and factoring in national circumstances) and verified as being i) conservative and ii) credible.

$$By = (TD * Dheating\ required)/1{,}000{,}000\ (2)$$

Where:

$$\frac{T_{inside\ PSH} - T_{outside\ PSH}}{T_{inside\ non\text{-}PSH} - T_{outside\ non\text{-}PSH}} * E_{non\text{-}PSH}$$

Where:

$T_{inside\ PSH}$ Average 24-hour temperature inside PSH house (°C)

$T_{inside\ non\text{-}PSH}$ Average 24-hour temperature inside non-PSH house (°C)

$T_{outside}$ Average 24-hour outside temperature at location of PSH house/ non-PSH house (°C)

$E_{non\text{-}PSH}$ Daily energy consumption of non-PSH houses (MJ)

TD =

$D_{heating\ required}$ = Number of days home require heating, derived from

Option A: Survey households (for each climatic area) in the project boundary,

Option B: Credible literature or by number of day outside average temperature falls below 15 ^{0}C from climate data.

Option C: Default value of 121 (derived from a 4 month heating need per year)

NCV = *Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne)*

➢ CERs POTENTIAL SCENARIOS CALCULATIONS PARAMETERS

Table 19- Different CERs scenarios parameters

Parameter		Current CDM meth	Current CDM with barrier analysis	Proposed new CDM meth with specific data	New meth using defaults	Unit
Emissions Reduction	ER	344.8	405.6	605.2	538.6	CER
ER per PSH per year		1.4	1.6	2.4	2.2	CER per unit per year
Biomass/energy requirement displaced in the project	B	337.3	337.3	N/A	N/A	Tons of biomass
Energy saved by PSH intervention (TJ)		N/A	N/A	6.6	6.6	TJ
Efficiency of the system being replaced	η	N/A	N/A			fraction
Fraction of Non renewable biomass	fNRB	0.835	0.835	N/A	N/A	fraction
Net Calorific Value of biomass	NCV	0.015	0.015	0.015	0.015	TJ/ton
Emission factors for expected (fossil or other) fuel use	EF project fossil fuels	81.6	96	91.6	81.6	tCo2e/ton
Number of PSH disseminated per year	I	250	250	250	250	units
Usable life time of PSH installation		28	28	28	28	years
Leakages	L	0.95	0.95	0.95	0.95	fraction
Fuel saving by PSH (tons biomass)		1.35				%
Thermal energy generated Tj/PSH/year	HG	N/A	N/A	0.026	0.026	MJ/hh/day
Average outdoor temp		N/A	N/A	-5	N/A	Degrees C
Average indoor temp		N/A	N/A	10	N/A	Degrees C
Temp difference	TD	N/A	N/A	15	15	Degrees C or default
Energy required for heating 1.C		N/A	N/A	0.001762	0.00173	Mj/degree C (calculated or default)
Minimum standard for heating		N/A	N/A	18	18	Degrees Celcius
Number of day requiring heating	D heating required	165	165	182.5	122	days

ANNEX 2: METHODOLOGICAL APPROACHES TO SUPPRESSED DEMAND FROM THE CDM - EB 62 ANNEX 6

IDENTIFICATION OF THE BASELINE TECHNOLOGY/MEASURE

Methodologies for project types that face a suppressed demand situation may identify the baseline technology/measure through a step-wise procedure that builds on the elements outlined below. This step-wise approach is illustrated through an example for providing lighting to households.

Step 1: Identify the various alternatives technologies/measures available to the project proponent that satisfy the same need as the need satisfied by the proposed project activity.

Example: In the case of lighting, the following alternative technologies may be identified to satisfy the same needs: small wick lamps, large hurricane lamps or pressure lamps, incandescent lamps, compact fluorescent lamps (CFLs), light-emitting diode (LED) lamps.

Step 2: Identify which alternatives technologies/measures identified in step 1 are in compliance with the local regulations. If any of the identified alternatives is not in compliance with the local regulations, then exclude it from further consideration.

Example: All technologies are in compliance with local regulations and none of them is removed.

Step 3: Rank the alternatives remaining after step 2 in order of decreasing efficiency (e.g. lumen/Watt) or quality of the service provided, i.e. from the highest efficiency or quality to the lowest efficiency or quality.

Example: The technologies are ranked as follows:

1. LED lamps;
2. Compact fluorescent lamps (CFLs);
3. Incandescent lamps;
4. Large hurricane lamps or pressure lamps;
5. Small wick lamps.

Step 4: Assess the alternatives in the sequence identified in step 3 and eliminate in that sequence those alternatives that face barriers such as the ones listed below:

(a) Income barrier, i.e. inability to meet the capital cost;

(b) Lack of infrastructure (e.g. non-existence of supply/service infrastructure);

(c) Lack of skills to operate the alternative;

(d) Technological barrier: e.g. technologies with low market share with market penetration rates of less than 5%.

Example: LED lamps, compact fluorescent lamps (CFLs) and incandescent lamps are removed, as these face barriers due to lack of infrastructure and technological barriers. The remaining two alternatives are the following:

Step 5: The first alternative not eliminated by step 4 and that is able to meet the minimum service level (see guidance below) under realistic conditions is deemed as the baseline technology/measure. If several fuels can be used for the same technology repeat the steps to identify the baseline fuel type.

Example: Large hurricane lamps or pressure lamps are identified as the baseline technology

IDENTIFICATION OF THE BASELINE SERVICE LEVEL

In baseline and monitoring methodologies, the service level used to determine baseline emissions can correspond to the following levels:

(a) The service level provided prior to the implementation of the project activity.

This approach is used for project types for which there could be significant incentives from the CER revenues to expand production (e.g. HFC-23 incineration from HCFC-22 production, N2O abatement from adipic acid production). Capping the baseline service level to historical level avoids such incentives. However, using the historical service level is less appropriate under a suppressed demand situation, given that the demand for the service is likely to rise over time even without the CDM, once the barriers would be overcome;

(b) The service level provided under the project activity.

This is the most commonly used approach: it is assumed that in the baseline the same service would be provided as under the project activity but with a different technology. However, this approach may not be realistic in some cases. For example, if a household receives 40 liter of clean water per day per person under the project scenario, it may not be realistic to assume that in the baseline 40 liter of water per day per person would be boiled, even if the income of the household would increase in the future. Using the project service level may also face some practical barriers, such as the difficulty of measuring the service provided under the project as well as for the baseline. For example, measuring the light output of a kerosene lamp could be challenging;

(c) A minimum service level.

This service level is a "choice" that reflects that the service provided prior to the implementation of the project activity would increase if it were not suppressed by the lack of income and high unit costs of the service. The service level is set at a level that satisfies basic human needs and makes possible the development of the type of project. However, the financial viability cannot be the only criteria for the determination of the minimum service level.

Reference end notes from Executive Summary

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[ix] For example Climate and Development Knowledge Network and the Suppressed Demand Working Group

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