UNEP/OECD/IEA workshop on baseline methodologies

Possibilities for Standardised Baselines for JI and the CDM

Background paper

This paper sets out some of the background on emission baselines, and answers the following questions:

- *what are emission baselines and why are they needed?*
- *why is it desirable to standardise emission baselines?*
- *what issues have to be considered when standardising emission baselines?*
- *how could emission baselines be standardised for electricity-generation, energy efficiency, industry and transport projects?*

The workshop aims to build on this background paper and country-specific information provided by workshop participants in order to develop methodological recommendations for standardised baseline calculations in the sectors examined, and to identify next steps.

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April 2001

[1] The authors thank Jan Corfee-Morlot, Jonathan Pershing, John Christensen, Tom Jones, Lasse Ringius, Lwazikani Tyani, and Deborah Salon for their suggestions and comments. The opinions expressed in this paper are those of the authors and do not necessarily represent those of UNEP, OECD, IEA or their member countries.

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1. Introduction[2]

1.1 What are emission baselines and why are they needed?

The Kyoto Protocol establishes two project-based mechanisms for greenhouse gas (GHG) mitigation: the clean development mechanism (CDM) and Joint Implementation (JI). These GHG mitigation activities[3] are intended to result in "additional" emission reductions, and investing in these activities via a JI or CDM project can give rise to "emissions credits" for sale on the international market.

To determine the number of credits that could be generated by an individual JI or CDM project, an indication is needed of what GHG emissions would have been in the absence of that project (i.e. what would have happened otherwise). The amount of GHG emitted in the hypothetical non-project scenario is referred to as a project's *baseline*. A baseline is thus a quantification of this hypothetical emission level and may be used for comparative purposes to test for the GHG "additionality" of an individual project[4]. CDM projects will qualify for certified emission reduction units (CERs) and JI projects will qualify for emissions reduction units (ERUs) if they are additional relative to the baseline. This paper (and the workshop) focuses on emission baselines.

Actual, monitored greenhouse gas emissions levels of the JI or CDM project are compared with the previously agreed baseline, and the difference between the two is the mitigation effect of the project, or the total emission credit amount. In practice, it is likely that the emission baseline will need to comprise only those sources and gases that can be monitored (at least for CDM projects, where emission reductions need to be certified). It is therefore important to take into account what could be monitored when assessing what an emissions baseline should comprise.

1.2 Why should emission baselines be standardised?

Experience with project-specific emission baselines has been gained during the pilot phase of "activities implemented jointly" (AIJ), but is rather limited. The majority of emission baselines were drawn up on a project-specific basis. Analysis of such experience (e.g. OECD 1999, Schwarze 2000) has indicated that in the absence of detailed guidelines on how to set up an emissions baseline, the methodologies and assumptions used are often incomparable, inconsistent and not transparent.

A project developer could presumably be a private entity, a non-governmental organisation (NGO) or a government. Depending on what the rules establishing the CDM contain, these entities, NGOs or governments could be based either in Annex I or in non-Annex I countries (i.e. the potential range of "project developer" could be from an energy company in an Annex

[2] This paper draws heavily on analysis on emission baselines done by the OECD and IEA in the context of the "Annex I Expert Group" (see OECD/IEA 2000 and http://www.oecd.org/env/cc/freedocs.htm).

[3] There are often linkages between national policies in a particular sector, and projects undertaken in that sector. However, there is no agreed definition of what exactly constitutes a "project", and in particular whether or not GHG reductions arising from a policy could be eligible to generate JI or CDM credits. This paper focuses on baseline calculations for "nuts and bolts" projects rather than "policies".

[4] For some project types, determining whether or not a project is actually additional may be as difficult as quantifying the additionality of the project. This paper focuses on quantifying additionality.

I country, to a host country government). A draft suggestion on JI specifies that legal entities, in addition to Parties, are eligible to participate.

Standardising baselines, methodologies or individual parameters would help to ensure consistency in the treatment of similar projects in similar circumstances. Standardisation would provide a high degree of transparency in baseline determination and could also, if developed by independent experts, limit the level of gaming/free riders (see OECD/IEA 2000 for a more detailed discussion). Compared to a project-specific approach, standardised baselines could also reduce the potentially high transaction costs associated with setting baselines, as one baseline could be applied to several projects[5].

The standardisation of methodologies to establish emission baselines and, ideally, the use of pre-established baseline values (i.e. multi-project baselines) could also facilitate and accelerate the required governmental acceptance and approval procedures for proposed projects in potential host countries. This may be particularly true in countries with limited administrative capacity and/or experience in baseline-setting. In addition, developing a methodology (or an actual value) for a multi-project baseline could help increase data collection and/or availability at a national level, which could create positive synergies with a country's other requirements under the United Nations' Framework Convention on Climate Change and its Kyoto Protocol. Standardised emission baselines may be especially important to encourage the initiation of small JI/CDM projects.

Since a baseline represents a hypothetical future scenario, it can change substantially with assumptions about future growth in economic activities and energy demand. While a baseline should allow for a reasonable growth of emissions in line with existing plans, emissions profile of the activities and expected economic growth in a host country, it should also ensure that possibilities to inflate the projected emissions are minimal. Standardising baselines could help in achieving this through guidelines on assumptions (e.g. about projected level of activities) while relating them to existing planning and activity structures in a country.

Drawing up a baseline will involve a trade-off between environmental credibility at the project level, transparency, baseline development costs, and investor certainty. Ensuring environmental effectiveness and encouraging participation in the project-based mechanisms need not be contradictory aims (Figure 1-1), yet there is some tension between the two. Baselines must seek to strike a balance to be environmentally credible while at the same time providing appropriate incentives to potential project developers to invest in emission reduction projects.

In practice, the success of the project-based mechanisms will depend on their overall contribution towards reducing GHG emissions. Elaborating the project-based mechanisms in such a way that only a few JI and CDM projects are implemented is not likely to yield either net GHG reductions or sustainable development. Two key factors related to baselines are expected to influence the success of the project-based mechanisms:

i) The baseline development process: Minimising the transaction costs associated with establishing a baseline should provide greater incentives to initiate projects. However, the extent of possible standardisation is likely to vary according to types of projects and according to sectors. For some types of projects, it may be possible to standardise the baseline value, while for others it may be possible to only standardise some parameters or methodologies. Guidance on baseline standardisation will thus need to

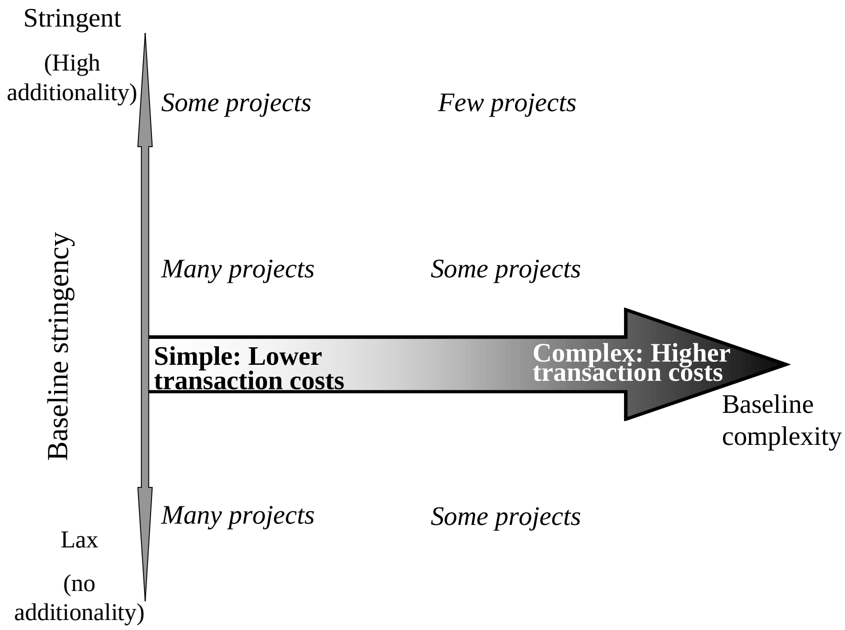
[5] The draft decision from COP6 on CDM includes a bracketed provision that would allow "small" electricity generation and energy efficiency projects to have a streamlined baseline-setting procedure. This may be particularly important in order to get small projects - that would individually only produce a small number of emission credits - off the ground.

balance the certainty about environmental effectiveness and the desire for simple, low-cost procedures.

ii) The stringency of the baseline: Using an overly stringent baseline (one at the lowest end of a possible range of baseline levels) may ensure that only additional JI/CDM projects are approved, but may also disqualify some environmentally additional projects. A less stringent baseline may mean that some non-additional credits are generated by projects, but increases the possibility that more additional projects are undertaken. Efforts to standardise the stringency of a baseline for a given type of project will thus need to balance the desire that only truly environmentally additional projects are adopted with the desire of ensuring that all additional projects are undertaken.

Figure 1-1

Possible effect of baseline stringency and complexity on project numbers and a project's environmental additionality



Source: Adapted from Ellis and Bosi (1999)

1.3 What issues have to be considered in baseline standardisation?

Given that baseline standardisation has potentially significant advantages, the next question is what form baseline standardisation should take. Baseline standardisation could take a number of different forms. These include standardising:

- Absolute baseline levels, or benchmark values (e.g. for project type X, the baseline to be used is Y kg CO_2/ton output if it is expressed in rates, or Z t CO_2/year if expressed in total CO_2 emissions saved)*;*

- Methodologies that would apply to a group of projects (e.g. for project type P, the baseline should be equivalent to the average performance of similar recently installed equipment); and/or

- Parameters that could be used in baselines that have both project-specific and standardised components ('hybrid' baselines, e.g. for project type N, total emissions equal

A + B + C. C needs to be calculated using site-specific data, but methodologies for A and B are given).

Which form is most appropriate to use will vary according to the sector and project category. Thus, determining project categories (i.e. assessing the types of projects to which one particular baseline can be used) is in itself also an important step.

Analysis carried out by the OECD and IEA (OECD/IEA 2000) indicates a number of important parameters when assessing if and how to standardise emission baselines for a particular project type:

- the appropriate geographic aggregation for a baseline (e.g. should a baseline be developed based on data aggregated at a local, regional, country or international level[6]?);
- The length of time over which a baseline can be used to assess the emission performance of a given project (i.e. the crediting lifetime of a baseline);
- Which project boundary is appropriate (e.g. which gases and sources should be included in the baseline, whether a baseline should be for an entire process or individual process steps);
- Which data assumptions are appropriate, and the availability of this data (e.g. should the data be based on average performances, performance of only recent similar projects or projections?); and
- The units in which baselines should be expressed (i.e. whether to express baselines in terms of absolute emissions, such as t CO_2, or in terms of a rate[7], such as t CO_2/GWh).

Many of these aspects are interlinked. For example, the level of geographic aggregation of a baseline can influence project boundaries and appropriate baseline units.

Variability across the different projects that are developed under a single baseline or baseline assumption will drive decisions on other standardisation factors, such as aggregation, lifetime, etc. Baseline levels may vary between project types in a given sector (e.g. energy efficiency and process change projects in the cement sector). Baselines may also vary within project types (e.g. baseline levels for an electricity generation project in India may be different from a similar project in Brazil). Any baseline guidelines or reference manual will need to determine acceptable levels of variation in project types and project performances before deciding to use a particular baseline to assess the emission reductions from a particular project.

[6] The Peruvian proposal for baseline methodologies suggests comparing the project to a rate outside one's own group, i.e. for CDM projects, the benchmark would be the average for Annex I countries.

[7] A decision on whether to express baselines in terms of a rate or absolute emissions will affect the simplicity with which a baseline can be drawn up. For example, baselines expressed in terms of absolute amounts will need to be adjusted for the output from a project, while a rate basis baseline could be used for similar projects with varying output levels (i.e. the baselines would be expressed in tGHG per unit of output). Expressing baselines in rate terms may be desirable for greenfield projects in growing economies in order to take into account the development objectives and needs of developing countries. A rate-basis baseline would also work to avoid a project generating credits by simply being closed down. On the other hand, a rate-basis baseline might present particular challenges in the case of a country with absolute emission target, as the country's emissions might still grow, as a result of the JI projects - albeit at a lower rate.

1.4 Sectors for consideration during the workshop

The workshop agenda includes discussion of the following sectors:

- Energy supply (focusing on electricity generation);
- Energy demand (focusing on energy efficiency);
- Heavy industry (focusing on cement and iron &steel); and
- Transport (focusing on road transport).

The remainder of this paper will discuss for each sector how to quantify emission reductions from projects, what form baseline standardisation could take, and the issues of baseline aggregation, lifetime, boundaries, data assumptions/availability and units.

2. Energy supply: a focus on the electricity sector

Electricity generation, whether grid-connected or off-grid, is a key aspect of energy supply[8], both in terms of projected growth and related GHG emissions. Electricity provides critical services (e.g. lighting, heating, power) that maintain and enhance countries' economic activity, as well as living standards.

Electricity generation[9] accounted for 37% of global energy-related CO_2 emissions in 1998 (IEA 2000). Growth in power generation is expected to be significant, averaging 2.6% p.a. for transition economies and 4.1% p.a. for developing countries from 1997 to 2020 (IEA 2000b). More than half of the projected additional worldwide generation capacity is to be installed in developing countries. This is anticipated to lead to a tripling of coal-fired electricity (1997-2020) and a more than two-fold increase in renewable power (although the proportion of non-hydro renewable electricity is projected to supply little more than 1% of total electricity in 2020).

Potential JI/CDM projects in electricity generation could include:

- New, lower-GHG intensive projects at greenfield sites;
- Retiring existing plants and replacing them with new ones;
- Refurbishment of existing plants (to increase energy efficiency); and
- Fuel switching.

In addition to the advantages of standardising baselines generally (as outlined above), multi-project electricity baselines would also facilitate the calculation of the GHG mitigation potential of other types of projects (e.g. energy efficiency projects), where assumptions regarding electricity-related emissions are critical parameters.

One of the first steps in developing electricity multi-project baselines is to define the *boundary* of an electricity generation JI or CDM project. Although a fully comprehensive approach might argue for boundaries to include all emissions (direct and indirect) related to electricity generation, this broad boundary definition is generally considered impractical for the development of CDM/JI emission baselines. Defining the boundaries around the direct GHG emissions from the combustion of fossil fuels to generate electricity (which represent the bulk of life-cycle emissions associated with electricity generation) seems preferable.

CO_2 emissions (calculated based on the type of fuel used by each plant) represent more than 99% of energy-related GHG emissions from electricity generation. Methane (CH_4) emissions are small and can be calculated based on the type of technology of each plant using IPCC default emission factors. Emissions of N_2O, also very small, are more difficult to estimate, as default emission factors are only available for few types of technologies. Robust multi-project baselines are likely to be possible without the inclusion of N_2O data.

[8] The energy supply sector could have a large potential for GHG reductions from the CDM. For example, ECN/AED/SEI(1999) find that fuel switching (oil and coal to natural gas) could constitute 17% of the CDM portfolio in the energy sector, renewable energy 14%, and energy efficiency measures in the power sector 25%.

[9] Includes public electricity and heat production, as well as autoproducers.

There is no truly objective crediting lifetime for electricity multi-project baselines. Various economic and technical factors/criteria (e.g. technical lifetime[10], economic lifetime[11] of power plants, time required to pay off the debt[12], etc.) can be considered when making this assessment. However, these factors need to be balanced out with environmental considerations. Taking these considerations into account, a crediting lifetime for electricity multi-project baselines of around 10-15 years seems appropriate.

A 10-15 years lifetime would mean that a project developer could use the same multi-project baseline for a particular power plant project over this entire period. However, this does not necessarily mean that all subsequent projects implemented during the 10-15 year period would use the same baseline. Given the ongoing changes[13] in countries' electricity sectors, it may be appropriate to consider periodically updating electricity multi-project baselines, e.g. every 5 years, in order to reflect developments in the electricity sector (for assessing reductions from future electricity projects). Thus, "revisable" baselines, as opposed to "fixed" baselines, may be appropriate, especially for projects with long lifetimes.

It may be appropriate to have different crediting lifetimes for greenfield and for refurbishment electricity projects, as the expected remaining lifetime of a plant being refurbished would normally be presumed to be shorter than the lifetime of a new power plant. However, distinguishing between a major "refurbishment" and a "greenfield" electricity project may be difficult, as they could have similar GHG mitigation effects and capital requirements (e.g. fuel switching from coal to gas and a new gas plant).

The development of a multi-project baseline is necessarily based on either historical or projection data. There are inherent uncertainties associated with forecasts and projections, as well as discrepancies between projections and forecasts of different origins, which make this data option more controversial in many cases.

Establishing multi-project baselines for power generation based on historical data can be done using national average performance figures using *all existing* electricity generation capacity or using only data on *recent* (and currently planned) electricity capacity additions.

Although simple to develop (and a useful basis of comparison), as data is usually readily available, a national multi-project baseline design based an *all existing* capacity may not best reflect "what would occur otherwise" in the power sector. In fact, capital investments in the power sector have a relatively long lifetime, but the type of new investments and fuel mix tend to change over time[14].

A multi-project electricity baseline based on *recent* capacity additions provides a relatively accurate estimate of what would occur without a JI or CDM electricity project. The development of electricity multi-project baselines based on *recent* capacity additions requires plant specific data on those *recent* plants/units included in the sample used to calculate the multi-project baseline:

[10] 15-50 years.

[11] Often more than 30-40 years, with experience showing that some large power plants (e.g. coal-fired plants) can continue operating even longer on relative modest maintenance schedules.

[12] Private bank loans are generally for a maximum of 10 to15 years, while corporate bonds can have a length of 15 to 30 years and government loans can be for 20 to 30 years.

[13] Changes over time do not necessarily result in a lower GHG intensity of countries'electricity sectors.

[14] For example, a national baseline based on a country's *entire* power generation capacity in a given year (e.g. 1999) can include 30-year old plants that would not be at all representative of typical investments made in more recent years.

- Commissioning date (in order to determine whether the plant/unit should be used in the sample of *recent* capacity additions).

- Type of technology (e.g. internal combustion engine, combined cycle gas turbine, etc.);

- Source of electricity generation (e.g. natural gas, water, bituminous coal, etc);

- Generating capacity (measured in MW – it is a necessary input to calculate the electricity production in MWh);

- Load factor (for what portion of total possible hours in a year is the plant/unit in operation – this is necessary to determine the electricity production in MWh);

- Conversion efficiency (for fossil fuels);

- Emission factors (to convert into GHG emissions).

Such data is generally available by individual power plant/unit[15]. In circumstances where requisite information is not available, assumptions, based on expert advice can be used in lieu of actual data on these variables.

Multi-project electricity baselines should be calculated on a rate basis, i.e. tonnes of GHG emissions per GWh of electricity produced (instead of total emissions, e.g. tGHG). Developing a multi-project baseline (measured in tCO_2-equivalent)/GWh) using *recent* capacity additions is calculated by summing up the weighted average GHG contribution by unit of electricity production of each recent plant:

$$(1)\ GHG\ emissions\ per\ unit\ of\ production = \sum_{z=1}^{n} \left[\frac{GHG\ emissions_z}{\sum_{z=1}^{n} electricity\ production_z} \right]$$

Where:
- *z* represents each individual electricity plant/unit in the database;
- *GHG emissions*$_z$ for each plant/unit "*z*" are calculated in tCO_2-equivalent (with disaggregated information, it is possible to calculate CH_4 emissions, as well as CO_2 emissions, using IPCC methodologies and default factors);
- E*lectricity production*$_z$ for each recent plant/unit "*z*" is measured in GWh.

Equation (1)'s *electricity output*$_z$ (GWh) and *GHG emissions*$_z$ are not generally readily available at the individual plant level[16], so will probably need to be estimated.

A range of options for geographical aggregation is available to set multi-project baselines for electricity generation projects. *Country-based* multi-project baselines may be suitable in many countries. *Multi-country* baselines for groups of small neighbouring countries with

[15] For example, the Data Institute (UDI)/McGraw-Hill *World Electric Power Plants Data Base* was used for the electricity baseline calculations in OECD/IEA(2000). Relevant electricity authorities within each country might also collect such information. Such data should also be available from electricity companies operating the facilities.

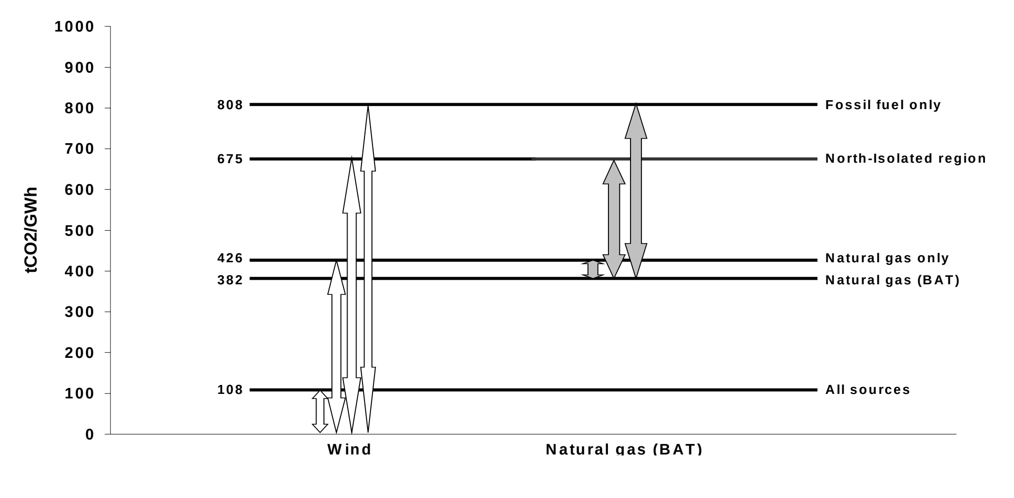
[16] This is unlike an electricity baseline based on nationally-aggregated data (including a country's all existing capacity) for a given year, where CO_2 emissions and electricity production (GWh) figures are readily available (e.g. in IEA 2000).

similar circumstances may also be possible and useful. Similarly, large countries may have regions with quite different resource availability and other characteristics determining the energy source and technology for recent facilities. Such countries may thus require multi-project baselines to be aggregated at the *sub-national* level.

Different sub-sectoral aggregation options also exist. For example, multi-project baselines based on recent capacity additions could be developed according to: (i) all sources; (ii) only fossil fuels; (iii) source –specific; (iv) region-specific; and (v) load-specific. The implications of these baseline assumptions, in terms of stringency, and incentives for investment in different types of facilities or energy sources depend upon national or regional circumstances. Figure 2-1 and Figure 2-2 illustrate such differences for the cases of India and Brazil (OECD/IEA, 2000).

Figure 2-1

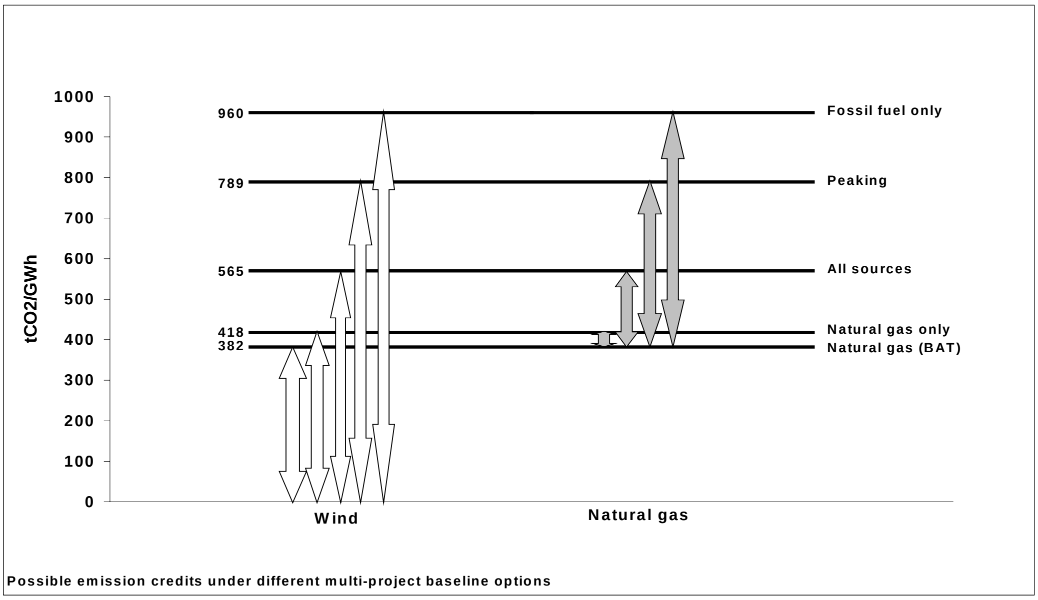
Brazil: Implications of multi-project baselines using recent capacity additions



Possible emission credits under different multi-project baseline options

Figure 2-2

India: Implications of multi-project baselines using recent capacity additions



The development of separate multi-project baselines for off-grid, isolated electricity systems would be useful, as they typically have particular characteristics (e.g. "North isolated region" in Brazil, Figure 2-1). Developing a separate multi-project baseline for peaking electricity may also be desirable, as those plants are typically different from base load plants (see Figure 2-2).

The evaluation of "stringency" (in terms of the baseline level) based on "average" performance depends on what exactly the "average" represents. For example, even with *recent* capacity addition, the *average* emission rate of *all sources* differs significantly from the *average* emission rate of *recent fossil fuel* capacity additions. Using Brazil as the example, the former would lead to a multi-project baseline of 108 tCO_2/GWh, while the latter would lead to a multi-project baseline of 808 tCO_2/GWh. The "average emission rate" of recent capacity additions including *all sources* may be viewed as sufficiently stringent in some cases (e.g. India) or perhaps too stringent in others (e.g. Brazil where recent capacity additions consist largely of non-GHG emitting hydropower plants). Nonetheless, it may be worth further considering the potential options and implications for better than average electricity multi-project baselines (Tellus et al. 1999).

Particular consideration might be needed for the evaluation of additionality of non-emitting sources, given that regardless of the stringency of a multi-project baseline for electricity generation projects, non-emitting sources would always be below the baseline level and thus theoretically eligible to generate emissions credits. This is irrespective of whether they are part of the BAU trend in countries' electricity generation sector. It might thus be useful to consider a "hybrid" (or "mixed") approach to assessing the GHG additionality of those zero-emitting projects. For example, it may be worth considering an additionality test to supplement the calculated baseline, which would screen out projects that have a significant probability of generating non-additional emission credits. Such a provision might require large projects to go through a more elaborate project evaluation process than smaller projects (they might only need to pass the multi-project baseline test, i.e. they would be "fast-tracked"). In order to further diminish the potential risk of non-additional credits, it might be useful to consider whether a more stringent electricity baseline could be used to asses the GHG mitigation from large zero-emitting electricity sources using mature technologies (e.g. large hydro) than sources using newer technologies (e.g. solar).

A "fast-tracking" provision, including a standardised baseline, applicable to only small electricity projects could have the potential to lead to a significant decrease in GHG-intensity of electricity generated via small plants. In fact the most common BAU source of electricity generation for the smallest electricity plants (i.e. under 5 MW or even under 15MW) in developing countries is oil, which is quite GHG-intensive.

National and regional circumstances, taking into account environmental, economic, administrative, and data availability criteria, can be expected to drive decisions on which multi-project baseline (s) is/are most appropriate, and at what level of stringency.

The evaluation of the contribution of the emission credits from a potential electricity CDM or JI project critically depends on the assumptions made (e.g. cost and revenues of the project, type of financing, discount rate, etc.). Another key factor, which cannot be generalised, is each investor's financial criteria (e.g. rate of return). It is thus not possible to draw general conclusions on the potential volume of electricity projects under different multi-project baseline options. However, a stringent baseline will limit the number of JI/CDM electricity projects. In fact, various studies indicate that that the impact of CERs on electricity investment decisions may be relatively small (e.g. Bernow et al. 2000 and Lanza 1999[17]).

To briefly sum up, the electricity sector lends itself to baseline standardisation. There are differences between countries' electricity sectors (and in some cases, differences within a country) that will need to be taken into account. Provisions to distinguish between grid-connected and off-grid electricity are also recommended. A baseline crediting lifetime for a given project of around 10-15 years seems appropriate to balance economic and environmental considerations. The treatment of large non-emitting electricity projects may require some other "additionality" test to supplement the calculated baseline. The fast-tracking of small electricity projects, using standardised baselines, could potentially lead to significant GHG reductions. Decisions on the appropriate baseline stringency for electricity baselines will need to take into account that a sufficient volume of CERs (at the credit prices estimated by models) is necessary to influence BAU electricity investment decisions.

[17] Available at *http://www.iea.org/clim/cop5/pubs/lanza.pdf*

3. Energy demand

Energy demand projects can take various forms:

- Energy efficiency projects, which involve retrofitting to upgrade energy using equipment (e.g. improving energy efficiency of a water boiler in a factory). The projects are predominantly technical in nature.

- Demand side management (DSM) projects, which deal with change in demand for energy at the consumer's end and offer an opportunity to reduce GHG emissions through JI/CDM. Most DSM programmes focus on energy-efficiency improvements at the consumer's end and are sometimes supplemented with energy pricing measures such as time-of-day tariff and energy price increases. DSM has traditionally been used in the electricity sector and involved consumers, electricity utilities and regulating authorities in the programmes. Replacement of incandescent lamps by compact fluorescent lamps (CFLs) in the residential sector with utility participation is an example of a DSM project. The utility may provide CFLs to households and recover the costs from savings to the consumers from use of CFLs. DSM projects may thus have any or all of the following components; behavioural, technical and policy.

- Other energy efficiency initiatives, such as energy efficiency improvements through regulations and standards. For example, a minimum energy efficiency standard can be specified for appliances such as refrigerators, washing machines and so on. Energy demand change in this case is policy driven. Energy pricing could also be used as a stand-alone measure to change the demand for energy but is unlikely to qualify as a JI / CDM project.

It is difficult to estimate the exact potential for GHG mitigation through energy efficiency projects. The potential for reduction varies across countries, and could be particularly significant in developing countries given their high projected growth in energy demand, low efficiency of currently installed technology in some cases and the relative cost effectiveness of energy efficiency projects in new constructions or major facility modification.

A country's potential for GHG mitigation through energy efficiency projects in a sector will depend on the sectoral share in its energy demand and its current level of energy efficiency. This can vary substantially from country to country. For example, share of residential sector in total electricity consumed was 22% for Thailand and 41% for Pakistan (IEA, 1999), so the potential for GHG mitigation in residential sector in Pakistan is likely to be higher in this sector. There may also be significant room for energy efficiency projects in the industry sector, often the largest energy using sector in many countries. Moreover, energy efficiency projects in industry may be easier to monitor as the target population may be less dispersed.

Energy demand projects can be initiated in residential, commercial, industrial and agriculture sectors. Table 3-1 below provides examples of energy efficiency projects in different sectors.

Table 3-1

Energy efficiency projects in different sectors

Sector	Examples of Energy Demand Projects
Residential	- Improving the energy efficiency of residential lighting & appliances - Improving energy efficiency of new and existing construction - Improving energy efficiency of space heating and cooling systems
Commercial	- Improving energy efficiency of building envelopes - Improving energy efficiency of equipment (e.g. lighting, motors heating, ventilation and air conditioning); - Community energy systems (e.g. district heating in commercial areas)
Industrial	- Improving energy efficiency of a single industrial process (e.g. aluminium smelting - Improving energy efficiency of motors spanning hundreds of industrial facilities
Agriculture	- Improving energy efficiency of pumps used for irrigation

Although traditional benefit-cost assessments of energy efficiency investments typically show projects to be cost-effective, these investments have generally not been undertaken by developing countries. Potential barriers to the implementation of projects (that are often not included in traditional cost-benefit assessments) include, for example:

- Information costs
- Attention cost
- Market distortion cost
- Technical barrier cost
- Capital scarcity cost
- Import (taxes and tariffs on imports of EE equipment) costs.

The baseline for energy efficiency projects should therefore be based on actual (business as usual assumption) rather than a theoretical assessment based on more traditional financial criteria.

Unlike potential JI/CDM projects in energy supply, that may involve a few actors and locations, energy demand projects may have numerous participants and locations. This is especially true of projects in the residential, commercial, small industries and agricultural sectors in developing countries. This has implications for how baselines are set up, and how project performance is monitored. For example, the AIJ energy efficiency residential lighting project in Mexico required participant (households in two metropolitan areas) and vendor (sellers of CFLs to the participants) surveys. National baseline data may thus not be adequate in such cases, although a useful starting point.

However, in some cases it may be possible to identify large-scale energy efficiency projects such as large-scale industrial applications or district heating systems, which will have implications on the baseline-development process and data requirements.

Development of an appropriate baseline for a DSM programme would be challenging. This especially may be the case where energy consumption was constrained due to energy shortages or budget constraints. In a residential lighting DSM programme for example, technical energy efficiency improvements may be “used” by the consumers to increase their energy consumption through higher overall demand[18]. This makes calculation of the mitigation effect of the project difficult. Increased energy consumption may however be desirable to provide needed energy services and its impact on sustainable development could also be positive. It will thus be important to take this into account, particularly in the case of emission baselines for EE projects in developing countries. DSM programmes may also require sound pricing policy for energy, the effects of which are difficult to quantify.

Experience from the AIJ pilot phase and through traditional EE projects and programmes (the latter mostly in industrialised countries) has been useful in providing valuable lessons for the development of baselines for energy efficiency projects.

The calculation of GHG emission baselines for EE projects can be divided into 2 main steps:

- The calculation of energy use baseline

- The "translation" of this baseline into GHG emissions (using, ideally, a standardised electricity baseline).

There are essentially three options, or levels, for the standardisation of energy use baselines for EE projects:

- Standardising baseline calculation methods;

- Standardising operating and performance parameters, and;

- Standardising energy use indices.

Calculation methods for estimating energy use by electric motors, for example, can be standardised and applied to a set of different project involving motor efficiency improvements. Data collection methods can also be standardised. Examples for operating and performance parameter that may be standardised are the values that describe energy use characteristics of a given technology such as the operating hours and efficiency of a motor. An example of an index that may be representative of the energy use is lighting kWh per square meter for the population of particular type of commercial buildings.

Due to the particularities of energy efficiency projects, unadjusted national, and even sector-specific, energy-use data may not be appropriate for baselines where energy efficiency project developers target a narrow set of facility types in specific regions. Nonetheless, national and sectoral energy use data are important for project planning, and they are a useful starting point for the development of baselines. They will need to be adjusted with in-field data on project participants. Such a building-block approach is expected to be less expensive than having each project develop its own baseline *de novo*.

For example, a baseline for a lighting efficiency project may indicate electricity used by chemical industries for lighting by incandescent bulbs in a particular area. Hours of usage, number of bulbs in use and their ratings are also estimated corresponding to the estimated electricity use of the project. These data can be used to estimate possible electricity savings from introduction of an efficient technology (e.g. CFL to replace incandescent lamp).

An EE baseline that reasonably reflects a BAU scenario can be considered good enough in terms of level of stringency. Where all (or the majority of) new sales are for equipment that has a higher efficiency level than older equipment, the new equipment efficiency level should

[18] Increased energy consumption may however be desirable to provide needed energy services and impact on sustainable development could also be positive.

be used for developing the baseline. However, if the new equipment accounts for only a small fraction (e.g. less than 30 per cent) of new sales, then the average efficiency level (or potentially a reasonable "better-than-average" efficiency level) of the stock of equipment in the field may be more appropriate.

The technical lifetime of the equipment used in some energy efficiency projects, such as lightbulbs, is relatively short (although the programme may run on a continuous basis). For example, a utility DSM programme to replace incandescent lamps by CFLs. In such cases it has been suggested (OECD/IEA 2000) to limit the crediting lifetime for energy efficiency JI/CDM projects to five years.

4. Heavy industry

Manufacturing industries and construction accounted for 4378 million tons of CO_2 (19.6% of global energy-related emissions) in 1998 (OECD/IEA, 2000). These industrial sector emissions are down in both absolute terms and in importance since 1990. The notion of 'heavy industry' comprises several sub-sectors, including chemical/petrochemical, iron and steel, non-ferrous metals (e.g. aluminium), non-metallic minerals (e.g. cement, glass), pulp and paper, and other industries.

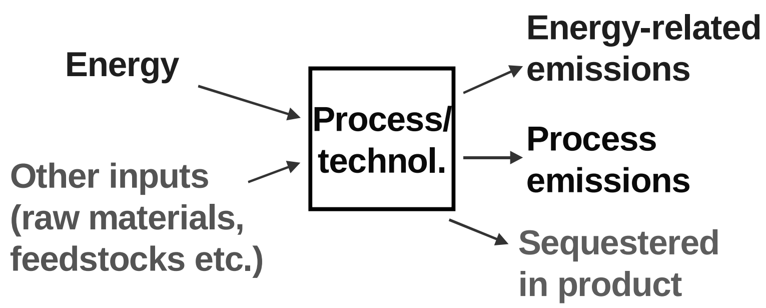
Industry can be a significant source of both energy-related and non energy-related emissions of GHG. This section focuses on baseline calculation in two sub-sectors of heavy industry: cement, and iron and steel. Detailed analysis of baseline development in these sectors are available[19]. However, much of the discussion is relevant for projects in other sectors as well.

In both iron & steel and cement, only a few production processes are in use, and are used all over the world. However, differences exist in the rate of penetration of more efficient processes (via new plants and refurbishments), and the rate of retirement of older or obsolete processes. In both sectors, cleaner production opportunities often exist, and a number of AIJ projects have been initiated in different industrial sectors. There is therefore likely to be both potential for and interest in JI/CDM projects in these sectors.

Calculating emission baselines for industry projects is potentially more complex than for energy projects. Like energy projects, projects in the industrial sectors will need to consider energy inputs to a process/technology and energy-related emissions from that technology. However, the relationship between energy inputs and energy-related emissions for industry projects is complicated by the need to consider non-energy inputs (such as raw materials and feedstocks), process-related emissions, and the fact that some of the energy or non-energy inputs may be sequestered in the project's output (Figure 4-1).

Figure 4-1

Inputs and outputs in industrial processes



There are different potential project types that could be considered as eligible for JI or CDM for industry. These include:

- changing the fuel used in a process (i.e. switching to low or no-carbon fuels);
- increasing the efficiency of fuel or electricity use;
- modifying the manufacturing process;
- reducing process emissions; and/or

[19] See http://www.oecd.org/env/cc/freedocs.htm (under "project-based mechanisms") and in OECD/IEA 2000.

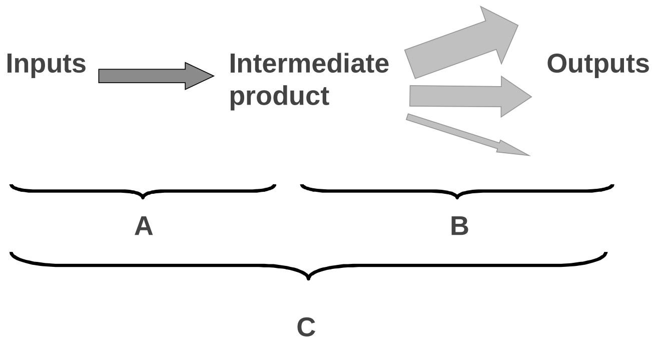
- changing the raw material used as an input.

While the first three options are likely to be applicable across many industrial sectors, the latter two are not. For example, the importance of process emissions in the cement sector can essentially be "diluted" by blending clinker (the key component of cement) with other, less GHG-intensive materials, so this project type may be a promising means to mitigate emissions from the cement industry (but not necessarily for other industries). Similarly, changing the raw material used as an input may be a potentially important project type in manufacture of metals, including iron and steel, but may not apply elsewhere.

One of the first decisions when drawing up a multi-project baseline is assessing the gases and sources that should be included in an emissions baseline, i.e. the baseline boundary. Industrial processes can frequently be characterised by processing inputs into a common intermediate product, and then transforming this intermediate product into a number of different final outputs. These products can have significantly different GHG intensities (e.g. the GHG intensity of different types of cement can vary by a factor of five). It may therefore be advisable for some project types to standardise a baseline or methodology for one or more process steps (i.e. for step A in Figure 4-2), rather than the whole manufacturing process (step C in Figure 4-2). Standardising a method for just one process step could help simplify and streamline the baseline-setting process, but could also have implications for leakage unless carefully set up.

Figure 4-2

Different potential boundaries for multi-project baselines in industry



However, this would have implications for the units in which a baseline is expressed. For example, baselines in the cement industry could be expressed in terms of clinker (rather than cement) production, and baselines in the iron and steel industry could be expressed in terms of crude steel production (rather than output of the finished product). Of course, standardising baselines for the intermediate product (baseline A) would mean that another baseline - either standardised or not - would be needed for the remainder of the activity (baseline B), if the JI/CDM project involved the whole production process.

Decisions on which gases should be included in a baseline are also needed. The relative importance of different gases and sources can vary significantly between different industrial sectors. For example, process-related CO_2 emissions can account for 50% of total emissions from cement manufacture[20], and may also be significant in other industries, e.g. aluminium. However, standardised baselines may reasonably exclude some sources and/or gases, for

[20] The exact proportion will vary, depending on the type of input fuel used, the fuel mix for electricity generation, and the composition of the finished cement.

example if - as in iron and steel production - CH_4 and N_2O emissions are relatively small, e.g. < 1% of project emissions, a standardised baseline could be drawn up to include CO_2 only.

Data availability may also influence decisions on what to include in a baseline boundary, and on what to base the baseline. For example, since data are available for the performance of "best available technologies" (BAT), setting baselines relative to BAT standards may be the most practical option. This might be done by scaling up the baseline slightly from any BAT standard, such as BAT or BAT * 1.X (although agreeing on a value for X may be difficult, as it could be positive or negative).

The appropriate type of baseline (e.g. geographic aggregation, project boundary) and baseline units will vary between, but also within, sectors (see sector-specific suggestions at end of section). For some JI/CDM project types, such as efficiency improvements, it may be appropriate to devise baselines along process/technology lines, so that they could apply to one technology type or process for many countries. For other JI/CDM project types, such as process changes, it may be more appropriate to aggregate at a geographical level (e.g. nationally or sub-nationally).

Determining the additionality of projects in industrial sectors may also be complex: the lifetime of many installations is long (sometimes more than 50 years) and business-as-usual (BAU) practice often - but not always - involves refurbishing a facility during its lifetime. In fact, for large, highly capital-intensive industries, more BAU projects are refurbishment projects rather than greenfield projects. However, it is difficult to provide an objective assessment of the additionality (and/or timing) of a project that refurbishes an industrial site, as decisions on when and if to refurbish sites depends on many factors, including possibly confidential company-specific information such as internal funding priorities and funding availability.

It may therefore be necessary to have different baseline methodologies, crediting lifetimes and/or baseline values for greenfield and refurbishment projects.

Work from the OECD/IEA indicate that emission baselines can be standardised for projects in the cement and iron/steel sectors. However, the level of appropriate standardisation will vary by project type. For cement:

- Internationally standardised energy values could be drawn up for energy efficiency-type projects (e.g. at the level of lower end of best practice);
- National or regional standards could be drawn up for process change projects;
- Standardised methodology could be developed for projects changing fuel inputs; but
- It would be difficult to make any baseline standardisation for blending-type projects.

For iron and steel:

- Standardised energy values could be drawn up for each production route;
- Because of data constraints, such a standardised value may be best expressed in terms of "better than average" performance that improves over time;
- Separate baselines should be set up for greenfield and refurbishment projects

For both industries, the standardisable component of baselines is the energy input (e.g. GJ per ton output). These values would need to be "translated" into GHG values using fuel-specific emission factors or electricity baselines. Another common point for the two industries is that some technologies currently in place are becoming obsolete, and should therefore not be used as the basis for setting emission baselines. Finally, determining an appropriate baseline lifetime is difficult as there are no fixed rules on when or how often plants are refurbished.

5. Transport

Transport is one of the largest sources of GHG emissions in the world, accounting for 23.7% of global energy-related CO_2 emissions in 1998 (IEA 2000). In the period between 1990 and 1998, global emissions in this sector have increased by 17%, ending the period at 5294 million tons CO_2[21]. In Non-Annex I countries transport contributed to around 16.3% (1998) of total energy-related non-Annex I emissions.

OECD (2000b) projects global CO_2 emissions from motor vehicles to increase by more than 300% by 2030 compared to 1990 level, with the majority of increase in the developing countries[22]. Substantial growth has already been noted during the 1990s: transport-related emissions increased 45% between 1990 and1998 in Latin America, and by more than 60% in Asian regions in the same time period (IEA 2000, OECD/IEA 2001).

However, the projected increase in transport GHG emissions suggests a potentially important role that transport projects could play under the CDM and JI. Some experience in evaluating emission reductions from transport projects has been gained under the Global Environmental Facility (GEF), which requires the evaluation of a baseline in order to estimate the incremental costs of projects (GEF 2001).

There are five main potential project types for reducing GHG emissions in the transport sector[23]:

- changing the fuel efficiency of vehicles;
- changing the type of fuel that vehicles use;
- switching transport mode to one that is less GHG-intensive (e.g. car to bicycle);
- reducing transport activity; and
- increasing the load factor (e.g. occupancy rate) of vehicles.

Each of these potential project types can be implemented in transport sub-sectors (e.g. passenger or freight, etc.). Moreover, they can be initiated in several different ways, including by introducing standards or policies, initiating infrastructure projects, changes in urban planning procedures, or by introducing specific technologies for a segment of the transport sector. Only one AIJ project has taken place to date in the transport sector (fuel switch from diesel to compressed natural gas in a Hungarian bus fleet)[24].

Together with energy demand, the transport sector poses some of the greatest challenges to baseline standardisation. Direct emissions from fuel combustion in a single vehicle are small, and thus require the aggregation over a set of vehicles, with standardised emission factors. Direct emission measurement -- except for large freight ships -- is likely to be too costly. In addition, offsetting behaviour needs to be evaluated and accounted for, as this has a large potential impact on emissions.

[21] Emissions from international marine and aviation bunkers are not included in this figure or in national totals, and accounted for a further 720 million tons CO_2 emissions in 1998.

[22] The increase in OECD countries is projected to be 56 percent, the major increase will occur in developing countries.

[23] This section of the paper draws from Deborah Salon, 2001 (unpublished) An Initial View on Methodologies for Emission Baselines: Transport Case Study, Draft OECD and IEA Information Paper.

[24] The Hungarian project is documented at http://www.unfccc.int/program/aij/aijact/hunnld01.html. One AIJ project reduced emissions from gas transport, but emissions from gas transport via pipelines are usually included in the "energy" rather than "transport" sector.

Anticipating which mode of transport people will use to move themselves or any other goods is complicated because it is closely linked to the decisions of these individuals. This makes it more difficult than in the cases of big power plants or heavy industry. In response to better private and public transport, for example, people may simply travel more frequently. In some instances this may reduce a project's short-term emission reduction impact substantially.

The transport sector can be divided into a number of sub-sectors, which can help already hint at certain boundaries for projects. These categories are summarised in Table 5-1 below.

Table 5-1

Categories of transport

Mode of transport:	Road; Rail; Waterways; Air; Pipelines
What is transported:	Person; Freight
Ownership:	Public; Private
Geography:	Urban; Rural; Connecting Regions
Distance:	Short-distance; Long-distance

Defining what a "project" constitutes in the transport sector is complex. Emissions in transport may be more than in any other sector affected by policies such as standards, taxes, and possibly emission permits. Also the removal of fuel subsidies can qualify as such a type of policy.

While the costs of passing laws may be comparatively low,[25] evaluating what would have happened in the absence of such a policy is challenging. In order to estimate the mere emissions reduction of a project, behavioural changes have to be recorded. What is more, in order to test additionality of a project an answer to the question 'would this policy have been implemented in the absence of CDM/JI?' has to be found. Considering the track record of past policies in the country can do this only qualitatively.

The existing literature considering transport projects has focused on the introduction of specific technologies for a segment of the transport sector. Examples are the conversion of a taxi fleet operating on gasoline to LPG taxis, conversion of public buses running on gasoline or diesel to buses running on natural gas (e.g. Morales 1999).

Undertaking financially viable JI or CDM projects in the transport sector may be even more difficult than in the other sectors, because of the high rate of subsidies in this sector, especially in developing countries. But turning the challenge around, it may be possible to use the existence and size of such fuel subsidies as indicators or tests for the additionality of a project. If subsidies are high, transport projects which lead to GHG reductions are comparatively more costly to implement, and thus 'would not have happened anyway'.

Based on the above discussion of mitigation options, it is possible to argue that in the transport sector, two different types of baseline methods may be applied:

- Sector emission projections
- Benchmarks such as 'carbon intensity per distance per vehicle'.

[25] If the barriers of achieving political consensus for such policies are not too high.

The first method may be necessary for large-scale projects and infrastructure projects, because only those would capture all direct and indirect impacts of the project. But as the method essentially implies ‘capping’ a sector, the idea may not be readily accepted - particularly as all transport indicators point to rapidly increasing demand.

Benchmarks are based on the average performance or vehicle technologies. The technology used for the JI / CDM project is compared against such performance benchmarks. The main question in this context is what performance benchmark to choose. It could be the average performance of a niche such as ‘public buses’, or the average of all vehicles driven. Also the regional boundaries need to be determined: should the project be compared against a sub-national, national, regional or international baseline? The Peruvian proposal for baseline methodologies suggests comparing the benchmark to a rate outside ones own group, i.e. for CDM projects, the benchmark would be the average for Annex I countries.

While sectoral projections can consider the development of a sector over time, and thus implicitly suggest what credit should be given, this is not the case for benchmarks. Anticipations about changing standards in the sector have to be applied to such benchmarks, and could be derived from sectoral analysis.

Average benchmarks may be calculated, but when using technologies as benchmarks, they have to be compared against the performance of a pre-chosen set of technologies, such as best available technologies (BAT). A common problem of this approach is how to choose such technologies, and how to update them in a cost-efficient manner.

The calculation of emissions in the transport sector can be summarised as follows (Halsnæs et al, 1999):

$$E = Trip \times Distance \times Fuel \times Emission\ Factor$$

Whereby the trip number can be further decomposed to take account of the increases in number of vehicles as follows:

$$Trip = Vehicles \times \frac{Persons}{Vehicle} \times \frac{Trips}{Persons}\ ;\ Trip = Vehicles \times \frac{Tons}{Vehicle} \times \frac{Trips}{Tons}$$

These equations not only reflect what type of data is required to evaluate an emissions baseline but also reflect where emissions can be reduced. Applying a standardised baseline such as 'fuel use per distance travelled' facilitates baseline calculation for projects that impact these parameters, but exclude other that reduce other parameters such as the emission factor. Obtaining sectoral historical transport data at the level of disaggregation that may be needed for standardised emissions baselines (e.g. fuel use/km) is frequently difficult except for centrally controlled vehicle fleets. Other data may not be available at all, such as average trip length. Data on technical characteristics of vehicles may be available, but may reflect laboratory rather than real driving conditions, and so may have limited applicability. Projected transport emissions (as with other projections) also suffer problems, including lacking transparency, the difficulty in aggregation of many transport sub-sectors, and the potential for gaming.

Lifetimes of projects in the transport sector vary widely. Infrastructure projects tend to have very long lifetimes, and may also have a long planning horizon (for example railway lines may be in place for a period of exceeding 100 years). Other projects such as fuel switching in cars, buses and lorries may have lifetimes shorter or comparable to projects in the energy supply sector, and may also have a shorter planning horizon. But lifetimes depend on individual usage, which needs to be estimated. So determining appropriate crediting lifetimes for transport projects can be quite difficult.

To sum up, the major challenges for developing standardised baselines in this sector are:

- The data availability and standardised data collection methods
- Defining appropriate project boundaries
- Identification and quantification of offsetting behaviour
- Developing 'unit sizes' and 'unit emissions reductions' as building bricks for the aggregation of larger transport projects.

6. Conclusions

Emission baselines are needed to quantify emission reductions from JI and CDM projects. Although sometimes difficult, standardisation of emission baselines for JI/CDM projects is both feasible and desirable. Baseline standardisation helps increase the transparency and comparability of JI or CDM projects, and lower related transaction costs (of which baseline development can be a significant part), without compromising the environmental objective of such projects. This paper discusses the key issues in baseline standardisation, with a focus on electricity generation, energy demand, heavy industry and transport.

This analysis indicates that baselines need to be designed to match sector characteristics as well as national (and sometimes sub-national) circumstances. The extent of baseline standardisation can also vary by type of project within a particular sector. Different types of standardisation approaches are also possible including setting absolute baseline levels, baseline methodologies, or parameters for baseline development.

Analysis of the four sectors examined in this paper leads to insights on the possibilities for and potential implications of baseline standardisation. It also highlights that some baseline issues do not have clear-cut answers and will require decisions balancing different objectives (e.g. being environmentally conservative while still providing investors appropriate incentives to implement JI/CDM projects).

Within each sector examined a number of different possible categories for potential projects emerge. Determining project categories, i.e. the project types to which a standardised baseline can apply, is an important step when setting up standardised baselines. A larger project category, such as for one particular technology type in a particular sector, would establish one standardised baseline that could be used globally. A narrower project category definition, such as average performance of recently installed production units in an individual country, may be more environmentally credible, but will restrict the potential numbers of JI/CDM projects to which it could be applied, and result in higher overall baseline development costs.

The boundaries chosen for baselines are of crucial importance, both in terms of the number of credits obtained from a project and the ease of baseline calculation and project monitoring. In the electricity sector boundaries should cover direct GHG emissions from fuel combustion. In heavy industry, the baseline may be broken down into individual process steps, rather than covering the entire manufacturing process. In energy efficiency and road transport single project activities are small and need to be aggregated. Indirect behavioural impacts on project performance are potentially bigger in transport and energy efficiency than for electricity and industry, and may need to be considered when drawing project boundaries. In all sectors a practical approach, based on data availability and relative importance of different sources, is generally recommended.

The number of years for which a project should generate credits is a key assumption determining the project's value, but it is difficult to estimate objectively. Measures in energy efficiency such as the promotion of energy-efficient light bulbs may be more short-lived, and thus should have shorter crediting times than larger single investments with longer technical lifetimes and high sunk costs, such as investments that occur in the electricity and industry sector. Consensus on a way forward on this subject would help to ensure that similar projects in similar circumstances receive similar treatment. Suggestions are provided for some project baselines in this paper. Decisions on crediting lifetimes, or on methods to set them, could be a useful first step in baseline standardisation. For example, agreeing crediting lifetimes could facilitate agreement on other aspects of standardised baselines, such as whether or how often a baseline should be revised during a project's lifetime and how stringent the baseline should be.

Assumptions on other key parameters (such as the baseline fuel, fuel mix or technology) also impact the number of credits from a project. But since there may be many potentially valid assumptions, project developers need guidance on which assumptions to take. For example, guidance could be set on whether assumptions should be based on the single "most likely" outcome in the absence of a project or on the average of different likely options. Guidance could also indicate what data set should be used when establishing assumptions (e.g. based on recent capacity additions), which would give a more accurate picture of "what would have happened otherwise", or on average performance of existing facilities, which may be more readily available.

The units in which to express emission baselines are also important, but not necessarily simple to determine. They will be influenced directly by decisions about the processes, sources and gases included within the project boundary. However, decisions on whether to express baselines in terms of absolute emission amounts or as a rate can have larger implications regarding the simplicity of baseline determination and the environmental performance of the mechanisms as a whole. For example, baselines expressed in terms of absolute amounts would require an extra step (of projecting project output), and could allow credits to be generated by a plant that was shut down. Baselines expressed in terms of rates would allow both "emission reduction" and "emission avoidance" type projects (e.g. those where per unit emissions are reduced, but absolute emissions increased due to increased output) to generate emission credits.

The issues of project additionality, free riders and gaming are related to baseline standardisation. Determining whether a project is additional can be complex - particularly for refurbishment projects in industry. If baselines are used as the only additionality "test" for a project, they could lead to significant numbers of non-additional credits or projects. However, if non-baseline additionality tests are required for all projects, this may raise transaction costs to a level that would reduce investor interest - particularly for small projects. To avoid the need for both baselines and additionality tests, development of standardised baselines could be designed to take into account the potentially double role of baselines: to test the eligibility and to quantify the additionality of a project.

Developing baselines requires judgement about the future to assess “what would have happened without the project.” Standardisation of baselines is possible and will help to level the playing field to similar projects in similar circumstances in addition to reducing transaction costs. Some types of projects (e.g. electricity projects) are more amenable to baseline standardisation than others (e.g. transport), but any level of standardisation is useful guidance to project developers, and can also reduce transaction costs. Important decisions remain to be made and will need to balance issues of environmental integrity and appropriate incentives. However, developing initial recommendations for baseline standardisation in selected sectors would initiate a dynamic process that will improve over time with more experience and more data.

7. References

Bernow, Steve, Sivan Kartha, Michael Lazarus, and Tom Page (Tellus Institute and Stockholm Environmental Institute – Boston Center), September 2000, *Cleaner Generation, Free Riders, and Environmental Integrity: Clean Development and the Power Sector,* An analysis for the World Wildlife Fund.

Chomitz, K., 1998, *Baselines for Greenhouse Gas Reductions: Problems,Precedents, Solutions*, Development Research Group, World Bank.

ECN / AED / SEI (1999). *Potential and Cost of Clean Development Mechanism: Options in the Energy Sector, Inventory of options in non Annex I Countries to reduce GHG emissions*. ECN Policy Studies.

Ellis, J. and M. Bosi (1999), *Options for project emission baselines,* OECD and IEA Information Paper, Paris, (http://www.oecd.org/env/cc/mechanisms.htm).

GEF (2001). www.gefweb.org and GEF Operational Program, www.gefweb.org.

Halsnæs, K., Callaway J.M. and H.J. Meyer, 1998, *Economics of Greenhouse Gas Limitations, Main Report, Methodological Guidelines*, UNEP Collaborating Centre on Energy and Environment, Risø National Laboratory, Denmark.

IEA, 1999, *Energy Statistics of Non-OECD countries*, Paris

IEA, 2000, *CO_2 emissions from fuel combustion,* Paris

IEA, 2000b, *World Energy Outlook*, Paris

Morales, R., 1999, Case Study: Interurban Transport project. Workshop on the Challenge of Financing and Ensuring Capacity Building in CDM projects, Mimeo CONAM (Peruvian Environment Agency)

OECD, 1999, *Experience with Emission Baselines under the AIJ Pilot Phase,* OECD Information Paper, Paris (http://www.oecd.org/env/cc/mechanisms.htm).

OECD/IEA, 2000, *Emission Baselines - Estimating the Unknown,* Paris

OECD, 2000a, *Framework for baseline guidelines*, OECD Information Paper, Paris (http://www.oecd.org/env/cc/mechanisms.htm)

OECD 2000b, *Environmentally Sustainable Transport: Futures Strategies and best Practices.* Guidelines for environmentally sustainable transport presented and endorsed at the international conference held from 4th to 6th October 2000 in Vienna, Austria. http://www.oecd.org/env/ccst/est/curract/vienna2000/EST-Guidelines-Vienna.pdf

Schwarze, R. , 2000, Activities implemented jointly: another look at the facts. *Ecological Economics*, **32**, pp. 255-267.

Tellus Institute, Stockholm Environment Institute, and Stratus Consulting, 1999, *Evaluation of Benchmarking as an Approach for Establishing Clean Development Mechanism Baselines,* (prepared for US EPA), Boston

U.S. Agency for International Development, 1999, *Handbook of Climate Change Mitigation Options for Developing Country Utilities and Regulatory Agencies*.

8. Glossary

AIJ	Activities Implemented Jointly
Baseline boundary	The emission sources and gases that are included in an emissions baseline.
Baseload	The minimum amount of electric power delivered or required in an electricity grid over a given period of time at a steady rate.
BAT	Best available technology
BAU	Business as usual
CDM	Clean Development Mechanism (defined in Article 12 of the Kyoto Protocol)
CER	Certified Emission Reductions (generated from CDM projects)
CH_4	Methane
CO_2	Carbon dioxide
Crediting lifetime	Number of years over which emission credits are generated by a JI/CDM project
EE	Energy Efficiency
Environmental additionality	Difference between baseline emissions and actual emissions for a JI/CDM project. An activity is 'additional' if it would not have taken place in the absence of JI and CDM.
ERU	Emission Reduction Unit (generated from JI projects)
FCCC	United Nations' Framework Convention on Climate Change
Free riding	In the context of baseline evaluation, a situation whereby a project generates emission credits, even though it is believed that the project would have gone ahead in the absence of JI or CDM. The emission reductions claimed by the project are therefore not "additional". Free riding increases the numbers of projects obtaining credits under JI and CDM.
Gaming	In the context of baseline evaluation, actions or assumptions taken by the project developer and/or project host that would artificially inflate the baseline and therefore the emission reductions. Gaming behaviour affects the number of emission credits claimed by a JI or CDM project.
GHG	Greenhouse gases
Greenfield projects	New projects (as opposed to old plants that are refurbished).
Greenhouse gas intensity	The amount of GHG emissions associated with a particular activity.
Hybrid baseline	An emissions baseline in which some components or values are standardised, and some are not
JI	Joint Implementation (outlined in Article 6 of the Kyoto Protocol)
Multi-project baselines	Emission baselines (also referred to as "benchmarks" or "activity standards" in the literature) that can be applied to a number of similar projects, e.g. to all electricity generation CDM or JI projects in the same country.

N_2O	Nitrous oxide
project-specific	Project-specific emission baselines are those that have been drawn up by examining projects on a case-by-case basis
Refurbishment projects	Projects (also referred to as brownfield projects) in which existing equipment is upgraded or replaced.