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Possibilities for Standardised Baselines for JI and the CDM

Chairman's Recommendations and Workshop Report

This document presents the Chairman's key recommendations and revises the background paper[1] *prepared for the workshop to include the results of the workshop discussions and recommendations.*

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[1] The background paper was written by Jane Ellis, Fanny Missfeldt, Martina Bosi and Jyoti Painuly and benefited from comments from Jan Corfee-Morlot, Jonathan Pershing, John Christensen, Tom Jones, Lasse Ringius, Lwazikani Tyani, and Deborah Salon. The opinions expressed in this report are those of the background paper authors and workshop participants in their individual capacities and do not necessarily represent those of UNEP, OECD, IEA or their member countries.

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Chairman's Recommendations

Emission baselines are needed to quantify emission reductions from JI and CDM projects. Baselines are essential for the assessment of potential CDM and JI projects by project developers. Standardisation of emission baselines for JI/CDM projects is desirable, as it helps increase the transparency and comparability of projects, and lower related transaction costs (of which baseline development can be a significant part), without compromising the environmental objective of such projects. The possibilities for standardisation -- whether methodologies, parameters or baseline values -- differ for different types of projects. However, all efforts leading to standardised baselines or baseline components, or even to clear "good" practice recommendations are useful, as they will help provide clarity and predictability about the environmental and financial performance of JI and CDM projects.

The UNEP/OECD/IEA baselines workshop, held May 7-9 in Roskilde, Denmark, was successful in starting a broad dialogue between more than 100 experts from 40 different countries on how to start developing standardised emission baselines, recognising that there are differences between baselines for different types of projects. Main recommendations from discussions on baselines for projects are outlined below in the following four sectors: electricity, energy efficiency, heavy industry, and transport. Of course, they only provide a starting point to developing the most appropriate emission baselines for each of these sectors. I hope that such discussions will continue and that their output will help climate negotiators and decision-makers to develop baseline guidance that will lead to the successful launch and implementation of the project-based mechanisms.

i) Electricity

There is a lot of potential and interest in developing electricity baselines. Different "types" of electricity projects lead to different baselines:

- A distinction needs to be made between electricity projects that are connected to the grid and those that are off-grid. Default baseline values are recommended for small off-grid renewables projects. This would be a necessary element of a recommended fast-tracking provision for small projects.
- Baselines for grid-connected projects need to take national and regional circumstances into account, and thus be based on national/sub-national or regional grids and/or transmission/powerpool constraints.
- A distinction should also be made between greenfield projects and retrofit projects. A retrofit project in the electricity sector should use previous plant emission levels (i.e. pre-retrofit level) as the baseline, as long as its output does not significantly exceed the previous total production.

The construction of baselines for electricity projects would need to take into account the following elements:

- Electricity baselines should be expressed in terms of gCO_2 equivalent/kWh. Some off-grid projects may require another unit, but this needs further examination.
- All direct on-site GHG emissions (CO_2 and other material[2] amounts of gases) from electricity generation should be included.

[2] "Material" (or "significant") can be defined as, e.g., 1% CO_2 equivalent for large projects and 5% for small projects.

- Some data may not be available or difficult to obtain, for example confidential data. This needs to be taken into account in the choice of baseline calculation methodology. Baseline-relevant data collection by dedicated organisations should be encouraged.
- Updates of standardised baseline values should apply to new projects.
- A longer baseline lifetime should apply to small projects with long lifetimes.

(ii) Energy Efficiency

The types of projects that could be included in the "energy efficiency" category could be quite diverse (e.g. lighting or heating in the residential or commercial sectors, as well as motors and equipment), which can make the task of standardising baselines quite challenging. However, clear baseline guidance is necessary to seek to maximise the great GHG-reducing potential from energy efficiency JI and CDM projects.

- Calculation formulae or algorithms used to calculate "energy use" baselines can be standardised for different types of energy efficiency projects. Relevant standardised electricity emission values should then be used to translate "energy use" baselines into GHG baselines.
- Some parameters to be included in the baseline calculations can be standardised, while others will likely require project-specific data.
- Reliable national or regional data on energy consumption trends are useful to develop "energy use" baselines for greenfield projects and they help identify potential energy efficiency projects. Greater data collection should be encouraged.
- For greenfield projects, the energy use baseline can be based on the average technology (or standard) put in place in recent years.
- Given the diversity of possible energy efficiency projects, it is not possible to standardise a single baseline unit for "energy use" baselines (e.g. kWh/m^3, kWh/appliance, kWh/year...).
- Baselines for energy efficiency projects help to quantify environmental additionality. Indirect effects of energy efficiency projects, e.g. spill-over and leakage, should also be assessed.
- The geographic boundaries of energy efficiency projects are defined by the location of the project, which may be in more than one location (e.g. an energy efficient lighting project in two cities). In-country and regional differences should be considered in the development of baselines.
- It would be reasonable that the crediting lifetime associated with a baseline be shorter than the technical lifetime of energy efficiency projects, especially if regulatory policies for areas affected by the project are changing during this period. Any change in the baseline methodology should not apply to energy efficiency projects started prior to that change (until the end of the agreed crediting period).
- Standardised approaches are useful for the fast-tracking of small energy efficiency projects. The size limit for fast-tracking eligibility should be such that CDM transaction costs/unit of emission reduced are kept low. A limit of 5 MW may be adequate.

(iii) Heavy Industry

The discussions focused on cement, iron and steel production.

- The main project categories are greenfield (new plants) and brownfield projects. Brownfield projects can involve fuel switching, process and control upgrading and replacement of individual equipment or units. Two other project types include input modification projects and product modification projects.

- In general, baselines for greenfield projects have the greatest potential for standardisation while brownfield and input modification (raw materials) projects have a medium potential for standardisation. Baselines for product modification projects will be difficult to standardise.
- Different types of baselines and standardisation may be appropriate for different types of projects e.g. brownfield projects that change energy use in an industrial production process may require parameters to vary by geographic region, whereas for other types of industry projects it may not be necessary to use region-specific parameters.
- The development of baselines should start with establishing baselines for different production routes, based on standard technologies in use for each. Then fuel-specific benchmarks (at an average value) for each production route would be needed.
- The data availability and quality may vary across countries, project types and production routes. Thus it is possible to have different levels of standardisation according to data availability.
- A minimum of five years crediting was suggested before baseline revision would take place. Crediting lifetimes can be a function of stringency of the baseline, e.g. more stringent baselines could lead to longer crediting lifetimes.
- Both direct, indirect and process greenhouse gas emissions can be significant. Significant emission sources should be included in the baseline.
- For many industrial project types, baselines can be expressed using a rate-based standard, in terms of energy use per ton of *intermediate* output (e.g. ton of crude steel, clinker.).
- Any fast-tracking provisions should also seek to include some industrial projects (e.g. rural industrialisation projects using scrap).
- Careful consideration should be given to whether a baseline could be the sole additionality check, or whether additional checks are needed.

(iv) Transport

This is the sector with perhaps least work undertaken so far in baseline development. Nevertheless significant conclusions were reached in this group.

- It would be useful to distinguish the following project categories in the transport sector: changing the fuel efficiency of vehicles, changing the type of fuel that the vehicle uses, switching transport mode to one that is less greenhouse gas intensive, reducing transport activity, and increasing the load factor of vehicles. Priority should be given to developing standardised baselines for the first two categories.
- For each project category, standardised methods for calculation should be used. Baseline calculation should proceed from project type identification to attribution of direct emissions to considering any eventual rebound or cross-sectoral effects.
- Rebound or cross-sectoral effects may be significant in the transport sector and should be accounted for in a standardised manner.
- The lack of data in the transport sector is significant. Thus reference databases should be developed and made available to the public.

(v) Next Steps

The workshop debate reflected that there is a clear need for more work and discussion in order to reach concrete baseline recommendations for different types of possible JI and CDM projects. The international community should consider possibilities to move this important work forward.

Workshop Report

1. Background

The 7-9 May 2001 workshop on *Identifying feasible baseline methodologies for CDM and JI projects* brought together more than 100 experts from Annex I and non-Annex I countries from governments, industry and non-governmental organisations. The workshop was organised jointly by UNEP, OECD and IEA, with the support of the Annex I Expert Group on the UNFCCC, and chaired by Mr. Kok Kee Chow of Malaysia, who also chairs discussions on the Kyoto Mechanisms at international negotiations on the UNFCCC[3].

The objectives of the workshop were to:

- gather information relevant for baseline development from Annex I and non-Annex I experts;
- outline the issues for standardising baseline methodologies for projects in energy supply (focusing on electricity), energy demand (focusing on energy efficiency), heavy industry (focusing on cement, iron and steel) and transport (focusing on road transport); and
- develop recommendations on the way forward for baseline development.

In order to facilitate progress at a sector level, participants worked mostly in parallel break-out groups (see attached workshop agenda).

This international dialogue on baseline methodologies was a first of its kind. It was a first step in the technical dialogue needed to identify areas of general consensus and identifying "challenge" areas when developing standardised emission baselines for Joint Implementation (JI) or Clean Development Mechanism (CDM) projects.

These project-based mechanisms are intended to help achieve lasting emission reductions in participating countries, by providing incentives for investment in clean technology and improving the performance of systems already operating. In order to be eligible, both JI and CDM activities have to show that the emission reduction they generate are "additional" to any that would occur in the absence of the certified project activity.

Baselines can be used to measure whether projects are additional as well as to quantify the emission reductions achieved by projects. Environmentally sound emission baselines are a pre-requisite for the measurement of emission reductions from joint implementation and CDM projects. At the same time, it is important that the development of these emission baselines be economically practical to ensure that they do not impose high transaction costs, which may create a barrier to potential project developers and investors. Transparency is also an important criteria to allow for verification and comparability. In this sense, efforts to develop standardised (or generic) baseline methodologies and data should be encouraged. Baseline standardisation would enable gaining economies of scale from scarce resources and facilitate the JI/CDM processes for all actors involved (e.g. project developers, and operational entities of the CDM).

Although the objective may be relatively clear, the way to get there is not obvious. Many considerations need to be taken into account, such as data availability, potential differences between (and sometimes within) countries, and differences between types of projects and between sectors.

[3] The workshop organisers are also grateful to DANIDA who provided funding for much of the workshop costs.

2. Introduction to emission baselines[4]

2.1 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[5] 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[6]. 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. The difference between the two is the mitigation effect of the project, provides the amount of emission credits (ERUs or CERs) eligible to be transferred from one Party or legal entity to another. 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).

2.2 Why standardise emission baselines?

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 I country, to a host country government). The Kyoto Protocol's text on JI specifies that legal entities, in addition to Parties, are eligible to participate; it is silent on this issue in the text on the CDM.

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[4] 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 the following internet site: http://www.oecd.org/env/cc/freedocs.htm).

[5] 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".

[6] 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.

Standardising baselines, methodologies and/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[7].

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 establishing baselines for projects. 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. Furthermore, agreement on standardised baselines, methods or assumptions would also facilitate project developers' assessment of potential JI or CDM projects. 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 profiles of relevant economic activities and expected economic growth in a host country, it should also ensure that possibilities to inflate the projected baseline emissions are minimal. Standardised approaches could help by providing guidance on methods and/or assumptions (e.g. about projected level of activities) while relating them to existing planning and activity structures in a country.

Ensuring environmental effectiveness and encouraging participation in the project-based mechanisms need not be contradictory aims (Figure 2-1), 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, and transparency, which will facilitate review and build confidence about "additional" environmental benefits to result from JI and CDM 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 a way that only a few JI and CDM projects are implemented is not likely to yield net GHG reductions nor will it enhance 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 methodologies or some parameters. Any type of standardisation or even "good practice" guidance can enhance transparency and help to limit free riding and gaming.

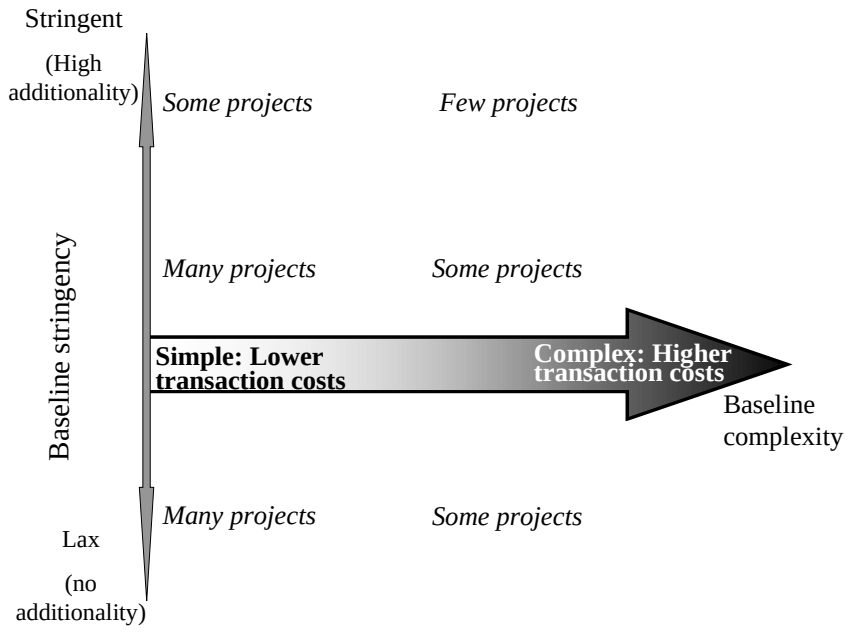
[7] The draft decision from COP6 on CDM includes a bracketed provision that would allow "small" electricity generation and energy efficiency projects to have a streamlined baseline-setting procedure. This may be particularly important in order to get small projects - that would individually only produce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

In this way standardisation is a means to achieve both lower transaction costs and improved environmental performance.

ii) The stringency of the baseline: Using an overly stringent baseline (one at the lowest end of a possible range of emission 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 also 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 2-1

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



Source: Adapted from Ellis and Bosi (1999)

2.3 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 how to develop 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[8]?);

- 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[9], such as t CO_2/GWh).

Many of these aspects are inter-linked. 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

[8] 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.

[9] 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.

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.

The remainder of this paper outlines for each of the four sectors discussed in the workshop 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. Where recommendations were made during the workshop, these are also included.

3. Energy supply: a focus on the electricity sector

Electricity generation, whether grid-connected or off-grid, is a key aspect of energy supply[10], 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[11] 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). According to IEA projections, natural gas-fired electricity is expected to grow to more than three-and-a-half times its current level. Market reform and liberalisation are also key trends influencing the future of the electricity sector in many countries.

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 (i.e. "brownfield" projects);
- Refurbishment of existing plants (to increase energy efficiency); and
- Fuel switching.

Power generated via renewable energy might be further enhanced with the possibility of qualifying as JI or CDM projects.

Developing standardised baselines would need to distinguish between grid and off-grid electricity projects, as well as between greenfield and brownfield projects. Baselines may also differ for small and large electricity projects.

In addition to the advantages of standardising baselines in general, the availability of standardised (multi-project) electricity baselines would also facilitate the calculation of GHG benefits 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 project boundary (coverage) of an electricity generation JI or CDM project. Although a fully comprehensive approach might argue for boundaries to cover 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. Workshop participants concluded that defining the boundaries around the direct on-site GHG emissions (CO_2 and other material[12] amounts of gases) from the combustion of fossil fuels to generate

[10] 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%.

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

[12] "Material amounts of gases" could be defined as, for example, gases representing 1% of total CO_2 equivalent for large projects and 5% for small projects.

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.

There is no truly objective validity lifetime for electricity multi-project baselines, i.e. length of time during which a baseline can be used to assess a project. Various economic and technical factors/criteria (e.g. technical[13] or economic lifetime[14] of power plants, time required to pay off the debt[15], etc.) can be considered when making this assessment. However, these factors need to be balanced out with environmental considerations. Taking these considerations into account, OECD/IEA (2000) suggests that a validity lifetime for electricity multi-project baselines of around 10-15 years may seem appropriate, at least in the context of the CDM. As JI projects are undertaken in countries with emission targets for the Kyoto Protocol's 2008-2012 commitment period, the baseline validity lifetime for JI projects likely needs to take into account the timing (and level) of the host country's commitment. Largely due to lack of time, workshop participants did not reach a conclusion on this item. However, they generally thought that there should be a longer baseline validity lifetime for small projects with long lifetimes (compared to larger projects).

A baseline validity (or "crediting") lifetime of [X] years would mean that a project developer could use the same multi-project baseline for a particular power plant project over this entire period[16]. However, this does not necessarily mean that all subsequent projects implemented during the [X] year period would use the same baseline. Given the ongoing changes[17] in countries' electricity sectors, workshop participants were of the view that it would be appropriate to periodically update electricity multi-project baselines in order to reflect developments in the electricity sector. These updated baselines would be used for assessing reductions from future electricity projects. However, the exact timing of such updates was not discussed.

It may be appropriate to have different baseline validity lifetimes for greenfield and for refurbishment electricity projects, as the expected remaining lifetime of a plant being refurbished would normally 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). This would need to be explored further.

The development of a multi-project baseline is necessarily based on either historical data or projected performance. 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. However, in the case of JI projects, some workshop participants were of the view that emission projections might be a necessary input for developing electricity baseline in countries with emission caps.

[13] 15-50 years.

[14] 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.

[15] 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.

[16] Some participants argued that the baseline validity lifetime should be equal to the project lifetime.

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

Workshop participants identified various options for electricity baseline data sets; for example:

- Fuel-specific (i.e. a different baseline for coal, a baseline for natural gas, etc.);
- A sector wide baseline (i.e. one baseline based on all sources of electricity generation);
- A fossil fuel baseline (i.e. one baseline based on the performance of all fossil fuel plants);
- A combination (e.g. some electricity projects in particular circumstances could use one data set, while others could use another set.).

A *fuel-specific* option was considered desirable by some participants, particularly in the case where CDM could be useful in stimulating investments in the cleaner use of coal than would otherwise occur, as only under a fuel-specific baseline could clean coal projects generate emission credits. A fuel-specific baseline might, in fact, be an important variable in promoting more environmentally-benign electricity infrastructure in countries with huge coal reserves, such as India and China. However, a *fuel-specific* option would not, in itself, encourage fuel switching, which is necessary to reduce the overall GHG-intensity of electricity generation.

Some workshop participants favoured a *fossil fuel* baseline, particularly in the case where a country's electricity sector was dominated by hydro or nuclear power, but new additional capacity was mostly fossil fuel-based. A fossil fuel baseline would thus not be lowered (i.e. made more stringent) as a result of the large proportion of non-emitting sources. This is viewed important to ensure that there are adequate incentives (in the form of emission credits) to stimulate investments in less-emitting electricity sources than would otherwise be the case.

A baseline based on the entire electricity mix (i.e. a *sector-wide* baseline) would ensure that only CDM/JI projects that are less GHG-emitting than the overall sector average generate credits. However, a sector-wide baseline will not provide incentives to reduce the GHG-intensity of the most GHG-intensive power sources, such as coal.

There was no agreement on which of these (or other) data sets would be most appropriate as a basis of standardised baselines. However, it was generally agreed that distinctions should be made between power plants used to generate baseload electricity and those generating peak load electricity (See Figure 1-2 for an illustration of the difference, in India).

In the case of brownfield (retrofits) projects in the electricity sector, workshop participants recommended that the baseline should be based on emission performance of the previous (pre-retrofit) plant for a time period equal to the remaining lifetime of the pre-retrofit plant, as long as the retrofit plant's output does not significantly exceed that of the pre-retrofit plant. For the electricity output that exceeds that of the pre-retrofit plant, the same baseline as for greenfield (new) electricity projects could be applicable.

Workshop participants concluded that for grid-connected electricity projects, multi-project baselines should be calculated on a rate basis, i.e. tons of GHG emissions per GWh of electricity produced (instead of total emissions, e.g. t GHG). Further considerations would be needed to conclude on the most appropriate baseline unit for off-grid electricity projects.

Different methodologies to calculate baseline emissions for electricity projects can lead to very different results. While workshop participants did not conclude on this issue, they identified several options that could be used to calculate emission baselines for electricity projects:

- System average (with and without base load plants):

- Operating margin;
- Build margin (e.g. baseline based on recent plants and those planned or under construction);
- Technology-based benchmarks; or
- Combination of the above methodologies;.

A *system average* baseline would be based on the performance of all existing plants operating in a country (or on a grid, depending on the agreed geographical boundary), irrespective of when those plants were installed. Although simple to develop (and a useful basis of comparison), as data are usually readily available, a national/regional/sub-national multi-project baseline design based on a system average (or *existing* capacity) may not best reflect "what would occur otherwise" in the power sector. In fact, although capital investments in the power sector have a relatively long lifetime, the type of new investments and fuel mix tend to change over time[18]. In addition such an approach often tends to bias the baseline towards existing baseload plants and older technologies. Several participants favoured excluding baseload plants from the baseline calculation, as these plants are generally the least likely to be replaced by CDM/JI plants.

A *marginal* approach may better reflect "what would occur otherwise". *Operating margin* approaches, as defined in Lazarus, Kartha and Bernow (April 2001) for example, seek to determine which plants are on the operating margin, i.e. the last units to be operated to meet demand, at each hour. This approach is based on the assumption that a CDM/JI electricity project will displace existing power generation on this operating margin. Operating margin information could be obtained using a weighted average marginal emission rate (WAMER) approach or dispatch models. This methodology is quite data intensive.

Build margin approaches seek to develop a proxy for what type of power plant would have been built (or built sooner) to meet the electricity demand should the CDM/JI electricity project not be implemented. For example, a build margin baseline could be based on plants recently built[19] or currently under construction, as in Lazarus et al. (1999 and 2000), as well as in OECD/IEA (2000). The development of such electricity multi-project baselines requires plant specific data on those *recent* plants/units included in the sample used to calculate the multi-project baseline:

- 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).

[18] 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.

[19] This approach may not be suitable for countries where there has been a low level of plant turnover or even overcapacity. For example, this is case in many countries in Central and Eastern Europe (i.e. potential JI host countries).

Such data is generally available by individual power plant/*J*[20]. When data is missing, assumptions, based on expert advice, can be used in lieu of actual data on these variables.

Developing a multi-project baseline (measured in tCO_2-equivalent)/GWh) can be calculated by summing up the weighted average GHG contribution by unit of electricity production of each plant represented in the baseline (e.g. all *recent* power plants):

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

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);
- *Electricity production*$_z$ for each 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[21], so will probably need to be estimated.

Another baseline option might be the emission rate associated with a particular technology (e.g. a natural gas turbine in combined cycle)

Any future follow-up on this discussion should include an examination of the advantages and disadvantages of all options, including an assessment of whether there are other options not discussed here. It would also be important to take into account the fact that some projects will be providing additional services (e.g. in the case of a rural electrification project) and that there may be data limitations. Indeed, some data may be confidential and thus difficult to obtain – a situation that many workshop participants believed would be increasingly common in the future, with the trend towards market liberalisation. Workshop participants felt that a recommendation ought to be made urging governments to ensure that data necessary for the development of emission baselines for electricity projects be collected by dedicated organisations and made available.

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 similar circumstances may also be possible and useful. *Sub-national* baselines may be needed for large countries that have regions with quite different resource availability and other characteristics determining the energy source and technology for recent facilities.

Different sub-sectoral aggregation options also exist. For example, multi-project baselines based on build margins (recent capacity additions) could be developed according to: (i) all

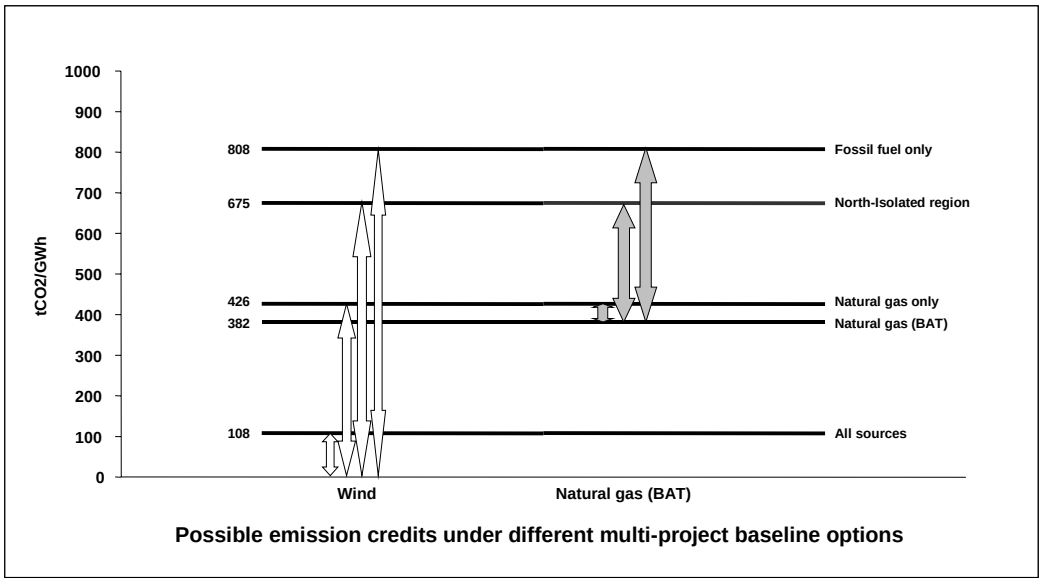
[20] For example, the Utility Data Institute (UDI)/McGraw-Hill *World Electric Power Plants Data Base* was used for the electricity baseline calculations, based on recent capacity additions, in OECD/IEA(2000). Several workshop participants identified which institution(s), in their country, collected plant-level data. Such data should also be available from electricity companies operating the facilities.

[21] 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).

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 3-1 and Figure 1-2 illustrate such differences for the cases of India and Brazil (OECD/IEA, 2000).

Workshop participants agreed that national/regional circumstances needed to be taken into account in determining the appropriate geographic boundaries. In this context, they also concluded that electricity baseline boundaries ought to be based on national/sub-national or regional grids and/or transmission power pool constraints. Participants also agreed that separate baselines should be developed for off-grid electricity projects, as they typically have particular characteristics (e.g. "North isolated region" in Brazil, Figure 3-1) which should be taken into account. In addition, participants recommended that *default baseline values* be developed for off-grid renewable projects (e.g. solar PV home systems).

Figure 3-1: Brazil: Implications of multi-project baselines using recent capacity additions



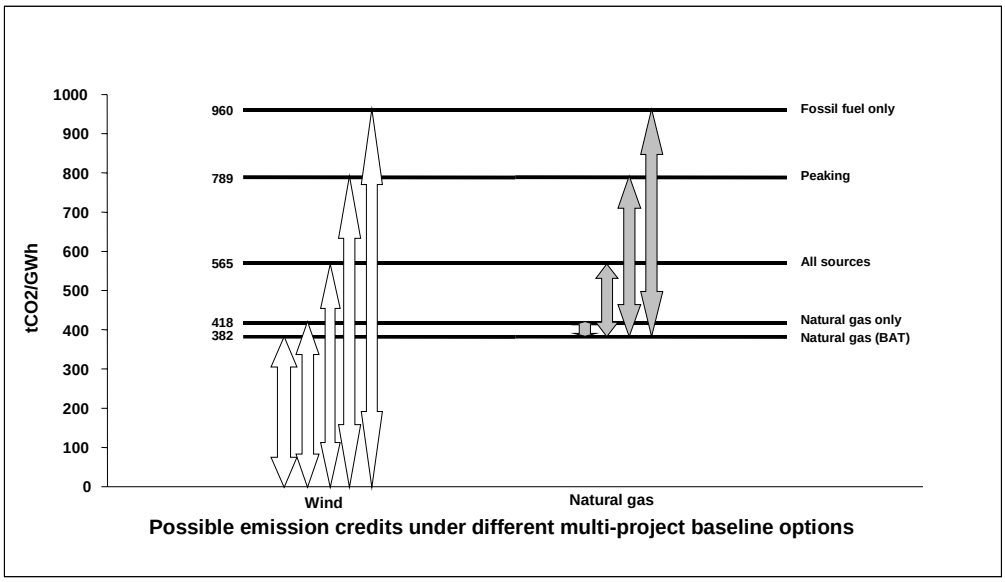
Source: OECD/IEA (2000)

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 (build margin), 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 (Figure 1-1), 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).

It is not possible to draw general conclusions on the potential volume of electricity projects under different multi-project baseline options. However, 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[22]).

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

Figure 3-2: India: Implications of multi-project baselines using recent capacity additions



Source: OECD/IEA (2000)

The question of baseline stringency is closely linked to that of project additionality, and merits further consideration, particularly on potential options and implications for "better than average" electricity multi-project baselines[23].

There was no consensus among workshop participants on whether an emission baseline would be sufficient to assess the "additionality" of a JI/CDM project in the electricity sector. Some participants considered that some kind of barrier analysis[24] would be necessary to ensure project additionality. Others considered that some form of investment additionality[25] test would be appropriate. Others, still, considered these other additionality tests as impractical and leading to unnecessary JI/CDM transaction costs. They argued that in most cases, as much as possible, the emission baseline should be sufficient to assess the GHG additionality of a project.

Notwithstanding, particular consideration might be needed for the evaluation of additionality of common 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" approach to assessing the GHG additionality of those zero-emitting projects. 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 might be useful. Such a provision might require large projects

[23] For more information, see Tellus et al. (1999).

[24] For example, demonstrating that institutional, financial, technological or informational barriers exist.

[25] In a presentation at the start of the workshop, Jasper Koch (WBCSD) argued that investment criteria (e.g. rate of return, payback period, etc.) varied between different companies and that it would not be possible to generalise them. Furthermore, it would be easy for project developers to manipulate financial figures related to a project should the international community end up agreeing on a investment additionality criteria.

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").

Workshop participants were in favour of fast-tracking provision for small electricity projects within JI and CDM. A "fast-tracking" provision, including a standardised baseline, that is applicable to only small electricity projects could potentially lead to a significant decrease in the GHG-intensity of electricity generated via small plants, as most small plants are fuelled by oil/diesel.

Workshop participants could not reach consensus (partly as a result of insufficient time to examine the issues fully) on many issues. In some cases, it was only possible to identify and briefly discuss likely options. Nonetheless, some specific recommendations were made. Furthermore, participants felt that the workshop was very valuable in starting a much needed dialogue on the development of emission baseline methodology and data for electricity projects. They thought that it was particularly important to continue such dialogue, building on and elaborating on the workshop's discussions and conclusions.

Process suggestions were made for follow-up activities:

- A follow-up workshop focused only on electricity baselines should be held, at which both baseline and electricity experts should participate.
- Material for such a workshop should include numerical examples of different baselines in different countries, as this would help participants to focus on different issues and examine possible related implications of different options.
- Greater use of international experience on project-based activities should be made in order to benefit from lessons learned elsewhere.
- Regional group discussion would be helpful.

4. Energy demand: A focus on energy efficiency

Energy efficiency (EE) is increased when an energy device, such as a household appliance, an automobile engine, or a steam engine, undergoes a technical change that enables it to provide the same service (lighting, heating motor drive) while using less energy (Sissine 1998). The volume of GHG reduced through energy efficiency projects will depend on the GHG-intensity of the energy source that is reduced with energy efficiency projects.

Experience to date with energy efficiency programs suggest that using energy efficiency as a way to reduce GHG emissions) has the potential to greatly reduce the costs of GHG mitigation, both in Annex I and non-Annex I countries. Further, these benefits extend beyond GHG emissions reductions by providing host countries with other sustainable development benefits associated with reduced energy use (e.g. local air, water and land use impacts), the installation of current technology in important sectors, and the development of a sustainable infrastructure.

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.

Moreover, JI/CDM energy efficiency projects could be undertaken in various sectors (e.g. residential, commercial, industrial and agriculture sectors). Workshop participants developed a possible categorisation of energy efficiency projects (Table 2.1).

It is difficult to estimate the exact potential for GHG mitigation through EE 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 EE projects in new constructions or major facility modification.

Table 2.1: Categorisation of energy efficiency projects[26]

		Greenfield investment (New construction, installation)	Retrofit	Process and system management improvement
Residential	Lighting	X	X	
	Heating/cooling	X	X	
	Household appliances	X	X	
	Insulation	X	X	
Commercial/ Institutional	Lighting	X	X	X
	Heating/cooling	X	X	X
	Building envelope	X	X	
	Motors, equipment	X	X	X
Industry		X	X	X
Agriculture		X	X	

A country's potential for GHG mitigation through EE 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 EE projects in the industry sector, 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.

Unlike potential JI/CDM projects in the energy supply sector, EE 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. For example, one AIJ pilot phase energy efficiency project in Mexico involved the replacement of existing lights with higher-efficiency compact fluorescent lamps. This project targeted residential energy use and in two geographic areas – the cities of Guadalajara and Monterrey.

While, in some cases it may be possible to identify large-scale EE projects such as large industrial applications or district heating systems, energy efficiency projects are more likely to be characterised by two factors:

- They will span a large number of sites or locations;
- While targeting multiple sites, there still is a specified target market area (e.g., the AIJ Pilot Phase lighting project in Mexico spanned many households in a target market covering two cities).

Although traditional benefit-cost assessments of EE investments typically show projects to be cost-effective, these investments have generally not been undertaken by developing countries. OECD/IEA (2000) identified examples of potential barriers to the implementation of projects (that are often not included in traditional cost-benefit assessments):

[26] Workshop participants thought that the identification of project types in the industry and agriculture sectors would need further elaboration. The transport sector, although relevant, was not included, as transport-related baseline issues were discussed in a separate sub-group.

- Information costs: lack of awareness and general misinformation about the potential benefits of energy efficiency projects;
- Attention cost: energy efficiency projects may be considered not worth the expenditure of attention of managers and households;
- Market distortion cost: pricing policies that do not reflect the true value of the resources consumed can make energy efficiency activities less economically attractive;
- Technical barrier cost: lack of information required to select the most appropriate technology;
- Capital scarcity cost: the capital pool in a country may not be sufficient and drive up the cost of capital to undertake energy efficiency projects;
- Import (taxes and tariffs on imports of energy efficiency equipment) costs: taxes and tariffs may discourage the import of foreign-manufactured energy efficiency equipment.

Baselines for energy efficiency projects should therefore be based on actual (business as usual) investments rather than theoretical assessments of what investments should be, based on more traditional financial criteria.

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

1) The calculation of energy use baseline:

$$EnergyUse = Quantity \times Power \times Operating\ Hour \times Diversity\ Factor\ ,$$

where *Energy Use* could be measured, for example, in kWh/year or kWh/m^2 for a lighting project; the *quantity* may be the number of devices; *power* represents the energy/electricity input to the device; *hours* are the annual hours during which the device is in operation; and the *diversity factor* may refer to the fraction of devices that are in use at any point in time (to take into account, for example, maintenance and repairs).

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

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.

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

- ***Standardising baseline calculation methods and data collection protocols*** (i.e., the algorithms and models used to compute energy use and the data that provide inputs to the algorithms);

- ***Standardising operating (e.g. number of hours) and performance (e.g. motor efficiency) parameters necessary for the baseline calculation*** *(i.e.,* the values that describe the energy use characteristics of a given technology or end-use);

- ***Standardising energy use indices (EUI) by sector, market segment and/or end-use (i.e.,*** indices that are representative of the energy use of a population of technologies or segment of the population, such as lighting kWh per square meter for certain commercial building types).

OECD/IEA (2000) suggests that calculation methods for estimating energy use by electric motors, for example, can be standardised and applied to a set of different projects 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.

Workshop participants concluded that formulae or algorithms used in the determination of the reduction in energy use, resulting from energy efficiency projects, could be standardised for the various EE types of projects identified in Table 2.1 above. As for the parameters of the formulae (e.g., operating and maintenance parameters, activity levels, etc.), workshop participants were of the view that it may not be possible to standardise them all for all types of EE projects. Project-specific data may thus be necessary.

It is not possible to determine a single baseline unit (e.g. kWh/m^3, kWh/year, or kWh/appliance, etc.) for all energy use baselines to assess EE projects. Consequently, both absolute GHG emissions (i.e. energy use activity levels multiplied by the fuel emission factor) and rate-based units (i.e. relative baselines that ignore factors that change over time) could be appropriate, depending on the type of EE project. As mentioned above, relevant standardised emissions factors from electricity production should be used in the calculations of GHG baseline from energy use baselines.

The development of baselines and the necessary data, need to take into account the particularities of energy efficiency projects (i.e. bundles of several small projects in different locations). For example, the AIJ energy efficiency residential lighting project in Mexico required participant (households in two metropolitan areas) and vendor surveys (sellers of CFLs to the participants).

Reliable national and, if appropriate regional sectoral data on energy efficiency and consumption trends are useful for identifying potential projects and developing baselines for greenfield projects. Although a useful starting point, *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. National data would then need to be adjusted with in-field data on project participants. This 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 be developed to set a standard for the amount of 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 would be 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).

In the case of large-scale EE projects, such as large-scale industrial applications or district heating systems, the baseline-development process and data requirements may be different.

There would be a need for reliable national databases to develop baselines, particularly in the case of EE greenfield investments. In fact, participants recommended that data collection efforts be extended and strengthened, particularly in CDM/JI host countries where the relevant data are not available. Further analysis should be made in order to specify the common elements of the national database, particularly in CDM/JI host countries.

The methodologies examined to estimate energy use baselines for energy efficiency projects normally only consider *direct* energy use. However, energy efficiency projects may lead to both spillover and free-rider effects. In addition, emission leakage may result from EE

projects by increasing indirect emissions through feedback effects. Workshop participants recommended that indirect effects of EE projects, as well as leakage, be addressed, but did not specify how[27].

The determination of environmental additionality of an energy efficiency project (and not financial additionality) was considered the key role of a baseline. Further methodological work would be needed to adequately take into account indirect effects and other environmental and sustainability impacts of EE projects for a comprehensive assessment of environmental additionality.

Workshop participants considered that baseline calculations for EE projects should include all GHGs covered by the Kyoto Protocol (as opposed to accounting only for CO_2, the main GHG).

Workshop participants also recommended determining, at the start of an energy efficiency CDM/JI project, the length of time during which a baseline methodology is considered valid for calculating a project's GHG emission reductions (and thus emission credits), i.e. the baseline should not be changed during the "crediting" period. Although the technical lifetime of an EE project could be easily estimated, workshop participants generally agreed that it was not a good proxy for the baseline validity lifetime. However, no consensus was reached on what should be an appropriate crediting lifetime for baselines used to assess JI/CDM energy efficiency projects.

As the technical lifetime of the equipment used in some energy efficiency projects, such as a utility DSM programme to replace incandescent lamps by CFLs, is relatively short (although the programme may run on a continuous basis), OECD/IEA (2000) suggests limiting the crediting lifetime to five years. A five-year baseline lifetime is considered adequate to balance environmental and project developers' interests. This would not preclude the possibility that the baseline be set such that energy efficiency is assumed to increase over the five-year period.

Recommendations for the geographic boundary of the baseline were that it should follow the geographic boundary of the energy efficiency project considered, which is usually defined by the location(s) where the project is implemented. In-country and regional differences should be considered in the development of baselines.

Baseline stringency is influenced by the assumptions used to define "business-as-usual" (BAU). Depending upon the assumptions made, the baseline can be set at a low energy use level (i.e. high stringency) leaving little room for incremental contributions to emissions reductions from potential energy efficiency projects; or they can be set to produce a high energy use baseline (i.e. low stringency) that will result in higher estimated emissions reductions, all else being equal. Key factors that influence the stringency of the business-as-usual case, which include assumptions about the energy efficiency of energy-using equipment, assumptions about what energy efficiency investments would have occurred in BAU, and the variability across projects, are:

i) *BAU In-Field Efficiency Levels*: the selection of *best practice* efficiency levels or the use of *average* efficiency levels of in-field equipment should be made on the basis of

[27] According to OECD/IEA (2000), when spillover and free riders are taken together, the end result is that there are two difficult-to-quantify baseline estimation biases that work in opposite directions. One option may be to decide that, as have some regulatory jurisdictions, in the absence of better information, free rider and spillover effects are assumed to cancel each other out for projects that reach a large number of facilities, unless substantive evidence is produced to indicate otherwise.

which more accurately represents business-as-usual. If all new sales are for equipment that has a higher efficiency level than older equipment, then the new equipment efficiency level should be used for developing the baseline. However, if the technology is new and only a small fraction (e.g. less than 30 percent) of new sales represent that technology, 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.

ii) *Assumptions about BAU Investments in Energy Efficiency*. *I*f certain theoretically economically energy efficiency actions are not currently being undertaken, it would seem to be inappropriate to assume that, under a BAU scenario, these investments would be made in the absence of an identified factor that would change this behaviour, e.g., remove the barriers to investment in energy efficiency.

Workshop participants, while acknowledging that more work and discussions are needed to fully conclude on this issue, were of the view that in the case of greenfield projects, the baseline technology could be assumed to be the *average* technology or standards used over a specified time period. In the case of new buildings, the average technology could be based on the average technology of the previous year.

Workshop participants generally supported a potential fast-track provision for small energy efficiency projects to allow them to move quickly and efficiently through the project approval process. However, there was no conclusion on what the appropriate definition of "small" would be, but suggestions included 5 MW or less. However, even 5MW was considered to be relatively large for an energy efficiency project. This issue would need further examination, taking into account the need to keep CDM/JI transaction costs low (relative to each kg of GHG emission reduced).

5. 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). Global industrial sector emissions are down in both absolute terms and in importance since 1990, although energy-related emissions of CO_2 from industry have increased in all non-Annex I regions except China between 1990-1998. 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. Discussions at the workshop focused on baseline calculation in two sub-sectors of heavy industry: cement, and iron and steel. Detailed analyses of baseline development in these sectors are available[28]. 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. In both sectors, cleaner production opportunities often exist (e.g. by introducing more efficient plants or processes, or by refurbishing existing plants), and a number of AIJ projects have been initiated in different industrial sectors. Combined with the projected continuing growth in demand for cement and iron & steel means, this means that there is likely to be both potential for and interest in JI/CDM projects in these sectors.

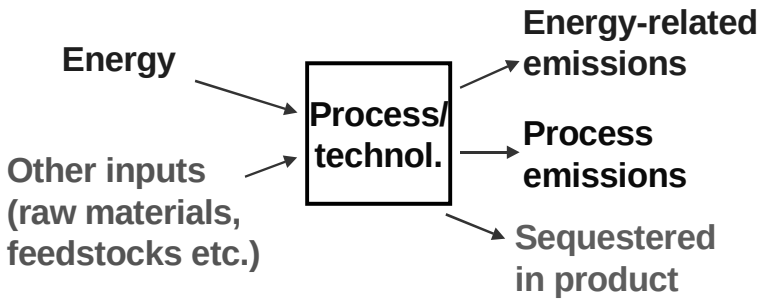
Significant differences exist in the rate of penetration of more efficient processes (via new plants and refurbishments), and the rate of retirement of older or obsolete processes for different countries. These differences in performance improvements are linked to the level of competition within an industry, and are also influenced by national circumstances (e.g. availability of infrastructure/resources, level of industrial activity, level and access to technology, capital endowment, type and size of units). Thus, the ownership of plants within a sector, and the importance of national and global trade in products can influence the baseline scenario.

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 5-1).

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

Figure 5-1

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 can be divided into four main categories:

- "greenfield" projects (i.e. new plants);
- "brownfield" projects (i.e. projects involving fuel-switch or substitution, process upgrade or modification, upgrading the controls used within an industrial plant, and replacing/upgrading individual pieces of equipment);
- input modification projects (i.e. changing the non-energy raw material inputs in a project, such as using scrap rather than ore); and
- product modification projects, which could be either demand-side or supply-side projects (i.e. either producing a low-GHG substitute for a currently produced product, or encouraging increased demand for low-GHG substitutes).

All of these project types could potentially affect either energy-related emissions or process emissions. However, the likelihood of the different project types occurring will vary by industry.

For example, product modification could potentially reduce the importance of process emissions in the cement sector by blending clinker (the key component of cement) with other, less GHG-intensive materials. However, this project type may be less applicable in 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.

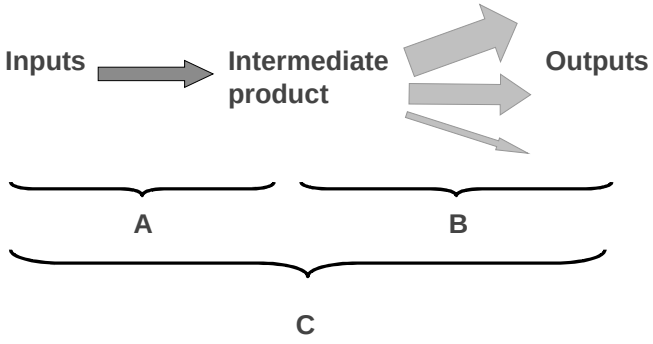
While many projects in heavy industry are large-scale, some potential JI/CDM projects could also be undertaken at smaller scales. It is important that small and climate-friendly industry projects (e.g. rural industrialisation projects using scrap) should also be able to benefit from any "fast tracking" opportunities established for small projects in other sectors, such as electricity. The definition of "small" projects should be linked to the product manufacturing capacity, and as such may be applicable to some production routes (e.g. steel production in electric arc furnaces based on scrap) rather than others (e.g. integrated steel plants, which are generally large).

The ease with which emission baselines for industrial projects can be standardised varies by project type. Workshop participants indicated that baselines for greenfield projects were likely to have the highest standardisation potential; baselines for brownfield and input modification projects were likely to have a medium potential for standardisation; while standardising emission baselines for product modification activities was likely to be difficult.

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 5-2), rather than the whole manufacturing process (step C in Figure 5-2). 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 5-2

Different potential boundaries for multi-project baselines in industry



This would have implications for the units in which a baseline is expressed. For example, standardised baselines for some projects occurring 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. Project-specific baselines may reasonably be expressed in terms of absolute amounts, or in terms of rates.

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[29], and may also be significant in other industries, e.g. aluminium. All significant sources of GHG emissions (whether direct, indirect or process) should be included both in a project's baseline and in project monitoring. This may mean that standardised baselines may exclude some sources and/or gases, for example direct emissions of CH_4 and N_2O in some industries. Work is needed to define "significant".

Data availability may also influence decisions on what to include in a baseline boundary, and on what to base the baseline. Obtaining the data needed to establish a baseline is often difficult, and even where data is available, it is not always reliable. Moreover, data availability and reliability varies between different countries, and is also different for different project types and production routes (as different project types will require different data in

[29] 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.

order to establish the baseline). Given the often significant gap between actual operating performance and the manufacturer's specifications, the ability to use these latter data as a "proxy" for operating data is limited. It may be advisable to set up different levels of baseline standardisation for different levels of data availability. In such a case, baselines for projects where fewer data are available should be more stringent than for when data are available (this is also necessary to reduce the risk of perverse incentives to "hide" data).

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 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).

The first step in setting up a baseline for supply-side projects in cement or iron & steel should be to establish different baselines for different production routes (e.g. direct reduced iron, or electric arc furnace for iron/steel making). A baseline would not need to be drawn up for processes becoming obsolete, as such processes are unlikely to be initiated in a without-project scenario. These production route baselines would need to be further disaggregated in terms of which fuel was/would have been used in the non-project scenario (e.g. an average figure for the direct reduced iron (DRI) process using gas, and another one for DRI using coal). Further disaggregation may be needed if variation within fuel categories is significant, or if different fuels have different impacts on the total energy requirements for a process.

Demand-side projects (e.g. those aiming to reduce demand for a GHG-intensive product in favour of a less GHG-intensive product), or supply-side products that modify the proportion of different products produced may need to have product-specific baselines.

Methodological decisions are needed on how to deal with brownfield projects that increase the capacity of an industrial project. For example, a JI/CDM project may include both a fuel-switch and a capacity-increase component. Further work is needed to determine whether the capacity increase part of the JI/CDM project should receive the same level of credit as a greenfield project.

Determining the additionality of projects in industrial sectors may 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. 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.

Further work is needed to determine whether an emissions baseline is suitable as the only additionality check for a project in heavy industry, and if so, at what level of stringency. If further additionality checks are needed, they should probably be simple (e.g. questions on national policies/standards and their implementation, knowledge/technical additionality of the proposed project). Given the importance of private ownership and commercial decisions in many industrial sectors, workshop participants indicated that perverse incentives may not be a significant problem for industry projects, although this may need further investigation.

Different crediting lifetimes and/or baseline values for greenfield and brownfield projects may be needed. It may also be advisable to vary the crediting lifetime (for all project types)

according to the stringency of the baseline: a project with a more stringent baseline could have a longer crediting lifetime.

In order to reduce investor uncertainty, participants suggested that investors be given the opportunity at the start of the project lifetime to chose to have a baseline either fixed for a shorter time period, or revisable (but over a longer time period). However, any baseline revisions should not apply until a project has been operating for five years.

Work from the OECD/IEA indicates 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 component of baselines to be standardised 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.

6. 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[30]. 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[31]. 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).

The transport sector poses the general challenge that as the transport system is improved, transport mobility is increased. In countries where the demand for transport is not met, this poses a specific problem, as transport projects will almost invariably lead to an increase in emissions. Such projects may be termed 'increasing access projects'. One aspect that needs to be reviewed in this context is the trend of transport emissions and activity. More research needs to be undertaken as to whether and how such projects can adequately be treated under JI/CDM.

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).

This section focuses on emission baselines for road-based passenger transport projects[32].

There are five main potential activities to mitigate GHG emissions in the transport sector[33]:

1. changing the fuel efficiency of vehicles (e.g. through vehicle efficiency or through traffic management/infrastructure changes);
2. changing the type of fuel that vehicles use (e.g. from petrol/diesel to biodiesel, CNG, electric vehicles, fuel cells);
3. switching transport mode to one that is less GHG-intensive (e.g. changing the modal split or traffic management/infrastructure, increasing public transport infrastructure such as light rail);
4. reducing transport activity (e.g. through town planning, road tolls, tele-working); and
5. increasing the occupancy rate of vehicles (e.g. through car sharing, telematics, subsidised public transport).

[30] 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.

[31] The increase in OECD countries is projected to be 56 percent.

[32] 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.

[33] Because transport demand is unmet in many countries, transport projects may reduce the growth in emissions rather than reduce actual emissions.

Standardised baseline development for transport projects should focus on the first two project categories, because behavioural aspects are a smaller problem in these categories. Increasing the load factor in the freight sector (5) is also less subject to behavioural changes.

Each of these activities 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)[34].

Together with energy demand projects, 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 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.

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. An investigation is needed as to whether policy-based activities should be eligible for JI/CDM status, and if so, how any credits accrue.

While the costs of passing laws may be comparatively low[35], 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'.

Defining the boundaries of a transport project may be complex as both indirect and secondary (or "rebound" effects may be significant. For example, baselines for both fuel-switch and modal change projects may need to take into account emissions generated from fuel/electricity production.

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

[34] The Hungarian project is documented at http://www.unfccc.int/program/aij/aijact/hunnld01.html.

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

- sector emission projections: trends in multiple parameters are estimated;
- benchmarks such as 'carbon intensity per distance per vehicle'. Two ways may be distinguished -
  - 'reduction measured in technical coefficient' times 'activity', where the technical coefficient is standardised, or
  - 'reduction in activity' times 'technical coefficient', where the activity is standardised;
- control groups: comparison to a comparable situation (e.g. similar vehicle fleet, road conditions) that is not the subject of a JI/CDM project.

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. For example, for projects aiming to increase the fuel efficiency of vehicles 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 excludes other that reduce other parameters such as the emission factor. Data requirements in transport have both technical and behavioural features. Technical features refer, for example, to aspects that modify the vehicle. Behavioural features refer to aspects that modify the transport activity.

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. Even basic data are difficult to find, including passenger km, ton km, occupancy, load factor and the quality of the vehicle fleet. 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.

It is important that data sets are developed to facilitate the construction of baselines in the transport sector. Such databases would be available for the use by countries in which certain parameters necessary to evaluate the baseline are missing.

Anticipating which mode of transport people will use to move themselves or any other goods is complicated because it is closely linked to behavioural 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. Such effects are referred to as rebound or secondary effects. These effects should be accounted for in a standardised way. Box 1 illustrates one possible way of standardising rebound effects, when little or no quantitative information on such effects is available.

While rebound and indirect effects occur in the transport sector, there are also linkages with other sectors that need to be considered. These include emissions from the production and transport of fuels and electricity, and emissions from vehicle production.

Box 1: A possible way of accounting for rebound effects.

Once the secondary or rebound effects of a project have been identified, a qualitative assessment of these effects should follow, and be applied on an 'ad hoc' basis. After the project type is identified in accordance with a standardised list, such as the bullet points 1-5 above, possible indirect effects in terms of the remaining project categories are identified. For example, a project may entail a fuel-switching component, but it could lead to an increase in transport activity. The project developers identify whether the effect is strong and positive, or - at the other end of the scale - strong and negative (i.e. emissions increase). Then the project emissions reductions measured are discounted with an ad hoc measure, such as X% of the emission credits generated by the project. A possible table or scale for evaluation is given here:

Very positive +10%
Positive +5%
Neutral 0
Negative -5%
Very negative -10%

For example, if the rebound effect of the fuel-switching project were negative, i.e. would increase transport activity, the total credits for that project would be calculated as follows:

Total credit = Emission reduction from direct effects - Rebound Effect
= Emission reduction from direct effects - 10%

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.

It may be worth exploring the possibility of fast-tracking some types of transport sector projects. Such fast-tracking could be carried out by e.g. indicating that a particular project type, such as projects aiming to increase the importance of public transport, is automatically eligible for CDM/JI status.

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 blocks for the aggregation of larger transport projects.

7. 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 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.

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 and the workshop leads to insights on the possibilities for and potential implications of baseline standardisation in each sector. It also highlights that some baseline issues do not have clear-cut answers and will require decisions balancing different objectives (e.g. being environmentally effective while not over-complicating the task of establishing baselines).

Some important cross-cutting issues emerge from the analysis of the different sectors. These are outlined below.

Additionality and the role of baselines

Determining whether a project is additional can be complex - particularly for refurbishment projects. However, the negotiations under the UNFCCC have not yet clarified whether passing the baseline "test" will be the only international check for project eligibility and additionality. While non-baseline additionality or eligibility checks can help reduce the extent of free riders, they may also increase the time and cost of labelling a project as CDM or JI. This may be a more important a barrier for some project types than others.

It may be advisable to allow emission baselines to have a different role for different project types. For example, emission baselines could be the sole additionality test for small projects with low emissions, such as renewable-based electricity generation. Further additionality or eligibility checks, such as questions on the relationship of the project to national pollution or technology policies, could be required for larger projects with higher emissions. Thus, design of standardised baselines could take into account a double role for baselines: to test the eligibility and to quantify the additionality of a project.

Project categories

Within each sector examined in this workshop, 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. However, this is not a simple task. For example, defining what constitutes a "project" may be difficult in some sectors, such as transport, where many different policy, technology actions and/or infrastructure developments can influence emission levels. Distinguishing a "greenfield" project from a "brownfield" project – although recommended - can also be difficult (e.g. in the case of a major refurbishment of an electricity or industrial plant).

Defining wider project categories, such as for one particular technology type in a particular sector, would enable one standardised baseline to be used e.g. at a global level. Defining narrower project categories, such as average performance of recently installed production units in a region of an individual country, may be more appropriate in some cases, but will restrict the potential numbers of projects to which it could be applied, and result in higher overall baseline development costs.

Baseline boundaries

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 (e.g. replacing a bulb with one that is more energy-efficient) are small and need to be aggregated to form a JI or CDM "project". Indirect behavioural impacts on project performance, as well as "spillover" effects, are potentially bigger in transport and energy efficiency than for electricity and industry, and may need to be considered when drawing project boundaries.

During the workshop, different sector groups made different recommendations as to which gases should be included in the emission baseline. For example, the electricity group recommended the inclusion of only "material" (or "significant") GHG from fossil fuel combustion to generate electricity. "Material" could be defined as, for example, gases representing more than 1 percent of total GWP-weighted GHG emissions, which would mean that N_2O could be excluded from a standardised emissions baseline. However, the energy efficiency group recommended including all gases. A general recommendation emerged to include other gases when they were "significant/material" through concrete guidance is needed on what constitutes "significant" (or "material"). Decisions on when not to include an emission source in a baseline will streamline the process of baseline-setting (and project monitoring).

Baseline methodology

The workshop made several recommendations on baseline methodology, both general and specific (see sections below). Firstly, baselines in the context of JI and CDM warrant separate examination to take into account the important differences between the trends, driving factors, as well as differences in climate change commitments of EITs and non-Annex I countries. In general, distinctions should also be made between greenfield and brownfield projects. Different groups made different suggestions for how to treat large-scale refurbishment projects that also increased capacity (e.g. either as two distinct projects, one greenfield and one brownfield, or alternatively as a greenfield project), and agreement on this point would be helpful.

Methodological distinctions may also be needed for different project contexts within e.g. CDM projects in a particular sector. For example, in some sectors, the same type of plant or technology under different ownership could have a different baseline (reflecting a difference in likely non-project scenario). A different extent of competition within the same sector in different countries could also lead to different methodologies or data sets being used for similar project types.

Data sets

Depending on the sector and project type, baselines may sensibly be drawn up using different aggregations of data. For example, supra-national data may be applicable in some cases (e.g.

for some industry projects), national-level data in others (e.g. for some electricity generating projects where one grid covers a whole country), or sub-national data (e.g. for some energy efficiency projects).

Assumptions on key parameters (such as the baseline fuel, fuel mix or technology) can significantly impact the number of credits from a project. Many valid assumptions may exist. Guidance on which assumptions to take under what circumstances can help to ensure transparency and environmental performance, while also simplifying the baseline development task. For example, guidance could be useful to clarify whether assumptions should be based on the single "most likely" outcome in the absence of a project (i.e. performance at the margin) or on the average of different likely options. More specifically, guidance could indicate what data set should be used when establishing assumptions (e.g. based on recent capacity additions at the national level for a particular type of project in one sector).

Baseline units

The units in which to express emission baselines are also important, but – like other aspects of baseline standardisation - 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, e.g. tons GHG per year, or as a rate, e.g. tons GHG per unit output, 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) based on expectations about economic activity and human behaviour. This could result in a situation where a project is earning more emission credits simply because production lagged with a slowed economy. Baselines expressed in terms of rates would not allow projects producing less output than expected to generate more credits. Opting for baselines in terms of rates, however, provides no check on reductions in absolute emission levels; rather, it aims to achieve reductions in emissions per unit of output. While establishing baselines as "rates" (emissions per unit of output) may be the most pragmatic option in many cases, it is important to recognise that this could lead to projects that avoid emissions, rather than reduce absolute emission levels. This has implications especially for JI projects, which must work within a nation's wider GHG accounting framework.

For projects where there is a homogeneous or easily-measurable intermediate "product", e.g. tons of clinker (for cement projects) or MWh electricity saved (for energy efficiency projects) it may be appropriate to express emission baselines in terms of the intermediate (i.e. MWh saved per energy-efficient installation). This would then be "translated" to GHG-equivalent by using a product or fuel/energy-specific emission factor, which could be standardised by geographic region.

Crediting lifetime

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. (This is true for both standardised and project-specific baselines). Projects 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.

"Fast-tracking" provisions

The consolidated negotiating text (UNFCCC 2001) includes a provision for "fast-tracking" the CDM procedure for small renewable electricity generating or energy efficiency projects. However, there is also potential for small (or relatively small) environmentally-friendly projects in the transport and industry sectors, such as public transport systems based on renewable fuels. It may be worthwhile exploring how any streamlined baseline procedure could also apply to these project types.

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9. Annex A: Workshop agenda

Identifying feasible baseline methodologies for CDM and JI projects

Expert workshop organised by UNEP, OECD and IEA
Chair: Kok Kee Chow

7-9 May 2001
UNEP Collaborating Centre on Energy and Environment,
Frederiksborgsvej 399, P.O. 49, DK-4000 Roskilde, Denmark

DAY 1: 7 May 2001

9:30 - 13:00 Plenary

9:30- 9:35	Welcome on behalf of the workshop organisers: UNEP, OECD, IEA (*John Christensen, UNEP*)
9:35 - 9:45	Aim of workshop (*Kok Kee Chow, workshop Chair*)
9:45 - 10:15	Update on the climate negotiations (*Christine Zumkeller and Maria Netto, UNFCCC*) Discussion
10:15 - 11:00	Fast Track Opportunities for Clean Technologies (*Liam Salter, WWF*) Discussion

11:00 - 11:30 Break

11:30 - 12:15	Making CDM/JI projects more credible and attractive to investors - implications for baseline setting (*Jasper Koch, World Business Council for Sustainable Development*) Discussion
12:15 - 12:30	Baseline issues for different sectors (*Jane Ellis, OECD*)
12:30 - 12:45	Survey paper results, and aim and functioning of each sectoral group (*Fanny Missfeldt, UNEP-Risø*)
12:45 - 13:00	Discussion

13:00 - 14:00 Lunch

14:00 – 18:00 Parallel breakout groups

Group 1:	Group 2:	Group 3:	Group 4:
Energy supply (focusing on electricity generation) Facilitator: *Einar Telnes* Rapporteur*: Martina Bosi, IEA*	**Energy demand** (focusing on energy efficiency) Facilitator: *Tamas Pálvölgyi* Rapporteur*: Jyoti Painuly, UNEP-Risø*	**Heavy industry** (focusing on cement, iron and steel) Facilitator: *Ogunlade Davidson* Rapporteur*: Jane Ellis, OECD*	**Transport** (focusing on road transport) Faciliator: *Jyoti Parikh* Rapporteur*: Fanny Missfeldt, UNEP-Risø*

Discussion of issues relevant to baseline construction (see below)

1. Sectoral characteristics and trends (e.g. sector characteristics, BAU behaviour, data availability/sources)
2. Potential project types (e.g. within a particular sector, greenfield/brownfield differences)
3. Geographic boundaries for standardisation:
   a) importance (or not) of national circumstances/regional variations (i.e. extent of homogeneity)
   b) implication of different national circumstances/regional variations on the additionality or not of a project
   c) data issues
4. Temporal boundaries and baseline standardisation
5. Technical boundaries for baseline standardisation
6. Baseline units
7. Additionality issues
8. Identification of factors determining the importance (or not) of perverse incentives in determining project baselines
9. Project size issues

DAY 2: 8 May 2001

9:30 – 13:00: Parallel breakout groups

Group 1: **Energy supply** (focusing on electricity generation)	Group 2: **Energy demand** (focusing on energy efficiency)	Group 3: **Heavy industry** (focusing on cement, iron and steel)	Group 4: **Transport** (focusing on road transport)

Continued discussion of baseline issues.

13:00 - 14:00 Lunch

14:00 - 15:00: Plenary

Interim report: stocktaking of different breakout groups

14:00 - 14:05	Group 1, *Einar Telnes*
14:05 - 14:10	Group 2, *Tamas Pálvölgyi*
14:10 - 14:15	Group 3, *Ogunlade Davidson*
14:15 - 14:20	Group 4, *Jyoti Parikh*
14:20 - 15:00	Discussion

15:00 - 15:30 Break

15:30 – 17:30: Parallel breakout groups

Group 1: **Energy supply** (focusing on electricity generation)	Group 2: **Energy demand** (focusing on energy efficiency)	Group 3: **Heavy industry** (focusing on cement, iron and steel)	Group 4: **Transport** (focusing on road transport)

Discussion of baseline issues.

DAY 3: 9 May 2001

9:30 - 10:30: Parallel breakout groups

Group 1: **Energy supply** (focusing on electricity generation)	Group 2: **Energy demand** (focusing on energy efficiency)	Group 3: **Heavy industry** (focusing on cement, iron and steel)	Group 4: **Transport** (focusing on road transport)

Agree group summary of outcome.

11:00 - 13:00: Plenary

Final report from group facilitators
Group 1, *Einar Telnes*
Group 2, *Tamas Pálvölgyi*
Group 3, *Ogunlade Davidson*
Group 4, *Jyoti Parikh*
Cross-cutting recommendations, *Kok Kee Chow*

Discussion
Chair's summary

End of workshop

10. Annex B: List of participants

Identifying Feasible Baseline Methodologies for CDM and JI Projects
Expert Workshop organised by UNEP, OECD and IEA
Roskilde (RISØ), Denmark, 7-9 May 2001

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11. 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.

MW	Megawatt
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.
Spillover effects	Positive, but indirect and unaccounted for, impacts that result from a project.