Joint Implementation for International Emissions Reductions through Electricity Companies in the European Union (EU) and in the Central and Eastern European Countries ("JOINT")

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WG2 Position Paper

Baseline Methodologies

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BACKGROUND

An emissions baseline describes the expected development of emissions that would occur in absence of the JI or CDM project. This means that an emissions baseline is by definition hypothetical. When looking at baselines as used in (the reporting of) AIJ projects, it becomes clear that different types of baselines are possible. Literature has distinguished the following key approaches with regard to developing the baseline for JI or CDM projects (see, e.g. [Puhl, 1998]):

- Baselines determined on a project-by-project basis;
- Guidelines developed that can be applied to a number of individual projects (method-based approaches).
- Generic/Multiproject baselines (applied as a reference for a number of projects at a certain level of aggregation)

A project specific baseline can be further categorised into either comparison based or simulation based approaches. A comparison based approach would be carried out using a control group and a simulation based approach may be carried out using an investment analysis and both approaches are relatively cheap to apply.

In most AIJ projects, the project by project approach was adopted mainly for reasons of cost effectiveness. The approach was developed on a rather ad-hoc basis, without following a general methodology. The Uniform Reporting Format provides some guidelines, but also leaves much room for interpretation (see also [Ellis, 1999]). Multiproject baselines were not developed during the AIJ phase due to the cost-effectiveness of the approach, there were only a limited number of projects involved and therefore the development of generic baselines has a relatively high initial cost component compared to project specific methodologies

Since this initial phase practical applications and structured guidelines for baselines have been developed and applied to a number of JI and CDM projects. The OECD/IEA has made assessments on the practical application of generic baselines to a number of industrial sectors [OECD, 2000]. The Dutch Ministry of Economic Affairs has developed project specific guidelines to be applied under JI projects submitted under the ERUPT scheme.

There is also the investment analysis methodology that has been used by the WorldBank's Prototype Carbon Fund (as described in [PCF, 2000a], commented upon in [PCF, 2000b] and applied in [PCF, 2000c]), which is also project specific. The PCF further describes the use of control groups as a project specific approach in [PCF, 2000a] and [World Bank, 1998], however this approach has not yet been documented for any JI or CDM projects, although such an approach is used extensively by the World Bank.

A control group method would seek to find a town, region, country etc, to the area of the CDM/JI project, where progress without CDM/JI intervention may be monitored. This would serve as a comparison for the CDM project. Ideally the control group would be identical so as to serve as a fully representative baseline for the proposed project. The control group would seek to establish behaviour in the absence of the CDM/JI.

Control groups are generally most useful when the number of observation units is large and a control group also fits well with projects where the geographical scope of the project is limited and there are no energy subsidies or other policy distortions. For these reasons the control group analysis may be more applicable to the CDM than JI and also because there have been no practical applications of this methodology for CDM or JI this methodology has not been included in the assessment.

There is now a great deal of research being undertaken with regard to the possible use of generic baselines for the CDM in order to significantly reduce the cost of CDM project development.

In the JOINT project, a number of criteria that a baseline methodology needs to fulfil have been developed (based on discussions within the team, the input papers from Meyer and Illum, etc). The three different methodologies/guidelines have been scored against these criteria, and the results have been assessed.

The following section gives an overview of the three different methodologies. The assessment of the methodologies against the criteria is given in Annex 1.

THE DIFFERENT METHODOLOGIES

The specific baseline methodologies that will be assessed are detailed below, from the available literature[1], as well as the opinions of various experts in the area of baseline development, these applications would appear to be the furthest progressed.

a. Generic baselines, as e.g. described in [OECD, 2000; Lazarus et al, 2000; Sathaye, 2001; Ruth et al, 2001]
b. Project specific baselines based on an investment analysis (simulation approach), as described in [PCF, 2000a] and applied in [PCF, 2000c]
c. Project specific baselines, as elaborated in [EruPT, 2000].

For a complete detailed description of the various methodologies and guidelines, we refer to the literature that is mentioned in the text.

GENERIC BASELINES

A generic baseline is a projected emissions baseline that may be applied to a number of projects. In most cases a generic baseline will be some reference value, a benchmark, that can be applied at different levels of aggregation such as regions, sectors or technologies. In most cases the generic baseline will be in the form of an emissions rate, i.e. emissions per unit output.

The methodology to derive a national electricity benchmark as described in [OECD, 2000] is based on an inventory of the recent[2] capacity additions in a country, and then using the IPCC methodology and conversion factors to calculate the GHG emissions generated per kWh for these plants. The following steps were carried out in the calculation:

[1] These include but are not restricted to literature from the WorldBank's Prototype Carbon Fund, amongst which PCF, 2000a/b/c], the Dutch EruPT program [ERUPT, 2000], various reports published by the OECD (among which [OECD, 2000; OECD, 1999]), various Uniform Reporting Formats from AIJ projects as derived from the UNFCCC website, [Lazarus et al, 2000].

[2] For the puposes of this work recent capacity additions are assumed to be over the past 5 years.

- Calculate the electricity production for each of the plants by taking the capacity and multiplying this with the plant load factor.
- Calculate the accompanying fuel consumption, by dividing the electricity production by the efficiency.
- Calculate the associated CO_2 emissions by multiplying the fuel consumption with the emission factor and correcting for the fraction of carbon that is oxidised.
- Calculate the methane emissions where appropriate, by multiplying fuel consumption with the methane emissions factor
- Convert the methane emissions into CO_2 equivalents by multiplying with the global warming potential for methane
- Calculate the GHG emission per kWh for each of the plants by dividing the total CO_2 emissions by total electricity output.

The baseline is then the sum of all the weighted average GHG emissions per kWh associated with each individual plant, so that:

Baseline Emissions per kWh = aA + bB + cC

Where: a = Weighting for Plant A
b = Weighting for Plant B
c = Weighting for Plant C
A = CO_2 Emissions per kWh from Plant A
B = CO_2 Emissions per kWh from Plant B
C = CO_2 Emissions per kWh from Plant C

The weighting is calculated according to the relative output from each plant.

It has been commented in [OECD, 2000] that regional benchmarks may provide more realistic estimates than national benchmarks, and that a distinction between peak and base load can also provide better estimates for certain projects. It is also acknowledged that future capacity additions may provide higher environmental integrity, but that these also give more opportunity for gaming.

In the context of the countries looked at in this work, there are a number of examples that highlight the issues identified by the OECD, particularly as the majority of the countries covered in JOINT are relatively small and therefore more sensitive to baseline selection.

It is clear that baselines need to be reviewed after a certain period, it is generally accepted at the international level that this period be every 5 years.

Example:

Following the steps described above, a benchmark value can be determined for the electricity sector of a specific country.
Using an inventory of recent capacity additions of electricity plants in India, [OECD, 2000] calculated a benchmark value for the Indian electricity sector of 565 t CO_2/GWh. Based on this number, the amount of credits that are generated by a CDM project in which a natural gas fired plant is implemented, can be estimated at 183 t CO_2/GWh. Separate baselines have been developed for base load and peak load in India. A generic baseline for India's peaking plants would be equal to 789 t CO_2/GWh, for base load plants, the baseline would be 556 t CO_2/GWh.

INVESTMENT ANALYSIS

The basic idea behind the investment/financial analysis that is described in the Prototype Carbon Fund documents, is that the project alternative with the highest financial attractiveness (expressed as internal rate of return), is considered to be the baseline technology. The emissions that would be associated to this technology may then be calculated according to its technical parameters. In the case of the Latvian waste management project the actual baseline emissions may be calculated according to the amount of landfill gas that is collected during the course of the project and the emissions that would have occurred in the baseline project. Estimations may be made as to the baseline emissions by either making assumption on the methane emissions from the site.

Following [PCF, 2000a], we derive the following steps to be taken to develop a baseline according to this approach.

- Identify the possible project alternatives, including the proposed project
- Eliminate those that do no fulfil the legal requirements
- Calculate the Internal Rate of Return (or another financial indicator) of all the remaining alternatives
- The one with the highest IRR is the baseline project
- Determine the accompanying GHG emissions (based on the application of the technology in a similar context); this is the project baseline

The investment analysis based baseline development approach selects the least-cost (or with highest rate of return) technological alternative as the baseline.

Example:

A concrete example can be found in [PCF, 2000a], the same document that was used to determine the required steps to establish a baseline based on investment/financial analysis. Only the landfill gas part of the baseline (excluding the replacement of electric power) is described, as illustration only.

The possible project alternatives have been identified, and are:
1. simple landfill
2. simple landfill with methane capture
3. sanitary landfill
4. sanitary landfill with methane capture
5. municipal or regional solutions
6. incineration
7. recycling, bio-reactors, composting
8. energy cells

Simple landfilling, either with or without methane capture, is not sufficient to meet national environmental standards and is thus eliminated as a baseline option.
Incineration is not appropriate due to high costs. Bio-reactors and composting are too expensive and not suitable as a large scale operation. Therefore, the following options remain:

– Regional sanitary landfill without LFG capture.
– Regional sanitary landfill with LFG capture but without methane utilisation.
– Regional sanitary landfill with LFG capture and with methane utilisation.
– Energy cells in various configurations.

Various project design options were identified, and economic and financial analyses for all the relevant options have been carried out, including a (limited) sensitivity analysis.

The most cost effective alternative turned out to be sanitary landfilling without landfill gas collection, at a place called Grobina. This is the baseline scenario for the proposed project.

Based on measurements on the composition of the waste and the technical parameters of the baseline project, an estimate can be made about the expected emission reductions. To determine the real emission reductions, the emissions from the landfill will be monitored and then compared to both the baseline technology and the project technology.

PROJECT SPECIFIC

As mentioned before, the project specific approach appears in many different shapes. Varying from the ad-hoc approaches as reported in the Uniform Reporting Formats as published on the UNFCCC website, to the structured approach as described in [EruPT, 2000], it shows that many different options are possible. The steps to be taken as given below form a kind of basic backbone, that should at least be included in the development of a project specific baseline. This approach is derived from the before mentioned sources, as well as from several other studies.

- Describe project characteristics
- Describe/determine GHG sources/sinks and system boundaries
- Describe current delivery system
- Describe/determine key factors influencing project and baseline emissions
- Develop a number of alternative baselines and select the most likely, in terms of the different investment options under different policy/legal environments and give evidence as to why this baseline has been chosen

THE ASSESSMENT OF THE METHODOLOGIES

The criteria that have resulted from the inventory are the following:

Environmental effectiveness

- Can the exact emissions reduction be determined?
- What are the chances for over crediting?
- Are the system boundaries clearly defined?
- Are the potential leakage effects specified?

Cost effectiveness

- What are the costs of data collection and processing, compared to overall GHG emission reduction, looking at:
    - Methodology development (fixed costs)
    - Operational costs
    - Costs for validation

Practicability

- Data availability
- Difficulty of the methodology (ease of calculations)
- Documentation of the methodology

Respect for the sovereignty of states

- Inclusion of host country in methodology development

Uncertainties

- What are the uncertainties in baselines, and
- How are these dealt with?

Transparency of the baseline methodology

- How easily can the methodology be reproduced?
- How transparent are the assumptions particularly with regard to third-party verification

Consistency over time

- Are dynamic baselines used?
- What is the crediting lifetime?
- Is ex post evaluation included?

Attractiveness of the methodology to the host country

- Difficulty of the procedures of baseline development and validation
- Transparency of the procedures related to baseline development and validation

The complete assessments of the different methodologies against the criteria are given in Annex I.

A brief overview of the results of these assessments resulting in an indication of the strengths and weaknesses of the various methodologies is given in Table 1.

It immediately becomes clear that all the methodologies have their own advantages and draw-backs.

Table 1. Strengths and weaknesses of the three different methodologies

	Generic benchmarking	Project specific	Investment analysis
Strengths	- Flexibility - Transparency - Cost effectiveness - Easy to apply - Extremely well documented	- Prescriptive, cookbook - Investor certainty on credits (2008-2012) - Baseline is fixed - Clear structures for validation - There is an uncertainty assessment included - The guidelines can be applied to all countries and most potential projects	- Accurate emissions reduction due to ex-post evaluation - Investor friendly, (looking at the amount of credits per year, not looking at the ex-post evaluation possibilities)
Weaknesses	- No reflection of real emissions reduction - Using recent capacity additions as in the OECD methodology may not be applicable to CEEC's where the recent capacity addition may well be the closure of old coal plants - Problems with leakage between heat and electricity sectors – but applicable to all methodologies - Data availability could be difficult when drawing up averages	- Crediting time is limited - Estimate of the national emissions intensity baseline	- Uncertainty for the investor due to ex-post evaluation - Discrete technology baselines, may not actually represent the real reductions - Data availability could be difficult due to commercial confidentiality - Uncertainties in baseline not dealt with extensively - Technology dumping could occur because the minimal baseline is used
Remarks	- Environmental integrity is dependent on the aggregation level - Perceived uncertainties in benchmarking are far greater than for the other two methodologies	- Environmental integrity is high due to high estimate of project emissions and low of baseline. The drawback is that the chances for undercrediting are present	

CONCLUSIONS

The project specific approaches will generally exhibit higher environmental integrity than the generic approaches such as those outlined by the OECD, when the accuracy of the emission reduction will be dependent upon the level of aggregation.

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ANNEX 1 – BASELINE METHODOLOGY REVIEWS

BASELINE METHODOLOGY REVIEW – ERUPT

General Questions on Methodologies

- **Does the methodology take project size into account?**

No - Minimum project size (100 ktonnes/yr CO2)

- **Does the Baseline Methodology take into account Macro-Economic Developments?**

Yes - but it is left to the project developer to take this into account and is not included in the methodology. All "legal, economic, political, social, sociodemographical, environmental and technical factors" that may influence the baseline methodology etc, must be listed. (P.13 Vol 2a) Time dependent CO2 emissions factors have also been included for each country (Work done by DNV and ECN).

- **Future developments?**

Yes - emissions factors, but limited

Environmental effectiveness

Direct offsite emissions - Emission factors used are on the national level.
Direct onsite emissions – Emission factor is technology specific and is proposed by project developer. Technology specific and project specific
Indirect offsite emissions – Leakage outside system boundary, outside control of developer
Indirect onsite emissions – Must also be considered as for direct on site

System boundaries are very strictly defined

- **Can the exact emissions reduction be determined?**

No and we do not know when there will be overcrediting or undercrediting

  - **What is the magnitude of uncertainty?**
  - **Level of aggregation? national, sectoral, project type, technology etc**
    Hybrid baseline approach. Co2 emissions factors aggregated on national level, but they are technology related national emission factors.
  - **Does the approach consider different types of electricity generating units and their implication on emissions?**
    Yes - for the project types that are taken into account, see the accounting forms in the appendix.
    - *Fuel switch (fossil fuel to fossil fuel, fossil fuel to waste, fossil fuel to biomass, fossil fuel to renewables)*
    - *CHP*
    - *Landfill gas recovery*
    - *Forestry*
  - **Is the approach able to match the load profiles of the project with the load profile in the grid and the respective emissions?**
    No. – yearly average emission factors used.

- **What are the main issues that may cause over crediting?**

Load profile and emissions factors from the guidelines, there are certain projects that may benefit from these factors. Only the projects that expect to gain more credits from a more detailed baseline
The problem is applying generic factors

- **What is the risk of under crediting?**

Baseline too conservative

- **Are the system boundaries clearly defined?**

Very clear on system boundaries and this is one of the strong points of the ERUPT guidelines but check the case of the Backup boiler.

- **Are the potential leakage effects specified?**

Yes, defined by developer and then validated. On site leakage's are taken into account very strictly

- **Where would leakage's occur?**

Indirect offsite. CHP, heating sector (back up boiler)

Uncertainties

- **How are the uncertainties dealt with? (e.g. sensitivity analysis)**

1. *Annual activity level.*
2. *Project specific emissions factors*
3. *Multiple baseline portfolio*

- **To what extent?**

1. Statistical analysis (P. 16 Vol 2a)
2. Expost monitoring and validation
3.Three step approach:
  - *Elimination of inappropriate baselines*
  - *Weighting according to "key factors"*
  - *Take the baseline with the lowest emission factor*

Cost effectiveness

- **What are the costs of data collection and processing, compared to overall GHG emission reduction (e.g. indicated as euro/tonne of CO2), looking at:**
- **Methodology development (fixed costs)**
  Zero
- **Operational costs**
  $20000 - $30000 per project
- **Costs for validation**
  $10000 per project

Practicability

- **Data availability**

Data given in guidelines for the countries with MoU's. Project specific data to be collected by the project developer

- **Difficulty of the methodology (ease of calculations)**

Back of large envelope level, reporting is however very extensive

- **Linkage of existing data basis with methodologies (do I have to type in every data unit or are there interfaces) Is the data already available in the required format? (e.g. UNFCCC reporting format, IEA)**

Data from UNFCCC reporting can be used. IPCC emissions factors used.

- **Documentation of the methodology**

Good

Transparency of the baseline methodology

- **How easily can the methodology be reproduced/repeated?**

If you have all of the project specific data then very easy

- **How transparent are the assumptions particularly with regard to third-party verification**

Very - validation guidelines are even given

Consistency over time

- **Are dynamic baselines used?**

Yes

- **What is the crediting lifetime?**

2008-2012

- **Are revisions of baselines included in the methodology?**

Yes after 5 years of crediting

Attractiveness to host country

- **Ease of access to procedures of baseline development and validation**
- **Transparency of the procedures related to baseline development and validation**

BASELINE METHODOLOGY REVIEW – GENERIC BASELINES (OECD)

General Questions on Methodologies

- **Does the methodology take project size into account?**

NO - Size independent

- **Does the Baseline Methodology take into account Macro-Economic Developments?**

No - but updated every 5 years to take these into account. Deals only with capacity, not generation or fuel mix

- **Future developments?**

As above

ENVIRONMENTAL EFFECTIVENESS

- **Can the exact emissions reduction be determined?**
- **What is the magnitude of uncertainty?**
  - **Level of aggregation? national, sectoral, project type, technology etc (Need to expand these questions)**

Levels looked at - national, regional, technology. (Brazil - regional, India - technology). Plant level information is used at a highly desegregated level.

  - **Does the approach consider different types of electricity generating units and their implication on emissions?**

Yes - Plant level data used

  - **Is the approach able to match the load profiles of the project with the load profile in the grid and the respective emissions?**

No

Is an approach that looks at recent capacity additions valid in the context of JOINT?, where all countries have over capacity and the only "capacity additions" have been refurbishments. - No.

What about Poland, where 30% of coal capacity has been closed down?

So the conclusion has to be that for the countries covered in JOINT we have to look at the expected additions.

Note that this report is based on CDM countries. For countries such as India there is definite undercapacity and therefore the issues are opposite.

- **What are the issues that may cause over crediting?**

Usage of historical data and cross technology averaging (issues here and below)

- **What is the risk of under crediting?**

Marginal capacity additions may give a higher baseline than projected capacity mix.
Renewables will have a large impact here.
A good example would be Brazil where the recent additions have been predominantly hydro.

To rely only on historical data may give a wrong impression particularly for the CEE countries.

- **Are the system boundaries clearly defined?**

Yes -

- **Are the potential leakage effects specified?**

Not explicitly.

- **Where would leakages occur?**

CHP in demand-side sector, heat and power sector that is feeding into the grid.

Uncertainties

- **How are the uncertainties dealt with? (e.g. sensitivity analysis)**

Not looking into the future. Minimal sensitivity analysis by applying the different reference cases to two projects (NGCC/wind)
- **To what extent?**

See above

Cost effectiveness

- **What are the costs of data collection and processing, compared to overall GHG emission reduction (e.g. indicated as Euro/tonne of CO2) , looking at:**
  1. **Methodology development (fixed costs)**
  Minimal costs
  2. **Operational costs**
  Minimal
  3. **Costs for validation**
  Minimal

Practicability

- **Data availability**
- **Difficulty of the methodology (ease of calculations)**
  Back of an envelope level
- **Linkage of existing data basis with methodologies (do I have to type in every data unit or are there interfaces) Is the data already available in the required format? (e.g. UNFCCC reporting format, IEA)**
  See data availability
- **Documentation of the methodology**
  Sufficiently developed

Transparency of the baseline methodology

- **How easily can the methodology be reproduced/repeated?**

Transparent.
- **How transparent are the assumptions particularly with regard to third-party verification**

Transparent.

Consistency over time

- **Are dynamic baselines used?**

No.
- **What is the crediting lifetime?**

10-15 years.
- **Are revisions of baselines included in the methodology?**

Every 5 years.

Attractiveness to host country

- **Ease of access to procedures of baseline development and validation**
- **Transparency of the procedures related to baseline development and validation**

BASELINE METHODOLOGY REVIEW – PCF LATVIA (FINANCIAL/INVESTMENT ANALYSIS)

General Questions on Methodologies

- **Does the methodology take project size into account?**

Specific case study, not relevant.

- **Does the Baseline Methodology take into account Macro-Economic Developments?**

No it's a financial analysis, which looks only at

- **Future developments?**

Ex-post evaluation

Environmental effectiveness

(Can the exact emissions reduction be determined?)

- **What is the magnitude of uncertainty?**
  - **Level of aggregation? national, sectoral, project type, technology etc**

  Project Level
  - **Does the approach consider different types of electricity generating units and their implication on emissions?**

  Not relevant – specific case study
  - **Is the approach able to match the load profiles of the project with the load profile in the grid and the respective emissions?**

  No only have financial indicators
- **What are the main issues that may cause over crediting?**
  Translation from reference project from IRR evaluation is very difficult/uncertain. Ex-post evaluation will reduce the risk of overcrediting.
- **What is the risk of under crediting?**
  See above
- **Are the system boundaries clearly defined?**
  Defined
- **Are the potential leakage effects specified?**
  They are discussed
- **Where would leakages occur?**
  Electricity sector
  Transport Sector – Distribution of waste, irrelevant, no change
  Domestic sector – These effects were said to be neutral.

Uncertainties

- **How are the uncertainties dealt with? (e.g. sensitivity analysis)**

Sensitivity analysis done on the IRR calculations, where the NPV is >0

- **To what extent?**

Cost effectiveness

- **What are the costs of data collection and processing, compared to overall GHG emission reduction (e.g. indicated as euro/tonne of CO2), looking at:**
  1. **Methodology development (fixed costs)**

     Done
  2. **Operational costs**

     High
  3. **Costs for validation**

     Higher than ERUPT, difficult to know what you are validating against, can choose methodology to be used.

Practicability

- **Data availability**

Problems obtaining financial data from investors. It may be that the data is not available for all of the options that are being considered under the IRR analysis.

- **Difficulty of the methodology (ease of calculations)**

IRR calculation is a standard methodology. Translation of IRR analysis could be more difficult particularly if the technology displacement is not discrete.

- **Linkage of existing data basis with methodologies (do I have to type in every data unit or are there interfaces) Is the data already available in the required format? (e.g. UNFCCC reporting format, IEA)**

Financial data will not be available in a standard format. Landfill data will also be difficult to obtain.

- **Documentation of the methodology**

Documentation not well developed.

Transparency of the baseline methodology

- **How easily can the methodology be reproduced/repeated?**

Quite easily

- **How transparent are the assumptions particularly with regard to third-party verification**

Transparent

Consistency over time

- **Are dynamic baselines used?**

No – ex post evaluation is employed

- **What is the crediting lifetime?**

Project lifetime (20yrs in this case), but subject to ex post evaluation, which could significantly reduce the crediting lifetime

- **Are revisions of baselines included in the methodology?**

Yes by anyone at any time!

Attractiveness to host country

- **Ease of access to procedures of baseline development and validation**

- **Transparency of the procedures related to baseline development and validation**