DRAFT DISCUSSION DOCUMENT 2

CCXG seminar breakout session 2b

Setting Emissions Baselines: Choosing Metrics for National and Sectoral Baselines[1]

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The ideas expressed hereafter are those of the authors and do not necessarily represent views of the OECD, the IEA, or their member countries, or the endorsement of any approach described herein.

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1. Introduction

1. Emissions baselines support climate change policy in two important ways: measuring performance and setting targets or goals. Recent work for the Climate Change Experts Group aimed to resolve ambiguity between different types of emissions baselines used for different purposes, and to identify key characteristics important to different baselines (Prag and Clapp, 2011). That discussion paper defined a baseline as a reference level of emissions that could be used to establish an emissions goal and/or to measure progress in emissions mitigation. The paper also identified baseline scope, metrics, historical data and assumptions on future drivers as key issues in setting baselines.

2. Issues involved in baseline setting have been discussed extensively (see, for example, CEPS 2010, Baron et al 2009, Sijm et al 2007, Ellis et al., 2001; OECD, 2000). Recently, baseline-setting has again become an issue of key importance in international climate policy. In addition to country-wide emissions targets proposed by Annex I countries for the post-2012 period, since COP15 in 2009 many non-Annex I countries have also set national or sectoral goals for emissions mitigation. Several of these are expressed as reductions against "business as usual" (BAU) emissions scenarios. Others are described as reductions in emissions intensity (generally emissions per economic output). The ambition of the aggregate global mitigation goal is partly dependent on the robustness of these "business as usual" baselines, the method used to construct them and the assumptions made on key drivers (such as growth in the economy).

3. Baselines can be established at different levels of aggregation (e.g. project-specific, multi-project, sectoral, regional, national). Baselines can also be expressed using different metrics, e.g. in terms of greenhouse gas emissions, or other terms (such as area re-forested, penetration of a particular technology or process). The choice of metrics used in setting emissions baselines according to these varied purposes remains relatively unexplored to date. This discussion document highlights issues related to the use of different metrics when establishing emission baselines.

2. Defining, measuring and setting baselines

4. How a baseline is set and measured depends on its purpose(s), which is in turn determined by policy considerations. A baseline can be used for either or both purposes outlined above and in Prag and Clapp (2011). This section explores the importance of the choice of metrics in ensuring that the baseline is effective in meeting the desired purpose.

5. Examples of baselines being used to set a goal or target can be found at the national and sector level. At the national level, baselines can be used as a projection of BAU emissions in order to set national targets or goals. Setting baselines that represent future emissions of a sector or country can be challenging for a number of reasons, including that there can be a range of plausible future pathways and that a GHG baseline can be sensitive to exogenous factors such as economic growth and international commodity prices. One key issue is how to incorporate expected changes in emissions trajectory from policy measures or other factors that are operational or being implemented. Some countries may choose to consider pre-existing mitigation measures as part of BAU and therefore include their effect on baseline emissions projections. Others may decide that the baseline should represent an emissions scenario without mitigation measures included, and against which existing and future mitigation actions are measured as a reduction.

6. Implementing the latter definition becomes increasingly complicated as time progresses. For example, the EU ETS was introduced in 2005 as a measure to help the EU meet its emissions commitments under the Kyoto Protocol. It will continue to operate post-2012 and is therefore usually incorporated into EU BAU baselines after 2012. Nevertheless it remains a key mitigation policy with real economic costs for the sectors and countries concerned, despite being considered as BAU. In time, this could also become an issue for developing countries too, either nationally when measuring

performance against BAU baselines, or for sector baselines used for new market mechanisms. A key question is whether it is good practice to include in BAU scenarios policies that are already implemented or agreed, and whether it is practical to do otherwise3.

7. An example of baselines being used as a scenario against which to measure performance is at the project level for the Clean Development Mechanism (CDM). In this case, a project's performance is measured against a hypothetical counter-factual scenario. This baseline is usually BAU, which refers to the hypothetical scenario of the amount of GHG emissions that would have been emitted in the absence of the CDM. Crediting mechanisms have also been proposed at the sector level, whereby the performance of an entire sector against an agreed baseline level could lead to crediting for the whole sector (Baron et al, 2009). New market mechanisms that could be developed under the UNFCCC could also use baselines as a scenario against which to measure – and potentially credit – performance (at a project, programme, policy and/or sector level).

2.1 The role of metrics in setting and measuring baselines

8. Comparing actual performance with a counterfactual baseline and/or a target or goal is facilitated if all are expressed in a common metric. There are two main types of emissions metrics used for baselines: fixed and relative; each defines both the methodological characteristics used to construct that baseline as well as the units used[4]. Baselines can also be constructed using a non-emissions metric as a proxy for emissions performance. Such indirect metrics could include the penetration rate of a particular low-emitting technology, or a deforestation rate as a proxy for net emissions as a result of deforestation[5].

2.1.1 Emissions metrics as baseline units

9. Emissions baselines are usually expressed in the following units:

i) tonnes of CO_2 equivalent (tCO_2e) (*fixed*); and/or

ii) tonnes of CO_2 equivalent for a given level of activity (*relative*), most commonly per unit of Gross Domestic Product (tCO_2e/GDP) or production output depending on the activity to which the baseline relates. For example, baseline units in the cement sector are typically expressed as tCO_2/t-clinker produced (tonnes of carbon dioxide per tonne of clinker, an intermediate product of cement) and the electricity sector usually expresses baseline units in tCO_2/MWh (megawatt-hour, the common unit of electricity output).

10. The choice of which metric to use in practice can be problematic and existing literature has analysed extensively the difficulties with using fixed and relative metrics respectively (see, for example, Hu and Liu, 2011 Marschinski and Edenhofer, 2010; Fisher and Springborn, 2009; Pizer, 2005 Laurikka, 2002; Ellis et al., 2001)

11. A baseline set using fixed emissions units makes assumptions about the underlying activity level of the emissions source in the future (either implicitly – as for a baseline used as a target or goal; or explicitly – as for a baseline used as a scenario against which to measure performance). These assumptions mean that fixed baselines will not take into account any changes in activity level that

[3] Other CCXG work is currently exploring this and other issues, including a recent workshop jointly organised by OECD and the Danish Energy Agency (DEA) to explore good practice in national baseline setting

[4] Indeed, most prior literature has tended to discuss units and methods in relation to metrics interchangeably (see, for example, Laurikka, 2002), whereas some authors make the distinction between "choice of units" and "methods" (Willems *et al*, 2001).

[5] Such a metric could be the basis for crediting activities for Reducing Emissions from Deforestation and forest Degradation (REDD). See Corfee-Morlot and Karousakis (2007) for a discussion of issues.

occur as a result of exogenous forces, for example an unexpected slowing or acceleration of the GHG-emitting activity due to economic growth; it will however reward CO_2 mitigation through a lower level of output (e.g. lower CO_2 through end-use electricity savings). A lack of institutional capacity or expertise to collect necessary activity data could hinder the development of 'fixed' baselines, as the information on which such baselines would build would not necessarily be robust. On the other hand, although relative baselines can be set with only estimated activity data, their effectiveness at delivering emissions intensity improvements still depends on the accuracy of the activity data. Poor data quality will meant that the baseline does not reflect existing real emissions intensity.

12. Although use of a relative metric would not face the rigidity of a fixed goal, an important characteristic of relative metrics is that they do not necessarily result in a reduction of total emissions, so the level of environmental performance associated with the use of such a baseline – and a goal or target set against the baseline – is not assured. This may be a risk if output levels are much higher than anticipated: total emissions may increase where the increase in actual activity level (e.g. tonnes of cement produced) outweighs a decrease in emissions intensity (such as tonnes of CO_2 per tonne of cement produced). As a result, attaining a relative goal or target may result in the issuing of credits or another specified benefit even though overall emissions have increased much above the anticipated level.

2.1.2 Non-emissions metrics as baseline units

13. Baselines, goals and targets can also be introduced using metrics that do not directly measure emissions. An example of such an indirect metric is one based on a level of technology implementation. Stakeholders in developing countries, including China, have expressed interest in technology-based metrics where the baseline is set and measured in relation to the penetration of a particular low-carbon technology within a given sector (Klein et al. 2009).

14. Such a baseline would estimate the current or expected BAU implementation rate of a particular efficient, low-carbon or other desirable technology type in a particular sector. A target or goal could then be set that represents a significant increased uptake or implementation of the technology type. For example, dry quenching of coke used in the production of iron is more energy efficient than conventional wet quenching. If it is estimated that currently only 30% of steelworks in a country employ dry quenching, a target could be set for 60% implementation by a certain date.

15. To measure the effect of such a target or goal – or to reward actors who contribute towards achieving the target (such as through carbon credits) – performance would be more accurately measured by setting a baseline of how technology penetration might have changed without the target or possible reward scheme.

16. Such technology baselines could be set in different ways, such as:

- Based on **best practice performance** (either at a global or national level). For example, the technologies associated with the lowest energy intensity and/or GHG intensity per output could be used as the reference technology configuration[6].

- Based on **the relative importance of technologies used** (global or national level): an inventory of all technologies is made and associated penetration figures developed (either for all plants, or for a sub-set of plants). The technology that is implemented the most frequently in a particular sector (e.g., plants with a production capacity of greater than 5,000 tonnes of

[6] This could be appropriate where GHG emissions are affected more by what technology is used (for example, CO_2 emissions from fossil fuel electricity generation) rather than on how it is used (for example, perfluorocarbon – PFC- emissions from aluminium production).

cement per day) or process type (e.g., new-process dry heat kiln) could then be used as the benchmark for setting a baseline.

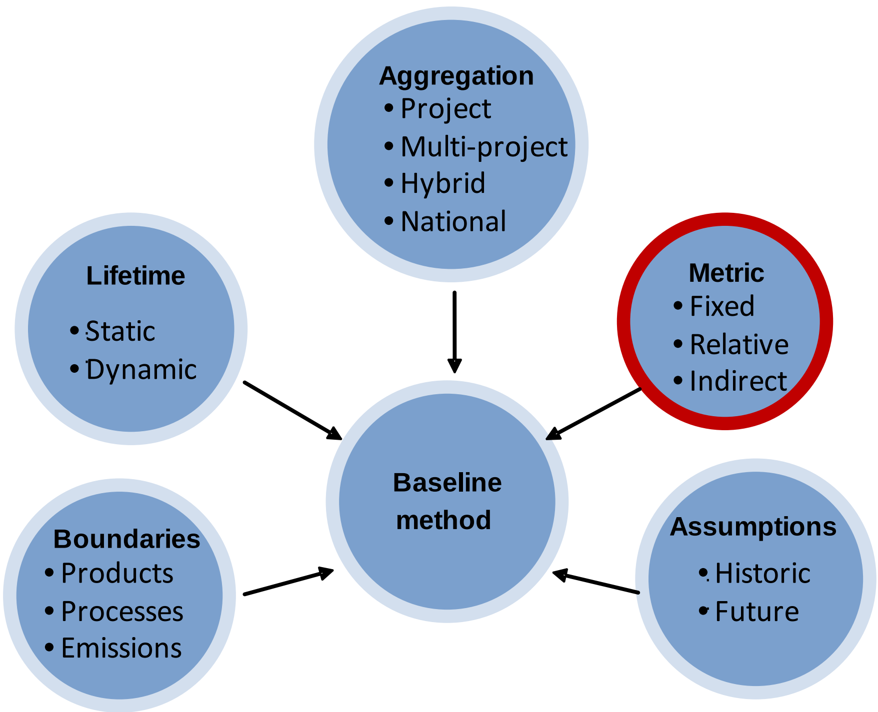
- Based on **changing trends of technology use** (e.g. at national level). This can take autonomous improvements into account, e.g. through retiring old plants and/or installing new, more efficient, plants.

17. Technology baselines can therefore be used as a form of proxy for emissions reductions. Depending on the type of technology baseline used, this could also reduce the need for accurate monitoring and reporting of emissions at individual installations. For example, if a country had a goal to install and connect to the grid 200 MW of renewable electricity generating capacity by a certain date, no emissions-specific (or activity level data) would need to be measured or reported in order to demonstrate that such a goal has been met; only information on installed renewable electricity capacity itself is needed. However, if a technology baseline is used as a scenario against which to measure emission improvements, then the scheme would need to make assumptions about how use of particular technology types translates to reductions in GHG emissions. There are many variables for how new technology will perform, and this can vary between installations even in the same country and sector. For example, PFC emissions from aluminium manufacture can vary widely within the same technology, depending on how it is used (IAI 2007). Therefore in order for a technology baseline to be robust and credible as a scenario against which to deliver emission credits, detailed analysis on the emissions performance of particular technology types may be needed in some cases. This conversion issue could be particularly challenging if a technology baseline is used to generate offsets for the international carbon market.

2.1.3 Metrics as a baseline method

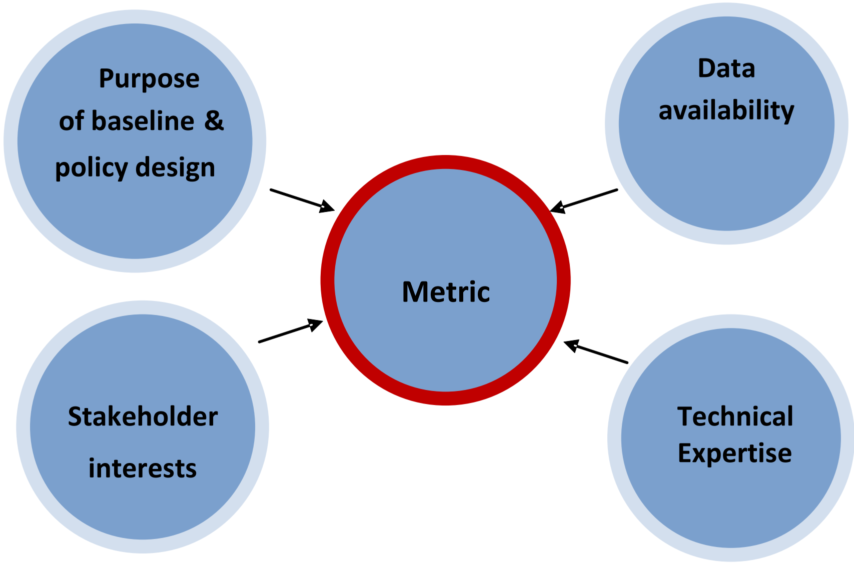
18. The choice of baseline metric is one of a number of methodological considerations to be used in defining, setting and measuring baselines for particular purposes (figure 1). The metric will often have implications for other considerations such as the boundary of emissions sources included in the baseline.

Figure 1: Key methodological considerations in constructing baselines



19. The choice of metric in defining, setting and measuring a baseline is influenced by both technical and policy issues, as illustrated in Figure 2.

Figure 2: The influence of technical and policy issues on baseline metrics



2.2 Choosing an appropriate baseline metric

20. The choice of metric is a key element of a baseline, as shown in figure 2. For example, if the purpose of a baseline is to define a fixed level of allowable emissions in a certain time period (as for some countries under the Kyoto Protocol), then it may be most appropriate to also use a fixed level of emissions as a baseline metric.

21. In terms of using a baseline to measure performance, a number of assessments of baseline methods are described in the existing literature (see, for example, Kartha et al., 2004; Laurikka, 2002; Ellis et al., 2001; Ellis and Bosi, 1999). The literature suggests that issues that are most relevant to baseline metrics are the following:

- *Accuracy*: including whether the baseline and goals measured against it are measurable, reportable and verifiable;
- *Purpose of baseline and provision of incentives for the project, sector or host country*: for example, for a mitigation policy using a market-based instrument, the type of mechanism will affect the choice of metric[7];
- *Practicality*: including issues such as availability of robust data, technical expertise, institutional capacity, and political sensitivity. This can vary within and between different baseline metrics. For example, while it will be relatively simple to identify what technology type is 'best practice' within a particular sector, quantifying the changing trends in a country's technology use would require much more data.

[7] For example, the combination of an intensity baseline/target and an ex-ante trading mechanism is problematic because converting an emissions intensity to an allowance levels still requires an assumption on the evolution of underlying activity levels.

22. In reality, the choice of metric will be a result of tradeoffs between these issues, for example between accuracy and practicality. The purpose of using these issues as a guide is not to evaluate the metric itself but rather to assess the strengths and weaknesses of the overall baseline method of which metrics are only one of several other considerations.

3. Selected examples of metrics in practice

23. Existing and planned policy measure and targets provide some experience of the use of baseline metrics in practice. This section assesses some examples of baseline metrics at the sector level. Baselines for individual sectors are important both as a core component of any national emissions baselines and as a means to set specific mitigation policies and measure performance against those policies.

24. Sectoral approaches have been considered as a means to achieve greater mitigation in both developed and developing countries after 2012[8]. The term "sectoral approach" has been used to encompass many different mitigation mechanisms. These range from cap-and-trade schemes (the EU ETS is effectively a sector-based approach) to crediting mechanisms offering credits for a sector that improves emissions intensity beyond a specified baseline or crediting threshold. Setting sector baselines for this purpose is a complex matter as there is a question of ambition in the crediting baseline, as well as technical issues (Aasrud et al, 2009).

3.1 Baseline metrics in the EU ETS

25. The first two phases of the EU ETS allocated emissions allowances using (country and entity-specific) historical emission levels of installations as the basis for projections of future activity. This essentially used an absolute metric – tCO_2 per covered installation – as a baseline.

26. The second phase of the EU ETS (2008-2012) is an example of how a fixed metric baseline can face problems due to unexpected economic changes. Analysis suggests that the EU ETS as a whole will be "long" over the Phase, with analysts forecasting a significant surplus of permits over the period (Deutsche Bank, 2011a). The banking provisions in the ETS mean that this surplus will effectively be added to the baseline used to set the cap in phase 3, due to installations choosing to bank allowances. One of the reasons for the surplus of allowances in phase 2 could be due to reduction in overall production levels due to economic recession, whilst the ETS cap remains fixed (Guerin and Spencer, 2011). One way that this could be addressed is to impose "set-aside" of allowances in Phase 3, whereby an agreed number of allowances would be removed from the overall market, thereby shortening supply and bolstering the price (European Commission, 2011a). In a way, this set-aside would indirectly alter the baseline used to set the Phase 3. The total number of set-aside allowances would be a political issue. Other options for dealing with this issue are described by Hood (2011).

27. The third phase of the EU ETS (2013-2020) is an example of how different metrics can be combined to achieve a single purpose. The EU ETS cap will continue to use an absolute metric, but the method of allocating allowances will change. With few exceptions, electricity generators will be required to purchase all their allowances at auction[9]. All other sectors will continue to receive some free allowances, but these will no longer be allocated by every country government using a baseline with an absolute metric based on historical emissions (European Commission, 2011b). Instead, allocation will be based on an emissions performance benchmark calculated as the 10% most GHG-

[8] The Bali Action Plan agreed under the UNFCCC included text specifically on "co-operative sectoral approaches and sector-specific actions" (or *sectoral approaches*) (Article 1(b)(iv)), as well as opportunities for using markets to achieve mitigation (Article 1(b)(v))`.

[9] In certain countries, some electricity generators will also receive some free allocation to account for special circumstances. See Deutsche Bank (2011b).

efficient installations in a particular sector, the same for all participating countries. This benchmark uses a relative metric, tCO_2/product, which will be multiplied by the historical production levels of each installation to calculate a number of allowances to be allocated for free. [10]

28. This type of allocation raises a number of issues including what percentage to choose for the benchmark level, how to define performance (GHG, CO_2 only, energy efficiency, where in the production chain) and which years' historical data to use for converting the benchmark to an allocation figure. This system also raises some issues specific to metrics, such as which products to select for the product-specific benchmarks (there is often more than one product per sector).

3.2 Illustration: baselines in India's Perform, Achieve and Trade (PAT) scheme

29. India is introducing a new national mandatory energy efficiency trading mechanism known as Perform, Achieve and Trade (PAT), due to be enacted in October 2011[11]. The first phase will run between 2011 and 2014 and applies to eight energy intensity sectors[12]. It is currently scheduled to cover 477 Designated Consumers (DCs), chosen based on their significant energy consumption (in 2008 they collectively accounted for about 35% of the total energy consumed in India). Once the first phase is completed, DCs who achieve energy savings that have been measured and verified as in excess of their target will be issued certificates *ex post* for trading during subsequent phases of the PAT mechanism; no trading will take place during this period (i.e., 2011 – 2014).

30. While not explicitly a carbon reduction mechanism, the PAT mechanism sets baselines in order to place targets on DCs to reduce their energy intensity (energy used to produce a particular product). It is too soon to evaluate the success of the decision to use a relative metric (i.e., energy intensity) in setting baselines and targets, or to assess the indirect impact on reducing GHG emissions. However, the scheme design provides some interesting insights on baseline issues.

31. The PAT scheme uses a relative metric because it aims to reduce energy use through efficiency measures, both improving energy security and usually also reducing GHG emissions intensity, whilst allowing overall output this to expand. A reduction in overall absolute emissions could occur if improvements in energy efficiency outweigh the increased amount of activity (assuming that the carbon intensity of the energy source does not increase dramatically), but this is not guaranteed and is not an objective of the scheme.

32. Energy baselines for individual installations are referred to as Specific Energy Consumption (SEC), calculated by dividing total energy input into the plant by the quantity of production (note that details of the baseline and target-setting process are taken from Bureau of Energy Efficiency, 2011). When calculating the total energy input of the DC, all energy sources are converted to a single unit of energy (in this case, metric tonnes of oil equivalent, Mtoe). The setting of SEC baselines for each DC is a critical issue. SECs are set based on production and energy consumption data reported by the DC for the 5 year period. Given that the PAT scheme had not yet been announced at the beginning of the data collection period, (i.e. when there was no specific requirement to gather detailed energy data), data quality and availability is likely to be an issue for some sites.

[10] For sectors deemed at risk of carbon leakage, installations will receive the benchmarked free allocation every year until 2020. For other non-electricity sectors, the free allocation will decrease year-on-year to 2020.

[11] According to news reports on 31 August 2011 (http://www.climate-connect.co.uk/Home/?q=node/1126). The scheme has been delayed from its original implementation date of April 2011.

[12] The other sectors include cement, iron and steel, pulp and paper, aluminium, chlor-alkali, textiles, fertilisers and thermal power-based electricity generation. The railways sector has been excluded from the first phase of the PAT scheme.

33. The SEC forms an individual baseline for each plant, using a relative metric. Target setting starts with an overall energy reduction target for the whole scheme, using an absolute metric: energy savings of 6.6 million Mtoe during the first phase (2011 – 2014). To disaggregate this to individual targets for each DC, the overall target reduction is divided amongst sectors proportionate to their energy use. DCs are then divided into bands based on common physical characteristics such as technology processes and raw material inputs.

34. This grouping aims to overcome heterogeneity of energy performance by ensuring that DCs in the same band have similar energy efficiency profiles, even though the categorisation is not specifically assigned by energy factors. In a way, this is a type of indirect technology metric acting as a proxy for energy use, ensuring that gaps in neither energy data availability nor quality will affect the categorisation of plants.

35. Within each band, each DC has its SEC indexed relative to the SEC of the best performer in the group. The best performer is then allocated a percentage target for energy efficiency improvement. The targets for the rest of the plants within that DC are then set by multiplying that plant's target by each plant's relative SEC (as indexed against the relative SEC of the best performer). This indexing system aims to ensure that the target for each plant is measured relative to a plant with similar physical characteristics, but that has historically achieved better energy efficiency. This is a way of ensuring fairness in the system and for not punishing 'early movers'.

36. At the end of the first phase (2014), Energy Savings Certificates (ESCerts) will be awarded to DCs that have achieved energy savings beyond their targets. These certificates may then be used for trading and/or compliance purposes in subsequent phases. The certificates represent energy *savings* rather than energy *consumed*.

37. There has not to date been widespread collection of energy and emissions data from industrial sectors in India, besides individual CDM projects at particular plants. Even CDM projects are only required to monitor and report very specific data as required to demonstrate emissions reductions from one particular activity. Therefore the PAT scheme faces severe challenges in ensuring reliable reporting of energy data from the outset. The first phase of the EU ETS showed that poor historical data can greatly affect the environmental effectiveness of a trading scheme in its early stages. However, the fact that the first phase of the PAT will operate purely as a target-based scheme, without any trading, may allow for any severe data irregularities to be noticed and ironed out during that phase, perhaps through alteration of individual site targets or movement of sites between the bands.

38. The system for comparing SEC ratings between plants based on best performers bears some similarity with the benchmarking process under the EU ETS. Both constitute a means to use emissions intensity from a range of plants to set targets under a trading scheme. The EU ETS benchmarking compares all installations and assesses every installation against a performance level represented by the 10% best performers. By contrast, the PAT attempts to sub-divide sectors according to physical or process characteristics (e.g. wet or dry clinker production for cement), before setting the performance level relative to the best performer in each category. This could be seen as a way to compare "apples with apples" to encourage performance improvement across the sector without putting any particular plant at an unfair disadvantage in a heterogeneous sector. It also potentially limits any unbalance that might arise due to poor data quality from one particular plant, as this would only affect plants in the same category, and in general the categorisation is not carried out using physical characteristics of plants, rather than emissions data. This categorisation based on physical characteristics could be seen as a form of indirect metric used to address energy use (which is itself an indirect metric for emissions).

3.3 Indirect and other metrics

39. Different types of metrics have been used by countries who have recently established post-2012 mitigation goals. For example China states three different goals for 2020, all related to emissions: 40-

45% reduction in the CO_2 intensity of its GDP, increasing non-fossil fuel in primary energy to 15% and increasing forest coverage by 40 million ha and forest stock levels by 1.3bn m^3 from 2005 levels. Only the first of these uses a direct (relative) emissions metric. The forestry metrics are a type of indirect metric, because there is not an automatic relationship between forest stock and sequestered CO_2. Such metrics may also be used to reward action on reducing deforestation under REDD.

4. Conclusions on use of metrics

40. Emission baselines can be defined in different ways and used for different purposes. For example, baselines can be used:

- As a scenario against which to **measure climate mitigation efforts at a national or sectoral level**. Some countries (particularly developing countries) are using emission baselines in this way.
- To **define a target or goal for emissions performance**. This is being used by both developed and developing countries, and at the sectoral or project level. For emissions trading schemes, an emissions baseline can be used to set a cap for free allocation of permits to installations, or as a threshold, e.g. to deliver partial free allocation through use of a performance benchmark.

41. It is increasingly important to have a clear idea of how emission baselines are calculated, and what they represent. This is particularly so as emission baselines could generate relevant input to the 2013-2015 review mandated by the Cancun Agreements, which is to assess the overall aggregated effects of the mitigation-related steps taken by Parties. A country's emissions relative to an emissions baseline can also help to identify a country's progress towards its own goals or targets, and as such could potentially also be used in the ICA and/or IAR processes that will be established.

42. Obtaining the activity and emissions data needed to develop meaningful emissions baselines may be challenging for some countries and sectors. Collecting data that is adequate to develop emission baselines has improved over time in the EU ETS (where plant-level monitoring for entities covered by the system is now mandatory).

43. There are different metrics by which baselines can be expressed:

- **Fixed metrics** (e.g. t GHG) either require emissions to be measured, or to be calculated. Measurement may be feasible in a few cases, e.g. CH_4 from landfills. However, for CO_2 emissions from fossil fuel combustion, fixed baselines are likely to be calculated.
- **Relative metrics** (e.g. t GHG/output) also require measurement or calculation of emissions for a given output. Estimating activity levels are therefore not needed for relative metrics, although they are for fixed metrics.
- **Indirect metrics**, e.g. technology penetration or decommissioning levels.

44. Each of these different metrics has advantages and disadvantages. The advantage of fixed metrics is that they provide certainty on GHG emission levels, although experience with the EU ETS has shown that this can reduce the effectiveness of the carbon price signal if historical data is unreliable (EU ETS phase 1) or there have been unexpected slowdowns in economic output (EU ETS phase 2). Relative metrics encourage emissions improvements in a particular sector or sub-sector irrespective of the levels of economic growth, but do not necessarily lead to fixed emission reductions or system-wide improvements[13]; in both cases, historical data are of paramount importance.

[13] So for the cement sector, a baseline expressed in terms of GHG/t clinker would encourage improved efficiency of clinker production, but would not encourage improved GHG-intensity of cement (which could also be achieved by e.g. increasing the proportion of additives in the final product).

45. The advantage of indirect metrics, such as technology penetration, is that the data required to establish the baseline (e.g. type of technology/process in place, or decommissioned) may be simpler to obtain in an accurate manner than data on energy use and GHG emissions. Baselines used to set targets or goals could therefore be more easily established (and subsequently appraised) using indirect metrics. They could therefore help countries to quantify their mitigation actions in a measurable, reportable and verifiable manner (albeit in an indirect fashion). However, if indirect metrics such as technology penetration were to be used to measure GHG performance and/or generate GHG credits, a method would need to be identified and agreed to do this, as would the relevant data, which raises the same data availability questions as for fixed and relative metrics.

46. The data requirements associated with these different baseline metrics can vary widely within and between them depending on:

- the desired accuracy/conservativeness of a baseline (more accurate baselines will generally need more data on which to base calculations),
- practical concerns (e.g. if little data is available but a baseline needs to be generated quickly).

47. There will be tradeoffs between these different issues. So for example, a fixed baseline (either as a goal/target, or as a means to measure performance) could be developed based on very little data. The ramifications of this will be different depending on the use of such a baseline. In terms of setting a target or goal, countries or sectors that do this in the absence of detailed data on current and expected emissions will provide certainty regarding future emissions performance – but lead to unknown levels of future costs and efforts, given uncertainty in trends in activity levels and technology performance. In terms of measuring performance, a fixed baseline based on little data is unlikely to be either accurate or transparent, so any credits generated by comparing performance against such a baseline would have questionable environmental integrity.

48. In some cases, more than one metric can be used to establish a baseline and associated goal or target. The EU ETS benchmarking procedure for non-electricity sectors in phase 3 essentially uses a product-based benchmark using a relative metric to set an allowance level for each plant. This raises issues such as how to set the performance level, how to select the products used and how to use historical production data to convert the benchmark into an allocation of permits for each installation. The latter can be important for rewarding early movers. In India, the PAT scheme, although based on energy rather than GHG metrics, uses aspects of fixed, relative and indirect metrics in setting baselines and targets. The target for the whole scheme is a fixed energy saving (6.6 million Mtoe in the first phase). The baseline for each installation uses a relative metric based on energy per unit of output. However, plants are categorised into bands based on physical characteristics that impact their energy use. This is in effect an indirect metric acting as a proxy for energy use. This helps to deliver achievable energy targets in sectors with heterogeneous energy performance and limited availability of historical data.

49. Thus, there is no single, correct way of establishing baselines. Rather, choices that countries make on the purpose for which they use a baseline, the method by which they establish it, and the metric that is used to express it will vary, depending on the context in which it is used. For example, if a baseline is developed in the context of a country which has a national emissions cap, then the certainty on emissions levels provided by the use of fixed metrics may be seen as outweighing the lack of flexibility to maintain a given stringency of an emissions cap in a varying economic climate. However, different approaches such as relative baselines, or baselines expressed in terms of an indirect 'proxy' such as technology penetration, may be favoured in countries without an emissions cap that aim to incentivise improvements in energy and emissions performance. In particular, technology metrics could therefore be a useful 'stepping stone' to improved performance, as well as to improved data and information.

4.1 Questions for discussion

50. The following questions could form the basis of discussion:

- Which situations are most suitable for baselines using direct, fixed GHG metrics, and which for other types of baseline metrics?
- Can a fixed baseline be designed to ensure that any emission reductions result from GHG mitigation activities (rather than variations in output due to extraneous economic factors)?
- Do relative metrics provide a useful means to establish baselines – and corresponding targets – in sectors where data availability is poor or unknown?
- Could indirect metrics have a role to play in setting baselines for measuring the performance of NAMAs and/or for crediting such performance?
- In what situations could technology metrics be appropriate, and how can uncertainty be accounted for, particularly in the conversion to absolute emissions reductions?

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