

Technical Note 5 | October 2013

Options and Guidance for the Development of Baselines



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For more information on the Partnership for Market Readiness, please visit the website: www.thepmr.org.

Glossary

Absolute baseline: A baseline expressed as an absolute quantity of GHG emissions.

Additional: Emission reductions are additional if they would not have occurred in the absence of the mechanism or instrument in question (crediting, trading, non-market).

Activity data or level: The measurement or estimation of the level of activity associated with a process that generates GHG emissions. Activity data can be expressed in many different ways depending on the kinds of activities being considered. Examples include total units of industrial production, quantity of goods or services consumed, square meters of building space used, or vehicle-miles traveled.

Aggregation (level): “The level of aggregation measures the extent to which consolidation of information from any parts or units to form a collective whole is undertaken. This consolidation is usually done within a common sector, to provide information at a broader level to that at which detailed observations are taken. Information on categories can be grouped or aggregated to provide a broader picture when this does not lead to misrepresentation. It can also be split or disaggregated when finer details are required by too much non-homogeneity.” (UNFCCC 2011b)

Baseline (scenario): A scenario that describes expected or desired greenhouse gas emissions levels or rates and that can be used as a basis for determining the amount of emissions reductions achieved as the result of a crediting, trading, or another mechanism.

Baseline period: The time period over which a baseline scenario is projected or considered to be valid. After that period, the baseline may need to be reviewed and updated. [Under a crediting mechanism, this period generally corresponds to an activity’s “crediting period,” i.e., the time period in which GHG emission reductions or removals can result in the issuance of credits. (adapted from UNFCCC 2012b).]

Business-as-usual (BAU) baseline: A counterfactual hypothesis or scenario that describes and estimates the emissions, or emission rates, that are expected to occur in the absence of the mechanism or instrument in question (crediting, trading, non-market).

Comparison group: A method that can be used to establish a BAU emissions baseline on an *ex post* basis, by tracking the characteristics and attributes of a group of emissions sources unaffected by the crediting, trading, or other mechanism.

Conservativeness: The use of assumptions, values, and procedures that are more likely to underestimate than overestimate GHG emissions reductions in order to reflect uncertainties that cannot otherwise be reduced or eliminated.

Coverage: The sectors and geographic area to which a mechanism applies, e.g., an entire economy, sector of the economy, a sub-sector, or even a small subset of activities or sources within a sub-sector. Coverage may be defined as entire country, a subnational jurisdiction, an ecological or climatic region, or some other geographical boundary.

Crediting baseline: The term used here to refer to a baseline used to quantify creditable emission reductions. The crediting baseline, depending on policy and technical considerations, can be a BAU baseline, performance standard baseline, or a net mitigation benefit baseline.

Crediting mechanism: A market mechanism established to generate emission reductions and issue credits or offsets corresponding to these reductions.

GHG intensity (and/or emission factor): the amount of gas (typically expressed in tonnes or tonnes CO₂ equivalent) emitted per unit of input, output, or level of activity. The term GHG intensity is typically used where the denominator is an aggregate activity or driver such as GDP or output. Where the denominator is a disaggregated parameter such as weight or volume of fuel combusted, the term emission factor is generally used. In this document, we use the term **GHG intensity** to refer to the aggregate metric(s) that is (are) used to estimate **relative emissions** reductions (e.g., tCO₂e/GDP for a broad multi-sectoral mechanism; tCO₂e/ton cement produced for cement sector mechanism; tCO₂e/household or tCO₂e/m² for a housing mechanism, and so on). We use the term **emission factor** to refer to emissions parameters (e.g., tCO₂e/kg fuel) used to calculate GHG intensities or, in the case of absolute emission estimates, total emissions.

Intensity baseline: A baseline expressed as a rate of GHG emissions per unit of input, output, or level of activity (i.e., GHG intensity).

Net mitigation benefit baseline: A crediting baseline set at a level intentionally more ambitious (lower) than a BAU baseline, such that creditable emission reductions will be fewer than total emission reductions as quantified against the BAU baseline. Since they are not used to offset other emissions, the resulting, uncredited emission reductions may lead to a net decrease in global GHG emissions, and thus constitute a net mitigation benefit. The level of net mitigation benefit may depend on how uncertainties are accounted for and the level of conservativeness in the BAU baseline.

Performance standard baseline: A baseline reflecting the rate of emissions associated with a selected practice, technology, or threshold of performance (e.g., the average performance of the lowest 20% of facilities in terms of emissions per unit of output);

Reference level: A term often used synonymously with the term baseline or baseline scenario, particularly in the context of land use, land use change, and forestry (LULUCF) and with respect to the reduction of emissions from deforestation and degradation (REDD+).

Results-based finance (RBF): A financing approach that can be used to support development objectives and domestic climate policy goals, such as reducing emissions. Under RBF, financial payments are made upon the achievement of “results”, such as the delivery of verified emission reductions or the attainment of climate-related sustainable development objectives (e.g., households provided with access to clean cooking fuels).

Scope: The specific types of activities, facilities, or emission sources involved in a mechanism. For example, for a mechanism designed to cover a regional electricity grid, the scope may include all current and potential new power plants on the grid, only current plants of a certain fuel type, or some other subset of power plants or technologies.

Trading mechanism: A market mechanism established to issue, and thereby enable trading of, permits or allowances to emit GHGs up to an agreed limit.

Background and Context – the Partnership for Market Readiness (PMR) and its Baselines Working Group

As the world seeks to enhance global greenhouse gas (GHG) mitigation efforts, countries are exploring innovative and cost-effective ways to scale up emissions reductions, move on a path of low emissions development and foster financial flows, including through carbon market instruments. To support, facilitate and build "readiness" for such instruments, the World Bank established the Partnership for Market Readiness (PMR), a grant-based, global partnership of developed and developing countries that provides funding and technical assistance for the collective innovation, design and implementation of market readiness and the piloting of market-based instruments for GHG emissions reduction. In addition, the PMR also provides a platform for technical discussions of such instruments to spur innovation and to support implementation.

The Participants of the PMR include 16 Implementing Country Participants (i.e., Brazil, Chile, China, Colombia, Costa Rica, Jordan, India, Indonesia, Mexico, Morocco, Peru, South Africa, Thailand, Turkey, Ukraine, and Vietnam) and 12 Contributing Country Participants (i.e., Australia, Denmark, European Commission, Finland, Germany, Japan, Norway, Sweden, Switzerland, The Netherlands, U.K., and U.S.A.).

A core element of Implementing Country Participants' engagement in the PMR involves the formulation of a Market Readiness Proposal (MRP), which serves as a roadmap to develop market readiness capacity and to assess and design market-based instruments.

Through the MRP development process, Implementing Country Participants identify gaps and needs in their technical and institutional capacities to scale up mitigation efforts and to design and implement market-based instruments. Some gaps and needs—in terms of readiness components—are common among countries. To complement the work these countries will be doing as they implement their MRP activities, support is provided by the PMR, through knowledge products, to share experience and knowledge in addressing common questions and issues, outline options to address them and their implications, highlight good practices and to build compatible national systems.

Early on, PMR Participants identified baselines as a key topic to address in the context of the PMR' technical work programme. A PMR technical workshop on baselines was held in May 2012. As a follow-up to this initial baselines discussion, it was decided to set-up a PMR Working Group (Annex 2) to support and advise on the elaboration of guidance for the development of baselines for market based mechanisms that can complement the PMR Tool for Market Readiness Proposal.

For more information on the PMR's technical work programme, please visit the PMR website: www.thepmr.org.

Executive Summary

Emissions baselines form the basis for the quantification of the greenhouse gas (GHG) mitigation impact of activities and are thus fundamental to market-based climate policy instruments, as well as to non-market-based ones such as results-based payments. For crediting mechanisms, they set the reference level that is used to determine the quantity of credits that will be awarded for a given mitigation action or effort for the associated emission reductions achieved. For trading mechanisms, baselines can help to establish the emissions target and to distribute emissions allowances to covered entities. For non-market mechanisms, baselines can be used to calculate the emission reductions associated with specific policies and actions and, in the case of results-based finance, as the basis to allocate financial payments.

This document offers options and guidance for the development of emissions baselines. Developed under the Partnership for Market Readiness (PMR), it is designed to support PMR Implementing Countries that are considering the establishment of new mechanisms for climate change mitigation. It may also assist other policy makers and policy analysts involved in mechanism design or review, practitioners developing baseline methodologies, and actors implementing mitigation initiatives whose impact needs to be quantified.

The document is organized in two parts. In Part I, the document focuses on the context for baselines, key concepts and terms, and principles, considerations, and potential trade-offs that can inform decisions in the development of robust and transparent baselines. Since there is already a rich body of work on baselines, especially for project-based crediting mechanisms as well as for BAU scenario development, this document builds heavily on, and provides pointers to, key references, websites, and other resource materials. Though it is intended to broadly assist developers of all types of market mechanisms, as well as non-market mechanisms that rely on quantification of emissions benefits, the document is most focused on options for the development of baselines for “scaled-up” crediting mechanisms that aim to stimulate emission reductions across broad segments of the economy.

Guidance Users are presented with the characteristics of, and methods for, developing three very broad types of baselines. The first and most common type of baseline is the so-called **business-as-usual (BAU)** baseline, which represents a projection of the emissions, or emission rates, that would occur absent the mechanism or instrument in question (crediting, trading, or other). Several options exist for developing BAU baselines from simple projections, application of more complex models to comparison group approaches. One of the more challenging aspects of developing and defining BAU baselines is the treatment of existing and planned policies, for which several approaches are possible.

The second type of baseline described here is **the performance standard**, which is based upon the rate of emissions associated with a selected practice, technology, or threshold of performance (e.g., the average performance of the lowest X% of facilities in terms of emissions per unit output). While involving a distinct set of methods – using historical performance data or expectations of future changes for a product, process, sector or technology -- performance standards can also be used to promote other objectives (such as technology or process innovation and transformation) or as a means to establish BAU baselines or net mitigation baselines.

Net mitigation (or “ambitious”) baselines are the third type of baseline discussed here. These baselines are set at a level more ambitious (lower) than a BAU baseline such that creditable emission reductions will be fewer than actual emission reductions as measured against the BAU baseline, . The level of net mitigation may depend on how uncertainties are accounted for and the level of conservativeness in the BAU baseline. While the choice of an approach for achieving a net mitigation benefit is ultimately a political and policy decision, there are several options for developing them, using mitigation potential and cost analysis, national targets, or other methods. Table ES-1 summarizes the key options and applications for each of these three baseline types.

Table ES-1. Overview of Baseline Types and Applications

Baseline type	Methodological Options	Application in:		
		Crediting	Trading	Non-Market Mechanism
Business-as-usual (BAU)	<ul style="list-style-type: none"> - Simple projection - Model-based projection - Comparison group approach 	Used to determine baseline emissions in many traditional crediting mechanisms. Important to estimate these emissions in any crediting mechanism, in order to ensure environmental integrity and estimate any net mitigation benefit.	Used to estimate emissions without the trading systems, and therefore the emission reductions resulting from meeting the cap	Used to estimate emissions without the mechanism, and therefore emission reductions attributable to actions.
Performance standard	<ul style="list-style-type: none"> - Performance benchmarking (top X%) - Practice or technology-specific standard 	Used in some standardized baseline methodologies. Typically, but not necessarily, more ambitious/stringent than BAU.	Used in some mechanisms to distribute allowances, often specifically to emissions-intensive, trade-exposed industries or facilities.	Could be used if minimum levels of emissions performance are desired.
Net mitigation (or “ambitious”)	<ul style="list-style-type: none"> - Mitigation analysis (cost and potentials) in conjunction with simple and model-based projections - Downscaling of national targets 	One way to seek a net decrease or avoidance of global GHG emissions that is required of new mechanism and units under the UNFCCC. Often referred to as a crediting threshold , in this context.	Used to set the target or cap.	Could be used to establish the ambition of the action or mechanism.

In developing baselines, users of guidance in this document will likely need to balance trade-offs among potentially competing considerations, principles, and requirements. International,

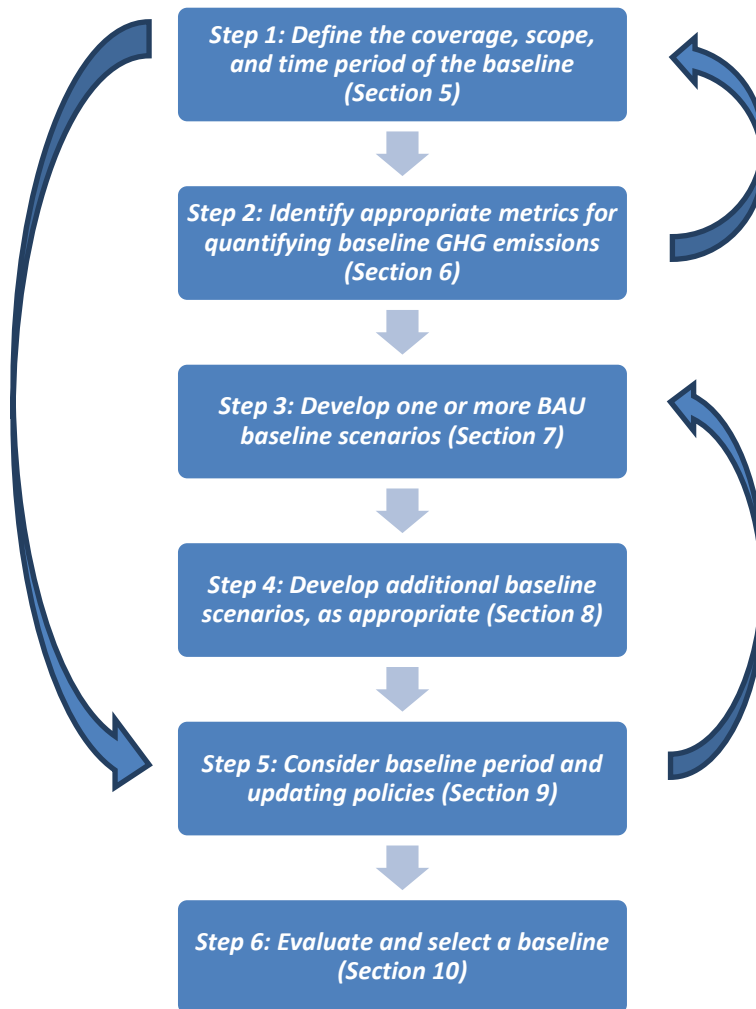
national, and/or local policy contexts, for example, may be relevant to consider in setting baselines. GHG accounting principles also guide the baseline setting process, including among others, practicality, completeness, transparency, and predictability. Furthermore, data quality and availability can influence the choice of baseline methods.

Part II provides a step-by-step description of how “guidance users”, a term we use here for those using this guidance, can develop baselines. Part II begins with a brief description of options for baseline development and approval, and proceeds in six further sections (5-10) to present options to define and update baselines. It should be noted that although Chapter 4 includes a list of questions to consider in terms of institutional arrangements for new, scaled-up market mechanisms, it does *not* address procedures, criteria, or institutional arrangements for auditing baselines to ensure their conformance with policy goals or other requirements¹.

Figure ES-1 indicates the basic process for developing a baseline described in these sections.

¹ For example, regulators may require audits of baselines to confirm that they are conservative (and/or provide sufficient level of confidence that resulting creditable emission reductions are associated with net GHG mitigation). Such baseline audit has been identified as a key aspect of safeguarding the overall environmental integrity and credibility of a mechanism. It could be the focus of future work

Figure ES-1. Technical Process for Developing a Baseline



Step 1 involves clearly defining the kinds of facilities and/or practices to which a baseline applies, including consideration of leakage effects. It also involves considering for how long a baseline will remain useful and valid. Step 2 involves considering metrics that can be used to quantify baseline GHG emissions. In some cases, consideration of metrics may lead to a refinement of the baseline’s coverage and scope (indicated by the arrow in Figure ES-1). Step 3 is to develop actual baseline scenarios reflecting assumptions about “business as usual” conditions. The guidance for this step provides both a conceptual overview of the baseline development process and a summary of different methods that can be used to develop baselines, including simple projections, simulation models, and comparison groups.

Step 4 involves developing alternative types of baseline scenarios if Guidance Users deem them appropriate and desirable, e.g., if the objective is to yield a net decrease or avoidance in emissions. Technical and policy considerations for developing both performance standard baselines and net mitigation baselines are discussed. Step 5 involves considering polices and processes for updating baselines, balancing objectives related to certainty and predictability with the need to ensure credibility and environmental integrity. Considerations about updating

may also affect decisions about the valid length of a baseline. The final step (Step 6) is to evaluate and select a baseline from among the scenarios developed in Steps 3 and 4.

It is hoped that the options and guidance outlined in this document will be useful for those involved in the development of baselines. In the context of the PMR Technical work program, the next phase of this work will focus on the application of the options and guidance through practical case studies.

1 Introduction

Developed under the auspices of the Partnership for Market Readiness (PMR) and with advice and input from its Baselines Working Group, this document offers guidance and options for the development of emissions baselines – a key component for assessing the emission reductions in both market and non-market based mechanisms. In the context of this document, a baseline refers to a scenario that describes expected or desired greenhouse gas emissions levels and that can be used as a basis for determining the amount of emissions reductions achieved as the result of a crediting, trading, or other mechanism.

The intent of the document is to support PMR Implementing Countries that are considering the establishment of new mechanisms for climate change mitigation, in particular, crediting mechanisms where baselines play a central role, but also emissions trading systems, results-based finance, and other mechanisms that measure performance in terms of GHG emissions reductions. The document may also be of interest and relevance to various stakeholders such as policy makers and analysts involved in mechanism design or review, experts and practitioners developing baseline methodologies, actors implementing mitigation initiatives whose impact needs to be quantified, and public, private, and non-governmental organisations and broader stakeholders seeking to assess mitigation and crediting proposals in which baselines are a key element. Furthermore, this document may be of interest to those involved in assessing the GHG benefits of policies and measures other than market mechanisms, such as NAMAs that cover a broad segment of the economy, or other mechanisms based on results-based payment.

Recognizing the wealth of information and experience in the area of baselines, this guidance builds on existing work. Table 1 and Table 2 (in Section 2 below) outline how this document can be used, in combination with other reference materials, to develop baselines that are specific to a mechanism. The document is most focused on options for the development of baselines for “scaled-up” crediting mechanisms that aim to stimulate emission reductions across broad segments of the economy, including sectors or other groups of emissions sources, taking into account different national circumstances.

This document is divided into two parts. Part I (Sections 2 and 3) presents the context for emissions baselines, introduces key concepts and terms, and describes principles, considerations, and potential trade-offs that can inform decisions in the development of robust and transparent baselines. Part II provides a step-by-step description of how “guidance users”, a term we use here for those using this guidance, can develop baselines. Part II begins with a brief description of options for baseline development and approval, and proceeds in six further sections (5-10) to present options to define and update baselines.

In the future, this document will be supplemented by additional documents illustrating how the guidance presented here can be applied to specific market or non-market mechanisms involving a variety of economic sectors and GHG emission sources.

Finally, this document is intended to be dynamic. Over time, as experience is gained and consensus emerges on best practices, this document may evolve to provide more specific guidelines, where and as appropriate.

PART I: Context, Concepts, and Considerations

2 The Context and Key Concepts of Baseline Setting

Emissions baselines are fundamental to market-based climate policy instruments, as well as to non-market-based ones such as results-based payments. For crediting mechanisms, they set the reference level that is used to determine the quantity of credits that will be awarded for a given mitigation action or effort for the associated emission reductions achieved. For trading mechanisms, baselines can help to establish the emissions target and to distribute emissions allowances to covered entities. For non-market mechanisms, baselines can be used to calculate the emission reductions associated with specific policies and actions, and in the case of results-based finance instruments to allocate financial payments.

The concept of an emissions baseline is used in a wide range of contexts, including in the projection of national-level emissions. For many years, countries have developed baseline emissions scenarios to inform planning and investment decisions, and have presented these baseline scenarios in their national communications to the UNFCCC (Danish Energy Agency, OECD, and UNEP Risoe Centre 2013). Some countries have defined emission reduction pledges on the basis of deviations from a baseline emissions trajectory (e.g., X% below a business-as-usual baseline for the year 2020) (Clapp and Prag 2012). Experience with these national baselines can provide an important source of input and guidance – including models, methods, and assumptions – for the development of mechanism-specific baselines, as explored in this document.

This section begins by introducing the evolving landscape of mechanisms, both market-based and non-market based, designed to address GHG emissions that countries are exploring through the PMR. It then discusses the role of baselines in each of three key mechanism types - emissions crediting, emissions trading, and results-based finance – and how this document can be used in those contexts. Three types of baselines are then presented and described: the business-as-usual (BAU) baseline, the performance standard baseline, and the net mitigation benefit baseline. This section concludes by suggesting additional resources that baseline developers may wish to consult.

Core Concepts:

- **Emissions baselines have many uses. They set the reference level used to determine the quantity of credits that will be awarded for a given mitigation action. They are a key reference in the establishment of the emissions target in trading systems and can be used to determine the distribution of emissions allowances to covered entities. They are used to calculate the distribution of results-based finance or to help associate emission reductions with specific policies and actions.**
- **A business-as-usual (BAU) baseline represents a projection of the emissions, or emission rates, that would occur in the absence the mechanism or instrument in question (crediting, trading, or other). BAU baselines are inherently unknowable, and thus uncertainty should be taken into account. Where uncertainty is significant, BAU baselines can be set using conservative assumptions in order to reduce the likelihood**

of overestimating emission reductions attributable to a mitigation policy. The treatment of existing and planned policies is one of the more challenging aspects of developing and defining BAU baselines.

- **A second type of baseline is the performance standard baseline. Such a baseline is established based upon the rate of emissions associated with a selected practice, technology, sector or threshold of performance (e.g., average of the top X% performing facilities in terms of emissions per unit output).**
- **A third type of baseline can be termed a net mitigation benefit baseline. Such a baseline is set deliberately below a conservative BAU level. The intent is to yield GHG reductions that are not attributed to – or accounted in - the crediting, trading, or other mechanism, and are thus not linked to credits or allowances used to meet an existing emissions cap or target, and are therefore, in principle, a “net mitigation benefit”. A similar outcome can be achieved, for example, through the use of discount factors applied to calculated emission benefits, or by limiting the length of crediting (or other accounting) periods.**
- **These three types of baselines are not mutually exclusive, e.g., a performance standard baseline can be used to achieve net mitigation benefit or to approximate BAU conditions.**

2.1 The evolving landscape of mechanisms to address GHG emissions

Market-based mechanisms can provide cost-effective policy instruments for meeting GHG emissions objectives at the international, national, and sub-national levels. Broadly speaking, two types of market mechanisms can be developed: *emissions trading systems* (ETS) and *crediting mechanisms*. These two types of mechanisms are often designed to work in tandem, with crediting mechanisms providing credits or “offsets” for use in trading systems, as a means for compliance with emissions obligations.² The Kyoto Protocol, for example, created an international emissions trading system with emission caps based on tradable national allowance units for individual countries, as well as with two project-based crediting mechanisms -- the Clean Development Mechanism (CDM) and Joint Implementation (JI) – that provide credits (associated with emission reductions generated by eligible projects in developing and industrialized countries respectively) that can be used for compliance in meeting these caps. Similar constructs, combining emissions trading systems with crediting mechanisms that offer a source of compliance credits, are also possible at national, sub-national, and regional levels.

Emissions trading systems establish a cap or limit on GHG emissions across a defined set of emission sources, for example, power generation and industrial facilities with significant GHG emissions (as in the EU Emissions Trading System) or across an entire country’s emissions (as in the Kyoto Protocol).³ Typically, a trading system administrator (e.g., international, national or

² While an ETS can be implemented as an essentially stand-alone instrument, a crediting mechanism needs to be linked to a source of demand, typically an ETS.

³ PMR Technical Note #2 (March 2012) provides an overview of the design elements of domestic emissions trading systems, including a summary of various existing and proposed schemes. It can be downloaded from www.wbcarbonfinance.org/pmr.

sub-national government entity) allocates (for free) or auctions (at a market clearing price) tradable *allowance* units to regulated participants⁴, facilities or entities covered by the system. Each allowance unit is essentially a permit to emit a corresponding amount of GHG (typically one ton of CO₂-equivalent). The administrator will typically allocate or auction these allowances (or “permits”) *ex ante*, that is, prior to a compliance period in which participants must manage their emissions. Once the compliance period (typically one or more years) is complete, regulated participants must surrender a quantity of allowances or credits equal to the GHG emissions from the sources they own or control.

Crediting (or “offset”) mechanisms or programs, in contrast, involve emissions sources that are typically outside the boundaries of an emissions trading system or other mitigation measure.⁵ Under a crediting program, the administrator (the Executive Board in the case of CDM or the Host Country registry administrator in the case of JI) issues credits corresponding to reductions in GHG emissions below the level set by a *baseline*. The appropriate setting of a baseline is critical for the effectiveness and for ensuring the environmental integrity of the crediting mechanism, and is thus the subject of this document. In contrast to allowance units in an ETS, credits are issued *ex post*, in other words, after the emission reductions have occurred. However, baseline emissions (or methods to quantify them) are established *ex ante*, prior to emission reducing activity.

Once issued, credits may be sold to participants in an emissions trading system, for example, who can use them to help meet their compliance obligations (i.e., both allowances and credits may be surrendered for compliance). Unlike typical emission trading systems, participation in a crediting mechanism is voluntary⁶; the entities that own or control eligible sources face no obligation to reduce emissions and are not penalized if their emissions exceed baseline levels.⁷ However, crediting mechanisms rely on external demand (i.e., external to the crediting scheme) for credits to provide the incentive for reducing GHG emissions below a baseline. In most cases, this demand comes from emissions trading systems that choose to make specific kinds of credits eligible for meeting compliance obligations. Other sources of demand can include public institutions, private entities and individuals that wish to voluntarily offset their emissions.

Figure 1 illustrates this relationship between GHG emissions trading and crediting mechanisms. Across the increasingly diverse landscape of existing and planned mechanisms, the largest in terms of unit flows and financial value of assets remain those with the longest history. The EU Emissions Trading System (EU ETS) generates the majority of current global demand for emissions credits, or offsets. The Clean Development Mechanism (CDM) and Joint Implementation (JI), as established under the Kyoto Protocol, are the only crediting mechanisms

⁴ Entities that are not regulated, i.e., don't have an obligation to surrender allowances or eligible credits to cover their emissions, may also be allowed to purchase tradable allowances.

⁵ Overlaps among crediting and trading or other mechanisms can occur, as has been the case for Joint Implementation in the EU, where entities covered by EU ETS could host JI projects. Special procedures are required in such circumstances, to avoid double counting of emission reductions, where relevant.

⁶ To clarify, participation at the country level in either crediting or trading mechanisms is voluntary, however, countries may elect to make participation mandatory at the installation or company level.

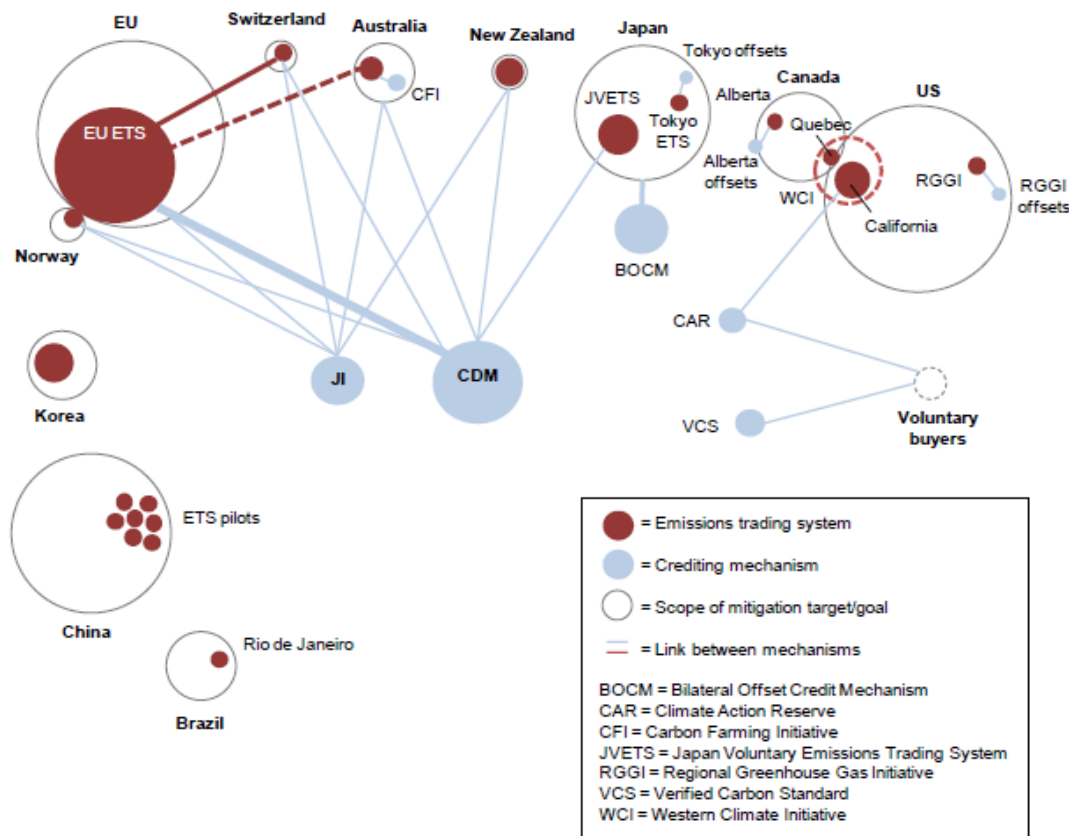
⁷ However, countries may elect to create charges or penalties for individual emission sources to ensure an entire “group of sources” or sector to reduce the emissions below the baseline.

currently supplying the EU ETS, as well as national buyers from Annex I countries with commitments under the Kyoto Protocol.

However, as Figure 1 shows, a large and growing number of other trading systems and crediting mechanisms now exist or are on the drawing boards. Newer emissions trading systems, such as those in Australia, Korea, California, and China, among others, could create demand for credits and allowances.⁸ This more complex, multi-faceted landscape will present both opportunities and challenges for new crediting and trading mechanisms. In all cases, however, baselines will be key elements and transparency on these will be important to facilitate any linkages between schemes.

⁸ In addition, several PMR Implementing Countries are in the process of preparing, assessing and/or designing new market-based instruments. For example, with PMR support, China is designing and preparing for a national ETS (building on the experience of the pilots covering five cities and two provinces); Costa Rica is designing its domestic carbon market; Chile is preparing and conducting the groundwork for a political decision on the potential implementation of an ETS in Chile's energy sector; while Mexico is elaborating three NAMAs for crediting.

Figure 1. Landscape of Existing and Planned Market Mechanisms
(from Prag, Briner, and Hood 2012)



Source: Authors

Discussions and decisions at the international climate negotiations regarding a framework for various approaches (FVA) and the new market mechanism (NMM) are key aspects of this evolving context. At its 17th session in Durban, South Africa, the Conference of the Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC) agreed that “bearing in mind different circumstances of developed and developing countries,” various approaches, including both market and non-market mechanisms “must meet standards that deliver real, permanent, additional and verified mitigation outcomes, avoid double counting of effort, and achieve a net decrease and/or avoidance of greenhouse gas emissions (decision 2/CP.17, paragraph 79).” In addition, the NMM, as defined in Durban, must take into account “stimulating mitigation across broad segments of the economy.” In other words, incentives should be provided for “scaled up” action that goes beyond a project-by-project approach and, in principle, spurs deeper emission reductions across entire sectors, sub-sectors, or groups of emissions sources (UNFCCC 2012d). In contrast to a decade ago, there is now greater emphasis on involving developing country governments in developing new market mechanisms and associated incentives, on scaling up their impacts across broad segments of the economy, and on achieving net mitigation benefits , as well as aligning mechanisms with host country climate change objectives and policies. As we will see below, these newer principles and objectives will have implications in terms of how baselines are established and how these processes are governed.

Finally, it is also important to note the relevance of this work to non-market instruments. While the potential range of non-market mechanisms is quite vast – from regulatory and financial to educational initiatives – this document is primarily focussed on results-based financing and other instruments that may rely upon the robust quantification of emission reductions in determining the level of financing flows or other types of support. Baselines would therefore play a key role in these types of non-market mechanisms.

2.2 The role of baselines and applicability of this document

This subsection reviews the role that baselines play in the mechanisms – crediting, trading, and non-market. It outlines how this document can be applied to various mechanisms, from those that focus on project-specific GHG emissions to those that operate at the scale of segments of the economy or groups of emissions sources (scaled-up mechanisms).

2.2.1 Crediting mechanisms

Baselines are a critical element of any crediting mechanism, as they set the reference level used to determine the number of credits that can be issued for a given action or activity. All crediting mechanisms operate based on the following equation⁹:

$$\text{Credits Issued} = \text{Baseline Emissions} - \text{Actual Emissions} - \text{Leakage Emissions}$$

This equation holds regardless of whether the mechanism operates at the scale of an individual project, as with much of the current crediting mechanisms (CDM, JI, and most voluntary offset programs), or at the scale of sectors or groups of sources, as with proposed new market mechanisms at the international level. Actual emissions of an individual project or groups of emissions sources can be directly estimated and verified based on measurements (e.g., direct emissions monitoring, surveys, fuel consumption and composition, or other data and emission factors). Baseline emissions, on the other hand, are a theoretical construct that can be defined in a number of ways that are a function of policy and technical considerations. As discussed below, baseline emissions can represent the best estimate of “business-as-usual” emissions, i.e. those that would most likely occur in the absence of the crediting mechanism. Alternatively, baseline emissions can represent a level of desired minimum performance, or otherwise embody an ambition to go beyond BAU levels.

Leakage emissions refer to emissions that may occur outside the coverage of the mechanism, yet may be attributable to it. For example, if implementation of an emissions trading system were to lead an industry to relocate its activities or investments to other regions or countries without comparable emissions limitations, emissions “leakage” could occur, compromising the environmental effectiveness of the greenhouse gas cap.¹⁰ As discussed below, emissions

⁹ If discounting of emission reductions prior to credit issuance were to be introduced as a means to deliver net mitigation benefit (see discussion in 2.3.3 below), then this equation would be expressed as: Credits Issued = d * (Baseline Emissions – Actual Emissions – Leakage Emissions), where d represents a discount factor used to achieve a net decrease of avoidance of emissions.

¹⁰ Emissions “leakage” would occur if implementation of a greenhouse gas policy (e.g., cap-and-trade legislation) were to induce industry sectors to replace domestic production with imports or to relocate production to foreign countries.

leakage can also occur as the result of a crediting mechanism, where the value of credits is sufficient to shift the location of production away from regions or countries with emissions limitations or simply with less emissions-intensive production (than the baseline used for crediting). Leakage can also result from life-cycle emissions not accounted for within the crediting system boundary (e.g., emissions from the extraction and transportation of natural gas). Leakage emissions are usually only considered if they are significant and result in a decrease in emission reductions attributed to the mechanisms.¹¹ The assessment of leakage is a baseline exercise, as it requires considering what would have occurred absent the crediting mechanism *outside the accounting boundary* for the credited activity. The setting of accounting boundaries and assessment of leakage emissions is discussed further in Section 5.2.

While the equation above applies regardless of the scale of a crediting mechanism, the process of baseline development may differ significantly. Table 1 shows how this guidance document may apply differently depending on whether a crediting mechanism awards credits based on the performance of individual projects, programs, policies, or groups of emissions sources.¹² Most existing crediting mechanisms operate by applying baselines to individual projects or programs of activities and together they have created a significant body of work, including regulatory guidance and oversight on how to establish baselines, that can be drawn upon. The CDM, for instance, offers a suite of over 190 methodologies in 15 different sector scopes, including many sector-specific standardized baselines and associated default values. Other crediting mechanisms, especially the voluntary market, rely on the CDM-developed baseline methodologies, but also provide dozens of other examples of baseline methodologies approved under different standards, in many cases covering regions, sectors, and activities absent in the CDM (Table 2).

As noted in Section 1, because there is less existing material to build upon and increased interest in the international community, this document focuses on the development of baselines for scaled-up mechanism designs, as indicated by the shaded rows in Table 1. Such mechanism designs, which include, among others, sectoral trading, sectoral crediting, and policy and NAMA crediting, establish baselines based on the performance of sectors or groups of sources.

Crediting and trading approaches for broad segments of economy may require added domestic policies to incentivize emission reductions at individual facilities. Such policies may be in the form of regulations or financial incentives, or alternatively, involve crediting of reductions at individual facilities. These domestic policies, depending on how they are designed, may require separate procedures to determine project- or facility-specific baselines as well as the additionality of emission reductions at individual facilities.

If that were to occur, emissions would increase in the other country, resulting in emissions “leaking” from the domestic to the foreign country (Dröge et al. 2009).

¹¹ Positive leakage (i.e., generation of emission reduction benefits beyond what are accounted for), such as spill-over effects, are not generally accounted for in crediting mechanisms, as they are generally viewed as inconsistent with a conservative approach.

¹² “Groups of sources” is a broad term that can be used to refer variously to “sectors”, “segments of the economy”, or other groupings of emission sources (A. Prag and Briner 2012).

Table 1. How to Apply This Baseline Guidance Document in Various Contexts

Shading connotes what is often referred to as a “scaled-up” mechanism

Context/ Mechanism	Potential uses of baseline	Credits (or allowances) awarded based on performance of:	Baselines established based on the performance of:	Applications and Status	How to use this guidance (in conjunction with other resources)
Crediting	<ul style="list-style-type: none"> - Determine number of credits to issue - Estimate net mitigation benefit 	Projects	Sources relevant to a specific project/activity	Used for most current CDM and other offset programs project types	<ul style="list-style-type: none"> • Consult general concepts presented here and rely on the considerable existing resources for baseline determination (see links below) • Consult other literature to assess project additionality, which is not covered here
		Projects	Sectors or “groups of sources”	Used for many of existing and proposed project types in CDM and other offset programs Could be used in conjunction with crediting to broad segments of economy to provide incentives to individual installations	
		Programs	Programs or “groups of sources”	Used for some CDM and voluntary offset market “programs of activities”	
		Policies (including credited NAMAs)	Sectors or “groups of sources”	Policy crediting and NAMA crediting (some variants),	<ul style="list-style-type: none"> • Depending on nature of crediting approach and policy in question, follow steps provided in Part II and/or consult other resources, such as the WRI GHG Protocol Policies and Actions Standard (under development)
		Sectors or “groups of sources”	Sectors or “groups of sources”	“Sectoral crediting” – proposed approaches (literature)	<ul style="list-style-type: none"> • Follow steps provided in Part II, and consult additional reference materials (below)
Trading	<ul style="list-style-type: none"> - Set targets - Distribute allowances 	Sectors or “groups of sources”	Sectors or “groups of sources”, Best Available Technology (BAT) standards, or national targets	“Sectoral trading” – proposed approaches (literature)	<ul style="list-style-type: none"> • Follow steps provided in Part II, and consult additional reference materials (below)
Results-based Finance	<ul style="list-style-type: none"> - Estimate mitigation benefit - Allocate finance 	Any of the above	Any of the above	Baselines developed routinely to estimate mitigation benefits; no widely accepted guidance or protocols	<ul style="list-style-type: none"> • Depending on nature of the mechanism, follow steps provided in Parts II and III and/or consult other resources, such as the WRI GHG Protocol Policies and Actions Standard (under development)

Table 2. Additional Reference Materials

Resource	Useful for:	Citations and links*
CDM Baseline Methodologies and Standards	Baselines for project-based and program-based crediting	(UNFCCC 2012a) (Website) (Booklet PDF)
Standardized Baselines in the CDM	Standardized baselines	(UNFCCC 2012a) (Website), (D Hayashi et al. 2010)(Mueller et al. 2011)(UNFCCC 2011b)(UNFCCC 2010)(Schneider et al. 2012)
Other Offset program methodologies	Baselines for project-based crediting	Voluntary Carbon Standard (VCS), Climate Action Reserve (CAR), American Carbon Registry (ACR), Regional Greenhouse gas Initiative (RGGI), Carbon Farming Initiative (CFI), among others
Report: Setting baselines for the new market mechanism: Examples from the power, cement and buildings sectors	Baselines for Sectoral Crediting	(Castro et al. 2012)
Report: National Greenhouse Gas Emissions Baseline Scenarios	National BAU baselines; key drivers and assumptions; use of models; management of data and uncertainty	(Danish Energy Agency, OECD, and UNEP Risoe Centre 2013) (PDF)
Draft Standards: WRI Mitigation Accounting Initiative: Policies and Actions Standard; and Mitigation Goals Standard	Baseline scenario methods and principles	World Resources Institute (WRI) (Website)
Various literature resources: Sectoral mechanisms	Baselines for sectoral crediting and sectoral trading	(Baron, Buchner, and Ellis 2009; Aasrud et al. 2009; Amatayakul and Fenhann 2009; Bosi and Ellis 2005; Butzengeiger-Geyer, Castro, and Dransfeld, Bjorn 2010; CCAP 2010; Ecofys et al. 2009; Ecofys, ERI, and Azure 2009; Hamdi-Cherif, Meriem and Guivarch, Céline; 2011; Hohne and Jung 2007; IEA 2009; Schneider and Cames 2009)

* See references at the end of the document for full bibliographic information.

Additionality

For project- and program-based crediting mechanisms, the baseline setting process is typically complemented by a separate additionality test designed to demonstrate that the emissions reductions (as estimated using a baseline) are additional to those that would have happened in the absence of the mechanism.¹³ Separate additionality tests are often particularly relevant where a mechanism awards credits to *individual facilities* (e.g., individual cement plants) based on their individual performance. Such tests aim to reduce the risk that a significant fraction of

¹³ Baselines, especially, in the form of emissions rates or intensities, already implicitly incorporate a notion of additionality: emission sources that do not achieve emissions below the baseline are effectively considered non-additional.

credits are awarded for emissions-reducing activities that would have taken place even in the absence of the crediting mechanism.¹⁴ In contrast, where a scaled-up mechanism awards credits for the performance of an *entire group of facilities* (e.g., all cement plants combined), the focus is on whether aggregate emissions for these facilities are reduced below what they would have been otherwise, not whether any particular activity or action is additional. As such, additionality may be demonstrated by comparing actual aggregate emissions to a robust baseline for the entire group (e.g., a BAU or more conservative estimate of cement sector emissions), . A key consideration for additionality then becomes how baselines account for existing and planned policies as discussed in Section 2.3.1 as well as in Part II.

2.2.2 Trading mechanisms

In the discussion of trading mechanisms, the terms “cap” and “benchmark” are used in place of “baseline”, though the concepts and tools involved are quite similar. The process of setting an emissions target or cap will typically involve projecting a BAU baseline for the sectors and emissions sources covered by a trading system, as well as projecting the lower-than-BAU emissions level that can be achieved by these covered entities, just as one might do for a crediting mechanism of similar scope and coverage. These two types of baselines are discussed in Section 2.3 below, while Part II provides tools and guidance for their development.

Furthermore, many trading systems provide free allocation of allowances to some covered entities. In many cases, trading programs utilize baselines for determining the amount of allowances that should be provided. Both California and the EU use performance standard baselines for this purpose, as described further below.

In trading mechanisms, the notion of additionality is embedded in the process of ensuring that BAU emissions are robustly estimated and that the emission target thus represents a level lower than BAU. The notion of leakage should also be taken into account, not merely from the standpoint of emissions impact but competitiveness risks to entities covered by a trading mechanism.

2.2.3 Non-market mechanisms

Some non-market mechanisms (i.e., mechanisms that do not involve transactions of carbon assets) also employ baselines in order to measure emission reductions benefits. A good example is results-based financing (RBF), a financing approach increasingly employed to support development objectives and domestic policy goals, such as reducing emissions.¹⁵ Under RBF, payments can be made upon the successful verification of emission reductions. Quantification of these emission reductions will require the use of baselines.

¹⁴ Additionality testing has proven one of the more difficult and controversial aspects of project and program based mechanisms to implement in practice.

¹⁵ http://siteresources.worldbank.org/EXTCARBONFINANCE/Resources/Revised_Appendices_I_IV_POSTED.pdf

2.3 Baseline “types”

This document presents methods for developing three generic types of baselines: business-as-usual, performance standard, and net mitigation (or ambitious) baselines. As described in Table 3 and further below, these types of baselines can be used in different ways depending upon the mechanism in question. In general, the BAU baseline is important to define and quantify for all mechanisms, while the performance standard baseline tends to be suitable only in some circumstances (adequate data or other technical and policy basis for selecting a standard, homogeneity of outputs). The net mitigation baseline is important for any market-based mechanism that seeks to deliver a net decrease in GHG emissions relative to business as usual.

It can be useful to distinguish these three types of baselines from a methodological perspective, even though their objectives may overlap. As shown in the third column of Table 3, each category can be associated with distinct methodological options, each with their own data requirements and analytical procedures. However, in terms of overall objective they may overlap. For example, a performance standard baseline, depending on how it is set, can be used to achieve net mitigation benefit.

Table 3. Overview of Baseline Types and Applications

Baseline type	Definition	Methodological Options	Application in:		
			Crediting	Trading	Non-Market Mechanism
Business-as-usual (BAU)	A scenario that describes and estimates the emissions or emission rates that would otherwise occur in the absence of future, additional mitigation efforts and policies, including the mechanism or instrument in question (crediting, trading, non-market); a projection based on assumptions regarding future developments.	<ul style="list-style-type: none"> - Simple projection - Model-based projection - Comparison group approach 	Used to determine baseline emissions in many traditional crediting mechanisms. Important to estimate these emissions in any crediting mechanism, in order to ensure environmental integrity and estimate any net mitigation benefit.	Used to estimate emissions without the trading system, and therefore the emission reductions resulting from meeting the cap.	Used to estimate emissions without the mechanism, and therefore emission reductions attributable to actions.
Performance standard	Baseline based upon the rate of emissions associated with a selected practice, technology, or threshold of performance (e.g., output-weighted average performance of lowest 20% emitting facilities in terms of emissions per unit output); A performance level often based on historical data.	<ul style="list-style-type: none"> - Performance benchmarking (top 10%, 20%, etc.) - Practice or technology-specific standard 	Used for some standardized baseline methodologies. Typically, but not necessarily, more ambitious/stringent than BAU.	Used in some mechanisms to distribute allowances, often specifically to emissions-intensive, trade-exposed industries or facilities.	Could be used if minimum levels of emissions performance are desired.
Net mitigation (or “ambitious”)	A baseline set at a level intentionally more ambitious (lower) than a BAU baseline, after accounting for uncertainties.	<ul style="list-style-type: none"> - Mitigation analysis (cost and potentials) in conjunction with simple and model-based projections (same as used for BAU) - Downscaling of national targets 	One way to achieve the net decrease or avoidance of global GHG emissions that is required of new mechanism and units under the UNFCCC. Often referred to as a “crediting threshold”, in this context.	Used to set the target or cap.	Could be used to establish the ambition of the action or mechanism.

2.3.1 Business-as-usual baseline

A **business-as-usual (BAU)** baseline represents a “counterfactual” or hypothesis of what would otherwise occur without the incentive provided by the mechanism in question (crediting, trading, or non-market).

When used as the basis for crediting, BAU baseline methodologies enable a crediting mechanism to function essentially as a “zero-sum” instrument, one that, in principle, should lead to no net mitigation impact (neither an increase nor decrease in global GHG emissions). The credited emission reductions are pure “offsets”. While crediting mechanisms are typically designed to lead to one credit for every ton of emission reduced below the baseline, emission trading or other systems typically allow buyers to increase their emissions by one ton for each ton of credit they surrender.

For trading mechanism, a BAU baseline allows the estimation of the level of emission reductions required to meet the emissions cap, and in so doing, can help in the process of cap setting itself. Understanding the BAU emissions and setting caps lower than that BAU level provides confidence that the emissions cap and allocations will lead to real emission reductions (i.e., avoidance of “hot air”)

For non-market mechanisms, a BAU baseline can be used to estimate emission reductions attributable to specific actions which can then trigger payments or other financial support.

For crediting mechanisms in particular, BAU baselines are generally set in a **conservative** manner so as to account for underlying uncertainties and thus provide a sufficient level of confidence that the baseline will not exceed BAU emission levels. Conservativeness helps to ensure environmental integrity by reducing the likelihood that more credits will be issued than emission reductions occurred. If credits are issued for reductions that were likely to occur anyway in the absence of a crediting mechanism, for example, then the GHG mitigation goals of an emissions trading system recognizing those credits – and its **environmental integrity** - would be undermined, because global emissions would increase beyond what they would have been if the credits were *not* recognized. However, highly conservative baselines may also lead to missed opportunities, if emission reductions are not pursued, reducing the economic efficiency of the crediting mechanism. As discussed further in Section 10, in practice, applying a conservativeness criterion can require striking a balance between certainty (that credited emissions reductions have occurred) and economic efficiency.

As described in Part II, approaches for setting a BAU baseline can range from simple extrapolation of trends from recent experience to more complex models that take into account expected technological changes, stock turnover, and other factors such as weather or other environmental controls that might affect emissions performance but should not directly affect the amount of creditable reductions.

In many cases, national BAU baseline scenarios may already exist (Danish Energy Agency, OECD, and UNEP Risoe Centre 2013), and the same methods, models, and assumptions may be applicable to the development of mechanism-specific baselines. Doing so can help to enhance consistency with respect to national actions.

Finally, given the large uncertainties regarding future development, it is often useful to develop multiple BAU scenarios to help understand key drivers and their implications. Where a BAU baseline is used directly for crediting, the most likely and/or conservative scenario can be used.

Addressing existing and planned policies

A key issue in the development of a BAU baseline is the decision on what to account and what not to account for, especially in terms of **existing and planned policies**, their likely level of implementation, and their overall impact on emission levels. This issue has been the subject of significant attention, as the inclusion of some policies in a BAU baseline, such as renewable energy standards or incentives, for example, may result in a lower baseline level and may thus reduce the amount of emission reductions that are attributable to mitigation actions. The exclusion of existing and planned policies, on the other hand (e.g., on the grounds that their implementation and outcome are uncertain), will result in a higher BAU baseline level and lead to greater amount of attributable GHG reductions.

As discussed further below (Section 7.1), the treatment of existing and expected policies is one of the most challenging aspects of the development of baselines. The determination of whether and when they are ultimately implemented and enforced often involves uncertainties and judgment calls. The decision to include and account such policies in the BAU baselines may provide a perverse incentive for countries to avoid or delay adoption of policies that can significantly reduce emissions (or appear to penalize early adopters of such policies), while a decision to exclude them might lead to overstating BAU emissions and rewarding credits for emission reductions likely to occur in the absence of the crediting mechanism. Where countries have already made ambitious economy-wide mitigation pledges, however, the risk of perverse incentives may be significantly reduced.

Two factors can be used to help discern which policies to consider as existing and/or planned (Danish Energy Agency, OECD, and UNEP Risoe Centre 2013):

- whether the policy has been adopted, made into law or regulation, or otherwise implemented and enforced, and
- whether the policy is expected to have a significant impact on GHG emissions.

As noted in a recent review of national baselines, and can also be said of sub-national baselines, “there is invariably a large subjective and sometimes politically-driven element involved in choosing which policies to include. Furthermore, it is not always an easy task to isolate and model the potential effects of a particular policy. This means that the decisions taken on how to treat particular policies in the baseline scenario can have a potentially large effect on the resulting projections.”¹⁶ As discussed below, building-in a process to predictably update baselines is important for mitigating any potential risks.

¹⁶ p. 28, Danish Energy Agency, OECD, and UNEP Risoe Centre 2013.

2.3.2 Performance standard baselines

In addition to a BAU baseline, mechanism administrators may elect to set a baseline at a **desired level of performance** that activities or entities are expected to exceed in order to achieve creditable emission reductions, create a surplus of allowances, or otherwise claim the value of emission reductions. Such baselines, often set on the basis of benchmarking performance across a group of sources, typically aim to be more ambitious or stringent than BAU baselines. For example, under the CDM, one of the options for setting baselines established in the Marrakech Accords (48c) is the average performance of the top 20% of activities in a given area. Similarly under the CDM's new standardized baseline guidance, baselines are set at the top 10% or 20% percentile of performance for a group of sources (subject to additional financial or other barriers) (UNFCCC 2011b).

In addition to baselines set based on the analysis of performance data for existing facilities, performance standard baselines can also be technology-specific or practice-based. For example, the EU ETS baseline for allocation to carbon-intensive, trade-exposed industries reverts to a best available technology (BAT) standard, where the data and method are insufficient for a performance standard baseline.¹⁷ Baselines can also be set based on notion of local or international common or best practice, as is done in the case for several of the Climate Action Reserve (CAR)'s baseline methodologies. Table 4 lists these and other examples of performance standard baselines currently in use in trading and crediting mechanisms. The general requirements for developing performance standard baselines are discussed in Section 8 below.

In general, "benchmarked" baselines require considerable data regarding facility performance, data on both facility output and emissions (or emissions-related parameters such as fuel use, consumption of other inputs, and process type) that may be proprietary, difficult to obtain, or simply non-existent. Efforts in developed countries to adopt benchmarked performance standards have been aided by voluntary industry initiatives, government-industry partnerships, and reliance on third-party consultants familiar with industry practices. While these efforts have shown that performance standards can be developed in dozens of industry sectors, the situation in developing countries may be quite different. Data coverage in many regions, even in industry-led initiatives, such the Cement Sustainability Initiative and the International Aluminum Institute reporting efforts, is still quite poor, and challenges can mount even further in lesser-developed countries. Despite efforts to develop and promote them, in the CDM, use of performance standards in sectors other than in the power sector has remained quite limited.¹⁸

Despite the fact that performance standard baselines are set at better-than-average levels, for the purposes of environmental integrity, it may still be important to ensure that such benchmarked baselines are actually more conservative than a BAU baseline. Even though a stringent "top" performer baseline might seem to be automatically "ambitious", in fast-changing

¹⁷ The development of BAT standards can also be challenging.

¹⁸ Under the CDM, performance based approaches to baseline setting have been used in a number of methodologies, including for household appliances, cement blending, PFC emissions from aluminum, construction of new efficient coal power plants, nitric acid production and HFC-23 abatement sectors, though difficulties to implement these approaches in practice have limited the application (i.e., use) of these methodologies

sectors this may not always be the case.¹⁹ BAU baselines take into account expected trends, while performance standard baselines are typically based on historical data, often from a few years prior to the setting of a baseline. Therefore, it is also important to carefully consider how trends can be accounted for in performance benchmarks, e.g., through regularly updating (ex post) or adopting an annual performance improvement factor (ex ante), e.g., based on observed trends in the past.

¹⁹ For example, lighting technologies have undergone rapid change in recent years. A performance standard for lighting based on historical data may not capture the speed at which compact fluorescent or light-emitting diode technologies are emerging.

Table 4. Examples of Performance Standard Baselines

Example	Mechanism Type	Mechanism	Normative performance level used	Unit of performance
Benchmarked (Performance Standard) allowance allocations for carbon-intensive, trade-exposed industries	Trading	EU ETS (Phase III)	Average performance of the top 10th percentile (on the cumulated production curve for sectors with a minimum of 8 installations reported). Best Available Technology (BAT) used as a fall-back for sectors where data and method insufficient.	tCO ₂ e per unit of product
Benchmarked allowance allocations for industrial leakage prevention and transition assistance ²⁰	Trading	California ETS	90% of the average emissions intensity during a historical base period or where too stringent, a “best-in-class” value. ²¹	tCO ₂ e per unit of product
CDM Standardized Baselines	Crediting	CDM	Performance of the top 10 th (priority sectors) or 20 th (other sectors) percentile technology	tCO ₂ e per unit of output
CDM Grid Emission Factor	Crediting	CDM	Weighted average of the build margin (recent plant additions) and operation margin (current operating plants)	tCO ₂ e per MWh
New grid connected fossil fuel fired power plants using a less GHG intensive technology (ACM0013)	Crediting	CDM	Average performance of top 15 th percentile of recent coal plant additions	tCO ₂ e per MWh
Several CDM methodologies (AM37, 59, 70, AM67, ACM5, ACM15, ACM18)	Crediting	CDM	Average performance of top 20 th percentile	Varies based on methodology
Some CDM methodologies (ACM19/nitric acid, AM1/HFC23)	Crediting	CDM	Best available technology	Varies based on methodology
Voluntary industry benchmarking efforts	Non-market	Voluntary	Up to individual companies and circumstances. International emissions performance data and curves have been made public in the cement and aluminum industries.	Varies based on methodology

2.3.3 Net mitigation benefit [ambitious] baselines

In an explicit departure from the simple zero-sum calculus of the CDM and other crediting mechanisms, the Cancun agreements reached at COP 16 in 2010 called for “one or more market-based mechanisms” capable of “ensuring a net decrease and/or avoidance of global greenhouse gas emissions”²², an intent that was further reiterated at COP 17 in Durban, as an expectation for “various approaches, including opportunities for using markets, to enhance the

²⁰ <http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/allowanceallocation.htm>

²¹ <http://www.arb.ca.gov/regact/2010/capandtrade10/candtappb.pdf>

²² FCCC/CP/2010/7/Add.1

cost-effectiveness of, and to promote, mitigation actions...”.²³ Therefore, net mitigation benefit has become an expectation associated with new mechanisms discussed at the international level, whether based on crediting or trading. As discussed below, setting an “ambitious” baseline offers one of several ways to achieve a net mitigation benefit.

For example, by setting a crediting baseline demonstrably below BAU, a crediting mechanism would issue fewer credits than the total number of tonnes of CO₂-equivalent emission reductions achieved relative to BAU. In practice, this would mean setting a baseline that is below the low range (or conservative) estimates of BAU emissions. **Error! Reference source not found.** (Figure 3). As a result, in principle, a mechanism using a net mitigation benefit baseline should, if successful, lead to more net reductions than would have otherwise been achieved. As noted above, most existing crediting mechanisms were not designed with this particular outcome in mind, although such objectives could likely be met with some adjustments such as making baselines more stringent.

This “net decrease” or “net mitigation” objective can also be met through other means. In the case of crediting mechanisms, shorter (than effective activity lifetime) crediting periods, and cancelling or systematically discounting credits before or after issuance (e.g. requiring buyers to surrender more than one credit per unit of emissions) can enable a net mitigation outcome, even where BAU baselines are used. Therefore, where net mitigation benefit is an objective, program administrators will need to consider whether they will use baseline setting and/or other procedures to achieve it.²⁴

It is important to note that a conservative BAU baseline, in and of itself, may not be an ambitious or net mitigation baseline. However, it has been estimated that conservative assumptions in CDM baselines, for example, may lead to significant emissions benefits beyond the number of CERs issued, i.e., uncredited emission reductions (Spalding-Fecher et al. 2012). However, conservativeness is generally introduced in order to account for uncertainty in data and assumptions, and ensure that CERs represent real emission reductions with a desired level of certainty. Therefore, if an ambitious baseline is to provide a net mitigation benefit with a similar level of certainty, it may need to be lower than this conservative BAU level.

For trading mechanism, the emissions target or cap itself should typically represent a net mitigation benefit baseline, (appreciably) below a conservative BAU baseline level (in order to avoid the possibility of “surplus” emission reductions not associated with mitigation (sometimes referred to as “hot air”).

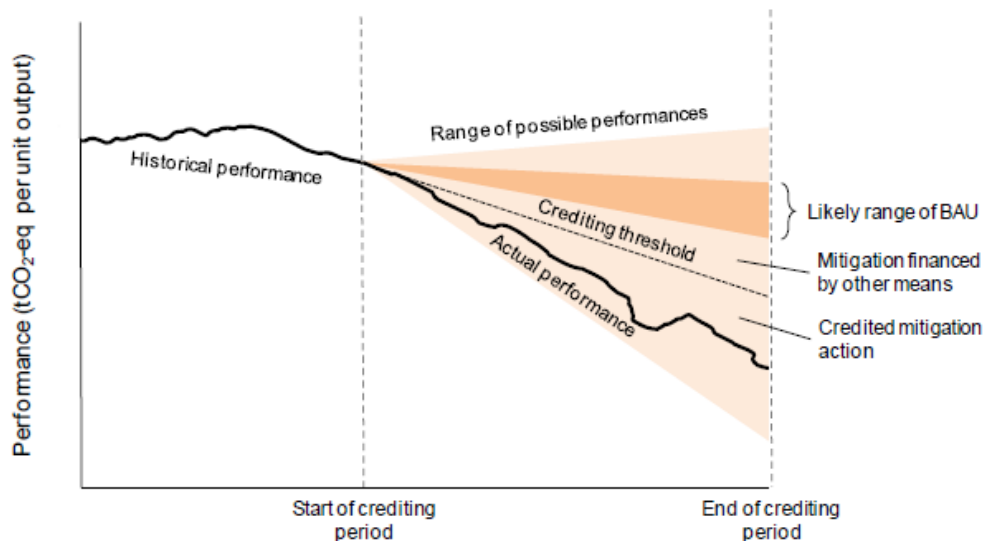
With non-market mechanisms, since emission reductions incentivized by results-based payment would not be used to offset the emissions of another entity, there is automatically a net GHG mitigation benefit.

²³ The report of the Conference of the Parties “emphasizes that various approaches, including opportunities for using markets, to enhance the cost-effectiveness of, and to promote, mitigation actions...must meet standards that ...achieve a net decrease and/or avoidance of greenhouse gas emissions ([decision 2/CP.17, paragraph 79](#)).

²⁴ For further discussion of means to achieve net mitigation benefit see, for example, Spalding-Fecher et al. (2012) and Project Developer Forum (2013).

As described in Section 8, the process of setting a net mitigation baseline can be informed by assessments of mitigation potential and cost, any mitigation goals or pledges that may exist at a national level, and rates of emission reduction achieved in the past, among other factors. Section 8 discusses options for setting net mitigation baselines in more detail.

Figure 2. Baseline Approaches and their Use
(From Prag and Briner, 2012).



This figure illustrates how BAU and net mitigation baselines can be used together in a crediting context. The uncertainty associated with BAU is indicated by the shaded range of BAU baseline scenarios. A conservative BAU baseline could be seen as representing the lower end of this range. A net mitigation baseline can then be set at discernibly lower level than that of the conservative BAU, as indicated here by the crediting threshold, a term often used for ambitious baselines in new market mechanisms. The actual emission performance of the group of emissions sources is indicated by the thick line, and the number of credits would then be calculated based on the difference between this line and the crediting threshold (times the unit of output, in this example).

2.4 Absolute vs. Intensity-Based Reductions

While all mechanisms ultimately aim to produce absolute emission reductions relative to BAU scenario, some operate on the basis of absolute emissions, while others operate on the basis emissions relative to specific indicator or activity level (economic output, physical output, or other measure), and can thus be considered “intensity-based”. Most crediting mechanisms to date, for example, and their methodologies for awarding credits, have been intensity-based: the number of credits issued depend upon, for example, the amount of electricity (e.g., megawatt-hours, or MWh) produced by renewable energy facilities or the amount of cement or clinker (e.g., tons) produced by cement facilities.

As described in Part II, baselines for crediting mechanisms and non-market mechanisms such results-based finance (as well as benchmarks for allowance allocation in emission trading

systems²⁵) are generally represented by an overall emissions intensity (tCO₂e/MWh or tCO₂e/ton of cement), though that need not always be the case. If a crediting or non-market mechanism (or allowance allocation in a trading mechanism) were to operate on an absolute basis, baselines would be set on an absolute basis (tCO₂e). Such absolute baselines would require pre-determined values for activity levels (e.g., vehicle-miles traveled or tons of cement produced), and departures from those values could affect the total amount of credits issued, allowances awarded, or results-based finance provided.

Therefore, Guidance Users and decision makers will need to carefully consider whether to operate on an intensity or absolute basis. Each type of basis has its advantages and disadvantages, as discussed in Section 2.2 of PMR Technical Note #3 (Partnership for Market Readiness 2012). Part II of this report also describes the implications of this choice: in addition to the same information required of intensity-based baselines, a mechanism based on absolute emissions will also require updated and realistic projections of the key economic and demographic factors that drive emission levels.

²⁵ Methods for allowance allocation to covered entities are typically based on performance standards as described in Sections 2.3 and 8, which are represented in terms of emissions intensity: an industrial facility may receive more allowances if the higher their total output is higher, and fewer allowances the lower it is.

3 Key Considerations in Baseline Setting

Policy and technical considerations, along with the overall context and design of a mechanism, can have important implications for how baseline methodologies are developed. This section reviews those considerations, and their implications, before delving more deeply into the mechanics of baseline setting in Part II of this document.

Core Concepts:

- **International climate change negotiations on market mechanisms have established a set of specific requirements for various approaches and the new market mechanism that are relevant for baselines.**
- **General GHG accounting principles can also guide the baseline setting process, including among others, practicality, completeness, transparency, and predictability.**
- **Data quality and availability are among the technical considerations that can influence the choice of baseline methods.**
- **Guidance Users will typically need to balance trade-offs among these potentially competing considerations, principles, and requirements.**

3.1 Requirements for various approaches and the new market mechanism under the UNFCCC

In recent years, decisions reached at international climate negotiations have established requirements for mechanisms that are relevant for baselines. In particular, “various approaches, including opportunities for using markets, to enhance the cost-effectiveness of, and to promote, mitigation actions, bearing in mind different circumstances of developed and developing countries²⁶, must:

- meet standards that deliver real, permanent, additional and verified mitigation outcomes,
- avoid double counting of effort, and
- achieve a net decrease and/or avoidance of greenhouse gas emissions;

As discussed in Section 2.3 and in Section 8, baselines can be used as one means to achieve a “net decrease”. Baselines can also play a role in avoiding double counting by accounting for other mechanisms (e.g., taking account of CDM or other reduction activities in units). As noted in Section 2.2.1, BAU baselines also implicitly include the notion of additionality by representing what would occur without a given mechanism, though baselines alone may not suffice to ensure environmental integrity, especially for mechanisms that credit individual facilities; in such cases, supplemental additionality tests (which can be in the form of eligibility requirements) may be needed.

²⁶ Decision 2/CP.17, paragraph 79 (UNFCCC 2012c, 17)

With respect to “standards that deliver... verified mitigation outcomes”, baselines themselves, as counterfactuals cannot be verified. Nonetheless, the data upon which they are based (e.g., power plant fuel use data used to calculate a grid emissions factor) can be verified. In addition, it can be verified that an agreed baseline methodology was followed, and that any assumptions were drawn from appropriate sources. Permanence is not typically considered a baseline issue, and since it is largely an issue for biological sequestration activities (e.g., REDD+) which are not covered by the PMR, it is not discussed further here.

Other key decision text adopted by the UNFCCC parties at COP 16 in Cancun, specified that “one or more market-based mechanisms to enhance the cost-effectiveness of, and to promote, mitigation actions” should take into account, among other considerations:

- (c) “Stimulating mitigation across broad segments of the economy;
- (d) Safeguarding environmental integrity; [and]
- (e) Ensuring a net decrease and/or avoidance of global greenhouse gas emissions;”²⁷

Item (c) provides the context for “scaling-up” under new market mechanisms as discussed throughout this document. Item (e), as noted above, is discussed in Section 2.3.3.

3.1.1 Safeguarding environmental integrity

Safeguarding environmental integrity, item (d), is the most commonly articulated consideration in designing and implementing all mechanisms. In the context of crediting mechanisms, safeguarding environmental integrity requires ensuring that use of a crediting mechanism does not lead to a net increase in global GHG emissions relative to a scenario without the crediting mechanism. This is a necessary minimum condition for effective crediting mechanisms.²⁸ Along with the closely-related question of additionality determination, baseline setting is typically the element of crediting mechanisms with the greatest impact on environmental integrity. Therefore, Guidance Users need to ensure that, overall²⁹, only GHG reductions below BAU emission levels – or a level even lower (i.e., more stringent) than BAU – are credited, or otherwise claimed. Robust and conservative baselines are a key means to meet that objective. Thus, as noted above, Guidance Users should seek to set baselines, especially for crediting mechanisms, in a manner ensuring that they do not overstate BAU emissions, taking into account uncertainties. In this context, checking that baselines are not overstated will be a key priority of a mechanism’s regulator.

²⁷ Decision 1/CP.16, paragraph 80 (UNFCCC 2011a).

²⁸ If credits are issued for reductions that were likely to occur anyway in the absence of a crediting mechanism, for example, then the GHG mitigation goals of an emissions trading system recognizing those credits – and its environmental integrity - would be undermined, because global emissions would increase beyond what they would have been if the credits were not recognized. Safeguarding environmental integrity (and thus avoiding such a situation) is also important for the credibility of the market mechanism and to sustain public support for it as an effective tool to meet GHG mitigation goals.

²⁹ It is often helpful to maintain an aggregate perspective when considering environmental integrity. In other words, given the many factors that can affect the circumstances surrounding individual activities, it may be difficult to ensure that for every credited activity that the baseline is no greater than BAU emission levels. It is thus important to consider how baseline (and other) procedures (e.g., the crediting period or the monitoring of creditable activities) will affect overall crediting levels, and in sum, that any over-crediting is more than balanced by likely under-crediting across the crediting mechanism, or within it, across a class of credited activities.

In addition to also ensuring that emission reductions are additional and verifiable, Guidance Users will also need to consider how to avoid leakage, and thereby ensure that reductions are in fact, “real”. It will also be important to assess whether allowance costs (to emitters in a trading mechanism), credit revenue, or other financial incentive (e.g., results-based finance) would be great enough to cause production to shift location, risking negating any environmental benefit achieved. For example, in the case of a crediting mechanism, it is important to consider whether the production of a good could face an unintended incentive to shift from a region with less-GHG intensive production (and thus a lower baseline and a reduced potential to reduce emissions and generate credits) to facilities which can receive more credits or finance, as this could lead to emissions leakage, increased global emissions, and more credits would be issued than actual emission reductions. Similarly, in the case of emissions trading systems, it is important to consider the risk of creating an unintended incentive to shift production of a good from a region with a cap on emissions to facilities that are not facing a similar cap. This issue is particularly relevant where emissions-intensive, trade-exposed sectors or activities are involved. Experience thus far has shown how such risks – if not mitigated – can raise concerns on environmental and competitiveness grounds.³⁰

Finally, in baseline setting processes, Guidance Users should also seek to anticipate and ultimately avoid perverse incentives that might artificially boost production. Where credit revenue or result-based finance is sufficient, and indexed to production levels, producers could seek to increase levels of activity (make more of the product than they otherwise would) simply to gain credit revenues. The groups of activities where the potential for this effect is most likely to be significant is limited (e.g., destruction of high GWP gases); in the context of these activities Guidance Users will need to carefully consider baseline setting to limit such risk, and consider whether other mechanisms may be more appropriate.

3.2 General principles

Numerous basic principles have been suggested for GHG project accounting generally and for baseline setting in particular (WBCSD and WRI, 2005; Hayashi and Michaelowa, 2012). Combining these general accounting principles with elements of the UNFCCC decisions noted above, a general list of principles can be defined. Throughout the process of developing baselines, Guidance Users should keep the following key principles in mind:³¹

- **Accuracy**, reducing uncertainties, subjective judgment, and bias in measurements, estimates, or calculations as in much as is practical, given the fundamental “unknowable” nature of a counterfactual baseline. While baselines themselves cannot be characterized by accuracy, the data and parameters used to calculate them can be.³²

³⁰ Researchers have found this activity shifting, or emission leakage, has likely occurred with adipic acid facilities, with production shifting from capped regions and facilities that emit fewer N₂O emissions to CDM project facilities that gain CERs for reducing N₂O emissions (Schneider, Lazarus, and Kollmuss 2010). On the other hand, research has also suggested that for other sectors, particularly the production of energy-intensive products, leakage is unlikely to have occurred at CER prices observed to date (Erickson et al. 2011).

³¹ Adapted from the GHG Protocol for Project Accounting (WBCSD and WRI 2005) as well as other work that builds on the CDM and other established crediting programs (Daisuke Hayashi and Michaelowa 2012).

³² For example, fuel use data can be used to calculate a grid emission factor can be considered more or less accurate, but whether that grid emission factor is an accurate representation of the electricity generation that would have otherwise occurred is difficult to say.

- **Conservativeness**, using assumptions, values, and procedures that are more likely to underestimate than overestimate GHG reductions where uncertainties³³ cannot otherwise be reduced. Conservativeness is a means of safeguarding environmental integrity, which is discussed further below.
- **Practicality**, developing methodologies that are as simple as possible in light of accuracy and environmental integrity considerations, bearing in mind data availability and quality, and costs and capacity to implement.
- **Completeness**, considering all relevant information and factors that may affect the accounting and quantification of GHG reductions. All relevant technologies or practices should be considered as potential elements of a baseline.
- **Consistency**, using data, methods, criteria, and assumptions that allow meaningful and valid comparisons over time and across units, activities, and mechanisms.
- **Transparency**, providing clear and sufficient information for reviewers to assess the data sources used to develop baselines and the methods used to establish them.
- **Predictability**, seeking to maximize the ability to anticipate (ex ante) how baselines might affect the calculation of the number of credits issued, allowances distributed, or other amounts, in order to enhance certainty and planning for investors and other stakeholders.

As well as, more specifically, following the UNFCCC decision texts:

- **Verifiability**, providing the ability to verify the data upon which a baseline is calculated and that an agreed baseline methodology has been followed.
- **Ability to account for additionality**, ensuring in an adequate manner that emission reductions are not attributed to actions or activities that would have otherwise occurred absent the mechanism in question, or where that is not possible, that supplementary procedures, such as separate additionality tests, are used.
- **Ability to account for leakage**, ensuring that emission reductions are real, and not undermined by increases in emissions outside the mechanism boundary.
- **Avoidance of double counting**, ensuring that emission reductions are not also claimed by other mechanisms, units, or activities.

Given variations in context and differences in individual mechanisms, Guidance Users may place different emphasis among these and potential other principles. In practice, a list of agreed principles can be used as an assessment tool when evaluating options and choices in baseline development, for example, among predictive models, simple extrapolations of past trends, or empirical data from control groups for establishing BAU baselines (Section 7).

As they develop baselines, Guidance Users will likely find that tradeoffs can arise among principles and that decisions involve finding an appropriate balance among them. For example,

³³ Acceptable levels of uncertainty will depend on the objectives for the mechanism and intended use of quantified GHG reductions. At a minimum, there must be a high level of confidence that baseline levels are not above expected BAU levels, using reasonable assumptions.

there may be tension between accuracy (e.g., using the most likely value of a given parameter) and conservatism (e.g., using a lower bound value of this parameter to reduce the risk of over-crediting), or between completeness (e.g., seeking to assess and account for all factors influencing a baseline) and practicality (e.g., focusing on those parameters and factors that can have a material impact on the baselines – and any claimed emissions credits – in a way that it keeps administrative and transaction costs associated with baseline development and assessment at a reasonable level).

In the context of crediting mechanisms, Guidance Users will need to consider that the more conservative the baseline is, the fewer the credits implementing entities may receive for a given amount of GHG reductions. In some cases, the effect of conservatism will only be to enhance the environment integrity of the mechanism. In other cases, conservatism could reduce the amount of credits awarded sufficiently to affect whether otherwise economically efficient mitigation actions are pursued. This tradeoff is most likely to occur where activities are highly dependent on credit revenues in order for investment to occur and operation to continue.

3.3 Technical considerations

Guidance Users will need to consider data requirements in selecting among various options for baseline determination, (as well as in determining the scope and coverage of mechanism as discussed in Section 5. Data quality and availability will influence the practicality, robustness, and verifiability of baseline approaches, and can affect whether a given group of sources or segment of the economy is suitable for a market mechanism. For example, performance standard approaches are often the most data-intensive of baseline approaches.

Experience suggests that in some cases, even where adequate data may exist, industries may be reluctant to share information given confidentiality and competitiveness concerns. As a result, Guidance Users may need to develop provisions or agreements that enable access to industry-sensitive data, where legitimate confidentiality concerns exist.

Guidance Users considering the use of more complex and modeling-based approaches (discussion of models Section 7.2) may need to examine whether local capabilities and adequate data exist to use them effectively. Regardless of the approach chosen, Guidance Users will need to ensure that the technical basis chosen (data, models, and assumptions) provides a sufficient degree of confidence in the appropriateness and environmental integrity of the baseline methodology.

PART II: The Baseline Development Process

The following chapters present a general step-by-step process to assist Guidance Users in the development and updating of baselines. Section 4 provides an overview of institutional and stakeholder considerations in developing a baseline (Step 0). Sections 5 through 10 then present step-wise approach to the technical process involved in establishing and updating a baseline, as shown in Figure 3. The general process is to first develop one or more BAU baseline scenarios (Steps 1-3). Next, depending on policy objectives (as described in Section 2.3), Guidance Users may wish to also develop baselines scenarios reflecting performance standards or a net mitigation objective (Step 4). Lastly, after considering updating policies and processes (Step 5), a final baseline is selected from the alternatives that have been developed (Step 6). The main elements of each step are as follows:

- **Step 1: Define the coverage, scope, and time period of the baseline.** The first step in developing a baseline is to clearly define the kinds of activities and facilities to which it applies. This will depend on the coverage and scope of the crediting mechanism (or other policy being implemented). It is also important to define the time period over which the baseline will be projected, i.e., when will it start and when will it end?
- **Step 2: Identify appropriate metrics for quantifying baseline GHG emissions.** As described in Section 2.4, baseline GHG emissions will be a product of activity data and GHG intensity. The appropriate metric(s) for measuring activity and GHG intensity will depend primarily on the baseline’s scope and coverage, but will also be influenced by considerations about how best to quantify the effects of GHG mitigation actions. In some cases, considerations about appropriate metrics may lead to adjustments to the baseline’s scope and coverage.
- **Step 3: Develop one or more BAU baseline scenarios.** The next step is to develop a scenario (or multiple scenarios) for how baseline GHG intensity (or absolute emissions) will *likely* evolve over time. Conceptually, there are a number of factors to consider in developing a baseline scenario, such as the nature and composition of baseline activities/facilities and how this composition may change over time due to legal, economic, or physical factors. In practice, there are a range of methods that can be used to develop a baseline scenario, with varying degrees of complexity, transparency, and credibility in terms of plausibly representing “business as usual” trends.
- **Step 4: Develop additional baseline scenarios, as appropriate.** Depending on the nature and objective of the mechanism in question, Guidance Users may wish to develop additional baseline scenarios that go beyond (i.e., below) BAU. If the objective of the mechanism is to yield a net decrease or avoidance in emissions, then various options for achieving such a net mitigation benefit need to be considered, including (for market mechanisms in particular) ambitious baselines that go beyond (below, in emissions terms) a conservative BAU level. Performance-standard baselines are example of a baseline type that may deliberately depart from BAU, either to achieve added mitigation benefit or simply to reward only top performers.
- **Step 5: Consider baseline period and updating policies and processes (and how they might affect baseline determination).** Providing certainty and predictability regarding

baseline emissions can be important for attracting investment in GHG mitigation actions. At the same time, baselines must be periodically reviewed and updated to maintain their credibility and adherence to policy goals. Balancing these objectives requires coming up with clear rules for how long a baseline will remain valid and clear procedures for how it may be revised. In some cases, requirements and considerations for updating may influence the choice of method used to develop a baseline.

- **Step 6: Evaluate and select a baseline.** The final step is to finalize the baseline by selecting from among the baseline scenarios developed in Steps 3 and 4³⁴. For intensity baselines, the final baseline will be a projection of GHG emissions intensity over time. For absolute baselines, the final baseline will be a projection of GHG emissions.

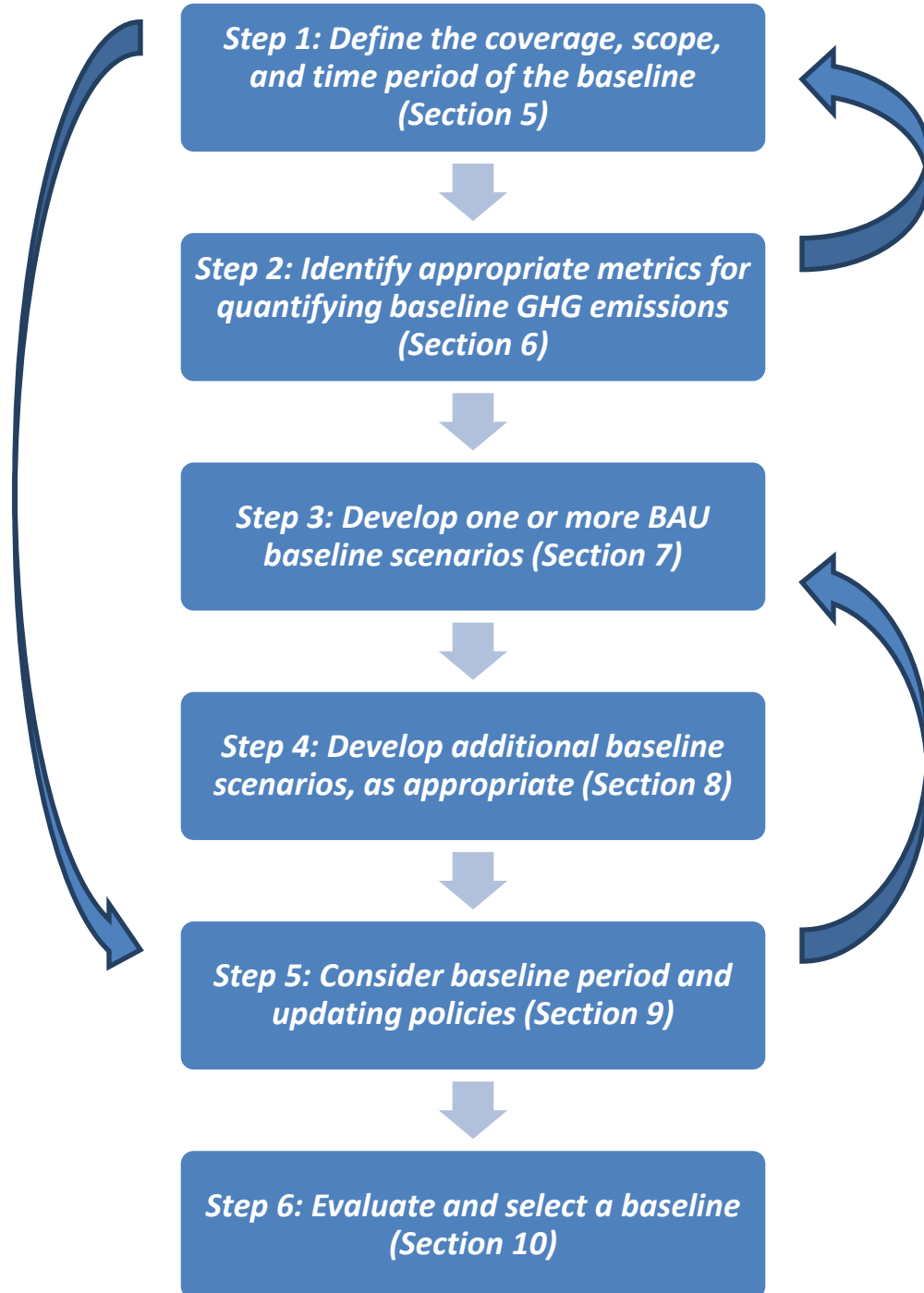
Some of these steps may be iterative. For example, Guidance Users may find that the process of identifying appropriate metrics for quantifying GHG emissions may lead to revisions in how the scope and coverage of a baseline is defined (Steps 1 and 2). Likewise, requirements for updating a baseline (Step 5) may influence decisions about the methods used to develop a baseline scenario (Steps 3 and 4), and will themselves depend on the valid length of the baseline (Step 1).

The details of any baseline development exercise will depend on the particular sectors and activities to which the baseline applies, available data and resources, and the principles and policy considerations discussed in Part I of this document. Furthermore, Guidance Users will need to consider what may be the appropriate institutional and stakeholder processes used for baseline development and approval, as they will have an important influence on how these steps are implemented.

Short examples are provided to help clarify key concepts, explain considerations involved, and elucidate tradeoffs in design decisions and/or methodologies employed.

³⁴ As noted earlier, the baseline will also need to be validated/checked/approved by the mechanism's regulator.

Figure 3. Technical Process for Developing a Baseline



4 Step 0: Establish Institutional and Stakeholder Process

This document is largely focused on the technical elements and considerations Guidance Users need to keep in mind in the development of baselines. This section, in contrast, describes options for how one can establish an institutional process and procedures for baseline development and approval. However, the section does not provide guidance on how the baseline should be audited against policy objectives or other criteria, as this subject lies outside the scope of this document.

Core Concepts:

- **The processes used to develop and update baselines are key to ensuring their credibility, acceptance, and effectiveness in quantifying and evaluating the effects of GHG mitigation actions associated with a mechanism.**
- **Specific procedures and processes for developing baselines will depend on national circumstances and the nature of the mechanism involved**
- **It is important to clarify upfront, to the extent possible, the resources that will be required in developing a baseline and where those resources can be obtained, including identification of relevant government and non-government organizations and institutions**
- **For baseline development, approval, and review, governments may consider clarifying procedures for:**
 - **Public stakeholder review**
 - **Engagement and consultation with affected sources, industries, sectors, companies, and organizations**
 - **Domestic and international peer review**

There are four key elements of the institutional process related to baseline development:

1. Development of standards/guidelines for baseline development
2. Development of proposed or draft baselines or baseline methodologies for specific mechanisms
3. Review, approval, and revision of baselines or baseline methodologies
4. Process for stakeholder engagement and peer review

Various market mechanisms have employed different institutional models for developing draft baselines or baseline methodologies, as laid out in Table 5. (Baseline methodologies are generally used in project-based crediting mechanisms where the precise baseline values may vary from project to project, but not necessarily the underlying algorithm and procedure to calculate baseline emissions). Some project-based mechanisms such as the CDM and VCS have relied largely upon project proponents to develop and propose draft methodologies which are then reviewed (e.g., by third-party validators and/or program authorities), approved, and subsequently revised (if needed) by the program administrator (e.g., the CDM Executive Board and its methodology panels).³⁵ This “bottom up” style of approach may be best suited for situations where the objective is to stimulate the development and adoption of a large number

³⁵ The CDM Executive Board and methodology panels have also led the development of “consolidated” methodologies that bring together common elements of individually submitted methodologies for similar project types in order to achieve greater consistency and standardization.

of diverse methodologies to cover a broad scope of potential activities. It requires relatively low upfront administrative investment, but relies on there being sufficient incentive for project proponents to develop and propose methodologies. Other project-based programs, such as CAR, have used a more top-down approach where the program administrator leads a multi-stakeholder workgroup in the development of draft baseline methodologies for a restricted scope of eligible activities which are approved after a period of public review. This approach requires significantly more programmatic resources to implement. Most existing project-based programs (e.g., RGGI, CAR, ACR, VCS, CDM/JI) incorporate both bottom-up and top-down elements to some degree. Most programs, for example, have program-wide standards and guidance that individual baseline methodologies follow, even where methodologies may be developed in “bottom up” fashion.³⁶

Top-down approaches tend to be developed by a technical working group made up of program administrators and stakeholders. Program administrators may be technical staff, as in the case of the voluntary programs, or various governmental agency staff in the case of regulatory programs, such as RGGI. Bottom-up approaches rely on project proponents to develop and submit baseline methodologies. Programs that use a bottom-up approach, such as CDM, VCS and ACR, use review by technical experts and auditors to evaluate methodologies submitted. Stakeholder and/or public review of draft baseline methodologies is common across all programs. Program administrators or governing boards most often make the final determination on baseline methodology approval.³⁷

For emissions trading systems, program administrators, as well as policy makers, play the central role in developing baselines, caps, and allowance distribution benchmarks. Both the EU and California have hired expert consulting teams to assist with the often highly technical work of developing sector- or product-specific benchmarks.

There is no direct experience to date with institutions for new scaled-up mechanisms, such as sectoral crediting and trading.³⁸ Therefore, while lessons can be learned from the existing crediting and trading systems, new models may need to be developed. Some PMR Implementing Countries may soon provide new examples as they develop their respective domestic processes and institutions. At the same time, some UNFCCC Parties have proposed institutional arrangements at the international level for the development and approval of crediting or trading baselines for scaled-up mechanisms.

Questions to consider include:

³⁶ For example, the CDM and VCS have established top-down frameworks for the development of standardized baselines and other types of methodologies. Conversely, programs like CAR often rely on methodologies submitted by third parties as seed documents for top-down development

³⁷ For more information on how different offset standards function and are set-up, readers may refer to the PMR Technical Note 6: Overview of Carbon Offset Standards: Similarities and Differences (2013). It is available at www.thepmr.org.

³⁸ However, PMR Implementing Countries elaborating (or planning to elaborate) scaled-up crediting mechanism are also relying on expert consulting teams to assist them. For example, Mexico presented its final Market Readiness Proposal (MRP) at the March 2013 PMR Partnership Assembly (www.thepmr.org) which outlines its plans to elaborate 3 crediting NAMAs as a scaled-up crediting mechanism. The PMR Partnership Assembly approved the funding allocation to enable Mexico carrying out the implementation of its MRP. Part of this funding is expected to be used towards the hiring of expert consulting teams.

- Is there an existing model that can be readily transferred or adapted to relevant domestic circumstances and institutional set-up? Guidance Users can draw from the experience of other mechanisms such as those described in Table 5.
- Does an appropriate, capable institution already exist or does one need to be created? Typically, market mechanisms are administered by an existing regulatory agency, as in the case of state regulatory agencies under RGGI, or by an administrative body established exclusively for the mechanism, as in the CDM's Executive Board. Voluntary offset providers are managed by a mix of Boards of Trustees, advisory committees and paid staff.
- What level of resources will be required to establish an institutional process? There are few, if any, published estimates of the cost associated with developing a new process, or adapting an existing one. Guidance Users should consider consulting with program staff of mechanisms noted in this document (e.g., Table 5).
- Which stakeholders should be included in the baseline development process and in what manner? When would stakeholder input be most valuable? When and under what mode of engagement would domestic and/or international stakeholders be consulted? What checks and balances can be incorporated to safeguard environmental integrity? As with the other questions above, which are included here to spur discussion and consideration, the answers will depend on the local circumstances, and the objectives of a particular mechanism.

Table 5. Examples of Institutional Processes of Baseline Development and Approval

Name of Program	Development of draft baseline methodology	Review and approval baseline methodology	Process for stakeholder review and input
Trading Systems			
European Union Emissions Trading Scheme (Caps and Allowance Allocation)	Caps developed by European Commission; Allocation benchmarks developed with assistance from sectoral experts.	European Commission and National administrators	Comment process and workshops
California Cap-and-Trade Program (Allowance Allocation)	California Air Resources Board staff and consultants	California Air Resources Board	Comment process and technical workshops
Regional Greenhouse Gas Initiative (RGGI) (Caps)	State officials and regulatory staff	State officials and respective legislatures	
Crediting Mechanisms			
UNFCCC Clean Development Mechanism	Project proponents, and more recently, UNFCCC Secretariat	CDM Executive Board and its Methodology Panels	Project proponents interact with methodology panels during review process
UNFCCC Joint Implementation	Project proponents	JI Supervisory Committee	
Regional Greenhouse Gas Initiative (Offsets)	Established in RGGI Model Rule. Developed by working groups of RGGI state agency staff	State legislatures and regulatory agencies	
American Carbon Registry (ACR)	General standards developed by ACR technical staff; Project-specific methodologies developed by project proponents	ACR	Public comment period Methodologies sent out for scientific peer review
Climate Action Reserve (CAR)	Program level standards developed by CAR staff; Project-specific baselines developed as part of multi-stakeholder workgroup which includes technical staff from CAR	CAR Board	Scoping meeting gathers input prior to development; stakeholders participate in workgroups; public review and public workshop once draft developed; ongoing public feedback and updating of methodologies
VCS	Project proponents develop and submit to VCS	Accredited VCS auditor (2 rounds) Final approval made by VCS staff	30-day global public stakeholder consult of submitted methodologies

5 Step 1: Define the Coverage, Scope, and Time Period of the Baseline

Core Concepts:

- The coverage and scope of the baseline refer to the geographic area(s), sectors, and specific activities, facilities, and/or emission sources to which it applies.
- Clearly defining the coverage and scope is essential for determining how baseline GHG emissions will be quantified and for developing baseline scenarios.
- Before developing baseline scenarios, it is also important to specify the time period over which the baseline will be used.

5.1 Define Coverage and Scope

The first step in developing a baseline is to clearly define its coverage and scope. The **coverage** of a baseline refers to the sectors and geographic areas to which it applies; the **scope** refers to the specific types of activities, facilities, or emission sources it covers. The coverage and scope will largely be determined by the nature and objective of the mechanism for which the baseline is being developed. The (forthcoming) WRI GHG Protocol *Policies and Actions Accounting and Reporting Standard* provides a helpful checklist of information that can be used to clearly define the coverage and scope of a mechanism (or other policy or action).³⁹ Key items Guidance Users will likely need to address include:

- Which greenhouse gases are being targeted?
- What is the mechanism’s intended geographic coverage?
- What specific interventions or **GHG mitigation actions** are being targeted or encouraged?
- What is the intended outcome or effect of these interventions or activities?
- Which activities, practices, technologies, facilities, installations, systems, and/or processes will these interventions or activities affect?
- What specific emission sources will be affected and where are they located?

Table 6 provides some examples of how possible mechanism objectives can lead to different scope and coverage definitions.

Table 6. Examples of Coverage and Scope Definitions

	Mechanism Objective	Targeted GHG Mitigation Actions	Coverage	Scope
1	Promote GHG reductions in grid-connected electricity production	<p>Improve efficiency of existing power plants</p> <p>Improve efficiency of new power plants</p>	National power grid (defined by physical interconnections within country X)	All grid-connected power plants / generators over 5 MW

³⁹ World Resources Institute, forthcoming, Table 5.2.

		<p>Deploy renewable generation capacity</p> <p>Change power plant dispatch order</p>		
2	Reduce energy consumption & associated GHG emissions from new housing developments	<p>Improving energy efficiency of lighting</p> <p>Improving heating/cooling energy efficiency</p>	New housing developments in country X	<ul style="list-style-type: none"> • All <i>new</i> housing developments • Energy production systems serving new housing developments • Water supply systems serving new housing developments
3	Reduce CH ₄ emissions from landfills	<p>Reduce organic waste production</p> <p>Divert waste from landfills (to compost facilities, digesters, etc.)</p> <p>Capture and destroy landfill methane</p>	Solid (organic) waste sector in country X	<p>Activities and facilities generating organic waste</p> <p>Composting facilities, organic waste digesters</p> <p>Landfills</p>
4	Reduce CO ₂ emissions from cement production	<p>Switch from wet kilns to dry kilns</p> <p>Other energy efficiency improvements</p> <p>Switch to lower carbon-intensity fuel for clinker production</p>	Cement production in country X	All cement plants in country X
5	Reduce GHG emissions from freight transportation	<p>Improve vehicle fuel-use efficiencies</p> <p>Switch fuels used in transport vehicles</p> <p>Switch to less GHG intensive modes of transportation</p>	Freight transportation in country X	All modes of freight transportation (road, railway, air, water)

Guidance Users will need to clarify what GHG mitigation actions are being targeted and the precise facilities/practices⁴⁰ they will affect. This is essential for determining how baseline GHG emissions will be quantified (i.e., the metrics that will be used) and for developing scenarios for what would happen in the absence of those actions (Steps 2 and 3).

5.2 Considering Leakage Effects

As discussed in Section 2.2.1, some GHG mitigation actions may affect GHG emissions outside the coverage of a mechanism. If emissions outside the coverage and scope of the mechanism are significantly increased by targeted mitigation actions, then this increase should be accounted for as “leakage” and deducted from in-boundary GHG reductions (see equation in Section 2.2.1). Leakage can be accounted for in two ways:

1. Expanding the coverage and scope of the *baseline* to incorporate facilities/practices that are formally outside the coverage and scope of the mechanism (effectively bringing leakage effects inside the “accounting boundary” for the mechanism).
2. Separately evaluating leakage effects, e.g., through a separate baseline-setting and quantification exercise.

Generally, an approach to quantifying leakage should be established wherever the *risk* of leakage is significant.

5.3 Defining the Valid Time Period of the Baseline

Finally, it is important for Guidance Users to have a clear idea of *the time period* over which a baseline will be projected (in the case of crediting mechanisms, this period often corresponds to the “crediting period”). Key considerations in determining this time period, if it has not already been established, include the following:

- *What is the typical investment horizon and profile of mitigation costs for the kinds of activities targeted by the mechanism?* For targeted activities that produce GHG reductions over long periods and have high mitigation costs, for example, a longer (10+ years) baseline period may be desirable or even necessary to stimulate investment.
- *How rapidly and predictably are conditions relevant to the baseline changing?* Baseline estimates will almost always be based on assumptions about social, economic, technological, or physical factors that drive the production of GHG emissions. These factors will frequently change over time. The more rapidly and unpredictably they change, the more likely it is that the initial assumptions used to set a baseline will be incorrect as time passes, resulting in emissions estimates that are too high or too low. If key variables are likely to change rapidly and unpredictably, a shorter baseline period should generally be used. (It may also be important for Guidance Users to set clear and predictable triggers for the updating the baseline prior to the end of the baseline period— see Step 5.)

⁴⁰ Depending on the nature of the mechanism, targeted GHG mitigation actions may affect behaviors, practices, technologies, facilities, installations, systems, and/or processes. Since this document is written for general application, it uses the term “facilities/practices” as shorthand for these possibilities.

- *How frequently can data be obtained to update the baseline?* If a baseline will be “renewed,” i.e., updated and extended based on new data, it may be important to consider how difficult or costly it will be to obtain updated data. All else equal, it may make sense to set a baseline period that corresponds to a reasonable timeframe for acquiring the data needed to update the baseline.
- *How conservative will baseline emissions estimates be?* One way to address uncertainty about baseline emissions (and mitigate the risk of it being above actual BAU emission level) is to use conservative estimates (e.g., using assumptions or projection methods that result in lower emissions totals). Notwithstanding how much uncertainty there may be about future baseline emissions, Guidance Users may want to seek a baseline based on conservative estimates to help minimize the risk of undermining environmental integrity. In these cases, a longer baseline period may be justified. The benefits of a longer baseline period, however, would need to be weighed against the possible investment disincentives caused by a potentially over-conservative baseline (e.g., for a crediting mechanism).
- *What is the expected duration of the mechanism for which the baseline is being developed?* If it is envisioned that a market mechanism will have a limited lifetime (after which it will be replaced by some other program or policy, for example), then – all else equal – it may make sense to equate baseline periods with the duration of the mechanism. If the mechanism is expected to be in place for a long time (or indefinitely), then Guidance Users may consider setting the baseline periods according to other factors.

6 Step 2: Identify Metrics for Quantifying Baseline GHG Emissions

Core concepts:

- **To develop a baseline, Guidance Users must identify a metric, or metrics, that will be used to quantify baseline activity data and GHG intensity.**
- **Depending on the coverage and scope of the mechanism, Guidance Users may need to specify multiple metrics for different types of covered facilities/practices and their associated activity data.**
- **Different metrics may fare better or worse in terms of their comprehensiveness and their precision in quantifying the effects of targeted GHG mitigation actions (e.g., isolating those effects from other factors that may drive changes in emissions). Guidance Users may need to carefully select between alternative metrics in order to balance tradeoffs.**
- **The choice of metric may also depend on considerations about transparency, data availability, and other criteria.**
- **In some cases, consideration of the pros and cons of different metrics may lead to a decision to refine the coverage and scope of the mechanism.**

Baseline GHG emissions are often quantified as the product of two variables: *activity data* and *GHG intensity*.

- *Activity data* indicate the level of activity associated with a process that generates GHG emissions.
- *GHG intensity* indicates the amount of gas emitted per unit of activity.

Thus, to establish a baseline it is usually⁴¹ necessary to define *metrics* for quantifying these two variables. Activity data can be expressed in many different ways depending on the kinds of activities being considered. Examples of metrics include total units of industrial production, quantity of goods or services consumed, square meters of building space used, vehicle-miles traveled, etc. GHG intensity is expressed as a ratio of a quantity of GHG emissions to the activity metric, e.g., tons of CO₂ generated per unit of production, goods consumed, building space used, vehicle-distance traveled, etc.

6.1 Specifying Activity Data Metrics

Good activity metrics are those that can be used to directly and precisely quantify the activities that give rise to GHG emissions at facilities/practices covered by a mechanism. If covered

⁴¹ Absolute baselines may sometimes be estimated using a simple projection of total emissions, without explicitly considering variables for activity data and GHG intensity.. Also, for some types of targeted mitigation activities, e.g., capture and destruction of fugitive GHG emissions, it may be unnecessary to explicitly define activity data and emission factors. For these types of activities, baseline emissions may be equated with actual captured (and destroyed) emissions, for example, as measured by gas meters. In these instances, however, there may still need to be a check to ensure that the quantity of gas captured and destroyed does not exceed the quantity that would have been produced and released in the baseline. Such a “reality check” may in fact be linked to underlying activity levels, e.g., production levels of HCFC-22, which determine the amount of HFC-23 captured and destroyed as a byproduct.

facilities/practices are involved in the production of a good or service, then the right activity metric will often be a measure of that production. For example, if power plants are being covered, the obvious choice for an activity data metric would be a measure of the amount of electricity produced, e.g., megawatt-hours. Table 7 contains examples of possible activity data and GHG intensity metrics associated with the hypothetical mechanism objectives presented in Table 6.

Table 7. Examples of Possible Activity Data & GHG Intensity Metrics

	Mechanism Objective	Targeted GHG mitigation actions	Possible activity data metric(s)	Associated GHG intensity metric
1	Promote GHG reductions in grid-connected electricity production	Improve efficiency of existing power plants Improve efficiency of new power plants Deploy renewable generation capacity Change power plant dispatch order	Megawatt-hours of electricity produced	Tonnes of CO ₂ emitted per megawatt-hour produced
2	Reduce energy consumption & associated GHG emissions from new housing developments	Improving energy efficiency of lighting Improving heating/cooling energy efficiency	Square meters of new housing space constructed	Tonnes of CO ₂ emitted per square meter of housing space
3	Reduce CH ₄ emissions from landfills	Reduce organic waste production Divert waste from landfills (to compost facilities, digesters, etc.) Capture and destroy landfill methane	Tonnes of organic waste produced MWh of electricity produced from CH ₄ combustion	Net tonnes of CH ₄ emitted per tonne of organic waste produced Tonnes of CO ₂ emitted per MWh
4	Reduce CO ₂ emissions from cement production	Switch from wet kilns to dry kilns Other energy efficiency improvements	Tonnes of cements and cement substitutes produced	Tonnes of CO ₂ emitted per tonne of cements/substitutes produced, from both thermal and electrical energy consumption

		Switch to lower carbon-intensity fuel for clinker production		
5	Reduce GHG emissions from freight transportation	<p>Improve vehicle fuel-use efficiencies</p> <p>Switch fuels used in transport vehicles</p> <p>Switch to less GHG intensive modes of transportation</p>	Tonne-kilometers of freight transported for each mode category: road, railway, air, and water	Tonnes of CO ₂ emitted per tonne-kilometer of freight transportation

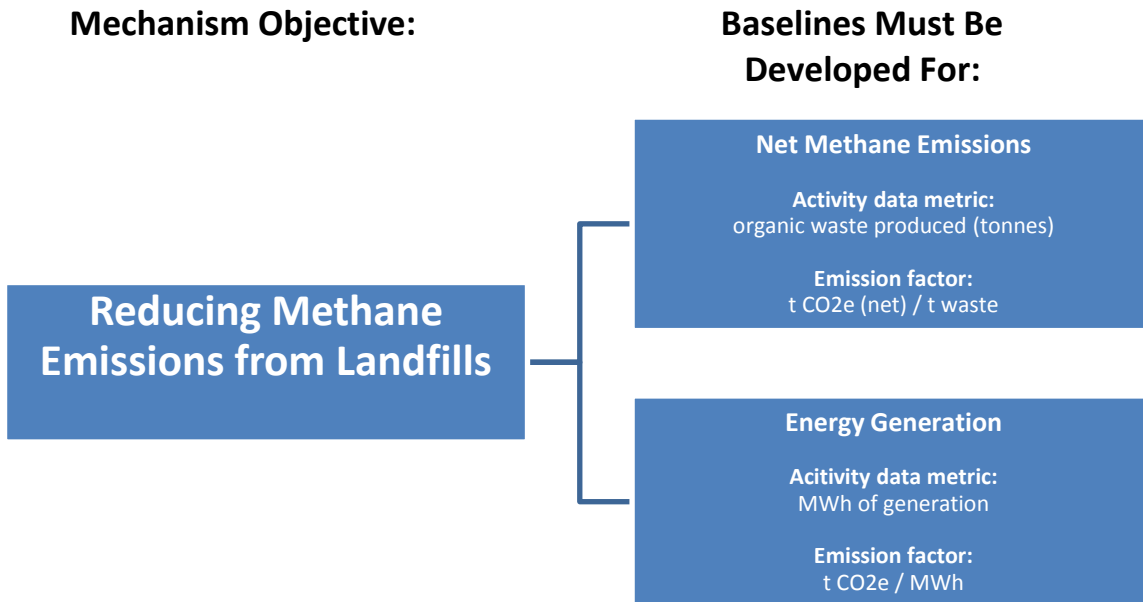
6.2 Specifying Activity Data Sub-Categories

For purposes of precisely quantifying baseline emissions, it may be desirable in some cases to specify not just an activity metric but also a distinct sub-category of activity to which the metric must be applied. In the second example in Table 5.2, for instance, activity data (square meters of building space) would be quantified only for newly constructed commercial buildings, not other building categories. In the last example (freight transportation), activity levels and GHG intensities could differ markedly for different transportation modes, making it desirable to specify the mode for which activity data must be quantified.

6.3 Considering Multiple Metrics

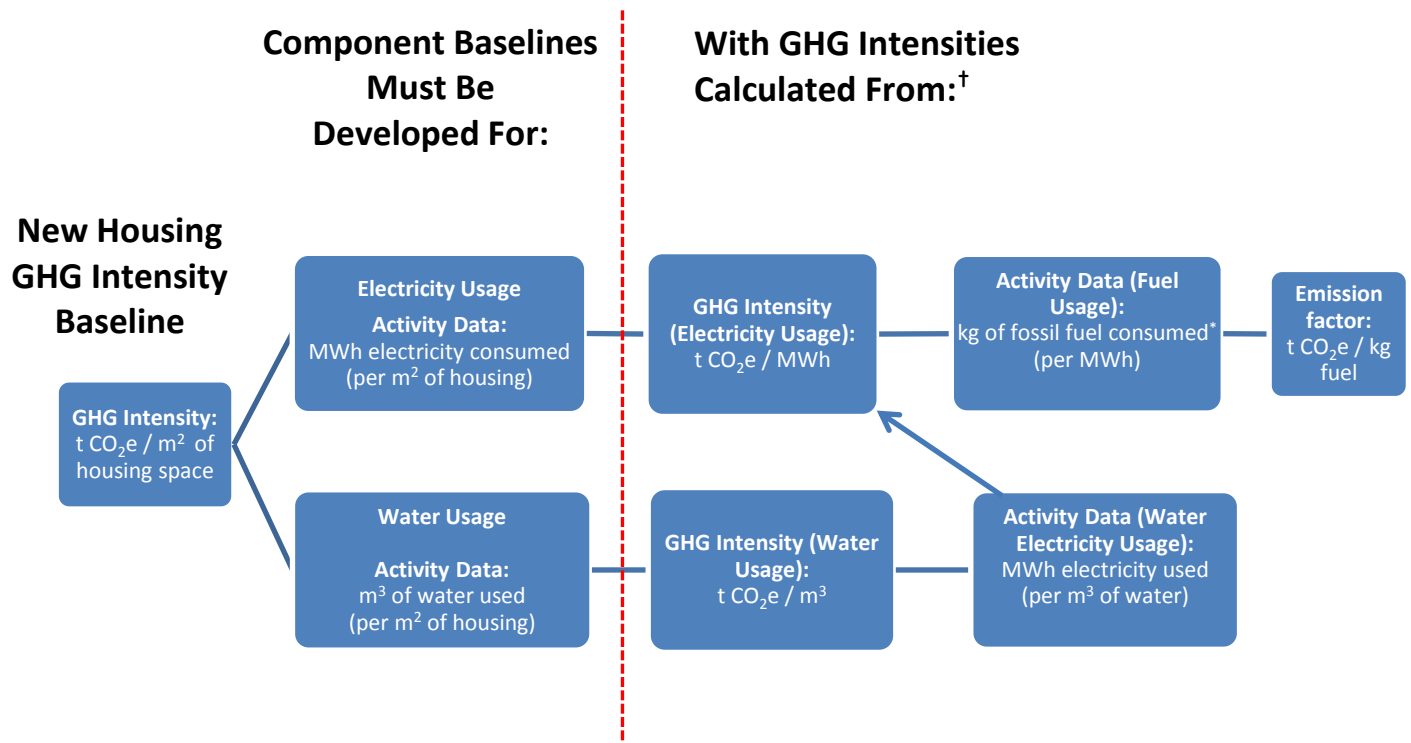
Ideally, a single activity metric can be identified that applies to the full range of facilities/practices covered by the mechanism. However, this may not always be feasible. In some cases, covered facilities/practices (and their associated GHG-producing activities) may be too heterogeneous for a single metric to be used. For example, as illustrated in Table 7, a crediting mechanism designed to reduce CH₄ emissions from landfills (example #3) might seek to encourage mitigation actions that divert organic waste (e.g., through waste reduction and diversion to composting), but could also target mitigation actions designed to capture landfill methane and use it to generate energy (electricity, heat, or pipeline-grade methane), displacing fossil fuel combustion. Thus, covered facilities/practices would include both landfills and energy generation equipment, and the overall baseline for this type of mechanism would need to be represented using two sets of activity and GHG intensity metrics – one for net landfill methane emissions and one for GHG emissions from energy generation. In practical terms, this means the “baseline” for a mechanism may in fact consist of multiple components corresponding to the activities being quantified (Figure 4). Each of these components may need to be established through its own baseline development exercise (in Step 3).

Figure 4. The “Baseline” for a Mechanism May Consist of Multiple Components with Separate Activity Data Metrics/Categories



In addition, it is important to note that the GHG intensity of an activity may be a product of component activities, each with its own GHG intensity factor. For example, energy consumption in new housing developments (example #2 in Table 7) could have a baseline GHG intensity defined as tonnes of CO₂e per square meter of housing space. Emissions, however, would be a function of electricity consumption, gas consumption, water consumption, and other factors. In principle, then, the baseline could be constructed by estimating baseline activity levels for each of these factors and multiplying by their respective GHG intensities (Figure 5 presents a partial example). (However, if a simple projection is used to estimate baseline GHG intensity per square meter, then a detailed analysis of these components could be avoided; see Section 7.2 for guidance on different baseline development methods.)

Figure 5. Partial Derivation of Baseline GHG Intensity of Energy Usage for New Housing Developments⁴²



* to be determined for each type of fossil fuel

† Baseline values for these variables may be assumed to be equivalent to actual measured values. However, if the effect of a mechanism is large enough that it might alter marginal GHG intensity (e.g., from water usage or energy usage), then component baselines may need to be developed for these factors as well.

Note that even though the overall baseline for new housing would be expressed in terms of GHG intensity (t CO₂e / m² of housing space), emissions per square meter would depend on the relative activity levels for electricity usage and water usage (combined with their respective GHG intensities). Thus, the components for electricity and water usage would require *ex ante* projection of baseline activity levels.

⁴² The full GHG intensity may depend on additional factors not presented here, e.g., heating oil use. This partial examples is intended merely to illustrate some of the concepts involved and relationships between variables. Water usage GHG intensity would depend, *inter alia*, on pumping and desalination requirements.

6.4 Assessing Activity Data Metrics and Categories

Quite frequently, a range of options will exist for specifying activity data metrics and categories. Choosing among options may require confronting tradeoffs with respect to breadth of coverage, accuracy, transaction costs, data availability and effectively incentivizing targeted mitigation activities. The following are some important considerations for Guidance Users in assessing activity data metrics and categories include the following:

- Metrics that are defined too broadly – or for too broad a category of facilities/practices– may be too imprecise in quantifying GHG reductions solely attributable to targeted mitigation activities. This could be the case where the activity being quantified is not the sole driver of relevant emissions. As a very basic example, the GHG intensity for an entire electricity grid would likely be too imprecise a metric for quantifying the effects of GHG mitigation actions targeted exclusively at improving the efficiency of coal-fired power plants.
- Metrics that are defined too narrowly – or for too narrow a category of facilities/practices – may fail to incentivize desirable mitigation activities and in some cases create leakage risks. For example, a focus on improving the GHG intensity of rail transportation (e.g., t CO₂e per passenger-kilometer traveled on rail) might forego opportunities to reduce emissions from other transportation modes, and could even lead to increased emissions from those modes if there is a resulting shift in transportation patterns (e.g., from rail to road). This could also indicate a problem with the way the coverage and scope of a mechanism are defined.
- Defining metrics with a high degree of specificity raise issues with respect to data availability and acquisition costs. Guidance Users may need to consider the different ways in which data for relevant activities can be (or are being) collected.

Table 8 presents some examples of these considerations applied to two of the hypothetical mechanisms presented in Tables 5.1 and 5.2, focusing on cement and transportation (examples #4 and #5).

Table 8. Examples of Pros and Cons Associated With Options for Activity Data and GHG Intensity Metrics

	Objective of Proposed Mechanism	Metric & Category Options	Pros	Cons
4	Reduce CO ₂ emissions from cement production	Activity: Tonnes of cement produced GHG intensity: t CO ₂ e from total energy consumption (thermal & electrical) per tonne of cement produced	Incentivizes a range of efficiency-improving mitigation options	Imprecise, because sales or purchases of clinker (a component of cement) would affect the apparent energy (and emissions) intensity of production.

		<p>Activity: Tonnes of cement produced</p> <p>GHG intensity: t CO₂e per tonne of cement produced, broken out separately for thermal and electrical energy consumption</p>	<p>Greater precision, because apparent thermal energy intensity will not be affected by clinker sales/purchases</p>	<p>Still somewhat imprecise, because apparent electrical energy intensity will still be affected by clinker sales/purchases</p>
5	Reduce GHG emissions from freight transportation	<p>Activity: Freight vehicle-kilometers traveled (all modes)</p> <p>GHG intensity: t CO₂e / vehicle-kilometer traveled</p>	<p>Can be used to evaluate effects of improved vehicle efficiency and fuel switching, and possibly modal shifting.</p> <p>Data on vehicle-kilometers traveled may be more easily acquired than tonne-kilometers (which would require data on freight quantities)</p>	<p>Too imprecise because vehicle-kilometers are not the sole driver of GHG emissions; GHG emissions may vary by weight of freight moved and by mode of transportation.</p> <p>Problematic for assessing the impact of modal shifting activities since different modes are likely to require different traveling distances.</p> <p>Using a single, consolidated metric for all modes means that GHG intensity improvements may be masked by changes in distances traveled among different modes.</p> <p>Would not capture or incentivize efforts to reduce the number of vehicle-kilometers traveled (e.g., through spatial planning or modal shifting)</p>

		<p>Activity: Tonne-kilometers traveled broken out by each mode of transportation (road, rail, air, water)</p> <p>GHG intensity: t CO₂e / tonne-kilometer traveled for each mode</p>	<p>Can be used to evaluate effects of improved vehicle efficiency and fuel switching.</p> <p>Better at capturing underlying drivers of emissions, i.e., both tonnage of freight and kilometers traveled.</p> <p>Specifying metrics separately for each mode allows accurate quantification of GHG intensity improvements within each mode, unaffected by variations in distance traveled between modes.</p>	<p>May be harder to acquire necessary data (including tonnage of freight for each mode).</p> <p>Not good for assessing the impact of modal shifting since each mode is quantified separately.</p> <p>Would not capture or incentivize efforts to reduce the number of vehicle-kilometers traveled (e.g., through spatial planning or modal shifting)</p>
		<p>Activity: Tonnes of freight transported (all modes)</p> <p>GHG intensity: t CO₂e / tonne of freight transported (all modes)</p>	<p>May capture effects of improved vehicle efficiency, fuel switching, and modal shifting.</p> <p>Could incentivize actions to reduce vehicle-kilometers traveled (through spatial planning & modal shifting), thereby reducing GHG emissions.</p>	<p>May be difficult to acquire freight tonnage data.</p> <p>Effects of mitigation activities may be obscured by exogenous changes in distance traveled (e.g., if freight transportation patterns & destinations change), since a key driver of emissions (kilometers traveled) is not controlled for.</p>

6.5 Specifying Final Activity Data Metrics & Categories

As the examples in Table 8 demonstrate, Guidance Users may find that there is no single “best” choice of a metric (or metrics) for baselines. The appropriate metric will depend on the intended coverage and scope of the mechanism and tradeoffs involved in choosing alternative activity data metrics and categories. The Guidance Users may want to keep in mind the following considerations when assessing the tradeoffs of different options and choosing metrics and categories:

- *Costs of data acquisition.* For some types of metrics and categories it may be difficult or costly to acquire activity data, notwithstanding their advantages.
- *Accessibility and verifiability of data.* Related to data acquisition costs, it may be important for data to be readily accessible by independent validators and verifiers.
- *The general principles of baseline development (Section 3.2).* For example, different metrics may fare better or worse with respect to yielding “real” reductions (e.g., not apparent reductions based on changes unrelated to targeted mitigation activities), transparency, avoiding perverse incentives, practicality, predictability, and completeness.
- *The scale of the mechanism and associated implementing entities.* If a particular subgroup of actors will be responsible for implementing mitigation activities and their performance needs to be directly measured (e.g., for crediting purposes), then activity data metrics and categories should be identified that are specific to their activities. For example, notwithstanding the full scope of a transport sector crediting mechanism, if the intention is to directly credit operators of passenger-bus fleets, then a baseline would need to be specified using activity metrics appropriate for quantifying GHG emissions from passenger-bus fleets.
- *The market for tradable units.* For emissions market mechanisms, buyers of tradable units may put a particular emphasis on certain principles or criteria (Section 3.2), or may require that certain metrics be used for transparency and consistency with other mechanisms or programs.

There may be cases where Guidance Users face situations where the apparent tradeoffs involved in choosing among possible metrics lead to a reconsideration of the coverage and scope of the mechanism. If assessing activity data metrics suggests that leakage may be a concern, for example, it may make sense to revise and expand the scope of the mechanism (e.g., expanding the scope from one mode of transportation to several modes). Alternatively, a broadly defined metric may lead to imprecision in quantifying the effects of mitigation activities, requiring either a refinement to the coverage and scope of the mechanism or the disaggregation of a baseline into multiple components. In the end, Guidance Users may be able to accept imprecision if it can be ensured that there is no systematic over-estimation of the baselines and credits.

7 Step 3: Develop One or More BAU Baseline Scenarios

A “baseline scenario” is a projection of the GHG intensity (or total GHG emissions) of the facilities/practices covered by a mechanism under an assumed set of future conditions. A “business-as-usual” (BAU) baseline scenario is one that is based on assumptions about what would *most likely occur* in the absence of the mechanism, including the appropriate assumptions on other policies and measures that might affect emissions within the boundaries of the mechanism.⁴³ Because baseline conditions are counterfactual and inherently uncertain, Guidance Users may be well advised to seek to develop multiple baseline scenarios using different assumptions about physical, economic, or policy constraints to cover a range of possibilities.

This section is divided into two sub-sections. The first sub-section describes important factors to consider in developing a baseline scenario. The second sub-section describes, and presents examples of, different methods that may be used to develop baseline scenarios. Different methods can vary in their complexity and in the degree to which they explicitly address conceptual elements. The section ends by describing how multiple baseline scenarios can be generated using the methods chosen.

7.1 Factors to Consider in Developing a BAU Baseline Scenario

Core Concepts:

- **Developing a BAU baseline scenario involves assigning values for baseline GHG intensity (and, for absolute baselines, activity levels) based on assumptions about future conditions that might hold in the absence of the mechanism and any other future policies and measures that might affect emissions.**
- **In principle, developing a BAU baseline scenario requires:**
 - **Projecting GHG intensity based on:**
 - **The expected mix of existing, modified, and new (greenfield) facilities/practices that would be deployed to achieve baseline activity levels**
 - **The expected combined emission rate of these facilities/practices**
 - **Projecting activity levels (for absolute baselines)**
- **In theory, making these projections requires a detailed understanding of the various drivers affecting GHG intensity and (possibly) activity levels under baseline conditions. In practice, methods for developing baseline scenarios may not explicitly account for underlying drivers.**

⁴³ For crediting mechanisms, establishing a scenario for what would most likely occur is important for ensuring environmental integrity: such a scenario forms essentially the upper bound of potential baselines that can be consistent with the aim of safeguarding environmental integrity. Baseline scenarios that result in higher emissions (or emission rates) than would likely have occurred in the absence of a crediting mechanism can lead to over-crediting of GHG reductions, undermining the credibility and integrity of the mechanism.

This section provides an overview of various considerations that Guidance Users may need to take into account, either quantitatively or qualitatively, depending on the complexity of the method, in developing a BAU baseline scenario.

For intensity baselines, developing a baseline scenario requires only a projection of GHG intensity over time, as quantified using the metric(s) specified in Step 2. Absolute baselines require projecting both activity levels and GHG intensity.

7.1.1 Considerations in Defining BAU Conditions

A BAU baseline scenario is one that reflects reasonable assumptions about what would most likely occur in the absence of a policy or mechanism. A very detailed description of BAU conditions would consider all the drivers affecting GHG intensity (or absolute emissions) for the facilities/practices covered by the mechanism, and attempt to characterize the influence of those drivers over time in the baseline. Depending on the context, key BAU drivers may include:

- Physical or environmental conditions;
- Economic conditions;
- Infrastructure constraints;
- Available resources;
- Input and output prices (including fuel and other commodities);
- Production or other activity levels;
- Technology characteristics;
- Common practices or behaviors;
- Laws and regulations;
- Governmental policies and/or development priorities.

As discussed in Section 7.2, not all methods for developing baseline scenarios are explicit about modeling underlying drivers and their effects. Nevertheless, Guidance Users may find it useful to consider how well the assumptions used in a baseline projection align with common expectations about key drivers or conditions. Some factors to consider include:

- *Alignment with existing (government) forecasts and/or national baseline projections.* Official forecasts – e.g., related to physical conditions, economic conditions, commodity prices, etc. – can provide a transparent basis for informing the assumptions used in developing a BAU baseline scenario. In particular, the models and assumptions used to develop national GHG emissions baselines, for domestic planning purposes or international reporting, may be useful in informing BAU baselines for policies or mechanisms.⁴⁴ Consistency with established forecasts can help bolster transparency and consistency with existing policy contexts⁴⁵.

⁴⁴ See, for example, Danish Energy Agency, OECD, and UNEP Risoe Centre 2013.

⁴⁵ There may be cases where projections may be developed in a way that is optimistic in terms of projected activity – which may be completely legitimate in the context of the main purpose of the projections. In such cases, it may thus make sense (for the purpose of safeguarding environmental integrity) for Guidance Users to use different assumptions and/or model results. The key will be to explain such differences.

- *Treatment of existing and planned policies and legal requirements.* One question that may arise in defining BAU conditions is how to treat governmental policies and legal requirements. Longstanding policies and legal requirements are usually considered part of BAU, i.e., they are taken into account in determining BAU drivers and conditions. How to deal with recently adopted policies and laws, with those that are not currently or expected to be fully or effectively implemented, or those being actively contemplated at the time a baseline is developed, may present more of a challenge. On the one hand, some observers may see such policies as distinct from the mechanism and therefore argue that they should be considered part of BAU, just like longstanding, well-implemented policies. This argument rests on the assumption that the policies or laws would be adopted and implemented regardless of the mechanism. On the other hand, treating all yet-to-be adopted or implemented laws and policies as part of the baseline could create a perverse disincentive against their future adoption and implementation. Furthermore, in some contexts new laws and policies may be adopted for the express purpose of achieving broad-scale emission reductions targeted by a mechanism. Renewable portfolio standards, for example, may be implemented to help achieve reductions under an emissions trading system or a sectoral crediting program.

Under the CDM, a detailed set of rules has been established regarding the treatment of new laws and policies in relation to setting baselines for individual projects.⁴⁶ For other mechanisms, treatment of new laws and policies will likely need to part of political negotiations concerning the linkage of these mechanisms to other policy contexts. For transparency purposes, it may be desirable to develop multiple baseline scenarios reflecting the presence and absence of new laws and policies, so that their expected role in achieving emission reductions may be considered by all stakeholders.

- *Building in conservativeness.* Baseline scenarios will always be subject to uncertainty – sometimes significantly so. To ensure environmental integrity, Guidance Users should be aware that the general practice for dealing with uncertainty is to use conservative assumptions, i.e., assumptions that result in lower estimates for baseline emissions than possible alternatives (Section 2.3.1). Such assumptions could, for example, take the form of assuming lower than expected future activity levels, based on current information, or making aggressive (lower than expected) assumptions about the GHG intensity of newly deployed technologies. Conservativeness may also be reflected in assumptions about underlying drivers of activity levels and GHG intensities, e.g., input and output prices, economic conditions, common practices, etc.

7.1.2 Considerations in Projecting Baseline GHG Intensity

In conceptual terms, baseline GHG intensity will depend on the composition, emission rates, and relative activity levels of all facilities/practices covered by a mechanism. As described in Section 7.2, some kinds of simulation models may try to discretely model the behavior of individual baseline facilities/practices over time. Other baseline development approaches, however, will not explicitly address the details of individual facilities/practices or the drivers affecting their

⁴⁶ See, for example, <http://cdmrulebook.org/1628>.

GHG emissions. Nevertheless, in assessing the usefulness and credibility of various approaches, Guidance Users may find it helpful to consider the factors that would go into an “ideal” analysis.

A detailed approach to estimating baseline GHG intensity might entail the following:

1. *Identifying all facilities/practices within the coverage and scope of the mechanism.* In principle, this means identifying any facilities/practices within the geographic area covered by the mechanism that could contribute to relevant activity levels, as defined by the metric(s) specified in Step 2. This may include some combination of:⁴⁷
 - a. Already existing facilities/practices at the start of the period in question;
 - b. Existing facilities/practices that would have changed or been upgraded over the course of the period in question;
 - c. Facilities/practices that would have been newly deployed or constructed over the period in question (i.e., “greenfield” facilities/practices).
2. *Characterizing the emission rates of identified facilities/practices.* The most detailed approach would involve identifying emission rates associated with each individual activity or facility expected to be present in the baseline.
3. *Characterizing the relative contribution of identified facilities/practices to total baseline activity levels.* Again, an approach would be to determine the exact level of activity at each individual activity or facility expected to be present in the baseline.⁴⁸

Characterizing these factors requires evaluating the effects of underlying drivers. Key drivers could include:

- *Rates of retirement and retrofits for existing facilities/practices, and growth and market penetration of new facilities/practices and their associated technologies/practices.* Both of these variables may depend on how overall activity levels (e.g., industry production levels) evolve over time. If production levels remain steady, for example, construction rates for new facilities/practices may remain low. If they grow over time, new activities/sources may achieve greater rates of market penetration.

⁴⁷ Some of these categories may or may not be necessary to consider, depending on the scope of the crediting mechanism and targeted mitigation activities. For example, some crediting mechanisms may be designed to achieve reductions in GHG emissions only at existing facilities. An example would be a program to credit reductions from retrofitting existing buildings. Other mechanisms may be designed to target only new facilities, e.g., incentivizing energy efficient designs for new commercial buildings or housing developments. Note that even if a mechanism is designed to target only existing facilities, it may be necessary to consider “new” alternatives in the baseline. For example, if an existing facility is retrofitted or retired, baseline emissions may depend on what the alternative retrofit or replacement technology would have been in the absence of the crediting mechanism.

⁴⁸ Note that the relative contribution of individual activities/facilities to overall activity levels may vary according to total activity and other factors. On a power grid, for example, different mixes of power plants will be dispatched to provide electricity at different load levels. In theory, this means that emission factors could vary for different activity levels. In practice, emission rates for baselines are usually fixed according to *ex ante* assumptions. Thus, even though actual activity levels may fluctuate over time, the assumed baseline GHG intensity will usually be fixed (either as a single estimate or a trajectory). What this means, however, is that even for intensity baselines it may be necessary – in principle – to make assumptions about average levels of activity over the baseline period in order to inform emission factor estimates.

- *Economic conditions.* Macroeconomic conditions may drive overall activity levels, which may in turn affect levels of activity at individual sources as well as rates of retirements/retrofits and the deployment of new facilities/practices.
- *System operation policies or constraints.* On a power grid, for example, relative activity levels for individual power plants will depend on the dispatch order used to service different load levels.
- *Environmental conditions.* Depending on the types of facilities/practices in question, environmental conditions may play a significant role in their relative activity levels. Hydrological conditions, for example, may dictate what components of a country's water pumping infrastructure are used to deliver water to urban communities.
- *Legal and regulatory frameworks.* Relevant laws and policies within the coverage of a mechanism may influence relative activity levels of individual facilities/practices. Pollution control laws, for example may affect how frequently or under what conditions certain facilities/practices can operate.

The overall baseline GHG intensity would be an average of the emission rates of all relevant facilities/practices, weighted by their contribution to overall activity levels. Again, as described in Section 7.2, different practical methods for estimating baseline GHG intensity may or may not explicitly mimic this kind of exercise.

7.1.3 Considerations in Projecting Baseline Activity Levels

Projecting baseline activity levels is generally only required for developing absolute baselines. Where it is required, however, it is often the most challenging part of developing a baseline scenario. Activity levels will generally be subject to more variability and volatility than rates of GHG intensity (e.g., because production levels can fluctuate more rapidly than production capacity), and may be influenced by a greater number of variables and drivers.

In theory, projecting activity levels requires considering the whole range of economic, legal, social, behavioral, and environmental drivers that could affect the activity in question, predicting how those drivers will evolve over time, and estimating the direction and magnitude of their effects. In practice, any of the various methods and approaches described in Section 7.2 could be used to make a projection, including projections based on extrapolating historical trends, use of comparison groups, or modeling. The details of any projection, and appropriate methods to use, will depend on the type of activity and how it is defined. Section 7.2 presents some examples of how Guidance Users may consider the use of different approaches in different contexts.

7.2 Methods for Developing a BAU Baseline Scenario

Core Concepts:

- **A variety of methods may be used to develop a baseline scenario ranging from simple to complex**
- **Methods can be broadly grouped into two categories:**
 - **(1) Projections, including:**
 - **Simple projection methods**

- **Simulation Modeling**
 - **(2) Use of comparison groups**
 - **Each of these methods may be used to estimate baseline activity data and GHG intensities**
 - **Different methods may be used for different baseline components or parameters (e.g., models may be used to estimate the mix of technologies that would be deployed in the baseline, but rely on exogenous simplified projections to characterize each technology's emission factor)**
 - **The choice of method will depend on issues of transparency, data quality and availability, credibility, and conservativeness.**

Section 7.1 described in conceptual terms the components of a baseline scenario and some considerations for how Guidance Users may go about developing a baseline. In practice, there are a variety of methods that may be used to predict baseline GHG intensities and emission factors. Broadly, these methods may be grouped into two categories:

1. Projection methods (including both historical extrapolation and simulation models);
2. Use of comparison groups.

Even within each category, specific methods may range from simple to complex and may differ in the degree to which they explicitly address baseline components and drivers. A simple projection based on historical trends, for example, may provide an estimate of baseline GHG intensity without explicitly considering the composition and relative activity levels of individual baseline facilities/practices, while more complex projections typically involve more data and assumptions, but also enable taking into account the implications of different drivers.

In addition, The Guidance User should note that the different types of methods described here are not mutually exclusive and may be used in a variety of combinations in a baseline development exercise. Simulation models, for example, may be used to determine the relative mix of old, modified, and new facilities that would be present under baseline conditions, but rely on simple trend projections to characterize the emission rates of new and modified facilities/practices. Likewise, data acquired from comparison groups could be used to adjust simple projections of GHG intensity or to calibrate parameters used in simulation models.

Guidance Users should be aware that choosing among methods to develop a baseline scenario will inevitably involve confronting tradeoffs. Deciding among options will involve consideration of the overall objectives of the mechanism, general principles of mechanism design (Section 3.2), and a variety of technical considerations. In particular, guidance users should give the following issues particular consideration:

- *Environmental integrity and/or credibility in representing BAU.* Chosen methods must provide a sufficient degree of confidence in the appropriateness and environmental integrity of the baseline. BAU baselines should adhere to consistent and transparent assumptions about BAU conditions, and/or be conservative. Uncertainties should be addressed through the use of conservative assumptions. It is especially important to be conservative where multiple drivers of GHG emissions are present and not all drivers are controlled for. To help bolster confidence in a particular baseline scenario, Guidance Users may conduct sensitivity analyses and/or cross-check the results of one method (e.g., linear extrapolation) with the results of another (e.g., modeling).

- *Transparency.* For the sake of transparency, it may be desirable to choose simpler baseline development methods, as these are easiest to explain and understand, but their ability to capture important interactions may be limited. Although simulation models, for example, can in theory capture interactions between activities and sectors and thus provide more sophisticated (and therefore, hopefully, more accurate) projections if they are properly designed and applied, their operation may be opaque to outside observers. In some cases, an extrapolation from historical trends may be easier for external stakeholders to evaluate and still provide a sufficiently credible baseline. In all cases Guidance Users should seek to make transparent the main assumptions affecting key drivers of emissions.
- *Practicality.* An overarching consideration in choosing a method is the availability and quality of data required. Extrapolating from historical trends may be untenable if sufficient data are not available, or if the data contain significant gaps or uncertainties. Similarly, most models require significant quantities of accurate data in order to produce robust results. All else equal, data constraints may influence the type of approach that is deemed to be most appropriate. The scale and scope of the targeted area of a mechanism or application of the baseline is also an important consideration, with simple methods being insufficient for larger scale and broader scope.
- *The market for tradable units.* Where market mechanisms are being considered, buyers of tradable units may put a particular emphasis on certain principles or criteria (Section 3.2), or may require that certain methods be used for transparency and consistency with other mechanisms or programs.

The remainder of this section provides an overview of the three categories of baseline development methods, along with examples of how they have been (or could be) applied in different contexts. Before evaluating the methods, however, it is important that Guidance Users consider the raw data required to inform them (on activity levels and emission rates) and how those data may be acquired.

7.2.1 Acquiring Initial Data and Assumptions on Activity Levels and Emission Factors

The methods described below for developing a baseline scenario are all concerned with estimating how GHG intensity (and possibly activity levels) will evolve over time under baseline conditions. Whichever method is used, however, a baseline scenario must begin with an accurate representation of initial conditions (i.e., conditions at the start of the baseline period). In developing a baseline scenario, it is important to identify how initial values for GHG intensity and/or activity levels will be determined.

Ideally, Guidance Users should base initial assumptions about emission factors on actual measurements. However, in some cases it may make sense to use default factors or other approximations. This could be the case, for example, where:

- Acquiring actual data on emission factors would cost too much or take too long.
- Consistency is desired or required with other accounting regimes or trading mechanisms (Sections 3.4 and 3.7).
- It can be shown that the default factors or other approximations are conservative and will not lead to an over-estimation of the baseline.

The IPCC, for example, publishes default emission factors for numerous physical processes that may be relevant for determining baseline emission factors.

Specific options and methods for determining GHG intensity and activity levels will depend on the nature of covered facilities/practices. Whichever methods are used, Guidance Users should seek to be transparent about:

1. Whether data are derived from direct measurements, statistical sampling, or from estimates based on proxy measurements. Some types of activity or emissions may be difficult to measure directly, but can be estimated using statistical techniques or other models. For example, passenger-kilometers traveled on an urban bus system could be based on actual data on kilometers traveled, combined with surveys of bus-ridership. Nitrous oxide emissions per unit of fertilizer applied to crops may be determined using biogeochemical process models.
2. What the range of uncertainty is associated with the data (e.g., expressed in terms of a confidence interval).
3. For GHG intensity, whether measured data or default factors will be used. For default emission factors, the source should be clearly identified and an explanation provided for why actual measurements were not used.
4. The vintage of the data or default factors being used.

Where possible, Guidance Users should obtain data and assumptions from peer reviewed and/or official studies.

7.2.2 Simple Projection Methods

Simple Projection Methods Pros and Cons

Pros	Cons
<ul style="list-style-type: none"> • Relatively straightforward • Lower cost than other methods • Can be relatively transparent • Can be more flexible with respect to data and capacity constraints • Can be equally credible and/or conservative as more complex models in some situations 	<ul style="list-style-type: none"> • May not adequately reflect the underlying drivers of change in activity levels or GHG intensities • May not be appropriate where future conditions or drivers may differ markedly or in unexpected ways from the past (e.g., where there have been recent changes in legal or regulatory requirements) • Credibility depends on sound understanding of the sector and sophistication of assumptions used

Simple projection methods are ones that avoid the direct use or creation of more sophisticated models, such as econometric, optimization, equilibrium, or detailed end-use simulation, though they might rely on the results of such models used in other studies. They typically involve creating a simple mathematical relationship or algorithms, with a limited number of parameters, and can usually be developed with simple and commonly used spreadsheet software. They often involve extrapolation of future conditions based on historical trends, along with educated assumptions about future trends, or both. Examples include:

- Projecting future activity data or GHG intensity based on a continuation of trends over the past 5 years.

- Assuming GHG intensity decreases by 1% per year from current levels based on existing studies and expert input.
- Assuming a switch from coal to gas use for new electricity generation facilities based on official plans or projections.
- Projecting GHG intensity by extrapolating historical trends related to key drivers of technology deployment or adoption

Extrapolations, documented assumptions, or use of other study or results, may vary in their sophistication and may be applied to any and all elements of a baseline scenario, including:

- Total future emissions levels;
- Future activity levels;
- Future GHG intensity;
- Future emission factors associated with new or modified facilities/practices;
- The future composition of baseline facilities/practices, including the mix of old, modified, and/or new facilities/practices.

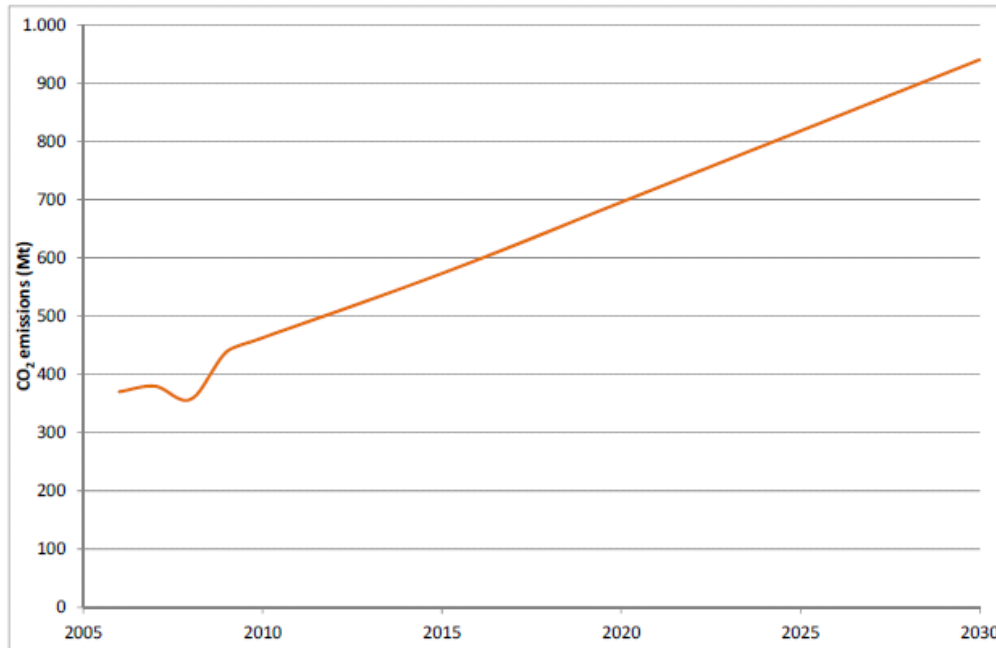
Regardless of application, a number of common questions should be addressed in developing simple BAU projections, including the following:

- *To what extent can future trends be expected to follow past trends?*

Nearly all historical extrapolations rely on an assumption of continuity between the past and future (at least through the end of the baseline period). In developing a projection, it is important to be transparent about why this assumption of continuity is reasonable and valid for the variable being projected. If discontinuities can be expected going forward – such as changes in laws or policies, economic conditions, technology deployment rates, or relevant physical conditions (e.g., the exhaustion of a natural resource) – then historical trends should either be modified to reflect reasonable expectations about their impacts, or alternative methods should be used to make baseline projections.

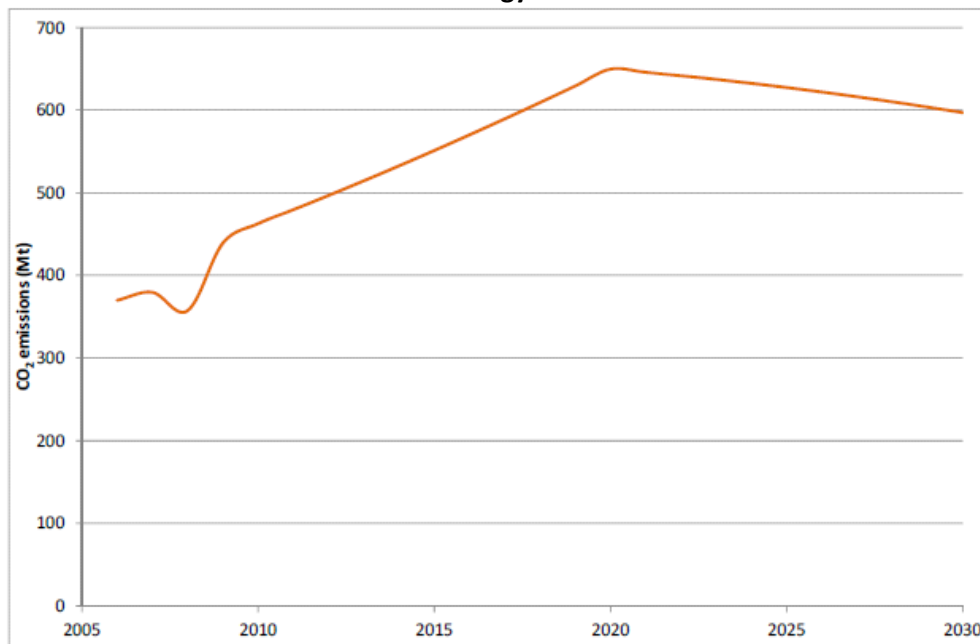
Sometimes an extrapolation of historical trends can be modified using basic (conservative) assumptions about expected future deviations from the past. For example, in a study of baseline projections for the Indian power sector, Castro et al. (2012) developed a simple projection of absolute emissions over time (Figure 6) and then modified it using some basic assumptions about how the mix of power plants and fuels is likely to change over time (Figure 7). The second projection is both more sophisticated and conservative, which may enhance its credibility with respect to plausibly representing BAU emissions.

Figure 6. Simple Projection of Indian Power Sector CO₂ Emissions Using Historical Trends



Source: Reproduced from Castro et al. (2012)

Figure 7. Projection of Indian Power Sector CO₂ Emissions, Modified Using Assumptions About Future Technology & Fuel Mix

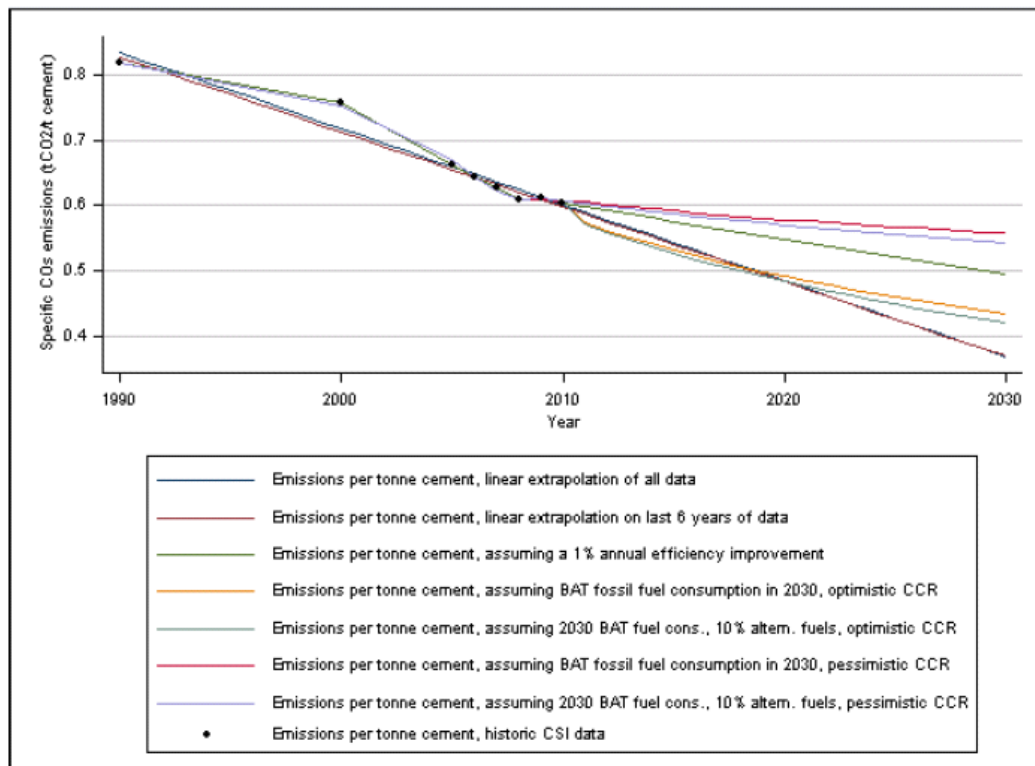


Source: Reproduced from Castro et al. (2012)

Another alternative is to make a simplified projection using educated assumptions about how a variable (or variables) are likely to change going forward, irrespective of historical trends to date. In developing CO₂ intensity baselines for the cement sector, for

example, Castro et al. (2012) assessed a number of options, including a projection based on assuming an autonomous 1% annual improvement in the energy efficiency of cement production. This assumption was based on historic improvement rates cited in other studies. However, as indicated in Figure 8, it appears to be less conservative than a simple linear projection based on historical emission rate trends.

Figure 8. Alternative Options for India Cement Sector Baseline Emission Factors



Source: Reproduced from Castro et al. (2012)

As a general rule, if modified projections or alternative assumptions are used, they should be transparently explained and justified.

Some baseline elements may be more susceptible to fluctuations and discontinuities than others. Activity levels, for example, are likely to have a greater number of drivers – and therefore greater fluctuations and volatility – than GHG intensities, which (depending on the sector and kinds of activities involved) tend to change less rapidly and may be less susceptible to changes in macroeconomic or environmental conditions. Simplified projections related to GHG intensity (including projections of the composition of individual baseline facilities/practices that contribute to aggregate GHG intensity) may be “safer” and more reliable than unadjusted projections of activity levels.

Regardless of which baseline elements are being projected, if major future discontinuities are expected or if multiple drivers are involved, it may be desirable to use methods that can more explicitly and/or credibly take these variables into account (e.g., comparison groups or modeling).

- *If a projection is based on a historical trend, what time period should be used to establish the trend?*

In extrapolating historical trends, one key consideration for Guidance Users is how far back in time and over what time period data must be collected in order to establish a trend. Some general considerations here include:

- *Avoiding perverse incentives.* The period used should be far enough back that there is no opportunity for entities targeted by the mechanism to “game” the baseline by artificially raising emissions levels and distorting emissions trends. In general, this means using a historical period that ends before the mechanism was first publicly proposed.
- *Avoiding historical discontinuities.* If significant changes occurred in the past related to the key drivers of activity levels or emission factors, then the period prior to those changes should generally be excluded from the time period used to establish a trend. For example, if a law was passed in 2007 directly or indirectly regulating GHG emission rates from power plants, then a historical projection of future power plant GHG emission rates should be based on data subsequent to the passage of the law.
- *Capturing cyclical patterns.* For some sectors and activities, drivers of activity levels or GHG intensity may follow cyclical patterns. As electricity grids grow, for example, they may alternate between periods of adding more base-load capacity and more peaking capacity, each of which will have a different emissions profile. All else equal, the historical period used to establish a trend should be long enough to cover these kinds of cycles.
- *Addressing data quality and consistency.* Establishing a trend based on historical data requires, of course, that those data be available. However, even where historical data are available there may be variations in quality and consistency over time. In some cases, historical record-keeping may not be comparable to more recent efforts, there may be gaps in data collection, or the methods used to produce the data may have changed over time. If there are significant discontinuities in data quality or consistency, then projections should be based only on a period over which the data are consistent and trustworthy, or corrections or adjustments should be made to data from other periods. Any corrections or adjustments should be transparently explained and justified.
- *Other factors.* Even where no discrete events can be identified that would cause a change in trends, there may be discernible shifts that can be identified by examining data over different time periods. In some contexts, more recent rates of change may be more indicative of future trends than rates of change over longer time periods. Where the drivers of such changes are poorly understood, however, it may make sense to use a time period that yields the most conservative projection. In projecting activity levels for cement production in India, for example, Castro et al. (2012) looked both at trends from 1990 to the present and trends over the last 10 years (Figure 6.8). Trends over the last 10 years produce a higher projection of production going forward than the long-term trends. However, unless the reasons for such a difference are clearly

understood and delineated, it could be argued that the longer-term trends should be used to establish a baseline.

- *Should projections be based on a simple average of historical data, or on a linear (or non-linear) regression?*

It is not always easy to discern a particular trend or how it should be modeled. The simplest form of extrapolation would be to simply calculate average activity levels or emission rates over a historical period and assume that future activity levels or emission rates will match that average. Whether such an assumption is reasonable depends on:

- Whether there is in fact no discernable trend up or down in activity or emission rates over time.
- What the drivers are behind activity levels or emission rates and whether those drivers can be expected to remain unchanged.

In practice, the best approach will often be to use regression analysis to find a best fit for historical data and, where feasible, include adjustments related to key drivers.

- *How sophisticated are the assumptions used to inform or adjust a projection?*

As the preceding discussion suggests, historical extrapolations can differ markedly in the quality of their assumptions and the detail with which they consider underlying baseline elements and drivers. As Figures 6.5 and 6.6 indicate, although it may be possible to establish a plausible best fit for historical trends in total GHG emissions for a sector, looking only at total emissions may gloss over important details about underlying drivers (including sub-trends in the composition and emission rates of baseline facilities/practices). The best projections from historical data, though inevitably simplified, will be informed by diligent analysis⁴⁹ of underlying drivers and technology or practice trends. Important sources of information that are often used to inform projections include:

- Market penetration studies;
- Industry surveys (e.g., regarding macroeconomic conditions and/or technology adoption);
- Historical data on facility retirement rates;
- Structured analyses of candidate technologies or practices and adoption trends (e.g., to estimate emission factors of new and modified facilities/practices).

⁴⁹ Guidance Users may want to ensure that findings and underpinnings of such analysis are communicated transparently to facilitate understanding and assessment of the baseline – especially where this may be important for linking the credits/mechanism to external potential buyers/funding providers.

7.2.3 Simulation Modeling Approaches

Simulation Modeling Pros and Cons

Pros	Cons
<ul style="list-style-type: none"> • Can predict future trends more precisely by taking into account more detailed economic, technological, and other factor. • Can control for multiple variables that might affect targeted GHG emissions 	<ul style="list-style-type: none"> • May be less transparent than other approaches, due to complexity • May be costly and resource intensive • May be subject to the same “cons” as simple projection methods (e.g., assumptions that future will mimic past)

Simulation models are designed to simulate physical, economic, and/or human behavioral processes. Simulation models may be employed in numerous ways to help develop a baseline scenario, including:

- Forecasting baseline activity levels (e.g., based on a simulation of the underlying drivers of activity)
- Determining baseline emission factors (e.g., through simulation of physical processes that give rise to emissions)
- Forecasting the composition of baseline facilities/practices (e.g., by simulating the effects of economic conditions on technology choice and adoption).
- Providing inputs to help calibrate simplified projections (e.g., by providing forecasts of GDP or population growth that could be used to calibrate a regression analysis used to project activity trends in a particular economic sector).

Some general types of simulation models that may be relevant to baseline scenario development are presented in Table 9.

Table 9. General Types of Simulation Models Relevant for Baseline Development

Model Type	General Description	Application to Baseline Development	Examples ⁵⁰
Engineering / System Optimization Models (Bottom Up)	Used to simulate how a system (e.g., a building system, power grid, or national energy system) will behave and/or develop given a range of inputs and constraints.	May be used to determine discrete baseline technology or practice choices and/or activity levels at baseline facilities/practices based on simulation of environmental, financial, technical, social, cultural, or other factors that might drive adoption and use.	MARKAL (optimization) LEAP (simulation) TEEMP (transportation systems)
Economic / Computable General Equilibrium Models (Top Down)	Used to simulate supply and demand of goods and services in an economy under various policy and macroeconomic conditions	May be used to forecast baseline activity levels and/or inform bottom-up models or simplified projections	MEDEE (econometric) Various Input-Output Models ENPEP-BALANCE (equilibrium)
Hybrid Models	Combine bottom-up and top-down models to comprehensively simulate how systems may respond under varying economic conditions	May be used to comprehensively forecast baseline activity levels and emission factors	
Physical Process Models	Used to simulate physical systems that give rise to GHG emissions	May be used to estimate baseline emission factors for facilities/practices using assumptions about baseline physical or environmental conditions	

It will generally make sense to use simulation models when:

- *The primary activity used to estimate baseline emissions is not the sole driver of those emissions and other variables need to be controlled for.* For example energy usage in new housing developments may depend on weather conditions, individual behaviors, and non-GHG related legal requirements. Multiple model runs (e.g., Monte Carlo analysis) may be used in some cases to calibrate simplified projections of activity data or emission factors.
- *Models suitable for the purpose of baseline development already exist, are in use, or are can otherwise be populated with appropriate, reliable data.*

Key considerations in whether to use simulation models include the following:

- *Transparency.* Because simulation models are often complex, it may be difficult for external stakeholders to fully understand their outputs. All else equal, simplified projections may be preferable to simulation models where simplicity and consistency are desired for policy purposes (Sections 3.4 and 3.7). Where simulation models are deemed necessary, it may similarly be preferable for transparency purposes to use well-known models developed for general application, rather than individualized or tailor-

⁵⁰ A good reference source for exploring these and other existing models is the Low Emission Development Strategy (LEDS) Toolkit, available at : <http://en.openei.org/apps/>

made models developed for a specific country or circumstance. Regardless of what kind of model is used, it will always be important to be transparent about inputs and assumptions related to key drivers (e.g., GDP growth, population growth, fuel prices, etc.).

- *Cost, resource, and data requirements.* Simulation models may be costly to run and require high levels of knowledge and expertise. In addition, some models may have extensive data requirements. Although models may offer higher precision in projecting trends based on underlying drivers, their potential advantages need to be weighed against possible higher resource requirements and costs. It may not make sense to use simulation models where the coverage and scope of the baseline is small and GHG reductions will be minimal.

7.2.4 Use of Comparison Groups

Comparison Groups Pros and Cons

Pros	Cons
<ul style="list-style-type: none"> • Can be used to calibrate a baseline scenario based on actual measurements of representative conditions • Useful where the activity being measured to estimate emissions is not the sole driver of those emissions • Can help ensure environmental integrity by avoiding the counting of apparent reductions not attributable to targeted mitigation activities 	<ul style="list-style-type: none"> • May be data intensive and costly • Validity depends on identifying truly comparable “control” groups for monitoring baseline parameters • Suitable comparison groups may be difficult to identify in practice, especially when coverage of the baseline is broad • Requires making <i>ex post</i> adjustments to, or determinations of, baseline activity data or emission factors

Comparison groups are used to calibrate a baseline scenario using data monitored from a group (or groups) of facilities/practices separate from – but with characteristics similar to – the facilities/practices covered by a mechanism. Comparison groups may in principle be used to calibrate any element of a baseline, but can be particularly useful for establishing:

- Baseline emission factors (for individual facilities/practices or groups of facilities/practices);
- The composition of baseline facilities/practices.

Comparison groups may be useful where the primary activity used to estimate baseline emissions – as defined by the activity data metric identified in Section 5 – is not the sole driver of those emissions, and other drivers need to be controlled for.⁵¹ Because comparison groups are used to make *ex post* adjustments to baseline assumptions, their usefulness is generally limited to situations where concerns about environmental integrity – specifically, the desire to avoid counting “apparent” emission reductions that are not attributable to mitigation activities – outweigh concerns about providing clear *ex ante* signals about baseline emission levels (e.g., to investors and other actors in a market mechanism).

The feasibility of using comparison groups will depend on:

⁵¹ See, for example, CDM methodology AM0046: [Distribution of efficient light bulbs to households --- Version 2.0.](#)

- *Whether it is possible to identify truly comparable groups of facilities/practices to those covered by a mechanism.* If a mechanism is designed to cover an entire country or jurisdiction (including both existing and new or modified facilities/practices), finding a valid comparison group may be difficult.
- *The practicality and cost of data collection efforts.* Effective use of comparison groups requires not just monitoring and verification of activities within the coverage and scope of the mechanism, but also monitoring and verification of comparison group data. This can add significantly to the cost of implementing the mechanism.

Box: Developing a range of baseline scenarios

As noted above, business-as-usual scenarios do not just represent the status quo, with technologies and practices “frozen” at current levels, or as a simple extrapolation of past trends. They should reflect what is viewed as the likely in terms of future trends and outcomes. However, often there are many views as to what these most likely trends and outcomes might be, and thus there are many possible baseline scenarios. For example, some BAU outlooks may expect more or less rapid economic growth, emphasis on different sectors of the economy, alternative pathways of technological innovation and diffusion, or simply different outcomes in terms of fuel price and availability. Each possible baseline scenario may have quite different implications for future emissions, and thus present a different baseline.

Given these uncertainties, Guidance Users should consider developing a range of baseline scenarios. Figure 8 provides one example of how alternative scenarios can be defined and presented. Analyzing multiple baseline scenarios can also help to identify through discussion and iteration what might be viewed as most likely, and well as to understand the distribution of possible outcomes in terms of emissions. If all scenarios seems equally reasonable, then often a conservative approach will suggest using the lowest among them.

8 Step 4: Develop Additional Baseline Scenarios, As Appropriate

As indicated in Section 2.3, there are situations where baselines other than BAU are desired, such as performance standard baselines and net mitigation baselines. Guidance Users may wish to develop these kinds of baselines to meet particular policy objectives. This section reviews methods for developing these baselines.

8.1 Developing Performance Standard Baselines

Core Concepts:

- Performance standards may be used in some contexts to establish a GHG intensity baseline.
- In general, performance standards should be set at a level that approximates, or is lower than, BAU GHG intensity.
- A performance standard can be based on either: (1) a statistical analysis of the emission rates of baseline technologies or practices, typically based on historical performance data (e.g., a weighted average or below-average percentile); or (2) the emission rate of a single generic reference technology or practice that serves as a benchmark.
- To establish a performance standard, baseline technologies or practices are generally identified from candidate technologies within an appropriate geographic area and range of vintages.
- Performance standards should be periodically updated to reflect changing conditions, or otherwise incorporate expected improvement rates.

One alternative method for developing an intensity baseline is to establish an emissions benchmark or performance standard.⁵² A performance standard may often represent a desired goal for minimum emissions performance rather than an explicit prediction of BAU conditions. They tend to reward only the top performing facilities, practices, or sectors rather than any that simply improve performance over historical levels or over an average expected BAU level. In general, top-performing benchmarking approaches have been used in other contexts (e.g., EnergyStar for appliances and buildings in the US) to promote innovation and adoption of advanced technologies and practices. Despite the fact that performance standards are often set at better-than-average level, given their frequent reliance on historical data, it may still be important to validate in some fashion that the baseline still approximates – or is lower than – projected BAU GHG intensity in order to achieve environmental integrity.

Numerous resources exist that provide guidance on how to develop performance standard baselines.⁵³ In general, however, performance standard approaches establish a baseline GHG

⁵² Performance standards could also be used to establish baseline emission rates for specific technologies or practices that are then used in conjunction with other baseline development methods (discussed in Section 7.2). This section discusses the use of performance standards to develop an overall GHG intensity baseline, but the principles and methods involved would be largely the same.

⁵³ For a full discussion of performance standard baseline development, see for example, Prag and Briner (2012), Hayashi et al. 2010 and Mueller et al. 2011).

intensity based on either: (1) a statistical analysis of identified baseline technologies or practices (e.g., a weighted average, or below-average percentile, of baseline technology emission rates)⁵⁴; or (2) a single generic reference technology or practice that serves as a benchmark. The process of identifying baseline technologies or practices generally involves surveying existing facilities/practices within a relevant geographic area and an appropriate range of vintages.

8.1.1 Defining the Relevant Geographic Area for Baseline Technologies or Practices

In setting a benchmark for baseline GHG intensity, the relevant geographic area to consider may be larger than the geographic area covered by a mechanism. Technologies or practices prevalent in neighboring regions, for example, could provide a guide to what would have been deployed at new or retrofitted sites within the mechanism boundaries. Some factors Guidance User may consider to define an appropriate geographic area include:

- *Common social or cultural characteristics.* Such factors would be appropriate to consider, for example, where adoption of alternative technologies or practices is mediated by social or cultural norms.
- *Common economic circumstances.* Economic conditions may significantly influence the types of technologies or practices used to produce products and services.
- *Common legal frameworks and jurisdictional boundaries.* Government policies and legal requirements may help drive economic conditions, and may directly promote or discourage the adoption of certain types of technologies or practices.
- *Physical infrastructure constraints.* Relevant reference technologies may be defined by the physical systems or infrastructure to which an actor is connected, e.g., electricity grids.
- *Common biophysical, climatic, or ecological characteristics.* These characteristics may be particularly relevant for defining reference technologies, practices, and conditions related to land use, building energy efficiency, waste management, etc.

8.1.2 Defining the Appropriate Range of Vintages for Baseline Technologies or Practices

Establishing a GHG intensity benchmark also requires considering how technologies and practices are changing over time. For example, for a mechanism targeting efficiency improvements in new commercial boilers, a baseline could be set by referring to the efficiency of existing commercial boilers within an appropriate geographic area. However, the existing set of commercial boilers may consist of some very old boilers with low efficiencies, newer boilers with high efficiencies, and others in between. In most cases, only more recently installed boilers will provide a good indication of what is likely to be installed in the future (under baseline conditions). Thus, baseline GHG intensity should reflect the emission factors of recent vintages of boilers. Some general rules for how to identify an appropriate range of vintages for establishing a performance standard baseline include the following:

- If the mechanism is designed to incentivize retrofits, operational improvements, or accelerated shutdowns at existing installations, then existing (new and old) technologies

⁵⁴ See, for example, Sathaye et al. (2004) and WBCSD and WRI (2005).

or practices could serve as a reference – along with examples of recent retrofits or improvements at those facilities.

- Where technological or practice changes are occurring slowly, it may be appropriate to also consider older installations or operations as references for characterizing new facilities/practices.
- Where technological or practice changes are occurring rapidly, characterizations of new facilities/practices should generally be based only on recent vintages. In some rapidly changing contexts, it may be most appropriate to base characterizations on future planned installations or technologies/practices that have been newly introduced.
- The choice of which vintages to consider in characterizing new facilities/practices may also depend on the relative conservativeness of the performance standard relative to BAU. Including only recent, lower-emitting reference technologies and practices would typically result in a more conservative baseline than one that includes older technologies and practices as well.

8.1.3 Performance Standard Updating

Performance standard baselines also need to be regularly updated to ensure that they continue to reasonably represent the BAU for new market entrants (or for changes in practice or technology at existing facilities) – and thus continue to help safeguard environmental integrity. In addition, an annual performance improvement factor can be applied (*ex ante*) based on observed or expected trends. Many of the same considerations that apply to updating baselines (Section 9) will also apply to updating performance standards.

8.2 Net Mitigation Baselines

Core Concepts:

- **A net mitigation baseline can be used in a crediting mechanism where the objective is to achieve net global GHG reductions rather than merely offsetting GHG emissions.**
- **For a trading mechanism, the emissions target or cap itself should typically represent a net mitigation benefit baseline, appreciably below a conservative BAU baseline level.**
- **A net mitigation baseline should represent a level of emissions that is significantly below the level projected for a (conservative) BAU baseline**
- **The degree to which the baseline is lowered than a (conservative) BAU may be influenced by:**
 - **Marginal abatement costs and abatement potentials**
 - **Performance standards**
 - **National emission reduction pledges**
 - **Other factors**

Section 2.3.3 introduced many of the key concepts regarding net mitigation baselines, noting that ultimately, the selection of a specific net mitigation baseline – either as crediting baseline or threshold in a crediting mechanism or as cap or target in a trading mechanism is ultimately a policy choice. Nonetheless, several options are available to inform this selection:

- **Marginal abatement cost and potential assessments** for the sectors or groups of emissions sources in question. Abatement studies can serve to identify technologies, policies, and measures that can reduce GHG emissions below BAU levels, and the marginal costs associated with achieving a given level of reduction below BAU. Using a marginal abatement cost curve, net mitigation baselines can be developed or otherwise informed using, for example, different marginal cost thresholds as expressed in a price of carbon. For example, a given abatement cost study might indicate that emissions can be reduced 10% by 2020 at marginal costs of less than \$10/tCO₂e. Alternatively, net mitigation baselines can be developed or otherwise informed using, instead, thresholds based on total costs (the area under the cost curve). For example, a baseline could be set on the basis of net abatement costs not exceeding, say \$X million by 2020, or even achieving a net zero abatement cost, assuming negative cost or “cost saving” options are identified and can be reached with the mechanism.
- **Performance standards or targets.** The methods described in the prior subsection can be used to develop a performance standard that is demonstrably lower than a conservative BAU scenario. For example, Castro et al. (2012) derive a hypothetical and ambitious emissions intensity target for the Indian cement sector based on a sectoral technology roadmap developed by WBCSD and IEA.
- **National emission reduction pledges.** Many countries have adopted emission reduction pledges for the year 2020, which in turn are based on, or can be used to inform, emission reduction plans and targets for individual sectors or groups of sources. Where relevant emission reduction targets exist for the groups of sources covered by a mechanism, then these targets can serve as net mitigation baselines (presuming they are below a conservative BAU level⁵⁵). Where such targets do not exist, and there are no plans to develop them, pledges (e.g., 10% below BAU) can be adjusted and applied, taking into account, as appropriate, abatement costs and potentials and any specific opportunities or constraints for that group of sources, relative to the country as a whole.

Other factors to consider in setting net mitigation baselines include the emissions impacts of other policies under consideration (both ones that might increase or decrease emissions), as well as risks and uncertainties that might be faced by the groups of sources in question.

⁵⁵ The question of whether conservative BAU baselines can yield a net mitigation benefit depends on whether the baseline is applied to many individual activities or projects or to the performance of an entire group of sources. Baselines need to be more conservative if they are intended to provide a given level of certainty of emission reductions for *each* of a number of individual activities than for all of those activities combined. Therefore conservative BAU baselines applied to a large number of projects within project-based crediting mechanisms (e.g., CDM) could indeed yield a net decrease in emissions with that same level of certainty.

9 Step 5: Consider Baseline Updating Policies

Core Concepts:

- In most cases, it will make sense to periodically review and update the parameters defining a baseline
- It is important to clarify upfront the policies and procedures for updating the baseline
- The required frequency of updating will depend, among other things, on baseline conservativeness. More conservative baselines may require less frequent updates.

9.1 Setting Policies of Updating Baseline Parameters

A “baseline parameter” is any variable, data point, or assumption used in the derivation of baseline activity data or emission factors, or in determining the relative composition of baseline activities or sources. Baseline parameters will generally be set according to assumptions about prevailing conditions in the absence of a mechanism. In most cases, baseline parameters should be periodically reviewed and updated to ensure that overall baseline emissions estimates continue to be credible and valid. For intensity baselines, activity data parameters will be set *ex post* according to actual measurements. Other baseline parameters will be set *ex ante*, and should be periodically reviewed.

The schedule for reviewing and updating baseline parameters will depend on individual circumstances and may involve a number of considerations regarding data availability, policy goals, and providing predictability to market participants. It will generally be important to stipulate upfront either a regular schedule for updating, or a set of conditions or “triggers” under which updates will be performed. Some general options Guidance Users may want to consider include the following:

- *Review and update all baseline parameters on a regular schedule.* At the project level, baselines are usually set for a fixed amount of time, referred to as a “crediting period.” Most *ex ante* baseline parameters are only reviewed and updated at the end of a crediting period (assuming the baseline can be renewed). For policies or larger mechanisms, a similar approach may also be feasible.
- *Review and update different baseline parameters on different schedules, or according to when new data become available.* Baseline parameters should only be revised if new data or information come to light indicating that a revision is warranted. For different parameters, new data may become available on different schedules. One option is to review and update individual parameters on different schedules, possibly linked to data availability.
- *Review and update baseline parameters only when a certain trigger is reached.* A “trigger” for updating a baseline parameter is a condition - or set of conditions - that must be satisfied before the parameter may be updated. Depending on circumstances, a single trigger or multiple triggers might be defined. Examples of triggers could include:
 - Fuel prices deviate by more than X% from initially assumed values.

- Relevant technology costs (e.g., for reference technologies) deviate by more than X% from initially assumed values.
- Market penetration rates for reference technologies or practices (e.g., in a “control” region outside the scope and coverage of the mechanism) differ from initially assumed rates.
- Actual measured emissions rates for reference technologies, practices, or conditions differ by more than X% from initially assumed values.
- Industrial production levels (e.g., used to determine activity data) deviate by more than X% from initially assumed levels.

Triggers could be linked to meeting several criteria in combination, or could be linked to meeting any one of several criteria. The more clearly and precisely triggers are defined, the better the outcomes in terms of providing predictability for implementing entities, while creating space to ensure that the baseline’s underlying assumptions are kept in line with reality. For clarity and transparency, it will generally be a good idea to identify the specific data sources that will be used in determining whether a trigger criterion has been met (e.g., official fuel price indexes, technology cost surveys, market reports, etc.).

Regardless of schedule, it is important to have clear policies on how updates will be undertaken and applied. Key considerations include:

- *What is the maximum allowable frequency for updates?* In general, updating should be an infrequent occurrence to provide predictability, as well as limit costs. However, it is necessary from time to time. To maintain predictability it may be desirable to establish a policy on the maximum frequency of updates.
- *When will an update take effect?* If a baseline parameter is updated, it will be important to clarify when the update will take effect. Depending on the circumstances, mechanism participants may need time to plan and prepare for any baseline revisions.
- *To what period will updates apply?* Similarly, it will be important to clarify how updates will be applied. In most cases, an updated baseline would be used only for determining GHG reductions going forward. There may be cases when, new information might justify a retroactive adjustment to baseline calculations. Since the possibility of retroactive adjustments could be (very) detrimental to investment certainty, Guidance Users might want to ensure this only happens in very rare or exceptional cases. Moreover, policies for when such adjustments might be applied (if ever) should be clearly stipulated.
- *Are there any constraints on the allowable magnitude of an adjustment?* For purposes of predictability, it may make sense to establish bounds on the extent to which baseline parameters are allowed to change. For example, it could be specified that baseline emission factors will not be changed by more than X% from one update to the next, notwithstanding data indicating more significant changes in the actual emission rates of baseline technologies. Setting such bounds could reduce uncertainty risks for implementing entities, but would need to be weighed against possible increased risks for environmental integrity.

10 Step: 6: Evaluate and Select a Baseline

The final selection of a baseline is a policy decision and will depend on the nature and objectives of the mechanism for which it was developed. Specific considerations will depend on the type of mechanism.

10.1 Crediting Mechanisms

The overarching concern for crediting mechanisms is that the baseline must safeguard environmental integrity. This means the baseline must reflect a fair and credible scenario for BAU emissions. Given the inherent uncertainty involved in projecting BAU conditions, it will often make sense to choose a baseline scenario that is conservative – i.e., one based on assumptions that will tend to underestimate GHG emissions, and/or that lies at the bottom range of plausible BAU forecasts (Figure 2 in Part I).

Depending on the context, a net mitigation baseline may also be appropriate for a crediting mechanism. Crediting mechanisms designed under the U.N.'s “new market mechanism” framework, for example, may be required to result in a net mitigation benefit (Section 2.1). The appropriate level of net mitigation will generally be determined through a combination of political negotiation and consideration of the approaches described in Section 8.2. However, the more ambitious the baseline is, the fewer the credits participants can receive for any given amount of GHG reductions. If the quantity and price of credits are insufficient to cover the costs of investing in GHG mitigation actions, then economically efficient and effective mitigation actions may go unrealized (compared to a situation with a less conservative baseline, for example). This could represent a significant opportunity cost (not to mention a significant wasted effort on the part of those who established the crediting mechanism). Thus, determining the appropriate level of net mitigation for a baseline will require balancing ambition against the need to provide sufficient incentives for investment. However, feasibility may be greatly influenced by enabling policies or measures designed to achieve targeted levels of net mitigation above the baseline.

Finally, performance standard baselines may also be appropriate for crediting mechanisms in some circumstances. Performance standards may be particularly useful for project-based crediting mechanisms, e.g., as a means to enable “standardized” consideration and crediting of carbon offset projects. They are also valuable if an objective is to reward only top performing facilities, practices, or sectors rather than any that simply improve performance over historical levels or over an average expected BAU level. They could also be applied in establishing an intensity baseline for scaled-up crediting mechanisms where the scope of the mechanism includes sufficiently homogeneous facilities/practices. Where a performance standard baseline is used, however, Guidance Users would need to demonstrate in some fashion that it is conservative with respect to BAU (i.e., not above BAU and thus helping safeguard environmental integrity).

10.2 Emissions Trading Systems

As discussed in Section 2.3, different types of baselines will have different applications in the context of designing a trading system (Table 3 in Part I). BAU baselines are helpful for evaluating the level of effort required in achieving alternative cap levels, i.e., as a reference for quantifying the total GHG reductions achieved by the cap. Developing a net mitigation baseline, in line with the considerations in Section 8.2, may be helpful in actually setting an emission cap. As a general rule, it is important to ensure that the “net mitigation baseline” (i.e., cap level) is set well below a conservative BAU emissions level. The precise level will depend on the ambition of the trading system.

Finally, performance standard baselines may be useful for determining allocation levels to individual capped facilities or installations, e.g., by applying the performance standard to historical output levels.

10.3 Non-Market Mechanisms (e.g., Results-Based Financing)

Again as discussed in Section 2.3, different types of baselines may be applied in the context of non-market mechanisms as well. Selecting a baseline will largely be dependent on the needs and objectives of funders and their recipients. Where a simple evaluation of results is desired, a (conservative) BAU baseline – very similar to baselines for crediting mechanisms - will typically be appropriate. However, depending on the arrangement, funders may also want to make funding contingent on performance relative to performance standard or net mitigation baseline.

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