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Final report

Adapting CDM methodologies for use under Article 6 of the Paris Agreement

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Abstract: Adapting CDM methodologies for use under Article 6 of the Paris Agreement

This study assesses whether existing international carbon market methodologies for determination of additionality and baselines and monitoring, particularly those from the Clean Development Mechanism (CDM), can be adjusted to transition to the Article 6.4 mechanism. We highlight the necessity of drawing from the experiences of the Kyoto Protocol. CDM methodologies need to be modified to align with the more rigorous requirements of Article 6.4 of the Paris Agreement. Reaching consensus among Article 6.4 Supervisory Body (SB) members on developing a methodology guidance has been challenging and shows that there is a wide range of interpretation of the Article 6.4 methodology requirements. On this basis, we discuss different options to operationalise the Article 6.4 methodology requirements and focus on the option to develop overarching methodological tools that can be applied to make CDM methodologies "Article 6.4 proof". We illustrate this approach by applying it to two CDM methodologies, ACM0005 ("Increasing the blend in cement production") and ACM0006 ("Electricity and heat generation from biomass"). For these methodologies, we propose specific adjustments to ensure alignment with Article 6.4 requirements, particularly regarding additionality determination, avoidance of lock-in of emissions, quantification of emission reductions and monitoring, reporting, and verification (MRV).

Kurzbeschreibung: Anpassung der CDM-Methodiken zur Anwendung im Rahmen von Artikel 6 des Pariser Abkommens

Die vorliegende Studie analysiert, inwiefern existierende Methodiken für die Bestimmung der Zusätzlichkeit und Referenzfälle und das Monitoring unter internationalen Kohlenstoffmärkten, insbesondere diejenigen aus dem Mechanismus für umweltverträgliche Entwicklung (CDM), für die Anwendung unter dem Artikel 6.4-Mechanismus angepasst werden können. Wir betonen dabei die Notwendigkeit, auf die Erfahrungen unter dem Kyoto-Protokoll zurückzugreifen. CDM-Methodiken müssen verändert werden, um den stringenteren Anforderungen unter Artikel 6.4 des Pariser Abkommens zu genügen. Einen Konsens zwischen den Mitgliedern des Aufsichtsgremiums des Artikel 6.4 bezüglich der zu entwickelnden Methodikrichtlinie war bisher eine Herausforderung und zeigt, dass es ein breites Spektrum an Interpretationen der Artikel 6.4-Methodikanforderungen gibt. Auf dieser Basis diskutieren wir verschiedene Optionen, diese Anforderungen zu operationalisieren und konzentrieren uns auf diejenige, übergreifende Methodikwerkzeuge einzuführen, die CDM-Methodiken „Artikel 6.4-tauglich" machen können. Wir erläutern diesen Ansatz, indem wir ihn auf die beiden CDM-Methodiken ACM0005 („Erhöhung des Anteils an Zuschlagstoffen bei der Zementproduktion") und ACM0006 („Strom- und Wärmeerzeugung aus Biomasse") anwenden. Für diese Methodiken schlagen wir spezifische Anpassungen vor, um sie mit den Artikel 6.4-Anforderungen konform zu machen, vor allem bezüglich der Zusätzlichkeitsbestimmung, der Vermeidung der langfristigen Fixierung von Emissionen, Quantifizierung der Emissionsreduktionen, und Monitoring, Berichterstattung und Verifizierung.

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Abbreviation	Explanation
A6.4ER	Article 6.4 emission reduction
BAT	Best Available Technologies
BAU	Business-as-usual
BC	Blended Cement
CDM	Clean Development Mechanism
CER	Certified emission reduction
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CO_2	Carbon dioxide
COP	Conference of the Parties
DNA	Designated National Authority
ETF	Enhanced Transparency Framework
fNRB	Fraction of non-renewable biomass
GHG	Greenhouse gas
ICAO	International Civil Aviation Organization
IFC	International Financial Corporation
II-AMT	International Initiative for Development of Article 6 Methodology Tools
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal rate of return
LDC	Least Developed Country
LT-LEDS	Long-term low GHG emission development strategy
MPG	Modalities, procedures and guidelines
NDC	Nationally Determined Contribution
N_2O	Nitrous oxide (laughing gas)
OMGE	Overall Mitigation in Global Emissions
PGC	Paris Goal Coefficient
PDD	Project design document
PoA	Programme of Activity
RMPs	Rules, modalities and procedures
SB	Supervisory Body
SD	Sustainable development

Abbreviation	Explanation
tCO_2e	Tonne of carbon dioxide equivalent
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars

Summary

This study developed under the research project "Evaluation of international Emission Reduction Projects", jointly conducted by Oeko Institut, Perspectives Climate Group and INFRAS on behalf of the German Environment Agency, examines how existing carbon market methodologies, specifically those of the Clean Development Mechanism (CDM), can be adapted for use under the new Article 6.4 mechanism of the Paris Agreement. In adapting the methodologies, it is important to draw on the knowledge gained from the carbon market mechanisms under the Kyoto Protocol. We find that many CDM approaches can be adjusted in a manner that they meet the more stringent Article 6.4 methodology requirements. Based on an overview of the new, more stringent, methodological requirements under the Paris Agreement we discuss what adjustments are needed to CDM methodologies to meet these requirements. We then assess the latest progress achieved by the Article 6.4 Supervisory Body (SB) in developing methodology guidance. We consider how existing methodologies can be adjusted to become "Article 6.4 proof" before diving deeper into the development of overarching methodological tools to facilitate the transition of existing methodologies. The report reflects on the ongoing development of Article 6 methodological tools. We apply Article 6 methodological tools for two selected CDM methodologies and make recommendations for the further development and testing of such methodology tools.

Overview of new methodological requirements under Article 6.4

While the high-level rules, modalities and procedures (RMPs) of the Article 6.4 mechanism were adopted at the 26th Conference of the Parties (COP26) in Glasgow, the detailed operationalisation is still ongoing. The RMPs establish more stringent requirements for methodologies than under the Kyoto mechanisms CDM and Joint Implementation (JI). Additionality has been defined more clearly than in the past, i.e. it needs to be demonstrated that the mitigation activity would not have happened without the incentives from the mechanism. Additionality determination shall now consider all relevant national mitigation policies, laws or regulation. Furthermore, technologies or carbon-intensive practices that lead to emissions lock-in and are not aligned with the Paris Agreement's long-term goals shall not be eligible.

Baseline methodologies now have to encourage increasing ambition over time, define a conservative and credible baseline scenario that is set below Business-as-usual (BAU), and shall avoid and minimise leakage. Baselines need to align with the Paris Agreement's long-term goal and the host country's Nationally Determined Contribution (NDC) as well as its long-term low greenhouse gas emission development strategy (LT-LEDS). Somewhat inconsistently, baselines shall also account for "suppressed demand" which in the past was meant to provide carbon market access for countries with low emission levels. It seems to be impossible to reconcile this concept with the need to increase ambition over time. It can undermine the host country's NDC achievement as well as environmental integrity. Three specific approaches for baseline setting are stipulated in the RMPs: A best available technologies (BAT) approach, an ambitious benchmark, and an approach based on existing actual or historical emissions adjusted downwards.

To tackle non-permanence risks, measures need to be implemented to minimise and fully address reversals over multiple NDC implementation periods. This can involve prolonged monitoring beyond crediting periods, the establishment of incentives for mitigation activity proponents to reduce reversal risks, the assignment of liability for compensating for reversals to different potential entities, and the introduction of compensation mechanisms like buffer pool reserves at the programme level. Notably, addressing non-permanence is not a new requirement. The CDM used temporary crediting approaches to address non-permanence for

afforestation and reforestation activities and imposed long-term monitoring and liability shift requirements for carbon capture and storage in geological formations.

The Article 6.4 Supervisory Body (SB) is currently working on general recommendations for methodologies which will guide the methodology development under the Article 6.4 mechanism. At COP27, Parties considered a recommendation of the SB on methodologies but could not agree to endorse it. Instead, they renewed the SB's mandate to develop these recommendations. As of September 2023, the SB met seven times to discuss the operationalisation of the Article 6.4 RMPs including recommendations for methodologies and removals. In the course of the seven meetings, the draft recommendation on methodologies underwent significant changes:

- Next to the development of an additionality tool, the SB also agreed to develop a baseline tool and one for addressing leakage.
- On additionality, the current draft recommendation specifies that either an investment analysis and/or an assessment of financial, technological and institutional barriers needs to be conducted. There is a requirement for a regulatory additionality analysis and a test to avoid that the activity locks in levels of emissions, technologies and carbon-intensive practices. In general, the recommendation is more generic; methodologies will need to include more specific guidance to implement these approaches. SB members already agreed to develop a methodological tool for additionality determination.
- The divide between SB members on whether qualitative or quantitative approaches should be used for encouraging ambition over time is still present even though references to these terms were removed while retaining most options in the text. Operationalisation options comprise an emphasis on technologies that are not widely used or available in specific regions, methodologies to enable promotion of progressively more efficient and less emissions intensive technologies or approaches that enable baselines to evolve over time or to result in downward adjustment to encourage ambition over time. The latter are particularly contested. The various approaches for enabling baselines to evolve over time or to result in downward adjustment were moved into a separate section and comprise three different operationalisation options: Application of forward-looking trajectories, the development of bottom-up or top-down default downward adjustment factors or the promotion of activities that enable deep decarbonisation.
- For the operationalisation of the principle 'contribution to the equitable sharing of mitigation benefits' between host countries and carbon credit buyers, options were narrowed down to adjusting crediting periods to be shorter than the lifetime of technology/measure implemented or generating only mitigation contribution Article 6.4 emission reductions (A6.4ERs).
- Regarding the requirement 'alignment with NDCs, the LT-LEDS and the Paris Agreement's long-term goals', the discussion was contentious with the latest recommendation specifying that the activity proponent needs to demonstrate that the envisaged crediting levels do not undermine the host country's ability to achieve its NDC. Operationalisation discussions on ensuring alignment with the Paris Agreement's temperature goal resulted in new text additions to consider different national circumstances, capabilities and emission pathways.
- The operationalisation of the principle 'being real, transparent, conservative, credible' has been formally uncontroversial notwithstanding that many of the controversies described above actually address this principle. It focuses on credible methods for estimating mitigation outcomes, transparent data sources, and robust monitoring systems.

- Regarding guidance for choosing a specific baseline setting approach, no hierarchy is established in terms of which approach to consider first. A justification covering specific factors is required for the chosen approach.
- SB members agreed to approach the operationalisation of suppressed demand by recognising alternative technology as baseline scenario in a context where the baseline equipment or measure cannot realistically provide the level of service required by the Article 6.4 activity. The SB is to assess whether suppressed demand applies on a case-by-case basis.

The SB is also developing a specific guidance for removals, where permanence risks are addressed. The primary approach to addressing reversal and permanence risks envisaged by the SB is through the establishment of buffer pools. In addition, insurance and guarantee approaches will be considered for addressing residual risk.

At COP26, the SB was also tasked with the review of CDM methodologies for application to the Article 6.4 mechanism. This review of CDM methodologies, including standardised baselines, methodological tools and guidelines, can only be undertaken once the general recommendations have been agreed. Efforts are already underway by the UNFCCC Secretariat to revise existing CDM methodologies for alignment with Article 6 requirements. Initiatives like the German Foundation for the Future of the Carbon Market are supporting this process.

The approach of methodological tools to be “grafted” upon existing methodologies

Developing entirely new methodologies is time-consuming and costly. Transitioning existing CDM methodologies to the Article 6.4 mechanism offers a pragmatic approach to methodology development under Article 6.4. An efficient approach is to develop modular tools that can be integrated into existing (CDM) methodologies. The International Initiative for Development of Article 6 Methodology Tools (II-AMT) is spearheading this effort, providing an additionality, baseline and MRV tool, and guidance for aligning existing methodologies with Article 6 requirements. Most recently, the UNFCCC Secretariat supporting the SB members has made a first proposal for tool outlines for determining additionality, setting the baseline, and addressing leakage. Such tools will play an important role in efficiently transitioning eligible existing methodologies to the Article 6.4 mechanism.

We therefore suggest that generic additionality, baseline and MRV tools be approved by the A6.4SB and used in conjunction with transitioned baseline and monitoring methodologies. These tools could be based on the work undertaken by the II-AMT.

The additionality test should cover all relevant mitigation policies, including legislation. Relevant legislation can also comprise laws that have already been agreed upon but are not fully enforced at the time the activity’s additionality is assessed. In addition, there needs to be consideration of uncertainty in deriving an overall conclusion of an activity’s additionality. A comparison between II-AMT’s tool on additionality and the additionality tool outline proposed by the UNFCCC Secretariat reveals numerous overlapping steps. Both tools incorporate a prior consideration test, a regulatory additionality/regulatory surplus test and a test aimed at preventing emissions lock-in. Furthermore, both tools include an assessment of the activity's inherent additionality risk, which determines whether a full investment analysis must be conducted (mandatory for activities with a medium to high risk). The Secretariat's tool outline includes one additional step, the common practice test, which is absent from the II-AMT additionality tool.

The Article 6.4 rules emphasise the need to promote increasing ambition over time, a novel concept rooted in the Paris Agreement context. Increasing ambition over time is generally understood to mean that crediting levels must be progressively reduced. Many different options are currently being discussed on how to operationalise this principle in a baseline. Options include incorporating progressively more efficient and less emissions intensive technologies and expanding user bases. Another option refers to the continued downward adjustment of crediting baselines by applying continuously falling multipliers. The II-AMT baseline tool applies such a multiplier ("Paris Goal Coefficient"), a generic adjustment factor declines over time.

Regarding baseline setting, the II-AMT tool incorporates more steps compared to the baseline tool framework prepared by the UNFCCC Secretariat. The II-AMT baseline tool introduces a hierarchical approach to baseline setting, where activity proponents are required to explore the feasibility of implementing a BAT approach or an ambitious benchmark approach before resorting to an approach based on actual/historical emissions adjusted downward. In contrast, the Secretariat's outline allows activity proponents to choose the appropriate baseline setting approach without prescribing a hierarchy. Another distinction is that the II-AMT baseline tool mandates a downward adjustment for all baseline setting approaches, while the Secretariat's outline only includes such an adjustment for the third baseline approach (actual/historical emissions). Additionally, the II-AMT baseline tool includes a further step that involves comparing the resulting activity-level crediting baseline with the stringency level of the NDC or a sectoral reference level.

Gaps regarding methodological requirements for Article 6.4 and how to address them

Double counting of emission reductions or removals poses a significant challenge in climate mitigation efforts, and the new Article 6.4 mechanism should comprehensively address all forms of double counting. One specific concern that relates to individual methodologies is that double issuance of carbon credits can occur due to overlaps of the accounting boundaries between mitigation activities. In this case, clear contractual arrangements specifying who can claim the emissions reductions are one option to prevent such double counting.

The Article 6.4 RMPs stipulate that negative environmental and social impacts must be minimised (where possible), for which various independent standards like the World Bank's "Environmental and Social Framework",' IFC Performance Standard 1, and the Carbon Credit Quality Initiative offer assessment frameworks. Further frameworks include the United Nations Development Programme's "Social and Environmental Standards" focusing on principles, project-level standards, and management system requirements, United Nations Environment Programme's "Environmental, Social and Economic Sustainability Framework" with a risk-informed approach and safeguard standards, and the Gold Standard's "Safeguarding Principles & Requirements" encompassing safeguarding principles, assessment questions, and project requirements. These frameworks can be incorporated into overarching regulations or specific methodologies to address environmental and social safeguards in Article 6.4 activities.

Adjustments needed to two selected CDM methodologies to align them with Article 6 requirements

In order to operationalise our theoretical findings, we apply them to two important CDM methodologies chosen based on their high likelihood of additionality, coherence with the Paris Agreement's long-term goals, possible applicability to several countries and reasonably high mitigation potential - ACM0005 ("Increasing the blend in cement production") and ACM0006 ("Electricity and heat generation form biomass"). We generally propose to apply the II-AMT tools to the CDM methodologies.

For ACM0005, the following adjustment needs were identified:

- To avoid emissions lock-in, the applicability conditions for greenfield cement plants need to be adjusted. Therefore, an emissions intensity benchmark of 0.5 t CO_2e/t cement is introduced in the adjusted methodology; cement plants with a worse emissions intensity are not eligible. In addition, activity developers need to demonstrate that the plant uses alternative fuels beyond the extent that they are cost competitive; we propose the share of alternative fuels to be at least 5% higher than it would be if only the cost-competitive alternative fuel would be used.
- The CDM's "Tool for the demonstration and assessment of additionality" referred to in the tool is to be replaced by the II-AMT additionality tool to ensure that all relevant mitigation policies and legislation as well as uncertainty are accounted for in the assessment.
- Regarding the calculation of baseline emissions and specifically the benchmark of share of clinker in the blended cement types produced in the host country, it is noted that the annual increase of the adjustment factor for the additives-blended cement ratio (2%) reflects the market trend. The clinker baseline is thus not set below BAU. We propose to align the second factor that influences the baseline emissions, the CO_2 emissions per tonne of clinker in the base year, with Article 6.4 requirements by incorporating step 1 of the II-AMT baseline tool. According to this tool, a BAT would need to be followed. We apply such an approach to the CO_2 emissions per tonne of clinker in the base year.
- Another adjustment need identified in the methodology is to satisfy the principle 'encouraging ambition over time'. For this purpose, a new step is incorporated in the calculation of CO_2 emissions per tonne of clinker in specific year. The determination and application of the *Paris Goal Coefficient* is included to adjust the baseline emissions intensity downwards over the years of the crediting periods.
- For addressing leakage, no adjustment is needed.
- Regarding the minimisation and avoidance of negative environmental and social impacts, additional monitoring parameters will need to be included in the methodology.

For ACM0006, we identify the following Article 6 alignment needs:

- To avoid emissions lock-in, an adjustment need for the applicability conditions of co-fired fossil plants is identified in terms of only allowing cofiring at the minimum needed for the start-up and for maintaining the combustion process. Over time, it would also be necessary to make only that biomass eligible that has previously been used for other purposes, due to the scarcity of the resource. A cascade use of biomass is therefore included in the applicable conditions, implying that biomass from dedicated plantations is not eligible and therefore deleted throughout the methodology.
- For additionality determination, a reference to the II-AMT additionality tool is incorporated to align the assessment with Article 6.4 additionality requirements. Since the methodology makes use of the "Combined tool to identify the baseline scenario and demonstrate additionality" and II-AMT did not develop such a combined tool, certain steps of the CDM tool are retained in the adjusted methodology.
- A new step "selection of the baseline scenario" is introduced to set a "below BAU baseline". The baseline should be set in line with option 3 (existing actual or historical emissions, adjusted downwards) of the II-AMT baseline tool. The only exemption are situations for

which new plants are identified as baseline scenario. In this case, a BAT approach (option 2, II-AMT baseline tool) is to be applied. In addition, the grid emissions factor calculation should be adjusted to be 'below BAU'.

- Regarding 'encouraging ambition over time', we propose to add an additional step to the existing five steps of the baseline emissions determination procedure to determine and apply the Paris Goal Coefficient.
- Addressing leakage effects is sufficiently covered by the current methodology.
- Also, additional monitoring parameters should be included to minimise and avoid negative environmental and social impacts.

As the examples show, the application of the methodological tools to the CDM methodologies is in principle feasible. For less complex methodologies, the replacement of certain steps in the additionality assessment and the baseline emission calculation is straightforward. The more references to various methodological tools and different scenarios (e.g., greenfield, retrofit, replacement etc.) a methodology contains, the more challenging becomes the application.

Generally, the application of the II-AMT tools to the two methodologies shows that the tools cover a significant share of the revision needs to make the methodologies "Article 6.4 proof". However, specific adjustments are necessary due to characteristics of the activity types that cannot be captured by a generic tool. The work of the A6.4SB, methodology specialists and the UNFCCC Secretariat should now assess the body of existing methodologies to develop a priority list of methodologies to be revised and identify key aspects that cannot be addressed by overarching tools, and to engage in specific revisions for these aspects.

Zusammenfassung

Die vorliegende Studie wurde im Rahmen des Forschungsprojekts „Evaluierung von internationalen Emissionsreduktionsprojekten“ gemeinsam durch das Oeko-Institut, die Perspectives Climate Group und INFRAS im Auftrag des Umweltbundesamts durchgeführt. Sie analysiert, wie bestehende Methodiken für die Bestimmung der Zusätzlichkeit, der Referenzfälle und das Monitoring von Kohlenstoffmarktaktivitäten, insbesondere die des Mechanismus für umweltverträgliche Entwicklung (engl. Clean Development Mechanism, CDM), für die Verwendung im Rahmen des neuen Artikel 6.4 Mechanismus des Pariser Abkommens angepasst werden können. Bei der Anpassung der Methoden ist es wichtig, auf das Wissen zurückzugreifen, das aus den Kohlenstoffmarktmechanismen des Kyoto-Protokolls gewonnen wurde. Wir stellen fest, dass viele CDM-Methodiken angepasst werden können, um den stringenteren methodischen Anforderungen des Artikel 6.4 gerecht zu werden. Auf Basis einer Übersicht dieser Anforderungen diskutieren wir, welche Anpassungen für die CDM-Methodiken erforderlich sind. Anschließend bewerten wir den aktuellen Stand der Entwicklung einer Methodikrichtlinie des Aufsichtsgremiums des Artikel 6.4 (engl. Article 6.4 Supervisory Body, SB). Dann analysieren wir unterschiedliche Möglichkeiten, bestehende Methodiken „Artikel 6.4-tauglich“ zu machen, bevor wir die Entwicklung übergreifender Methodikwerkzeuge zur Übertragung von Methodiken in Artikel 6.4 unter die Lupe nehmen. Wir wenden solche Artikel 6.4-Methodikwerkzeuge auf zwei ausgewählte CDM-Methodiken an und leiten daraus Empfehlungen für die zukünftige Entwicklung und das Testen solcher Methodikwerkzeuge ab.

Überblick über die neuen methodischen Anforderungen des Artikel 6.4

Während das Regelwerk (engl. Rules, modalities and procedures, RMPs) für den Artikel 6.4-Mechanismus durch die 26. Vertragsstaatenkonferenz (COP26) in Glasgow verabschiedet wurde, dauert seine detaillierte Ausarbeitung an. Das Regelwerk etabliert stringentere Methodikanforderungen als unter den Kyoto-Mechanismen CDM und JI. Das Prinzip der Zusätzlichkeit wurde klarer definiert als in der Vergangenheit, d.h. es muss gezeigt werden, dass die Minderungsaktivität nicht ohne den Anreiz seitens des Mechanismus stattgefunden hätte. Die Zusätzlichkeitsbestimmung muss nunmehr alle relevanten nationalen Minderungspolitiken, Gesetze oder Regulierungen berücksichtigen. Außerdem sind Technologien oder kohlenstoffintensive Praktiken, die zu einer langfristigen Fixierung von Emissionen führen, nicht mehr zulässig.

Referenzfallmethodiken müssen nunmehr zu einer Erhöhung der Ambition im Zeitverlauf führen, ein konservatives und glaubwürdiges Referenzszenario definieren, und negative indirekte Emissionseffekte vermeiden und minimieren. Referenzfälle müssen mit den Langfristzielen des Pariser Abkommens sowie dem nationalen Emissionsziel (NDC) sowie der langfristigen Emissionsstrategie (LT-LEDS) vereinbar sein. Sie sollen auch „unterdrückte Nachfrage“ berücksichtigen, was in der Vergangenheit Ländern mit niedrigen Emissionsniveaus ermöglichen sollte, an den internationalen Kohlenstoffmarktmechanismen teilzunehmen. Es erscheint allerding unmöglich, dieses Konzept mit der Ambitionssteigerung im Zeitverlauf konsistent zu machen. Drei spezifische Ansätze für die Referenzfallbestimmung sind im Regelwerk festgelegt: ein Ansatz der besten verfügbaren Technologien (BAT), ein ambitionierter Benchmark und ein Ansatz basierend auf den derzeitigen Emissionen oder denjenigen der Vergangenheit, die nach unten hin angepasst werden.

Um das Risiko der Nicht-Dauerhaftigkeit von Emissionsreduktionen anzugehen, müssen Maßnahmen ergriffen werden, um Umkehrungen über mehrere Implementierungsperioden des NDC zu minimieren und vollständig zu berücksichtigen. Dies kann durch Monitoring über die Anrechnungsperiode hinaus, die Setzung von Anreizen für die Reduzierung der Emissionen aus

Speichern, die Haftung für Emissionen aus Speichern seitens unterschiedlicher Akteure, und die Einführung von Kompensationsmechanismen wie Pfandkonten auf dem Niveau von Programmen geschehen. Die Dauerhaftigkeit musste bereits in der Vergangenheit berücksichtigt werden. Der CDM wandte temporäre Anrechnungsverfahren für Auf- und Wiederaufforstungsaktivitäten an und setzte langfristige Monitoringverpflichtungen und Übergang der Haftung für Speicherung in geologischen Formationen (engl. Carbon Capture and Storage) fest.

Das Aufsichtsgremium des Artikel 6.4 arbeitet derzeit an allgemeinen Empfehlungen für Methoden, welche die Methodikentwicklung im Rahmen des Artikel 6.4 Mechanismus leiten werden. Auf der COP27 haben die Vertragsparteien eine Empfehlung des Aufsichtsgremiums zu Methodiken geprüft, konnten sich jedoch nicht auf eine Befürwortung einigen. Stattdessen haben sie das Mandat des Aufsichtsgremiums zur Entwicklung dieser Empfehlungen erneuert. Bisher (Stand September 2023) hatte das Aufsichtsgremium sieben Sitzungen, um die Operationalisierung der RMPs des Artikel 6.4 zu diskutieren, einschließlich Empfehlungen für Methodiken und Kohlenstoffentnahme. Im Laufe der sieben Sitzungen wurde der Entwurf der Empfehlung für Methodiken erheblichen Änderungen unterzogen:

- Neben der Entwicklung eines Zusätzlichkeitswerkzeugs wird auch eines für Referenzfallbestimmung und Bestimmung indirekter Effekte erstellt.
- Bezüglich der Zusätzlichkeit sieht der aktuelle Entwurf vor, entweder eine Investitionsanalyse oder eine Analyse finanzieller, technologischer und institutioneller Barrieren durchzuführen. Darüber hinaus muss eine Analyse der Regulierungen sowie ein Text der Vermeidung der Fixierung von Emissionen, Technologien oder kohlenstoffintensiven Praktiken umgesetzt werden. Im Allgemeinen bewegt sich die Empfehlung auf einem allgemeinen Niveau; die Methodiken werden deutlich spezifischere Richtlinien beinhalten müssen.
- Die Uneinigkeit der SB-Mitglieder hinsichtlich der Frage, ob qualitative oder quantitative Ansätze zur Ambitionssteigerung im Laufe der Zeit verwendet werden sollten, besteht immer noch, obwohl Verweise auf diese Begriffe entfernt wurden, während die meisten Optionen im Text beibehalten wurden. Umsetzungsoptionen umfassen einen Fokus auf Technologien, die nicht stark genutzt werden, oder in bestimmten Gegenden nicht verfügbar sind, Methodiken zur Förderung von immer effizienteren und emissionsärmeren Technologien, oder Ansätze, Referenzfälle im Zeitverlauf zu verschärfen. Die letzteren sind besonders umstritten. Drei verschiedene Ansätze werden aufgeführt: vorausschauende Pfade, bottom-up oder top-down Diskontierungskoeffizienten oder die Förderung von Aktivitäten, die starke Dekarbonisierung vorantreiben.
- Für die Umsetzung des Prinzips "Beitrag zur gerechten Aufteilung der Minderungsvorteile" zwischen Gastländern und Käufern von Emissionsgutschriften wurden die Möglichkeiten enger gefasst; nunmehr werden nur die Kürzung der Anrechnungsperioden unter die Lebensdauer der Technologien oder die ausschließliche Erzeugung nichtautorisierter Minderungsbeiträge betrachtet.
- Bezüglich der Anforderung „Konsistenz mit NDCs, der LT-LEDS und dem Langfristziel des Pariser Abkommens“ gab es eine kontroverse Diskussion. Der letzte Stand der Empfehlung verlangt vom Entwickler der Aktivität zu zeigen, dass die geplante Erzeugung von Emissionsgutschriften nicht die Fähigkeit des Gastlandes beeinträchtigt, seinen NDC zu erreichen. Bezüglich des Langfristziels wurde neuer Text bezüglich unterschiedlicher nationaler Umstände, Fähigkeiten und Emissionspfade eingebracht.

- Die Umsetzung des Prinzips "real, transparent, konservativ, glaubwürdig zu sein" war unumstritten und konzentrierte sich auf glaubwürdigen Methoden zur Schätzung von Minderungsergebnissen, transparenten Datenquellen und robuste Monitoringsysteme.
- In Bezug auf die Auswahl eines spezifischen Ansatzes für die Bestimmung des Referenzfalls wird keine Hierarchie hinsichtlich des zuerst zu berücksichtigenden Ansatzes festgelegt. Es ist eine Begründung erforderlich, die spezifische Faktoren für den gewählten Ansatz abdeckt.
- Die SB-Mitglieder einigten sich darauf, die „unterdrückte Nachfrage" dadurch zu berücksichtigen, dass eine alternative Technologie als Referenzszenario gewählt werden kann, wenn die Referenzfalltechnologie oder -maßnahme das geplante Dienstleistungsniveau der Artikel 6.4-Aktivität nicht erreichen kann. Der SB soll analysieren, ob dies fallspezifisch angewandt wird.

Das Aufsichtsgremium entwickelt auch spezifische Richtlinien für Kohlenstoffentnahmen, durch die Risken für die Dauerhaftigkeit der Speicherung angegangen werden sollten. Der Hauptansatz hier ist die Festlegung von Pfandkonten. Darüber hinaus sollen Versicherungslösungen und Garantien berücksichtigt werden, um Restrisiken abzudecken.

Auf der COP26 wurde das Aufsichtsgremium auch mit der Überprüfung von CDM-Methodiken für die Anwendung im Rahmen des Artikel 6.4 Mechanismus beauftragt. Diese Überprüfung von CDM-Methodiken, einschließlich standardisierter Referenzfälle, Methodikwerkzeuge und Leitlinien, kann erst durchgeführt werden, nachdem die allgemeinen Empfehlungen vereinbart wurden. Das UN-Klimasekretariat ist bereits dabei, CDM-Methodiken entsprechend zu überarbeiten, Initiativen wie die deutsche „Stiftung für die Zukunft des Kohlenstoffmarktes" unterstützen diesen Prozess.

Methodikwerkzeuge, die zu bestehenden Methodiken hinzugefügt werden können

Die Entwicklung gänzlich neuer Methodiken ist zeitaufwändig und kostspielig. Die Überleitung bestehender, angepasster CDM-Methodiken in den Artikel 6.4-Mechanismus ist ein pragmatischer Weg für Methodikentwicklung unter Artikel 6.4. Die Die Internationale Initiative für die Entwicklung von Artikel 6-Methodenwerkzeugen (engl. International Initiative for Development of Article 6 Methodology Tools, II-AMT) treibt diese Bemühungen voran und hat bereits je ein Zusätzlichkeits-, Referenzfall- und Monitoringwerkzeug entwickelt sowie eine Anleitung für die Anpassung bestehender Methodiken an die Anforderungen des Artikel 6.4. Unlängst hat das UN-Klimasekretariat zur Unterstützung der Mitglieder des SB einen ersten Entwurf für die Struktur von Werkzeugen für Zusätzlichkeitsbestimmung, Referenzfallerstellung und Kalkulation indirekter Effekte erstellt. Solche Werkzeuge werden eine wichtige Rolle bei der effizienten Übertragung existierender Methodiken in den Artikel 6.4-Mechanismus spielen. Wir schlagen daher vor, dass allgemeine Zusätzlichkeits-, Referenzfall- und Monitoringwerkzeuge durch den SB genehmigt und in Verbindung mit übertragenen Referenzfall- und Monitoringmethodiken eingesetzt werden. Diese Werkzeuge könnten auf der Arbeit der II-AMT aufbauen.

Das Zusätzlichkeitswerkzeug sollte alle relevanten Minderungspolitiken und -gesetze abdecken. Letztere sollte auch solche Gesetze und Regulierungen umfassen, die zwar eingeführt wurden, aber zum Zeitpunkt der Überprüfung der Aktivität noch nicht vollständig umgesetzt wurden. Darüber hinaus muss Unsicherheit bei der Bewertung der Zusätzlichkeit berücksichtigt werden. Ein Vergleich zwischen dem II-AMT-Zusätzlichkeitswerkzeug und dem Vorschlag des UN-Klimasekretariats für ein Zusätzlichkeitswerkzeug zeigt viele Gemeinsamkeiten. Beide Werkzeuge beinhalten eine Prüfung der frühzeitigen Berücksichtigung, der regulatorischen Zusätzlichkeit und eine Prüfung der Vermeidung der Fixierung der Emissionen. Darüber hinaus enthalten beide Werkzeuge eine Analyse des inhärenten Zusätzlichkeitsrisikos der Aktivität, aus deren Resultat die Notwendigkeit für eine komplette Investitionsprüfung (für Aktivitäten mit mittlerem/hohem Risiko) abgeleitet wird. Das Sekretariatswerkzeug enthält darüber hinaus eine Prüfung, ob der Aktivitätstyp bereits allgemein im Einsatz ist.

Die Artikel 6.4-Regeln betonen die Notwendigkeit, eine Ambitionssteigerung im Lauf der Zeit zu erreichen. Dies ist ein neues im Kontext des Pariser Abkommens verankertes Konzept. Es ist allgemein anerkannt, dass eine Ambitionssteigerung bedeutet, dass die Menge der Emissionsgutschriften im Lauf der Zeit reduziert wird. Derzeit werden viele Möglichkeiten diskutiert, wie dieses Prinzip bei Referenzfallmethodiken umgesetzt werden kann. Optionen umfassen die Einbeziehung effizienterer und weniger emissionsintensiver Technologien und Erweiterung ihrer Nutzerbasis, die kontinuierliche Reduktion der Referenzfallintensität durch die Anwendung gleichmäßig fallender Multiplikatoren. Das II-AMT-Referenzfallwerkzeug wendet einen kontinuierlich fallenden Paris-Ziel-Koeffizienten an, welches auch als „Paris-Ziel-Koeffizienten“ bezeichnet wird.

Bezüglich der Referenzfallbestimmung wendet das II-AMT-Werkzeug mehr Stufen an als das des Klimasekretariats. Das II-AMT-Werkzeug führt einen hierarchischen Ansatz ein, demzufolge Aktivitätsentwickler zunächst prüfen müssen, ob sie einen BAT-Ansatz oder Benchmark anwenden; der historische Ansatz kann erst verwendet werden, wenn beide anderen Ansätze nicht umsetzbar sind. Das Werkzeug des Klimasekretariats lässt den Aktivitätsentwicklern dagegen die freie Wahl des Ansatzes. Ein weiterer wichtiger Unterschied ist, dass das II-AMT eine Anpassung nach unten für alle drei Ansätze verlangt, das Klimasekretariat aber nur für den dritten Ansatz (derzeitige/vergangene Emissionen). Darüber hinaus verlangt das II-AMT-Referenzfallwerkzeug den Vergleich des aktivitätsspezifischen Referenzfalls mit der Stringenz des nationalen Emissionsziels oder einem sektoralen Referenzfall.

Lücken bezüglich der Methodikanforderungen von Artikel 6.4 und Lösungsansätze

Doppelzählungen von Emissionsreduktionen oder Kohlenstoffentnahmen stellen ein signifikantes Problem für den Klimaschutz dar, und der neue Artikel 6.4-Mechanismus sollte umfassend alle Formen von Doppelzählung angehen. Eine besondere Problematik bezüglich spezifischer Methodiken ist die mögliche Doppelausgabe von Emissionsgutschriften aufgrund der Überlappung von Anrechnungsgrenzen verschiedener Minderungsaktivitäten. In solchen Fällen sind klare vertragliche Regeln erforderlich, wer Emissionsgutschriften beanspruchen kann, eine Möglichkeit zur Vermeidung von Doppelzählung.

Die Artikel 6-Regeln legen fest, dass negative Wirkungen auf Umwelt und Soziales minimiert werden sollen. Dafür bieten verschiedene unabhängige Standards, wie das Weltbank ‘Environmental and Social Framework,’ der IFC Performance Standard 1, und die Carbon Credit Quality Initiative Bewertungsschemata an. Weitere Rahmen sind die “Social and Environmental Standards” des UN-Entwicklungsprogramms mit einem Fokus auf Prinzipien, Projektstandards, and Managementsystemanforderungen. Das UN-Umweltprogramm bietet das “Environmental, Social and Economic Sustainability Framework” mit einem risikobasierten Ansatz an, während Gold Standard “Safeguarding Principles & Requirements” Safeguarding-Prinzipien, Analysefragen und Projektbedingungen definieren. Diese Rahmenbedingungen können in allgemeine Regulierungen oder spezifische Methodiken integriert werden, um Umwelt- und Sozialsicherungen bei Artikel 6.4-Aktivitäten einzubauen.

Anpassungsbedarf für zwei ausgewählte CDM-Methodiken zur Artikel 6.4-Kompatibilität

Wir wenden unsere theoretischen Ergebnisse auf zwei wichtige CDM-Methodiken an, die wir ausgewählt haben, da sie eine hohe Wahrscheinlichkeit der Zusätzlichkeit, Kohärenz mit den langfristigen Zielen des Pariser Abkommens, Anwendbarkeit in mehreren Ländern und ein vernünftiges Minderungspotenzial aufweisen: ACM 0005 („Erhöhung des Anteils an Zuschlagstoffen bei der Zementproduktion“) und ACM 0006 („Strom- und Wärmeerzeugung aus Biomasse“). Wir schlagen generell vor, die II-AMT-Werkzeuge auf diese CDM-Methodiken anzuwenden.

Für ACM0005 wurden die folgenden Anpassungsbedarfe identifiziert:

- Um die Fixierung von Emissionen zu vermeiden, müssen die Anwendungsbedingungen für Greenfield-Zementwerke angepasst werden. Daher wird ein Benchmark der Emissionsintensität von 0.5 t CO_2e/t Zement angewandt, Zementwerke mit einer höheren Emissionsintensität sind nicht zulässig. Außerdem müssen die Entwickler der Aktivität zeigen, dass das Zementwerk mehr alternative Brennstoffe verwendet als kommerziell gerechtfertigt wäre; wir schlagen vor, dass der Anteil alternativer Brennstoffe mindestens 5% höher liegen muss, als wenn nur die kommerziell attraktiven Alternativbrennstoffe genutzt worden wären.
- Das "Tools für die Demonstration und Bewertung der Zusätzlichkeit" des CDM, auf das in der Methodik Bezug genommen wird, soll durch das II-AMT-Zusätzlichkeitstool ersetzt werden, um sicherzustellen, dass alle relevanten Minderungspolitiken und -gesetze sowie Unsicherheiten bei der Bewertung berücksichtigt werden.
- Bezüglich der Bestimmung der Referenzfallemissionen, insbesondere des Benchmarks für den Klinkeranteil in den im Gastland produzierten Zementmischungen, stellen wir fest, dass der jährliche Anstieg von 2% für den Anpassungsfaktor für die Mischanteile nur den Markttrend reflektiert. Der Klinker-Referenzfall liegt also auf BAU und nicht darunter. Wir schlagen vor, den zweiten Koeffizienten, der die Referenzfallemissionen beeinflusst, die CO_2-Emissionen je Tonne Klinker im Basisjahr Artikel 6.4-konform zu machen, indem Stufe 1 des II-AMT Referenzfallwerkzeugs angewandt wird. Gemäß diesem Werkzeug muss ein BAT-Ansatz verfolgt werden. Wir wenden solch einen Ansatz auf die CO_2-Emissionen pro Tonne Klinker im Basisjahr an.
- Eine weiterer Anpassungsbedarf bezieht sich auf das Prinzip der Ambitionssteigerung im Zeitverlauf. Dafür wird eine neue Stufe in der Berechnung der CO_2-Emissionen pro Tonne Klinker im Jahr y eingefügt. Die Berechnung des Paris-Ziel-Koeffizienten wird eingefügt, um die Referenzfallintensität im Laufe der Anrechnungsperioden zu reduzieren.
- Für die Bestimmung der indirekten Effekte ist keine Anpassung nötig
- Bezüglich der Minimierung und Vermeidung negativer Folgen für die Umwelt und Soziales müssen zusätzliche Monitoringparameter in die Methodik eingefügt werden.

Für ACM0006 identifizieren wir folgende Anforderungen zur Anpassung an Artikel 6:

- Zur Vermeidung der Fixierung von Emissionen müssen die Anwendbarkeitskriterien folgendermaßen angepasst werden: Zufeuerung fossiler Brennstoffe ist nur erlaubt, soweit es für den Start und Erhalt des Verbrennungsprozesses erforderlich ist. Im Zeitverlauf sollte nur noch diejenige Biomasse zulässig sein, die vorher schon für andere Zwecke genutzt wurde. Eine Kaskadennutzung der Biomasse ist daher in den Anwendbarkeitskriterien niedergelegt, was bedeutet, dass Biomasse aus Plantagenproduktion nicht akzeptiert wird und somit aus der Methodik gestrichen wird.
- Für die Zusätzlichkeitsbestimmung wird ein Verweis auf das II-AMT-Zusätzlichskeitswerkzeug eingefügt, um die Artikel 6.4-Zusätzlichkeitskriterien abzubilden.

Da die Methodik das kombinierte Zusätzlichkeits- und Referenzfallwerkzeug des CDM nutzt und ein solche kombiniertes Werkzeug unter der II-AMT nicht verfügbar ist, wurden bestimmte Stufen des CDM-Werkzeugs in der Methodik beibehalten.

- Ein neuer Schritt „Auswahl des Referenzszenarios“ wird eingeführt, um ein Referenzszenario unterhalb BAU zu erstellen. Dieses Referenzszenario soll im Einklang mit der 3. Option (tatsächliche oder vergangene Emission) des II-AMT-Referenzfallwerkzeugs erstellt werden. Die einzige Ausnahme sind Neuanlagen, in deren Fall ein BAT-Ansatz (Option 2 des II-AMT Referenzfallwerkzeugs) verwendet werden muss. Darüber hinaus muss die Berechnung des Netzemissionsfaktors angepasst werden, um ebenfalls unter dem BAU-Niveau zu liegen.
- Bezüglich der Steigerung der Ambition im Zeitverlauf schlagen wir eine zusätzliche Stufe vor, um den Paris-Ziel-Koeffizienten zu bestimmen und anzuwenden.
- Die Erfassung der indirekten Effekte wird durch die derzeitige Methodik hinreichend abgedeckt.
- Bezüglich der Minimierung und Vermeidung negativer Folgen für die Umwelt und Soziales müssen zusätzliche Monitoringparameter in die Methodik eingefügt werden.

Wie die Beispiele zeigen, ist die Anwendung der Methodikwerkzeuge auf die CDM-Methodiken prinzipiell machbar. Für weniger komplexe Methodiken können bestimmte Stufen in der Zusätzlichkeitsprüfung und der Referenzfallberechnung einfach ersetzt werden. Je mehr eine Methodik Querverweise zu unterschiedlichen Methodikwerkzeugen und Szenarien enthält, desto schwieriger wird die Anwendung.

Allgemein zeigt die Anwendung der II-AMT-Werkzeuge auf die beiden Methodiken, dass die Werkzeuge einen erheblichen Teil des Überarbeitungsbedarfs abdecken, um die Methodiken „Artikel 6.4-tauglich“ zu machen, aber das spezifische Anpassungen erforderlich sind, da die Aktivitätstypen Eigenschaften aufweisen, die durch ein allgemeines Werkzeug nicht abgedeckt werden können. Die Arbeit des SB, der Methodikexperten und des Klimasekretariats sollte nun das Korpus der existierenden Methodiken analysieren, um eine Prioritätenliste der Methodiken für die Überarbeitung zu erstellen. Darüber hinaus müssen Schlüsselaspekte identifiziert werden, die nicht durch übergeordnete Werkzeuge abgedeckt werden können, und spezifische Überarbeitungen für diese vorgenommen werden.

1 Introduction

The second work package of the project "Evaluation of international Emission Reduction Projects" aims to answer the question to which extent existing Clean Development Mechanism (CDM) methodologies can be transitioned to the new Paris Agreement carbon market mechanism. As outlined in the report prepared under the first work package of this project, the experiences gained, and material developed in the context of the Kyoto Protocol are valuable resources and important insights that should not just be discarded by the international community. In fact, it was shown in the preceding report that many approaches could be adjusted to meet the more stringent Article 6.4 requirements that establish the new international market mechanism.

The rules, modalities and procedures (RMPs) of the Article 6.4 mechanism have been adopted at the third Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA.3) in Glasgow. While they provide the general steering direction, further decisions on the operationalisation of the individual requirements are to be taken by the CMA based on the technical work by the mechanism's oversight and technical body, the Supervisory Body (SB).

At the 27th Conference of the Parties (COP27) in Sharm el-Sheikh, some progress was achieved regarding the operationalisation of the Article 6.4 mechanism. However, the SB could not reach an agreement on recommendations for methodologies and could not comply with its mandate on forwarding those to CMA.4. Consequently, the CMA could not take any decision on the further operationalisation of Article 6.4 methodological requirements. In the end, Parties asked the SB to continue the development of recommendations on methodologies and to forward them to CMA.5 at COP28 in Dubai. Regarding removal activities, the SB adopted some recommendations at the last minute of its third meeting. However, those were met with great criticism by both Parties and non-state actors and eventually rejected, mandating the SB to continue its work.

The Glasgow decision also asks the SB to review existing CDM baseline and monitoring methodologies in terms of their applicability with revisions under the mechanism (UNFCCC 2022a, para. 5). According to the 2023 workplan that the SB adopted at its fourth meeting (SB 004), the review of CDM methodologies, standardised baselines, methodological tools and guidelines for application to the Article 6.4 mechanism was planned to start at SB 006 and to continue at SB 007, at SB 008 and beyond 2023 (UNFCCC 2022b). The workplan was updated at SB 007, the most recent meeting, disclosing that the work on reviewing CDM methodological elements will only be started beyond 2023 (UNFCCC 2023a). Considering this context, it is important to advance the methodological work outside the intergovernmental sphere to discuss new and ambitious approaches to the further operationalisation of Article 6.4 requirements that could potentially be picked up by the SB and the international community and to assess the revision needs in selected CDM methodologies.

Transitioning existing CDM methodologies by adjusting them to the new context of the Paris Agreement would be a pragmatic approach to the methodological challenges under Article 6.4 and can potentially serve as benchmark for the implementation of Article 6.2 activities. Considerable expertise went into the development of CDM methodologies, and this knowledge should be built upon. Not all CDM methodologies should, however, be allowed to transition to the new Paris mechanism. The Paris Agreement stipulates that net zero must be reached in the second half of this century, meaning that activities that lead to the adoption of, or the prolongation of the lifetime of an emissions-intensive practice or technology (emissions lock-in) should not be supported through carbon finance anymore. It might also be that some CDM methodologies are not easily adjustable, or the underlying technology has become common practice or economically viable.

While the scope of this study does not allow for the assessment of a broad range of CDM methodologies in terms of their suitability for transition to the new mechanism, it will provide an in-depth analysis of the adjustment needs of two relevant CDM methodologies. Besides, it provides recommendations for the further operationalisation of rules for the implementation of Article 6.4 at the negotiation and technical work level.

Section 2 describes the selection of the two relevant methodologies that are assessed in detail. Subsequently, the new methodological requirements as well as programme-level requirements are outlined in Section 3.1 before adjustment implications for both methodologies are discussed in Section 3.2.

2 Selection of relevant CDM methodologies

For the selection of the CDM methodologies, in a first step the 20 most frequently used CDM methodologies of projects with German involvement were identified. This analysis included both the most frequently used methodologies by issuances of certified emission reductions (CERs) and CDM project registrations (for full overview, see Appendix A in Schneider et al. forthcoming).

In a second step, criteria to assess these TOP20 methodologies were established in consultation with the German Environment Agency. The selection of these criteria was guided by our and the agency's assessment of relevant characteristics of Article 6 activities. The following criteria were established:

- Medium to high likelihood of additionality
- Measure/technology coherent with Paris Agreement long-term goals and transition towards net zero (absence of emissions lock-in)
- Reasonably high mitigation potential
- Applicable to several countries (≥ 10 countries)

The first criterion was treated as an exclusion criterion, meaning that project types that have a low likelihood of additionality were excluded from the analysis. For most criteria, a simple assessment in terms of analysing whether they would be met, somewhat met, or not met was carried out.

Thus, we arrived at the following shortlist of methodologies:

Table 1: Methodology selection

Shortlisted CDM methodologies (medium to high likelihood of additionality)	
ACM0005: Clinker replacement	AMS-III.E.: Biomass power generation
AMS-I.D.: Small-scale renewable power generation	ACM0018: Biomass power generation
AM0034: Nitrous oxide (N_2O) abatement from nitric acid production	AMS-III.F.: Composting
AMS-I.E.: Cooking with renewable energies	AM0025: Alternative waste treatment
ACM0019: N_2O abatement from nitric acid production	AMS-I.C.; AMS-III.E.: Biomass power generation
AMS-I.C.: Small-scale renewable energy generation	AMS-III.AV.: Water purification
AMS-II.C.: Energy efficient household appliances	AMS-I.A.: Household renewable energies
ACM0006: Biomass power generation	

Source: Authors

For the shortlisted methodologies, a more differentiated assessment to determine the mitigation potential of these project types was carried out. Based on this assessment and the priorities by the German Environment Agency, the following two methodologies were selected: ACM0005 (Clinker replacement) and ACM0006 (Biomass power generation). Both activity types are considered to be additional with a high likelihood, most likely entail a high mitigation potential, are in line with the Paris Agreement's goals.

3 Transition of CDM methodologies to the Article 6.4 mechanism

This section assesses the applicability of the two selected methodologies under the Article 6.4 mechanism. While highlighting important lessons learned for the shaping of future project approaches from the Kyoto era in the preceding report, this section will look more into the specific Article 6.4 requirements and what these imply for the CDM methodology transition.

Section **Error! Reference source not found.** outlines specific Article 6.4 requirements that go beyond the Kyoto requirements. The second sub-section dives into the two selected CDM methodologies and pinpoints areas where the methodologies would need to be adjusted to be compatible with the Article 6.4 requirements. In doing so, we would differentiate between issues that can be addressed at the methodology level and those that need higher level regulatory decisions going beyond methodologies.

3.1 New methodological requirements for market-based cooperation

Drawing on the lessons learned from the Kyoto mechanisms, Article 6 negotiators agreed on a new set of rules for market-based cooperation in the Paris era, with many requirements going beyond those of the Kyoto era. In the following, it is described to which extent the rules became more stringent for key carbon crediting principles.

3.1.1 Additionality

Regarding additionality, a key principle for carbon crediting mechanisms, the Article 6.4 rules stipulate that “additionality shall be demonstrated using a robust assessment that shows the activity would not have occurred in the absence of the incentives from the mechanism” (UNFCCC 2022a, para. 38). Furthermore, additionality demonstration must consider all relevant national policies including legislation, so activities must go beyond action required by law or regulation. Also, a conservative approach must be taken for the additionality determination that prevents any lock-ins into emissions or carbon-intensive practices that are not in line with the Agreement’s long-term temperature goal.

The definition of additionality is no longer circular as under the Kyoto Protocol where the definition stated “a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred *in the absence of the registered CDM project activity*” (UNFCCC 2006, para. 43). This definition did not address at all the reasons why the activity would be implemented. The new definition now clearly requires a “robust assessment that shows the activity would not have occurred in the absence of the incentives from the mechanism” (UNFCCC 2022a, para. 38) and thus allows to look more closely into the functioning of the “incentives”. The other additionality requirements are new. As described in the preceding report (Schneider et. al. forthcoming), so-called “E- policies”, meaning policies that reduced emissions, did not always have to be considered in assessing additionality under the CDM if adopted after a certain point of time, which undermined the additionality test outcome in some cases. Under the new mechanism, there will not be any exclusion of policies. New is also that the definition includes the avoidance of lock-in risks which implies that activities supporting new, or prolonged use of, fossil fuel infrastructure may not be deemed additional and thus not be eligible anymore. The implications of the new requirements are summarised in Table 2.

Table 2: Article 6.4 additionality requirements and implications for methodologies

Article 6.4 additionality requirements	Implications
Para. 38: “taking into account all relevant national policies, including legislation”	As compared to the CDM, additionality determination under the Article 6.4 mechanism needs to consider all relevant mitigation policies and not solely mandatory laws and regulations
Para. 38: “representing mitigation that exceeds any mitigation that is required by law or regulation”	Additionality determination under the Article 6.4 mechanism also needs to consider not yet enforced regulations
Para. 38: “taking a conservative approach”	Uncertainty will need to be considered to derive an overall conclusion on additionality as conservativeness is linked to uncertainty
Para. 38: “avoids locking in levels of emissions, technologies or carbon-intensive practices incompatible with paragraph 33”	Exclusion of activities that prolong emissions-intensive practices or technologies

Source: UNFCCC 2022a

3.1.2 Quantification of emission reductions

Regarding the quantification of emission reductions, it is specified that methodologies shall encourage ambition over time, be conservative, credible, below BAU and avoid leakage (UNFCCC 2022a, para. 33). In addition, crediting baselines shall recognize suppressed demand and align with the long-term temperature goal of the Paris Agreement, contribute to reducing emission levels in the host Party and align with its NDC as well as its long-term low GHG emission development strategy (LT-LEDS). In fact, three specific baseline setting approaches that are in line with paragraph 33 are stipulated by the Article 6 rules: A best available technologies (BAT) approach, an ambitious benchmark approach and an approach based on existing actual or historical emissions that are adjusted downwards (UNFCCC 2022a, para. 36). The Article 6.4 RMP further stipulate that mechanism methodologies must consider policies and measures as well as country- or region-specific circumstances (UNFCCC 2022a, para. 34).

In the CDM context, crediting baselines were generally set at the BAU level, with a few cases that went below BAU. With the Paris Agreement’s net-zero target, it became clear that baselines cannot continue to enable potential increases of absolute emission in host countries. This was however allowed under the CDM, if the overall production level of the good or service increases (overcompensating any potential decrease in the emissions intensity); see also the discussion below regarding “suppressed demand”. The alignment with the long-term temperature goal of the Paris Agreement, the NDC and (if existing) the country’s LT-LEDS are, therefore, essential new requirements that ensure that the crediting baseline contributes to a net reduction of global GHG emissions. While CDM projects needed to account for leakage, the Article 6.4 rules stipulate that these leakage effects need to be avoided. Therefore, leakage effects such as sectoral shifts, behavioural changes and rebound effects (e.g., increase consumption of good and services due to lower costs) need to be identified and addressed.

The concept of “suppressed demand” describes a concept where for the baseline activity levels may be considered higher, or technologies considered more carbon-intensive than found in reality before the project is introduced (Fuessler et al. 2019). In the CDM context, suppressed demand was considered to enable carbon market access to countries with low emission levels such as Least Developed Countries (LDCs). Applying the concept of suppressed demand basically resulted in inflated baseline emissions (e.g., assuming growing demand for energy services due to poverty alleviation and thus expansion of electricity production, which in the inflated baseline scenario is achieved using fossil fuels). This has played an important role in the CDM. However, in light of increasing ambition over time, the operationalisation of "suppressed demand" is inconsistent with Article 6.4 requirements.

Finally, if a host country transfers mitigation outcomes from NDC-covered sectors and applies corresponding adjustments, this could undermine its NDC achievement (Spalding-Fecher et al. 2020). This "overselling risk" cannot be directly covered by methodologies but must be addressed through overarching regulations.

The specific Article 6.4 requirements for baseline setting are summarised in Table 3.

Table 3: Article 6.4 baseline requirements and implications for methodologies

Article 6.4 baseline requirements	Implications
Para. 33: "shall encourage ambition over time"	Crediting baselines need to become continuously more ambitious; this could for example be achieved by steadily reducing the baseline over time.
Para. 33: "be […] conservative, credible and below 'business-as-usual'"	Crediting baselines must be set below BAU, meaning below the emissions scenario that would most likely have occurred in the absence of the carbon crediting activity.
Para. 33: "avoid leakage"	Potential leakage effects will need to be identified by the activity participants in the monitoring parts of the methodology and appropriately accounted for. This needs to be done in a more systematic manner than under the CDM where often simplistic default leakage coefficients were used.
Para. 33: "recognize suppressed demand"	The recognition of "suppressed demand" is inconsistent with the long-term goal of the Paris agreement to bring global emissions to net zero, unless the production of the additional goods and services required to satisfy the suppressed demand is emissions free. To at least partially address this problem, suppressed demand will require a different operationalisation than in the CDM context, in order not to undermine the host country's NDC achievement as well as environmental integrity.
Para. 33: "contribute to reducing emission levels in the host Party, and align with its NDC, if applicable, its long-term low GHG emission development strategy, if it has submitted one, and the long-term goals of the Paris Agreement"	The emissions intensity approach to baseline setting cannot continue as under the CDM, as it cannot guarantee absolute emission reductions. The use of a gradually decreasing adjustment factor (<1) will be crucial to ensure absolute emissions reductions.
Para. 36: „Each mechanism methodology shall require the application of one of the approach(es) below to setting the baseline […]. A performance based approach taking into account: (i) Best available technologies that represent an economically feasible and	In the CDM and JI context, some experience was made with best available technologies and ambitious benchmark approaches, showing that their operationalization is challenging. Further guidance still needs to be developed by the SB for the specificities of the three approaches.

Article 6.4 baseline requirements	Implications
environmentally sound course of action, where appropriate; (ii) An ambitious benchmark approach where the baseline is set at least at the average emission level of the best performing comparable activities providing similar outputs and services in a defined scope in similar social, economic, environmental and technological circumstances; (iii) An approach based on existing actual or historical emissions, adjusted downwards to ensure alignment with paragraph 33 above."	

Source: UNFCCC 2022a

3.1.3 MRV

Regarding the **monitoring, reporting and verification** (MRV) of the emissions and mitigation outcomes, the Article 6.4 rules require mitigation outcomes to be verified and measured in tCO_2e (UNFCCC 2022a, para. 1).

3.1.4 Addressing non-permanence

With regard to addressing **non-permanence**, the Article 6.4 rules specify that mitigation activities that involve carbon storage (such as afforestation and reforestation activities) shall "minimize the risk of non-permanence of emission reductions over multiple NDC implementation periods and, where reversals occur, ensure that these are addressed in full (UNFCCC 2022a, para. 31(d), subparagraph (ii)). This implies that activity developers, and the Article 6.4 SB, need to identify approaches to minimise and address reversals risks for activities with material reversal risks, such as land-used based activities. The risk of reversals can be addressed through a variety of means which are often combined, including:

- Monitoring requirements beyond the crediting period (e.g. 50-100 years) to identify whether reversals take place;
- Incentives or legal obligations for mitigation activity proponents to reduce reversal risks, such as conducting a risk assessment, making any contributions to "buffer pools" dependent on the risk assessment, liability for mitigation activity owners to compensate for any reversals, or establishing legal requirements that ensure that land must continue to be used as forest land;
- The introduction of insurance or compensation mechanisms, such as buffer pools, at the programme level to compensate for any unavoidable reversals.

Addressing non-permanence is not a new requirement under the Paris Agreement. The CDM addressed the risk through the issuance of temporary CERs and long-term monitoring and liability shift requirements for geological storage.

Table 4: Article 6.4 non-permanence requirements and implications for methodologies

Article 6.4 MRV requirements	Implications
Para. 34: "address reversals, where applicable" Para. 50: "monitor potential reversals over a period to be decided by the Supervisory Body"	Long-term monitoring and liability shift requirements for geological storage need to be enshrined in the monitoring parts of the methodology. This will be a necessary, but not sufficient condition to ensure permanence (for example, clear liability / insurance requirements to cover reversal risks, which cannot be covered in the baseline/monitoring methodology)

Source: UNFCCC 2022a

3.1.5 Further requirements

Double counting means that the same emission reductions or removals are counted more than once towards achieving climate mitigation targets. It can occur in different ways and requires different measures to address it. Under the CDM, some forms of double counting were addressed, others not. As outlined in the first work package of this research projects, the new Article 6.4 mechanism should address all forms of double counting (see Schneider et al. forthcoming). This requires mostly overarching regulations at the level of the mechanism.

One form of double counting is, however, particularly relevant at the level of individual methodologies: double issuance of carbon credits due to **overlaps of the accounting boundaries between mitigation activities**. For example, an efficient cookstove project uses the fraction of non-renewable biomass (f_{NRB}) as a key baseline parameter. The project generates emission reductions by avoiding the losses of biomass carbon stocks, e.g. by reducing forest degradation. If a forestry project is implemented in the same area – such as an afforestation, avoided deforestation or improved forest management project – the emission reductions or removals generated by the cookstove project would implicitly also be claimed by the forestry project. Another case are emission reductions from renewable electricity if this electricity is also used to fuel electric vehicles. To prevent double claiming contractual clarity on who can claim the emission reductions is required. In this case, there is no methodological issue other than the eligibility criterion specifying that the project developer has a contract that shows the claim and can be checked by the regulator. There are instances where such overlapping claims can be more indirect and more difficult to address (Climate Works Foundation et al. 2019). Since the Article 6.4 requirements go beyond existing ones, other elements need to be included that are currently not reflected in CDM methodologies. These elements could be addressed by revising the respective methodologies, through further tools that are then referenced in the CDM methodologies, or through the introduction of higher-level regulatory decisions. In the following, these elements are discussed in detail.

As stated in chapter 3.1, the Article 6.4 rules specify that mechanism methodologies shall **encourage ambition over time**. As this is a newly introduced concept in the Paris Agreement, there are several potential operationalisation options that are being discussed at the international level. A quantitative approach to increasing ambition over time is the application of a downward adjustment factor. This is a multiplication factor which discounts the baseline emissions of the activity to bend the emissions curve to more closely align with the trajectory of emissions that host Parties aim to achieve (UNFCCC 2022c). In addition to the quantitative approaches, several qualitative approaches to increasing ambition over time have been discussed: Progressively including more efficient and less GHG intensive technologies and measures in the distribution plan when using a programmatic approach, expanding the user base of the project technology and/or installation of more project equipment/measures among the existing users, and additional coverage of sectors are some qualitative options for operationalising the principle of increasing ambition over time (UNFCCC 2022c).

The Article 6.4 rules specify an essential new requirement that the mechanism methodologies must **align with the host country's NDC, LT-LEDS (if submitted) and the long-term goals of the Paris Agreement**. The implication of this new requirement is that activity participants must ensure that the crediting baseline contributes not just to host country's emission reduction targets, but to reaching net zero of global emissions in the second half of this century. Potential operationalisation options include:

- applying one or more operationalisation options described in the requirement 'encouraging ambition over time' to further ensure alignment with the long-term goals of the Paris Agreement.
- assessing the activity-level baseline for alignment with the NDC unconditional target scenario[1] and sector-specific strategies by comparing the stringency level of NDC/sectoral reference scenario with activity level crediting baseline, followed by adjusting the crediting baseline downward if needed.

As per the Article 6.4 rules, an Article 6.4 activity must be designed in a way **that minimises and, where possible, avoids negative environmental (other than GHG emissions) and social impacts**. Consequently, activity participants must ensure that appropriate environmental and social safeguards are in place to address these impacts. While the CDM did not sufficiently provide an evaluation framework for assessing the environmental and social impacts of a project, there are several independent standards that have developed such assessment frameworks which can be utilised as potential options for operationalising this Article 6.4 requirement. The use of such tools could be required in overarching regulations under the Article 6.4 mechanism. If specific safeguards are only relevant in the context of certain types of mitigation activities, these could also be specified in the relevant methodologies. Some examples being:

- The World Bank's 'Environmental and Social Framework' consists of ten Environment and Social Standards which set out requirements for the identification and assessment of environmental and social risks and impacts associated with projects supported by the Bank through Investment Project Financing (World Bank 2017).
- The IFC Performance Standard 1 under the IFC's Sustainability Framework aims to identify and evaluate environmental and social risks and impacts of the project and promote improved environmental and social performance of clients through the effective use of management systems (IFC 2012).

The Carbon Credit Quality Initiative provides a methodology for assessing the quality of different types of carbon credits, including regarding environmental and social safeguards and sustainable development impacts (Schneider et al. 2021). The Environmental and Social Impacts quality indicators focus on procedural requirements, requirements for local stakeholder consultations and specific requirements of environmental and social safeguards.

The United Nations Development Program's "Social and Environmental Standards" aim to mainstream social and environmental sustainability in UNDP's programmes and projects to support sustainable development (UNDP 2021). The key elements include:

[1] The actual baseline should be lower than the unconditional NDC target in order to ensure that mitigation remains within the host country and not everything is sold

- Programming principles like 'leave no one behind', 'human rights' and 'gender equality'
- Project-level standards
- Social and Environmental Management System requirements

UNEP's "Environmental, Social and Economic Sustainability Framework" aims to strengthen the sustainability and accountability of UNEP programmes and projects (UNEP 2020). It applies a risk-informed approach and includes guiding principles, 8 safeguard standards and related operational modalities.

The Gold Standard's "Safeguarding Principles & Requirements" include the following elements (Gold Standard 2019):

- Principles: 9 safeguarding principles and rationale for the inclusion of the given assessment
- Assessment Questions: To identify potential risks and adverse outcomes of the project and determine how the requirements shall be met for each principle
- Requirements: Define what a Project shall achieve through design, management or risk mitigation.

3.2 Methodology-specific adjustment

Building on the Article 6.4 requirements described above, we developed an assessment framework to evaluate which elements of the selected CDM methodologies may need to be updated to conform with Article 6.4 requirements. Before delving into the assessment, a brief overview of the methodologies is provided.

The CDM methodology "ACM0005: Increasing the blend in cement production" with a sectoral scope on manufacturing industries provides guidelines to produce blended cement (BC) beyond current practices. This can be achieved by increasing the share of additives, thereby reducing the share of clinker.

The CDM methodology "ACM0006: Electricity and heat generation from biomass" with a sectoral scope that focuses on energy industries (renewable- / non-renewable sources) aims to facilitate GHG emissions mitigation through renewable energy, energy efficiency improvements, fuel switching. It sets requirements for e.g., the types of biomass that can be used or the amount of fossil fuel that can be co-fired

The results for methodology ACM0005 are presented in Table 5 and for methodology ACM0006 in Table 6.

Table 5: Assessment results for ACM0005 (Version 07.1.0)

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
Additionality determination	Consideration of all relevant mitigation policies and consideration of not yet enforced regulations in the additionality determination	Additionality section, section on identification of the baseline scenario and para. 24-25 in "Tool for the demonstration and assessment of additionality": Tool only tests consistency with mandatory laws and regulations but not with all relevant mitigation policies and legislation including laws that are about to take effect (according to agreed legal documents) but have not yet been fully enforced	Additionality assessment is not in line with the Art. 6 requirements. The regulatory analysis should consider all (existing and new) mitigation policies and go beyond what is required by law or regulation, even if not enforced yet (but set to take effect). While there are currently no blending requirements in any relevant cement producing country, this may be the case in the future.
	Consideration of uncertainty in deriving an overall conclusion on an activity's additionality (link to conservativeness)	Additionality section (p. 5-6) and para. 28, 32, 46 in "Tool for the demonstration and assessment of additionality": By leaving it up to the project participants to select the appropriate additionality test, the tool does not account for difference in inherent additionality risks. A robust approach would require activities that are risk prone to run through more comprehensive additionality tests than others.	The current tool does not address uncertainty regarding activities with a higher risk of non-additionality. In principle, the tool should be adjusted in a manner that risk-prone activities are not allowed to choose the approach (barrier or investment analysis) at their discretion. The decision between two tests can greatly affect the results of the assessment for additionality as each test has its own set of criteria, assumptions, and priorities.
	Avoidance of emissions lock-in	Applicability conditions for greenfield cement plants	In the methodology, no specific criteria (emission intensity, BAT, etc,) are defined for the greenfield cement plants. If greenfield plants with high emissions intensity and outdated technology were eligible under the

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
			methodology, high emissions from clinker production will be locked in for the lifetime of the new plants, and absolute emissions from cement production may increase. Wet kiln plants and plants with less than five-stage preheaters should not be eligible. In general, the methodology should not be applicable in greenfield cement plants with an emissions intensity below 0.5 CO_2e/t cement. In addition, activity participants need to show that more alternative fuels are used than would available in sufficient quality and at net costs comparable to fuels normally used in the area.
Quantification of emission reductions	Encouragement of crediting baselines that become continuously more ambitious	Step 1 - 2: There is no element that would ensure the continuous adjustment of the baseline in terms of progressively reducing the crediting levels	Such an element would need to be added in both steps, ideally in form of an adjustment factor that decreases over time.
	Crediting baseline set in a conservative manner and below BAU in line with one of the three baseline setting approaches (BAT, ambitious benchmark, existing actual or historical emissions that are adjusted downwards)	Step 1 "Determination of CO_2 emissions per tonne of clinker in year y ($BE_{clinker,y}$)": For existing plants, emissions are based on the historical data of the project plant; for greenfield cement plants, baseline emissions are based on the first operational year or date from the technology supplier; so the baseline is set at, not below, BAU.	Methodology is not in line with the approaches identified in para. 36 of the RMPs. To be below BAU, the baseline should be set in line with one of the following approaches: BAT approach, ambitious benchmark or existing actual or historical emissions adjusted downwards.

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
		“Tool to calculate the emission factor for an electricity system”	Furthermore, the “Tool to calculate the emission factor for an electricity system” does not define a baseline below BAU as the combined margin represents BAU. The combined margin therefore should be complemented by a coefficient that adjusts the combined margin downwards. An alternative approach would be the one proposed by the UNFCCC Secretariat (see UNFCCC 2023b). It includes a proposal to increase in the weight of the build margin in the combined margin calculation and a proposal to base the build margin "at least at the average emission level of the best performing comparable activities providing similar outputs and services".
		Step 2 "Determination of BBlend,y": Determination of baseline benchmark of share of clinker per tonne of blended cement	While the methodology already incorporates an adjustment factor for the additives-blended cement ratio (2% increase yearly), this factor aims to reflect a market trend towards more blending that was observed in the past and can thus not be seen as a factor that aims to ensure that the baseline is set below BAU. The factor is thus not sufficient and the overall baseline setting approach thus needs adjustment to conform with the Article 6.4 requirements. The baseline calculation for the share of clinker per tonne of blended cement is

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
			based on the historical average of the host country and thus potentially not below a projected BAU trajectory if the BAU development of the share of clinker is a decrease. The proposed calculation method for baseline emissions could lead to an increase in emissions-intensive clinker production. The factor clinker per tonne of blended cement should therefore be adjusted downwards.
	Conservativeness in estimating leakage effects	The tool "Project and leakage emissions from road transportation of freight" referenced in the methodology allows conservative coverage of leakage	N.a.
	Operationalisation of "suppressed demand" by not undermining the host country's NDC target	N.a.	N.a.
	Alignment with host country's NDC, LT-LEDS and with the long-term goals of the Paris Agreement	Step 1 - step 2: The current baseline setting approaches do not seek alignment with the host's NDC or the Paris Agreement's net-zero target	An alignment with the NDC can be incorporated by considering reference scenarios from the host's NDC. In order to achieve an alignment with the Paris Agreement's net-zero target, the crediting baseline needs to be characterised by a continuous downward trend.
MRV: Monitoring methodology	Minimisation and avoidance of negative environmental and social impacts	Monitoring methodology section (p. 28): No respective monitoring parameters are included in the methodology	Monitoring parameters should be adopted and/or new monitoring parameter should be added to ensure

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
			that negative environmental and social impacts are avoided.

Source: Authors

Table 6: Assessment results for ACM0006 (Version 16.0)

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
Additionality determination	Since the steps for additionality determination in the “Combined tool to identify the baseline scenario and demonstrate additionality” are the same as in the in "Tool for the demonstration and assessment of additionality", the same adjustment needs are identified for ACM006 as for ACM0005 (see Table 5).		
	Avoidance of emissions lock-in	Applicability conditions for co-fired fossil plants. In the methodology ACM0006, no specific criteria (emission intensity, BAT, etc.,) are defined for the co-fired fossil plants.	Even though total emissions of the power plants will decrease it is still allowed to use up to a maximum of 80% fossil fuel. This could lead to an incentive for continued operation of power plants with high emissions intensity and outdated technology. Therefore, the methodology’s applicability conditions need to be adjusted. Moreover, biomass is a scarce resource where different objectives compete, including the need to maintain forests and enhance removals, preserving biodiversity and ensuring food security. To achieve these goals, it may be necessary that over time biomass is only combusted after it has been used for other purposes before (cascade use of biomass). The methodology is, however, not limited to biomass residues but

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
			allows directly using biomass from plantation for combustion. This use may actually be associated with temporarily higher emissions to the atmosphere, as the CO2 is immediately emitted, while forests need time to regrow. It may thus lead to locking in a use that is not sustainable in the long-term. The methodology should therefore limit the use of biomass for power and heat generation to biomass sources that are residues that have no other use or biomass that has previously been used for other purposes and has no other use.
Quantification of emissison reductions	Encouragement of crediting baselines that become continuously more ambitious	Step 1 - 5: There is no element that would ensure the continuous adjustment of the baseline	Such an element would need to be added in both steps, ideally in form of an adjustment factor that decreases over time.
	Crediting baseline set in a conservative manner and below BAU in line with one of the three baseline setting approaches (BAT, ambitious benchmark, existing actual or historical emissions that are adjusted downwards)	Step 1 – 5: The different baseline scenarios are set at BAU, not below BAU.	The different baseline scenarios need to be adjusted, so that they enable below BAU baseline setting. While some baseline scenarios use existing actual or historical emissions, others assume that a new plant would be constructed in the baseline scenario. Scenarios building on existing actual or historical emissions would need to be adjusted downwards. If the baseline scenario results in the construction of new plants as most plausible scenario, a BAT of the specific technology could be taken into account.

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
		Step 2.3 "Determination of grid emission factor" (p. 19) and "Tool to calculate the emission factor for an electricity system": Grid emission factor calculation is based on the historical data of the grid; So, the baseline is not below BAU.	Methodology is not in line with one of the approaches identified in para. 36. The "Tool to calculate the emission factor for an electricity system" is not aligned with the requirements regarding baseline setting as it does not define a baseline below BAU. It should be complemented by a coefficient that leads the baseline to deviate from BAU.
		Step 5 "Determine the baseline emissions due to uncontrolled burning or decay of biomass residues": Methodology gives option to include baseline emissions from decay of biomass, which may be above or below the actual historical emissions.	The inclusion of uncontrolled burning or decay of biomass into the baseline calculation is optional which could lead to different outcomes for the same project activity. Project participants should not have multiple options for baseline calculations where they will inevitably choose the most attractive one that generates the highest volume of credits.
	Conservativeness in estimating leakage effects	The tools "Tool 12: Project and leakage emissions from transportation of freight" and "Tool 16: Project and leakage emissions from biomass" and are referenced in the methodology to address leakage emissions. Tool 12 provides two options: either using real data or conservative default values to account for all leakage emissions originating from the transportation of materials. Tool 16 addresses the leakage emissions originating from the	N.a.

Methodology element	Article 6.4 methodological requirements	Identified issue in ACM0005 and associated tools	Adjustment needs in CDM methodology
		cultivation of biomass, diversion of biomass from other activities, and biomass transport emissions outside of the project boundary. Tool 16 provides conservative default values.	
	Operationalisation of "suppressed demand" by not undermining the host country's NDC target	N.a.	N.a.
	Alignment with host country's NDC, LT-LEDS and with the long-term goals of the Paris Agreement	Step 1 - step 5: The current baseline setting approaches do not seek alignment with the host's NDC or the Paris Agreement's net-zero goal	An alignment with the NDC can be incorporated by considering reference scenarios from the host's NDC or other national strategies (e.g. biomass strategies). In order to achieve an alignment with the Paris Agreement's net-zero goal, the crediting baseline needs to decrease.
MRV: Monitoring methodology	Minimisation and avoidance of negative environmental, economic and social impacts	Monitoring methodology section (p. 43): No respective monitoring parameters are included in the methodology. Also, no criteria for sustainability/renewable biomass and procedure for public consultation and stakeholder involvement.	Monitoring parameters should be adopted and/or new monitoring parameter should be added to ensure the environmental integrity of the project activity and minimise/avoid negative impacts. Public consultation and stakeholder involvement procedures could be also defined at the programme level.

Source: Authors

4 Operationalising the Article 6.4 methodology requirements

After introducing the new requirements and the methodological implications and outlining the adjustment needs in both selected methodologies, this section discusses the progress achieved by the mechanism's oversight body to date to operationalise the methodological requirements.

Being able to only meet three times in 2022 due to a late start caused by the inability of UN regions to agree on nominations of members, the SB could not agree on a recommendation on the application of requirements relating to methodologies to CMA.4 at its third meeting (SB 003) in November 2022 (UNFCCC 2022d). While many observers had hoped that the Glasgow decisions on the methodological principles and requirements would lead to a convergence of opinions in the SB on how to operationalise them, this was not the case. Conflicts between members calling for more lenient approaches and members insisting on stringent approaches re-emerged and could not be overcome despite an all-night negotiation session. The information note provided by the secretariat after the meeting (UNFCCC 2022d) summarised the state of the discussion after COP27.

At SB 004, SB members did not engage extensively in substantial discussions. It was agreed that SB members should finalise their work on the requirements for the development and assessment of mechanism methodology by SB 007 in September 2023. Prior to SB 007, a structured public consultation took place based on the draft recommendations that were considerably advanced by the informal working group (see UNFCCC 2023c). At SB 007, substantial progress was made by SB members. In the end, they could not fully finalise the recommendations (UNFCCC 2023d). It was decided to continue working on the basis of the latest version of the draft recommendation coming out of the meeting. The informal working group of the SB is now tasked to further update the draft recommendation, so that it can be adopted at SB 008 and subsequently forwarded to CMA for adoption at COP28.

Across the seven SB meetings, the draft recommendation has considerably changed. The latest version of the draft recommendation includes only a few brackets still (UNFCCC 2023e), indicating further need for discussion among SB members. The chosen approach for operationalising each of the Article 6.4 methodology requirements is outlined in the following:

- Regarding '**encouraging ambition over time**', the obvious divide between SB members on qualitative versus quantitative approaches to operationalise the principle were bridged by removing any references to the terms 'qualitative' or 'quantitative'. While quantitative approaches were usually referring to those that would increase the baseline's stringency over time, qualitative approaches aim to result in a progressive move towards more efficient and less GHG intensive technologies. In fact, the most recent draft recommendation outlines three options (para. 14-15):
  - Prioritising technologies that are not widely used or available in specific locations, thereby facilitating technology transfers, removing barriers to deployment and reducing decarbonisation costs
  - Including progressively more efficient and less GHG intensive technologies, supporting replicable and scalable mitigation activities
  - Applying one of the approaches to address elements of paragraph 33 of the RMP and downward adjustment element of paragraph 36 of the RMP (see discussion below)

- The operationalisation of the requirement '**being real, transparent, conservative, credible'** has not been contentious. The draft recommendation specifies in this regard that methodologies shall ensure that activities represent actual tonnes of GHG mitigation, require a transparent elaboration and disclosure of data sources as well as a robust monitoring and data capture system.
- Regarding '**establishing that the selected baseline is below BAU'**, there were many discussions on the definition of 'below BAU' at the SB meetings. In the end, the text in the draft recommendation was considerably shortened and now stipulates that 'below BAU' can be demonstrated by estimating the difference between emissions of the baseline in line with the three baseline setting approaches and BAU emissions (para. 26). Whereas previous versions of the draft recommendation also referred to the possibility of applying a baseline adjustment factor to the third baseline setting approach (approach based on existing actual or historical emissions, adjusted downwards) to operationalise a 'below BAU' baseline, this does not feature in the most recent draft recommendation.

The SB proposes to operationalise the principle '**contribution to the equitable sharing of mitigation benefits by participating Parties**' by either ensuring that the total length of the crediting period(s) is shorter than the lifetime of technology/measure implemented or by ensuring that only mitigation contribution A6.4ERs are generated (para. 28). Further options such as the application of a more stringent baseline (e.g., by applying a baseline adjustment factor) and retaining the resulting additional mitigation outcomes were removed.

The operationalisation of the requirement '**alignment with the NDC of each participating Party, if applicable and LT-LEDS, if it has submitted one and the long-term goals of the Paris Agreement'** was discussed contentiously during many SB meetings. The reference to the long-term goals of the Paris Agreement remained therefore bracketed in many previous versions. The latest draft recommendation specifies that methodologies require activities to demonstrate that the envisaged crediting levels do not undermine the host country's ability to reach its NDC.

For the operationalisation of the requirement '**aligning with the long-term temperature goal of the Paris Agreement**' the SB proposes to avoid crediting those activities that foster perverse incentives or emissions lock-in (para. 36). New language was introduced that different national circumstances, capabilities and emission pathways need to be considered for the operationalisation of the principle. Mechanism methodologies shall also ensure that crediting levels do not undermine the host country's achievement of its LT-LEDS (para. 37).

- What concerns the **baseline setting approaches**, the latest draft recommendation asks for a justification of the appropriateness of the chosen baseline setting approach: BAT, ambitious benchmark approach or an approach based on existing actual or historical emissions, adjusted downwards (para. 41). Consequently, the document does not establish a hierarchy in terms of what approach to consider first. The hierarchy was a contentious issue in the Article 6 negotiations. The document includes specific factors to be addressed in the justification (e.g., homogeneity or variability of emission sources with respect to technologies and measures applied). For the third baseline setting approach (existing actual or historical emissions, adjusted downwards), the draft document makes clear that one of the approaches in the next paragraph needs to be used to adjust those downwards.
- The most contentious issue from the beginning of the SB's work were the approaches to **enable baselines to evolve over time or to result in downward adjustment** to address elements in paragraph 33 and 36 of the RMP. The first versions of the recommendation

mainly included two options: quantitative and qualitative approaches. These were first discussed in the context of the requirement ‘encouraging ambition over time’. Addressing it in a separate paragraph, entirely new wording was now introduced to circumvent the quantitative versus qualitative approaches divide within the SB. There are now three approaches listed (para. 48):

- Approach A foresees the application of forward-looking baselines whose parameters are updated regularly and by applying an annual discount factor to account for autonomous improvements of baseline parameters.
- Approach B stipulates the development of default downward adjustment factors for emission reduction estimates that are consistent with emissions trajectories to achieve climate goals while considering host country’s differing circumstances. The approach allows for bottom-up and top-down development of these factors. This is basically the same approach that was previously discussed as ‘baseline contraction factor’.
- Approach C calls for transformative activities in terms of enabling deep decarbonisation in the context of methodologies. Transformative is defined as transforming an entire sector towards low carbon options due to their scalability or innovativeness as compared to incremental improvements.

► SB members discussed that '**recognizing suppressed demand’** should be implemented in a context where the baseline equipment or measure cannot realistically provide the level of service level of service required by the Article 6.4 activity. In these contexts, the SB will recognise an alternative technology as baseline scenario (para. 60). The SB is to assess whether suppressed demand applies on a case-by-case basis. The discussion did not address the trade-offs between the suppressed demand criterion and other key requirements (see discussion in Chapter 3.1).

► For the operationalisation of the requirement ‘**taking into account policies and measures and relevant circumstances**’, the draft recommendation specifies that the SB will develop further guidance how mechanism methodologies are to take into account policies and measures as well as relevant circumstances in the future (para. 65).

► Regarding **additionality**, the draft recommendation specifies that either an investment analysis and/or an assessment of barriers (financial, technological, institutional barriers) needs to be conducted (para. 79). In addition, a regulatory analysis must to be carried out to ensure that the activity represents mitigation that is required by applicable law or regulation. Another assessment that needs to be carried out is to check whether the activity avoids locking in levels of emissions, technologies or carbon-intensive practices. Regarding the development of national positive lists that need to be approved by the SB is allowed, the draft recommendation outlines a number of conditions (para. 84).

► On **leakage**, the draft recommendation requires activity developers to avoid or minimise all sources of leakage to the greatest extent possible and handle any remaining leakage by discounting credited volumes (para. 87). Five different measures are listed to avoid, minimise or address leakage (para. 89): discounting credited volumes, scrapping of baseline equipment, demonstration of abundance of resources, application of higher-level elements and upscaling implementation.

Regarding non-permanence and reversals, the methodology guidance specifies that the recommendation will refer to the removal guidance. The primary approach to addressing reversal and permanence risks envisaged by the SB is through the establishment of buffer pools. The reversal risk assessment tool – to be developed by the A6.4SB – is expected to establish categories of activity types based on their inherent level of permanence (e.g., differentiating between chemically stable forms of CO_2 storage versus storage in organic matter), which are expected to determine the project types' respective levels of stringency regarding buffer pool size (as well as post-project monitoring period and frequency of updates). Insurance and guarantee approaches will be examined as possible measures to address residual risk in addition to buffer pools as primary instruments for addressing reversal.

Throughout the SB meetings, many elaborations on the operationalisation of the different requirements were removed. Consequently, the document is rather high-level in its nature, which was also raised by some SB members during the last meetings. This implies that activity developers will require further guidance to actually implement the high-level recommendations. This was also recognised by SB members which is why further guidance is to be developed for baseline setting, additionality determination and leakage in the form of methodological tools (see para. 44, para. 80, para. 91). Regarding the additionality tool, it is specified that mechanism methodologies may require its application.

5 Facilitating the methodology transition

To not overstretch capacities and resources, a pragmatic approach to the transition of CDM methodologies and potentially other existing methodologies is required. This approach should, however, not undermine the robustness of transitioning methodologies, as this would harm the future Article 6 market. This section describes how the adjustment of existing methodologies to the requirements of Article 6 could be implemented. We first discuss possible approaches for adjusting methodologies (section 5.1), then provide an overview of the main ongoing initiative to develop Article 6 tools (section 5.2), and finally test the existing tools in the context of the two selected methodologies (section 5.3).

5.1 Possible approaches for adjusting existing methodologies

The Article 6.4 RMP specify that activity participants, host Parties, stakeholders or the SB may develop mechanism methodologies (UNFCCC 2022a, para. 35). The SB recognises that there are capacity-building needs for host Parties to participate in the mechanism, including related to methodologies (UNFCCC 2022d). Vast challenges exist regarding development of new methodologies, including the need to harness significant financial and human resources, which are exacerbated by a loss of knowledge on CDM methodology development due to methodology experts leaving the field after the crash of the CDM market. Experiences from CDM indicate that developing a new methodology from scratch can require 1-2 years to develop the methodology and can cost anything between 0.1 and 0.2 million USD i.e., the current body of ~250 methodologies under the CDM has a value of 25-50 million USD (Michaelowa et. al. 2020).

Against this background, accelerating or streamlining the revision process of existing CDM baseline and monitoring methodologies for use in the A6.4M is highly relevant. Both inside and outside the Article 6.4 regulatory structure, initiatives have started to work on facilitating the methodology transition process.

The German Foundation for the Future of the Carbon Market under the framework of the German International Climate Initiative is supporting the UNFCCC Secretariat in its work on revising existing CDM methodologies that include standardisation and upscaling on a sectoral level for alignment with the Paris Agreement (ZDK 2020). In this context, the mitigation division of the UNFCCC secretariat carried out a revision of Programme of Activities (PoA)-relevant CDM methodologies for application under the Article 6.4 mechanism. The main objective was to identify methodologies applied in PoAs by considering issuance success as well as other factors such as mitigation measures frequently cited in the NDCs, mitigation options listed by IPCC, methodologies applied by Article 6 pilots and methodologies applied by 'vulnerable' types of projects and to assess how these shortlisted methodologies[2] could be applied under the mechanism.

While efforts to revise existing methodologies are underway, it must be acknowledged that revising an existing methodology is also a time and cost-intensive process, albeit less costly than developing methodologies from scratch, requiring 6-12 months and approximately 50,000 USD to undertake the full revision of a methodology. Therefore, in order to prevent a 'valley of death' for the implementation of Article 6.4 activities, there is a need to rapidly transition CDM

[2] The shortlisted methodologies include: cookstoves and safe-drinking water (AMS-I.E., AMS-I.I., AMS-II.G., AMS-III.R., AMS-III.AV., AMS-III.BG.); grid- and off-grid renewable electricity (ACM002, AMS-I.A., AMS-I.D, AMS-I.F., AMS-I.L.); biogas and manure management (ACM0001, AMS-I.I., AMS-III.D., AMS-III.R.); electric vehicles (AMS-III.C.); and efficient lighting (AMS-II.J., AMS-III.AR).

methodologies to the Article 6.4 mechanism while upholding the principles of environmental integrity.

One time-efficient and least cost approach is to develop tools that can be plugged into existing baseline and monitoring methodologies in a modular fashion, thereby eliminating the need to develop or revise methodologies. Such an approach was also taken under the CDM, wherein CDM tools were developed with cross-cutting modules that could be applied to many different methodologies. For the Article 6.4 mechanism, the SB is also considering the development of tools for additionality, baselines and leakage that can be plugged into existing methodologies. While the recommendations for methodologies can be comprehensive and broad, methodology tools can further detail the approaches, thereby providing more concrete thresholds and defaults (UNFCCC 2023f).

In this spirit of rapidly transitioning existing methodologies to be fit for Article 6, the International Initiative for Development of Article 6 Methodology Tools (II-AMT) was launched in late 2021 as an independent, expert-led process to enable the alignment of approved CDM baseline and monitoring methodologies with rules and principles for collaboration under Article 6 of the Paris Agreement (II-AMT 2023d)[3]. It aims to provide a pragmatic, yet robust approach to the transition of existing methodologies and to make them fit for Article 6. To date, the group of experts from all continents has developed three Article 6 methodology tools and one guidance document: Tool to demonstrate and assess additionality (II-AMT TOOL01); tool for robustly setting baselines (II-AMT TOOL02); tool for monitoring, reporting and verification of emission reductions and removals (II-AMT TOOL03) and guidance to evaluate activities' links to the host country NDC and LT-LEDS (II-AMT GUIDE01). The tools will be applicable to activities at the project or programme level. The Article 6 tools and guidance shall serve as 'add on' guidance coupled to existing methodologies for baseline scenario definition, additionality determination and monitoring of emission reductions or removals. These tools could be combined with existing methodologies. The approach is analogous to the application of CDM tools to a set of CDM methodologies.

Among the SB 007 documents was also a concept note prepared by the UNFCCC Secretariat (see UNFCCC 2023f) that provided background information on options outlined in the draft recommendation. The Secretariat included three outlines for methodology tools including an additionality, baseline and leakage tool. The tools were not subject of the discussion at SB 007 and will be further advanced beyond 2023. The tools include the scope definition, definitions, outline data requirements, a description of general approaches for additionality demonstration as well as concrete steps for each tool.

5.2 Overview of methodology tool development

In the following, the tools and tool outlines developed by II-AMT and the UNFCCC Secretariat are presented in more detail.

5.2.1 II-AMT

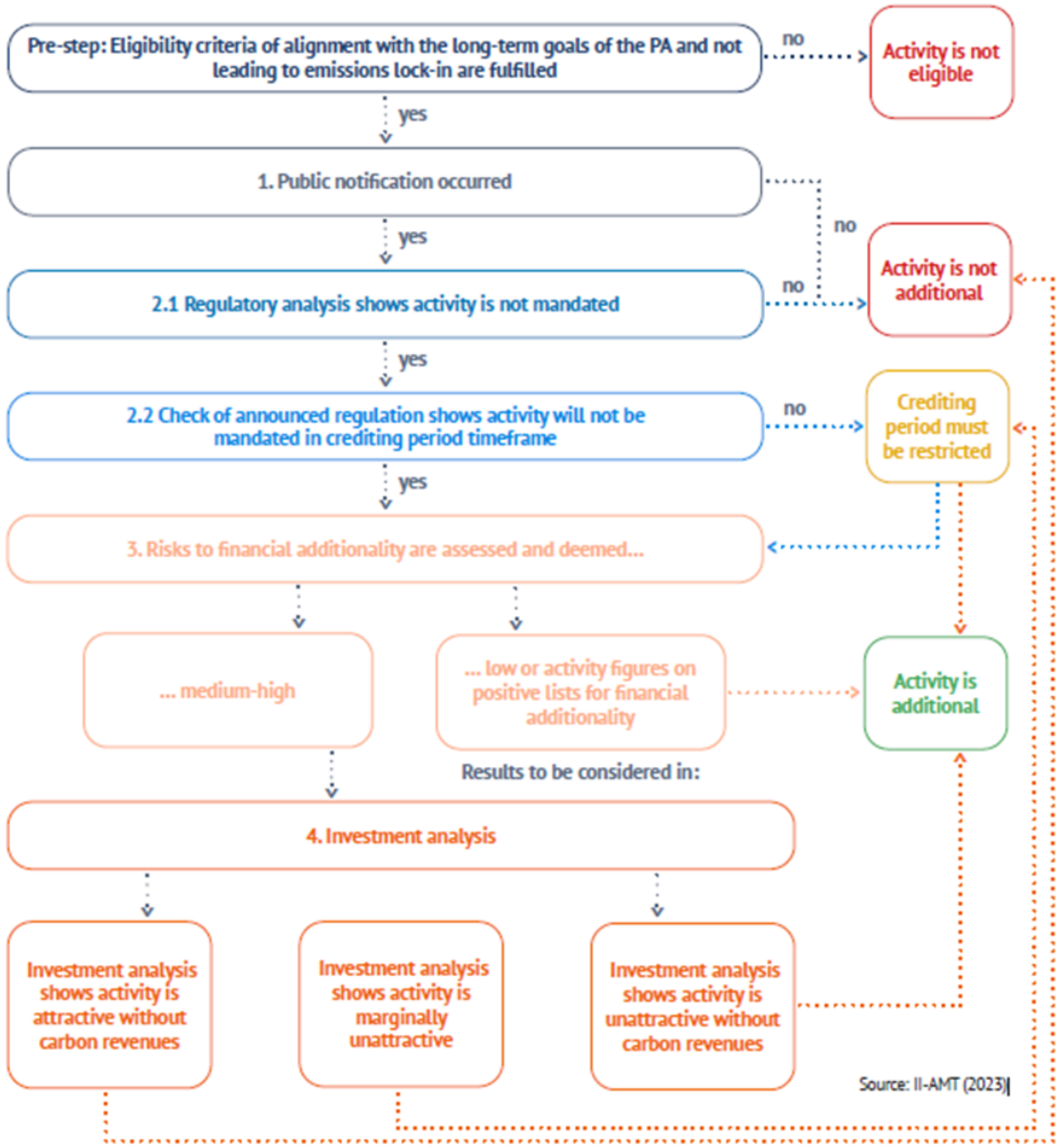
Additionality tool

The additionality tool proposed by the experts of the II-AMT foresees the following stepwise approach to determine additionality (II-AMT 2023a):

[3] The initiative is run by Perspectives Climate Group and supported by the governments of Germany, Sweden, Japan, and the United Kingdom as well as the African Development Bank.

1. First, the activity proponent will need to pass an eligibility pre-check to ensure that the activity is in line with the Paris Agreement's long-term temperature goal. The activity proponent is therefore to demonstrate that the proposed activity does not result in an emissions lock-in. This implies that the activity must not be part of any negative list adopted by the SB or the host country and that it must be in line with the host country's long-term low emission development strategy.
2. Pre-start public notification by the activity proponent that the intention is to get revenues from selling carbon credits and that this has been taken into account in the investment decision. The notification must comprise information on the location, title, activity participants and a description.
3. Regulatory additionality determination to confirm that the activity is neither directly mandated by law nor by legal requirements that are already in effect or "set to take effect". Legal requirements thereby comprise legally binding agreements, covenants, consent decrees or contracts.
4. Evaluation of the inherent financial additionality risk of the proposed activity type to identify whether there is generally a low, medium or high risk of non-additionality. Activity proponents are to identify these risks such as evidence of potential profitability, short payback periods and availability of subsidies. At the same time the non-monetary barriers to the implementation of the activity are to be identified. If the inherent additionality risk is determined to be low, no investment analysis needs to be carried out. In case the risk is found to be medium-high, a full investment analysis needs to be run through. The consideration of the identified non-monetary barriers in the investment analysis may be required for those activity types where a medium to high consolidated implementation risk is identified.
5. For those activity types with a medium to high inherent financial additionality risk, an investment analysis is to be carried out. The investment analysis' purpose is to identify similar alternatives to the proposed activity that will serve as benchmark, thus enabling the determination of the economic assessment parameter's value (e.g., internal rate of return (IRR) at which the mitigation activity would no longer be considered economically or financially feasible. The analysis thereby considers all revenues and savings triggered by the activity. Identified implementation risks (in the previous step) may be incorporated but would need to be denominated as monetary indicators. The activity is not additional if it is found to be attractive without revenues from credits. In case of identified marginal unattractiveness, the tool calls for a shorter crediting period. According to the tool, if the activity is financially found unattractive without carbon market revenues, the investment test is successfully passed as the activity is clearly additional.
6. The final step that the tools foresee is the re-assessment of the activity's eligibility regarding its emissions lock-in potential as well as its regulatory additionality once its crediting period gets renewed.

Figure 1: Proposed Article 6.4-aligned steps to determine additionality



Source: II-AMT (2023a)

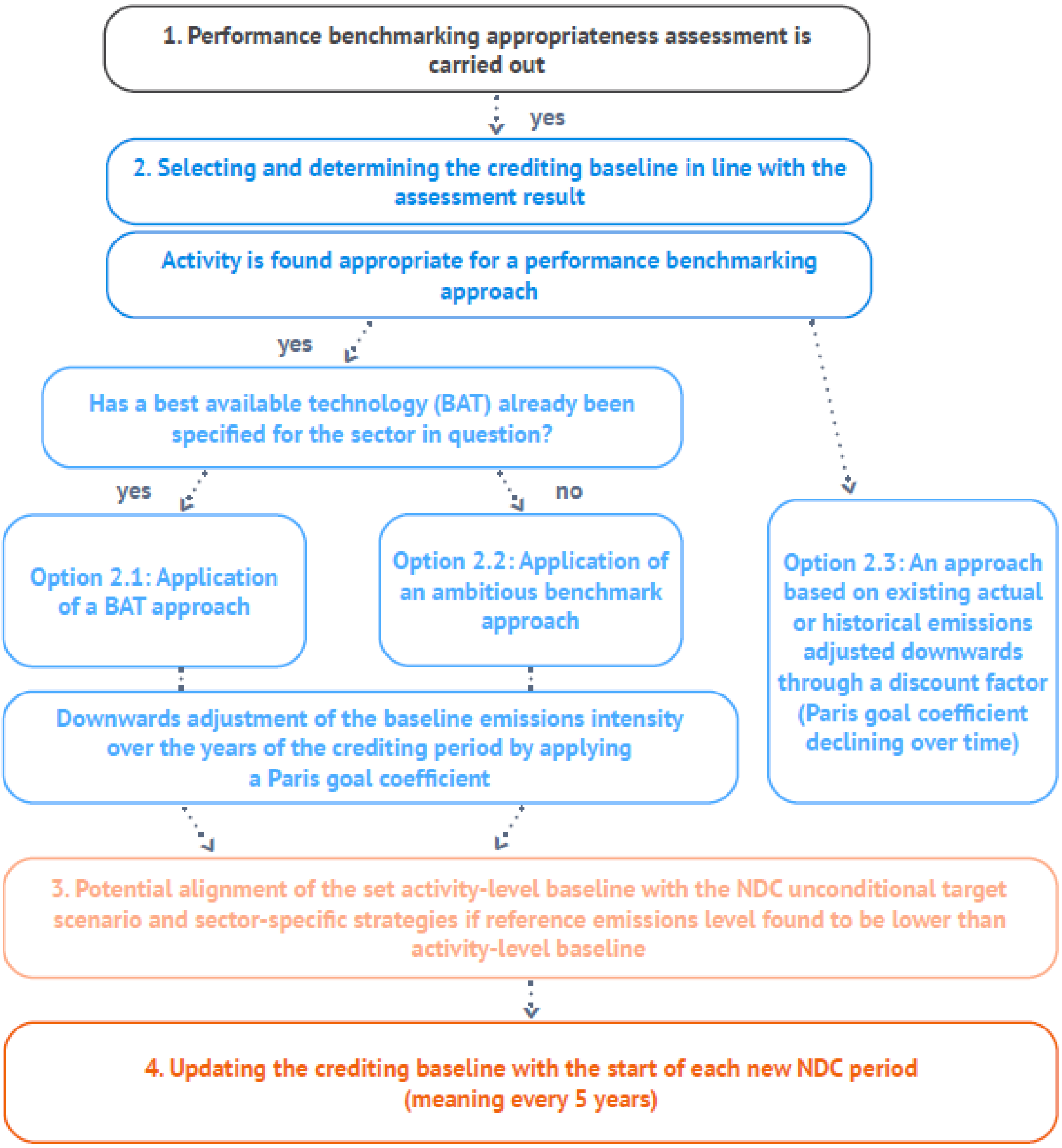
Robust baseline setting

Regarding baseline setting, the initiative's experts propose the following steps (II-AMT 2023b):

1. Selecting a baseline approach among the three ones eligible under Article 6. For sectors with comparable outputs of produced goods and services (homogeneous production), the tool proposes to prioritise a best available technology (BAT) approach if the necessary data is available. If this is not the case, then an ambitious benchmark approach should be selected. In case of a complex sector and a lack of data on the performance of technologies, the third baseline setting approach, meaning setting the baseline based on existing actual or historical emissions adjusted downwards, should be chosen.
2. The next step would be to set the baseline according to one of the three approaches: BAT, ambitious benchmark approach or in line with existing actual or historical emissions that are adjusted downwards.

3. For BAT, the following sub-steps are proposed: Definition of technology category of the activity; definition of the potential baseline technologies that produce an equivalent output of good/service and deemed available in the host country; determination of economically feasible baseline technologies; identification of environmentally sound baseline technologies; determination of the performance parameters and valued of the best technology among the economically feasible baseline technologies for the activity either in the national or regional context; downward adjustment of the baseline emissions intensity over the year of the crediting period by applying a mandatory "Paris goal coefficient"; continued monitoring and updating of baseline parameters across the crediting period.
4. For an ambitious benchmark, the following sub-steps are proposed: Determination of a performance distribution curve using the most recent data of all technologies providing similar outputs or services in similar conditions; determination of an ambitious benchmark (at minimum at the 20th percentile of the performance distribution curve); calculation of the average emissions intensity; downwards adjustment of the benchmark emissions intensive over the years by applying a mandatory "Paris goal coefficient"; continued monitoring and updating of baseline parameters across the crediting period.
5. For a baseline based on existing actual or historical emissions adjusted downwards, the following sub-steps are proposed: Determination of an actual or historical emission baseline; adjustment of actual or historical emissions downwards through a discount factor ("Paris goal coefficient") to the actual/historical emissions intensity, declining over time.
6. Subsequently, the stringency level of the NDC/sectoral reference level is to be compared against the activity-level crediting baseline to consider whether the baseline needs to be adjusted downwards. This step is proposed to ensure that the sector-specific NDC unconditional target is not more stringent than the crediting baseline.
7. In addition, the baseline is to be updated on a regular basis at the beginning of each new NDC period assuming the common timeframes decision is interpreted in the way that a new NDC period starts every 5 years.

Figure 2: Proposed Article 6.4-aligned steps to robustly set baselines



Source: II-AMT (2023b)

MRV tool

The II-AMT MRV tool focuses on revising the existing CDM MRV framework to meet the requirements under Article 6, acknowledging that the MRV protocols used during the Kyoto Protocol era by and large suitable for programme and activity-level crediting (II-AMT 2023c). To ensure alignment with the Article 6.2 guidance; the RMP of the Article 6.4 mechanism; and the modalities, procedures and guidelines (MPGs) of the enhanced transparency framework (ETF), the MRV tool aims to provide guidance on updating the monitoring components of CDM methodologies, as well as corresponding reporting and verification components. Based on a comparison of the latest Article 6 decisions against the existing CDM framework, the II-AMT tool provides guidance on the following four elements that. need to be incorporated into the existing MRV framework for it to be in line with Article 6 requirements (II-AMT 2023c):

- **Ensuring conservativeness:** A shortcoming of the CDM MRV framework is the lack of integration of the concepts of conservativeness and uncertainty. In a robust MRV framework that applies a conservative approach, the costs to reduce uncertainty (i.e. increase accuracy) must be compared to an increase in revenues (since reduced uncertainty permits the use of a lower conservativeness discount factor). Striving for the highest degree of accuracy can be cost-intensive for activity developers. The II-AMT MRV tool attempts to balance this trade-off between accuracy and cost through the concept of uncertainty. The MRV tool suggests that the activity developer should aim for the highest possible level of accuracy without prohibitive costs when developing the monitoring methodology. Should higher level of accuracy lead to prohibitive costs, then the activity developer can opt for a less precise methodology, provided it ensures that emissions are rather overestimated, and removals are rather underestimated.

- **Monitoring of all relevant policies**: Under the CDM, there was no requirement to align activities to host countries' national policies since host countries were not required to have mitigation targets, like the NDCs or LT-LEDS. However, Article 6.4 rules stipulate that activities need to be compatible with host country's NDC and LT-LEDS (both now required to be communicated under the Paris Agreement) and/or the Paris Agreement's long-term goals, while at the same time encouraging ambition over time. Furthermore, the changing policy landscape of a host country has consequences for assessing the additionality of an Article 6.4 activity, i.e., the activity must demonstrate that the mitigation achieved from the activity exceeds any mitigation that is required by law or regulation. Therefore, it is essential for activity participants to monitor all relevant policies. The MRV tool provides a risk-informed approach for monitoring policies.

- **Monitoring of reversals**: The CDM offers limited guidance on adequately identifying and addressing the risk of reversals. Projects with the risk of reversals (e.g., afforestation/reforestation activities) applied temporary crediting approaches (temporary Certified Emission Reductions). While relevant conceptual work on permanence issues with carbon, capture and storage was carried out under the CDM, it was not followed up with practical implementation. Independent standards have been leading the charge on developing reversal-related monitoring and methodological work as well as undertaking its practical implementation. The MRV tool adopts the best practices from existing standards and outlines a monitoring approach for activities with a high risk of reversals. Furthermore, it includes provisions for monitoring beyond the crediting period of a mitigation activity.

- **Monitoring of Sustainable Development impacts**: The CDM SD tool was criticised due to the lack of quantification of co-benefits, lack of safeguards against negative SD impacts, voluntary MRV of co-benefits, and lack of guidance on stakeholder consultations. As a result, there is a need to develop a reformed tool to track and monitor SD impacts as well as a safeguards assessment framework. As the SB is developing a Sustainable Development tool, after considering the SD tools under different standards as well as the feedback received from monitoring experts, the II-AMT MRV tool recommends the use of the tool being developed by the SB. Furthermore, the II-AMT MRV tool provides a Safeguards Tool, which specifies a minimum threshold that a mitigation activity must adhere to abide by the "do-no-harm" principles and provides a framework for assessing the environmental, economic, and social impacts of the proposed mitigation activity.

Beyond these, the II-AMT expert team deems elements of accuracy, completeness, consistency, comparability, leakage, materiality, confidential information, IPCC global warming potentials and quality assurance/quality control as sufficiently addressed under the existing CDM framework.

5.2.2 Outlines of methodology tools prepared for SB meetings

As mentioned above, in the concept note (UNFCCC 2023f) that was published for SB 007, an outline for an additionality, baseline and leakage tool were included in the annexes. The concrete steps proposed by the tool outlines are presented in this section.

Outline of the tool for the demonstration of additionality

The following steps are proposed in the additionality tool outline (UNFCCC 2023f, Appendix 1):

1. A prior consideration test where activity proponents need to show that the carbon market revenues were taken into account in the decision to implement the activity.
2. Subsequently, a regulatory surplus test needs to be carried out by the activity proponent to demonstrate that the activity's mitigation outcomes go beyond what is required by current or relevant laws or regulatory at the activity's start date.
3. In the next step, the activity proponent needs to run through a number of additionality tests:
   a. Through a lock-in emissions test, the activity proponent needs to show that the activity is in line with the Paris Agreement's temperature goals and the host country's policies.
   b. Once the lock-in emissions test is successfully passed, a first-of-its-kind test is to be carried out to demonstrate that the proposed technology has never been implemented before in the same geographic region.
   c. Subsequently, the activity proponent needs to assess whether the activity has a low, medium or high additionality risk by considering the activity's revenues and implementation of similar activities.
   d. If the activity has a medium to high additionality risk, either a financial barrier or an investment analysis is to be conducted through either an investment comparison or a benchmark analysis to prove that the activity is not economically or financially feasible without the carbon market revenues.
   e. Other barrier tests such as a technological and institutional barrier test (subsequent steps) can be applied if a financial barrier test or investment analysis has been carried out (and led to a negative result).
4. Eventually, all activities must pass the common practice test in terms of assessing whether the activity has already been frequently implemented in the respective sector within a geographic area.

Outline of the tool for the implementation of baseline approaches

The outline (UNFCCC 2023f, Appendix 2) presents step-wise approaches for the three baseline setting approaches: BAT, ambitious benchmark and downward adjustment to existing, actual or historical emissions.

- Regarding BAT, first the activity's output/service is to be determined, then available technologies with a similar output/service in the geographic area are to be identified which are to be assessed regarding their alignment with environmental protection regulations. Among the remaining economically feasible technologies, the least emission intensive option is to be identified.

- An ambitious benchmark is set by determining the activity's output/service, subsequently identifying each technology that provides the same output/service within the same area under similar circumstances. For the identified technologies, data of their emissions intensity is to be gathered and a distribution curve to be developed. Then a certain percentile (not yet specified) of the distribution curve is chosen as the comparison group and their average performance identified to serve as the ambitious benchmark which is to be updated at crediting period renewal.

- For the third approach, first the actual (most recent calendar year) or historical (average across the most recent three calendar years) emissions intensity of the activity are to be identified. Consequently, the emissions intensity is to be adjusted downwards by an approach that is not further specified in the document.

Outline of the tool to address leakage

The leakage tool outline (UNFCCC 2023f, Appendix 3) foresees first the identification of potential sources of leakage and subsequently the introduction of provisions to avoid or minimise those through discounting, scrapping, showing the surplus of resource availability in a certain area, incorporate in a higher-level monitoring system or uptake of upscaled approaches.

5.2.3 Comparison of the methodology tools

The comparison of the II-AMT TOOL01 and the additionality tool outline prepared by the UNFCCC Secretariat for SB 007 shows that many steps are in fact identical. Both include a prior consideration test which would be a novel proposal as the mandatory prior notification in the CDM context had to be issued for projects which had already started (submission within 6 months of project start date). Both tools foresee a regulatory additionality/regulatory surplus test and a test to avoid emissions lock-in. Also, both include a step to assess the activity's additionality risk upon whose result the performance of an investment test depends (mandatory for activities with a medium to high risk). For the II-AMT tool, non-monetary barriers may be incorporated into the investment tests while barrier testing in the additionality tool outline from the Secretariat would be particularly relevant for activities with a low risk (not going through investment test). As compared to the CDM where the application of an investment analysis was left to activity participants, the II-AMT experts call for a mandatory application of the investment analysis if inherent additionality risks are medium or high and it looks like the Secretariat's current outline follows the same approach. The Secretariat's tool outline foresees one additional step which is the common practice test that is not covered by the II-AMT additionality tool.

Regarding baseline setting, the II-AMT TOOL02 incudes more steps than the baseline tool outline prepared by the UNFCCC Secretariat. The II-AMT baseline tool stipulates a hierarchical approach to the baseline setting approach, meaning that first activity proponents are to check whether a BAT approach or ambitious benchmark approach can be implemented before an approach based on actual/historical emissions adjusted downwards is chosen. The baseline tool outline of the Secretariat leaves the selection of the appropriate baseline setting approach to the activity proponents. Another difference is that the II-AMT baseline tool foresees a downward adjustment for all baseline setting approaches while the Secretariat's outline only includes such an adjustment for the third baseline approach (actual/historical emissions). Also, the II-AMT baseline tool includes the additional step of comparing the resulting activity-level crediting baseline against the stringency level of the NDC/sectoral reference.

6 Application of the Article 6 tool to the CDM methodologies

As shown in chapter 5, the II-AMT methodology tools and the tool outlines prepared the UNFCCC Secretariat have many similarities. The tool outlines proposed by the UNFCCC Secretariat might still see substantial changes though. The tool outlines have not been discussed yet by SB members in the context of their meetings. Once the methodology guidance is adopted by the CMA, SB members might turn to elaborating the proposals.

Against this background, we discuss in the following the results of applying the II-AMT tools to ACM0005 and ACM006.

6.1 Application results

The approach chosen for applying the tools was to replace the elements identified to need adjustments in section 3.2 with the respective steps in the II-AMT Article 6 tools or additional new text. New additions or deletions in the existing methodologies ACM0005 and ACM0006 are marked red in Appendix A of this report. In the following we describe the results from the application per methodology.

Application to ACM0005

- To avoid emissions-lock-in, the applicability conditions for greenfield cement plants are restricted by including an emissions intensity threshold of below 0.5 t CO_2e/t cement (see Transition Pathway Initiative 2018). This implies that cement plants with a worse emissions intensity are not eligible. This step is based on the II-AMT additionality tool's eligibility criteria and its definition of emissions-intensive technology implying that only cement plants qualify that have a design efficiency equal to the best commercially available efficiency in the host country.
- Before the baseline scenario is identified in the methodology, further steps of the eligibility pre-check of the II-AMT TOOL01 are included in the methodology. Consequently, the activity developers need to demonstrate that the plant uses alternative fuels beyond the extent that they are cost competitive. We propose the share of alternative fuels to be at least 5% higher than it would be if only the cost-competitive alternative fuel would be used.
- The CDM's "Tool for the demonstration and assessment of additionality" referred to in the methodology is replaced by the II-AMT additionality tool to ensure that all relevant mitigation policies and legislation as well as uncertainty are accounted for in the assessment. Therefore, all references to the CDM tools have been removed in the adjusted methodology ACM0005 (also see Appendix A).
- Components listed in the methodology to calculate the financial indicators (additionality section) for either an investment comparison analysis or a benchmark analysis in the CDM additionality tool (TOOL01) are incorporated into the evaluation of the inherent financial additionality risk assessment of the II-AMT additionality tool (step 3).
- The '*First of its Kind*' test is removed from the adjusted methodology as this is covered by the application of the II-AMT TOOL02, step 3.
- Regarding the calculation of baseline emissions and specifically the benchmark of share of clinker in the blended cement types produced in the host country, it is noted that the annual increase of the adjustment factor for the additives-blended cement ratio (2%) reflects the

market trend. The clinker baseline is thus not set below BAU. We propose to align the second factor that influences the baseline emissions, the CO_2 emissions per tonne of clinker in the base year with Article 6.4 requirements by incorporating step 1 of the II-AMT baseline tool. Following the first step of TOOL02, a BAT approach would be chosen as the applicable baseline setting approach due to the good data availability in the cement sector. Therefore, references to CO_2e emissions/t clinker in the base year are replaced by reference to a BAT plant with guidance on quantifying the emissions intensity of the BAT plant. We apply such an approach to the CO_2 emissions per tonne of clinker in the base year but not to the benchmark of shared of clinker in the blended cement types. The latter is not a technology and raising relevant data is considered overly challenging.

- Another adjustment need identified in the methodology is to satisfy the principle 'encouraging ambition over time'. For this purpose, a new step is incorporated in the calculation of CO_2 emissions per tonne of clinker in year y. The determination and application of the *Paris Goal Coefficient* is included to adjust the baseline emissions intensity downwards over the years of the crediting periods. This is one of the sub-steps within the II-AMT TOOL02 for all baseline setting approaches. Further guidance on how to determine the 'Paris Goal Coefficient' is provided in the new step 1.1.5 in the adjusted methodology.
- For addressing leakage, no adjustment is needed.
- A reference to additional monitoring parameters for minimising and negative environmental and social impacts is included in the methodology.

Application to ACM0006

- In the tool reference section, the II-AMT TOOL01 and TOOL02 are included.
- To prevent emissions lock-in, the applicability conditions for fossil fuel co-fired plants are adjusted based on the II-AMT TOOL01 eligibility pre-check. Consequently, fossil fuels may be co-fired as to the minimum needed to start-up and maintaining the combustion process.
- As discussed in section 3.2, the methodology is not limited to biomass residues but allows directly using biomass from plantation for combustion which may result in locking in a use that is not sustainable in the long-term. Over time, it would thus be necessary to make only that biomass eligible that has previously been used for other purposes, due to the scarcity of the resource. A cascade use of biomass is therefore included in the applicable conditions, implying that biomass from dedicated plantations is not eligible and therefore deleted throughout the methodology.
- For additionality determination, a reference to the II-AMT additionality tool (step 1-4) is incorporated to align the assessment with Article 6.4 additionality requirements. The methodology makes, however, use of CDM's "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality". II-AMT has not developed such a combined tool which implies that more adjustments would be required throughout section 5.3. To avoid, extensive adjustment needs, a reference to the step 1-3 of the combined tool is retained to identify the baseline scenario and demonstrate additionality. A reference to step 1-4 of the II-AMT TOOL01 is also included in the new section for additionality determination (see section 5.3.1).
- Regarding quantification of emission reductions, the methodology includes many different scenarios (e.g., greenfield, retrofit, replacement etc.). For the "selection of the baseline scenario", a reference to the II-AMT TOOL02, is introduced to set a "below BAU baseline".

The baseline should be set in line with option 3 (existing actual or historical emissions, adjusted downwards) of the II-AMT baseline tool. The only exemption are situations for which new plants are identified as baseline scenario. In this case, a BAT approach (option 2, II-AMT baseline tool) is to be applied. In addition, the grid emissions factor calculation should be adjusted to be 'below BAU'.

- To adjust the baseline emissions downwards, the *Paris Goal Coefficient* in year y (PGC_y) is included in the baseline emissions equation. The new step 6 (section 5.5.7) provides further details on how such a coefficient would be determined. The parameter is also included among the parameters that do not need to be monitored at the end of methodology.
- For addressing leakage, no adjustment is needed.
- A reference to additional monitoring parameters for minimising and negative environmental and social impacts is included in the methodology.

6.2 Recommendations for methodology tool development

The application of the II-AMT methodology tools has shown that an application to existing CDM methodologies is in principle feasible. In the case of ACM0006, more adjustments are required due to the use of the combined additionality and baseline CDM tool (TOOL02) and the different scenarios included to calculate baseline emissions.

In general, the development of methodology tools that are in line with Article 6.4 methodology requirements can facilitate the transition of CDM methodologies. In the following, we summarise some reflections and recommendations for the methodology tool development:

- The more references to different tools and different scenarios (e.g., greenfield, retrofit, replacement etc.) a methodology contains, the more challenging becomes the endeavour to adjust existing methodologies with the help of an additionality, baseline or other tool.
- Due to the current nature of the methodology guidance, it is likely that activity participants will require further guidance also in the form of methodology tools which outline concrete steps. By building on the previous CDM tools, new methodology tools meeting Article 6.4 methodology requirements can be developed in a manner to keep transaction costs low. Ideally, similar structures as under the CDM are followed for the development of such tools as activity participants are already familiar with CDM tools which allows for ease of application.
- The definition of an emission intensive practice or technology may be challenging at the necessary level of detail. This impacts the eligibility test in methodologies and might require further sector-specific guidance in terms of what is in line with the Paris Agreement's long-term temperature goal. This reveals that specific adjustments are necessary due to characteristics of the activity types that cannot be captured by a generic tool. The work of the SB, methodology specialists and the UNFCCC Secretariat should focus on assessing the body of existing methodologies to develop a priority list of methodologies to be revised. Moreover, key aspects need to be identified that cannot be addressed by overarching tools, and specific revisions for these aspects embarked upon.

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A Appendix: Adjusted methodology ACM0005

Approved consolidated baseline and monitoring methodology ACM0005

"Increasing the blend in cement production"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

This consolidated baseline methodology is based on elements from the following proposed new methodologies:

- NM0045-rev2: "Birla Corporation Limited: CDM Project for "Optimal Utilization of Clinker", whose project design document, and baseline study, monitoring and verification plans were developed by Birla Corporation Limited;
- NM0047-rev: "Indocement's Sustainable Cement Production Project Blended Cement Component", whose project design document, and baseline study, monitoring and verification plans were developed by PT. Indocement Tunggal Perkasa;
- NM0095: "ACC New Wadi Blended Cement Project", whose project design document, and baseline study, monitoring and verification plans were developed by Agrinergy Ltd.;
- NM0106: "Baseline methodology for optimization of clinker use in the cement industry through investment in grinding technology", whose project design document, and baseline study, monitoring and verification plans were developed by Ecosecurities Ldt.

This methodology also refers to the latest approved versions of the following tools:

- "Tool to calculate the emission factor for an electricity system";
- ~~"Tool for the demonstration and assessment of additionality";~~
- "II-AMT Tool for the demonstration and assessment of additionality";
- "II-AMT Tool for robust baseline setting";
- ~~"Assessment of the validity of the original/current baseline and to update of the baseline at the renewal of the crediting period";~~
- "Project and leakage emissions from road transportation of freight".

For more information regarding the proposed new methodologies and the tools as well as their consideration by the CDM Executive Board please refer to <~~http://cdm.unfccc.int/goto/MPappmeth~~>.

~~**Selected approach from paragraph 48 of the CDM modalities and procedures**~~

~~"Existing actual or historical emissions, as applicable".~~

Definitions

For the purpose of this methodology, the following definitions apply:

Blended cement (BC). Blended cement is a mixture of clinker and additives containing less than 95% clinker.

Blended cement types. Blended cement types are defined by the national standard[4] of the host country. Blended cement types are distinct products with different uses that have different additives and different shares of clinker (for example, Portland Pozzolana Cement or Portland Blast Furnace Slag etc).

Relevant cement type. Relevant cement type is the type of blended cement produced under the ~~CDM~~ project activity.

Additives. Additives are defined as materials (e.g. fly ash, gypsum, slag, pozzolana etc) to be blended with clinker to produce blended cement types.

Greenfield cement plant. Greenfield cement plant is defined as cement plant with no operational history at the start of the ~~CDM~~ project activity.

Applicability

This methodology is applicable to project activities that produce blended cement (BC) beyond current practices in the host country either: (i) in Greenfield cement plant with an emissions intensity of below 0.5 t CO2e/t cement or (ii) in existing cement production plant by increasing the share of additives (i.e. reduce the share of clinker). The methodology is applicable under the following conditions:

- This methodology is applicable to domestically sold blended cement of the project activity plant and excludes export of blended cement;
- The methodology is not applicable if blending of cement outside the cement production plants is a common practice in the host country (e.g. localized blending in construction sites);
- All clinker used in the project activity shall be produced by the cement plant that is included within the project boundary, hence, cement grinding only plants cannot use this methodology (e.g. plants with no clinker manufacturing facility);
- Adequate data are available on cement types in the market.

The eligibility pre-check of the "II-AMT Tool for the demonstration and assessment of additionality" shall be applied and project participants need to demonstrate that 5% more alternative fuels are used than would be available at net costs comparable to fossil fuels normally used in the area.

II. BASELINE METHODOLOGY PROCEDURE

Project Boundary

The project boundary includes the cement production plant, any onsite power generation (if applicable), and the power generation in the grid (if applicable).

The power grid or plant from which the cement plant purchases electricity and its losses will be considered in determining indirect emissions. Any transport related emissions for the delivery of additional additives will be included in the emissions related to the project activity as leakage. Emissions reductions from transport of raw materials for clinker production are not taken into account as a conservative simplification.

[4] In cases, where there is no national standard, revision to the methodology is deemed necessary.

Table 1: Emissions sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Calcinations of raw material in the kiln	CO_2	Yes	Direct emission from clinker kiln
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of fuel in the kiln including burner	CO_2	Yes	Direct emissions from clinker kiln
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of fuel for drying raw materials & kiln fuel	CO_2	Excluded	excluded for simplification
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of electricity (grid and self generated) for the preparation of fuels and raw materials for clinker, and for the operation of equipments related to the kiln (engines, compressors, fans etc)	CO_2	Yes	Direct emission from self generation sources and indirect emission from plants connected to the grid supplying the plant with electricity for feeding system, preparation of materials, and driving kiln
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of electricity (grid and self generated) for the preparation of Additives and for Grinding cement types	CO_2	Yes	Direct emission from self generation sources and indirect emission from plants connected to the grid supplying the plant with electricity for crushing and grinding Additives and grinding cement
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
Project activity	Calcinations of raw material in the kiln	CO_2	Yes	Direct emission from clinker kiln.
		CH_4	Excluded	Emissions negligible, excluded for simplification

	Source	Gas	Included?	Justification / Explanation
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of fuel in the kiln including burner	CO_2	Yes	Direct emission from clinker kiln.
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of fuel in driers for drying raw materials & kiln fuel	CO_2	Excluded	Excluded for simplification
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of electricity (grid and self generated) for the preparation of fuels and raw materials for clinker, and for the operation of equipments related to the kiln (engines, compressors, fans etc)	CO_2	Yes	Direct emission from self generation sources and indirect emission from plants connected to the grid supplying the plant with electricity for feeding system, preparation of materials, and driving kiln
		CH_4	Excluded	Emissions negligible, excluded for simplification
		N_2O	Excluded	Emissions negligible, excluded for simplification
	Use of electricity (grid and self generated) for the preparation of Additives and for Grinding cement types	CO2	Yes	Direct emission from self generation sources and indirect emission from plants connected to the grid supplying the plant with electricity for crushing and grinding Additives and grinding cement
		CH4	Excluded	Emissions negligible, excluded for simplification
		N2O	Excluded	Emissions negligible, excluded for simplification

Identification of the baseline scenario

Project participants shall identify the most plausible baseline scenario among all realistic and credible alternatives(s). Steps ~~2 and/or 3~~ 1 and 2 of the latest ~~approved~~ version of the "II-AMT Tool for robust baseline setting ~~the demonstration and assessment of additionality~~" should be used to assess which of these alternatives should be excluded from further consideration (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive). Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario.

In doing so, project participants shall consider all realistic and credible production scenarios for the relevant cement type that are consistent with current rules and regulations, including the existing practice of cement production, the proposed project activity, and practices in other manufacturing plants in the region using similar input/raw materials, and facing similar economic, market and technical circumstances.

Additionality

The additionality of the project activity shall be demonstrated and assessed using step 1-4 of the latest version of the "II-AMT Tool for the demonstration and assessment of additionality" ~~approved by the CDM Executive Board~~.

~~In applying the tool, where investment analysis is used, project participants shall apply Option II (investment comparison analysis) or Option III (benchmark analysis).~~

While ~~calculating the financial indicator for Options II or III~~ evaluating the inherent financial additionality risks of the specific activity type within the applicable geographic area (Step 3), project participants shall consider the following components in the analysis:

- Capital expenditures related to the equipment/modifications in production lines required for the increase in the share of additives in the production of blended cement e.g. pneumatic systems/conveyors/bucket elevators for transfer of the additives, feeding systems, bag dust collectors, additional laboratory equipment for quality control, Cement Vertical Roller Mills, storage silos, facilities for handling and proportioning of additive materials such as hoppers and feeders;
- Savings related to decrease in energy consumption and other savings as a result of decrease in clinker production due to the increased use of additives;
- Costs related to the operation and maintenance of the cement production plant;
- Expenses related to development of in-house capacity and/or research to operate new blending technology and control the quality of blended cement;
- Costs related to the sourcing of blending material and material cost for blending;
- If required, other costs related to the marketing of the new blended cement, e.g. market awareness campaigns; and
- Additional revenues related to the increased production of cement (due to the increased share of additives), if applicable.

Based on the analysis, the consolidated inherent financial additionality risk is high, medium or low, defined as follows:

1. High, meaning the activity type is implemented frequently without incentives from the mechanism (at least 3 activities of this type already have been implemented without incentives);

2. Medium, meaning the activity type has been implemented without incentives from the mechanism (at least one activity of this type already has been implemented without incentives); or

3. Low, meaning the activity type has not been implemented without incentives from the mechanism (no such activity implemented).

If consolidated inherent additionality risk is assessed as:

i. Low: Activities are eligible for a global positive list for financial additionality and do not have to go through Step 4

ii. Medium: Step 4 (investment analysis) is mandatory.

iii. High: Step 4 (investment analysis) is mandatory. In addition, the activity developer must justify how the specific activity differs from the general implementation of the activity type by justifying the input(s) to its financial analysis that drive financial unattractiveness.

In evaluating the implementation risks~~, applying the latest version of the "Tool for the demonstration and assessment of additionality", where project participants use the barrier analysis,~~ only the following barriers may be ~~claimed~~ considered:

~~*First of its Kind*~~

~~Only projects implementing blended cement projects for the first time are allowed to claim this barrier (i.e. project participants which are increasing the percentage of additives from a historical value to a higher value are not allowed to use this barrier).~~

~~In order to demonstrate additionality using When claiming the "First of its Kind" barrier, the applicable geographical area shall include the entire domestic market in the host country and the methodology requires information concerning the market share for blended cement sold in the domestic market in the host country. The project activity shall be considered as the one that applies a technology that is different from any other technologies able to deliver the same output (blended cement) if the market share for blended cement in the host country is below 5% the level produced by the smallest plant serving the market.~~

~~The market share shall be calculated as the percentage of the amount of blended cement in the total amount of all cement types produced in the host country (tons blended cement/total tons cement production x 100%) during the last three years prior to: (a) the start date of the CDM project activity; or (b) the start of validation, whatever is earlier. The market share value must be based on reliable and publicly available data sources (e.g. cement manufacturers associations or governmental agencies). Other CDM Article 6 projects shall be included in this assessment.~~

~~*Investment barriers*~~

~~In case that project participants claim for investment barriers, they should follow the latest approved "Guidelines for objective demonstration and assessment of barriers".~~

Market acceptability barriers, inter alia

- Perception that high additive blended cement is of inferior quality;
- Lack of awareness of customers on the use high additive blended cement.

Claims on market acceptability barriers shall be supported by objective evidences using one or more of the following:

- Letters of complaints from customers, establishing the failure of blended cement to gain their confidence in the market. It should be demonstrated that such complaints is much higher than those received for any new similar product in the market;
- Circulars/notices or any other communication from public works department (Government Department) on the use of blended cement, clearly establishing their low/no preference for blended cement;
- Independent surveys conducted by third parties concluding that blended cement is not accepted in the market where the blended cement will be supplied.

Project participants should demonstrate in an objective manner how ~~the CDM~~ Article 6 alleviates the claimed barriers to the new blended cement produced under the project activity, to a level that the project is not prevented anymore from occurring by such barrier. The project participants shall provide transparent and documented evidence as presented above and illustrated in the "Tool for the demonstration and assessment of additionality".

Based on the analysis, the consolidated implementation risk is high, medium or low, defined as follows:

1. High, meaning the barrier would prevent implementation

2. Medium, meaning the barrier may prevent implementation.

3. Low, meaning other activities with the barrier have been implemented.

If consolidated implementation risk is deemed "low", barriers shall not be included in the investment analysis and not considered further. Otherwise, barriers to implementation may be incorporated in the investment analysis and impacts on the investment decision explained in step 4. Special circumstances of LDCs, SIDS apply in this step and for mitigation activities located in LDCs. Barriers to implementation may be considered as a complement to the investment analysis, while for other countries they must be incorporated in the investment analysis as explained in Step 4 of the "II-AMT Tool for the demonstration and assessment of additionality".

Baseline emissions

The baseline setting shall follow the latest version of the "II-AMT Tool for robust baseline setting". According to the tool´s Step 1 (Selection of baseline approach), a best available technologies (BAT) approach is followed to set the baseline, due to 1) the sector being characterised by homogeneous production i.e., if there are comparable outputs of produced goods or services, and 2) the availability of a BAT.

The baseline emissions depend on two factors:

- The benchmark of share of clinker in the blended cement types produced in the host country; and
- The CO2 emissions per tonne of clinker in the base year at a BAT plant, which in turn depends on:
  - Quantity and carbon intensity of the fuels used in clinker making;
  - Quantity and carbon intensity of electricity;
  - CO_2 emissions from calcinations.

This methodology requires data from ~~the **base year**~~ a typical BAT plant to calculate the baseline emissions (CO_2 emissions per tonne of clinker in the base year: $BE_{clinker,\cancel{BSL}BAT}$).

~~In case of existing cement plants, the base year is defined as the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken in determining CO_2 emissions per tonne of clinker.~~

~~In case of Greenfield cement plants, the base year for determining CO_2 emissions per tonne of clinker is defined as first operational year.~~ The emissions intensity of the BAT plant is taken from the specifications of the BAT plant as per the legal text of the jurisdiction where the project plant is located. If there is no such legal text available, the legal text of similar jurisdictions is to be applied. A jurisdiction is similar if it is located on the same continent and belongs to the same World Bank income grouping category. If no similar jurisdiction with a legal text is found, then the next higher income category of jurisdictions is assessed until a jurisdiction with a legal text is found. Where BAT is defined in several jurisdictions within a group, the value from the jurisdiction with the lowest associated GHG emissions intensity shall be used. ~~For ex-ante calculation for the preparation of PDD, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions.~~

Baseline emissions are calculated as follows:

$$BE_y = BC_y \times (BE_{clinker,y} \times B_{Blend,y} + BE_{ele,ADD,BC}) x\ PGCy \qquad \textbf{(1)}$$

Where:

BE_y	=	Baseline emissions in year y (t CO_2)
BC_y	=	Blended cement produced and sold in the domestic market in year y (t BC)
$BE_{clinker,y}$	=	CO_2 emissions per tonne of clinker in year y (t CO_2/t clinker)
$B_{Blend,y}$	=	Baseline benchmark of share of clinker per tonne of BC updated for year y (t clinker/t BC) (see Step 2 below)
$BE_{ele,ADD,BC}$	=	Baseline electricity emissions for BC grinding and preparation of additives (t CO_2/t of BC)
PGC_y	=	Paris Goal Coefficient in year y

Step 1: Determination of $BE_{clinker,y}$

CO_2 emissions per tonne of clinker in year y ($BE_{clinker,y}$) are calculated as:

$$BE_{clinker,y} = min(BE_{clinker,\cancel{BSL}BAT}, PE_{clinker,y}) \qquad \textbf{(2)}$$

Where:

$BE_{clinker,y}$	=	CO_2 emissions per tonne of clinker in year y (t CO_2/t clinker)
$BE_{clinker,\cancel{BSL}BAT}$	=	CO_2 emissions per tonne of clinker in the ~~base year~~ BAT plant (t CO_2/t clinker)
$PE_{clinker,y}$	=	CO_2 emissions per tonne of clinker in the project activity plant in year y (t CO_2/t clinker) (See project emission section below)

Step 1.1: Determination of $BE_{clinker,BAT\cancel{BSL}}$

CO_2 emissions per tonne of clinker in the BAT plant ~~base year~~ ($BE_{clinker,BAT\cancel{BSL}}$) are calculated as:

$$BE_{clinker,BSL} = BE_{calcin} + BE_{fosslfuel} + BE_{ele,grid,CLNK} + BE_{ele,sg,CLNK} \qquad \textbf{(3)}$$

Where:

$BE_{clinker,BAT\cancel{BSL}}$	=	CO_2 emissions per tonne of clinker in the BAT plant ~~base year~~ (t CO_2/t clinker)
BE_{calcin}	=	Baseline emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate (t CO_2/t clinker)
$BE_{fossil\ fuel}$	=	Baseline emissions per tonne of clinker due to combustion of fossil fuels for clinker production (t CO_2/t clinker)

$BE_{ele,grid,CLNK}$	=	Baseline grid electricity emissions for clinker production per tonne of clinker ($t\ CO_2/t$ clinker)
$BE_{ele,sg,CLNK}$	=	Baseline emissions from self generated electricity for clinker production per tonne of clinker ($t\ CO_2/t$ clinker)

Step 1.1.1: Determination of BE_{calcin}

Baseline emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate (BE_{calcin}) are calculated as:

$$BE_{calcin} = \frac{0.785 \times (OutCaO - InCaO) + 1.092 \times (OutMgO - InMgO)}{CLNK_{BSL}} \quad \textbf{(4)}$$

Where:

BE_{calcin}	=	Baseline emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate ($t\ CO_2/t$ clinker)
0.785	=	Stoichiometric emission factor for CaO ($t\ CO_2/t\ CaO$)
1.092	=	Stoichiometric emission factor for MgO ($t\ CO_2/t\ MgO$)
$InCaO$	=	Baseline non-carbonated CaO content in the raw material (t CaO)
$OutCaO$	=	Baseline CaO content in the clinker produced (t CaO)
$InMgO$	=	Baseline non-carbonated MgO content in the raw material (t MgO)
$OutMgO$	=	Baseline MgO content in the clinker produced (t MgO)
$CLNK_{BSL}$	=	Annual production of clinker in the base year (t clinker)

Step 1.1.2: Determination of $BE_{fossil\ fuel}$

Baseline emissions per tonne of clinker due to combustion of fossil fuels for clinker production ($BE_{fossil\ fuel}$) are calculated as:

$$BE_{fossilfuel} = \frac{\sum FF_{i,\cancel{BSL}BAT} \times EFF_i}{CLNK_{BSL}} \quad \textbf{(5)}$$

Where:

$BE_{fossil\ fuel}$	=	Baseline emissions per tonne of clinker due to combustion of fossil fuels for clinker production ($t\ CO_2/t$ clinker)
$FF_{i,BAT\cancel{BSL}}$	=	Fossil fuel of type *i* consumed for clinker production in BAT plant ~~the base year~~ (t fuel)
EFF_i	=	Emission factor for fossil fuel *i* ($t\ CO_2/t$ fuel)
$CLNK_{BSL}$	=	Annual production of clinker in the base year (t clinker)

Step 1.1.3: Determination of $BE_{ele,grid,CLNK}$

Baseline grid electricity emissions for clinker production per tonne of clinker ($BE_{ele,grid,CLNK}$) are calculated as:

$$BE_{ele,grid,CLNK} = \frac{BELE_{grid,CLNK} \times EF_{grid,\cancel{BSL}BAT}}{CLNK_{BSL}} \quad \textbf{(6)}$$

Where:

$BE_{ele,grid,CLNK}$	=	~~Baseline~~BAT grid electricity emissions for clinker production per tonne of clinker (t CO_2/t clinker)
$BELE_{grid,CLNK}$	=	Grid electricity consumed for clinker production in BAT plant ~~base year~~(MWh)
$EF_{grid,\cancel{BSL}BAT}$	=	~~Baseline~~BAT grid emission factor (t CO_2/MWh) (See Step 6.1 below)
$CLNK_{BSL}$	=	Annual production of clinker in the base year (t clinker)

Step 1.1.4: Determination of $BE_{ele,sg,CLNK}$

Baseline emissions from self generated electricity for clinker production per tonne of clinker ($BE_{ele,sg,CLNK}$) are calculated as:

$$BE_{ele,sg,CLNK} = \frac{BELE_{sg,CLNK} \times EF_{sg,BSL}}{CLNK_{BSL}} \quad \textbf{(7)}$$

Where:

$BE_{ele,sg,CLNK}$	=	Baseline emissions from self generated electricity for clinker production per tonne of clinker (t CO_2/ t clinker)
$BELE_{sg,CLNK}$	=	Self generation of electricity for clinker production in the base year (MWh)
$EF_{sg,BSL}$	=	Emission factor for self generated electricity in the base year (t CO_2/MWh) (See Step 6.3 below)
$CLNK_{BSL}$	=	Annual production of clinker in the base year (t clinker)

Step 1.1.5: Determination of $PGC_{,y}$

$$PGC_y = 1 - \frac{number\ of\ years\ elapsed\ since\ 2021}{number\ of\ years\ between\ 2021\ and\ year\ of\ net\ zero\ target} \quad \textbf{(8)}$$

The "Paris Goal Goefficient" (PGC) serves to downward adjust the baseline emissions intensity over the years of the crediting periods to ensure it is in line with the host country's net-zero target, consistent with the long-term goal of the Paris Agreement and taking into account the principle of Common but Differentiated Responsibilities and Respective Capabilities. It is set by the Article 6.4 Supervisory Body and ensures that baseline emissions fall linearly over time, reaching net zero at the time of the host country's net-zero target. The Paris goal coefficient would be set at 100% in 2021 and at zero in 2050 for a country whose net-zero target date is 2050. For countries without a net-zero target, the Article 6.4 Supervisory Body would specify the year in which the Paris goal coefficient reaches zero.

Step 2: Determination of $B_{Blend,y}$

The "Region" for the benchmark calculation needs to be clearly determined and justified by project participants. The default is the national market but project participants can define a geographic region as the area where each of the following conditions are met: (i) at least 75% of project activity plant's cement production is sold (percentage of domestic sales only); (ii) includes at least 5 other plants with the published data required to calculate $B_{Blend,y}$; and (iii) the production in the region is at least four times the project activity plant's output. Only domestically sold output is considered and any export of cement produced by the project activity plant are excluded in the estimation of emission reductions.

Step 2.1: Determination of baseline benchmark of share of clinker per tonne of BC at the start of the project activity ($B_{Blend,1}$)

Data concerning average blending ratio, annual production and import of the relevant cement type(s) in the region shall be collected for one year prior to the start date of ~~CDM~~ project activity.

Baseline benchmark of share of clinker per tonne of BC at the start of the project activity ($B_{Blend,1}$), which shall be used in the calculation of emission reduction for the first year of each crediting period, is determined as the lowest value among the following approaches:

Average (weighted by production) mass fraction of clinker (t clinker/t BC) for the 5 plants producing cement with the highest share of additives:

Identify the amount of the relevant cement type produced by each plant in the region;

Determine the average (weighted by production) mass fraction of clinker (t clinker/t BC) for the 5 plants producing cement with the highest share of additives of the relevant cement type in the region;

If the region comprises of less than 5 plants producing the relevant cement type, the national market should be used as the default region.

Production weighted average mass fraction of clinker (t clinker/t BC) in the top 20% (in terms of share of additives) of the total production of the blended cement type:

Identify the amount of the relevant cement type produced by each plant in the region;

Determine the production weighted average mass fraction of clinker (t clinker/t BC) in the top 20% (in terms of share of additives) of the total production of the blended cement type in the region;

If 20% falls on part capacity of a plant, that plant is included in the calculations.

Mass fraction of clinker (t clinker/t BC) in the relevant cement type produced in the proposed project activity plant before the implementation of the ~~CDM~~ project activity:

Determine the mass fraction of clinker (t clinker/t BC) in the relevant cement type produced in the proposed project activity plant before the implementation of the ~~CDM~~ project activity, if applicable (for Greenfield cement plant this option shall not be included in the analysis);

The project participants shall use the lowest share of clinker used over the 3 most recent years before the implementation of the ~~CDM~~ project activity.

Note: If the average annual amount of the relevant cement type imported by the host country is more than 10% of the total production volume in the region, the weighted average mass fraction of clinker in the relevant type of imported cement shall be considered in the analysis under approach (a) and (b) above as it would have been produced in a virtual plant located in the region. For example, if there are several companies importing the relevant cement type, the weighted average mass fraction of clinker in the imported cement from each company shall be considered as it would have been produced in a virtual one plant. In this case, the clinker share of the imported cement type may be obtained as specified on the cement bag or import document.

To determine the benchmark for approaches (a) and (b), statistically significant random sampling is done for the high blend brands in the relevant cement type in the region. In other words, for the cement type under consideration and for high blend brands in the region, random and statistically significant samples are selected and analyzed for the share of clinker by an independent laboratory. The sampling of the relevant type of blended cement type produced in the region should exclude cement plants or output from cement plants that have registered blended cement ~~CDM~~ project activities. If reliable and up to date annual data are available from reputable and verifiable external sources (for example, industry manufacturers association or government agencies), these may be used to determine the benchmark.

Step 2.2: Updating of baseline benchmark of share of clinker per tonne of BC for year y within the crediting period

The project participants shall recalculate the benchmark value for each crediting year y within the crediting period, starting from second year.

Baseline benchmark of share of clinker per tonne of BC updated for year y ($B_{Blend,y}$) is determined as follows:

Step 2.2.1: For approaches (a) and (b) above, the project participants shall choose between two options to update the benchmark of share of clinker per tonne of BC

Option 1: Update the benchmark annually and incorporate only an decreasing trend of clinker share (a decreasing trend would require the baseline to remain constant);

Data concerning average blending ratio, annual production and import of the relevant cement type(s) in the region shall be collected. To calculate the benchmark value for year y, data should be collected for the year prior to the year *y*.

If the benchmark value calculated at year y is higher than previous year (y-1), the project participants shall use the benchmark value of the previous year (y-1).

$B_{Blend,y}$ replaces $B_{Blend,y-1}$ if $B_{Blend,y} > B_{Blend,y-1}$

Otherwise, $B_{Blend,y}$ remains unchanged.

Option 2: Update the benchmark annually based on 2% default increase in the share of additives (i.e. decreasing share of clinker) up to the limit of the regulatory/product norm in the region/national market.

$B_{Blend,y}=B_{Blend,1} \times (1-0.02)^y$ till $B_{Blend,y}$ reaches the limit of the regulatory/product norm in the region/national market for the share of clinker in the cement type.

Step 2.2.2: For approach (c) above, update the benchmark annually based on 2% default increase in the share of additives (i.e. decreasing share of clinker) up to the limit of the regulatory/product norm in the region/national market

$B_{Blend,y}=B_{Blend,1} \times (1-0.02)^y$ till $B_{Blend,y}$ reaches the limit of the regulatory/product norm in the region/national market for the share of clinker in the cement type.

Step 2.3: Updating of baseline benchmark of share of clinker per tonne of BC at the renewal of the crediting period

At the renewal of the crediting period, the benchmark is recalculated following the Step 2.1 above. The basis (among the 3 approaches contained in the Step 2.1 above) of the benchmark may change from the approach selected during the previous crediting period.

Step 3: Determination of $BE_{ele,ADD,BC}$

Baseline electricity emissions for BC grinding and preparation of additives ($BE_{ele,ADD,BC}$) are calculated as:

$$BE_{ele,ADD,BC} = BE_{ele,grid,BC} + BE_{ele,sg,BC} + BE_{ele,grid,ADD} + BE_{ele,sg,ADD} \qquad (\cancel{8}9)$$

Where:

$BE_{ele,ADD,BC}$ = Baseline electricity emissions for BC grinding and preparation of additives (t CO_2/t BC)

$BE_{ele,grid,BC}$ = Baseline grid electricity emissions for BC grinding (t CO_2/t BC)

$BE_{ele,sg,BC}$ = Baseline self generated electricity emissions for BC grinding (t CO_2/t BC)

$BE_{ele,grid,ADD}$ = Baseline grid electricity emissions for additive preparation (t CO_2/t BC)

$BE_{ele,sg,ADD}$ = Baseline self generated electricity emissions for additive preparation (t CO_2/t BC)

Step 3.1: Determination of $BE_{ele,grid,BC}$

Baseline grid electricity emissions for BC grinding ($BE_{ele,grid,BC}$) are calculated as:

$$BE_{ele,grid,BC} = \frac{BELE_{grid,BC} \times EF_{grid,BSL}}{BC_{BSL}} \qquad (\cancel{9}10)$$

Where:

$BE_{ele,grid,BC}$ = Baseline grid electricity emissions for BC grinding (t CO_2/t BC)

$BELE_{grid,BC}$ = Baseline grid electricity for grinding BC (MWh)

$EF_{grid,BSL}$ = Baseline grid emission factor (t CO_2/MWh) (See Step 6.1 below)

BC_{BSL} = Annual production of BC in the base year (t BC)

Step 3.2: Determination of $BE_{ele,sg,BC}$

Baseline self generated electricity emissions for BC grinding ($BE_{ele,sg,BC}$) are calculated as:

$$BE_{ele,sg,BC} = \frac{BELE_{sg,BC} \times EF_{sg,BSL}}{BC_{BSL}} \qquad (\cancel{10}11)$$

Where:

$BE_{ele,sg,BC}$ = Baseline self generated electricity emissions for BC grinding (t CO_2/t BC)

$BELE_{sg,BC}$ = Baseline self generation electricity for grinding BC (MWh)

$EF_{sg,BSL}$ = Emission factor for self generated electricity in the base year (t CO_2/MWh) (See Step 6.3 below)

BC_{BSL} = Annual production of BC in the base year (t BC)

Step 3.3: Determination of $BE_{ele,grid,ADD}$

Baseline grid electricity emissions for additive preparation ($BE_{ele,grid,ADD}$) are calculated as:

$$BE_{ele,grid,ADD} = \frac{BELE_{grid,ADD} \times EF_{grid,BSL}}{BC_{BSL}} \qquad (\cancel{11}12)$$

Where:

$BE_{ele,grid,ADD}$ = Baseline grid electricity emissions for additive preparation (t CO_2/t BC)

$BELE_{grid,ADD}$	=	Baseline grid electricity for grinding additives (MWh)
$EF_{grid,BSL}$	=	Baseline grid emission factor (t CO_2/MWh) (See Step 6.1 below)
BC_{BSL}	=	Annual production of BC in the base year (t BC)

Step 3.4: Determination of $BE_{ele,sg,ADD}$

Baseline self generated electricity emissions for additive preparation ($BE_{ele,sg,ADD}$) are calculated as:

$$BE_{ele,sg,ADD} = \frac{BELE_{sg,ADD} \times EF_{sg,BSL}}{BC_{BSL}}$$ (~~12~~13)

Where:

$BE_{ele,sg,ADD}$	=	Baseline self generated electricity emissions for additive preparation (t CO_2/t BC)
$BELE_{sg,ADD}$	=	Baseline self generation electricity for grinding additives (MWh)
$EF_{sg,BSL}$	=	Emission factor for self generated electricity in the base year (t CO_2/MWh) (See Step 6.3 below)
BC_{BSL}	=	Annual production of BC in the base year (t BC)

Project Emissions

In the project activity plant emissions are determined per unit of clinker or per unit of BC accounting for:

Emissions from calcinations of limestone;

Emissions from combustion of fossil fuel and electricity for clinker production and processing of raw material;

Emissions from electricity used for additives preparation and grinding of cement.

The project emissions are calculated as:

$$PE_y = BC_y \times \left(PE_{clinker,y} \times P_{Blend,y} + PE_{ele,ADD,BC,y}\right)$$ (~~13~~14)

Where:

PE_y	=	Project emissions in year y (t CO_2)
BC_y	=	Blended cement produced and sold in the domestic market in year y (t BC)
$PE_{clinker,y}$	=	CO_2 emissions per tonne of clinker in the project activity plant in year y (t CO_2/t clinker)
$P_{Blend,y}$	=	Share of clinker per tonne of BC in year y (t clinker/t BC)
$PE_{ele,ADD,BC,y}$	=	Electricity emissions for BC grinding and preparation of additives in year y (t CO_2/t BC)

Step 4: Determination of $PE_{clinker,y}$

CO_2 emissions per tonne of clinker in the project activity plant in year y ($PE_{clinker,y}$) are calculated as:

$$PE_{clinker,y} = PE_{calcin,y} + PE_{fossilfuel,y} + PE_{ele,grid,CLNK,y} + PE_{ele,sg,CLNK,y}$$ (~~14~~15)

Where:

$PE_{clinker,y}$	=	CO_2 emissions per tonne of clinker in the project activity plant in year y (t CO_2/t clinker)
$PE_{calcin,y}$	=	Emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate in year y (t CO_2/t clinker)
$PE_{fossil\ fuel,y}$	=	Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year y (t CO_2/t clinker)
$PE_{ele,grid,CLNK,y}$	=	Grid electricity emissions for clinker production per tonne of clinker in year y (t CO_2/ t clinker)
$PE_{ele,sg,CLNK,y}$	=	Emissions from self-generated electricity per tonne of clinker production in year y (t CO_2/t clinker)

Step 4.1: Determination of $PE_{calcin,y}$

Emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate in year y ($PE_{calcin,y}$) are calculated as:

$$PE_{calcin,y} = \frac{0.785 \times (OutCaO_y - InCaO_y) + 1.092 \times (OutMgO_y - InMgO_y)}{CLNK_y} \qquad (~~15~~16)$$

Where:

$PE_{calcin,y}$	=	Emissions from the calcinations of limestone (t CO_2/t clinker)
0.785	=	Stoichiometric emission factor for CaO (t CO_2/t CaO)
1.092	=	Stoichiometric emission factor for MgO (t CO_2/t MgO)
$InCaO_y$	=	Non-carbonated CaO content in the raw material in year y (t CaO)
$OutCaO_y$	=	CaO content in the clinker produced in year y (t CaO)
$InMgO_y$	=	Non-carbonated MgO content in the raw material in year y (t MgO)
$OutMgO_y$	=	MgO content in the clinker produced in year y (t MgO)
$CLNK_y$	=	Clinker production in year y (t clinker)

Step 4.2: Determination of $PE_{fossil\ fuel,y}$

Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year y ($PE_{fossil\ fuel,y}$) are calculated as:

$$PE_{fossilfuel,y} = \frac{\sum FF_{l,y} \times EFF_l}{CLNK_y} \qquad (~~16~~17)$$

Where:

$PE_{fossil\ fuel,y}$	=	Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year y (t CO_2/t clinker)
$FF_{l,y}$	=	Fossil fuel of type l consumed for clinker production in year y (t fuel)

EFF_l	=	Emission factor for fossil fuel l (t CO_2/ t fuel)
$CLNK_y$	=	Clinker production in year y (t clinker)

Step 4.3: Determination of $PE_{ele,grid,CLNK,y}$

Grid electricity emissions for clinker production per tonne of clinker in year y ($PE_{ele,grid,CLNK,y}$) are calculated as:

$$PE_{ele,grid,CLNK,y} = \frac{PELE_{grid,CLNK,y} \times EF_{grid,y}}{CLNK_y} \quad (\cancel{17}18)$$

Where:

$PE_{ele,grid,CLNK,y}$	=	Grid electricity emissions for clinker production per tonne of clinker in year y (t CO_2/t clinker)
$PELE_{grid,CLNK,y}$	=	Grid electricity for clinker production in year y (MWh)
$EF_{grid,y}$	=	Grid emission factor in year y (t CO_2/MWh) (See Step 6.1 below)
$CLNK_y$	=	Clinker production in year y (t clinker)

Step 4.4: Determination of $PE_{ele,sg,CLNK,y}$

Emissions from self-generated electricity per tonne of clinker production in year y ($PE_{ele,sg,CLNK,y}$) are calculated as:

$$PE_{ele,sg,CLNK,y} = \frac{PELE_{sg,CLNK,y} \times EF_{sg,y}}{CLNK_y} \quad (\cancel{18}19)$$

Where:

$PE_{ele,sg,CLNK,y}$	=	Emissions from self-generated electricity per tonne of clinker production in year y (t CO_2/t clinker)
$PELE_{sg,CLNK,y}$	=	Self generation of electricity for clinker production in year y (MWh)
$EF_{sg,y}$	=	Emission factor for self generated electricity in year y (t CO_2/MWh) (See Step 6.2 below)
$CLNK_y$	=	Clinker production in year y (t clinker)

Step 5: Determination of $PE_{ele,ADD,BC,y}$

Electricity emissions for BC grinding and preparation of additives in year y ($PE_{ele,ADD,BC,y}$) are calculated as:

$$PE_{ele,ADD,BC,y} = PE_{ele,grid,BC,y} + PE_{ele,sg,BC,y} + PE_{ele,grid,ADD,y} + PE_{ele,sg,ADD,y} \quad (\cancel{19}20)$$

Where:

$PE_{ele,ADD,BC,y}$	=	Electricity emissions for BC grinding and preparation of additives in year y (t CO_2/t BC)
$PE_{ele,grid,BC,y}$	=	Grid electricity emissions for BC grinding in year y (t CO_2/t BC)

$PE_{ele,sg,BC,y}$ = Emissions from self generated electricity for BC grinding in year y ($t\ CO_2/t\ BC$)

$PE_{ele,grid,ADD,y}$ = Grid electricity emissions for additive preparation in year y ($t\ CO_2/t\ BC$)

$PE_{ele,sg,ADD,y}$ = Emissions from self generated electricity additive preparation in year y ($t\ CO_2/t\ BC$)

Step 5.1: Determination of $PE_{ele,grid,BC,y}$

Grid electricity emissions for BC grinding in year y ($PE_{ele,grid,BC,y}$) are calculated as:

$$PE_{ele,grid,BC,y} = \frac{PELE_{grid,BC,y} \times EF_{grid,y}}{BC_y}$$ (~~20~~21)

Where:

$PE_{ele,grid,BC,y}$ = Grid electricity emissions for BC grinding in year y ($t\ CO_2/\ t\ BC$)

$PELE_{grid,BC,y}$ = Grid electricity for grinding BC in year y (MWh)

$EF_{grid,y}$ = Grid emission factor in year y ($t\ CO_2/MWh$) (See Step 6.1 below)

BC_y = Blended cement produced and sold in the domestic market in year y (t BC)

Step 5.2: Determination of $PE_{ele,sg,BC,y}$

Emissions from self generated electricity for BC grinding in year y ($PE_{ele,sg,BC,y}$) are calculated as:

$$PE_{ele,sg,BC,y} = \frac{PELE_{sg,BC,y} \times EF_{sg,y}}{BC_y}$$ (~~21~~22)

Where:

$PE_{ele,sg,BC,y}$ = Emissions from self generated electricity for BC grinding in year y ($t\ CO_2/t\ BC$)

$PELE_{sg,BC,y}$ = Self generated electricity for grinding BC in year y (MWh)

$EF_{sg,y}$ = Emission factor for self generated electricity in year y ($t\ CO_2/MWh$) (See Step 6.2 below)

BC_y = Blended cement produced and sold in the domestic market in year y (t BC)

Step 5.3: Determination of $PE_{ele,grid,ADD,y}$

Grid electricity emissions for additive preparation in year y ($PE_{ele,grid,ADD,y}$) are calculated as:

$$PE_{ele,grid,ADD,y} = \frac{PELE_{grid,ADD,y} \times EF_{grid,y}}{BC_y}$$ (~~22~~23)

Where:

$PE_{ele,grid,ADD,y}$ = Grid electricity emissions for additive preparation in year y ($t\ CO_2/t\ BC$)

$PELE_{grid,ADD,y}$ = Grid electricity for grinding additives in year y (MWh)

$EF_{grid,y}$ = Grid emission factor in year y ($t\ CO_2/MWh$) (See Step 6.1 below)

BC_y	=	Blended cement produced and sold in the domestic market in year y (t BC)

Step 5.4: Determination of $PE_{ele,sg,ADD,y}$

Emissions from self generated electricity additive preparation in year y ($PE_{ele,sg,ADD,y}$) are calculated as:

$$PE_{ele,sg,ADD,y} = \frac{PELE_{sg,ADD,y} \times EF_{sg,y}}{BC_y} \quad (\cancel{23}24)$$

Where:

$PE_{ele,sg,ADD,y}$	=	Emissions from self generated electricity additive preparation in year y ($t\ CO_2/t\ BC$)
$PELE_{sg,ADD,y}$	=	Self generation electricity for grinding additives in year y (MWh)
$EF_{sg,y}$	=	Emission factor for self generated electricity in year y ($t\ CO_2/MWh$) (See Step 6.2 below)
BC_y	=	Blended cement produced and sold in the domestic market in year y (t BC)

Step 6: Determination of Electricity Emission Factors ($EF_{grid,BSL}$, $EF_{grid,y}$, $EF_{sg,y}$ and $EF_{sg,BSL}$)

Step 6.1: Determination of $EF_{grid,BSL}$ and $EF_{grid,y}$

Baseline grid emission factor ($EF_{grid,BSL}$) and grid emission factor in year y ($EF_{grid,y}$) shall be calculated using the latest version of the "Tool to calculate the emission factor for an electricity system", including use of a Paris Goal Coefficient (see section 1.1.5 above).

Step 6.2: Determination of $EF_{sg,y}$

The emission factor for self generated electricity in year y ($EF_{sg,y}$) is calculated as the generation-weighted average emissions per electricity unit ($t\ CO_2/MWh$) of all self-generating sources in the project boundary serving the system in year y.

$$EF_{sg,y} = \frac{\sum_{k,j} F_{k,j,y} \times COEF_k}{\sum_j GEN_{j,y}}\ x\ PGCy \quad (\cancel{24}25)$$

Where:

$EF_{sg,y}$	=	Emission factor for self generated electricity in year y ($t\ CO_2/MWh$)
$F_{k,j,y}$	=	Amount of fuel k consumed by relevant power sources j in year y (mass or volume unit)
j	=	On-site power sources
$COEF_k$	=	CO_2 emission coefficient of fuel k, taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year y ($t\ CO_2$/mass or volume unit)
$GEN_{j,y}$	=	Electricity generated by the source j in year y (MWh)
PGCy	=	Paris Goal Coefficient in year y (see section 1.1.5 above)

CO_2 emission coefficient of fuel k ($COEF_k$) is obtained as:

$$COEF_k = NCV_k \times EF_{CO2,k} \times OXID_k \quad (\cancel{25}26)$$

Where:

$COEF_k$	=	CO_2 emission coefficient of fuel k, taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year y (t CO_2/mass or volume unit)
NCV_k	=	Net calorific value per mass or volume unit of a fuel k (GJ/ mass or volume unit)
$OXID_k$	=	Oxidation factor of the fuel k (see page 1.29 in the 1996 Revised IPCC Guidelines for default values)
$EF_{CO2,k}$	=	CO_2 emission factor per unit of energy of the fuel k (t CO_2/GJ)

Step 6.3: Determination of $EF_{sg,BSL}$

Emission factor for self generated electricity in the base year ($EF_{sg,BSL}$) is calculated as the generation-weighted average emissions per electricity unit (t CO_2/MWh) of all self-generating sources in the project boundary serving the system in the base year.

$$EF_{sg,BSL} = \frac{\sum_{m,n} F_{m,n,BSL} \times COEF_m}{\sum_n GEN_{n,BSL}} \; x \; PGCBSL \qquad (\cancel{26}27)$$

Where:

$EF_{sg,BSL}$	=	Emission factor for self generated electricity in the base year (t CO_2/MWh)
$F_{m,n,BSL}$	=	Amount of fuel m consumed by relevant power sources n in the base year (mass or volume unit)
n	=	On-site power sources
$COEF_m$	=	CO_2 emission coefficient of fuel m, taking into account the carbon content of the fuels used by relevant power sources n and the percent oxidation of the fuel in the base year (t CO_2/mass or volume unit)
$GEN_{n,BSL}$	=	Electricity generated by the source n in the base year ~~y~~ (MWh)
PGC_{BSL}	=	Paris Goal Coefficient in the base year (see section 1.1.5 above)

CO_2 emission coefficient of fuel m ($COEF_m$) is obtained as:

$$COEF_m = NCV_m \times EF_{CO2,m} \times OXID_m \quad (\cancel{27}28)$$

Where:

$COEF_m$	=	CO_2 emission coefficient of fuel m, taking into account the carbon content of the fuels used by relevant power sources n and the percent oxidation of the fuel in the base year (t CO_2/mass or volume unit)
NCV_m	=	Net calorific value per mass or volume unit of a fuel m (GJ/ mass or volume unit)
$OXID_m$	=	Oxidation factor of the fuel m
$EF_{CO2,m}$	=	CO_2 emission factor per unit of energy of the fuel m (t CO_2/GJ)

Leakage

Leakage emissions consist of:

Leakage emissions due to transport of additional additives; and

Leakage emissions due to the diversion of additives from existing uses.

$$LE_y = LE_{TR,y} + LE_{ADD,y} \qquad (\cancel{28}29)$$

Where:

LE_y	=	Leakage emissions in year y (t CO_2)
$LE_{TR,y}$	=	Leakage emissions due to transport of additional additives in year y (t CO_2)
$LE_{ADD,y}$	=	Leakage emissions due to the diversion of additives from existing uses in year y (t CO_2)

Step 7: Determination of leakage emissions due to transport of additional additives

Leakage emissions due to transport of additional additives in year y ($LE_{TR,y}$) are calculated applying the latest approved version of the methodological tool “Project and leakage emissions from road transportation of freight” where $LE_{TR,y}$ corresponds to $LE_{TR,m}$ in the tool, and $Q_{ADD,y}$ corresponds to $FR_{f,m}$ in the tool.

Step 7.1: Determination of $Q_{ADD,y}$

$$Q_{ADD,y} = \left(A_{PJ,blend,y} - A_{BSL,blend,y}\right) \times BC_y \qquad (\cancel{29}30)$$

Where:

$Q_{ADD,y}$	=	Quantify of additional additives transported in year y (t additives). This parameter shall be used instead of $FR_{f,m}$ in the tool “Project and leakage emissions from road transportation of freight”
BC_y	=	Blended cement produced and sold in the domestic market in year y (t BC)
$A_{PJ,blend,y}$	=	Share of additives per tonne of BC in year y (t additives/t BC)
$A_{BSL,blend,y}$	=	Baseline share of additives per tonne of BC updated for year y (t additives /t BC)

Step 8: Determination of leakage emissions due to the diversion of additives from existing uses

Another possible leakage is due to the diversion of additives from existing uses.

In this case, project participants shall demonstrate that the use of the additives do not result in increased emissions elsewhere. For this purpose, project participants shall assess as part of the monitoring the supply situation for the additives used in the project activity. The following options shall be used to demonstrate that the additives used in the project activity did not increase emissions elsewhere:

L_1 Demonstrate that at the sites from where the project activity is receiving additives, the additives have not been collected or utilized but have been dumped, land-filled, not excavated or burnt prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the ~~CDM~~ project activity, e.g. by showing that in the monitored period no market has emerged for the additives considered, no price has been allocated for the additives other than transport, excavation and/or processing or by showing that it would still not be feasible to utilize the additives for any purposes (e.g. due to the remote location where the additives are generated). At the renewal of crediting period, the project participants shall re-demonstrate this requirement. This approach is applicable to situations where project participants use only additives from specific sites and do not purchase additives from the market. During each verification, DOE shall check that the additives are sourced from the same sites as indicated in the PDD.

L_2 Demonstrate that there is an abundant surplus of the additives in the zone from where the additives are sourced. For this purpose, demonstrate that the quantity of available additives in the zone is at least 25% larger than the quantity of additives that are utilized within the zone and the project activity. The zone for the purpose of demonstration of abundant surplus of the additives shall be considered as either (i) the entire country from where the additives are sourced from, or (ii) the area defined by the project participants, with a radius of at least 200 km from where the additives are sourced. This shall be demonstrated during each crediting year. In case, the source of additives changes during the crediting year and the zone has to be redefined, then the project participants shall follow the relevant procedures for such changes.

Where project participants wish to use approach L1 and did not meet the above condition in L1, the leakage emissions due to the diversion of additives from existing uses in year y shall be calculated as follows:

$$LE_{ADD,y} = \left(BE_y - PE_y\right) \times \alpha_y \quad (\cancel{30}31)$$

Where:

$LE_{ADD,y}$	=	Leakage emissions due to the diversion of additives from existing uses in year y ($t\ CO_2$)
BE_y	=	Baseline emissions in year y ($t\ CO_2$)
PE_y	=	Project emissions in year y ($t\ CO_2$)
α_y	=	Leakage penalty factor in year y (fraction)

Step 8.1: Determination of α_y

$$\alpha_y = \frac{ADD_{NS,y}}{ADD_y} \quad (\cancel{31}32)$$

Where:

α_y	=	Leakage penalty factor in year y (fraction)
$ADD_{NS,y}$	=	Amount of additives used for BC production in project plant for which the project participants could not substantiate that they are surplus in year y (t additives)
ADD_y	=	Amount of additives used for BC production in project plant in year y (t additives)

Where project participants wish to use approach L2 and did not meet the above condition in L2 in any of the crediting year, emission reductions for that crediting year shall be regarded as zero.

Emission reductions

The emission reductions are calculated as:

$$ER_y = BE_y - PE_y - LE_y \qquad (~~32~~33)$$

Where:

ER_y	=	Emissions reductions in year y due to project activity in year y (t CO_2)
BE_y	=	Baseline emissions in year y (t CO_2)
PE_y	=	Project emissions in year y (t CO_2)
LE_y	=	Leakage emissions in year y (t CO_2)

In the case that overall negative emission reductions arise in a year, emission reductions are not issued to project participants for the year concerned and in subsequent years, until emission reductions from subsequent years have compensated the quantity of negative emission reductions from the year concerned. (For example: if negative emission reductions of 30 t CO_2e occur in the year t and positive emission reductions of 100 t CO_2e occur in the year t+1, 0 ~~CERs~~ A6.4ERs are issued for year t and only 70 ~~CERs~~ A6.4ERs are issued for the year t+1.)

In case the project activity consists of production of more than one cement type, the emission reduction shall be calculated above for each cement type i produced. The total emission reduction from the project activity shall be calculated as the sum of emission reductions for all cement types i produced.

Changes required for methodology implementation in 2nd and 3rd crediting periods

Refer to the latest approved version of the Methodological tool "Assessment of the validity of the original/current baseline and to update of the baseline at the renewal of the crediting period".

While applying the Step 1.4 of the tool, the benchmark value Blend,y is recalculated following Step 2.1 above.

Data and parameters not monitored

In addition to the data and parameters listed below, the guidance on all tools to which this methodology refers applies.

Parameter:	**PGC_y**
Data unit:	Dimensionless

Parameter:	**PGC_y**
Description:	Paris Goal Coefficient to ensure that baseline is progressively downward adjusted to be in line with the long-term temperature goals of the Paris Agreement
Source of data:	Calculation as per equation 8
Measurement procedures (if any):	-
Any comment:	-
Parameter:	EFF_i
Data unit:	t CO_2/t fuel
Description:	Emission factor for fossil fuel *i*
Source of data:	Actual measured or local data is to be used. If not available, regional data should be used and, in its absence, IPCC defaults can be used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Any comment:	-

Parameter:	**$OXID_k$**
Data unit:	-
Description:	Oxidation factor of the fuel *k*
Source of data:	See page 1.29 in the 1996 Revised IPCC Guidelines for default values
Measurement procedures (if any):	-
Any comment:	-

Parameter:	**$EF_{CO2,k}$**
Data unit:	t CO_2/ GJ
Description:	CO_2 emission factor per unit of energy of the fuel *k*
Source of data:	Actual measured or local data is to be used. If not available, regional data should be used and, in its absence, IPCC defaults can be used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Any comment:	-

Parameter:	InCaO
Data unit:	t CaO
Description:	Baseline non-carbonated CaO content in the raw material
Source of data:	On-site measurements in plant records. In case of existing plants, historical data and in case of Greenfield cement plants, the data from first operational year
Measurement procedures (if any):	This parameter is calculated as the non-carbonated CaO content (%) of the raw material times the raw material quantity [Q_{rm}]. Project participants can use a conservative default value of 2% for the non-carbonated CaO content of the raw material if they can demonstrate that they were not using non-carbonated raw materials, for example, gypsum, anhydrite, and fluorite etc
Any comment:	In case of existing plants, this parameter shall be based on historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions Non-carbonated CaO content (%) shall be calculated as the percentage of CaO in the total raw material

Parameter:	OutCaO
Data unit:	t CaO
Description:	Baseline CaO content in the clinker produced
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the clinker times clinker produced [$CLNK_{BSL}$]
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	InMgO
Data unit:	t MgO
Description:	Baseline non-carbonated MgO content in the raw material
Source of data:	On-site measurements in plant records

Parameter:	InMgO
Measurement procedures (if any):	This parameter is calculated as the non-carbonated MgO content (%) of the raw material times the raw material quantity [Q_{rm}]
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions Non-carbonated MgO content (%) shall be calculated as the percentage of MgO in the total raw material

Parameter:	OutMgO
Data unit:	t MgO
Description:	Baseline MgO content in the clinker produced
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the clinker times clinker produced [$CLNK_{BSL}$]
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	Q_{rm}
Data unit:	t raw materials
Description:	Quantity of clinker raw material used in the base year
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Weight meters
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility

Parameter:	**Q_{rm}**
	study used for plant procurement and latest production plan to calculate the baseline emissions This parameter is used to calculate InCaO and InMgO

Parameter:	**$CLNK_{BSL}$**
Data unit:	t clinker
Description:	Annual production of clinker in the base year
Source of data:	On-site measurements in plant records

Measurement procedures (if any):	**Weight meters**
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	**$FF_{i,\cancel{BSL}BAT}$**
Data unit:	t fuel
Description:	Fossil fuel of type i consumed for clinker production in ~~the base year~~BAT plant
Source of data:	~~On-site measurements in plant records~~ As specified in public regulation
Measurement procedures (if any):	Weight meters
Any comment:	This parameter shall be based on parameters and values of the best performing plant in the targeted jurisdiction. ~~In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken~~ ~~In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions~~

Parameter:	**$BELE_{grid,CLNK}$**
Data unit:	MWh
Description:	Grid electricity consumed for clinker production in BAT plant~~base year~~
Source of data:	~~On-site measurements in plant records~~ As specified in public regulation
Measurement procedures (if any):	Electricity meter
Any comment:	This parameter shall be based on parameters and values of the best performing plant in the targeted jurisdiction. ~~In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken~~ ~~In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions~~

Parameter:	**$BELE_{sg,CLNK}$**
Data unit:	MWh
Description:	Self generation of electricity for clinker production in BAT plant~~base year~~
Source of data:	~~On-site measurements in plant records~~ As specified in public regulation
Measurement procedures (if any):	Electricity meter
Any comment:	This parameter shall be based on parameters and values of the best performing plant in the targeted jurisdiction. ~~In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken~~ ~~In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions~~

Parameter:	**$BC_{\cancel{BSL}BAT}$**
Data unit:	t BC
Description:	Annual production of BC in BAT plant ~~the base year~~
Source of data:	~~On-site measurements in plant records~~ As specified in public regulation

Parameter:	$\mathbf{BC}_{\cancel{BSL}BAT}$
Measurement procedures (if any):	Weight meters
Any comment:	This parameter shall be based on parameters and values of the best performing plant in the targeted jurisdiction. ~~In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken~~ ~~In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions~~

Parameter:	$\mathbf{BELE}_{sg,BC}$
Data unit:	MWh
Description:	Baseline self generation electricity for grinding BC
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Electricity meters
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	**BELEgrid,BC**
Data unit:	MWh
Description:	Baseline grid electricity for grinding BC
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Electricity meters
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants

Parameter:	**BELEgrid,BC**
	can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	**$BELE_{grid,ADD}$**
Data unit:	MWh
Description:	Baseline grid electricity for grinding additives
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Electricity meters
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	**$BELE_{sg,ADD}$**
Data unit:	MWh
Description:	Baseline self generation electricity for grinding additives
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Electricity meters
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	**$F_{m,n,BSL}$**
Data unit:	mass or volume unit
Description:	Amount of fuel *m* consumed by relevant power sources *n* in the base year
Source of data:	On-site measurements in plant records

Parameter:	$F_{m,n,BSL}$
Measurement procedures (if any):	Use weight or volume meters
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	$GEN_{n,BSL}$
Data unit:	MWh
Description:	Electricity generated by the source *n* in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meters
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	NCV_m
Data unit:	GJ/mass or volume unit
Description:	Net calorific value per mass or volume unit of a fuel *m*
Source of data:	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the project participants	If a) is not available
c) Regional or national default values	If b) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95%	If c) is not available

Parameter:	**NCV_m**
	confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Any comment:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

Parameter:	**$OXID_m$**
Data unit:	-
Description:	Oxidation factor of the fuel *m*
Source of data:	Refer to the latest version of the IPCC Guidelines for default values
Measurement procedures (if any):	-
Any comment:	-

Parameter:	**$EF_{CO2,m}$**
Data unit:	t CO_2/GJ
Description:	CO_2 emission factor per unit of energy of the fuel *m*
Source of data:	Actual measured or local data is to be used. If not available, regional data should be used and, in its absence, IPCC defaults can be used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Any comment:	In case of existing plants, this parameter shall be based of historical records of the plant for the year prior to the start of the ~~CDM~~ project activity. If data is available for multiple years prior to the start of the project activity, the average value of up to three years shall be taken. In case of Greenfield cement plants, this parameter shall be determined based on the monitoring value of first operational year. For ex-ante calculation, project participants can

Parameter:	$EF_{CO2,m}$
	use data from technology supplier information, quarry test results, latest feasibility study used for plant procurement and latest production plan to calculate the baseline emissions

III. MONITORING METHODOLOGY

Monitoring procedures

All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

In addition, the monitoring provisions in the tools referred to in this methodology apply.

Data and parameters monitored

Data / Parameter:	BC_y
Data unit:	t BC
Description:	Blended cement produced and sold in the domestic market in year *y* (t BC)
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	This will be calculated and measured as part of normal operations Use weight meter
Monitoring frequency:	Annually
QA/QC procedures:	Cross check measurement results with records (i.e. invoices) for sold blended cement
Any comment:	-

Data / Parameter:	$P_{Blend,y}$
Data unit:	t clinker/t BC
Description:	Share of clinker per tonne of BC in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$InCaO_y$
Data unit:	t CaO
Description:	Non-carbonated CaO content in the raw material in year *y*

Data / Parameter:	**$InCaO_y$**
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the raw material in year *y* times the raw material quantity used in year *y* [$Q_{rm,y}$]. Project participants can use a conservative default value of 0% for the non-carbonated CaO content of the raw material in year *y*
Monitoring frequency:	Daily
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$OutCaO_y$**
Data unit:	t CaO
Description:	CaO content in the clinker produced in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the clinker in year *y* times clinker produced in year *y* [$CLNK_y$]. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$InMgO_y$**
Data unit:	t MgO
Description:	Non-carbonated MgO content in the raw material in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the raw material in year *y* times the raw material quantity in year *y* [$Q_{rm,y}$]. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$OutMgO_y$**
Data unit:	t MgO
Description:	MgO content in the clinker produced in year *y*
Source of data:	On-site measurements in plant records

Data / Parameter:	$OutMgO_y$
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the clinker in year *y* times clinker produced in year *y* [$CLNK_y$]. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$Q_{rm,y}$
Data unit:	t raw materials
Description:	Quantity of clinker raw material used in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use weight meter
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	Parameter required to calculate $InCaO_y$ and $InMgO_y$

Data / Parameter:	$CLNK_y$
Data unit:	t clinker
Description:	Clinker production in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use weight meter
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$FF_{i,\cancel{BSL}BAT}$
Data unit:	t fuel
Description:	Fossil fuel of type *I* consumed for clinker production in year *y*
Source of data:	On-site measurements in ~~plant~~ public records
Measurement procedures (if any):	Use weight meter
Monitoring frequency:	Annually

Data / Parameter:	**$FF_{i,\cancel{BSL}BAT}$**
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**EFF_l**
Data unit:	t CO_2/t fuel
Description:	Emission factor for fossil fuel *l*
Source of data:	Actual measured or local data is to be used. If not available, regional data should be used and, in its absence, IPCC defaults can be used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$PELE_{grid,CLNK,y}$**
Data unit:	MWh
Description:	Grid electricity for clinker production in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meter
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$PELE_{sg,CLNK,y}$**
Data unit:	MWh
Description:	Self generation of electricity for clinker production in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meter
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	ADD_y
Data unit:	t additives
Description:	Amount of additives used for BC production in project plant in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use weight meter
Monitoring frequency:	Monthly and aggregated yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$ADD_{NS,y}$
Data unit:	t additives
Description:	Amount of additives for which the project participants could not substantiate that they are surplus in year *y*
Source of data:	National data or data collected by the project participants
Measurement procedures (if any):	Demonstrate using the L1 approach in Step 8
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$PELE_{grid,BC,y}$
Data unit:	MWh
Description:	Grid electricity for grinding BC in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meter
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$PELE_{sg,BC,y}$
Data unit:	MWh

Data / Parameter:	**$PELE_{sg,BC,y}$**
Description:	Self generated electricity for grinding BC in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meter
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$PELE_{grid,ADD,y}$**
Data unit:	MWh
Description:	Grid electricity for grinding additives in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meter
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$PELE_{sg,ADD,y}$**
Data unit:	MWh
Description:	Self generation electricity for grinding additives in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meter
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$F_{k,j,y}$**
Data unit:	mass or volume unit
Description:	Amount of fuel *k* consumed by relevant power sources *j* in year *y*
Source of data:	On-site measurements in plant records

Data / Parameter:	**$F_{k,j,y}$**
Measurement procedures (if any):	Use weight or volume meter
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**NCV_k**
Data unit:	GJ/mass or volume unit
Description:	Net calorific value per mass or volume unit of a fuel *k*
Source of data:	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the project participants	If a) is not available
c) Regional or national default values	If b) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If c) is not available

Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency:	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards
Any comment:	-

Data / Parameter:	**$GEN_{j,y}$**
Data unit:	MWh
Description:	Electricity generated by the source *j* in the year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Use electricity meter
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$A_{PJ,blend,y}$**
Data unit:	t additives/t BC
Description:	Share of additives per tonne of BC in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**$A_{BSL,blend,y}$**
Data unit:	t additives/t BC
Description:	Baseline share of additives per tonne of BC updated for year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	In case of existing plants, the value of $A_{BL,blend,y}$ is 1- mass fraction of clinker in the relevant cement type produced in the proposed project activity plant before the implementation of the CDM project activity, as determined in Step 2, approach (iii) In case of Greenfield cement plants, the value of $A_{BL,blend,y}$ is 1-$B_{Blend,y}$
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

IV. REFERENCES AND ANY OTHER INFORMATION

Not applicable.

~~History of the document~~

~~Version~~	~~Date~~	~~Nature of revision(s)~~
~~07.1.0~~	~~11 May 2012~~	~~EB 67, Annex 14~~ ~~Amendment to:~~ ~~Include as an option, conservative default values for the calcium oxide (CaO) concentration in the raw material;~~ ~~Include a provision for the demonstration that an abundant surplus of the additives is available in an area, with a radius of at least 200 km, from where the additives are sourced; and~~ ~~Other editorial changes.~~
~~07.0.0~~	~~EB 66, Annex 36~~ ~~2 March 2012~~	~~Revision to:~~ ~~Align the first of its kind barrier and investment barrier analysis with the latest guidelines on first of its kind barrier and objective demonstration and assessment of barriers;~~ ~~Improve and reorganize the procedure to determine the baseline benchmark of share of clinker and its update;~~ ~~Correct the calculation of leakage emissions due to transport of additives and improve the procedure to calculate leakage from diversion of additives;~~ ~~Delete the leakage emissions due to electricity consumption for conveyor system for additives;~~ ~~Correct and reorganize the calculation of emission reductions;~~ ~~Correct the description of parameters to make them consistent within the methodology;~~ ~~Improve the clarity of the language; and~~ ~~Add a reference to methodological tools "Assessment of the validity of the original/current baseline and to update of the baseline at the renewal of the crediting period" and "Project and leakage emissions from road transportation of freight".~~
~~06.0.0~~	~~EB 65, Annex 17~~ ~~25 November 2011~~	~~Revision to:~~ ~~Provide an approach to determine the data to calculate baseline emissions in case of Greenfield cement plants;~~ ~~Improve the methodology so as to increase its readability, consistency and simplicity;~~ ~~Clarify that the methodology is not applicable to situations where cement blending is common at the construction site; and~~ ~~Provide an approach to determine the blending benchmark taking into account the imported cement.~~ ~~Change of title from "Consolidated Baseline Methodology for Increasing the Blend in Cement Production" to "Increasing the Blend in Cement Production"~~
~~05~~	~~EB 50, Annex 10~~ ~~16 October 2009~~	~~Revision to include:~~ ~~Guidance on applying the "Tool for the demonstration and assessment of additionality";~~ ~~Updated monitoring tables; and~~ ~~Editorial changes to improve the clarity of the methodology text.~~
~~04~~	~~EB 35, Paragraph 24~~ ~~19 October 2007~~	~~Revision to include the "Tool to calculate the emission factor for an electricity system".~~
~~03~~	~~EB 24, Annex 2~~ ~~19 May 2006~~	~~Revision to amend the three options for selecting the benchmark for baseline emissions.~~
~~02~~	~~EB 22, Annex 7~~ ~~28 November 2005~~	~~Revision to correct some of the formulae relating to leakage and references to the blend content in formulae.~~

~~Version~~	~~Date~~	~~Nature of revision(s)~~
~~01~~	~~EB 21, Annex 12~~ ~~30 September 2005~~	~~Initial adoption.~~

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ACM0006

Large-scale Consolidated Methodology

Electricity and heat generation from biomass

Version 16.0

Sectoral scope(s): 01

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1 Introduction

1. The following table describes the key elements of the methodology:

Table 1: Methodology key elements

Typical project(s)	Co-generation of power and heat using biomass. Typical activities are new plant, capacity expansion, energy efficiency improvements or fuel switch projects
Type of GHG emissions mitigation action	Renewable energy; Energy efficiency; Fuel switch; GHG emission avoidance.

2 Scope, applicability, and entry into force

2.1 Scope

8. This methodology is applicable to project activities that operate biomass (co-)fired power-and-heat plants.[1] The CDM project activity may include the following activities or, where applicable, combinations of these activities:
    a. The installation of new plants at a site where currently no power or heat generation occurs (Greenfield projects);
    b. The installation of new plants at a site where currently power or heat generation occurs. The new plant replaces or is operated next to existing plants (capacity expansion projects);
    c. The improvement of energy efficiency of existing biomass-based power-and-heat plants (energy efficiency improvement projects), which can also lead to a capacity expansion, e.g. by retrofitting the existing plant;
    d. The total or partial replacement of fossil fuels by biomass in existing power-and-heat plants or in new power-and-heat plants that would have been built in the absence of the project (fuel switch projects), e.g. by increasing the share of biomass use as compared to the baseline, by retrofitting an existing plant to use biomass.

2.2 Applicability

9. The eligibility pre-check of the "II-AMT Tool for the demonstration and assessment of additionality" shall be applied and project proponents need to demonstrate that 5% more alternative fuels are used than would be available at net costs comparable to fossil fuels normally used in the area.
10. The methodology is applicable under the following conditions:
    a. Biomass used by the project plant is limited to biomass residues~~,~~ biogas and RDF[2] ~~and/or~~ biomass that had previously already at least one other use;
    b. Fossil fuels may be co-fired as to the minimum needed for start-up and maintaining of the combution process ~~in the project plant. However, the amount of fossil fuels co-fired does not exceed 80% of the total fuel fired on energy basis;~~
    c. For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards),the implementation of the project does not result in an increase of the processing capacity of (the industrial facility generating the residues) raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process;
    d. The biomass used by the project plant is not stored for more than one year;
    e. The biomass used by the project plant is not processed chemically or biologically (e.g. through esterification, fermentation, hydrolysis, pyrolysis, bio- or chemical-degradation, etc.) prior to combustion. Drying and mechanical processing, such as shredding and pelletisation, are allowed.
11. In the case of fuel switch project activities, the use of biomass or the increase in the use of biomass as compared to the baseline scenario is technically not possible at the project site without a capital investment in:
    a. The retrofit or replacement of existing heat generators/boilers; or
    b. The installation of new heat generators/boilers; or

[1] Power-only project activities should refer to the consolidated methodology "ACM0018: Electricity generation from biomass in power-only plants". Heat-only project activities should refer to the approved methodology "AM0036: Fuel switch from fossil fuels to biomass in heat generation equipment".

[2] Refuse Derived Fuel (RDF) may be used in the project plant but all carbon in the fuel, including carbon from biogenic sources, shall be considered as fossil fuel.

   c. A new dedicated supply chain of biomass established for the purpose of the project (e.g. collecting and cleaning contaminated new sources of biomass residues that could otherwise not be used for energy purposes); or
   d. Equipment for preparation and feeding of biomass.
12. If biogas is used for power and heat generation, the biogas must be generated by anaerobic digestion of wastewater[3], and:
   a. If the wastewater generation source is registered as a ~~CDM~~ project activity, the details of the wastewater project shall be included in the PDD, and emission reductions from biogas energy generation are claimed using this methodology;
   b. If the wastewater source is not a ~~CDM~~ project, the amount of biogas does not exceed 50% of the total fuel fired on energy basis.
13. ~~In the case biomass from dedicated plantations is used, the "TOOL16: Project and leakage emissions from biomass" shall apply to determine the relevant project and leakage emissions from cultivation of biomass and from the utilization of biomass residues.~~
14. The methodology is only applicable if the baseline scenario, as identified per the "Selection of the baseline scenario and demonstration of additionality" section hereunder, is:
   a. For power generation: scenarios P2 to P7, or a combination of any of those scenarios; and
   b. For heat generation: scenarios H2 to H7, or a combination of any of those scenarios;
   c. If some of the heat generated by the ~~CDM~~ project activity is converted to mechanical power through steam turbines, for mechanical power generation: scenarios M2 to M5:
      i) In cases M2 and M3, if the steam turbine(s) are used for mechanical power in the project, the turbine(s) used in the baseline shall be at least as efficient as the steam turbine(s) used for mechanical power in the project;
      ii) In cases M4 and M5, steam turbine(s) generating mechanical power to be used for the same purpose as in the baseline are not allowed;
   d. For the use of biomass residues: scenarios B1 to B5, or a combination of any of those scenarios;
   e. For the use of biogas: scenarios BG1 to BG3, or a combination of any of those scenarios.
15. ~~The methodology is not applicable if the baseline scenario involves the cultivation of biomass in dedicated plantations.~~

2.3 Entry into force

16. The date of entry into force is the date of the publication of the approved methodology.~~of the EB 113 meeting report on 11 March 2022.~~

2.4 Applicability of sectoral scopes

17. For validation and verification of ~~CDM~~ projects and programme of activities by a designated operational entity (DOE) using this methodology application of sectoral scope 01 is mandatory.
18. If emission reductions are claimed for preventing disposal and/or preventing uncontrolled burning of biomass residues in the baseline, then sectoral scope 13 applies.
19. ~~If biomass is sourced from dedicated plantations, then sectoral scope 15 applies.~~
20. If emission reductions are claimed for preventing disposal and/or preventing uncontrolled burning of biomass residues in the baseline ~~and biomass is sourced from dedicated plantations~~, then sectoral scope~~s~~ 13 ~~and 15 apply~~applies.

[3] Landfill gas project activities should refer to the consolidated methodology "ACM0001: Flaring or use of landfill gas".

3 Normative references

21. This consolidated baseline and methodology is based on elements from the following approved consolidated baseline and monitoring methodologies:
    a. “ACM0014: Treatment of wastewater” (hereinafter referred as “ACM0014”);
    b. “ACM0017: Production of biodiesel for use as fuel” (hereinafter referred as ”ACM0017”);
    c. “AMS-III.H.: Methane recovery in wastewater treatment” (hereinafter referred as ”AMS-III.H”).
22. This methodology also refers to the latest approved versions of the following tools:
    a. “II-AMT TOOL01: Tool for the demonstration and assessment of additionality” (hereinafter referred to as “II-AMT TOOL01”);
    b. “II-AMT TOOL02: Tool for robust baseline setting” (hereinafter referred to as “II-AMT TOOL02”);
    c. “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality” (hereinafter referred as ”TOOL02”);
    d. “TOOL03: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (hereinafter referred as ”TOOL03”);
    e. “TOOL04: Emissions from solid waste disposal sites” (hereinafter referred as TOOL04);
    f. “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (hereinafter referred as ”TOOL05”);
    g. “TOOL07: Tool to calculate the emission factor for an electricity system” (hereinafter referred as ”TOOL07”);
    h. “TOOL09: Determining the baseline efficiency of thermal or electric energy generation systems” (hereinafter referred as ”TOOL09”);
    i. “TOOL10: Tool to determine the remaining lifetime of equipment” (hereinafter referred as ”TOOL10”);
    j. “TOOL12: Project and leakage emissions from transportation of freight” (hereinafter referred as ”TOOL12”);
    k. “TOOL16: Project and leakage emissions from biomass” (hereinafter referred as ”TOOL16”).
23. ~~For more information regarding the proposals and the tools as well as their consideration Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) please refer to http://CDM.unfccc.int/goto/MPappmeth .~~

3.1 ~~Selected approach from paragraph 48 of the CDM modalities and procedures~~

24. ~~“Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment”.~~

4 Definitions

25. ~~The definitions contained in the Glossary of CDM terms shall apply.~~
26. For the purpose of this methodology, the following definitions apply:
    a. **Cogeneration plant** - a power-and-heat plant in which at least one heat engine simultaneously generates both process heat and power;
    b. ~~**Dedicated plantations** - plantations that are newly established as part of the CDM project activity for the purpose of supplying cultivated biomass to the project plant;~~
    c. **Heat** - useful thermal energy that is generated in a heat generator (e.g. a boiler, a cogeneration plant, thermal solar panels, etc.) and transferred to a heat carrier (e.g. hot liquids, hot gases, steam, etc.) for utilization in thermal applications and processes, including power generation. For the purposes of this methodology, heat does not include waste heat, i.e. heat that is transferred to the environment without utilization, for example, heat in flue gas, heat transferred to cooling towers or any other heat losses. Note that heat refers to the net quantity of thermal energy that is transferred to a heat carrier at the heat generation unit. For example, in case of a boiler it refers to the difference of the enthalpy of the steam generated in the boiler and the enthalpy of the feed water or, if applicable, any condensate return;
    d. **Heat generator** - a facility that generates heat by combustion of fuels. This includes, for example, a boiler that supplies steam or hot water, a heater that supplies hot oil or thermal fluid, or a furnace that supplies hot gas or combustion gases. When several heat generators are included in one project activity, each heat generator is referred to as “unit”;
    e. **Heat-to-power ratio** - the quantity of process heat recovered from a heat engine per unit of electricity generated in the same heat engine, measured in the same energy units. For example, a heat engine producing 1 MWhel of electricity and 2 MWhth of process heat has a heat-to-power ratio of 2;
    f. **Net quantity of electricity generation** - the electricity generated by a power plant unit after exclusion of parasitic and auxiliary loads, i.e. the electricity consumed by the auxiliary equipment of the power plant unit (e.g. pumps, fans, flue gas treatment, control equipment etc.) and equipment related to fuel handling and preparation
    g. **Process heat** - the useful heat that is not used for electric power generation. It could include the heat used for mechanical power generation, where applicable;
    h. **Power** - electric power, unless explicitly mentioned otherwise;
    i. **Power plant** - an installation that generates electric power through the conversion of heat to power using a heat engine. The heat is produced in a heat generator and consumed in a heat engine (e.g. steam turbine) coupled to an electricity generator;
    j. **Power-only plant** - a power plant to which the following conditions apply:
        i) All heat engines of the power plant produce only power and do not cogenerate heat; and
        ii) The thermal energy (e.g. steam) produced in equipment of the power plant (e.g. a boiler) is only used in heat engines (e.g. turbines or motors) and not for other processes (e.g. heating purposes or as feedstock in processes). For example, in the case of a power plant with a steam header, this means that all steam supplied to the steam header must be used in turbines;
    k. Power-and-heat plant - Power-and-heat plants encompass two broad categories of power plants: cogeneration plants (as defined above) and plants in which heat and power are produced at the same installation although not in cogeneration mode, e.g. a common heat header supplies heat for both process heat and power generation.

5 Baseline methodology

5.1 Project boundary

27. The spatial extent of the project boundary encompasses:
    a. All plants generating power and/or heat located at the project site, whether fired with biomass, fossil fuels or a combination of both[4];
    b. All power plants connected physically to the electricity system (grid) that the project plant is connected to;
    c. If applicable, all off-site heat sources that supply heat to the site where the ~~CDM~~ project activity is located (either directly or via a district heating system);
    d. The means of transportation of biomass to the project site;
    e. If the feedstock is biomass residues, the site where the biomass residues would have been left for decay or dumped;
    f. ~~If the feedstock is biomass produced in dedicated plantations the geographic boundaries of the dedicated plantations;~~
    g. The wastewater treatment facilities used to treat the wastewater produced from the treatment of biomass;
    h. If biogas is included, the site of the anaerobic digester.

Table 7: Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Electricity and heat generation	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Uncontrolled burning or decay of surplus biomass residues	CO_2	No	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Yes or No	Project participants may decide to include this emission source, where case B1, B2 or B3 has been identified as the most likely baseline scenario
		N_2O	No	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources
Project activity	On-site fossil fuel consumption	CO_2	Yes	May be an important emission source

[4] Note that the project boundary encompasses not only the plants generating power and/or heat that are directly affected by the ~~CDM~~ project activity (e.g. retrofitted or installed) but also all other plants generating power and/or heat located at the same site as the ~~CDM~~ project activity, whether fired with biomass, fossil fuels or a combination of both. Thus, power and heat generation, grid power and heat imports/exports should be considered for the whole site where the ~~CDM~~ project activity is located and all facilities are to be included in the power and heat balances.

Source		Gas	Included	Justification/Explanation
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Off-site transportation of biomass	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Combustion of biomass for electricity and heat	CO_2	No	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Yes or No	This emission source must be included if CH_4 emissions from uncontrolled burning or decay of biomass residues in the baseline scenario are included
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	Wastewater from the treatment of biomass	CO_2	No	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Yes	This emission source shall be included in cases where the waste water is treated (partly) under anaerobic conditions
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	~~Cultivation of land to produce biomass feedstock~~	~~CO_2~~	~~Yes~~	~~This emission source shall be included in cases biomass from dedicated plantation is used~~
		~~CH_4~~	~~Yes~~	~~This emission source shall be included in cases biomass from dedicated plantation is used~~
		~~N_2O~~	~~Yes~~	~~This emission source shall be included in cases biomass from dedicated plantation is used~~

5.2 Project documentation

28. The project participants shall document the specific situation of the CDM project activity in the ~~CDM~~ PDD:
    a. For each plant generating power and/or heat that operated at the project site in the three years prior to the start of the ~~CDM~~ project activity: the type and capacity of the heat generators, the types and quantities of fuels used in the heat generators, the type and capacity of heat engines, and whether the equipment continues operation after the start of the ~~CDM~~ project activity;
    b. For each plant generating power and/or heat installed under the ~~CDM~~ project activity: the type and capacity of the heat generators, the types and quantities of fuels used in the heat generators, the type and capacity of heat engines and direct heat extractions;
    c. For each plant generating power and/or heat that would be installed in the absence of the ~~CDM~~ project activity: the type and capacity of the plant, the type and capacity of the heat generators, heat engines and electric power generators and the types and quantities of fuels which would be used in each heat generator;
    d. A schematic diagram of the configuration of the ~~CDM~~ project activity and the baseline scenario.

5.3 Selection of the baseline scenario and demonstration of additionality

29. The selection of the baseline scenario and demonstration of additionality shall be conducted by following ~~TOOL02~~ II-AMT TOOL01 and II-AMT TOOL02 using the following guidance.

5.3.1 Additionality determination

30. The additionality of the project activity shall be demonstrated and assessed by applying step 1-4 of II-AMT TOOL01.

5.3.2 Selection of the baseline scenario

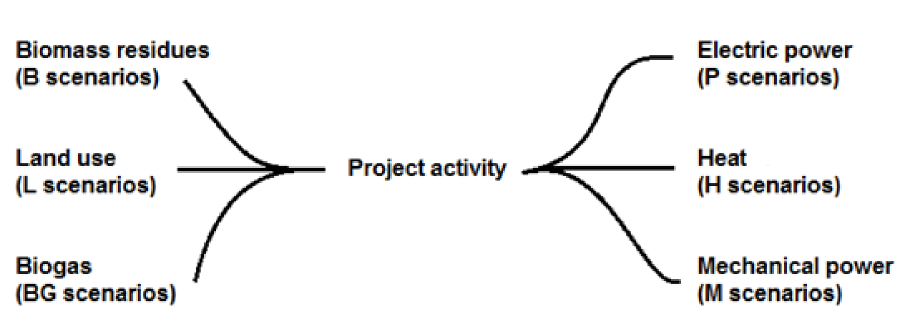
31. The baseline setting shall follow the latest version of II-AMT TOOL02. Option 3 shall be followed taking into consideration the following guidance. Step 1 to Step 3 of the Combined tool to identify the baseline scenario and demonstrate additionality (CDM Tool 07) shall be applied.

5.3.3 Identification of alternative scenarios

32. The alternative scenarios shall specify:
    a. How electric power would be generated in the absence of the ~~CDM~~ Article 6.4 project activity (P scenarios);
    b. How heat would be generated in the absence of the ~~CDM~~ Article 6.4 project activity (H scenarios);
    c. If the ~~CDM~~ Article 6.4 project activity generates mechanical power through steam turbine(s): how the mechanical power would be generated in the absence of the ~~CDM~~ project activity (M scenarios);
    d. If the Article 6.4~~CDM~~ project activity uses biomass residues, what would happen to the biomass residues in the absence of the ~~CDM~~ Article 6.4 project activity (B scenarios);
    e. ~~If the CDM Article 6.4 project activity uses biomass cultivated in dedicated plantations, what the land use would be in the absence of the CDM Article 6.4 project activity (L scenarios); and~~
    f. If the ~~CDM~~ Article 6.4 project activity uses biogas from on-site wastewater, what would happen to the biogas in the absence of the ~~CDM~~ Article 6.4 project activity (BG scenarios).

Box 1. Non-binding best practice example 1: Selection of the baseline scenario

Project participants should identify all alternative scenarios in terms of input and output in the absence of the project activity, including the project activity not being undertaken as a CDM project activity, the continuation of the current situation and all plausible and relevant alternatives scenarios.



33. The alternative scenarios for electric power should include, but not be limited to the scenarios below, including the combination of relevant scenarios:
    a. P1: The proposed project activity not undertaken as an Article 6.4 ~~CDM~~ project activity;
    b. P2: If applicable,[5] the continuation of power generation in existing power plants at the project site. The existing plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the starting date of the Article 6.4 ~~CDM~~ project activity;
    c. P3: If applicable (see footnote 4), the continuation of power generation in existing power plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the starting date of the project Article 6.4 ~~CDM~~ activity;
    d. P4: If applicable,[6] the retrofitting of existing power plants at the project site. The retrofitting may or may not include a change in fuel mix;
    e. P5: The installation of new power plants at the project site different from those installed under the Article 6.4 ~~CDM~~ project activity;
    f. P6: The generation of power in specific off-site plants, excluding the power grid;
    g. P7: The generation of power in the power grid.
34. The alternative scenarios for heat should include, but not be limited to, inter alia:
    a. H1: The proposed project activity not undertaken as an Article 6.4 ~~CDM~~ project activity;
    b. H2: If applicable (see footnote 5), the continuation of heat generation in existing plants at the project site. The existing plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the starting date of the Article 6.4 ~~CDM~~ project activity;
    c. H3: If applicable (see footnote 5), the continuation of heat generation in existing plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the Article 6.4 ~~CDM~~ project activity;
    d. H4: If applicable (see footnote 5), the retrofitting of existing plants at the project site. The retrofitting may or may not include a change in fuel mix;
    e. H5: The installation of new plants at the project site different from those installed under the Article 6.4 ~~CDM~~ project activity;
    f. H6: The generation of heat in specific off-site plants;

[5] This alternative is only applicable if there are existing plants operating at the project site.

[6] This alternative is only applicable if there are existing plants operating at the project site.

g. H7: The use of heat from district heating.

35. The alternative scenarios for mechanical power should include, but not be limited to, inter alia:
    a. M1: The proposed project activity not undertaken as an Article 6.4 ~~CDM~~ project activity;
    b. M2: If applicable (see footnote 5), the continuation of mechanical power generation from the same steam turbines in existing plants at the project site;
    c. M3: The installation of new steam turbines at the project site;
    d. M4: If applicable (see footnote 5), the continuation of mechanical power generation from electrical motors in existing plants at the project site;
    e. M5: The installation of new electrical motors at the project site.
36. For any of the alternative scenarios described above, all assumptions with respect to installed capacities, load factors, energy efficiencies, fuel mixes, and equipment configuration, should be clearly described and justified in the Article 6.4 ~~CDM~~ PDD;
37. If existing plants operated at the project site prior to the implementation of the ~~CDM~~ Article 6.4 project activity, the remaining lifetime of the existing equipment shall be determined as per TOOL10 and a baseline based on historical performance only applies until the existing power plant would have been replaced or retrofitted in the absence of the Article 6.4 ~~CDM~~ project activity.
38. When using biomass residues, the alternative scenarios of the biomass residues in absence of the project activity shall be determined following TOOL16.
39. In addition to the alternative scenarios (B scenarios) included in TOOL16, the project participants shall include scenario B5:
    a. The biomass residues are used for power or heat generation at the project site in new and/or existing plants.
40. ~~When using biomass cultivated in dedicated plantations, the project shall consider what the land use would be in the absence of the Article 6.4 CDM project activity (L scenario).[7]~~
41. In case the proposed project activity includes the use of biogas, the project shall consider the following baseline alternatives for the biogas:
    a. BG1: No biogas would be generated, and wastewater would not be treated by anaerobic digestion;
    b. BG2: Biogas is captured and flared;
    c. BG3: Biogas is captured and used to produce electricity and/or thermal energy;
    d. BG4: Biogas is captured and used as feedstock or transportation fuel.
42. When defining plausible and credible alternative scenarios for the use of biogas, the guidance below should be followed:
    a. If scenario BG1 and BG2 are selected, no biogas shall be included in the baseline scenario of the proposed project activity;[8]
    b. If scenario BG3 is selected, the same amount of biogas produced in the project shall be included in the baseline scenario.
    c. In case the biogas is supplied by an existing ~~CDM~~ project activity its reference shall be included in the PDD.

5.4 Emission reductions

43. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (1)}$$

Where:

~~[7] The methodology is not applicable if the baseline scenario involves the cultivation of biomass in dedicated plantations.~~

[8] Project activities that intend to claim emission reductions for the avoidance of methane as per scenario BG1, shall be developed as a separate biogas CDM project activity applying approved methodologies ACM0014 or AMS-III.H.

ER_y = Emissions reductions in year *y* (t CO_2)

BE_y = Baseline emissions in year *y* (t CO_2)

PE_y = Project emissions in year *y* (t CO_2)

LE_y = Leakage emissions in year *y* (t CO_2)

5.5 Baseline emissions

44. Baseline emissions are calculated following step 2, option 3 of II-AMT TOOL02.
45. In many cases, it may be difficult to clearly determine the precise mix of power generation in the grid and power or heat generation with biomass residues or fossil fuels that would have occurred in the absence of the Article 6.4 ~~CDM~~ project activity. For this reason, this methodology adopts a conservative approach based on the following assumptions and taking into account any technical and operational constraints:
    a. Biomass residues, if available in the baseline scenario, would be used in the baseline as a priority for the generation of power and heat over the use of any fossil fuels;
    b. When different types of biomass result in different levels of heat generation efficiency, the allocation of biomass shall be guided to maximize the heat generation efficiency of the set of heat generators;
    c. If different types of fossil fuels can technically be used in the heat generators, the type of fossil fuel used should be guided by the principle that fossil fuels would be used so as to maximize the heat generation efficiency of the set of heat generators;
    d. Where heat can technically be generated in more than one heat generator, it should be assumed that it is generated from the most efficient to the less efficient heat generators to the maximum extent possible, taking into account any technical and operational constraints, including co-firing and the partial use of the heat generator in the previous steps;
    e. The heat provided by heat generators is used first in heat engines which operate in cogeneration mode, then in thermal applications to satisfy the heat demand, and after that in heat engines which operate for the generation of power only;
    f. Where heat can technically be used in more than one engine type, it should be allocated from the most efficient to the less efficient heat engines to the maximum extent possible;
    g. Where heat can technically be used in more than one cogeneration heat engine type, it should be assumed that it is allocated so as to maximize the cogeneration of process heat.
46. Project participants shall document and justify in the ~~CDM-~~PDD in a transparent manner the allocation approach.
47. Baseline emissions are calculated as follows:

Equation (2)

$$BE_y = (EL_{BL,GR,y} \times EF_{EG,GR,y} + \sum_f FF_{BL,HG,y,f} \times EF_{FF,y,f} + EL_{BL,\frac{FF}{GR},y} \times min\left(EF_{EG,GR,y}, EF_{EG,FF,y}\right) + BE_{BR,y}) \times PGCy$$

Where:

BE_y = Baseline emissions in year *y* (t CO_2)

$EL_{BL,GR,y}$ = Baseline electricity sourced from the grid in year *y* (MWh)

$EF_{EG,GR,y}$	=	Grid emission factor in year *y* (t CO_2/MWh)
$FF_{BL,HG,y,f}$	=	Baseline fossil fuel demand for process heat in year *y* (GJ)
$EF_{FF,y,f}$	=	CO_2 emission factor for fossil fuel type *f* in year *y* (t CO_2/GJ)
$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity generation in the grid or on-site or off-site power-only units in year *y* (MWh)
$EF_{EG,FF,y}$	=	CO_2 emission factor for electricity generation at the project site or off-site plants in the baseline in year *y* (t CO_2/MWh)
$BE_{BR,y}$	=	Baseline emissions due to disposal of biomass residues in year *y* (t CO2e)
f	=	Fossil fuel type
$PGCy$	=	Paris Goal Coefficient in year y

48. The procedure to determine baseline emissions can be summarized as follows:
   a. Step 1: Determine the total baseline process heat generation, electricity generation and capacity constraints, and efficiencies;
   b. Step 2: Determine the baseline electricity sourced from the grid and emission factors;
   c. Step 3: Determine the baseline biomass-based heat and power generation;
   d. Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation;
   e. Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.
   f. Step 6: Determine the Paris Goal Coefficient and apply it to the determined baseline emissions. If the identification of the baseline scenario results in construction of new plants as most plausible scenario, the quantification of baseline emissions as described in the following sections, should take into account BAT of the specific technology identified as baseline technology in determining the baseline efficiency of such plants. Further guidance on BAT is provided by II-AMT TOOL02, step 2.

5.5.1 Step 1: Determine the total baseline process heat generation (HCBL,y), electricity generation and capacity constraints, and efficiencies

5.5.1.1 Step 1.1: Determine the total baseline process heat generation

49. The amount of process heat that would be generated in the baseline in year *y* ($HC_{BL,y}$) is determined based on continuously monitored data of process heat generated in the project scenario.[9,10] The process heat should be calculated net of any parasitic heat used for drying of biomass.

[9] Heat supplied during the CDM project activity to a district heating system shall count as process heat and be included in the process heat.

[10] Heat supplied during the CDM project activity to a mechanical steam turbine shall count as process heat and be included in the process heat.

50. This methodology assumes for the sake of simplicity that the steam consumed in the baseline scenario would be the same quality as the steam used in the proposed ~~CDM~~ project activity and transported through one steam header in both scenarios.[11]

5.5.1.2 Step 1.2: Determine the baseline capacity of electricity generation (CAPEG,total,y)

The total capacity of electricity generation available in the baseline is calculated as follows:

$$CAP_{EG,total,y} = LOC_y \times \left[\sum_i \left(CAP_{EG,CG,i} \times LFC_{EG,CG,i}\right) + \sum_j \left(CAP_{EG,PO,j} \times LFC_{EG,PO,j}\right)\right]$$

Where:

$CAP_{EG,total,y}$	=	Baseline electricity generation capacity in on-site and off-site plants in year y (MWh)
$CAP_{EG,CG,i}$	=	Baseline electricity generation capacity of cogeneration-type heat engine *i* (MW)
$CAP_{EG,PO,j}$	=	Baseline electricity generation capacity of power-only-type heat engine *j* (MW)
$LFC_{EG,CG,i}$	=	Baseline load factor of cogeneration-type heat engine *i* (ratio)
$LFC_{EG,PO,j}$	=	Baseline load factor of power-only-type heat engine *j* (ratio)
LOC_y	=	Operation of the industrial facility using the process heat in year *y* (hour)
i	=	Cogeneration-type heat engine in the baseline scenario
j	=	Power-only-type heat engine in the baseline scenario

5.5.1.3 Step 1.3: Determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines

51. The efficiencies of heat generators ($\eta_{BL,HG,BR,h}/\eta_{BL,HG,FF,h}$) and heat engines ($\eta_{BL,EG,CG,i/j}/\eta_{BL,EG,PO,j}$) shall be calculated as per TOOL09.
52. The heat-to-power ratio of cogeneration-type heat engines (e.g. backpressure and heat-extraction steam turbines) is calculated as follows:
    a. **Case 1:** For existing heat engines with a minimum three-year operational history prior to the Article 6.4 ~~CDM~~ project activity:

$$HPR_{BL,EG,CG,/PO,i/j} = \frac{1}{3.6} \times MAX\left\{\frac{HC_{BR,CG/PO,x,i/j}}{EL_{BR,CG/PO,x,i/j}};\frac{HC_{BR,CG/PO,x-1,i/j}}{EL_{BR,CG/PO,x-1,i/j}};\frac{HC_{BR,CG/PO,x-2,i/j}}{EL_{BR,CG/PO,x-2,i/j}}\right\}$$

[11] In case the baseline scenario involves steam headers with different steam enthalpies the project participants shall assume the use of the header that ensures a conservative estimation of the baseline emissions.

Where:

$HPR_{BL,i}$	=	Baseline heat-to-power ratio of the heat engine i (ratio)
$HC_{BR,CG/PO,x,i/j}$	=	Quantity of process heat extracted from the heat engine i/j in year x (GJ)
$EL_{BR,CG/PO,x,i/j}$	=	Quantity of electricity generated in heat engine i/j in year x (MWh)
x	=	Last calendar year prior to the start of the crediting period
i	=	Cogeneration-type heat engine in the baseline scenario
j	=	Power-only-type heat engine in the baseline scenario

b. **Case 2:** For heat engines without a minimum three-year operational history prior to the CDM project activity the heat-to-power ratio should be determined as per the design conditions of the plant, for the configuration identified as baseline scenario".

5.5.2 Step 2: Determine the baseline electricity generation in the grid and emission factors decay

5.5.2.1 Step 2.1: Determine the baseline electricity generation (ELBL,y)

53. The amount of electricity that would be generated in the baseline in year *y* equals the amount of electricity generated in the project scenario as follows:

$$EL_{BL,y} = EL_{PJ,gross,y} + EL_{PJ,imp,y} - EL_{PJ,aux,y}$$

Where:

$EL_{BL,y}$	=	Baseline electricity generation in year y (MWh)
$EL_{PJ,gross,y}$	=	Gross quantity of electricity generated in all power plants included in the project boundary in year y (MWh)
$EL_{PJ,imp,y}$	=	Project electricity imports from the grid in year y (MWh)
$EL_{PJ,aux,y}$	=	Total auxiliary electricity consumption required for the operation of the power plants in year y (MWh)

Box 2. Non-binding best practice example 2: Auxiliary electricity requirement

Project participants should account for the total auxiliary electricity consumption (ELPJ,aux,y) required for the operation of the power plants at the project site. When appropriate, the total auxiliary electricity consumption may be estimated by considering the consumption capacity of all the installed equipment and assuming that they operated at maximum load during the monitoring period.

Example – A project activity involves the use of biomass residues to produce electricity and heat in an existing industrial facility. In order to operate the project activity, the project participants installed a biomass drier and a conveyor belt, and utilizes auxiliary electricity for the actual operation of the power plant.

As a conservative approach, the project participants calculate the total auxiliary electricity consumption during year y as the sum of the capacity of each equipment, times 8760 hours of operation per year (24 hours/day).

5.5.2.2 Step 2.2: Determine the baseline electricity sourced from the grid (EGBL,GR,y)

54. The amount of electricity that would be sourced from the grid in the baseline is calculated assuming that the amount of electricity generated on-site and off-site in the baseline shall be limited by the installed capacity of power generation available in the baseline scenario (on-site and off-site):

$$EL_{BL,GR,y} = \max\left(0, EL_{BL,y} - CAP_{EG,total,y}\right)$$

Where:

$EL_{BL,GR,y}$	=	Baseline electricity sourced from the grid in year y (MWh)
$EL_{BL,y}$	=	Baseline electricity generation in year y (MWh)
$CAP_{EG,total,y}$	=	Baseline electricity generation capacity in on-site and off-site plants in year y (MWh)

55. For baseline alternatives not connected to the grid or otherwise technically or legally impossible to import/export power from/to the grid, it shall be assumed that $EL_{BL,GR,y} = 0$

5.5.2.3 Step 2.3: Determine the emission factor of grid electricity generation (EFEG,GR,y)

56. The grid emission factor ($EF_{EG,GR,y}$) shall be determined using the latest approved version of TOOL07.

5.5.2.4 Step 2.4: Determine the emission factor of on-site electricity generation with fossil fuels (EFEG,FF,y)

57. If no fossil fuel based power generation was identified as part of the baseline scenario, or if fossil fuel based power generation was identified as part of the baseline scenario, but all capacity of power generation based on fossil fuels is used in the cogeneration mode (i.e. up to step 4.2), then it should be assumed in equation (2) that $EF_{EG,FF,y} = EF_{EG,GR,y}$.
58. When fossil fuel based power only generation is identified as part of the baseline scenario and if fossil fuel power plants were operated at the project site prior to the implementation of the ~~CDM~~ project activity, either Option A or Option B can be used to determine the emission factor ($EF_{EG,FF,y}$). For new power plants that would be constructed at the project site in the baseline scenario, Option B shall be used.
    a. **Option A:** Determine $EF_{EG,FF,y}$ as per the procedure described under "Scenario B: Electricity consumption from an off-grid captive power plant" in the latest approved version of TOOL05, using data from the three calendar years prior the date of submission of the PDD for validation of the Article 6.4 ~~CDM~~ project activity, adjusted downwards by 10%;
    b. **Option B:** Determine a default emission factor for $EF_{EG,FF}$ based on the efficiency of the Best Available Technology (BAT) power plant that would be operated at the project site in the baseline. The emissions intensity of the BAT plant is taken from the specifications of the BAT plant as per the legal text of the jurisdiction where the project plant is located. If there is no such legal text available, the legal text of similar jurisdictions is to be applied. A jurisdiction is similar if it is located on the same continent and belongs to the same World Bank income grouping category. If no similar jurisdiction with a legal text is found, then the

next higher income category of jurisdictions is assessed until a jurisdiction with a legal text is found. Where BAT is defined in several jurisdictions within a group, the value from the jurisdiction with the lowest associated GHG emissions intensity shall be used. A default CO_2 emission factor for the fossil fuel types[12] that would be used, by the baseline plant would be applied as follows:

$$EF_{EG,FF} = 3.6 \times \frac{EF_{BL,CO2,FF}}{\eta_{BL,FF}}$$

Where:

$EF_{EG,FF,y}$	=	CO2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year y (tCO2/MWh)
$EF_{BL,CO2,FF}$	=	CO2 emission factor of the fossil fuel type that would be used for power generation at the project site in the baseline (tCO2/GJ)
$\eta_{BL,FF}$	=	Efficiency of the fossil fuel power plant(s) at the project site in the baseline (ratio)

5.5.3 Step 3: Determine the baseline biomass-based heat and power generation

5.5.3.1 Step 3.1: Determine the baseline biomass-based heat generation (HGBL,BR,y)

59. It is assumed that the use of biomass residues for which scenario B5 has been identified as the baseline scenario ($BR_{B5,n,y}$) would be prioritized over the use of any fossil fuels in the baseline. Assuming that the equivalent amount of heat that would be generated with biomass residues ($HG_{BL,BR,y}$) shall be determined as follows[13]:

$$HG_{BL,BR,y} = \sum_{h}\sum_{n}\left(BR_{B5,n,h,y} \times NCV_{BR,n,y} \times \eta_{BL,HG,BR,h}\right)$$

Where:

$HG_{BL,BR,y}$	=	Baseline biomass-based heat generation in year y (GJ)
$BR_{B5,n,h,y}$	=	Quantity of biomass residues of category n used in heat generator h in year y with baseline scenario B5 (tonne on dry-basis)
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis)
$\eta_{BL,HG,BR,h}$	=	Baseline biomass-based heat generation efficiency of heat generator h (ratio)

60. The allocation of biomass residues to the different heat generators ($BR_{B5,n,h,y}$) shall be guided so as to maximize the heat generation efficiency of the set of heat generators, taking into account the following:

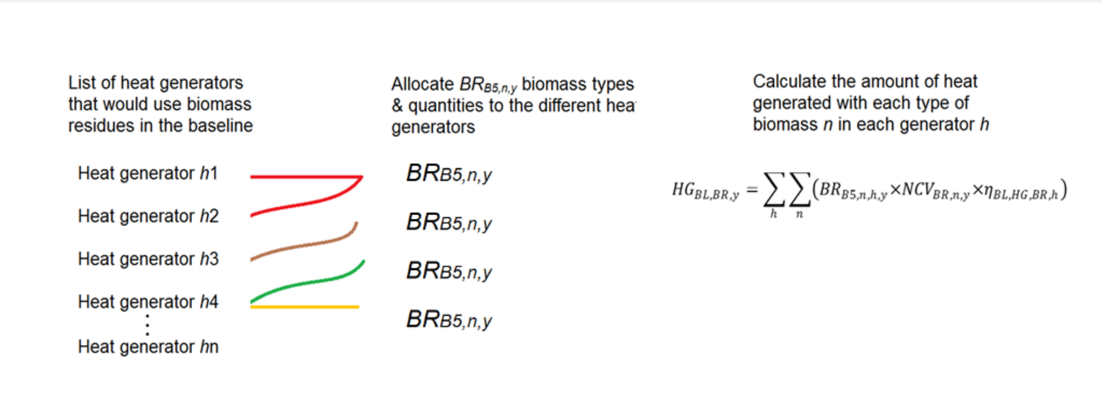
[12] In the situation where there are several plants using different fossil fuels, the emission factor shall be determined ensuring a conservative estimation of baseline emissions.

[13] The biomass residues used in each heat generator ($BR_{B5,n,h,y}$) shall not exceed the total amount of biomass residues available and the heat generation in each heat generator should not exceed the total capacity of the heat generator.

a. Where only one category of biomass residues would be used in the baseline in clearly identifiable baseline heat generators, the monitored quantities of biomass residues used in the project can be directly allocated to those baseline heat generators;
b. Where one category of biomass residue from one particular source could be used in the baseline in two or more heat generators with different efficiencies, the project participants shall specify in a transparent manner how the respective amounts of biomass residues are allocated to each of the heat generators;
c. Where one category of biomass residue category can technically be used in heat generators which do not require co-firing fossil fuels as well as heat generators which require co-firing fossil fuels, it should be assumed that the biomass is used to the maximum extent possible in the heat generator which does not require co-firing fossil fuels, taking into account any technical and operational constraints. Any remaining biomass residue quantities are then allocated to the subsequent heat generators which require co-firing fossil fuels;
d. Where biomass residues could be used for power generation at the project site (B5), the respective amounts shall be determined based on the largest amounts of that category of biomass used for power and/or heat generation in the most recent three calendar years prior the date of submission of the PDD for validation of the ~~CDM~~ project activity.

Box 3. Non-binding best practice example 3: Baseline biomass-based heat generation (step 3.1)

This methodology assumes that the use of biomass residues ($BR_{B5,n,y}$) would be prioritized over the use of any fossil fuels in the baseline. The equivalent amount of heat that would be generated with biomass residues ($HG_{BL,BR,y}$) should be determined based on the allocation of the quantities of each type of biomass to the different generators.



5.5.3.2 Step 3.2: Determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction

61. It is assumed that cogeneration of process heat and power using biomass-based heat ($HG_{BL,BR,y}$) would be prioritized over other uses of this biomass-based heat as well as over the use of fossil fuels for the generation of process heat and power on-site. With that assumption the equivalent amount of electricity ($EL_{BL,BR,CG,y}$) and process heat ($HC_{BL,BR,CG,y}$) that would be generated from biomass-based heat ($HG_{BL,BR,y}$) are determined as follows: [14]
62. Calculate

$$EL_{BL,BR,CG,y} = \frac{1}{3.6} \times \sum_i \left(\frac{1}{(HPR_{BL,i} + 1)} \times \eta_{BL,EG,CG,i} \times HG_{BL,BR,CG,y,i} \right)$$

[14] The biomass-based heat used in cogeneration mode ($HG_{BL,BR,CG,y,i}$) should not exceed the total biomass-based heat generated and the electricity generation in each heat engine should not exceed the total capacity of the heat engine.

$$HC_{BL,BR,CG,y} = \sum_{i}\left(\frac{HPR_{BL,i}}{(HPR_{BL,i}+1)} \times \eta_{BL,EG,CG,i} \times HG_{BL,BR,CG,y,i}\right)$$

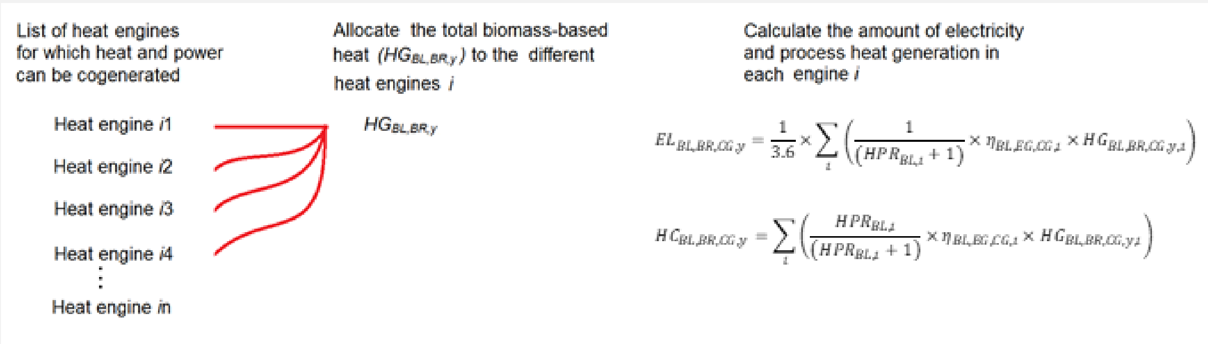
Where:

$EL_{BL,BR,CG,y}$	=	Baseline biomass-based cogenerated electricity in year y (MWh)
$\eta_{BL,EG,CG,i}$	=	Baseline electricity generation efficiency of heat engine i (MWh/GJ)
$HG_{BL,BR,CG,y,i}$	=	Baseline biomass-based heat used in heat engine i in year y (GJ)
$HC_{BL,BR,CG,y}$	=	Baseline biomass-based process heat cogenerated in year y (GJ)
$HPR_{BL,i}$	=	Baseline heat-to-power ratio of the heat engine i (ratio)

63. The total biomass-based heat ($HG_{BL,BR,y}$) shall be allocated to the different heat engines ($HG_{BL,BR,CG,y,i}$) so as to maximize the cogeneration of process heat. For instance, in case of steam cycles, if both back-pressure and heat-extraction steam turbines are identified in the baseline, heat should be first allocated to back-pressure turbines and then to heat-extraction turbines to the maximum extent possible, taking into account any technical and operational constraints.

Box 4. Non-binding best practice example 4: Baseline biomass-based cogeneration (step 3.2)

This methodology assumes that cogeneration of process heat and power using biomass-based heat ($HG_{BL,BR,y}$) would be prioritized over the use of fossil fuels. The equivalent amount of electricity ($EL_{BL,BR,CG,y}$) and process heat ($HC_{BL,BR,CG,y}$) that would be generated are determined based on the allocation of biomass based heat to the different engines *i*.



64. The next step to be followed depends on the outcomes of the calculations above. The following cases are possible:
    a. Cases 3.2.1: all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines:
        i) Case 3.2.1.1: all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines and would match all process heat demand;
        ii) Case 3.2.1.2: all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines, but still some process heat demand would remain to be met using fossil fuel;
    b. Case 3.2.2: excess biomass-based heat would be available after meeting the baseline process heat demand with biomass-based heat sourced from co-generation units, and used for generation of power in power-only mode;

c. Cases 3.2.3: biomass-based heat exceeds or equals the demand of cogeneration-type heat engines:
   i) Case 3.2.3.1: the biomass-based heat equals the remaining demand for process heat. Then, there is no more biomass-based heat available and the demand for process heat has been met;
   ii) Case 3.2.3.2: excess biomass-based heat is less than the remaining demand for process heat. Then, all biomass-based heat is used and there still remains process heat demand to be met using fossil fuels;
   iii) Case 3.2.3.3: excess biomass-based heat is greater than the remaining demand for process heat, then there remains some biomass-based heat to be used after the demand for process heat was met in power-only generation units.

65. Case 3.2.1.1: $HG_{BL,BR,y} = \sum_i HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} = HC_{BL,BR,CG,y}$ If all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines and would match the demand of process heat, it is assumed that the use of fossil fuels on-site and off-site in the baseline scenario would be uncertain (except for the amount required due to technical constraints) because it would depend on a number of factors that are not taken into account in this methodology.

66. Based on these assumptions:
   a. $EL_{BL,\frac{FF}{GRy}} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$,
   b. $EL_{PJ,offset,y}$ = 0, and
   c. $EL_{BL,HG,y,f}$ = 0

Where:

$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity sourced from the grid or o n-site or off-site power-only units in year y (MWh)[15]
$EL_{PJ,offset,y}$	=	Electricity that would be generated in the baseline that exceeds the generation of electricity during year y (MWh)[16]
$EL_{BL,HG,y,f}$	=	Baseline electricity generation using fossil fuel f in year y (MWh)
f	=	Fossil fuel type

67. Then, project participants may proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

68. Case 3.2.1.2: $HG_{BL,BR,y} = \sum_i HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} > HC_{BL,BR,CG,y}$ If all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines but still some process heat demand would remain to be met, it is assumed that the remaining process heat balance is met with fossil fuels.

69. Under these assumptions:
   a. $HC_{balance,FF,y} = HC_{BL,y} - HC_{BL,BR,CG}$, and
   b. $EL_{balance,FF,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$,

Where:

$HC_{balance,FFy}$	=	Process heat balance demand after cogeneration in year y (GJ).

[15] Please refer to Equation 2.

[16] Please refer to Equation 36.

$EL_{balance,FF,y}$ = Balance of electricity generated with fossil fuels in year y (MWh)

70. Then, project participants should proceed to Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation.
71. Case 3.2.2: $HG_{BL,BR,y} > \sum_i HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} = HC_{BL,BR,CG,y}$If all process heat demand would be met with biomass-based heat in the baseline and still there would be some biomass-based heat to be used, it is assumed that this heat would be used for generation of power in power-only mode, i.e. without cogeneration of process heat.
72. Project participants shall define:
    a. $HG_{balance,BR,PO,y} = HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i}$, and
    b. $EL_{balance,PO,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$

Where:

$HG_{balance,BR,POy}$ = Balance of heat produced using biomass residues used in power-only mode in year y (GJ).

$EL_{balance,PO,y}$ = Balance of electricity generated in power-only in year y (MWh)

73. Then, project participants should proceed to Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode.
74. Case 3.2.3: $HG_{BL,BR,y} > \sum_i HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} \geq HC_{BL,BR,CG,y}$, If there would be biomass-based heat in the baseline that could still be used and process heat demand to be met, it is assumed then that this balance of biomass-based heat would be extracted from the heat header and used to meet the process heat demand without cogeneration of power. Three cases should thus be considered.
75. Case 3.2.3.1: $HC_{BL,y} - HC_{BL,BR,CG,y} = \frac{h_{LOW,y}}{h_{HIGH,y}} \times \left(HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i}\right)$, If the balance of biomass-based heat (right-hand side of the equation) equals the remaining demand for process heat (left-hand side of the equation), then there is no more biomass-based heat available and the demand for process heat has been met. It is assumed then that the use of fossil fuels on-site would be uncertain in the baseline scenario (except for the amount required due to technical constraints) because it would depend on a number of factors that are not taken into account in this methodology.
76. Under these assumptions:
    a. $EL_{BL,FF/GR,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, and
    b. $EL_{PJ,offset,y} = 0$, and
    c. $FF_{BL,HG,y,f} = 0$

Where:

$EL_{BL,FF/GR,y}$ = Baseline uncertain electricity sourced from the grid or on-site or off-site power-only units in year y (MWh)

$EL_{PJ,offset,y}$ = Electricity that would be generated in the baseline that exceeds the generation of electricity during year y (MWh)

$FF_{BL,HGy,f}$ = Baseline fossil fuel demand for process heat in year y (GJ)

$h_{LOW,y}$ = Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes)

$h_{HIGH,y}$	=	Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes)

77. Then, project participants should proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.
78. Case 3.2.3.2: $HC_{BL,y} - HC_{BL,BR,CG,y} > \frac{h_{LOW,y}}{h_{HIGH,y}} \times \left(HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i}\right)$If the balance of biomass-based heat (right-hand side of the equation) is less than the remaining demand for process heat (left-hand side of the equation), then all biomass-based heat was used and there still remains process heat demand to be met. It is assumed then that this process heat demand would be met by using fossil fuels in the baseline.
79. Under these assumptions:
    a. $HC_{balance,FF,y} = \left(HC_{BL,y} - HC_{BL,BR,CG,y}\right) - \frac{h_{LOW}}{h_{HIGH}} \times \left(HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i}\right)$ and
    b. $EL_{balance,FF,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$

Where:

$HC_{balance,FFy}$	=	Process heat balance demand after cogeneration in year y (GJ).
$EL_{balance,FF,y}$	=	Balance of electricity generated with fossil fuels in year y (MWh)

80. Then, project participants should proceed to Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation.
81. Case 3.2.3.3: $HC_{BL,y} - HC_{BL,BR,CG,y} < \frac{h_{LOW}}{h_{HIGH}} \times \left(HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i}\right)$, If the balance of biomass-based heat (right-hand side of the equation) is greater than the remaining demand for process heat (left-hand side of the equation), then there remains some biomass-based heat to be used after the demand for process heat was met. It is assumed then that this heat would be used to generate electricity in power-only mode, i.e. without cogeneration of process heat.
82. Under these assumptions:
    a. $HG_{balance,BR,PO,y} = \left(HG_{BL,BL,y} - \sum_i HG_{BL,BR,CG,y,i}\right) - \frac{h_{HIGH}}{h_{LOW}} \times \left(HC_{BL,y} - HC_{BL,BR,CG,y}\right)$, and
    b. $EL_{balance,PO,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$

Where:

$HG_{BL,BR,PO,y,j}$	=	Baseline biomass-based heat used in heat engine *j* in year *y* (GJ)
$HC_{BL,BR,CG,y}$	=	Baseline biomass-based process heat cogenerated in year *y* (GJ)
$EL_{balance,PO,y}$	=	Balance of electricity generated in power-only in year y (MWh)

83. Then, project participants should proceed to Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode.

5.5.3.3 Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode

84. If power-only-type heat engineshave been identified in the baseline scenario, it is assumed that the balance of heat produced using biomass residues, if any, would be used in power-only mode.

85. The amount of biomass-based electricity generated in power-only mode in the baseline[17] is calculated as follows:

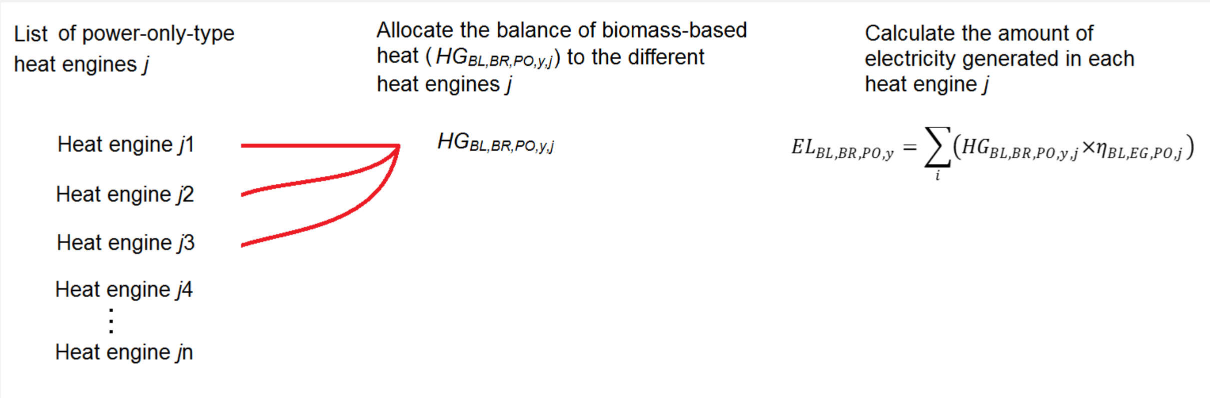
$$EL_{BL,BR,PO,y} = \sum_{i} \left(HG_{BL,BR,PO,y,j} \times \eta_{BL,EG,PO,j} \right)$$

Where:

$EL_{BL,BR,PO,y}$	=	Baseline biomass-based electricity (power-only) in year y (MWh)
$HG_{BL,BR,PO,y,j}$	=	Baseline biomass-based heat used in heat engine j in year y (GJ)
$\eta_{BL,EG,PO,j}$	=	Average electric power generation efficiency of heat engine j (MWh/GJ)

Box 5. Non-binding best practice example 5: Baseline biomass-based power-only (step 3.3)

This methodology assumes that if power-only-type heat engines have been identified in the baseline scenario, the balance of heat produced using biomass residues, if any, would be used in power-only mode. The baseline biomass-based electricity in power-only ($EL_{BL,BR,PO,y,j}$) is determined based on the allocation of the balance of biomass based heat to the different engines *i*.



86. The following cases are possible depending on the results of the calculations above:
    a. Case 3.3.1: the amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario;
    b. Case 3.3.2: the amount of electricity generated on-site in the baseline is larger than the amount of electricity generated in the project scenario, and grid-export was available in the baseline.

87. Case 3.3.1: If $EL_{balance,PO,y} \geq EL_{BL,BR,PO,y}$, the amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario, Project participants shall define:
    a. $EL_{BL,FF/GR,y} = EL_{balance,PO,y} - EL_{BL,BR,PO,y}$,
    b. $EL_{PJ,offset,y} = 0$, and
    c. $FF_{BL,HG,y,f} = 0$

Where:

[17] The biomass-based heat used in the heat engines should not exceed the biomass-based heat balance and the electricity generation in each heat engine should not exceed the total capacity of the heat engine.

$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity sourced from the grid or on-site or off-site power-only units in year y (MWh)
$EL_{PJ,offset,y}$	=	Electricity that would be generated in the baseline that exceeds the generation of electricity during year y (MWh)
$FF_{BL,HGy,f}$	=	Baseline fossil fuel demand for process heat in year y (GJ).

88. Then, project participants should proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.
89. Case 3.3.2: If $EL_{balance,PO,y} < EL_{BL,BR,PO,y}$, the amount of electricity generated on-site in the baseline is larger than the amount of electricity generated in the project scenario, and if grid-export was available in the baseline, this result indicates that the ~~CDM~~ project activity results in a decrease of power output which is likely to be supplied by the grid.[18] As a consequence, project emissions in the form of generation of electricity in the grid should be accounted as $EL_{PJ,offset,y}$. Under these assumptions,:
    a. $EL_{BL,FF/GR,y} = 0$,
    b. $EL_{PJ,offset,y} = EL_{BL,BR,PO,y} - EL_{balance,PO,y}$, and
    c. $FF_{BL,HG,y,f} = 0$

Where:

$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity sourced from the grid or on-site or off-site power-only units in year y (MWh)
$EL_{PJ,offset,y}$	=	Electricity that would be generated in the baseline that exceeds the generation of electricity during year y (MWh)
$FF_{BL,HGy,f}$	=	Baseline fossil fuel demand for process heat in year y (GJ).

90. Then, project participants may proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

5.5.4 Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation

5.5.4.1 Step 4.1: Determine the baseline fossil fuel based cogeneration of process heat and electricity and the remaining process heat demand

91. When the amount of biomass residues available is not sufficient to generate the heat required to meet the process heat demand[19], it is assumed that the balance of process heat is met using fossil fuels, resulting in related fossil fuel baseline emissions. Where fossil fuel based cogeneration, capacity is available it is assumed that the remaining process heat demand will first be supplied by cogeneration and then by direct use of heat supplied by heat generators.
92. The amount of cogenerated electricity and the amount of heat that would need to be generated with fossil fuels in heat generators in order to supply the cogeneration heat engine i, shall be calculated as follows[20]:

[18] This situation should not be expected, as eligible project activities under this methodology should lead to using biomass more efficiently, which should result in surplus of power generation when compared to the baseline scenario.

[19] Cases 3.2.2 and 3.2.4.3 above.

[20] The fossil fuel based cogenerated process heat ($HC_{BL,FF,CG,y,i}$) should not exceed the balance of process heat demand ($HC_{balance,FF,y}$).

$$HG_{BL,FF,CG,y,i} = \frac{\left(HPR_{BL,i} + 1 + GGL_{default}\right)}{HPR_{BL,i}} \times HC_{BL,FF,CG,y,i}$$

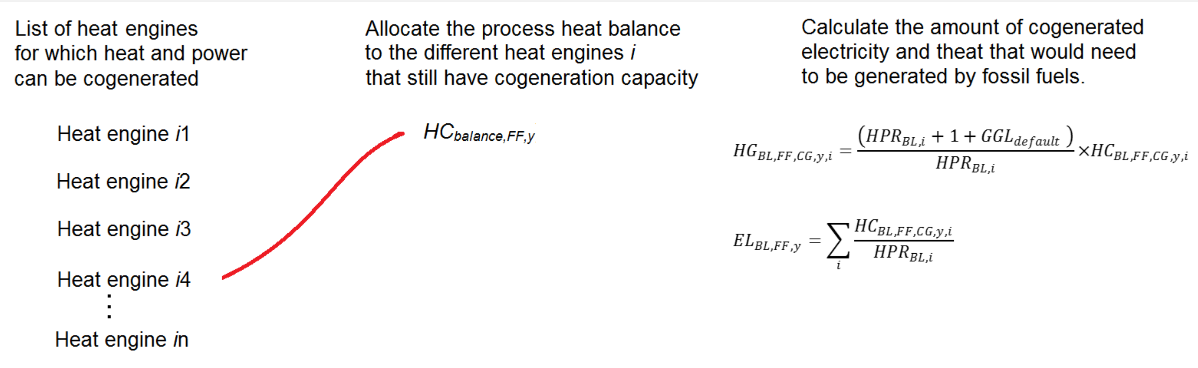
i.e.

Where:

$HG_{BL,FF,CG,y,i}$	=	Baseline fossil-based heat used in heat engine *i* in year *y* (GJ)
$HC_{BL,CG,FF,y}$	=	Baseline fossil based process heat cogenerated in year *y* (GJ)
$GGL_{default}$	=	The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. (Default value of 0.05) (ratio)
$HPR_{BL,i}$	=	Baseline Heat Power Ratio of heat engine *i* (ratio)

Box 6. Non-binding best practice example 6: Baseline fossil fuel based cogeneration (step 4.1)

This methodology assumes that in many cases, the amount of biomass residues available is not enough to generate the heat required to meet the process heat demand. In such cases, and if fossil-fuel-based heat generators have been identified in the baseline scenario, it is assumed that the balance of process heat is met using fossil fuels. The amount of cogenerated electricity and heat that would need to be generated by fossil fuels are determined based on the allocation of the heat balance to the different engines *i*.



93. When after step 4.1 $HC_{balance,FF,y} > HC_{BL,FF,CG,y}$, there would still be process heat demand to be met, it is assumed then that this balance of process heat would be generated with fossil fuels and extracted from the heat header and used to meet the process heat demand without cogeneration of power until all baseline process heat is met.

$$HG_{BL,FF,DHE,y} = \left(HC_{balance,FF,y} - HC_{BL,FF,CG,y}\right) \times \frac{h_{HIGH,y}}{h_{LOW,y}}$$

$$HG_{BL,FF,y} = HG_{BL,FF,CG,y} + HG_{BL,FF,DHE,y}$$

Where:

$HC_{balance,FF,y}$	=	Balance of process heat demand after cogeneration in year y (GJ)
$HC_{BL,FF,CG,y}$	=	Baseline fossil-fuel-based process heat cogenerated in year y (GJ)

$h_{LOW,y}$	=	Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes)
$h_{HIGH,y}$	=	Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes)
$HG_{BL,FF,y}$	=	Baseline fossil-based heat generation in year y (GJ)
$HG_{BL,FF,DHE,y}$	=	Baseline fossil-based heat used to meet baseline process heat demand via direct heat extraction in year y (GJ)
$HG_{BL,FF,CG,y}$	=	Baseline fossil-based heat cogeneration in year y (GJ)

94. The following cases are possible depending on the results of the calculations above:
    a. Case 4.1.1: the amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario;
    b. Case 4.1.2: the amount of electricity generated on-site in the baseline exceeds the amount of electricity generated in the project scenario and grid-export was available in the baseline.
95. Case 4.1.1: $EL_{balance,FF,y} \geq EL_{BL,FF,y}$: The amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario. In order to determine the resulting baseline emissions project participants should define:
    a. $EL_{BL,FF/GR,y} = EL_{balance,FF,y} - EL_{BL,FF,y}$, and
96. $EL_{PJ,offset,y} = 0$, then project participants should proceed to Step 4.2.
97. Case 4.1.2: $EL_{balance,FF,y} < EL_{BL,FF,y}$The amount of electricity generated on-site in the baseline exceeds the amount of electricity generated in the project scenario. If grid-export was available in the baseline, this result indicates that the ~~CDM~~ project activity results in a decrease of power output which is likely to be supplied by the grid. As a consequence, project emissions in the form of generation of electricity in the grid should be accounted for via the parameter $EL_{PJ,offset,y}$.
98. Project participants shall define:
    a. $EL_{BL,FF/GR,y} = 0$*, and*
    b. $EL_{PJ,offset,y} = EL_{BL,FF,y} - EL_{balance,FF,y}$

Then, project participants should proceed to Step 4.2.

5.5.4.2 Step 4.2: Determine the baseline heat generation to meet the fossil-based cogeneration of heat and power and the heat to meet the balance of process heat

99. Estimate the total amount of fossil fuels required to generate the heat required for the cogeneration[21] in Step 4.1 and the balance of process heat as follows:

$$\sum_h HG_{BL,FF,y,h} = HG_{BL,FF,DHE,y} + HG_{BL,FF,CG,y}$$

$$FF_{BL,HG,y,f} = \sum_h \left(\frac{HG_{BL,FF,y,h}}{\eta_{BL,HG,FF,h}} \right)$$

Where:

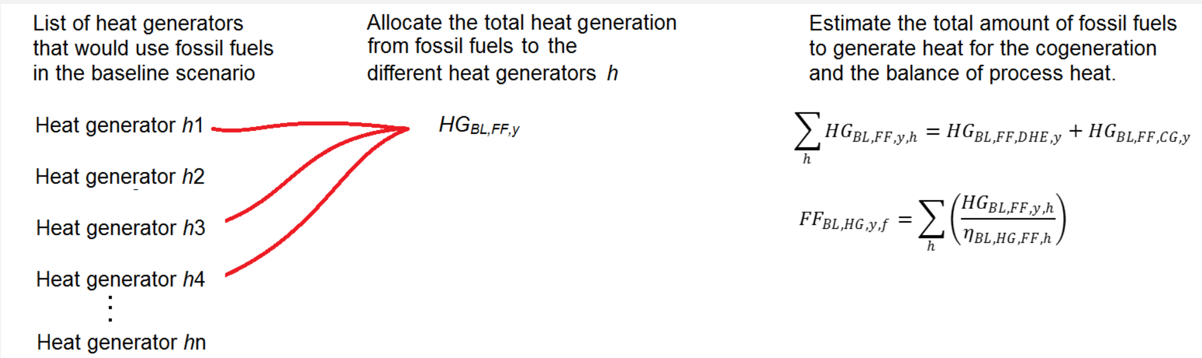
[21] The heat generation in each heat generator ($HG_{BL,FF,y,h}$) should not exceed the total capacity of the heat generator.

$FF_{BL,HG,y,f}$	=	Baseline fossil fuel demand for process heat in year y (GJ)
$HG_{BL,FF,y,h}$	=	Baseline fossil-based heat generation in heat generator h in year y (GJ)
$\eta_{BL,HG,FF,h}$	=	Baseline fossil-based heat generation efficiency of heat generator h (ratio)[22]
$HG_{BL,FF,DHE,y}$	=	Baseline fossil-based heat used to meet baseline process heat demand via direct heat extraction in year y (GJ)
$HG_{BL,FF,CG,y}$	=	Baseline fossil-based heat cogeneration in year y (GJ)

100. The total heat generation required from fossil fuels ($HG_{BL,FF,y}$) shall be allocated to the different heat generators ($HG_{BL,FF,y,h}$), so as to maximize the heat generation efficiency, subject to the difference in heat content in the different heat carriers, up to the level required for meeting the balance of process heat demand.

Box 7. Non-binding best practice example 7: Baseline heat generation to meet the fossil-based cogeneration (step 4.2)

This methodology considers that several heat generators might be identified as part of the baseline scenario. In such cases, the total heat generation required from fossil fuels is allocated to the different heat generators *h* in order to determine the total amount of fossil fuels required to generate the heat required for the cogeneration and the balance of process heat.



5.5.5 Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues

101. The calculation of baseline emissions due to uncontrolled burning or decay of biomass residues is optional and project participants can decide whether to include these emission sources or not. If project participants wish to include these emission sources, the procedure below should be followed, and emissions from combustion of biomass residues under the ~~CDM~~ project activity should be also be determined. Otherwise, this section does not need to be applied and project emissions do not need to include emissions from the combustion of biomass residues under the ~~CDM~~ project activity.

[22] In case of connection to a district heating system or off-site heat supply from which the individual sources cannot be identified, the district heating system shall be considered the most efficient heat source. The capacity of the district heating system shall be considered unlimited unless it can be justified (based on historical consumption data or heat purchase contracts) that the amount of heat to be consumed from/ or delivered to the district heat system was limited. The emission factor of the district heating system shall be considered 0.

102. Baseline emissions due to uncontrolled burning or decay of biomass residues are only determined for those categories of biomass residues for which B1, B2 or B3 has been identified as the baseline scenario.

103. The emissions are determined separately for biomass residues categories for which scenarios B1 and B3 (aerobic decay or uncontrolled burning) apply, and for biomass residues categories for which scenario B2 (anaerobic decay) apply:

$$BE_{BR,y} = BE_{BR,B1/B3,y} + BE_{BR,B2,y}$$

Where:

$BE_{BR,y}$	=	Baseline emissions due to disposal of biomass residues in year y (t CO2e)
$BE_{BR,B1/B3y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year y (t CO_2)
$BE_{BR,B2,y}$	=	Baseline emissions due to anaerobic decay of biomass residues in year y (t CO_2)

5.5.5.1 Step 5.1: Determine BEBR,B1/B3,y

104. For the biomass residues categories for which the most likely baseline scenario is either that the biomass residues would be dumped or left to decay under mainly aerobic conditions (B1), or burnt in an uncontrolled manner without utilizing them for energy purposes (B3), baseline emissions are calculated assuming, for both scenarios (aerobic decay and uncontrolled burning), that the biomass residues would be burnt in an uncontrolled manner.

105. Baseline emissions are calculated as follows:

$$BE_{BR,B1/B3,y} = GWP_{CH4} \times \sum_{n} BR_{B1/B3,n,y} \times NCV_{BR,n,y} \times EF_{BR,n,y}$$

Where:

$BE_{BR,B1/B3y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year y (t CO_2)
GWP_{CH4}	=	Global Warming Potential of methane valid for the commitment period (tCO_2/t CH_4)
$BR_{BR,B1/B3,n,y}$	=	Quantity of biomass residues of category n used in the ~~CDM~~ project activity in year y for which the baseline scenario is B1 or B3 (tonnes on dry-basis)
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis)
$EF_{BR,n,y}$	=	CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year y (tCH_4/GJ)
n	=	Biomass residue category

106. To determine the CH_4 emission factor ($EF_{BR,n,y}$), project participants may undertake measurements or use referenced default values.

107. In the absence of more accurate information for $NCV_{BR,n,y}$ and $EF_{BR,n,y}$.[23] a default value of 0.0027 t CH_4/ t biomass is recommended,[24] adjusted by a conservativeness factor (i.e. 0.73) to address the high level of uncertainty. In this case, an emission factor of 0.001971 t CH_4/t biomass should be used.

Box 8. Non-binding best practice example 8: Baseline emissions due to uncontrolled burning (step 5.1)

Project participants may opt to consider baseline emissions due to uncontrolled burning for those categories of biomass residues which baseline has been identified as B1 (biomass residues are dumped or left to decay mainly under aerobic conditions) or B3 (the biomass residues are burnt in an uncontrolled manner).

Example – A project activity involves the utilization of wood residues that are burnt in an uncontrolled manner in the baseline, and empty fruit bunches that are left to decay aerobically. The project participants choose to determine baseline emissions due to uncontrolled burning of biomass based on the monitored quantities of each type of biomass and the default emission factor of 0.001971 t CH_4/t biomass.

$$BE_{BR,B1/B3,y} = GWP_{CH4} \times \left(BR_{woodresidues,y} + BR_{emptyfruitbunches,y}\right) \times \ 0.001971 \ (\text{tCH4/t})$$

5.5.5.2 Step 5.2: Determine BEBR,B2,y

108. For the biomass residues categories, as described in the biomass residues categories table, for which the most likely alternative scenario is that the biomass residues would decay under clearly anaerobic conditions (case B2), project participants shall calculate baseline emissions using the latest approved version of the TOOL04. The variable $BE_{CH4,SWDS,y}$ calculated by tool corresponds to $BE_{BR,B2,y}$ in this methodology. The project participants shall use as waste quantities prevented from disposal ($W_{j,x}$) in tool, those quantities of biomass residues ($BR_{n,B2,y}$) for which B2 has been identified as the baseline scenario.

109. The determination of $BR_{n,B2,y}$ shall be based on the monitored amounts of biomass residues used in power plants included in the project boundary. Where all biomass residues with the alternative scenario B2 come from one particular source, the monitored quantities of biomass residues used from that source in the project plant can be directly used. Where only parts of the biomass residues from one source would be dumped and left for decay under clearly anaerobic conditions (B2), an allocation should be made consistently with the information provided for the ~~CDM~~ project activity in the ~~CDM-~~PDD. The allocation should be made in a conservative manner and consistent with the guidance provided for $BR_{B4,n,y}$.

110. Step 6: Determine the Paris Goal Coefficient

The Paris Goal Coefficient is calculated as follows:

$$PGC_y = 1 - \frac{number\ of\ years\ elapsed\ since\ 2021}{number\ of\ years\ between\ 2021\ and\ year\ of\ net\ zero\ target} \quad \text{Equation (19)}$$

The "Paris Goal Coefficient" (PGC) serves to downward adjust the baseline emissions intensity over the years of the crediting period to ensure it is in line with the host country's net-zero target,

[23] 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.

[24] 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.

consistent with the long-term goal of the Paris Agreement and taking into account the principle of Common but Differentiated Responsibilities and Respective Capabilities. It is set by the Article 6.4 Supervisory Body, and ensures that baseline emissions fall linearly over time, reaching net zero at the time of the host country's net-zero target. The Paris goal coefficient would be set at 100% in 2021 and at zero in 2050 for a country whose net-zero target date is 2050. For countries without a net-zero target, the Article 6.4 Supervisory Body would specify the year in which the PGC reaches zero.

5.6 Project emissions

111. Project emissions are calculated as follows:

$$PE_y = PE_{Biomas,y} + PE_{FF,y} + PE_{GR1,y} + PE_{GR2,y} + PE_{CBR,y} + PE_{BG2,y}$$

Where:

PE_y	=	Project emissions in year y (t CO_2)
$PE_{Biomass,y}$	=	Project emissions associated with the biomass and biomass residues in year y (t CO_2)
$PE_{FF,y}$	=	Emissions during the year y due to fossil fuel consumption at the project site (t CO_2)
$PE_{GR1,y}$	=	Emissions during the year y due to grid electricity imports to the project site (t CO_2)
$PE_{GR2,y}$	=	Emissions due to a reduction in electricity generation at the project site in year y (t CO_2)
$PE_{CBR,y}$	=	Emissions from the combustion of biomass during the year y (t CO2e)
$PE_{BG2,y}$	=	Emissions from the production of biogas in year y (t CO2e)

5.6.1 Determination of PEBiomass,y

112. $PE_{Biomass,y}$ shall be determined by applying the provisions form TOOL16 and involve the following emission sources:

a. ~~Project emissions resulting from the cultivation of biomass in a dedicated plantation of a CDM project activity that uses biomass (PE_{BC});~~
b. Project emissions resulting from the transportation of biomass (PE_{BT});
c. Project emissions resulting from the processing of biomass (PEBP);
d. Project emissions resulting from the transportation of biomass residues (PEBRT) if the project consumes biomass residues;
e. Project emissions resulting from the processing of biomass residues (PEBRP) if the project consumes biomass residues.

5.6.2 Determination of PEFF,y

113. The following emission sources shall be included in determining $PE_{FF,y}$:

a. Emissions from on-site fossil fuel consumption for the generation of electric power and heat. This includes all fossil fuels used at the project site in heat generators (e.g. boilers) for the generation of electric power and heat; and
b. Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electric power and heat. This includes fossil fuels required for the operation of auxiliary equipment related to the power and heat plants (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.) which are not accounted in (a) above.

114. The latest approved version of TOOL03 shall be used to calculate $PE_{FF,y}$. All combustion processes *j* as described in the two bullets above should be included.

115. Fossil fuels required for the operation of equipment related to on-site or off-site preparation, storage, processing and transportation of fuels and biomass and/or biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting processes, etc.) shall be treated under $PE_{Biomass,y}$.

Box 9. Non-binding best practice example 9: Emissions due to fossil fuel consumption

Project participants should determine the project emissions due to fossil fuel consumption taking into account the on-site fossil fuel consumption for the generation of electric power and heat, and on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electric power and heat.

Example - A project activity that utilizes fossil fuels purchased from the market as auxiliary fuel for the generation of electric power and heat.

The quantities of fossil fuel purchased are monitored continuously using mass or volume meters and cross-checked with invoices that can be identified specifically for the proposed CDM project activity.

5.6.3 Determination of PEGR1,y

116. If electricity is imported from the grid to the project site during year *y*, corresponding emissions should be accounted for as project emissions, as follows:

$$PE_{GR1,y} = EF_{EG,GR,y} \times EL_{PJ,imp,y}$$

Where:

$PE_{GR1,y}$	=	Emissions during the year y due to grid electricity imports to the project site (t CO_2)
$EL_{PJ,imp,y}$	=	Project electricity imports from the grid in year y (MWh)
$EF_{EG,GR,y}$	=	Grid emission factor in year y (t CO_2/MWh)

5.6.4 Determination of PEGR2,y

117. If $EL_{balance,PO,y} < EL_{BL,BR,PO,y}$ (Step 3.3.2) or $EL_{balance,FF,y} < EL_{BL,FF,y}$ (Step 4.2.2), the amount of electricity generated on-site in the baseline is higher than the amount of electricity generated in the project scenario. In such cases, it is assumed that an equivalent amount of electricity is generated during year *y* in order to offset this reduction in electricity generation at the project site. Corresponding emissions should be accounted as project emissions as follows:

$$PE_{GR2,y} = EF_{EG,GR,y} \times EL_{PJ,offset,y}$$

Where:

$PE_{GR2,y}$	=	Emissions due to a reduction in electricity generation at the project site in year y (tCO_2)
$EF_{EG,GR,y}$	=	Grid emission factor in year y (tCO_2/MWh)
$EL_{PJ,offset,y}$	=	Electricity that would be generated in the baseline that exceeds the generation of electricity during year y (MWh)

5.6.5 Determination of PECBR,y

118. If project proponents chose to include emissions due to uncontrolled burning or decay of biomass residues ($BE_{CBR,y}$) in the calculation of baseline emissions, then emissions from the combustion of this category of biomass residues have also to be included in the project scenario. Otherwise, this emission source may be excluded. Corresponding emissions are calculated as follows:

$$PE_{CBR,y} = GWP_{CH4} \times EF_{CH4,BR} \times \sum_{n} BR_{PJ,n,y} \times NCV_{BR,n,y}$$

Where:

$PE_{CBR,y}$	=	Emissions from the combustion of biomass residues during the year y (tCO_2e)
GWP_{CH4}	=	Global Warming Potential of methane valid for the commitment period ($tCO_2/tCH4$)
$EF_{CH4,BR}$	=	CH_4 emission factor for the combustion of biomass residues in the project plant (tCH_4/GJ)
$BR_{PJ,n,y}$	=	Quantity of biomass residues of category n used in the ~~CDM~~ project activity in year y (tonnes on dry-basis)
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis)

119. To determine the CH4 emission factor (EFCH4,BR), project participants may conduct measurements at the plant site or use IPCC default values, as provided in Table 3 below. The uncertainty of the CH4 emission factor is in many cases relatively high. In order to reflect this and for the purpose of providing conservative estimates of emission reductions, a conservativeness factor of 1.37 is applied to the CH4 emission factor.

Table 3: Default CH4 emission factors for combustion of biomass residues[25]

	Default emission factor (kg CH_4 / TJ)	Assumed uncertainty
Wood waste	30	300%
Sulphite lyes (Black Liquor)	3	300%

[25] Values are based on the 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.2 to 2.6.

	Default emission factor (kg CH_4 / TJ)	Assumed uncertainty
Other solid biomass residues	30	300%
Liquid biomass residues	3	300%

5.6.6 Determination of PEBG2,y

120. In case the project includes biogas, the consideration of project emissions associated with the production of biogas depends on the selected baseline scenario for biogas and whether the biogas is sourced from a registered ~~CDM~~ project activity according to the following provisions:
  a. In case the biogas is provided by a registered ~~CDM~~ project activity, the project emissions will be covered in the PDD of the registered ~~CDM~~ project activity;
  b. In case the biogas is not provided by a registered ~~CDM~~ project activity:
    i) If baseline scenario BG1 is selected, the project emissions should be included in this proposed ~~CDM~~ project activity. The emission source shall include project emissions from physical leakage of methane from the anaerobic digester, from treatment of wastewater effluent from the anaerobic digester (where applicable), and from land application of sludge (where applicable). The estimation of these emission sources shall follow the procedures for these sources as identified in the project emissions section of ACM0014;
    ii) In case of baseline scenario BG2 and/or BG3, no project emissions need to be included.

5.7 Leakage

121. Leakage emissions shall be calculated according to TOOL16. When doing so, the project participants shall indicate in the PDD which emission sources are included. If emission sources are not included, the project participants shall provide proper justifications in the PDD.
122. In the case that negative overall emission reductions arise in a year through application of the leakage emissions, the certified emission reductions (CERs) are not issued to project participants for the year concerned and in subsequent years, until emission reductions from subsequent years have compensated the quantity of negative emission reductions from the year concerned.[26]

5.8 Data and parameters not monitored

123. In addition to the parameters and procedures described herein, all monitoring provisions contained in the tools referred to in this methodology also apply.
124. Document and justify all selected values in the ~~CDM~~ PDD.

Table 1: Data / Parameter

Data / Parameter:	Biomass categories and quantities used for the selection of the baseline scenario selection and assessment of additionality
Data unit:	Category (i.e. bagasse, rice husks, empty fruit bunches, etc.); Source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, ~~from dedicated plantations~~ etc.); Fate in the absence of the ~~CDM~~ project activity (scenarios B); Use in the project scenario (scenarios P); Quantity (tonnes on dry-basis)

[26] For example, if negative emission reductions of 30 tCO2e occur in the year t and positive emission reductions of 100 tCO2e occur in the year t+1, only 70 CERs are issued for the year t+1.

Data / Parameter:	Biomass categories and quantities used for the selection of the baseline scenario selection and assessment of additionality
Description:	Explain and document transparently in the ~~CDM~~ PDD, which quantities of which biomass categories are used in which installation(s) under the ~~CDM~~ project activity and what is their baseline scenario. Include the quantity of each category of biomass (tonnes). For the selection of the baseline scenario and demonstration of additionality, at the validation stage, an ex ante estimation of these quantities should be provided
Source of data:	On-site assessment of biomass categories and quantities
Measurement procedures (if any):	---
Any comment:	This parameter is related to the procedure for the selection of the baseline scenario selection and assessment of additionality

Table 8: Data / Parameter

Data / Parameter:	$BR_{HIST,n,x}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category n used for power or heat generation at the project site in year *x* prior the date of submission of the PDD for validation of the ~~CDM~~ project activity (tonnes on dry-basis) prior the time of submission of the PDD for validation of the ~~CDM~~ project activity
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight or volume meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available). In case of volume meters use the fuel density to convert the measurement to mass basis
Any comment:	Biogas should be included as appropriate if applicable (in which case convenient units such as m^3 should be used)

Table 3: Data / Parameter

Data / Parameter:	$BR_{n,h,x}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category n used in heat generator *h* in year *x* (tonnes on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight or volume meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available)
Any comment:	Biogas should be included as appropriate if applicable (in which case convenient units such as m^3 should be used)

Table 4: Data / Parameter

Data / Parameter:	***$FF_{f,h,x}$***
Data unit:	mass or volume unit/yr
Description:	Quantity of fossil fuel type *f* fired in heat generator *h* in year *x* (mass or volume unit/yr)
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight or volume meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available). In case of volume meters use the fuel density to convert the measurement to mass basis
Any comment:	---

Table 5: Data / Parameter

Data / Parameter:	***$HG_{h,x}$***
Data unit:	GJ
Description:	Net quantity of heat generated in heat generator *h* in year *x* (GJ/yr)
Source of data:	On-site measurements
Measurement procedures (if any):	This parameter should be determined as the difference of the enthalpy of the heat (steam or hot water) generated by the heat generators(s) [in the ~~CDM~~ project activity, monitored during year *y*,] minus the enthalpy of the feed-water, the boiler blow-down and any condensate return. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure
Any comment:	In absence of temperature and pressure records, use the default values from equipment as reference

Table 6: Data / Parameter

Data / Parameter:	***$HG_{BR,CG/PO,x,i,j}$***
Data unit:	GJ
Description:	Quantity of heat used in heat engine *i/j* in year *x* (GJ)
Source of data:	On-site measurements
Measurement procedures (if any):	This parameter should be determined as the difference of the enthalpy of the process heat (steam or hot water) generated by the heat generators(s) [in the ~~CDM~~ project activity, monitored during year *y*,] minus the enthalpy of the feed-water, the boiler blow-down and any condensate return. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure
Any comment:	---

Table 7: Data / Parameter

Data / Parameter:	***$HC_{BR,CG/PO,x,i/j}$***
Data unit:	GJ
Description:	Quantity of process heat extracted from the heat engine *i/j* in year *x* (GJ)
Source of data:	On-site measurements
Measurement procedures (if any):	This parameter should be determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the ~~CDM~~ project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure
Any comment:	---

Table 8: Data / Parameter

Data / Parameter:	***$EL_{BR,CG/PO,x,i/j}$***
Data unit:	MWh
Description:	Quantity of electricity generated in heat engine *i/j* in year *x* (MWh)
Source of data:	On-site measurements
Measurement procedures (if any):	Electricity meters
Any comment:	---

Table 9: Data / Parameter

Data / Parameter:	***P_x***
Data unit:	Use suitable units, as appropriate
Description:	Quantity of the main product of the production process (e.g. sugar cane, rice) produced in year *x* from plants operated at the project site
Source of data:	On-site measurements
Measurement procedures (if any):	---
Any comment:	---

Table 10: Data / Parameter

Data / Parameter:	***$CAP_{HG,h}$***
Data unit:	GJ/h
Description:	Baseline capacity of heat generator *h* (GJ/h)
Source of data:	On-site measurements or reference plant design parameters
Measurement procedures (if any):	This parameter should reflect the design maximum heat generation capacity (in GJ/h) of the baseline heat generator *h*. It should be based on

Data / Parameter:	$CAP_{HG,h}$
	the installed capacity of the heat generator. Project participants should document transparently and justify in the ~~CDM~~-PDD how this parameter was determined
Any comment:	---

Table 11: Data / Parameter

Data / Parameter:	$CAP_{EG,CG,i}$ $CAP_{EG,PO,j}$
Data unit:	MW
Description:	$CAP_{EG,CG,i}$ = Baseline electricity generation capacity in on-site and off-site plants in year y (MWh) of cogeneration-type heat engine *i* (MW). $CAP_{EG,PO,j}$ = Baseline electricity generation capacity of power-only-type heat engine *j* (MW)
Source of data:	On-site measurements or reference plant design parameters
Measurement procedures (if any):	This parameter should reflect the design maximum electricity generation capacity (in MW) of the baseline heat engines *i* and *j*. It should be based on the installed capacity of the heat engines. Project participants should document transparently and justify in the ~~CDM~~-PDD how this parameter was determined
Any comment:	---

Table 12: Data / Parameter

Data / Parameter:	$LFC_{HG,h}$
Data unit:	Ratio
Description:	Baseline load factor of heat generator *h* (ratio)
Source of data:	On-site measurements or reference plant design parameters
Measurement procedures (if any):	This parameter should reflect the maximum load factor (i.e. the ratio between the 'actual heat generation' of the heat generator and its 'design maximum heat generation' along one year of operation) of the baseline heat generator *h*, taking into account downtime due to maintenance, seasonal operational patterns, and any other technical constraints. Project participants should document transparently and justify in the ~~CDM~~-PDD how this parameter was determined (e.g. using historical records)
Any comment:	---

Table 13: Data / Parameter

Data / Parameter:	$HPR_{BL,i}$
Data unit:	Ratio
Description:	Baseline heat-to-power ratio of the heat engine *i* (ratio)
Source of data:	On-site measurements or reference plant design parameters
Measurement procedures (if any):	---

Data / Parameter:	$HPR_{BL,i}$
Any comment:	---

Table 14: Data / Parameter

Data / Parameter:	$LFC_{EG,CG,i}$ $LFC_{EG,CG,j}$
Data unit:	Ratio
Description:	$LFC_{EG,CG,i}$ = Baseline load factor of cogeneration-type heat engine *i* (ratio) $LFC_{EG,PO,j}$ = Baseline load factor of power-only-type heat engine *j* (ratio)
Source of data:	On-site measurements or reference plant design parameters
Measurement procedures (if any):	This parameter should reflect the maximum load factor (i.e. the ratio between the 'actual electricity generation' of the heat engine and its 'design maximum electricity generation' along one year of operation) of the baseline heat engine *i* or *j*. The actual electricity generation of the heat engine should be determined taking into account downtime due to maintenance, seasonal operational patterns, and any other technical constraints. Project participants should document transparently and justify in the ~~CDM~~-PDD how this parameter was determined
Any comment:	---

Table 15: Data / Parameter

Data / Parameter:	$EF_{BL,CO2,FF}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of the fossil fuel type that would be used for power generation at the project site in the baseline ($t\ CO_2/GJ$)
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the value in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards
Any comment:	In case of plants existing before project implementation, the lowest CO_2 emission factor should be used in case of multi fuel plants

Table 16: Data / Parameter

Data / Parameter:	$\eta_{BL,FF}$
Data unit:	ratio
Description:	Efficiency of the fossil fuel power plant(s) at the project site in the baseline
Source of data:	Either use the higher value among (a) the measured efficiency and (b) manufacturer's information on the efficiency; or use default values as provided in Appendix 1 of the "Tool to calculate the emission factor for an electricity system"; or assume an efficiency of 100%

Data / Parameter:	$\eta_{BL,FF}$
Measurement procedures (if any):	If measurements are conducted, use recognized standards for the measurement of the heat generator efficiency, such as the "*British Standard Methods for Assessing the thermal performance of boilers for steam, hot water and high temperature heat transfer fluids*" (BS845). Where possible, use preferably the direct method (dividing the net heat generation by the energy content of the fuels fired during a representative time period), as it is better able to reflect average efficiencies during a representative time period compared to the indirect method (determination of fuel supply or heat generation and estimation of the losses). Document measurement procedures and results and manufacturer's information transparently in the ~~CDM~~ PDD
Any comment:	---

Table 17: Data / Parameter

Data / Parameter:	$NCV_{BR,n,x}$
Data unit:	GJ/tonnes on dry-basis
Description:	Net calorific value of biomass residues of category n in year *x*
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards
Any comment:	The NCV is to be calculated for wet biomass as used in the heat generator (i.e. deducting the energy used for the evaporation of the water contained in the biomass residues). Biogas should be included as appropriate if applicable (in which case convenient units such as GJ/m^3 should be used)

Table 18: Data / Parameter

Data / Parameter:	$NCV_{FF,f,x}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value of fossil fuel type *f* in year *x* (GJ/mass or volume unit)
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards
Any comment:	---

Table 19: Data / Parameter

Data / Parameter:	***GWP_{CH4}***
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential of methane valid for the commitment period (tCO2/tCH4)
Source of data:	IPCC
Measurement procedures (if any):	Shall be updated according to any future COP/MOP decisions
Any comment:	---

Table 20: Data / Parameter

Data / Parameter:	**PGC_y**
Data unit:	Dimensionless
Description:	Paris Goal Coefficient to ensure that baseline is progressively downward adjusted to be in line with the long-term temperature goals of the Paris Agreement
Source of data:	Article 6.4 Supervisory Body
Measurement procedures (if any):	---
Any comment:	---

6 Monitoring methodology

6.1 Monitoring procedures

125. Describe and specify in the ~~CDM~~ PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry practices.

126. In addition to the parameters and procedures described herein, all monitoring provisions contained in the tools referred to in this methodology also apply.

6.2 Data and parameters monitored

127. In addition to the parameters listed in the table 20, the parameters of the CDM sustainable development (SD) tool are to be monitored. Once the Article 6.4 Supervisory Body has finalised the new SD tool, it is to replace the CDM SD tool.

Table 21: Data / Parameter

Data / Parameter:	Biomass categories and quantities used in the ~~CDM~~ project activity
Data unit:	Category (i.e. bagasse, rice husks, empty fruit bunches, tree bark etc.); Source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, ~~dedicated plantations~~ etc.); Fate in the absence of the ~~CDM~~ project activity (scenarios B); Use in the project scenario (scenarios P and H); Quantity (tonnes on dry-basis)
Description:	Explain and document transparently in the ~~CDM~~ PDD which quantities of which biomass categories are used in which installation(s) under the ~~CDM~~ project activity and what is their baseline scenario. Include the quantity of each category of biomass (tonnes on dry-basis). These quantities should be updated every year of the crediting period as part of the monitoring plan so as to reflect the actual use of biomass in the project scenario. These updated values should be used for emissions reductions calculations. Along the crediting period, new categories of biomass (i.e. new types, new sources, with different fate) can be used in the ~~CDM~~ project activity. In this case, a new line should be added to the table. If those new categories are of the type B1, B2 or B3, the baseline scenario for those categories of biomass residues should be assessed using the procedures outlined in the guidance provided in the procedure for the selection of the baseline scenario and demonstration of additionality
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	-

Table 22: Data / Parameter

Data / Parameter:	**For biomass residues categories for which scenarios B1, B2 or B3 is deemed a plausible baseline alternative, project participants shall demonstrate that this is a realistic and credible alternative scenario**
Data unit:	Tonnes
Description:	Quantity of available biomass residues of category *n* in the region Quantity of biomass residues of category *n* that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region Availability of a surplus of biomass residues category *n* (which cannot be sold or utilized) at the ultimate supplier to the project and a representative sample of other suppliers in the defined geographical region
Source of data:	Surveys or statistics
Measurement procedures (if any):	-
Monitoring frequency:	At the validation stage for biomass residues categories identified ex ante, and always that new biomass residues categories are included during the crediting period
QA/QC procedures:	-
Any comment:	-

Table 23: Data / Parameter

Data / Parameter:	$BR_{PJ,n,y}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass of category n used in the ~~CDM~~ project activity in year *y* (tonnes on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	The biomass residue quantities used should be monitored separately for (a) each category of biomass residue (e.g.) and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.). Biogas should be included as appropriate if applicable (in which case convenient units such as m^3 should be used)

Table 24: Data / Parameter

Data / Parameter:	$BR_{B1/B3,n,y}$
Data unit:	tonnes on dry-basis

Data / Parameter:	$BR_{B1/B3,n,y}$
Description:	Quantity of biomass residues of category n used in the ~~CDM~~ project activity in year *y* for which the baseline scenario is B1or B3 (tonnes on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	Biogas should be included as appropriate if applicable (in which case convenient units such as m^3 should be used)

Table 25: Data / Parameter

Data / Parameter:	$BR_{B4,n,y}$
Data unit:	tonnes of dry matter
Description:	Quantity of biomass residues of category n used in the ~~CDM~~ project activity in year *y,* for which the baseline scenario is B4 (tonnes on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	Biogas should be included as appropriate if applicable (in which case convenient units such as m^3 should be used)

Table 26: Data / Parameter

Data / Parameter:	$BR_{B5,n,y}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category n used in the ~~CDM~~ project activity in year *y* for which the baseline scenario is B5 (tonne on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	The procedures in Step 1.4 should also be followed

Table 27: Data / Parameter

Data / Parameter:	$EF_{BR,n,y}$
Data unit:	tCH_4/GJ
Description:	CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year *y* (tCH4/GJ)
Source of data:	Conduct measurements or use reference default values
Measurement procedures (if any):	To determine the CH_4 emission factor, project participants may undertake measurements or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 t CH_4 per ton of biomass as default value for the product of NCV_k and $EF_{burning,CH4,k,y}$
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Table 28: Data / Parameter

Data / Parameter:	$EF_{FF,y,f}$
Data unit:	T CO_2/GJ
Description:	CO_2 emission factor for fossil fuel type *f* in year *y* (t CO_2/GJ)
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the value in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards
Monitoring frequency:	In case of measurements: At least every six months, taking at least three samples for each measurement. In case of other data sources: Review the appropriateness of the data annually
QA/QC procedures:	Check consistency of measurements and local/national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements
Any comment:	-

Table 29: Data / Parameter

Data / Parameter:	$EF_{CH4,BR}$
Data unit:	T CH_4/GJ
Description:	CH_4 emission factor for the combustion of biomass residues in the project plant (tCH4/GJ)
Source of data:	On-site measurements or default values, as provided in Table 3 (see page 133 above).
Measurement procedures (if any):	The CH_4 emission factor may be determined based on a stack gas analysis using calibrated analyzers

Data / Parameter:	$EF_{CH4,BR}$
Monitoring frequency:	At least quarterly, taking at least three samples per measurement
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements
Any comment:	Monitoring of this parameter for project emissions is only required if CH_4 emissions from biomass combustion are included in the project boundary. Note that a conservative factor shall be applied, as specified in the baseline methodology

Table 30: Data / Parameter

Data / Parameter:	$EF_{CO2,LE}$
Data unit:	T CO_2/GJ
Description:	CO_2 emission factor of the most carbon intensive fossil fuel used in the country (t CO_2/GJ)
Source of data:	Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication/GHG inventory. If available, use national default values for the CO_2 emission factor. Otherwise, IPCC default values may be used
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Table 31: Data / Parameter

Data / Parameter:	$HC_{BL,y}$
Data unit:	GJ
Description:	Baseline process heat generation in year *y* (GJ)
Source of data:	On-site measurements
Measurement procedures (if any):	This parameter should be determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the ~~CDM~~ project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure
Monitoring frequency:	Calculated based on continuously monitored data and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	-

Data / Parameter:	***$HC_{BL,y}$***
Any comment:	-

Table 32: Data / Parameter

Data / Parameter:	***$EL_{PJ,gross,y}$***
Data unit:	MWh
Description:	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y* (MWh)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	The consistency of metered electricity generation should be cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years)
Any comment:	-

Table 33: Data / Parameter

Data / Parameter:	***$EL_{PJ,imp,y}$***
Data unit:	MWh
Description:	Project electricity imports from the grid in year *y* (MWh)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	The consistency of metered electricity generation should be cross-checked with receipts from electricity purchases
Any comment:	-

Table 34: Data / Parameter

Data / Parameter:	***$EL_{PJ,aux,y}$***
Data unit:	MWh
Description:	Total auxiliary electricity consumption required for the operation of the power plants at the project site in year *y* (MWh)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters

Data / Parameter:	***$EL_{PJ,aux,y}$***
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	The consistency of metered electricity generation should be cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years).
Any comment:	$EG_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.). In case steam tubines are used for mechanical power in the baseline situation and electric motors for the same purpose in the project situation, the electricity used to run these electric motors shall be included in $EL_{PJ,aux,y}$

Table 35: Data / Parameter

Data / Parameter:	***$NCV_{BR,n,y}$***
Data unit:	GJ/tonnes of dry matter
Description:	Net calorific value of biomass residue of category n in year *y* (GJ/tonne on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV on dry-basis
Monitoring frequency:	At least every six months, taking at least three samples for each measurement.
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass
Any comment:	Biogas should be included as appropriate if applicable (in which case convenient units such as GJ/m^3 should be used)

Table 36: Data / Parameter

Data / Parameter:	***$h_{LOW,y}$*** ***$h_{HIGH,y}$***
Data unit:	GJ/tonnes
Description:	$h_{LOW,y}$ = Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes) $h_{HIGH,y}$ = Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes)
Source of data:	On-site measurements

Data / Parameter:	$h_{LOW,y}$ $h_{HIGH,y}$
Measurement procedures (if any):	The specific enthalpies should be determined based on the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	-
Any comment:	The process heat demand side refers to where heat is finally used for heating purposes by end-users and the heat generator side refers to where heat is generated

Table 37: Data / Parameter

Data / Parameter:	P_y
Data unit:	Use suitable units, as appropriate
Description:	Quantity of the main product of the production process (e.g. sugar cane, rice) produced in year *y* from plants operated at the project site
Source of data:	On-site measurements
Measurement procedures (if any):	---
Monitoring frequency:	Data aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	-
Any comment:	-

Table 38: Data / Parameter

Data / Parameter:	LOC_y
Data unit:	Hour
Description:	Operation of the industrial facility using the process heat in year *y* (hour)
Source of data:	On-site measurements
Measurement procedures (if any):	Record and sum the hours of operation of the ~~CDM~~ project activity facilities during year *y*
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Appendix 1: Alphabetical list of parameters

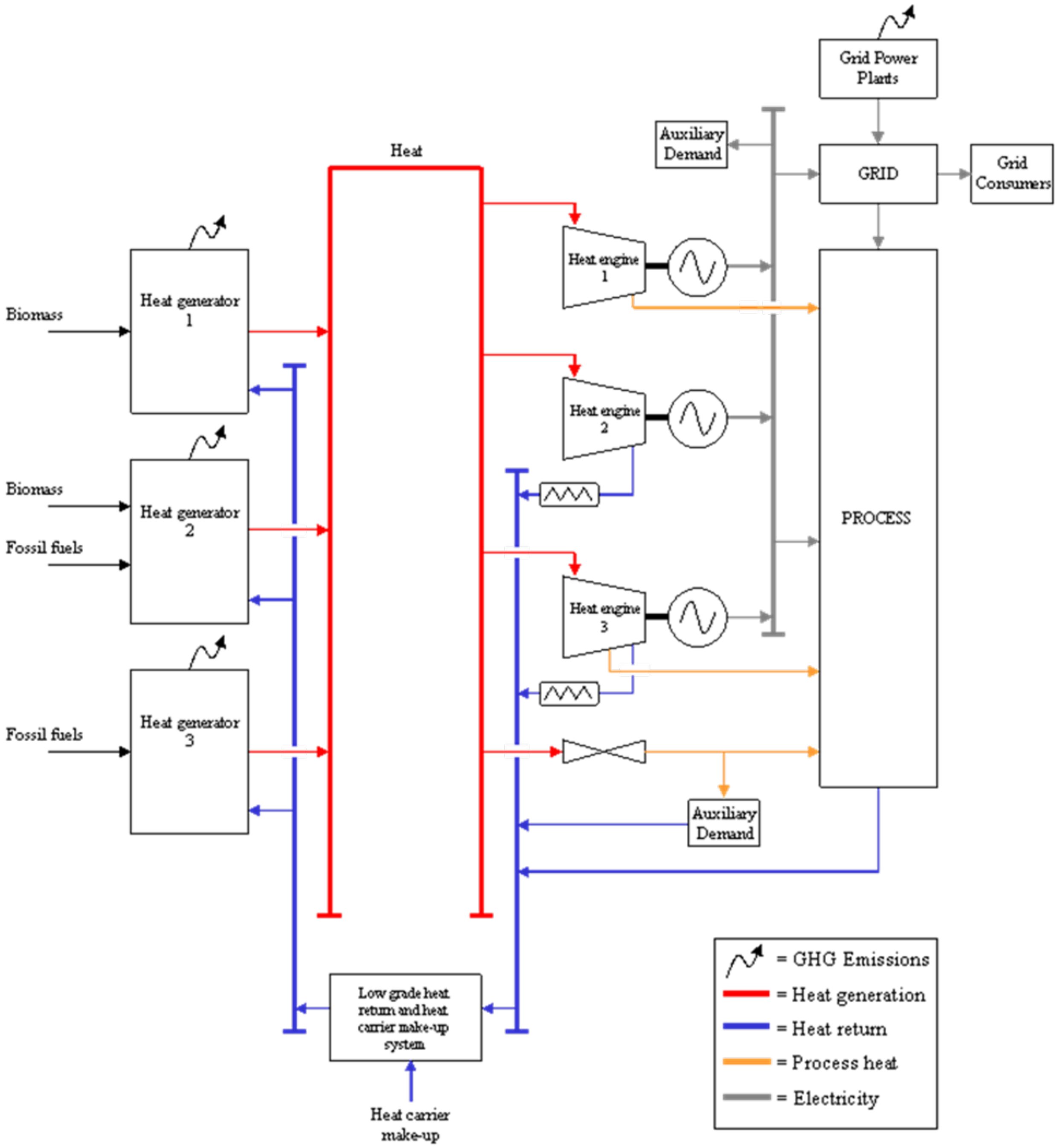
$BE_{BR,y}$	=	Baseline emissions due to disposal of biomass residues in year y (t CO2e)
$BE_{BR,B1/B3y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year y (t CO_2)
$BR_{PJ,n,y}$	=	Quantity of biomass residues of category n used in the ~~CDM~~ project activity in year y (tonnes on dry-basis)
$BE_{BR,B1/B3,n,y}$	=	Quantity of biomass residues of category n used in the ~~CDM~~ project activity in year y for which the baseline scenario is B1 or B3 (tonnes on dry-basis)
$BE_{BR,B2,y}$	=	Baseline emissions due to anearobic decay of biomass residues in year y (t CO_2)
$BR_{B5,n,h,y}$	=	Quantity of biomass residues of category n used in heat generator h in year y with baseline scenario B5 (tonne on dry-basis)
$CAP_{EG,total,y}$	=	Baseline electricity generation capacity in on-site and off-site plants in year y (MWh)
$CAP_{EG,CG,i}$	=	Baseline electricity generation capacity of cogeneration-type heat engine i (MW)
$CAP_{EG,PO,j}$	=	Baseline electricity generation capacity of power-only-type heat engine j (MW)
$EF_{BL,CO2,FF}$	=	CO_2 emission factor of the fossil fuel type that would be used for power generation at the project site in the baseline (tCO_2/GJ)
$EF_{BR,n,y}$	=	CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year y (tCH_4/GJ)
$EF_{CH4,BR}$	=	CH_4 emission factor for the combustion of biomass residues in the project plant (tCH_4/GJ)
$EF_{EG,GR,y}$	=	Grid emission factor in year y (t CO_2/MWh)
$EF_{EG,FF,y}$	=	CO_2 emission factor for electricity generation with fossil fuels in the baseline in year y (t CO_2/MWh)
$EF_{FF,y,f}$	=	CO_2 emission factor for fossil fuel type f in year y (t CO_2/GJ)
$EL_{balance,FF,y}$	=	Balance of electricity generated with fossil fuels in year y (MWh)

$EL_{balance,PO,y}$	=	Balance of electricity generated in power-only in year y (MWh)
$EL_{BL,y}$	=	Baseline electricity generation in year y (MWh)
$EL_{BL,BR,CG,y}$	=	Baseline biomass-based cogenerated electricity in year y (MWh)
$EL_{BL,BR,PO,y}$	=	Baseline biomass-based electricity (power-only) in year y (MWh)
$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity sourced from the grid or on-site or off-site power-only units in year y (MWh)
$EL_{BL,GR,y}$	=	Baseline electricity sourced from the grid in year y (MWh)
$EL_{BL,HG,y,f}$	=	Baseline electricity generation using fossil fuel f in year y (MWh)
$EL_{PJ,aux,y}$	=	Total auxiliary electricity consumption required for the operation of the power plants in year y (MWh)
$EL_{PJ,gross,y}$	=	Gross quantity of electricity generated in all power plants included in the project boundary in year y (MWh)
$EL_{PJ,imp,y}$	=	Project electricity imports from the grid in year y (MWh)
$EL_{PJ,offset,y}$	=	Electricity that would be generated in the baseline that exceeds the generation of electricity during year y (MWh)
f	=	Fossil fuel type
$FF_{BL,HG,y,f}$	=	Baseline fossil fuel demand for process heat in year y (GJ)
$GGL_{default}$	=	The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. (ratio)
GWP_{CH4}	=	Global Warming Potential of methane valid for the commitment period (tCO_2/tCH4)
$h_{HIGH,y}$	=	Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes)
$h_{LOW,y}$	=	Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes)
$HC_{balance,FFy}$	=	Process heat balance demand after cogeneration in year y (GJ).
$HC_{BL,BR,CG,y}$	=	Baseline biomass-based process heat cogenerated in year y (GJ)
$HC_{BL,CG,FF,y}$	=	Baseline fossil based process heat cogenerated in year y (GJ)

$HC_{BL,FF,CG,y}$	=	Baseline fossil-fuel-based process heat cogenerated in year y (GJ)
$HG_{balance,BR,PO,y}$	=	Balance of heat produced using biomass residues used in power-only mode in year y (GJ)
$HC_{BR,CG/PO,x,i/j}$	=	Quantity of process heat extracted from the heat engine i/j in year x (GJ)
$HG_{BL,BR,y}$	=	Baseline biomass-based heat generation in year y (GJ)
$HG_{BL,BR,CG,y,i}$	=	Baseline biomass-based heat used in heat engine i in year y (GJ)
$HG_{BL,BR,PO,y,j}$	=	Baseline biomass-based heat used in heat engine j in year y (GJ)
$HG_{BL,FF,y}$	=	Baseline fossil-based heat generation in year y (GJ)
$HG_{BL,FF,y,h}$	=	Baseline fossil-based heat generation in heat generator h in year y (GJ)
$HG_{BL,FF,CG,y}$	=	Baseline fossil-based heat cogeneration in year y (GJ)
$HG_{BL,FF,CG,y,i}$	=	Baseline fossil-fuel-based heat used in heat engine i in year y (GJ)
$HG_{BL,FF,DHE,y}$	=	Baseline fossil-based heat used to meet baseline process heat demand via direct heat extraction in year y (GJ)
$HPR_{BL,i}$	=	Baseline heat-to-power ratio of the heat engine i (ratio)
i	=	Cogeneration-type heat engine in the baseline scenario
j	=	Power-only-type heat engine in the baseline scenario
$LFC_{EG,CG,i}$	=	Baseline load factor of cogeneration-type heat engine i (ratio)
$LFC_{EG,PO,j}$	=	Baseline load factor of power-only-type heat engine j (ratio)
LOC_y	=	Operation of the industrial facility using the process heat in year y (hour)
n	=	Biomass residue category
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis)

$PE_{Biomass,y}$	=	Project emissions associated with the biomass and biomass residues in year y (t CO_2)
$PE_{BG2,y}$	=	Emissions from the production of biogas in year y (t CO2e)
$PE_{CBR,y}$	=	Emissions from the combustion of biomass during the year y (t CO2e)
$PE_{FF,y}$	=	Emissions during the year y due to fossil fuel consumption at the project site (t CO_2)
$PE_{GR1,y}$	=	Emissions during the year y due to grid electricity imports to the project site (t CO_2)
$PE_{GR2,y}$	=	Emissions due to a reduction in electricity generation at the project site in year y (t CO_2)
$\eta_{BL,EG,CG,i}$	=	Baseline electricity generation efficiency of heat engine i (MWh/GJ)
$\eta_{BL,EG,PO,j}$	=	Average electric power generation efficiency of heat engine j (MWh/GJ)
$\eta_{BL,FF}$	=	Efficiency of the fossil fuel power plant(s) at the project site in the baseline (ratio)
$\eta_{BL,HG,BR,h}$	=	Baseline biomass-based heat generation efficiency of heat generator h (ratio)
$\eta_{BL,HG,FF,h}$	=	Baseline fossil-based heat generation efficiency of heat generator h (ratio)
x	=	Last calendar year prior to the crediting period

Appendix 2: Example of a project activity configuration[31]



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Document information

[31] For simplicity, power only units are not displayed in the diagram.

~~Version~~	~~Date~~	~~Description~~
~~16.0~~	~~11 March 2022~~	~~EB 113, Annex 14~~ ~~Revision to:~~ ~~Indicate the emission sources that are relevant in the calculation of project emissions associated with biomass and biomass residues, in line with "TOOL16: Project and leakage emissions from biomass" (version 05.0);~~ ~~Make editorial improvements.~~
~~15.0~~	~~14 December 2020~~	~~EB 108, Annex 6~~ ~~Revision to:~~ ~~Address inconsistencies and ambiguities in the language used in some parts of the methodology;~~ ~~Simplify the approach for the estimation of emission reductions.~~
~~14.0~~	~~29 November 2018~~	~~EB 101, Annex 9~~ ~~Revision to include non-binding best practice examples.~~
~~13.1~~	~~31 May 2017~~	~~Editorial revision to correct paragraph numbering.~~
~~13.0~~	~~4 May 2017~~	~~EB 94, Annex 5~~ ~~Revision to:~~ ~~Add reference to the methodological tool "Project and leakage emissions from biomass" (TOOL16);~~ ~~Streamline the provisions associated with cultivation of biomass from a dedicated plantation.~~
~~12.1.1~~	~~13 September 2012~~	~~EB 69, Annex 17~~ ~~Amendment to:~~ ~~Broaden the applicability of the methodology to utilization of biomass from dedicated plantations;~~ ~~Change the title from "Consolidated methodology for electricity and heat generation from biomass residues" to "Consolidated methodology for electricity and heat generation from biomass".~~
~~12.1.0~~	~~2 March 2012~~	~~EB 66, Annex 39~~ ~~Editorial amendment to modify equations in pages 36 and 39 where the amount of electricity generated in the baseline is higher than the amount of energy generated in the project activity.~~
~~12.0~~	~~2 March 2012~~	~~EB 66, Annex 39~~ ~~Revision in order to incorporate reference to the tools:~~ ~~"Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period";~~ ~~"Tool for project and leakage emissions from road transportation of freight".~~
~~11.2~~	~~29 September 2011~~	~~EB 63, Annex 16~~ ~~Amendment to:~~ ~~Broaden the applicability of the methodology to situations where mechanical energy is produced from process heat generated from biomass;~~ ~~Broaden the applicability of the methodology by increasing the maximal share of the co-fired fossil fuels in the total fuel fired from 50% to 80% on an energy basis.~~
~~11.1~~	~~26 November 2010~~	~~EB 58, Annex 8~~

		~~The methodology was revised in order to include project activities that use biogas produced from anaerobic digestion of wastewater as fuel. The revision also corrects editorial mistakes in equations and definitions of parameters.~~
~~11.0~~	~~17 September 2010~~	~~EB 56, Annex 6~~ ~~The revised methodology, now titled “Consolidated methodology for electricity and heat generation from biomass residues”, is made in response to the EB 37 request to undertake a review of ACM0006 with a view to: (i) Provide more clarity on the applicability of various scenarios; (ii) Consolidate the various scenarios, where possible; (iii) Provide a simple guide for PPs to identify which scenario is applicable to their project activity and (iv) Explore the possibility of splitting the methodology if there are very distinct types of project activities to which the methodology is applicable. Consequently, this overall revision inter alia removes the scenario-based approach to determining applicability and provides an overall change in approach for determining baseline emissions and project emissions;~~ ~~Due to the overall modification of the document, no highlights of the changes are provided;~~ ~~Consequently, all information contained in history boxes below is not relevant to this version of the methodology.~~
~~10.1~~	~~30 July 2010~~	~~EB 55, Annex 16~~ ~~Editorial revision to:~~ ~~Revise the monitoring procedure of the biomass moisture content so that the parameter can be monitored for each batch of biomass, rather than continuously.~~
~~10.0~~	~~12 February 2010~~	~~EB 52, Annex 8~~ ~~The applicability of the methodology was restricted to power and heat projects due to the approval of a new consolidated methodology ACM0018 for power-only projects. Power-only projects were excluded from this methodology.~~
~~09.0~~	~~17 July 2009~~	~~EB 48, Annex 10~~ ~~Equation 15 was divided into two different equations in order to be correctly applied in case of scenario 13.~~
~~08.0~~	~~25 March 2009~~	~~EB 46, Annex 6~~ ~~Scenario 22 was included in the methodology in response to the request for revision AM_REV_0118. Furthermore, scenario 21 was wrongly mentioned in the field “Any comment” in the table for parameter~~ $\cancel{BF_{k,boiler,historic,3yr}}$ ~~which was corrected.~~
~~07.0~~	~~13 February 2009~~	~~EB 45, Annex 11~~ ~~The methodology was revised to include the following requests for revision and clarifications:~~ ~~AM_REV_0074 - inclusion of Scenario 21;~~ ~~AM_CLA_0065 - the statement “the efficiency of heat generation in the project plant is smaller or the same compared to the reference plant” was removed from the description of the scenarios to ensure internal consistency with the calculation of emissions reductions due to heat production.~~
~~06.2~~	~~02 August 2008~~	~~EB 41, Paragraph 26(g)~~ ~~The title of the “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site” changes to “Tool to~~

		~~determine methane emissions avoided from disposal of waste at a solid waste disposal site".~~
~~06.1~~	~~16 May 2008~~	~~EB 39, Paragraph 22~~ ~~"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" replaces the withdrawn "Tool to calculate project emissions from electricity consumption".~~
~~06.0~~	~~27 August 2007~~	~~EB 33, Annex 10~~ ~~The methodology was revised:~~ ~~To have its applicability broadened to project activities that install a new cogeneration facility using biomass;~~ ~~To modify the equation for baseline methane emissions from avoided dumping of biomass residue to reflect the situation where only a part of the biomass residue available is in surplus which, therefore, would result in dumping leading to methane emissions;~~ ~~To include the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" and the "Tool to calculate project emissions from electricity consumption".~~
~~05.0~~	~~18 May 2007~~	~~EB 31, Annex 11~~ ~~The methodology was revised in response to the request AM_REV_0044 to expand the applicability of the approved methodology by including new scenario for project activities that improve the efficiency of biomass use in generating electricity.~~
~~04.0~~	~~02 November 2006~~	~~EB 27, Annex 6~~ ~~In response to the requests AM_REV_0023 and AM_REV_0024 the methodology was revised:~~ ~~To include the use of the first order decay model for calculation of avoided methane emissions from natural decay. That was implemented by incorporating the FOD tool as an option in cases where the biomass residues would be dumped under clearly anaerobic conditions in the baseline scenario;~~ ~~To include a scenario for fossil fuel based electricity and heat generation in the baseline case. The approved methodology was also revised, as per the recommendation of the panel;~~ ~~To have the scope of five Scenarios (5, 6, 7, 8 & 11) broadened to allow the possibility that existing fossil fuel fired power plants may also be retired as a result of the project activity;~~ ~~To make the methodology consistent with AM0036, particularly with respect to the monitoring provisions;~~ ~~To update emissions factors used in the methodology based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories;~~ ~~To make provisions related to the lifetime of existing installations that are replaced as a result of the project activity in compliance with guidance by the Board on this matter (section C of annex 2 of EB 22).~~
~~03.0~~	~~19 May 2006~~	~~EB 24, Annex 1~~ ~~Inclusion of definitions section;~~ ~~The methodology was revised in order to clarify the process for estimating the net quantity of increased electricity from implementation of project activity under Scenario 14.~~
~~02.0~~	~~03 March 2006~~	~~EB 23, Annex 11~~ ~~Inclusion of the name of the project developer;~~ ~~Inclusion of Scenario 16.~~

~~01.0~~	~~30 September 2005~~	~~EB 21, Annex 13~~ ~~Initial adoption.~~

~~Decision Class: Regulatory~~
~~Document Type: Standard~~
~~Business Function: Methodology~~
~~Keywords: biomass, cogeneration, electricity generation, heat generation, thermal power plant~~