Verified Carbon Standard

MODULE TO DETERMINE THE BASELINE SCENARIO RETIREMENT DATE OF A COAL-FIRED POWER PLANT

Document Prepared by The Rockefeller Foundation-led Coal to Clean Credit Initiative

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1 SOURCES

This module is based on the following modules/tools/methodologies:

- Clean Development Mechanism (CDM) *Tool 02: Tool to identify the baseline scenario and demonstrate additionality*
- Clean Development Mechanism (CDM) *Tool 27: Investment Analysis Tool*

The following have also informed the development of the module:

- Proposed guidance on addressing bias uncertainty, CDM – Meth Panel, Thirty-second meeting, Report Annex 14

This module uses the latest versions of the following modules/tools:

- VM00XX: Methodology for Early Retirement of Coal-Fired Power Plants Using a Just Transition
- Clean Development Mechanism (CDM) ACM0002: Grid-connected electricity generation from renewable sources
- Clean Development Mechanism (CDM) Tool 10: Tool to determine remaining technical life of equipment.
- Clean Development Mechanism (CDM) Tool 27: Investment Analysis Tool

2 SUMMARY DESCRIPTION OF THE MODULE

This module establishes criteria and procedures to determine the baseline scenario retirement date of a Coal Fired Power Plant (CFPP).

3 DEFINITIONS

The module applies the definitions as established in the latest version the *VCS Program Definitions* and as established in the latest version of *VM00XX: Methodology for Early Retirement of Coal-Fired Power Plants Using a Just Transition*. Additional relevant definitions specific to the operationalization of the tool are as follows:

Accelerated Depreciation
A utility finance tool that accelerates the depreciation, and therefore return on and return of capital on its rate base, over a shorter period.

Asset level phase-out plan
A documented and approved plan to retire CFPPs (and other fossil fuel power plants) in a jurisdiction (national or subnational) where the plan specifies the retirement date of each CFPP. Both the jurisdictional government and Independent Power Producer (IPP) can have an asset level phase-out plan. However, only a plan by a government is considered legally binding.

Coal Transition Mechanism (CTM)
The financial products and services that aim to accelerate a managed transition of a CFPP that has remaining fair value to their owners. This is done by changing the underlying cost of capital of a CFPP or its revenues to deliver necessary returns. Any carbon market mechanism leveraging the revenue generated from carbon credits, including compliance market, Voluntary Carbon Market (VCM) and Article 6, is excluded from the definition of a coal transition mechanism.

Jurisdictional level phase-out commitment
A documented and approved commitment by the jurisdictional (national or subnational) government that specifies the date of CFPP phaseout in the jurisdiction without specifying the retirement of each CFPP. The end phaseout date is considered legally binding for all CFPP.

Regulatory asset
A utility finance tool that allows a utility to continue to include an asset in its rate base, and therefore continue to realize a return on and return of capital on the asset, even after it has ceased operation.

Required revenues
The revenue that a regulated utility needs to earn in a year in order to provide adequate service to its customers and its allowed return for its shareholders.

4 APPLICABILITY CONDITIONS

The projects applying this module must demonstrate compliance to applicability conditions established in the latest version of *VM00XX: Methodology for Early Retirement of Coal-Fired Power Plants Using a Just Transition*.

5 PROCEDURES

The baseline scenario retirement date must be the earliest CFPP retirement date under the following possible CFPP retirement scenarios:

1) End of technical life
2) Regulatory-determined CFPP phaseout date
3) End of a long-term power purchase agreement (PPA)
4) Committed coal transition mechanism (CTM)
5) Financially feasible retirement by a regulated utility or PPA off taker

5.1 End of the technical life

This baseline scenario assumes the CFPP is retired at the end of its technical life. The technical life of each CFPP unit must be determined according to the latest version of the CDM Tool 10: *Tool to determine remaining technical life of equipment.*

5.2 Regulatory-determined coal phaseout date

All of the following cases must be evaluated when establishing the retirement date in this baseline scenario:

1) A coal phaseout date in a country's Nationally Determined Contribution
2) A coal phaseout date stipulated in the electricity system's most recent integrated resource or electricity sector plan, which has been approved by the electricity regulator or electricity sector governing body
3) A coal phaseout date set in a national or subnational legislation, law, or executive mandate

The above commitments and plans may be at a jurisdictional level (e.g., a commitment to phase out all CFPPs by 2040) or an asset-level (e.g., an asset phaseout plan). If an asset-level coal phaseout plan exists, the CFPP retirement date under the plan must be considered as the retirement date. Otherwise, the jurisdictional phaseout commitment date must be taken as the retirement date.

5.3 End of the existing PPA

The retirement date for a CFPP with a long-term PPA will be the end of the PPA term. [*PPA extensions executed after December 31 2023 are not eligible and the original PPA term must be used.*]

5.4 Committed CTM

The retirement date of a CFPP with a committed CTM is the announced retirement date under the specific CTM that has been committed for the project CFPP. A CFPP is considered to have a committed CTM if a specific retirement date has been announced and any of the following conditions have been achieved:

1) The financial close of a transaction, including transfer of ownership of the CFPP, equity investment or full or partial buyout of equity shares of the CFPP, development of a special purpose vehicle or fund to invest in the CFPP, refinancing, or new financing agreement, that would lower the existing cost of capital, for example by lowering the cost of equity, cost of debt, or leverage ratio, or required returns of the CFPP.
2) The signing of an electricity contract for a defined early retirement, such as a PPA, PPA renegotiation, or other contractual agreement detailing retirement ahead of the CFPP's current PPA term or technical life.

5.5 Financially feasible retirement

Retiring a CFPP ahead of its technical life, regulatory-determined phaseout date, committed CTM retirement date, or before the end of its PPA term may be financially feasible to a regulated utility or PPA off-taker.

A retirement is deemed financially feasible if replacing it with cheaper resources would result in net savings for the regulated utility or off-taker (i.e. would result in lower overall electricity costs), including any additional contract termination costs (e.g., early PPA termination fees). Such analysis requires the net present value of electricity costs to be less than or equal to the electricity costs in a scenario where the CFPP would have continued to operate. As a result, it integrates considerations of ratepayer impacts into the feasibility assessment. However, because electricity costs are evaluated on a net present basis, certain scenarios may be deemed financially feasible in this tool that result in increases in electricity costs in a single year—but result in overall lower electricity costs over the period of assessment.

Financially feasible retirement must be evaluated for the following sub-scenarios, where applicable:

1) For a CFPP owned by a regulated utility owner, the following sub-scenarios must be assessed for the applicability to the CFPP:
    a) Accelerated depreciation - In this retirement scenario, the utility achieves capital recovery and earns return on capital for the CFPP over an accelerated period, retires the CFPP after capital recovery has been achieved, and replaces its generation with alternative resources.
    b) Regulatory Asset - If creation of a regulatory asset is permitted under existing utility regulation, early retirement enabled through the creation of a regulatory asset must be evaluated as a baseline retirement scenario. In this retirement

scenario, the utility retires the CFPP and replaces it with alternative resources but is allowed to continue to realize return of capital and return on capital for the CFPP after its retirement.

c) Securitization - If existing utility regulation allows mechanisms to refinance the CFPP's value in the utility's rate base (e.g., through ratepayer-backed bond securitization), early retirement enabled through such a mechanism must be evaluated as a baseline retirement sub-scenario. In this retirement sub-scenario, the utility is provided capital recovery, the CFPP's underlying cost of capital (or regulated return) is replaced with a lower rate, and the utility retires and replaces the CFPP with alternative resources.

d) Refinancing - If the utility is a state-owned utility whose costs are subsidized by the government, an early retirement scenario enabled by the refinancing of the CFPP's fair value through sovereign debt must be evaluated as a baseline retirement scenario, This sub-scenario is a specific case of retirement case c) for a regulated-utility owned CFPP. If allowed under existing regulations or if there has been a precedent for such a transaction in the jurisdiction in which the project is occurring.

2) For a CFPP owned by an independent power producer (IPP) that has a long-term PPA with a regulated utility off taker, the project proponent must evaluate the financial feasibility of early retirement due to the early termination of its PPA by the off taker. In this sub-scenario, the off taker pays early termination fees to the IPP, retires the CFPP, and procures alternative sources of generation. PPA termination fees negotiated in contracts would typically enable the IPP to meet its financial and contractual obligations and achieve a fair return of its capital.

5.5.1 Procedures for determination of financially attractive retirement date of CFPP

The financially feasible retirement date is the earliest of the financially feasible retirement years of all applicable sub-scenarios.

The financially feasible retirement date under each applicable sub-scenario must be determined through a financial analysis. This financial analysis evaluates each possible AR year in each sub-scenario. This begins from the year the project proponent is undertaking the analysis until the continued operation year, CO. The retirement year in which the relevant financial metric (Equation 1 below) is satisfied must be used as the financially feasible retirement year for that sub-scenario (Fr_j).

This process is illustrated in Figure 1.

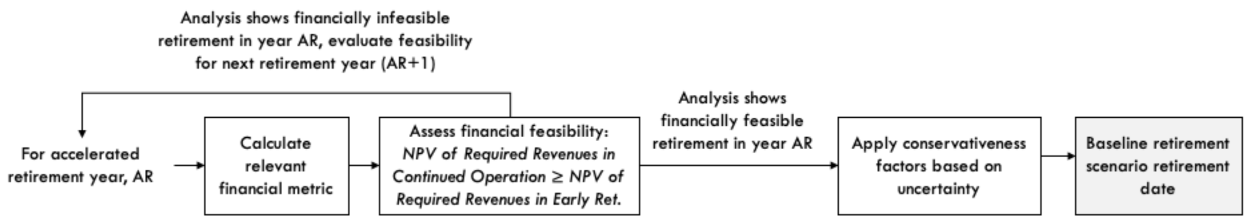

Figure 1: Determination of the financially feasible retirement date under each applicable financially feasible baseline retirement sub-scenario

The Net Present Value (NPV) of required revenues must be used as the relevant financial metric to evaluate financial feasibility of early retirement for a regulated utility or IPP with a regulated utility PPA off taker. A financially feasible retirement date for the utility or off-taker is defined as the earliest retirement date that provides an NPV of required revenues that is less than the NPV of required revenues if the CFPP were to continue operating.

Equation 1 presents this condition and must be used to evaluate each potential accelerated retirement (AR) year.

$$NPVRRC_{S,CO} \geq NPVRRC_{S,AR} + NPVRRRG_{S,AR} \qquad (1)$$

Where

$NPVRRC_{S,CO}$	=	Net present value of required revenues associated with the CFPP for the relevant stakeholder, S (utility'U' or offtaker 'O') in the continued operation case (currency unit)
$NPVRRC_{s,AR}$	=	Net present value of required revenues associated with the CFPP for the relevant stakeholder, S (utility 'U' or offtaker 'O') in an accelerated retirement case, where AR is the early retirement year (currency unit)
$NPVRRRG_{S,AR}$	=	Net present value of required revenues for replacement generation for the relevant stakeholder, S (utility or offtaker) following the retirement of the CFPP in year AR (currency unit)

The continued operation year, CO, must be the lower of:

1) [*20 years (Required revenue calculations are typically done over a standard period, where 20 years is a reasonable period)*],
2) For a CFPP owned by a regulated utility: the remaining technical life determined as per the latest version of the CDM Tool 10: *Tool to Determine Remaining Technical Life of equipment.*
3) For a CFPP owned by an IPP with a PPA: the remaining number of years under its existing PPA.

The analysis only considers the value of generation, rather than including the value of additional grid services that the CFPP may provide (e.g., capacity, ancillary services). This ensures conservativeness in estimation of the accelerated retirement date. It is conservative because the need for additional services will likely increase the cost of replacement resources, making retirement less attractive.

The assessment of financial feasibility in Equation 1 must include uncertainty propagation or default uncertainty factors, which correspond to default conservativeness factors (see section 5.5.4 for details). The resulting conservativeness factor must be applied to the financially feasible retirement year to determine a conservative baseline scenario retirement date in each sub-scenario.

Financial analyses should be done in real terms. If the analysis is done in nominal terms, inflation must be accounted for following the guidance provided in the CDM TOOL 27: *Methodological Tool: Investment Analysis.*

5.5.2 Financial metric for a utility or off-taker: Net present value of required revenues

Required revenues represent the cost of generating or procuring electricity services and must be calculated according to the procedures below.

5.5.2.1 Required revenues associated with the CFPP

In the case of a regulated-utility-owned CFPP, the NPV of required revenues must be calculated based on CFPP costs as shown in Equation 2:

$$NPVRRC_{U,AR} = \sum_{y=RO}^{y=RY} \frac{CAPEX_y + PDEBT_y + \left(IDEBT_y + VOM_y + FOM_y + FUEL_y + CONTRACT_y - CTMREV_y\right)\times(1-T) - DEP_y \times T + CARBON_y}{(1-T)\times(1+WACC_U)^{y-RO}} \quad (2)$$

Where:

$NPVRRC_{U,AR}$	=	Net present value of required revenues associated with the CFPP for the utility for retirement year AR (currency unit)
y	=	Year of CFPP operation (dimensionless)
RY	=	Retirement year (dimensionless)
RO	=	Year of the baseline scenario analysis (dimensionless)
$CAPEX_y$	=	Capital expenditure including equity return of capital and equity return on capital (currency unit)
$PDEBT_y$	=	Principal payment for asset-level debt (currency unit)
$IDEBT_y$	=	Interest payment for asset-level debt (currency unit)
VOM_y	=	Variable operations and maintenance (O&M) costs (currency unit)
FOM_y	=	Fixed O&M costs (currency unit)

$FUEL_y$	=	Fuel costs (currency unit)
$CARBON_y$	=	Cost of carbon (currency unit)
$CONTRACT_y$	=	Contract termination costs (currency unit)
$CTMREV_y$	=	Revenues due to a coal transition mechanism, as relevant (currency unit)
T	=	Tax rate (%)
DEP_y	=	Depreciation for tax purposes (currency unit)
$WACC_U$	=	WACC of the Utility (%)

In the case of an off taker of a CFPP PPA, the NPV of required revenues must be calculated based on the terms of the PPA as shown in Equation 3:

$$NPVRRC_{O,AR} = \sum_{y=RO}^{y=RY} \frac{\left(PPAE_y \times G_y + PPAC_y \times A_y + PPAOS_y \times OS_y + CONTRACT_y\right) \times (1-T) + CARBON_y}{(1-T) \times (1 + WACC_O)^{y-RO}} \tag{3}$$

Where:

$NPVRRC_O$	=	Net present value of required revenues associated with the CFPP for the off-taker for retirement year RY (currency unit)
y	=	Year of CFPP operation (dimensionless)
RY	=	Retirement year (dimensionless)
RO	=	Year of the baseline scenario analysis (dimensionless)
$PPAE_y$	=	Remuneration for electricity generation under PPA contract (currency unit per unit of generation, e.g., $/MWh)
G_y	=	CFPP electricity generation in year y (generation e.g., MWh)
$PPAC_y$	=	Remuneration for available capacity under PPA contract (currency unit per unit of available capacity)
A_y	=	Availability (available capacity unit)
$PPAOS_y$	=	Remuneration for other electricity services, as relevant (currency unit per unit of service)
OS_y	=	Other yearly services provided by the CFPP, as relevant (service unit)
T	=	Tax rate (%)
$CARBON_y$	=	Cost of carbon, included if carbon costs are passed through to off-taker (currency unit)
$WACC_o$	=	WACC of the off-taker (%)

5.5.2.2 Required revenues for replacement electricity generation

Replacement electricity generation costs prior to the retirement year of the CFPP, AR, must equal zero. For other years, the replacement generation cost is determined based on the unit cost of generation multiplied by the volume of generation required to replace the CFPP's expected generation.

The net present value of required revenues from replacement generation is calculated as shown in Equation 4:

$$NPVRRRG_{AR} = \sum_{y=RO}^{y=CO} \frac{(UCG_{AVG}, UC_{PS}) \times G_y}{(1-T) \times (1+WACC)^{y-RO}} \quad (4)$$

Where:

$NPVRRRG_{AR}$	=	NPV of required revenues for replacement generation starting in CFPP retirement year AR (currency unit)
y	=	Year (dimensionless)
CO	=	Continued operation year (dimensionless)
UCG_{AVG}	=	Unit cost of generation in the electricity system (currency unit per generation unit, e.g., $/MWh)
UC_{PS}	=	Unit cost of replacement generation in the project scenario (currency unit per generation unit, e.g., $/MWh)
G_y	=	Coal plant generation (generation unit e.g., MWh)
T	=	Tax rate (%)
WACC	=	Weighted average cost of capital of the offtaker or utility (%)

The unit cost of replacement generation (UCG_{AVG} or UC_{PS}) in future years must not increase in the financial analysis and should be assumed to be constant in real terms.

The CFPP generation, G_y, should be assumed to be constant and must be consistently applied across all required revenue calculations.

5.5.2.3 Unit cost of replacement generation

The unit cost of replacement generation must be estimated [*as the minimum between the average cost of generation in the electricity system and the project scenario unit cost of replacement generation, shown below*]:

1) The average cost of generation in the electricity system - This must be estimated as the weighted average cost of generation in the electricity system in the year that the baseline scenario assessment is undertaken.

$$UCG_{AVG} = \frac{\sum_i (GU_i \times UCG_i)}{\sum_i GU_i} \quad (5)$$

Where

UCG_{AVG}	=	Average cost of generation in the electricity system (currency unit per generation unit, e.g., $/MWh)
GU_i	=	Generation of unit i in the electricity system (generation unit, e.g., MWh)
UCG_i	=	Average unit cost of generation of unit i (currency unit per generation unit, e.g., $/MWh)

2) The project scenario unit cost of replacement generation - This must be estimated as the generation-weighted average of the average cost of generation in the electricity system and the levelized cost of energy (LCOE) for the proposed paired renewable energy under the project.

$$UC_{PS} = \frac{UCG_{AVG} \times (Gy - GR) + LCOE_{RE} \times GR}{G_y} \quad (6)$$

Where:

UC_{PS}	=	Unit cost of replacement generation in the project scenario (currency unit per generation unit, e.g., $/MWh)
UCG_{AVG}	=	Average cost of generation in the electricity system (currency unit per generation unit, e.g., $/MWh)
Gy	=	Annual CFPP generation (generation unit, e.g., MWh)
GR	=	Annual paired renewable energy generation (generation unit, e.g., MWh)
$LCOE_{RE}$	=	Levelized cost of paired RE energy generation (currency unit per generation unit, e.g., $/MWh)

5.5.2.4 Levelized cost of paired renewable energy generation

The unit cost of paired renewable energy generation should be calculated as the levelized cost of electricity.

$$LCOE_{RE} = \frac{\sum_{t=0}^{t=L} \frac{CAPEX_t + PDEBT_t + (IDEBT_t + FOM_t + VOM_t + FUEL_t) \times (1-T) - DEPTAX_t \times T + CARBON_t}{(1+K_e)^t}}{(1-T) \times \sum_{t=0}^{t=L} \frac{GR_t}{(1+K_e)^t}}$$

(7)

Where:

LCOE	=	Levelized cost of electricity (currency unit per generation unit, e.g., $/MWh)
t	=	Project year since initial investment (years)
L	=	Project lifetime (years)
$CAPEX_t$	=	Capital expenditure, including the equity portion of upfront capex, maintenance capex, and decommissioning costs (currency unit)
$PDEBT_t$	=	Principal payment on debt (currency unit)
$IDEBT_t$	=	Interest payment on debt (currency unit)
FOM_t	=	Fixed operations and maintenances costs (currency unit)
VOM_t	=	Variable O&M (currency unit)
$FUEL_t$	=	Fuel costs (currency unit)
$DEPTAX_t$	=	Depreciation allowance for asset (currency unit)
T	=	Tax rate (%)
$CARBON_t$	=	Carbon cost in year t (currency unit)
K_e	=	Cost of equity of the renewable energy owner (%)
GR_t	=	Generation of renewable energy in year t (energy unit e.g., MWh)

The calculation of the LCOE should follow the guidance on cost of capital stipulated in CDM TOOL 27: *Investment Analysis* along with the additional guidance below:

- The initial capital investment must be assumed to be financed with at least 70% debt unless the technology is the first of its kind in the host country.
- Investment costs should be benchmarked against national or regional values and must not be assumed to increase in the future. References from the International Energy Agency, International Renewable Energy Agency, or Bloomberg New Energy Finance may be used to estimate initial capex costs. Investment costs should include any policy support (e.g., grants, investment credits) that exist for the replacement RE.
- Carbon costs must be excluded for technologies that would not generate emissions according to the CDM *ACM0002: Grid-connected electricity generation from renewable sources.* Carbon costs may also be excluded in other cases.
- Depreciation for tax purposes should include any existing policies or tax codes that would provide a tax benefit to renewable energy technologies. Otherwise, straight-line depreciation over the project lifetime may be assumed.
- Project lifetime should be taken as the length of a PPA contract for IPP-owned renewable energy assets, and the technical life of the asset for utility-owned assets.

- Renewable generation must be estimated using at least the P50 energy yield arising from an independently-prepared resource assessment, prepared by a qualified firm with prior experience conducting such studies.

5.5.3 Guidance for determining specific parameters

The sections below provide general guidance for determining specific parameters used in the financial analysis that apply to all analyses, in order to ensure conservativeness in the baseline determination.

5.5.3.1 Costs of capital

The weighted average cost of capital should be based on the relevant stakeholder's cost of equity, share of the initial CFPP investment financed through equity, share of the initial investment financed through asset-level debt, and its cost of asset-level debt.

$$WACC_s = K_{e,s} \times w_{e,s} + K_{d,s} \times w_{d,s} \tag{8}$$

Where:

$WACC_s$	=	Weighted average cost of capital for stakeholder S (%)
$K_{e,s}$	=	Cost of equity for stakeholder S (%)
$w_{e.s}$	=	Share of initial CFPP investment financed by equity (%)
$K_{d,s}$	=	Cost of asset-level debt on plant owned by stakeholder S (%)
$w_{d.s}$	=	Share of initial CFPP investment financed by asset-level debt (%)

For utilities and single-buyer PPA off-takers, the cost of equity should be their regulated return. The shares of equity and debt and cost of asset-level debt should be based on historical audited data, given the investment in the CFPP will have already occurred.

5.5.3.2 Capex costs

Capital expenditure costs including equity return of capital and equity return on capital are amortized over the remaining lifetime of the asset. This approach is recommended as upfront investment costs will have been made prior to the start of project registration and the execution of the financial analysis.

$$CAPEX_y = \frac{EV \times K_e \times (1 + K_e)^L}{(1 + K_e)^L - 1} \tag{9}$$

Where:

$CAPEX_y$	=	Yearly capital expenditure cost (currency unit)
EV	=	Equity value of asset (currency unit)
K_e	=	Cost of equity of the CFPP owner (%)
L	=	Lifetime of the CFPP asset from commissioning until retirement (years)

Where L is the technical life for a utility-owned CFPP and the end of the PPA term for an IPP-owned CFPP.

Where the equity value of asset, EV, should be determined based on the share of equity in the upfront investment (i.e. the initial investment cost of the CFPP minus any project-level debt) plus any accumulated maintenance capex and future maintenance capex. This maintenance capex is assumed to occur at the time of initial CFPP investment. While this does not represent the timing of maintenance capital expenditure, assuming all maintenance capex happens at the time of initial investment both simplifies the methodology calculations and is conservative, as it would increase the cost of coal operation in the continued operation case, therefore making earlier retirement more attractive.

$$EV = E + AMC + FMC \tag{10}$$

Where:

EV	=	Equity value of asset (currency unit)
E	=	Equity portion of initial investment (currency unit)
AMC	=	Accumulated maintenance capex until registration year (currency unit)
FMC	=	Expected future maintenance capex until two years prior to retirement year (currency unit)

Future maintenance capex should be based on existing maintenance contracts and should assume no additional maintenance capex is spent in the two years prior to the CFPP's retirement. Where maintenance contracts are unavailable, future maintenance capex may be projected using historical maintenance capex spending.

5.5.3.3 Debt

Debt service costs include asset-level debt that was used to finance the initial investment in the CFPP, refinance asset-level debt, or new debt issuance (e.g., under a committed CTM). Debt service costs, including interest and principal payments, should be calculated according to the terms of the existing financing agreement. The after-tax cost of debt should be used in the analysis.

If a CFPP would be retired before the end of its existing loan tenor, the remaining principal on unpaid debt may be assumed to need to be fully repaid in the year of the CFPP retirement.

5.5.3.4 Fixed and Variable Operations & Maintenance Costs

Fixed and variable O&M costs should be based on historical data over the previous five years prior to registration of the project. If fewer than five years of operational data exist, then the average of the historical fixed and variable operations and maintenance costs over the entire lifetime of the CFPP must be used. These costs should be assumed to be fixed in real terms in the baseline assessment.

5.5.3.5 Depreciation costs for tax purposes

Depreciation costs should be estimated assuming straight-line depreciation of the net book value of the CFPP over the remaining technical life of the CFPP.

$$DEPTAX_y = \frac{NBV_{RO}}{RTL_{RO}} \tag{11}$$

Where:

$DEPTAX_y$	=	Depreciation for tax purposes (currency unit)
NBV_{RO}	=	Net book value of CFPP in the year of the analysis (currency unit)
RTL_{RO}	=	Remaining technical life in the year of the analysis (dimensionless)

Technical life must be determined according to the latest version of the CDM Tool 10*: Tool to Determine Remaining Technical Life of equipment.*

5.5.3.6 Fuel costs

Fuel costs should be based on historical data over the previous five years prior to date the baseline scenario assessment is undertaken and must include transportation costs of fuel. If fewer than five years of operational data exist, then the average of the historical fuel costs over the entire lifetime of the CFPP must be used. Fuel costs should be fixed in real terms for the baseline scenario analysis.

5.5.3.7 Costs of carbon

Costs of carbon must be included where a carbon pricing scheme exists or is planned. The carbon price must be determined as follows:

- Where a regulator or government agency in the host country has published a schedule of expected carbon prices, this schedule must be used when projecting future carbon costs.
- Where several pricing scenarios are available, the carbon price data set to be applied must be the one with the most ambitious, i.e., highest carbon price.
- Where a regulator or government agency in the host country has only published a range of expected carbon costs for its carbon pricing scheme, the carbon cost must be assumed to increase linearly to the maximum value in the range over the period for which the range was forecasted.
- [*If the assessment period extends beyond the published schedule or range or prices, the carbon cost must be projected forward using a linear trendline based on the average rate of change of carbon prices over the last five years of available data*.]

The cost of carbon should be calculated based on the emissions factor of the CFPP, its generation, and the carbon price.

$$CARBON_{y,i} = CP_y \times G_{y,i} \times EF_i \quad (12)$$

Where:

$CARBON_{y,i}$	=	Carbon cost in year y for plant or unit I (currency unit)
CP_y	=	Carbon price in year y (currency unit per emissions unit, e.g., $/tCO2e)
$G_{y,i}$	=	Generation of plant or unit i in year y (generation unit e.g., MWh)
EF_i	=	Emissions factor of plant or unit I (emissions per generation e.g., tCO2e/MWh)

[*The emissions factor of the plant should be calculated as the three-year average annual emissions factor. If asset-level emissions data is unavailable, default emissions factors based on plant specifications may be utilized.*

$$EF_i = \frac{1}{3} \times \sum_{y=REG-3}^{y=REG} \frac{EM_{y,i}}{G_{y,i}} \quad (13)$$

Where:

$EF_{y,i}$	=	*Emissions factor of plant or unit I (emissions per generation e.g., tCO2e/MWh)*
$EM_{y,i}$	=	*Plant or unit emissions in year y (emissions unit, e.g., tCO2e)*
$G_{y,i}$	=	*Generation of plant or unit i in year y (generation unit e.g., MWh)]*

5.5.3.8 Generation and Availability

The future yearly generation (G_y) and availability (A_y):

- Should be calculated as historical averages of the CFPP over the last five years.
- If fewer than five years of operational data exist, then the average of the historical generation and availability over the entire lifetime of the CFPP should be used.
- If the CFPP has an existing PPA with a take-or-pay clause, the take-or-pay levels set in the PPA must be used as a minimum for yearly generation, G_y.
- Annual generation and availability should be assumed to be constant throughout the analysis period.

5.5.3.9 Contract termination costs

In the baseline retirement scenario that involves PPA termination by the off-taker, PPA termination costs should be assumed to be borne by the off-taker in the CFPP retirement year. These termination costs should be determined based on the existing terms of the PPA between the IPP and off-taker at the time of the project validation. If this information is unavailable, the PPA termination cost may be estimated as the net book value of the CFPP asset to the IPP in a given retirement year, AR. This should be determined assuming a straight-line depreciation of the remaining book value of the CFPP over the remaining PPA term. Contract termination costs must not include additional costs to cover termination of the IPP's Fuel Supply Agreement(FSA) or O&M agreements.

$$CONTRACT_{AR} = NBV_{RO} - \{\left(\frac{NBV_{RO}}{PPA_{term} - PPA_{AR}}\right) \times (PPA_y - PPA_{RO})\} \quad (14)$$

Where:

$CONTRACT_{AR}$	=	PPA contract termination cost borne by the off-taker in retirement year AR (currency unit)
RO	=	Year the baseline assessment is undertaken (dimensionless)
NBV_{RO}	=	Net book value of the CFPP asset in the year the baseline assessment is undertaken (Currency unit)
PPA_{term}	=	Total length of the PPA term (years)
PPA_{RO}	=	Number of years since the start of the PPA term and the year the baseline assessment is undertaken (years)
PPA_{AR}	=	Number of years since the start of the PPA and the retirement year (years)

For retirement scenarios in which a regulated utility retires its own CFPP, the following contract termination costs may be considered.

- Early fuel supply agreement (FSA) termination costs if the FSA existing at the time of the project would expire after the expected early retirement of the CFPP. These early termination costs must be based on the existing terms of the FSA.
- Early operations and maintenance (O&M) agreement termination costs if the O&M agreements existing at the time of the project would expire after the expected early retirement of the CFPP. These early termination costs must be based on the existing terms of the O&M agreement.

5.5.4 Guidance on uncertainties

The project proponent must undertake an uncertainty analysis at the project level by applying error propagation, in line with guidance provided in the *CDM Meth Panel's Proposed Guidance on Addressing Bias Uncertainty*. Uncertainties should be considered for the following parameters:

- Fuel price
- Carbon price

- CFPP generation
- Average cost of grid generation
- Utility or off taker cost of equity
- Continued operation date
- Contract termination costs
- Renewable energy capex
- Renewable energy cost of equity
- Renewable energy cost of debt
- Renewable energy debt tenor
- Renewable energy generation

[*If the overall level of uncertainty exceeds 15% (at a 95% confidence level), the project proponent must apply the default conservativeness factors, C, provided in the table below as per CDM Meth Panel's Proposed Guidance on Addressing Bias Uncertainty.*]

Table 1: Conservativeness Factors

Estimated Uncertainty range at 95% confidence level	Conservativeness factor, C
> +/- 15%, ≤ +/- 30%	0.943
> +/- 30%, ≤ +/- 50%	0.893
> +/- 50%, ≤ +/- 100%	0.836

If a project proponent is unable to undertake an uncertainty analysis, the following default uncertainties and conservativeness factors must be applied, in line with the *CDM Meth Panel's Proposed Guidance on Addressing Bias Uncertainty*:

- The remaining technical life of the CFPP is less than 10 years: Conservativeness factor of 0.943.
- The remaining technical life of the CFPP is greater than 10 years: Conservativeness factor of 0.893.

The resulting conservativeness factor must be applied to the number of years of operation in the feasible baseline retirement case in each sub-scenario, calculated according to Equation 1, and rounded down to the nearest whole number.

$$BR_j = \lfloor FR_j \times C_j \rfloor \quad (15)$$

Where:

BR_j	=	Baseline retirement year in baseline retirement sub-scenario j (dimensionless)
FR_j	=	Feasible retirement in baseline retirement sub-scenario j (dimensionless)
C_j	=	Conservativeness factor for baseline retirement sub-scenario j (dimensionless)

6 DATA AND PARAMETERS

6.1 Data and Parameters Available at Validation

Data / Parameter	$PDEBT_y$
Data unit	Currency unit
Description	Principal payment for asset-level debt
Equations	Equations 2,7
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$IDEBT_y$
Data unit	Currency unit
Description	Interest payment for asset-level debt

Equations	Equations 2,7
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	VOM_y
Data unit	Currency unit
Description	Variable operations and maintenance (O&M) costs
Equations	Equations 2,7
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	FOM_y
Data unit	Currency unit
Description	Fixed O&M costs
Equations	Equations 2,7

Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$FUEL_y$
Data unit	Currency unit
Description	Fuel costs
Equations	Equation 2
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	T
Data unit	Percentage (%)
Description	Total blended tax rate
Equations	Equations 2,3,4,7
Source of data	Local tax documentation

Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$DEPTAX_y$
Data unit	Currency unit
Description	Depreciation for tax purposes
Equations	Equations 2,11
Source of data	CFPP financial records, calculated as per equation 11
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$WACC_U$
Data unit	%
Description	WACC of the Utility
Equations	Equations 2,4
Source of data	CFPP financial records
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$CTMREV_y$
Data unit	Currency unit
Description	Revenues due to a coal transition mechanism
Equations	Equation 2
Source of data	CTM financial documentation
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$PPAE_y$
Data unit	Currency unit per unit of generation (e.g., $/MWh)
Description	Remuneration for electricity generation under PPA contract
Equations	Equations 3
Source of data	CFPP PPA terms
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	A_y
Data unit	Available Capacity Unit
Description	Availability
Equations	Equation 3
Source of data	CFPP PPA terms
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	G_y
Data unit	Generation unit (e.g., MWh)
Description	CFPP electricity generation in year y
Equations	Equations 3,4,6,12,13
Source of data	CFPP utilization/generation records
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$PPAC_y$
Data unit	Currency unit per unit of available capacity
Description	Remuneration for available capacity under PPA contract
Equations	Equation 3
Source of data	CFPP PPA terms
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$PPAOS_y$
Data unit	Currency unit
Description	Remuneration for other electricity services, as relevant
Equations	Equation 3
Source of data	CFPP PPA terms
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$WACC_o$
Data unit	%
Description	WACC of the off-taker
Equations	Equation 3
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	OS_y
Data unit	Services unit
Description	Other yearly services provided by the CFPP
Equations	Equation 3
Source of data	CFPP PPA terms
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$K_{e,s}$
Data unit	%
Description	Cost of equity for stakeholder S
Equations	Equations 7, 8, 9
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$w_{e.s}$
Data unit	%
Description	Share of initial CFPP investment financed by equity
Equations	Equation 8
Source of data	CFPP financial records
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$K_{d,s}$
Data unit	%
Description	Cost of asset-level debt on plant owned by stakeholder S
Equations	Equation 8
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$W_{d.s}$
Data unit	%
Description	Share of initial CFPP investment financed by asset-level debt
Equations	Equation 8
Source of data	CFPP financial records
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	E
Data unit	Currency unit
Description	Equity portion of initial investment
Equations	Equation 10
Source of data	CFPP financial records
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/a
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	AMC
Data unit	Currency unit
Description	Accumulated maintenance capex until registration year
Equations	Equation 10
Source of data	CFPP financial records
Value applied	As determined from the source data

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	FMC
Data unit	Currency unit
Description	Expected future maintenance capex until two years prior to retirement year
Equations	Equation 10
Source of data	CFPP records, estimated as per the comments
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	Future maintenance capex should be based on existing maintenance contracts and should assume no additional maintenance capex is spent in the two years prior to the CFPP's retirement. Where maintenance contracts are unavailable, future maintenance capex may be projected using historical maintenance capex spending.

Data / Parameter	NBV_{RO}
Data unit	Currency unit
Description	Net book value of CFPP in the year of the analysis
Equations	Equation 11,14

Source of data	CFPP financial accounts
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	RTL_{RO}
Data unit	Dimensionless
Description	Remaining technical life in the year of the analysis
Equations	Equation 11
Source of data	CFPP records, determined according to *CDM Tool to Determine Remaining Technical Life*
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	CP_y
Data unit	Currency unit per emissions unit (e.g., $/tCO2e)
Description	Carbon price in year y
Equations	Equation 12

Source of data	Regulatory documentation on carbon price/price pathway
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	Carbon price values for each year over the life of the plant shall be determined by assuming a carbon price (Carbon Tax, ETS allowance price, etc) annual growth in accordance to host country plans or policy scenarios at the time of validation. If the length of the assessment period exceeds the period over which a carbon price target is set or forecasted, the carbon price to be applied to the remaining years shall be the CO2 price corresponding to the last year for which an official target or forecast price exists, projected forward using a linear trendline based on the average rate of change of carbon prices over the last five years of available data, or forecasted according to Government sources. Where several pricing scenarios are available, the carbon price data set to be applied shall be the one with the most ambitious, i.e., highest, carbon price.
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	EF_i
Data unit	Emissions per generation (e.g., tCO2e/MWh)
Description	Emissions factor of plant or unit
Equations	Equation 12
Source of data	CFPP technical reporting, calculated as per methodology
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	The emissions factor of the plant should be calculated as the three-year average annual emissions factor. If asset-level emissions data is unavailable, default emissions factors based on plant specifications may be utilized
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	$EM_{y,i}$
Data unit	Emissions unit (e.g., tCO2e)
Description	Plant or unit emissions in year y
Equations	Equation 13
Source of data	CFPP emissions reporting
Value applied	As determined from the source data
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	UCG_i
Data unit	Currency unit per generation unit (e.g., $/MWh)
Description	Average unit cost of generation of unit i
Equations	Equation 5
Source of data	Grid system operator data
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	GU_i
Data unit	Generation unit (e.g., MWh)
Description	Generation of unit i in the electricity system
Equations	Equation 5
Source of data	Grid system operator data
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	GR_t
Data unit	Generation unit (e.g., MWh)
Description	Generation of renewable energy in year t
Equations	Equation 7
Source of data	Paired RE operating data
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	PPA_{term}
Data unit	Years
Description	Total length of the PPA term
Equations	Equation 14
Source of data	PPA terms
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	PPA_{RO}
Data unit	Dimensionless
Description	Number of years since the start of the PPA term and the year the baseline assessment is undertaken
Equations	Equation 14
Source of data	PPA terms
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	PPA_{AR}
Data unit	Dimensionless
Description	Number of years since the start of the PPA and the retirement year
Equations	Equation 14
Source of data	PPA terms
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	C_j
Data unit	Dimensionless
Description	Conservativeness factor for baseline retirement sub-scenario j
Equations	Equation 15
Source of data	Project proponent uncertainty analysis, or UNFCCC CDM conservativeness factor (below)
Value applied	If a project proponent is unable to undertake an uncertainty analysis, the following default uncertainties and conservativeness factors must be applied, in line with the *CDM Meth Panel's Proposed Guidance on Addressing Bias Uncertainty*: • The remaining technical life of the CFPP is less than 10 years: Conservativeness factor of 0.943. • The remaining technical life of the CFPP is greater than 10 years: Conservativeness factor of 0.893.

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	

7 APPENDIX 1: DOCUMENT HISTORY

Version	Date	Comment
V0.1	4 Dec 2023	Initial draft version for public consultation