



## CALL FOR INPUT

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Instruction: Enter your input in the table below.

Document reference number and title: (Recommendation from the MEP to SBM020)				
A6.4-MEP011-A02: Draft methodological tool - Emissions from electricity generation and consumption (version 02.0)				
Item	Section no. (as indicated in the document)	Paragraph/Table/Figure no. (as indicated in the document)	Comment (including justification for change)	Proposed change (including proposed text)
1	Section 5.7.1.2 (Applicability)	NA	<p><b>Operating Margin (OM): Ensuring Proportionality</b></p> <p>The Draft Tool mandates "Conservative Default Values" (Option B) when hourly data is unavailable. This implies that the uncertainty of annual data is so severe that the baseline must be slashed by &gt;60% to be safe.</p> <p><b>Scientific Assessment:</b> We support the tool's intent to move toward Consequential (Marginal) Accounting. However, review of peer-reviewed literature reflects that the "Impact Gap" between Annual and Hourly accounting is statistically bounded:</p>	<p><i>Insert into Section 5.7.1.2 (Applicability):</i></p> <p>"In instances where hourly dispatch data is not <b>Readily Available</b> (accessible via public API or standardised reports), the following staggered approach shall apply:</p> <ol style="list-style-type: none"><li><b>Tier 1 (Mature):</b> Where data is available, hourly calculation is mandatory.</li></ol>

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			<ul style="list-style-type: none"> <li>i. Recent comprehensive analysis of 113,000 load profiles across 52 grid regions (Miller et al., 2022) establishes that while annual accounting introduces bias, the error is statistically bounded. The study found that "most bias falls in the range of <math>\pm 5\%</math>," with extreme outliers reaching <math>\sim 35\%</math> only in specific high-variance scenarios.</li> <li>ii. Recent meta-analysis of Impact Accounting (<i>WattTime, 2025</i>) confirms that while Annual Matching is less precise than Hourly Matching, it still captures 70% to 90% of the decarbonization value. The "Impact Gap" (error) is 10% to 30%.</li> </ul>	<ul style="list-style-type: none"> <li>b. <b>Tier 2 (Transitional):</b> For a period of 5 years, Activity Participants may apply the Average OM utilizing Annual Data, subject to a Standardised Intermittency Discount 10% to conservatively account for temporal correlation errors as bounded by peer-reviewed literature (e.g., <i>WattTime, 2025; Miller et al., 2022</i>).</li> <li>c. <b>Tier 3 (LDCs/SIDS):</b> Exempt from hourly requirements; Annual Data applies without discount."</li> </ul>

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			<p><b>Disproportionality:</b> The Draft Tool imposes a baseline reduction of <b>60% to 80%</b> (via Default Values). This penalty is disproportionate, exceeding the typical scientific error margin (10-15%) by a factor of five to eight. Unlike a scientifically bounded discount, the Tool applies a punitive deduction that effectively sanctions the Host Party's lack of digital infrastructure.</p> <p>Refer to the <a href="#">detailed commentary</a> below for further details.</p>	
2	Appendix 2.	NA	<p><b>The Build Margin (BM):</b></p> <p>The Draft Tool uses linear regression to calculate the vintage discount (<math>F_{BM}</math>). In fast-growing economies or policy volatile electricity systems, this creates a statistical artifact where verified data is rendered mathematically "worthless" (hitting zero) faster than it can be administratively published.</p>	<p><i>Appendix 2</i></p> <p>"To prevent statistical anomalies resulting from short-term regression, the value of the annual discount factor (<math>F_{BM}</math>) shall be the lower of: (i) the regression value, or (ii) a <b>Technical Ceiling of 5%</b>. This ceiling reflects the maximum plausible rate of systemic capital stock turnover in electricity systems."</p>

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			<p>As shown in Table 3 in the Detailed Commentary below, the regression derived from Appendix 2 implies that Chile's grid will reach Zero Emissions in 2.06 years. This contradicts physical infrastructure inertia and penalizes sovereign reporting delays.</p> <p>Refer to the <a href="#">detailed commentary</a> below for further details.</p>	

## Detailed Commentary (Annex)

### 1. The Risk of Structural Exclusion

#### A. Alignment with Paris Agreement Core Principles

The Article 6.4 Mechanism is mandated to foster "equitable geographic distribution" and "sustainable development" (Paris Agreement, Article 6, Para 4). Operationalizing these goals requires adhering to the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC). A methodology that functions effectively for digitized economies in the Global North, while structurally excluding emerging economies in the Global South due to sovereign infrastructure gaps, risks being misaligned with this inclusivity mandate.

#### B. Technical Barrier

We commend the MEP for integrating scientific rigor regarding marginal displacement and temporal correlation into Draft Tool A6.4-MEP011-A02. However, the specific provisions – summarised below, unintentionally create a technical barrier by penalizing Host Parties for sovereign infrastructure deficits:

- **Operating Margin:** By mandating Hourly Dispatch Data (which <15% of nations possess via public API or standardised reporting) and penalizing its absence with punitive defaults, the tool effectively channels carbon finance toward Tier 1 nations (Advanced Economies) and away from Tier 2 & 3 nations (Emerging Economies/LDCs). This creates a market distortion where investment flows to countries with better IT infrastructure, rather than countries with the highest marginal emissions displacement potential.
- **Build Margin:** The Regression-Based Vintage Discount mathematically penalizes countries with recent renewable growth by extrapolating short-term trends to erase baselines in less than four years.

### C. The Perverse Incentive (Carbon Leakage Risk)

Strict application of the current tool drops the eligible Grid Emission Factor (GEF) in emerging economies (e.g., Turkey) to ~0.10 tCO<sub>2</sub>/MWh, despite the physical grid running on ~50% fossil fuels. This artificially low baseline renders grid-connected renewable projects unviable. Crucially, this may create a perverse incentive for industries to disconnect from the grid and install captive fossil-fuel generation (Scenario B) to secure a higher, calculable baseline, thus creating a leakage risk. This outcome directly contradicts the decarbonization objective of the mechanism.

## 2. GLOBAL READINESS ASSESSMENT

To contextualize the exclusion risk, we categorized global electricity systems into three "Readiness Tiers" based on their ability to meet the Draft Tool's requirements. This assessment highlights that the tool's strict mandates are incompatible with the vast majority of Article 6.4 Host Parties' current data and institutional conditions. Most LDC/SIDS NDCs are conditional on international finance to transition from imported fossil fuels to renewables. By artificially suppressing baselines to near-zero, the tool removes the financial lever (carbon revenue) required to make these projects bankable, effectively blocking NDC achievement.

**Table 1: Global Grid Data Readiness & Financial Implications**

Readiness Tier	Status of Digital Infrastructure	Global Share (Est.)	Financial Consequence of Draft Tool
<b>Tier 1</b> <i>(Fully Ready)</i>	<b>Open/Digitized:</b> TSO publishes machine-readable hourly dispatch data via public API/CSV (e.g., USA, EU, Brazil, Chile).	<b>&lt; 15%</b>	<b>Finance Flows Here:</b> Projects can calculate accurate, high emission factors by proving they displace fossil fuels during specific hours.

<b>Tier 2</b> <i>(The Data Gap)</i>	<b>Restricted/Siloed:</b> Hourly data exists internally for balancing but is restricted, sold commercially, or locked in PDF reports (e.g., Turkey, India, China, Vietnam).	~ 25%	<b>Finance is Penalized:</b> Without accessible hourly logs, projects are forced to use "Conservative Defaults," reducing baselines by <b>60-80%</b> .
<b>Tier 3</b> <i>(Not Ready)</i>	<b>Analog/Manual:</b> Grid monitoring relies on manual logs and monthly fuel invoices. Real-time fuel mix data does not exist (e.g., LDCs, SIDS).	~ 60%	<b>Finance is Blocked:</b> Compliance with hourly mandates is technically impossible. Projects are forced into the lowest default tier.

Data sources: [Global Grid Assessment](#), [EIA-930 Docs](#), [EIA Open Data](#), [ENTSO-E Assessment](#), [Ember Asia Report](#)

### 3. COMPARATIVE IMPACT:

To illustrate the severity of this inequity, we simulated identical renewable energy projects across the three tiers. This comparison exposes how identical physical displacement yields radically different financial outcomes based solely on the host country's IT infrastructure, rather than differences on the grid dynamics or marginal emissions displacement.

**Table 2: Comparative Impact on Project Viability**

*(Metric: Grid Emission Factor in tCO<sub>2</sub>/MWh)*

<b>Scenario Context</b>	<b>Tier 1 Benchmark</b> <b>(e.g., USA - California)</b>	<b>Tier 2 Scenario</b> <b>(e.g., Turkey)</b>	<b>Tier 3 Scenario</b> <b>(e.g., LDC Hydro/Diesel Mix)</b>
<b>Grid Physics</b>	<b>High RE</b> (Solar/Wind) + Gas Peakers	<b>High RE</b> (Hydro/Solar) + Coal/Gas Baseload	<b>High RE</b> (Hydro >67%) + Diesel/HFO Peakers
<b>Probable Marginal Unit</b> <i>(Economic Merit Order)</i>	<b>Natural Gas</b> <i>(Verified via Hourly Data)</i>	<b>Mix: Coal/Gas &amp; Hydro</b> <i>(Unverified due to Data Gap)</i>	<b>Mix: Diesel &amp; Hydro</b> <i>(Unverified due to Data Gap)</i>
<b>Data Status</b>	<b>Open API</b> <i>(Hourly Data Available)</i>	<b>Restricted / PDF</b> <i>(Data Exists but Locked)</i>	<b>Manual Logs</b> <i>(No Hourly Data Exists)</i>
<b>Draft Tool Assumption</b> <i>(Under Option B)</i>	<i>N/A (Uses Dispatch Data)</i>	<b>Assumes RE displaces RE</b> <i>(Surplus/Curtailment)</i>	<b>Assumes RE displaces RE</b> <i>(Surplus/Curtailment)</i>
<b>Resulting GEF</b>	<b>~0.450 tCO<sub>2</sub>/MWh</b>	<b>0.100 tCO<sub>2</sub>/MWh</b>	<b>0.030 tCO<sub>2</sub>/MWh</b>

Variance vs. Reality	Accurate	-83% Loss	-96% Loss
Strategic Outcome	Project Viable	Project Insolvent	Creating a <b>&gt;90% haircut</b> that renders projects unbankable. This jeopardizes the conditional NDCs of the very nations the Paris Agreement aims to support. This <b>under-estimation of ~96%</b> is a massive scientific error.

### Analysis of the Limitations:

1. The Tier 1: The digitized economy secures a robust baseline (0.450) because it possesses the data infrastructure to mathematically verify the specific hours where wind power displaces marginal gas generation, filtering out hours of renewable curtailment.
2. The Tier 2: In Turkey, the grid operates with a mix of Hydro/Solar and essential fossil baseload. While renewable curtailment does occur during surplus hours, the merit order effect dictates that thermal units often set the margin during load-following periods. However, without hourly data to distinguish these periods, the Tool forces a default of 0.100. This effectively assumes the project displaces zero-carbon sources for ~90% of its operation — a statistical assumption that contradicts the grid's reliance on fossil fuels for stability.
3. The Tier 3: The LDC grid faces the most severe market failure due to the disconnect between Average and Marginal mechanics.
  - a. While the grid's average mix is dominated by legacy Hydro (>67%), system stability and peak balancing often rely on expensive, dispatchable Diesel/HFO generators. Under standard economic dispatch, expensive diesel is the first source ramped down when zero-cost renewable energy enters the grid.
  - b. The Draft Tool relies on the Average share rather than the Marginal price signal. Lacking hourly logs, it assigns the lowest possible default (0.030), mathematically ignoring the high probability of diesel displacement.
  - c. This creates a Perverse Incentive to disconnect from the grid and run a captive fossil fuel generator (Scenario B) to secure a calculable baseline, directly risking Carbon Leakage.

## 4. SCIENTIFIC VALIDATION

### A. Operating Margin (OM): Ensuring Proportionality

The Draft Tool mandates "Conservative Default Values" (Option B) in the absence of hourly data. This is based on the premise that annual data fails to capture marginal displacement. While scientifically valid in principle, the *implementation* is disproportionate to the actual error margins observed in scientific literature.

- Evidence Stream A (Inventory Bias): Analysis of 113,000 profiles (Miller et al., 2022) confirms that the error between Annual vs. Hourly accounting for inventories is bounded between  $\pm 5\%$  and 15%.
- Evidence Stream B (Impact Gap): Recent meta-analysis of Impact Accounting (WattTime, 2025) confirms that while Annual Matching is less precise than Hourly Matching, it still captures 70% to 90% of the decarbonization value. The "Impact Gap" (error) is 10% to 30%.
- Evidence Stream C (Directionality): Research indicates that in some fossil-heavy grids, Annual Accounting can actually be more conservative than Hourly Accounting due to capacity overbuild effects (E3 & ACORE, 2023).
- Conclusion: The Tool's default penalty (reducing baselines by 60-90%) is disproportionate to the scientific error margin (~10-30%). A 10% Standardised Discount is a robust, conservative proxy that aligns with the scientific consensus without acting as a market barrier.

## **B. Build Margin (BM):**

The Draft Tool uses linear regression to calculate the vintage discount ( $F_{BM}$ ). By using linear regression on short-term trends in rapidly evolving electricity systems, the tool creates a "Data Shelf-Life" that is often shorter than the administrative time required to publish the data.

- Administrative Lag Penalty: Activity participants are penalized for sovereign infrastructure variables entirely outside their operational control. National governments in Tier 2/3, and may publish official grid data with unavoidable delays. The tool applies the vintage discount to this administrative lag. A project is penalized not just for the actual decarbonization of the grid, but for the *government's slowness in reporting it*.
- Mathematical Anomaly: As shown in Table 3, the regression derived from Appendix 2 implies that Chile's grid will reach Zero Emissions in 2.06 years and Turkey's in 3.71 years. The regression-based  $F_{BM}$  values create a reality where verified historical data is rendered mathematically worthless within a few years despite continued operation of fossil fuel assets.
- Linear regression extrapolates short-term volatility (e.g., a hydro boom or policy shift) into a permanent trend. This is a Regression Fallacy. Energy transitions are asymptotic, not linear. Thermal power plants have physical lifespans of 30–40 years due to "Infrastructure Inertia" (Smil, 2017). They do not vanish in 3 years. The proposed 5% Technical Cap aligns the tool with the maximum plausible rate of systemic capital stock turnover.

**Table 3: "Data Shelf-Life" of Verified Historical Data**

*(Source: Mathematical derivation from A6.4-MEP011-A02 Appendix 2)*

Host Country	FBM (Annual Discount)	Data Shelf-Life (Years to Zero)	Impact of 2-Year Sovereign Reporting Lag	Strategic Implication
Chile	48.48%	~2.06 Years	97% Reduction	Total Erasure: Baseline erased upon publication.
Turkey	26.96%	~3.71 Years	54% Reduction	Unviable: Bureaucracy erases project value.
South Africa	22.34%	~4.48 Years	45% Reduction	Severe Barrier: Coal-heavy grid treated as clean.
Brazil	16.07%	~6.22 Years	32% Reduction	Impaired: Hydro volatility misread as trend.
India	15.70%	~6.37 Years	31% Reduction	Restricted: Significant loss of verified reductions.
Viet Nam	12.02%	~8.32 Years	24% Reduction	Challenged: Rapid growth penalized by regression.
China	10.04%	~9.96 Years	20% Reduction	Impacted: Scale of grid buffers impact.
Mexico	7.10%	~14.08 Years	14% Reduction	Manageable: Approaches reasonable uncertainty.
Indonesia	3.30%	~30.30 Years	7% Reduction	Ideal: Aligns with physical capital turnover.
Thailand	1.23%	~81.30 Years	2% Reduction	Ideal: Reflects stable grid evolution.

## 5. PROPOSED SOLUTIONS

To resolve these structural barriers without requiring a drastic rewrite of the tool, we recommend two targeted amendments to the Applicability Conditions and Appendix.

### **Recommendation A: Staggered Data Readiness (Operating Margin)**

*Insert into Section 5.7.1.2 (Applicability):*

"In instances where hourly dispatch data is not **Readily Available** (accessible via public API or standardised reports), the following staggered approach shall apply:

- a. **Tier 1 (Mature):** Where data is available, hourly calculation is mandatory.
- b. **Tier 2 (Transitional):** For a period of 5 years, Activity Participants may apply the Average OM utilizing Annual Data, subject to a Standardised Intermittency Discount 10% to conservatively account for temporal correlation errors as bounded by peer-reviewed literature (e.g., WattTime, 2025; Miller et al., 2022).
- c. **Tier 3 (LDCs/SIDS):** Exempt from hourly requirements; Annual Data applies without discount."

## Recommendation B: Technical Cap on Vintage Discounts (Build Margin)

Insert into Appendix 2

"To prevent statistical anomalies derived from short-term regression, the value of the annual discount factor ( $F_{BM}$ ) shall be the lower of: (i) the regression value, or (ii) a Technical Ceiling of 5%. This ceiling reflects the maximum plausible rate of systemic capital stock turnover."

## 6. REFERENCES

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- **Zucker, A., Hinchliffe, T., & Spisto, A.** (2019). Assessment of the marginal emission factor of the electricity system: A case study of Cyprus. *Energy Policy*, 132, 742-750.
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