PAGE PARTNERSHIP FOR ACTION ON GREEN ECONOMY

Measuring Circularity: The Circular Economy

M&E Module in AKSARA



UN environment programme

International Labour Organization

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Measuring Circularity: The Circular Economy M&E Module in AKSARA

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Executive summary

Indonesia now has a working method to measure how circular its economy is, and a system design to keep measuring it every year under government ownership. The Circular Economy (CE) Monitoring and Evaluation (M&E) module in AKSARA, Bappenas' national platform for low-carbon and climate-resilient development, tracks three national indicators across the five priority sectors of the National Circular Economy Roadmap: the Circular Input Rate, the Usage Rate and the Recycling Rate.

What has been designed. An indicator hierarchy from 48 variables through fifteen sector indicators to three national indicators, each with documented formula, boundary, source, data owner and confidence level; a material-flow analysis per sector that tests whether the indicators are internally consistent; an approval-based data workflow in which ministries submit, the system checks and Bappenas verifies before anything is published; a dashboard with national, sector and data-quality views; and a data-improvement plan with named owners. The chosen methodology has been endorsed by an external peer review and tested in a desk-based pilot of 14 scenarios.

What the numbers say. On the current methodology, Indonesia's Circular Input Rate rose from 4.82% in 2023 to an indicative 6.47% in 2025, against a RAN ES target of 8.75%; the Usage Rate stayed below 1% (target 4.00%); and the Recycling Rate held at about 3.3% (target 5.23%). Progress is concentrated on the input side and in the two largest sectors, food and construction. The 2025 figures rest largely on proxies and policy milestones and should be read as indicative until actual data replace them.

Table 1. At a glance: national indicators against RAN ES targets (adopted methodology option)

Indicator	2023 baseline	2025 (indicative)	RAN ES target
Circular Input Rate	4.82%	6.47%	8.75%
Usage Rate	0.76%	0.70%	4.00%
Recycling Rate	3.25%	3.29%	5.23%

Why it matters. The module gives Bappenas, line ministries and Indonesia's partners a government-owned, auditable evidence base for the RAN ES, the RPJMN 2025–2029 and the NDC, one that shows the quality of every number, assigns an owner to every gap and places CE results in the same reports as other climate actions. Its design principle is transparency about uncertainty rather than false precision.

What comes next. A live pilot with ministries; formal adoption of the metadata and procedures as Bappenas guidance; standing data-sharing agreements; replacement of low-confidence proxies; integration with SIINas and SIPSN; a life-cycle assessment to express CE outcomes in emission terms; and extension to provincial and district governments.

This paper is one of three knowledge products prepared under UN-PAGE Indonesia with Bappenas and UNDP. Its companion, *Integrating the Circular Economy into Indonesia's NDC: The AKSARA Planning Module*, covers the planning side, and the policy brief *From Plans to Proof* summarises both for decision-makers.

It draws on the October 2026 indicator metadata and material-flow analysis, the October 2026 calculation workbook, the external peer review of September 2026 and the Deliverable 4 pilot-testing report.

Purpose, scope and structure of this paper

This paper explains how Indonesia's three national circular-economy indicators are defined, calculated, verified and reported through the M&E module in AKSARA. It is written for three audiences: Bappenas and line-ministry staff who will operate the module; development partners and reviewers who need to judge how much weight the published figures can bear; and policy-makers who want to know what the indicators can and cannot yet tell them about progress under the RAN ES and the NDC.

The paper covers the design of the module and the results of its first application to 2023 baseline and indicative 2025 data. It does not cover the planning module (treated in the companion paper), nor does it present a life-cycle assessment of emission outcomes, which remains a next-phase task. All indicator values are reported under the methodology option adopted by Bappenas following the peer review; the alternative options are referenced only as sensitivity analyses.

The paper proceeds from rationale to results to roadmap. It first sets out why a dedicated M&E system was needed and the principles that shaped it; then defines the three indicators, their sector coverage and the material-flow analysis behind them; then explains the methodology, the data-flow and verification workflow, and the dashboard. The closing sections take stock of data gaps, strategic value, sustainability, risks and next steps.

Why a dedicated M&E system

The first phase of UN-PAGE support built the CE planning module in AKSARA and updated the baseline indicators. What it could not yet do was track them. Four gaps stood between the roadmap's ambition and the evidence needed to manage it:

1. **Data scattered across institutions.** The variables behind the three indicators sit with at least ten ministries and agencies, industry associations and company reports, with different units, boundaries and release cycles.
2. **No standard reporting protocol.** There was no agreed calendar, template or responsibility for who reports what, when, and to whom.
3. **No measurement, reporting and verification (MRV) framework.** Numbers could be produced but not audited: there was no record of confidence level, proxy status or the formula path from a raw variable to the national figure.
4. **No way to assess performance.** Without a time series and a verification trail, Bappenas could not tell whether CE actions were working or what their contribution to the NDC and LCDI might be.

The M&E module is the response. It is designed to make the three national indicators reproducible, auditable and owned, and to do so inside the platform the Government already uses for climate reporting, rather than in a parallel system.

Design principles

The module was designed to a set of principles agreed with Bappenas and tested against the peer review. They explain many of the choices described in the rest of this paper.

Table 2. Design principles of the M&E module

Principle	What it means in the design

Principle	What it means in the design
Government ownership	Bappenas holds the system, the metadata and the approval authority; the consultant team's role ends with handover and training
Integration, not duplication	The module lives inside AKSARA, uses its roles and calendar, and reads ministries' existing outputs rather than creating a parallel reporting line
Transparency about uncertainty	Every figure carries a confidence level and a proxy flag; a gap is shown as a gap, never closed by assumption
Standards-based measurement	Boundaries, the 100% rule and no-double-counting follow ISO 59020; material-flow analysis is the consistency check
Verification before publication	Two quality gates and Bappenas approval precede any published value; every value is traceable to its source and approver
Sector-specific, nationally comparable	Each sector has its own formulas and boundaries, aggregated through a common GDP-weighted method, with sector values published unweighted alongside
Continuous improvement	An annual cycle of measurement, evaluation and follow-up, with versioned methodology so the 2023 baseline stays comparable
Minimum burden	Reporting is limited to the 48 indicator variables; everything else is drawn from existing systems and statistics

The three national indicators

The indicators follow material through one cycle: what comes in, how long it stays in use, and how much comes back. Each is calculated per sector and then aggregated nationally.

Table 3. The three national indicators: definitions and values, 2023 and 2025

Indicator	Definition	Position in the material cycle	2023 (baseline)	2025 (indicative)
Circular Input Rate (*Tingkat Input Material Sirkular*)	Share of secondary, recycled, reused or alternative material that enters production, against total material input with the same boundary	Inflow to production	4.82%	6.47%
Usage Rate (*Tingkat Daya Guna*)	Share of material or product kept in function through reuse, repair, refill, refurbishment or food rescue	Use, stock and life extension	0.76%	0.70%
Recycling Rate (*Tingkat Daur Ulang*)	Share of post-use material actually processed into secondary material and returned to the cycle, net of process losses	Post-use to secondary material	3.25%	3.29%

Source: *Analisis Input Output, Metadata Indikator Utama, PDB Sektor, dan Indikator Sektor Ekonomi Sirkular*, October 2026 (adopted methodology option). Figures for 2025 are built largely from proxies, RAN ES milestones and institutional projections; they will be replaced with actual data as it becomes available.

Reading the 2023–2025 movement. Of the three indicators, only the Circular Input Rate moved materially between 2023 and 2025, from 4.82% to 6.47%, closing about 42% of the gap to its 8.75% RAN ES target. The movement is driven by the two sectors with the largest GDP weights: food, whose Circular Input Rate more than doubled from 3.02% to 7.33% on organic fertiliser and alternative feed inputs, and construction, which rose from 40.23% to 47.78% on alternative raw materials in steel and cement. Because the 2025 values in both sectors rest largely on RAN ES milestones and institutional projections, the national gain should be read as what the roadmap expects to achieve, not yet as what has been measured.

The Usage Rate (0.76% to 0.70%) and the Recycling Rate (3.25% to 3.29%) are essentially flat at the national level. In both cases the flat aggregate conceals sector movement in opposite directions (plastic-packaging recycling rose sharply from 24.74% to 45.09% while food-waste recycling fell from 14.03% to 11.37%), and in both cases the sectors that moved carry small GDP weights, so the national figure barely registers them. This is the clearest illustration of why sector values are published unweighted alongside the aggregate.

Three features of the design matter for interpretation:

- **The indicators are physical, not economic.** They measure tonnes of material, not rupiah. GDP enters only as a weight when sectors are aggregated.
- **Each indicator has a sector formula.** Fifteen sector indicators (five sectors × three indicators) each have an explicit numerator, denominator, boundary and data source, documented in the indicator metadata. The electronics Usage Rate and the electronics and construction Recycling Rates are flagged "under confirmation" because their combined formulas are not yet written out in the metadata, a gap the module makes visible rather than hides.
- **The national figure is a weighted sum.** The aggregate is the sum of each sector's indicator multiplied by that sector's share of national GDP, so sectors with large GDP shares (food, construction) dominate the national number while high circularity in small sectors (plastic packaging, electronics, textiles) moves it only slightly.

Indicator hierarchy

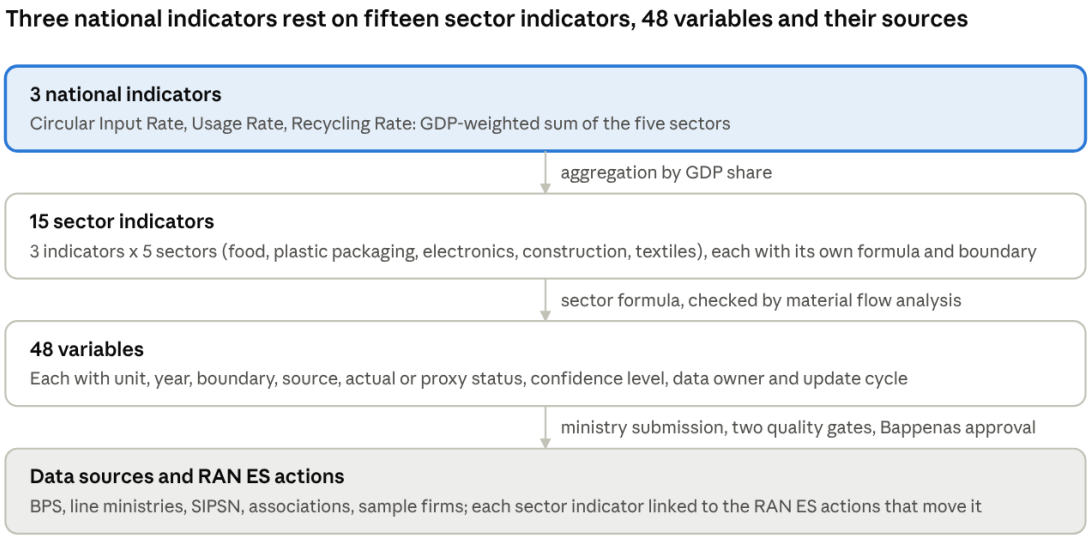


Figure 1. Indicator hierarchy: four tiers from 48 variables to three national indicators

The hierarchy is also the audit trail. A national figure can be decomposed into its five sector contributions, each sector indicator into its variables, and each variable into its source document, year and approver. The reverse path, from a RAN ES action to the variable it affects and the national indicator it moves, is what connects the M&E module to the planning module.

Between the raw variables and the sector indicators sits a layer of derived variables: sums, products and scaled values such as circular food raw material, secondary steel and cement material scaled from sample firms to national production, or e-waste collected derived from printed circuit boards and their share of device mass. These derived variables are computed by the system from the entered values, not entered themselves, so that the arithmetic is reproducible and cannot drift between contributors. Three calculation rules follow from this design. Each national indicator is built only from the sector indicators of the same type. Where one physical flow feeds two indicators (printed circuit boards collected by the informal sector, which enter both the electronics Usage Rate and the electronics Recycling Rate), it is stored once and referenced twice, so the two cannot diverge. And where a variable carries a fixed reference year, such as the 2022 values for locally sourced and imported recycled resin used for both 2023 and 2025, the metadata records this explicitly and the data owner is expected to replace the value when newer data become available; the action trail records every such change.

What each indicator can and cannot tell us

The three indicators are deliberately simple, and each has a characteristic blind spot that the reader should keep in mind.

The Circular Input Rate responds fastest to policy because its numerator (secondary, recycled, reused or alternative material entering production) is often reported by producers or their associations and can be influenced directly through procurement rules, product standards and incentives. Its weakness is that it says nothing about where the secondary material came from: imported recycled resin raises the rate as much as domestically recovered resin, and a rise in the rate can coexist with growing total material consumption.

The Usage Rate is the hardest of the three to measure, because reuse, repair, refill and food rescue happen largely outside formal statistics, in households, informal markets and small enterprises. The very low national values (below 1%) reflect this measurement difficulty as much as the underlying behaviour, and improvement in the Usage Rate will come first from better data on reuse and repair before it comes from the activity itself. The construction and textiles values, which are higher, rest on sector-specific proxies rather than on surveys of actual reuse.

The Recycling Rate is the most familiar indicator and the one most directly comparable with international statistics, but its definition here is stricter than in many waste statistics: it counts material actually processed into secondary material and returned to the cycle, net of process losses, rather than material collected for recycling. Rates will therefore look lower than collection-based figures published elsewhere, and this difference should be explained when the figures are cited.

Read together, the three indicators describe one loop. A high Circular Input Rate alongside a low Recycling Rate, as in construction, means secondary material is coming from somewhere other than the sector's own post-use stream (alternative raw materials, in that case), and the loop is not yet closed. The material-flow analysis in the next section is the tool for seeing where it opens.

Sectoral coverage and material flow analysis

Each of the five priority sectors is measured on its own terms, with a boundary chosen to fit the material that matters most in that sector.

Table 4. Sector boundaries and indicator values by sector, 2023 → 2025

Sector	Material boundary	Circular Input Rate 2023 → 2025	Usage Rate 2023 → 2025	Recycling Rate 2023 → 2025
Food	Organic fertiliser and alternative feed inputs; food rescue; food waste treated	3.02% → 7.33%	0.03% → 0.04%	14.03% → 11.37%
Plastic packaging	Recycled resin (local and imported) in production; reuse and refill; plastic waste recycled	7.30% → 6.57%	0.0007% → 0.0024%	24.74% → 45.09%
Electronics	Recycled content in mobile phones and computers in use; printed circuit boards collected and processed	13.80% → 17.96%	0,07% → 0,03%	2,61% → 1,54%
Construction	Alternative and renewable raw materials in steel and cement (sample firms scaled by market share); reuse of construction materials; construction waste recycled	40.23% → 47.78%	6.17% → 5.89%	3,75% → 7,50%
Textiles	Circular fibre input; repaired and reused textiles; textile waste recycled	2.00% → 2.00%	12.00% → 9.47%	12.00% → 10.00%

"Under confirmation" marks sector formulas whose combined expression is still being finalised in the metadata; provisional values exist in the calculation workbook but are not published until the formula is locked.

Material flow analysis as the consistency check

Behind each sector sits a material flow analysis (MFA) that places every variable at a stage of the cycle: input, production, use or stock, post-use, and return as secondary material or exit as loss and disposal. The MFA is used as a test rather than a result: an indicator is only accepted when its numerator and denominator refer to the same boundary, the same year and the same unit of mass.

Two layers are kept for each sector. The *MFA as available* uses only the variables that exist today and shows the gaps explicitly; the *ideal MFA* describes the full mass balance that would be needed to close the loop. The distance between the two is the sector's data-development agenda:

- **Food**: the fertiliser and feed inputs and the food-waste flows are not yet connected by a single supply-use balance.
- **Plastic packaging**: several denominators still cover all plastics rather than packaging alone.
- **Electronics**: the stock side covers phones and computers while the e-waste side covers all devices; the two cannot be closed into one loop until categories are harmonised.
- **Construction**: no material stock account or demolition outflow yet, and a risk of double counting between cement and concrete.
- **Textiles**: reuse and recycling proxies are not yet mutually exclusive, so they cannot be summed.

The MFA approach follows ISO 59020 principles for measuring circularity (explicit system boundaries, the 100% rule for classifying flows, no double counting between reuse, recycling, recovery, loss and disposal), as recommended by the peer review.

Positioning against international practice

Indonesia's approach sits between two established models of circularity measurement. The first is the economy-wide model, exemplified by the European Union's circular economy monitoring framework and the circular material use rate derived from economy-wide material flow accounts, which measures the share of secondary material in total material use for the whole economy. The second is the organisation- or product-level model codified in ISO 59020, which measures circularity performance within a defined system boundary using mass-based inflow and outflow indicators.

The AKSARA module adopts the standards and mass-balance logic of ISO 59020 but applies them at the level of five priority sectors, aggregated by economic weight. This choice reflects Indonesia's starting point: a full economy-wide material flow account does not yet exist, whereas sector data for the roadmap's priority sectors can be assembled from existing ministries, associations and company reporting. The result is a system that is more granular and more directly linked to policy actions than an economy-wide rate, but that cannot yet be compared one-for-one with national circular material use rates published by other countries. The improvement plan's longer-term goal of an economy-wide material-flow account is what would close that gap.

Two practical implications follow for international reporting. First, when Indonesia's figures are cited alongside those of other countries, the sector-weighted scope and the stricter net-of-losses recycling definition should be stated. Second, the module's variable-level metadata (boundary, source, confidence, status) already meets the documentation expectations of the Paris Agreement's enhanced transparency framework and of SDG 12 reporting, so the constraint on comparability is one of scope, not of method.

Methodology: weighting, scenario choice and confidence

GDP weighting

The national value of each indicator is the sum, across the five sectors, of the sector indicator multiplied by the sector's share of national GDP (BPS, current prices):

$$I_{national} = \Sigma_s \left(w_s \times I_s \right), \quad \text{where} \quad w_s = GDP_s / GDP_{national}$$

Table 5. GDP weights by sector, 2023 and 2025

Sector	GDP weight 2023	GDP weight 2025
Food	18.46%	19.68%
Construction	9.92%	9.83%
Electronics	1.57%	1.60%
Textiles	1.21%	1.20%
Plastic packaging	0.40%	0.37%

The weights are drawn from the KBLI (Indonesian industrial classification) categories closest to each sector's system boundary. Following the peer review, forestry was removed from the food base, footwear was retained in textiles only for its textile-fibre component, and the plastic-packaging base was narrowed from all rubber and plastic products toward the packaging sub-industry. Because the

weights sum to about one third of GDP, the national indicators are best read as "circularity of the five priority sectors, weighted by economic size" rather than as an economy-wide rate. Sector values are published alongside the aggregate so that high performance in a small sector is not lost. The weights are stored in the system as they are, not rescaled to sum to 100%; if a normalised figure is ever required for policy reporting, it should be added as a derived output rather than by changing the stored weights, so that the published series remains traceable to BPS.

Worked example: the food Circular Input Rate for 2025. The calculation runs in four layers, each visible in the module. First, raw variables are combined into derived variables: circular food raw material is the sum of organic fertiliser production (669,177 t) and alternative feed protein (1,883,728 t), giving 2,552,905 t; total food raw material is the sum of total fertiliser (14,500,000 t) and total feed (20,350,000 t), giving 34,850,000 t. Second, the sector indicator is the ratio of the two: 2,552,905 ÷ 34,850,000 = 7.33%. Third, the sector's GDP weight for 2025 is taken from BPS (19.68%). Fourth, the sector contributes 7.33% × 19.68% ≈ 1.44 percentage points to the national Circular Input Rate of 6.47%, with the other four sectors contributing the remainder. Every intermediate value in this chain is stored, so the national figure can be re-performed by hand from the variable catalogue.

Choice of methodology option

Three methodology options were tested, combining old and updated GDP weights with old and updated sector formulas. The option that pairs updated GDP weights with the updated sector methodology was endorsed by the peer review and adopted by Bappenas as the official method. The other options are retained as sensitivity analyses, not as alternative results. The largest effects of the methodology change were in construction (where the Usage Rate formula was corrected from roughly 40% to about 6%) and plastic packaging (where national waste-system data from SIPSN raised the Recycling Rate).

The three options differ along two dimensions. The first is the GDP weight set: the original KBLI mapping used in the first-phase baseline, or the updated mapping that removes forestry from the food base, limits footwear to its textile-fibre component and narrows plastic packaging toward the packaging sub-industry. The second is the sector formula set: the original 2023 formulas, or the updated formulas that correct the construction Usage Rate, adopt SIPSN as the national source for plastic-waste recycling and align each numerator and denominator to a single boundary, year and mass unit. The option that retains the original weights and formulas is kept as the reference point to the first-phase baseline; the option that updates only one dimension isolates the effect of that change; the adopted option updates both.

Four considerations guided the choice. Consistency with the material-flow analysis: only the updated formulas pass the boundary and double-counting tests described above. Comparability over time: the updated weights are recalculated for every year from the same KBLI mapping, so the 2023 baseline is restated rather than broken. Transparency: each change from the original method is recorded in the metadata with its rationale and its effect on the indicator value. Endorsement: the peer review assessed all three options and recommended the one adopted. Because the baseline has been restated, the 2023 values in this paper differ from those published in the first phase; the earlier values remain available in the calculation workbook for reference. The same caution applies to the baseline figures recorded in the RAN ES planning tables, which were compiled with a different method and are not directly comparable with the module's 2023 results. Year-on-year progress should therefore be read from the module's own series, and Bappenas should agree how the two baselines are presented side by side before achievement figures are published.

Confidence levels and data status

Every one of the 48 variables carries two quality labels in the metadata: a confidence level for how the data were obtained (high, medium or low) and a status (actual, or proxy/estimate for at least one year). Variables rated low include organic fertiliser production, alternative feed protein, circular fibre volume, PCB collection by private recyclers, reused recycled construction material and locally sourced recycled plastic. Most 2025 values are proxies drawn from RAN ES 2025–2029 milestones or institutional projections.

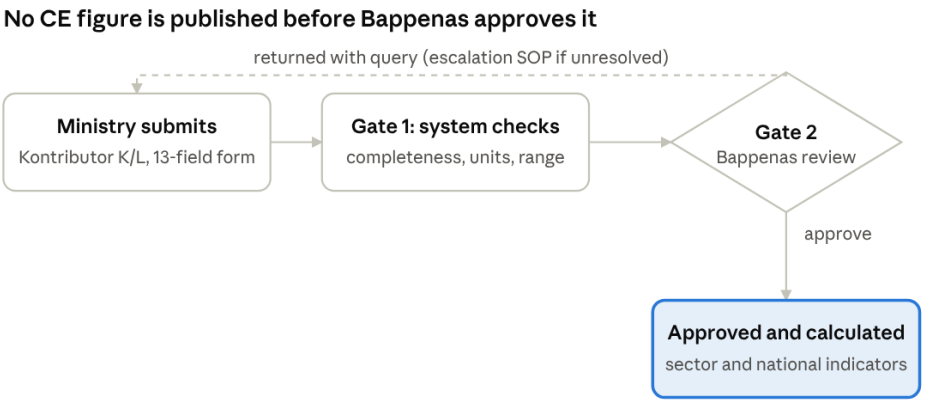
The module carries these labels into the system: each data field has a quality score, a data owner responsible for replacing proxies, and two quality gates before a figure is published.

How the labels are read. The confidence level describes the way a value was obtained rather than the value itself. A high rating is reserved for figures taken from official statistics or administrative records with national coverage for the reference year, such as BPS national accounts or SIPSN waste data. A medium rating applies to figures from industry associations, company reporting or sample surveys that cover the sector only partly or require scaling, such as the steel and cement sample in construction or APPI fertiliser data. A low rating applies to proxies, expert estimates and values borrowed from another year or a neighbouring category. The status label is independent of the confidence level: a value can be actual yet medium-confidence if its coverage is partial, or a proxy drawn from a high-quality source for a different year.

From variable to indicator. Because each indicator combines several variables, the dashboard shows an overall confidence rating for each sector and national indicator alongside the ratings of its inputs. The overall rating is governed by the weakest variable that materially drives the result, so that a national figure cannot appear more certain than the data beneath it. This is why the 2025 national indicators are presented as indicative: the variables that move them most, in food and construction, are proxies drawn from RAN ES milestones. As those proxies are replaced through the improvement plan, the overall rating rises without any change to the formula, and the dashboard's data-quality view records the date of each replacement.

Data flow and verification

The module uses an approval-based workflow, confirmed by Bappenas in preference to a direct-entry model: ministries submit, the system checks, Bappenas reviews, and only approved data enter the indicator calculation.



Each field carries confidence level, proxy flag and data owner; the quality score decides whether Gate 2 can pass.

Figure 2. Approval-based verification workflow: two quality gates and one return loop

A submission that fails a check is returned to the ministry with a query; a submission that cannot be resolved within the reporting window follows an escalation procedure to the Bappenas directorate responsible for the sector. Returned submissions keep their history, so every published value can be traced back to who entered it, when, from which source, and who approved it.

Entry statuses. In the system each entry (one variable in one year) is always in one of four statuses: not entered, awaiting validation, validated or revision needed. Only validated values enter the indicator calculation, and the sector and national indicators for a year are recalculated automatically whenever the set of validated values changes. A ministry contributor moves an entry from not entered to awaiting validation by submitting a value with its data source while the entry period is open; changing a value that is already awaiting validation or validated returns it to awaiting validation; and resubmitting after a revision request requires both a data source and a revision note. Bappenas reviewers move entries from awaiting validation to validated (with the option of correcting the value at approval) or to revision needed, which always carries a written note back to the contributor. Reviewers may also enter or correct values directly, including outside the entry period, so that late corrections do not require a reporting period to be reopened. Supporting documents can be attached or changed at any status without altering the status itself.

Roles

Table 6. User roles in the M&E module

Role	Who	Can do
Super-administrator / Editor	Bappenas	Define and lock indicator metadata per period; review and approve submissions; publish; manage users and the reporting calendar
Kontributor K/L	Mapped line ministries and agencies	Enter and update the variables they own; attach source documents; respond to queries
Viewer	Government and public (dashboard)	Read published indicators and metadata

What each submission carries

Every data point is entered against a locked metadata record with 13 fields, including: variable name and code, unit, reference year, geographical and material boundary, data source and document, data type (actual or proxy/estimate), confidence level, data owner, update cycle, and the variable's position in the sector's material flow. Locking the metadata per period and versioning any change means that a revised boundary or a replaced proxy is documented, and the time series stays traceable.

Reporting cycle

The metadata and indicator values are updated annually, aligned with the release of BPS national accounts and sectoral statistics. Each cycle runs through six steps:

1. **Lock.** Bappenas confirms and locks the indicator metadata for the reporting period, including any versioned change to a boundary, formula or source.
2. **Submit.** Kontributor K/L enters the variables they own against the locked metadata, attach source documents and flag each value as actual or proxy with its confidence level.

3. **Check.** The system applies the first quality gate: completeness, unit and range checks, and consistency with the material-flow structure sector. Failed submissions are returned with a query.
4. **Review.** Bappenas reviewers apply the second quality gate, reconcile the submitted variables against the material-flow analysis and either approve, return or escalate to the responsible directorate.
5. **Calculate and publish.** Approved variables feed the fifteen sector indicators and the GDP-weighted national figures, which are published to the dashboard with their confidence ratings and carried into AKSARA's standard reports.
6. **Evaluate and follow up.** Results are reviewed through the RAN ES coordination mechanism; proxies due for replacement and unresolved gaps are assigned to data owners for the next cycle.

The ministries and sources mapped to the module include Statistics Indonesia (BPS), the Ministries of Agriculture, Industry, Trade, Environment (including the SIPSN national waste information system) and Public Works, the National Food Agency, the fertiliser producers' association (APPI) and sample companies in the steel and cement industries. Integration with the Ministry of Industry's SIINas reporting system and with existing e-waste recovery reporting at the Ministry of Communication and Digital Affairs are recommended as the next data links.

Ownership of the variables is concentrated. In the module's variable catalogue nearly half of the variables are assigned to the Ministry of Industry as data steward, covering recycled content, alternative raw materials and production volumes across plastics, electronics and construction; about a quarter sit with the Ministry of Environment, chiefly the waste-generation, collection and recycling flows drawn from SIPSN; Bappenas itself holds the GDP reference values used for weighting; and the Ministries of Agriculture and Public Works and the National Food Agency each hold a small number of sector-specific variables. Most variables are expressed in tonnes, with the remainder being percentage shares and GDP values in IDR trillion. This concentration means that the first live reporting cycle depends above all on two institutions, and that the data-sharing arrangements with the Ministries of Industry and Environment should be the first to be formalised.

The dashboard and reporting

The monitoring dashboard is the public face of the module. It is designed around three views:

- **National view.** The three headline indicators for the latest year, their change from the 2023 baseline, and their position against the RAN ES targets. Each figure is shown with its overall confidence rating so that a reader sees at once how much of it rests on actual data.
- **Sector view.** The fifteen sector indicators, each with its formula, boundary, data sources and the RAN ES actions linked to it. Sector values are displayed unweighted, so that strong performance in a small sector (plastic-packaging recycling, for example) is visible even though it barely moves the national figure.
- **Data-quality view.** For every variable: data owner, actual or proxy status, confidence level, last update and the next scheduled update. This view doubles as the work list for closing data gaps.

The monitoring module (*Pemantauan*) is separate from AKSARA's reporting module (*Pelaporan*). Approved indicator values flow from monitoring into the standard AKSARA reports that Bappenas produces for the national development plan, the LCDI and Indonesia's NDC reporting. The CE

indicators appear there alongside mitigation actions from other sectors, which is what integration into the climate architecture means in practice.

The indicator module is complemented by a second, lighter form of monitoring: a thematic CE tag on ministries' detailed outputs (*Rincian Output*, RO) already reported in AKSARA. Each CE-relevant RO is classified by sector, climate pillar (low-carbon, climate-resilient or both), type of contribution and lead ministry, so that it can be read in the PRK or PBI dashboard and through the CE lens at the same time. Where the three indicators measure physical outcomes, the RO layer tracks the policy activity behind them (which sectors are most integrated, which outputs recur across ministries without coordination, where the leverage lies) and feeds that reading into the next planning cycle. Neither adds a reporting obligation beyond the indicator variables themselves.

Following one number through the chain. The plastic-packaging Recycling Rate illustrates how the module works end to end. Its 2025 value of 45.09% is calculated from two variables: plastic packaging waste recycled into secondary material, and plastic packaging waste generated, both in tonnes for the same reference year. The numerator is taken from the SIPSN national waste information system managed by the Ministry of Environment and carries a medium-to-high confidence rating; the denominator still uses an all-plastics base in part, which is why the data-development agenda for the sector lists narrowing it to packaging alone. Both variables were entered by the responsible Kontributor K/L against a locked metadata record, passed the system checks on unit, range and material-flow position, were reviewed and approved by Bappenas, and then flowed into the sector indicator. The sector value is published unweighted in the sector view, where it stands out as the strongest recycling result; in the national view it is multiplied by the sector's GDP weight of 0.37%, which is why a 20-point increase in the sector moves the national Recycling Rate by less than a tenth of a point. A reader who questions the figure can open the data-quality view, see the source document and the approver for each variable, and see when the denominator is next scheduled for revision.

The module does not yet convert indicator changes into greenhouse-gas reductions. The peer review confirmed that the indicators measure material circularity, and recommended life-cycle assessment as the complementary method for a later phase. Until that link is built, the dashboard reports circularity outcomes and their RAN ES targets, not tonnes of CO_2 equivalent.

Data gaps, limitations and the improvement plan

The module is built to be honest about its inputs. The main limitations, as documented in the October 2026 metadata, are:

- **2025 values are mostly estimates.** Most 2025 variables are drawn from RAN ES 2025–2029 milestones or institutional projections, not realised data.
- **Reference years differ.** Some 2023 values use data from other years as proxies (APPI 2022, Ministry of Agriculture 2024), introducing a time lag.
- **Several variables have low confidence**, including organic fertiliser production, alternative feed protein, circular fibre volume and PCB collection by private recyclers.
- **Sample dependence.** The construction Circular Input Rate is scaled up from sample steel and cement companies by market share, so it is sensitive to the choice of sample.
- **Availability versus use.** Some variables measure material that is available (for example alternative feed protein) rather than material actually used in production.

- **GDP weighting effect.** Sectors with small GDP shares influence the national figure only marginally, however circular they become.

The improvement plan attached to the metadata turns each limitation into an action with an owner:

Table 7. Data-improvement plan: actions, leads and timing

Action	Lead	Timing
Replace 2025 proxies with realised data, starting with low-confidence variables	Data-owning ministries, coordinated by Bappenas	First annual update cycle
Harmonise reference years and national coverage across 2023 and 2025	Bappenas with BPS	First annual update cycle
Establish annual data-sharing arrangements with BPS, line ministries, the National Food Agency and industry associations	Bappenas	Before first live reporting cycle
Measure actual material input to production rather than availability or output	Ministries of Industry and Agriculture	Progressive, per sector
Write out the combined formulas for electronics Usage Rate and electronics and construction Recycling Rates	Consultant team with Bappenas	Before publication of those cells
Set the annual metadata and indicator update cycle with documented source changes	Bappenas	Adopted with the module
Prepare for provincial and district involvement, spatial breakdowns and third-party validation	Bappenas, next project phase	Follow-on phase

Strategic value for national and international reporting

The M&E module serves four reporting obligations with one data chain.

Table 8. Reporting obligations served by the module

Reporting need	What the module supplies	Current limitation
RAN ES 2025–2029 progress and the RPJMN mid-term review	Annual values of the three national and fifteen sector indicators against RAN ES targets, with sector decomposition	2025 values indicative until proxies are replaced
LCDI and PRKBI reporting to Government	CE indicators published through AKSARA's standard reports alongside other low-carbon actions; RO tagging shows CE activity by ministry	Emission effects not yet quantified
NDC implementation and the Paris Agreement transparency framework	A traceable, verified chain from action to indicator that meets the transparency principles of accuracy, completeness and consistency; a documented methodology and versioning	Contribution to NDC mitigation targets remains structural until the LCA link is built
SDG 12 and related goals	National circularity metrics complementary to SDG 12 indicators on material footprint and waste	Indicators cover five sectors, not the whole economy

Sustainability and scaling strategy

The module is designed to outlast the project that built it. Five conditions determine whether it does.

Institutional anchoring. The indicator metadata, reporting calendar, verification procedure and escalation SOP should be issued as Bappenas guidance so that ministry participation rests on a formal basis. The Directorate of Environment and the LCDI Secretariat are the natural custodians; the RAN ES coordination mechanism is the forum for annual review of results.

Financing. Operation and maintenance of the module should be absorbed into the AKSARA budget line, with the first live cycle supported by UN-PAGE. The annual data-collection effort is deliberately small (48 variables, most drawn from existing statistics), so the recurrent cost is primarily staff time for verification.

Capacity. A user manual and training package for Kontributor K/L and Bappenas reviewers are part of the final deliverable. Capacity needs differ by role: contributors need clarity on definitions, units and evidence; reviewers need the quality-scoring rubric and the material-flow reconciliation checks.

Technical integration. The module's data schema, API and RO-tagging fields need to be agreed with the AKSARA development team and maintained as part of the platform's release cycle, not as a separate codebase.

Data partnerships. Standing arrangements with BPS, the sectoral ministries, the National Food Agency and industry associations, plus system links to SIINas and SIPSN, convert one-off data requests into routine flows.

The scaling path runs in three directions once the first cycle is routine: **deeper** (replacing proxies with measured flows and closing the ideal material-flow balance per sector), **wider** (provincial and district data and roles, and a gender and inclusion marker on tagged outputs), and **further up the results chain** (the life-cycle assessment that converts circularity into emission terms, and in time an economy-wide material-flow account).

Risks and mitigation

Table 9. Risks and mitigation measures

Risk	Effect	Mitigation
Indicative 2025 figures are cited as actuals	Misleading progress claims; loss of credibility with reviewers and partners	Confidence levels and proxy flags published with every figure; "indicative" label retained until replacement
Ministries stop reporting after project close	Broken time series; stale register	Bappenas guidance; calendar aligned to existing AKSARA cycle; escalation SOP
Boundary or formula drift between periods	Series not comparable to 2023 baseline	Metadata locked per period; versioned methodology; MFA reconciliation check
Three "under confirmation" formulas remain unresolved	National Recycling Rate cannot be fully audited	Formulas written out and locked before the first live cycle; cells withheld until then
Sample dependence in construction	Sectors result sensitive to firm selection	Widen the sample; move to industry-association or SIINas data
GDP weighting masks	Policy signals lost for small	Sector values published unweighted; sector-

Risk	Effect	Mitigation
sector progress	sectors	specific review
Technical integration delayed	Module runs as a side system	Early schema and API agreement; phased integration

Next steps: pilot, institutionalization and scale-up

The module has passed three tests so far: an external peer review by researchers from BRIN, ITB, ITS and Life Cycle Indonesia (September 2026), which endorsed the methodology and produced 23 recommendations that have been accommodated in full or in part; a desk-based simulated pilot of 14 test scenarios run on the 2023–2025 data; and technical consultation with Bappenas on the workflow, roles and quality gates.

On the technical side, the module's backend, database schema, API and user interface have been built and verified on AKSARA's staging environment: all fifteen sector and three national indicator values for 2023 and 2025 produced by the system were reproduced against the reference calculation workbook, and automated tests cover the calculation engine and the status workflow. The achievement page is designed as a single view in which the national indicator cards and the sector-by-indicator matrix act as filters on the variable list beneath them, so that the link between a variable and the indicators it feeds is always visible to contributors and reviewers. Production deployment is pending, and the public CE page currently displays only the RAN baseline; the achievement figures calculated by the module will be shown publicly once Bappenas takes the publication decision, after which the integration can be switched on without further development.

What remains:

1. **Live pilot with ministries.** A first reporting wave with the plastic-packaging and food sectors, chosen because their data chains are the most complete, followed by electronics, construction and textiles.
2. **Platform integration.** Agreement with the AKSARA development team on database schema, APIs and the link to the planning module.
3. **Formal adoption.** Issuance of the indicator metadata, reporting calendar, verification procedure and escalation SOP as Bappenas guidance, so that reporting is an obligation rather than a project activity.
4. **Capacity building.** User guidelines and training for Kontributor K/L and Bappenas reviewers.
5. **Next-phase agenda.** Sub-national data and roles, spatial breakdowns, third-party validation, SIINas integration, and the life-cycle assessment needed to express CE outcomes in NDC emission terms.

Conclusion

The M&E module turns the circular economy from a policy ambition into something Indonesia can measure, audit and manage. Its contribution is less than the three headline numbers than the chain behind them: 48 documented variables, fifteen sector formulas, a material-flow test for consistency, a two-gate verification workflow and a dashboard that shows the quality of every figure. That chain is what allows Bappenas to say not only how circular the five priority sectors are, but how confident it is in the answer and who is responsible for improving it.

The results so far are a baseline and direction of travel, not a verdict. Progress is visible on the input side and in the largest sectors, while the Usage and Recycling Rates remain far from their RAN ES targets and most 2025 values still rest on proxies. The module's value in the next two years will be measured by how quickly those proxies are replaced with reported data, how reliably ministries submit on the annual calendar, and whether the life-cycle link is built so that circularity can be counted in the NDC in emission terms.

The decisions that matter now are institutional rather than technical: issuing the metadata and procedures as Bappenas guidance, agreeing the platform integration with the AKSARA development team, and running the first live reporting wave with the plastic-packaging and food sectors. With those in place, Indonesia will have what few countries yet have: a government-owned, standards-based circularity measurement system embedded in its national climate-reporting architecture.

Acronyms

Table 10. Acronyms used in this paper

Acronym	Meaning
AKSARA	Indonesian Low Carbon Development Planning and Monitoring Application
API	Application programming interface
APPI	Indonesian Fertiliser Producers Association
Bappenas	Ministry of National Development Planning
BPS	*Badan Pusat Statistik* (Statistics Indonesia)
BRIN	National Research and Innovation Agency
CE / ES	Circular economy / *Ekonomi Sirkular*
GDP / PDB	Gross domestic product / *Produk Domestik Bruto*
IDR	Indonesian rupiah
ISO	International Organization for Standardization
ITB	*Institut Teknologi Bandung*
ITS	*Institut Teknologi Sepuluh Nopember*
K/L	*Kementerian/Lembaga* (ministries and agencies)
KBLI	Indonesian Standard Industrial Classification
LCA	Life-cycle assessment
LCDI	Low Carbon Development Initiative
M&E / MRV	Monitoring and evaluation / Measurement, reporting and verification
MFA	Material flow analysis
NDC	Nationally Determined Contribution
PAGE	Partnership for Action on Green Economy
PCB	Printed circuit board
PRK / PBI / PRKBI	Low-carbon / climate-resilient / low-carbon and climate-resilient development
RAN ES	National Circular Economy Action Plan
RO	*Rincian Output* (detailed output line in a ministry's work plan and budget)
RPJMN	National medium-term development plan

Acronym	Meaning
SDG	Sustainable Development Goal
SIINas / SIPSN	National industrial information system / National waste management information system
SOP	Standard operating procedure
UNDP	United Nations Development Programme