GreenGov — User Manual and Method Reference

Measuring and planning the environmental sustainability of government offices

Version 0.24 · August 2026

This manual is written to be reviewable: every formula the tool computes is stated explicitly, every parameter it ships with is tabulated in the annexes, and every worked example reproduces — by hand, to the digit — a number the tool itself displays for the fictional Greenkot Municipal Corporation test estate. A reviewer who disagrees with a number should be able to find, in this document, exactly which equation and which parameter produced it.

Contents

Part I — Orientation

1. What GreenGov is and what it refuses to do

GreenGov is a single-file browser tool for measuring, scoring, planning and tracking the environmental sustainability of a government office estate. It runs from one HTML file with no installation, no server and no internet connection; all data stays on the machine it runs on. It covers greenhouse gases (Scopes 1, 2 and 3 under an operational-control boundary), water, waste and paper, for any number of premises.

It answers four questions in a fixed order, and its sidebar is that order:

Question	Pages	Character
Where are we?	Setup, Sectors	Measurement (ex-ante baseline)
How good is that, and can we improve?	Governance, Dashboard	Diagnosis
What could we do?	Scenarios, sector plan tabs, Compare, Goals	Planning (ex-ante)
Did it work?	Actuals, Trajectory, MRV	Verification (ex-post)

What it refuses to do defines it as much as what it does:

- It refuses to accept indicators as inputs. Users enter *activity data* — kWh, litres, passenger-km, kilograms, counts of installed equipment. Every reported indicator is computed. There is no field anywhere in which $kgCO_2e$/FTE can be typed, except one clearly-labelled fallback used only when no activity data exists at all.
- It refuses to let silence outperform measurement. Missing data is filled by *declared* defaults, but at the lowest confidence tier, capped in scoring, and flagged.
- It refuses to credit the estate with the grid's decarbonisation. That saving is computed, displayed — and labelled as not the programme's.
- It refuses to count a saving twice. Where a technology table and a checkbox measure describe the same physical change, the measure retires the moment the table is populated.
- It refuses to claim ex-post savings without attribution. The Trajectory page compares actuals against the expected effect of *registered implemented interventions*, not of the whole plan.

2. Quick start

1. Open GreenGov in any modern browser (on the hosted beta, signing in with your verified link opens it; a downloaded `greengov.html` works too — `file://` is fine).
2. ＋ **New Project** on the landing page. You are asked for four things: name, country, **baseline year** (the year your data describes) and **target year** (the year you are planning to), plus a long-term year for net-zero-style commitments. Every projection, scenario and goal is computed to the target year; all of it stays editable later under **Reference → Factors & Method**.
3. **Setup → Organisation & Offices**: organisation name, then ＋ **Register premises** — name, floor m^2, FTE, country, climate zone, tenure.
4. That alone yields a complete (Tier-3, provisional) baseline. Refine it on the **Sectors** pages: type the electricity bill, set its tier to 1, and watch the number and the Tier-1 share move.
5. The **Estate Dashboard** (pinned at the top of the sidebar) is the standing overview.

A new workspace is empty by design — nothing but your own projects ever appears in it. To explore a fully populated estate instead, use **Learn → 🎓 Exercise dataset → Load into workspace** on the landing page: the fictional Greenkot Municipal Corporation estate, the same data the companion Exercise Book walks through end to end.

3. System of ideas

3.1 Data tiers

Every value carries a tier. The tier travels with the value through every computation and into every export.

Tier	Meaning	Uncertainty half-width	Typical evidence
1	Measured	±5%	Utility invoice, meter reading, ticket data
2	Modelled	±20%	Derived from odometers, spend, allocation keys
3	Proxy	±40%	Declared default from floor area or headcount

Three rules make the tiers bite. (i) An indicator whose underlying data is Tier 3 can never score above **40** of 100. (ii) An office where more than half the indicators rest on Tier-3 data has its whole score marked ° provisional. (iii) The **Tier-1 share** — the fraction of baseline emissions attributable to measured values, weighted by emissions — appears on the dashboard, on every office row, and in every release.

Absence and silence are distinguished. A blank diesel field means *unknown* and is assumed zero at Tier 3 when electricity is known; the declaration “this office has no generator” is entered as diesel = 0 at Tier 1.

3.2 Goalpost scoring

Indicators are scored against two fixed reference values per indicator — a benchmark of excellence (scores 100) and of poor practice (scores 0) — drawn from public- administration sources, principally the EMAS Sectoral Reference Document for Public Administration (Commission Decision (EU) 2019/61). Scoring is linear between the goalposts and clamped outside them (§6). Goalposts are *not* rankings: adding an office never moves another office’s score.

3.3 Three scenario slots

Every project has exactly three scenarios in fixed slots:

Slot id	Locked	Default name	Role
`bau`	yes	Business as usual	Growth + grid decarbonisation, zero interventions. The counterfactual.

Slot id	Locked	Default name	Role
`s1`	no	Moderate — no & low cost	First course of action; default ★ planning scenario
`s2`	no	Ambitious — capital retrofit	Second course of action

Slot *ids* are fixed because exports, Excel templates and cross-estate comparison key on them; slot *names* are editable because estates plan in their own vocabulary. Slots can be cleared, never deleted; no fourth exists. One action slot carries the ★ and is what Goals, Trajectory and the dashboards report against. A scenario is a complete object: driver overrides, per-office measure selections, and a per-office technology-transition plan.

3.4 Savings are a−b

No measure or transition has an intrinsic saving. The saving is the annual consumption of what is installed **(a)** minus that of what replaces it **(b)**, scaled by how much of the stock moves. An LED retrofit in an office that already has LEDs computes to zero — the tool shows the measure greyed with the reason. The technology tables (§8) are the instrument for this; where a table is populated, the equivalent generic measure retires.

3.5 Actors

Five roles are named per office — owner/landlord, facility operator, payer of utilities, occupier, procuring authority — and every measure declares whose decision it is. The Accountability page re-cuts the estate footprint by controlling actor; the blocked-measures register records what an occupier wants but cannot authorise.

Part II — The computations

Notation: `F.x` is a factor from Annex A; `M.x` a method parameter from Annex B/C; office properties are floor area `A` (m^2), headcount `FTE`, climate zone `z`, country `c`. All emissions in $kgCO_2e$ unless noted; displayed figures are tCO_2e (=kg/1000).

4. The baseline inventory, formula by formula

Computed per office by `computeInventory`; the estate is the plain sum over offices.

4.1 Energy (Scopes 1 and 2)

Entered: electricity `E` (kWh/yr), generator diesel `D` (L/yr), natural gas `G` (kWh/yr), LPG `L` (kg/yr), renewable (market) share `r_mkt` (%).

Defaults when blank (all Tier 3): E_0 `= A × EUI(z) × (1 − g/100)` and D_0 `= A × EUI(z) × (g/100) / e_d`, where `EUI(z)` is the climate-zone benchmark (Annex C), `g = 20%` the default generator share, and `e_d = 3.8` kWh useful energy per litre of diesel at

typical genset efficiency. If electricity *is* entered but diesel is not, diesel is assumed **0 at Tier 3** (unknown ≠ declared absent).

```
S1 = D·F.diesel + G·F.natgas + L·F.lpg                          [kg]
S2 = E · grid(c)                                                [kg]
(location-based, reported)
S2m = E · (1 − r_mkt/100) · grid(c)                             [kg]
(market-based, shadow)
```

Energy conversions for the intensity indicator: diesel `D·3.8` kWh, LPG `L·12.8` kWh. Primary energy `P = 2.0·E + 1.1·(D·3.8 + G + L·12.8)` (electricity primary factor 2.0, fuels 1.1 — chosen so the EMAS primary-energy goalposts apply).

4.2 Business travel (Scope 3)

Entered: air short-haul `a_s` and long-haul `a_l` (pax-km), premium-cabin share `p` (%), car km `k_c`, rail km `k_r`, fleet petrol `f_p` (L), fleet diesel `f_d` (L). Freight comes from the goods & freight technology table (§8.2).

```
Air    = a_s·F.air_short·(1 + p/100·(1.5−1)) + a_l·F.air_long·(1 +
p/100·(2.9−1))
Car    = k_c·F.car        Rail = k_r·F.rail
Fleet  = f_p·F.petrol_l + f_d·F.diesel_l
Freight = Σ_rows techAnnual(row)
(§8.2)
S3t    = Air + Car + Rail + Fleet + Freight
```

The premium-cabin multipliers (1.5 short, 2.9 long) are DEFRA-style seat-area factors applied to the premium *share* of pax-km. The per-FTE travel figure shown everywhere is `S3t / FTE` — an output. Only if **no** activity field is entered does the tool fall back to a directly-entered kg/FTE (labelled "fallback"), else to the 350 kg/FTE Tier-3 default.

4.3 Staff commuting (Scope 3 category 7 — opt-in)

Zero unless commuting mode counts are entered, so pre-existing baselines never shift. From the commuting table (staff count `n` and one-way km `d` per mode, mode intensity `i` kg/km):

```
commuting days  cd = M.workingDays × (1 − WFH%/100)
(workingDays = 220)
S3c = Σ_modes n · d · 2 · cd · i
```

4.4 Water, waste, paper (Scope 3 other)

Waste is stream-based when any stream is entered (residual `w_r`, recycled `w_c`, organic `w_o`, kg/yr): total `W = w_r+w_c+w_o`, diversion `v = (w_c+w_o)/W·100` % — both computed. Fallback: direct total + diversion %, else per-FTE defaults.

```
WasteE = W·(1−v/100)·F.landfill + W·(v/100)·F.diverted     (0.45 /
0.02 kg per kg)
WaterE = V · F.water                                        (V m³/yr ×
0.34 kg/m³)
PaperE = s · FTE · 220 · F.sheet_kg · F.paper_kg            (0.005
```

```
kg/sheet × 0.92 kg/kg)
S3o    = WasteE + WaterE + PaperE
```

Paper `s` (sheets/FTE/day) is computed from reams when entered: `s = reams·500 / (FTE·220)`.

4.5 Totals, tier share, confidence

```
total        = S1 + S2 + S3t + S3o + S3c            (location-based,
the reported figure)
totalMarket  = S1 + S2m + S3t + S3o + S3c           (market-based
shadow)
Tier-1 share = Σ (emissions of parts whose tier = 1) / total
confidence   = Σ (emissions-weighted tier half-widths)
(±5/20/40%)
```

5. Worked example: one office, by hand

Greenkot Central Office (Civic Centre): A = 9,500 m², FTE = 480, Hot-dry, India (grid 0.71). Entered data as shipped in the test pack. Every line below can be checked against the tool, which displays 1,424.8 tCO₂e for this office.

Scope 1. Diesel 8,200 L × 2.68 = **21,976 kg = 21.98 t ✓**

Scope 2. 1,520,000 kWh × 0.71 = **1,079,200 kg = 1,079.20 t ✓** Market-based shadow: 1,520,000 × (1−0.18) × 0.71 = 884.9 t.

Business travel (premium share p = 8%):

Term	Computation	kg
Air short	92,000 × 0.15 × (1+0.08×0.5) = 13,800 × 1.04	14,352
Air long	18,000 × 0.11 × (1+0.08×1.9) = 1,980 × 1.152	2,281
Car	224,000 × 0.17	38,080
Rail	61,000 × 0.04	2,440
Fleet	9,800×2.31 + 14,200×2.68 = 22,638 + 38,056	60,694
Freight (table)	tanker/van/collection rows	17,000
S3t		**134,847 = 134.85 t ✓**

Commuting (WFH 5% → cd = 220×0.95 = 209 days):

Mode	n × d × 2 × 209 × i	kg
2-wheeler ICE	258 × 7 × 2 × 209 × 0.083	62,657

Mode	n × d × 2 × 209 × i	kg
Bus	58 × 9 × 2 × 209 × 0.10	21,820
Car solo	68 × 11 × 2 × 209 × 0.17	53,153
Carpool	26 × 12 × 2 × 209 × 0.068	8,868
e-2-wheeler	16 × 6 × 2 × 209 × 0.021	843
Walk/cycle	× 0	0
S3c		**147,341 = 147.34 t ✓**

Water, waste, paper. Streams 62,400/24,000/9,600 kg → W = 96,000, v = 35%: WasteE = 62,400×0.45 + 33,600×0.02 = 28,080+672 = 28,752… *note the engine computes `W(1−v)·0.45 + W·v·0.02 = 28,080 + 672 = 28,752 kg? Displayed component: 28.08 + 0.48 + 0.19 = 28.75 t — identical, decomposed per stream.* Water 4,820×0.34 = 1,639 kg. Paper 4,800 reams × 500 = 2.4 M sheets × 0.005 = 12,000 kg × 0.92 = 11,040 kg. **S3o = 28,752 + 1,639 + 11,040 = 41,431 kg = 41.43 t ✓**

Total = 21.98 + 1,079.20 + 134.85 + 41.43 + 147.34 = 1,424.79 t ✓ — matching the tool to the second decimal. **Tier-1 share** = (S1 + S2 + water + paper as invoiced… i.e. emissions of Tier-1-backed parts)/total = **76.6%** as displayed.

6. Indicators and scoring

Ten indicators are computed per office (values for the worked office in brackets):

Indicator	Formula	HQ value
Final energy kWh/m² (primary)	P / A	323.6
GHG kg/m²	total·1000 / A	150.0
Renewable %	r_mkt (baseline)	18
Travel kg/FTE	S3t / FTE	280.9
Water m³/FTE	V / FTE	10.04
Waste kg/FTE	W / FTE	200
Landfill %	100 − v	65
Paper sheets/FTE/day	s	22.7
Green tenders %	green/total×100	16.7
Space m²/FTE	A / FTE	19.8

Score per indicator (goalposts `good`, `bad` from Annex B):

```
score = clamp( (value − bad) / (good − bad) × 100 , 0, 100 )
if underlying tier = 3:  score = min(score, 40)
```

Worked: energy 323.6 against (good 60, bad 300): (323.6−300)/(60−300)×100 = −9.8 → **0**. GHG 150.0 against (5, 120): (150−120)/(5−120)×100 = −26 → **0**. Renewable 18 against (80, 0):

18/80×100 = **22.5**. Water 10.04 against (6.4, 25): (10.04−25)/(6.4−25)×100 = **80.4**. Paper 22.7 against (15, 60): **82.9**.

Aggregation. Domain score = arithmetic mean of its indicators; overall = geometric mean of the six domain scores (each floored at 1 to keep the geometric mean defined):

```
overall = exp( (1/6) Σ ln(max(1, domain_d)) )
```

Domains: Energy & carbon {energy, GHG, renewable} · Mobility {travel} · Resources {waste, landfill, paper} · Water {water} · Procurement & ICT {green tenders} · Governance & estate {space}. The worked office lands at **39** — the geometric mean punishes its zero-scoring energy domain in a way an arithmetic mean would hide, which is the design intent: a brilliant paper policy cannot buy off a terrible energy performance.

Maturity (independent axis): L0 registered → L1 any datapoint → L2 focal point + policy + metering plan → L3 verified + green procurement + Tier-1 share ≥ 50% → L4 disclosed + overall ≥ 70. Each claim carries a clickable evidence note.

7. Projection: BAU and the grid path

At year `t` after the baseline, with drivers `r` (%/yr — method defaults, overridden per scenario, then per office; Annex A lists the shipped defaults):

```
FTE(t)   = FTE·(1+r_fte)^t          E(t) = E·(1+r_floor)^t
fuels(t) = fuels·(1+r_fuel)^t       travel/FTE(t) =
(S3t/FTE)·(1+r_travel)^t
water, waste, paper scale with headcount.
```

Grid factor at year t — two regimes, anchored beating assumed:

```
if country c has a target-year anchor (value g_T in year T):
    grid(t) = g_0 · (g_T / g_0)^( t / (T − t_0) )          (geometric
through the anchor)
else:
    grid(t) = g_0 · (1 − r_grid/100)^t
```

Worked: India g_0 = 0.71, driver 3.5%/yr → grid(2030) = 0.71×0.965^6 = **0.573**. With an anchor 0.35 by 2035: 0.71×(0.35/0.71)^(6/11) = **0.483**. Under the anchor, estate BAU 2030 falls from 3,680 to 3,295 t — and the Compare page reports the grid-driven share separately: estate BAU with the grid *frozen* at g_0 is 4,260 t, so **580 t of the BAU "improvement" belongs to the grid, not to the estate**, and is labelled so.

Worked office: BAU 2030 = 1,320.2 t; with grid frozen 1,540.7 t.

8. Scenarios: measures and technology transitions

8.1 Measures

A measure `m` has an abatement range `[ab_lo, ab_hi]` (% of its target component), a target (`elec`, `diesel`, `travel`, `water`, `landfill`, `paper`, `s3o`, `elecMkt`), a cost class, an actor, and

optionally a generation flag (`gen`). Applied multiplicatively to its component at the chosen bound (lo/mid/hi), scaled by **fit**:

```
effect = component × ab(bound) × fitScale        ab capped at 95%
```

`fitScale` implements a–b at the measure level: 0 (and the box greys out) when the end-state technology is already installed; partial when partially installed. Where the office's technology table for the same system carries any transition in the edited scenario, the measure is **superseded** (shown with the reason) — the table wins, preventing double-counting. Generation measures (`solar`, `genset`, `shw`) additionally accumulate their kWh into on-site generation (§9.1).

8.2 Technology transitions

For category `cat`, current-technology row (count `n`, and for transport distance `d`), transition (to technology `b`, share `q` %):

```
unit categories:      annual(tech) = n × i_tech
[kWh, m³, kg, ream units — Annex D]
distance categories:  annual(tech) = n × d × trips/day × days × i_tech
                      days = commuting days (net of WFH) for
commuting; 1 for freight (d is km/yr)
Δ(row) = ( annual(a) − annual(b) ) × q/100
```

Worked (the s1 lighting plan at the Central Office): 600 T8 tubes (110 kWh/fixture/yr) → LED (35), 50%: Δ = 600 × 0.5 × (110–35) = **22,500 kWh/yr**. At 2030 under the BAU grid: 22,500 × 0.573 = **12.9 tCO₂e/yr**.

Calibration. Bottom-up implied consumption per component (`Σ annual(current stock)`) is compared to the metered total; if implied > metered, all deltas in that component scale by `metered/implied` (never above 1). At the worked office the electricity tables imply less than the meter (scale 1.0) but the water-fixture inventory over-implies: scale **0.644** — visible on the table, and the reason a fixtures transition saves less than its naïve arithmetic. One function computes every transition delta for projection, savings display and economics alike, so the three can never disagree.

8.3 One scenario, in full

s1 "Moderate — no & low cost" as shipped: 68 measure selections and 60 transitions across 10 premises → estate 2030 = **3,410 t** (–7.3% vs BAU); s2 "Ambitious — solar & retrofit": 112 and 188 → **2,258 t** (–38.6%). The abatement band (lo/hi bounds) is displayed around every mid trajectory.

9. Derived indicators under scenarios

9.1 Renewable share of consumption

```
consumption = purchased + generated          renewable = generated +
purchased·r_mkt
renew% = renewable / consumption × 100
```

Generated kWh comes from `gen`-flagged measures (each contributes its abatement of the electricity then remaining). Under s2, the estate reaches **30.0%** renewable — PV displaces purchases *and* counts as renewable consumption — yet still misses a 50% goal: the honest reading that generation alone does not get there without a green tariff on the residual.

9.2 Landfill share

Base share `1 − v/100`; measures targeting `landfill` move it multiplicatively; a waste-route transition out of landfill to a diversion route moves it too:

```
share' = share × (1 − q/100)      per transition row from landfill
```

Indicator only: the tonnes of that diversion are already counted once through the transition delta; adjusting the emissions term too would double-count (found and fixed by exactly that check — totals must not move when the indicator adjustment is applied). Worked: s1 plans 30% out of landfill → 76.4%×0.70 = **53.5%**; s2 plans 55% → **34.4%**.

10. Goals and the gap advisor

A goal is a typed object: *reduction vs baseline* (`target = base×(1−pct/100)`) or a *threshold* (≥ or ≤), each with its **own target year** (default: the first horizon). It is evaluated against baseline, latest actuals, BAU and the ★ plan at that year; "met" means the ★ plan's mid-bound estimate satisfies it. A goal set beyond the first horizon carries **decade milestones** — a 2050 target is shown with its expected 2030 and 2040 readings, because a 24-year goal is managed through checkpoints, not stared at from a distance. Progress = share of the *required movement from baseline* delivered.

The gap advisor answers "the target is not met — what would meet it?" For each unmet goal it enumerates every candidate the plan has not taken up:

- unselected measures, where they physically fit (a–b) and are not superseded;
- for every technology row with stock, a switch to the cleanest *compatible* technology in its category at 100% (or deepening an existing partial transition). Compatibility is enforced by service class — a toilet cannot become a urinal, a waste-collection truck cannot become a parcel van, an AC is not a ceiling fan.

Each candidate's effect is computed by the projection engine itself (the affected office is recomputed under a cloned scenario — no heuristics), candidates are ranked, then applied cumulatively in rank order until the target is crossed or the list is exhausted. The output names each intervention, its premises, its **actor**, its **cost class** (with an explicit warning counting the items that need a capital budget line), its individual effect and the cumulative position; every row carries → **Open**, which lands on the exact sector page, tab, office and ★ scenario where that change is made — the advisor recommends, it never writes to the plan itself — and, when the whole catalogue is not enough, says so: for the Greenkot −45% GHG goal, all 347 candidates reach 2,378 t against a 2,159 t target, so the tool states the remainder requires an instrument outside the catalogue (green tariff on residual electricity, driver policy, or target revision) rather than leaving a red chip unexplained.

11. Ex-post: actuals, the implemented register, attribution

Annual actuals are entered per office per year; fields not re-entered carry forward at Tier 3, flagged. The Trajectory page plots estate actuals against BAU and the ★ plan band, and the year-by-year table interpolates expectations linearly between model years.

The **implemented-interventions register** (MRV page) records which planned measures and transitions were actually delivered and when. Trajectory then computes, per actual year `y`:

```
expected_impl(y) = projection under a synthetic scenario containing
only
                   register entries with year ≤ y
claimable(y)     = BAU(y) − expected_impl(y)
unexplained(y)   = actual(y) − expected_impl(y)
```

Worked (Greenkot 2025, three registered interventions at the Central Office): actual **3,892**, BAU **3,878**, expected-implemented **3,691** → claimable **−187 t**, unexplained **+201 t**. The +201 is not a scandal — most of it is nine premises' carried-forward Tier-3 actuals — but it is *visible*, which is the point: a saving claim without this register is unattributable.

12. Economics

Each measure/transition line is costed from the unit-cost table (Annex F): energy, water, paper and waste savings valued at lo/mean/hi unit costs, carbon at the shadow price. The measure-economics view on Compare ranks by cost-effectiveness; cost classes (none / low / capital) come from the measure library. Costs are deliberately coarse — the tool ranks and scopes; it does not replace an investment-grade audit, and says so.

Part III — Operations

13. The workflow, page by page

The sidebar reads top-to-bottom as the workflow; the Estate Dashboard is pinned above the groups. Dots mark data presence — guidance, never a gate.

Project Home / Estate Dashboard. Standing overview: footprint tiles under the scenario lens (switchable in the sidebar), Tier-1 share, performance-vs-maturity quadrant (execution gap vs missing system), per-premises footprint, the estate indicator ring (full ring = benchmark), blocked measures by actor.

Setup → Organisation & Offices. Identity, baseline year, estate BAU drivers, the goals editor, the premises register (register with three fields; delete with a confirmation that states exactly what is lost), and the whole Excel route in one card.

Setup → Scenarios. The three slots: rename, describe, driver overrides, ★ selection, clear, and the parked-scenario swap for pre-slot projects.

Sectors (Energy · Mobility · Water & Waste · Procurement & ICT). One page per data call. Tabs: Activity data (values + tiers + computed-indicator cards + per-office driver overrides) · one tab per technology category (stock + per-scenario transitions + calibration line) · Policies & operations (measures, with fit and supersession shown) · Results (this sector across scenarios; the Procurement page labels its tonnes as the shared consumables slice that its instruments shrink). **By office (all data)** shows every field of every office with performance, maturity and tier.

Governance. Maturity checklist with evidence; actor roles; the Accountability re-cut and blocked-measures register.

Results — ex-ante. Compare Scenarios (trajectories + band, savings by actor, the separately-reported grid share, measure economics; Excel/PNG export) and ES Goals (per-goal cards with the gap advisor).

Ex-post. Annual Actuals; Trajectory vs Plan (with the ex-post attribution card); MRV & Data Calls (assignments through two gates, the implemented register, frozen hashed releases, append-only audit).

Analysis Report (Results group) — the whole analysis as one printable document; Print → "Save as PDF" renders it offline with vector charts, from the same engine calls as the live pages.

Reference → Factors & Method. Every parameter, editable, versioned; the grid target-year anchor columns; the method summary.

14. The Excel round trip

The template *is* the data call, and it is exported **after** planning, so the plan travels inside it.

Workbook	Sheets
SETUP	Organisation · Offices · Goals (incl. per-goal target year) · Scenarios · ScenarioPlan · ScenarioMeasures
Per sector	Offices · that sector's data sheet · its Stock_* sheets · the three scenario sheets (that sector's rows)
Full	ReadMe + all of the above (25 sheets)

Import rules, all verified by automated round-trip tests: only sheets present are read (a returned Energy workbook cannot touch Mobility); offices match by name with case, punctuation and dash-style normalised; unknown premises open a **reconciliation dialog** (nothing written until the user chooses; ambiguous matches are never auto-merged); stock columns are located by header text so a differently-ordered workbook cannot misfile counts; numbers survive human spreadsheets (thousands separators, comma decimals, unit suffixes, text-formatted cells — the unparseable remainder is quoted back by office and field); scenario sheets replace only the sectors they cover. Every import ends with a report: per-sheet applied/skipped counts, premises created, unmatched names, and where the data landed.

Reference round trip (from an empty project, importing the five filled Greenkot sector workbooks in order): estate 4,270 (setup, Tier-3 defaults) → 3,544 → 3,958 → 3,926 → **3,926 t** with s1 = **3,410** and s2 = **2,258** — identical to the shipped project, plan included.

15. Data management, MRV and releases

The browser's IndexedDB autosaves every change; the `.greengov.json` export is the archive and hand-off format and contains *everything*, including the versioned method block and factor library, so any figure can be recomputed later. Imports validate and migrate additively (new catalogue entries and measures appear; user values are never overwritten; surplus scenarios park rather than vanish). An optional loopback-only `server.js` provides an explicit mirror with optimistic concurrency and `.bak` files.

MRV-lite mirrors a server-grade workflow in one file: data calls pass submission → QC → approval with returns restarting the chain; every mutation appends to the audit log; a **release** freezes baseline/BAU/plan totals with the approved-call count and an FNV-1a content hash, archiving the factor versions with it. Editing any factor afterwards marks the library `-edited` — the published figure stays regenerable and the deviation traceable.

16. Quality assurance of the tool itself

The package ships its own verification, which a reviewer can run:

- `npm test` — 72 unit tests (`node:test`, zero dependencies) transcribing the worked examples of this manual and the Exercise Book's answer key into assertions: the Central Office inventory to the decimal, commuting, grid driver and anchor paths, transition a–b with calibration, scoring incl. the geometric mean and proxy cap, import migration (slot folding, additive catalogue), Excel number parsing, the gap advisor's verdicts and service-class rules, and the shipped default factors.
- `node smoke.mjs` — loads the test estate, visits all 17 pages and all 26 sector sub-tabs, fails on any script error, any page rendering empty, any missing template/import control, any view orphaned from navigation, any breach of the workflow order, and any export that fails to produce a file.
- `./verify.sh` — the whole gate in order: build → unit → integration → smoke.
- Round-trip tests (project JSON; five sector workbooks; whole workbook; a deliberately column-shuffled workbook; a v0.16-era legacy workbook) all reproduce 3,926 t and the full plan.
- Engine identity checks: Scope components sum to totals under every scenario (≤0.01 t); dashboard baseline equals projection at t=0; Goals, Compare, Trajectory and the dashboard lens all derive the same ★ figure; the transition delta used by projection, savings display and economics is one shared function (a 37 t three-way discrepancy was found and eliminated by unifying it).
- `samples/console-check-stock.js` — a read-only console diagnostic that prints where every stored technology count sits, for "the import said N but my table is empty".

17. Troubleshooting

Imported values but tables look empty — read the import report's "data landed on" line; check the office selector; run the console diagnostic. Almost always the data matched (or created) different premises.

A transition doesn't change results — check the scenario column edited vs compared, the % > 0, the stock count > 0, and the calibration line (a scaled component saves less than naïve arithmetic).

Old project crashes or misses categories — re-import through the landing page; migration rebuilds the catalogue and parks surplus scenarios.

Numbers changed after editing factors — intended; the factor version now ends `-edited` and appears in exports and releases.

A goal seems unreachable — it may be: run the gap advisor and read its verdict; the tool will say when the catalogue cannot close the gap.

Annexes

Annex A — Factor library (shipped values)

Illustrative defaults in the range of common public factor sets (IPCC 2006 fuel factors, national grid bulletins, DEFRA-style travel factors). Replace with national values on the Factors page; edits version-mark the library.

Fuels ($kgCO_2e$): diesel 2.68/L · petrol 2.31/L · natural gas 0.18/kWh · LPG 2.98/kg. Conversions: diesel 3.8 kWh useful/L (genset), LPG 12.8 kWh/kg.

Travel ($kgCO_2e/km$): air short-haul 0.15, long-haul 0.11 (per pax-km); car 0.17; rail 0.04; van 0.25; truck 0.85. Premium-cabin multipliers ×1.5 short, ×2.9 long.

Water/waste/paper: water 0.34 kg/m^3 · landfill 0.45 kg/kg · diverted 0.02 kg/kg · paper 0.005 kg/sheet and 0.92 $kgCO_2e$/kg.

Grid ($kgCO_2e/kWh$), editable per country, with optional target-year anchor. Shipped examples include India 0.71 and a Generic default 0.45.

Climate-zone EUI benchmarks ($kWh/m^2/yr$): Temperate 170 · Hot-dry 200 · Hot-humid 230 · Cold 240 · Tropical highland 150.

BAU driver defaults (%/yr): headcount 1.0 · floor 0.5 · travel 2.0 · fuel 0.0 · grid decarbonisation 2.5. (The Greenkot project overrides these: 1.5/1.0/2.0/0.5/3.5.)

Annex B — Goalposts, domains, scoring parameters

Indicator	Goalpost 100	Goalpost 0	Domain
Final energy (primary) kWh/m²/yr	60	300	Energy & carbon
GHG kgCO_2e/m²/yr	5	120	Energy & carbon
Renewable share %	80	0	Energy & carbon
Business travel kg/FTE/yr	50	800	Mobility
Water m³/FTE/yr	6.4	25	Water
Waste kg/FTE/yr	100	400	Resources
Waste to landfill %	0	100	Resources
Paper sheets/FTE/day	15	60	Resources
Green-criteria tenders %	80	0	Procurement & ICT
Space m²/FTE	12	35	Governance & estate

Primary-energy factors 2.0 (electricity) / 1.1 (fuels); Tier-3 score cap 40; provisional ° above 50% proxy indicators; domain mean arithmetic, cross-domain geometric (floor 1). Award bands (communication layer only): Gold ≥90, Silver ≥80, Bronze ≥60.

Annex C — Tier-3 defaults and plausibility bounds

Defaults: travel 350 kg/FTE · water 12 m³/FTE · waste 250 kg/FTE (15% diverted) · paper 30 sheets/FTE/day · generator share 20% of building energy. Tier half-widths ±5/20/40%.

Bounds (entry warnings, non-blocking): electricity ≤800 kWh/m² · diesel ≤400 kWh/m² · travel ≤5,000 kg/FTE · water ≤100 m³/FTE · waste ≤2,000 kg/FTE · paper ≤200 sheets/FTE/day; percentage fields 0–100; green tenders ≤ total tenders.

Annex D — Technology catalogue (14 categories, 99 technologies)

Intensities are per-unit annual figures (`i`); transitions compute a–b from them (§8.2). Distance categories carry count *and* km per row.

Lighting (kWh/fixture/yr): incandescent 200 · halogen 150 · T12 125 · T8 110 · T5 75 · CFL 45 · LED 35 · LED panel 90 · HPSV compound 1,100 · solar outdoor 0.

Cooling & ventilation (kWh/unit/yr): ceiling fan 190 · BLDC fan 80 · pedestal fan 140 · evaporative cooler 300 · window AC 3,000 · fixed split 2,600 · inverter 3★ 2,100 · inverter 5★ 1,700 · VRF/TR 1,400 · chiller std/TR 1,000 · chiller HE/TR 820.

Office equipment (kWh/unit/yr): desktop+monitor 250 · laptop 75 · thin client 35 · MFD 600 · MFD ENERGY STAR 300 · server 3,000 · fridge old 750 · fridge 5★ 220 · dispenser 800 · dispenser ES 440 · kettle/urn 400 · microwave 175 · induction 600 · lift 2,500.

Water heating (kWh/unit/yr): geyser 600 · instantaneous 250 · solar 0. **Water pumping (kWh/pump/yr):** fixed 1,500 · VFD 1,050 · solar 0.

Water sources ($kgCO_2e/m^3$): mains 0.34 · borehole 0.50 · tanker 1.20 · rainwater 0.05 · greywater 0.15. **Wastewater ($kgCO_2e/m^3$):** sewer+treatment 0.30 · septic 0.70 · untreated 1.00 · on-site plant 0.25 · wetland 0.10. **Water fixtures (m^3/fixture/yr):** single-flush 58 · dual-flush 22 · standard tap 34 · low-flow 15 · sensor 10 · urinal 24 · waterless 0.

Waste routes ($kgCO_2e$/kg): landfill 0.45 · open burning 1.20 · incineration+energy 0.30 · recycling 0.02 · composting 0.05 · waste bank 0.02. **Paper ($kgCO_2e$/ream):** virgin 2.3 · certified 2.0 · recycled 1.4 · digital 0.

ICT embodied ($kgCO_2e$/device/yr): desktop 4-yr 90 / 6-yr 60 · laptop 4-yr 50 / 6-yr 33 · thin client 20 · refurbished 15.

Staff commuting ($kgCO_2e$/km, ×2 trips × commuting days): walk 0 · bus 0.10 · rail 0.04 · 2-wheeler 0.083 · e-2-wheeler 0.021 · car solo 0.17 · carpool 0.068 · EV 0.107 · shuttle 0.05. **Freight ($kgCO_2e$/km, km/yr):** courier 0.083 · van diesel 0.25 · van EV 0.075 · truck small 0.50 · truck large 0.85 · taxi 0.17 · water tanker 0.60 · waste collection 0.80. **Fleet ($kgCO_2e$/vehicle/yr):** petrol 2,200 · diesel 2,300 · CNG 2,150 · hybrid 1,550 · EV 1,450 · 2-wheeler 800 · e-2-wheeler 300 · pickup 3,100.

Users can add technologies (with intensity and source) — additions live in the method block and travel with the project.

Annex E — Measure library (27 measures)

Id	Measure	Target	Abatement	Cost	Actor
led	LED luminaire retrofit	elec	8–15%	low	Owner/ landlord
occ	Occupancy sensors	elec	4–6%	low	Facility operator
day	Daylight dimming	elec	3–6%	low	Owner/ landlord
bmsctl	Controls: schedules, setpoints 24–26°C, night shutdown	elec	5–15%	none	Facility operator

Id	Measure	Target	Abatement	Cost	Actor
invac	Inverter/VRF replacement	elec	10–25%	capital	Owner/ landlord
chiller	High-efficiency chiller	elec	5–15%	capital	Owner/ landlord
maint	Coil/filter/ refrigerant maintenance	elec	4–10%	none	Facility operator
freecool	Economiser/ free cooling	elec	0–10%	low	Facility operator
film	Solar film & shading	elec	3–12%	low	Owner/ landlord
insul	Roof insulation	elec	2–8%	capital	Owner/ landlord
solar ⚡	Rooftop PV (grid-tied)	elec	10–30%	capital	Owner/ landlord
genset ⚡	PV + storage generator displacement	diesel	30–80%	capital	Owner/ landlord
tariff	Green tariff / PPA	market share	40–100%	none	Payer (utilities)
shw ⚡	Solar water heating	elec	0–2%	low	Owner/ landlord
travbud	Travel carbon budget	travel	10–30%	none	Occupier
vcfirst	Videoconference-first	travel	15–40%	low	Occupier
econ	Economy-class policy	travel	10–30%	none	Occupier
fleetev	Pool-fleet electrification	travel	10–35%	capital	Procuring authority
fix	Low-flow fixtures & dual-flush	water	10–25%	low	Owner/ landlord
leak	Leak detection & repair	water	5–15%	low	Facility operator
rain	Rain/ greywater	water	10–40%	low	Owner/ landlord

Id	Measure	Target	Abatement	Cost	Actor
	harvesting				
seg	Segregation + recycling contract	landfill	40–70%	low	Owner/ landlord
bank	Waste bank & composting	landfill	10–30%	none	Occupier
paperless	Digitisation / paperless	paper	20–60%	low	Occupier
printmgmt	Managed print (duplex, quotas)	paper	15–30%	none	Procuring authority
gpp	Green criteria in tenders	upstream	5–15%	none	Procuring authority
ictlife	ICT lifetime extension	upstream	3–8%	none	Procuring authority

⚡ = counts as on-site generation for the renewable share. `led`, `invac`, `fix`, `rain`, `fleetev` retire when the corresponding technology table is populated (the table carries the decision); the others coexist with tables, with supersession per system as in §8.1.

Annex F — Unit costs (USD, lo/mean/hi — replace with local tariffs)

Electricity 0.08/0.12/0.18 per kWh · diesel 0.80/1.00/1.30 per L · water 1.0/1.5/2.5 per m^3 · paper 0.006/0.010/0.014 per sheet · waste 0.02/0.05/0.10 per kg · carbon 1/5/50 per t (shadow).

Annex G — File formats

`.greengov.json` — the archive: format/version headers, project descriptor, and `data` = { factors (incl. grid targets), method (goalposts, catalogue, measures, costs, goals, drivers, versions), offices (identity, actors, data with tiers, maturity + evidence, blocked, technology stock, actuals), scenarios (3 slots), retiredScenarios, implemented register, MRV store }. Everything needed to recompute every figure.

Workbooks — sheet inventory as §14; value+tier column pairs on data sheets; stock sheets one column per technology (two + WFH for transport); scenario sheets in long format keyed on slot ids.

Annex H — Glossary

a–b saving = current-technology consumption minus replacement's. **Anchor** — a stated target-year grid factor overriding the %/yr driver. **BAU** — growth + grid decarbonisation, zero estate action. **Calibration** — capping bottom-up stock estimates at metered totals. **Claimable**

saving — BAU minus expected-with-implemented. **Data call** — a formal, gated request to an office for a period's data. **Driver** — a %/yr growth assumption. **Goalpost** — fixed benchmark value scoring 100 or 0. **Release** — a frozen, hashed, factor-archived snapshot for publication. **Slot** — one of the three fixed scenario positions (bau/s1/s2). **Supersession** — a table's transitions retiring the equivalent checkbox measure. **Tier** — evidence class 1/2/3. ★ **planning scenario** — the action slot that Goals and Trajectory report against.

Annex I — Reviewer's checklist

1. Re-run the worked example (§5) from the stated inputs and factors; every component should land within rounding of 21.98 / 1,079.20 / 134.85 / 41.43 / 147.34 / 1,424.79.
2. Verify a score by hand (§6) including the geometric aggregation and the Tier-3 cap.
3. Verify the grid path (§7): $0.71 \times 0.965^{6} = 0.573$; anchored $0.71 \times (0.35/0.71)^{(6/11)} = 0.483$; and that the Compare page attributes 580 t of BAU improvement to the grid.
4. Verify one transition (§8.2): $600 \times 0.5 \times (110 - 35) = 22{,}500$ kWh; check the calibration line's scale is applied where implied exceeds metered.
5. Import the five sector workbooks into an empty project and confirm 3,926 / 3,410 / 2,258 with the plan intact (§14).
6. Run the gap advisor on the −45% goal and confirm it reports unreachability with the whole-catalogue residual (§10) rather than an unexplained failure.
7. `./verify.sh` — build, 72 unit tests, three integration suites and the E2E smoke must all pass; `npm test` runs the dependency-free unit suite alone.
8. Challenge the boundaries: ICT embodied emissions appear only as savings potential, not in the baseline; commuting is opt-in; wastewater route factors affect abatement and water-source accounting but the reported inventory keeps metered components — each is a documented scoping decision a reviewer may legitimately contest.

End of manual.