

DAI – RBC Estimate Daily EWMA Updater v1.0 (Live-Aligned)

Prepared by: ChatGPT (GPT-5 Thinking)
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Design Framework: DAI + RBC Framework v5.85 (October 2025)
Change Reference: Documentation – Live YAML Alignment (No behavioural change).

1. Functional Overview

Updates the ****Daily Demand Estimate**** at 23:59 using a robust EWMA of today's actual total load. The automation reads the current estimate, today's actual usage, and a tunable α helper, computes $\text{new_est} = (1-\alpha) \cdot \text{old_est} + \alpha \cdot \text{actual}$, clamps to 0–120 kWh, and only writes when $|\Delta| > 0.05$ kWh. A Home Assistant start guard ensures the estimator only runs after 23:59 if HA restarts near midnight. All numeric coercion is explicitly guarded against 'unknown'/'unavailable' values to maintain safety.

2. Entity Map

Entity ID / Var	Purpose	Direction
input_number.dai_expected_usage_daily_kwh	Rolling Daily Demand Estimate (kWh) – target helper	Read/Write
sensor.brenchley_total_load_today_kwh	Actual total daily usage (kWh) for current day	Read
input_number.rbc_ewma_alpha_daily	EWMA α (0–1) smoothing factor	Read
max_kwh (var=120)	Clamp ceiling for estimate (kWh)	Constant / Read
deadband (var=0.05)	Minimum absolute Δ to write	Constant / Read
input_text.dai_estimator_reason (optional)	Text sink for traces (not written in current YAML)	—

Numeric Sanitisation: all inputs use explicit guards to coerce non-numeric states to 0.0. α is bounded to 0...1.

3. Trigger Matrix

Trigger ID	Condition	Purpose
t_2359	Time = "23:59:00"	Primary nightly estimate update
t_ha_start	Home Assistant Start AND current time \geq 23:59	Guarded restart handling

4. Logic Flow

1. If trigger is t_ha_start, proceed only when local time \geq 23:59 (otherwise exit).
2. Fetch old_est from input_number.dai_expected_usage_daily_kwh (safe-coerced).
3. Fetch actual_daily from sensor.brenchley_total_load_today_kwh (safe-coerced).
4. Fetch alpha from input_number.rbc_ewma_alpha_daily; bound to [0,1] with default 0.30.
5. Compute unclamped = $(1 - \alpha) * \text{old_est} + \alpha * \text{actual_daily}$.
6. Clamp new_est = $\min(\max(\text{unclamped}, 0), 120)$.
7. If $|\text{new_est} - \text{old_est}| > 0.05 \rightarrow$ write rounded 2dp to input_number.dai_expected_usage_daily_kwh and log to logbook.
8. Else: no write (automation ends without log in this YAML).

5. Guards and Safety

- No inverter writes – helper only.
- Explicit coercion of 'unknown'/'unavailable' to 0.0 prevents template errors.
- α is bounded to 0...1 to avoid instability.
- Clamp 0–120 kWh prevents runaway estimate values.
- Deadband 0.05 kWh reduces churn and log noise.
- `mode: single` avoids overlapping midnight and HA-start runs.

6. Scheduling

Runs nightly at 23:59:00 and on HA start (only if current time is 23:59 or later) to protect against restarts near midnight.

7. Acceptance Tests

Test ID	Scenario	Expected Result
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T1	Normal 23:59 run with $\Delta > 0.05$	Helper updates; logbook entry 'RBC — Daily Forecast EWMA' written.
T2	$\Delta \leq 0.05$	No write performed; estimate unchanged.
T3	HA restart at 23:45	Guard prevents execution; no write.
T4	HA restart at 23:59	Guard allows execution; write occurs if $\Delta > 0.05$.
T5	alpha helper out of range (-0.2 or 1.5)	α bounded into $[0,1]$; computation proceeds safely.
T6	Unknown sensor values	Coercion to 0.0 ; computation proceeds; clamp enforces $0-120$ kWh.

8. Version Lineage & Governance

v1.0 – Nightly 23:59 EWMA update with HA-start guard, numeric sanitisation, 0.05 kWh deadband, and $0-120$ kWh clamp.

Governance: Protected Architecture Mode v5.9; Two-Phase Code-Change Gate v2.2. This document is aligned to the supplied live YAML; no code changes introduced.

9. YAML Reference (Read-Only Excerpt)

triggers: t_2359 @ "23:59:00", t_ha_start (guard: time \geq "23:59")

vars: old_est, actual_daily, alpha (bounded), unclamped, max_kwh=120, new_est (clamped), deadband=0.05, delta, need_write

write: input_number.dai_expected_usage_daily_kwh when need_write; logbook name "RBC — Daily Forecast EWMA".

10. Compliance Checklist

- ✓ Entity \leftrightarrow ID alignment confirmed against live YAML: dai_expected_usage_daily_kwh, brenchley_total_load_today_kwh, rbc_ewma_alpha_daily.
- ✓ Triggers have IDs and HA-start time guard present.
- ✓ Visual-Editor-safe structure; no anchors/includes.
- ✓ No inverter writes; Master-only rule unaffected.
- ✓ Design references retained in description when editing YAML in future.