DAI – Cosy Night Cheap Charge v1.2 – Detailed Design Specification (v1.0)

Issue Date: 2025-10-26

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Design Framework: DAI + RBC Framework v5.85 (Oct 2025)

Governance Reference: CR001 (Addendum A – Trigger-Only Enhancement, approved 26-10-2025)

Change Control: No-Surprises Protocol – Semantics Frozen by default.

1. Functional Overview

The DAI – Cosy Night Cheap Charge (v1.2) automation manages Octopus Cosy's third cheap-rate window (22:00–23:59). It ensures the inverter charges only when required, maintains SoC hysteresis control, and enforces a hard stop at 23:59 to return to Self Use Mode. A secondary verifier at 00:02 ensures the inverter mode is correct even if the midnight stop was delayed. The automation is fully Visual-Editor safe and references only the SolaX Master inverter entities.

2. Entity and Helper Map

Role	Entity ID	Direction	Description
Tariff selector	input_select.octopus_tariff_d	Read	Indicates current tariff (Cosy/Flux/etc.)
Session override flag	input_boolean.dai_session_override_active	Read/Write	Prevents conflicting session writes
Battery SoC (%)	sensor.solax_house_battery_capacity	Read	Monitors Master inverter battery capacity
Target SoC (%)	number.solax_house_selfuse_nightcharge_upper_soc	Read	Grid Planner target; controller references only
Charger Mode	select.solax_house_charger_use_mode	Write	Primary inverter mode

			control (Self Use / Manual)
Manual Mode Select	select.solax_house_manual_mode_select	Write	Set to 'Force Charge' when charging manually
Logbook entry	logbook.log	Write	Used for recording automation actions

3. Trigger Matrix and Expected Outcomes

Trigger ID	Source	Event/Time	Expected Outcome
t_start_2200	Time	22:00	Begin cheap-rate window; enter Manual/Force Charge if SoC < target
t_tick_2200_2359	Time pattern	Every 1 min (22:00–23:59)	Maintain SoC ladder ±1%; idempotent writes
t_hard_stop_2359	Time	23:59	Apply 5s dwell, set Self Use Mode, log 'Hard Stop applied'
t_verify_0002	Time	00:02	Check mode; if not Self Use → correct + log 'Verifier restored Self Use'
t_tariff_change	State	Tariff change	Force Self Use Mode; exit Cosy window
t_ha_start	Event	Home Assistant start	Re-evaluate if restart during active window

4. Logic Flow Description

• Start (22:00): If tariff = Cosy and override = off, the inverter enters Manual Mode + Force Charge when SoC is below target; otherwise remains in Self Use.
• Tick Loop (22:00–23:59): Reassesses every minute to maintain ±1 % hysteresis control; switches modes idempotently.
• Hard Stop (23:59): Applies a 5 s dwell, then writes Self Use Mode and logs 'Hard Stop applied at 23:59'.
• Verifier (00:02): Confirms inverter returned to Self Use Mode; if not, performs correction and logs the action.
• Tariff Change: If tariff changes during the window, immediately switches to Self Use Mode.
• HA Restart: Logs restart notice; subsequent tick reasserts proper state.

5. Interaction and Control Hierarchy

Layer	Role	Behaviour / Control
Cosy Night Controller	Manages Cosy night charge window	Takes control between 22:00–23:59; yields afterward
Free Energy Session Controller	Overrides during Octopus Free/Saving Sessions	Cosy controller pauses when override ON
Grid Charge Planner	Determines SoC targets	Owns SoC floors; controller reads but does not modify
Minimise PV Clipping	PV surplus manager	Yields during override; resumes normal operation after 00:02

6. Safety and Recovery Mechanisms

• Override guard prevents writes when a Free or Saving Session is active.
• All writes are limited to the Master inverter (solax_house_*).
• Idempotent logic ensures no redundant mode changes.
• Hard Stop includes a 5 s dwell delay to avoid tick collision.
• Verifier at 00:02 acts as a post-window failsafe to restore Self Use Mode.
• HA-start recovery ensures proper state re-evaluation on reboot.

7. Notifications and Logging

The automation does not issue mobile notifications directly. All key actions are logged to the Home Assistant logbook with contextual messages. Example entries include:
• '22:00 start triggered – mode adjusted per SoC and target.'
• 'Hard Stop applied at 23:59 – inverter set to Self Use.'

• '00:02 verifier detected Manual Mode – corrected to Self Use.'
• 'Tariff changed – exited Cosy window, set Self Use Mode.'

8. Acceptance Test Cases

Test Case	Action	Expected Result
A1 – Normal Run	Allow full 22:00–23:59 cycle	Inverter charges then switches to Self Use at 23:59; verifier confirms
A2 – Missed Hard Stop	Simulate tick overlap at midnight	00:02 verifier restores Self Use; log entry present
A3 – Override Active	Enable override flag before 22:00	No writes or mode changes occur
A4 – Tariff Change Mid-Window	Switch tariff helper at 23:30	Controller exits and writes Self Use Mode
A5 – HA Restart During Window	Restart Home Assistant at 23:45	HA-start branch logs restart notice; tick resumes control

9. Version Lineage and Governance

v1.2 (2025-10-26): Added 23:59 Hard Stop (+5 s dwell) and 00:02 Verifier branch. Resolved midnight race condition. Governance Reference: CR001 (Addendum A – Trigger-Only Enhancement). Linked to Design-Doc v5.85 §7.5.
v1.1 (2025-10-25): Unified controller for Cosy cheap-rate window; override guards added.
v1.0 (2025-10-24): Initial Cosy-only Night Charge implementation (consolidated Start/End).