ENERGY MANAGEMENT · MODULE 03

Energy Management Brief

Farm32 · Agadir-Massira · PV + battery dispatch analysis

PROJECT	Farm32 · 650 m² indoor basil facility
LOCATION	Agadir-Massira, Morocco (30.32°N, -9.41°W)
CURRENT DESIGN	480 kWp roof-mount PV + 600 kWh LFP battery · synchronized 18 h photoperiod
SCOPE	Six-scenario design sensitivity on the modelled Farm32 load (16.5 kWh/kg-FW)
ISSUED BY	SOLARA
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A short summary of the Module 03 pre-build energy analysis: how the current design performs, where the deficit lives, and which design and operating levers close the gap.

At a glance

The current 480 kWp PV + 600 kWh battery meets 82 % of annual demand at the EnergyPlus-modelled intensity of 16.5 kWh/kg. Annual PV (830 MWh) exceeds annual load (695 MWh) — the constraint is seasonal storage, not nameplate generation. Shortfall is concentrated in November–February, when consecutive low-irradiance days exhaust the battery before sunrise.

ANNUAL LOAD	PV GENERATION	SELF-SUFFICIENCY	SHORTFALL
695 MWh / yr	**830** MWh / yr	**82.1%** of load met	**124 MWh** 2,733 h / yr

Where the deficit lives

45 % of unmet energy lands in November–February — the four months with the deepest single-month deficits. December carries 16 MWh of unmet energy across 240 shortfall hours; November and January each add ~14 MWh. The remaining shortfall hours spread across summer cooling peaks (Jul–Aug add ~17 MWh combined), but the energy is concentrated in winter.

Only 8 days per year see daytime PV fall below daytime load. The other 357 days produce enough sunlight to cover the lit window; the question is whether the battery can carry the dark side. In winter, with shorter days and frequent cloud, it cannot — and that is where the design and operating levers must act.

Design sensitivity — which levers close the gap

Six configurations at the EnergyPlus-modelled load. Capital levers change hardware; operational levers change how we run. All use the identical TMYx weather year and the synchronized 18 h photoperiod.

Scenario	PV kWp	Battery kWh	Load MWh/yr	Self-suf %	Shortfall h/yr
Current design (current)	480	600	695	82.1	2,733
PV + battery balanced	720	1,800	695	**99.6**	**50**
Double the battery	480	1,200	695	96.4	442
Oversize the PV	720	600	695	86.3	2,422
Trim winter photoperiod	480	600	665	85.8	2,320
Pause production in December	480	600	647	83.2	2,506

Same 8,760-hour dispatch engine, identical weather. Bold row = best-in-track.

What the design track reveals

Storage beats panels. Doubling the battery to 1,200 kWh lifts self-sufficiency from 82 % to 96 % and cuts shortfall from 2,733 h to 442 h. Oversizing PV alone to 720 kWp only reaches 86 % — excess midday generation has nowhere to go without more storage or grid export.

The 99 % point requires both levers. 720 kWp PV with 1,800 kWh battery brings shortfall to ~50 hours per year and self-sufficiency to 99.6 %. The marginal capital between 1,200 and 1,800 kWh buys the residual winter coverage that an oversized PV cannot reach.

Operational levers help at the margin. Trimming the photoperiod by four hours during Nov–Feb lifts self-sufficiency to 86 % at unchanged hardware. A December production halt reaches 83 %. Useful when storage cannot be expanded further, not a substitute for it.

Recommendation

COMMIT FOR PROCUREMENT (DEMO SCOPE)

Hold the 480 kWp PV + 600 kWh battery as the demo reference and procure a single doubling of storage to 1,200 kWh LFP as the first incremental step. This lifts self-sufficiency from 82 % to 96 % at modest capital and removes most of the winter shortfall. The 720 kWp + 1,800 kWh balanced configuration is the design-space sweet spot for near-complete (99.6 %) on-site coverage and is the procurement target if year-one measurement confirms the modelled load curve.

Next steps

- Year-one measurement — instrument the facility to compare measured against the EnergyPlus-modelled load (LED + chiller + aux). Off-envelope loads (dehumidification overhead, post-harvest, standby) are not in this dispatch and should be metered separately for the next sizing pass.
- Hardware procurement — quote 1,200 kWh LFP battery vendors; confirm 150 kW continuous discharge and 90 % usable DoD.
- Operating policy — pre-define the Nov–Feb photoperiod trim as a reserve mode, triggered when measured shortfall exceeds the modelled baseline.
- Module 04 handoff — the committed configuration becomes input to the environmental impact module.

Assumptions & limitations

- Weather — single TMYx weather year for Agadir-Massira (30.32°N, -9.41°W). Inter-annual variability and climate-shift trends not modelled.
- Load source — EnergyPlus 8,760-hour simulation on the Farm32 facility (16.46 kWh/kg-FW). Breakdown: LED canopy 70 %, chiller via COP 3.7 21 %, aux 9 %. Dehumidification overhead, post-harvest, and standby loads sit outside the EnergyPlus envelope and are not included in this dispatch.
- Dispatch model — pvlib PVWatts (30° tilt, 14 % losses) + LFP battery (BATT_RTE 0.92, BATT_DOD 0.90, BATT_POWER_KW 150). Greedy hourly priority. No grid export; no degradation curve.
- Costs — capital cost, NPV, and LCOE not in scope of this brief; sizing recommendations are based on energy and shortfall only.

Full methodology and 8,760-hour traces: SOLARA Design · Module 03 · Energy Management.