

What is proven, and what has to be built

A statement of deployed capability for BiH ancillary services, written to be checked rather than believed. Every claim in the first table has a running plant behind it.

PURPOSE

This document exists so that a counterparty can tell the difference between what COMEX operates today and what COMEX would build for them. It is written for a party evaluating a fourteen-month aFRR-s delivery programme, and it separates the two deliberately. Nothing in the proven column is aspirational; nothing in the gap column is presented as solved.

Rev C, 10 September 2026. Rev B corrected the Raduša battery figures against the plant configuration (Rev A stated 250 kW / 500 kWh; the commissioned pack is 261 kWh at 125 kW), recorded the known caveats on the cross-border corridor branch, and stated plainly that no nomination optimiser is in production. Rev C corrects the curtailment mechanism: the fleet acts on the inverters, by a Modbus active-power setpoint or by a digital-output shutdown signal, never by a site relay or breaker. Every other claim is unchanged.

Deployed fleet

FOUR LIVE SITES – ONE BATTERY, THREE PV CURTAILMENT

Raduša 261 kWh · 125 kW BESS + PV + grid meter. Primary pack 261 kWh, 125 kW charge / 120 kW discharge, plus a 45 kWh secondary pack. A second 261 kWh pack is on order, not yet commissioned. Schneider Modicon M262, industrial PC, OPC UA. Full dispatch stack.	PV site A PV · per-inverter Modbus throttle across two inverters against a market price flag, 96 decisions/day.	PV site B PV · per-inverter Four inverters under Modbus throttle, with a cross-border corridor branch on the export decision.
PV site C PV · shutdown signal Curtailment by a digital-output shutdown signal from the router to the inverters. No per-inverter active-power setpoints.		

The three PV sites are not a pilot. Price-driven curtailment is the delivered product at those sites, and it has been running at fifteen-minute resolution — 96 control decisions per site per day — long enough to have a measured defect rate, which appears further down.

Proven capability

RUNNING IN PRODUCTION, WITH THE EVIDENCE THAT SUPPORTS EACH CLAIM

CAPABILITY	EVIDENCE	STATUS
Deterministic dispatch to a PLC	Schneider Modicon M262 running IEC 61131-3, OPC UA server on TCP 4840 under Sign & Encrypt with Basic256Sha256 and an IP whitelist. Schedule Executor applies setpoints at interval start by OPC UA write.	PROVEN
15-minute optimisation horizon	192 slots (today plus tomorrow) written to OPC UA with a per-slot validity flag; the PLC copies only valid slots. Until D+1 prices publish, 96 slots are marked valid. Contract agreed with the PLC programmer.	PROVEN

CAPABILITY	EVIDENCE	STATUS
Linear-programme dispatch optimiser	Cycle-depreciation penalty, anti-cycling start-charge penalty, waste penalty, terminal SoC valuation, solar-priority weighting, structural no-grid-buy constraint. Live-tuned against a real plant.	PROVEN
Exactly-once command delivery	QoS 2 on <code>cmd/schedule</code> , <code>cmd/override</code> and <code>cmd/halt</code> ; idempotent by run id; override reverts automatically to schedule at expiry.	PROVEN
One-second telemetry	TimescaleDB hypertable at 1 s resolution carrying SoC, active power, import, export, solar, cell temperature and alarms. Sign conventions resolved by live cross-check against the plant SCADA readout.	PROVEN
Three-layer fail-safe	MQTT Last Will at the broker; cloud watchdog marking a plant offline after 2 minutes without heartbeat; PLC-resident fallback driving setpoints to zero and holding SoC after 30 s. Heartbeat written every 5 s. Verified in the field by cutting the WAN link.	PROVEN
Read-before-act discipline	Inverter bound check, SoC boundary check and mutual-exclusion check before any setpoint write; read-after verification; every edit logged with user identity and high-precision timestamp.	PROVEN
Compliance detection and reporting	Plant-side law checks with one alert per law rather than per slot, a stable correlation key, automatic resolution when a violation clears, and state restored from disk across restarts.	PROVEN
Price-driven curtailment	Modbus active-power setpoint per inverter, or a digital-output shutdown signal to the inverter, on the 15-minute slot price, with a cross-border branch that compares the local price against the export corridor's marginal price. Three sites, 96 decisions/day each. Two documented caveats on the corridor branch: it sets a 15-minute energy price against an hourly capacity price without quarter-hour scaling, which is defensible for a one-megawatt block over an hour and is flagged rather than changed because changing it changes what a contactor does; and until 2 August 2026 it fell back silently to the domestic threshold for the first hours of each delivery day when the auction file had not yet been ingested. The fallback is fixed; the scaling question is open and recorded.	PROVEN
Market data ingest	Day-ahead and intraday prices, cross-border auction results, NOSBiH imbalance settlement prices from the operator's published daily and monthly workbooks, PV forecasting with per-plant model selection and provenance plus satellite bias calibration.	PROVEN
Fleet security	mTLS per gateway from a private CA with 12-month rotation, per-plant broker ACLs, outbound port 8883 only, no inbound ports at any site.	PROVEN

All of the above is **market-facing control**: decide a setpoint from a price or a plan, deliver it reliably, execute it at the right moment, prove afterwards that it happened. What COMEX does not build is **grid-facing control** — following a setpoint issued by the system operator in real time, reactive power and voltage regulation, and certified ramp behaviour. That half is bundled free with every major inverter and is certified per country as a component.

This is a deliberate position, not an oversight. The market-facing layer is where the differentiation and the revenue are; the grid-facing layer is a commodity held by incumbents. It matters here because **aFRR-s is a grid-facing product** — which is precisely why it is a build rather than a capability.

Gap to aFRR-s

FOUR ITEMS, WITH AN HONEST ESTIMATE AGAINST EACH

01 Closed-loop AGC setpoint follower, PLC-resident

Today's control structure applies a setpoint at slot start and holds it. aFRR-s requires continuous following of an external regulation signal at 10 MW per second — sixty times the standard aFRR gradient of 10 MW per minute — with the full range reached inside one second for anything contracted under 10 MW. The controller must also declare the gradient it can actually hold: the operator analyses the declared figure against the delivered response. That loop must live in IEC 61131-3 on the controller, not in the dispatch layer.

ESTIMATE: 8–12 WEEKS OF PLC ENGINEERING, PLUS BENCH VALIDATION.

PREREQUISITE: CONFIRM THE M262 AND THE INVERTERS HOLD A 10 MW/S RAMP AT PLANT SCALE — NOT YET MEASURED.

02 Real-time telemetry link to the system operator

Regulation signal exchange happens at virtual-unit level between the provider's control centre and the TSO's SCADA. MQTT into COMEX's own broker is not a TSO interface. This is IEC 60870-5-104 or IEC 61850 territory, with the associated telecom provisioning.

ESTIMATE: 8–12 WEEKS INCLUDING OPERATOR-SIDE COORDINATION. LONGEST LEAD ITEM; START FIRST.

03 Availability accounting per settlement period

Compliance is assessed every fifteen-minute settlement period against two cumulative AGC counters: *Unit blocked* or *Unit off remote control* for at most one minute, and *Unit Not Following* for at most five. Fail either and the period is unsatisfactory. This is a measurement, retention and reporting obligation with money attached to it.

ESTIMATE: 3–4 WEEKS. CLOSEST TO EXISTING WORK — THE COMPLIANCE DETECTION PATTERN ALREADY IN PRODUCTION IS THE RIGHT SHAPE FOR IT.

04 Response envelope and prequalification testing

Current design constants are a 5-second heartbeat and a 30-second fail-safe. Sub-second response requires revisiting those, then passing the operator's practical conformity test, including a response-speed test on the physical asset.

ESTIMATE: 4–6 WEEKS OF TUNING, PLUS THE OPERATOR'S OWN TESTING WINDOW. CANNOT BEGIN BEFORE THE ASSET IS ENERGISED.

These are sequential in parts and parallel in others. Against a fourteen-month contractual window from framework signature to conformity, the engineering is not the binding constraint — asset construction and grid energisation are. That is the argument for starting items 01 and 02 during construction rather than after it.

Two conditions sit outside all four items, on the asset rather than the control layer. The procedures require an energy storage system able to inject or withdraw at rated power for **at least four hours** — written as “at least 0.25C”, which read as a C-rate says the opposite, so the four-hour clause is the one to quote. And they require conditional registration in the operator’s facility register, which follows from the grid connection conditions and manufacturer evidence. Neither is affected by anything in this section, and both should be checked against the battery specification before a bid is priced. COMEX’s own plant at Raduša is about two hours at rated power and would not meet the first; it is a reference for the dispatch layer, not for the fast reserve product.

SOURCE FOR EVERY RULE IN THIS SECTION: NOSBIH *ANCILLARY SERVICES PROCEDURES* V1.8, APPLYING FROM 1 AUGUST 2025, PUBLISHED 4 MARCH 2026 — SECTIONS 3.4 TO 3.6, WITH THE CONFORMITY TEST AT 3.3.3.1.

Known issues

OPEN DEFECTS, STATED BECAUSE A DOSSIER WITHOUT THEM IS MARKETING

- **Modbus read reliability on the V1 curtailment fleet.** Roughly one read in five fails across the throttled sites — on the order of 155–174 failures per 24 hours against about 210 successful synchronisations. The curtailment decision still lands, because the digital-output shutdown path is independent of the per-inverter Modbus read, but the defect is long-known and open.
- **One undiagnosed production event at Raduša.** On 15 August 2026 output collapsed from 137 kW to under 2 kW for roughly 25 minutes in full sun and did not recover in a way the price threshold or the SoC ceiling explains on their own. Onset is consistent with the ceiling binding; persistence is not. Open, and deliberately not explained away.
- **Sign conventions are commissioning-dependent.** Battery and grid power signs at Raduša were resolved by live cross-check rather than from a hardware standard. A different integrator commissioning a different controller could commit the opposite convention. For any second site this belongs in an explicit per-plant configuration field or a standardised commissioning template.
- **Edge provisioning is not automated.** Node provisioning from the operations console is still a user-interface mock pending the backend endpoints. New sites are commissioned by a documented but partly manual path.

WHAT COMEX DOES NOT CLAIM

No grid-code component certification is held in any jurisdiction. No reactive power or voltage regulation function is built. No aFRR, aFRR-s or FCR service has been delivered to any system operator. No asset in the fleet is prequalified for ancillary services. No nomination optimiser or imbalance-penalty tracker is in production; imbalance work today is analysis on the ingested settlement data. The largest battery under management is 261 kWh at 125 kW, with a 45 kWh secondary pack beside it, and no site above one megawatt has been commissioned. Any of these can be built or obtained; none of them exists today, and a counterparty should price them as work rather than assume them as capability.

Continuity

THE QUESTION EVERY BUYER ASKS ABOUT A SMALL VENDOR

An operator taking a five-year obligation on a control layer supplied by a small company is right to ask what happens if that company stops. The answer offered here is contractual rather than reassuring: source code held in escrow with release triggered on defined events, interface and protocol documentation delivered as part of the scope rather than on request, a documented handover procedure, and no dependency on a proprietary cloud service that a third party could not operate. The control path already runs on standard protocols — OPC UA to the controller, MQTT over TLS to the broker, Modbus to field devices — with no proprietary wire format anywhere in it.

How to verify this

OFFERED CHECKS, NOT ASSERTIONS

Site visit

Raduša can be visited and the control cabinet inspected. The fail-safe can be demonstrated by disconnecting the wide-area link and observing the controller drive setpoints to zero.

Telemetry history

One-second resolution history is retained and can be shown for any past interval, including the undiagnosed event above.

Dispatch audit trail

Every command carries a run identifier, an acknowledgement status and a reason. The dispatch log can be exported for any period.

Reference contact

The plant owner and the PLC programmer can both be approached directly.