

Baja Ducati — Prototype Cost Band, BOM & Development Timeline

The program-and-money spine, built on the engineering feasibility read

([artifacts/engineering/feasibility-read.md](#)). Every load-bearing figure below traces to a supplier or dealer page fetched for this brief (cited inline) or is written as an honest range with the cost driver named. Where a number is an engineering planning estimate, it is marked as one — inherited from the engineering read's discipline. No false precision reaches an insider's hands.

Prepared for: a strategic / insider audience (a manufacturer, a race outfit, moto engineers) who will pressure-test every number. **Currency:** EUR throughout, mid-2026 pricing. Dealer figures found in USD or GBP are converted at ~1.08 USD/EUR and ~1.17 EUR/GBP and flagged. **Date:** 24 September 2026. **Companion workbook:** [artifacts/cost/prototype-bom.xlsx](#) — the live BOM with the cost band summing across sheets (change an input, the totals move).

0. The number, and the one framing that makes it credible

A single running prototype of this machine costs on the order of €340,000 — €795,000. Call it a **€350k–€800k prototype**, and the honest planning centre of that band — the number to raise against — is **~€500k–€600k** for one demonstrable, desert-tested machine.

That range is wide on purpose, and the reason it is wide is the whole insider story:

The prototype cost is NRE-dominated, not part-cost-dominated.

The parts bolted to this machine — cells, motor, inverter, suspension, frame tubes, wheels — total **~€51k–€105k**. The *engineering that turns those parts into a first-of-kind, two-energy-system desert motorcycle* — bespoke frame, bespoke sealed pack, and the range-extender genset that has no off-the-shelf equivalent — totals **~€290k–€690k**. The engineering is **five to six times the hardware**.

An insider expects exactly this shape and distrusts a pitch that doesn't show it. The naive founder quotes a €60k BOM and implies that's the prototype. The credible one says: *a first prototype is far more expensive per unit than any production estimate, because you are paying to design the machine once, not to build it a thousand times*. This document builds the band as **components + NRE + test**, and names the three biggest lines — **frame engineering, battery-pack engineering, genset integration** — as the cost drivers, because they are.

The production-vs-prototype distinction, stated plainly: at volume, the frame NRE amortizes to near zero per unit, the pack becomes a repeatable assembly, the genset becomes a productized module, and the component cost (falling further with volume purchasing) dominates. A production unit cost is a different, much smaller number and a later question. **This document is about the prototype: the one machine that proves the thesis is real.** Do not let the two numbers be confused — that confusion is the fastest way to lose an insider's trust.

1. How to read the cost band

The band is three buckets. Each line is a **low–high range**, because at the prototype stage honest ranges *are* the truth — a written quote at BOM lock collapses each range to a point, and this document says so rather than inventing the point now.

Bucket	Low (EUR)	High (EUR)	What it is
Components (hardware on the machine)	~51,200	~104,500	Every part that ships on the bike; no engineering labour
NRE, integration & test	~290,000	~690,000	The engineering that makes a first-of-kind prototype exist
Total prototype	~341,200	~794,500	One running, desert-tested machine

(These totals are computed live in the companion workbook and re-add from their line items; the figures here match the workbook at composition. Component and NRE line items follow in §3 and §4.)

Why the low and high are so far apart is itself a credibility signal: it is the honest spread between (a) a lean build that reuses an existing engine platform, buys a used EMRAX, and runs a tight test program, and (b) a fuller build with more genset-integration iteration, a more instrumented desert test campaign, and a healthy contingency reserve. A first-of-kind hybrid prototype lands somewhere inside that spread depending on how much of the genset and pack work is done in-house versus contracted, and how many desert test iterations the calibration needs. Naming that spread honestly is the point; pretending to a single tidy figure is what an insider would catch.

2. The cost drivers, named as drivers

Three lines carry most of the prototype's cost, and they are the three bespoke subsystems the engineering read named as the hard parts. This is not a coincidence — **the hard engineering and the expensive engineering are the same list.**

- 1. Range-extender genset integration — €60k–€140k (and the longest schedule pole).** There is no off-the-shelf ~15–25 kW motorcycle-scale series-hybrid genset you can order as a unit (engineering read §2.6; the market's compact range-extendors are car-scale — Brogen's smallest is 65/80 kW at 270 kg — or bespoke demonstrators). So this is an *integration job, not a purchase*: a single-cylinder engine run at a fixed efficient RPM, coupled to a PM generator, with a rectifier and a genset controller that holds the best-efficiency point and manages start/stop, plus NVH isolation. The *hardware* is a few thousand euro; the *engineering to make it a constant-speed genset* is the cost. This is the single most bespoke line on the machine.
- 2. Battery-pack engineering & test — €50k–€120k.** A ~15 kWh, ~350–400 V, high-power, **sealed and liquid-cooled** pack is bespoke — there is no 15 kWh motorcycle pack in this power class you bolt in (engineering read §2.5). The cost is the pack design (cell-to-module-to-pack), the BMS integration and tuning, the sealed IP67 liquid-cooled enclosure design, the thermal model for 45–50 °C desert ambient, and the abuse/safety test. The *cells* are a commodity line (§3); the *pack engineering* is a cost driver.
- 3. Frame design & fabrication engineering — €40k–€90k.** A bespoke steel trellis, re-proportioned for rally geometry and packaged around the pack and genset, is NRE-heavy for a one-off: design, the packaging puzzle (engineering read §6.2, the defining design task), jig and tooling for a single frame, weld, iterate, test. The *tube and fabrication material* is a modest line (§3); the *frame engineering and one-off tooling* is a cost driver.

Below those three sit the development lines — vehicle-control/by-wire integration (€30k–€70k), desert traction-control calibration (€20k–€50k), assembly labour (€25k–€60k), and the instrumentation & desert test program (€25k–€70k) — plus a contingency reserve (€40k–€90k) that an insider *expects* to see on a first-of-kind integration prototype and would be suspicious not to find.

3. Component BOM — the hardware, grounded

Every component below is a real, orderable part or a proven part-class from the engineering read, with the cost grounded to a supplier or dealer page fetched 24 Sep 2026, or written as an honest range with the basis named. Component subtotal: ~€51,200 – €104,500. Full live

version with per-line ranges: [artifacts/cost/prototype-bom.xlsx](#), sheet "Component BOM".

3.1 The grounded lines (real supplier pricing found)

Battery cells — €4,000–€8,000 (cell cost only). MoliceL INR-21700-P42A / P45B high-power 21700 cells (engineering read §2.5 — the correct high-power chemistry, 45 A continuous each). Grounded pricing: **retail ~\$7.49–\$10.75/cell** (liionwholesale P45B \$7.49; batterymart P42A \$10.16–\$10.75 in 25–50 qty), **bulk ~\$5.85/cell** at a 200-cell tier (EVolve Electrics: 200 × P42A for \$1,170), and wholesale/OEM as low as ~\$1.55–\$2.22/cell at scale (Alibaba, pack-quantity). At ~15.5 Wh/cell, a ~15 kWh pack needs ****~970 cells****; at the ~€5–€8/cell prototype-buy band, that is ****~€4,000–€8,000 in cells****. (*Note: cell cost only; the pack that holds them is a separate bespoke build — see below and §4.*)

Traction motor — €3,500–€6,500. EMRAX 228 or 268 axial-flux PMSM, liquid-cooled IP65/66 (engineering read §2.2). Grounded pricing: a used EMRAX 228 HV changed hands at **~\$2,500** (diyelectriccar), and unsold-stock 228HV units were offered at **£2,500–£2,750** (~€2,900–€3,200; endless-sphere). New units are quote-only through EMRAX's configurator (emrax.com/get-a-quote), which puts a new liquid-cooled 228/268 in the **several-thousand-euro class**; €3,500–€6,500 is the honest new-unit prototype band. (*Basis: real used/stock listings + quote-only new; a written EMRAX quote collapses this at BOM lock.*)

Traction inverter — €5,000–€9,000. A Cascadia Motion CM200DX-class HEV/off-road-rated inverter (engineering read §2.3 — 450 A continuous, 300–800 VDC, explicitly HEV/off-road rated). Grounded pricing: the **Cascadia CM200DX bare inverter is listed at \$8,700** (~€8,050; fuel2electric), a PM100-class unit ~\$5,500 (~€5,100). (*Distinction that matters: Cascadia's complete drive-system kits run \$35k–50k, but those bundle the motor and gearbox — the bare inverter is the four-figure line the engineering read named, and that is what belongs here.*)

Suspension — €5,000–€8,000. WP XACT/XPLOR PRO-class ~300 mm rally fork + piggyback shock, or an Öhlins equivalent (engineering read §3.2 — the KTM/Husqvarna rally-racing choice). Grounded pricing: WP XACT Pro AER fork **\$4,495** (~€4,160) and a WP XACT Pro linkage shock **\$2,895** (~€2,680) at retail (direct-suspension.com) — a ~€6,800 retail pair; WP's own package deals discount this (a fork+shock package advertised at **£3,599**, ~€4,200, a £1,215 saving; enduro21). A KTM 790 R WP XPLOR Pro set retails ~\$8,998 AUD (~€5,600;maschine.com.au). The honest prototype band is **€5,000–€8,000** for a premium rally fork + remote-reservoir shock.

3.2 The estimated lines (part-class ranges, no single dealer point)

These are real, orderable part-classes from the engineering read; a prototype buys them as a spread rather than one catalogue SKU, so each is an honest range with its basis named.

Line	Band (EUR)	Basis
Battery pack build (BMS, contactors, welded sealed IP67 liquid-cooled enclosure, cold-plate, hardware)	6,00 0– 12,0 00	Bespoke pack <i>hardware</i> only; the pack <i>engineering</i> is the €50k–€120k NRE line in §4 — do not double-count
Range-extender genset hardware (single-cyl ~450–690 cc EFI four-stroke + PM generator + rectifier + controller)	8,00 0– 16,0 00	Engine-class hardware (KTM LC4-690 / Husqvarna-701-class singles exist as proven, homologated hardware; the base engine is a fraction of an ~€9k–€13k complete bike) + a compact PM generator; the <i>integration</i> is the €60k–€140k NRE line in §4
Frame material & fabrication (steel trellis tube, weld, finish)	4,00 0– 9,00 0	Fabrication material and shop time for a one-off; the <i>design + jig/tooling</i> is the €40k–€90k NRE line in §4
Wheels & tyres (spoked 21”F/18”R rally rims + hubs, rally knobby + mousse/HD tubes)	2,00 0– 4,00 0	Rally-raid COTS (engineering read §3.3)
Brakes (off-road disc, calipers, masters, lines)	1,20 0– 2,50 0	Brembo/J.Juan-class off-road COTS
By-wire throttle & VCU (twist-grip sensor + vehicle control unit)	2,00 0– 5,00 0	Bosch/Magneti-Marelli-class proven moto tech (engineering read §2.4)
Stability/traction ECU hardware (IMU + control unit)	1,50 0– 4,00 0	Bosch MSC-class hardware; the desert <i>calibration</i> is the dev line in §4

Line	Band (EUR)	Basis
Cooling hardware (two loops: radiators, pumps, fans, cold-plate, hoses, dust-protected housings)	2,000–4,500	Motorsport cooling COTS (engineering read \$4.3, \$6.3)
Sealed connectors & harness (IP67 HV + signal, bespoke sealed loom)	2,500–5,500	Amphenol/TE Deutsch-class COTS + build labour
Bodywork & fuel system (panels, seat, sealed tank, exhaust, air intake w/ multi-stage desert filter)	3,000–7,000	Bespoke bodywork + fuel/exhaust/intake
Fasteners, bearings, misc (sealed bearings, brackets, hardware, consumables)	1,500–3,500	COTS small parts

The no-double-counting rule, stated for the insider: the pack, genset, and frame appear *twice* on purpose — once as **hardware** here in §3 (the physical parts), and once as **NRE** in §4 (the engineering that designs and integrates them). The hardware line is the tube and the cells; the NRE line is the design, the jig, the BMS tuning, the genset controller. Adding them is correct; conflating them is the error. The workbook keeps them on separate sheets for exactly this reason.

4. NRE, integration & test — the engineering that dominates the cost

This is the bucket that makes the prototype expensive, and the bucket a lean production estimate omits. Subtotal: ~€290,000 – €690,000. Live version: [artifacts/cost/prototype-bom.xlsx](#), sheet "NRE & Test". These are engineering-effort estimates — the basis is the scope of work the engineering read defines, priced at senior small-team vehicle-engineering rates; they are not vendor quotes and are marked as such.

Line	Band (EUR)	What it is	Driver class
Frame design & fabrication engineering	40,000 – 90,000	Trellis frame design, the packaging puzzle around pack + genset (engineering read §6.2), jig/tooling for a one-off, weld, iterate, test	Cost driver
Battery-pack engineering & test	50,000 – 120,000	Pack design (cell-to-module-to-pack), BMS integration & tuning, sealed liquid-cooled enclosure design, desert thermal model, abuse/safety test	Cost driver
Range-extender genset integration	60,000 – 140,000	Constant-speed genset: engine-to-generator coupling, rectifier, genset controller (BSFC-point hold, start/stop), NVH isolation	Cost driver (longest pole)
Vehicle control & by-wire integration	30,000 – 70,000	VCU torque maps, ride-by-wire integration, HV-bus power management (battery ↔ genset), safety interlocks	Development
Desert traction-control calibration	20,000 – 50,000	Bespoke slip-target calibration for controlled sand wheelspin (engineering read §6.5); hardware proven, calibration is dev	Development
Assembly & integration labour	25,000 – 60,000	Prototype assembly, wiring, plumbing two cooling loops, fit-out, shakedown to a running machine	Build
Instrumentation & desert test program	25,000 – 70,000	Sensors, data logging, bench/dyno time, desert test days (40–50 °C, sand, thermal), iterate	Test
Contingency (integration risk)	40,000 – 90,000	Integration-execution risk reserve on a first-of-kind two-energy-system prototype (~15–20% of engineering)	Reserve

Why these are estimates and not quotes — and why that is honest. You cannot get a written quote for "design me a bespoke desert-hybrid frame" the way you can for a WP fork; the number is an engineering-effort estimate against the scope the feasibility read defines. What makes it credible is that the *scope* is grounded (the engineering read names every task) and the *rate* is a real senior-vehicle-engineering rate, not a guess. At program kickoff, each of these becomes a

statement of work with a contracted partner and the range collapses. **An insider reads "estimate" here as honesty, not as weakness** — the alternative, a false-precision "€187,500 for the frame," is the tell of someone who has never scoped a bespoke build.

5. Development timeline — built backward from the critical path

The timeline is built off the engineering read's critical path (§7.2) and the lead-time table (§5). Lead times are engineering-planning estimates, flagged as such in the read; a real build confirms them with written quotes at BOM lock. Inherited discipline: no fantasy schedule.

5.1 The three schedule drivers (the long poles)

The engineering read names three bespoke, long-lead subsystems that gate the whole prototype. They are the same three cost drivers — the hard parts, the expensive parts, and the slow parts are one list:

Long-lead item	Duration (planning estimate)	Why it gates
Range-extender genset integration	~20–36 weeks	No off-the-shelf unit; it is engine + PM generator + controller, integrated. The longest pole — start it first .
Frame design + fabrication	~12–24 weeks	Gates the whole rolling chassis; every packaging decision flows through it.
Battery-pack design + build	~16–28 weeks	Bespoke, and it defines the mass centroid the frame is built <i>around</i> .

The interlock is the honest part of the schedule. These three do not simply run in parallel and finish on the longest one — they *interlock*: the frame is designed *around* the pack and genset (engineering read §6.2, §7.2), so the real driver is **frame → pack → genset co-design**, not any single part's ship date. You cannot finalize the frame until the pack and genset envelopes are fixed; you cannot fix those envelopes without frame packaging constraints. That co-design loop is the schedule's spine, and pretending the three are independent parallel tracks is the fantasy an insider would catch.

5.2 Phases to a running prototype

Built backward from the ~20–36 week genset pole and the co-design interlock, the honest phase plan to **one running, desert-tested prototype is ~14–20 months**.

Phase 0 — Architecture lock & co-design kickoff (weeks 0–8). Freeze the powertrain architecture, pack sizing, and genset sizing. Kick off the frame ↔ pack ↔ genset co-design loop *simultaneously* — this is the single most important scheduling move, because all three long poles depend on the shared packaging envelope. Place the genset-integration partner and battery-integrator contracts first (they are the longest leads). Order long-lead COTS (EMRAX motor ~10–20 wk, inverter ~8–16 wk, WP suspension ~8–16 wk) now so they arrive when the chassis is ready.

Phase 1 — Bespoke subsystem development, in parallel (weeks 4–36). The three long poles run concurrently but interlocked:

- *Genset* (weeks 4–36+): the longest pole; constant-speed engine + PM generator + controller integration, bench-tested to a stable BSFC-point hold before it ever goes in the frame.
- *Battery pack* (weeks 6–34): design, build, BMS bring-up, sealed enclosure, thermal validation.
- *Frame* (weeks 8–32): design finalized once the pack and genset envelopes converge (~week 12–16), then jig, weld, finish. COTS parts (motor, inverter, suspension, wheels, electronics) arrive across this window and stage for assembly.

Phase 2 — Integration & first power-on (weeks 30–44). Rolling chassis assembled, powertrain installed, two cooling loops plumbed, harness built and sealed, VCU and by-wire brought up. First HV power-on, first genset-to-bus, first wheel turn under power on a stand. This is where integration surprises surface — the reason the contingency line exists.

Phase 3 — Shakedown, calibration & desert test (weeks 40–60+). Shakedown, then the desert-specific work: traction-control slip-target calibration (dev, not a fixed duration — it iterates), thermal validation at 45–50 °C ambient, sand-ingress validation of seals and filters, range and genset-endurance runs toward the 200-mile-no-charger claim. **The machine is "done" when it has completed a real desert test day, not when it first turns a wheel** — an insider draws that line, and so does this plan.

Honest total: ~14–20 months from architecture lock to a desert-tested running prototype, driven by the genset pole and the co-design interlock, not by any single ship date. A build that contracts more of the genset and pack work to established partners lands nearer 14 months; a leaner in-house build with more iteration lands nearer 20.

6. The funding-ask logic — what a first raise must fund

This section feeds the deck's "the ask" slide. It states what the money actually buys, so a partner can pressure-test the ask against the deliverable.

What the raise must fund: one demonstrable, desert-tested running prototype — the machine that proves the thesis is real. That is the milestone that de-risks the next, larger raise, and it is the honest object of a first round.

The ask, sized off this document:

- **The prototype itself:** ~€350k–€800k (this document; centre ~€500k–€600k), NRE-dominated.
- **The team and runway to build it:** a first prototype is not built by parts arriving in a box — it is built by a small senior team over ~14–20 months (§5). A realistic first raise carries the prototype cost **plus** the team runway, facilities, tooling, and operating burn to reach the desert-test milestone.
- **The honest first-round envelope:** ~€1.0M–€1.8M — the prototype build (~€500k–€600k) plus ~12–20 months of a lean senior team, workshop, test program, and reserve. This funds *one thing well*: getting to a running, desert-tested machine, not to production.

What the ask does NOT claim to fund — and saying so is the credibility move. This raise does not fund homologation, tooling for volume, a production line, or a second unit. It funds the prototype that makes those the *next* conversation. A first round that claims to reach production on prototype money is the pitch an insider walks out of; a first round that says "this gets us to a machine you can watch cross the desert, and here is exactly what that costs and how long it takes" is the one they lean into.

The de-risking logic, stated for the partner: the money is spent almost entirely on **integration and engineering execution** — not on unproven physics and not on unobtainium parts (engineering read §7.1). Every component exists; every hard problem has a named mitigation. That is a *fundable risk profile*: the risk is "can this team execute a hard integration," which capital and a good team retire, not "does the physics work," which they cannot. The prototype raise buys the answer to the only open question.

7. Truth standard & source ledger

Every grounded component figure traces to one of these, fetched 24 September 2026:

- **Battery cells** — MoliceL P42A/P45B pricing: liionwholesale (P45B \$7.49), batterymart (P42A \$10.16–\$10.75), EVolve Electrics (200× P42A \$1,170 → ~\$5.85/cell), Alibaba wholesale (\$1.55–\$2.22/cell at pack scale), 18650batterystore (P42A spec, 15.5 Wh/cell).
- **Traction motor** — EMRAX 228/268: diyelectriccar (used 228HV ~\$2,500), endless-sphere (228HV stock £2,500–£2,750), emrax.com (new = quote-only configurator).
- **Traction inverter** — Cascadia Motion: fuel2electric (CM200DX bare \$8,700; drive-system kits \$35k–50k *include motor+gearbox* — distinguished, not used as the inverter line).
- **Suspension** — WP Pro: direct-suspension.com (XACT Pro AER fork \$4,495, linkage shock \$2,895), enduro21 (WP package £3,599),maschine.com.au (KTM 790 R WP XPLOr Pro ~\$8,998 AUD).
- **Genset engine class** — KTM LC4-690 / Husqvarna-701 single-cylinder engines confirmed as proven, homologated hardware (autoX, motorcyclespecifications); no off-the-shelf motorcycle-scale range-extender genset unit exists (engineering read §2.6, Brogen/MAHLE/Horse context) — the genset is an integration job, priced as NRE.

All NRE, integration, test, timeline, and cost-band figures are engineering-effort and planning estimates against the scope the engineering feasibility read defines, priced at senior small-team vehicle-engineering rates and lead times. They are not vendor quotes and are marked as such throughout, so no false precision reaches an insider's hands. A real build confirms every one with a written quote or statement of work at BOM lock — and the honest ranges in this document collapse to points at that moment, not before.