

HydroBit

Containerized Hydro-Powered Bitcoin Mining

Whitepaper v3.7 — October 2026

Gabriel Marciel, Founder · Central Coast, California · gmarciel1@icloud.com · X: @GabrielMar18965

Concept and business plan only. HydroBit has no units built, no sites operating, no permits, and no partners, customers or letters of intent as of this date.

Market snapshot: October 29, 2026, 11:10 a.m. PDT. Figures labeled “estimate” are HydroBit assumptions, not quotes.

1. Summary

HydroBit is a factory-built ISO shipping container holding a small hydro turbine, a bank of hydro-cooled Bitcoin miners, switchgear, fire suppression, remote controls and a Starlink uplink. Set it beside a penstock at a site with steady flow and elevation, connect the pipe, and commission. No grid, no fuel.

A 1 MW unit exceeds what one box can usefully hold, so that size pairs a 40 ft power container with a separate dry-cooler skid; smaller sizes stay single-box.

Two business lines: a fleet of containers HydroBit owns on partner land, and sale of complete containers to landowners who already hold water rights. Both depend on the same product, which does not yet exist.

At today's network economics (BTC \$80,761; \$0.0337 gross revenue per TH/s per day; 90% uptime; free water power; civil works excluded):

Container	Mining load	Gross / month	Capex	Per kW	Payback	sats / \$ of capex / yr
50 kW (20 ft)	45 kW	\$3,489	\$199,180	\$3,984	69 mo	260
100 kW (20 ft)	91 kW	\$6,978	\$312,110	\$3,121	52 mo	332
250 kW (40 ft)	227 kW	\$17,445	\$608,350	\$2,433	39 mo	426
500 kW (40 ft)	460 kW	\$35,326	\$1,121,420	\$2,243	35 mo	468
1000 kW (40 ft + cooler skid)	925 kW	\$71,088	\$2,072,820	\$2,073	32 mo	510

Landowner-owner case, flat price and difficulty, after 2% pool fee, \$55/mo Starlink and 3%/yr O&M and insurance. Payback stretches to 120 / 86 / 60 / 52 / 46 months if the 2028 halving lands at month 18. Civil works, water rights and permitting are excluded and are site-specific.



Figure 1. The whole system in one line: water, turbine, generator, miners, reserve, collateral. Nothing on this diagram exists yet except on paper.

Larger is better, and the reason is simple: controls, safety and integration cost roughly the same on every box, so spreading them over more kilowatts cuts capex per kW from \$3,984 at 50 kW to \$2,073 at 1 MW, and raises Bitcoin captured per dollar of capex from 260 to 510 sats a year.

What that is for, and what it is not for: the reserve is the collateral behind Echo coin. It is not the wage account. User wages come from Ecosystem revenue — ads, data sales, marketplace fees — as that revenue actually arrives, and Section 6 keeps the two pots separate. The difference from Meta is where the money ends up: shareholders there, the users themselves here, through a coin they hold and no shares at all.

2. The Product

The containerized hydro plant is not new. Siapro builds a 150 kW unit in a 20 ft box [11]; ADDNEW markets 40 ft plants up to 1,000 kW [10]; Ganz offers a 500 kW containerized Francis unit [12]; Mesa/NuSTREEM builds 20 ft and 40 ft triple-turbine containers to 750 kW [13]. HydroBit's contribution is putting the mining load, its cooling and the satellite link inside the same factory-tested box. That integration is unbuilt.

- Hydraulics: penstock flange, inlet valve, Pelton or Turgo runner (crossflow or Francis on low-head sites), jet deflector to survive a load rejection, tailrace outlet.
- Generator: 400 V three-phase synchronous, so hydro miners can be fed without a step-down transformer. Electronic load controller with a resistive dump load.
- Mining bay: insulated partition, racked hydro ASICs, closed glycol loop, coolant distribution unit and dry cooler. Hydro ASICs take 20–50°C coolant [7].
- Electrical: breaker, generator protection, metering, PDUs, surge protection, earthing, plus an export port for selling power instead of mining it.
- Safety and controls: clean-agent suppression, smoke and heat detection, flood and leak sensors, E-stop, PLC/SCADA, UPS for black-start, cameras, Starlink.

Connectivity runs over Starlink Business: Local Priority from \$55/mo (50 GB) to \$530/mo (2 TB), Global Priority \$250–\$2,150/mo, about 75–100 W average draw and a 99.9% uptime SLA on business plans [18]. Mining traffic and telemetry use only a few GB a month (estimate), so the smallest plan should do. Starlink does not serve China or Russia, and licensing must be checked per country [19].

3. Site Requirements

Output is $P = \rho g Q H \eta$, with water-to-wire efficiency estimated at 0.80. HydroBit's box needs elevation; low-head sites need a different machine entirely.

Net head	Flow	Flow (US)	Output	Turbine
30 m	0.21 m ³ /s	~3,300 gpm	49 kW	Crossflow / Turgo
100 m	0.064 m ³ /s	~1,010 gpm	50 kW	Pelton / Turgo
150 m	0.085 m ³ /s	~1,350 gpm	100 kW	Pelton
200 m	0.16 m ³ /s	~2,540 gpm	251 kW	Pelton
50 m	0.64 m ³ /s	~10,100 gpm	251 kW	Francis / Turgo

Head net of penstock friction; design for under 10% loss (estimate).

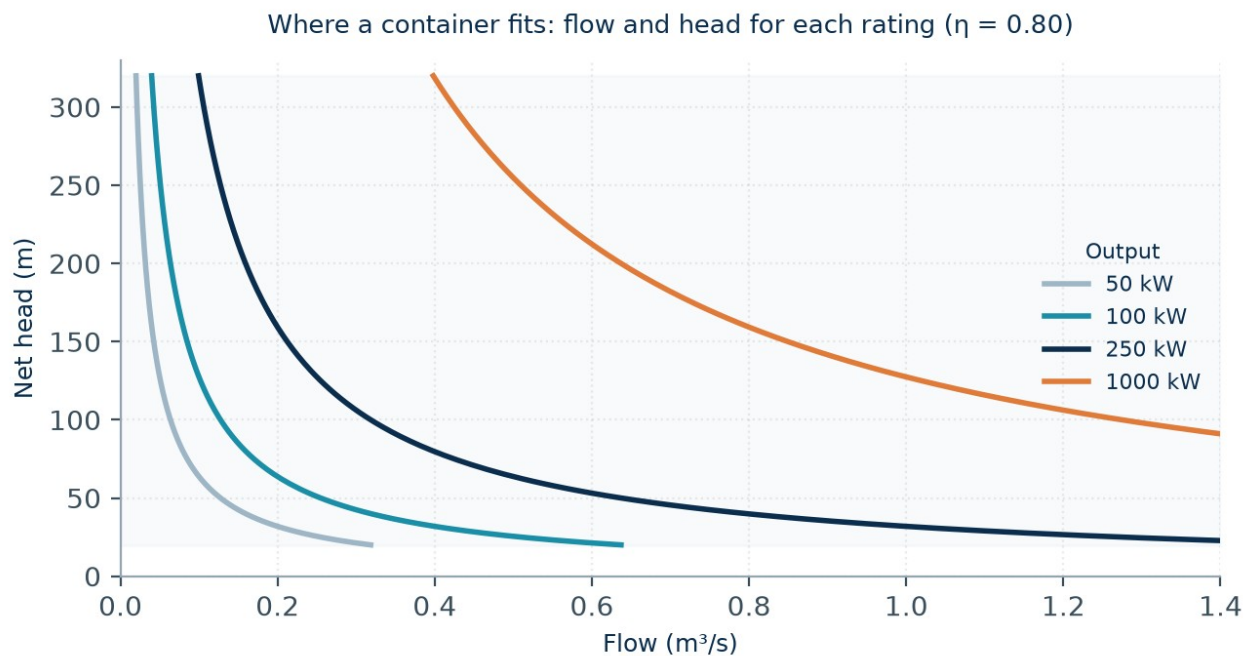


Figure 7. Flow and head required for each rating at 80% water-to-wire efficiency. A 1 MW unit needs a serious stream.

What a site needs: 30 m of net head minimum and 50–300 m preferred; firm flow after bypass requirements (a year of gauged data is strongly preferred, since many coastal streams are seasonal and dry-season flow governs annual output); a penstock route with under 10% friction loss; truck and crane access for a 20 or 40 ft box; a flood-safe pad; a clear sky view; and the legal right to use the water.

4. Hardware and Cost

The base model uses Bitmain's S21 XP Hyd: 473 TH/s at 5,676 W, 12 J/TH, 380–415 V three-phase input, \$5,750–\$7,199 typical, and a 365-day warranty [6][7]. Newer S23 Hydro units reach 8.9–9.5 J/TH but cost \$20–28 per TH against roughly \$13 for the S21 XP Hyd [8]. When the power is free and capped by the turbine, cheap per-kilowatt hardware wins: the S21 recovers its own cost in about 385 days at this hashprice, the S23 in about 645.

Reserving 7% of generator output for fans, pumps, controls and Starlink gives 8 miners at 50 kW, 16 at 100 kW, 40 at 250 kW, 81 at 500 kW and 163 at 1 MW. Floor space is not the constraint; commercial 20 ft hydro containers hold up to 210 units [17].

Line item	50 kW	100 kW	250 kW	500 kW	1 MW
Turbine-generator, valve, governor, dump load	\$25,000	\$45,000	\$85,000	\$150,000	\$260,000
Container, mining bay, coolant loop, dry cooler	\$35,000	\$45,000	\$70,000	\$115,000	\$190,000
Switchgear, protection, PDUs, earthing	\$10,000	\$15,000	\$30,000	\$55,000	\$95,000
Fire suppression and detection	\$6,000	\$8,000	\$12,000	\$20,000	\$34,000
SCADA, UPS, cameras, Starlink kit	\$8,000	\$8,000	\$8,000	\$12,000	\$16,000
Factory integration and test	\$15,000	\$20,000	\$30,000	\$50,000	\$85,000
Freight and logistics (excl. duty)	\$10,000	\$12,000	\$18,000	\$30,000	\$50,000
Site installation and commissioning	\$15,000	\$20,000	\$30,000	\$45,000	\$70,000

Hydro ASICs (S21 XP Hyd @ \$6,150)	\$49,200 (8)	\$98,400 (16)	\$246,000 (40)	\$498,150 (81)	\$1,002,450 (163)
Contingency (15%)	\$25,980	\$40,710	\$79,350	\$146,272	\$270,368
Total capex	\$199,180	\$312,110	\$608,350	\$1,121,420	\$2,072,820

HydroBit estimates; no supplier quotes obtained. Benchmarked against published turbine listings of \$35k–\$120k for 20–500 kW sets [9], mining-container fit-outs of \$60k–\$155k at MW scale [17], and ASIC and Starlink prices [6][18]. Excludes civil works, water rights, land and import duty. China-origin ASICs entering the US pay about 40.1% duty versus 12.6% for Malaysian origin [16]; duty on China-built turbine assemblies is unverified and needs a customs broker.

Hydro cost is dominated by the site, not the box. IRENA puts 2024 global average hydropower at \$2,267/kW [14]; micro and mini hydro ranges run \$1,374–\$5,272/kW [15]. Civil works are typically 20–60% of total micro-hydro cost [15]; this paper treats them separately at \$1,000–\$2,500/kW, plus permitting that can cost tens to hundreds of thousands and take years.

5. Economics

Payback in dollars mixes two questions: how much Bitcoin the machines make, and what the market pays for Bitcoin today. For an operator who intends to hold, sats per dollar of capex is the operational metric, because it depends on difficulty and the subsidy, not on price. It is not immune to the market — difficulty follows price, and ASIC prices rise with it — but it is the right lens.

Container	Capex	BTC / year	sats / \$ / yr	After 2% pool fee
50 kW	\$199,180	0.518	260	255
100 kW	\$312,110	1.037	332	326
250 kW	\$608,350	2.592	426	418
500 kW	\$1,121,420	5.249	468	459
1000 kW	\$2,072,820	10.563	510	499

Pre-halving. After the April 2028 halving each figure roughly halves unless difficulty falls.

Bigger containers spread the fixed cost: 5.4× more sats per dollar from 50 kW to 1 MW

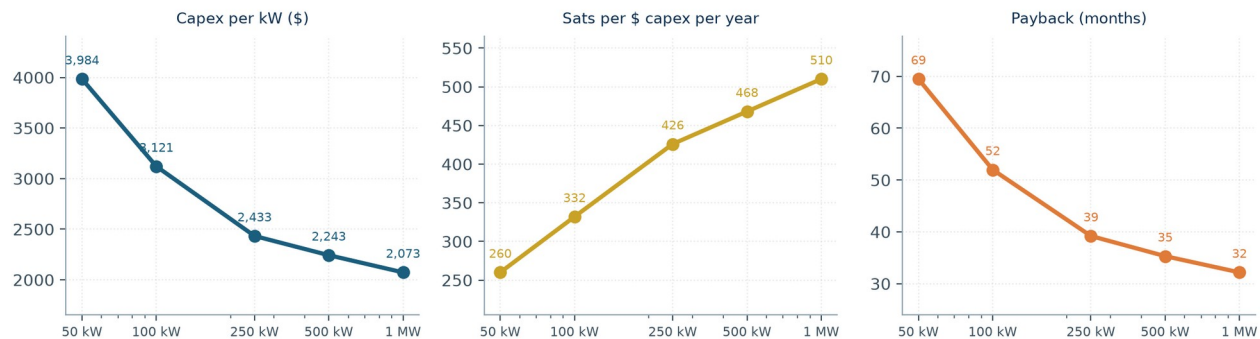


Figure 2. Scale economics across five container sizes. Fixed costs per box fall away as the rating rises.

A hundred 100 kW units is 756.8 PH/s, about 0.07% of the network, and would mine roughly 104 BTC in year one at flat difficulty. Cumulative gross output over ten years, before any BTC is sold for costs:

Difficulty growth	Year 1	Year 3	Year 5	Year 10
0%	104 BTC	231 BTC	334 BTC	476 BTC
25% / yr	93 BTC	178 BTC	220 BTC	250 BTC
40% / yr	88 BTC	157 BTC	185 BTC	199 BTC

Assumes all 100 units online from month 1, 90% uptime, halvings at month 17.4 and 65.4, no fees. Tranched deployment would lower early totals.

Net of the cash HydroBit must actually spend — pool fee, a 15% landowner royalty, and about \$103,000 a month of Starlink, O&M and insurance across the fleet, paid by selling BTC — the reserve is smaller and, at high difficulty growth, it peaks and then shrinks:

Retained BTC	Year 1	Year 3	Year 5	Year 10
0%	71	146	202	243
25% / yr	62	102	107	55

40% / yr	58	85	77	12
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At 25–40% annual difficulty growth the fleet's output eventually falls below what must be sold to keep it running. A reserve is not self-sustaining without price support, outside cash for operations, or ASIC refresh.

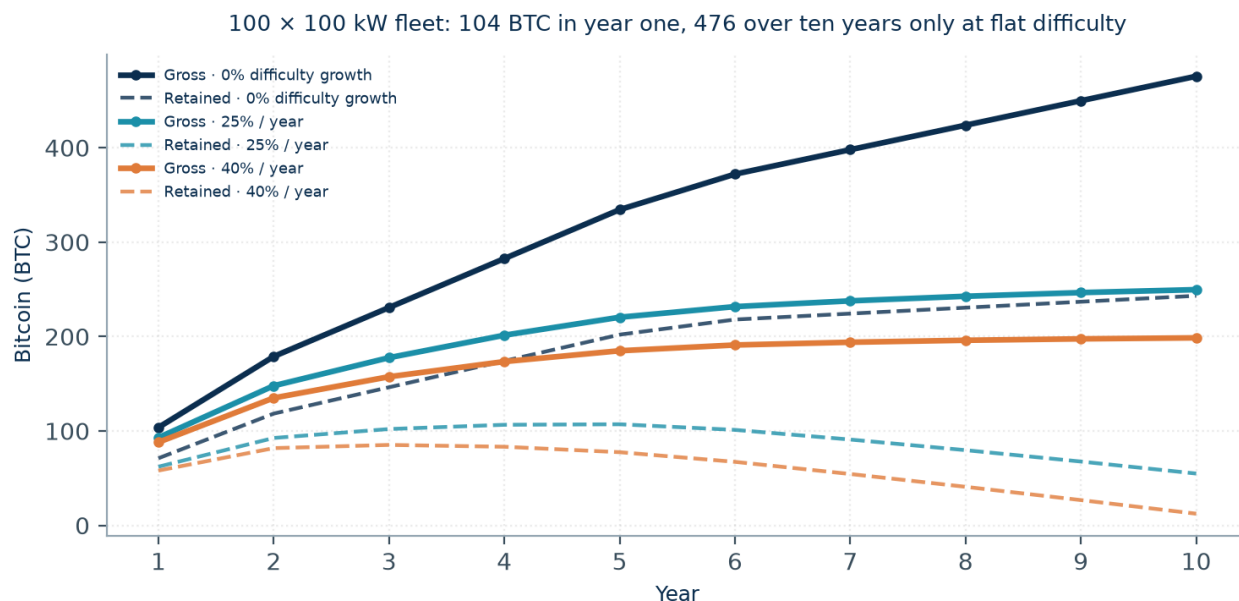


Figure 3. Gross against retained Bitcoin under three difficulty paths. At 25–40% growth the reserve peaks and then falls.

Sensitivity, 100 kW unit, months to recover \$312,110:

BTC price	Diff. -10%	Diff. flat	Diff. +25%	Diff. +50%
\$50,000	81	92	122	157
\$65,000	59	67	87	110
\$80,761	46	52	67	84
\$100,000	36	41	53	65
\$125,000	29	32	41	50
\$100,000 (post-halving)	80	91	122	156
\$125,000 (post-halving)	62	70	91	115
\$150,000 (post-halving)	50	56	73	91
\$200,000 (post-halving)	36	41	52	65

Static conditions. Three-year payback needs roughly \$112,000 BTC before the halving and about \$215,000 after it, at flat difficulty.

6. Two Pots, Not One: Reserve Versus Revenue

One hundred 100 kW containers mine about 103.7 BTC in year one, worth \$8.4 M at today's price or \$22,941 a day. That is real money, and it is not the money that pays users. Two different pots are being confused, often on purpose, by projects that want the credibility of mining without the arithmetic.

HydroBit's job is the reserve. It mines Bitcoin continuously and holds it, and the reserve is the collateral behind Echo coin. It is not a wage account, and it was never meant to be one.

User wages come from Ecosystem revenue: ads, data sales, marketplace fees, subscriptions and outbound transfer friction. That revenue has to exist before wages can be paid at any daily rate, and the honest way to say it is that the wage scales with what the revenue actually is. A million users at \$17.50 a day needs \$6.39 B a year of Ecosystem revenue. Nobody should pretend that arrives in month one.

Wages are a revenue question, not a mining question

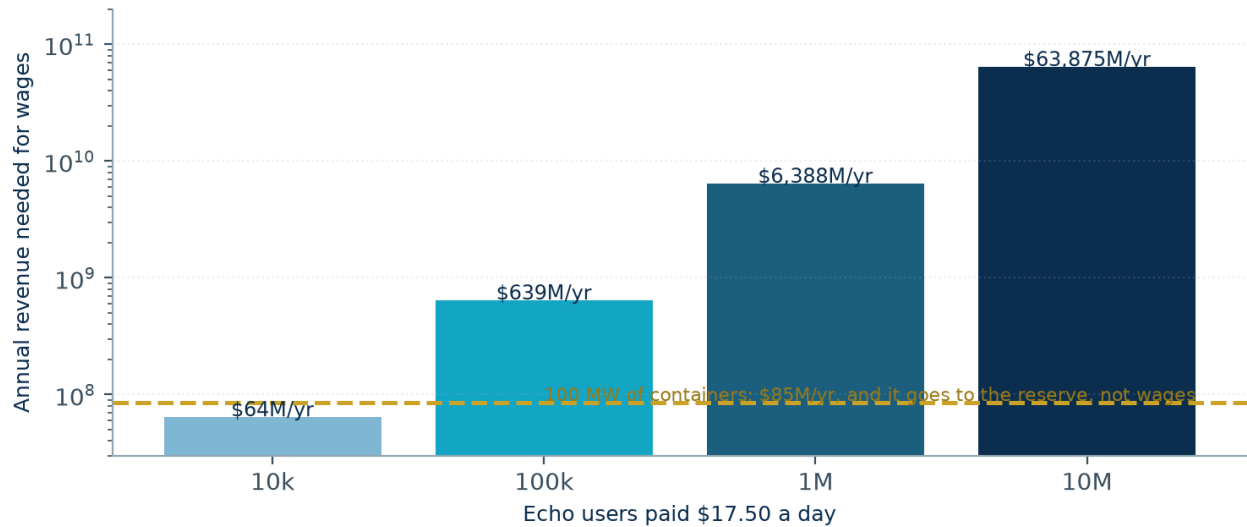


Figure 4. What user wages require in annual revenue, against what a 100 MW fleet mines. The mining line is not a wage line, and drawing it as one is the mistake this paper avoids.

This is where Echo differs from Meta, and the difference is not a slogan. Meta earns from ads, data and attention, and that money goes to shareholders through buybacks and dividends. Echo will earn from ads, data sales and marketplace fees, and there will be no shareholders and no shares. The owners are the people holding Echo coin, which is to say the users. The Ecosystem pays for operations, then pays wages, and what compounds behind it backs the coin those same users hold.

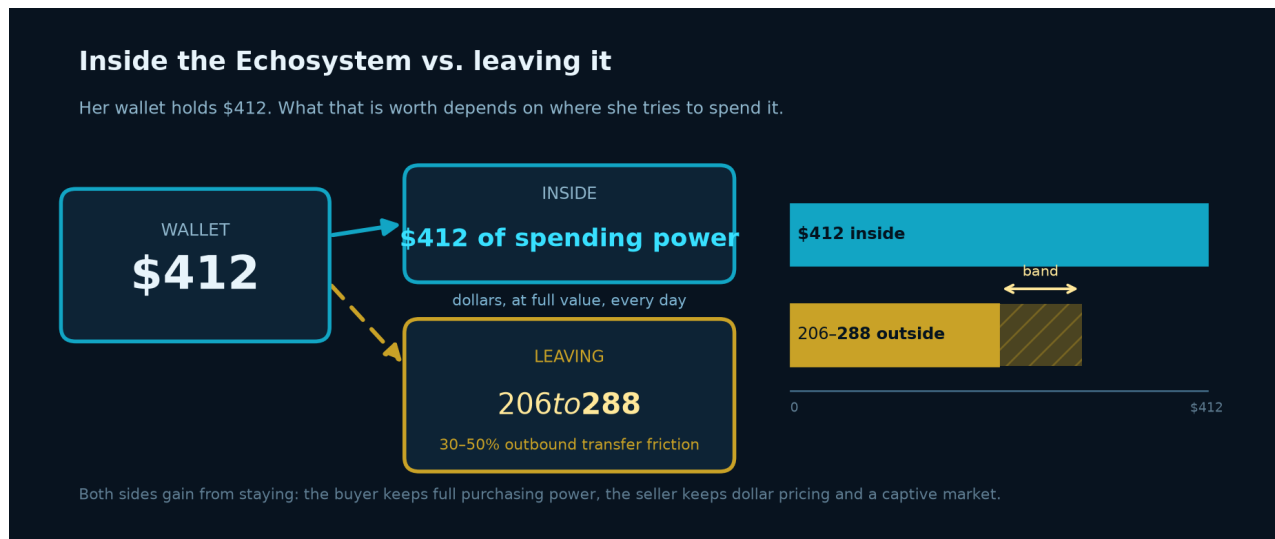


Figure 5. The internal dollar and the exit. Full value inside, 30-50% outbound transfer friction on the way out.

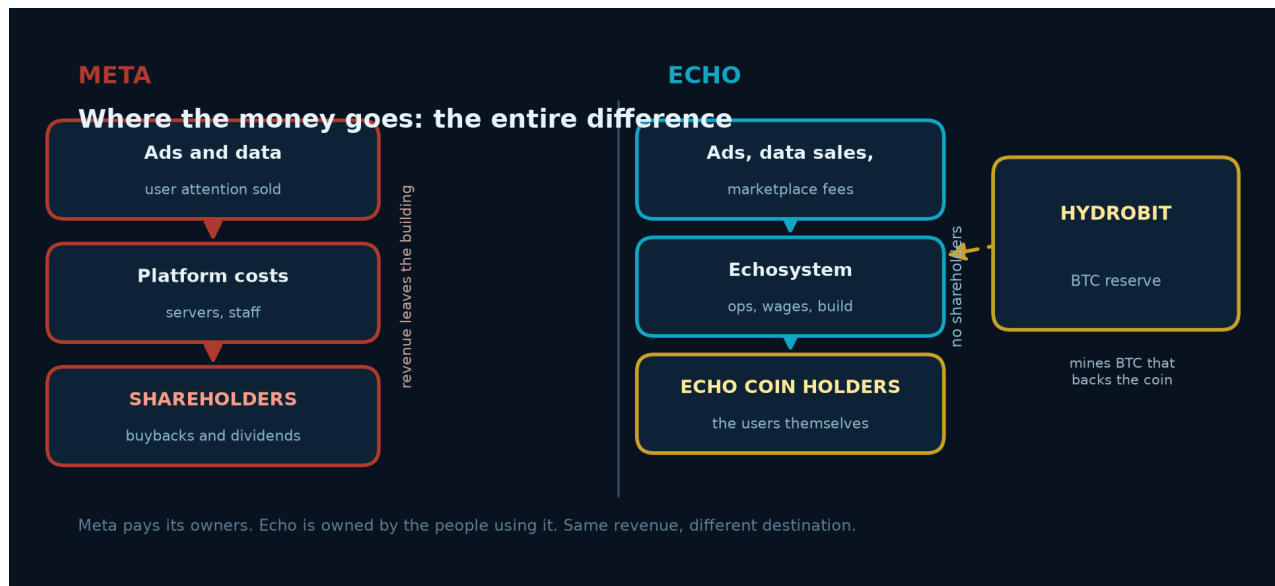


Figure 6. The same revenue, a different destination. Meta's owners are outside the product; Echo's owners are the product's users.

Two constraints remain, and neither is rhetorical. The same Bitcoin cannot both sit in the reserve as collateral and be paid out as wages; every sat spent lowers the backing behind every coin. And no amount of mining substitutes for revenue: the reserve makes the coin credible and gives it a floor of real assets, while wages depend on the Ecosystem actually selling something people want.

6.1 What the user sees: dollars, not coin

Echo coin is plumbing. Users never see a token balance, a ticker, a chart, or a wallet address. The interface shows dollars, and the coin does its work behind that number.

The internal dollar is stable by design. A user with \$412 in her wallet has \$412 of spending power inside the Ecosystem today and tomorrow, whatever Echo coin is doing on a given afternoon. Vendors price in dollars and get paid in dollars. Nobody inside the marketplace has to think about the coin, watch a chart, or hedge anything.

- The headline is a dollar amount that does not wobble. Her \$412 buys \$412 of goods and services inside, regardless of coin price.
- Purchasing power is stated plainly underneath: a week of groceries, a month of phone service. The promise is what the dollars buy, not what a token is trading at.
- No token vocabulary reaches the screen. Nobody is asked to understand a coin, hold a key, or read a chart to earn a wage.
- Both sides are pulled inward. Buyers keep full spending power inside and lose value on the way out; sellers reach people who cannot spend anywhere else, and keep dollar pricing they understand.

The exit is where the peg shows. If she tries to leave the Ecosystem with her \$412, she does not get \$412 of outside money. Leaving costs between 30% and 50% of the liquidity she tries to take with her: on \$412 that is a \$124 to \$206 reduction, so she receives between \$288 and \$206. The published band, the exact rate in force, and the resulting dollar figure are shown before she moves anything, in dollars, not in token math.

This is not a trick, and it has to be said out loud rather than discovered: the internal dollar is a claim on the Ecosystem, not a bank deposit, and it is not redeemable at face value outside. What makes that fair rather than exploitative is that the value is real while she is inside, the band is disclosed in advance, and the reserve and the coin are what give the claim anything to stand on at all.

Why a band and not a single rate. The friction has three jobs: it keeps value circulating inside, it damps runs, and it funds the treasury that pays wages. Those pull in different directions. A rate pinned at 50% maximizes retention and looks

punitive; a rate near 30% still discourages casual exit without trapping anyone. A published band lets the rate move with conditions — wider when reserves are thin or outflows spike, narrower when they are strong — while never exceeding the stated ceiling. Every movement of the rate inside the band has to be disclosed when it happens, not after.

Two honest caveats belong on that screen. The internal peg holds only while the Ecosystem keeps earning and the reserve keeps backing it; a fixed number of dollars in a system that stops selling anything is worth nothing. And the exit discount is a strong incentive to stay, which is a business advantage and a consumer-protection question at the same time — it needs counsel, plain disclosure, and no dark patterns.

So the sequence is: one pilot container to prove the hardware and the permitting path; a published reserve with no coin behind it yet while Echo grows on its own revenue; a coin backed by that reserve only after legal review and an audited reserve, at a supply the reserve can credibly cover; and then scale, funded by container sales margin and outside capital.

7. The Echo Coin Layer (design proposal, not a plan of record)

Nothing in this section is live, audited or legally reviewed. Echo coin has not been minted.

- Issuance: an ICRC-1/ICRC-2 token on ICP [21], issued by an Ecosystem canister and governed by a planned Ecosystem Foundation DAO.
- Collateral: the Bitcoin reserve is intended to be the coin's backing. ICP canisters can hold native BTC and sign Bitcoin transactions with threshold ECDSA and Schnorr, and ckBTC is a 1:1 BTC-backed token on ICP [21], so the reserve could sit at canister-controlled addresses rather than a single key.
- Earning and spending: users earn Echo coin for verified participation and spend it inside the Ecosystem on goods, tips, services and boosts.
- Liquidity retention: moving Echo coin out of the Ecosystem carries outbound transfer friction, a disclosed fee whose purpose is to keep value circulating inside and dampen runs. Rate, exemptions and schedule would be disclosed before anyone earns or buys.
- Buybacks: part of the reserve may occasionally buy Echo coin on the open market. These are discretionary, not guaranteed, and each one spends collateral that would otherwise back every other holder.

Unresolved before any launch: what happens to backing if BTC falls (a 50% drop halves it, and there is no redemption guarantee unless one is built and funded); how buyback timing is decided without insiders trading ahead of it; who controls reserve keys — single wallet, multisig, or a DAO-governed canister with threshold signatures; and whether the reserve and the liabilities against it are independently attested.

Legal status, which is not a footnote. A coin backed by a reserve, supported by issuer buybacks and described as gaining value from scarcity invites analysis as an investment contract under Howey [20]. The SEC/CFTC interpretation of March 17, 2026 (Release No. 33-11412) sets out a crypto-asset taxonomy and states that Howey remains binding [20]. Buybacks meant to raise value, and any marketing of appreciation, weigh toward that conclusion. Wage-like payouts raise employment and tax questions, and moving value for users raises money-transmitter questions under FinCEN guidance and state licensing [22]. Echo coin is intended to be a security-like instrument, and early participants would be buying it knowingly while it has no established value, as one component of a larger structure. None of this has been reviewed by counsel. No coin should be sold, promised or marketed until securities, commodities, money-transmission, tax and consumer-protection lawyers have reviewed the design in each target jurisdiction.

8. Where the Electricity Is Worth More Than Mining

A 100 kW container makes about 2,160 kWh a day at 90% uptime. What that is worth depends entirely on whether anyone nearby will buy it.

Outlet	Price	Per day	Per month	Source
Mining, 12 J/TH, today	≈11.7¢/kWh-equivalent gross	\$230	\$6,978	Section 5
California ReMAT small-renewable FIT (2024)	5.29¢/kWh	\$114	\$3,474	CPUC [24]

US industrial retail (Aug 2026)	9.64¢/kWh	\$208	\$6,330	EIA [23]
US commercial retail (Aug 2026)	14.47¢/kWh	\$313	\$9,502	EIA [23]
Displacing remote diesel	\$0.25–\$0.50+/kWh	\$540–\$1,080	\$16,400–\$32,800	Alaska, Nunavut studies [25]

Retail rates are what customers pay, not what a small generator receives. Grid export needs interconnection that is usually unavailable at remote sites; diesel displacement needs a co-located customer and local permission to sell power.

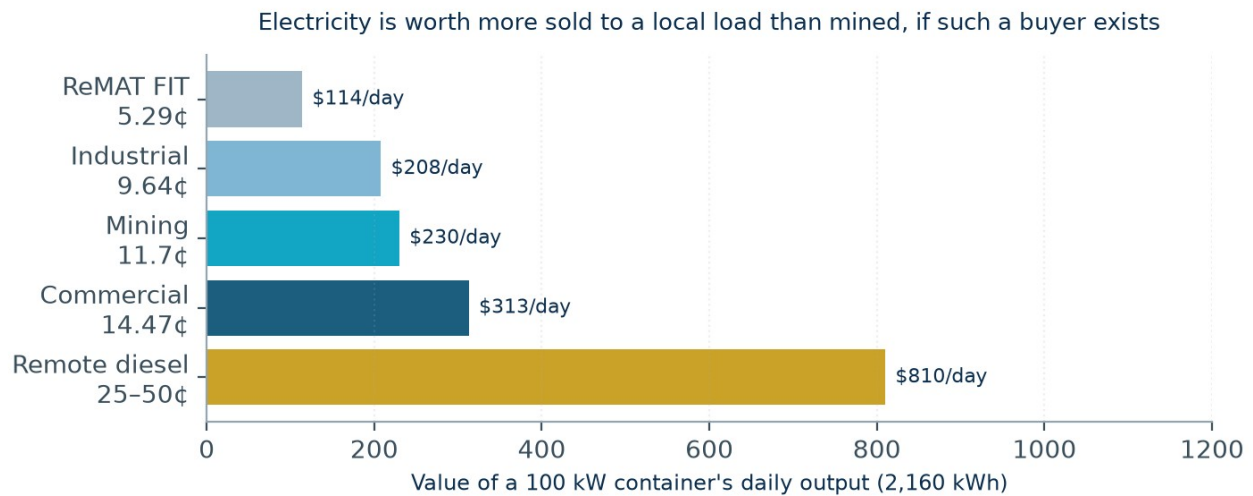


Figure 8. What a 100 kW container's daily 2,160 kWh is worth by outlet. Mining sits between industrial and commercial retail; diesel displacement dwarfs all of it.

Hence the export port in the design. The rule is mine when it pays: run the local load first, mine the surplus, and shut down when stream flow drops below the required instream minimum. Water has no fuel cost, so mining is cash-positive whenever it runs.

9. Permitting and Risk

Hydro is the most legally intensive renewable to site. HydroBit holds no permits and makes no claim that any site is permissible.

- California: diverting water requires an appropriative right from the State Water Resources Control Board unless the landowner already holds one, and hydro needs its own application separate from consumptive uses; small domestic registrations cannot be used for hydroelectric generation [26]. Expect a streambed alteration agreement, Clean Water Act 401/404 review where work touches the channel, CEQA, and county grading and building permits.
- Federal: most hydro on non-federal land in interstate commerce needs a FERC license or exemption. A project on an existing man-made conduit may qualify through a qualifying-conduit Notice of Intent, and a separate 10 MW exemption exists for natural features and existing dams [27]. Whether a fully off-grid unit falls under FERC jurisdiction is a legal question answerable only site by site.
- Bitcoin price and difficulty: revenue tracks one and runs inverse to the other. Difficulty rose 5.9% on Oct 16, 2026, with another ~5.7% expected on Oct 29 [2][3].
- The 2028 halving cuts revenue per TH by about half in roughly 18 months unless price, fees or difficulty compensate. Today's ASICs will be superseded well before most paybacks complete; the turbine, generator and container should outlast several miner generations, and can be refitted or switched to selling power.
- Hydrology: dry-season flow, drought, flood and sediment mean real uptime may fall well below 90% on seasonal streams. Environmental effects include reduced flow in the bypassed reach, fish screening at the intake, construction disturbance and fan noise, mitigated mainly through minimum bypass flow, screens and siting.

- Supply chain and execution: unverified Chinese supplier quality, tariffs, UL/NRTL listing or field evaluation for US electrical equipment, Starlink licensing and crypto-mining legality varying by country — on top of a founder-only team with no prototype.

10. Plan and Team

Gabriel Marciel, Founder, authored HydroBit v1.0 and leads design, business development and fundraising. There are no other employees, advisors or contracted partners. Intended hires as funding allows: a licensed hydro or civil engineer for site studies, an electrical engineer for protection and controls, a California water-rights and environmental attorney, a China-based sourcing and quality manager, and a mining operations lead. None has been retained.

- Q4 2026 – Q1 2027: supplier quotes, detailed design, and a pilot site with existing water rights.
- 2027: build and test one 100 kW pilot; publish measured performance; open pre-orders only after acceptance.
- 2027–2028: small-batch production for sale, first fleet tranche subject to financing and site agreements, and economics re-run before every purchase, especially ahead of the April 2028 halving.

Why sales come before fleet: the buyer funds hardware, civil works and permits while HydroBit earns product margin plus monitoring and service fees. A fleet keeps the mining upside but needs roughly \$31 M of containers before a single civil work. A 25% markup would price the 100 kW unit at \$390,138 with \$78,028 of gross profit, which is an assumption, not tested demand.

11. Sources

Market data, retrieved Oct 29, 2026: [1] CoinGecko BTC/USD \$80,761, api.coingecko.com; [2] mempool.space hashrate and difficulty (140.58 T); [3] ChainQuery difficulty report; [4] Firsthand Bitcoin subsidy, fees and halving countdown; [5] Cloudminecrypto hashprice \$0.0366/TH/day, IonGrid \$36.68/PH/day.

Hardware: [6] Bitmain S21 XP Hyd specification and pricing, bitmain.com/vc and asicminervalue.com (\$5,750–\$7,199); [7] hydro ASIC coolant inlet 20–50°C and 365-day warranty, simplemining.io; [8] S23 Hyd / XP Hyd / M73S pricing, cryptominersdirect.com.

Hydro equipment: [9] Chengdu Forster Pelton sets, 100–110 kW at 110–160 m, FOB \$35k–\$120k for 20–500 kW, made-in-china.com; [10] ADDNEW 40 ft container plants to 1,000 kW, renewableenergyworld.com (2011); [11] Siapro 20 ft container to 150 kW, siapro-hydro.com; [12] Ganz 500 kW containerized Francis, blueworldpower.com; [13] Mesa NuCONTAINER 20 ft and 40 ft to 750 kW, mesainc.com.

Costs: [14] IRENA Renewable Power Generation Costs 2024, \$2,267/kW global average hydro; [15] IRENA 2021 micro/mini hydro range as cited in a UWE Nepal study; [16] ASIC tariff rates, millionminer.com, Oct 29, 2026; [17] Apexito 1.2 MW container \$60.8–\$80.5k, CoinTainerz from \$75,550, minersdeals.com.

Connectivity: [18] Starlink Business plans and power draw, dishycentral.com summary of starlink.com (checked Sept 25, 2026), starlink.com spec sheet; [19] Starlink coverage, leosatnetwork.com.

Law: [20] SEC/CFTC interpretation Release No. 33-11412 (Mar 17, 2026), sec.gov, and SEC v. W.J. Howey Co., 328 U.S. 293 (1946); [21] ICP Bitcoin integration and ckBTC, internetcomputer.org, ICRC-1 github.com/dfinity/ICRC-1; [22] FinCEN FIN-2019-G001; [23] EIA Electric Power Monthly, Aug 2026; [24] CPUC 2025 Padilla report, 2024 ReMAT prices; [25] remote diesel costs, Applied Energy (Alaska) and qec.nu.ca (Nunavut); [26] California Water Code and SWRCB small hydro guidance; [27] FERC qualifying conduit and 10 MW exemption, ferc.gov.

Arithmetic note. Hashprice basis: $450 \text{ BTC/day} \times \$80,761 \div 1.08 \times 10^9 \text{ TH/s} = \$0.03365 \text{ per TH/s per day}$. Difficulty basis: $10^{12} \times 86,400 \times 3.125 \div (140.58 \times 10^{12} \times 2^{32}) = 4.47 \times 10^{-7} \text{ BTC}$, or \$0.0361, matching the published \$0.0366 once fees are included. This paper uses the slightly conservative \$0.0337. Per kW: \$2.81/day at 12 J/TH, \$1.93 at 17.5 J/TH, \$3.55 at 9.5 J/TH.