

Opportunity Assessment

- AI Data Center Cooling

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About Entalpic

Entalpic is the AI Engine that cuts material discovery time from years to months, enabling industries to find, rank and validate cleaner materials faster across various high-impact industries.

Entalpic in numbers

2025

Est
Since

25+

People
strong

10+

PHDs in AI &
Chemistry

2

Countries
Present

Value proposition & mission

Find, rank, and deliver better materials faster for real industrial needs.

Use **generative AI** and **predictive models** to explore a larger design space at lower cost.

Score candidates on **target properties** and **manufacturability**, then **down-select**.

Hand back a **lab-ready shortlist** with **rationale** and a **path to scale**.



**Build a generative AI platform to find better chemistry & materials
for selected industrial needs, towards sustainability**

What Entalpic does

WHAT

Delivering
collaboration with
Industrial & Academic
partners

HOW

Through short POCs
and longer co-
development
programs

WHY

To accelerate discovery
and validation cycles for
sustainable materials
discovery

Functionalities

- Propose a list of candidates, with desirable target properties
- Integrate synthesis & manufacturing constraints
- Applicable to materials, surfaces and molecules, including additive and dopants

Applications



Solid materials



Coatings



Electro Catalysis

Industries



Energy Storage



Carbon Capture



Critical Materials

Why AI data center cooling? Why now?

The AI Boom is Fueling Explosive Data Volumes & Compute Demand

Explosive growth of AI workloads

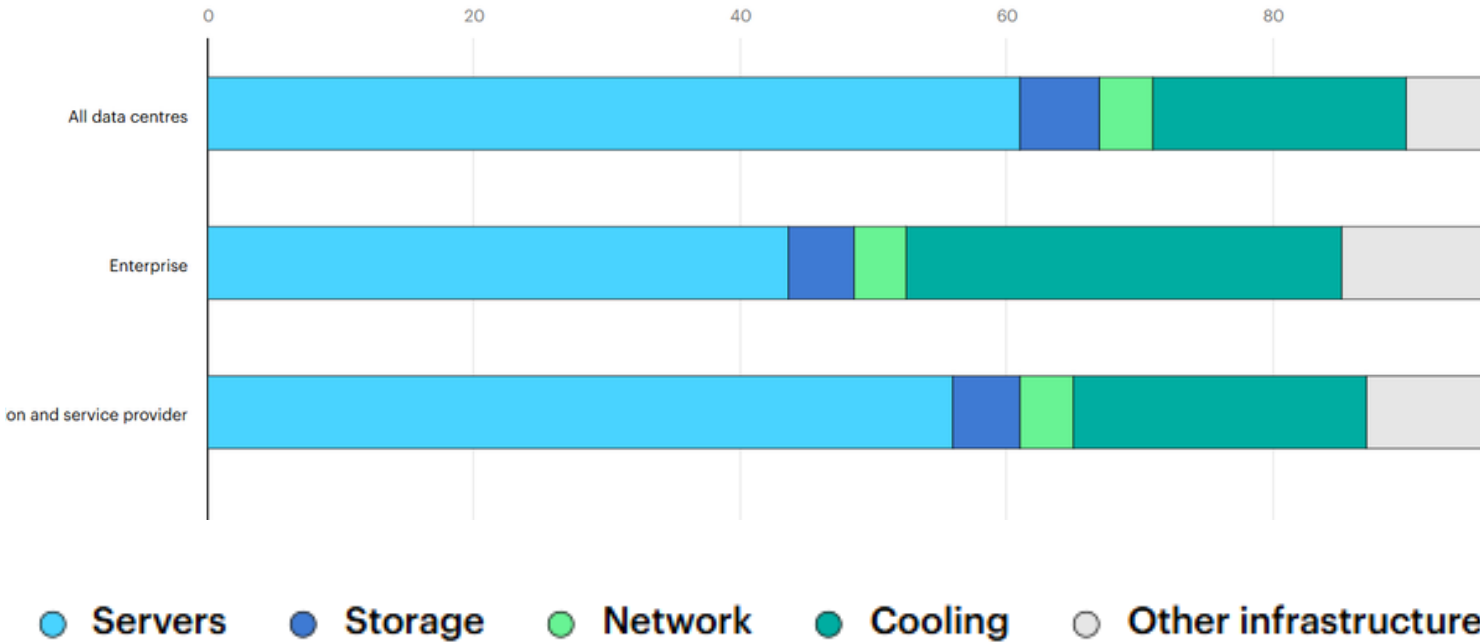
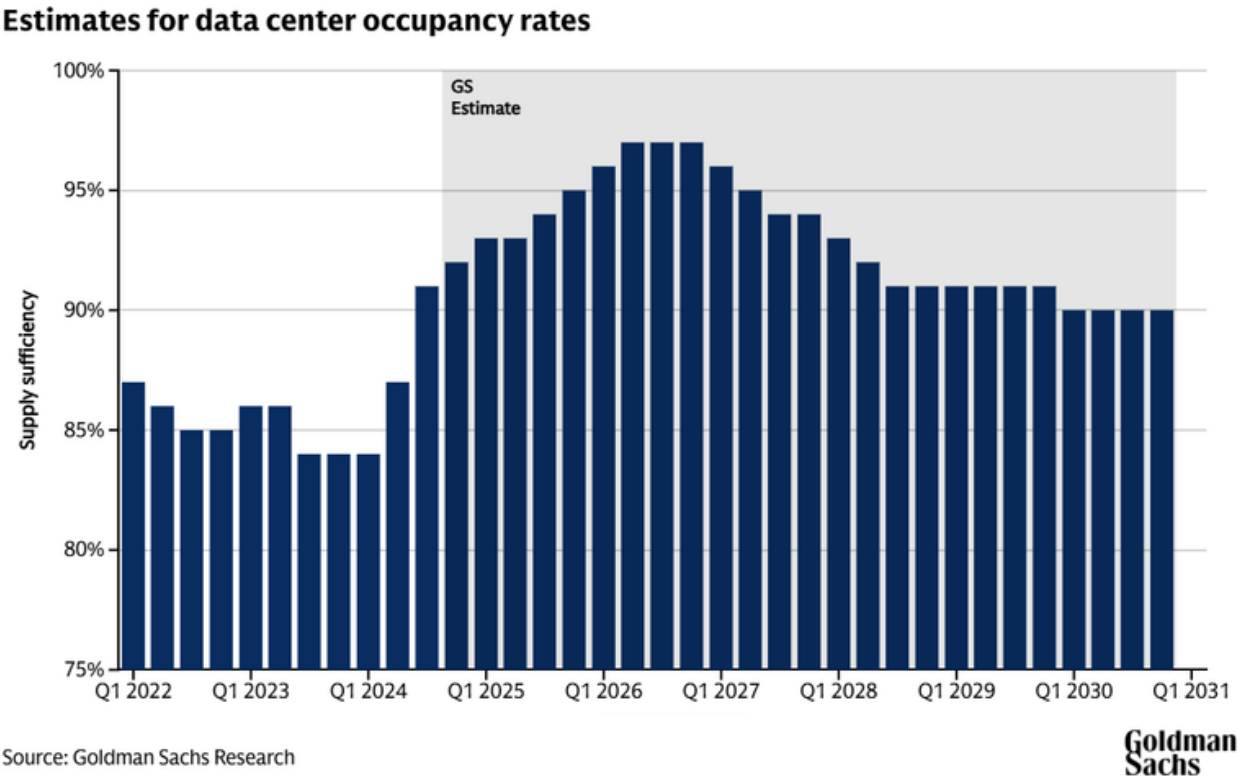
- In just **4 years**, Google has **doubled their data center energy** use (30.8 million MW-hours)
- Processing + Energy = 37% of the cost per Zettabyte of Data
- GPU/AI racks are now hitting **40–120 kW per rack**.
- Data centers currently consume ~1.5% of global electricity, a figure projected to **double to 3% by 2030** driven by AI training and hyperscale expansion.

The Market Potential we target

- The global data center liquid cooling market size is projected to reach **\$17.77 billion by 2030**, growing at a CAGR of 21.6% from 2025 to 2030.
- Data-center liquid cooling market expected to grow **25–30% CAGR through 2030**.
- Even a 5–10% improvement in thermal efficiency translates into millions in savings per site.

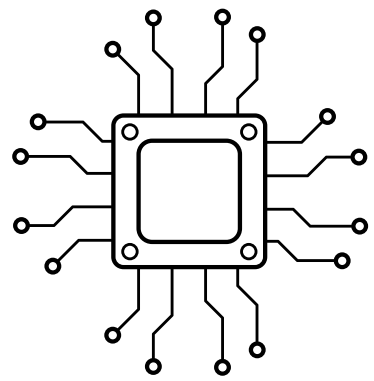
Pain Points for Intervention

- PFAS bans (EU 2025+, US state bans 2024–2026) will make 3M Novec-style fluids obsolete.
- Cooling accounts for 30–50% of a data center’s total energy use.**
- As chip power increases, heat removal becomes the limiting factor for performance.

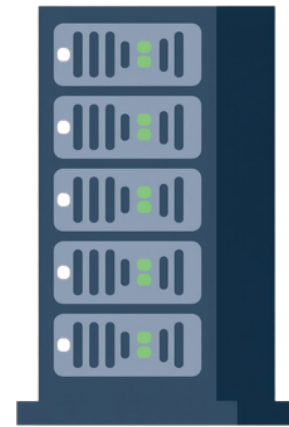


Sources: XAngle Liquid Cooling Startups Article; KSB; DOE estimates, Deloitte reports; Industry analyst consensus: Allied, MarketsAndMarkets, Dell’Oro

Cooling stack



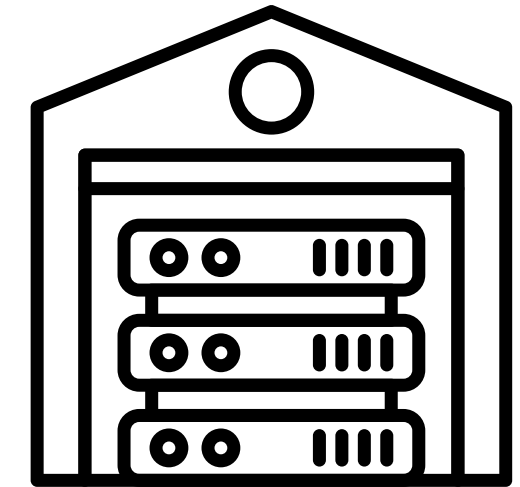
Chip



Servers



Server Racks



Data Centres

A Massive Value Chain

There are opportunities at every stage of the value chain

- Currently, Air cooling is the most dominant cooling technology deployed across data centers. However, with the emergence of power-dense AI specialized chips, and servers also increasing in density, the byproduct is high and concentrated levels of heat being produced. (400-600W+)
- With massive amount of heat produced by chips and racks, and air cooling only designed to handle heat to a certain extent, there is potential for intervention at every stage of the data centre cooling value chain
- Multiple technologies currently for each step of the cooling stack, along with a handful of new and exciting solutions, all with their own advantages and drawbacks.

Our Approach

Identifying opportunities through in-depth market research

- We segmented each step of the cooling stack to identify potential opportunities in our opportunity longlist.
- For each opportunity, we have identified the use case and potential entry point for Entalpic to enter the market.
- Our aim was to narrow down on one specific opportunity by evaluating it based on the feasibility, attractiveness and environmental impact.

Sources: McKinsey's Beyond compute: Infrastructure that powers and cools AI data centers Report, 2025

Opportunity longlist (1/2)

Longlist maps materials levers from chip to plant and highlights five pilotable use cases with the strongest Entalpic fit and near-term operator pull.

Opportunity Table



Layer	Use case	What it is	Why it matters	Entalpic's play	Feasibility
 Chip & package	High performance Thermal Interface Materials (TIMs)	Thin heat bridge under the lid	Lowers chip temperature and improves reliability	Design a higher-conductivity, stable paste/film	
	HBM thermal underfills	Heat-friendly glue under stacked memory	Keeps HBM reliable by letting heat escape	Formulate an underfill that conducts heat yet insulates electrically	
	Vapor chamber lid	Thin sealed spreader in the lid	Smooths hotspots so the cooler works better	Tailor wick coating and matching working fluid	
 Inside server loop	PFAs-free single-phase coolants	Safer liquid for cold plates	Moves more heat with less pumping and better ESG	Create a new coolant recipe plus compatibility guidance	
	Two-phase working fluids	Boil-on-chip coolant	Removes a lot of heat quickly at very high loads	Design a controlled-boiling fluid with the right boiling point and wetting	
	Corrosion and fouling inhibitor packs	Loop-cleaner additives	Prevents clogging and reduces downtime	Build a targeted additive blend for mixed metals and warm loops	
	Seal and elastomer recipes	Leak-proof O-rings and hoses	Avoids swelling and leaks with new coolants	Develop rubber material mixes that stay stable at higher temps	
	Anti-fouling high-k coatings (cold plates)	Non-stick, heat-friendly lining	Keeps microchannels clean and performance steady	Create an ultra-thin, conductive, fouling-resistant coating	

Opportunity longlist (2/2)

Longlist maps materials levers from chip to plant and highlights five pilotable use cases with the strongest Entalpic fit and near-term operator pull.

Opportunity Table



Layer	Use case	What it is	Why it matters	Entalpic's play	Feasibility
 Rack & row	Phase-change thermal buffers (PCM modules)	Small thermal battery blocks	Absorb short heat spikes so servers avoid throttling	Engineer PCM material with the right melt point and cycling life	
	High-temperature secondary-loop fluids	Hotter loop for heat reuse	Enables district heat without fluid breakdown	Formulate stabilized hot-loop fluids or stabilizer packs	
	Low-GWP refrigerant blends and oils	Climate-friendly chiller gases	Meet rules while staying efficient and safe	Discover low-GWP blends and matching compressor oils	
 Monitoring & reliability	Coolant health tracers	Smart dye or signal in fluid	Early warning for aging, corrosion, or leaks	Design tracers that are safe and easy to detect	



LOGIC USED

- Materials play, making Entalpic's role crucial
- Buyer pain being current
- Final preference to fast to pilot/strong sustainability push



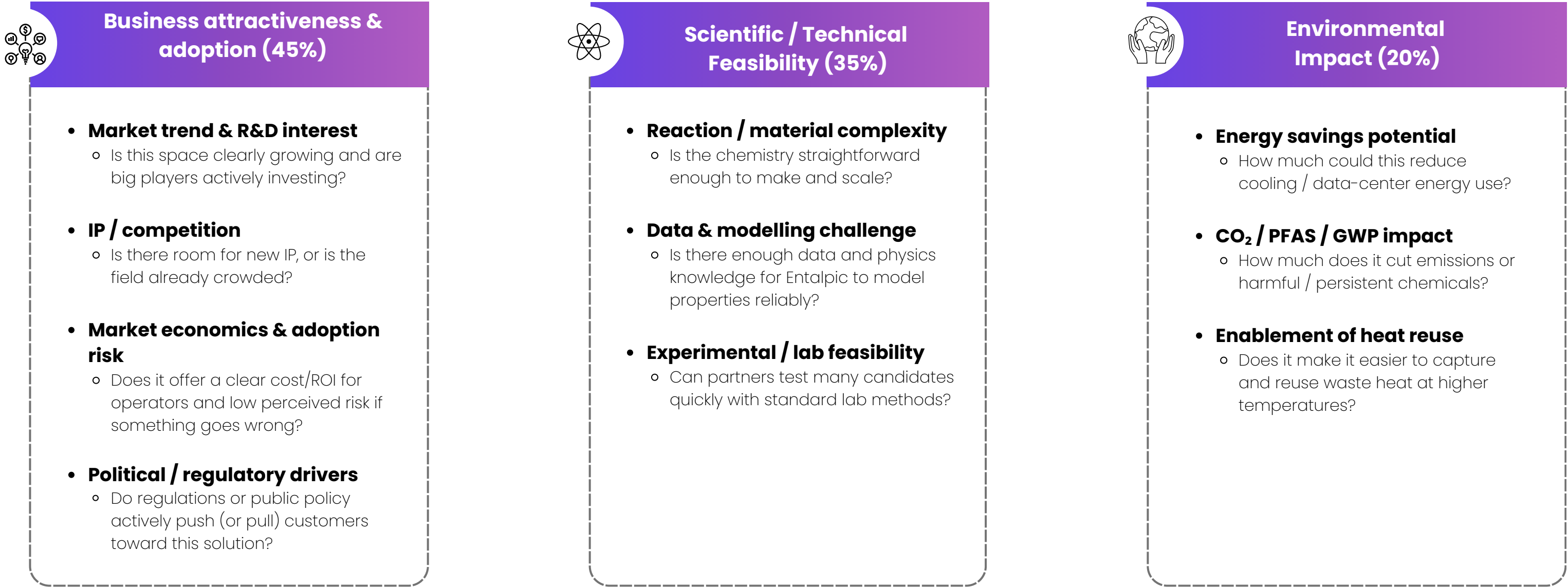
TOP 5 PICKS FOR THE NEXT STEP

- TIMs
- PFAs-free coolants
- Inhibitor packs
- High-temperature secondary-loop fluids
- Anti-fouling coatings.

Scoring framework & method

We compare 5 use cases along 3 lenses: business & adoption, scientific fit for Entalpic, and climate impact. All criteria are scored from 1–5 per use case, then combined using the weights

Methodology & Criteria



SCORING FORMULA



Total score = 0.45 × Business + 0.35 × Scientific + 0.20 × Climate

SCORING KEY



5 Very Attractive **3** Medium **1** Unattractive

Shortlist & rationale

PFAs-free dielectric direct-to-chip coolants rank highest on our scorecard, offering the strongest operator pull, credible technical path, and clear climate upside, so they move to deep dive.

Scoring Table

Use Cases	Business attractiveness & adoption	Scientific / Technical Feasibility	Environmental Impact	Total Weighted Average Score ¹
High-performance TIMs	4	4	3	3.8
PFAs-free dielectric coolants (direct-to-chip)	5	4	5	4.7
Inhibitor packages for warm loops	4	4	4	4
High-temp secondary-loop fluids for heat reuse	4	3	5	3.9
Seal / elastomer materials for new coolants	3	4	3	3.4



The scoring methodology leads us to select **PFAs-free dielectric direct to chip coolants** as the **most feasible use case** for Entalpic based on Business, Scientific, & Environmental criterion and hence merits a deep dive

Sources: Detailed Justifications for the weighted score on the [Excel model](#)



PFAs-free dielectric coolants *(focus: single phase, direct-to-chip)*

AI racks need liquid at the chip now, and a PFAs-free single-phase D2C fluid that qualifies fast is the safest path; Entalpic de-risks adoption with a validated shortlist, a 12-week pilot test matrix, and a compatibility data pack for metals, seals, and sensors.

The problem

-  AI racks are **hitting air limits**, **liquid** at the chip is **needed** to move more heat without electrical risk
-  Many **current** dielectrics are **fluorinated**, **PFAS scrutiny** and **supply risk** are increasing
-  **Buyers** want **performance, reliability**, and an **ESG-acceptable** fluid they can qualify quickly

Where this lives in the stack

-  **Inside the server loop** that **touches CPUs** and **GPUs**
-  Touch points include **plate metals** and **coatings, manifolds, pumps, elastomers, sensors**

Why this fits now

-  **Rising rack power** is pushing **liquid adoption** at the chip.
-  **PFAS regulation** and **supplier exits** increase urgency for non-fluorinated options.
-  Server-side **qualification paths exist** with **OEM labs** and **D2C vendors**.

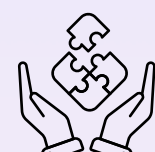
Target outcomes for success

- 

Thermal efficiency

Move more heat at a given flow with sensible pump energy
- 

Electrical safety

High dielectric strength and very low conductivity
- 

Compatibility

No adverse effects on copper, aluminum, stainless steel, or common seals
- 

ESG

PFAs-free with low persistence and compliant additives
- 

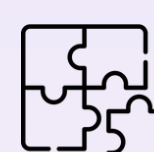
Stability

Low fouling and consistent properties over the operating range

Entalpic's role and near-term deliverables

- 

Shortlist of 5-10 PFAs-free candidates with predicted property bands
- 

A first test matrix suitable for a 12-week loop pilot
- 

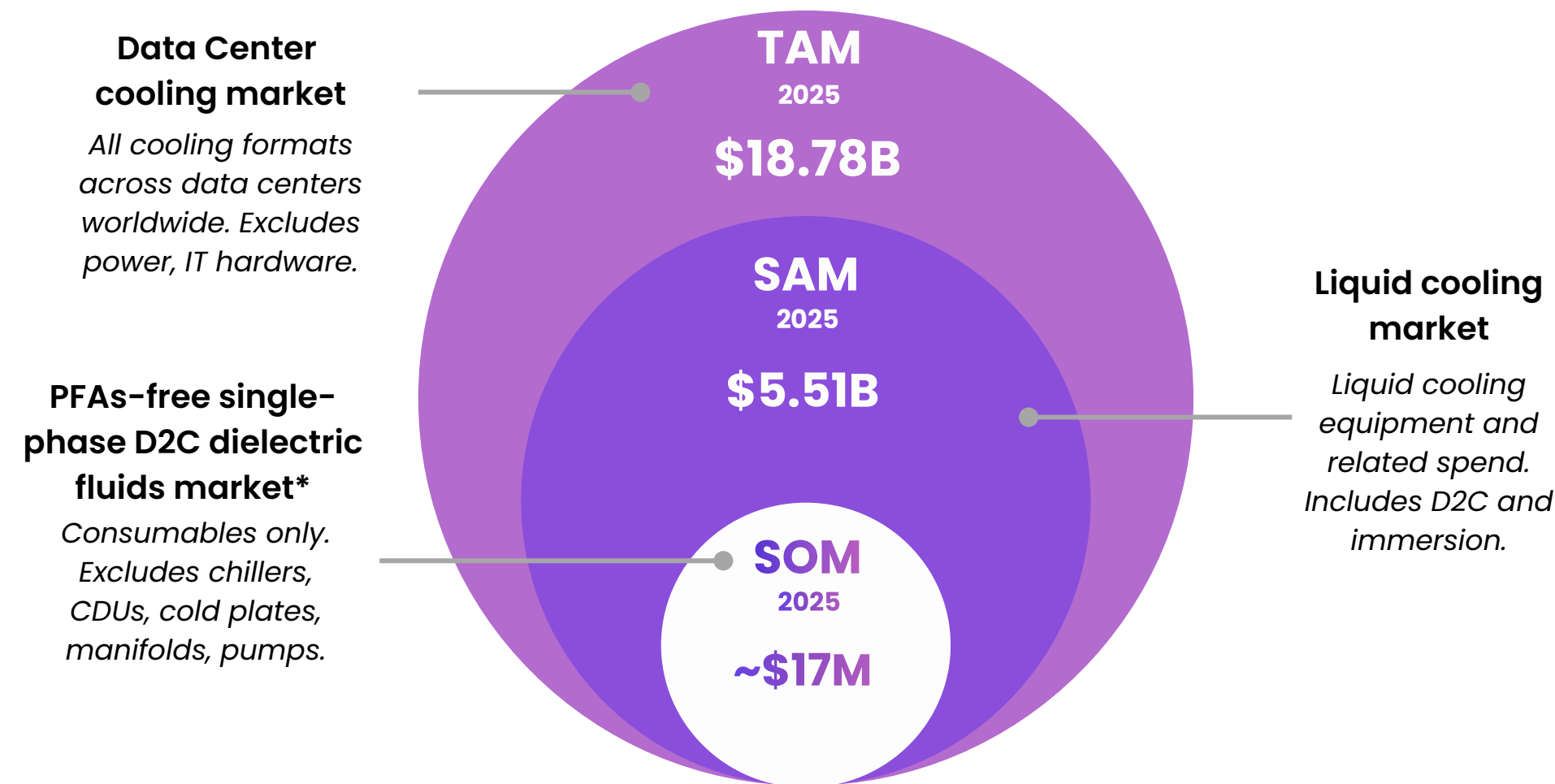
A compatibility data pack for metals, seals, and sensors

Sources: Dell, Lenovo press, Open Compute Project Market intelligence function, Ashrae, NRDC, ECHA, 3M Multimedia, Iceotope, Cool IT Systems, Knowde, Castrol, Soltexinc

Market size & context

A small consumables niche today (~\$17M in 2025) inside a \$5.5B liquid-cooling market is opening fast as AI racks scale and PFAS pressure rises, giving Entalpic a timely entry via OEM lab pilots with D2C partners.

Sizing the global opportunity



Methodology for SOM (2025)

Data:
Dielectric Fluids Market in 2025: \$216.7M

***Assumptions:**
D2C share of dielectric fluids in 2025: 20%
PFAS free share inside D2C in 2025: 40%

To further validate

- CAGR for the market
- D2C share in dielectric fluids
- PFAs free share in D2C

Initial focus

Who: server OEM validation labs and top colos piloting direct-to-chip in US and EU

Offer: PFAs-free single-phase D2C fluid shortlist + compatibility data pack

Market context

-
- Adoption**
 - Data center physical infrastructure revenue: \$8.9B in Q2-25, +18% YoY
 - Direct liquid cooling +156% YoY, becoming standard on large AI clusters
-
- Value case**
 - Higher usable compute per rack at similar OPEX
 - Lifecycle studies show energy 15–20% and water 31–52% savings vs air
-
- Regulation & signals**
 - PFAS scrutiny rising and supplier exits create urgency for non-fluorinated options
 - Strategic moves: large OEMs promote D2C reference designs; Schneider acquired Motivair, Microsoft LCA confirms liquid cooling’s lifecycle benefits, strengthening operator business cases.

Sources: Fortune Business Insights, Mordor Intelligence, InsightAce, Microsoft, Manufacturing dive, Ricardo, Schneider electric, NVIDIA Developer, Lenovo, HPE, Dell’Oro group

Competitive landscape and partners

Today our real rivals are AI materials discovery outfits. Around them sit D2C hardware vendors and immersion-fluid suppliers that shape partner choices and budgets. The lane for PFAs-free single-phase D2C fluids + a compatibility data pack is still open.

Direct competition: AI chemistry discovery platforms



AI materials for thermal management. Public work in electronics cooling and two-phase D2C hardware. Risk if buyers want a one-stop shop.

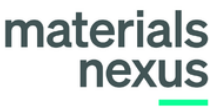
Single-phase D2C consumables focus plus compatibility data pack.



Enterprise materials informatics for chemicals and formulations. Competes when buyers prefer a generalist platform.

Domain depth in D2C fluids and a faster path to OEM-lab pass.

GENERALIST AI FOR MATERIALS PLAYERS



Indirect competition (to our partners)

D2C HARDWARE VENDORS

They control cold plates, CDUs, test rigs, and approved-fluid lists.

They gate qualification. Must to secure rig access and routes to approved-fluid status.



FLUID AND ADDITIVE SUPPLIERS

Mostly immersion-first today, but they own QA, SDS, compliance, and distribution.

They can be the manufacturing and scale partner once a formulation is selected.



IMMERSION AND OTHER SUBSTITUTES

They fix tank-based layouts and fluid requirements that exclude D2C options.

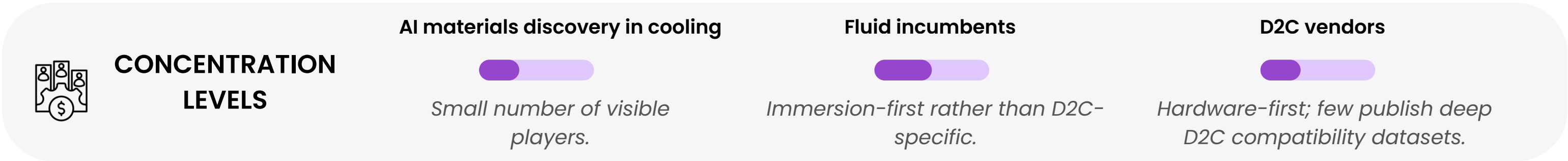
These paths can divert projects away from D2C or lock non-compatible specs.



REAR-DOOR HEAT EXCHANGERS

UPGRADED AIR

There is room for a neutral discovery-plus-qualification player that delivers PFAs-free single-phase D2C consumables with a compatibility data pack and partners for scale.



Sources: Company Websites, OCP cold-plate qualification guide, Iceotope validated coolants
(Orbital Materials, Citrine, Materials Nexus, Schrödinger Materials Science, Kebotix, CoolIT systems, Asetek, Corintis, ZutaCore, Engineered fluids, Shell, Castrol, Valvoline, Submer, GRC, Iceotope),

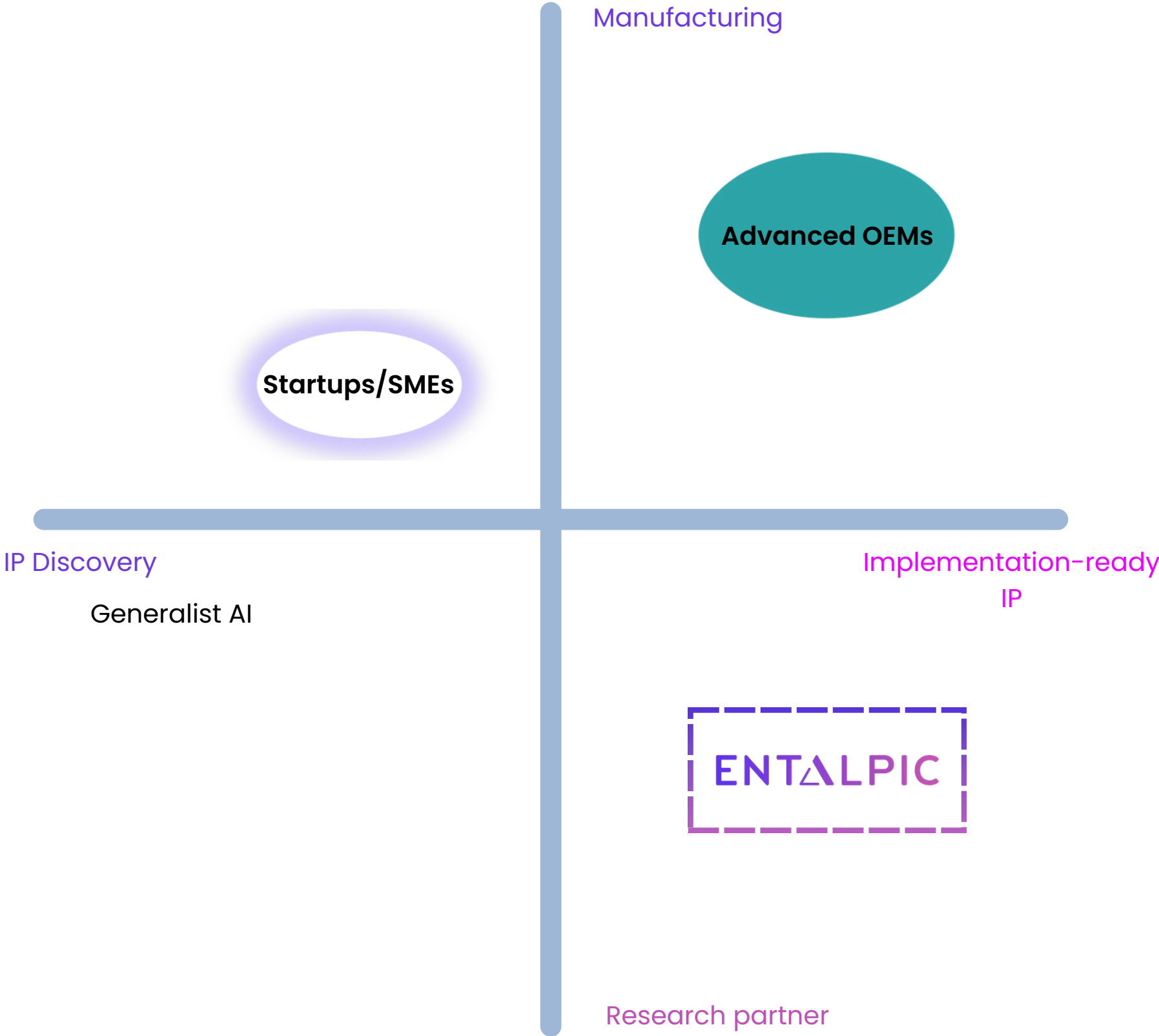
Positioning & differentiation

Given the competitive landscape, we believe there is an exciting opportunity for Entalpic to differentiate itself from its competitors, and occupy a role that is currently uncatered to in the market.

Differentiation

- **White-box Collaboration**
 - Instead of offering a product whose chemical composition is unknown, Entalpic will work with clients in developing the materials suited to their needs
 - Transparency, rigorous testing and proof-of-concept to build trust
- **Qualification-ready IP**
 - Entalpic will offer the entire data package along with the shortlisted IPs to the clients - cutting months of the OEM Manufacturing lifecycle.
 - Clients can go from Candidate phase to Go-to-Market phase faster than competitors as Entalpic will handle the compatibility and stability testing of the IPs.
- **Niche Focus**
 - Market entry point is a deep specialisation in a high stakes market that is garnering attention.
 - Entalpic can grow organically by solving the most urgent and relevant pain points facing the market one after another.

Positioning



Go-to-market: How Entalpic enters PFAs-free D2C coolants

Entalpic wins as a neutral AI discovery partner, co-developing PFAs-free coolants with D2C vendors and fluid OEMs, instead of competing with them.

Target Customers & Influencers *(Who)*

Primary customers (short term)

- D2C liquid-cooling vendors (e.g. providers of direct-to-chip cold plates and CDUs)
- Need PFAs-free, high-performance coolants that are proven compatible with their systems.

Secondary customers (mid-term)

- Fluid/chemical OEMs
- Want next-gen formulations plus a data-backed way to qualify them quickly with their own customers.

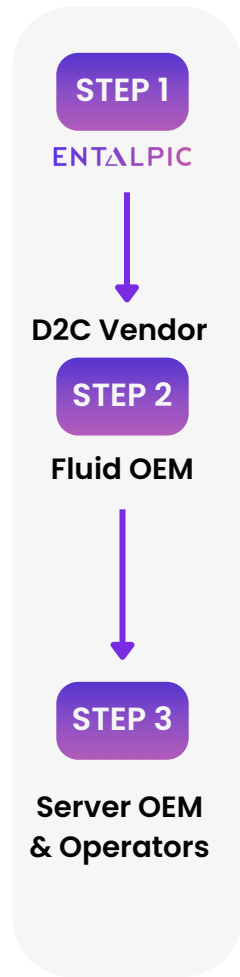
Key influencers

- Server OEM validation labs & hyperscale operators
- Gatekeepers for test protocols and “approved fluid” lists; their buy-in de-risks adoption.

Commercial Model *(How entalpic gets paid)*

Stream	What Entalpic sells	Who pays	Logic
Discovery projects	Use-case-specific AI discovery + shortlist of PFAs-free candidates	D2C vendors / fluid OEMs	One-off or project fee
Data & compatibility packages	Metals / elastomer compatibility matrix, performance data, lab protocols	D2C vendors / fluid OEMs	One-off or project fee
Co-development support	Iteration on formulations during testing (lab & pilot phase)	D2C vendors	Licensing fee or annual access

Route to Market & Partnerships *(How)*



Co-develop with D2C vendors

- Use Entalpic’s platform to generate and shortlist PFAs-free single-phase candidates for direct-to-chip loops.
- Run tests on D2C vendor test rigs (cold plates, loops, CDUs).
- *Output:* fluid shortlists + compatibility & performance data

Bring in fluid OEMs for scale

- License formulations + property targets + compatibility dataset to a fluid/chemical OEM.
- OEM manufactures and distributes the final coolant on industrial scale.
- Entalpic stays upstream as the AI discovery and data partner.

Secure OEM & operator approval

- Work with server OEM labs and selected hyperscalers to qualify the coolant for specific racks and configurations.
- Result: coolant listed in approved-fluid programs, making it easy to deploy in new AI clusters.

Sources: Future Market Insights, Datacenters.com, EnviroTech International

Entalpic does not manufacture or sell the fluid themselves in the short term

Key messages & actions



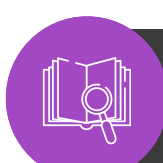
WHAT TO REMEMBER

Decision

- **Recommended use case:** PFAs-free, single-phase direct-to-chip dielectric coolant
- **Entalpic role:** discovery + qualification package (shortlist + compatibility data pack)
- **Business model:** partner-led scale (D2C vendors + fluid OEMs)

Why this wins now

- **Clear urgency:** AI racks are moving to liquid and PFAS pressure increases
- **Clear gap:** few players focus on D2C consumables plus qualification-ready compatibility data
- **Clear wedge:** small consumables niche today but attached to a fast-growing liquid cooling buildout



HOW TO USE THIS DECK

Where to look for details

- What is Entalpic? → Company overview
- What options exist? → Opportunity longlist + shortlist logic
- How big is it? → Market sizing
- Who else plays? → Competitive landscape
- How do we enter? → GTM and partners

NEXT STEPS

Stakeholder	Ask	Output
D2C vendors (rig access + approval path)	access to test rig + materials list + pass criteria for "approved fluid"	pilot scope agreed + route to approved-fluid listing opened
Server OEM validation labs (qualification gatekeepers)	protocol template + coupon list + sign-off process	qualification plan and report format locked
Fluid OEMs (QA + SDS + compliant supply)	co-dev slot + QA plan + commercial path for licensing/supply	scale pathway defined (license or co-manufacture)

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Thank You

Thank you for your attention! We hope this was helpful. Please reach out with any questions!