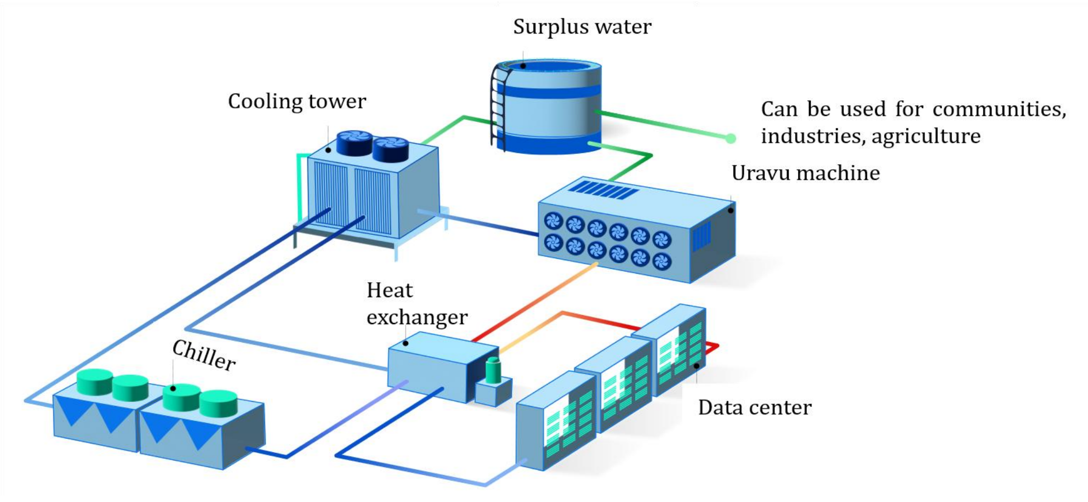
Executive Summary

Data centers are facing growing pressure to simultaneously reduce operating costs, cut carbon emissions, and address escalating water risks. Cooling alone accounts for a substantial share of data center energy use, carbon footprint, and water consumption, particularly in hot, humid, and water-stressed regions. This report evaluates the integration of Uravu's waste-heat-driven and hybrid-electric atmospheric water generation systems with data center cooling infrastructure across multiple global locations, with a focus on economic and sustainability outcomes.

> 🌍 The atmosphere contains orders of magnitude more freshwater than daily global human demand, and this moisture is renewed every 8-10 days through natural evaporation and weather cycles. Uravu's systems are designed to scale with thermal availability without heat pumps, external water sources, or additional grid load.

Solution and Integration

Uravu's technology enables data centers to **cool their infrastructure while simultaneously producing freshwater** by directly using the waste heat already available within the facility. Unlike conventional heat-recovery approaches, Uravu does **not** do any form of waste-heat temperature upgrading through heat pumps. The system operates entirely within the native temperature range of data center waste heat, utilizing it as is to drive a liquid-desiccant-based water generation process. This direct thermal coupling allows cooling and water production to occur without additional electrical load or thermal amplification.



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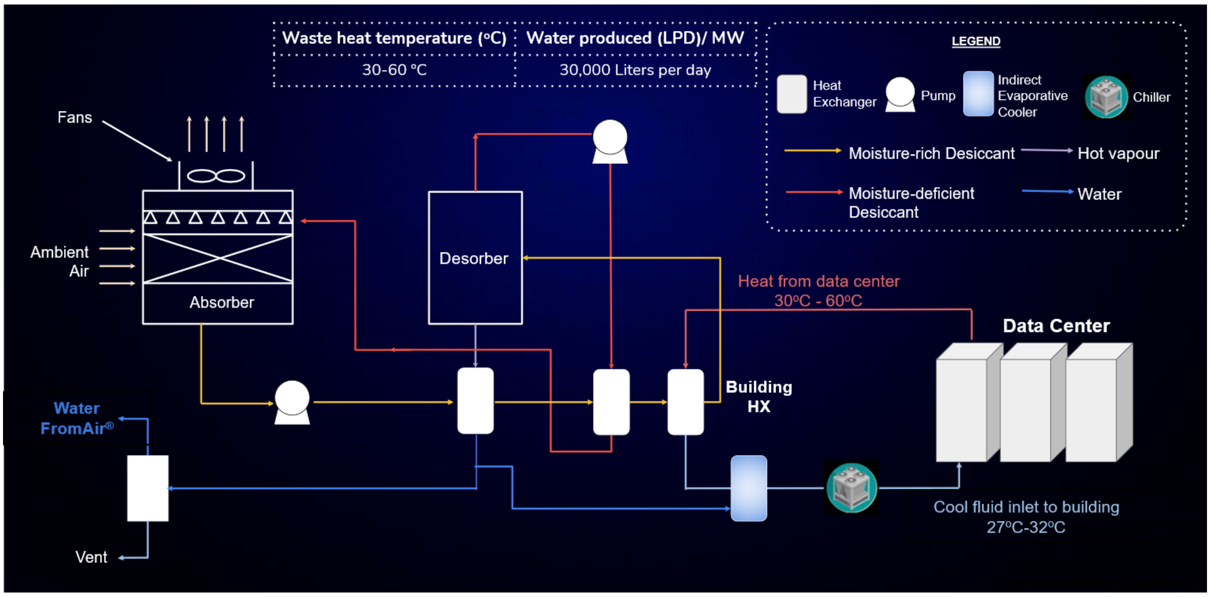
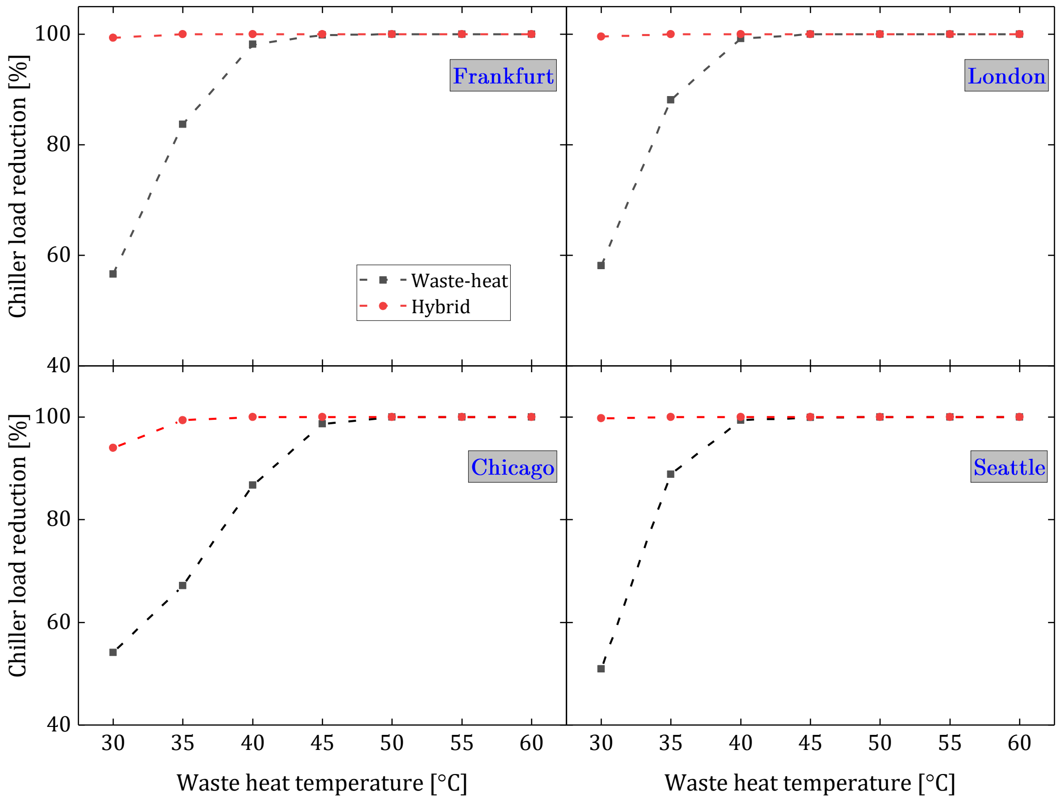


As illustrated by the chiller-load reduction trends, increasing waste-heat availability leads to a **progressive displacement of mechanical cooling**, with chiller usage approaching zero at moderate waste-heat temperatures across multiple climates. This reduction is achieved not by lifting the waste-heat temperature, but by **removing heat from the data center while converting it into freshwater**.



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In effect, Uravu converts waste heat into a continuous thermal sink, reducing cooling energy demand and operational costs while eliminating the need for heat pumps, thereby enabling water-positive, low-carbon data center operations.

Cost and Financial Implications

1. Lower long-term cooling costs

The analysis shows that as waste-heat temperature rises beyond moderate levels, Uravu-based systems consistently achieve lower levelized cooling costs (as low as \$ 10/MWh) than conventional air-cooled and hybrid cooling architectures. In simple terms: **hotter waste heat makes cooling cheaper**, converting thermal inefficiency into financial advantage.

2. Water production at net zero or negative cost

When cooling energy savings are factored in, the cost of water produced by Uravu declines significantly. In many locations, especially those with hot and humid climates, avoiding cooling costs fully offsets water production expenses, resulting in zero-cost or net-positive water economics. This reframes water from an operating expense into a value-generating asset.

> 🤖 🔥 As AI drives data centers toward high-performance computing workloads, which generate **higher waste-heat temperatures** which will lead a shift to liquid cooling. Uravu can be integrated to converts that heat into lower cooling costs and renewable on-site water. 💧 ⚡

3. Capital-efficient sustainability

Unlike solutions that require extensive electrical upgrades or investments in water infrastructure, Uravu leverages existing waste heat and integrates with standard data center cooling loops. This reduces incremental CAPEX while delivering recurring OPEX savings, improving payback periods, and total cost of ownership.

Key ESG Implications

1. Carbon reduction through waste-heat reuse

Uravu systems convert unavoidable data-center waste heat into a productive input, directly displacing electricity-intensive cooling. As waste-heat temperature increases, reliance on mechanical chillers declines sharply, resulting in substantial reductions in Scope-1 CO_2 emissions. In many warm and high-load regions, cooling-related emissions approach near-zero at higher waste-heat temperatures. This positions Uravu as a

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powerful lever for decarbonization, aligned with net-zero and science-based climate targets.

2. Water neutrality and water positivity

Conventional cooling systems consume large volumes of water, both directly (through cooling towers) and indirectly through electricity generation. Uravu fundamentally reverses this paradigm by **producing freshwater while reducing cooling demand**. At higher waste-heat availability, the system achieves net water savings, as reflected by a negative Water Usage Effectiveness (WUE). In water-stressed regions, Uravu enables data centers to move from water consumption to water contribution, supporting water-neutral and water-positive ESG commitments.

3. Reduced exposure to grid water and energy risks

By lowering electricity consumption for cooling, Uravu significantly cuts the indirect (Scope-2) water footprint associated with power generation. The reduced dependency on grid infrastructure improves resilience to energy and water price volatility and strengthens long-term operational sustainability, particularly relevant for regions facing grid congestion and water scarcity.

Strategic Value for Data Center Operators

- **ESG compliance with measurable impact**: Tangible reductions in CO_2, direct water use, and indirect grid water consumption.
- **Future-proofing against regulation**: Alignment with tightening global regulations on cooling efficiency, carbon emissions, and industrial water use.
- **Scalable and flexible deployment**: Uravu-waste heat systems maximize value where usable heat is available. At the same time, Uravu-electric provides a universal solution for sites with low-grade or insufficient waste heat.
- **Competitive differentiation**: Enables credible sustainability claims backed by operational data, not offsets.

🌱 Environmental Impact

Impact Area	Conventional Cooling	With Uravu	Quantified ESG Benefit
CO_2 Emissions	High electricity-driven cooling	Waste heat replaces mechanical cooling	**↓ 30–80% CO_2** (highest at ≥45 °C waste heat)
Water Use (Scope-1)	Cooling towers consume large volumes	Net water generation	**↓ 70–120% water use** (water-neutral to water-positive)

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Impact Area	Conventional Cooling	With Uravu	Quantified ESG Benefit
Water Use (Scope-2)	High grid-water footprint	Lower electricity demand	**↓ 40–85% indirect water**
Waste Heat	Entirely rejected to the ambient	Productively reused	**Up to 100% of usable waste heat is valorized**

💧 Water & Social Impact

Impact Area	Conventional Cooling	With Uravu	Quantified Benefit
Water Security	Competes with local supply	On-site freshwater generation	**Net 2–15 million liters/year per MW** (site & climate dependent)
Climate Resilience	High vulnerability to drought & heatwaves	Reduced grid & water dependence	**30–70% lower exposure to water risk**
Community Impact	Neutral or negative in stressed regions	Potential surplus potable water	**Positive local ESG contribution**

⚙️ Governance & Compliance

Area	Without Uravu	With Uravu	Governance Outcome
Regulatory Readiness	Increasing compliance risk	Future-proofed cooling & water strategy	**Aligned with net-zero & water mandates**
ESG Reporting	Limited operational metrics	Auditable CO_2 & water reductions	**Stronger ESG scores & disclosures**
Operational Risk	Volatile energy & water costs	Lower, predictable OPEX	**Improved long-term cost governance**

💰 Financial Co-Benefits (Executive Lens)

Value Driver	Impact Range
Cooling OPEX Savings	**↓ 20–60%** vs conventional cooling
Net Value of Water (NVW)	From **cost-positive** → **cost-neutral** → **value-positive**
Payback Acceleration	Faster in hot & humid regions
Asset Attractiveness	Sustainability-premium data center infrastructure

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Deployment approach: Modular, Scalable, and Data-Center Ready

Uravu systems are designed for **modular deployment**, allowing data center operators to scale capacity incrementally based on site size, cooling demand, and available waste heat. Each module operates as a self-contained unit that integrates seamlessly with existing cooling infrastructure, enabling phased adoption without disrupting ongoing operations. This modularity allows deployments to start small, such as pilot installations, and expand over time as cooling loads, AI workloads, or sustainability targets increase.

The technology is inherently **scalable across data center typologies**, from edge facilities to hyperscale campuses. As IT density rises and operating temperatures increase, particularly with the adoption of AI workloads and liquid cooling, Uravu performance improves rather than degrades. Higher waste-heat availability directly enhances system uptime, chiller displacement, and water output, ensuring that the solution remains future-proof as thermal loads evolve. By avoiding heat pumps and complex thermal upgrading, Uravu minimizes integration complexity, reduces electrical infrastructure requirements, and enables rapid, repeatable deployment across global portfolios.

Microsoft Analysis for cooling cost savings

The analysis evaluates cooling cost savings and water production for a few of Microsoft's selected data center sites, covering both existing and planned capacity in 2025, as well as projected expansion through 2030.

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	2025 – Installed/planned		2030 - Projection		
Location	Capacity (MW)	Cooling Cost Savings ($ M/Yr)	Capacity (MW)	Cooling Cost Savings - 50% adoption	Cooling Cost Savings - 75 % adoption
Northern Virginia	5,000	206	10,000	206	309
Amsterdam	600	4	1,200	4	5
Frankfurt	800	15	2,000	18	28
Sydney	600	46	1,500	57	85
London	1500	7	3,000	7	11
Total	8.5 GW	$ 283 million/year	17.7 GW	$ 292 million/year	$ 438 million/year

	2025 – Installed/planned		2030 - Projection		
Location	Capacity (MW)	Water Production	Capacity (MW)	Water Production - 50% adoption	Water Production - 75 % adoption
Northern Virginia	5,000	38,413	10,000	38,417	57,625
Amsterdam	600	6,550	1,200	6,550	9,825
Frankfurt	800	7,638	2,000	9,547	14,320
Sydney	600	5067	1,500	6,333	9,500
London	1500	16,317	3,000	16,317	24,476
Total	8.5 GW	73.9 Billion liters/year	17.7 GW	77.2 Billion liters/year	115.7 Billion liters/year

Next steps: From Evaluation to Deployment

1. Select Pilot Site: Identify a representative site based on cooling load, waste-heat availability, and climate, and establish a clear baseline for cooling energy and water use.

2. Site-Specific Assessment: Conduct a detailed analysis of levelized cost of cooling (LCoC), water production, CAPEX, and OPEX to quantify cost savings and ESG impact for the selected site.

3. Pilot Deployment: Deploy a modular pilot system with minimal operational disruption, designed to reflect real-world operating conditions and future scalability.

4. Measure Success: Evaluate performance using clear metrics like chiller load reduction, cooling energy savings, on-site water production, CO_2 and water footprint reduction, and system uptime.

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Verified cost savings and consistent performance under live data center loads will define success.

> The pilot converts modeled benefits into verified operational, financial, and ESG outcomes—de-risking scale-up decisions.

Business Model

Uravu uses waste heat to deliver cooling + net water production, enabling water-positive cooling and improved sustainability outcomes.

Three engagement models (what Microsoft can choose)

Model	Commercial structure	What Microsoft gets	Why it's useful
1) CAPEX Sale	Microsoft buys the equipment outright.	Owns the asset and retains **physical water + water credits**.	Best for the lowest long-term TCO and maximum upside capture.
2) OPEX / Cooling & Water-as-a-Service (CWaaS)	Uravu funds, owns, and operates entire cooling infrastructure. Microsoft pays for delivered cooling/water under a service contract.	Guaranteed lower all-in cooling cost vs baseline (LCOC/TCO basis), plus operational simplicity. Option to retain water credits as "insets".	Fastest path to deployment with **zero upfront CAPEX** and a contractual **discount to baseline LCOC**.
3) Integrated Water Asset	Microsoft buys the equipment. Water monetization is explicitly structured through an off-take (Uravu/partner) with an agreed fee or revenue share.	Owns the asset + **physical water** (and credits, if included). Gets a contract-backed water revenue stream with low internal effort.	Best for permitability/compliance and **bankable** monetization in constrained regions (reduced execution risk vs Model 1).

Baseline used for pricing and comparisons

- **Baseline system:** Dry Cooler + Air-Cooled Chiller.
- **Baseline pricing basis (for CWaaS):** baseline is **Levelized Cost of Cooling (LCOC)** for the reference system, i.e. **annualized CAPEX + energy + maintenance**, divided by delivered cooling.
- **Why LCOC (instead of just OPEX):** CWaaS is **zero upfront CAPEX** for Microsoft, so the relevant comparison is **all-in cost** (TCO/LCOC), not only annual power savings.
- **Typically excluded unless explicitly stated:** civil works or building modifications, water storage and distribution infrastructure, permitting and compliance costs, and any third-party water offtake logistics.
- **Incremental / new capacity:** baseline includes *avoided baseline CAPEX* → **LCOC discount** is the right contract.

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Responsibilities + what Microsoft needs to provide (per model)

- Model 1 (CAPEX):
  - **Responsibilities:** Microsoft purchases and owns equipment and retains **all** water revenue and credits.
  - **Microsoft to provide:** asset owner/ops owner, site integration scope, and a plan for water monetization (who contracts off-take, who handles permits/compliance, and whether water credits are claimed as part of the value stack).

- Model 2 (CWaaS):
  - **Responsibilities:** Uravu funds/owns/operates. Microsoft pays for cooling service under a long-term contract. Uravu typically retains **water sales + credits** (Microsoft can retain water credits as "insets", if desired).
  - **Commercial intent:** Microsoft pays a **discounted LCOC** vs the reference system.
  - **Microsoft to provide:** site access, utilities interface, metering points, and service contract sign-off.

- Model 3 (Integrated):
  - **Responsibilities:** Microsoft buys & owns equipment and physical water; Uravu **secures offtakers + structures contracts** and earns an **agreed share/fee** from water monetization.
  - **Microsoft to provide:** same as Model 1 for site integration, plus approval to allow Uravu/partner to **structure off-take** and define how **physical water + credits** are allocated in the monetization pool.

> Model 1 vs Model 3 (Microsoft buys equipment in both)
>
> **Both Model 1 and Model 3 are Microsoft-CAPEX models.** The difference is **who executes water monetization** and **how the value is shared**.
>
> - **Model 1 (CAPEX Sale)**: Microsoft keeps **100% of water value** (physical water + credits) but must execute monetization (permits, storage/distribution, offtake contracts, pricing, billing, and ongoing compliance) internally or via vendors.
> - **Model 3 (Integrated Water Asset)**: Microsoft keeps the asset + **physical water**, and water monetization is made **contract-backed ("bankable")** via structured offtake led by Uravu/partner. Uravu earns an **agreed fee or revenue-share** from water cashflows.
>
> **Why Microsoft chooses Model 3:** lower internal effort and lower execution risk, at the cost of sharing some upside.

Commercial numbers

Model 1 - CAPEX (if Microsoft purchases equipment):

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Reference: **~$500k/MW (Uravu waste-heat) → ~$5.0M for a 10 MW block**.

Model 2 - CWaaS (priced as a discount to baseline LCOC):

Zero upfront CAPEX (Uravu/partner funded).

Pricing logic (what Microsoft should be comparing against):

- Under CWaaS, Microsoft avoids owning the cooling asset. So pricing should be benchmarked to the **baseline LCOC (all-in cost)**, not only annual OPEX reduction.
- Baseline LCOC (conceptual) = *(annualized CAPEX of baseline plant + baseline energy + baseline maintenance) ÷ (delivered cooling)*.

How to price CWaaS (two-part, bankable):

- **Availability/capacity payment ($/MW-month):** covers Uravu capital recovery and minimum O&M.
- **Usage payment** ($/$\mathrm{MWh_{cool}}$ or $/ton-hour): charged on metered delivered cooling.

Discount promise:

- CWaaS price is set so the effective unit rate is a **5–30% discount to baseline LCOC**, depending on site and waste-heat quality.

How to express this cleanly (for a 10 MW block):

- Let baseline LCOC = **$Y per $\mathrm{MWh_{cool}}$** (or $ per ton-hour).
- Let CWaaS discount = **d** (e.g., 10–20%).
- Then CWaaS charge for a period = **(1 − d) × Y × (metered cooling delivered) + capacity payment**.

Notes:

- Water sales + credits can be treated as Uravu-side revenue, reducing **the required CWaaS price** while keeping the Microsoft discount intact.
- **Typically excluded unless explicitly stated:** civil works/building modifications, water storage + distribution infrastructure, permitting/compliance costs, and any third-party water off-take logistics.

Model 3 - Integrated Water Asset:

Structure recap: Customer owns the equipment + physical water; Uravu structures off-take and earns an agreed fee/share (see **Model 1 vs Model 3** callout above).

Economics (how to size the value share):

- Simple economics:
  - Annual gross water value = **Water volume (m^3/yr) × Price ($/$m^3$)**

  - Customer annual net = (1 − **Uravu share**) × **gross water value**
  - Uravu annual earnings = (**Uravu share** × **gross water value**) + **any fixed structuring/operations fee**
- **Example (using the Frankfurt case at 35°C):** 80,000 m^3/yr × \$4/m^3 = **\$320k/yr** gross.
  - If Uravu share = 25%: Customer keeps **\$240k/yr**, Uravu earns **\$80k/yr** (plus any agreed fixed fee).
- **Sensitivity (water price):** if price is \$2–\$6/m^3, the same volume maps to **\$160k–\$480k/yr** gross.

Techno-economic assumptions

- Project lifetime: **15 years**
- CAPEX (Uravu waste-heat): **\$500,000/MW**
- CAPEX (Uravu electric): **\$650,000/MW**
- CAPEX (Air-cooled chiller): **\$350,000/MW**
- CAPEX (Dry cooler): **\$100,000/MW**
- Maintenance rate: **Uravu 2%, ACC 3%**

10 MW facility comparison (three climates)

Site (10 MW)	Waste heat	Model	CAPEX (10 MW)	Annual savings/value statement	Water asset value	Payback + responsibilities
Bengaluru (Tropical)	35°C	Model 2 · CWaaS *Powered by Uravu Electric*	Zero upfront CAPEX (Uravu/partner funded)	Cooling bill ~**\$296k**/yr (10% discount), lower than baseline. Rationale: Best path to move fast with no CAPEX; Uravu captures water value directly.	~\$400k/yr (Water sales + credits)	Recommended Uravu owns assets & sells water. Microsoft buys inset credits.
Bengaluru (Tropical)	45°C	Model 2 · CWaaS *Powered by Uravu Waste-heat*	Zero upfront CAPEX (Uravu/partner funded)	Cooling bill ~**\$51k**/yr (5% discount) lower than baseline. Rationale: Better savings + higher water value; CWaaS stays simplest for Microsoft.	~\$300k/yr (Water sales + credits)	Recommended Uravu owns assets & sells water. Microsoft buys inset credits.
Phoenix (Hot & Dry)	35°C	Model 2 · CWaaS *Powered by Uravu Waste-heat*	Zero upfront CAPEX (Uravu/partner funded)	Cooling bill ~**\$290k**/yr (10% discount), lower than baseline. Rationale: Clear operating savings; fastest path with no CAPEX.	~\$150k/yr (Water sales + credits)	Recommended Uravu owns assets & sells water. Microsoft buys inset credits.

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Site (10 MW)	Waste heat	Model	CAPEX (10 MW)	Annual savings/value statement	Water asset value	Payback + responsibilities
Phoenix (Hot & Dry)	45°C	Model 2 · CWaaS *Powered by Uravu Waste-heat*	Zero upfront CAPEX (Uravu/partner funded)	Cooling bill ~**$188k**/yr (10% discount), lower than baseline. Rationale: Strongest operating savings case in the table; keep Microsoft decision simple.	~$400k/yr (Water sales + credits)	Recommended Uravu owns assets & sells water. Microsoft buys inset credits.
Frankfurt (Temperate)	35°C	Model 3 · Integrated	Microsoft pays **$5.0M** (Uravu WH) + **$3.5M** chiller (10 MW) = **$8.5M** total +~$4.0M premium vs baseline	~40% energy savings + water revenue ($342k/yr) + compliance. Rationale: Higher incremental CAPEX; monetization is contract-backed (easier to approve).	~85,000 m³ @ $4 = $342k/yr	Recommended Payback ~4 years (incremental CAPEX). Microsoft owns asset + physical water. Uravu structures: off-take and earn-share/fee.
Frankfurt (Temperate)	45°C	Model 1 · CAPEX	Microsoft pays **$5M** +~$0.5M premium vs baseline	OpEx at parity Rationale: Economics are already strong; Microsoft should keep 100% of water upside.	~110,000 m³ @ $4 = $440k/yr	Recommended Payback ~1.2 years (incremental CAPEX). Microsoft owns assets & water revenue.

How to read this table (quick decision criteria):

- Waste heat quality (35°C vs 45°C) and resulting cooling economics.
- Local feasibility of water offtake and permitting.
- Internal appetite to execute water monetization (Model 1) vs outsource execution risk (Model 3).

Water asset value definition: values shown represent **gross annual value** from physical water sales and any credits *only where explicitly noted*.

Decision guide

Quick takeaway	When to choose
Model 1 (CAPEX)	Best when Microsoft wants **maximum long-term upside** and is comfortable executing water monetization (off-take/contracts/compliance) internally or via vendors.
Model 2 (CWaaS)	Fastest deployment with **zero upfront CAPEX**. Best default when Microsoft wants a **contractual discount to baseline LCOC (all-in cooling cost)** and does not want to own/operate the cooling asset.
Model 3 (Integrated Water Asset)	Best when Microsoft wants **bankable water monetization + compliance/permitability** with low internal effort. Customer buys equipment, and Uravu helps make water value real through structured off-take.

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Overall Conclusion

This assessment demonstrates that Uravu fundamentally redefines data center cooling by converting unavoidable waste heat into a strategic asset. By operating entirely within the native temperature range of data center cooling loops, without the use of heat pumps or waste-heat upgrades, Uravu simultaneously reduces cooling energy demand, lowers carbon emissions, and generates on-site freshwater. As waste-heat availability increases, particularly with the industry shift toward AI workloads and liquid-cooled architectures, system performance improves further through deeper chiller load reduction and enhanced water output.

Beyond technical feasibility, Uravu delivers measurable economic and ESG value, including lower long-term cooling costs, reduced exposure to water and energy risks, and a clear pathway to achieving water-neutral or water-positive operations. Its modular, scalable deployment model enables phased adoption across edge, colocation, and hyperscale data centers, while pilot-led validation ensures low-risk scale-up. Collectively, these outcomes position Uravu as a practical, future-ready solution that aligns cost efficiency, sustainability mandates, and the evolving thermal profile of next-generation data centers.

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