LIQUID COOLING — GUIDE

Retrofit vs New Build: Liquid Cooling Deployment Strategies

Compare brownfield retrofit and greenfield new-build approaches for liquid cooling: costs, timelines, technical constraints, and decision framework.

Updated November 1, 2026

Choosing between retrofitting an existing data center and building a new liquid-cooled facility shapes cost, timeline, risk, and long-term flexibility. This guide compares both paths.

Decision framework

Factor	Retrofit (brownfield)	New build (greenfield)
Capital cost	Higher per kW (rework, structural, phasing)	Lower per kW (integrated design)
Timeline	6-18 months per phase	12-24 months total
Operational risk	High (live facility, downtime windows)	Low (commissioning before load)
Density ceiling	Limited by structure, power, ceiling height	Designed for 100-150+ kW/rack
Free cooling integration	Constrained by existing chiller plant	Optimized for W27-W45 from day one
Fluid infrastructure	Piping in occupied space, penetrations	Purpose-routed, accessible corridors
Regulatory	Existing permits, incremental approvals	Full permitting, modern codes
Best for	Incremental AI capacity, colocation hall-readiness	AI factories, hyperscale campuses, >5 MW liquid

Retrofit pathways

1. Rear-door heat exchangers (lowest disruption)

- **Scope**: Replace rear doors on existing racks; connect to facility water
- **Density gain**: 30-75 kW/rack (air-side limited)
- **Downtime**: Minutes per rack (door swap)
- **Structure**: Minimal (door weight similar to original)
- **Facility loop**: Requires chilled water or cooling tower capacity at rack row
- **Example**: NorthC deployed Legrand USystems RDHx at Münchenstein without interruption (Nov 2025, Mordor Intelligence, 2026)

2. Single-rack liquid conversion with liquid-to-air CDU

- **Scope**: Remove one air-cooled rack; install liquid-cooled rack + liquid-to-air CDU
- **Density gain**: 50-150 kW in one rack footprint
- **Downtime**: One rack slot; adjacent racks unaffected
- **Structure**: CDU + rack may be substantially heavier; load spreaders often required (IEA 4E, 2026, cited in Mordor Intelligence, 2026)
- **Facility loop**: CDU rejects heat to room air; no facility water needed

- **Use case**: Pilot, proof-of-concept, urgent GPU deployment

3. Row/pod conversion with row-based CDU

- **Scope**: Convert 4-10 racks to direct-to-chip; install row CDU (300 kW - 2 MW)
- **Density gain**: 50-150 kW/rack across the row
- **Downtime**: Phased per rack; requires CDU installation window
- **Structure**: Overhead piping, manifold trays, CDU footprint (~2-4 rack equivalents)
- **Facility loop**: Connects to facility water (chilled or cooling tower)
- **Phasing**: Typically 2-4 racks per maintenance window

4. Full hall conversion (highest disruption)

- **Scope**: Facility water loop upgrade/replacement, CDU farm, overhead piping throughout
- **Density gain**: Uniform 100+ kW/rack across hall
- **Downtime**: Major; often requires hall evacuation or phased zone shutdown
- **Structure**: Significant; piping supports, seismic, floor loading
- **Rarity**: IEA 4E (2026) describes as "often impractical and very expensive"

New-build design principles

1. Define W-class early

- Target W27-W32 for maximum free cooling hours
- Match to OEM server liquid cooling spec (NVIDIA GB200 NVL72, AMD Helios, etc.)
- Document in basis of design (BOD)

2. Facility water loop architecture

- **Primary loop**: Dry coolers (adiabatic assist for peak) !’ plate heat exchangers !’ secondary loops
- **Secondary loops**: Per CDU farm or zone; variable speed pumps, temperature control
- **Redundancy**: N+1 dry coolers, N+1 heat exchangers, N+1 pumps
- **Water quality**: Filtration, corrosion inhibitor, biocide, conductivity monitoring

3. CDU deployment model

- **Rack CDU** (50-300 kW): Modular, phased growth, localized fault domain
- **Row CDU** (300 kW - 2 MW): Balance of density and centralized control; typical for AI pods
- **Facility CDU** (1.5-3.5 MW): Large-scale default architecture; Schneider WCDU up to 3.5 MW (Sep 2026)

4. Piping and distribution

- **Overhead supply/return**: Insulated stainless or coated carbon steel
- **Quick-disconnects** at each rack (dripless, rated for pressure/temperature)
- **Manifold trays** in-rack or overhead
- **Expansion loops**, anchors, guides for thermal cycling
- **Leak detection**: Zone-based, integrated with BMS and CDU shutdown

5. Structural and architectural

- **Floor loading**: Design for 2,000+ kg/rack position (rack + CDU share + piping)
- **Ceiling height**: Accommodate overhead piping + cable trays + containment
- **Door/aisle width**: CDU and rack maneuvering path
- **Seismic**: Category per local code; liquid-filled piping adds mass

6. Commissioning sequence

1. Facility loop hydrotest, flush, fill, water quality baseline
2. CDU factory acceptance test (FAT), site acceptance test (SAT)
3. Rack-level cold-plate loop test (pressure, flow, leak)
4. Integrated heat load test (load banks or live servers)
5. Controls tuning: supply temp, 9E@, redundancy switchover
6. Handover: as-builts, water quality logs, O&M manuals

Hybrid: Colocation hall-ready model

Colocation providers (Equinix, Digital Realty/Teraco, AirTrunk, SINES) build halls with:

- Facility water loop stubs at row positions
- CDU footprint allocation (power, space, drainage)
- Leak detection zoning
- Structural capacity for liquid-cooled racks

Tenant benefit: Deploy liquid cooling without facility Capex or lead time. Equinix KL2 (Cyberjaya, Malaysia) and AirTrunk JHB2 (Johor Bahru) specify liquid cooling in design (Mordor Intelligence, 2026). Teraco JB4 (Ekurhuleni, SA) enables direct-to-chip for tenants (2025).

Cost comparison (indicative)

Cost element	Retrofit (per rack equivalent)	New build (per rack equivalent)
CDU equipment	$50k-150k	$40k-120k
Piping & installation	$30k-80k	$15k-40k
Structural mods	$10k-50k	$5k-15k (designed in)
Facility loop upgrades	$20k-100k	$10k-30k (designed in)
Commissioning & phasing	$15k-40k	$10k-25k
Total incremental	**$125k-420k**	**$80k-230k**
Downtime cost	High (revenue loss)	None (pre-revenue)

Figures are indicative 2026 USD for 100 kW direct-to-chip rack. Varies by region, vendor, and site conditions.

When to choose each

Choose retrofit when:

- Incremental AI capacity needed now (<6 months)
- Existing lease/power contract constrains relocation
- Colocation hall-ready space available
- Pilot or proof-of-concept before full commitment

- Brownfield site with structural capacity for target density

Choose new build when:

- >5 MW liquid-cooled capacity planned
- 3+ year horizon; total cost of ownership favors integration
- Target density >100 kW/rack uniform
- Free cooling / PUE targets require W32+ facility design
- Campus development with multiple buildings

Choose hybrid (colocation hall-ready) when:

- Need operational control but not facility ownership
- Deployment timeline <12 months
- Workload portable across regions
- Capital preservation priority

Sources

- Mordor Intelligence. "Data Center Liquid Cooling Market Report." 2026. https://www.mordorintelligence.com/industry-reports/data-center-liquid-cooling-market
- IEA 4E. "EDNA Report on Data Center Cooling." 2026. (Cited in Mordor Intelligence, 2026)
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Frequently asked questions

Can I retrofit liquid cooling into an existing air-cooled data center?

Yes, but with constraints. Common retrofit paths: (1) Rear-door heat exchangers on existing racks (no server downtime), (2) Replace a row of air-cooled racks with one high-density liquid rack + liquid-to-air CDU, (3) Full row conversion with row-based CDU. IEA 4E (2026) notes complete overhauls are often impractical and very expensive (Mordor Intelligence, 2026).

What is the typical cost premium for retrofit vs new build?

Retrofit adds structural work (load spreaders, floor reinforcement), piping in occupied spaces, phased commissioning, and operational risk. Mordor Intelligence (2026) names high upfront retrofit costs as a market restraint. New build integrates liquid cooling from design, avoiding rework.

How long does a retrofit take vs new build?

Retrofit: 6-18 months for a phased row/pod conversion (depends on downtime windows). New build: 12-24 months for full facility, but liquid cooling is integrated in the critical path, not a separate phase.

Can I mix air-cooled and liquid-cooled racks in the same room?

Yes. Many colocation halls (Equinix KL2, Teraco JB4) are built 'hall-ready' with facility water loops and space for CDUs, enabling tenants to deploy liquid-cooled racks alongside air-cooled

rows. Microsoft Fairwater uses >90% liquid-cooled capacity but the facility supports both (Mordor Intelligence, 2026).