# High-Density Dry Cooling System for Data Center Infrastructure

Chart Industries · Air Cooled Heat Exchangers

COOLER DATA CENTERS BY DESIGN

Data centers are demanding more heat rejection in less space — at lower parasitic power. Kaldris™ features dense bundle arrays engineered to maximize heat transfer, large-diameter Tuf-Lite IV™ fans with velocity recovery stacks to improve fan efficiency, and a field-proven design that significantly reduces the maintenance burden associated with conventional cooler arrays.

## KEY PERFORMANCE METRICS

| | | | |
|---|---|---|---|
| **93%** | **34%** | **<5%** | **$1.4M+** |
| Reduction in fan count vs. conventional | Smaller footprint for equivalent duty | Hot air recirculation (vs. 5-35% conventional) | NPV O&M savings per chiller (8% / 25 yr) |

## THE DATA CENTER COOLING CHALLENGE

Hyperscale and colocation operators face a hard constraint: heat rejection density requirements are growing faster than site footprints allow. A conventional finned-tube air cooler — optimized for shipping economics, not lifecycle performance — delivers exactly the wrong tradeoffs: dozens of small fans, belt drives, motor starters, and a recirculation-prone geometry that erodes thermal performance under wind load.

At the scale of a 22 MW+ data center campus, those inefficiencies are not rounding errors. They are structural costs embedded in every operating hour for the life of the facility.

## THE APPROACH

This design reframes the air cooler from first principles. Specifically designed dense heat exchanger bundles maximize bare tube area within a given footprint — delivering 15-19% more heat transfer surface per chiller compared to conventional bundle layouts while holding the same plot area.

A single large-diameter Tuf-Lite IV™ fan (24'–28') with a tall velocity recovery stack serves multiple bundles, replacing up to 9-15 small fans and their associated drivetrain. The result is fewer rotating components, better aerodynamic efficiency, and a dramatically cleaner maintenance profile — without changing the proven heat transfer core.




*Performance data based on CFD analysis. Site-specific performance subject to thermal sizing and layout review.*

## DESIGN COMPARISON — PER CHILLER (EQUIVALENT HEAT REJECTION DUTY)

| Parameter | Conventional Design (372 × 14′ Fans) | KALDRIS — Design A (24 × 28′ Fans) | KALDRIS— Design B (36 × 24′ Fans) |
|---|---|---|---|
| **Total Fans** | 372 | 24 (−94%) | 36 (−90%) |
| **Fan Stacks** | 3′ straight-sided | 14′ velocity recovery | 14′ velocity recovery |
| **Shaft Bearings & Belts** | 744 bearings · 372 belts | None | None |
| **Motors · Cables · Starters** | 372 × 40 HP · 2,232 ends | 24 × 150 HP · 144 ends | 36 × 100 HP · 216 ends |
| **VFD** | Additional cost / not standard | Standard — replaces starter | Standard — replaces starter |
| **Footprint (ft²)** | 8,704 | 5,760 (−34%) | 5,760 (−34%) |
| **Hot Air Recirculation** | 5%–35% (wind dependent) | <5% — CFD validated | <5% — CFD validated |
| **Total Fan BHP** | 372 | 372 | 372 |

### Footprint Dividend

The 34% footprint reduction is not just a space savings — it is a capacity multiplier. On a constrained data center site, the same plot area that previously served one conventional chiller circuit can now serve 1.5x the heat rejection load or alternatively deliver the same capacity at meaningfully lower absorbed fan power once the space constraint is relaxed.

## ECONOMIC SUMMARY — NPV ANALYSIS (8% DISCOUNT RATE · 10-YEAR HORIZON)

| Economic Measure | Conventional | Design A Annual | Design B Annual | NPV Design A | NPV Design B |
|---|---|---|---|---|---|
| **Mechanical O&M (Motors & Drivetrain)** | $216,000/yr | $24,000/yr | $36,000/yr | $1,199,000 | $1,124,000 |
| **VFD Power Savings (vs. on/off staging)** | Base case | $29,000/yr | $32,000/yr | $181,000 | $200,000 |

## KEY BENEFITS

### DENSITY BY DESIGN

Dense bundle arrays pack up to 19% more bare tube area into the same footprint as a conventional layout — directly translating to higher MW-thermal per acre on land-constrained data center campuses.

### RECIRCULATION ELIMINATED

CFD-validated geometry separates hot discharge air from cold intake by more than triple the distance of small-fan designs. Recirculation drops from 5-35% to below 5% under all wind conditions — protecting rated thermal output around the clock.




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### DRIVETRAIN SIMPLIFIED

Belt drives, shaft bearings, and motor starters are eliminated entirely. Tuf-Lite IV™ fans with integrated VFDs are the only moving parts — reducing maintenance labor by over 90% and dramatically extending meantime between interventions.

### VFD AS STANDARD

Variable Frequency Drives are standard on all units. Fan power scales with speed cubed: reducing speed to 75% of full load cuts power consumption by nearly 60%, delivering $29,000–32,000/yr in avoided parasitic power per chiller versus on/off fan staging.

### CONSTRUCTION EFFICIENCY

89% fewer motor connections and up to 73% fewer foundations versus an equivalent conventional array. Modular plenum trusses and prefabricated fan deck sections reduce field labor — compressing installation schedules on constrained sites.

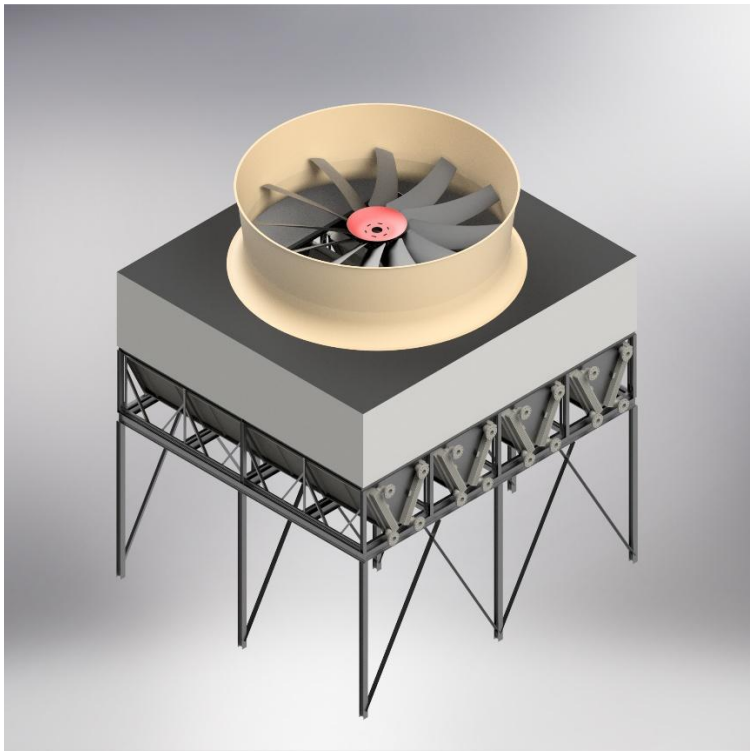
### PROVEN AT SCALE

Large-fan induced draft geometry with velocity recovery stacks is field-validated in demanding power generation applications, including CFD modeling across multiple wind speeds, directions, and seasonal temperature profiles.

## WHY CHART

This product integrates Hudson Products' Tuf-Lite IV™ fan technology — the result of decades of large-diameter fan development for power and process applications — with Chart's established air cooled heat exchanger manufacturing capability. The dense bundle configuration for high-density data center duty is a purpose-built extension of proven large-fan technology into a market segment that demands it.

Chart's application engineering team provides full thermal sizing, CFD recirculation analysis, and site-specific layout optimization as part of the proposal process.



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