REUSING EXHAUST HEAT IN IDCS VIA FREE COOLING WITH TURBO BLOWERS

Green Power Engineering Corporation

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REUSING EXHAUST HEAT IN IDCS VIA FREE COOLING WITH TURBO BLOWERS

COOLING ENVIRONMENTS

Speaker **Mr. Alexander Chen**

Marketing Director /
Green Power Engineering Corporation

Outline

1. Company Information
2. General Heat Recovery via Free Cooling in IDCs
3. Benefits of Heat Recovery via Free Cooling in IDCs
4. Real-World Examples
5. Air-Based Cooling System with Turbo Blower
6. Technical Specifications of GPE Turbo Blower

Company Information

Green Power Engineering Corporation (GPE) has been engaged in the R&D, testing, and maintenance of turbine-related rotating machinery for more than 20 years.

We specialize in turbo blowers, turbines, centrifugal compressors, and other related components.

Company Scale

1. Factory Scale:

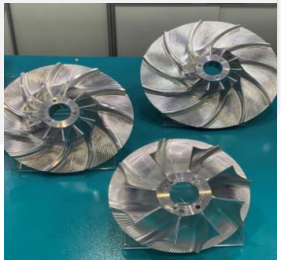
- Kaohsiung Factory-1: Design & Testing Center, Aerospace Five-Axis Processing.
- Kaohsiung Factory-2: Production Center, Repair Center, Testing Center(Balancing).
- Taoyuan Factory: Analysis Center.
- Taipei Office: Sales and Engineering Center.

2. Equipment: Five-axis machining equipment, 3D inspection software, wind tunnel lab, and precision testing instruments.

3. Advantages: In-house design, analysis, R&D, manufacturing, testing, and maintenance.

GPE

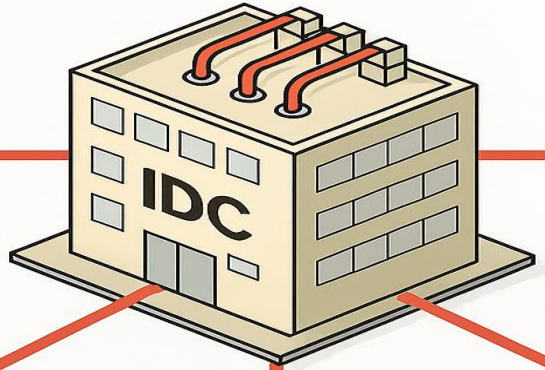
Company Achievement



Industries: Power plants, petrochemical plants, electronics factories, and steel mills.
Applications: Power generation, gas compression, air transport, air knife systems, vacuum processes, and dust collection.

General Heat Recovery via Free Cooling in IDCs

Waste heat from IDCs, especially when integrated with free cooling, can be repurposed for:



District Heating

Hot water (25–60 ˚C) can be fed into district heating networks to warm homes, offices, or public buildings.
For example, Equinix's collaboration with Plaine Commune Énergie in France recovers 6.6 MW of heat, supplying 10,800 MWh annually.

On-Site Uses

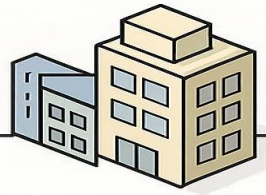
Heat can be reused within the data center for office heating and hot water. This is exemplified by the National Renewable Energy Lab (NREL), which achieves a PUE of 1.04.

Agricultural Uses

Low-grade heat (20–40 ˚C) can be used to warm greenhouses, aquaculture farms, or for drying agricultural products.

Industrial Processes

Recovered heat supports drying processes for wood pellets, biomass, or sludge. EcoDataCenter in Sweden, for instance, supplies heat to a wood pellet factory.



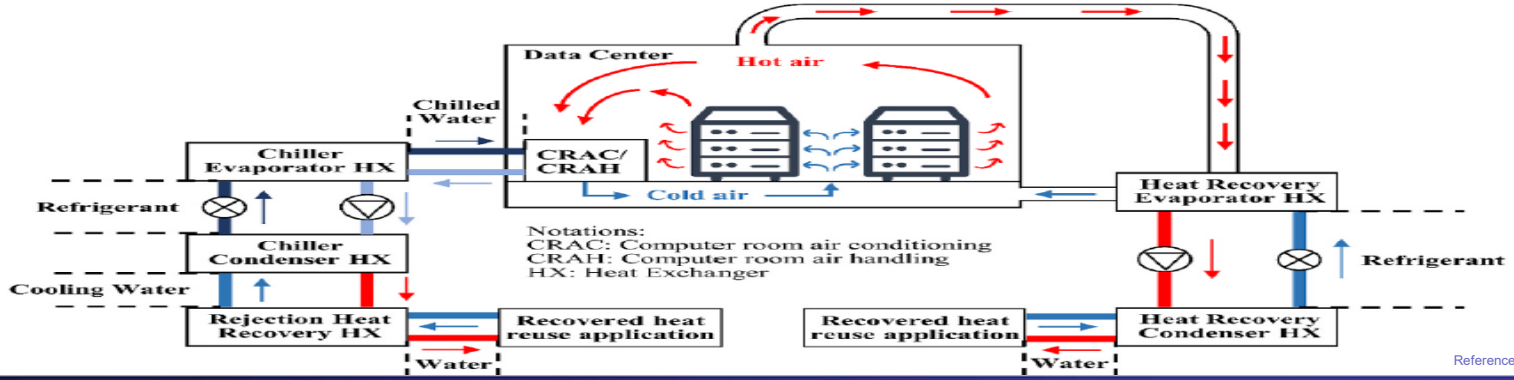
Electricity Generation

Waste heat can drive absorption chillers or turbines for power generation, although efficiency is typically lower compared to direct heat reuse.

General Heat Recovery via Free Cooling in IDCs

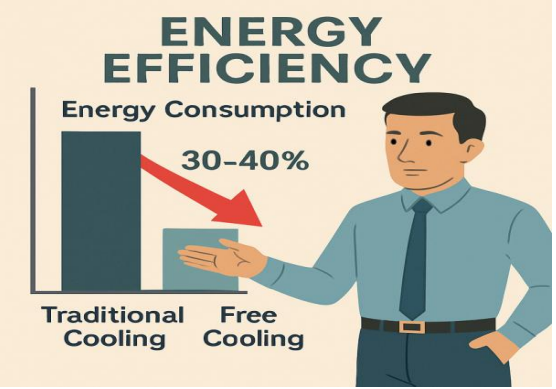
The waste heat temperature levels for different source cooling system in IDCs.

DC cooling form		Description	Potential heat source	Temperature (°C)	Recycling potential rank	
					Waste heat Temp	Application scope
Air-side cooling	CRACS	Room level cooling	Return warm water	15–20	☆	☆☆☆☆
			Return hot air	25–47	☆☆☆	☆☆☆☆☆
	CRAHS		Condenser coolant	40–50	☆☆☆☆	☆☆
Air to liquid	Heat exchanger	In-row & rear door cooling	Return warm water	20–30	☆☆	☆☆☆
			Condenser coolant	40–50	☆☆☆☆	☆☆
Liquid cooling			Return hot water	50–60	☆☆☆☆☆	☆



References: Waste heat recoveries in data centers： A review.pdf

Benefits of Heat Recovery via Free Cooling in IDCs



1.Energy Efficiency

Free cooling can reduce cooling energy consumption by up to 30–40%, as it minimizes or eliminates the need for mechanical chillers.
When combined with heat recovery, it can further improve energy reuse effectiveness (ERE), potentially achieving PUE values as low as 1.2–1.4.

2.Cost Savings

Reduced cooling energy costs and revenue from selling recovered heat (e.g., to district heating networks) help lower operational expenses.
For instance, Villanova University found that using absorption chillers for heat recovery in a 10 MW data center could yield a payback period as short as 4–5 months.

Benefits of Heat Recovery via Free Cooling in IDCs

3.Environmental Impact

Projects such as Meta's data center in Odense, Denmark, aim to recover 100,000 MWh of heat annually for local heating, reducing CO_2 emissions by more than 1,500 metric tons per year.

4.Sustainability and Compliance

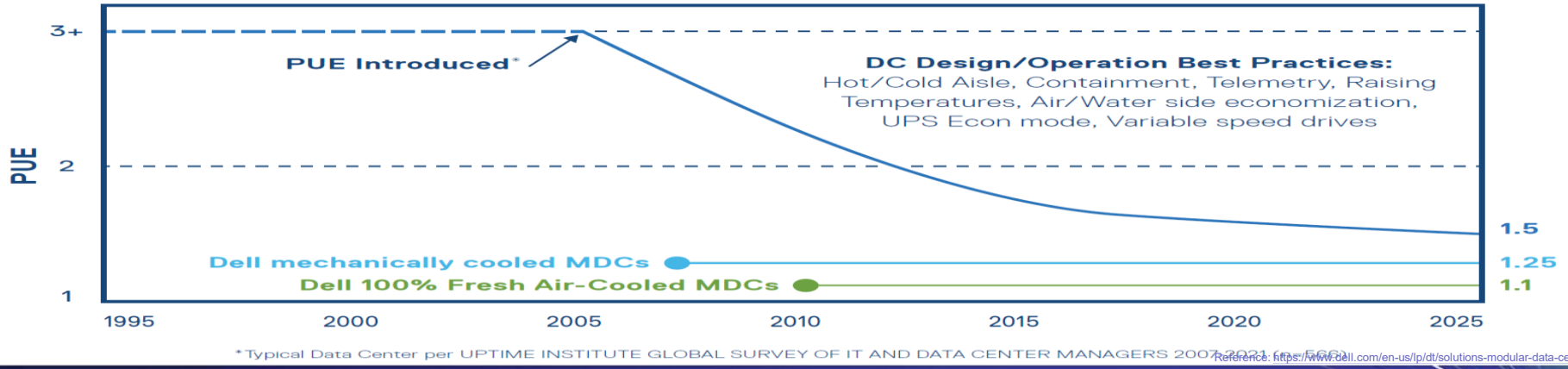
EU regulations may require new data centers to investigate heat reuse for permitting, supporting global net-zero goals.

5.New Revenue Streams

IDCs can sell excess heat to nearby communities, greenhouses, or industries, transforming data centers into energy suppliers.

Real-World Examples

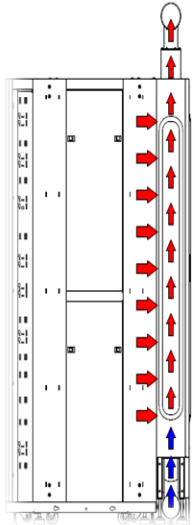
- **Meta, Odense, Denmark:** Uses air-based cooling with heat recovery to supply **100,000 MWh of heat** annually to a local hospital and community via district heating.
- **EcoDataCenter, Sweden:** Employs liquid immersion cooling to recover heat for a wood pellet factory and district heating, reducing carbon emissions.
- **NREL, USA:** Integrates free cooling and heat recovery to warm campus buildings, achieving a **PUE of 1.04**.
- **Equinix, France:** Recovers 6.6 MW of heat from a data center for district heating, supplying **10,800 MWh/year**.
- **Polytechnic University of Valencia, Spain:** Uses a 300 kW polyvalent heat pump with free cooling to recover 1.66 GWh of heat for campus buildings, saving **64% energy.**

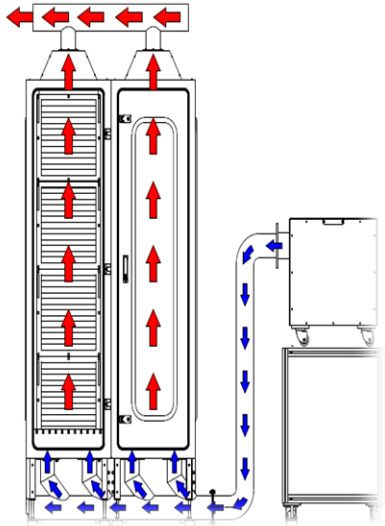


*Typical Data Center per UPTIME INSTITUTE GLOBAL SURVEY OF IT AND DATA CENTER MANAGERS 2007-2021 (n=5668)

Reference: https://www.dell.com/en-us/lp/dt/solutions-modular-data-centers

Air-based Cooling System with Turbo Blower





High Pressure for Long-Distance Heat Transmission

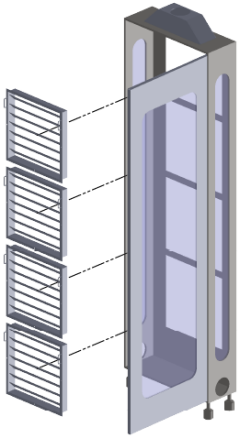
Low Noise

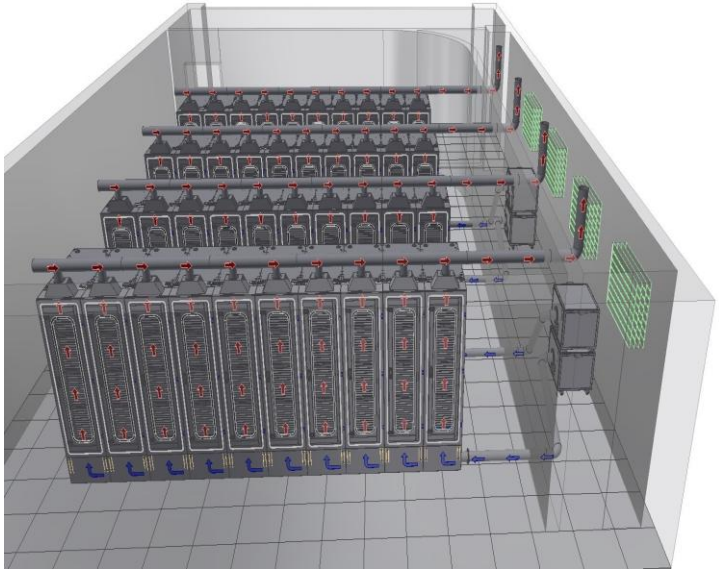
Adjustable Speed to Match IDC Load for Energy Saving

Turbo Blower: Reliable 24/7 Operation

Maximum Power Efficiency

Air-based Cooling System with Turbo Blower





Technical Specifications of GPE Turbo Blower

GPE applies forged materials and five-axis machining to build aerospace-grade turbines and impellers for air flow generation, offering the advantage of long service life.

Model	Power	Voltage	Rotating Speed	Absolute Pressure	Air Flow	Total Efficiency
	kW	V	RPM	bar(a)	CMM	%
K005-110	3.7	3Φ220 3Φ380	21000	1.1 (Output)	14	73
K005-120	3.7	3Φ220 3Φ380	24000	1.2 (Output)	7.4	80
K005-130	3.7	3Φ220 3Φ380	24000	1.3 (Output)	5.2	76
K005-10H	3.7	3Φ220 3Φ380	21000	0.9 (Input)	10	57-61

GPE Experience in Cooling and Heat Reuse: Warship Engines, Military Bunkers

Low Noise, Vibration, Starting Current

- Low Noise (70-75dB(A))
- Low Vibration (below 1.2 mm/sec)
- Low Starting Electric Current.

Aerospace-Grade Impeller

Discussions and Future Works

- Turbo blowers provide **strong airflow and pressure** for heat extraction in data centers.
- **Modular design** allows direct integration into existing infrastructure.
- Combined with free cooling, **overall energy use is reduced**.
- **Recovered heat supports secondary uses** like heating and drying.
- The system contributes to **lower PUE** and **improved sustainability metrics**.

- Evaluate performance across varied **IDC sizes, layouts, and climates**.
- Develop **AI-driven control** for real-time thermal and airflow optimization.
- Explore **broader heat reuse applications** beyond on-site facilities.
- Conduct full lifecycle and **ROI assessments** to guide adoption.
- Create **standardized, modular product lines** for scalable deployment.

Call to Action

- Improve **thermal management** in data centers with high-efficiency turbo blowers.
- Cut **energy use and PUE** through air-based free cooling.
- Repurpose **exhaust heat** for heating, hot water, or industrial use.
- Use a **modular, oil-free system** built for continuous, low-maintenance operation.
- Connect with GPE to boost performance and sustainability through our KAVAS turbo blower solutions.

Thank You!

GREEN POWER ENGINEERING CORPORATION


Alexander Chen


kavas.turbo@gpe.com.tw


https://gpe400.wixsite.com/website-4

TEL: +886-7-6955216 FAX: +886-7-6955217

Address: No.6, Luke 3rd Road, Luzhu Dist, Kaohsiung City, 821011, Taiwan.