



US PATENT 7,753,766 B2

Mission Critical

Solving global energy challenges

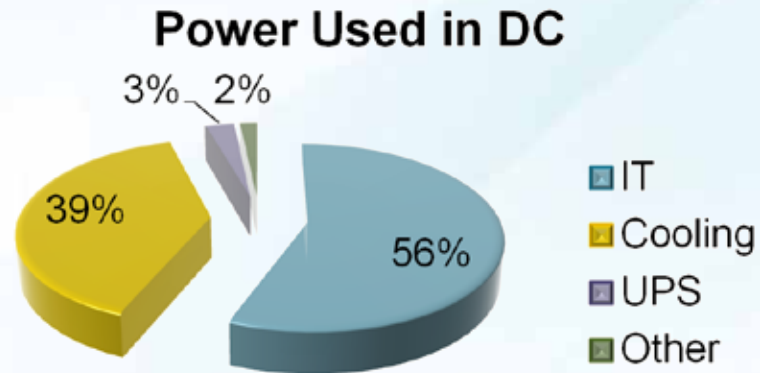


The Changing Face of Cooling Metrics

ΔT (Delta T) of IT Equipment is on the rise. This is the rise in temperature through IT equipment from intake to exhaust. This is increasing as OEM vendors seek ways to appear more Green by reducing fan power.

In legacy data centers that do not support higher ΔT by design this means installing more cooling and reduced efficiency. With KyotoCooling high ΔT Equipment can be cooled with 50% less Energy

Data Center Cooling is the largest controllable cost in the facility. The workload of IT is fixed by needs of users and heat and resultant need for cooling results directly from the waste heat of IT workloads.



In most data centers in Canada and the United States today the relationship of IT workload (Critical Load) to Cooling (PUE(m)) is 1:8. The derived cost therefore is Critical load kW x .8 x cost/kWhr x 8760. In a typical jurisdiction that's for a 1Mw Facility: 1000 x .8 x .11 x 8760 or \$770,880/year.

A KyotoCooling Installation delivers a PUE(m) of 1.1. That means a cost basis of 1000 x .1 x .11 x 8760 or \$96,360/year.

The facility savings are \$674,520. Assuming 1mW is delivered at 100w/sq ft that's 10,000 sq ft and approximately 200 5kW cabinets. This amounts to \$3373/cabinet/year input cost reduction. That's \$281/month in input cost reduction plus taxes versus a competitor.

Comparing Co-location contracts in 2010, the average high to low standard deviation in RFP responses for cabinets of this class in Tier III class facilities was \$300.

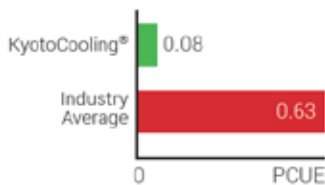
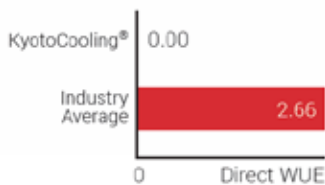
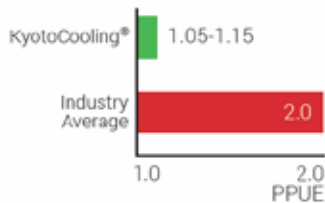
Containment by the Numbers



KyotoCooling reduces oversupply to a minor 2%, maximizes the inherent designs of OEM manufacturers and ensures consistent SLA 's on supply temperature across cabinet face.

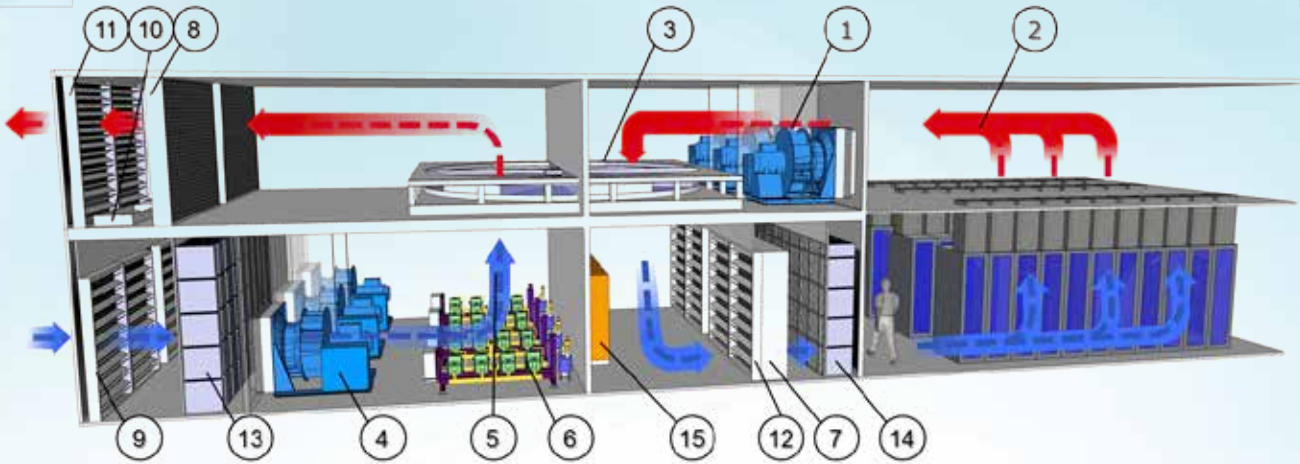
KyotoCooling thrives on high ΔT equipment and in general makes best use of the thermal transfer efficiency of containment or "separation" of supply and return air streams.

Existing Data Centers today provide 40-50% too much air, a strategy required because air is not controlled. That creates lower ΔT reducing the efficiency of cooling systems and requiring more fan power.



KyotoCooling Dynamically adapts to changing workloads, changing IT Equipment and Changing ΔT without operator intervention and in real time.

Separated air streams, heat rejection thru single transfer process



Fans⁽¹⁾ maintain air flow circulation⁽²⁾ in the data hall; A slowly rotating heat wheel⁽³⁾ cools recirculation air. Fans⁽⁴⁾ in the outside air plenum maintain outside air flow⁽⁵⁾ through the heat wheel; DX (direct expansion) coolers⁽⁶⁾, evaporator coils⁽⁷⁾ and condenser coils⁽⁸⁾ provide backup cooling. Control dampers^{(9),(10),(11)} and ⁽¹²⁾ to control airflow; air filters⁽¹³⁾ and ⁽¹⁴⁾; electrical cabinet⁽¹⁵⁾ with controls and power distribution;

Safe, Effective, KyotoCooling

KyotoCooling is designed from inception to support separated air flow distribution. KyotoCooling utilizes new techniques and approaches to support air cooling cabinets to 40kva and above while maintaining best practice approaches of modularity, redundancy and absolute control through autonomous self-adaptive integrated controls. Each change in the data center is adapted to without intervention with the application of strategic approaches to energy efficiency and reliability. The result is the world's most efficient and reliable autonomous cooling solution for data centers.

KyotoCooling has the largest worldwide installed base of New Generation Mission Critical Cooling both in raw Megawatt Capacity and in terms of operating hours/unit capacity. KyotoCooling is proven, hardened Mission Critical Cooling Solution. With over 1.7 Million continuous hours of operation with common design, controls and engineering the concept is proven from -50F to 110F Ambient Conditions on 5 Continents.

Complete Control

Controls and Operational Issues account fully for 50% of facility failures. We recognize this real life fact. KyotoCooling Controls are designed to be robust, with no single point of failure and automatic in operation through all manner of failure modes and changing conditions inside or outside the facility.

We monitor vibration, filter conditions, and every aspect of supply and return air flow and conditions. Each KyotoCell monitors over 240 specific critical functions and self balances in real time.

Our controls are stable and proven across a wide range of environmental conditions from 5% load to 100% load in standard and emergency load conditions from -50C to +40C.

Simply put we eliminate the problem of operator experience. In addition we log, alert and escalate as needed and by design are anywhere manageable.

- Rapid, Easy Installation
- Simple Commissioning
- Minimal Maintenance

KyotoCooling units are available from 35 KW to 1.3 MW designs providing sensible critical load capacity at 22F ΔT (to 13C ΔT) over IT.





Basics of Operation

To cool with air you must control that air. Normally bypass and recirculation account for a 30% overall loss of efficiency in a data center. So we begin with the idea that we want to separate cold and warm air optimally. This can be by aisle containment, or chimney cabinet or fixtures for high density cabinets provided by a myriad of companies specializing in this control process.

The impact of this control is immediate and sensible. There is consistency in temperature of the air delivered to the IT systems in the data center. There is certainty in airflow. There are no longer anomalies and inconsistencies in temperature at inlet in the data center. We have resolved the first risk of cooling, knowing that we have a temperature that is constant across long aisle spaces from floor to top of rack.

We precisely control the flow of air based on measured ΔT , and air flow differentials using a monitoring system known as Airlull. We are able to maintain precise balance in pressure between cold and hot spaces created by containment systems to deliver to servers a perfect environmental condition. We do not underflow, nor overflow. We deliver a precise volume of air at a precise temperature to the cabinet face, even under changing load conditions, all without operator intervention.

The next question is how to cool this. Here we start with the traditional cooling process. We provide an adequate amount of direct expansion or chilled water-cooling to fully cool the intended load. Both are well-understood processes. We design this in traditional ways using proven engineering.

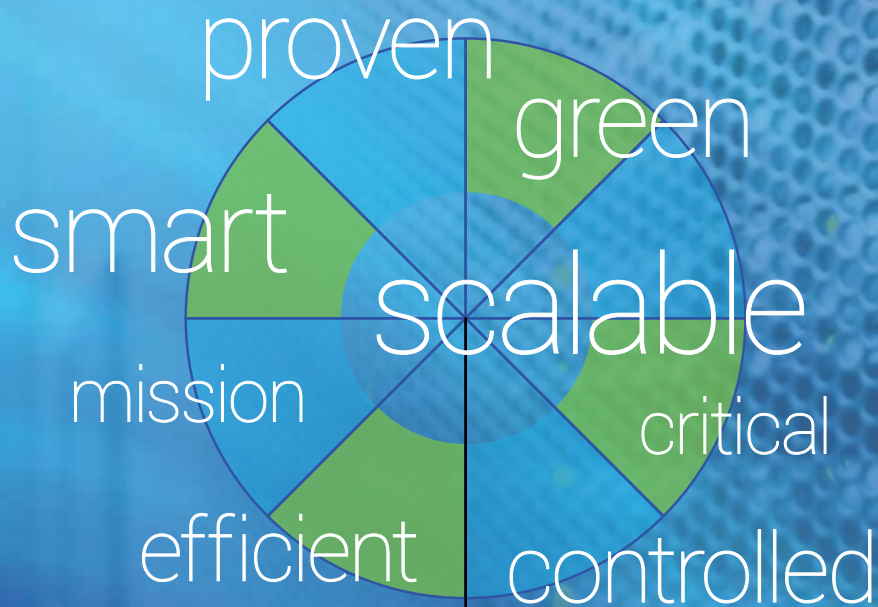
The next thing that we do is to add into the airflow a patented design use of a heat wheel. This is not a conventional heat wheel design. This heat wheel does not bring outside air into the data center. That would mean a risk. We have designed a system that uses the heat wheel for air-o-air heat transfer without bringing outside air into the data center. The heat wheel achieves exchange of heat without humidity or particulate impacts on the conditioned space. This heat wheel use is unique to us worldwide and we have received international patents on this application. (US PATENT 7753766). Fundamentally the only possible use of heat wheel in a data center is protected and unique to KyotoCooling. More importantly we are the experts in air leakage reduction, direct drive, integration and optimization in this use. The proof is in the results.

Approach over the wheel can be as low as 5°F, Leakage is at peak less than 0.3% (less in soon to be released designs), Rotational speed averages less than one (1) RPM yet we reject up to 850kW at 22°F ΔT and up to 1.7mW at 44°F ΔT scaling as IT equipment changes to higher ΔT . Effective economization runs to 8500 hours in Central and Northern United States and Canada.

We are able to maintain precise balance in pressure between cold and hot spaces.

We do not underflow, nor overflow.

We deliver a precise volume of air at a precise temperature even under changing load conditions, all without operator intervention.



○ transform your data center

KyotoCooling® provides mission-critical, water-free cooling with unparalleled levels of reliability, efficiency and modularity for data centers.

Our patented SmarterCooling™ technology is the best choice for providing the maximum ROI with the lowest risk and operating cost.

KyotoCooling® is available in modular building blocks from 8kW to 1.5MW that can be deployed in unlimited site capacities and cabinet densities.



For more information about how a KyotoCooling® system can work for you, contact:

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