

# Improve Data Center Cooling Efficiency by 95%



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# Company Overview



- Headquartered in Rochester, New York
- Affiliate of RIT Clean Energy Program
- Deliver award-winning OptiCool™ – *the most effective data center cooling technology on the planet*
- Core technology was developed at Bell Laboratories
- 2010 Japan “Green IT Award” recipient



# What is a Data Center?

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- Facility to house computer and storage systems (large computer room)
- Companies need fast internet connectivity, security, and nonstop operations for critical applications
- No “downtime” (redundant power and cooling)

# Why are Data Centers Important to NYS?

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- NYS has the second-most data centers in the U.S.
- Data centers consume 3% of the electricity in NYS
  - 4.5 Billion kW-hr or \$584 Million/year
- Half of this is spent on cooling costs

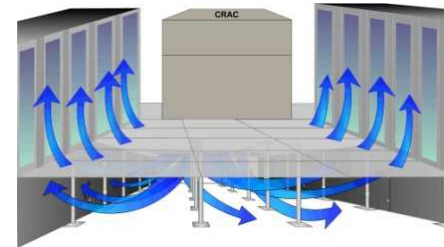
# Data Center Cooling Industry - 2011

New equipment is generating significant heat load



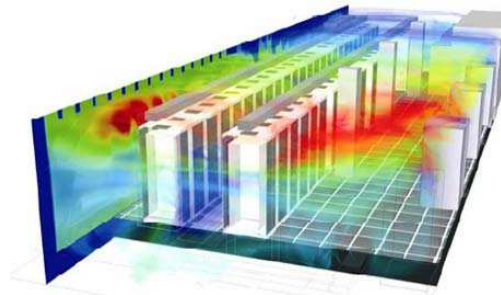
- All new blade server technology
- The new Cisco / EMC / VMware Vblock

Computer Room Air Conditioning is extremely inefficient



- Moving air requires significant energy
- Elaborate raised floor systems and significant cooling footprint is costly

Managing “airflow” is overly complex and costly



- Hot aisle / cold aisle planning
- Computational Fluid Dynamics (CFD) planning

# OptiCool™ Data Center Design Implications

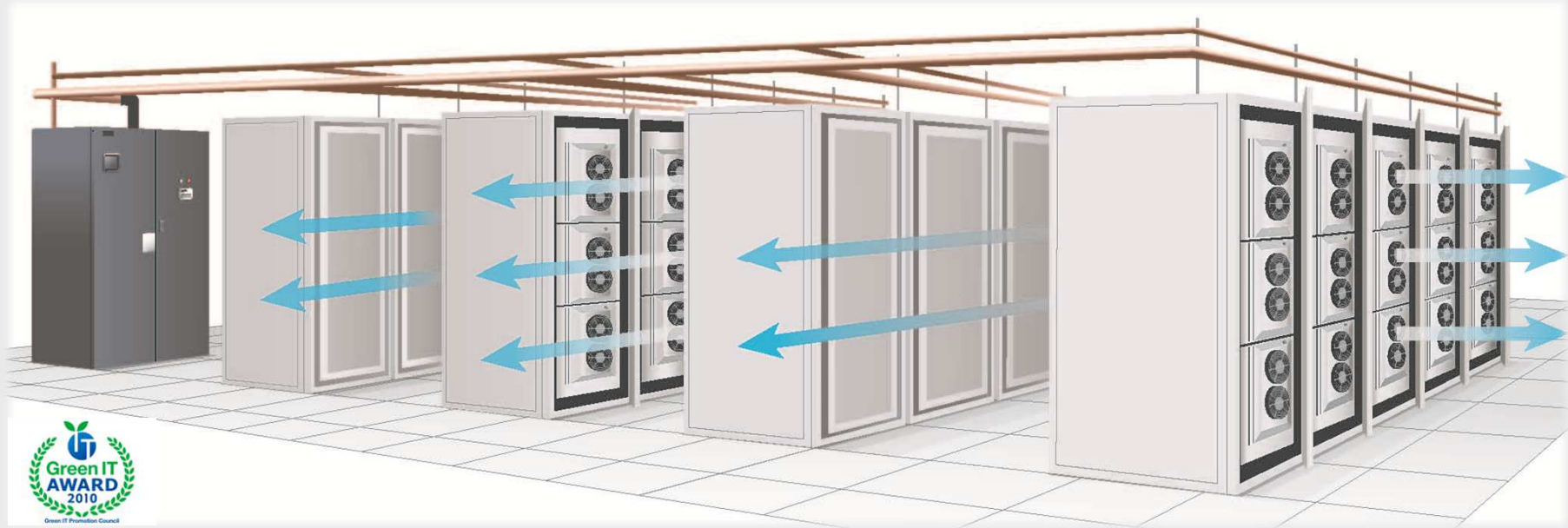
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## Paradigm Shift for Data Center Cooling

- Eliminates the premier design concern – *Airflow Management*
  - Eliminates the need for a raised floor
  - Eliminates “Hot-Aisle / Cold Aisle” design
- Supports high-density cooling
  - Up to 30 kW per rack
- Supports in-rack redundancy
  - Up to 20 kW cooling at all times
- Significant space utilization improvement
  - Can increase equipment space by 100%+
- Reduces energy, carbon footprint and costs
  - An overall reduction of 95%+

# OptiCool™ Data Center Cooling Solution



## Features

- Refrigerant-based cooling
- Non-toxic, non-conductive, non-corrosive
- 10 kW cooling per unit / 30 kW per rack
- Retrofitted to existing cabinets
- "Active" heat extraction
- Modular design configured to heat load
- Interlaced Cooling™ for redundancy

## Benefits

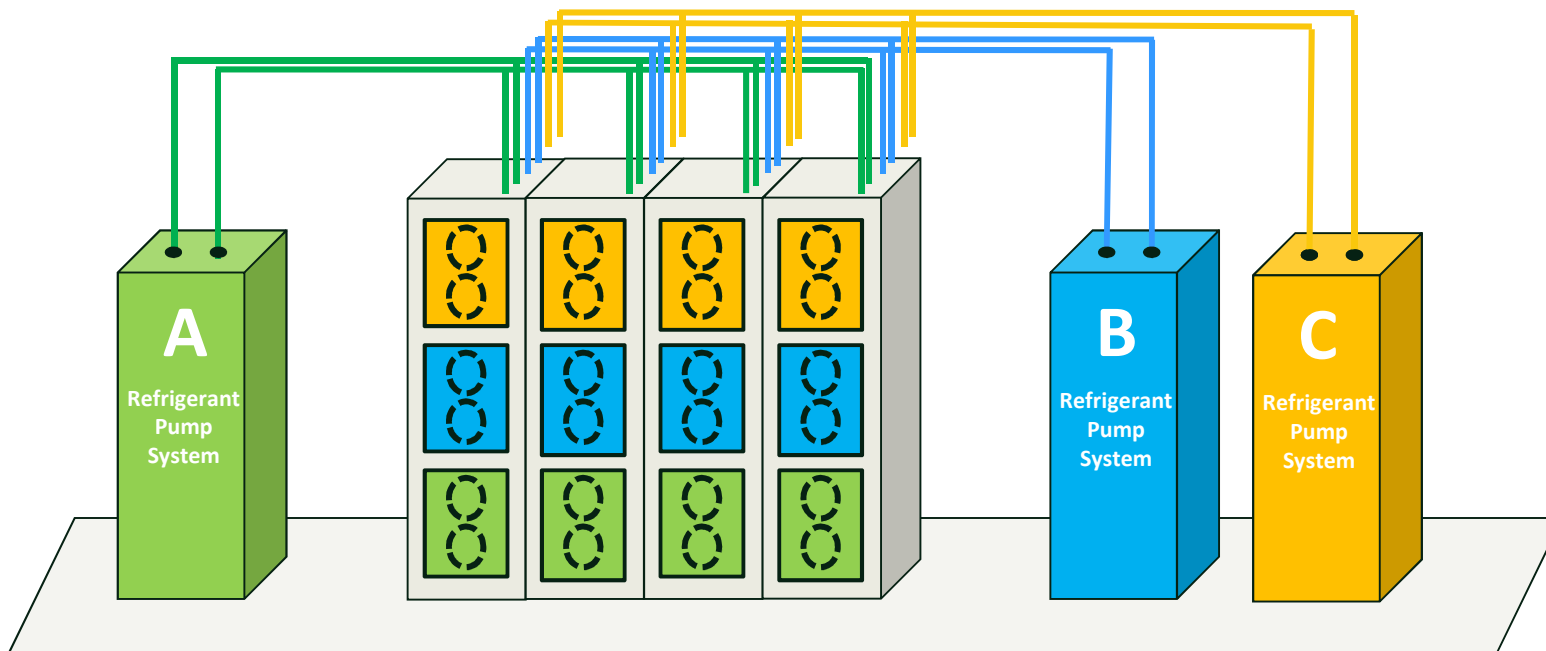
- 💰 Reduce in-room cooling energy usage (up to 95%)
- 💰 Reduce energy usage by computing equipment
- 💰 Optimize "floor space" efficiency
- 💰 Optimize "rack space" efficiency
- 💰 Government incentive funding
- 💰 Reduced maintenance costs
- 🔊 Reduced noise levels



Adaptable. Efficient. Effective.

# Interlaced Cooling™ for In-Rack Redundancy

Premier solution for redundant, high-density cooling applications



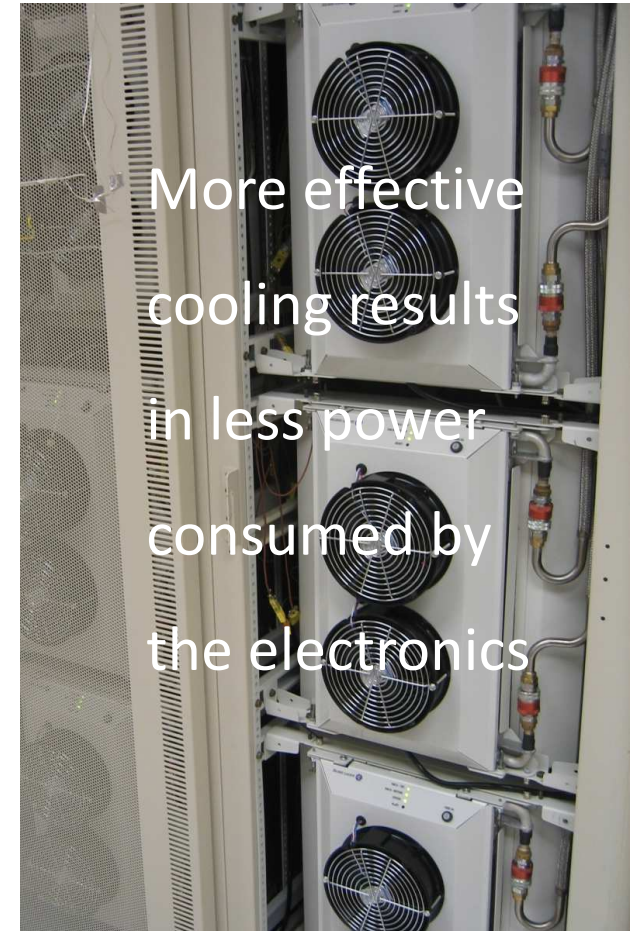
## Key Messages

- High capacity (30 kW cooling per rack)
- Cooling source redundancy to each rack – **20 kW** in-rack cooling
- Vastly superior to maximum capacity of CRACs / 6 kW per rack


# OptiCool™ Reduces Computer Energy Usage

- OptiCool™ fans cause computing equipment fans to work less
- “NetZero Cooling” is a reduction in computing equipment energy usage, off-set against cooling energy usage
- The NetZero formula is as follows:
  - 38 watts saved per 1 kW of heat load  
*less 30 watts per AHX*
  - For example, the NetZero “give back” for a 10 kW rack load with 2 AHX units would be as follows:

$$\begin{array}{rclcl} 10 & \times & 38 & = & 380 & \text{gross watt savings} \\ 2 & \times & 30 & = & (60) & \text{AHX fan energy usage} \\ & & & & \underline{320} & \text{net watt savings per rack} \end{array}$$



# Efficiency Face-off: OptiCool™ Versus CRACs

| Type  | Quantity | Sensible Cooling Capacity | Total Power Consumption              | Estimated Annual Energy Cost*    |
|---|----------|---------------------------|--------------------------------------|----------------------------------|
| 20 Ton CRAC   | 4        | 51 kW / CRAC<br>204 kW    | 42 kW<br>(10.5 kW/CRAC)              | \$36,792                         |
| 1 Refrigerant Pump and 40 AHX's   | 1        | 200 kW / Pump             | 2 kW<br>(0.8 kW pump + 1.2 kW AHX's) | \$1,752                          |
|  |          |                           | <b>Power Savings</b>                 | <b>Estimated Energy Savings*</b> |
|   |          |                           | OptiCool™ - 40 kW                    | <b>\$35,040</b>                  |
|   |          |                           | NetZero (80% of cap) - 6.0 kW        | <b><u>\$5,326</u></b>            |
|   |          |                           |                                      | <b>\$40,366</b> ✓                |

\* Assumes \$0.10 / kW-hr electricity rate for continuous cooling (8760 hr / year)

# New Data Center Budgetary Estimate

## Chilled Water Heat Rejection



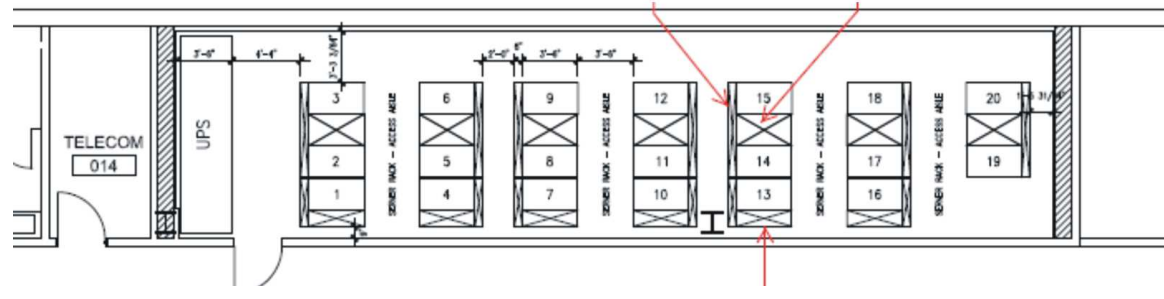
| Assumptions                        | Computer Room Air Conditioning  | Cost                | Emerald Technologies OptiCool Solution   | Cost              | Savings           |
|------------------------------------|---|---------------------|--|-------------------|-------------------|
| <b>Capital Costs</b>               |   |                     |  |                   |                   |
| A. Data Center Size                | 1,500 Square Feet   | -                   | 1,500 Square Feet  | -                 |                   |
| B. Raised Floor                    | Yes / \$150 per square foot   | \$ 225,000          | Not Necessary  | \$ -              |                   |
| C. Computer Racks                  | 40 - 50% capacity for air flow  | \$ 280,000          | 20 - with rack densification   | \$ 140,000        |                   |
| D. Heat Load                       | 200 kW  |                     | 200 kW   |                   |                   |
| E. Cooling Solution and Capacity   | 4 / 20 Ton CRAHS @ 51 kW sensible cooling for a total of 204 kW of cooling capacity (5 kW/Rack) (INSTALLED) | \$ 192,000          | 1 / OptiCool RPW-200 Refrigerant Pump @ 200 kW sensible cooling for a total of 200 kW cooling capacity (10 kW/Rack) along with 40 AHXs (INSTALLED) | \$ 298,000        |                   |
| F. Energy Efficiency Grant funding | Not Applicable  |                     | Government Incentive \$0.12/kW-Hr  | \$ (42,048)       |                   |
| <b>Total Capital Cost</b>          |   | <b>\$ 697,000</b>   |  | <b>\$ 395,952</b> | <b>\$ 301,048</b> |
| <b>Annual Costs</b>                |   |                     |  |                   |                   |
| G. Energy Usage                    | 10.5 kW per CRAH / 42 kW total @ \$0.10/kW-Hr   | \$ 36,792           | 800 W per Pump / 30 W per AHX / 2 kW total @ \$0.10/kW-Hr  | \$ 1,752          | \$ 35,040         |
| H. NetZero Energy Give Back        |   | \$ -                | (200 kW @ 80% x 0.038 W) @ \$0.10/kW-Hr  | \$ (5,326)        | \$ 5,326          |
| I. Maintenance Costs               | 4 CRAHS @ \$4,000   | \$ 16,000           | 1 RPW-200 Pumps @ \$6,000  | \$ 6,000          | \$ 10,000         |
| <b>Operating Cost</b>              |   | <b>\$ 52,792</b>    |  | <b>\$ 2,426</b>   | <b>\$ 50,366</b>  |
| <b>Total Cost of Ownership</b>     | 10 Year Total Cost of Ownership   | <b>\$ 1,224,920</b> | 10 Year Total Cost of Ownership  | <b>\$ 420,211</b> | <b>\$ 804,709</b> |
|                                    |   |                     | <b>Additional Upside Benefits</b>  |                   |                   |
|                                    |   |                     | 1. 30% floor space efficiency with 12 additional racks   |                   | \$ \$             |
|                                    |   |                     | 2. 100% equipment capacity increase within existing racks  |                   | \$ \$             |
|                                    |   |                     | 3. Reduce noise levels, improve work environment   |                   |                   |

# Comparing OptiCool™ and In-Row Cooling

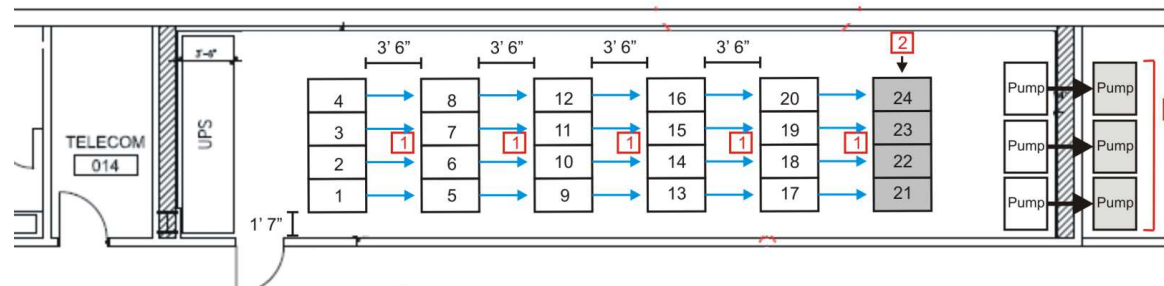
## Cool Case Study

- High Density Cooling
- 750 square foot
- 20 racks
- 20 kW / rack
- 400 kW total heat load

## In-Row → Hot-Aisle/Cold-Aisle Plus Containment



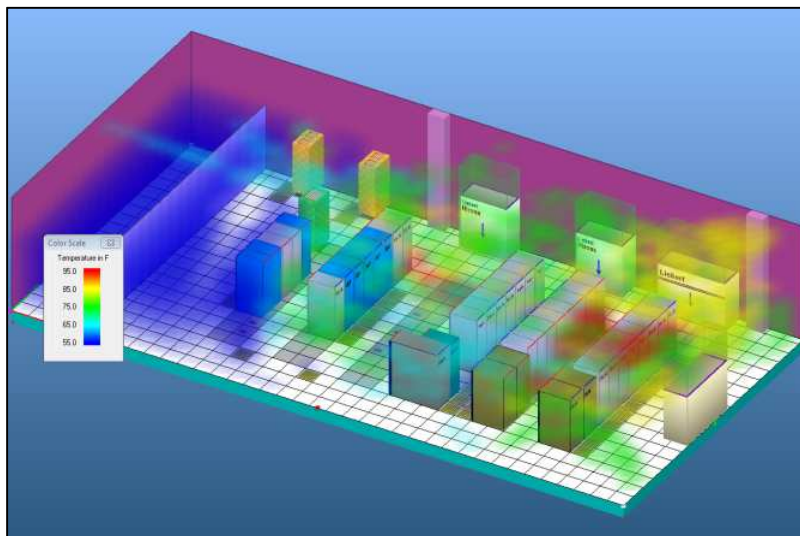
## Emerald Technologies OptiCool™ → Laminar Flow



## Benefits

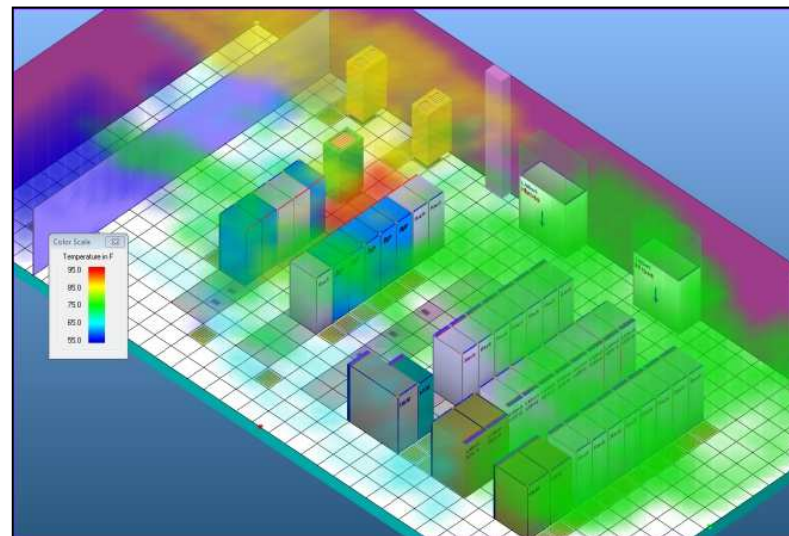
- A laminar design provides superior airflow and eliminates the need for containment systems
- Reduces cooling footprint within the data center allowing for up to 20% more racks
- Energy savings of 48 kW or \$50,400 (@ \$0.12/ kW-hr)

# Computational Fluid Dynamics Case Study



## Expansion Project with 4-CRACS

- Existing/Baseline – (2) 20 Ton CRACS
- Add 3 new rows (29 racks)
- 
- Add (2) 20 Ton CRACS



## Expansion Project with 1-CRAC & OptiCool™

- Existing/Baseline – (2) 20 Ton CRACS
- Add 3 new rows (29 racks)
- 
- Turn off (1) 20 Ton CRAC
- Add **OptiCool™** Cooling Solution

- Estimated energy savings of 46 kW or \$48,000/year (@ \$0.12/kW-hr)

# RG&E Custom Rebate Program

## ***Computer Room Air Conditioner Option***

- Deploy (4) 20 Ton CRAHs
- Energy Consumption of 42 kW

## ***OptiCool™ Option***

- Deploy 1 OptiCool™ refrigerant pump and 48 AHX units
- Energy Consumption of 2 kW

## ***Design for Efficiency***

- *Efficient design utilizing new technology saves 40 kW of energy*
- ***\$70,500 incentive***

**Tim Karski**

RG&E/NYSEG Key Account Manager

## ***Benefits***

- OPEX cost reduction through energy savings of 40 kW or \$35,040/year (@ \$0.10/kW-hr)

# The OptiCool™ Differentiation

- 🌀 **Safety** – R134a is non-toxic, non-conductive and non-corrosive
- 🌀 **Design** – High-capacity cooling leverages micro-channel and fan design
- 🌀 **Scalability** – Modularity supports redundancy and cooling as needed
- 🌀 **Efficiency** – 95% more efficient than air flow systems, supports “NetZero Cooling” when including computer energy reduction
- 🌀 **Reliability** – The solution is over-engineered, designed for 30 year life cycle and is NEBS compliant

## **Active Heat Extractor**



**Cooling Capacity:** 0 kW - 10 kW

**Weight:** 16 lbs

**Power Consumption:** 30 watts

***Thank you!***

