Technology Connection
Energy Sleuth™

Energy Sleuth™

Detect Hidden Savings with the Most Advanced Solution

Energy Sleuth™ is the first energy-modeling solution that enables enterprise-class data centers and labs to accurately quantify and reduce energy consumption using the most comprehensive techniques available. Just as important, it incorporates the latest standards and calculation methods from the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).

A Theoretical Approach: Challenge, Solution, Result

The Challenge Facing Clients

Data centers face a mammoth task: reducing energy costs. But how can they improve thermal efficiency and reduce energy consumption?

The Solution

In brief, an effective solution requires three main steps:
- Gather all related data to build a complete picture of current consumption
- Understand the rectification options and provide a return on investment (ROI) estimate for each
- Implement the options that improve air flow and chilled water delivery – maximizing efficiency and protecting IT operations

The Result

An ideal solution must deliver four key benefits:
- Reduced energy consumption in life-cycle components (chillers, CRAH units, rack-mounted equipment, etc.)
- Improved life cycle for cooling equipment without compromising IT equipment
- Greater data-center resiliency
- More potential "headroom" for additional IT capacity

Before Energy Sleuth: The Past Approach

Historically, computational fluid dynamics (CFD) modeling was the forensic tool of choice to identify problems and improve data-center airflow. But gains were "muted" and came with shortcomings:

- Provided a benchmark against which to evaluate results
- Furnished a rough ROI estimate to analyze energy use
- Failed to incorporate climate, geography, facility analysis, and adjacent activities
- Failed to consider chiller plant, pumps, and heat-rejection method
- Relied on rule-of-thumb estimates and industry-standard averages (not *in situ* data) for energy calculations

The New Approach: Energy Sleuth

Energy Sleuth begins where CFD modeling ends. It joins traditional CFD modeling to more detailed, comprehensive modeling for more accurate "predictive cost savings." It is the only solution that digs into *all of the factors* that affect energy consumption:

- Incorporates geography, climate, and weather data for the location
- Includes a complete inventory of all computer thermal loads and their placement; all cooling-loop energy costs and components including chillers, pumps, water-side economizers, CRAH and CRAC units; and the heat-rejection method
- Builds a model of the current data-center space, interior layout, and features; the building management system (BMS), and power consumption records and costs
- Builds a model of the future data center space with rectifications that demonstrate future costs with high accuracy
- Offers improved ROI calculations
- Furnishes "decision support" for cooling infrastructure improvements and changes

An Energy Model Based on ASHRAE Methods

Energy Sleuth modeling is based on and complies with the latest ASHRAE data-center methodologies and standards:

- Complies with ASHRAE 90.4 data-center energy standards and methods
- Implements and enhances the energy calculation method developed by TC9.9 to support the 90.4 standard
- Will be recognized as the new standard for modeling energy consumption and data-center design

Energy Model: Information Collection

Energy Sleuth clients supply the data-center information (definition) that includes the outdoor heat-rejection system (primary system). Then Energy Sleuth calculates system capacity and power consumption using typical annual hourly weather data based on more than 1,000 locations. The list for the heat-rejection (primary) system includes the following elements:

- Direct expansion condensing units
- Chilled water cooling systems, including water-side economizers and cooling towers
- All air-cooling systems with air economizers and cooling/heating coils (phase 2 adiabatic evaporation, heat wheel)

Energy Model: Calibration

After creating the site's specific energy model, Energy Sleuth calibrates the model using power-meter readings, BMS, and data-center power and temperature sensors. The model includes the following data and tasks:

- Available HVAC power-monitoring data
- Available component energy use from fans, compressors, condensing units, pumps, and cooling towers
- The following options when information is not available:
  - Temperature differences and flows across heat exchangers, chillers, cooling towers, etc.
  - Dis-aggregated ongoing power meter data, obtained by monitoring short-term component power to dis-aggregate ongoing power meter (i.e., utility) data
- Establishment of actual IT power schedule and utilization, temperature difference, and air flow across IT equipment

Energy Calculation Results for an "Unrectified" (As-Is) Model

This is an example of a data center with poor power usage effectiveness (PUE) – with energy consumption costs of $762,102 per year.

FULL SET OF RESULTS FOR "AS IS" MODEL

PUE 1.62

RTI 67.29

RCI_HI 100

RCI_LO 21.77

Parameter	Value
COP - Coefficient of Performance Specified by User	3
PUE - Power Utilization Effectiveness	1.62
DCIE - Data Center Infrastructure Efficiency (%)	61.77
RTI - Return Temperature Index[1] (%)	67.29
RCI_HI - Rack Cooling Index - High[1] (%)	100
RCI_LO - Rack Cooling Index - Low[1] (%)	21.77
Total Facility Power (kW)	867.7
Annual Operating Cost ($USD)	760,102

[1] RTI, RCI_HI, and RCI_LO are trademarks of ANCIS Inc.

Energy Calculation Results for "Rectified" Model Output

This is an example of data-center calculations that predict a $148,000 saving per year by implementing Energy Sleuth consumption rectification measures.

FULL SET OF "REVISED" MODEL OUTPUT

PUE 1.3

RTI 83.07

RCI_HI 100

RCI_LO 100

Parameter	Value
COP - Coefficient of Performance Specified by User	3.47
PUE - Power Utilization Effectiveness	1.3
DCIE - Data Center Infrastructure Efficiency (%)	76.75
RTI - Return Temperature Index[1] (%)	83.07
RCI_HI - Rack Cooling Index - High[1] (%)	100
RCI_LO - Rack Cooling Index - Low[1] (%)	100
Total Facility Power (kW)	689.38
Annual Operating Cost ($USD)	611,785

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Example of Modeling Output: Energy Optimization Yield

A comparison of the "before rectification" data (Base Value column) and "after-rectification" data (Base Case column on far right) illustrates the maximum improvement obtained by rectification:

• Increased coefficient of performance (COP) from 3 to 3.47
• Decreased power usage effectiveness (PUE) from 1.62 to 1.3
• Savings of 19.5%, or $148,000 per year

Parameter	Base Value 6 AHU's 60F SAT	Base Value 6 VFD's 60F SAT	Base Value 6 VFD's 60F SAT	Base Value 10 VFD's 68F SAT
COP – Coefficient of Performance Specified by User	3	3	3.0	3.47
PUE – Power Utilization Effectiveness	1.62	1.43	1.35	1.3
DCIE – Data Center Infrastructure Efficiency (%)	61.77	70.08	74.19	76.75
RTI – Return Temperature Index1 (%)	67.29	97.34	83.07	83.07
RCI_HI – Rack Cooling Index - High1 (%)	100	100	100	100
RCI_LO – Rack Cooling Index - Low1 (%)	21.77	22.94	100	100
Total Facility Power (kW)	867.7	764.82	722.47	689.38
Annual Operating Cost ($USD)	$760,102	$ 669,979	$ 632,880	$611,785

Resources for Data-Center Clients

Energy Sleuth enables data centers to conduct the following important energy-consumption analysis tasks:

• **Build and validate** a base CFD model of the data center, including the chiller plant – providing insight and knowledge of the upside potential
• **Perform energy analyses** based on CFD model output – predicting energy consumption and operating costs based on the existing, unrectified configuration
• **Optimize** the CFD model for thermal efficiency and resiliency – using advanced airflow management techniques
• **Update energy analyses** to predict cost savings – used as a basis for ROI analysis and proposal options
• **Implement** recommended changes as appropriate

Benefits for Data-Center Clients

For each data center, Energy Sleuth's analytical models deliver the following benefits:

• **Predict** the current state of energy consumption by the data center (before rectification)
• **Estimate** the upside potential impact on data center energy consumption after rectification, in the following ways:
  – Energy savings resulting from chiller-plant optimization
  – Reduced operating costs as a result of energy savings
  – Exploitation of previously unrecognized IT capacity (revealed by headroom analysis) at the data center
  – Additional "resiliency to failure" characteristics of the cooling system components
• **Identify** the most critical steps necessary to achieve the greatest ROI – using "what-if" scenarios to predict the areas of greatest gains

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