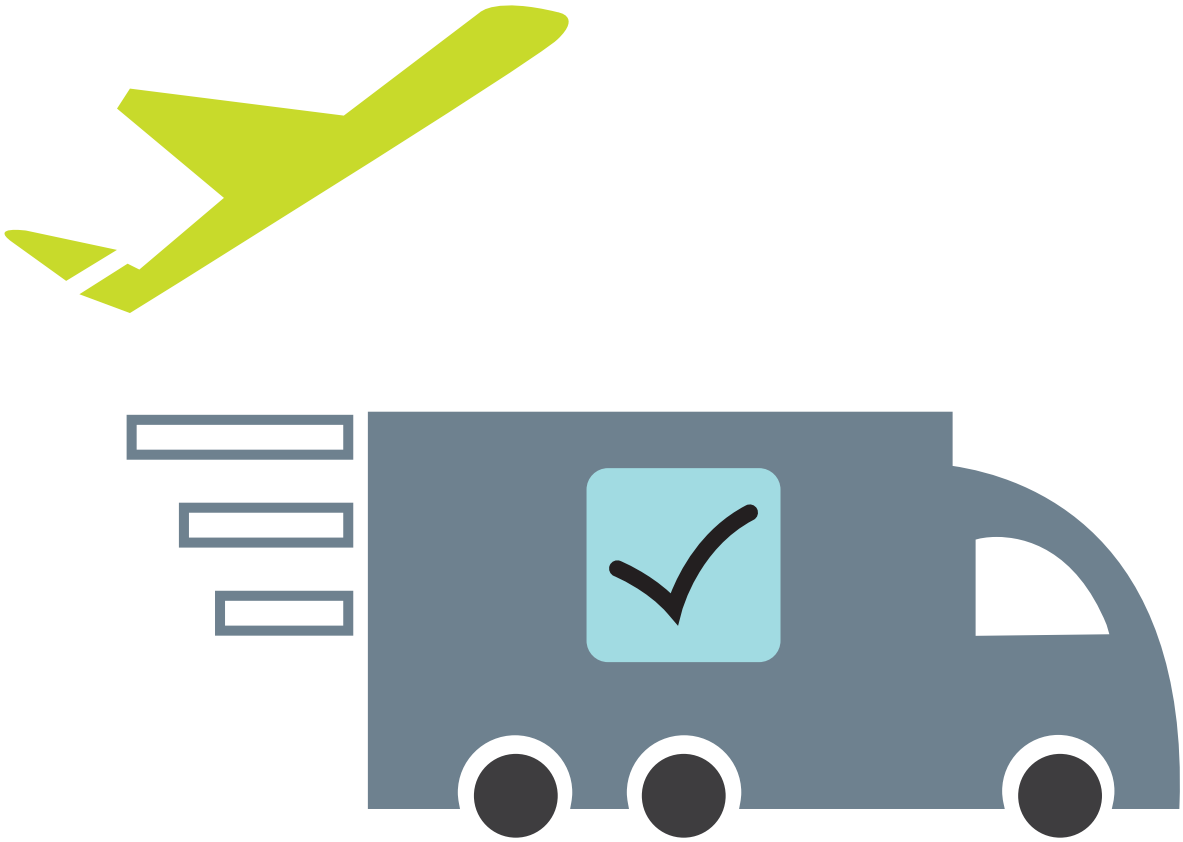
Wipro EcoEnergy

# ACHIEVING ENERGY EFFICIENCIES IN COLD STORAGES



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## Abstract

Globally, most perishable food items require refrigeration and electricity expense is a significant component of any cold storage business' running cost. This means that after manpower, energy is the next most significant cost element in any cold storage. And organizations globally are under pressure to reduce costs and be energy efficient, while not compromising on service quality.

Governments do give incentives for setting up cold storages. However, there are no incentives that support their day-to-day operations. The ever-increasing costs of running a cold storage, therefore, impact business viability.

This paper discusses the challenges in energy management for cold storages. It suggests ways to collect and analyze energy, asset performance, product and operations data to arrive at energy saving strategies that when applied would help in cost, performance and energy efficiencies.

# Stumbling Blocks

Any organization that manages a chain of cold storages is faced with 3 key challenges in energy management.

### Lack of Centralized Visibility

Most cold storages today are built with availability (business readiness) and service quality in mind, and not necessarily with a focus on energy efficiency. There is no centralized view of energy consumption, asset performance or even operations. Supervisory Control and Data Acquisition (SCADA) or PLC systems installed are also very site-specific and information collected by these systems do not get shared across sites. Therefore, there is no way that someone at the headquarters or a central team could do a multi-site comparison or multi-site, multi-asset comparison to draw out inefficiencies or share best practices across sites.

### Staff Costs

Staff costs account for a significant portion of a cold storage's operating expense. Thus, it becomes impossible for any cold storage company to have a dedicated energy management team at each location. The operations staff at each site has a charter of "running" the operations and not necessarily that of "saving energy." This leads to significant wastages in the form of over cooling (i.e. pessimistic control point settings) or increased asset utilization – all adding up to significant costs.

### Expert Judgment vs. Data-driven Analytics

Cold storage companies rely on expert opinion when it comes to taking decisions about operations, asset optimization, preventive maintenance scheduling and facility tune-ups. This leads to a lot of wasted effort and missed opportunities as less data points are used to arrive at those decisions. There is lack of correlation between data on operations, asset key performance indicators and their variance over a continuous period of time, and external impacting parameters such as weather data, product type, product input temperature, geographical location and loading/un-loading patterns.

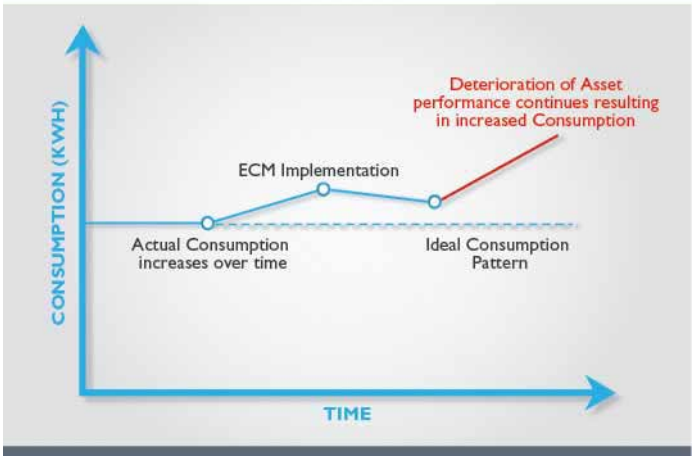
# Framework for Cold Storage Energy Management

To overcome the challenges in energy management, there is a need for cold storage managers to move from an expert-led approach (where decisions are based on years of experience of expert technicians) to a data-driven approach. This approach of analyzing data, identifying inefficiencies and fixing them on a continuous basis is referred to as the process of Continuous Commissioning.

# Continuous Commissioning

Asset performance deteriorates over a period of time. This triggers the need for monitoring-based Continuous Commissioning

**Impact of Asset Performance on Energy Consumption over Time**




Monitoring-based Continuous Commissioning relies heavily on data analytics. Detailed analysis of this data related to energy and asset performance can help identify Energy Conservation Measures (ECMs), which, if implemented, could result in lower energy consumption.

However, analyzing this data requires a combination of energy experts, and expert mathematicians and statisticians who can use advanced statistical techniques. Often plant operations teams do not have the expertise, time or access to the required tools and techniques to perform this analysis.

The key aspects of achieving energy consumption reduction through data analytics include:

I. Data Acquisition, Communication and Storage

II. Data Analysis-based Energy Savings Strategy identification and implementation

## I. Data Acquisition, Communications System and Storage-monitor, Measure and Manage

Most industrial refrigeration plants are equipped with SCADA systems to monitor the performance-linked operating parameters. This data is neither stored for a long time nor actively used for analysis. There is a need to collect, store and analyze this data. It is most effective if this data is made available to a team of energy analysts who can perform detailed correlations between energy and energy impacting parameters such as temperature set point, chiller operating hours, suction and discharge pressure, etc. This means that the data would have to be transferred to a centralized location for use by the energy analysts.

Components of such a system include:

- **Data Acquisition System** – Key parameters such as electrical energy (kWh), temperature, relative humidity, pressure, flow, control valve positions, etc., are measured and monitored in plant refrigeration systems through SCADA/Building Management Systems (BMS). These critical process parameters are initially stored in a local database and transferred through GPRS/Internet to a remote server. An important byproduct of data acquisition is the fact that every parameter that is measured is time-stamped, filtered and available for advanced analytics
- **Control System** – Every parameter measured as part of the energy management process can be diagnosed and used to control the process optimally (like refrigeration equipment turned ON & OFF to control temperature, capacity regulation control, etc.) either on-site or through remote intervention
- **Alert System** – Alerts can be sent through SMS/email to the operations team to indicate any critical deviation which could affect energy consumption
- **Communications System** – The data collected is time-stamped and sent over the Internet to the Energy Management Platform residing on a remote server, on a periodic basis

## II. Data Analytics-based Energy Savings Strategy Identification

Data analytics yields insights into the nuances of critical operations. Coupling the power of Data Analytics with Energy Management and Refrigeration System expertise leads to identification of Energy Conservation Levers/Strategies. Samples of these are:

### Thermal Analysis and Profiling

By collecting and analyzing time series data from temperature sensors along with the key performance indicators of the energy assets, a thermal profile of the cold storage can be arrived at. Using this thermal profile, we can identify the overcooling and undercooling in terms of percentage for any given time period. When monitored continuously, deviations from defined thresholds can be avoided and this results in absolute energy consumption reduction.

### Energy Consumption Analysis

Energy consumption profiling for the refrigeration system can be achieved by first segregating the consumption of the refrigeration system from the total plant load. Once this is done, a correlation between the absolute energy consumed (kWh) and operational details such as input temperature of product stored, quantity of product stored, percentage utilization of the total capacity of the warehouse, will help arrive at a KPI such as kWh/MT/m3/year. This value can be compared across multiple cold storages to identify the best and worst performing warehouses in terms of energy consumption.

### Weather Influence on Energy Consumption

Ambient conditions affect the performance of the refrigeration system and the cold storage. Correlating data such as weather (temperature, humidity, sunrise and sunset times), plant operating hours, asset performance, warehouse utilization and characteristics of product stored, one can identify the exact influence of weather on energy consumption.

### Improving Chiller Operations by Analyzing Chiller Parameters

By collecting key chiller operational parameters one can identify ways to fine-tune the chiller operations. This includes strategies such as capacity regulation and compressor sequencing, so as to achieve optimal energy footprint for the chillers.

## Conclusion: A Data-centric Approach

This framework will shift the focus of cold storage energy management from being site-specific to an enterprise one, using advanced data analytics.

By monitoring energy and energy impacting parameters within cold storages, identifying deviations and preventing them, we are able to not just ensure the quality of products stored but do so by consuming lesser energy. By collecting and collating centrally, all data related to assets and operating conditions, we can help provide an overview of what is happening at multiple storage sites. This in turn, helps make informed decisions around retrofits, technology upgrades, vendors and product mix.

As operations become more efficient and asset performance improves, absolute energy consumption decreases, thereby bringing down costs.

# References

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# About the Author

**Shaju Nair**

Shaju Nair heads the Energy Management business, focused on the Transportation and Logistics industry. With more than 17 years of global experience, he has built and taken to market industry-leading solutions and has been involved in building a patent pending Energy Management Platform that powers 100% of the revenues for Wipro EcoEnergy.

He is experienced in business strategy, product management, new product development and innovation program management.

He has completed an Executive Business Program from San Jose State University and has studied International Business Management and International Finance from UC Berkeley Extension, California.


## About Wipro EcoEnergy

Wipro EcoEnergy is the energy services business division of Wipro Limited that provides intelligent, sustainable solutions for energy consumption and management. Utilizing leading edge analytical tools we deliver energy efficient solutions to our clients that reduce their carbon footprint, energy usage & recover avoidable energy losses.

Wipro EcoEnergy's Managed Energy Services offering, holistically addresses the entire spectrum of energy and sustainability services providing sustained energy savings. Wipro EcoEnergy has created a strong local ecosystem of partners in North America, Europe & APAC and has deployed its Energy Management Services solution for a number of clients around the world. These clients have seen substantial energy savings and cost reduction during the course of their engagement with Wipro EcoEnergy.

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