

# HOTEL ENERGY MANAGEMENT AND HVAC OPTIMISATION

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## A. ABSTRACT

Energy is a significant cost to hotel operators. Energy saving is always welcomed so long as it stacks up against the economic justification. Hotel owners are also interested in improving their environmental image to be green. Energy star rating improvement also adds up increasing the real estate value of the hotel. Heating ventilation and air-conditioning, commonly abbreviated as HVAC, is the foremost energy user in the building. Higher star rating hotels use more energy for the HVAC system, providing more facilities and increased comfort levels.

HVAC systems in a hotel can use more than 60% of the hotel's electrical energy consumption. Today's state of the art, cutting edge technology can substantially reduce energy use by 50% to 60% of the HVAC system. It is now possible to reduce your overall energy cost of the hotel by 25%. These savings are now so real that the suppliers are willing to provide guarantees on their estimated saving targets.

The major energy use in a HVAC system in a hotel is by;

- Chiller System: This is one of the primary energy consumers in a HVAC system. Around 15% to 25% of the hotel electrical energy use is common for a central chiller plant in a city hotel. This can consume substantially more when using an alternative air cooled DX system.
- Pumps: Pumps are used for the chilled water system (CHWS) and heating hot water system (HHWS) and is a substantial energy user. Around 10% to 15% of the hotel electricity use is very common. These pumps are:

- Chilled water pumps
- Condenser water pumps
- Heating hot water pumps

- Fans: Fans are extensively used in hotels for air-conditioning and ventilation systems, consuming 15% to 30% of electricity. These fans are:
  - AHU and FCU
  - Carpark ventilation
  - Kitchen exhaust
  - Toilet exhaust

## B. ENERGY SAVING TECHNOLOGY

### I. Plant Equipment Upgrade

**Chiller upgrade:** The technology of chillers has significantly improved with the introduction of VSD control and the use of magnetic bearings. Also as the older refrigerants are environmentally unfriendly and currently being phased out, the chillers now use a more environmental friendly refrigerant. The old conventional Chillers behave and operate very differently than the modern chillers with VSD. The overall efficiency can improve more than 250% over the conventional design. The other benefit of modern chillers is the capability of running the chiller at a very low load condition, usually less than 10% of the chiller capacity, whilst maintaining good energy performance. This also eliminates the need of maintaining a small chiller to provide winter or low load cooling to the hotel.

Chillers are normally replaced when they finish their lifecycle, however they can also be replaced for energy efficiency improvement, and providing a more environmentally friendly refrigerant option. The return

on investment based on energy saving is well over seven years which is normally considered uneconomical. If the chiller is to be replaced for other reasons then it is recommended to replace it with an energy efficient chiller which will be more expensive than the conventional chiller. The return on investment of utilising an energy efficient chiller with VSD compared with that of a conventional chiller is very attractive and is normally less than two years.

### 2. Control System Upgrade

**BMS:** A building management system (BMS) is essential to provide effective comfort level, maintenance of HVAC equipment, and energy efficiency of the hotel. Significant energy savings can be achieved by introducing a full blown BMS. Possible energy savings are in the order of 6 to 12 % of overall energy use of the hotel.

**EMS:** An energy management control system (EMS) will provide advanced and optimal control of the HVAC system, incorporating the use of VSD, primarily to save energy. The prerequisite of an EMS is to have a good BMS which can incorporate advanced control, monitoring, and a reporting facility. The functions of an EMS include;

- Chiller Optimal Control – This is to optimise chiller operation to reduce energy usage and run hours of the chillers. The energy management functions of this CHWS optimal control are as follows;
  - Optimal chilled water temperature reset for energy performance
  - Optimal condenser water temperature reset for energy performance
  - Optimal cooling tower fan speed control for energy performance

- Optimal condensing pressure control for air-cooled and evaporative condenser models
  - Optimal chiller selection, optimal start/stop and optimal loading of chiller to improve chiller energy performance
  - Model based chiller interlocking for energy performance
  - Provide necessary display to tune and monitor the control system
  - Chiller KPI (Key Performance Index). Power usage per unit of cooling load against target estimated on weather condition
  - Chiller plant daily and monthly energy usage
  - Optimal variable volume pump speed control for energy performance
- Boiler Control Optimisation. The energy management functions of the HHWS control include;
    - Boiler selection
    - Hot water temperature reset
    - Optimal variable volume pump speed control for energy performance
  - HVAC Optimisation and Control. The functionality of the control includes;
    - Demand based ventilation in
      - o Common area: Monitor CO<sub>2</sub> to control fresh air to the space with fan VSD
      - o Car Park area: Monitor CO to control fresh air for ventilation with fan VSD
      - o Kitchen exhaust: Control exhaust fan based on demand with fan VSD
    - Economy cycle: Use of fresh air to cool the space with fan VSD
    - Use of VSD on AHU and FCU fans, car park ventilation fans, and kitchen exhaust fans
  - Demand management and control with daily and monthly energy (Electricity) usage and peak demand of the day and month

### 3. Field Equipment Upgrade

As the hotel is ageing, not only the major plant equipment is required to be replaced, the control valves and dampers should be replaced as well. As control valves get older they can begin to leak or seize – creating the unwanted and inefficient situation of simultaneous heating and cooling whilst attempting to maintain the comfort level of the room. It is sometimes difficult to diagnose whether the valves are faulty or not. It is recommended to change all the control valves as the life cycle is finished. The payback time of replacing all valves is very short and economically viable, generally well within three years.

Temperature sensors as they finish their life cycle or are faulty should also be replaced. Otherwise they not only become a source of inefficient operation of the HVAC system, but also do not maintain desired comfort level of the space.

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#### 4. Room Management System

It is very important to have some form of room management system in order to turn off the heating and cooling system and/ control occupied/unoccupied room temperature set points. This can be a simple key card system to a more sophisticated electronic room management system.

### C. CASE STUDIES

The Enman EMS has been installed in many hotels who have enjoyed the benefit of the system, including the following:

- **Shangri-la hotel**  
Energy savings: over 15% of electricity use
- **Mercure hotel**  
Energy savings: 25% of electricity use  
Demand reduction: over 10%
- **Holiday Inn**  
Energy savings: 23% of electricity use  
Demand reduction: over 20%
- **Sheraton hotel**  
Energy savings: over 22% of electricity use  
Demand reduction: over 10%
- **Marriott hotel**  
Energy savings: 25% of electricity use  
Demand reduction: over 20%

- **Park Hyatt hotel**

Energy savings: 15% of electricity use  
Demand reduction: over 10%

- There are many other hotels who have enjoyed the benefit of energy cost reduction through HVAC upgrade and optimisation.

### D. CONCLUSION

It is possible to improve energy efficiency of the hotel HVAC system by up to 60% with good economic benefit. The longest term economic benefit is always from major equipment upgrade such as chillers and boilers. The economic benefit from installing a BMS and EMS is much more favourable, usually within two to three years. It is as important to replace old and faulty control valves as it is to upgrade/install a BMS and EMS.

**The typical energy saving through HVAC optimisation and an energy management system is normally 20% to 25%. The return on investment is normally two to three years which is attractive and economically viable.**

*Enman has been developing and working on the HVAC optimisation and energy management control system for well over 30 years. During this time a large number of such projects have been implemented for hotels, shopping centres, and commercial and industrial buildings.*



#### Enman's services

- Energy audit and NABERS rating
- Project engineering and management for major projects including turnkey supply for:
  - Chiller system upgrade
  - Boiler system upgrade
  - Control system upgrade BMS/HEMS
  - Variable speed drive, control and optimisation
  - HVAC Upgrade
  - LED lamps
  - Room management system
  - Co/Tri generation
- Assist in government subsidies and funding
- Assist in carbon trading

#### Enman's promise:

*Energy reduction up to 50% depending upon current energy efficiency*

#### **Benefit: Hotel Energy Management System**

- **A higher Energy Saving up to 25% from the conventional control reducing your carbon footprint further**
- **Demand reduction**

#### Enman's product

Hotel energy management system (HEMS) is the ultimate control, monitoring, reporting and housekeeping to reduce energy consumption of your hotel incorporating Enman's cutting edge technology.

#### Features

- Chiller optimal control and performance monitoring
- Advanced optimal control of variable speed drives for all pumps, fans, plant and equipment
- Advanced HVAC Control
- Demand management and control
- Energy performance

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