Economising Energy Use in Healthcare

Image: Thermal Energy International

Hospital energy use and carbon emissions are among the highest of all building types - these facilities use 2.5 times more energy than an office in average. The German programme 'Klinergie' estimates that, per hospital bed, hospitals consume as much electricity and heating as two households. Unlike many other buildings hospitals are heavily regulated 24/7 operations comprised of a wide range of services and functional units such as operating theatres, wards, laboratories, etc.

In Europe, healthcare infrastructure alone accounts for some 1.6% of total EU energy consumption. This is estimated at 206,000 GWh per annum, or equivalent to the total annual energy consumption of Portugal.
The Health Service Executive (HSE) is Ireland's largest public sector employer, and the largest public sector procurer of goods and services.
It has an extensive building portfolio with approximately 2,655 healthcare properties.
Hospitals are among the most intensive energy users in the country.

Let's take a look at the facts and energy figures for healthcare. In 2014 the total public sector energy spend was €599 million, with healthcare accounting for as much as 18% or €110 million.
The total primary energy consumption for healthcare sector was 1,902 GWh.
Our Healthcare buildings consumed 816 GWh of electricity in 2014, which is 16% of the public sector' total electrical consumption.

Healthcare sector is the largest public consumer of thermal energy, it is also the largest public sector gas consumer - 39% of all gas in public sector is used by the healthcare.

So hospitals are among the nation's most complex and energy intensive facilities and 80% of energy costs are from heating alone. Whether it's heating, hot water, or steam, boilers are at the heart of the hospital energy centres and plantrooms.
Boilers are crucial to the everyday operations of hospitals, providing steam which powers a number of critical hospital systems including sterilization, humidification, hot water, space heating, laundries, etc.

Fuel cost accounts for more than 90% of the boiler overall costs on a life-cycle basis, therefore boiler and energy plantroom improvements are absolutely necessary for achieving 33% energy saving target by 2020 as pledged by the Government. This means that the HSE must implement this target across the range of healthcare buildings, both new builds and existing buildings.

In order to identify the measures for boiler plant improvements we should first consider what are the major energy losses and how to fix them. Fuel cost is the largest operating cost in the operation of a boiler. Depending on the boiler 10-20 % and in some cases even 30 % of the energy input into the boiler as fuel is being lost. Stack loss can be massive, in fact it is the largest single loss in boiler operations and must be kept as low as possible for more effective operations and higher efficiency. Reducing stack temperature can be done by specifying a high efficiency boiler with an economizer. A rule of thumb is that every 20°C reduction in flue gas temperature will give a fuel saving of around 1%.

The stack losses consist of the heat carried away by flue gases as they flow through the chimney or stack. Many factors influence stack loss, but the major contributors are the flue gas temperature and excess air amount. Stack loss analysis is based on combustion principles with the main input data being flue gas exit temperature, ambient temperature, and flue gas oxygen content. Boiler efficiency can be improved by preventing and/or recovering heat loss. Installation of economisers to extract the surplus heat from the flue gas is one of the recommendations in a Reference Report by the Joint Research Centre of the European Commission on "Best available technologies for the heat and cooling market in the European Union."

US Department of Energy states that "boilers equipped with condensing economizers can have an overall efficiency that exceeds 90%" and that "condensing economizer can increase overall heat recovery and steam system efficiency by up to 10% by reducing the flue gas temperature below its dew point, resulting in improved effectiveness of waste heat recovery."

Sustainable Energy Authority of Ireland published several documents on steam systems improvements and using economisers in so-called Energy Wizards. Another recently published document, which focuses on the use of steam at lower pressures and temperatures for a variety of uses in a building services environment, is CIBSE TM58 Design and Operation of Modern Steam Systems 2015.

SEAI advises the issues to consider when installing an Economiser are:

a) A suitable location to install an economiser, between the boiler and the flue stack must be available
b) The economiser must not create a large resistance to the passage of flue gasses; the boiler manufacturer should be consulted.
c) The economiser should be sized to match the boiler feed water requirements.

The specification, design, manufacture and installation of the economiser will usually take about 12 months. Installation and commissioning will take up to 4 weeks. Among the points to note are that "the use of an economiser may require the upgrading of the combustion air fan and/or the induced draft fan due to added airflow resistance of the economiser heating surfaces." Another issue to consider is to "maintain the flue gas temperature at the economiser outlet above acid dewpoint to avoid corrosion of heat transfer surfaces. This is particularly important with oil or coal firing systems."

An economiser is equipment, which transfers heat from the flue gas to a media, which can be used for preheating of combustion air or feed water pre-heating. Or, in other words, economisers are heat exchangers installed in steam boiler flues whose purpose is to recover heat from the flue gases and thereby increase the overall efficiency of the steam boiler system.

Energy efficient Steam Systems are eligible for the Accelerated Capital Allowance - a tax incentive for companies who invest in highly efficient equipment to avail of tax breaks by allowing them to deduct the full cost of such equipment from taxable profits in the year of purchase rather than over the usual "Wear and Tear" eight year period. To be eligible for inclusion on the Energy Technology Product List, products must meet the eligibility criteria.

Economisers specific Eligibility Criteria are:

1) Thermal Efficiency
   Condensing: Minimum of 9% increase in the net boiler thermal efficiency for which it is designed 1; Non-condensing: Minimum of 3% increase in the net boiler thermal efficiency for which it is designed.
2) Economiser performance must be measured using EN 308 "Heat exchangers. Test procedures for establishing performance of air to air and flue gases heat recovery devices", or scientific equivalent.
3) It must be declared what boiler fuel the economiser is suitable for use with.

References

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