GOVERNMENT OF DUBAI

Trakhees

Guidelines – Energy, Water Conservation and Management

Issued by: Inspection Department – Operations Section

1.0 Introduction

Energy conservation and management is a managerial issue as well as technical one. While there is no doubt that technical knowledge is required to identify and implement energy saving measures, it is our organization's management philosophy that drives a successful energy conservation program.

We tend to overlook the many small and large energy wastage that is taking place all around us, all the time. Some everyday examples:

- Incandescent bulbs
- Idling pumps
- Computers "ON" when not in use
- Outdated chillers with no controls
- Leaking water pipes

In themselves, these may appear insignificant or normal, but the sum total of these makes up a rather sorry picture for energy and resources wastage. Energy wastage also means:

- Operating equipment inefficiently, i.e. no load or part – load conditions
- Using over-designed equipment
- Using the inappropriate equipment at the inappropriate place
- Human error & insensitivity

An effective energy conservation program is achieved through a combination of proper knowledge, correct approach and a strong management commitment.

PCFC has prepared this guide to motivate our clients and make them aware about energy and water conservation and to reduce the consumption of the same. It also emphasizes on the importance of energy efficiency as a management issue and provides guidance on how to motivate staff and start energy awareness and saving campaign in the areas of steam systems, compressed air systems, motors, combustion, lighting, ventilation, air conditioning, heating, refrigeration, etc.

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A sustainable use of energy and water conservation has direct commercial benefits and adds a competitive edge. Improvements in the way PCFC clients use energy and water conservation will enhance working conditions, reduce operating costs and improve productivity and profitability as well as contribute in saving our planet and environment.

2.0 Background

While energy and water conservations are at the heart of economic development, their excessive use is the cause of environmental concern at the local, national and global levels. United Nations Environment Programme (UNEP) is actively addressing these issues through the UNEP Collaborating Center on Energy and the Environment (UCCEE).

The demand for energy, mostly met with fossil fuel (particularly oil), has increased steadily during recent years. Demand is expected to continue growing.

The energy systems developed so far to meet this demand are clearly unsustainable, as they lead directly or indirectly to health-damaging levels of air pollution, acidification of ecosystems, land and water contamination, loss of biodiversity, and global warming.

Nevertheless, there are reasons to hope that the destructive link between energy use and environmental quality can be broken. Improvements in technology, and the willingness to experiment with new economic approaches to energy pricing, are fundamentally changing energy markets and presenting new opportunities. It is increasingly true that there are no reasons why we cannot enjoy the benefits of a high level of energy services and a better environment.

Renewable energy technologies, clean and efficient use of fossil fuels, have in many ways come of age. These will give an excellent opportunity to bypass the polluting energy path.

Clearly we must eventually shift to sustainable energy systems. How soon that shift occurs depends on actions taken today. If investment is directed towards clean energy technologies, we will all enjoy economy that is more secure and much cleaner.

This guide addresses the broad issues of energy and water conservation and ideas concerning practical actions that can be taken to make PCFC more energy and water conservation efficient. PCFC stands ready to contribute towards achieving such goal.

3.0 Energy Conservation Programme

An ECP can easily identify energy wastage means in a system and provide solutions to avoid these losses, thereby making the system more efficient.

The objective of an ECP is to achieve the same output required but by utilizing less energy input. In fact, in cases, an effective ECP may improve the conditions and boost production levels.

The first step of an ECP is a Detailed Energy Study (DES), the objective of which is to identify opportunities and methods of savings/conserving process energy requirements, which are termed Energy Saving Measures. This is the micro-level approach.

At the macro-level energy conservation (ENCON) needs to be measured and benchmarked. Benchmarking norms need to be set that are accurate, practical and reflect true scenarios.

A three pronged approach needs to be followed while conducting a DES, namely:

- Capacity utilization of existing/new equipment
- Fine tuning of these equipment
- Technology up gradation

All three being equally important for achieving reduction in energy consumption.

As part of the macro-level methodology, one has to understand that any system/process requires an energy input. This is converted into:

- Productive output or theoretical requirement (work done)
- Unavoidable losses (laws of thermodynamics)
- Avoidable losses (target of energy conservation program)

A detailed energy study should:

- Concentrate on avoidable losses
- Quantify these losses
- Identify ways and means of reducing these avoidable losses
- Implement the energy conservation measures identified

4.0 Industry / Specific Energy Efficient Technologies

Industry uses more than one-third of all the energy used. Certain industries require a large amount of energy per unit of product, and are the best candidates on which to focus energy-efficiency efforts.

Efforts to develop energy-efficient technologies are focused on the most energy-intensive industries, including the glass industry, the metal-casting industry, the petroleum industry, and the steel industry.

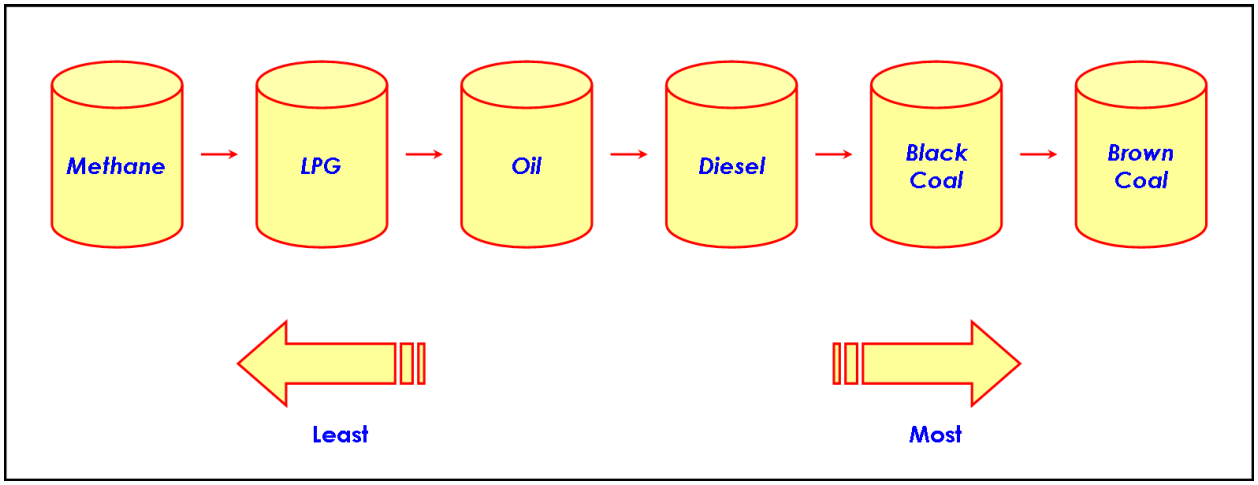
For more information refer to useful web sites like:

a. www.energy.gov
b. www.osti.gov

5.0 Energy Sources

The following must be done in choosing energy sources:

- Investigate alternative energy sources such as solar hot water, waste, bio-ethanol and wind energy.
- Use a clean fuel such as LPG or methanol
- Use fuels with the least greenhouse impact (see diagram below)



6.0 Combined Heat and Power Systems

The onsite production of electricity should be particularly attractive to industries that can also make use of the waste heat. Such combined heat and power systems – also called cogeneration systems – achieve higher thermal efficiencies than stand-alone power plants.

For more information refer to useful web sites like:

a. www.epa.gov
b. www.pnl.gov
c. www.ost.gov

7.0 Motors

7.1 Major causes of energy wastage in motors include:

- Use of less efficient motors
- Oversized/under loaded motors
- Improper supply voltage
- Voltage fluctuations
- Poor power factor
- Less efficient-driven equipment
- Idle running

7.2 Impact of voltage optimization on motors include:

- Reduction in voltage dependent losses – drop in Magnetization current
- Capacity reduces
- PF improves
- Load current drops
- Load factor improves
- Efficiency improves

Almost all motors in operation today, operate at varying load at different times.

Motor-driven equipment accounts for nearly 60% of the electricity consumed by industries. Energy-efficient motors can cut this energy use by nearly 15%.

For more information refer to useful web sites like:

a. www.oit.doe.gov/bestpractices
b. www.oitdev.nrel.gov

8.0 Air Conditioning (AC)

In facilities in UAE, AC load comprises the major portion of the overall electricity consumption, ranging anywhere between 60 to 75% of the total energy consumption. This is true for buildings, both commercial and residential. In industries, the share of AC will vary depending on type of process. For example, in cold stores, AC may consume approximately 95% of the overall energy requirement while in foundries, AC share may be negligible. The wastewater from ACs should be used for plants/ garden, especially in the evening to ensure minimum evaporation.

The AC load mentioned above includes the consumption of the actual air-condition units (chillers, package units, window AC, split units, etc) chilled water pumps, air handling units and ventilation fans (if any). A typical building's energy consumption in UAE shows that A/C amount for more 56%, lighting is more than 37% and usage is more than 6%.

If facility is operational 24 hours and lighting is ON all the time. Hence, the AC share is slightly less than usual. Industries normally opt for chillers or package unit ACs.

A centralized AC system is the most efficient in terms of economies of scale. This is also easier to control and energy conservation techniques may be applied to both at the end – user level as well as the chiller plant level.

From the energy conservation point of view, the following issues need to be addressed while installing or operating AC system:

a. During the procuring of air-conditioning equipment, check the energy consumption per unit refrigeration. Although a chiller with low energy consumption may have higher initial cost, but in the long run, it will consume less energy and therefore would be cheaper to operate.

b. Watch out for the amount of glass area. If the glass area is large compared to overall exposed area of the facility, it is advisable to install double glazed or even triple glazed glass. In addition to reducing heat load, this will also remove the problem of external condensation on high humidity days.

c. For retrofit on existing facilities with single glazed glass, window films may be applied to reduce the head load (and thereby air-conditioning load).

d. For facilities with large exposed areas (roofs and walls) application of solar reflective paint (at both design stage and retrofit applications) can cut down heat gains through these areas by up to 50% depending on the quality of the paint applied.

e. Particularly in office complexes, it is natural hum tendency to leave thermostat ON even when not inside. While it is inadvisable to turn OFF the air-conditioning completely due to adverse impact of humidity and certain temperature requirement of equipment, the set points may be raised during unoccupied periods. This is possible through utilization of programmable thermostats that come in one-day or seven – day programmable varieties. It is best to install these during design stage so that the net investment is minimized.

f. The cold exhaust air from a facility can be used to pre-cool the fresh air intake, thereby reducing load on the chillers. Waste heat recovery is possible in facilities with centralized exhaust system. At the design stage, it is important to ensure that the fresh air intake to a facility is physically located in close proximity to the centralized exhaust system. In industries, inlet air to a boiler may be pre-heated by waste hot air thrown out into the atmosphere.

g. Chilled water pumps (CHWP) have a tendency to operate 24hrs at rated speed. During lean hours, particularly in office complexes, the heat load is less and therefore, speed of a CHWP can be varied to meet demand. A variable speed drive with either a temperature sensing mechanism or a simple time schedule can be used to reduce the speed of CHWPs without affecting comfort conditions.

h. Nature of the lights used in a facility also plays a role in the heat load of the facility. Incandescent bulbs and halogen low voltage lamps generate more heat than light (in fact more than 90% of the electrical energy input to such lamps is converted into heat) Usage of compact fluorescent fixtures that operate “cool” can substantially reduce load on chillers, particularly in facilities that use of large number of lighting points.

i. Chiller technology has been evolving over the years and the kW/TR consumption of chillers has drastically reduced from more than 1 kW/TR to the range of 0.5 kW/TR. This means that a new chiller will actually consume less than half the energy compared to an old chiller and yet produce the same comfort conditions. In existing old facilities using chillers more than 15

years old, a full – scale chiller replacement can lead to savings that will help pay back for additional investment in 2 years time.

j. Polarized refrigerant additives when injected into existing package units operate as an internal cleaning mechanism. With cleaner heat exchanges, heat transfer efficiency improves and this leads to higher overall efficiency, thereby reducing energy consumption for same desired comfort conditions.

9.0 Steam Systems

Nearly 50% of all the fuel burned by the manufacturers is consumed to raise steam. A typical industrial facility can realize steam savings of 20% by improving its steam system. Simple approaches to improving energy performance include insulating steam and condensate return lines, stopping any steam leaks, and maintaining steam taps. Condensate return to the boiler is essential for energy efficiency.

For more information refer to useful web sites like:

a. www.ciac.lln.gov
b. www.sandia.gov

10.0 Compressed Air Systems

Optimization of compressed air systems can provide energy-efficiency improvements of 20-50%. Compressors using variable-speed drives are saving energy, while simple measures like detecting and fixing air leaks remain all-important.

For more information refer to useful web sites like:

a. www.cdiac.esd.ornl.gov
b. www.rrede.nrel.gov

11.0 Combustion and Transport

Boilers, furnaces and motor vehicles all rely on combustion/ burners to operate. These should, however, operate on environmentally friendly fuels for their clean and efficient output. Emissions of pollutants such as nitrous oxides (NOx), Carbon Monoxide (CO), Particulates and Sulfur Dioxide (SO2) are always of environmental concern in combustion processes. Always use energy efficient equipment and appliances. Opt for car pooling and shared vehicles, when feasible, to reduce pollution from vehicles. Go for eco-friendly options like unleaded petrol, catalytic converters, etc.

For more information refer to useful web sites like:

a. www.http.lle.etd.lbl.gov
b. www.ca.sandia.gov/CRF

12.0 Sensors and Controls

All industrial systems rely on sensors and controls. Advanced sensors and control systems can allow processes to operate at their optimal conditions.

For more information refer to useful web sites like:

a. www.energy.gov
b. www.dpa.gov

13.0 Lighting

13.1 The total lighting concept includes:

- The right light
- At the right place
- At the right cost

13.2 Lighting terminology is explained below:

a. Lumens – flux emitted by lamp.
b. Luminous Efficacy – lumens / watt
c. Illuminance – lumens / square meters (also known as lux)
d. Colour Rendering Index – colours of surfaces illuminated given light sources

13.3 Basic Components of Lighting

a. Lamp or light source
b. Control gear
c. Luminaire / fixture

13.4 Comparison of various lamps is given below:

Type	Watt	Lumens	Efficacy
GLS	100	1380	14
Fluorescent	36	2450	68
Slim	40	2770	69
Conventional	36	3250	90
Colour – 80 series	250	13500	54
HPMV	250	27000	108
HPS V	250	17000	68
Metal Halide	20	1200	60

13.5 The following lighting energy saving techniques can be utilized depending on application and requirement:

a. At the design stage and even for retrofit applications, guidelines on lux level requirement in various areas should be used.

b. Whenever possible, use of incandescent, halogen low voltage and mercury vapor lamps are to be avoided. In areas like corridors, office areas, food courts, washrooms and for external lighting application, compact fluorescent, metal halide and sodium vapor lamps are most desirable from the energy conservation point of view.

c. Use of high efficiency reflectors can cut down lighting energy consumption (particularly in 4x18-watt or 2x36 watt florescent fixtures) by 50%.

d. In warehouses and factories, use of translucent sheets on the roof is recommended for utilizing maximum daylight.

e. Electronic ballasts are highly energy efficient and in most facilities, these are replacing conventional chokes.

f. The traditional problems with compact fluorescent lamps (CFLs) have been their shape and colour- rendering index. Manufactures have been able to overcome these problems and CFLs are now available in various shapes as well as colours. In fact, one manufacturer has even developed as standard CFL replacement for halogen low voltage lamp. A 50-Watt halogen low voltage lamp can be directly replaced with a 13-Watt such fixture!

g. The right light at the right place is particularly noticeable in corridors. In some facilities, halogen low voltage fixtures are used for general lighting. While in themselves these fixtures are beautiful, they do not have uniform spread of light an invariable tend to create dark spots, in addition to consuming more energy.

h. Grouping of fixtures has specific applications in open offices areas where there are extended lunch breaks. It is preferable to have many switches at higher initial investment than one Switch for all lamps.

i. In factories and warehouses where colour rendering is not sensitive issue, it is best to use high pressure sodium vapor (HPSV) lamps or Metal Halide (MHI) lamps instead of the traditional Mercury Vapor lamps. The latter can be directly replaced with HPSV fixtures of almost half the rating and yet produce the same lux.

j. While fluorescent fixtures are becoming commonplace, it is indeed unfortunate that some facilities still have conventional fat fluorescent tubes. Simply replacing these slim tubes can generate 10% saving from each lamp.

k. Occupancy sensors (OCC) for office cabins and toilets with time delay action should be used for energy savings. The added advantage is that the same OCC can be use to control all lighting an AC with in that area.

l. Lighting energy saver that reduces the supply voltage to discharge lights can be use to save up to 20% where existing light levels are higher than recommended.

m. For external lighting, the most appropriate energy saving technique is the use of photo-sensors. This can achieve even higher savings than timer control and does not require to be adjusted depending on weather conditions or seasons.

13.6 Energy efficient lights / bulbs are commercially available. Let us use it and save energy!

For more information refer to useful website like:

a. www.lesskwh.com
b. www.positive-energy.com
c. www.ecsave.com
d. www.kwhsavings.com

14.0 Green Building

14.1 Green building incorporates several Green features:

a. Efficient use of water
b. Energy efficient and eco-friendly equipment
c. Use of renewable / solar energy
d. Use of recycled / recyclable materials
e. Effective use of landscapes
f. Effective control and building management systems
g. Indoor air quality for human safety and comfort

14.2 Green building rating covers the following:

a. Rating reflects the extend of Green
b. Extent of Green
c. Local Conditions
d. Economic factors
e. Rating programs

14.3 For more information refer to useful websites like:

a. www.epa.gov/greenbuilding
b. www.nesea.org/buildings
c. www.buildinggreen.com

15.0 Energy in Process

a. Improve insulation of all hot process items and steam line to minimize simple heat loss.

b. Remove frost of refrigerated coolant lines through better insulation. This will keep the ice where you need it and where it can add value to your business.

c. Avoid steam leaks. A 1 kg/min steam leak costs $1 / hour and $2 / hour in an air conditioned space.

d. Find ways to transfer heat from hot process streams into cold streams.

e. Ensure your boiler is tuned properly and those blows down losses are minimized. Improved feed water quality may help reduce blow down losses.

f. Require suppliers to quote the energy consumption and costs of a new piece of equipment.

16.0 Water Conservation

Avoid wasting water while brushing/ showering/ shaving as it can save resources and your bills. Water saving measures have the lowest payback periods (in months) and are easy to achieve through simple techniques, as listed below:

a. Aerators in taps of wash basins

Aerators inject air bubbles in the water stream flowing from the taps, thereby providing a sensation of full flow. These air bubbles occupy the space that would otherwise be occupied by water and hence the flow rate reduces. Aerators may be fitted on taps in washbasins. While these are effective everywhere, the maximum savings occur where water consumption is inherently high, like sinks.

b. Adaptors in showerheads

Adaptors have a similar function to that of aerators but are used in showerheads.

c. Urinal Sensors

In most old facilities, urinals are flushed by overhead flush tanks that flush the urinals when they are full. This happens irrespective of the utilization level of the urinals. A simple urinal sensor hooked to the flush tank through a pneumatic valve will ensure that flushing takes place only when there is requirement.

d. Flush tanks in toilets

The olden day toilet flush tanks have bigger capacity and sometimes may be even of 11 liters. Newer toilet flush tanks are more efficient and utilize only about 6 liters of water for every flush.

e. Waste water recycling

Facilities with laundries themselves can theoretically recycle the entire wastewater generated by the washing cycles. It can be achieved by installing a reverse osmosis plant within the complex.

- Theoretically 100%waste water can be recovered and recycled
- Considering system losses, more than 90% water can be recovered practically
- This not only reduces water consumption but also reduces sewerage charges – double benefit
- RO plants can match the purity of municipality water

f. Ozone wash

- Ozone laundry systems use ozone as a cleansing agent
- This saves on water used for washing
- This also saves on chemicals
- Ozone levels need to be closely monitored from the point of view of corrosion

For more information refer to useful websites like:

a. www.swcs.org
b. www.waterwiser.org
c. www.h2ouse.org

Reminder!!! Segregate wastes to promote recycling and conserve energy at the same time. For example, paper, aluminum cans, plastic/ PET bottles, glass, oil, used ink/ toner cartridges.

Guidelines – Energy, Water Conservation and Management

Let us conserve energy and water conservation and manage it smartly. Adopt energy efficient equipment, machines and products!

TOGETHER TOWARDS THE FUTURE!