Promotion of efficient electric motor systems

ProMot

A decision tool to select
the most efficient motor systems
for your company or building
...and save your money

www.eu-promot.org

This tool was developed under the auspices of the EC-Save Programme

www.eu-promot.org

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Promotion of efficient electric motor systems

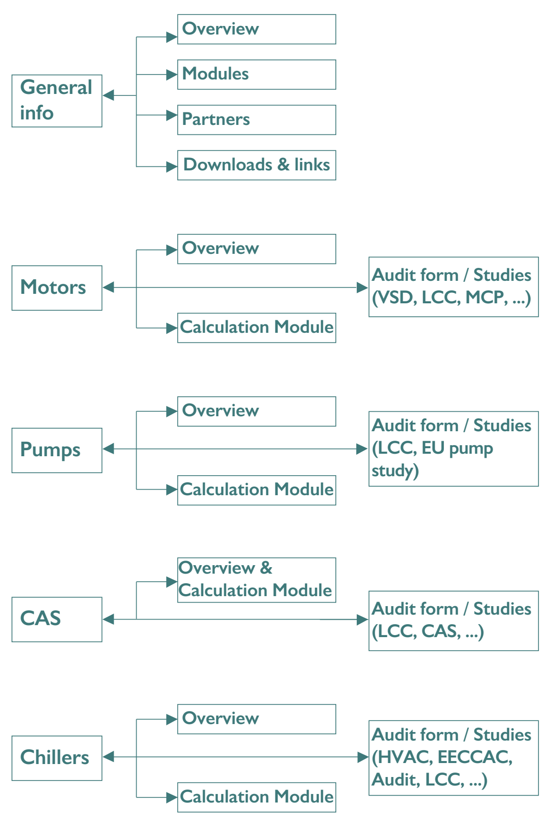
ProMot general

Motor systems in industry and service sector buildings are the largest single type of use of electricity. Electric energy savings potential is huge and has been estimated by Commission programmes to exceed 100 TWh in each of the two sectors across Europe.
A decision support tool is being developed, within the framework of a project cofinanced by SAVE, aiming to aid end-users to explore the possibility of energy savings, in motor systems of an industrial or tertiary installation. It has been designed for users having basic technical expertise. Motor systems considered and analysed by the tool include electric motors, pumps, compressed air as well as chillers (heat pumps), while fans and other relevant topics are also addressed. General introductory information is provided on the topics treated. The tool helps in auditing an installation, and performing simple meaningful calculations of purchasing, replacing existing or retrofitting electric motor systems. These technical and economic calculations are based on equipment data retrieved from widely accepted and regularly updated European databases and methodologies.

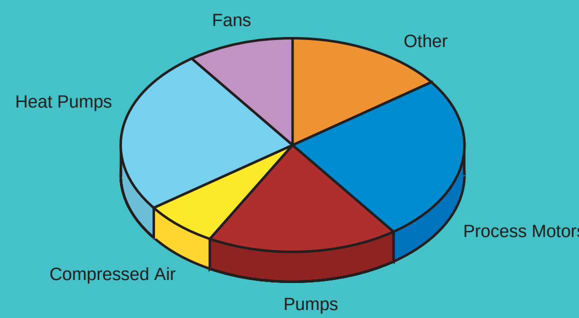
ProMot decision support tool analyses four basic electricity driven systems (modules):

1. **Motors and Drives**
2. **Compressed Air Systems (CAS)**
3. **Water Pumps**
4. **Chiller (heat pump) systems**

Structure



Electricity Use in a Large Installation



Motor and Drive Systems module informs the user about the existing motors efficiency classifications and the benefits of using a high efficient motor and drive system. It also guides the users on proper sizing of a motor system and gives tips on how they can reduce transmission losses. The calculation part of the module is based on the EuroDEEM database, which currently contains data of over 18000 motors (provided by manufacturers). The user can calculate the energy and operating cost savings potential of replacing, repairing or buying a new motor.

CAS Systems module takes the user through a "Guided Tour" of the existing system, to identify the priority actions for energy savings. It provides information, cost and saving analyses for three cases:

a) Low cost measures to improve operation and maintenance

b) Major repair or extension and

c) Design, purchase and installation of a new compressed air system.

The **Pumping Systems** module examines the possibilities for energy savings from (clean water) pumping equipment and associated controls. Like other systems, the initial purchase cost of a pump is a small fraction of its operating energy cost. The introductory part of the module provides general guidance on choice of pumps and associated systems. The calculation part lets the user define the nameplate values of pumps and the load profile and calculates the energy consumption based on operating costs. The benefit of control by VSD (Variable Speed Drives) systems for the given load profile is also treated in this module.

Chillers module provides general information on the basic components of an HVAC system (chillers, pumps/fans, pipes/ducts, AHUs and FCUs, ventilation, etc). It provides direct links to the Eurovent-Cecomaf site for up to date information on products. The calculation part of the Chiller module treats Air and Water Cooled Chillers. In a fashion very similar to the Motors module, the user can calculate the energy consumption and analyze the effect of choosing various chillers for a new or an under refurbishment installation. Calculations are based on the Eurovent-Cecomaf database, which is regularly downloaded and updated.

The support tool will be hosted on the web will be managed by the Joint Research Centre – DG JRC, and will be available to interested users.

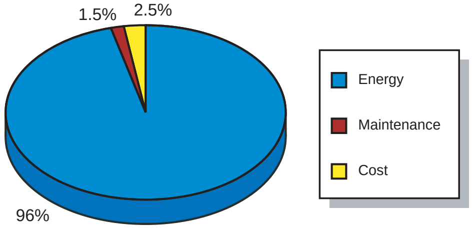
Motors

Motor and Drive Systems

Electrical motors in Europe is one of the main energy consumption source.
Estimates are that motors account for:

- 70 % of the electricity consumed inindustry
- 1/3 of the tertiary electrical consumption

Over its lifetime, costs associated with operating a motor are (approximately):



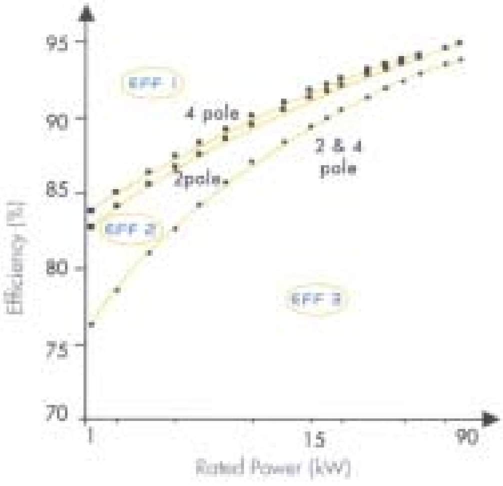
When buying a motor it is really important to consider this energy consumption and to minimize it. So as to achieve an economical management of its motors, the main following parameters have to be considered:

Motors efficiency classification
Motor sizing
Transmission losses
Repairing/Rewinding
Variable Speed Operation

Motor Efficiency classification

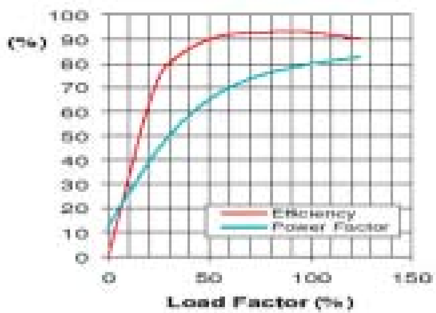
In Europe a classification for the low voltage AC motors has been created from 1999 and been agreed by the main European motors manufacturers. The energy efficiency classes are:

- EFF1: High efficiency motors
- EFF2: Standard efficiency motors
- EFF3: Poor efficiency motors



Electrical motors are very often oversized. The maximum efficiency is obtained for the motors between 60% to 100% full load. Significantly over sizing a motor:

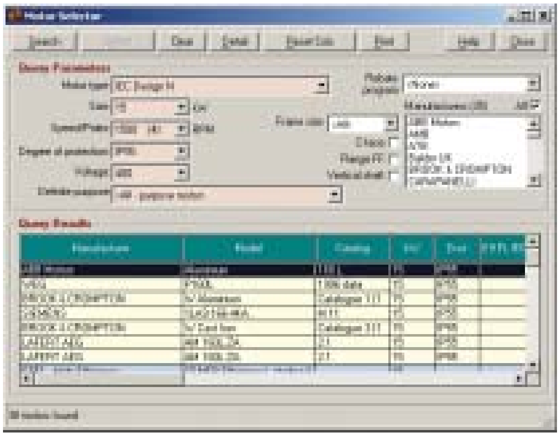
- increases the capital cost
- decreases the functional motor efficiency
- can increase the motor's operating speed. For example, for a fan and a pump, a small increase in the motor speed (ex.: 1440 rpm to 1460 rpm (+ 1.4%)) can result in a 4% increase in the load and in the energy consumption.

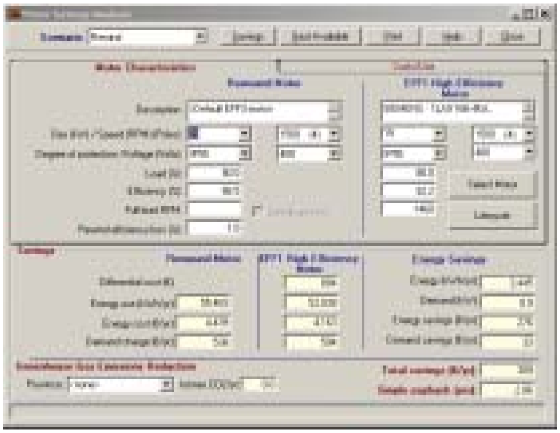


Calculation Module

The technical calculation module allows the user to specify parameters for a desired motor system, such as power, speed, manufacturer, etc.

Based on the input and using data for over 18000 products in the EuroDEEM database, available motors as well as economic analysis is presented to the user.



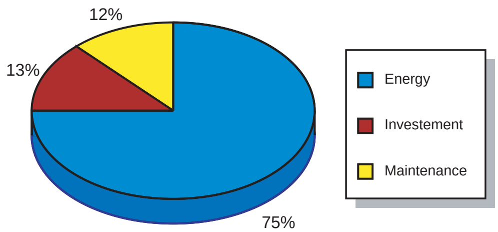


Cas

Compressed Air Systems (CAS)

Overview page

Using compressed air in the industrial and service sectors is a common practice, since production, handling and use are safe and easy. Nonetheless, compressed air is expensive, costing from 0.6 to 6 cents per Nm^3. The energy efficiency of many compressed air systems is low: simple actions can lead to savings from 5 to 50 %.



Note: for 6000 hours/yr, 5 yr life cycle

Energy savings are possible in:

- Production and treatment of compressed air
- Compressed air networks
- End use devices
- Overall system design and operation.

Take a "Guided Tour" of your system, to identify the priority actions for energy savings

Guided Tour

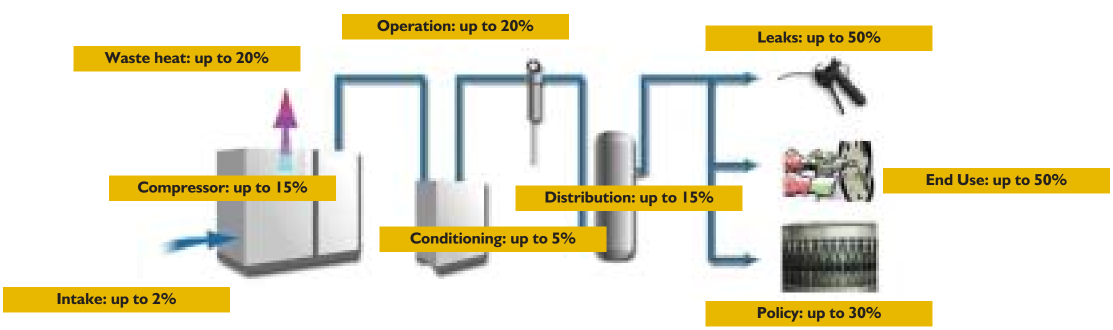
What kind of energy efficiency measures are you looking for?

Simple, low cost measures to improve operation and maintenance? O&M

Major repair or extension? Repair

Design, purchase and install a new compressed air system? New

Estimated range of possible savings through several categories of action



Sample parts of Calculation Module

Enter at least one of the following, to allow the decision aid tool to identify priority energy savings actions.

[ ] Workforce [ ] Turnover (000 _/yr) [ ] Annual electricity bill (_/year)

Optional data on compressed air systems. Enter if available

2500 Production hours per year *0.06* Average electricity cost (_/kWh)

[ ] Total Compressed Air System installed power (kW) [ ] Number of production sites [ ] Number of compressors (all sites)

Select appropriate context Stage in system life cycle *Select Sector* Branch

Take a "Guided Tour" of your system, to identify the priority actions for energy savings:

Reducing air leaks is probably the single most important energy saving measure, applicable to almost all systems. Awareness of the importance of a regular leak detection programme is low, in part because air leaks are invisible, and generally cause no damage. Correct design and installation of the network can greatly diminish air leaks. Nevertheless, the essential issue is one of proper maintenance.	**Reducing leakage might save up to 50% annually**	
Do you have a regular leak detection programme?	[ ] *yes*	[ ] *no*
Have you measured leakage recently?	[ ] *yes*	[ ] *no*
Do you specify high quality quick disconnect couplings and flexible hose?	[ ] *yes*	[ ] *no*
Do you use hand a held leak ultrasonic leak detector ('sniffer')?	[ ] *yes*	[ ] *no*
Are unused machines or portions of the network shut off at night or weekends?	[ ] *yes*	[ ] *no*
Do you use no air loss condensate draining devices ?	[ ] *yes*	[ ] *no*

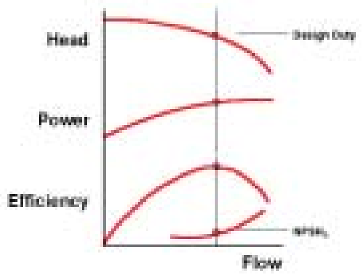
Progress in guided tour

Water Pumps

Pumping Systems

Recent studies carried out by the European Commission in Europe and the Department Of Energy in the USA identify Motor Driven Systems accounting for nearly 20% of the worlds electricity demand . Pumping Systems subsequently account for 22 –25% of the motor driven system electricity which roughly equates to 4% of the worlds electricity consumption.

Other studies have shown that with Rotodynamic pumps up to 40% of the energy consumed by pump systems could be saved

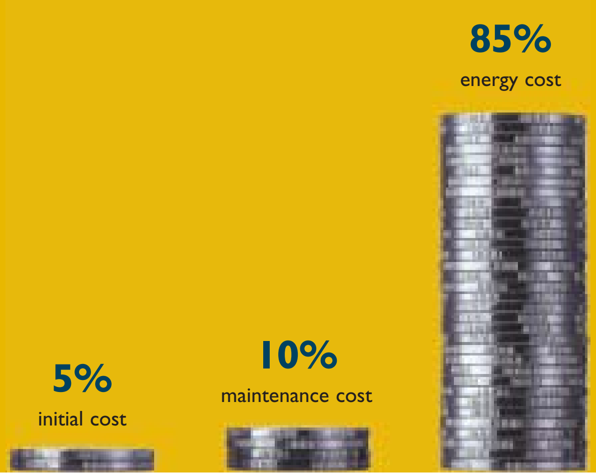


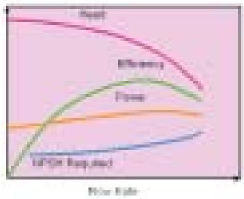
- *selecting a higher efficiency pumps: 3%*
- *selecting a better sized pump: 4%*
- *better installation /maintenance: 3%*
- *better system design 10%*
- *better system control 20%*

Total possible energy saving 40%

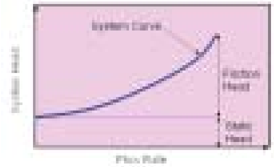
Pumps are typically purchased as individual components, they provide a service only when operating as part of the system. The energy and materials used by by a system depend on the design of the pump, the design of the installation and the way the system is operated. Pumping systems are used everywhere from domestic to industrial applications. The two main categories are Rotodynamic (centrifugal) and Positive Displacement. Rotodynamic pumps represent 73% of the pump population and the greatest energy savings potential. The ProMot data will subsequently concentrate on Rotodynamic pumps only.

Typical life cycle cost of a pump

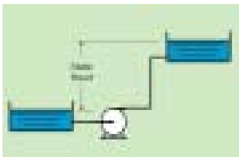




To Understand a Rotodynamic Pumping System you first need to understand how a pump works within a system



Most system curves have a combination of static and friction head



Static Head is simply the difference in height of the supply and destination reservoirs. Friction head (sometimes called dynamic head loss) is the friction loss, on the liquid being moved, in pipes, valves and equipment in the system

To achieve optimum efficiency within the pumping system the goal is to ensure the systems curve intersects the pump performance curve at its best efficiency point.

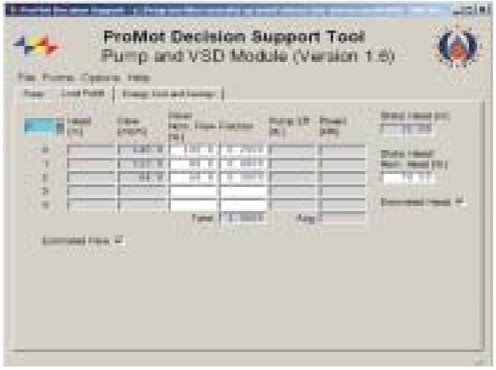
Calculation Module

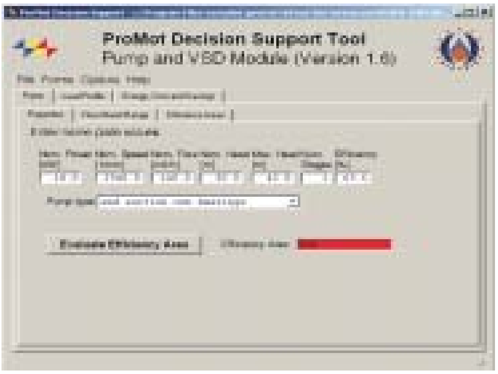
ProMot Pump and VSD module:

energy efficiency improvement of pumping systems:

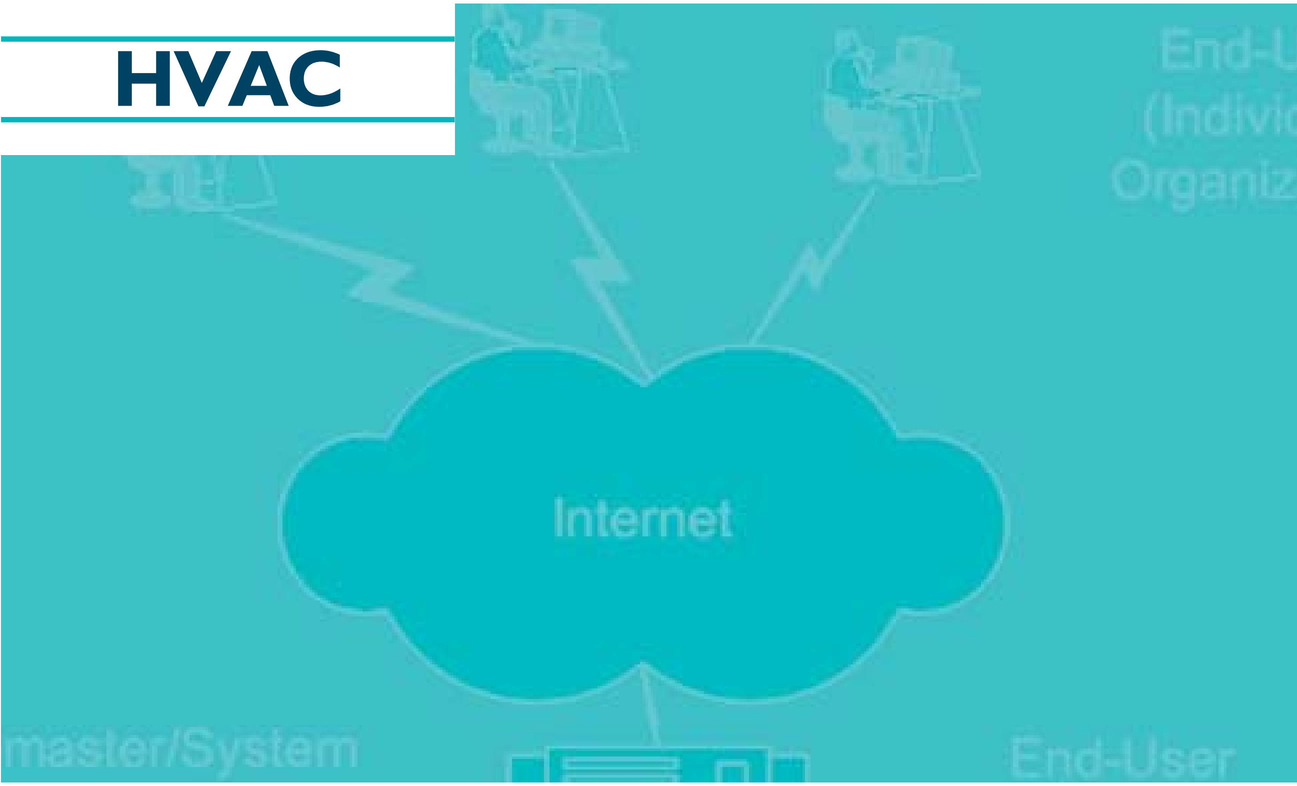
- determine the efficiency category of a given pump
- find the most cost and energy effective action for your pumping system

Get ProMot Pump and VSD module





HVAC



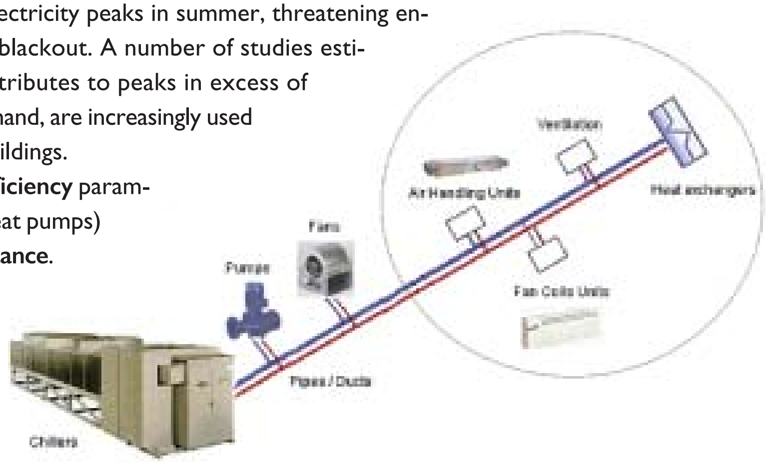
Methodology for Chillers

A typical HVAC system comprises of the heating or cooling producing equipment (boilers, heat pumps etc), pumps and/or fans, piping networks, and heat exchangers transferring or absorbing heat from a space or a process.
The current part of the software is devoted to the analysis of chillers, as a part of an HVAC system. Chillers, in the current work, are defined to be heat pumps (HP) used for cooling, possibly reversible able to produce heat. Studies have shown that about **90% of the energy in an HVAC system is consumed by the chiller/heat pump** and the rest 10% by peripheral machinery.
Data for the analysis is drawn from the Eurovent-Cecomaf database. Differences in energy performance between 3600 different machines contained in the database are significant and is in the range

Energy performance at full load

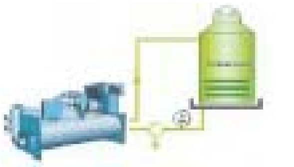
Chiller type	EER Min - Max	COP Min - Max
Air cooled	1.61 - 3.97	2.16 - 4.18
Water cooled	2.62 - 6.38	2.33 - 4.94

Energy consumption for cooling is gaining attention during the last years, since it is contributing greatly to the electricity peaks in summer, threatening entire geographic regions with a blackout. A number of studies estimate that air conditioning contributes to peaks in excess of 40%. Heat pumps, on the other hand, are increasingly used for heating in tertiary sector buildings.
Consideration of the **energy efficiency** parameter in the choice **of chillers** (heat pumps) is, therefore, of **outmost importance**.

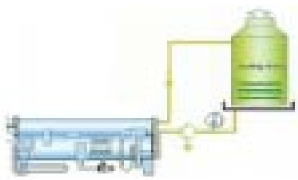


Air Cooled Chillers

Air Cooled Chillers



Water Cooled Chillers



Absorption Systems

General

Systems made to produce cold (and hot) heat transfer medium - water or air. The primary energy source is electricity, while heat is rejected to (and absorbed from) the environment, through air-cooled heat exchangers.

Design Considerations

Packaged systems serving a very wide range of cooling (and heating) needs. Easy straightforward installation at external - well ventilated spaces.

Maintenance Considerations

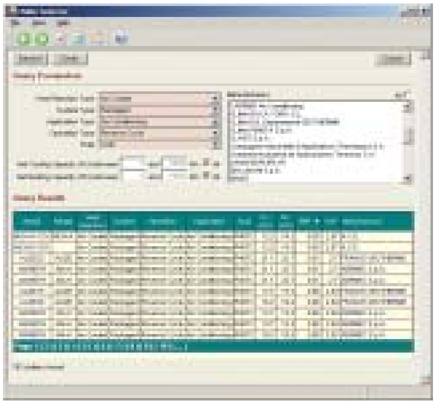
Need servicing at least once a year (twice for systems used for cooling and heating).

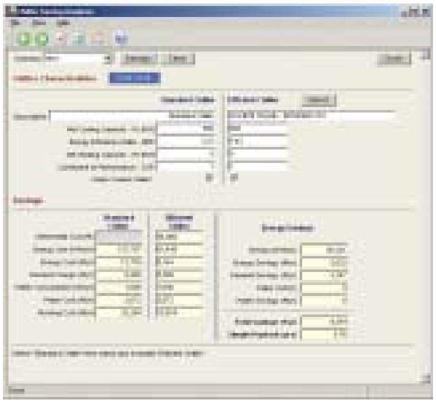
Maintenance includes checking and adjusting or cleaning

- heat exchangers, filters,
- measurements of inflow and outflow temperatures of working fluids,
- pressure level around compressors,
- electricity (current) measurements for compressors and fans

Module

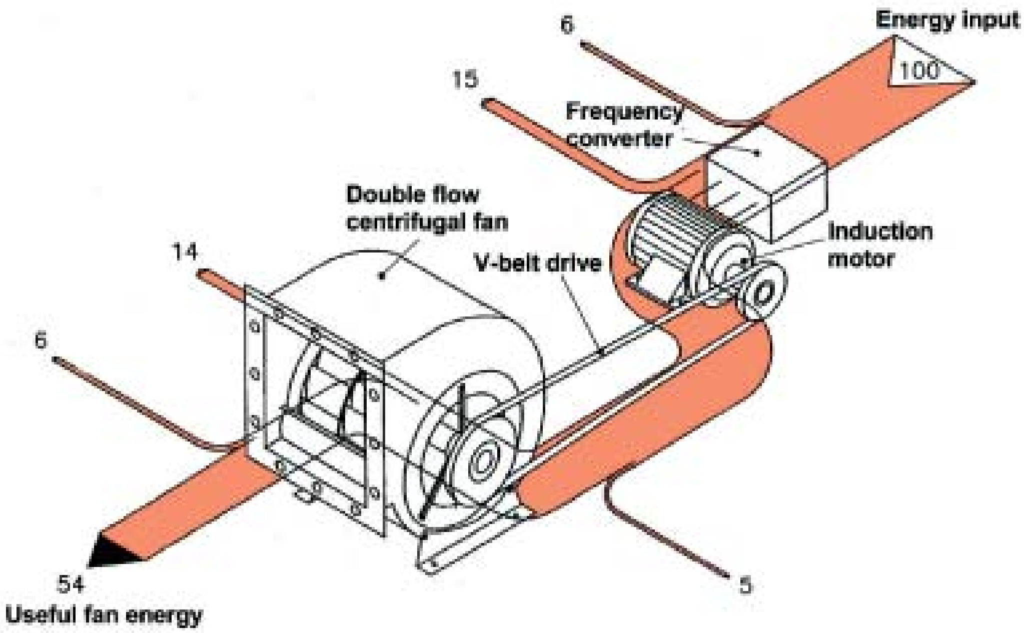
ProMot Chillers module treats Water and Air Cooled Chillers. The user can calculate the energy consumption and analyse the effect of choosing various chillers for a new or an under refurbishment.





Relevant studies / Fans

- Fan Saving Potential is about 5 to 10 %
- Fan System Saving Potential is about 17.5 %
- Cost saving would be worth 2592 Million Euro per year
- Fan energy consumption will increase in all scenarios until 2020 due to the extended use of fans, especially for HVAC systems in commercial buildings
- Fan electricity consumption is about 100 TWh in Industry, 94 TWh in the Tertiary sector and 3.4 TWh in the Transport Sector



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