AUDITAC

Technical guides for owner/manager of an air conditioning system: volume 12

The AC-cost user's guide

Supported by
Intelligent Energy Europe

auditAC

France (Project coordinator)
Armines - Mines de Paris

Austria
Austrian Energy Agency

Belgium
Université de Liège

Italy
Politecnico di Torino

Portugal
University of Porto

Slovenia
University of Ljubljana

UK
Association of Building Engineers

BRE
(Building Research Establishment Ltd)

Welsh School of Architecture

Eurovent-Certification

Authors of this volume
Jérôme ADNOT (Armines, France)
Daniela BORY (Armines, France)

Before beginning

AC-cost is a simple sheet that aims at helping to understand the status of the operation of an air conditioning plant through the analysis of the history of running costs bills including energy, water, maintenance. Moreover, we propose to estimate the possible savings through some energy saving opportunities.
A certain amount of information would be asked in order to do estimation about the future costs and the energy savings due to some measures. Some data are seldom available such as the electricity consumption of the cooling system that is in general included in the total electricity bills and not available separately, but the users are not stopped if they don't have it! The software will provide estimations methods for any lost information.
More detail you enter from the **real** system more precise will be the calculations!
Even two different years of costs are enough.
Note that a certain number of constraints and hypothesis have been done: the calculations are just for "cooling" and not for heating even if the plant can supply both, the estimations are based on an office building type, the energy for cooling is only electricity, no data for absorption systems have been included, the values are not inflated or deflated.

How to use it

Follow the instructions in the green cells, fill the blue ones, and the yellow cells will give you the results of the calculations.
If there is any lack of information the buttons will guide you in the estimation calculations.
Two steps are required:

1) The present plant description and costs definition
2) The estimation of the impact of measures

Be careful to fill as many cells as you can. Before trying different possibilities for the same proposed project you should previously reset the project (button at the top "Reset projects") and fill all the project data again to be certain to use the correct ones in the calculations.

The data you need

The worksheet asks you several data that we can help you to find.
For the existing plant you can retrieve the information required:

- Starting from design plans and documents for the building and for the air conditioning plant
- From the monitoring system if present: electricity measurements for the air conditioning system, water consumption at the cooling tower can be recorded and saved all along the life of the system
- Electricity bills
- Maintenance contracts, logbook and extra bills.

If you have many different systems in different zones of the building, consider it separately and make several calculations (different work sheet) with reference only to one system and its cooled area at each time.

More in detail, the worksheet asks for (the item with * indicate that the worksheet allows to estimate it if unknown or lost information):

- The conditioned area*: you can find it in the design plans and calculations of the building or of the air conditioning plant. If you cannot retrieve this information, you can use the total area of the building and try to exclude the non-conditioned areas.
- The system type: you can find it in the design plan and calculations of the air conditioning plant. If you cannot retrieve this information you can refer to our technical guide Vol. 3: System recognition guideline for field visit. A direct look at the system plates can also help you in the comprehension of the system type.
- The installed capacity*: this term refers to the capacity of cooling of the primary system: you can refer to the plate values if the design plans and documents are not available.
- The year the present plant has been installed: it is an information included in the design plans, refers to the primary system installation, in some case it can coincide with the year of construction of the building.
- In which year do you plan to stop the existing plant for complete renovation*: it represents the year you planned to replace your system and if not planned yet, a conventional lifetime of the system is used to define the time basis for calculations.
- What was the initial cost of the plant (€)*: this can be retrieved by the initial design bills.
- Energy costs*: if you have air conditioning consumptions in kWh measured for example by the building energy management systems recorder over at least two years you can convert into bills using a simple average cost of electricity and enter them directly in the corresponding years. At least data for two different years would be necessary.
- Water costs*: this costs have be entered only if a wet cooling tower is used as condenser, if you have water consumptions measured and recorded thanks to a meter over at least two years, you can convert into bills using a simple average cost and water and enter them directly in the corresponding years. At least data for two different years would be necessary.
- Maintenance costs*: if you have a specific contract for air conditioning maintenance you can enter the annual cost of it, when not included in the contract try to add the extra costs due to corrective maintenance activities. At least data for two different years would be necessary.

What you can calculate

The first part of the worksheet allows to observe the past behaviour of your plant also through a graph showing the costs curves versus time.
In the second part, four projects of retrofit or renovation are proposed:

1) Replacement of the system of cooling production with a better efficiency
2) Replacement of the system of cooling production with a lower capacity system (better or not efficiency)
3) Conversion for air system using air handling units from constant volume type to variable air type
4) Benefit from the use of free cooling.

The item with * indicate that the worksheet allows to estimate it if unknown.

1) The replacement of the system of cooling production requires the knowledge of the possibilities for replacement: Eurovent-Certification (http://www.eurovent-certification.com/) provides information about certified performances for a large variety of equipment types and capacities, you can also retrieve from the Eurovent-Certification site information about the system in place if included in the past directories of Eurovent.[1] If not the EER* of the present system can be calculate from the plate data as the ratio between the capacity (kWh) and the absorbed power (kWh) at nominal conditions.

2) The replacement with a lower capacity system can be advised when there is evidence of important oversizing or when a cooling load reduction action is set up. Care should be done taking into account all the ancillary system resizing in order to full benefit from the replacement. The EER* of the present system can be calculate from the plate data as the ratio between the capacity (kWh) and the absorbed power (kWh) at nominal conditions.

3) The variable airflow systems have been showed to be strongly reducing the consumption respect constant flow especially due to the lower consumption of the fans[2] with total cost savings of 50% magnitude as showed in the EECCAC study. You can enter directly the investment* of the action if a previous estimation has been done.

4) Free-cooling techniques benefit from the lower temperature of the outdoor air to bypass the cooling system and provide fresh air to the building. It can be implemented when the condenser technique is a cooling towers (we call then free-chilling) or directly through the ventilation system (air side free cooling). Free chilling is infrequent because of the many barriers to application. Airside free cooling is a key option in a cost benefit analysis: small cost, large potential. Many regulations make it more or less compulsory (USA, Portugal). Of course, free cooling is very climate and control dependent. You can enter directly the investment* of the action if a previous estimation has been done.

More actions can be possible to improve your system, you can find more on the AuditAC web site on the document: Energy Conservation opportunities list for air-conditioned building.

All the mentioned documents are available on:
http://www.eva.ac.at/projekte/auditac_publ.htm

For any comments or a to request an open version of the tool please contact Daniela.bory@ensmp.fr. We would be pleased to receive any feedback and improvement proposal!

[1] For more information on how retrieve data on the installed system you can seek advice from AuditAC Technical guides for owner/manager of an air conditioning system volume 6: How benefit from the Eurovent database and retrieve data for equipment.
2 EECCAC, Final Report 2003, “Energy Efficiency and Certification of Central Air Conditioners”, SAVE Project.