EUROVENT-AHU©

Version: 01/2006

User Manual

1. General Information

EUROVENT-AHU© is a computer program to determine the annual energy costs of air handling units. The calculation procedures are strictly based on the procedures defined in the EUROVENT RECOMMENDATIONS FOR CALCULATIONS OF ENERGY CONSUMPTION FOR AIR HANDLING UNITS.

EUROVENT-AHU© was designed by Prof. Dr. Michael Haibel, Biberach University of Applied Sciences, Germany in cooperation with EUROVENT and WG 6C. The platform for EUROVENT-AHU© is EES (Engineering Equation Solver; S.A: Klein; F-Chart Software). The implemented climate data for the different locations were taken from test reference years (TRY) created with the program METEONORM© Version 4.00 (J. Remund, R. Lang, S. Kunz; METEOTEST Switzerland), taking into account long terms mean values for temperature und relative humidity of the outdoor air.

More information on the basic considerations and the calculation procedures is given in the EUROVENT RECOMMENDATIONS FOR CALCULATIONS OF ENERGY CONSUMPTION FOR AIR HANDLING UNITS.

NOTE: THE AUTHOR DOES NOT TAKE UPON WARRENTY ON ANY KIND OF IMPACTS ON HARD- AND SOFTWARE AND ON THE PHYSICAL AND COMMERCIAL RESULTS OF THE PROGRAM

EUROVENT-AHU© is given in different versions. Those different versions are identical concerning the basis codes and differ only in the implemented European locations:

- EUROVENT-AHU© – EUROPE-I:
  This version is fed with a variety of data for test reference years of different locations in Scandinavia:

  Bergen, Borlaenge, Esbjerg, Göteborg, Helsinki, Jonkoping, Kajaani, Kobenhavn, Kuusamo, Lund, Oestsund, Orland, Oslo, Oulu, Sola, Stockholm, Storuman, Sundsvall, Umea, Vaasa

- EUROVENT-AHU© – EUROPE-II:
  This version is fed with a variety of data for test reference years of different locations in France, Great Britain and Ireland:

  Aberdeen, Belfast, Birmingham, Bordeaux, Bourges, Caen, Cork, Dublin, Edinburgh, Glasgow, London, Lyon, Manchester, Marseille, Nancy, Nantes, Norwich, Paris, Plymouth, Toulouse

- EUROVENT-AHU© – EUROPE-III:
  This version is fed with a variety of data for test reference years of different locations in Spain and Portugal:

  Alicante, Barcelona, Coimbra, Cordoba, Faro, LaCoruna, LasPalmas(Gran Canaria), Lisboa, Madrid, Malaga, Palma (Mallorca), Porto, Salamanca, Santander, Sevilla, Valencia, Vigo, Zaragossa

- EUROVENT-AHU© – EUROPE-IV:
  This version is fed with a variety of data for test reference years of different locations in Belgium, The Netherlands, Luxemburg, Germany, Czech Republic and Poland:

  Amsterdam, Berlin, Brno, Bruxelles, DeBilt, Dresden, Eelde, Essen, Frankfurt (Main), Gdansk, Hamburg, Hradec-Kralove, Krakow, Luxemburg, Muenchen, Poznan, Praha, Szczezin, Warszawa, Wroclaw

- EUROVENT-AHU© – EUROPE-V:
  This version is fed with a variety of data for test reference years of different locations in Switzerland, Austria, Slovakia, Hungary and Romania:

  Bratislava, Bucuresti, Budapest, Cluj-Napoca, Constanca, Debrecen, Geneve, Iasi, Innsbruck, Klagenfurt, Pecs, Poprad, Szego, Szombathely, Timisoara, Wien, Zuerich

- EUROVENT-AHU© – EUROPE-VI:
  This version is fed with a variety of different locations in Italy, Malta, Slovenia, Croatia, Bosnia Herzegovina, Serbia and F.Y.R.O.Macedonia:

  Ancona, Bari, Beograd, Bologna, Bolzano, Crotone, Genova, Ljubljana, Milano, Napoli, Palermo, Pescara, Pristina, Roma, Sarajevo, Skopie, Split, Udine, Valletta, Zagreb

- EUROVENT-AHU© – EUROPE-VII:
  This version is fed with a variety of data for test reference years of different locations in the Baltic States, Ukraine, Belarus and Russia:

  Kaliningrad, Kaunas, Kyjiv, L ‘Viv, Minsk, Moskva, Odessa, Riga, St. Peterburg, Tallinn, Vilnius

- EUROVENT-AHU© – EUROPE-VIII:
  This version is fed with a variety of data for test reference years of different locations in Greece, Bulgaria and Turkey:

  Adana, Ankara, Antalya, Athinai, Burgas, Irakleion, Istanbul, Izmir, Kalamata, Kars, Larisa, Naxos, Pleven, Rhodos, Sofia, Thessaloniki, Trabzon, Varna

Apart from the implemented test reference years (TRY), the user is able to enter his own meteorological data in a “user’s location”.

All versions of EUROVENT-AHU© including a handbook and users guide are on one CD. To obtain the EUROVENT-AHU© - CD, please contact the head office of EUROVENT in Paris.

2. Installation of EUROVENT-AHU©

The program EUROVENT-AHU is an easy-to-handle exe-file, which can run on each WINDOWS-based computer. It can be started from hard disc or from CD. As the program is fairly complex, the recommended performance of the PC is 133 MHz and 256 MB RAM at least.

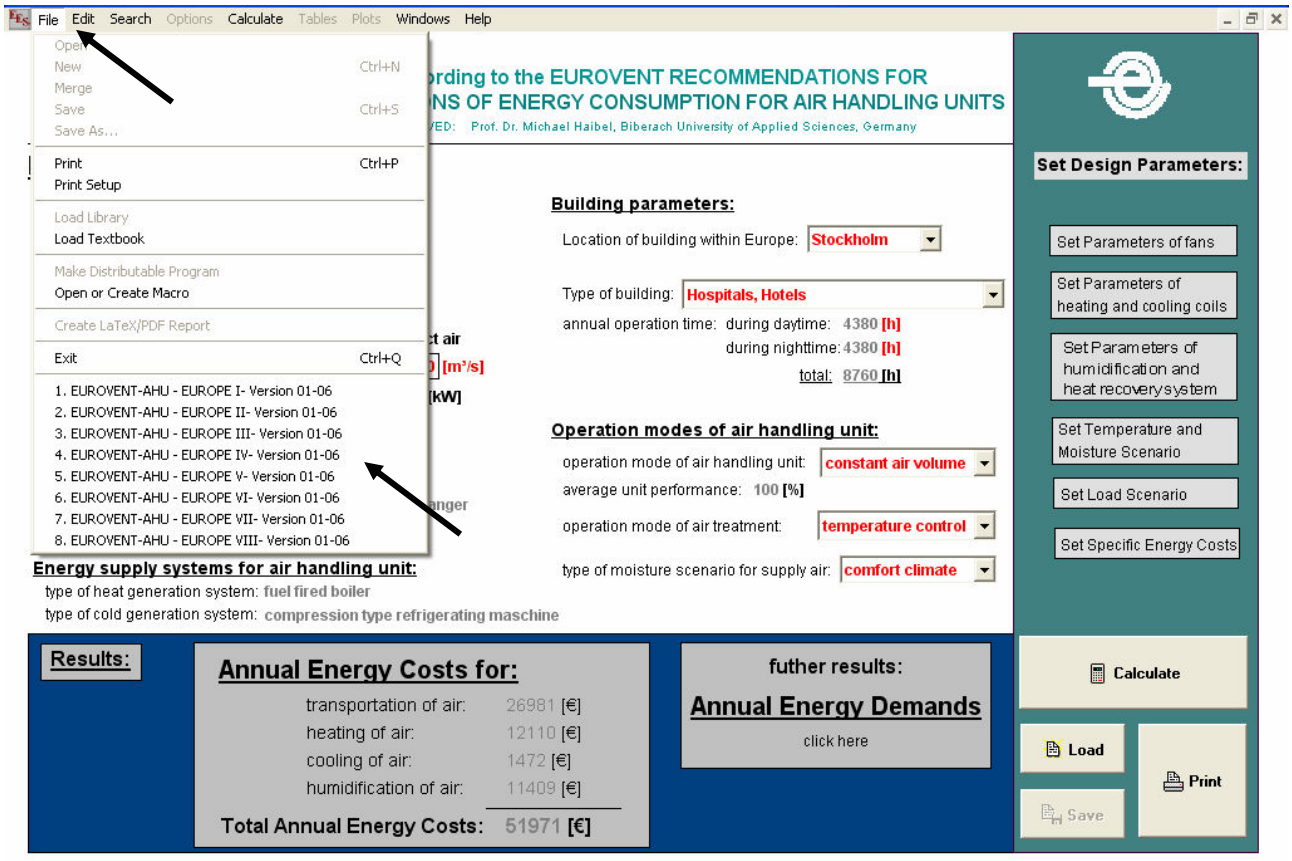
To start EUROVENT-AHU, go into the directory of EUROVENT-AHU (hard disc or CD) and open the exe-file with a double mouse click. That's all.

And now, have a nice time with EUROVENT-AHU.

3. How to open EUROVENT-AHU©

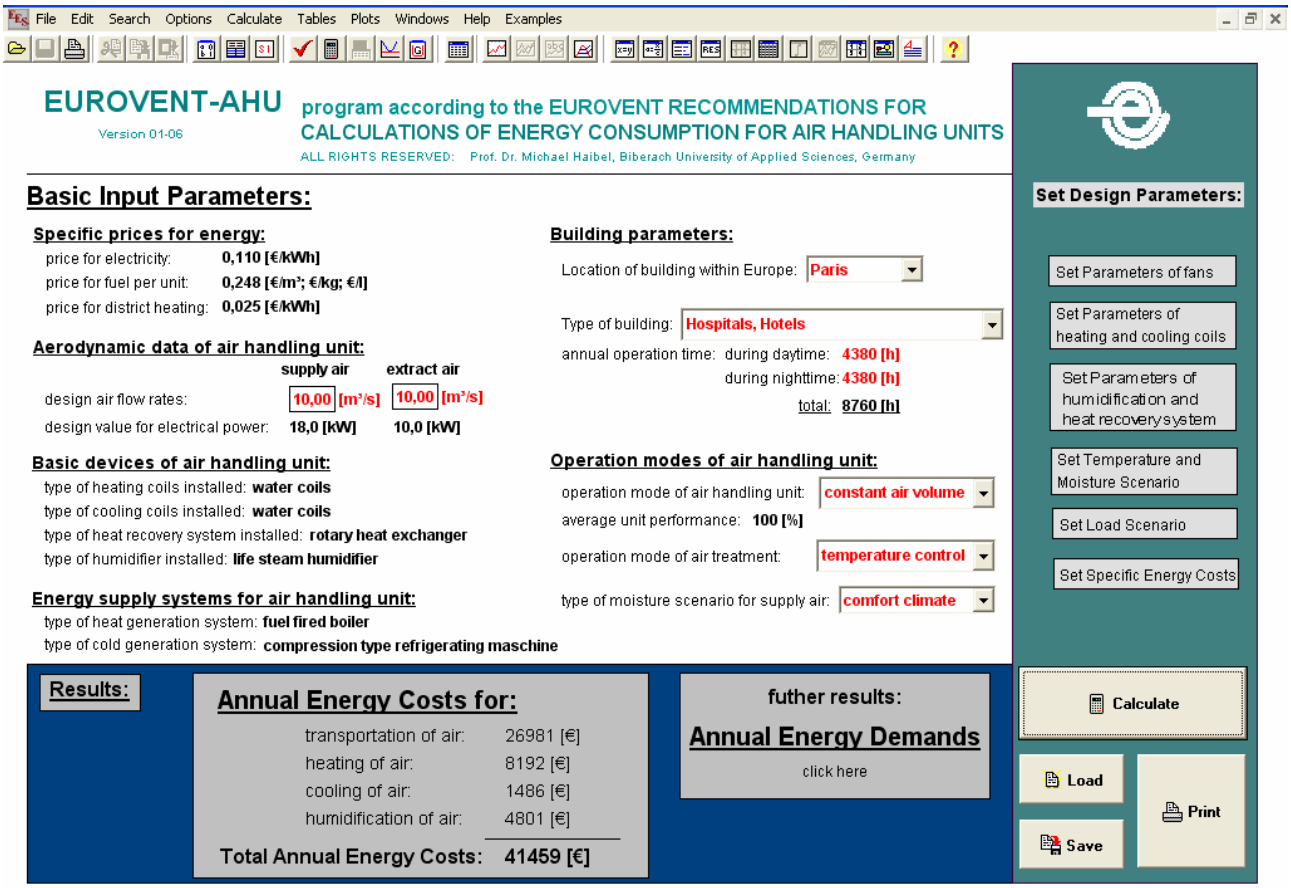
The program has the file name "EUROVENT-AHU – EUROPE I – Version 01-2006.exe". Open this exe-file in the well known common way (by mouse click or by command).

The program opens always in the standard version "EUROPE I" with all the locations mentions previously. To open the other versions "EUROPE II" to "EUROPE VIII", move the mouse to the top line on the FILE – symbol to open the pull down menu. At the bottom of that menu you will find all program versions. You can open those version by mouse click.



4. Features of EUROVENT-AHU©

After EUROVENT-AHU© is opened, you'll see the main frame of the program:



The features of this frame are:

- section INPUT PARAMTERS:
  Here you enter the aerodynamic parameters of the air handling unit, the operation modes of the air handling system and the parameters of the building

  Basis operation parameters, selected in the frames of SET DESIGN PARAMETERS are shown in the sections BASIC DEVICES OF AIR HANDLING UNIT and ENERGY SUPPLY SYSTEM FOR AIR HANDLING UNIT.

- section RESULT:
  Here you see the results of the calculation concerning the annual costs.
  To see the calculated energy demands, click on ANNUAL ENERGY DEMANDS

- section SET DESIGN PARAMETERS:
  Here you can go to further frames to set the parameters of the air handling unit, of the air handling system, of the building and of the operation conditions

NOTE: All Input parameters are high lightened in red

Section INPUT PARAMETERS:

In this section you enter the basic parameters of the air handling unit, of the air handling system and of the building

Aerodynamic data of air handing unit:

air flow rate:
Enter the air flow rate (unit: m³/s) of your air handling unit for the supply air side and of the extract air side; if no extract air side exists, enter **0** (NOTE: if no extract air flow rate exists, heat recovery factors must be set to **0** either)

Building parameters:

Location of building:
In this pull down menu you can select the climate data (temperature and relative humidity of outdoor air for each hour of a test reverence year) of several predefined locations or you can define your own locations.
To define our own location select the location >>users location<<. The procedure how to enter climate date for user's locations will be described later

Type of building:
In this pull down menu you can select predefined utilizations of the building with redefined annual operation times during daytime and during night time. The annual operation times during daytime and during nighttime and in total are shown in the lines below the pull down menu.
To define your own annual operation times select the building type >>users specification<<. Therewith you can enter the annual operation times during daytime and during nighttime in the input boxes.

NOTE: the total annual operation will be depicted not unit the calculation process was activated

Operation Mode:

operation mode of air handing unit:
In this pull down menu you can select three different operation modes of your air handling unit:

- constant air volume (operation mode with 100% fan performance over whole operation time)
- constant pressure (operation mode with a variable fan performance making sure a constant pressure in the air handling system over the whole operation time; energy demands for thermal air treatment and air transport are reduced linear by the average annual unit performance; the annual average unit performance can be defines in the frame SET LOAD SCENARIO)
- variable air volume (operation mode with a variable fan performance making sure a air flow rate in the air handling system on demand over the whole operation time; air flow rate and energy demands for thermal air treatment are reduced linear by the average annual unit performance and the energy demand for air transport is reduced with the 3rd power of the average performance; the annual average unit performance can be defines in the frame SET LOAD SCENARIO)

The average performance of the unit is depicted in the line beneath.

NOTE: the average performance will be depicted not unit the calculation process was activated

operation mode of air treatment:
Two different air treatment modes can be selected with the pull down menu:

- temperature control (outdoor air is cooled down only to the required temperature of the supply air; the received moisture content follows this supply air temperature and is not controlled)
- moisture control (outdoor air is cooled down to the required moisture of the supply air; if the air temperature behind the cooling coil is below the required supply air temperature, the air is reheated)

moisture scenario of supply air:
Two types of moisture scenarios for the supply air are given:

- Comfort Climate
- Industrial Climate:

The characteristics of the scenarios can be defined in the frame SET TEMPERATURE AND MOISTURE SCENARIO

Section RESULTS

In this section all results of the calculation process concerning the annual energy costs are depicted.

Annual Energy Costs:
Depiction of the calculated annual energy costs to run the air handling unit

- **transportation of air:**
  annual costs for energy for fans incl. costs to run the speed control system (unit: €)

- **heating of air:**
  annual costs for thermal heating of the air incl. costs to run the heating coil pumps and the heat recovery system (unit: €)

- **cooling of air:**
  annual costs for thermal cooling and re-heating of the air incl. costs to run the cooling coil pumps (unit: €)

- **humidification of air:**
  annual costs for humidification and re-heating of the air incl. costs for to run the water treatment system (unit: €)

- **Total Annual Energy Cost:**
  sum of annual costs for air transportation, heating, cooling humidification (unit: €)

NOTE: the specific prices for heating, cooling and electrical energy as well as the types of energy generation systems are defined in the frame SET SPECIFIC ENERGY COSTS

To see the calculated annual demands of energy to run the entire air handling unit, click to “further results: Annual Energy Demands” in the section RESULTS.

Section SET DESIGN PARAMETERS

In this section you can open further frames to define the performance and operation conditions of the air handling unit more precise. The frames to open are:

Set Parameters of fans:
In this frame you can define all design parameters of the utilized fans for supply air and extract ar.

Set Parameters of heating and cooling coils:
In this frame you can define the types of coils and the design and operation parameters of the utilized heating and cooling coils and the parameters and calculation mode to determine the absorbed power of the coil pumps.

Set Parameters of humidification and heat recovery system:
In this frame you can define the types and the design and operation parameters of the utilized humidification and heat recovery systems and the parameters and calculation mode to determine the absorbed power of the air washer pumps and run around coil pumps.

Set Temperature and Moisture Scenario:
In this frame you can define the temperature and the moisture content of the supply air in dependence on the temperature and moisture content of the outdoor air, the temperature of the extract air in dependence of the outdoor air temperature and the increase of the moisture content in the extract air due to room loads.

Set Load Scenario:
In this frame you can define the performance of the air handling system and the load scenario respectively to obtain the average unit performance and the energy reduction factors for thermal air treatment and air transport for the unit operation modes “variable air volume” and “constant pressure”.

Set Specific Energy Costs:
In this frame you can enter the specific prices (€ per kWh) for electrical energy, fuel and district heating and select the types of and seasonal efficiencies for the generation systems for heating energy, cooling energy and steam.

Buttons:

Calculate – Button: You activate the calculation process of the program by clicking on this button

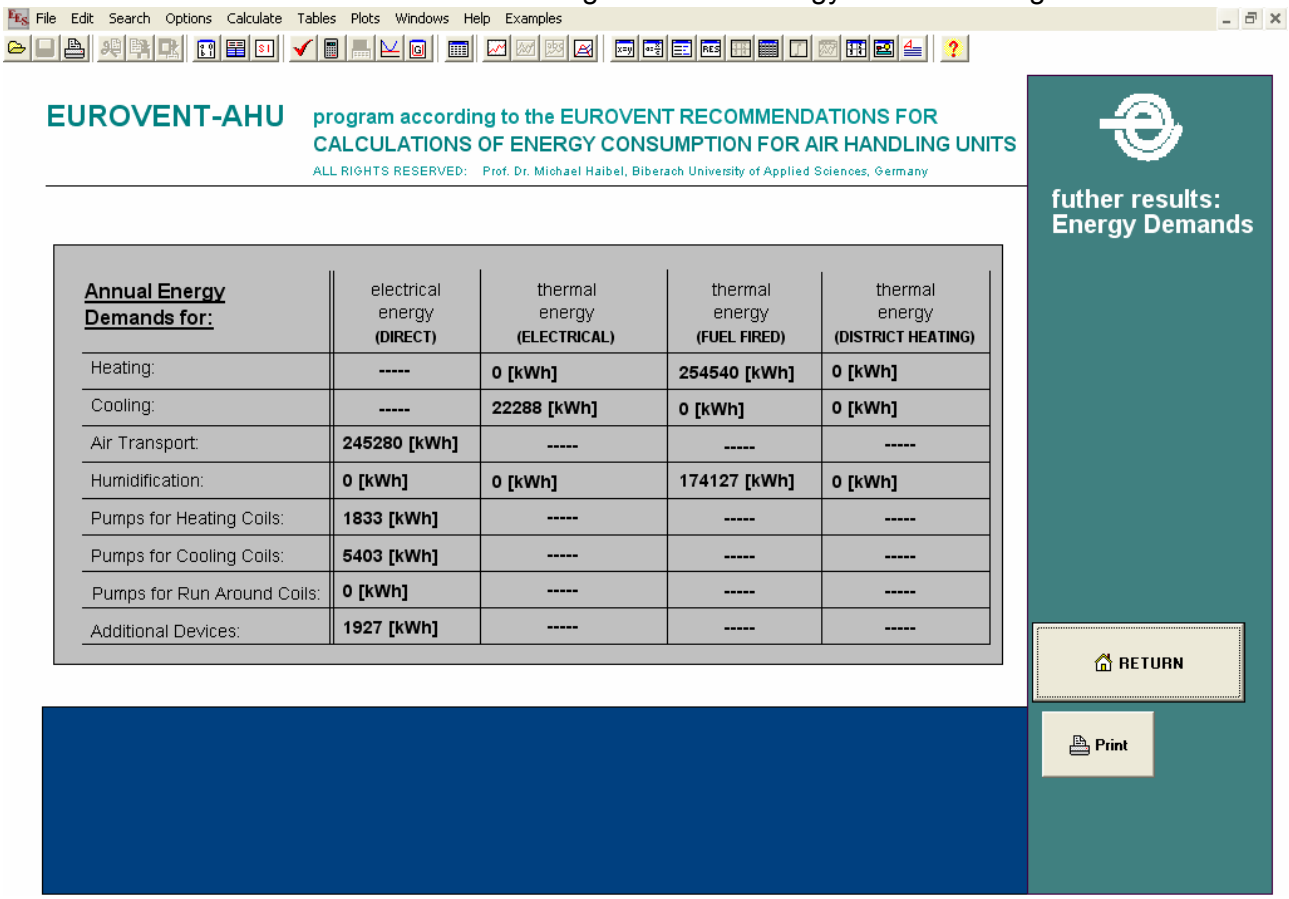
Save – Button: You can save the entered parameters and the calculated results by clicking this button

Print – Button: You can print single frames or all frames of the program with all of the entered parameters by clicking this button

Load – Button: You can load a former saved project

Frame: further results – Annual Energy Demands

In this frame the calculated results concerning the annual energy demands are given.



Annual Energy Demands for:	electrical energy (DIRECT)	thermal energy (ELECTRICAL)	thermal energy (FUEL FIRED)	thermal energy (DISTRICT HEATING)
Heating:	-----	0 [kWh]	254540 [kWh]	0 [kWh]
Cooling:	-----	22288 [kWh]	0 [kWh]	0 [kWh]
Air Transport:	245280 [kWh]	-----	-----	-----
Humidification:	0 [kWh]	0 [kWh]	174127 [kWh]	0 [kWh]
Pumps for Heating Coils:	1833 [kWh]	-----	-----	-----
Pumps for Cooling Coils:	5403 [kWh]	-----	-----	-----
Pumps for Run Around Coils:	0 [kWh]	-----	-----	-----
Additional Devices:	1927 [kWh]	-----	-----	-----

The annual energy demands are split up into 4 types of energy:

- electrical energy (direct): electrical energy to run fans, pumps and other mechanical devices
- thermal energy (electrical): electrical energy to generate thermal energy by means of electrical air heaters, electrical refrigerating machines and electrical steam generator
- thermal energy (fuel fired): thermal energy generated by means of fuel firing to run air heaters, thermal refrigerating machines (absorption) and fuel fired steam generator
- thermal energy district heating): thermal energy take from district heating systems to run air heaters, thermal refrigerating machines (absorption) and fuel fired steam generator

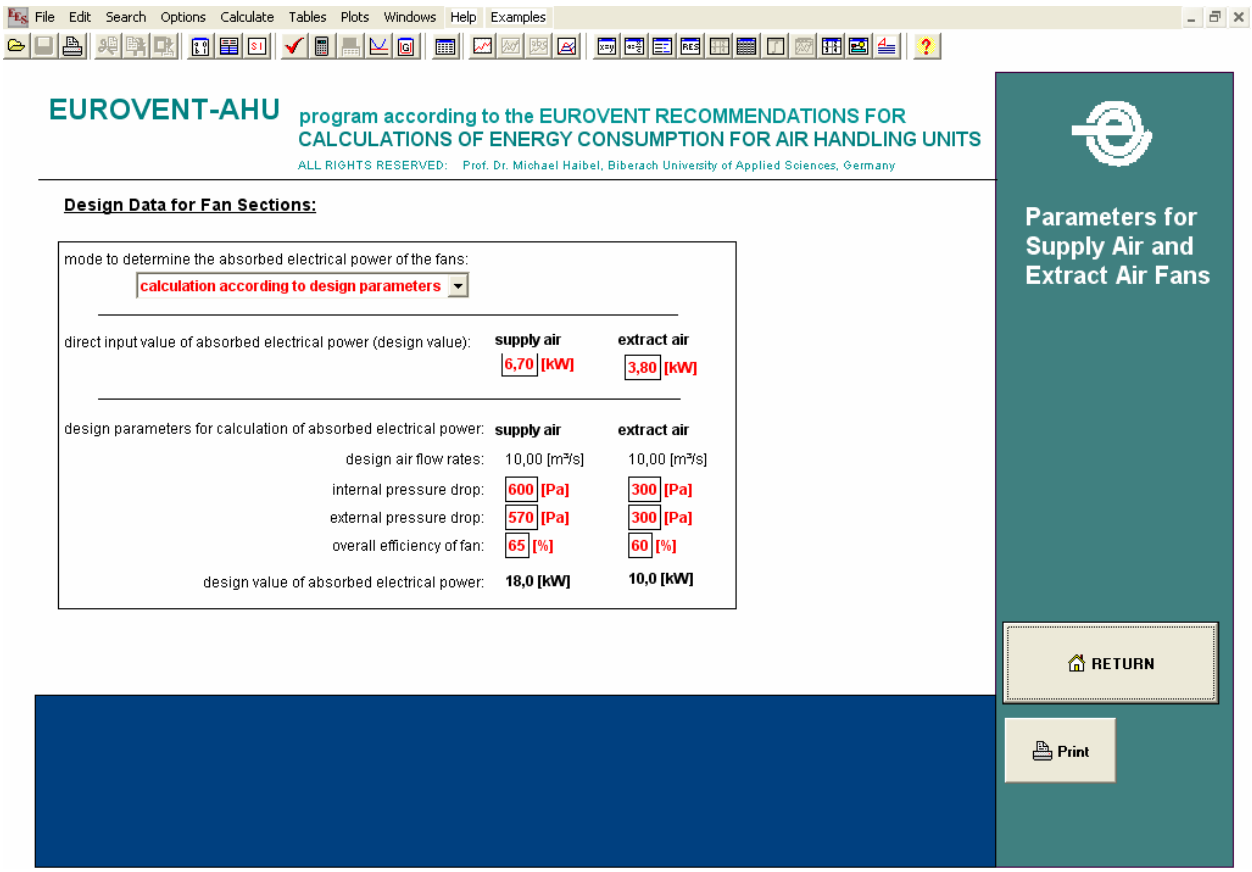
Annual Energy Demands:

- Heating: annual demand of energy for air heating (thermal or electrical, depending on the type of heating coil installed)
- Cooling: annual demand of energy for air cooling (only thermal) and for air re-heating (thermal or electrical, depending on the type of heating coil installed)

- Air Transport: annual demand of energy for air cooling (only electrical) and for running the speed control system, if installed (only electrical)
- Humidification: annual demand of energy for air humidification (thermal or electrical, depending on the type of humidifier installed) incl. air treatment system (only electrical), if installed and for air re-heating (thermal or electrical, depending on the type of heating coil installed)
- Pumps for Heating Coils: annual demand of energy (only electrical) to run the heating coil pumps, if water fed coils are installed
- Pumps for Cooling Coils: annual demand of energy (only electrical) to run the cooling coil pumps
- Pumps for Run Around Coils: annual demand of energy (only electrical) to run the pumps for run around systems, if run around systems are installed
- Additional Devices: annual energy demand to run the drive of the rotary heat exchanger, if installed

Frame: Set Parameters of fans:

In this frame you can define the design parameters of the utilizes fans.



mode to determine the absorbed electrical power of the fans:
Two different calculation modes can be selected with the pull down menu:

- direct input of absorbed power: you enter the nominal power input of the supply air fan and the exhaust air fan in the box right below
- calculation according to design parameters: the absorbed power of the fans is calculated my means of the internal an the external pressure drop the AHU and the duct works, the air flow rate an the overall efficiency of the fans

direct input value of absorbed electrical power:
If this mode is selected, enter the values for the supply air fan and the extract air fan (unit kW)

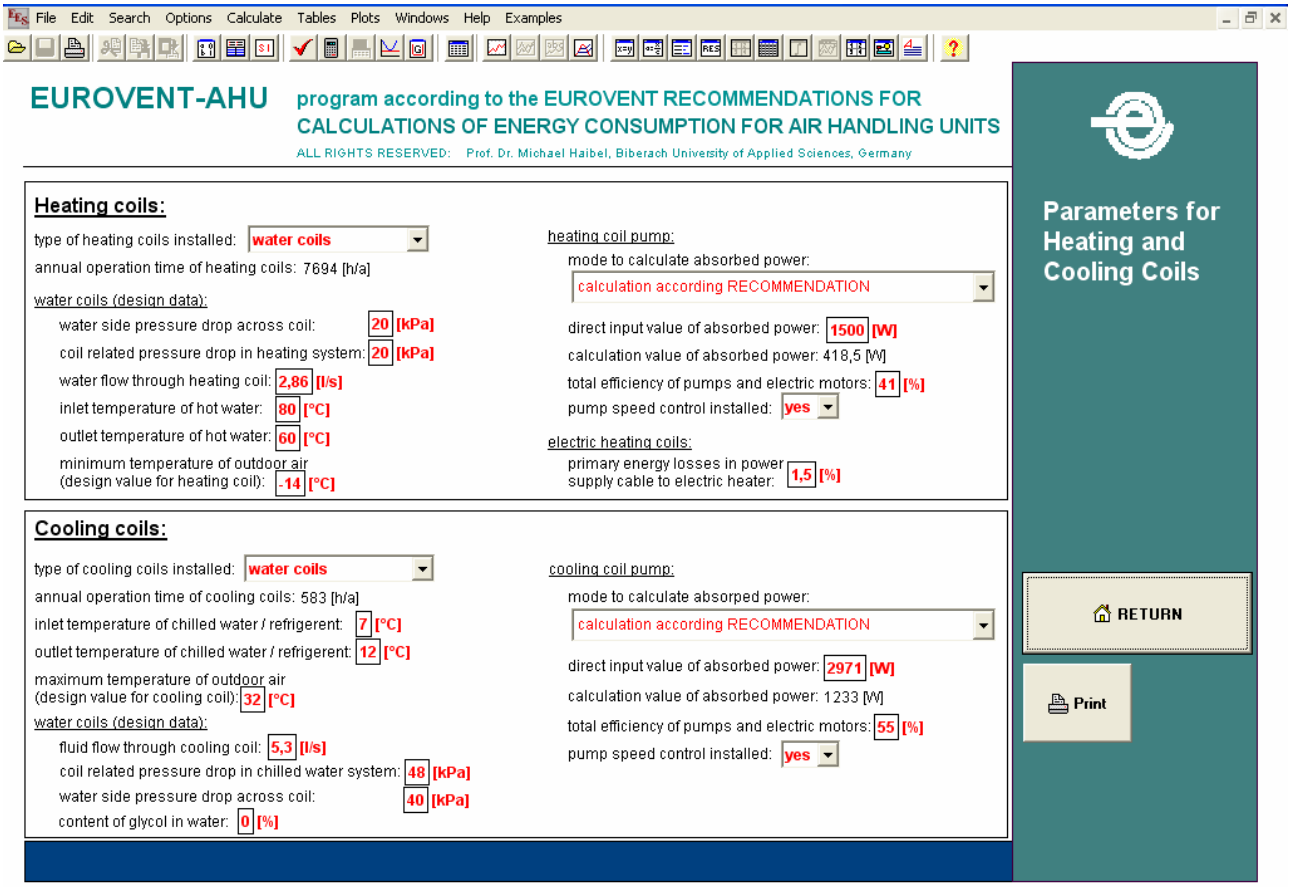
internal pressure drop:
Enter the internal pressure drop (unit: Pa) of your air handling unit for the supply air side and for the extract air side incl. heat recovery system.

external pressure drop:
Enter the external pressure drop (unit: Pa) of your duct system for the supply air side and for the extract air side

total fan efficiency:
Enter the total fan efficiency (unit: %) of your supply air fan and of your extract air fan; make sure that the total fan efficiencies you enter are defined in the way given in the EUROVENT RECOMMENDATION.

Frame: Set Parameters of heating and cooling coils:

In this frame you can define the types of coils and the design and operation parameters of the utilized heating and cooling coils and the parameters and calculation mode to determine the absorbed power of the coil pumps.



Heating Coils:
In this section the design and operation parameters of the utilized heating coils of the air handling unit are defined.

- type of heating coil installed: select of the type of utilized heating coil (water coils, steam coils, electric heating coil)
- annual operation time of heating coil: depiction of the calculation result of the annual running time utilized heating coil
- water side pressure drop: enter the design value for the waterside pressure drop across in the heating coil in kPa
- coil related pressure drop in heating system: enter the design value for the waterside pressure drop of the heating system in kPa
- water flow through heating coil: enter the water flow through the heating coil in l/s; if the value is not available, you can determine a default value by selecting “calculation of default value according design parameters” in the section “mode to calculate absorbed power” on the right side

- inlet temperature of hot water: enter the design value for the inlet temperature of the hot water in the heating coil in °C

- outlet temperature of hot water: enter the design value for the outlet temperature of the hot water in the heating coil in °C

- minimum temperature of outdoor air: enter the nominal value of the outdoor air temperature in °C with which the heat capacity of the heating coil was originally designed

- mode to calculate absorbed power: in this section, the calculation mode to determine the absorbed power of the heating coil pump can chosen. There are three types of modes available:
  - direct input of the absorbed power: this mode should be selected, if the real value of the absorbed power is known

  - calculation according RECOMMENDATION: this mode should be selected, if the real value of the water flow through coil is known; in this mode the calculation of the absorbed power is in full alignment with the EUROVENT RECOMMENDATION

  - calculation of default value according design parameters: this mode should be selected, if neither the absorbed power nor the water flow though the coil is known; in this mode the water flow and the absorbed power is roughly calculated by the given design data of the coil

- direct input value of absorbed power: enter the real value of the absorbed electrical power of the heating coil pump, if known

- calculation value of absorbed power: depiction of the calculation value of the absorbed power of the coil pump

- total efficiency of pumps and motors: enter the percentage of the total efficiency of utilized coil pump

- pump speed control system installed: selection whether pump speed control system is installed or not

- primary energy losses in power supply cable to electric heater: enter the percentage of the energy losses which occur in the power supply cables of electric heaters (see Table of default values in the RECOMMENDATION)

Cooling Coils:
In this section the design and operation parameters of the utilized cooling coils of the air handling unit are defined.

- type of cooling coil installed: select of the type of utilized heating coil (water coils, direct expansion coils)

- annual operation time of cooling coil: depiction of the calculation result of the annual running time utilized cooling coil

- inlet temperature of chilled water / refrigerant: enter the design value for the inlet temperature of the chilled water or the refrigerant in the cooling coil in °C

- outlet temperature of chilled water / refrigerant: enter the design value for the outlet temperature of the chilled water or the refrigerant in the cooling coil in °C

- maximum temperature of outdoor air: enter the nominal value of the outdoor air temperature in °C with which the cooling capacity of the cooling coil was originally designed

- fluid flow through cooling coil: enter the fluid flow through the cooling coil in l/s; if the value is not available, you can determine a default value by selecting “calculation of default value according design parameters” in the section “mode to calculate absorbed power” on the right side

- coil related pressure drop in cooling system: enter the design value for the waterside pressure drop of the chilled water system in kPa

- water side pressure drop: enter the design value for the waterside pressure drop across in the cooling coil in kPa

- mode to calculate absorbed power: in this section, the calculation mode to determine the absorbed power of the cooling coil pump can chosen. There are three types of modes available:
  - direct input of the absorbed power: this mode should be selected, if the real value of the absorbed power is known
  - calculation according RECOMMENDATION: this mode should be selected, if the real value of the fluid flow through coil is known; in this mode the calculation of the absorbed power is in full alignment with the EUROVENT RECOMMENDATION
  - calculation of default value according design parameters: this mode should be selected, if neither the absorbed power nor the fluid flow though the coil is known; in this mode the fluid flow and the absorbed power is roughly calculated by the given design data of the coil

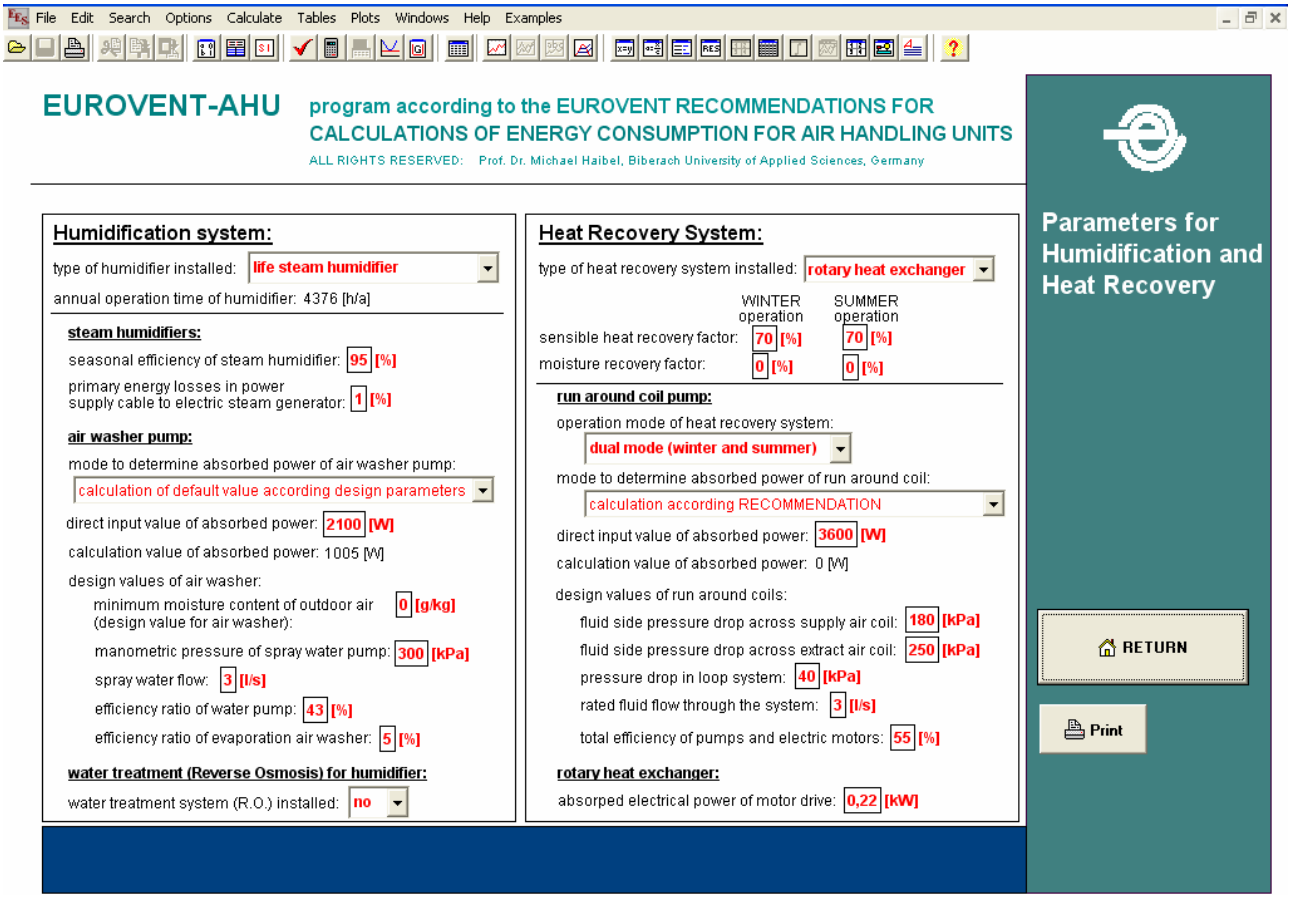
- direct input value of absorbed power: enter the real value of the absorbed electrical power of the cooling coil pump, if known

- calculation value of absorbed power: depiction of the calculation value of the absorbed power of the coil pump

- total efficiency of pumps and motors: enter the percentage of the total efficiency of utilized coil pump
- pump speed control system installed: selection whether pump speed control system is installed or not

Frame: Set Parameters of humidification and heat recovery system:

In this frame you can define the types and the design and operation parameters of the utilized humidification and heat recovery systems and the parameters and calculation mode to determine the absorbed power of the air washer pumps and run around coil pumps.



Humidification System:

In this section the design and operation parameters of the utilized systems of the air handling unit for the humidification of the supply air are defined.

- type of humidifier installed: select of various type of steam and spray humidifier system; if not humidification system is required, it should be selected “no humidifier installed”
- annual operation time of humidifier: depiction of the calculation result of the annual running time utilized humidification system

- seasonal efficiency of steam humidifier: enter the percentage of the seasonal efficiency of utilized steam humidification system (see Table of default values in the RECOMMENDATION)

- primary energy losses in power supply cable to electric steam generator: enter the percentage of the energy losses which occur in the power supply cables of electric steam generator (see Table of default values in the RECOMMENDATION)

- mode to calculate absorbed power: in this section, the calculation mode to determine the absorbed power of the pump to run the air washer can chosen. There are three types of modes available:
  - direct input of the absorbed power: this mode should be selected, if the real value of the absorbed power is known
  - calculation according RECOMMENDATION: this mode should be selected, if the real value of the spray water flow through coil is known; in this mode the calculation of the absorbed power is in full alignment with the EUROVENT RECOMMENDATION
  - calculation of default value according design parameters: this mode should be selected, if neither the absorbed power nor the spray water flow of the air washer is known; in this mode the spray water flow and the absorbed power is roughly calculated by the given design data of the coil

- direct input value of absorbed power: enter the real value of the absorbed electrical power of the air washer pump, if known

- calculation value of absorbed power: depiction of the calculation value of the absorbed power of the air washer pump

- manometric pressure of spray water pump: enter the value of the overpressure in kPa, generated by the spray water pump

- spray water flow: enter the value of the spray water flow in l/s in the air washer

- efficiency of water pump: enter the percentage of the efficiency of utilized water pump (see Table of default values in the RECOMMENDATION)

- efficiency ratio of evaporation air washer: enter the percentage of circulating spray water, which evaporates in the air washer (default value: 5%)

- water treatment for humidifier: select, whether a reverse osmosis system (R.O.) for the treatment of water is installed or not

Heat Recovery System:
In this section the design and operation parameters of the utilized heat recovery systems of the air handling unit are defined.

- type of heat recovery system installed: select of the type of utilized heat recovery system (plate heat exchanger; rotary heat exchanger; run around coils)

- sensible heat recovery factor: enter the value of the sensible heat recovery factor in % of the utilized heat recovery system

- moisture recovery factor: enter the value of the moisture recovery factor in % of the utilized heat recovery system

- mode to calculate absorbed power: in this section, the calculation mode to determine the absorbed power of the pumps to operate the run around coil system can chosen. There are three types of modes available:
  - direct input of the absorbed power: this mode should be selected, if the real value of the absorbed power is known

  - calculation according RECOMMENDATION: this mode should be selected, if the real value of the fluid flow through run around coils is known; in this mode the calculation of the absorbed power is in full alignment with the EUROVENT RECOMMENDATION

  - calculation of default value according design parameters: this mode should be selected, if neither the absorbed power nor the fluid flow though the run around coils is known; in this mode the fluid flow and the absorbed power is roughly calculated by the given predefined design data of the run around coil system (airborne temperatures: $t_{outdoor}$ = -5°C; $t_{extract}$ = 24°C; temperature spreading in fluid flow: 10 K)

- direct input value of absorbed power: enter the real value of the absorbed electrical power of the run around coil pump, if known

- calculation value of absorbed power: depiction of the calculation value of the absorbed power of the run around coil pump

- fluid side pressure drop across supply air coil: enter the design value for the waterside pressure drop of the supply air coil in kPa

- fluid side pressure drop across extract air coil: enter the design value for the waterside pressure drop of the extract air coil in kPa

- pressure drop in loop system: enter the design value for the pressure drop in the loop system of the run around coil system in kPa

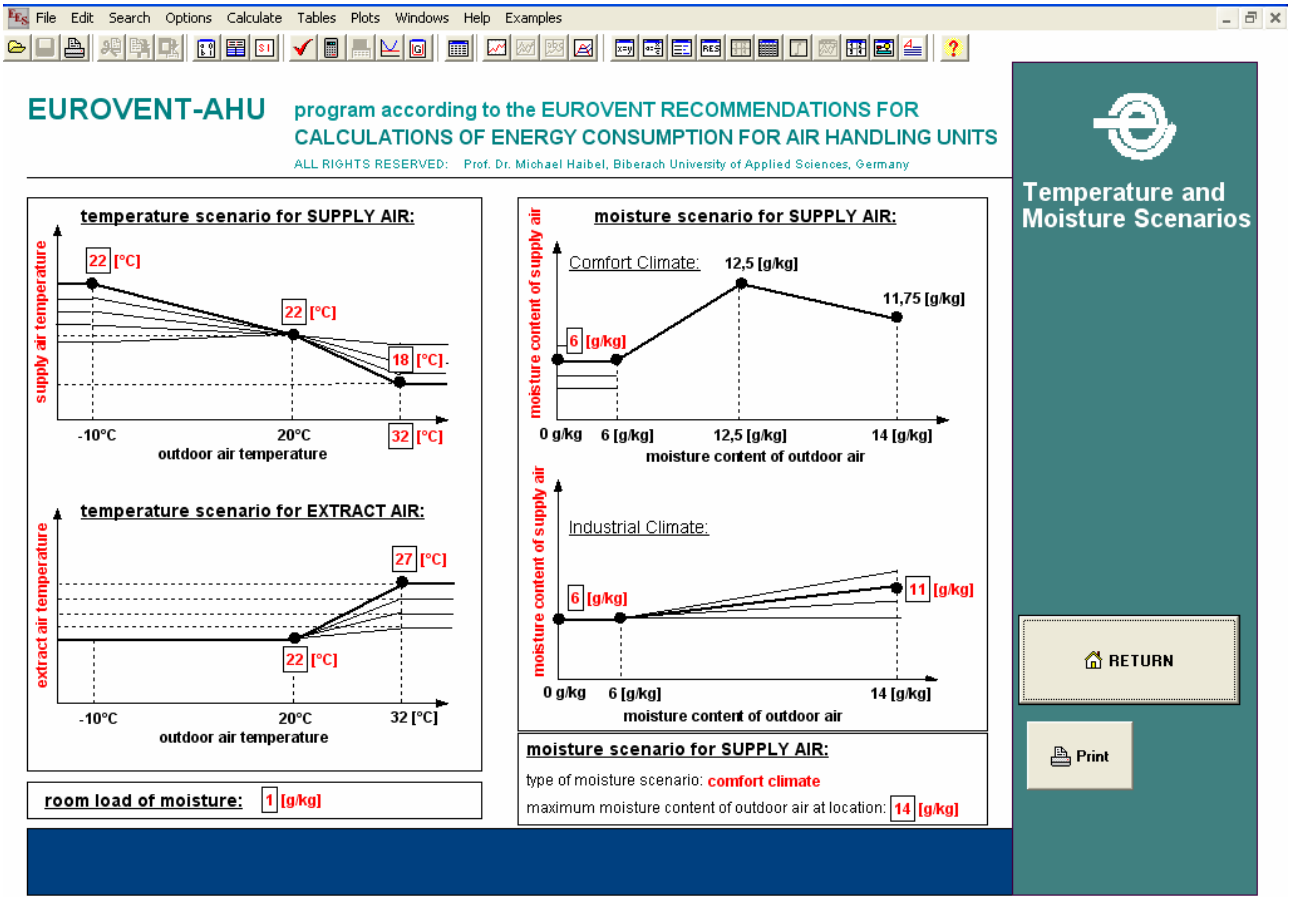
- rated fluid flow through the system: enter the fluid flow through the run around coil system in l/s; if the value is not available, you can determine a default value by selecting “calculation of default value according design parameters” in the section “mode to calculate absorbed power” on the right side

- total efficiency of pumps and motors: enter the percentage of the total efficiency of utilized pump for the run around coil system

- absorbed electrical power of the motor drive: enter the value of the absorbed electrical power of the drive motor of the utilized rotary heat exchanger

Frame SET TEMPERATURE AND MOISTURE SCENARIOS

In this frame you can define the temperature and the moisture content of the supply air in dependence on the temperature and moisture content of the outdoor air, the temperature of the extract air in dependence of the outdoor air temperature and the increase of the moisture content in the extract air due to room loads



temperature scenario of SUPPLY AIR:
You can define the characteristics of the supply air temperature and its dependence on the outdoor air temperature by entering four basic values:

- supply air temperature at outdoor air temperature of -10°C
- supply air temperature at outdoor air temperature of 20°C
- supply air temperature at maximum design outdoor air temperature
- maximum design outdoor air temperature

temperature scenario for EXTRACT AIR:
You can define the characteristics of the extract air temperature and its dependence on the outdoor air temperature by entering two basic values:
- extract air temperature at maximum design outdoor air temperature
- extract air temperature at outdoor air temperature of 20°C

NOTE: The extract air temperature at outdoor air temperature of 20°C should not be below the supply air temperature

room load of moisture:
You can enter the expected increase of moisture content due to room loads

moisture scenario of SUPPLY AIR:
Two types of moisture scenarios for the supply air are given:
- Comfort Climate
- Industrial Climate:

Comfort Climate: You can define the characteristics of the moisture content of the supply air and its dependence on the moisture content of the outdoor air by entering the minimum required moisture content of the supply air:
- minimum moisture content of the supply air

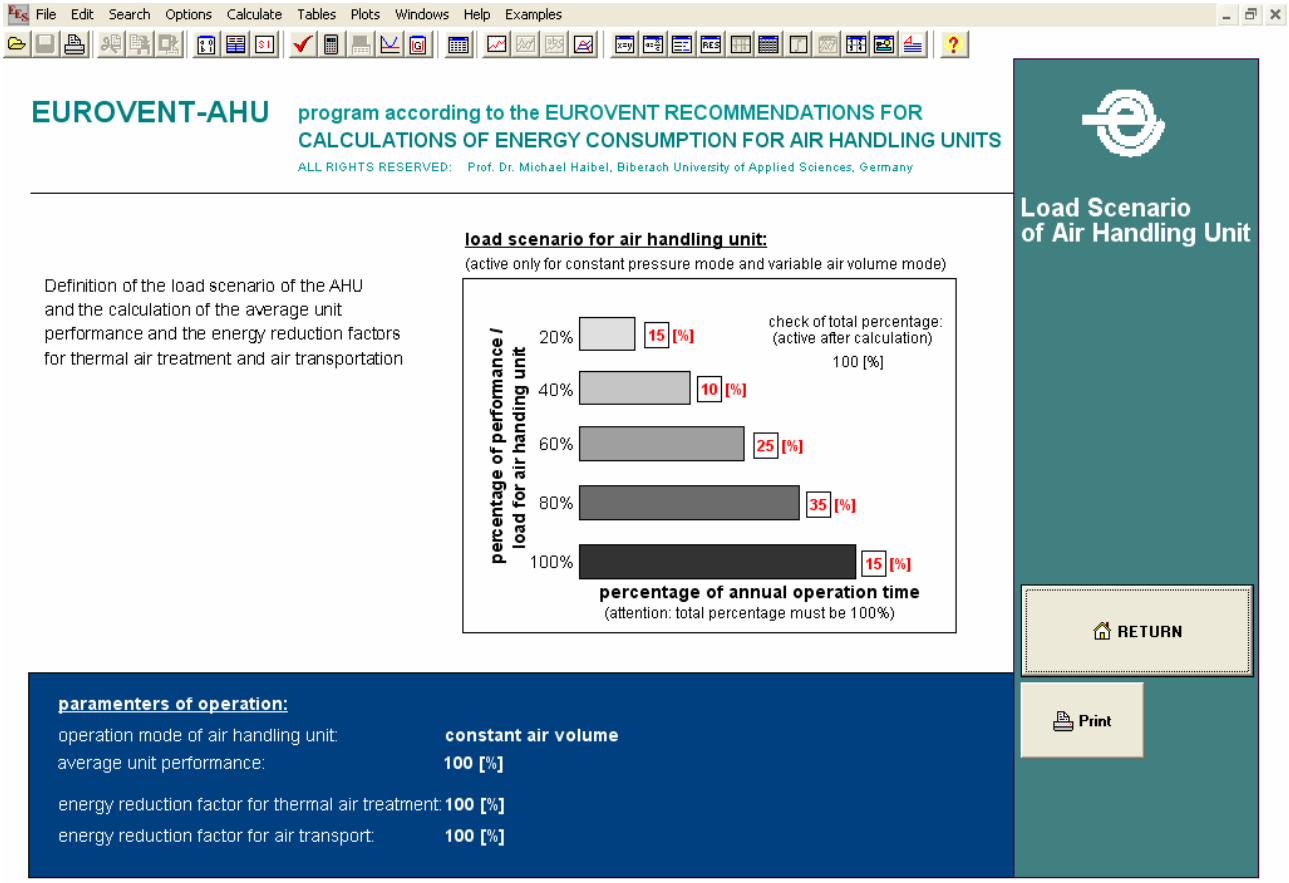
Industrial Climate: You can define the characteristics of the moisture content of the supply air and its dependence on the moisture content of the outdoor air by entering two basis values:
- minimum moisture content of the supply air
- moisture content at design value of maximum moisture content of the outdoor air

NOTE: If you do not require any moisture control, enter the same moisture content for the supply air as given for the outdoor air.

- type of moisture scenario: selection of the required moisture scenario (comfort climate; industrial climate)
- maximum moisture content of outdoor air at location: enter the maximum moisture content of outdoor air at the location of interest

Frame SET LOAD SCENARIO

In this frame you can define the performance of the air handling system and the load scenario respectively to obtain the average unit performance and the energy reduction factors for thermal air treatment and air transport for the unit operation modes “variable air volume” and “constant pressure”



load scenario for air handling unit:
The diagram depicted consists of 5 columns, representing the operation of the air handling with a performance of 20%, 40%, 60%, 80% and 100%. To define the estimated, expected or determined performance profile of the air handling unit, you can enter the percentage of annual operation time of the unit for each of the 5 performance values (20%, 40%, 60%, 80%, 100%).

NOTE: the total percentage of operation time must be 100%

NOTE: the load scenario is only active for the unit operation modes “constant pressure” and “variable air volume”

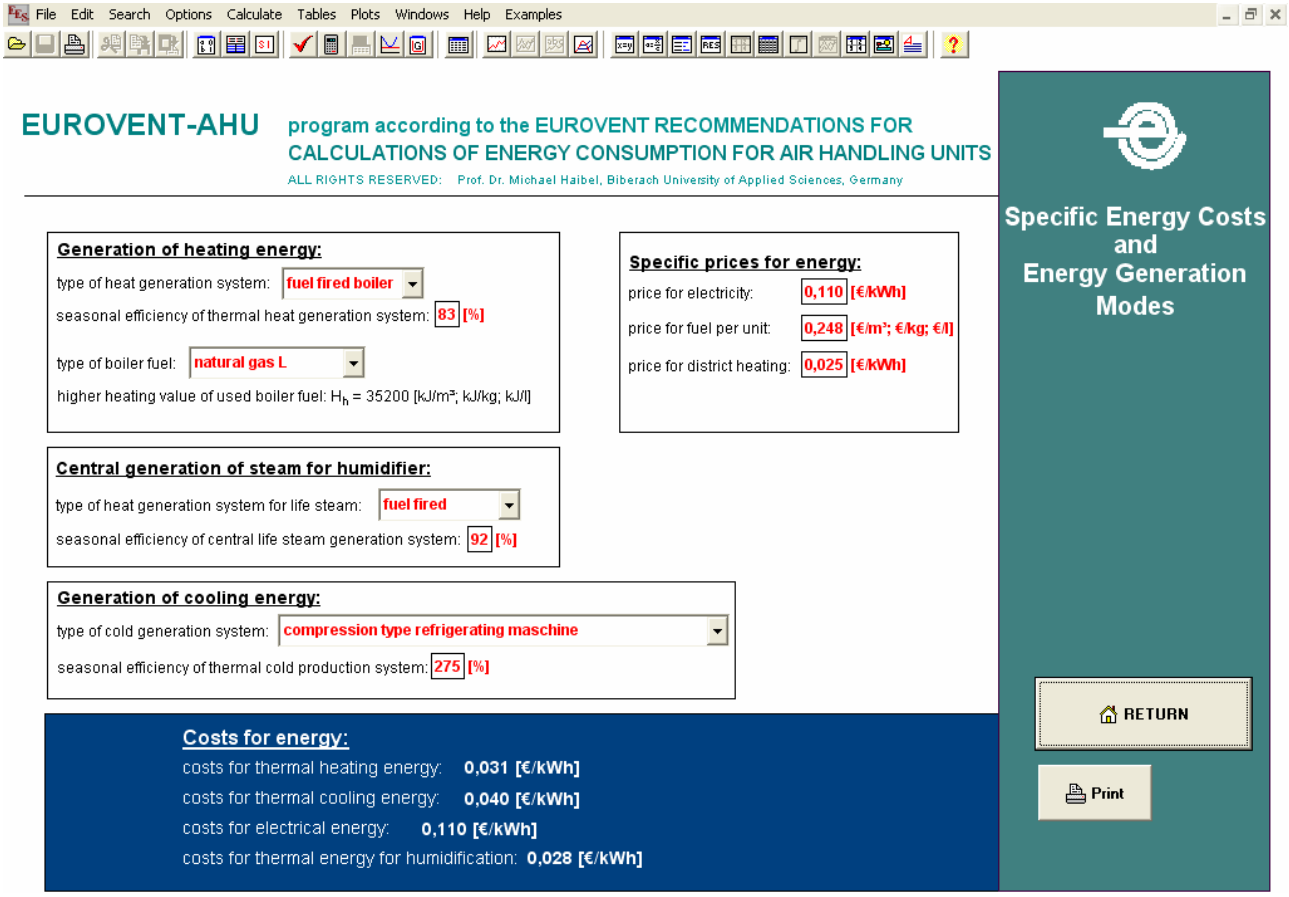
parameters of operation:
In this section the calculated operation parameters due to the defined load scenario are depicted:

- operation mode of air handling unit (copy of input from main frame)
- average unit performance
- energy reduction factor for thermal air treatment
- energy reduction factor for air transport

NOTE: the operation parameters will not be depicted unit the calculation process was activated

Frame SET SPECIFIC ENERGY COSTS:

In this frame you can enter the specific prices (€ per kWh) for electrical energy, fuel and district heating and select the types of and seasonal efficiencies for the generation systems for heating energy, cooling energy and steam.



Generation of heating energy:

- type of heat generation system: select the type of heat generation system or type of heating energy provided (fuel fired boiler; electric boiler; district heating)

- seasonal efficiency of thermal heat production system: enter the percentage of the seasonal efficiency of the utilized type of heat generation system (see Table of default values in the RECOMMENDATION)

- type of boiler fuel: select the type of boiler fuel utilized (natural gas H; natural gas L; light oil; users specification)

- higher heating value of used boiler fuel: depiction of the higher heating value of the selected fuel; if you've selected "users specification" you can enter the number of the higher heating value

Generation of cooling energy:

- type of cold generation system: select the type of cold generation system utilized

(compression type refrigerating machine; hot water absorption refrigerating machine; direct fired absorption refrigerating machine)

- seasonal efficiency of thermal cold production system: enter the percentage of the seasonal efficiency of the utilized type of cold generation system (see Table of default values in the RECOMMENDATION)

Generation of steam for humidifier:

- seasonal efficiency steam humidifier: enter the percentage of the seasonal efficiency of the utilized type of steam humidifier (see Table of default values in the RECOMMENDATION)

Specific prices for energy:

- prize for electrical energy: enter the prize of electrical energy (€/kWh) at the location of interest
- fuel prize per unit: enter the prize for required liquid, gaseous or solid fuel (unit depending on type of fuel: €/m³; €/l; €/kg) at the location of interest
- prize for district heating: enter the prize for district heating (€/kWh) at the location of interest

Costs for energy:

In this section the calculated values of the energy costs are depicted.

- costs for thermal heating energy
- costs for thermal cooling energy
- costs for electrical energy
- costs for thermal energy for humidification

NOTE: the costs for energy will not be depicted unit the calculation process was activated

5. User defined locations

If you are not satisfied with the climate date stored in the data base of EUROVENT-AHU, you can import your own climate data. Therefore you find in end of the pull down menu LOCATION OF BUILDING (in the main frame) the “locations” USER’S LOCATION 1 to 5. These locations have no stored climate data and stand by to import your own data.

NOTE: please be aware that imported climate data can not be saved in the exe-version of the program. This means, that you have to feed the program with these data each time you open EUROVENT-AHU (see. section SAVING OF USER’S CLIMATE DATA and section OPENING OF USER’S CLIMATE DATA)

In the upcoming chapter, the procedure of importing, saving and re-opening of user defines locations will be explained.

Format of user's climate data

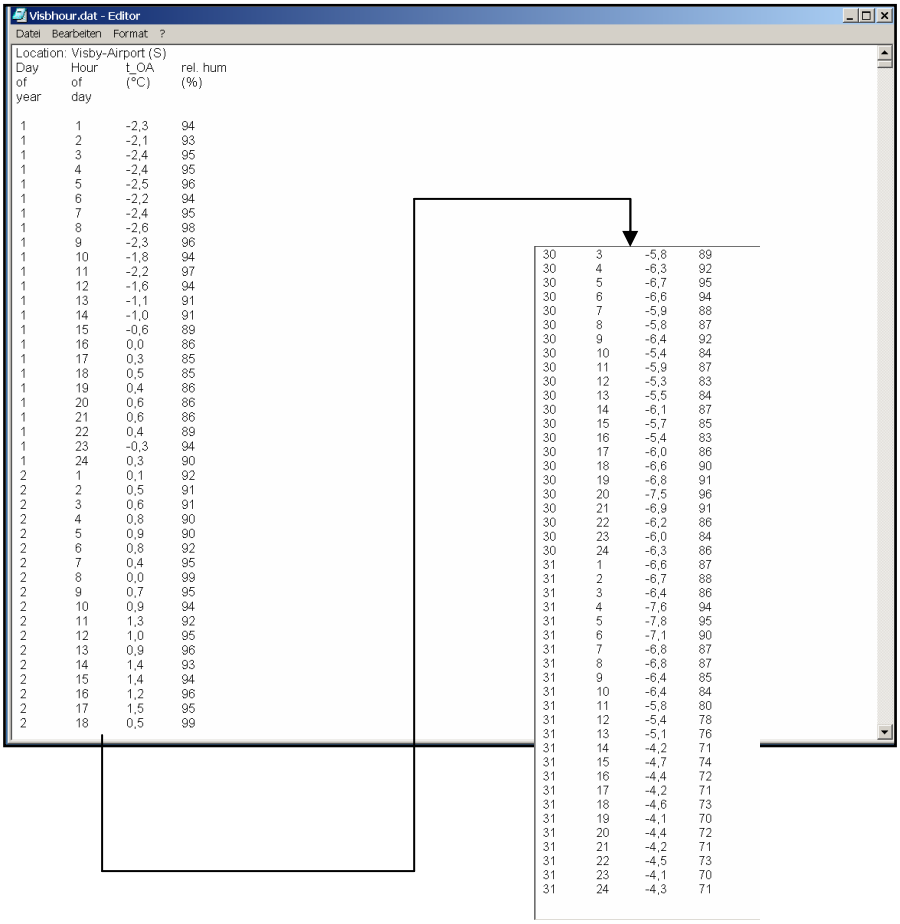
To work with your own climate data, these data must have a specific format. To feed the tables with your own test reference year (TRY) properly, the data must be given in 4 columns:

- column 1: day of month (already set in the table)
- column 2: hour of day (already set in the table)
- column 3: temperature of outdoor air (unit: °C)
- column 4: relative humidity of outdoor air (unit: %)

The data base of our test reference year must have 8760 lines, representing each hour of a year.

The format of the data base can be an ASCII-format, a copy of an ECXEL-sheet or what ever.

Upcoming figure depicts an example of an ASCII-data base.



Input of user's climate data

In this section you will be shown how you can import your own climate data into EUROVENT-AHU.

Step 1: open lookup table of user's location (user's location 1, 2, 3, 4 or 5) via >>Windows → Lookup Table → user's location 1 (or 2 or 3 or etc.)<<

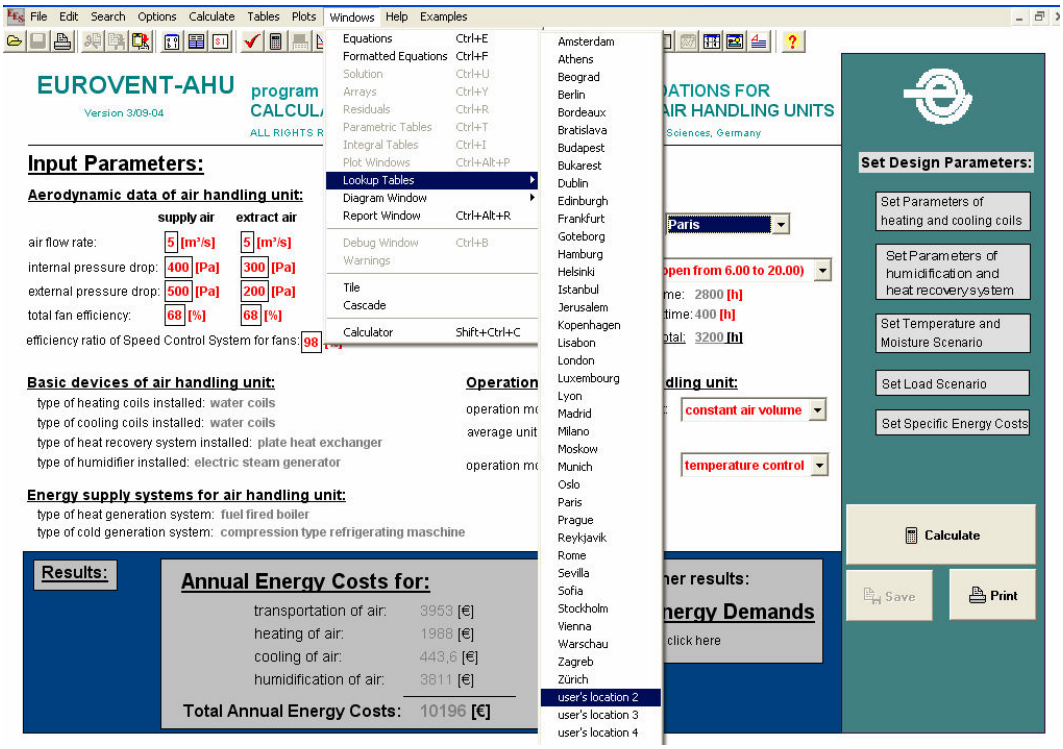
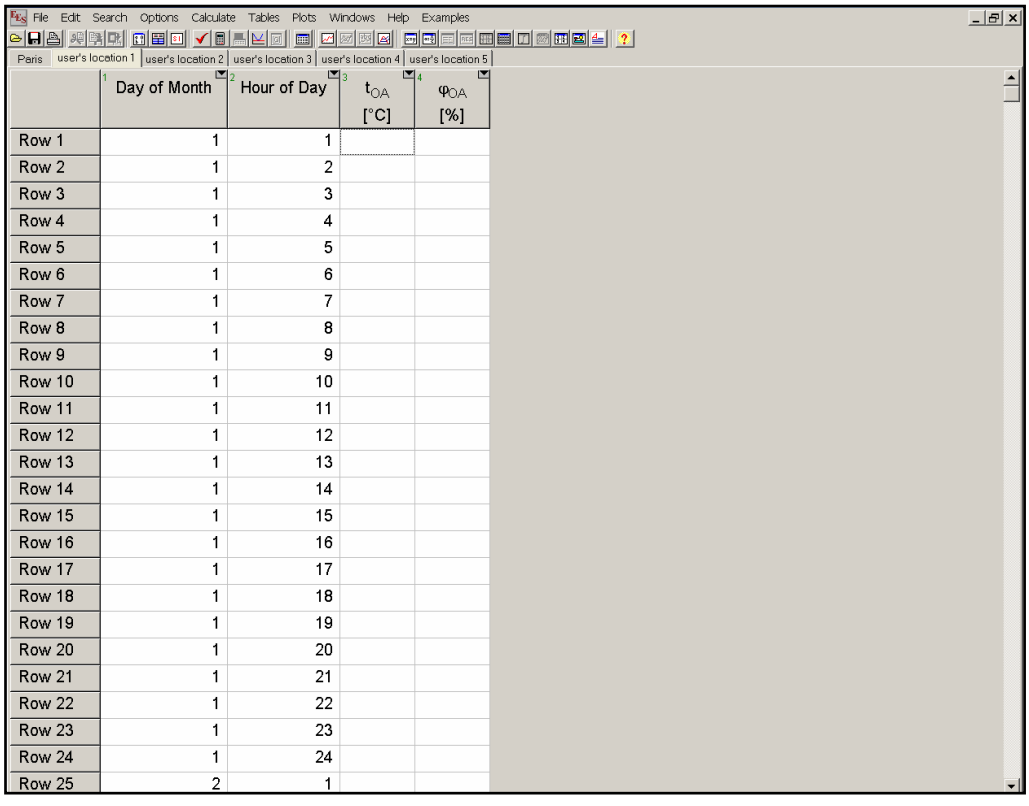


Image of the opened lookup table "user's location 1"



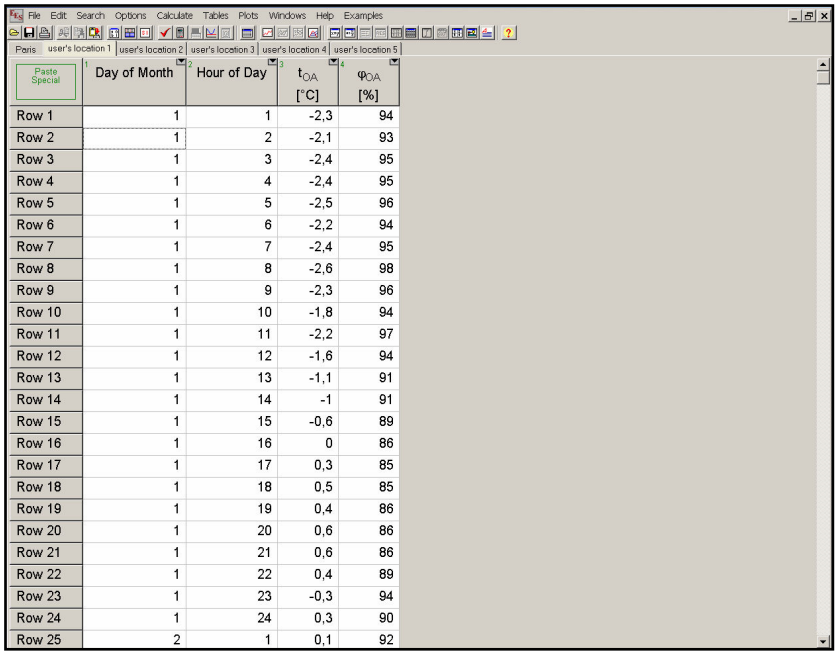
	1 Day of Month	2 Hour of Day	3 t_{OA} [°C]	4 φ_{OA} [%]
Row 1	1	1		
Row 2	1	2		
Row 3	1	3		
Row 4	1	4		
Row 5	1	5		
Row 6	1	6		
Row 7	1	7		
Row 8	1	8		
Row 9	1	9		
Row 10	1	10		
Row 11	1	11		
Row 12	1	12		
Row 13	1	13		
Row 14	1	14		
Row 15	1	15		
Row 16	1	16		
Row 17	1	17		
Row 18	1	18		
Row 19	1	19		
Row 20	1	20		
Row 21	1	21		
Row 22	1	22		
Row 23	1	23		
Row 24	1	24		
Row 25	2	1		

Step 2: Place the cursor at 1st row and 1st column of the lookup table and paste your climate data by CTRL-V

NOTE: to paste the climate data you should copy them first by CRTL-C in the ASCII-editor, EXCEL-sheet or want ever you use

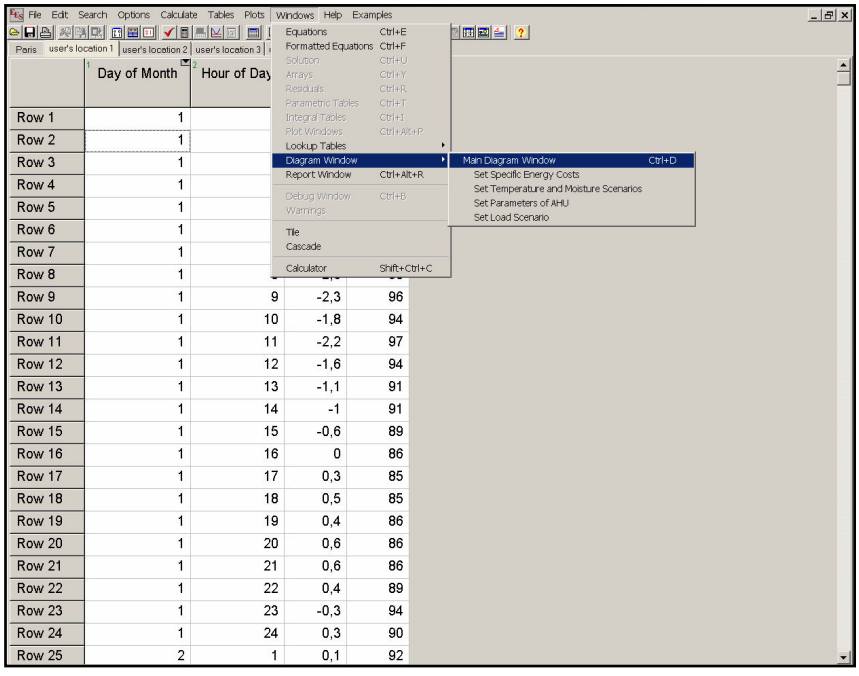
NOTE: be sure that data file you pasted has 8760 lines; if not, EUROVENT-AHU will not work properly

NOTE: if your data base consists only of 2 columns (outdoor ait temperature and relative humidity of outdoor air), place the cursor at the 1st row and 3rd column and paste the data by CTRL-V

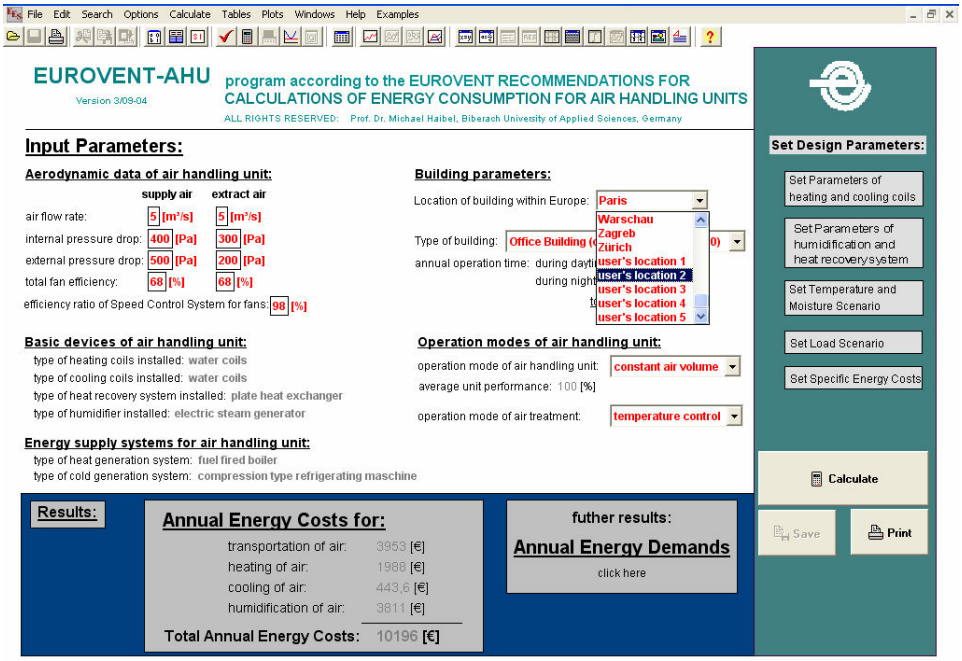


	Day of Month	Hour of Day	t_{OA} [°C]	φ_{OA} [%]
Row 1	1	1	-2,3	94
Row 2	1	2	-2,1	93
Row 3	1	3	-2,4	95
Row 4	1	4	-2,4	95
Row 5	1	5	-2,5	96
Row 6	1	6	-2,2	94
Row 7	1	7	-2,4	95
Row 8	1	8	-2,6	98
Row 9	1	9	-2,3	96
Row 10	1	10	-1,8	94
Row 11	1	11	-2,2	97
Row 12	1	12	-1,6	94
Row 13	1	13	-1,1	91
Row 14	1	14	-1	91
Row 15	1	15	-0,6	89
Row 16	1	16	0	86
Row 17	1	17	0,3	85
Row 18	1	18	0,5	85
Row 19	1	19	0,4	86
Row 20	1	20	0,6	86
Row 21	1	21	0,6	86
Row 22	1	22	0,4	89
Row 23	1	23	-0,3	94
Row 24	1	24	0,3	90
Row 25	2	1	0,1	92

Step 3: Return to the main frame of the program via
>>Windows → Diagram Windows → Main Diagram Window<<



Step 4: Select “user’s location 1” (or 2or 3or etc.) in the pull down menu LOCATION OF BUILDING

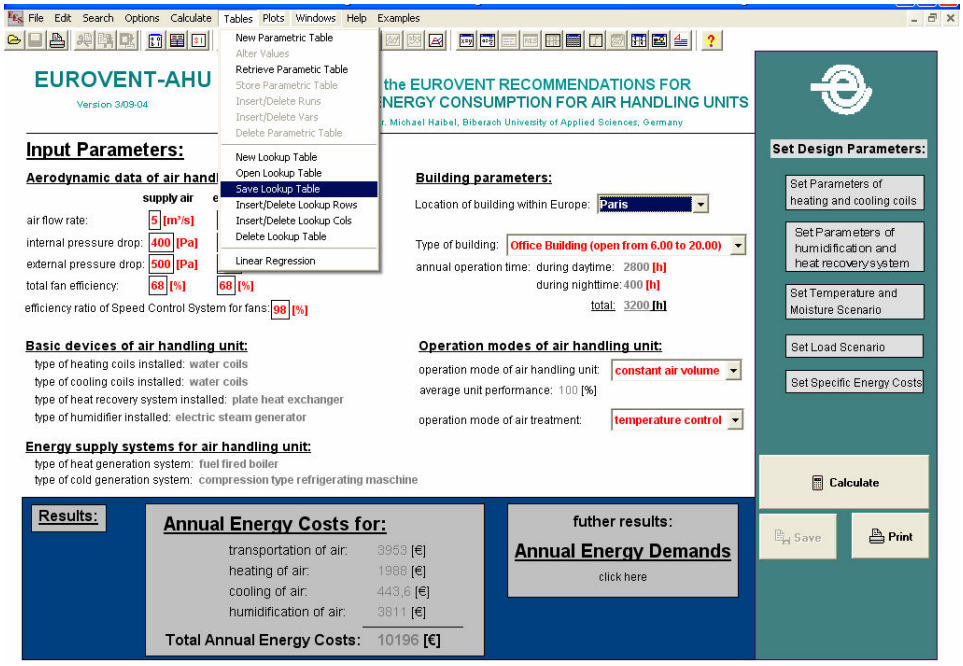


Now you can begin with the regular set of parameters or with the calculation procedure.

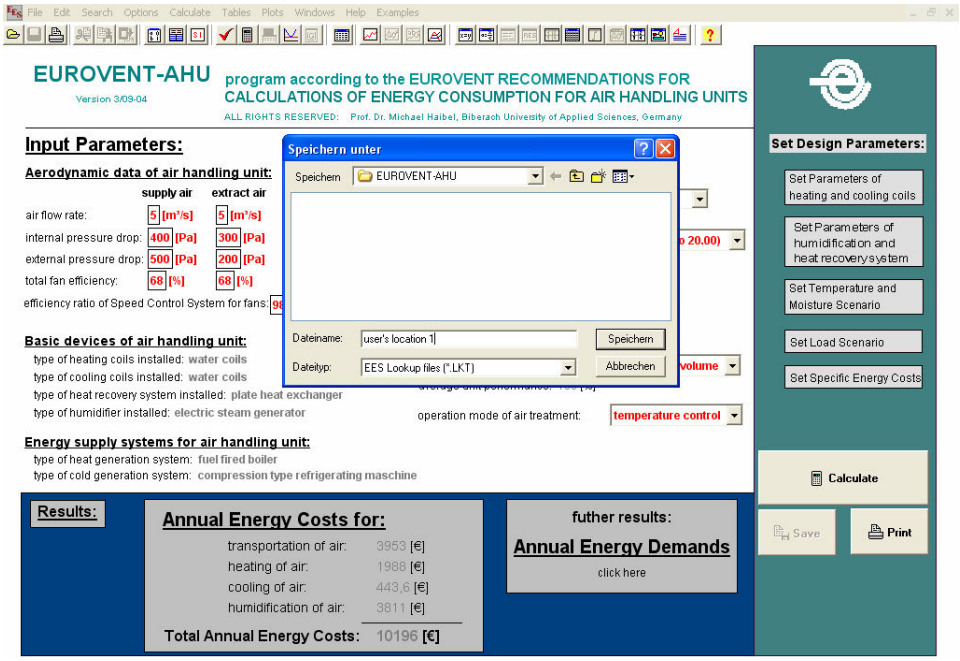
Saving of user's climate data

In this section you will be shown how you can save your own climate data in a special file, so that you can transfer it easily after restarting EUROVENT-AHU.

Step 1: open saving operation via
>>Windows → Lookup Table → Save Lookup Table<<



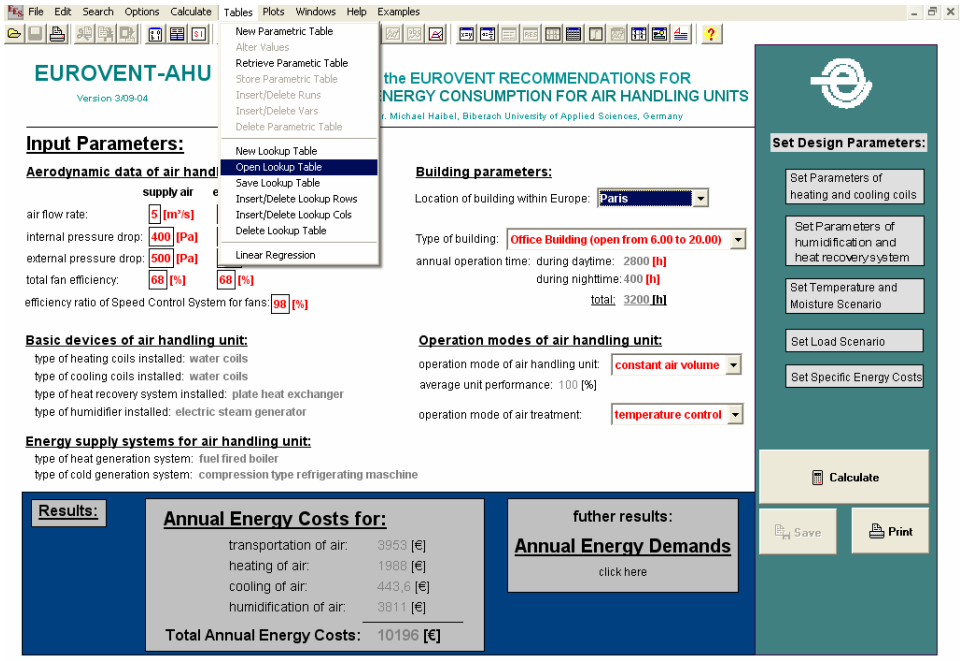
Step 2: Save the lookup table with the same name as the name of the original table, i.e. user's location 1 (or 2 or 3 or 4 or 5).
ATTENTION: never use other file names as the original table names (user's location 1 or 2 or 3 or 4 or 5).
NOTE: the file must be stored in the save directive as the exe-file of EUROcalc



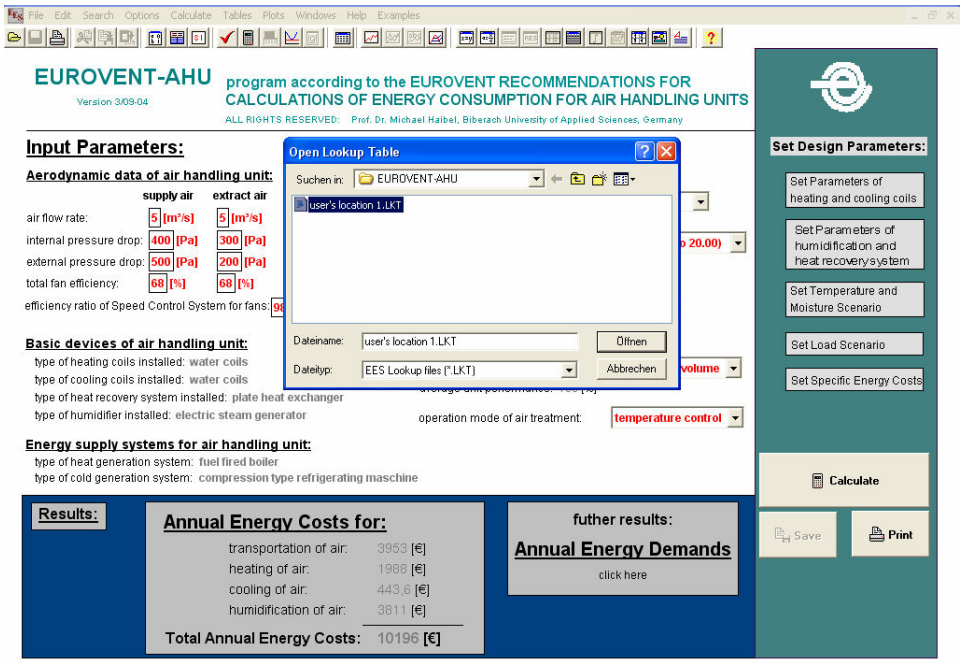
Opening of user's climate data

In this section you will be shown how you can open your own saved climate data to transfer them into the program after restarting EUROVENT-AHU.

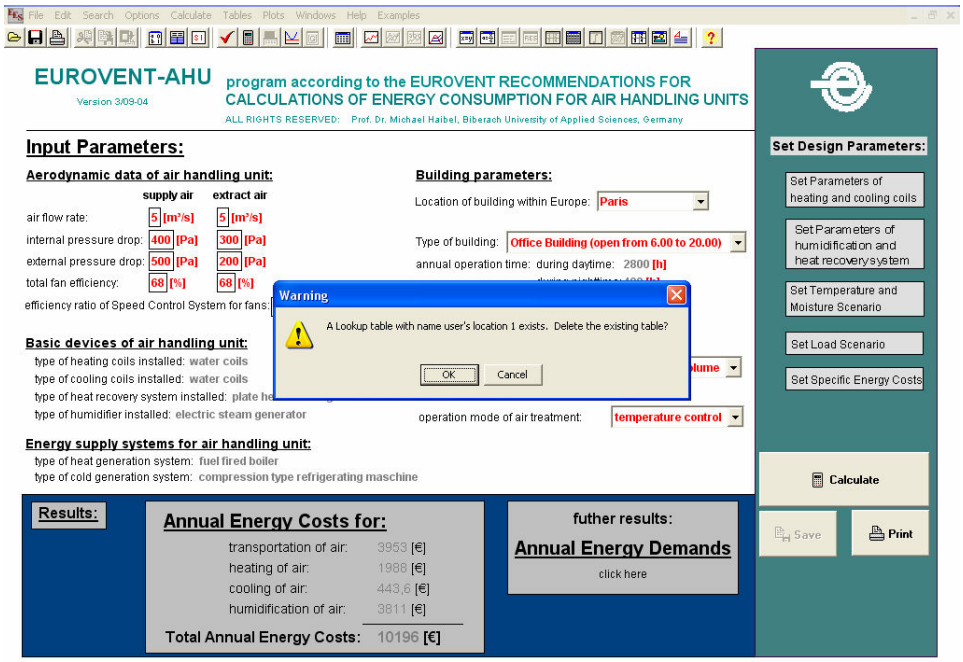
Step 1: open opening operation via
>>Windows → Lookup Table → Open Lookup Table<<



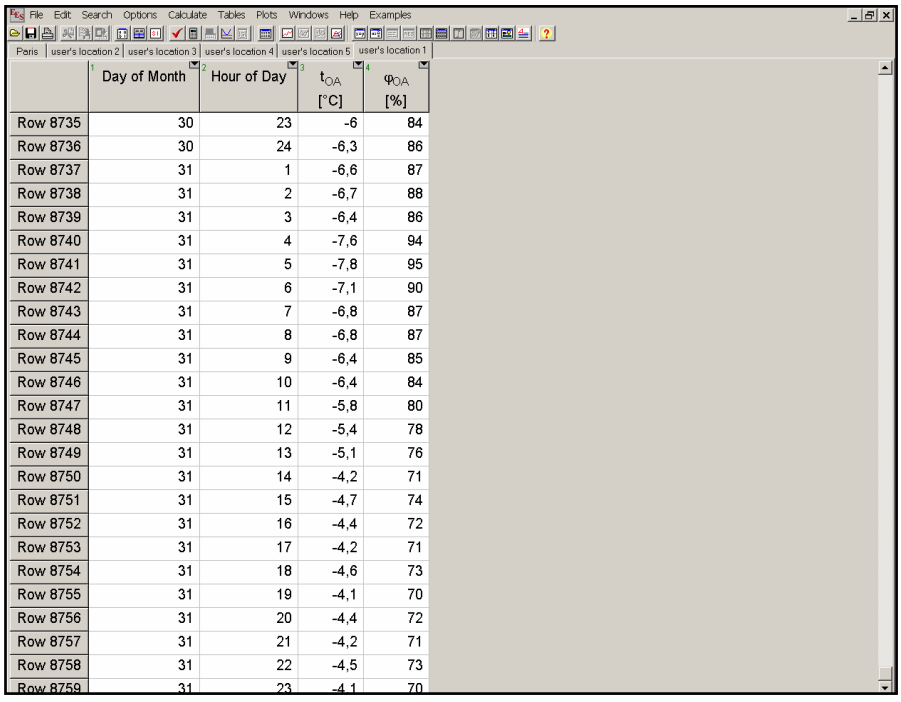
Step 2: Click on the OPEN-button to copy the data file user's location 1.LKT (or 2 or 3 or 4 or 5) in the lookup table of the program



Step 3:As the lookup table user's location 1(or 2 or 3 or 4 or 5) already exists in a predefined version, ignore the warning and click OK



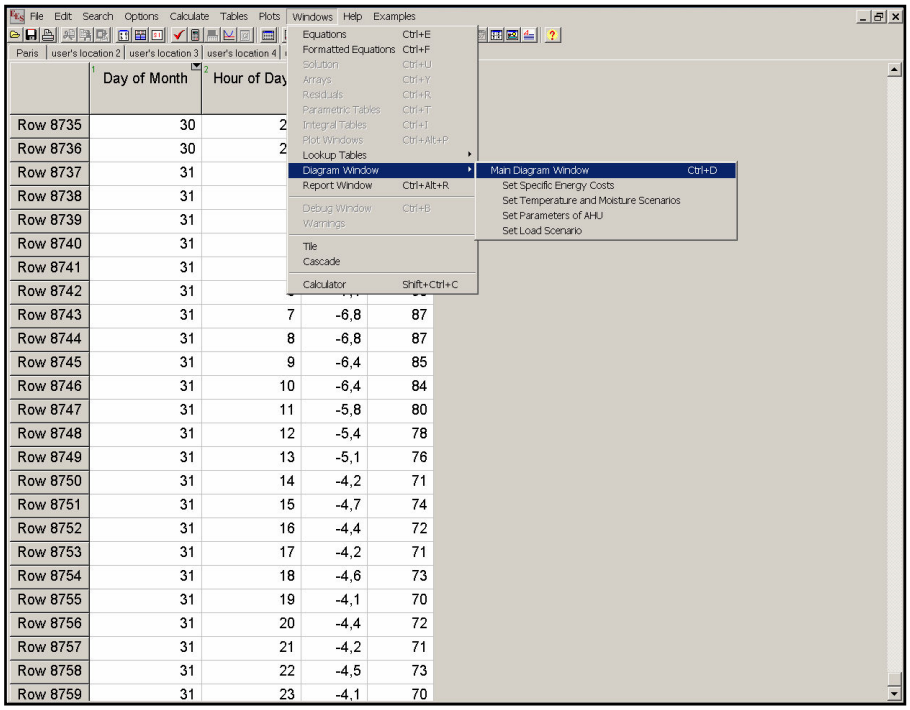
Next, the lookup table window with the imported table is visible



Paris | user's location 2 | user's location 3 | user's location 4 | user's location 5 | user's location 1

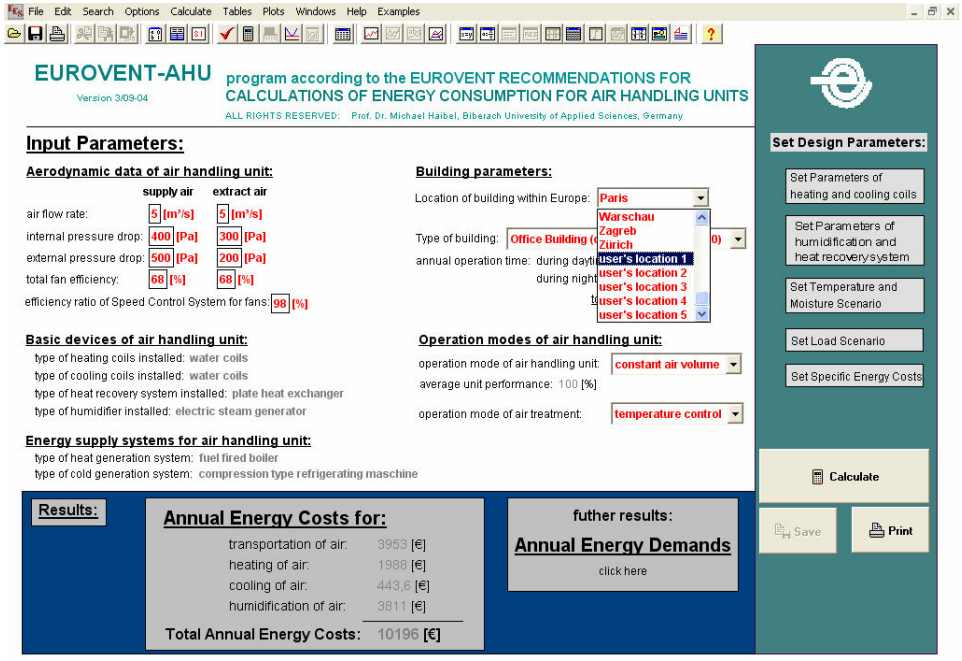
	Day of Month	Hour of Day	t_{OA} [°C]	φ_{OA} [%]
Row 8735	30	23	-6	84
Row 8736	30	24	-6,3	86
Row 8737	31	1	-6,6	87
Row 8738	31	2	-6,7	88
Row 8739	31	3	-6,4	86
Row 8740	31	4	-7,6	94
Row 8741	31	5	-7,8	95
Row 8742	31	6	-7,1	90
Row 8743	31	7	-6,8	87
Row 8744	31	8	-6,8	87
Row 8745	31	9	-6,4	85
Row 8746	31	10	-6,4	84
Row 8747	31	11	-5,8	80
Row 8748	31	12	-5,4	78
Row 8749	31	13	-5,1	76
Row 8750	31	14	-4,2	71
Row 8751	31	15	-4,7	74
Row 8752	31	16	-4,4	72
Row 8753	31	17	-4,2	71
Row 8754	31	18	-4,6	73
Row 8755	31	19	-4,1	70
Row 8756	31	20	-4,4	72
Row 8757	31	21	-4,2	71
Row 8758	31	22	-4,5	73
Row 8759	31	23	-4,1	70

Step 4:Return to the main frame of the program via
>>Windows → Diagram Windows → Main Diagram Windows<<



Row 8735	30	2		
Row 8736	30	2		
Row 8737	31			
Row 8738	31			
Row 8739	31			
Row 8740	31			
Row 8741	31			
Row 8742	31			
Row 8743	31	7	-6,8	87
Row 8744	31	8	-6,8	87
Row 8745	31	9	-6,4	85
Row 8746	31	10	-6,4	84
Row 8747	31	11	-5,8	80
Row 8748	31	12	-5,4	78
Row 8749	31	13	-5,1	76
Row 8750	31	14	-4,2	71
Row 8751	31	15	-4,7	74
Row 8752	31	16	-4,4	72
Row 8753	31	17	-4,2	71
Row 8754	31	18	-4,6	73
Row 8755	31	19	-4,1	70
Row 8756	31	20	-4,4	72
Row 8757	31	21	-4,2	71
Row 8758	31	22	-4,5	73
Row 8759	31	23	-4,1	70

Step 5: Select “user’s location 1” (or 2or 3 or etc.) in the pull down menu LOCATION OF BUILDING



Now you can begin with the regular set of parameters or with the calculation procedure.