VisualEPlus Software

User’s Manul

Version：2.0

Tongji University　　Shandong University

Overview

This manual is offered for users of VisualEPlus, which consists of three parts:

1) Introduction of VisualEPlus installation;
2) Introduction of main interface of VisualEPlus;
3) Users' manual of HVAC configuration & reporting model of VisualEPlus.

Installation introduction

1) As a “Green” Software,VisualEPlus can be used just after unzipped.
2) The path of VisualEPlus mustn’t include chinese characters or space;
3) The uninstallation can be finished just by deleting the directory of VisualEPlus;
4) In Win7,the user must run VisualEPlus as an actor of system administator when first using the software.

Introduction of VisualEPus as an Interface for EnergyPlus

VisualEPlus2.0 is a Chinese interface for EnergyPlus developed by Tongji University (TJU), Shandong University (SDU), in collaboration with White Box Technologies (WBT) and Oak Ridge National Laboratory (ORNL), with support from USDOE through the Asia-Pacific Partnership on Clean Development and Climate. Although the goal of the project was to make EnergyPlus easier to use in China, the interface was designed to be generic, so that it can be used in any country as well as be linked to other modeling tools and interfaces for EnergyPlus.

The interface has three main functions:

(1) A Building Loads Module established through introducing IDF file of EnergyPlus defining the building geometry, envelope, and space conditions;

(2) A HVAC System Module with a drag-and-drop feature for defining the HVAC system;

(3) A View Report Module with a reporting and visualization tool for EnergyPlus reports and outputs.

The interface is bilingual in Chinese and English. The users can choose to start either Chinese (VisualEPlus_CN.exe) or English program (VisualEPlus_CN.exe).

The VisualEPlus2.0 main interface consists of six modules – Building Model, HVAC System, IDF File, Report Setup, Simulation and View Report (Figure 1).

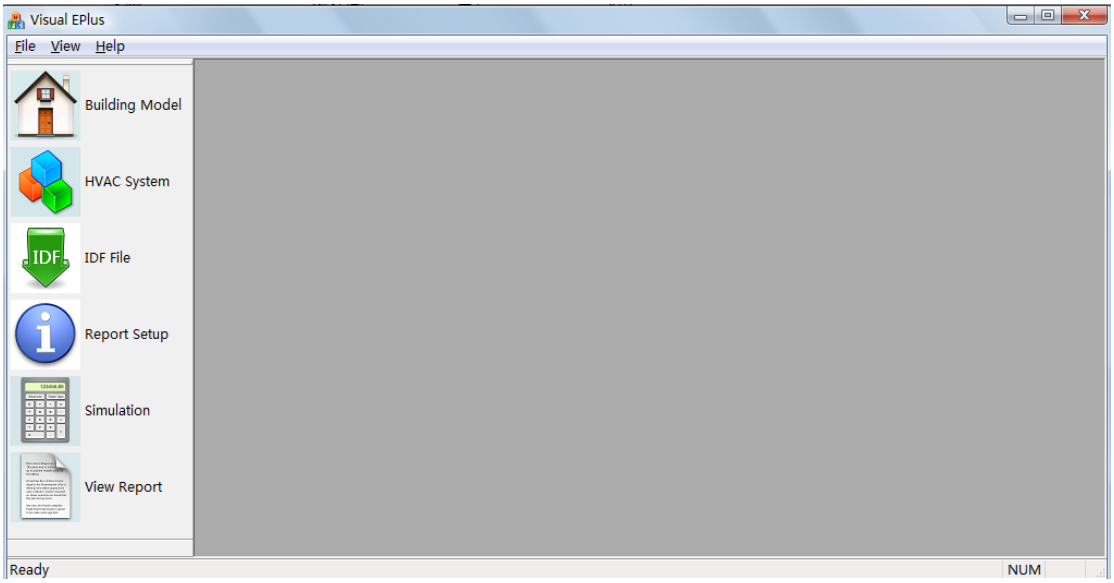

Figure 1 EnergyPlus Interface

The interface of VisualEPlus2.0 is programmed in Delphi and integrates Building Model Module and a drag-and-place graphical interface for HVAC system configuration (HVAC System Module) as well as a reporting and visualization tool for report output (View Report Module). VisualEPlus2.0 is based on Energyplus6.0. Users can import building geometry information of IDF files (converted to version 6.0 of EnergyPlus) established by EnergyPlus (or other user interfaces based on EnergyPlus like DesignBuilder) through the function of “Import building model” in the interface. This software would only read the data of geometry, envelope, internal loads and operating schedules in these file. (Other data in the input IDF file would not be read).

The software would generate a BDL file according to the input data after the building load data input (geometry, envelope, internal load, schedule) is finished. (The file would be saved in an automatic generated folder named *BDL* under current working directory). The drag-and-place HVAC system configuration interface (Figure 2) allows the users to freely configure a HVAC system using basic HVAC components, such as zone, fan, coil, pump, pipe, chiller, boilers, etc.

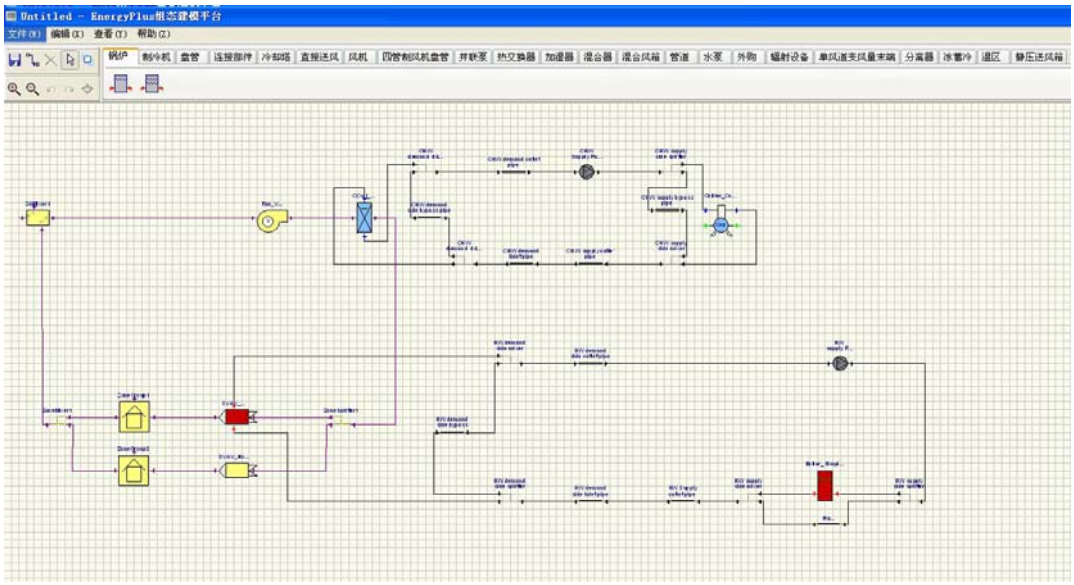

Figure 2 HVAC system interface

The properties of the basic components, such as name, size/autosize, performance curve, node names, branch names and parameters can be changed on the interface (Figure 3).

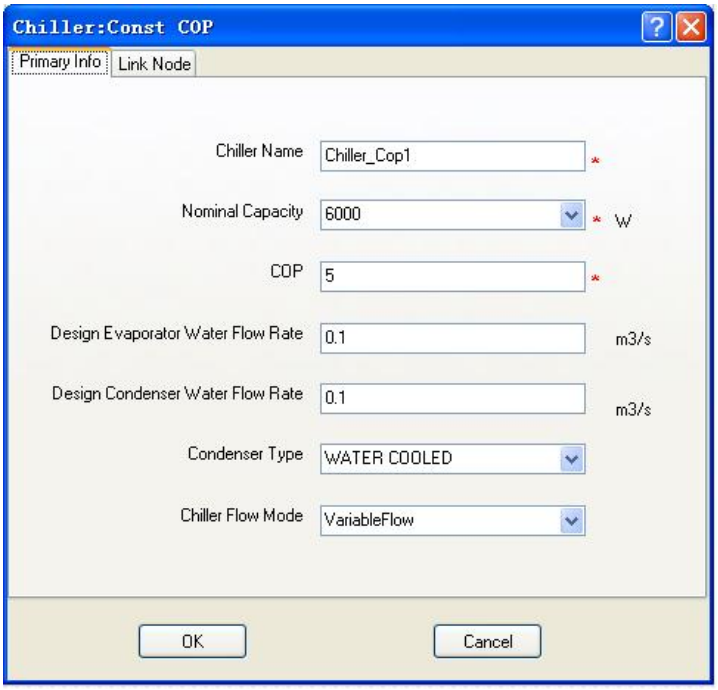

Figure 3 Chiller parameter setup interface

The module of “HVAC system” of VisualEPlus2.0 can develop some forms of HVAC, as below (Table 1, 2, 3).

Table 1 Plant equipments

Heat and cooling resources	Heating source	Boiler: Simple
		Boiler: Steam
	Cooling source	Chiller:Electric
		Chiller:Const COP
		Chiller: Absorption
		Purchased: Chilled Water
		Chiller:Absorption:Indirect
	Heat pump	HeatPump:WaterToWater
Thermal storage	Ice storage	Thermal Storage:Ice:Simple
		Thermal Storage: Ice:Detailed
	Water storage	ThermalStorage:ChilledWater:Mixed
		ThermalStorage:ChilledWater:Stratified
Condenser Equipment	Cooling Tower	Cooling Tower:Single Speed
		Cooling Tower:Two Speed
		Cooling Tower:Variable Speed
	Ground source heat pump	Ground Heat Exchanger: Vertical
		Ground Heat Exchanger:Pond
		Ground Heat Exchanger:Surface
	Other	Heat Exchanger:Hydronic

Table 2 Equipments of water system

Water system form	Primary water system
	Secondary water system
Connection between primary and secondary system	Connection Component:Plantloop
Pump	Pump:Constant Speed
	Pump:Variable Speed
	Headered Pumps:Simple:Constant Speed
	Headered Pumps:Simple:Variable Speed

	Pump:VariableSpeed:Condensate
Coils	Coil:Electric:Heating
	Coil:Water:Cooling, Coil:Water:SimpleHeating
	Coil:Cooling/Heating: DX: Single/Multi Speed

Table3 Equipments of airloop

Fan	Fan:Simple:Const Volume
	Fan:Simple:Variable Volume
	Fan:OnOff
	Fan:ZoneExhaust
	FanPerformance:NightVentilation
Outdoor air	Outside Air Mixer
Supply and return air	Zone Supply Plenum
	AirLoopHVAC:ReturnPlenum
	Zone Splitter
	Zone Mixer
Humidifiers	Humidifier:Steam:Electrical
Heat Recovery	Heat Exchanger:Air to Air:Flat Plate
	Heat Exchanger:Air to Air:Generic
Air Distribution Equipment	Purchased Air
	Fan Coil Unit:4 Pipe
	Single Duct: Uncontrolled
	Single Duct:VAV:Reheat
	Single Duct:VAV:NoReheat
	Single Duct:Series:PIU:Reheat: ConstVolum
	Single Duct:Parallel:PIU:Reheat: ConstVolum
	ZoneHVAC:PackagedTerminalAirConditioner
	ZoneHVAC:PackagedTerminalHeatPump

	ZoneHVAC:WaterToAirHeatPump
	ZoneHVAC:EnergyRecoveryVentilator
Unitary Equipment	AirLoopHVAC:UnitarySystem:HeatPump:AirToAir
	AirLoopHVAC:UnitarySystem:HeatPump:WaterToAir
	AirLoopHVAC:UnitarySystem:MultiSpeedHeatPump:AirToAir
	AirLoopHVAC:UnitaryCoolOnly
Evaporative Coolers	EvaporativeCooler:Direct:CelDekPad
	EvaporativeCooler:Indirect:CelDekPad
Solar Collectors	SolarCollector:FlatPlate:Water

In VisualEPlus2.0, users can configure typical HVAC systems through the function of load template, including: HVAC file, building model file and weather file (Figure 4).

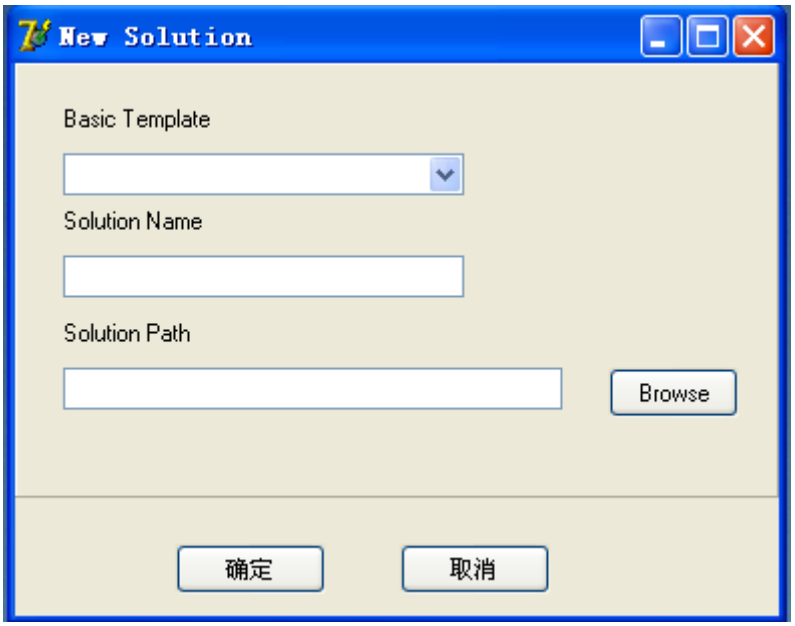

Figure 4 Typical template configuration interface of VisualEPlus2.0

After the user finishes all HVAC system input, the HVAC configuration interface will generate a XML file with user's system configuration data which would be saved in an automatic generated folder named HVAC under current working directory. User could find more detail description of HVAC system configuration in Users' manual of HVAC configuration & reporting model of VisualEPlus. Also, user could use IDF File function (Figure 5) after finish all the data

input to import result IDF file. The software would merge the BDL file with the XML file mentioned above to generate an IDF file which would be saved in an automatic generated folder named output under current working directory.

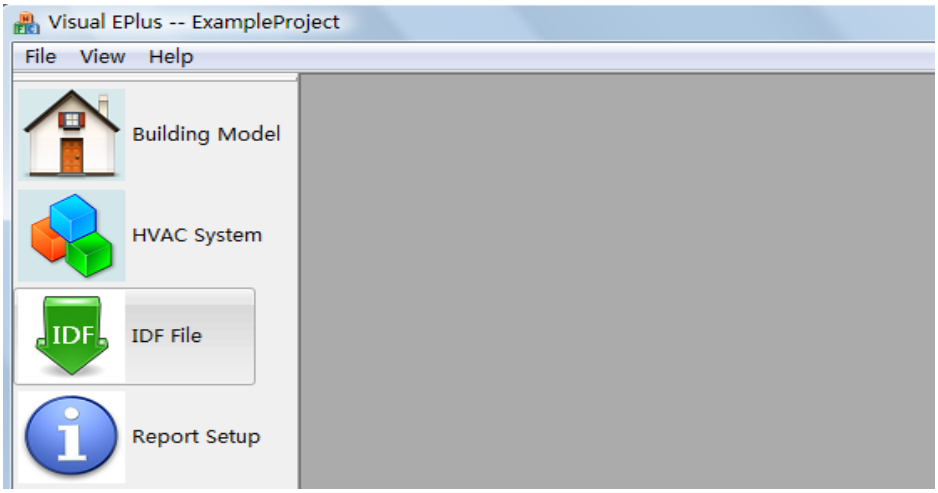

Figure 5 The IDF file export

After the IDF file was generated, user should use Report Setup function to define the variables and meters among all available output data as well as the frequency of outputting. When the Report Setup icon is clicked, the software will have the initial test run. If there is severe error, a warning message window would show up as follow, and then user should modulate the model to eliminate the error before run the simulation (Figure 6).

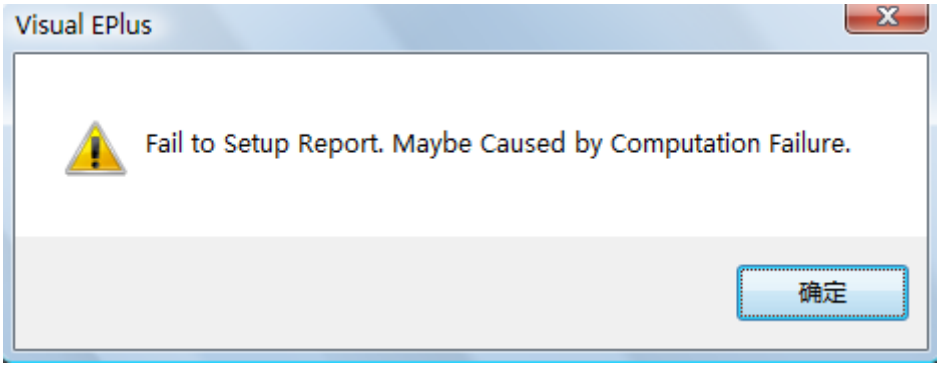

Figure 6 Warning message window

If there is no severe error occurs during simulation, the report setup window (Figure 7) will be activated in which users could select the variables, meters that will be reported and the frequency of reporting.

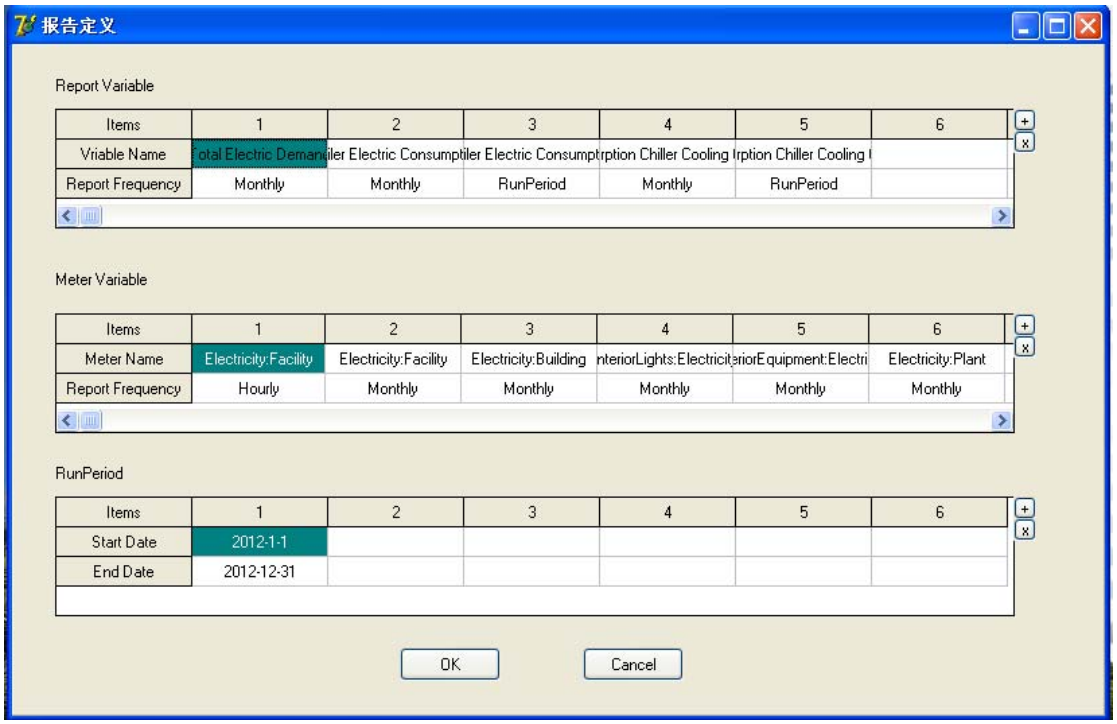

Figure 7 Report setup window

After the report setup is done, the software would add the report definition part to the existing IDF file to generate a complete IDF file for output, review and simulation running (IDF File module).

User could import weather file using Select Weather File function (File-Select Weather File) .The software would generate an EPW file which will be saved in an automatic generated folder named output under current working directory according to the import weather file.

The View Report module is capable of displaying both Standard Report and User-defined Report. Standard Report (Figure 8) includes all-year and monthly energy consumption and all-year and monthly energy cost as well as energy consumption breakdown.

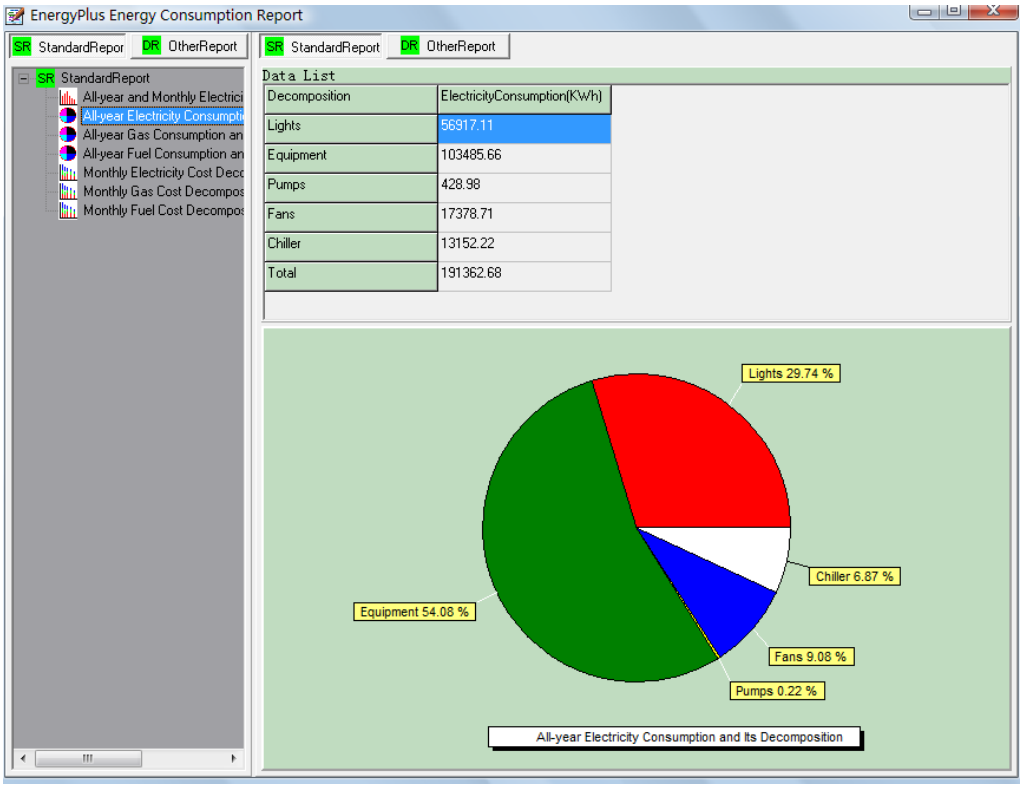

Figure 8 Standard report output interface

User-defined Report can display other simulation results defined by the users, such as indoor air temperatures, flow rates of nodes, hourly energy consumption, etc. (Figure 9)

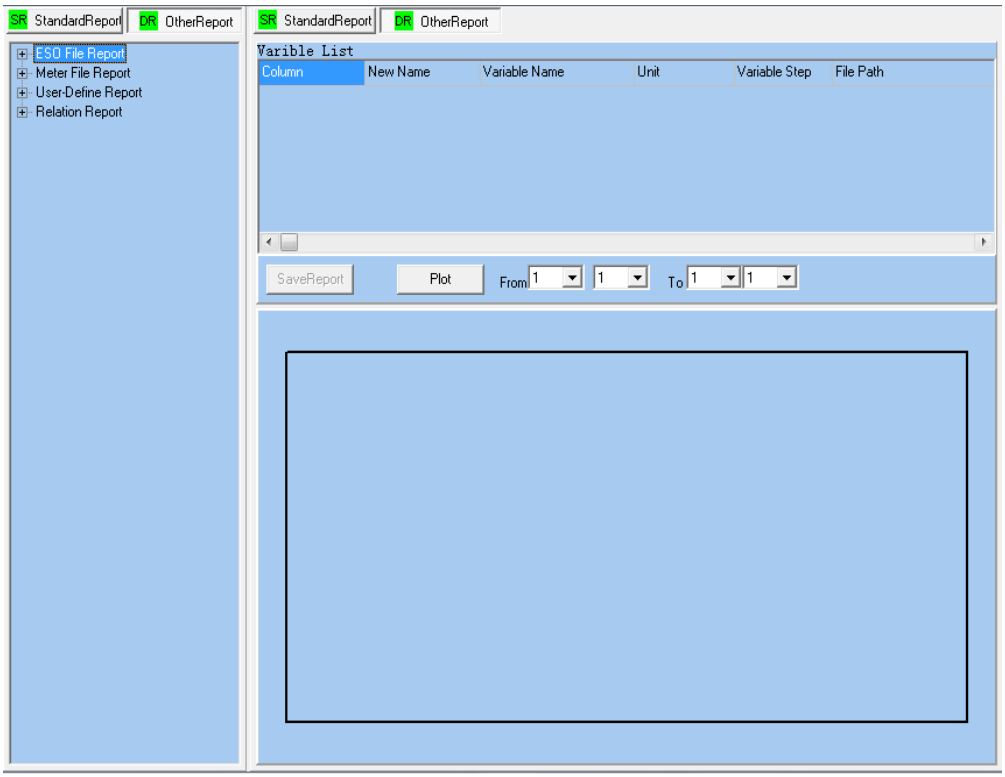

Figure 9 User-defined report output interface

Specification of HVAC Configuration & Reporting model of VisualEPlus

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1 Overview

1.1 Functional Overview:

(1) Users imply components supplied by this system to assemble the air-conditional modeling part. In the modeling process, users can set and modify the properties of the components.

(2) The report output part is targeted to analyze the two main output files generated during the running of EnergyPlus, including the standard Eso files and the Meter files.

(3) The software gives some default values of the system and components, and uses these preset values to calculate without users' modifying. Users can manually change the default properties, like the default coil inlet temperature.

(4) The software gives 11 typical systems(listed in the following form). User can load typical system templates，and the air condition modeling satisfying your needs can be established based on these templates.

Template Name	Number of Zones	System Specification
1ZoneEvapCool	1	Direct evaporative cooler system
5ZoneNightVent	5	Standard VAV system(using night ventilation system)
5ZoneWaterCooled_Baseboard	5	Standard VAV system, water baseboard heaters
ExampleProject	16	VAV system
GSHPSimple-GLHE	5	Water to water ground source heat pump
MultispeedHeatPump	3	Multispeed heat pump
PackagedTerminalAirConditioner	3	Packaged terminal air conditioner
PackagedTerminalHeatPump	3	Packaged terminal heat pump

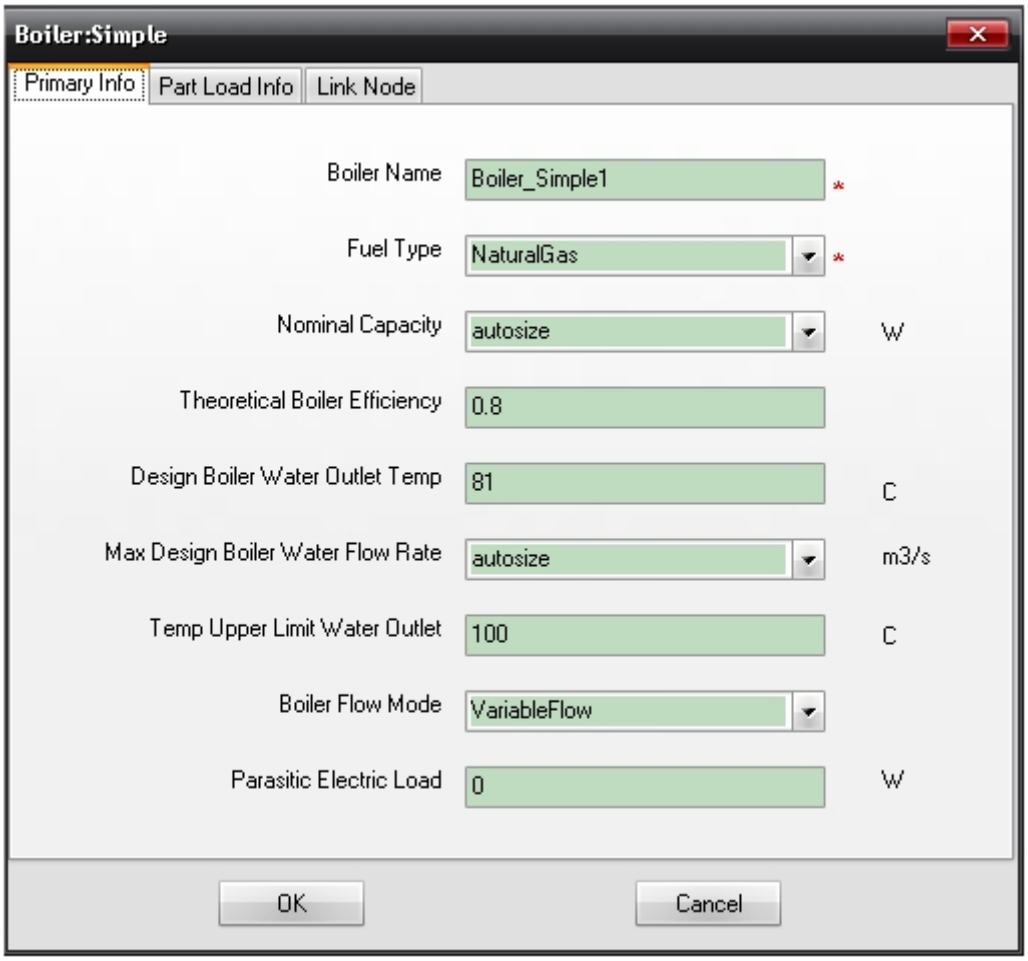
RadHiTempElecTermReheat	3	CAV+electric high temperature heater
RadLoTempCFloHeatCool	3	Low temperature radiant system
SolarCollectorFlatPlateWater	0	Solar domestic hot water system

(5) The software supplies data check function. After users fill in the edit box corresponding data, the system checks this data automatically to determine the data type, check the uniqueness on the name of components, and inspect the upper and lower limits of the data with scope limits. If the data doesn’t meet the requirements, the error reports will pop up, the cursor will stay in the wrong place, and promote the user to re-fill.

(6) The software is available for two editions in Chinese and English, option for Chinese or English in air conditioning modeling and option interface for Chinese or English in Report are used to choose language automatically referring to the configuration file when users run the software. The English edition and the Chinese edition use different language in the error reports, the menu titles and the editing windows. In the client area of main area of the main screen, all of the device classifications and component names apply English only.

1.2 The editing function

For each component in the client area, users can open the editing window by double-clicking it, and set or modify its properties. For example, double-click the “General boiler” component; the following editing window will pop up.



The editing window

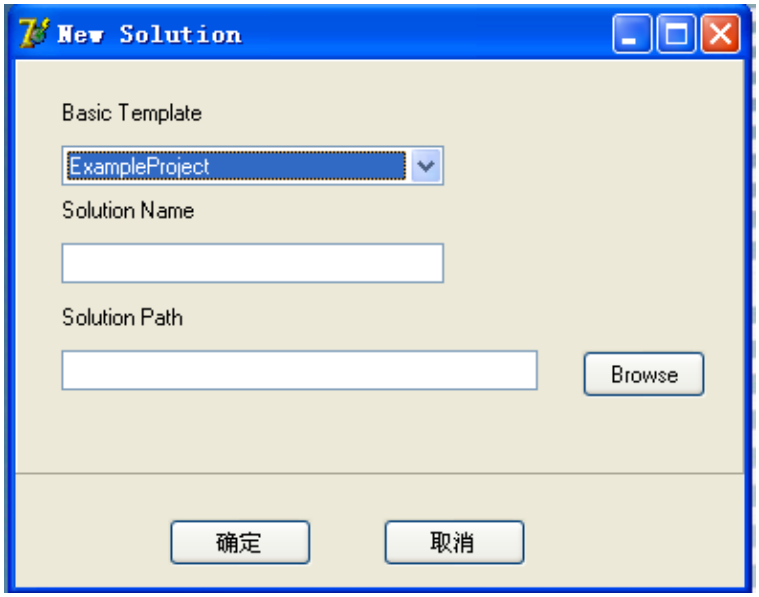
1.3 Saving function

The software only supplies saving function for the modeling part, users can save unfinished model, there is not saving function in Reports part. After user create a new model or modify the original model, user can click the saving item in “File” menu or click the  icon to save the model (The saving path has been set in the configuration file).When users choose to quit the software, but there is model file without saving in the client area, this system will automatically pop up the saving dialog box. Users can change the saving path and the default name as well.

1.4 Loading templates

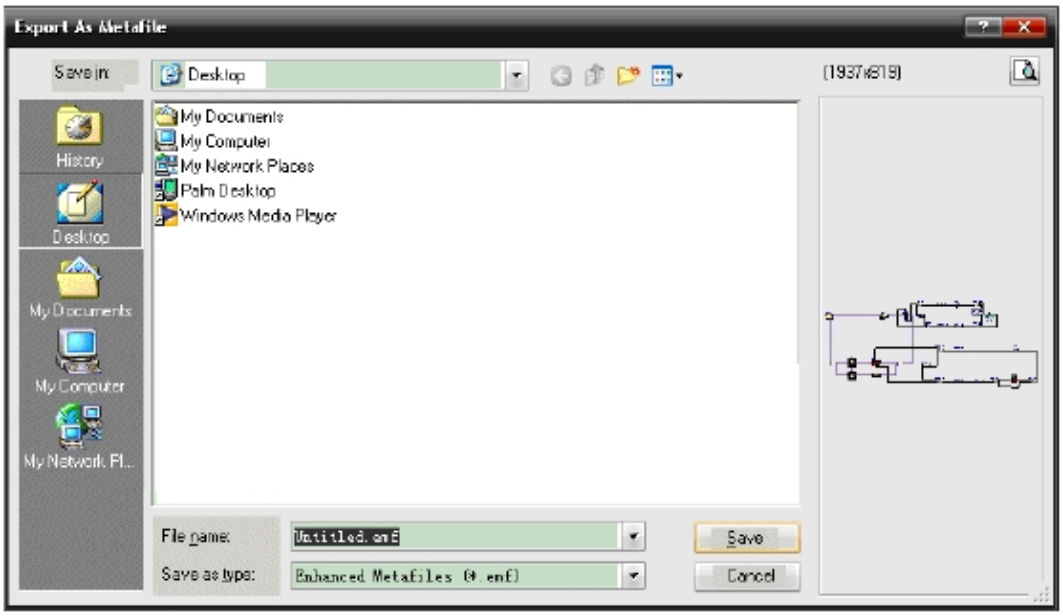
If we want to load the existing template to a new solution, we should select

“New Solution” of the “File” menu, choose the “Basic Template”. After solution name and path are filled, a typical system has been loaded to the solution to be established. It can be modified to meet our need.



1.5 Export function

The software supplies export function to the user. After constructing the HVAC model, the user can save the model as a graphic file using the “export function”. Select “Export” of the “File” menu, and then the window is as shown.



Export function window

2 Design philosophy

2.1 Design philosophy of the air conditioning modeling part

The air conditioning modeling part is used to help users establish EnergyPlus air conditioning model, mainly uses the way of graphic interface, establish air conditioning model by choosing, arranging, connecting components, and setting or modifying their properties.

The original modeling way of EnergPlus is very complicated, users need a deep understanding of this software to finish modeling, and it’s time-consuming. Through the way of graphic interface, that’s easy to establish a model for engineers with some understanding of air conditioning and the EnergyPlus software, it’s intuitive, speedy and reducing the errors generated.

Besides, the software gives the typical system models, including frequently used air conditioning types during the engineering design. Users can select corresponding system and modify it to create a model meeting needs and this reduces the difficulties of the work to a large extent.

2.2 Design philosophy of the report part

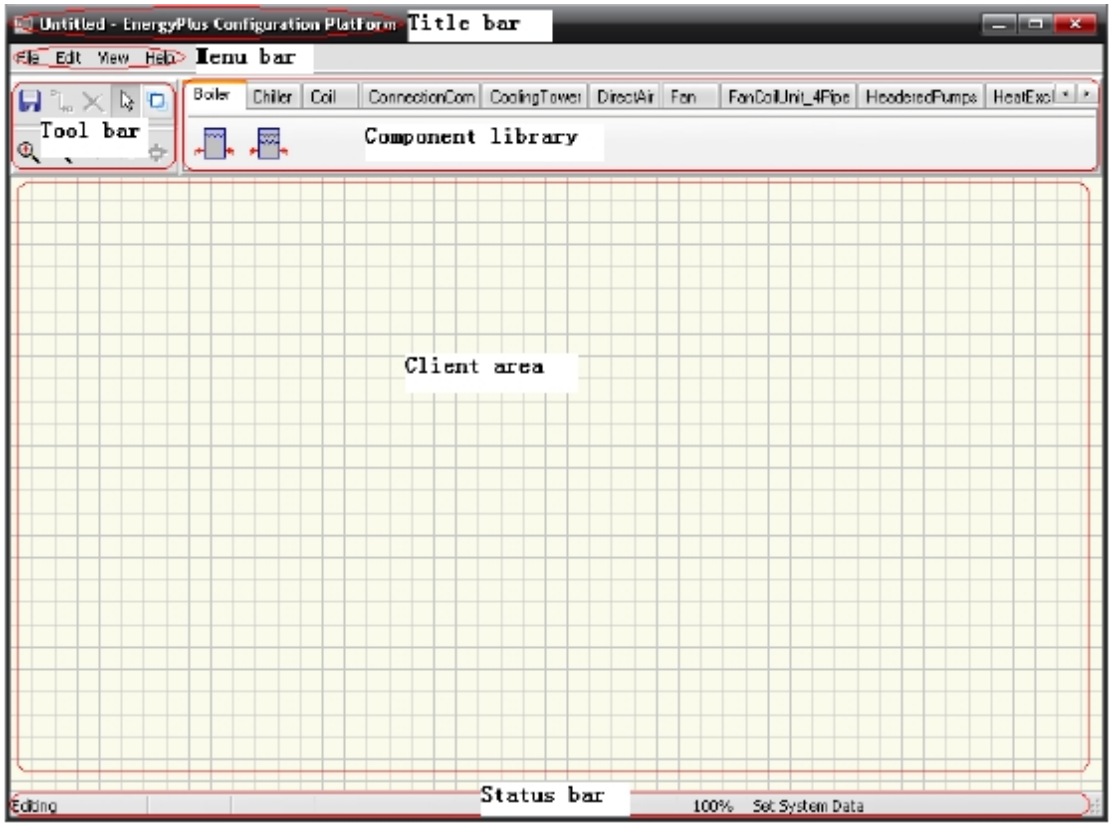
The report part is a data analyzing software targeted to the EnergyPlus energy consumption output results; it carries out analysis of the data in the two outputted files generated during the running of EnergyPlus, including the standard Eso file and Meter file. The data outputted by EnergyPlus is all in simple text format, inconvenient for analysis, and the report part is designed based on this problem, integrating the data, showing the data in the form of tables and graphs classified, and makes it convenient to analyze the relationship between different energy consumption.

The main purpose of the report part is to make the EenergyPlus output graphical, we call each item shown after analysis a report, so a complete report is constituted by report name, related energy consumption data and corresponding graph. A report can

contain one or more EnergyPlus output variables, we put them in one report to analyze the relationship between them. We can display value and graphics of one variable separated, or put several together as well, then give the data corresponding to the variables by extracting the data, display graphically, finally get results intuitively.

3 Air-conditioning modeling

3.1 Introduce to the system modeling interface



Models-established Interface

3.1.1 Menu bar

“File” provides functions of saving, exporting, closing, e.t.; “Edit” provide functions of setting targeted to air conditioning parameters.

3.1.2 Tools bar

With fast icon buttons of saving, zooming, narrowing, the tools in this bar can zoom or narrow the whole client area, and has connecting line buttons for each air conditioning component. It also provide shortcut buttons for setting of Loop, Branch, and system parameters, it’s convenient for users to use.

3.1.3 Components Library

It shows all the components icons in a tag page form, when users select different tag page, different components icons are available. It create air conditioning model in the client area by users’ clicking to choose related components.

3.1.4 Client area

Users operate modeling in client area, and can wholly zoom or narrow it. The length and width can extent indefinitely to meet users require of the air conditioning model.

3.1.5 Status bar

It shows all of the current operations carried out by users.

3.2 Instruction of XML file

Modeling part of this software could enable users to built air conditioner model with configuration pattern, and the air conditioner model could carry out energy consumption simulation with EnergtPlus. EnergyPlus uses model files of *.idf, which would be relatively difficult to create directly. So this software proposes a solution of creating *.xml file first and converting the *.xml file into *.idf file for EnergyPlus use in simulating. When user clicks save button, model will be saved as *.xml file. For instance, if the current model was named as Project, the finally model file would be

Project.xml.

When user intends to open an existent model, the model file must also be in format of *.xml.

3.3 Components modeling

3.3.1 Insert components

In the upper panel, all of the components are sorted in different tag page, as the following shows:

Map of components tag page

With users' clicking on different tag page, the corresponding tag page will show all of the components included. Users click the component icon, and then they just need to click in the client area where they want to create this component. Including Zone, these tag pages have a total of 28 types of icons, the related components and icons will be detailedly introduced in Components library.

3.3.2 Connecting components

There is a  button in the upper left corner of the main interface; it is used to connect the components. The steps of connecting components: After clicking the  icon, move the cursor to the output node of the source component; When the input focus shows up, left-click; Then move the cursor to the supposed mid-point and left-click; Repeat to draw a series of mid-points (8 at most); Then move the cursor to the input node of the target component, when input focus shows up, left-click, and a connecting line is finished. During the connecting, you can right-click to cancel connecting. If you want to delete a connecting line, just click the delete button after selecting the line.

Different component connecting lines are different in line color:

Purple line: Used in gas circuit connecting;

Black line： Used in waterway connecting.

Components connecting needs to follow some rules: the connecting lines and controls in gas circuit cannot connect with the lines and controls in waterway, otherwise illegal connection error report will pop up.

3.3.3 Components selection

There are three operational approach of components selection:

(1) Click the component to select it, select more components simultaneously with the Shift key being pressed down; Click the selected component to cancel selecting.

(2) The  is in the upper corner of the client area, hold down the left mouse button to drag out a region after clicking this button, then all of the components in this region is selected.

(3) When users want to select all of the components, they can click the “select all” item of the “edit” menu, then all of the components in the client area is selected.

3.3.4 Moving components

Selecting the component (Maybe more than one), drag with the mouse, move the component to the supposed position. The lines connecting with it will adjust the position automatically.

3.3.5 Delete components

The object types can be deleted：

Component

Link

Connector

Zone

Schedule

NodeList

BranchList

ConnectorList

Scheme

SchemeList

EquipmentsList

Controller

ControllerList

SystemAvailabilityManager

SystemAvailabilityManagerList

SetPointManager

When users want to delete an object, the system will automatically delete factors related to this object depending on the situation, the detailed rules is:

Component

(1) When users delete a Component, if its corresponding Branch only contains this Component, this Branch will be automatically deleted too; If the corresponding Branch-list only contains this Branch, the BranchList will be automatically deleted too; If the Plant Loop is using this BranchList, the contained Branch-list is deleted automatically.

(2) When users delete a Component, the corresponding Branch doesn't contain this Component only, the Component is cleared and other items containing this Component in the Branch is cleared too.

(3) When users want to delete a Component contained in (Plant，Condenser，Air distribution) EquipmentList, the corresponding item in EquipmentList will be deleted.

(4) When users delete a Component in the waterway part, the related Node will be automatically deleted; If the NodeList of it only contains this Node, the Node-list will be deleted automatically; If the NodeList is used in PlantLoop, ControlledZoneEquipConfiguration, OutsideAirInletNodeList, SetPointManager, the corresponding item will be deleted automatically.

(5) When users delete a Component in the gas circuit part, the node next to this Component will be deleted.

(6) When users delete Components more than one in the gas circuit part, only the communal nodes of these Components will be deleted; If each Node-list of each node only contain this node, the Node-list will be deleted automatically. If the Node-list used in PlantLoop, ControlledZoneEquipConfiguration, OutsideAirInletNodeList, SetPointManager, the corresponding item will be deleted automatically.

(7) The related Schedule, Scheme, SystemAvailabilityManagerList, SystemAvailabilityManager to the Components can't be deleted automatically, but users can delete them manually.

Link

Link can be deleted manually by users freely, and the number is unlimited.

Connector

(1) When users delete mixer or splitter manually, the corresponding items in ConnectorList will be deleted.

(2) When users delete the mixer-splitter pairs manually, it clears the corresponding ConnectorList, and the items in the Plant loop and CondenserLoop containing the ConnectorList will be deleted automatically.

(3) ZoneMixer and ZoneSplitter can be deleted freely, and the number is unlimited.

Zone

(1) When users delete a Zone, the related Schedule can't be deleted.

(2) When users delete a Zone, the related Infiltration, Zone Sizing, Controlled Zone Equip configuration, Zone Control will be deleted automatically.

Schedule

(1) When users delete a Component, a Zone or some other components related to Schedule, Schedule will not be deleted automatically, it can only be deleted by users manually.

(2) When users delete unneeded Schedule, in order to ensure consistency, it's necessary to delete all of the items referring to this Schedule manually.

NodeList

Users can delete NodeList manually, but need to delete all the items referring to the NodeList at the same time to the Node to ensure consistency.

BranchList

Users can delete BranchList manually, but need to delete all the items referring to the BranchList at the same time to ensure consistency.

Connectorlist

Users can delete Connect-list manually, but need to delete all the items referring to the Connect-list at the same time to make consistent.

Scheme

(1) When users delete components related to Scheme, Scheme will not be deleted automatically; users had to do a manual deleting.

(2) Users can delete unneeded Scheme, but need to delete all the items referring to the Scheme at the same time to make consistent.

SchemeList

SchemeList can only be deleted manually, and it's must to delete all the items referring to the SchemeList manually afterward.

EquipmentsList

(1) EquipmentsList can be deleted automatically and manually.

(2) The principles of deleting automatically refers to Conponent(3)

(3) Users can delete EquipmentList manually, but need to delete all the items referring to it at the same time to make consistent.

Controller

(1) When users delete a Controller, if the corresponding ControllerList only contains this Controller, the ControllerList will be deleted automatically, the AirPrimaryLoop, OutsideAirSystem will delete the related items automatically.

(2) When users delete a Controller, if the ControllerList doesn't contain this Container only, it's only to delete the item of this Controller.

ControllerList

Users can delete ControllerList manually, but need to delete all the items referring to this ControllerList at the same time to make consistent.

SystemAvailabilityManager

(1) SystemAvailabilityManager can be deleted manually, if the corresponding SystemAvailabilityManagerLists contains this SystemAvailabilityManager only, then the SystemAvailabilityManagerLists will be deleted automatically, AirPrimaryLoop will delete the item related to this SystemAvailabilityManagerLists automatically.

(2) When users delete a SystemAvailabilityManager, if the System Availability Manager List does not contains this SystemAvailabilityManager only, the item of this SystemAvailabilityManager in the SystemAvailabilityManagerList will be deleted automatically.

SystemAvailabilityManagerList

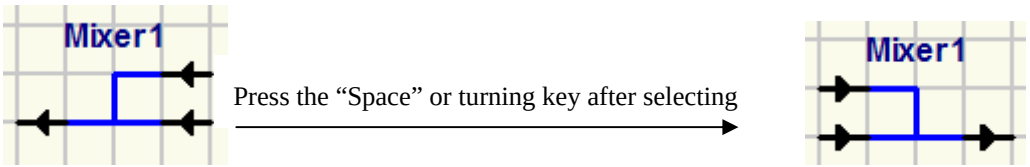
(2) Users can delete SystemAvailabilityManagerList manually, but need to delete all the items referring this System-Availability-Manager-List at the same time to make consistent.

SetPointManager

Users can delete SetPointManager manually, but the related Schedule, node, nodelist will not be deleted.

3.3.6 Components rotation

Select the component (singly); press the “Space” key to turn the input node and output node at the left and right side of the component. The following diagram shows a turn of a Mixer.



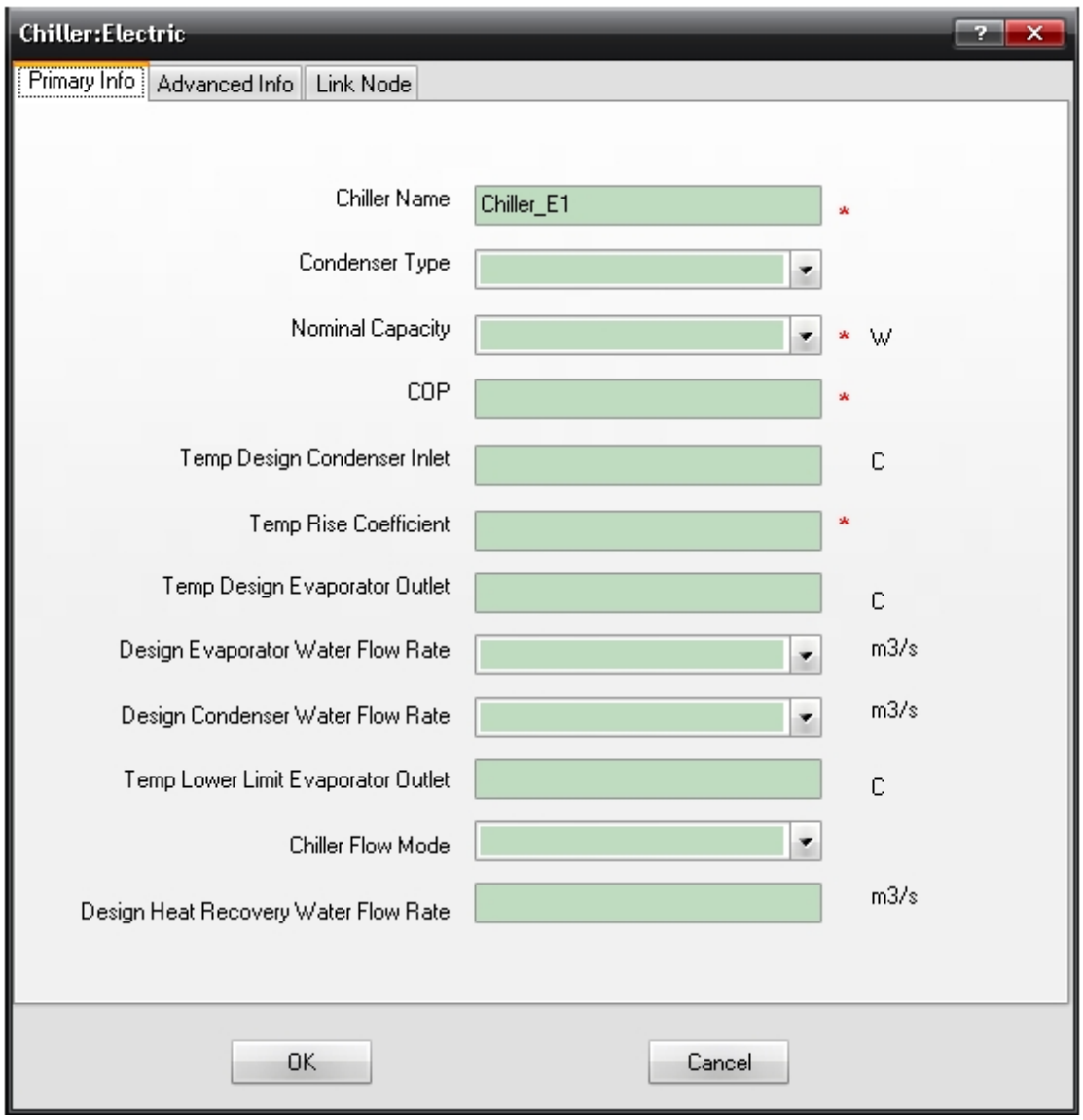
3.3.7 Zooming in and out of components

Each component of this software is a fixed factor, and without the functions of zooming in or zooming out, and the zooming in and out of components is synchronous with the whole client area. Users can zoom in or out the graphics by clicking  buttons.

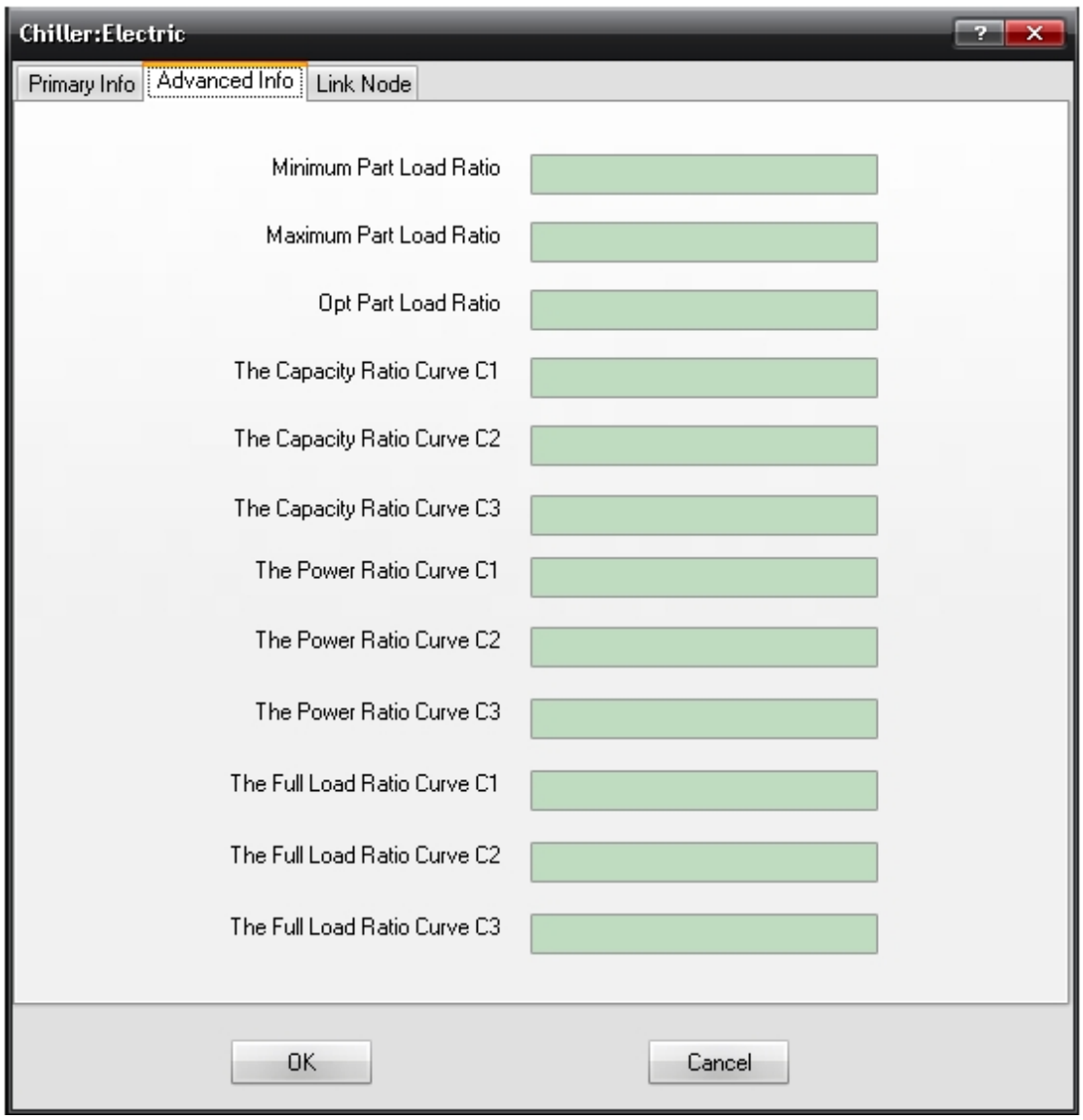
3.4 Component model setting

3.4.1 Properties setting of common components

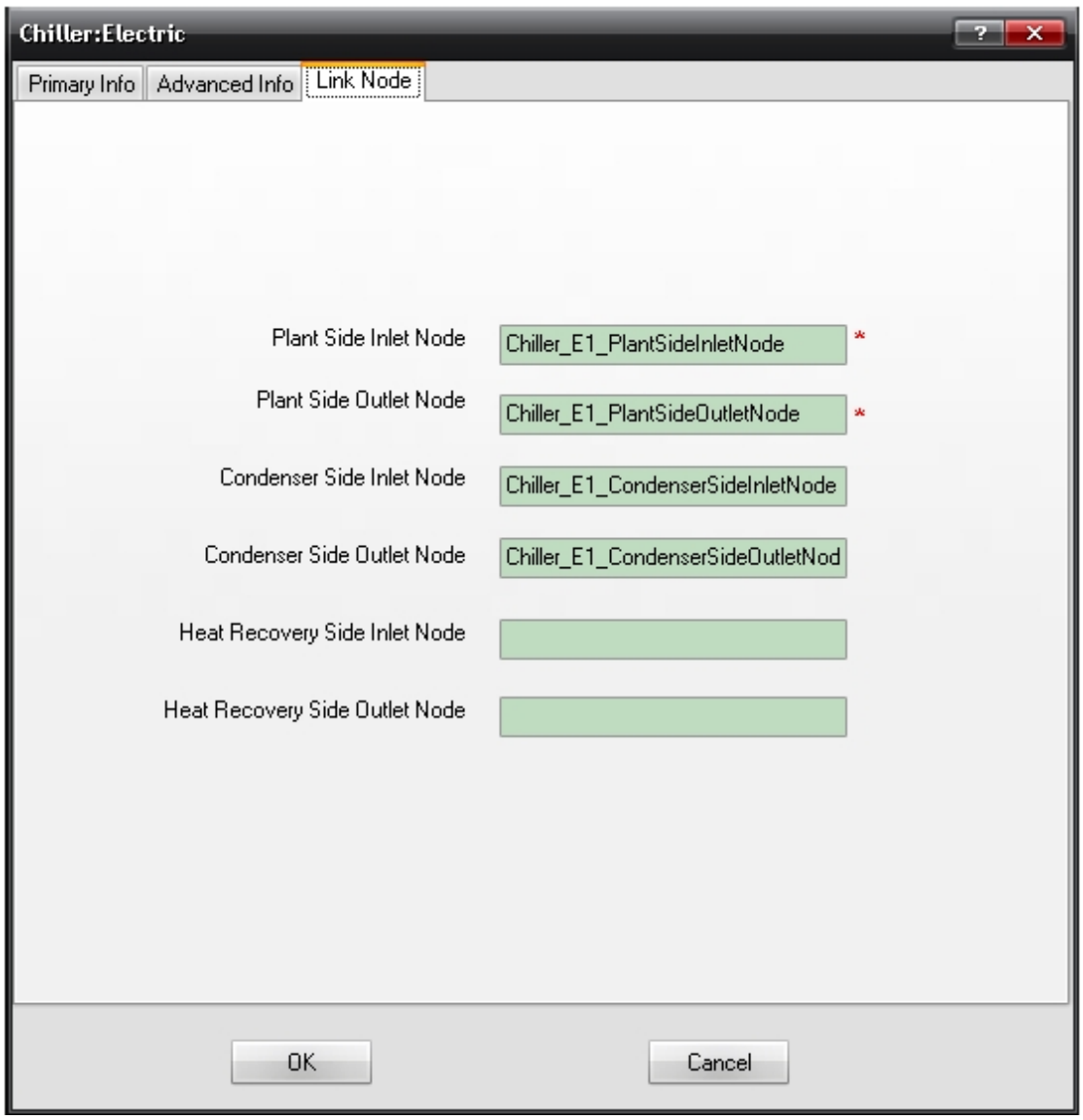
Open the editing dialog box by double-clicking components in the client area. For example, double-clicking the icon of electric refrigerator in the client area, the editing pop up as the following diagram shows. Properties are classified in different tag pages for components with a large number of properties, users can select different tag page to setting or modifying the properties of Chiller. After users fill in corresponding data in the editing dialog box, the system runs a automatic check-up, judge the data type, check the uniqueness of the component names, examine the upper and lower limit of the data with a range limit. If there is data unsatisfying the requirements, an error report will pop up; the cursor will stay in the location of the error, prompting to re-fill. The properties editing dialog box of Chiller is as the following shows:



The properties editing dialog of electric refrigerator-Basic properties



The properties editing dialog of electric refrigerator-Advanced properties



The properties editing dialog of electric refrigerator-Connecting point information

Generally, the properties of each component are arranged in three tag page:

1) Basic properties: These are the most common properties familiar to the users, including the component name. The name, input node, output node of the electric refrigerator is generated automatically, only for the designers to refer (Modifiable), the program generates default values for these properties, and users can change them if necessary.

2) Advanced properties: The more complicated properties in air conditioning models, it is fit for the users with a deep understanding in the mechanism of air conditioning to fill in.

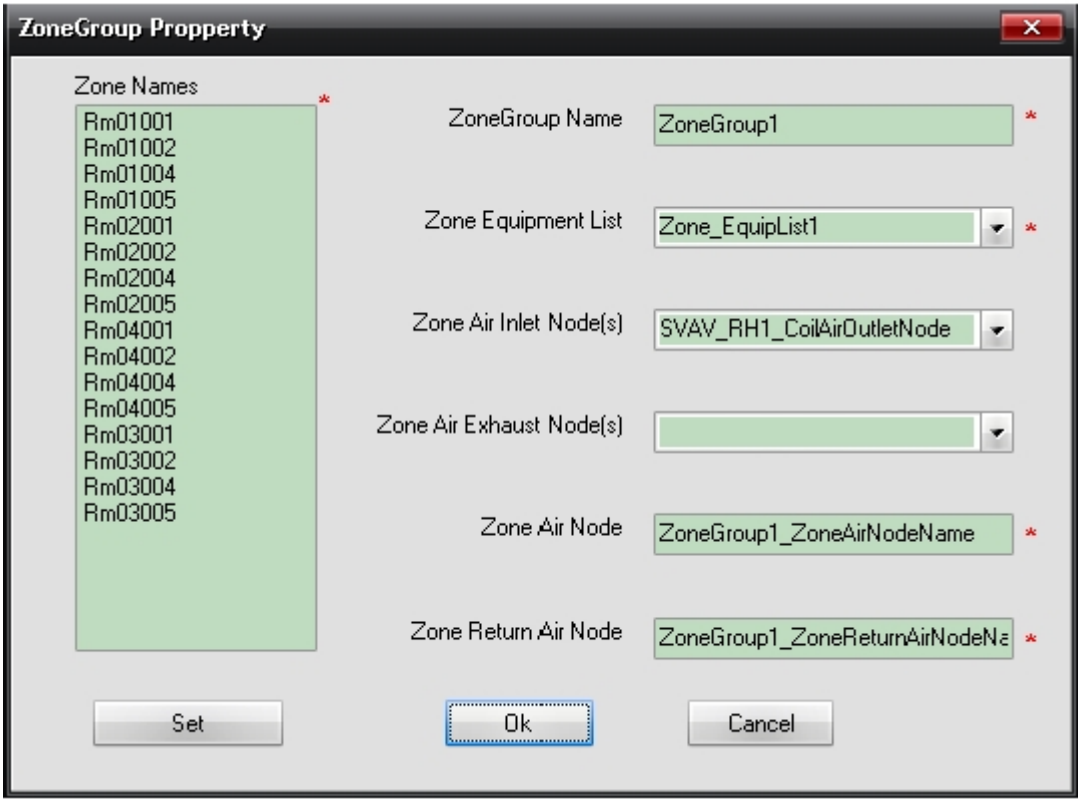
3) Connecting point information: Including the controlling node, input node,

output node and the nodes connecting to other components.

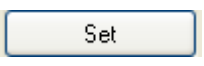
3.4.2 Attributes Configuration of Zone

As for an air conditioner system, there might be multiple zones using it. In favor of convenience and aesthetics of modeling in client area, this software uses a single zone icon indicating a class of zones, which share the same air conditioner system. Thus there is some differences in attributes configuration between Zone and other components.

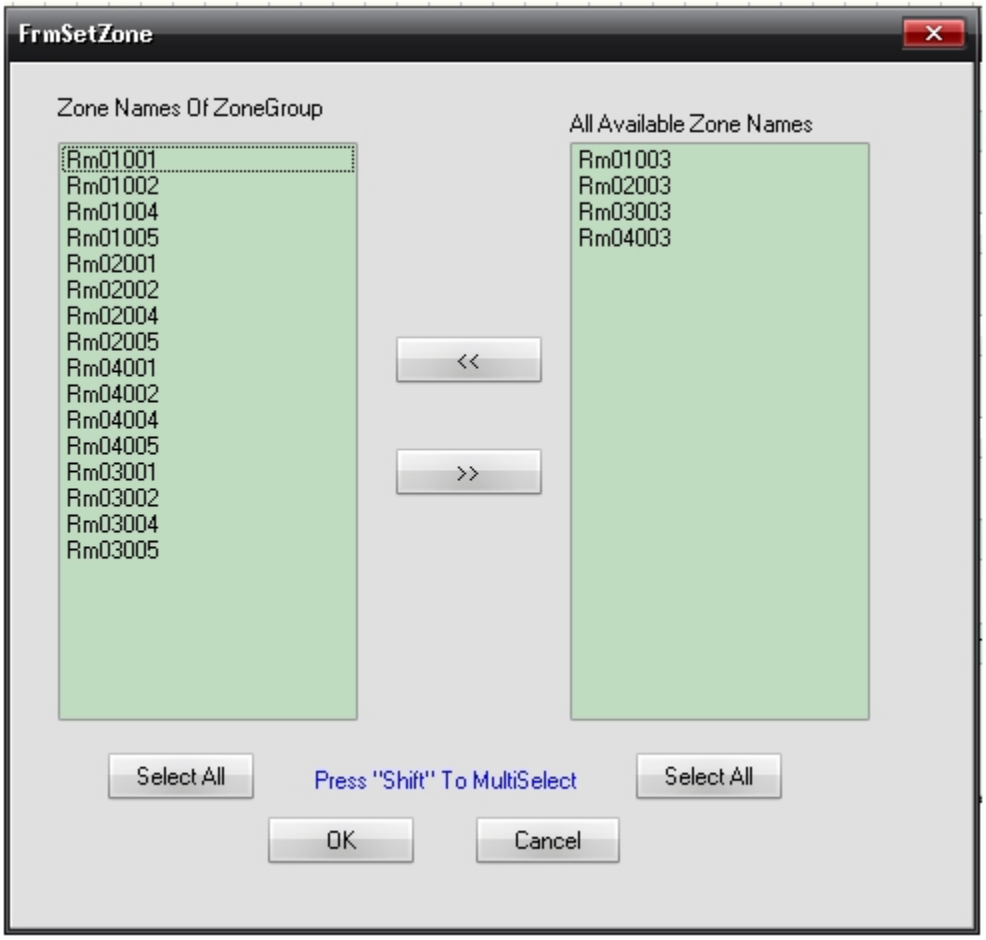
User can Zone attributes edit dialog by double clicking on Zone icon, as shown below.



Attributes Setting of ZoneGroup

By clicking 

button, Zone configuration dialog with all zone names of this class will be opened, as shown below.



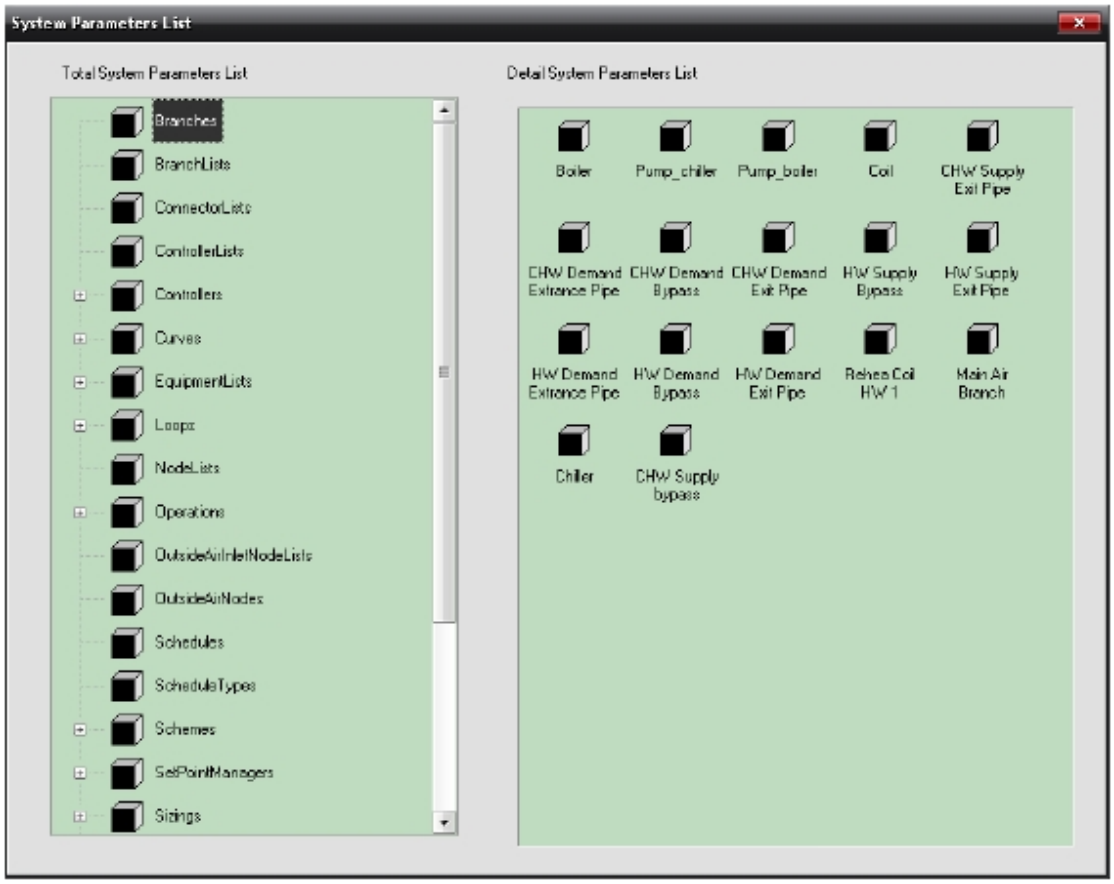
Attributes Setting Window of Zone

All current available Zone names are listed in right, and all Zone names belong to Zone of current class are in left list box. User can move selected Zone name between two list boxes with buttons << and >>. Through button "Select All", user can select all of List box. By "Shift" user can select multiple items.

3.5 System Parameter Configuration

3.5.1 Overview of Configuring System Parameters

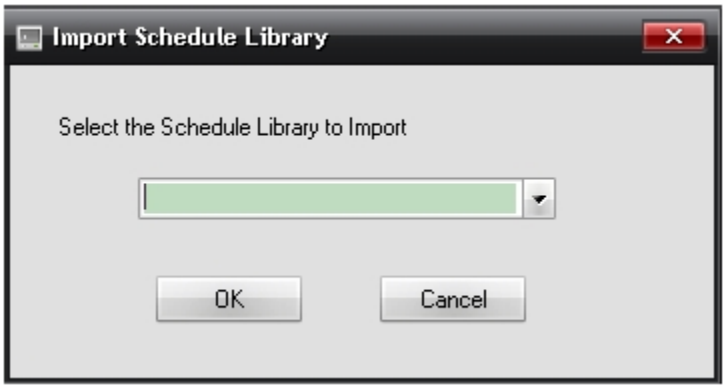
This function is for configuring system parameter. System parameters are relevant to the whole air conditioner system, and independent from specific components. Through menu item "set the system data" in edit menu or button , user can open configuring window of system parameters, as shown below.



Graph of configuring system parameter

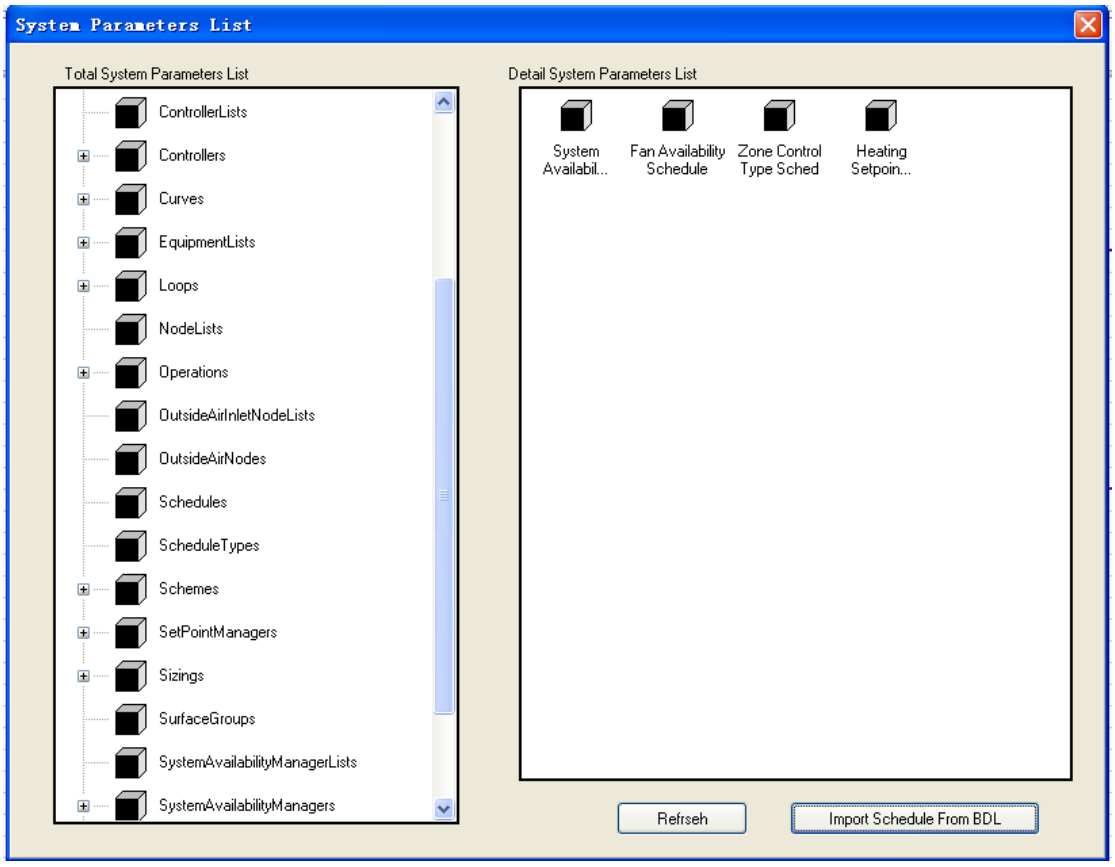
On left side of system parameter window lays general list of system parameter, in which is all system parameter names. With clicking on corresponding item, all system parameters belong to it would be shown in right-aligned “Concrete system parameter list”. After corresponding system parameter has been selected, click right mouse button, then a button “New” will prompt, by clicking which can enter edit window of system parameter.

Right clicking on Schedule, and selecting “Import Schedule” in prompted menu, import window of Schedule Library will be opened, shown as below.

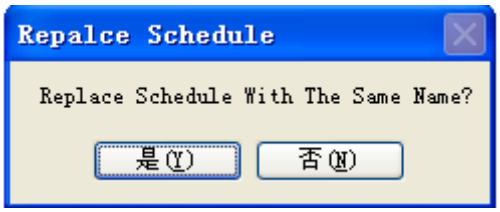


Import Window of Schedule Library

Importing will be completed, by selecting Schedule in dropdown list and clicking OK button. Users can also click" Import Schedule from BDL" and use schedules established in BDL.



When users import schedules from BDL, the form "replace the schedule with the same name" will pop out as below.



When clicking the item of “Concrete System Parameter List”, attributes edit dialog of this item will be opened. Then user can set or modify this item.

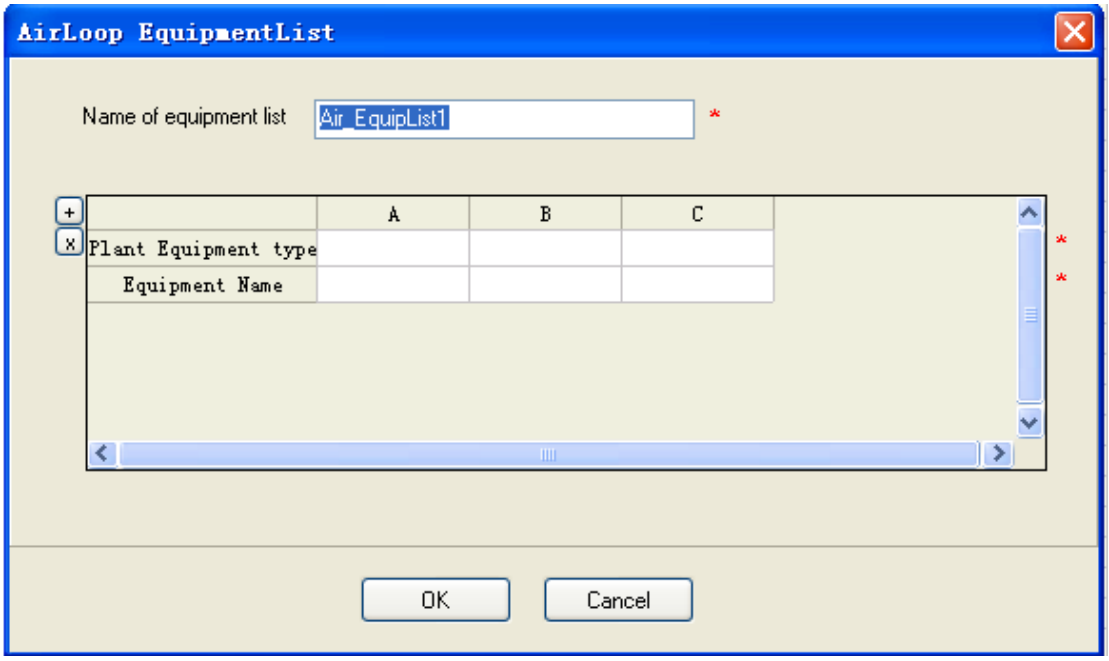
All system parameter are listed in left-aligned List of System Attributes. System parameter with plus symbol indicates that there are several sub items of different types. When user clicks the plus symbol, all types will be unfolded under root directory, in which user can select sub list name to build.

User can set attributes of list in attributes edit window. This window will be closed and a new list will be created, when OK button is clicked. The newly-built object will be deleted, when clicking the Cancel button is clicked. When Delete button is clicked, options selected in “List of System Attributes” will be deleted.

An example of setting attributes list of air Loop devices is given below. Four different List names are displayed when user selects EquipmentLists, as shown below.

Unfolded window of EquipmentLists

Select the first AirLoopEquipmentLists, and enter newly-built edit window, shown as below.



AirLoopEquipmentLists Attributes Edit

After name has been filled, attributes of AirLoopEquipmentLists can be set through member list.

3.5.2 System Parameters

Branches：

This system parameter can be used to configure the Branches Settings of the HAVC systems. Branches can be considered the mid-level grouping of items in the EnergyPlus HVAC loop scheme. Components are the lowest level of information. A collection of components in series forms a branch. It should be noted that each component has at least two nodes associated with it-an inlet node and an outlet node, and also each branch must have at least one component on it. In the edit window, you can assign components in the component list to branches. If you select a type in the ComType, all component names of this type will be list in the ComName, then you can select any component name you need. The InletNode and OutletNode are the names of the inlet node and the outlet node of components respectively. The ControlType is the control type of components, whose value can be ActiveX，Passive, Bypass or SeriesActive.

BranchLists：

This system parameter can be used to configure the Branch Lists Settings of the HAVC systems. A branch list is intended to define the branches or portions of a particular loop that are present on an individual loop such as a plant or condenser loop.

In the edit window, you can assign branches to branch lists. First, give a branch list name, and then select one or several branch names in the shown list. In this way, the branch list will be composed of the selected branches.

ConnectorLists：

A connector list is a collection of either one or two connection devices (Mixer or Splitter). The user can assemble connection devices to a connector list for control. The Connector List Names are not allowed to be empty. The connection list simply allows the specification of the types and names of these devices. The user can select the types and names of connectors in a popup dialog.

Controllers：

There are two controller types, which are:

Controller:Simple

Controller:OutsideAir

If you want to create a new controller, you should select a controller type, and click the NEW button to open the controller edit window. Then you can configure the controller you want to create.

ControllerLists：

This item can be used to create or modify a list of controllers. The Controller List Names are not allowed to be empty. In the edit window, you can assign controllers to controller lists. First, give a controller list name, and then select the types and names of controllers. In this way, the controller list will be composed of the selected controllers.

EquipmentLists：

There are two equipment list types, which are:

PlantEquipmentList

AirLoopEquipmentList

CondenserEquipmentList

ZoneEquipmentList

The EquipmentList Names are not allowed to be empty. The create method of EquipmentLists is similar to that of BranchLists.

Loops：

Loops can be considered the top-level grouping of items in the EnergyPlus HVAC model. It should be noted that each branch must be assigned to a loop. The Loops Settings is to define the loop names and to determine the branches in each loop.

There are three loop types, which are:

AirPrimaryLoop

PlantLoop

CondenserLoop

If you want to create a new loop, you should select a loop type, and click the NEW button to open the loop edit window. Then you can configure the loop you want to create.

NodeList：

This item is used to define the nodes of a particular loop that are present on an individual loop such as a plant or condenser loop. The create method of NodeLists is similar to that of BranchLists。

Operations：

There are nine operation types, which are:

CoolingLoadRangeBasedOperation

ComponentSetpointBasedOperation

HeatingLoadRangeBasedOperation

OutdoorDrybulbRangeBasedOperation

OutDoorDrybulbTemperatureDifferenceBasedOperation

OutdoorRhpercentRangeBasedOperation

OutdoorWetbulbRangeBasedOperation

OutdoorWetbulbTemperatureDifferenceBasedOperation

UncontrolledLoopOperation

If you want to create a new operation, you should select an operation type, and click the NEW button to open the operation edit window. Then you can configure the operation you want to create. The operation names are not allowed to be empty.

OutsideAirInletNodeLists：

The function of this item is similar to that of NodeLists.

OutsideAirNodes：

The function of this item is similar to that of NodeLists.

PlantSizing：

This item can be used to configure the estimation settings of equipment parameters.

RadiantSystemSurfaceGroups：

This item can be used to configure the settings of radiant system surface parameters.

Schedules：

This item can be used to configure the settings of schedules. There is only one schedule type provided in this system, which is the CompactSchedule in EnergyPlus.

The user can create a new schedule, or select an existing one from the schedule database.

ScheduleType：

A “schedule type” can be used to validate portions of the other schedules. This item should be used with Schedules.

Schemes:

There are two scheme types, which are:

CondenserOperationSchemes

PlantOperationSchemes

The user can edit the schemes for control.

SetPointManagers：

There are fourteen types of this item, which are:

SetPointManager_Schedule

SetPointManager_Warmest

SetPointManager_Coldest

SetPointManager_MixedAir

SetPointManager_OutsideAir

SetPointManager_OutsideAirPretreat

SetPointManager_ReturnAirBypassFlow

SetPointManager_Scheduled_DualSetpoint

SetPointManager_SingleZoneCooling

SetPointManager_SingleZoneHeating

SetPointManager_SingleZoneMaxHum

SetPointManager_SingleZoneMinHum

SetPointManager_SingleZoneReheat

SetPointManager_WarmestTempFlow

If you want to create a new Set Point Manager, you should select a type, and click the NEW button to open the Set Point Manager Edit Window. Then you can configure the Set Point Manager you want to create. The names of Set Point Manager are not allowed to be empty.

SizingParameter：

This item allows the user to specify a global sizing ratio.

SystemAvailableManagerLists：

This item should be set along with System Available Manager. The set method is similar to that of BranchedLists.

SystemAvailableManagers：

System Availability Managers are one of the high-level control constructs in EnergyPlus. There are eight types of this item, which are:

SystemAvailabilityManager_Scheduled

SystemAvailabilityManager_DifferentialThermostat

SystemAvailabilityManager_HighTemperatureTurnOff

SystemAvailabilityManager_HighTemperatureTurnOn

SystemAvailabilityManager_LowTemperatureTurnOff

SystemAvailabilityManager_LowTemperatureTurnOn

SystemAvailabilityManager_NightCycle

SystemAvailabilityManager_NightVentilation

SystemSizing：

This item is used to configure the settings of air system.

Thermstats：

This item is used to define the set temperature in the air system. There are eight types of this item, which are:

SingleThermalComfortHeatingSetpoint:Fanger

DualSetpointWithDeadband

DualThermalComfortSetpointWithDeadband:Fanger

SingleCoolingSetpoint

SingleHeatingCoolingSetpoint

SingleHeatingSetpoint

SingleThermalComfortCoolingSetpoint:Fanger

singleThermalComfortHeatingCoolingSetpoint:Fanger

ZoneControl：

The following types are totally included:

ZoneControl_Thermostatic

ZoneControl_Humidistat

ZoneControl_ThermalComfort

ZoneControl_Thermostatic_OperativeTemperature

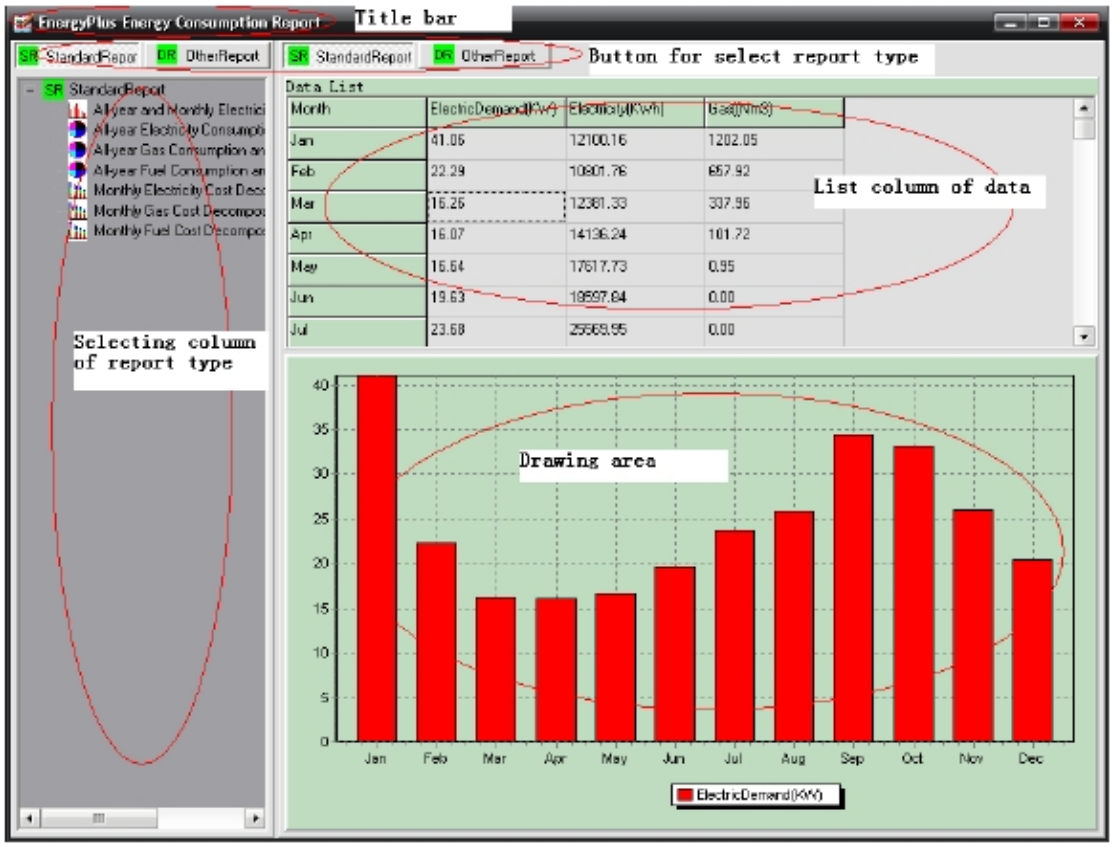
The name can’t be empty, it could be used to create ZoneControl, enter the editing window by clicking the new button of chosen ZoneControl type.

ZoneSizing：

The item is used to estimate temperature zone parameters.

4 Report Generation

4.1 Introduction of Report System Interface



Program main interface (Interface of standard report)

(1) **Button for selecting report type:** There are two buttons for selecting report types in selection column of report type and list view of data. Both buttons have the same function for user's convenience. User can switch interfaces between standard reports and other reports with these buttons.

(2) **Selection column of report type:** Selection column will list out all report types for user's selection, when user has selected standard reports or other reports.

(3) **List column of data:** List view of data will show corresponding data, when user selects report type in the view of report type.

(4) **Drawing area:** Data in list area would be displayed in patterns of pie chart or histogram chart, in favor of users' analysis.

4.2 Main Functions

Generally, this software contain there functions as follows:

- ✧ Standard reports
- ✧ Other reports

Standard reports include:

1) Monthly and annual consumption of electricity, fuel gas, and fuel oil.

2) Annual total electricity consumption and subentry electricity consumption

3) Annual total gas consumption and subentry electricity consumption

4) Annual total fuel oil consumption and subentry electricity consumption

5) Decomposition of monthly electricity consumption

6) Decomposition of monthly gas consumption

7) Decomposition of monthly fuel oil consumption

Other reports include:

1) All variables in standard output file (single)

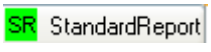
2) All variables in Meter file (single)

3) User defined report (permitting multiple variables)

4) Relation report (including two variables)

4.3 Standard Reports

Main interface of program is used to display analysis graphs and charts of standard report and other reports. As startup of program, standard reports will firstly display in main interface, as shown in introduction of Report system interface.

Interfaces of standard reports and other reports can be switched by clicked buttons of standard reports 

and other reports 

. Interface of other report will be introduced in next part.

There are three parts in standard reports:

✧ Report list area: Type list is aligned left, which contains the eight types of standard reports introduced above.

- ✧ Form area: display forms of energy consumption data are displayed in right top.
- ✧ Drawing area: Graphs and charts correspond to data of form area are shown in right bottom, which includes histogram chart and pie chart.

Operating flow

Unfolded left-aligned tree list of report types, and double click a report type, then corresponding data and graphs will shown in right-aligned form area and drawing area.

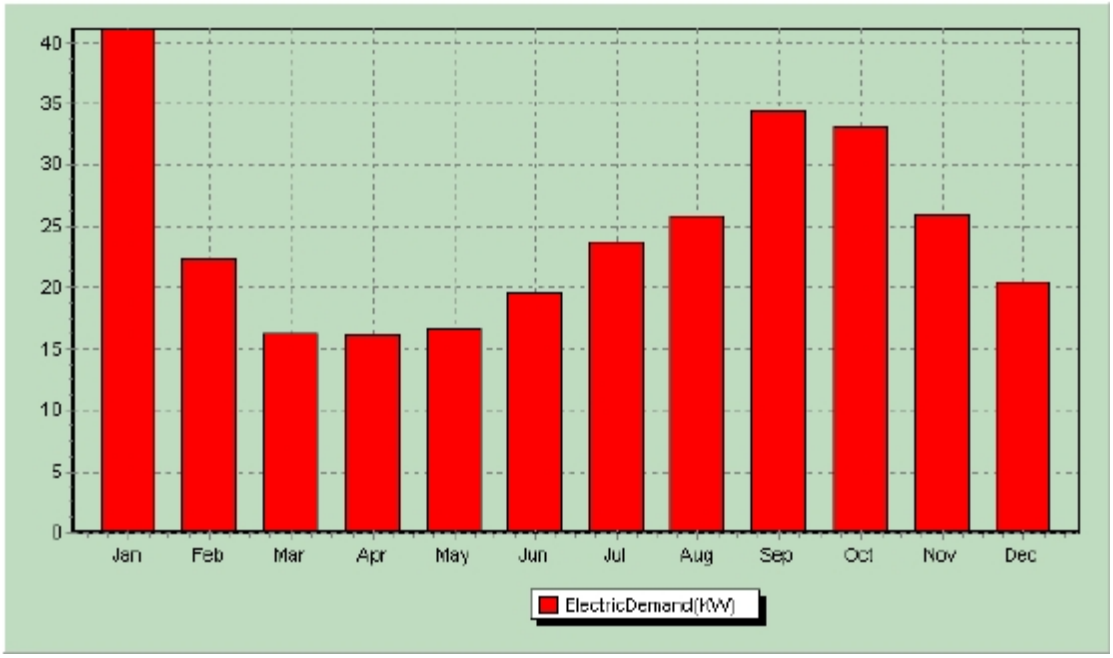
There are two types of operation here:

a. Applicable for standard report (1). Double clicked report name, corresponding energy consumption data would display in form area as shown in figure 3. Then double click a certain column, and data of this column will display in drawing area. For instance, double click the column of “Electricity Load”, and the drawing area will display as following.

Data List

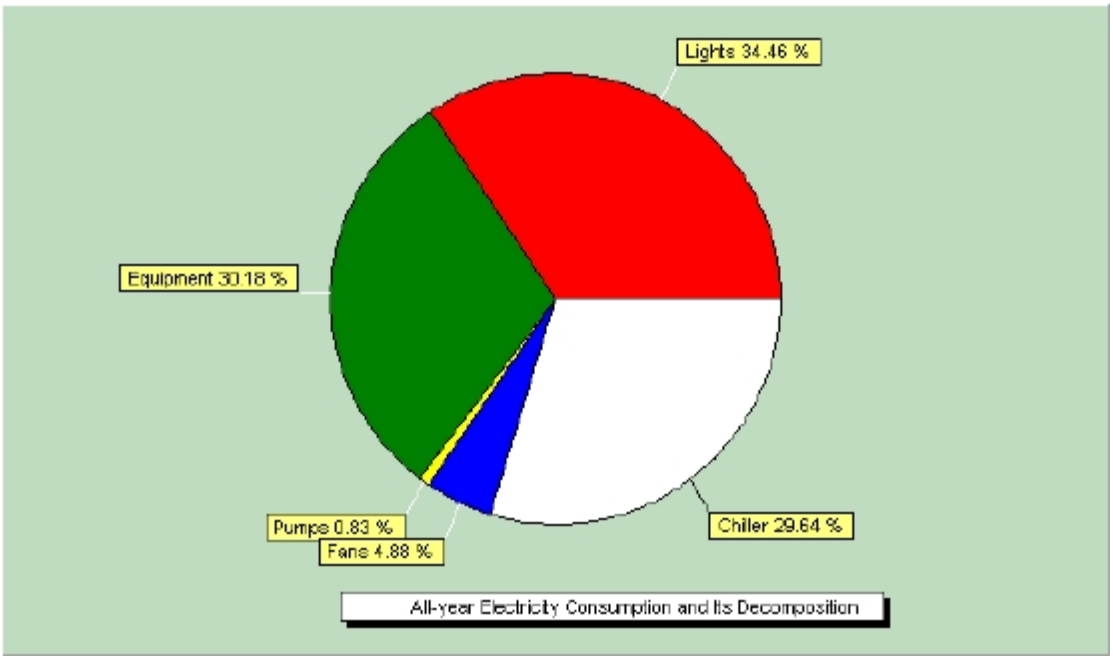
Month	ElectricDemand(KW)	Electricity(KWh)	Gas((Nm3)
Jan	41.06	12100.16	1202.05
Feb	22.29	10801.76	657.92
Mar	16.26	12381.33	337.96
Apr	16.07	14136.24	101.72
May	16.64	17617.73	0.95
Jun	19.63	18597.84	0.00
Jul	23.68	25569.95	0.00

Standard report (1) Data display format

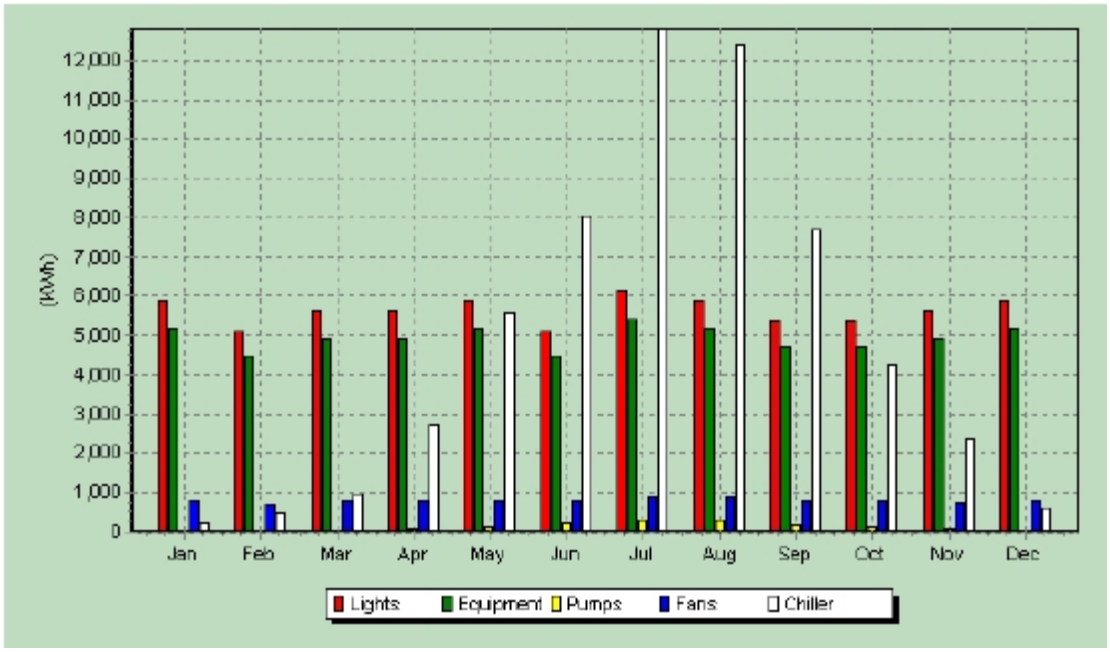


Standard report (1) drawing display format

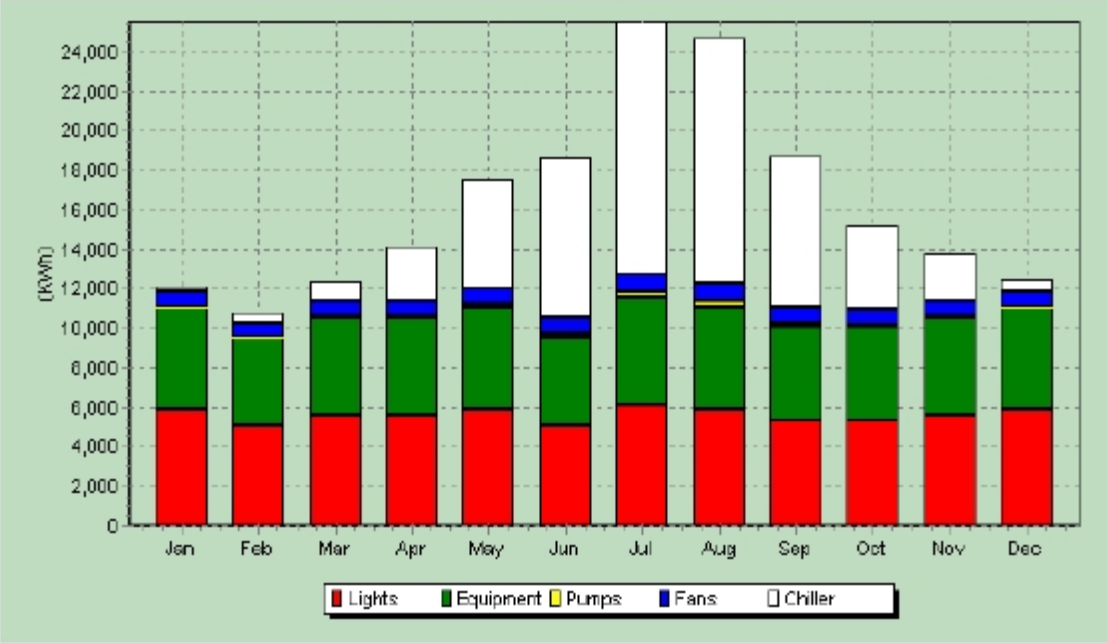
b. Applicable for standard report (2)-(7). Corresponding forms and graphs would be directly shown in form area and drawing area with double click on report name, which is different from clicking form area data as required in the above first condition. Two graph types of histogram and pie chart would be displayed in drawing area.Graphs of report (2) to report (4) are pie charts, such as stacked chart, in which report name, component names and component percentage would be displayed. Graphs of report (5) to report (7) are histogram, such as decomposed chart. There are two display types of histogram. When users right click in drawing area, a shortcut menu ”Stacked or Unstacked” would prompt up, through which display types of stacked and decomposed can be switched to each other. Decomposed chart and stacked chart are shown as following.



Pie chart



Decomposed chart



Stacked Chart

4.4 Other Reports

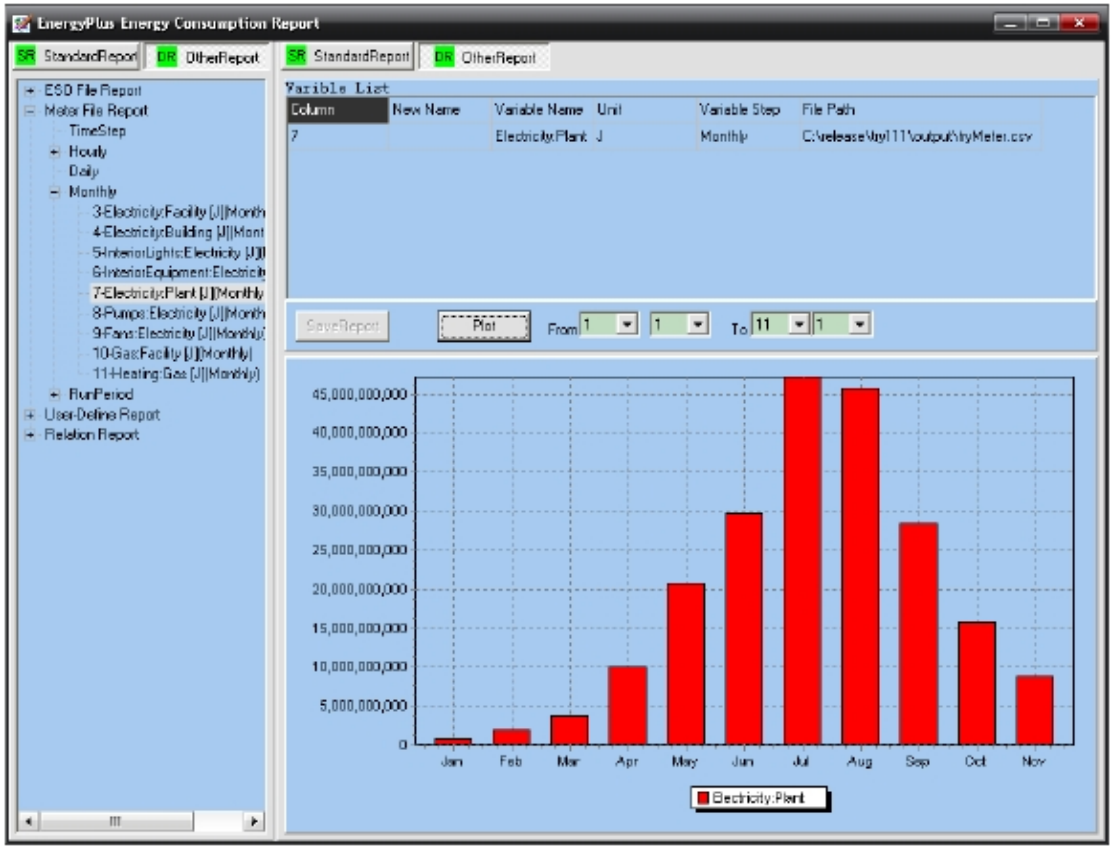
Click DR OtherReport in main interface of program, and interface would switch to display window of other reports, as below figure.

Likewise, other reports also contain three parts as list area, table area and drawing area. As shown in below figure, list area of report is divided into four parts as ESO file report, Meter file report, other reports and user defined report, which respectively correspond to four report types introduced previously and locate in the first layer node of list area. Output time step length lies in the second layer of area report, which is inherent as the startup of program and contains hourly, daily, monthly, and running time length. And the third layer nodes correspond to relevant step length variables in output file. For instance, first layer node is ESO file report, second layer node time step length, and the third layer nodes as the following node of time step length would be all variable names of time step length in ESO file.

ESO file report node contains all variable names of standard file; Meter file report contains all variable names of Meter file; Variables of other reports node are added by user, which could be single or multiple, and could be derived from ESO file

or Meter file; Variables of user defined report node are also added by user, which are required to contain two variables, and could be derived from ESO file or Meter file as well.

According to operating pattern of the third layer nodes, ESO and Meter can be classified in a part, while other report and user defined report in another part. Then the operating flow introduction would be followed as the two parts.



Main Interface of Program (Interface of Other Reports)

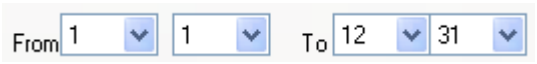
Operating Flow

a. For portions of ESO file report and Meter file report

The main difference between this part and next part is that the report of next part, i.e. type and amount of parameters, needs to be defined by user. This portion of report has been created automatically when loading ESO and Meter files. The second layer of node, i.e. time step length, hourly, daily, monthly and running time length, is output time step length of EnergyPlus output parameters. The third layer corresponds to all parameters (created automatically) of ESO file or Meter file with corresponding step

length. Operating flows are as following:

1） Click the third layer of the list, i.e. parameter name, then parameter names, units, step lengths, file store path, and the store column number of this parameter in file would be listed out in table area, and user might type in a new parameter name in column of parameter name. There is only a single parameter name in each report.

2) Select time periods from dropdown list 

in form area and drawing area, and the graphs in drawing area would contain consumption data of the selected time period, then graphs corresponding to parameters of table area would be drawn in drawing area, when clicking 

, Click right button in drawing area, a shortcut menu 

would pop up, and values of graph parameters would be listed dialog when selecting this menu.

b. For portions of relation report and user defined report

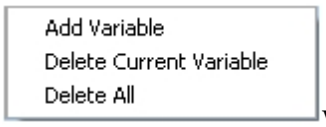
At the initial moment of this software's startup, there was only the second layer of node, i.e. time step length, for two portions, without the third layer, so we have to add parameters required by ourselves. Operating flows are as follows:

1) Select the second layer node, click the right button, and a shortcut menu 

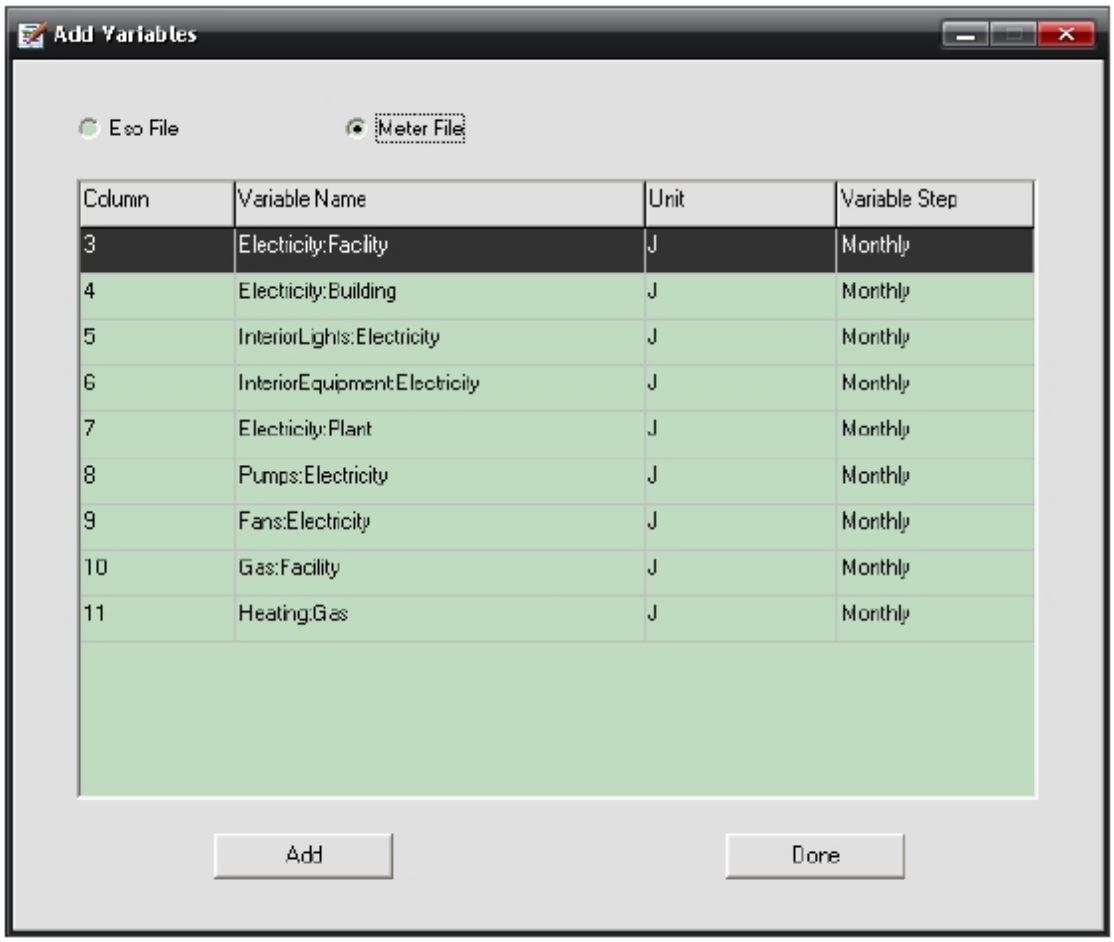
will pop up. Select the shortcut menu, and a default name report would be added into the third layer node. Select this node, and click right button, then a shortcut menu 

would prompt for renaming or deleting this report type. Thus we could define many report type with various step lengths.

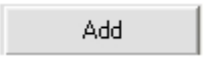
2) Select the third layer node, i.e. user defined report type, with left button, and corresponding parameter names, units, step length, file store path and store column number of parameter in file would be listed in table area. As there is no corresponding parameter when defining report, there would no data in table area, and we would add parameter name in report. Click right button in table area, a shortcut menu

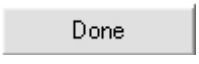


would pop up, and a user defined parameter dialog as below would prompt when select “add parameter” item of the menu.



Dialog of user defined variables

Select the above radio boxes of Eso File and Meter File, and parameters corresponding to each report time step would be showed in dialog’s list. Select parameter name and click 

, then the selected parameter would be added into the form, and click 

for completion of addition. Return main interface and click 

, then the newly-added parameter would be saved. For the portion of user defined report, several variables can be added, while two variables for the portion of relation report, i.e. value of one parameter for x-coordinate and value of another for y-coordinate. “Delete current parameter” and “Delete all parameters” in shortcut menu are used for deletion of current parameter and all

parameters from the report respectively.

3) Select time periods from dropdown list 

in form area and drawing area, and the graphs in drawing area would contain consumption data of the selected time period, and then graphs corresponding to parameters of table area would be drawn in drawing area, when clicking 

. For user defined report, graphs are line chart, histogram and pie chart, while scatter gram only for relation report, and x-coordinate and y-coordinate of point correspond to values of two parameters in report. Likewise, click right button in drawing area, a shortcut menu 

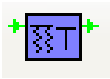
would pop up, and values of graph parameters would be listed dialog when selecting this menu.

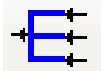
5 Component Library

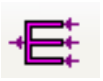
5.1 Introduction of Component Library

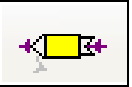
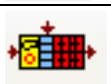
The component library of this software provides with 109 components, which classified into 28 classes. Components have layout on different tabs according to their classes. When mouse is hovering an icon, the software would show its name. Instruction of icons is listed in below table.

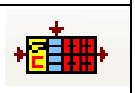
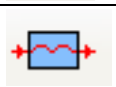
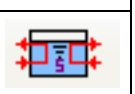
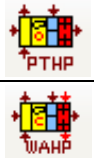
Group	Component name	Icon
BOILER	Boiler: Simple	
	Boiler: Steam	
CHILLER	Chiller:Electric	
	Chiller:Electric:Eir	
	CHILLER:ABSORPTION	
	Chiller:Direct Fired Absorption	

	Chiller:Const COP	
	Chiller:Absorption:Indirect	
Coil	Coil:Electric:Heating	
	Coil:Water:Cooling	
	Coil:Water:SimpleHeating	
	Coil:Cooling: DX: Single Speed	
	Coil:Cooling:DX:MultiSpeed	
	Coil:Heating:DX:SingleSpeed	
	Coil:Heating:DX:MultiSpeed	
Connection Component	Connection Component:PlantLoop	
Cooling Tower	Cooling Tower:Single Speed	
	Cooling Tower:Two Speed	
	Cooling Tower:Variable Speed	
Desiccant Dehumidifiers	Dehumidifier:Desiccant:NoFans	
	Dehumidifier:Desiccant: Fans:Variable Speed	
	Dehumidifier: Desiccant: System: Constant Speed	
	Dehumidifier: Desiccant: System:Variable Speed	
Evaporative Coolers	EvaporativeCooler:Direct:CelDekPad	
	EvaporativeCooler:Indirect:CelDekPad	
Fan	Fan:Simple:Const Volume	
	Fan:Simple:Variable Volume	

	Fan:OnOff	
	Fan:ZoneExhaust	
	FanPerformance:NightVentilation	
Fan Coil Unit:4 Pipe	Fan Coil Unit:4 PIPE:FANCon	
	Fan Coil Unit:4 PIPE:FANVar	
	Fan Coil Unit:4 PIPE: FanOnOff	
Headered Pumps	Headered Pumps:Simple:Variable Speed	
	Headered Pumps:Simple:Constant Speed	
Heat Exchanger	Heat Exchanger:Air to Air:Flat Plate	
	Heat Exchanger:Air to Air:Generic	
	Heat Exchanger:Hydronic	
	Ground Heat Exchanger:Pond	
	Ground Heat Exchanger:Surface	
	HeatExchanger:Desiccant:BalancedFlow	
	HeatExchanger:Desiccant:BalancedFlow:PerformanceDataType	
Heat Pump	HeatPump:WaterToWater:EquationFit:Cooling	
	HeatPump:WaterToWater:EquationFit:Heating	
	HeatPump:WaterToWater:ParameterEstimation:Cooling	
	HeatPump:WaterToWater:ParameterEstimation:Heating	
Humidifier	Humidifier:Steam:Electrical	
Mixer	Mixer	

	Zone Mixer	
Outside Air Mixer	Outside Air Mixer	
Pipe	Pipe:Adiabatic	
	Pipe:Indoor	
	Pipe:Outdoor	
	Pipe:Underground	
	Duct	
	Valve:Tempering	
Pumps	Pump:Constant Speed	
	Pump:Variable Speed	
	Pump:VariableSpeed:Condensate	
Purchased	Purchased: Chilled Water	
	Purchased: Hot Water	
Radiate Device	Low Temp Radiant System:Hydronic	
	BASEBOARD HEATER:Water:Convective	
	ZoneHVAC:LowTemperatureRadiant:ConstantFlow	
	ZoneHVAC:HighTemperatureRadiant	
	ZoneHVAC:LowTemperatureRadiant:Electric	
	ZoneHVAC:Baseboard:Convective:Electric	
	ZoneHVAC:Baseboard:RadiantConvective:Electric	
	ZoneHVAC:Baseboard:RadiantConvective:Water	

Solar Collectors	SolarCollector:FlatPlate:Water	
Single Duct	Air Terminal: Single Duct: Uncontrolled	
	Single Duct:VAV:NoReheat	
	Single Duct:VAV:Reheat:electric coil	
	Single Duct:VAV:Reheat;water coil	
	Single Duct:Series PIU: Reheat:electric coil	
	Single Duct: Series PIU: Reheat;water coil	
	Single Duct:Parallel PIU: Reheat:electric coil	
	Single Duct: Parallel PIU: Reheat:water coil	
Splitter	Splitter	
	Zone Splitter	
Thermal Storage	Thermal Storage:Ice:Simple	
	Thermal Storage: Ice:Detailed	
	ThermalStorage:ChilledWater:Mixed	
	ThermalStorage:ChilledWater:Stratified	
Unitary Equipment	AirLoopHVAC:UnitarySystem:HeatPump:AirToAir:FanCon	
	AirLoopHVAC:UnitarySystem:HeatPump:AirToAir;FanOnOff）	
	AirLoopHVAC:UnitarySystem:HeatPump:WaterToAirFanCON	
	AirLoopHVAC:UnitarySystem:HeatPump:WaterToAir: FanOnOff	
	AirLoopHVAC:UnitaryCoolOnly	
	AirLoopHVAC:UnitarySystem:MultiSpeedHeatPump:AirToAir:	

	FanOnOff	
	AirLoopHVAC:UnitarySystem:MultiSpeedHeatPump:AirToAir; FanCon	
Water system and water heater	WaterUse:Storage	
	WaterUse:Equipment	
	WaterUse:Connections	
	Water Heater:Mixed	
	Water Heater:Stratified	
Zone	Zone	
Zone Forced Air Units	Purchased Air	
	ZoneHVAC:PackagedTerminalAirConditioner （FanCon/ElectricCoil）	
	ZoneHVAC:PackagedTerminalAirConditioner （FanCon/WaterCoil）	
	ZoneHVAC:PackagedTerminalAirConditioner （FanOnOff/ElectricCoil）	
	ZoneHVAC:PackagedTerminalAirConditioner （FanOnOff/WaterCoil）	
	ZoneHVAC:PackagedTerminalHeatPump（FanCon）	
	ZoneHVAC:PackagedTerminalHeatPump（FanOnOff）	
	ZoneHVAC:WaterToAirHeatPump（FanCon）	
	ZoneHVAC:WaterToAirHeatPump（FanOnOff）	
	ZoneHVAC:EnergyRecoveryVentilator	
Zone Plenum	Zone Supply Plenum	

	AirLoopHVAC:ReturnPlenum	

5.2 Introduction of Component Icons

In favor for modeling, input and output nodes (I/Os) are marked with different colors, to distinguish different connective nodes. Relevant regulations are as follow.

BlueI/Os: Connect to equipments corresponding to ChilledWater;

Green I/Os: Connect to equipments corresponding to CondensorWater;

Red I/Os: Connect to equipments corresponding to HotWater.

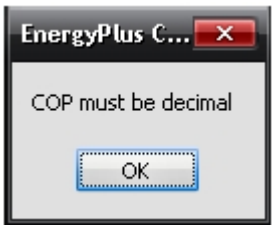
Purple I/Os: Connect to equipments corresponding to air path.

6 Data Inspection

When component attributes are set or modified, software would carry out data inspection on parameters. Data inspection includes four parts:

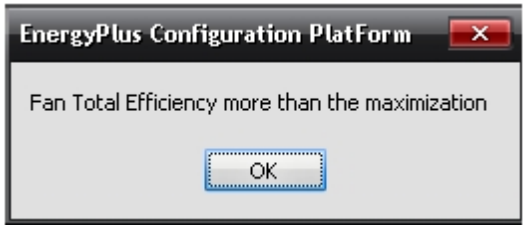
6.1 Inspection of data type

Software will carry out a primary inspection on data type of filled value. For parameters as name and type, etc, char type is permitted, and for flow rate and COP value, etc, numeric value is permitted. Or else, prompt as below would be given.



6.2 Inspection of data scope

Numbers filled should not exceed specified data scope, or error message would prompt to show whether the value is over upper limit or lower limit.



6.3 Inspection of Chinese characters

It is not permitted to input Chinese characters in any edit boxes, otherwise the below error message would prompt out as the cursor leaving the edit box.

6.4 Inspection of component's name

There is a unique name for each component. And if the name of a newly-built component has already existed, the below error message would prompting out: