

GRAPHISOFT EcoDesigner Workflow

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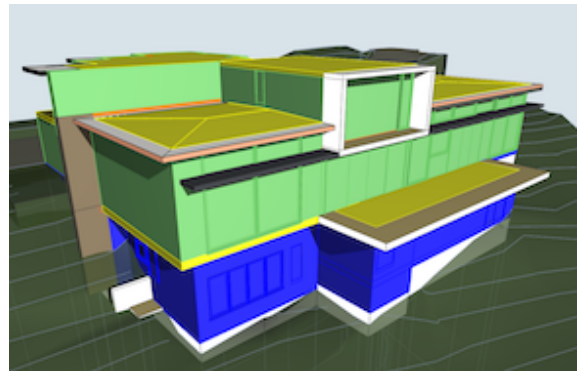
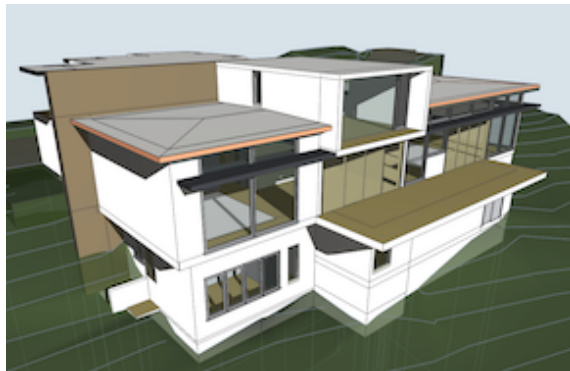
BIM-integrated Energy Modeling

GRAPHISOFT EcoDesigner uses a simple, three-step workflow to determine the energy characteristics of the project directly within the familiar ArchiCAD design environment:

Model > Evaluate > Report.

1. Model

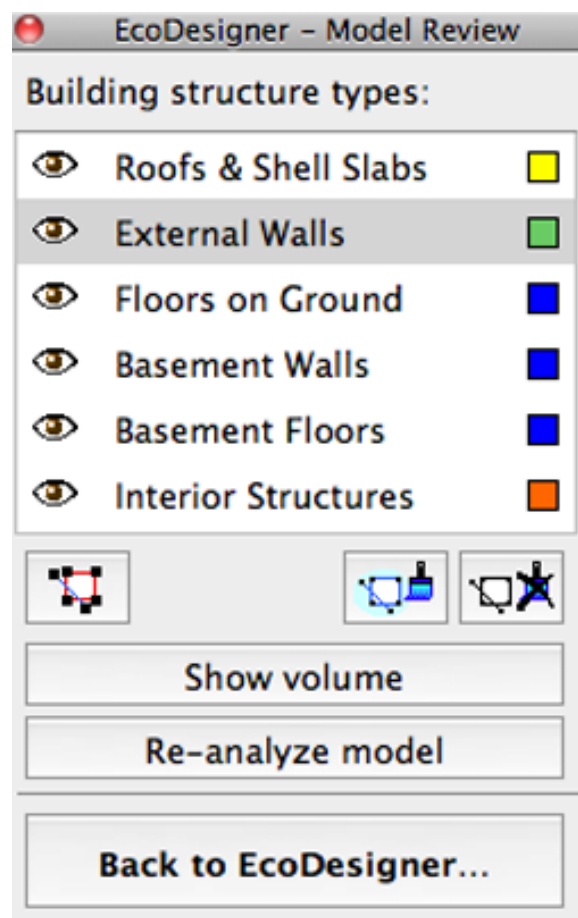
Turn the ArchiCAD Virtual Building into a building energy model with minimal effort



Automated BIM analysis

EcoDesigner updates the building energy model automatically during architectural design.

- **Color-coded building energy model display** - on the floor plan and in 3D.
- **Model Review Palette** - enables manual optimization of the automatically generated building energy model.
- **Structures** – components of the building envelope are automatically listed with their default physical properties. These may be reviewed or changed. Use the extensive built-in material database to assemble composites, and the U-value Calculator to control their heat transfer characteristics. It is also possible to set the heat transfer coefficient of multiple structure groups directly, using the U/R-value override function.



Building shell elements:				Model Review		
Orientation	Building structure	Area [m2]	Thickness	U-value[W/m2K]	Surface	Infiltration [l/sm2]
Underground	Hatch-Solid ...	13.80	1'-4"	0.55	Colored p...	Average (1.10)
East	11450.504	1.23	2"	0.55	Colore...	Average (1.10)
North	2x4 studs w...	0.40	5 3/8"	0.55	Colored p...	Average (1.10)

- **Openings** - EcoDesigner compiles the list of fenestration and external doors automatically. Use the Openings Catalog to assign performance data to openings, or enter specific product properties manually, and then equip fenestration with fixed or mobile shading devices, in order to control solar gains.

Openings on building shell:							
Orientation	Opening type	Area [m2]	Shading device	Glass %	U-value[W/m2K]	TST %	Infiltration [l/sm2]
North	Window	66.02	None	✓ None			0.80
North	Door	46.42	None	Curtain			0.80
West	Window	2.17	None	Venetian Blinds			0.80
East	Window	10.96	None	Roller Blinds			0.80
East	Door	3.90	None	Awnings			0.80
				External Blinds			0.80

Additional data input

Fast, easy and intuitive. Use the robust feature set to collect and define variables, and let EcoDesigner do the rest.

- **Location-specific Weather Data** - ASHRAE standard-compliant IWEC air temperature, relative humidity, wind speed, and solar radiance data for default cities are included in the program's built-in database. If a custom location is entered using geographical coordinates, EcoDesigner downloads its weather data from an online weather server and adds it to the built-in content for future reference.
- **Building Location** - the Project North, Grade level to project zero, Wind protection and Surrounding surfaces settings define basic site characteristics and the building's situation on the site, while Façade Shadings determine shadows on the building's elevations.

Project Location:

Latitude:

Longitude:

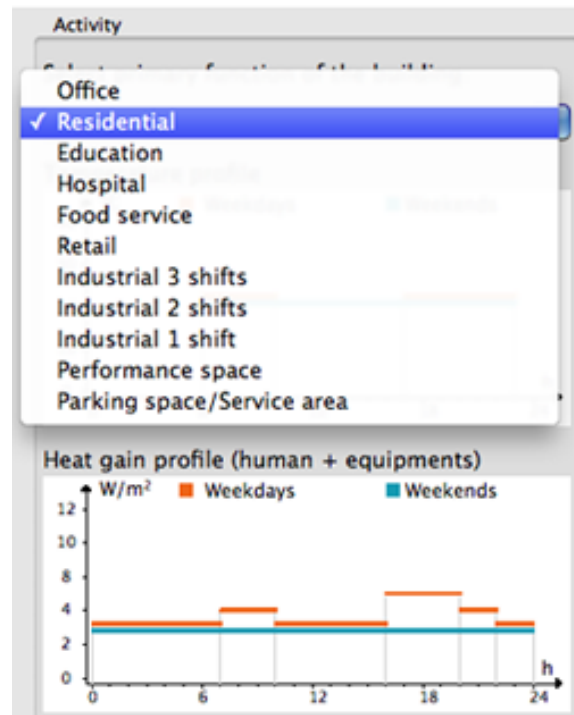
Weather data has been downloaded.

Grade level to project zero:

Wind protection:

Surroundings:

- **Activity Type** - define building function or multiple functions (offices, residential buildings, hospitals, schools, various industries, etc.) to assign day-by-day internal temperature and internal heat gain profiles (including human and equipment-related heat loads) to the project.



- **MEP Systems & Energy** - Information about Heating, Cooling, Ventilation, Hot Water Generation and Interior Lighting is essential for accurate calculations. The correct definition of Energy Prices and Sources enable EcoDesigner to calculate the building's annual Energy Supply Costs and Carbon Footprint accurately.

The screenshot shows the 'MEP Systems & Energy' configuration panel. The 'Heating type' dropdown is set to 'Natural', with 'Local boiler / water heater' and 'District' as options. The 'Efficiency' is set to 90%. The 'Target' is set to 'Heating only'. The 'Cooling type' is set to 'Mechanical', and the 'Type' is set to 'Water cooled'. The 'Ventilation type' is set to 'Natural'. The 'Air change per hour' is set to 1.00.

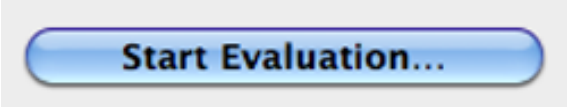
- **Green Energy** - Substituting fossil fuels with green energy sources not only lower the carbon footprints of buildings, but can be very economical, too. EcoDesigner is capable of dynamically calculating the effect of the installation of air-to-air recovery systems, solar collectors and various heat pump types on the energy household of buildings. Combine several green MEP systems, or use them for multiple purposes simultaneously, to evaluate the resulting carbon emission reductions and cost benefits.

The screenshot shows the 'Green Energy' configuration panel. The 'Heat pump' checkbox is checked. The 'Source' is set to 'External air'. The 'Capacity' is set to 15.00 kW. Under 'Targets', the 'Hot water generation' checkbox is checked, while 'Space heating' and 'Fresh air heating' are unchecked. A note at the bottom states: 'Note: Fresh air heating requires installed mechanical ventilation.'

2. Evaluate

The runtime of the energy simulation integrated in ArchiCAD is just a few seconds, even on large projects or multiple buildings.

- **VIPCore Calculation Engine** - when all necessary input data is provided, activate Strusoft's high-end energy calculation module within EcoDesigner. It only takes one click of the mouse to perform the dynamic analysis that determines the building's energy balance at every hour, throughout one year.



Start Evaluation...

3. Results

The Building Energy Evaluation Report is an accurate, easy to read representation of the yearly energy balance simulation results, instantly available in PDF format.

- **Key Values** - displays basic information, such as Project Name, Location, Activity Type and the date of the evaluation. Furthermore, the treated floor area and ventilated volume, outer heat capacity, the minimum and maximum heat transfer coefficients for every building structure group and for the openings on the building shell are also shown. Under Specific annual demands, the most important energy performance data (net demand and gross consumption data) - projected to a unit area of the building - are listed, making the comparison of different sized projects possible.

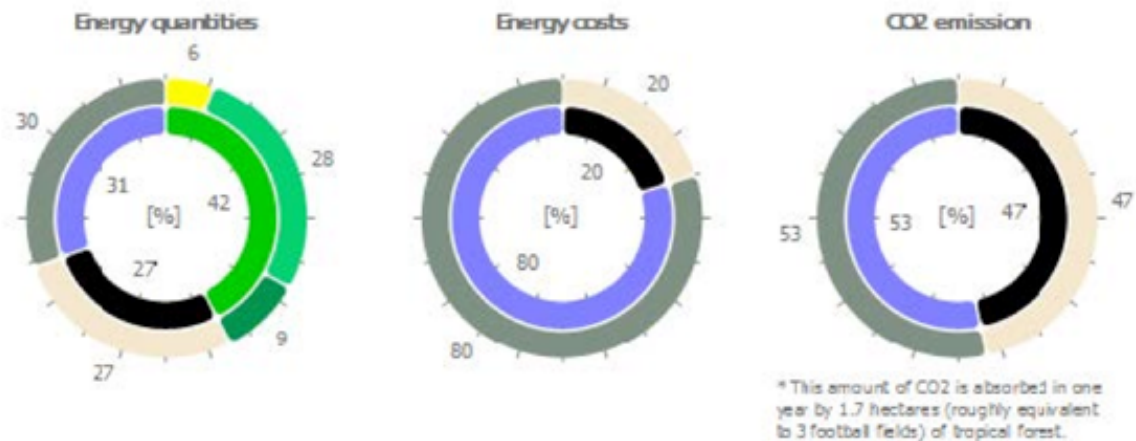
Key Values			
General project data			
Location:	Stockholm		
Activity Type:	Office		
Evaluation Date:	5/23/2011 2:27 PM		
Building geometry data			
Treated floor area:	14014	m ²	
Building shell area:	9562	m ²	
Ventilated volume:	46246	m ³	
Glazing ratio:	22	%	
Building shell performance data			
Air leakage:	0.45	AQH	
Outer heat capacity:	-	J/m ² K	
Heat transfer coefficients			
Building shell average:	0.63	U value	[W/m ² K]
Roofs:	0.25 - 0.25		
External walls:	0.45 - 0.45		
Basement walls:	-		
Openings:	1.60 - 1.60		
Specific annual demands			
Net heating energy:	37.26	kWh/m ² a	
Net cooling energy:	18.31	kWh/m ² a	
Energy consumption			
Energy consumption:	196.47	kWh/m ² a	
Primary energy:	238.77	kWh/m ² a	
Operation cost:	10.54	EUR/m ² a	
CO ₂ emission:	24.43	kg/m ² a	

- **Energy Consumption by Sources** - This section of the Evaluation Report contains one table and three pie charts. The table's leftmost column lists energy Sources by type (Renewable, Fossil and Secondary) and name, plus their color codes used in the pie chart. The Quantity column lists the magnitude [e.g. kWh/a] while the Cost column shows the price [currency/a] of each energy source consumed in one year. The table's rightmost column shows the carbon footprints associated with the listed energy source magnitudes.

Energy Consumption by Sources

Energy				CO2 emission
Source type	Source name	Quantity	Cost	
		MWh/a	EUR/a	kg/a
Renewable	Solar collector	152.4		0
	Exhaust air	759.4		0
	Environment	256.6		0
Fossil	Natural gas	741.4	29657	160150
Secondary	Electricity	843.5	118092	182199
	Sum:	2753.3	147749	342350*

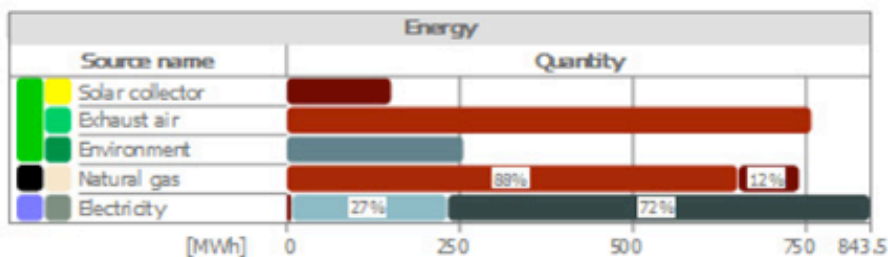
- The Distribution by Sources pie charts graphically display the percentage distributions of the quantities, costs and carbon footprints of the used energy sources. The internal indicator ring shows the energy source type distribution while the external ring displays the actual energy source distribution.



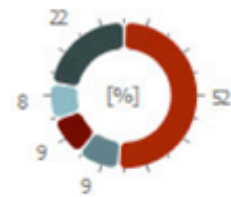
- Carbon Footprint** - Besides the information on the carbon dioxide emissions resulting from the building's operation over the course of a year, the magnitude of equivalent CO2 absorbent vegetation is also displayed on the Energy Balance Evaluation, under the CO2 Emission by Energy Sources pie chart. The CO2 emission factors assigned to the energy sources differ according to building location. Use the Energy Source Factors dialog to enter the region-specific data if available, or evaluate the project using the default assignments offered by EcoDesigner (based on standard DIN V-18599).
- Energy Consumption by Targets** - This section of the Evaluation Report contains two tables and three pie charts. The table's leftmost column lists energy Targets by name, plus their color codes used in the pie chart. The Quantity column lists the magnitude [e.g. kWh/a] while the Cost column shows the price [currency/a] of energy spent on each target in one year. Next to the Primary energy breakdown, the table's rightmost column shows the carbon footprints associated with the listed energy target magnitudes.

Energy Consumption by Targets

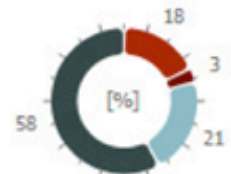
Target name	Energy			CO2
	Quantity	Cost	Primary	Emission
	MWh/a	EUR/a	MWh/a	kg/a
Heating	1412.0	26107	718.0	140980
Cooling	256.6	0	0	0
Hot water generation	248.8	4617	120.5	20816
Ventilation fans	225.1	31508	675.2	48613
Lighting & appliances	610.8	85515	1832.5	131938
Sum:	2753.3	147749	3346.1	342350



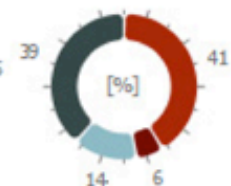
Energy quantities



Energy costs

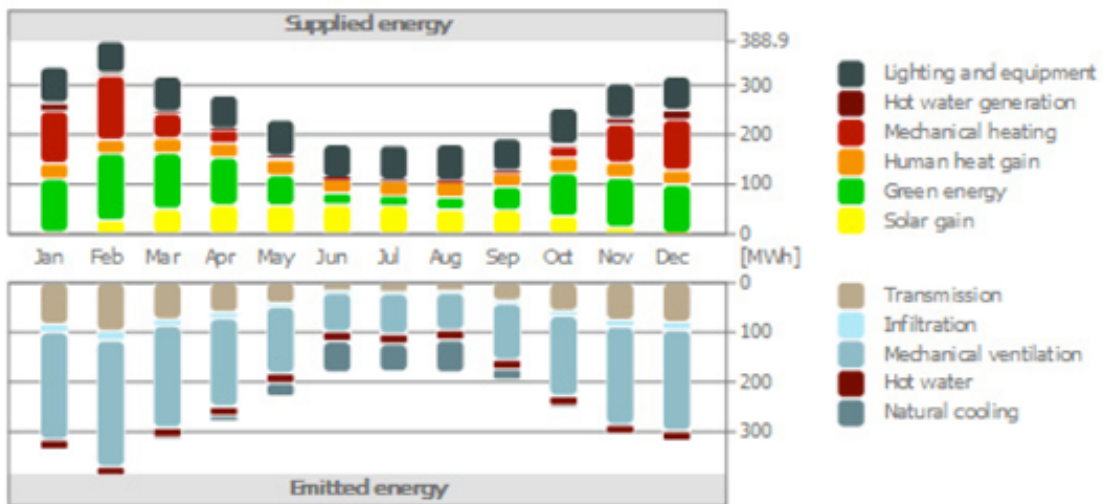


CO2 emission



- The Distribution by Targets pie charts graphically display the percentages of the quantities costs carbon footprints associated with each energy target. The Target Quantities by Energy Sources bar chart links the information found on the Energy Consumption by Sources and on the Energy Consumption by Targets tables together, by displaying the energy target type, magnitude and percentage of each energy source.
- **Primary Energy** - the 'common denominator' among different energy source consumption types, when determining the building's total energy consumption. Not only does it indicate the net energy source consumed, but it also incorporates the energy needed for the manufacturing, transportation and the raw material processing of the energy source, as well as its transportation to the place of use. Minimizing the specific primary energy demand is a great way to improve the designed buildings' overall performance. The primary energy factors assigned to the energy sources differ according to building location. Use the Energy Source Factors dialog to enter the region-specific data if available, or evaluate the project using the default assignments offered by EcoDesigner (based on standard DINV-18599).
- **Monthly Energy Balance Bar Chart** – The Monthly Energy Balance bar chart is a graphical display of the amount of energy the building emits, as well as the building's Supplied energy: the amount of energy it absorbs from the environment and its own internal heat sources, by month.

Monthly Energy Balance



- According to the energy balance equation - which is the fundament of building physics - the Emitted energy and Supplied energy bars must be equal every month. The vertical axis of the chart shows an energy scale. Along the horizontal axis, the twelve months of the year are shown. The Monthly Energy Balance Bar Chart shows the cumulative results of the hourly energy balance calculations executed by The VIPCore Calculation Engine.
- **Monthly Energy Balance Table** - In EcoDesigner for ArchiCAD 15 it is possible to export the energy balance calculation results into an XLS spreadsheet.

for EcoDesigner User Manual			July	August	September	October	November	December	Annual total	Annual total absolute	Annual total specific (kWh/m2)
All numbers are in [kWh]											
Human heat gain			30214.11	31587.48	27467.38	31587.48	30214.11	28840.74	318449.23	358449.23	25.58
Solar gain			56515.42	49353.75	47619.50	35298.61	13064.70	1837.80	49198.07	49198.07	32.77
Green energy - Supplied			20739.83	25197.05	48549.04	87748.39	100895.34	97614.63	9:9394.56	919394.56	65.63
	Solar collector		17940.24	17803.51	16548.65	15590.13	6834.37	503.04	140038.75	140038.75	11.42
		Space heating	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Fresh air heating	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Hot water generator	17940.24	17803.51	16548.65	15590.13	6834.37	503.04	140038.75	140038.75	11.42
	Air to air recovery		2799.59	7593.54	32200.41	72158.26	94060.98	97111.59	759355.81	759355.81	54.19
		Heat pump	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Space heating	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Fresh air heating	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Hot water generator	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Green energy - Emitted			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Heat pump for cooling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ventilation			-62443.89	-55906.81	-94669.88	-142773.24	-179190.07	-184665.63	-1674342.01	1674342.01	119.48
		Natural	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mechanical	-62443.89	-55906.81	-94669.88	-142773.24	-179190.07	-184665.63	-1674342.01	1674342.01	119.48
Hot water			-19622.51	-19622.51	-18989.51	-19622.51	-18989.51	-19622.51	-211099.16	211099.16	16.49
	Hot water generation		1682.27	2019.01	2640.90	4832.38	12155.16	19119.48	71000.54	71000.54	5.07
Heating			0.00	121.38	1616.67	22564.59	77656.92	102265.82	522150.97	522150.97	37.26
		Natural	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mechanical	0.00	121.38	1616.67	22564.59	77656.92	102265.82	522150.97	522150.97	37.26
		District	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cooling			-56197.57	-66480.21	-21221.62	-5469.53	0.00	0.00	-256572.16	256572.16	18.31
		Natural	-56197.57	-66480.21	-21221.62	-5469.53	0.00	0.00	-256572.16	256572.16	18.31
		Mechanical	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		District	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lighting and Appliances			51487.44	53827.77	46806.76	53827.77	51487.44	49147.10	6:0828.22	610828.22	43.59
		Lighting	16956.94	17727.71	15415.40	17727.71	16956.94	16186.17	281170.97	281170.97	14.36
		Appliances	34530.50	36100.06	31391.36	36100.06	34530.50	32960.93	409657.25	409657.25	29.23
Supplied energy			140639.07	162106.44	174700.25	235459.22	285473.67	298825.57	2943021.59	2943021.59	209.86
Emitted energy			-160143.38	-162366.09	-176955.73	-234621.89	-286738.59	-299315.11	-2940128.23	2940128.23	209.83
Difference			495.70	-259.65	-2255.49	437.33	-1264.92	-489.54	693.35	693.35	0.05
Auxiliary systems			19970.40	19954.31	19275.08	19855.63	18815.14	19138.97	232687.56	232687.56	16.60

The level of data detail displayed on the Monthly Energy Balance Excel Table exceeds the level of detail of the Monthly Energy Balance bar chart:

- Green Energy is further broken down according to each specific target of the solar collector and the heat pump and the energy regained by the air-to-air energy recovery system is also enumerated separately.
- Lighting and Appliance electricity consumptions are listed separately as opposed to combined.
- The electricity consumption of the Auxiliary Systems is enumerated separately, not just as part of the energy currents associated to the heat pump, solar Collector and/or mechanical ventilation.