2   Exchange Requirements for Energy Simulation Input

Name	Exchange of Energy Simulation Input Parameters

Identifier	ER_EnergyAnalysis_Inputs_1 and ER_EnergyAnalysis_Inputs_2

Change Log		
15-May-08	Initial version, adapted from Energy Analysis IDM originally developed by Jeff Wix for buildingSMART Norway	Richard See
05-Jun-08	Changes for version 0.15	Richard See
27-Aug-08	Changes for version 0.2	Benjamin Welle Richard See
07-Sept-08	Changes for version 0.3	Benjamin Welle Richard See
11-Sept-08	Changes for version 0.4	Benjamin Welle Richard See
12-Nov-08	Changes for version 0.8	Benjamin Welle Richard See
04-Dec-08	Changes for version 0.91	Benjamin Welle Richard See
18-Jan-09	Changes for version 0.95	Benjamin Welle Richard See

Project Stage	0	Portfolio requirements	
	1	Conception of need	
	2	Outline feasibility	

3	Substantive feasibility	
4	Outline conceptual design	✓
5	Full conceptual design	✓
6	Coordinated design and procurement	
7	Production information	
8	Construction	
9	Operation and maintenance	
10	Disposal	

2.1   Overview

The scope of this exchange requirement is the exchange of information about spaces with associated energy information and about proposed energy analysis zones. The purpose of the exchange requirement is to support the coordination of energy analysis requirements with general zoning and spacing requirements.

The exchange requirement assumes that a building model is available from which relevant geometric information required for energy analysis can be derived. It is anticipated that the building model will provide context information about the project including units to be used, coordinate systems to be adopted and the direction of true north.

The building model will provide specific information about:

- the building, its location, composition, overall shape and orientation
- the shape and location of adjacent buildings to enable shading effects to be determined
- building stories within the building
- spatial configuration

Information that is provided by this exchange requirement to enhance the initial set of building model information includes:

- space type and function identification with type data being obtained from a project space type library (which is in turn derived from an industry space type library). This data will drive assumptions on internal loads, conditioning requirements, etc.
- building elements construction type data with type data being obtained from a project construction type library (which is in turn derived from a industry construction type library). This data will provide information on the thermal characteristics of the building envelope and internal constructions.

- space boundaries that define the relation between spaces and building elements and the geometry that describes the space boundary connection
- energy targets
- HVAC zoning, daylighting, and the use of photovoltaics

2.2   Exchange Requirements - Energy Analysis Inputs 1 (Architect)

Type of Information	Information Needed	Required	Optional	Data Type	Units
Project	The following properties should be included:				
	o Identification	X		String	n/a
	o Owner/Client information		X	String	n/a
	o Model Author		X	String	n/a
Site	The following properties should be included:				
	o Address		X	String	n/a
	o Global Coordinates	X		(2) triples	deg/min/sec
	o Site Elevation (datum)(relative to sea level)	X		Real	m
	o 2D Geometry		X	IFC Geometry	varies
	o 3D Geometry		X	IFC Geometry	varies
Site Context	The following properties should be included for existing buildings adjacent to the subject building:				
	o Identification	X		String	n/a
	o 3D Geometry	X		IFC Geometry	m
Building	The following properties should be included (if not known then probable values should be used):				
	o Identification	X		String	n/a
	o Global Coordinates	X		(2) triples	deg/min/sec
	o Functional Classification (OmniClass)		X	String	n/a
	o Orientation (deviation of building grid from true north, clockwise)	X		Real	Angular Degrees
	o Elevation (relative to the site datum)	X		Real	m
Building (Energy Target)	The following properties should be included (if not known then probable values should be used):				
	o Energy Target Units (mandatory if Energy Target Value is included)		X	String	varies
	o Energy Target Value		X	Real	varies

Type of Information	Information Needed	Required	Optional	Data Type	Units
Building Stories	The following properties should be included (if not known then probable values should be used):				
	o Identification	X		String	n/a
	o Elevation (relative to building datum)	X		Real	m
Spaces	The following properties should be included (if not known then probable values should be used):				
	o Identification	X		String	n/a
	o Description		X	String	n/a
	o Functional Classification - OmniClass Table 13 (reference to a classification -- see below)		X	Relationship	n/a
	o Functional Classification – Client Space Type (reference to a classification -- see below)	X		Relationship	n/a
	o Inside or Outside space	X		Boolean	
	o Space Usage (thermal simulation type) (Enumeration modified from California Title 24 list of occupancy types (table N2-7). We added: Open to Below, Supply Plenum, Return Plenum)		X	Enumeration value	n/a
	o 2D Geometry		X	IFC Geometry	varies
	o 3D Geometry	X		IFC Geometry	varies
	o Links to Space Boundaries	X		List of Relationships	n/a
	o Space Conditioning Requirement (heated and cooled, heated only, cooled only, unconditioned)		X	Enumeration value	n/a
Second Level Space Boundaries	The following properties should be included for 2nd level space boundaries:				
	o Space Boundary Type (1=internal, 2=external, 3=virtual)	X		Enum	n/a
	o Space Boundary Tag (2nd level, "face")	X		String	n/a
	o 3D planar geometry	X		IFC Geometry	m
	o Link to Space	X		Relationship	n/a
	o Link to Building Element	X		Relationship	n/a
Building Elements (General)	The following properties should be included (if not known then probable values should be used):				
	o Building Element Type (wall (exterior/interior), curtain wall, roof, floor, ceiling, window, door, shading device)	X		Enum	n/a
	o Construction type (e.g. wall type, door type, window type, shading device type, etc.) Window constructions from Window 6, opaque constructions from ASHRAE Fundamentals.	X		String	n/a

Type of Information	Information Needed	Required	Optional	Data Type	Units
	o Classification - UniFormat (reference to a classification -- see below)		X	String	n/a
	o 3D Geometry	X		IFC Geometry	varies
	o Exterior or Interior Element (i.e. Is Exterior)	X		Boolean	n/a
	o Link to Space Boundary	X		Relationship	n/a
Building Elements (Opaque- Wall, Roof, Floor, Ceiling, Door)	Added to the list above, the following properties should be included for opaque building elements (e.g. walls, floors, ceilings, roofs, doors, etc.):				
	o Link to Material Layer Set	X		String	n/a
Building Elements (Glazing- Curtain Wall, Glazed door, Skylight, Window)	Added to the Building Elements list above, assigns thermal information to building elements to enable energy analysis. The following properties should be included for glazed building elements (e.g. windows, curtain walls, glazed doors, and skylights):				
	o Window Assembly Exterior Surface Color of Glass (clear, bronze, silver, gold, copper, blue, green, gray, mirror)		X	Enum	n/a
	o Window Assembly Interior Surface Color of Glass (clear, bronze, silver, gold, copper, blue, green, gray, mirror)		X	Enum	n/a
Material (Opaque)	A building material (e.g. wood, concrete, steel, etc.):				
	o Identification	X		String	n/a
Material Layer (Opaque)	An individual building layer in a material layer set:				
	o Identification	X		String	n/a
	o Description	X		String	n/a
	o Material	X		String	n/a
Material Layer Set (Opaque)	An ordered list of material layers used in a building element construction:				
	o Identification	X		String	n/a
	o Description	X			
	o List of material layers	X		List of String	n/a
Photovoltaics	The following describes properties for PV electricity generation on-site:				
	o Photovoltaics		X	Boolean	
	o Host Building Element (required if 'Photovotaics' = TRUE)		X	Relationship	n/a

Type of Information	Information Needed	Required	Optional	Data Type	Units
	o Active Area Fraction (fraction of host element with PVs) (required if 'Photovotaics' = TRUE)		X	Real	%
	o DC to AC Inverter Conversion Efficiency (required if 'Photovotaics' = TRUE)		X	Real	%
	o PV Surface Integration (Decoupled, Integrated, Integrated w/ Ventilation) (required if 'Photovotaics' = TRUE)		X	Enum	n/a
	o PV Cell Efficiency (required if 'Photovotaics' = TRUE)		X	Real	%

2.3   Exchange Requirements - Energy Analysis Inputs 2 (Mechanical Engineer/Energy Consultant)

Type of Information	Information Needed	Required	Optional	Data Type	Units
	*** NOTE: ALL INFORMATION THAT IS REQUIRED IN INPUTS 1 -- IS ALSO REQUIRED IN INPUTS 2 --- ALL INFORMATION THAT IS OPTIONAL IN INPUTS 1 -- IS EITHER OPTIONAL OR REQUIRED (SEE YELLOW SHADED CELLS) IN INPUTS 2 ***				
Building (Energy Target)	The following properties should be included (if not known then probable values should be used):				
	o Energy Target Units (mandatory if Energy Target Value is included)	X		String	varies
	o Energy Target Value	X		Real	varies
Spaces	The following properties should be included (if not known then probable values should be used):				
	o Space Usage (thermal simulation type) (Enumeration modified from California Title 24 list of occupancy types (table N2-7). We added: Open to Below, Supply Plenum, Return Plenum)	X		Enumeration value	n/a
	o Space Conditioning Requirement (heated and cooled, heated only, cooled only, unconditioned)	X		Enumeration value	n/a
	o Space Occupant Density	X		Real	People/m2
	o Occupant Heat Rate	X		Real	Watts/ person
	o Space Occupant Load	X		Real	W/m2
	o Space Lighting Load	X		Real	W/m2
	o Space Equipment Load	X		Real	W/m2
	o Occupancy Schedule	X		List of	Calendar

Type of Information	Information Needed	Required	Optional	Data Type	Units
				Day/Time	
	o Lighting Schedule	X		List of Day/Time	Calendar
	o Equipment Schedule	X		List of Day/Time	Calendar
Spaces (Thermal Comfort Criteria)	Define the temperatures required in a space for heating and cooling. The following properties should be included (if not known then probable values should be used):				
	o Inside dry bulb temperature for cooling design	X		Real	°C
	o Inside relative humidity for cooling design	X		Real	%
	o Inside dry bulb temperature for heating design	X		Real	°C
	o Inside relative humidity for heating design	X		Real	%
Spaces (Ventilation Criteria)	Set the requirements for ventilation in a space. The following properties should be included (if not known then probable values should be used)				
	o Indication that the space is required to have natural, mechanical ventilation, or mixed mode ventilation.	X		Enumeration value	n/a
	o Natural air change rate required for the space concerned		X	Real	ach
	o Mechanical air change rate required for the space concerned		X	Real	ach
	o Design quantity of outside air to be provided per person in the space	X		Real	m3/s/person
Spaces (Ventilation Design)	Set the results for ventilation design in a space. The following properties should be included (if not known then probable values should be used):				
	o Air flow rate required during the peak cooling conditions		X	Real	m3/s
	o Air flow rate required during the peak heating conditions		X	Real	m3/s
	o Design exhaust air flow rate for the space. (Note that for a space that is to be under positive pressure, this value will be less than the values indicated above.)		X	Real	m3/s
	o Whether a ceiling plenum is to be used for return air or not (True/False)	X		Boolean	n/a
Building Elements (Opaque- Wall, Roof, Floor, Ceiling, Door)	Added to the list above, the following properties should be included for opaque building elements (e.g. walls, floors, ceilings, roofs, doors, etc.):				
	o Composite Thermal Resistance	X		Real	m2-K/W
Building Elements (Glazing- Curtain Wall,	Added to the Building Elements list above, assigns thermal information to building elements to enable energy analysis. The following properties should be included for glazed building elements (e.g.				

Type of Information	Information Needed	Required	Optional	Data Type	Units
Glazed Door, Skylight, Window)	windows, curtain walls, glazed doors, and skylights):				
	o Window Assembly Exterior Surface Color of Glass (clear, bronze, silver, gold, copper, blue, green, gray, mirror)		X	Enum	n/a
	o Window Assembly Interior Surface Color of Glass (clear, bronze, silver, gold, copper, blue, green, gray, mirror)		X	Enum	n/a
	o Transmittance (Visible)		X	Real	**%**
	o Transmittance (Solar)		X	Real	**%**
	o Composite U-Value		X	Real	W/m2-K
	o Shading Coefficient (SC)		X	Real	%
	o Solar Heat Gain Coefficient (SHGC)		X	Real	%
	o Manufacturer		X	String	n/a
	o Product ID		X	String	n/a
Material (Opaque)	A building material (e.g. wood, concrete, steel, etc.):				
	o Roughness (VeryRough, Rough, MediumRough, MediumSmooth, Smooth, VerySmooth)		X	Enum	n/a
	o Density		X	Real	kg/m3
	o Specific Heat		X	Real	J/kg-K
	o Thermal Conductivity		X	Real	W-m/m2-K
Material Layer (Opaque)	An individual building layer in a material layer set:				
	o Thermal Resistance (not possible in binding to IFC 2x3. To be added in binding to 2x4)	X		Real	m2-K/W
	o Thickness	X		Real	mm
	o Absorptivity (Thermal) (not possible in binding to IFC 2x3. To be added in binding to 2x4)		X	Real	%
	o Absorptivity (Solar) (not possible in binding to IFC 2x3. To be added in binding to 2x4)		X	Real	%
	o Absorptivity (Visible) (not possible in binding to IFC 2x3. To be added in binding to 2x4)		X	Real	%
Energy Analysis Zones	The following properties should be included (if not known then probable values should be used). All spaces in the building must be assigned to only one thermal zone.				
	o Identification (User facing)	X		String	n/a
	o Description		X	String	n/a
	o Zone Type (Energy Analysis) (Enum: thermal zone, plenum, other)	X		Enumeration	n/a

Type of Information	Information Needed	Required	Optional	Data Type	Units
				value	
	o Zone Conditioning Requirement (Enum from ???: heated and cooled, heated only, cooled only, unconditioned)	X		List of Enumeration values	n/a
	o Member spaces (i.e. list of links)	X		List of Relationships	n/a
	o HVAC System Type (Enum from ???: CV, VAV, Unitary, HP, Radiant, UFAD, DV, NV, MM, Other (specify))	X		Enumeration value	n/a
	o User Defined HVAC System Type (required if HVAC System Type = "Other")		X	String	
	o HVAC Operating Schedule	X		List of Day/Time	Calendar
	o Heating Setpoint Occupied	X		Real	°C
	o Heating Setpoint Unoccupied	X		Real	°C
	o Cooling Setpoint Occupied	X		Real	°C
	o Cooling Setpoint Unoccupied	X		Real	°C
	o Infiltration Rate	X		Real	ach
	o Is Daylit Zone	X		Boolean	n/a
	o Number of Daylighting Sensors (Required if Daylit = TRUE)		X	Integer	Count
	o Coordinates of each Daylighting Sensor (Required if Daylit = TRUE)		X	Real	m
	o Design Illuminance (Required if Daylit = TRUE)		X	Real	Lux
	o Lighting Controls (Continuous, Stepped, Continuous/Off) (Required if Daylit = TRUE)		X	List of Controls	n/a
Photovoltaics	The following describes properties for PV electricity generation on-site:				
	o Photovoltaics	X		Boolean	
	o Host Building Element (required if 'Photovotaics' = TRUE)		X	Relationship	n/a
	o Active Area Fraction (fraction of host element with PVs) (required if 'Photovotaics' = TRUE)		X	Real	%
	o DC to AC Inverter Conversion Efficiency (required if 'Photovotaics' = TRUE)		X	Real	%
	o PV Surface Integration (Decoupled, Integrated, Integrated w/ Ventilation) (required if		X	Enum	n/a

Type of Information	Information Needed	Required	Optional	Data Type	Units
	'Photovotaics' = TRUE)				
	o PV Cell Efficiency (required if 'Photovotaics' = TRUE)		X	Real	%

3   Exchange Requirements for Energy Simulation Results

Name	Exchange of Energy Simulation Output Results

Identifier	ER_EnergyAnalysis_Results

Change Log		
15-May-08	Initial version, adapted from Energy Analysis IDM originally developed by Jeff Wix for buildingSMART Norway	Richard See
05-Jun-08	Changes for version 0.15	Richard See
27-Aug-08	Changes for version 0.2	Benjamin Welle Richard See
09-Sept-08	Changes for version 0.3	Benjamin Welle Richard See
11-Sept-08	Changes for version 0.4	Benjamin Welle Richard See
04-Dec-08	Changes for version 0.91	Benjamin Welle Richard See
18-Jan-09	Changes for version 0.95	Benjamin Welle Richard See

Project Stage	0	Portfolio requirements	
	1	Conception of need	
	2	Outline feasibility	
	3	Substantive feasibility	

	4	**Outline conceptual design**	✓
	5	**Full conceptual design**	✓
	6	**Coordinated design and procurement**	
	7	**Production information**	
	8	**Construction**	
	9	**Operation and maintenance**	
	10	**Disposal**	

3.1   Overview

The scope of this exchange requirement is the exchange of information about energy demand, comfort, and annual energy consumption. The purpose of the exchange requirement is to enable coordination of energy analysis with other design roles based on the results of energy analysis and the ability to comply with set energy targets. The exchange requirement assumes that the information provisions outlined in the exchange requirement ER_EnergyAnalysis_Inputs_2 have been satisfied.

Information that is provided by this exchange requirement to includes:

- ventilation requirements
- peak thermal loads
- energy demand
- annual energy consumption
- utility rates
- energy costs

3.2   Exchange Requirements - Energy Analysis Results

Type of Information	Information Needed	Required	Optional	Data Type	Units
Prerequisites	The provisions of the exchange requirements ER_EnergyAnalysis_Inputs_2 must be satisfied.	X			
Project	The following properties should be included:				
	o Identification	X		String	n/a
	o Owner/Client information		X	String	n/a
Site (Outside Design Criteria)	The following properties should be included (if not known then probable values should be used):				
	o Outside dry bulb temperature for heating design	X		Real	°C
	o Outside wet bulb temperature for heating design	X		Real	°C
	o The month, day and time that has been selected for the heating design calculations	X		Date/Time	Calendar
	o Daily Temperature Range		X	Real	°C
	o Barometric Pressure		X	Integer	Pa
	o Sky Clearness		X	Real	none
	o Snow Indicator (0=no snow on ground, 1=snow on ground)		X	Boolean	n/a
	o Rain Indicator (0=dry surfaces, 1=wet surfaces)		X	Boolean	n/a
	o The prevailing wind angle direction measured from True North (0 degrees) in a clockwise direction during the winter	X		Real	Angular Degrees
	o The design wind velocity coming from the direction specified by the PrevailingWindDirection attribute during the winter	X		Real	m/s
	o Outside dry bulb temperature for cooling design	X		Real	°C
	o Outside wet bulb temperature for cooling design	X		Real	°C
	o The month, day and time that has been selected for the cooling design calculations	X		Date/Time	Calendar
	o Daily Temperature Range		X	Real	°C
	o Barometric Pressure		X	Integer	Pa
	o Sky Clearness		X	Real	none
	o Snow Indicator (0=no snow on ground, 1=snow on ground)		X	Boolean	n/a
	o Rain Indicator (0=dry surfaces, 1=wet surfaces)		X	Boolean	n/a
	o The prevailing wind angle direction measured from True North (0 degrees) in a clockwise direction during the summer	X		Real	Angular Degrees

Type of Information	Information Needed	Required	Optional	Data Type	Units
	o The design wind velocity coming from the direction specified by the PrevailingWindDirection attribute during the summer	X		Real	m/s
	o The site weather data station description or reference to the data source from which weather data was obtained	X		String	n/a
Ventilation Design	Set the results for ventilation design. *(Note that ventilation design may be captured for any unit of spatial structure. It is required that ventilation design will be captured for building and zones.)*				
	o Air flow rate required during the design day cooling conditions	X		Real	m3/s
	o Air flow rate required during the design day heating conditions	X		Real	m3/s
	o Exhaust air flow rate during the design day cooling conditions (Note that if the area is to be under negative pressure, this value may be the same as the air flow rates indicated above. If the area is to be under positive pressure, this value will be less than the values indicated above)	X		Real	m3/s
	o Air flow rate required during the peak cooling conditions	X		Real	m3/s
	o Air flow rate required during the peak heating conditions	X		Real	m3/s
	o Exhaust air flow rate during the peak cooling conditions (Note that if the area is to be under negative pressure, this value may be the same as the air flow rates indicated above. If the area is to be under positive pressure, this value will be less than the values indicated above)	X		Real	m3/s
	o The month, day, and time that the peak cooling ventilation requirement occurs	X		Date/Time	Calendar
	o The month, day, and time that the peak heating ventilation requirement occurs	X		Date/Time	Calendar
Peak Loads	Capture the results of peak load calculations. *(Note that peak loads may be captured for any unit of spatial structure. Here, it is assumed that peak loads will be captured for the building and zones.)*				
	o The total sensible heat or energy gained during the design day cooling conditions	X		Real	kW
	o The total amount of heat or energy gained during the design day cooling conditions	X		Real	kW
	o The total amount of heat or energy lost during the design day heating conditions	X		Real	kW
	o The total people heat or energy gained (sensible/latent) during design day cooling conditions	X		Real	kW
	o The total lighting heat or energy gained (sensible) during design day cooling conditions	X		Real	kW
	o The total equipment heat or energy gained (sensible) during design day cooling conditions	X		Real	kW
	o The total envelope heat or energy gained (sensible) during design day cooling conditions	X		Real	kW
	o The total ventilation (OA) heat or energy gained (sensible/latent) during design day cooling conditions	X		Real	kW
	o The total infiltration heat or energy gained (sensible/latent) during design day cooling conditions	X		Real	kW

Type of Information	Information Needed	Required	Optional	Data Type	Units
	o The total sensible heat or energy gained during the peak cooling conditions	X		Real	kW
	o The total amount of heat or energy gained during the peak cooling conditions	X		Real	kW
	o The total amount of heat or energy lost during the peak heating conditions	X		Real	kW
	o The total people heat or energy gained (sensible/latent) during peak cooling conditions	X		Real	kW
	o The total lighting heat or energy gained (sensible) during peak cooling conditions	X		Real	kW
	o The total equipment heat or energy gained (sensible) during peak cooling conditions	X		Real	kW
	o The total envelope heat or energy gained (sensible) during peak cooling conditions	X		Real	kW
	o The total ventilation (OA) heat or energy gained (sensible/latent) during peak cooling conditions	X		Real	kW
	o The total infiltration heat or energy gained (sensible/latent) during peak cooling conditions	X		Real	kW
	o The month, day, and time that the peak cooling load occurs	X		Date/Time	Calendar
	o The month, day, and time that the peak heating load occurs	X		Date/Time	Calendar
Energy Consumption	Captures the rate of energy consumption over a designated period of time for various categories of energy consumption and for total energy consumption. *(Note that energy consumption may be captured for any unit of spatial structure. Here, it is assumed that energy consumption will be captured for the building and zones.)*				
	o The unit period of time in which energy consumption is measured (per month, per year, etc.)	X		Enumeration value	n/a
	o The amount of energy consumed for heating purposes during the time period specified	X		Real	kWh
	o The amount of energy consumed for cooling purposes during the time period specified	X		Real	kWh
	o The amount of energy consumed for lighting purposes during the time period specified	X		Real	kWh
	o The amount of energy consumed for equipment (plug load) purposes during the time period specified	X		Real	kWh
	o The amount of energy consumed for other (other than heating, cooling, lighting and equipment) purposes during the time period specified	X		Real	kWh
	o The total amount of energy consumed for all purposes during the time period specified	X		Real	kWh
Thermal Comfort	Captures the number of annual operating hours at the building and zone level that the design conditioning requirements cannot be met.				
	o Number of hours design cooling requirements cannot be met	X		Real	hours
	o Number of hours design heating requirements cannot be met	X		Real	hours
Energy Tariff	Cost values that apply to the source of energy and its form of usage. (During the early stages of				

Type of Information	Information Needed	Required	Optional	Data Type	Units
	design, information may be obtained from similar projects. As design progresses, information is obtained from the energy source provider. Multiple energy tariffs may be defined based on project needs. Energy and demand charges may apply.)				
	o Energy Source (Electricity, Gas, Propone, Other)	X		Enumeration value	n/a
	o Energy Tariff Unit (kWh, kW, therm, etc.)	X		Enumeration value	varies
	o Cost value to be applied	X		Real	$/unit
	o Identification that the cost value is an energy tariff (True/False)	X		Boolean	n/a
	o Time series applicability of the energy tariff (The tariff may be applicable not only to the energy source but also to when the energy source is used. For instance, electrical energy may carry a lower tariff when it is used in 'off peak' situations since such this may be useful to the source provider in load balancing.) Options are "summer peak, summer shoulder, summer offpeak, winter peak, winter shoulder, winter offpeak)	X		List of Day/Time	Calendar
Energy Costs	Captures the annual energy costs at the building level.				
	o Annual Electricity Costs	X		Real	$/yr
	o Annual Gas Costs	X		Real	$/yr
	o Annual Fuel Costs (Other)	X		Real	$/yr
	o Peak Demand Charge	X		Real	$/month
	o Month of Peak Demand	X		String	n/a
	o Photovoltaic Energy Delivered (required if 'Photovotaics' = TRUE)		X	Real	kWh/yr