Website: www.tessolarwater.com

E-mail: tes@tessolarwater.com

TES®

a member of TES Group Limited

SOLAR ENERGY PRODUCTS
ENERGY SAVING EQUIPMENT

Certifi. EN 12975 - 2
ISO 9806 -1, ISO 9806 -2

TESZEUS® Photovoltaic-Thermal Hybrid Solar Collector

Photovoltaic thermal hybrid solar collectors, also known as **hybrid PV/T systems** or **PVT**, is a system that converts solar radiation into thermal and electrical energy. These systems combine a photovoltaic cell, which converts electromagnetic radiation (photons) into electricity, with a solar thermal collector, which captures the remaining energy and removes waste heat from the PV module. Photovoltaic (PV) cells suffer from a drop in efficiency with the rise in temperature due to increased resistance. Such systems can be engineered to carry heat away from the PV cells thereby cooling the cells and thus improving their efficiency by lowering resistance.

The result is a cool working PV panel with higher efficiency and longer life time due to the elimination of decay of Si and the production of hot water that can be used for residential, commercial or industrial applications.

The **TESZEUS® PV-T** Photovoltaic-Thermal Hybrid Solar Collector can be combined with normal thermosyphon systems or can be installed in split type installations or multi panel arrays for high electrical and thermal energy capacity demands.

PV Paradox

Photovoltaics (PV) are semi-conductors and operate in a paradox – they need sunlight to generate electricity but suffer degradation in performance as they get hotter.

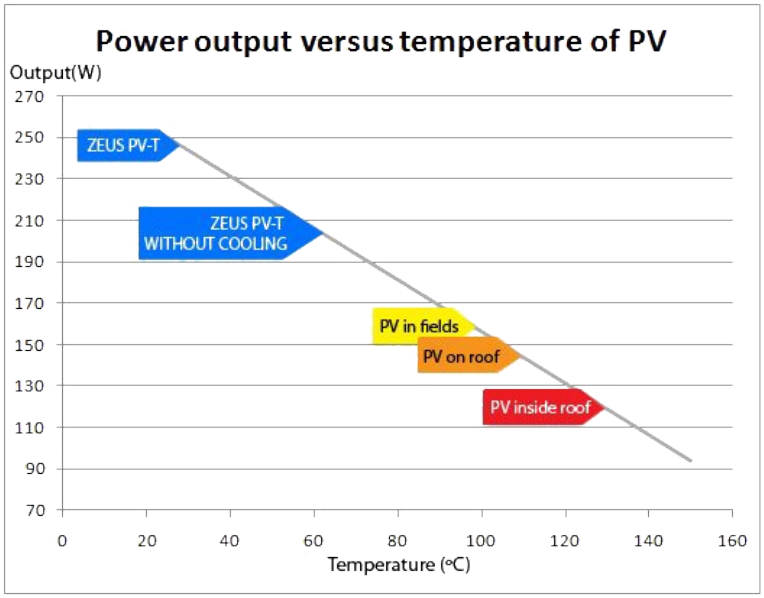
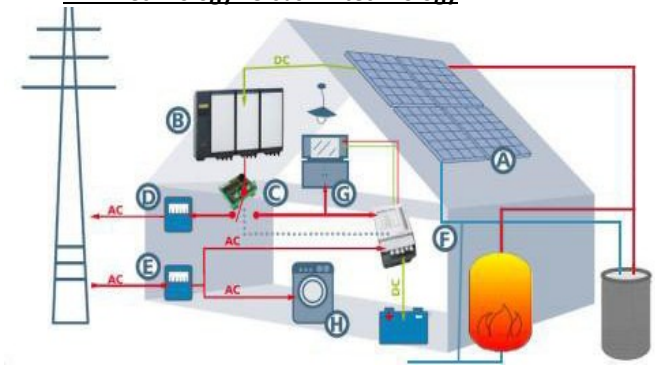


Figure Performance vs. Temperature of PV-T and PV panels of 250Watt peak output

PV-T stands for **Photovoltaic-Thermal.** It generates both electricity and usable thermal heat at the same time from one panel. These systems combine a photovoltaic cell, which converts electromagnetic radiation (photons) into electricity, with a solar thermal collector, which captures the remaining energy and removes waste heat from the PV module.

PV-T Technology versus PV technology



The electricity flows into an inverter for use in the building or export to the grid as per a standard PV configuration. The temperature is regulated via a control sensor and the coolant is transferred using a pump to a heat exchanger which heats water in a storage tank for use in the hot water, heating and optional cooling systems. The system provides hot water for any kind of usage such as sanitary use, domestic applications (such as dish and clothes washing) and any other required usage. The heating output can be used for room heating and cooling as well as pool heating and other heating equipment.

- Dual solar collection 2 usable energy outputs with one collection system.
- Improved PV generation up to 50% more electricity than an equivalent conventional PV system with same peak output.
- Lower installation cost than an equivalent performance system comprised of a separate Solar PV and Solar thermal systems.
- Hybrid PV-T System's ROI (Return on Investment) is shorter than standard PV systems due to higher electrical yield and eliminate heating costs.
- Lifetime of PV cells is lengthened because cell operating temperature is reduced.
- Thermal Energy output can be converter to cooling using an additional device, without any electrical use. The cooling output increases as the ambient external temperature rises.
- A residence can be completely autonomous by producing its own free electrical, thermal and cooling supply as well as its own free water supply. (Water supply production capacity depends on relevant ambient temperature and humidity).
- TESZEUS PV-T Hybrid modules are the only systems that can survive and efficiently work in very high temperature climates of areas like Middle-East, North and Central Africa, deserts and other similar climates.

Specifications of TESZEUS® PV-T Photovoltaic Thermal Module

Polycrystalline PV-T Hybrid Collector

TESZEUS **240**P	
External Dimensions (mm)	1650 x 992 x 50
Thermal Absorber material	Copper/Aluminum
Peak power (pm)	240W
Open Circuit (Voc)	37.00V
Short Circuit (Isc)	8.54A
Maximum Power Voltage (Vmp)	30.20V
Maximum Power Current (Imp)	7.95A
Cell efficiency	16.75%
Panel efficiency	14.60%
Loss Factor Pmax [%/K]	0.40%
Working Temperature	-40°C TO +85°C
Tolerance	±3%

TESZEUS **280**P	
External Dimensions (mm)	1956 x 992 x 50
Thermal Absorber material	Copper/Aluminum
Peak power (pm)	280W
Open Circuit (Voc)	44.30V
Short Circuit (Isc)	8.40A
Maximum Power Voltage (Vmp)	36.10V
Maximum Power Current (Imp)	7.76A
Cell efficiency	16.00%
Panel efficiency	14.46%
Loss Factor Pmax [%/K]	0.40%
Working Temperature	-40°C TO +85°C
Tolerance	±3%

Monocrystalline PV-T Hybrid Collector

TESZEUS **250**M	
External Dimensions (mm)	1650 x 992 x 50
Thermal Absorber material	Copper/Aluminum
Peak power (pm)	250W
Open Circuit (Voc)	36.50V
Short Circuit (Isc)	9.51A
Maximum Power Voltage (Vmp)	29.80V
Maximum Power Current (Imp)	8.39A
Cell efficiency	17.36%
Panel efficiency	16.83%
Loss Factor Pmax [%/K]	0.40%
Working Temperature	-40°C TO +85°C
Tolerance	±3%

TESZEUS **300**M	
External Dimensions (mm)	1956 x 992 x 50
Thermal Absorber material	Copper/Aluminum
Peak power (pm)	300W
Open Circuit (Voc)	44.53V
Short Circuit (Isc)	8.90A
Maximum Power Voltage (Vmp)	37.10V
Maximum Power Current (Imp)	8.09A
Cell efficiency	17.35%
Panel efficiency	15.54%
Loss Factor Pmax [%/K]	0.40%
Working Temperature	-40°C TO +85°C
Tolerance	±3%

TESZEUS PV-T Thermal Power Output

Peak Power output for G = 1000 W /m² and u = 0 m/s = 651 W Power output per m²

Tm – Ta = 2K	Net irradiance G		
	G = 400 W / m²	G = 700 W / m²	G = 1000 W / m²
u = 0.0 m/s	248	448	651
u = 1.0 m/s	245	438	644
u = 1.5 m/s	244	441	641
u = 2.0 m/s	242	438	637
u = 2.5 m/s	241	436	634
u = 3.0 m/s	240	429	630
u = 3.5 m/s	238	432	627

Certifications: CE, ROHS, IEC 61215:2005, EN 61000-6-1:2007, EN61000-6-3:2007, IEC61730

Photos of installation of one PV-T panel for electrical production and daily production of 120liters of hot water at 60 degrees Celsius

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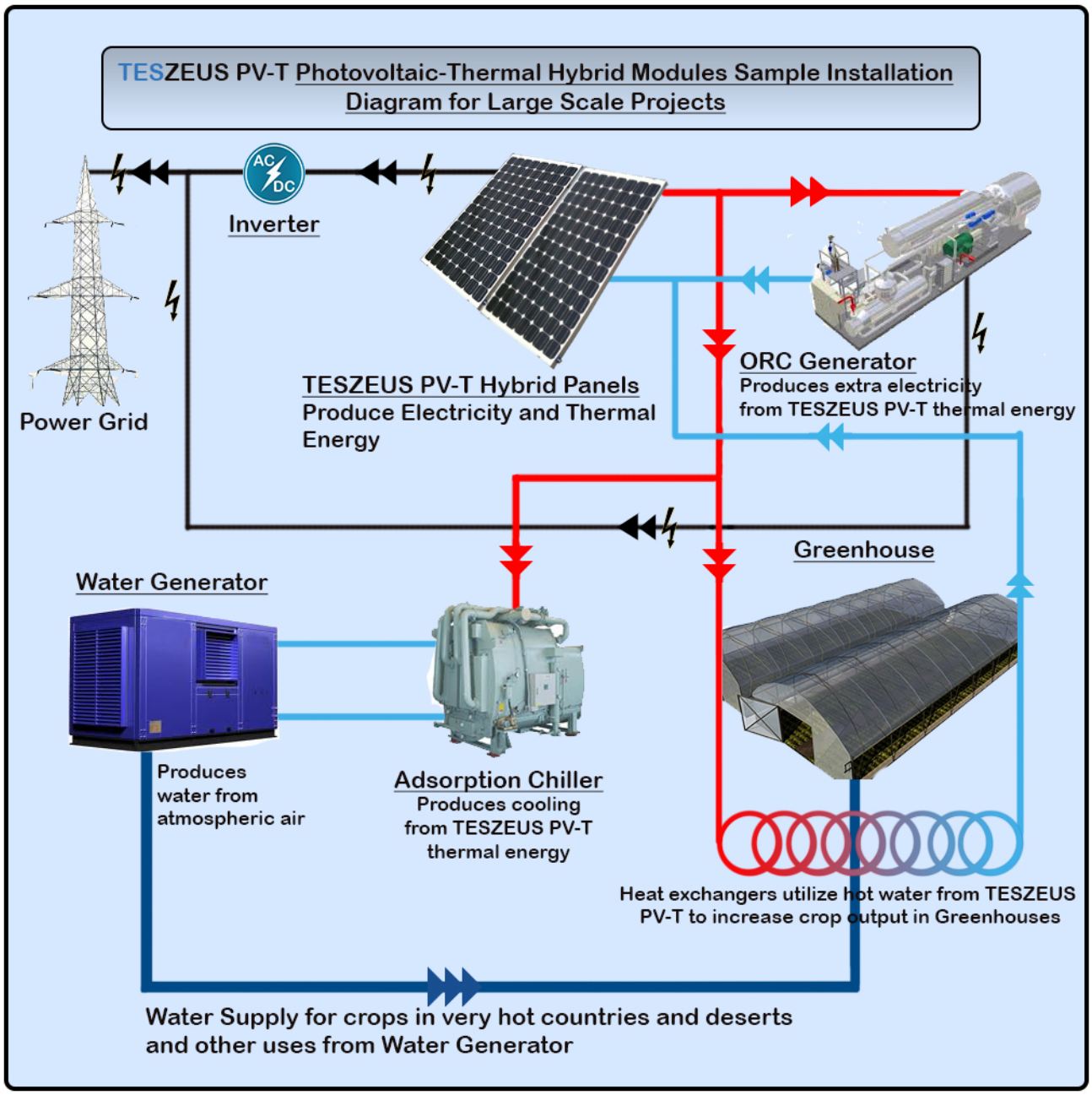
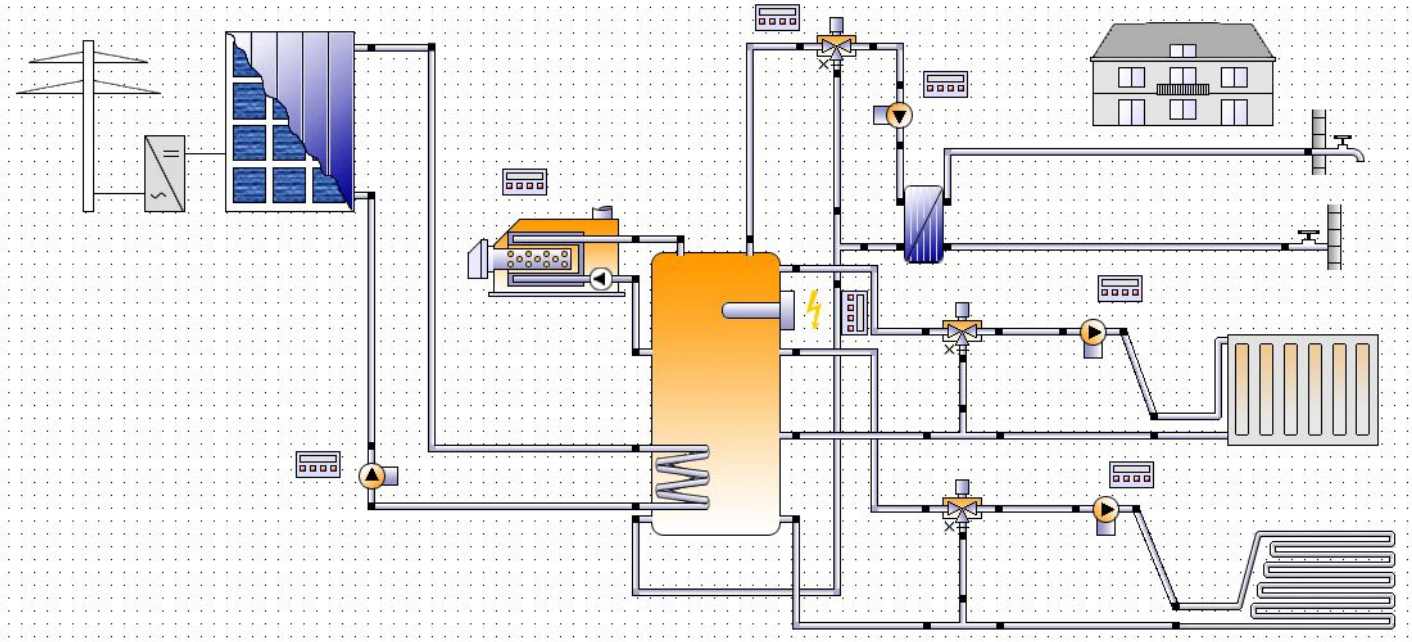
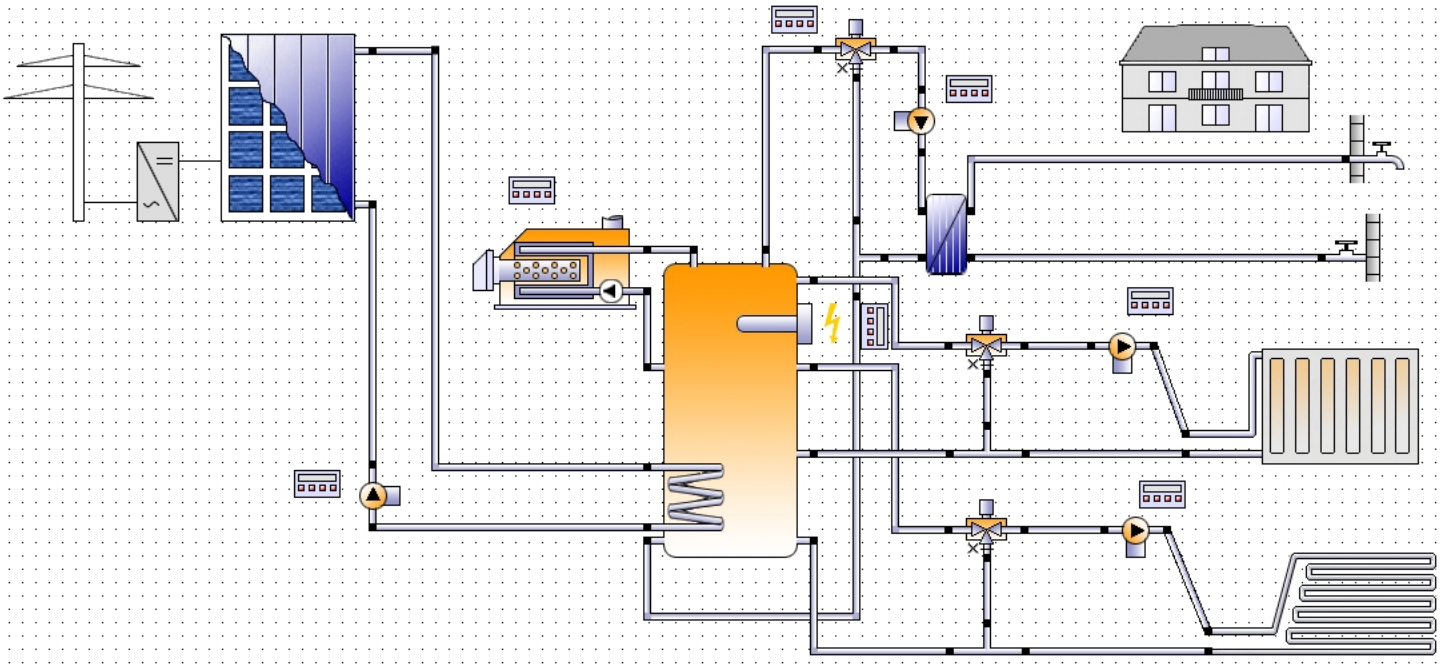
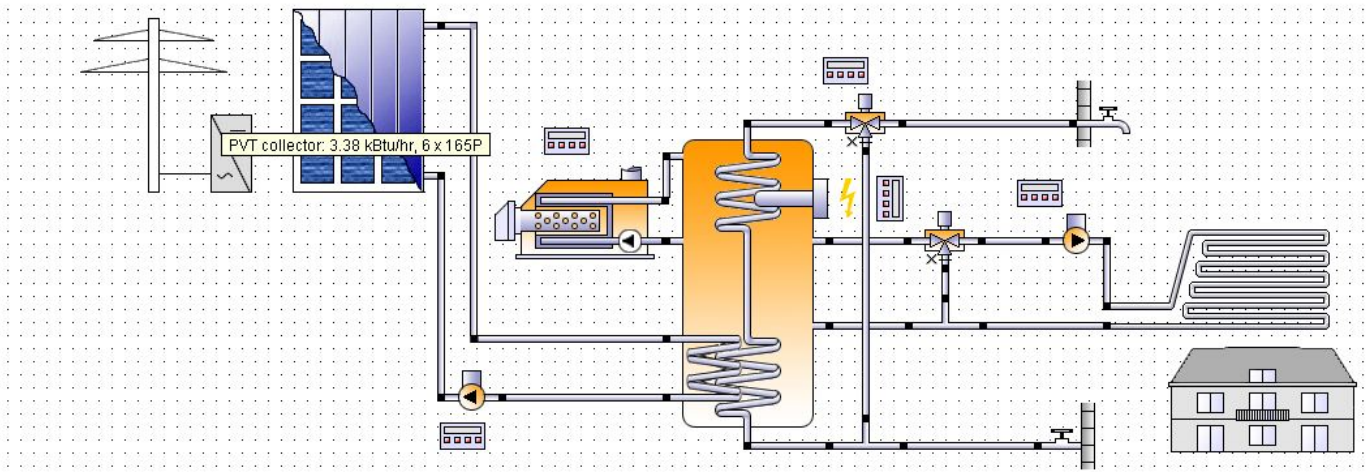

TESZEUS PV-T Photovoltaic-Thermal Hybrid Modules Sample Installation Diagram for Large Scale Projects
AC
DC
Inverter
Power Grid
TESZEUS PV-T Hybrid Panels
Produce Electricity and Thermal Energy
ORC Generator
Produces extra electricity from TESZEUS PV-T thermal energy
Greenhouse
Water Generator
Produces water from atmospheric air
Adsorption Chiller
Produces cooling from TESZEUS PV-T thermal energy
Heat exchangers utilize hot water from TESZEUS PV-T to increase crop output in Greenhouses
Water Supply for crops in very hot countries and deserts and other uses from Water Generator

Template System diagram PVT: buffer 2 heating loops

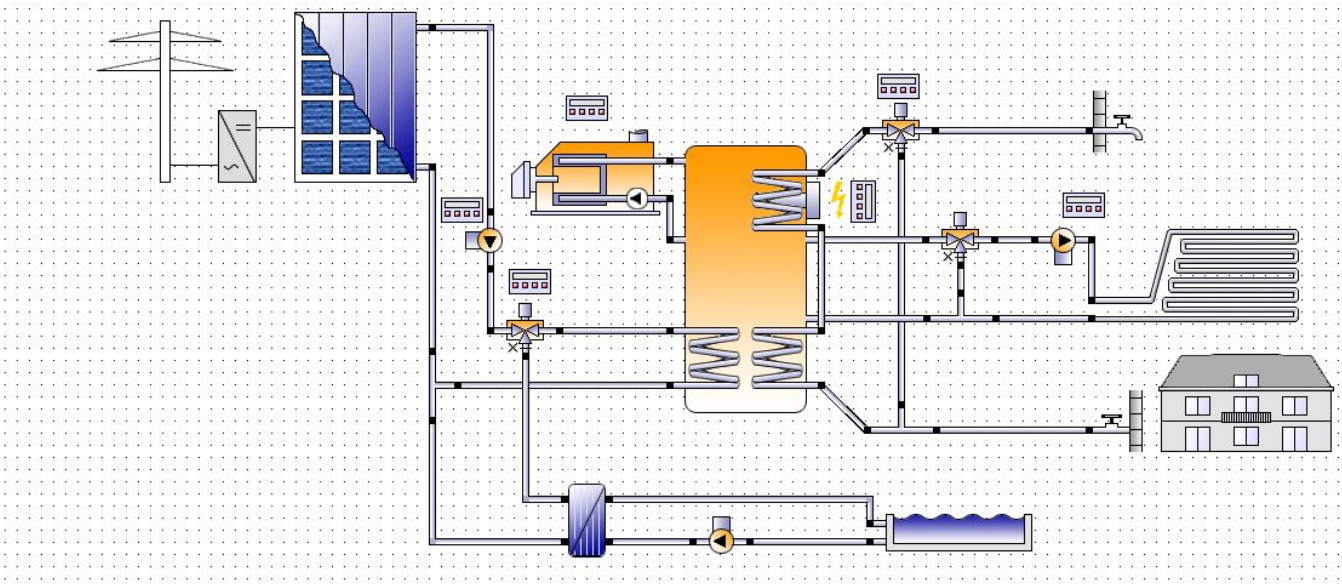




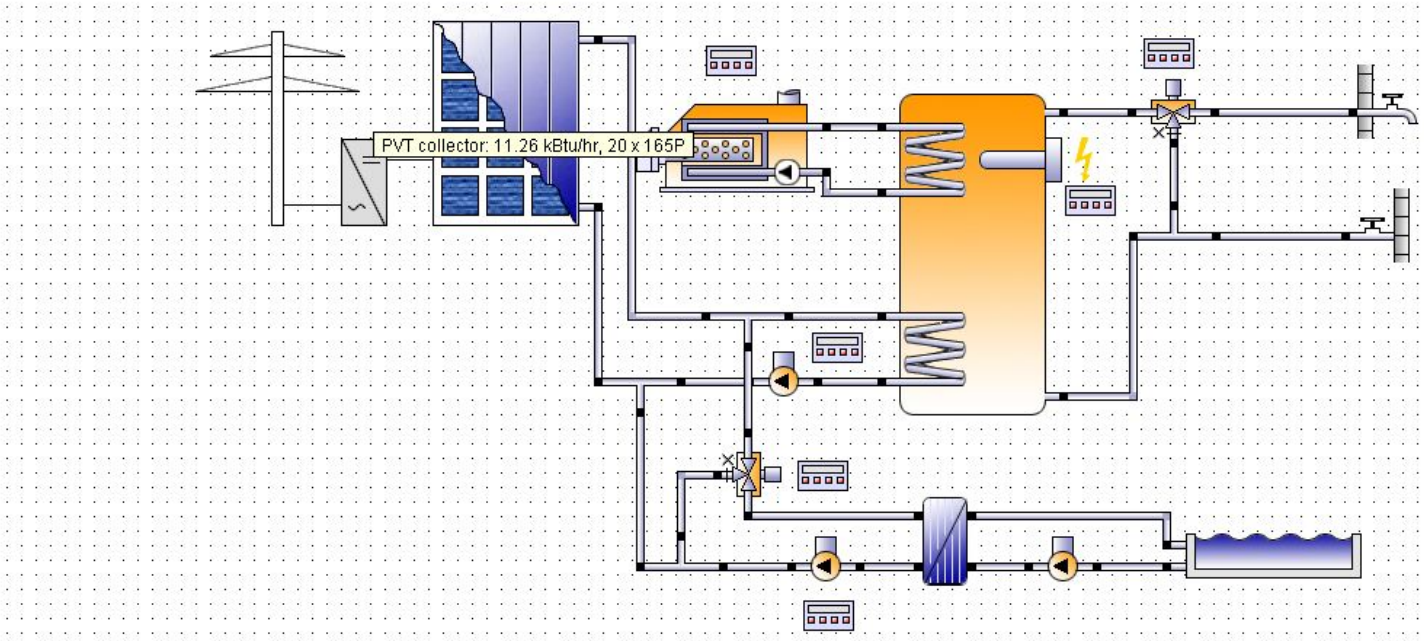
Project Project - System diagram PVT: combined tank



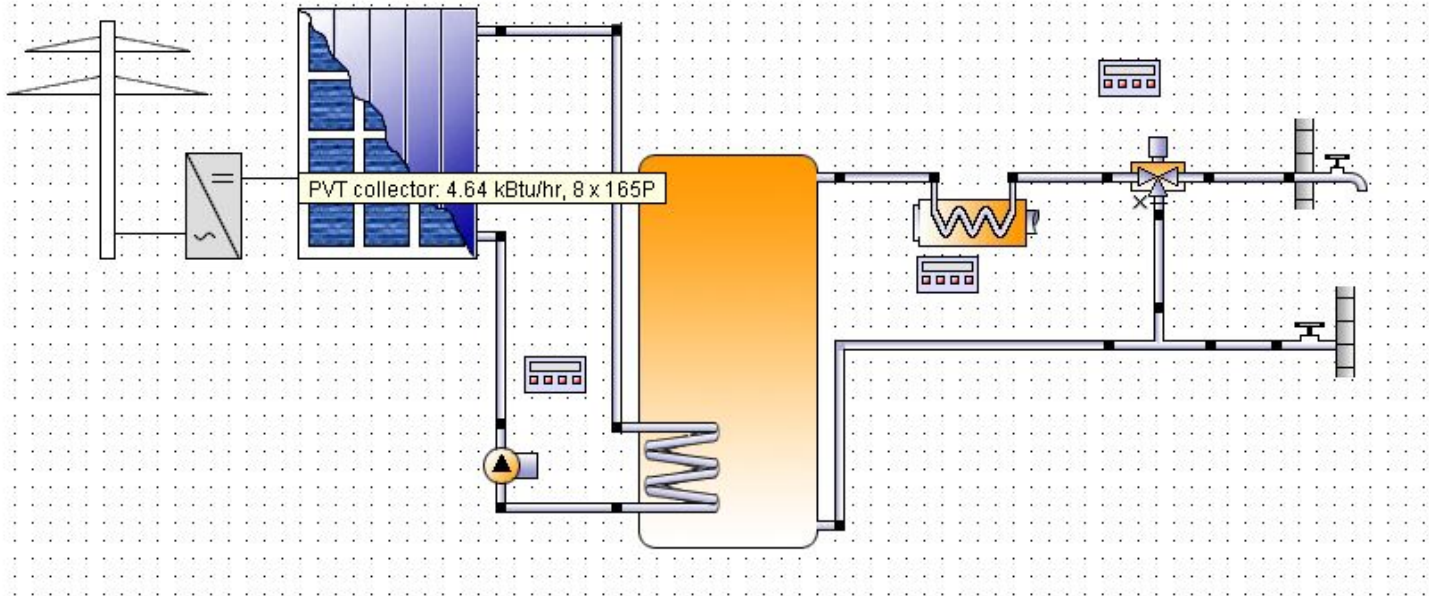
Template System diagram PVT: combined tank with pool



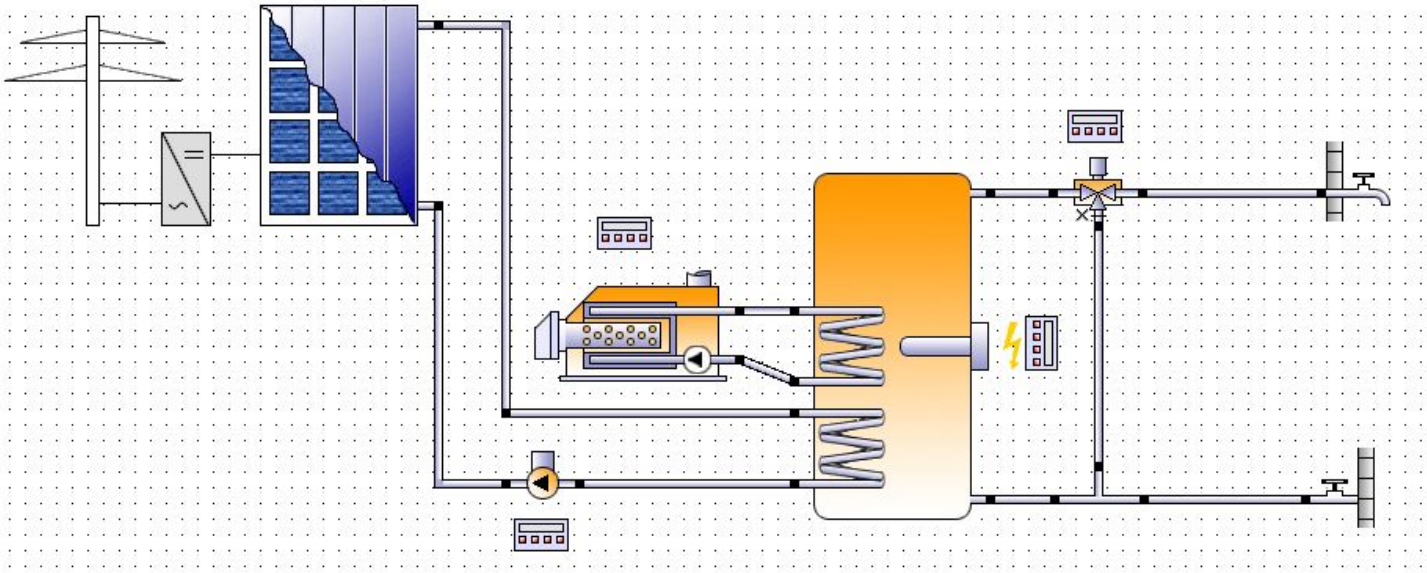
Template System diagram PVT: DHW pool



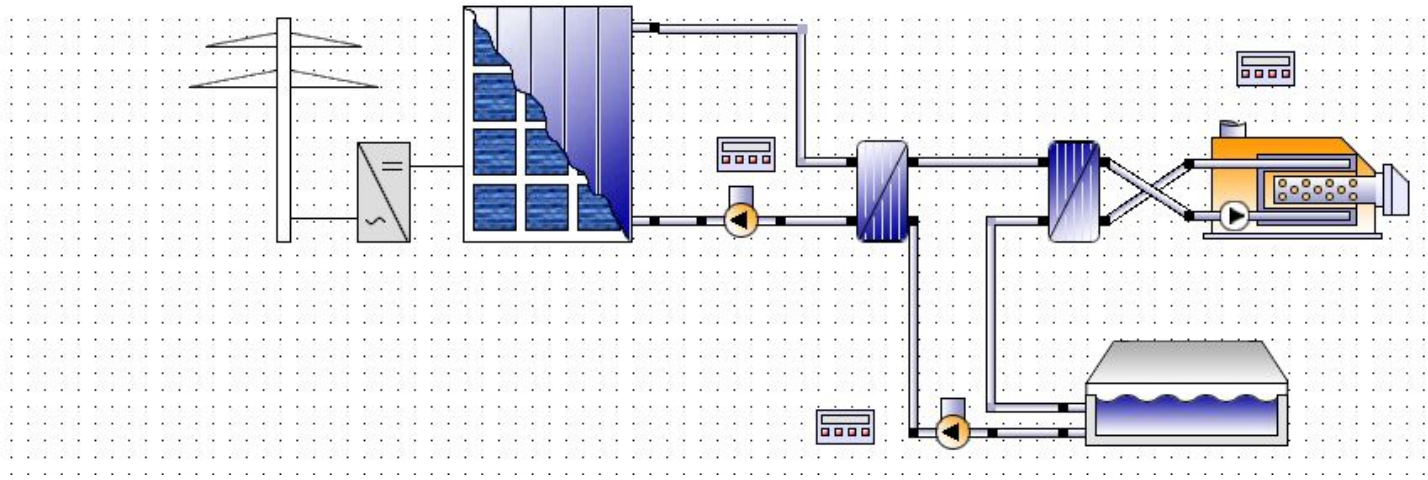
Template System diagram PVT: DHW continuous flow heater



Template System diagram PVT: DHW tank



Template System diagram PVT: pool



Template System diagram PVT: 2 tanks