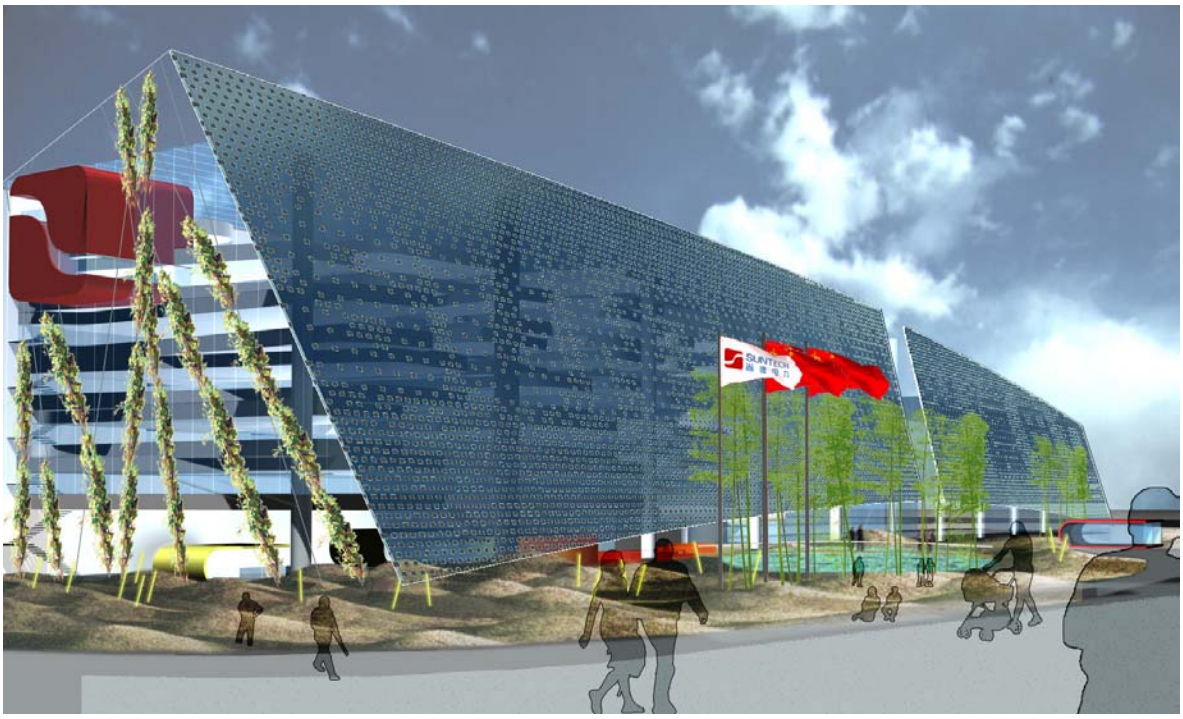

Project definition Green Energy
Zero Energy Building SunTech
Wuxi, China

Deerns consulting engineers

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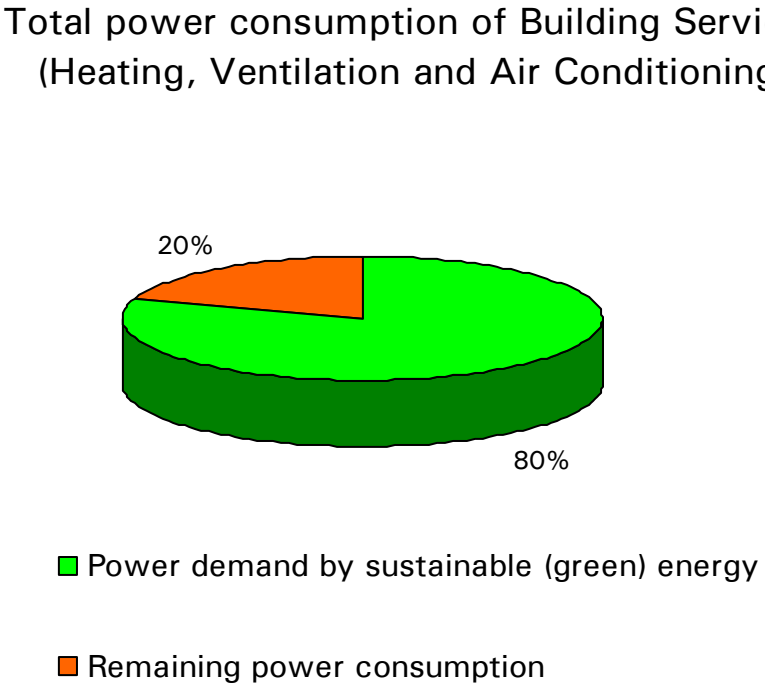
C O N T E N T S

1. DEFENITION OF ZERO (GREEN) ENERGY BUILDING STANDARD

Suntech Power Holdings Co.Ltd. plan to enlarge and to reorganize the location of their production plant at the location in Wuxi, China. Next to the existing production hall an office building and a recreation building are being developed.
For the office building a zero energy standard is defined, in order to minimize the energy consumption of the building. Only the office building has to be constructed according the ZEB standard. The recreation centre will be designed with the same concepts for the climate installations as the office building.

The ZEB standard means that the office building has to be constructed with as less external power consumption as possible taken into account the demands of internal climate conditions. The amount of sustainable power supply will be no less then 80% regarding the HVAC power consumption of the total power demand of the office building. For the recreation centre will be strived to achieve low power consumption also.



2. STARTING POINTS

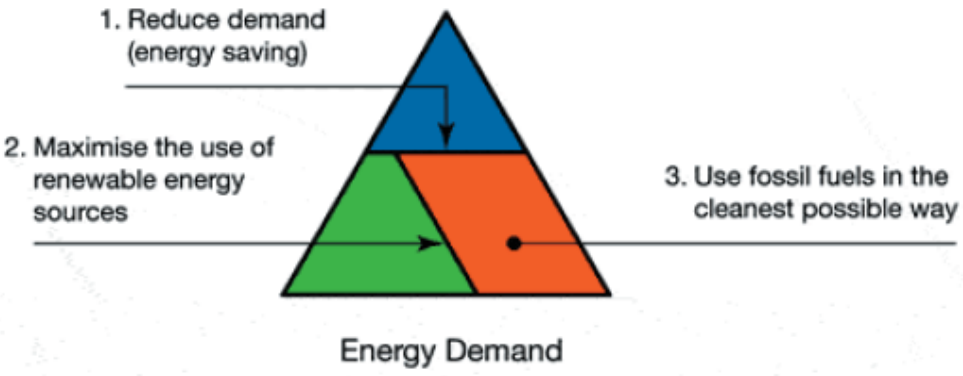
ZEB standard, green energy concept is based upon:

- Office building: 11,500 m^2 (effective for installation design approx. 10.000 m^2)
- Recreation building: 4,500 m^2.
- Photovoltaic Solar cells integrated is the facade; approx 6.000 m^2 which generate approx. 300 kW electrical peak power coupled directly on the electrical distribution grid;
- Low temperature heating and high temperature cooling by means of a climate ceiling, and based upon two heat pumps with high coefficient of performance (COP > 5) and two or more deep wells which are connected in a closed circuit high efficiency heat exchanger to the climate ceiling and the heat pumps.
- Minimum power consumption on analyses regarding the "Trias Energetica" related to the building physics (quality of the façade), the electrical power needed for the lights, the cooling and the heating;
- Air Handling base upon high efficiency air handling units (AHU's) with minimum of air supply, minimum pressure drop, high efficiency rotary heat recovery, high efficiency fans.

3. SYSTEM CONCEPT OF THE ZERO ENERGY BUILDING

The standard of zero energy for the Suntech office building will be accomplished by using the Trias Energetica concept. Trias Energetica is a simple and logical concept that helps to achieve energy savings, reduce our dependence on fossil fuels, and save the environment. The 3 elements of Trias Energetica are:

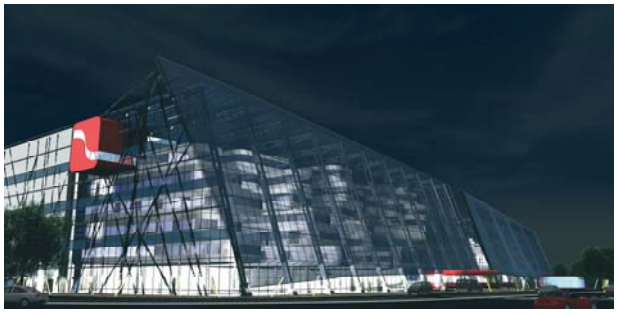
1. Reduce the demand for energy by avoiding waste and implementing energy-saving measures;
2. Use sustainable (green) sources of energy instead of finite fossil fuels;
3. Produce- and use fossil energy as efficiently as possible.



3.1. Reduce Energy demand

3.1.1. Façade

Relating to the building concept the most important aspect of reducing the energy demand is that the whole office building has an insulated jacket. The transparent façade reduces the heating energy in winter and cooling energy in summer. The façade has following design parameters:



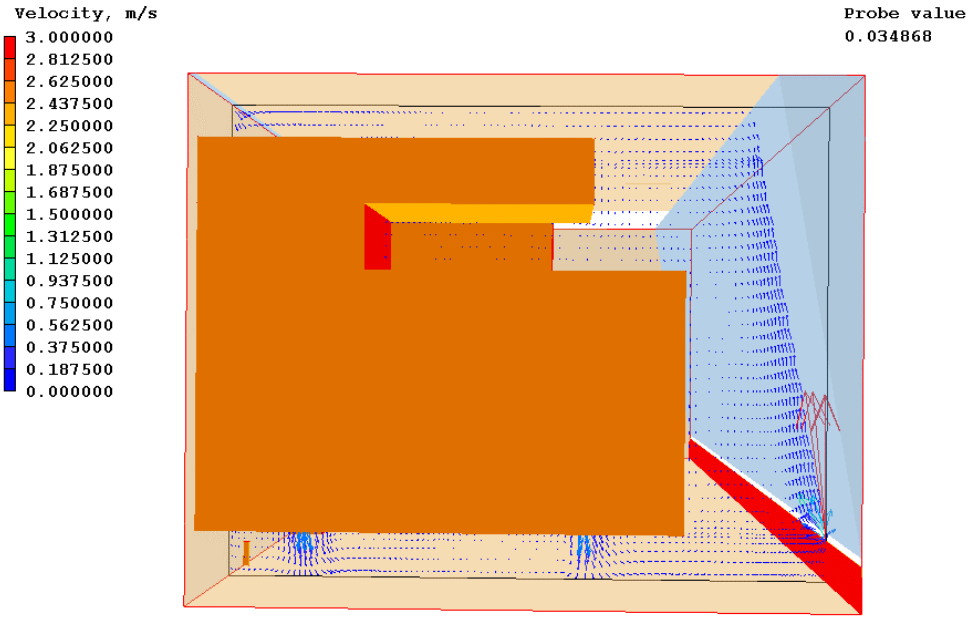
Thermal insulation of the façade is: U = 1.0 (W/m^{2}K)

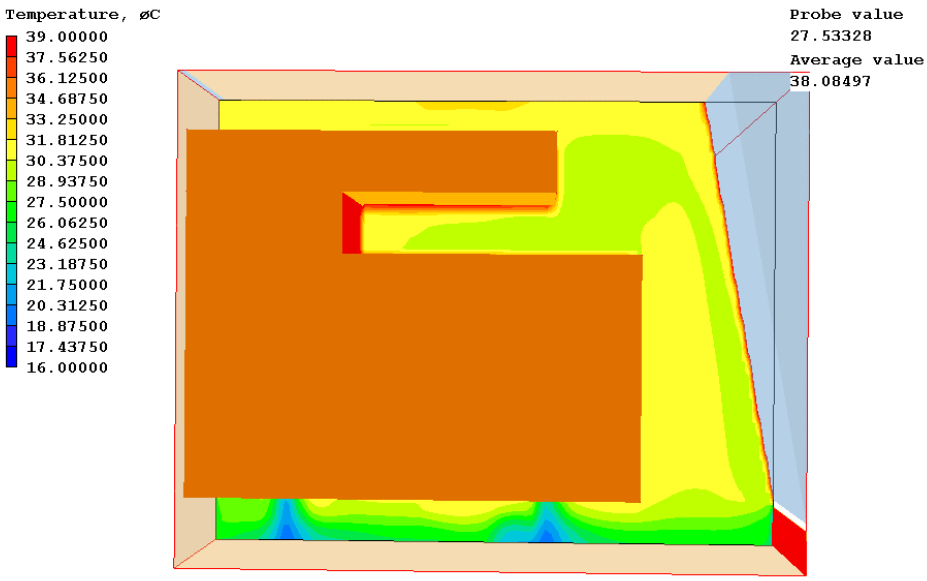
Sun heat transparency: ZTA = 35% (also known as g-value: solar heat gain coefficient)

Sun light transparency: LTA = 50%

To remove the heat in summer the roof of the building has electric louvers where the hot air can leave the inner space directly.

Of the inner space a CFD model (computational fluid dynamics) has been made to show the effects of the single skin façade on the climate. The figures below show some previsional results of the model with summer conditions.





3.1.2. Climate Ceiling

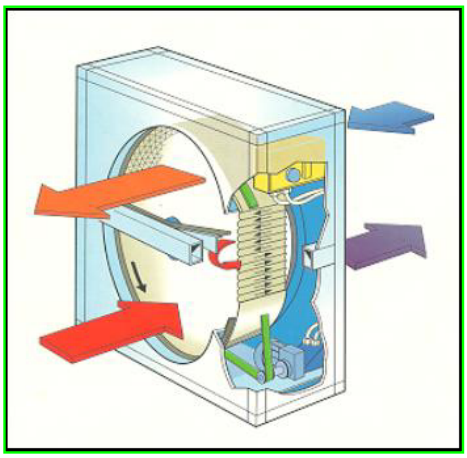
Relating to the installation concept the most important aspect of reducing the energy demand is that the whole office building has a climate ceiling. So the way heating and cooling is done is by means of radiation. This way is very comfortable and needs far less energy that when heating and cooling is done by air movement. Now the amount of air can be reduce to a minimum what is needed only for the people.

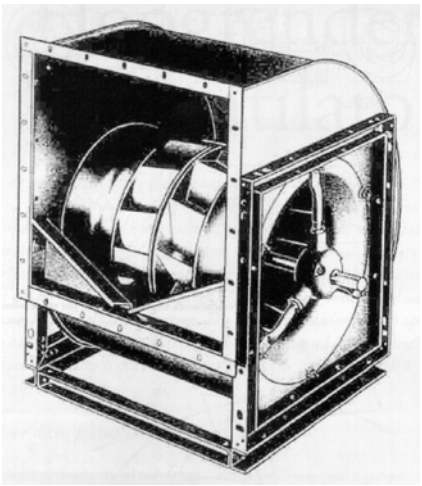
3.1.3. Air handling units

Important consumers of HVAC energy are the air-handling units (AHU's). To reduce the energy demand for the AHU's it is very important to minimize the pressure drop. So the air handling units and the ductwork has to be large enough. Average air velocity in the air-handling unit has to be less then 2 m/s; average air velocity in the ductwork has to be less then 5 m/s.

The air-handling unit has a rotary heat exchanger, which realizes high efficiency (80%) heat recovery and high efficiency recovery of moisture. In this case there is also in summer is an important recovery of cooling energy.

The air-handling units are also equipped with high efficiency direct driven fans with frequency controlled electro motors.





3.1.4. Lighting

The energy that is used by the lighting installation can be reduced in order to take the following measures:

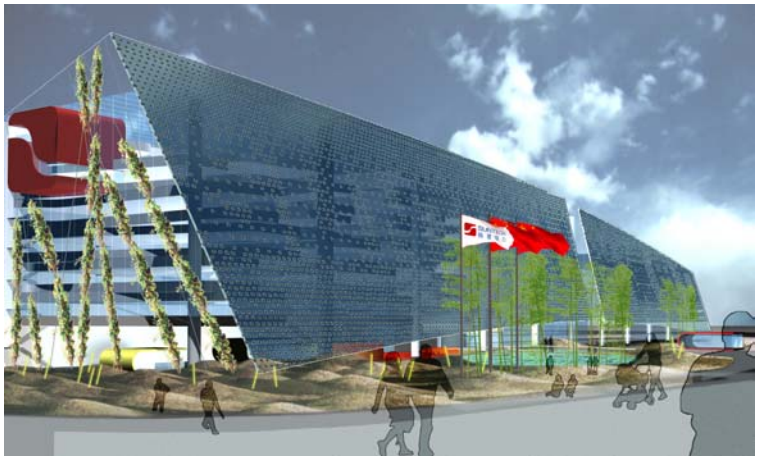
- use of mainly fluorescent lamps with high-frequency ballasts;
- use of automatically dimmable lights which depends on the availability of daylight;
- use of a computerized lighting control system for example DALI;
- use of detectors to switch the lights on the presence of people in a room.

3.2. Green Energy

The green energy concept of the office building is based upon the solar power station in the façade for the electrical power supply and the aquifer thermal storage system (ATES) consisting of the heat pumps with deep wells for the high efficiency heating and cooling of the building.

3.2.1. Solar power station

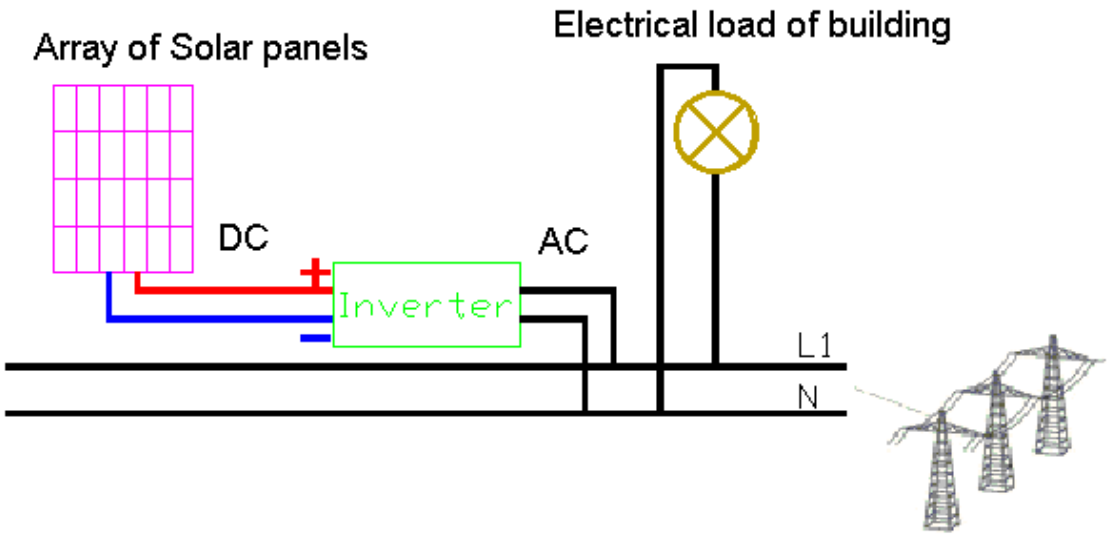
The total front side of the building consists of a façade with integrated solar power station. This solar power station contains approx. 6000 m^2 solar panels that generate approx. 300 kW_p electrical power.



The solar panels are integrated with high efficiency glass to construct a unique single skin façade.

The solar power station is directly coupled to the grid, so al the “sun generated” electricity is used and there are no losses in storage equipment. In this way the efficiency of the solar power station in as high as possible.

The amount of electrical energy generated by the solar power station is approx: 30 MWh/y



3.2.2. Aquifer Thermal Energy Storage

ATES is a high sustainable, very efficient way of supplying heating energy and cooling energy to the office building.

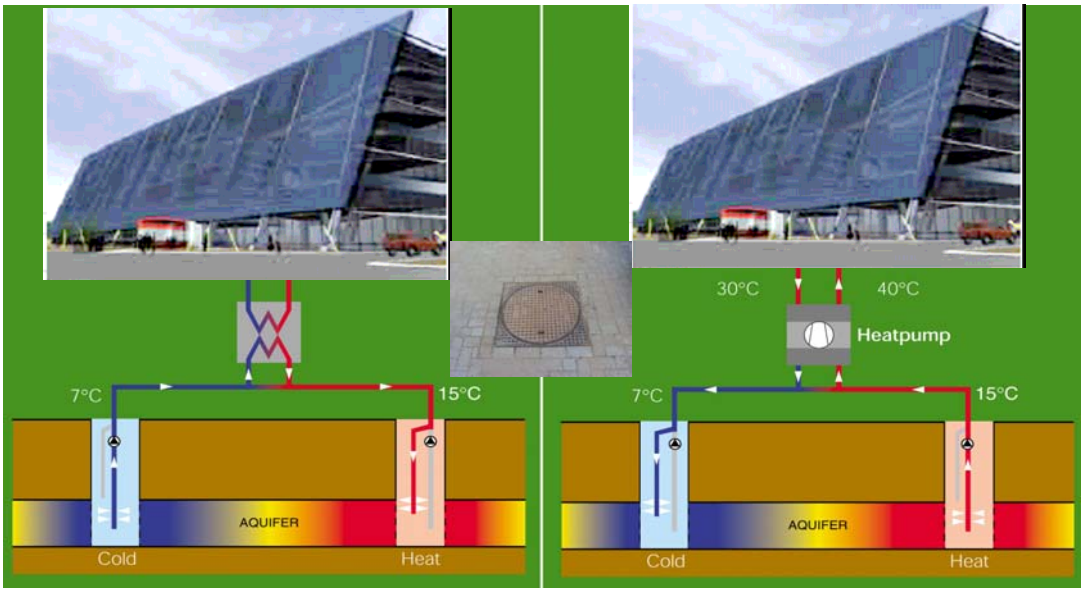
The energy of the closed system groundwater is transported to the building system in the high efficiency heat exchanger.

Closed system means that the groundwater that is extracted from one well has no contact with the outside environment and is at the same time injected in the injection well. The chemical and biological composition of the groundwater does not change. Only the temperature changes between a range of 5 and 25 degrees Celsius (°C).

Regarding the fact that the groundwater is simultaneously extracted and injected within a short distance (150 meters) means that there are only very little effects on ground settlings or groundwater level. These effects are simulated in a computer model and the design of the ATES system is adapted in such a way that the influences are minimized.

In wintertime the heat pump gets the energy from the warm well (approx. 18 °C) and transforms it into a higher temperature (approx. 35 °C) for heating the building and the ventilation air. The water of the warm well has cooled down (approx. 6 °C) and is stored in the cold well. To keep a thermal balance in the ATES it is likely that there has to be generated extra cold in winter with a high efficiency cooling tower to fill the cold well with enough cooling energy needed for the summertime.

In summertime the energy from the cold well is used for cooling the office building with the climate ceiling and cooling the ventilation air with the air-handling units.



So in fact there will be a thermal balance and the water flow balance in the ATES.
The capacity of the Aquifer Thermal Energy Storage is approx. 200 m^3/h which corresponds with approx. 1.000 kW cooling energy at a temperature range of:
13 °C – 18 °C.
–Closed system of 4 wells depth 60 m. and approx 800 mm. In diameter
–Heat pump of 450 kW for heating; Temperature range approx. 35 °C – 25 °C.
Summary of important environmental aspect:

- ATES has a closed groundwater system.
- ATES does not influence groundsettlings.
- ATES does not influence groundwater polutions.
- ATES has a thermic balance: Heat storage = Cold storage.
- ATES has a balance in groundwater flow.
- Electronic measurments to control and rapport environmental values

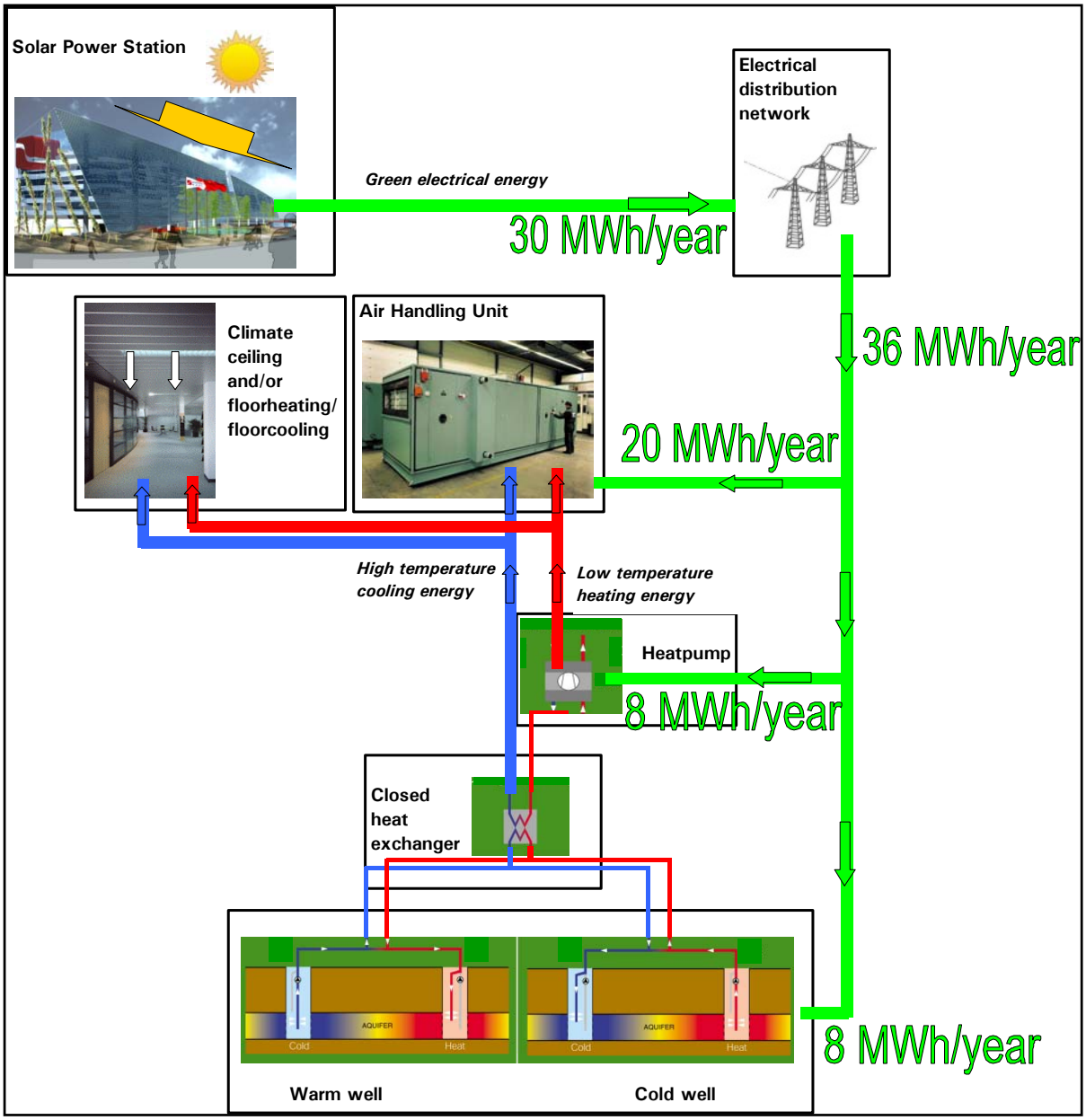
3.3. Less Fossil energy

To complete the analysis of the Trias Energetica it is important that the remaining needs of fossil energy is produced in a clean as possible way.
So investigated if it is possible to buy green energy from the energy suppliers. For instance green electricity and or green gas.
There is also an investigation running if the remaining needs of fossil energy for the office building can be compensate in buying CO_2 certificates.

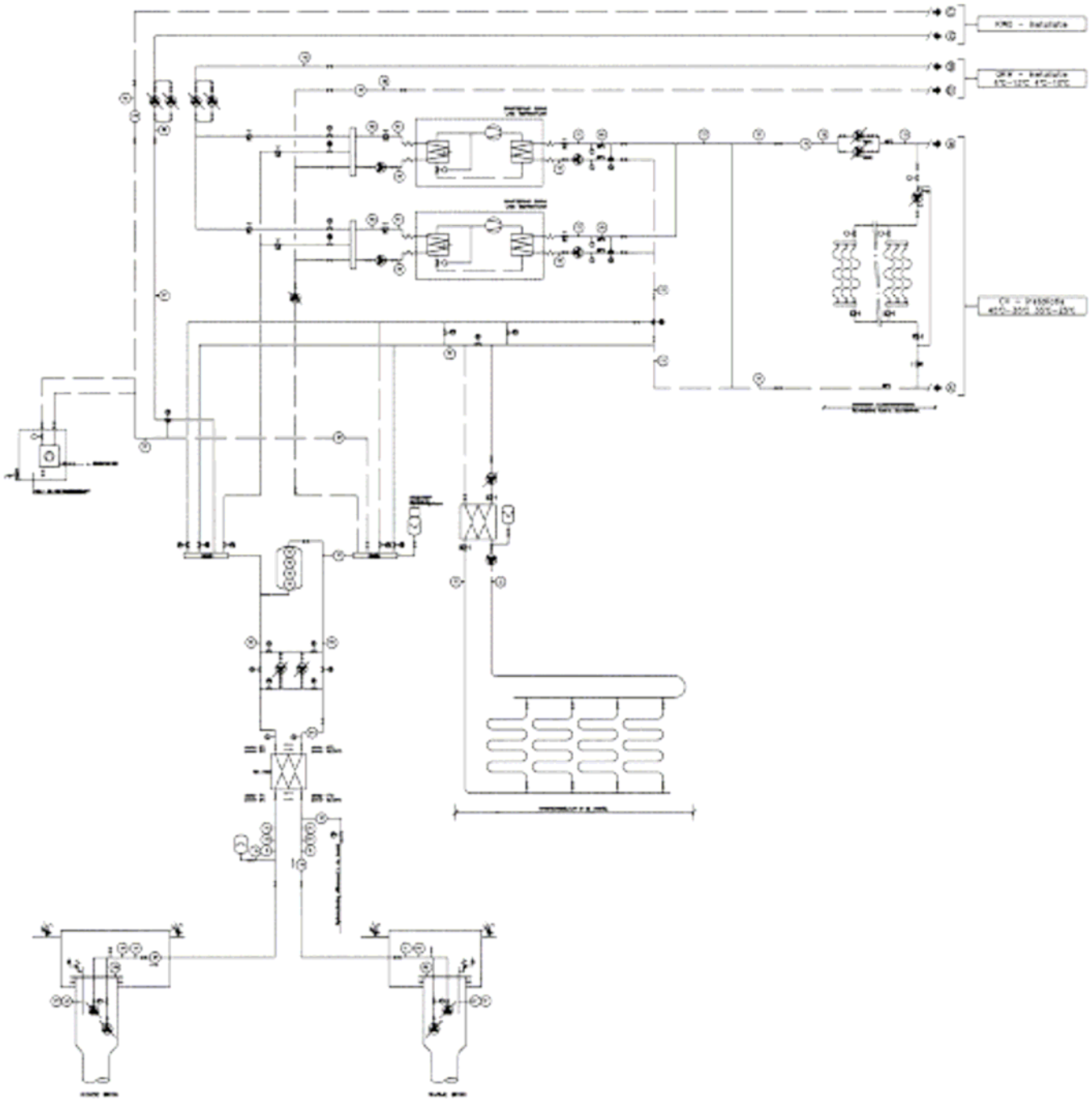
4. ENERGY FLOW

4.1. Concept overview

In the figure below the zero energy concept has been sumarized. Solar power station generates a total amount of approx. 30 MWh/year electrical energy. The HVAC installation of the office building needs approx. 36 MWh/year electrical energy. High efficiency heating with the heat pumps and high efficiency cooling with the ATES result in a very low amount of energy needed fot heating and cooling.



5. PRINCIPLE DRAWING OF ATES



6. PRINCIPLE DRAWING OF AHU