**Solar Thermal Energy**

Solar thermal energy is an application of solar energy that is very different from photovoltaics. In difference to photovoltaics, where we used electrodynamics and solid state physics for explaining the underlying principles, solar thermal energy is mainly based on the laws of thermodynamics.

**Solar thermal basics**

We start this section with the definition of heat, which sometimes also is called thermal energy. The molecules of a body with a temperature different from 0 K exhibit a disordered movement. The kinetic energy of this movement is called heat. The average of this kinetic energy is related linearly to the temperature of the body Usually, we denote heat with the symbol Q. As it is a

form of energy, its unit is Joule (J). If two bodies with different temperatures are brought

together, heat will flow from the hotter to the cooler body and as a result the cooler body will be heated. Dependent on its physical properties and temperature, this heat can be absorbed in the cooler body in two forms, sensible heat and latent heat. Sensible heat is that form of heat that results in changes in temperature. It is given as

Q = mCp(T2 − T1)

where Q is the amount of heat that is absorbed by the body, m is its mass, Cp is its heat capacity and (T2 − T1) is the temperature difference. On the other hand, if a body absorbs or releases latent heat, the temperature stays constant but the phase changes. This happens for example when ice is melting: When its temperature is equivalent to its melting point, heat that is absorbed by the ice will not result in increasing temperature but in transformation into from the solid to the liquid phase, which is water. Mathematically, this is expressed as

Q = mL

where L is the specific latent heat.

In the beginning, the body is solid and has temperature T1. It then heats up and the heat is stored as solid sensible heat. When its melting point T is achieved, its temperature will not increase any more but the phase will change from solid to liquid. After everything is molten the liquid will heat up further, the heat now is stored as liquid sensible heat.