



Zurich University of Applied Sciences Department N, Grüentalstrasse 14, CH-8820 Wädenswil, Switzerland / Talmon-Gros Max Jacques & Christoph Koller / 19.08.2014

# ZEBISTIS Tools and Technologies for Energy

## Case Study St. Paul's green school [Part 1]

### Introduction

The ZEBISTIS project was associated with the process of design of a “green school” in South Korea. This pilot study gives an overview of possibilities in order to cover the energy demand of a green school in Korea

#### BUILDING FRAME CONDITIONS

THE BUILDING STRUCTURE IS BASED ON THE PASSIVE HOUSE STANDARD WITH FOLLOWING KEY DIMENSIONS		
U-value	Heating E demand (Climate dependent factor)	Below 15kWh/m <sup>2</sup> .year
	Primary energy demand	Below 120kWh/m <sup>2</sup> .year
	Opaque envelope	Below 0.15W/m <sup>2</sup> .K
	Exterior wall	0.08-0.15W/m <sup>2</sup> .K
	Roof	0.06-0.15W/m <sup>2</sup> .K
	Window below	0.80W/m <sup>2</sup> .K (g-value: over 50%)
	Basement Floor / Basement Ceiling	Below 0.15W/m <sup>2</sup> .K
- requires mechanical air ventilation: heat recovery up to 90%		
Size of the conditioned area	4599 m <sup>2</sup> (unconditioned 3364 m <sup>2</sup> )	
Occupants	690	
School class days	195	
Operation time for the heating system [days]	85	
Hot water demand	30 l/day and person	
<b>ENERGY DEMAND (FIRST DRAFT OF THE SCHOOL)</b>		
Heat demand (with frame values - Passive House Standard)	68'986 kWh/a	
Heat demand for hot water	644 kWh/d (30 l/pers. and day)	
Electrical consumption lights and facility equipment	6'7425 kWh/a	

All calculations were done with the Polysun 6.0, T\*SOL 5.5. and PVSOL 6.0.

#### TECHNOLOGY FOR SOLAR ENERGY PHOTOVOLTAIC

Mono-crystalline modules (LG295N1C-G3 from LG Electrics Inc. Korea) are high end performing photovoltaic panels to be used on the roof to reach optimal performance without risk of shading.

- 295 Wp (STC) with a effectiveness of approximately 18%
- panels facing direction south with an angle of 30° (optimal orientation for Korea)

#### SOLAR THERMAL COLLECTORS

are usually used to preheat, with typical cover ratios of 60% for hot domestic water (HDW) or 30% for heating systems (yearly energy usage). Vacuum tube- or flat collectors are suggested to reach high cover ratios up to 90%. Vacuum-tube collectors to be installed in the façade (orientation: W, E and S)

#### HEAT PUMP SYSTEMS

- Air to Air/water heat pumps (ASHP):  
Easy to install and cheap but with low efficiency at cold source temperatures (air in for example at winter days).
- Brine-/water to water heat pumps in connection with an earth collector (shallow geo-thermal energy approx. 5 m under the ground):  
Low operation and maintenance costs and high efficiency but relatively high investment and installation costs. Efficiency depends on the quality of the ground.
- Brine/Water heat pumps (with a earth probe):  
System with one of the highest efficiency and small operation and maintenance costs. Usable also for large scale buildings with a field of geo-thermal probes. These systems need precise calculations for the drilling costs of the boreholes, which is difficult