



Solar Thermal Heating In General and for District Heating

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for Vedvarende Energi

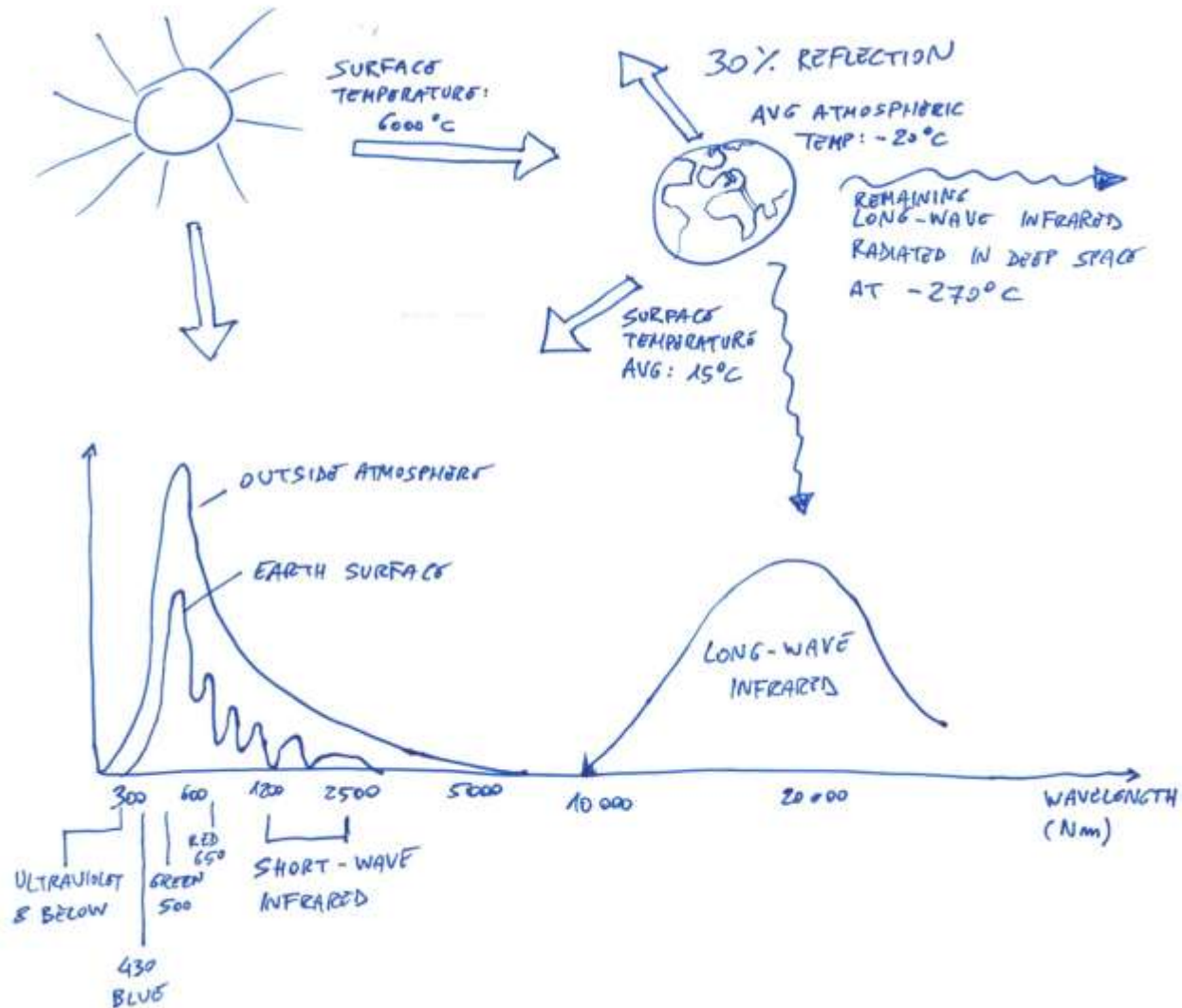
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Where Does the Energy Come from?



Source: Renewable Energy – Power for a sustainable future, Boyle

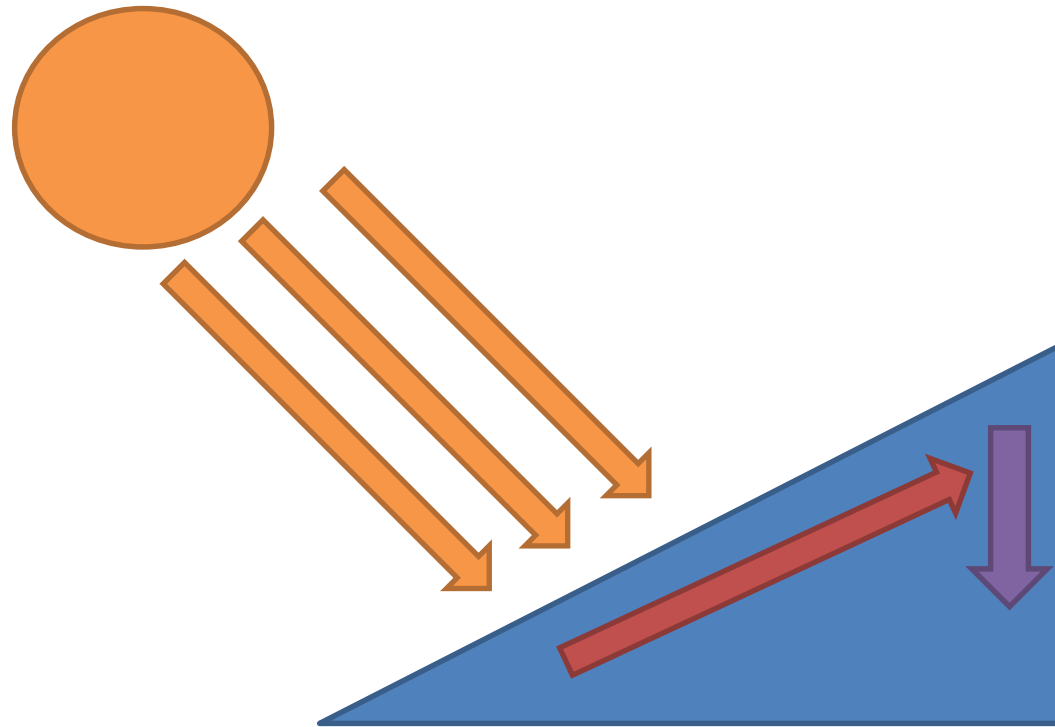


Solar heat collectors



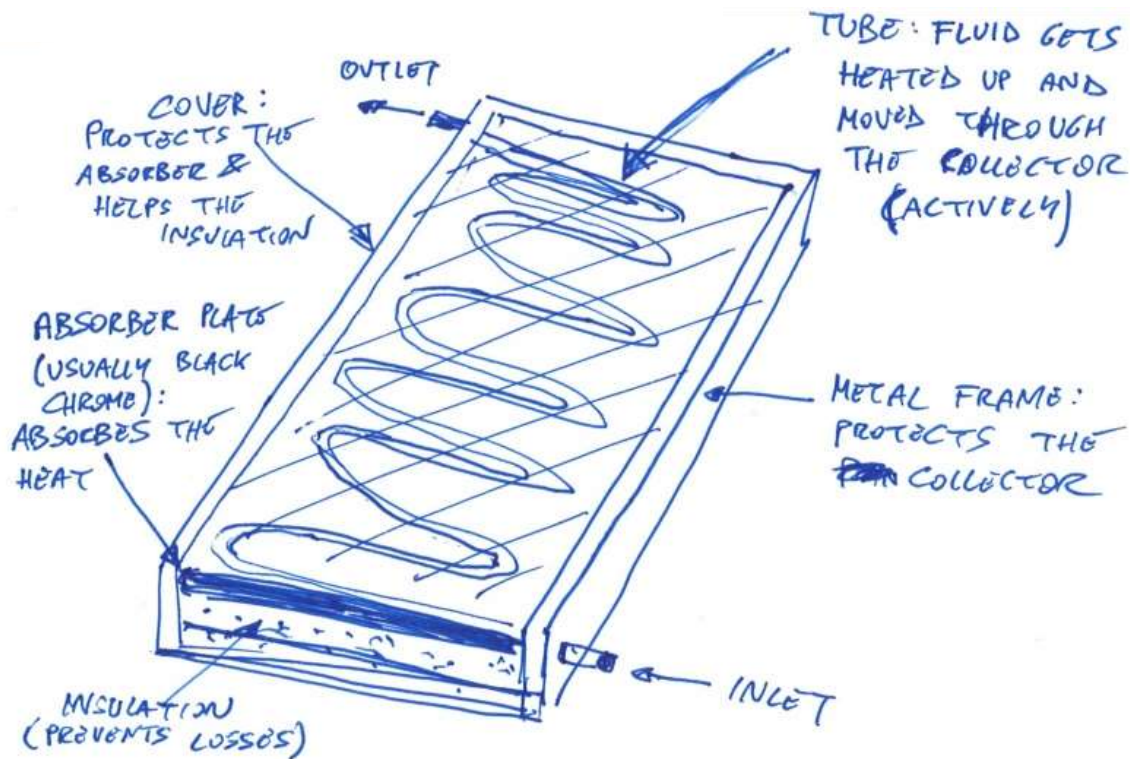


Heat Transfer in a Solar Panel



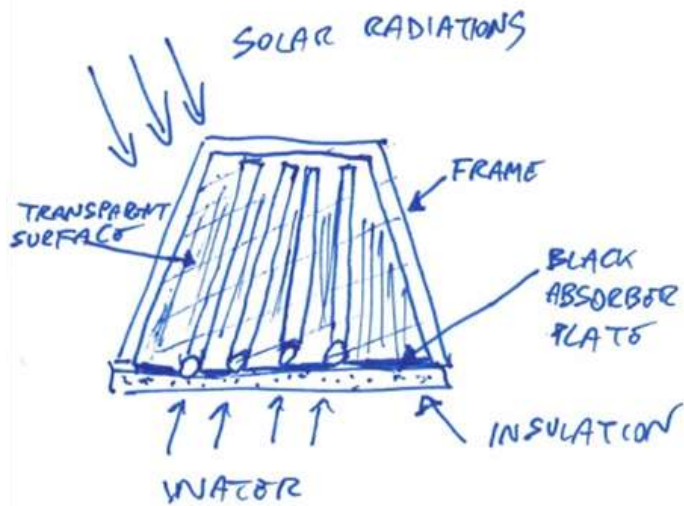


Flate Plate Collector

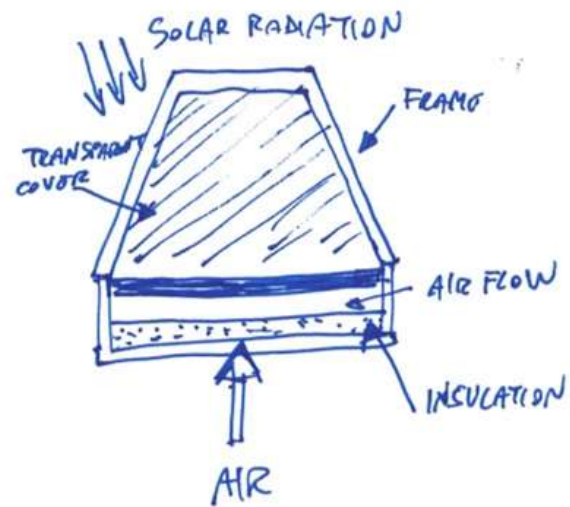




Flate Plate Collector



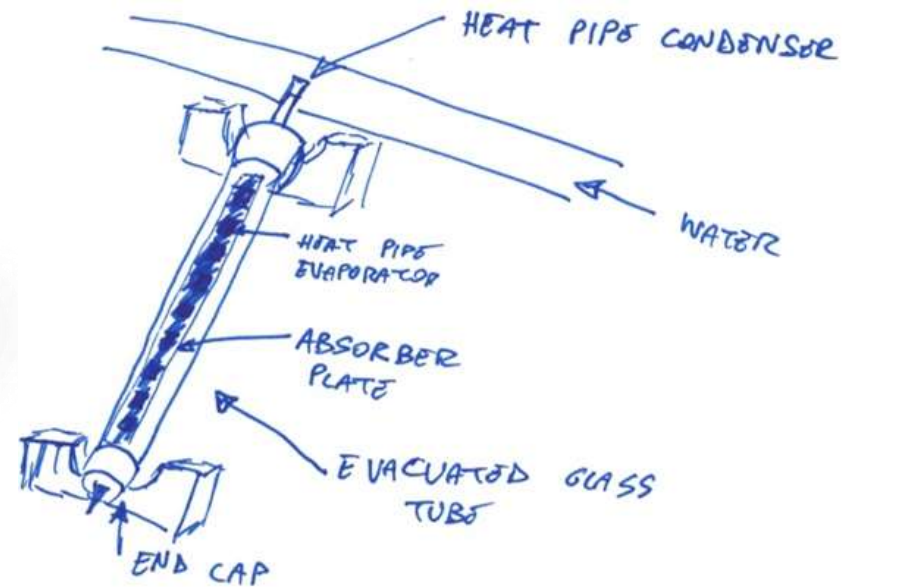
FLAT PLATE (WATER)
COLLECTOR
(0-50° C RISE)



FLAT PLATE COLLECTOR
(AIR)
0-50° C RISE



Vacuum Tube Collector

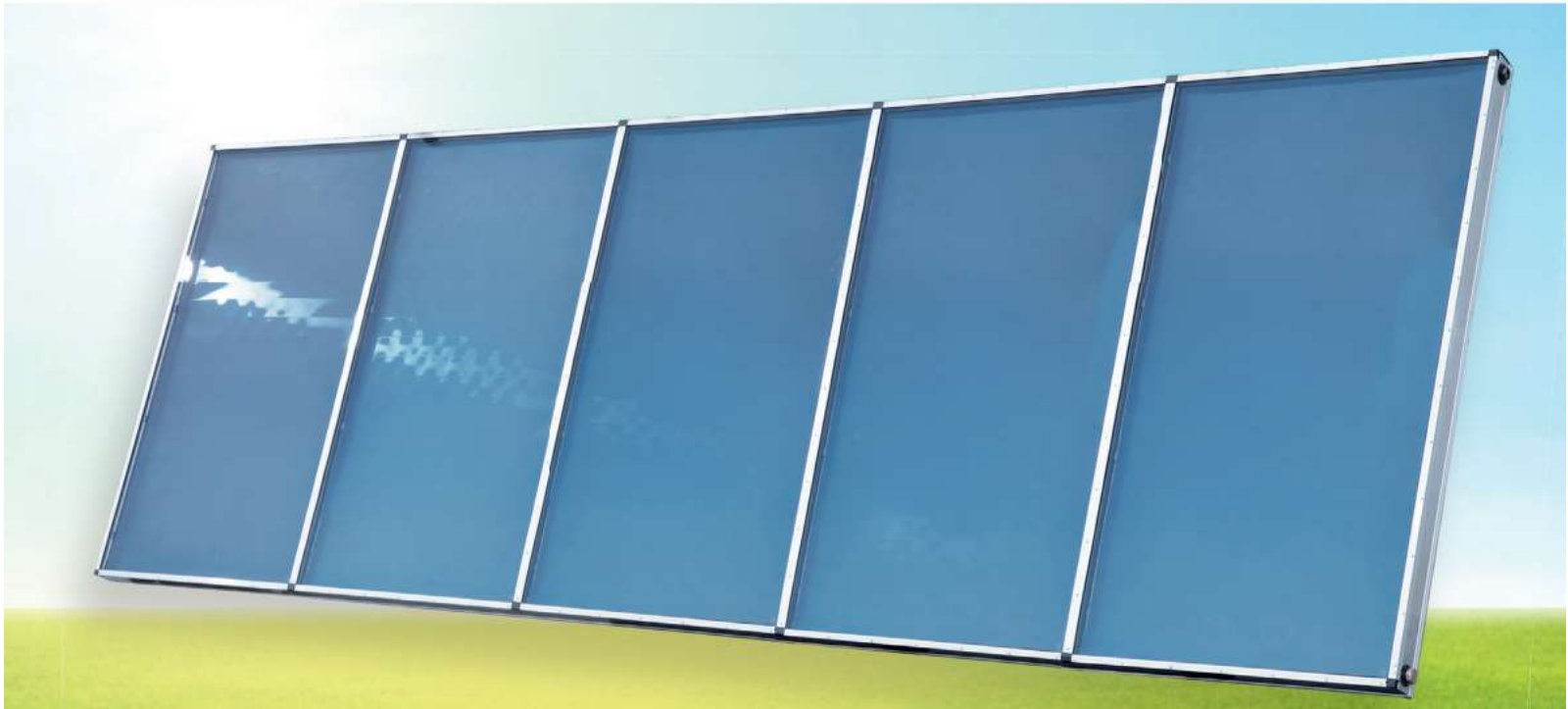


EVACUATED TUBE / VACUUM SOLAR COLLECTOR

10 - 150 °C RISE

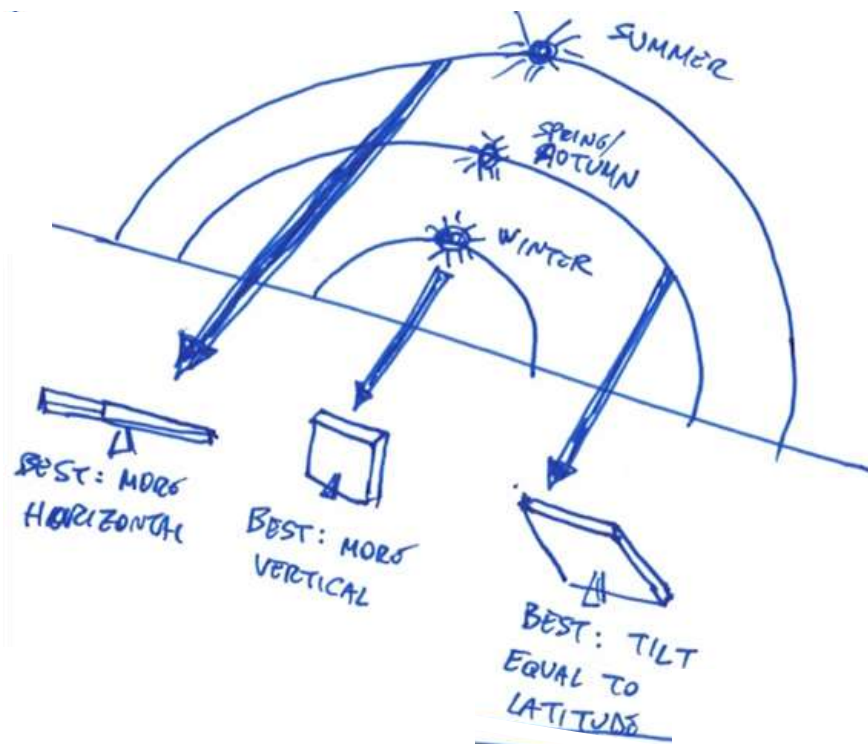
For district heating: 12 m² panels

GREENoneTEC **1**
SOLAR COLLECTORS





The Importance of the Angle



How much solar energy?

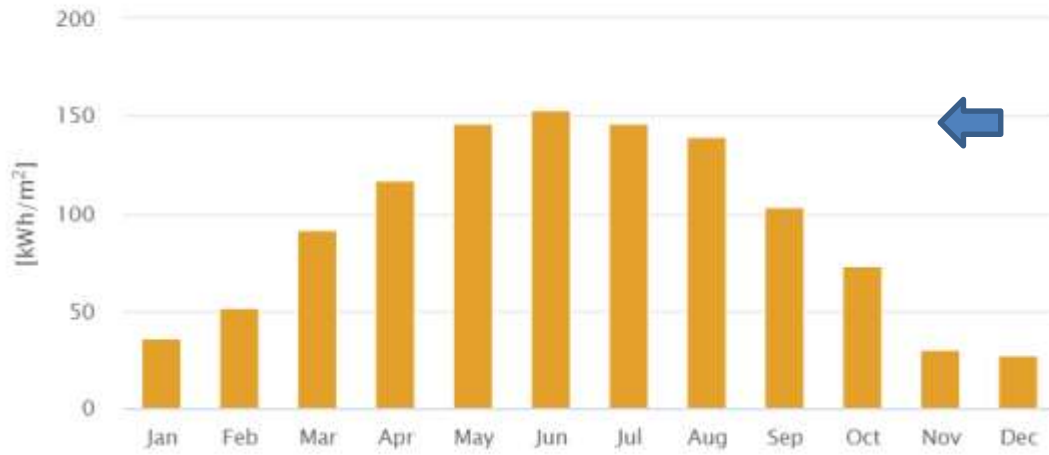


Free solar data from <https://globalsolaratlas.info/>

How much solar energy per month?

Monthly averages

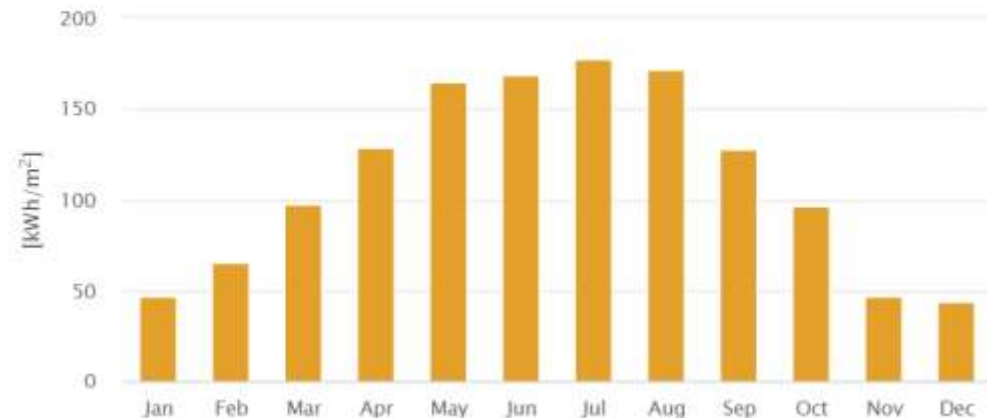
Direct normal irradiation



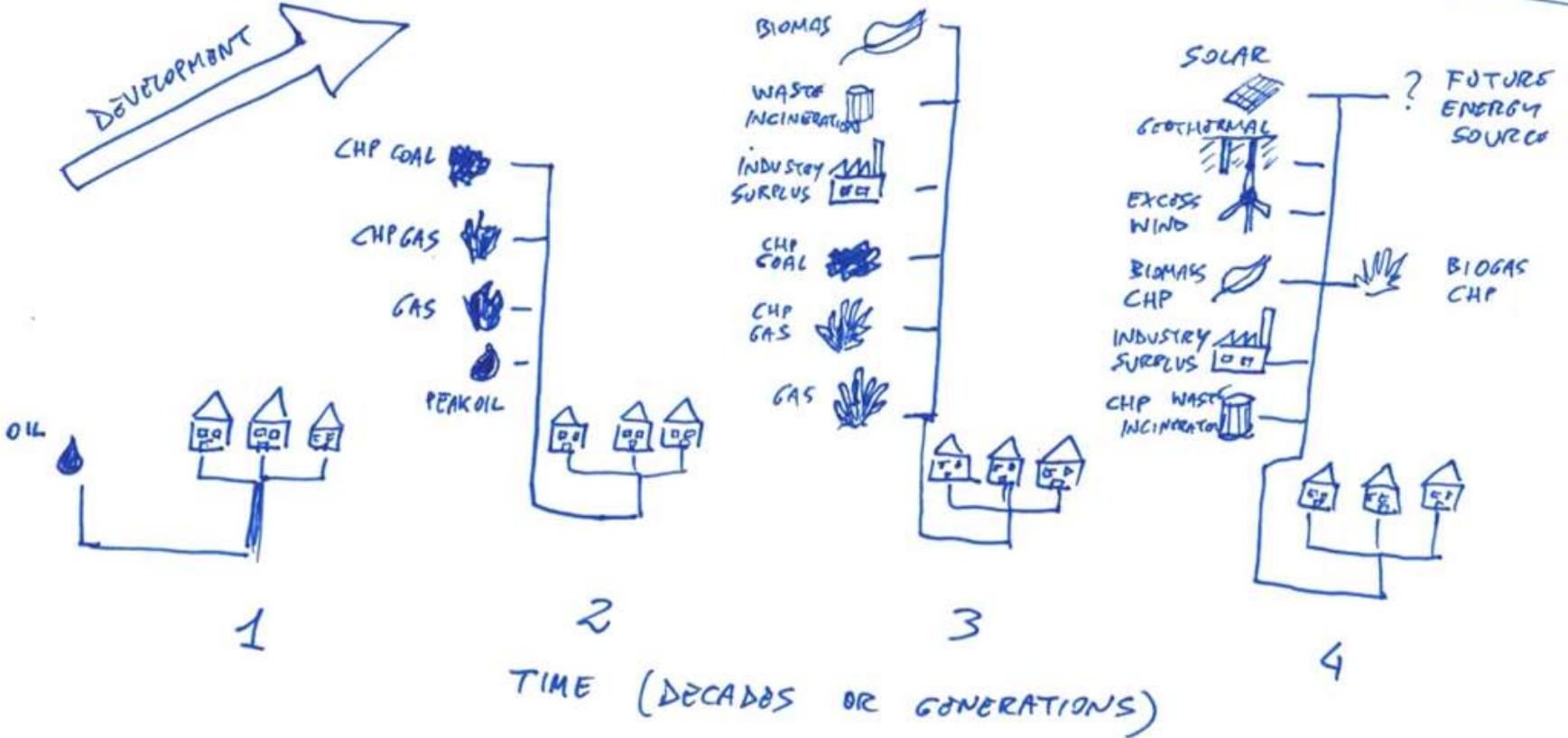
Optimal tilted plane:
Kyiv 1383 kWh/y/m²



Odessa 1578 kWh/y/m²



District Heating



District Heating



District heating



Solar tank



Technical Building for Solar District Heating



District heating with tank



Solar Seasonal Thermal Storage



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CASE DISTRICT ENERGY DISTRICT HEATING ENERGY STORAGE +3

World largest thermal heat storage pit in Vojens

12. OCTOBER 2014

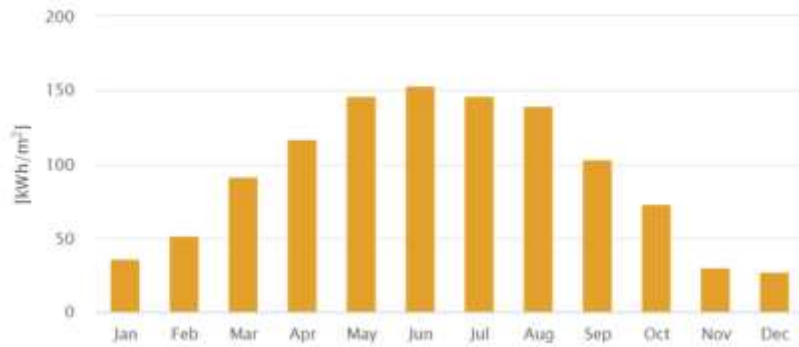


Source: State of Green

Solar heating yield

Monthly averages

Direct normal irradiation



Forward temp.: 70°C
Return temp.: 35°C
Efficiency 50-60% av.



Kyiv: 568 kWh/m²/y
Odessa 750 kWh/m²/y



Monthly averages

Direct normal irradiation



Cost calculation (simplified)

Based on Danish technology catalogue, www.ens.dk

Solar panels		10000 m ²	Tank	2000 m ²		
Plant excluding day-night storage		1.920.000 €				
Storage tank		120.000 \$				
Investment cost		2.040.000 €				
Fixed O&M	0,04 €/m ²	400 €/year				
Electricity use	3,1 kWh/MWh_h	882 €/y at electricity price	50 €/MWh =	2000 UAH/MWh		
Pay-back	5% interest	132705 €/year, lifetime	30 years			
Annual costs		133987 €/year				
Yield, Kyiv		5677 MWh/year				
Heat price Kyiv		0,023 €/kWh =		938 UAH/MWh		
Yield, Odessa		7500 MWh/year				
Heat price Odessa		0,018 €/kWh		710 UAH/MWh		

- 40000 m² plant give 10% cheaper solar heat

Thank you



- www.inforse.org/europe
- www.Folkecenter.net



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