



Solar Thermal Heating in General and for District Heating

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INFORSE-EUROPE
International Network for Sustainable Energy



Nordic Folkecenter
for Renewable Energy

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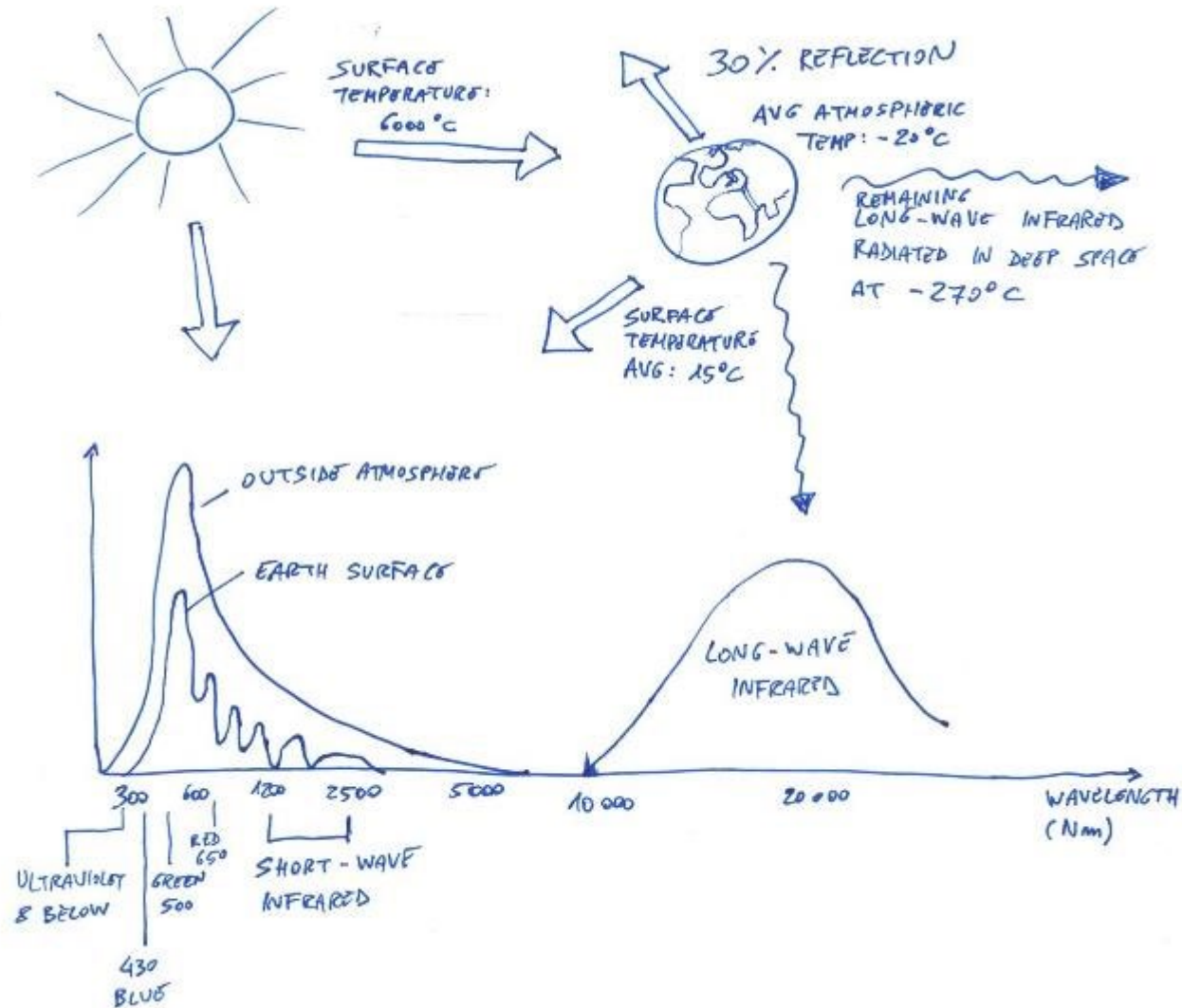
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Funded by
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Where Does the Energy Come from?



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

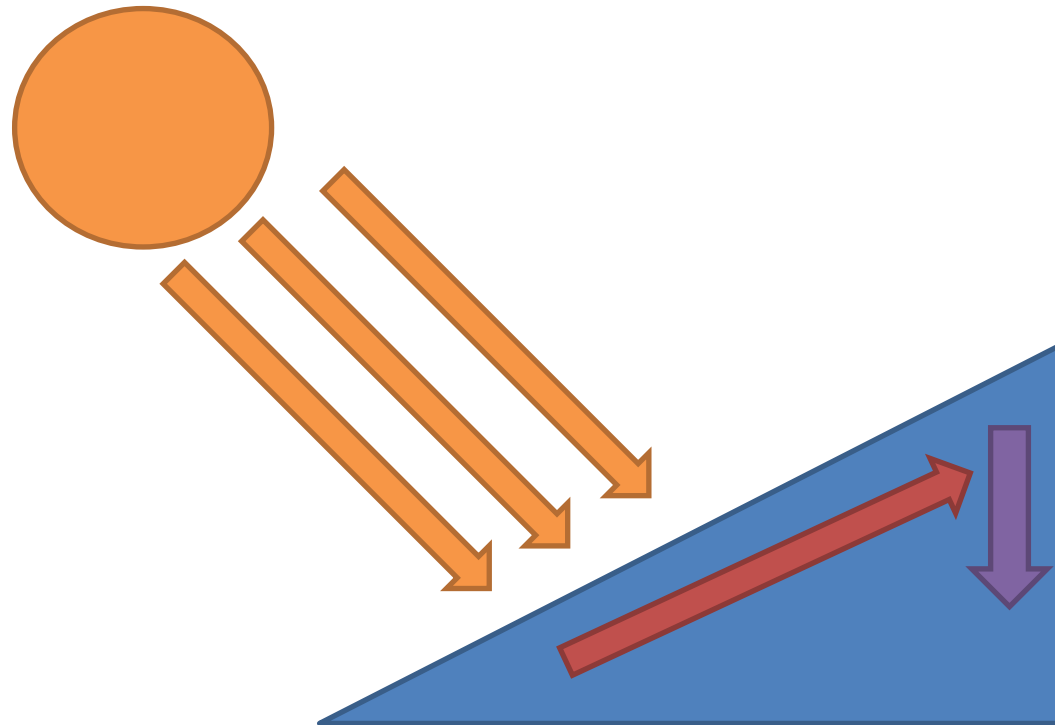


Solar heat collectors



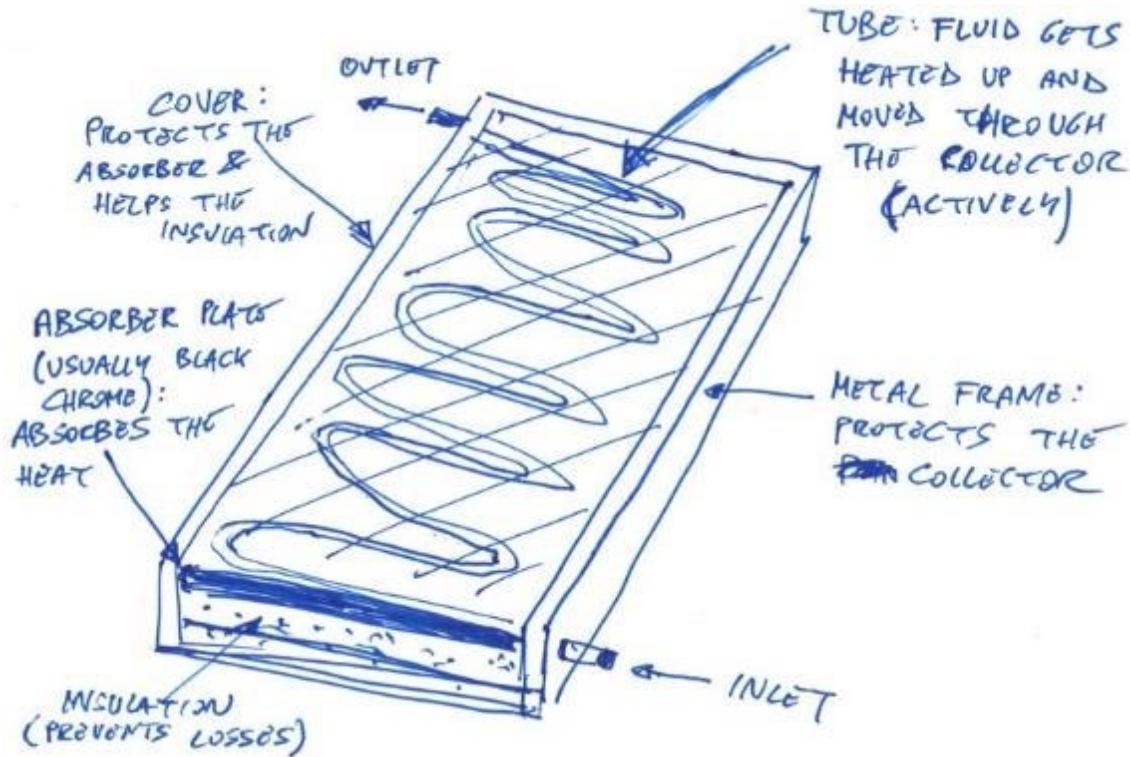


Heat Transfer in a Solar Panel



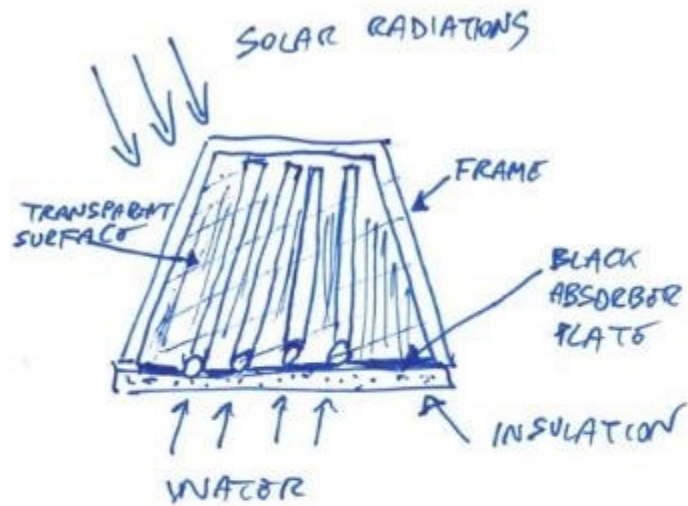


Flate Plate Collector

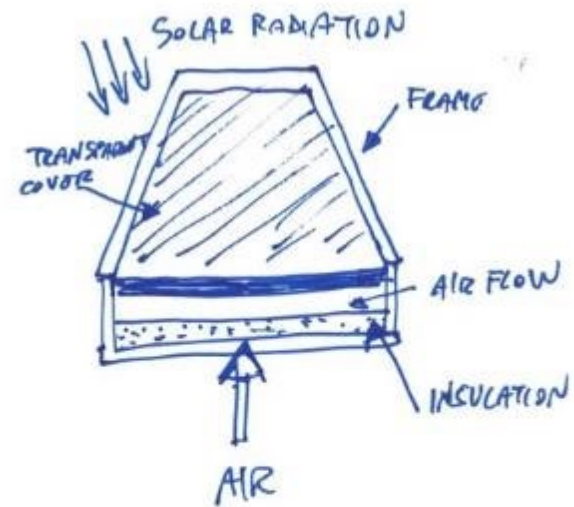




Flate Plate Collector



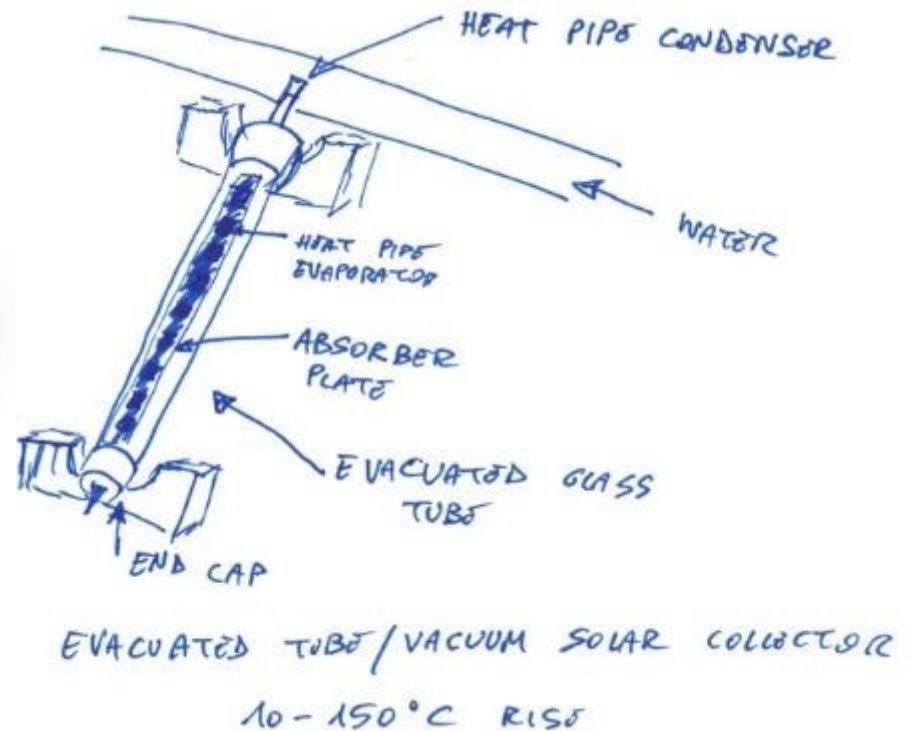
FLAT PLATE (WATER)
COLLECTOR
(0-50° C RISE)



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



Vacuum Tube Collector



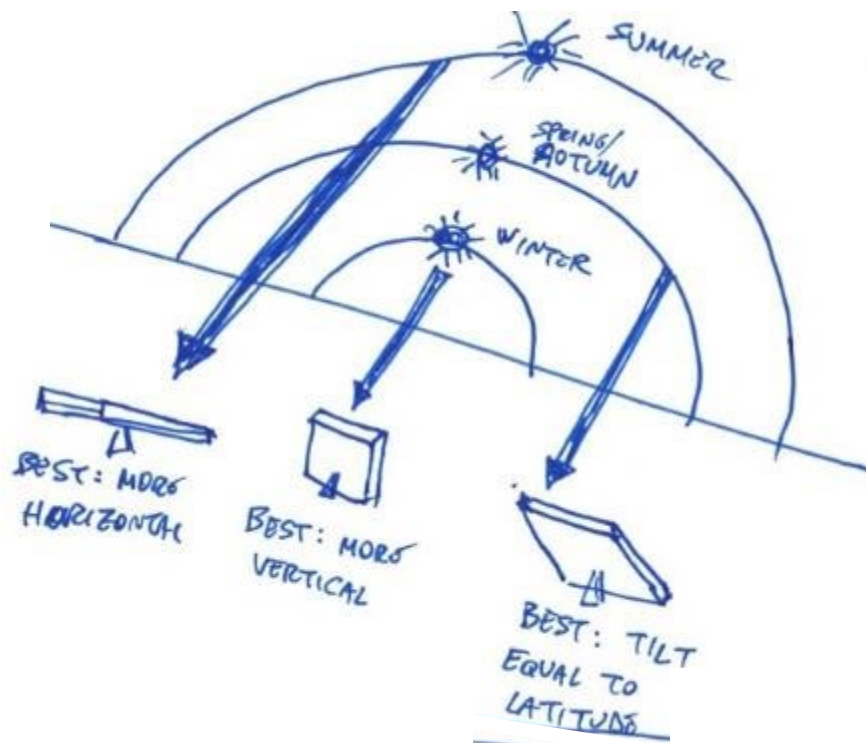
For district heating: 12 m² panels

GREENoneTEC **1**
SOLAR COLLECTORS

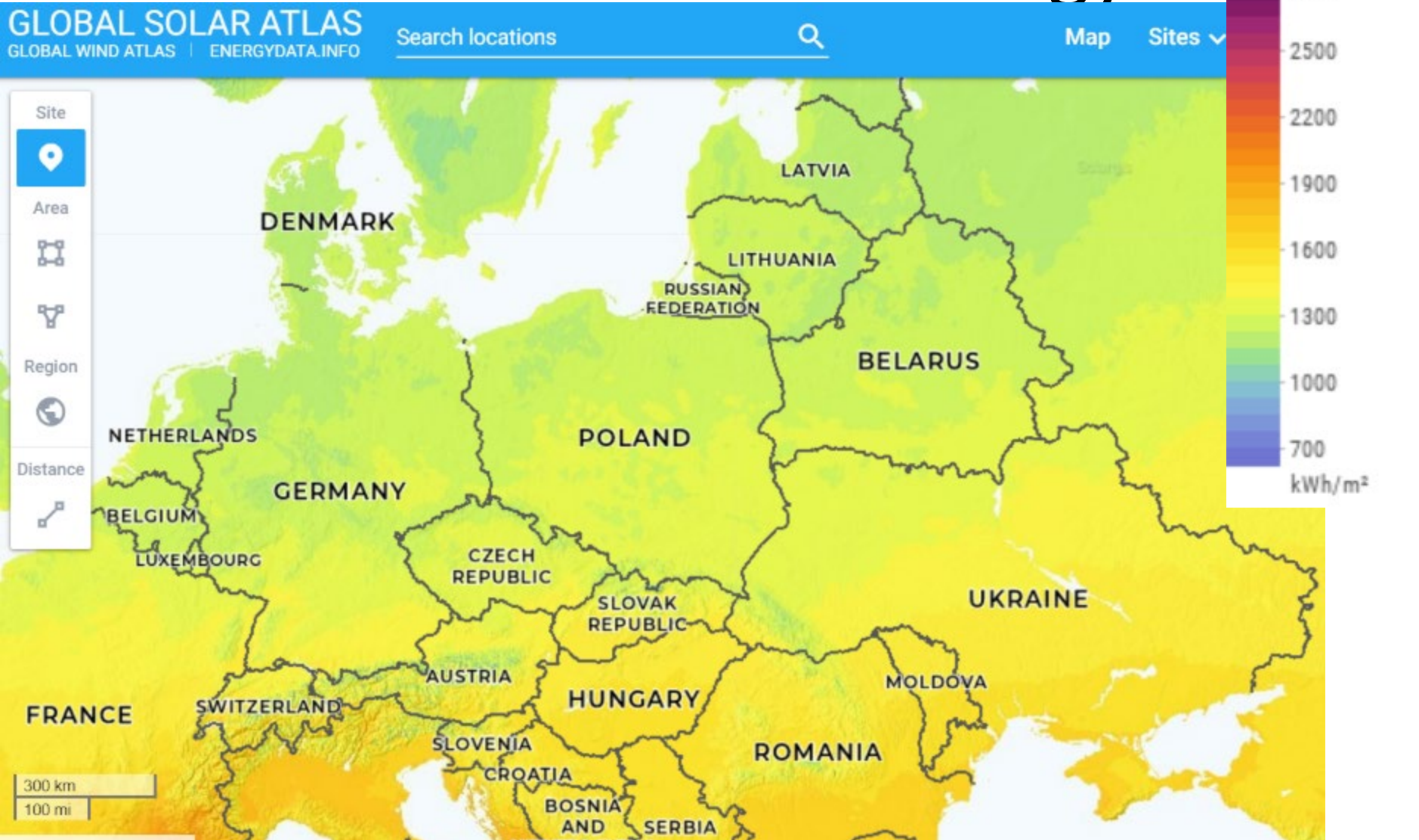




The Importance of the Angle



How much solar energy?

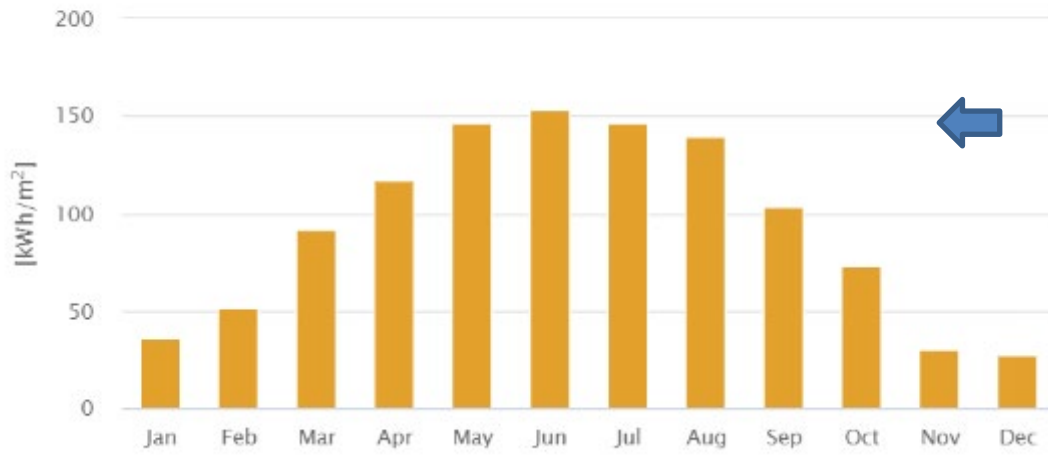


Free solar data from <https://globalsolaratlas.info/>

How much solar energy per month?

Monthly averages

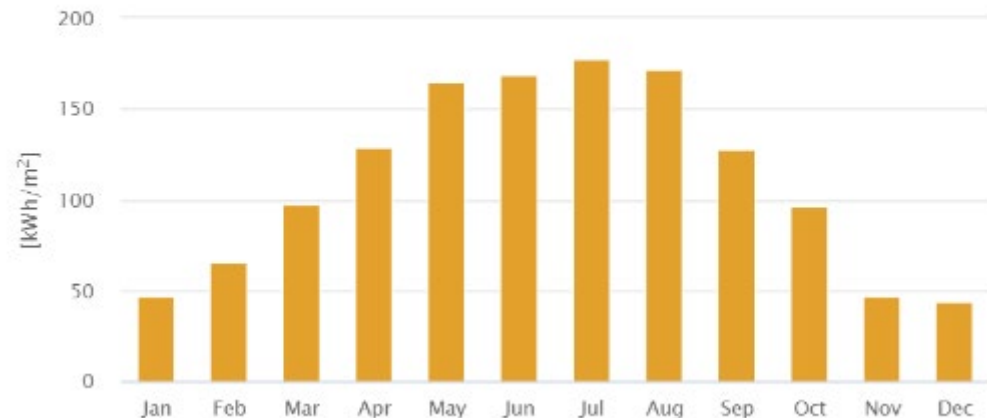
Direct normal irradiation



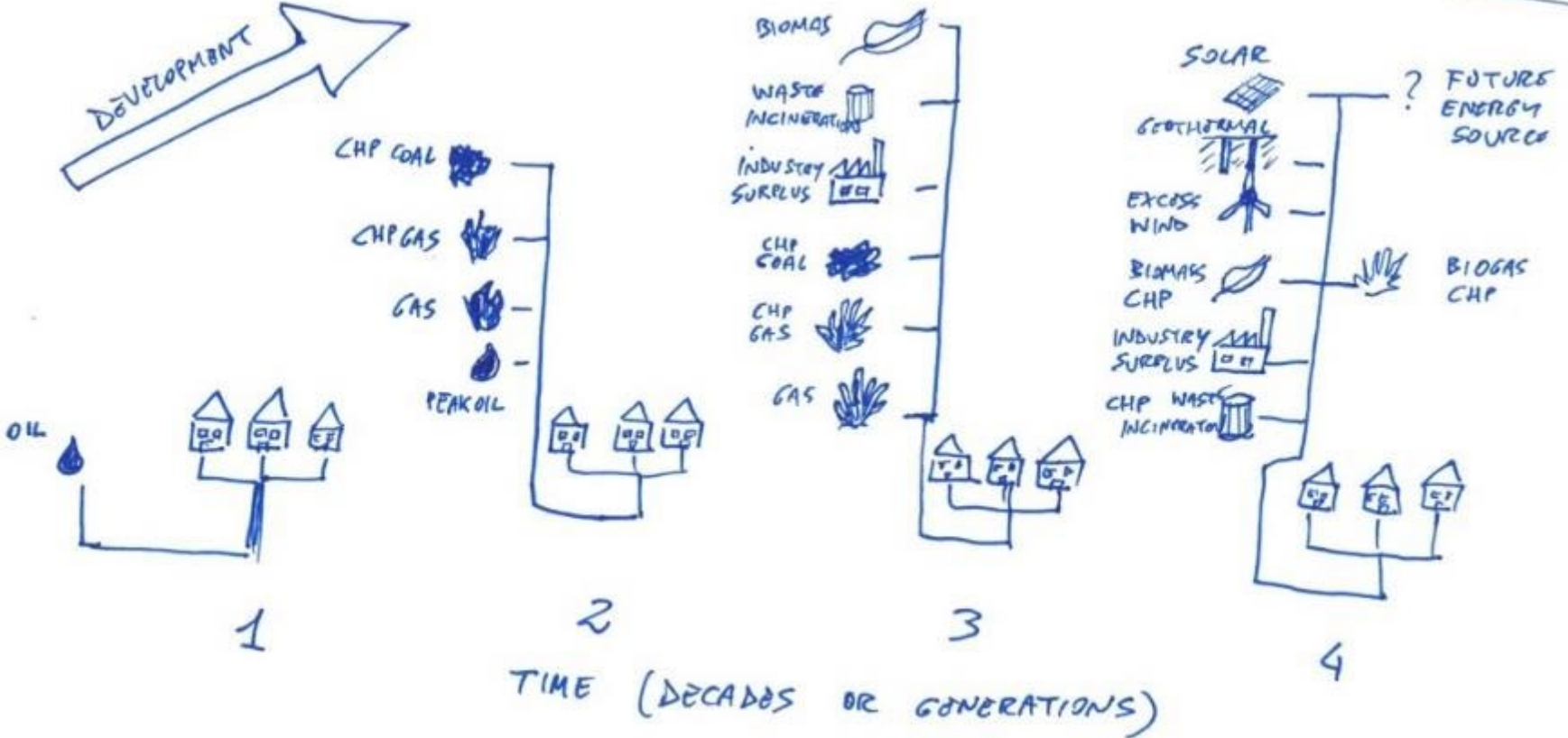
Optimal tilted plane:
Kyiv 1383 kWh/y/m²



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



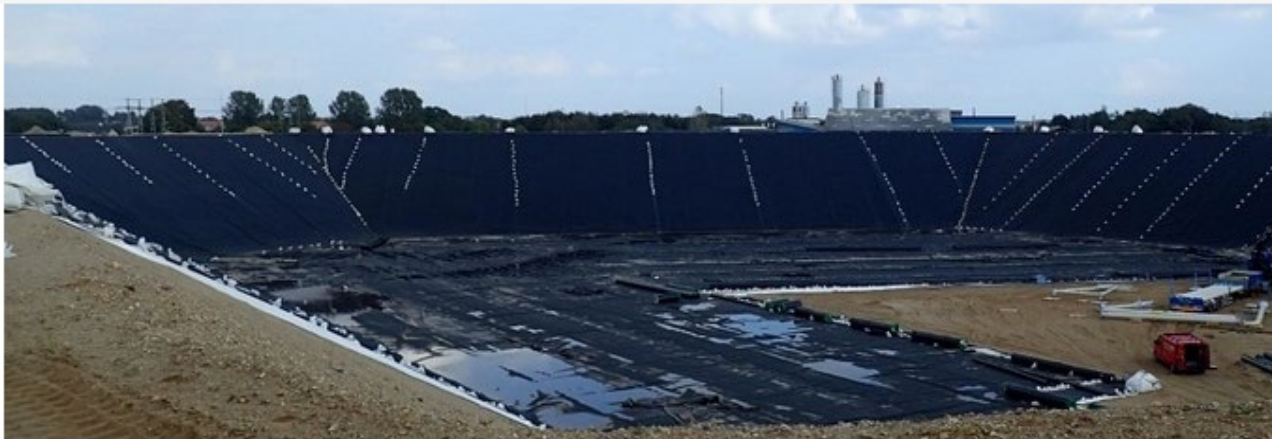
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CASE DISTRICT ENERGY DISTRICT HEATING ENERGY STORAGE +3

World largest thermal heat storage pit in Vojens

12. OCTOBER 2014

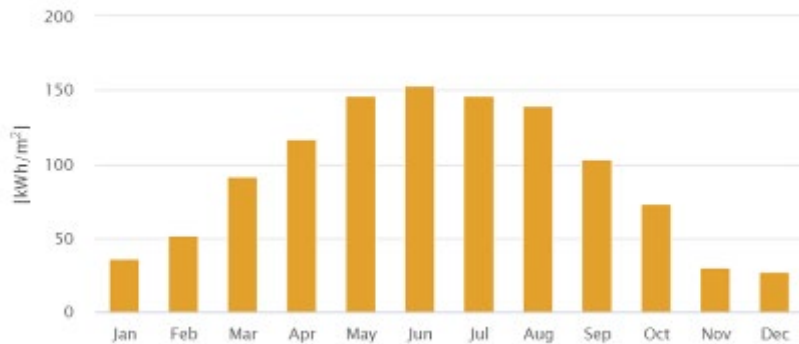


Source: State of Green

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 ³		
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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