



Water Heating Based on Solar Energy

**Marinko Stojkov^{1,*}, Krunoslav Hornung², Ante Čikić¹,
Dražan Kozak¹, Damir Šljivac³, Danijel Topić³**

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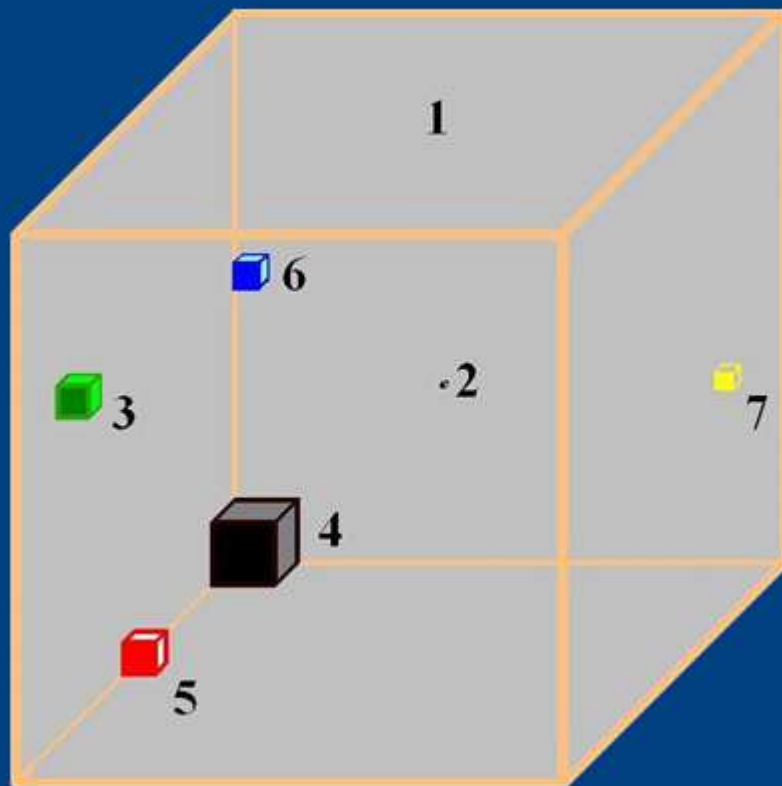


Renewable Energy Sources:

- **Everywhere**
- **Influence on life development**
- **Solar energy as presumption for life (plants)**
- **Influence on civilization development**
- **Weather conditions, Clime**
- **Renewables as energy transformations caused by Sun**



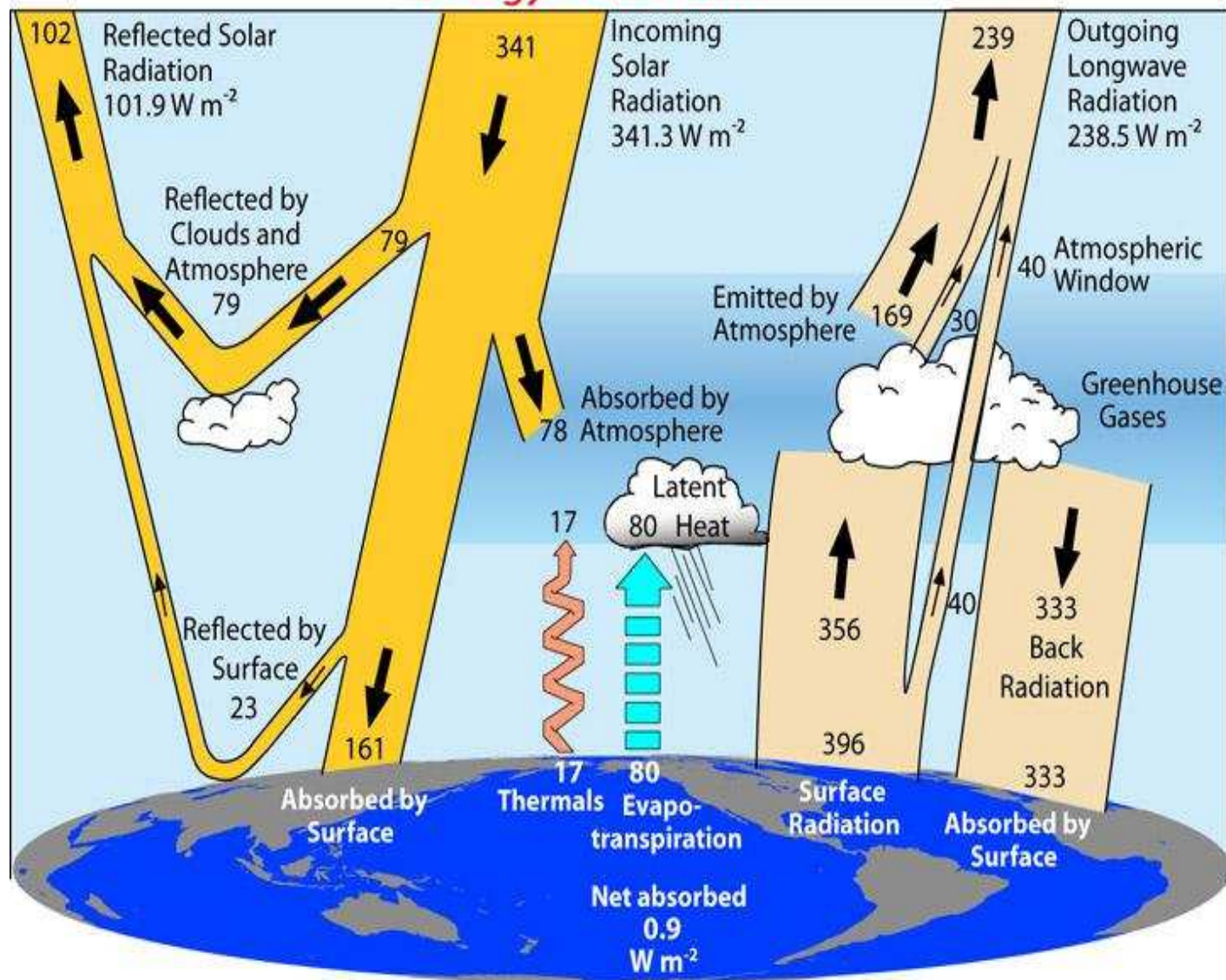
SUN AS ENERGY SOURCE



1. Solar energy annually irradiated on the Earth surface
2. Solar energy applied by technical systems
3. Natural Gas reserves
4. Coal reserves
5. Oil reserves
6. Uranium reserves
7. Annual world energy demand

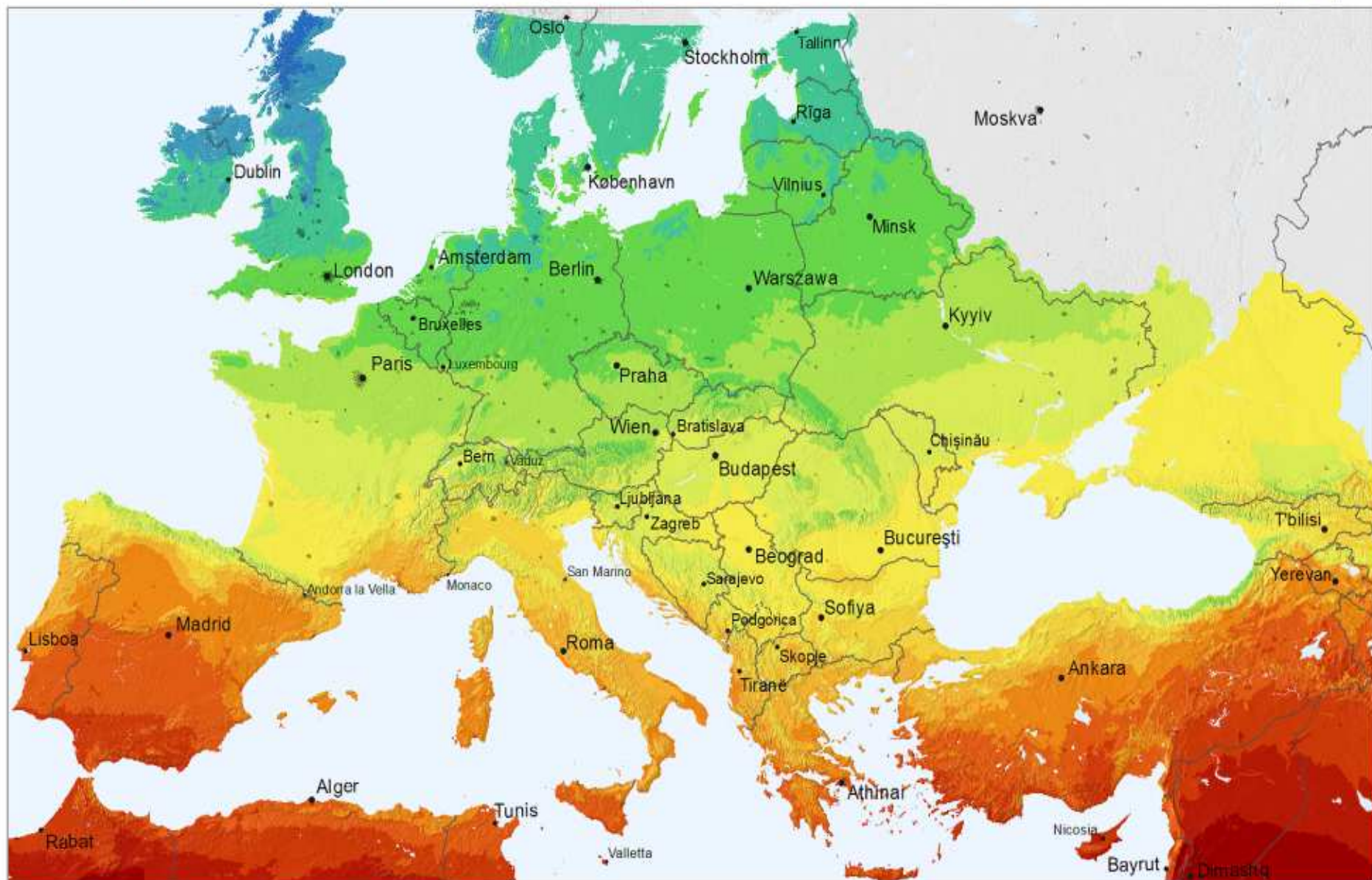


Energy Flows $W m^{-2}$



Global Horizontal Irradiation (GHI)

Europe



Average annual sum, period 1994-2010



0 400 km

1000 2000 3000 4000 5000 6000 7000 8000 9000 10000



Solar irradiation

Month	Average	2007.	2008.	2009.	2010.	2011.	2012.	2013.
	V (m ³)	V (m ³)	V (m ³)	V (m ³)	V (m ³)	V (m ³)	V (m ³)	V (m ³)
January	17.557,86	11.181	20.295	15.438	17.543	19.952	20.151	18.325
February	13.523,57	11.803	14.540	13.927	12.852	14.231	13.987	13.325
March	11.268,71	9.853	11.611	11.197	10.835	11.562	12.035	11.788
April	5.127,571	4.276	7.532	4.060	4.652	4.951	5.124	5.298
May	1.629,571	1.490	1.619	1.785	1.645	1.712	1.543	1.613
June	1.192,714	1.309	1.256	1.027	1.123	1.254	1.201	1.179
July	1.070,167	---	1.279	904	1.002	1.120	1.097	1.019
August	1.041,333	---	1.030	952	987	1.102	1.086	1.091
September	2.648,286	1.546	3.113	2.871	2.718	2.914	2.875	2.501
October	6.768,857	7.098	7.085	6.328	6.283	6.814	6.901	6.873
November	12.657,43	15.675	10.005	11.093	11.688	13.541	13.848	12.752
December	17.234,71	15.215	18.428	17.109	17.654	17.988	17.530	16.719



Solar Energy Transformation

- Heating energy
Solar collectors





Heating Energy – self made, 40 years old



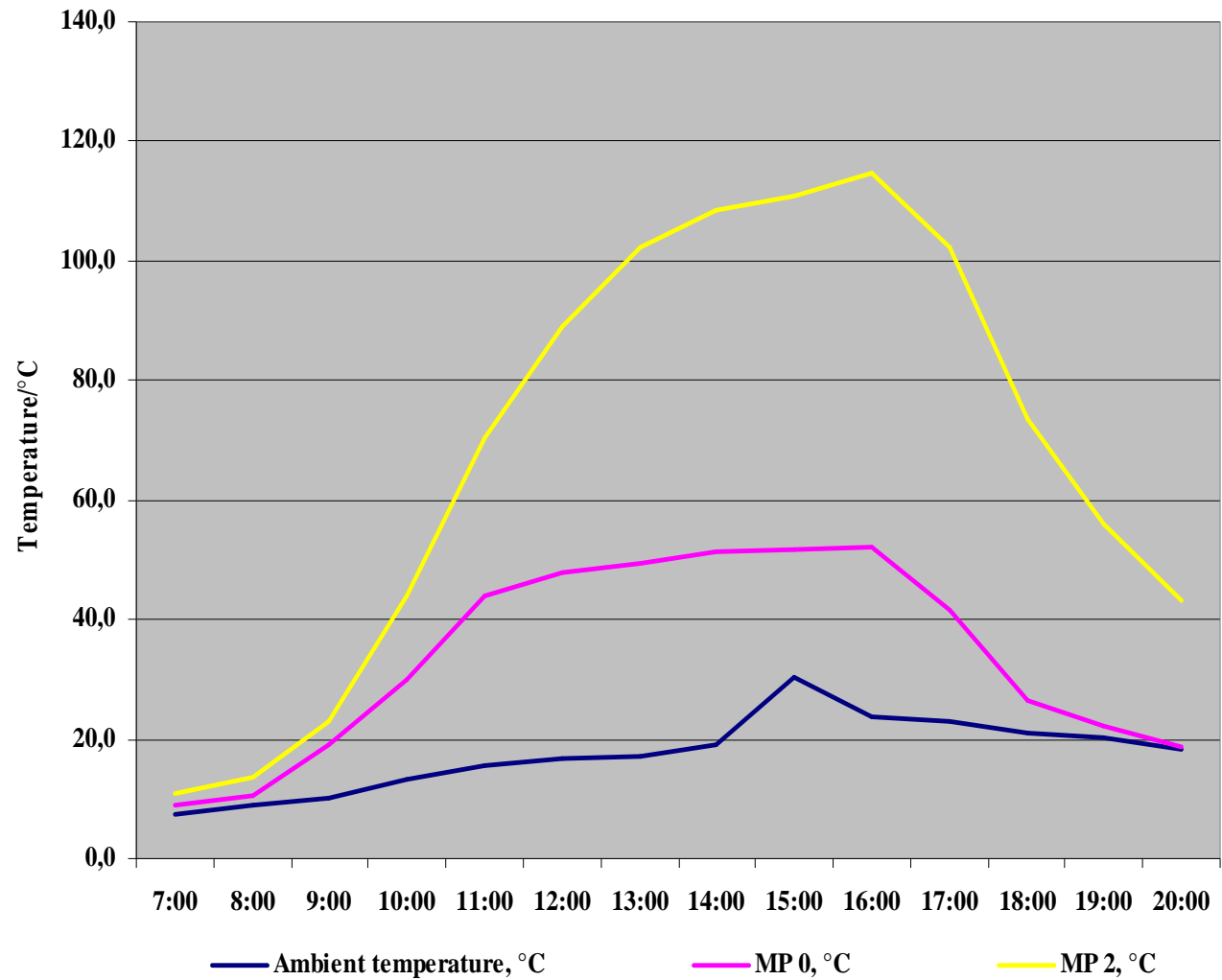


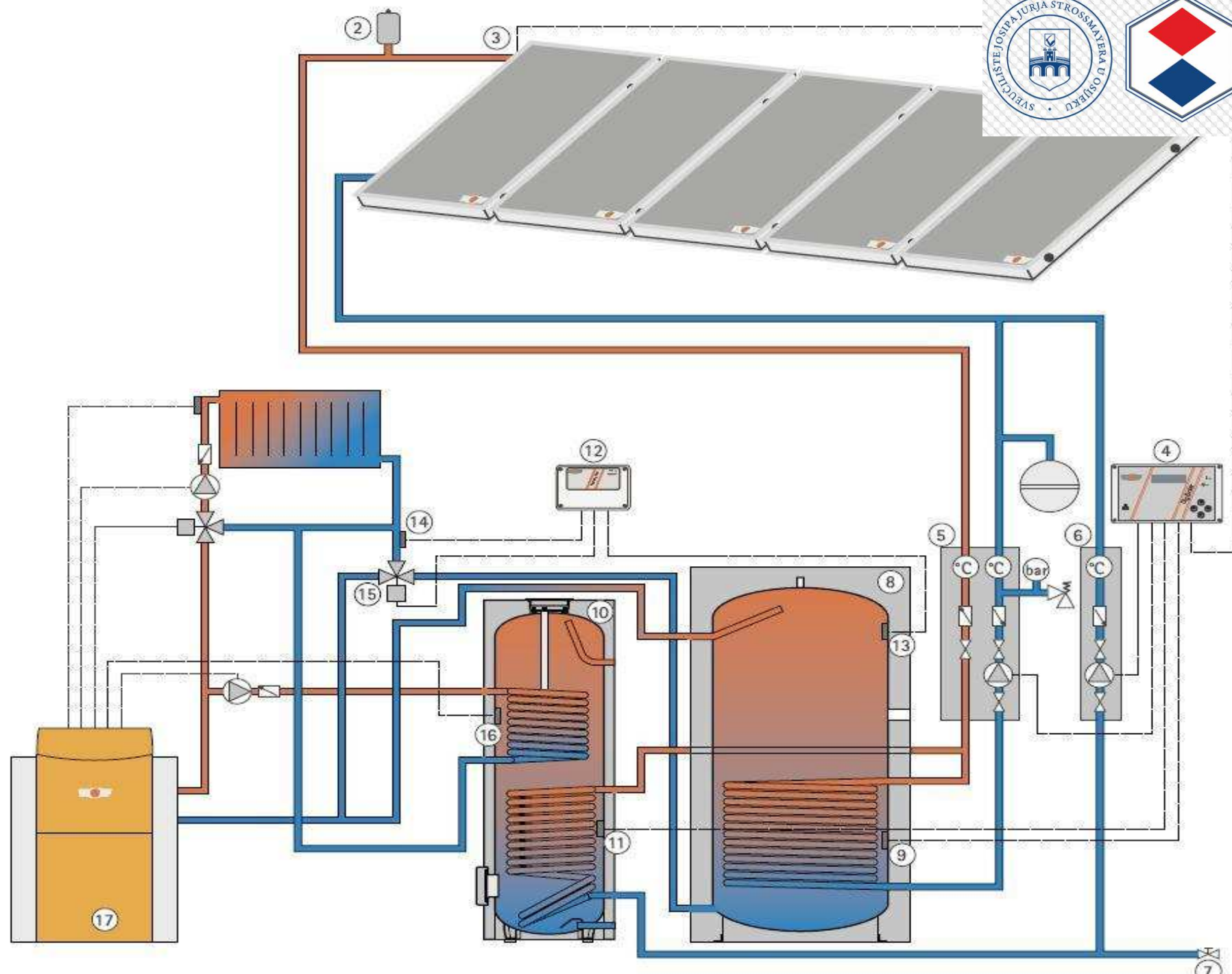
Example of temperature measurements during the day, 18th April 2010.

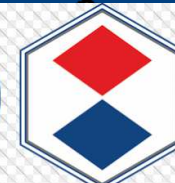
Time	Ambient temperature /°C	MP 0 (°C)	MP 2 (°C)	Weather conditions
7:00	7,3	8,8	10,8	Clear
8:00	9,1	10,6	13,5	Clear
9:00	10,2	19,2	23,1	Clear
10:00	13,1	30,1	43,8	Clear
11:00	15,5	43,9	70,3	Clear
12:00	16,8	47,8	88,9	Clear
13:00	17,1	49,4	102,1	Cloudy / nimbuses
14:00	19,1	51,3	108,6	Cloudy / nimbuses
15:00	20,2	51,6	110,9	Cloudy / rain
16:00	23,8	52,3	114,9	Cloudy / nimbuses
17:00	22,9	41,8	102,4	Cloudi / rain
18:00	21,1	26,4	73,4	Cloudy / nimbuses
19:00	20,1	22,1	56,1	Cloudy / nimbuses / sunset



Heating energy

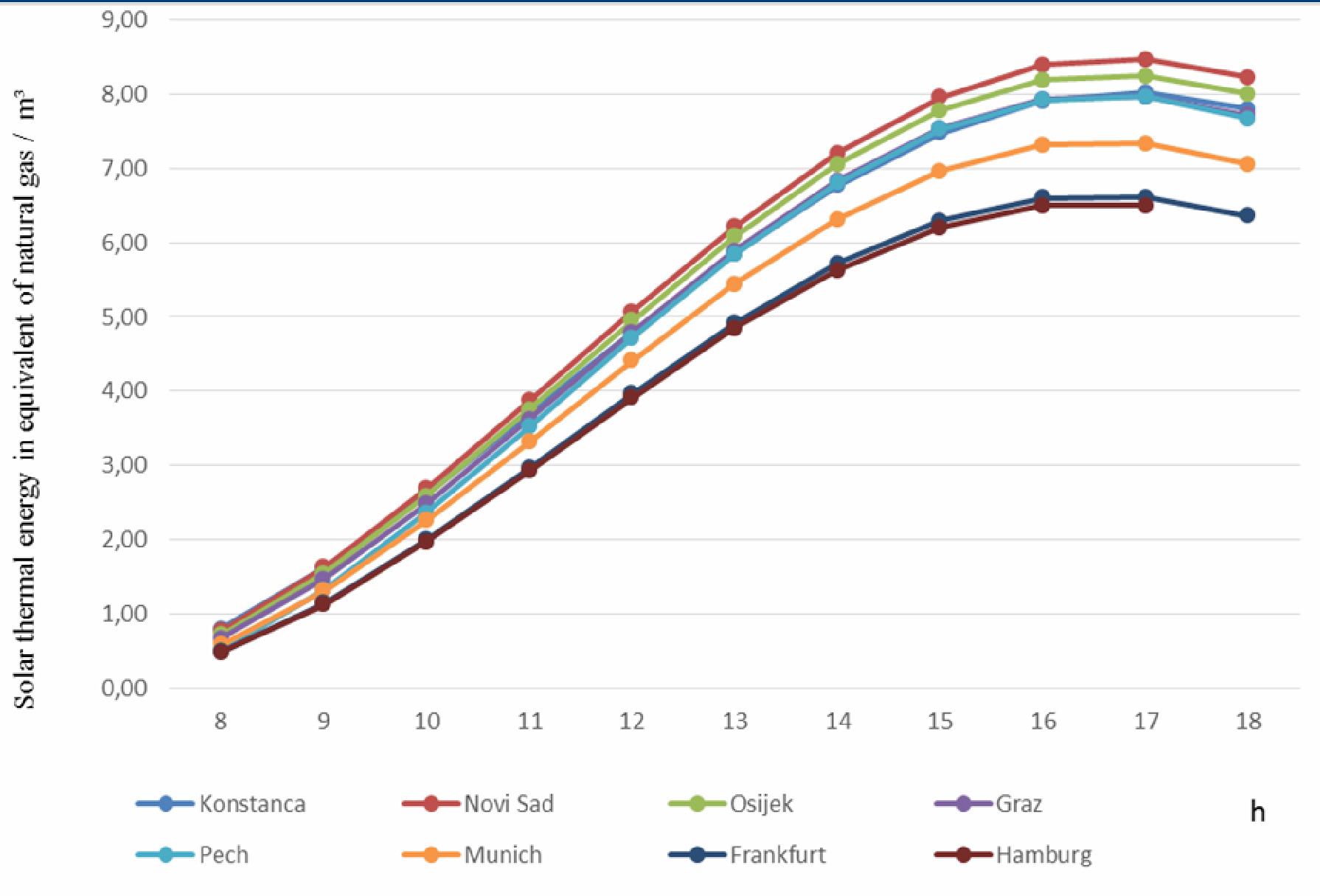
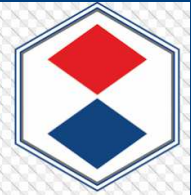


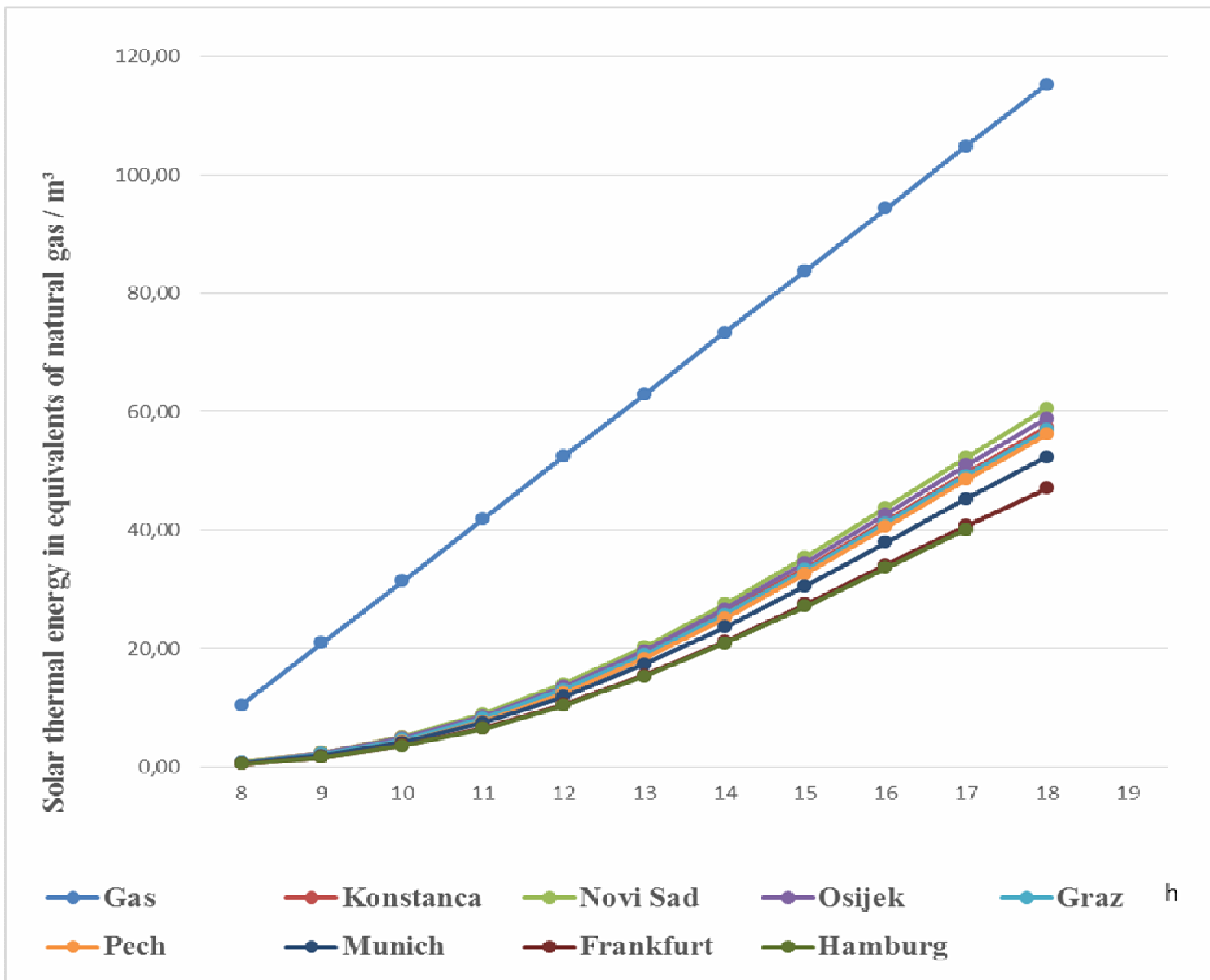


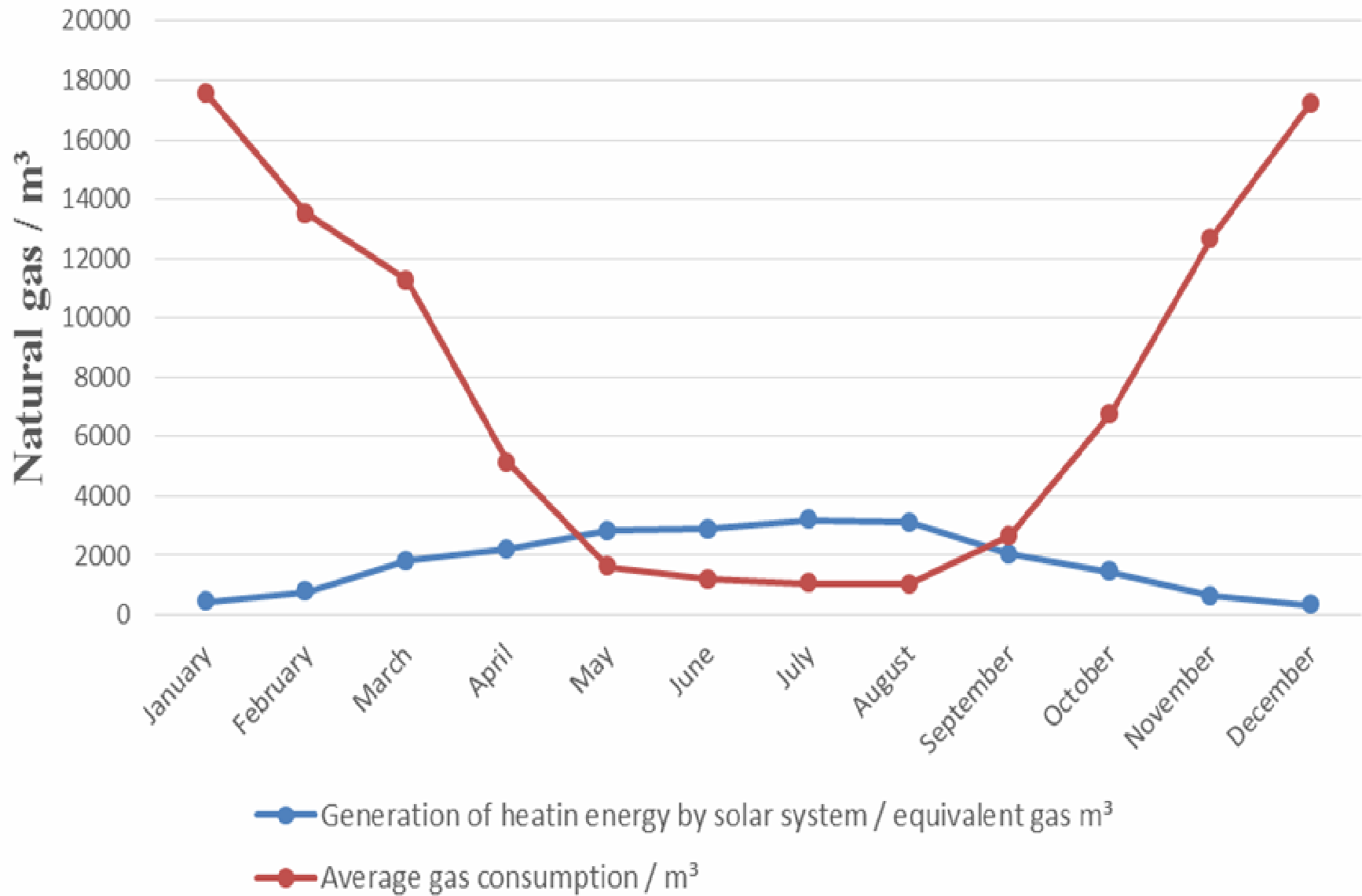


Coverage of gas consumption by equivalent solar energy

Month	Consumed natural gas, m ³	Daily production, m ³	Weekly production, m ³	Percentage %
January	17.557,9	13,98	433,287	1,62
February	13.523,6	28,14	787,846	4,80
March	11.268,7	58,88	1.825,31	11,18
April	5.127,57	73,97	2.218,97	23,99
May	1.629,57	91,43	2.834,34	159,02
June	1.192,71	96,00	2.880,01	213,06
July	1.070,17	102,60	3.180,55	237,09
August	1.041,33	100,41	3.112,78	278,16
September	2.648,29	67,74	2.032,21	64,12
October	6.768,86	46,38	1.437,78	17,26
November	12.657,4	21,31	639,41	4,74
December	17.234,7	10,66	330,489	1,23
Total :	91.720,8		27.712,98	









CONCLUSION

Solar energy application can improve:

- **Reduce of heating energy demand and energy demand for hot water production,**
- **Reduce of total energy demand,**
- **Reduce of transportation costs of conventional (non- renewable) sources,**
- **Reduce of emissions of CO₂.**

Full or partially energy autonomy of building.