RESEARCH IN SOLAR DISTRICT HEATING APPLICATION FOR HP CERAK IN BELGRADE

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AT BEGINING

- PAY ATTENTION: IT IS PRODUCTION OF HEAT ENERGY – NOT ELECTRIC ENERGY
- IT'S SOLAR HEATING PLEANT – NOT ELECTRIC PLANT
- APPLICATION OF THERMAL SOLAR PANELS – NOT PHOTOVOLTAIC
- FOR PRICES – RESPONSIBILITY OF CITY OR LOCAL GOVERNMENT, NOT FEDERAL OR REPUBLIC AGENCIES

PREFACE

- FOR SUCCES OF SDH THE MAIN ROLE HAVE A 3 ACTERS:
- **LOCAL CITY GOVERMENT,**
- **LOCAL COMPANY OF DISTRICT HEATING,**
- **LOCAL SOLAR INDUSTRY.**
- SDH HAVE A POSSITIVE EFFECT IN ENERGY EFFICIENCY IN URBAN AREAS,
- POSITIVE FOR EMPLOYMENTS,
- LESS IMPORT OF FOSSIL FUELS,
- SIGNIFICANT IMPACT FOR SUSTAINABLE DEVELOPMENT.

PREFACE

- TECHNOLOGY OF SOLAR DISTRICT HEATING IS READY FOR APPLY;
- IT CONSIDERES:
- **TEHNICAL SOLUTIONS,**
- **URBAN PLANING,**
- **BUSINES MODELS.**

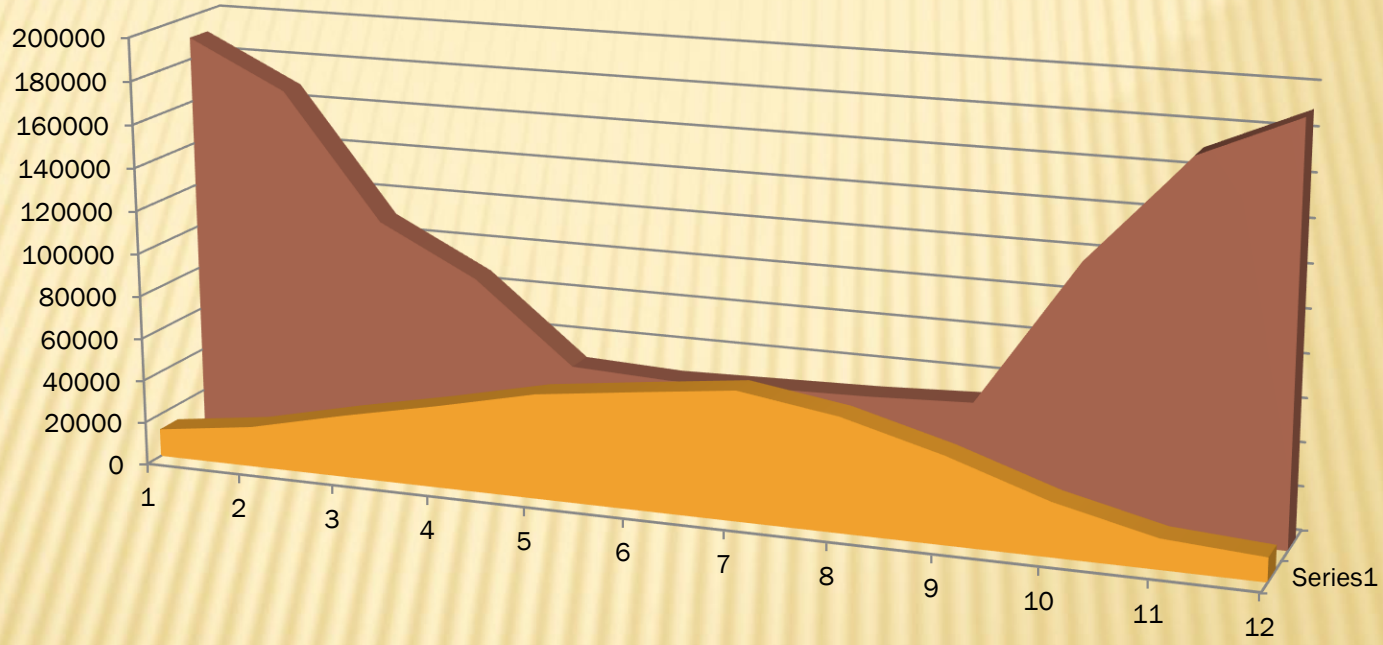
PREFACE

- SOLAR DISTRICT HEATING HAS EXPANSION IN LAST TWENTY YEARS IN ALL EUROPE.
- HERE EXISTS OVER 163 SOLAR HEATING PLANTS WITH MINIMUM 500 m2 OF THERMAL SOLAR PANELS.
- IT INCLUDES 31 SOLAR HEATING PLANTS OVER 10.000 m2.
- 60 OF 163 SOLAR HEATING PLANTS HAVE A POWER BIGER OF 1 MW.
- SOME HEATING PLANTS HAVE SEASONAL THERMAL STORAGE.

SDH FOR SERBIA

- SOLAR RAYS IN SERBIA ARE 30-40% HIGHER THAN SCANDINAVIA, WHERE IS SDH APPLICATIONS SIGNIFICANT.
- DISTRICT HEATING IN SERBIA EXISTS IN MORE THAN 50 CITIES.
- RETURN TEMPERATURES IN PIPELINES ARE VERY ATRACTIVE FOR SDH APPLICATION IN BELGRADE.
- CHIPER PROVIDING OF WORKS.
- SDH CAN OPERATE VERY PROFITABLE IN SERBIA.

LIMITATION: NEEDS AND PRODUCTION OF HEAT



CERAK HEATING PLANT

- The first step in SDH in Serbia was made as a part of the National Energy Efficiency Program of the Ministry of Science of the Republic of Serbia in the period 2006-2009, when basic research was done for the project of Substitution of fossil fuel with solar energy in applied for Domestic Hot Water (DHW) in the Heating Plant Cerak in Belgrade. The research was conducted by the Institute of Nuclear Sciences “Vinča”, Laboratory for Thermal Engineering and Energy (from Belgrade) and participant was PUC Beogradske elektrane.

CERAK HEATING PLANT

- It composed a Feasibility Study for SDH application in Heating Plant Cerak. The simulation has been performed within software package TRNSYS16 specialized for various systems calculation including solar systems.

HP CERAK

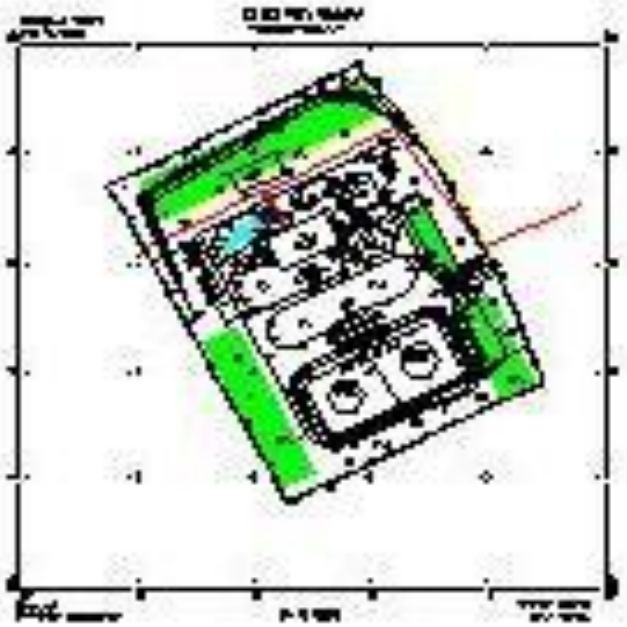
- Heating plant Cerak is an integral part of PUC Beogradske Elektrane and it produces and delivers heat energy for heating and domestic hot water to customers in Belgrade municipalities of Čukarica and Rakovica. Basic fuel currently used in the plant is natural gas or fuel oil. Total boiler installed capacity is 244,3MW, the consum capacity for heating and hot water is 230MW, while the estimated installed capacity of 16,3 MW produces hot water.

HP CERAK

- The previous summer operation mode was set up at 62/45°C for the capacity of 6MW with flow of 300 m3/h of hot water. It was expected that in the upcoming period modernization, which was done in 2008. and new operation mode of district heating substations would be set up at 250 m3/h flux and temperature mode of 60/40°C.

HP CERAK

HP CERAK



Heat pipeline

Solar collector's area

AREAS OF SOLAR FIELDS

- The four surfaces can be utilized immediately for solar collectors mounting. The surface area dimensions are as follows:
- 1. 210 x 35 m,
- 2. 150 x 30 m,
- 3. 90 x 30 m and
- 4. 60 x 20 m.
- The last two represent the parking places necessary to cover with special structures. The total sum of area is roughly 15000 m2. According to the recommendations for collectors mounting and maximum avoidance of collectors shading, the calculation for each individual surface has been done.

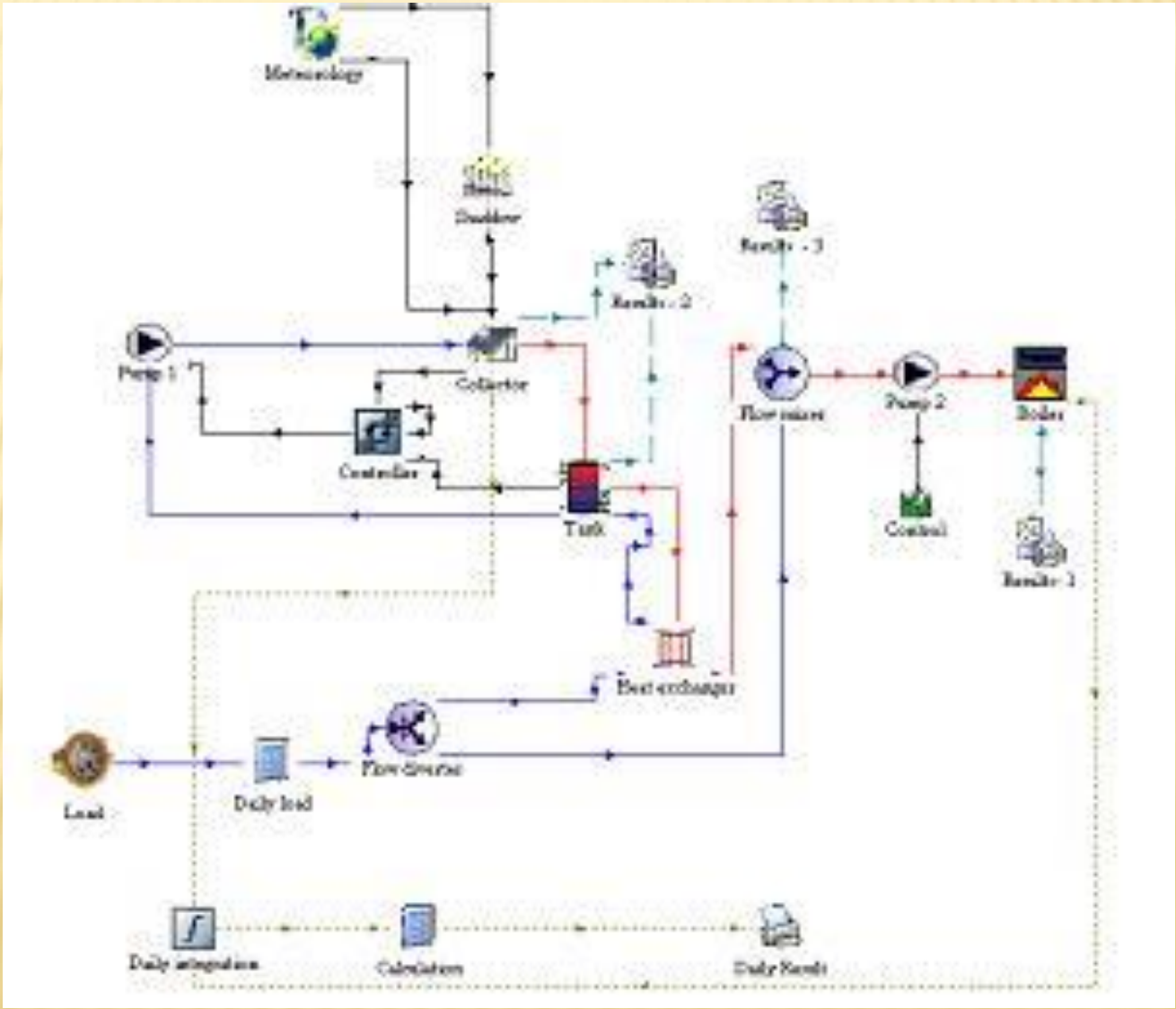
TRNSYS COMPONENTS CHARACTERISTIC

- Meteorological data are taken from software package METEONORM obtained from ten years measurements on the Belgrade locations.
- Two collector types are used for calculation: evacuated tube collectors (manufacture Apricus type AP-30, Australian-British company manufacturing in China) and flat-plate collector (NAU type FLATLINE BE Ultra plus – Germany and manufacture GJ-Sunmark Denmark A/S type GJ 140A, Danish company manufacturing in Vietnam)

COMPONENTS CHARACTERISTIC

- All manufactures possess product certificates (Apricus has ISO9001 certificate and SRCC for US and Canada markets, while NAU and GJ have European certificates EN 12975-2) that were the source for necessary simulation data. Simulation have done for collector angle of 20 degree.

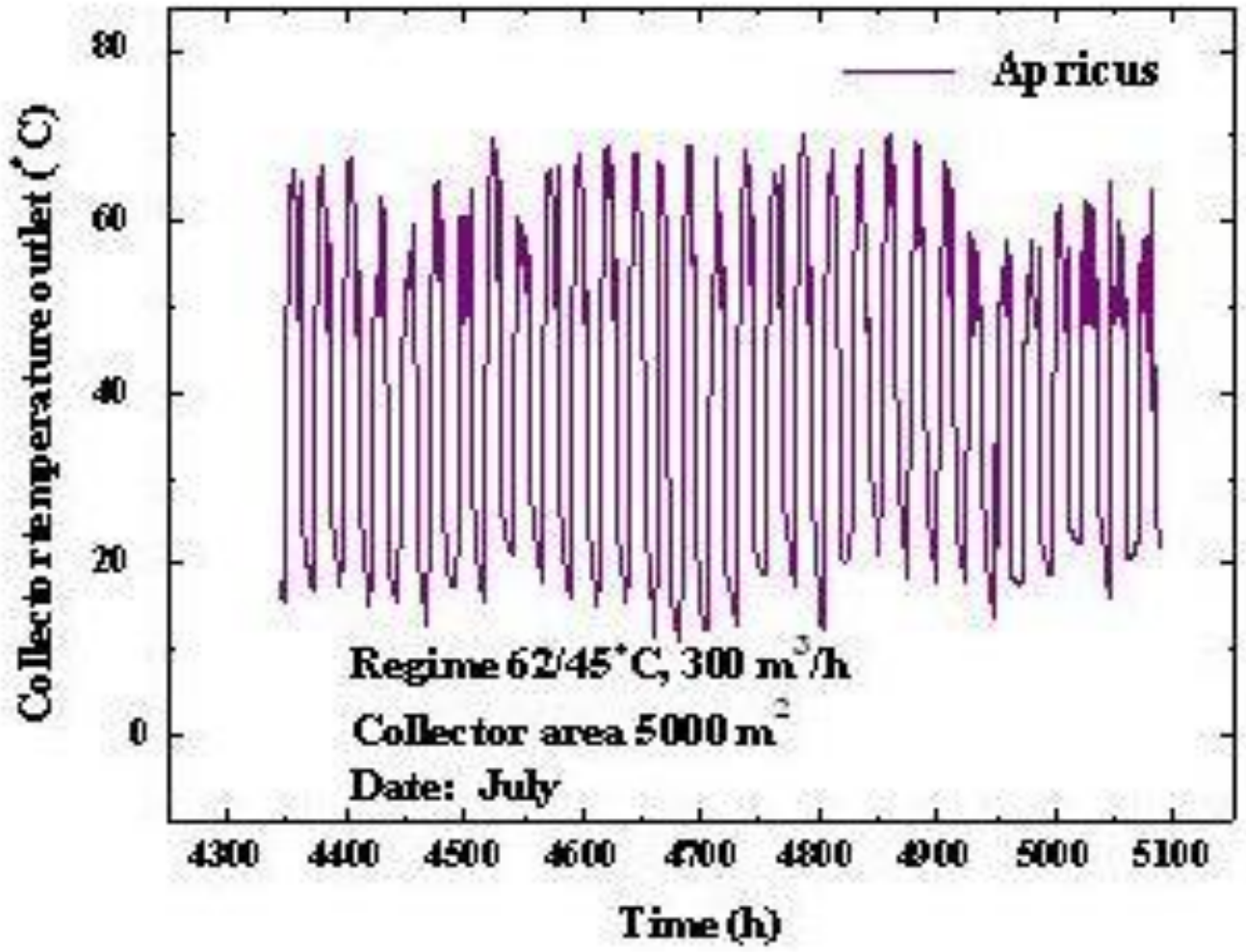
HP CERAK – TRNSYS SCHEME



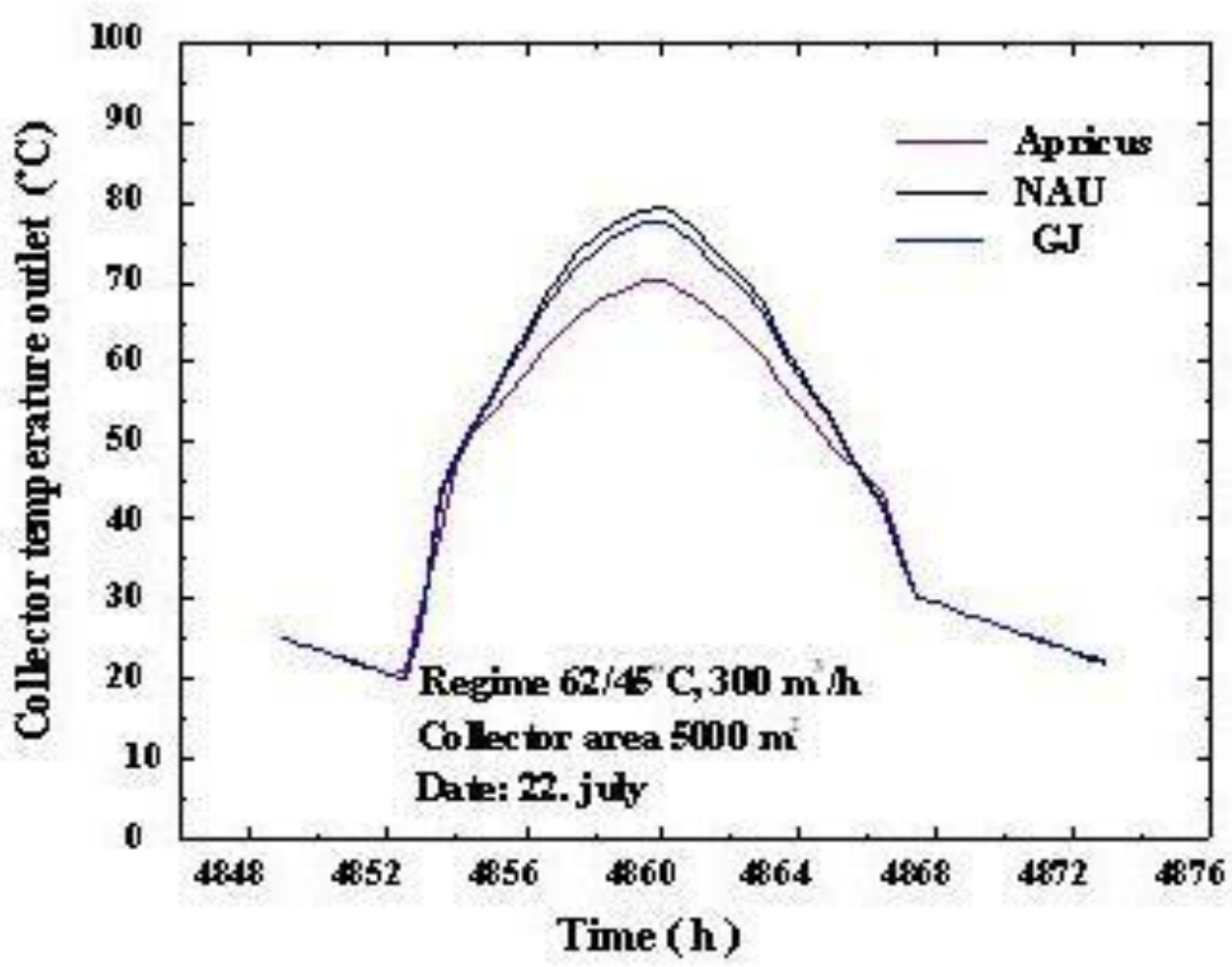
TRNSYS

- IN SIMULATION WERE USED DATAS FOR:
- METEONORM,
- SOLAR PANELS,
- PUMPS WITH AUTOMATIC CONTROL,
- HEAT EXCHANGERS,
- STORAGE TANKS,
- BOILERS.

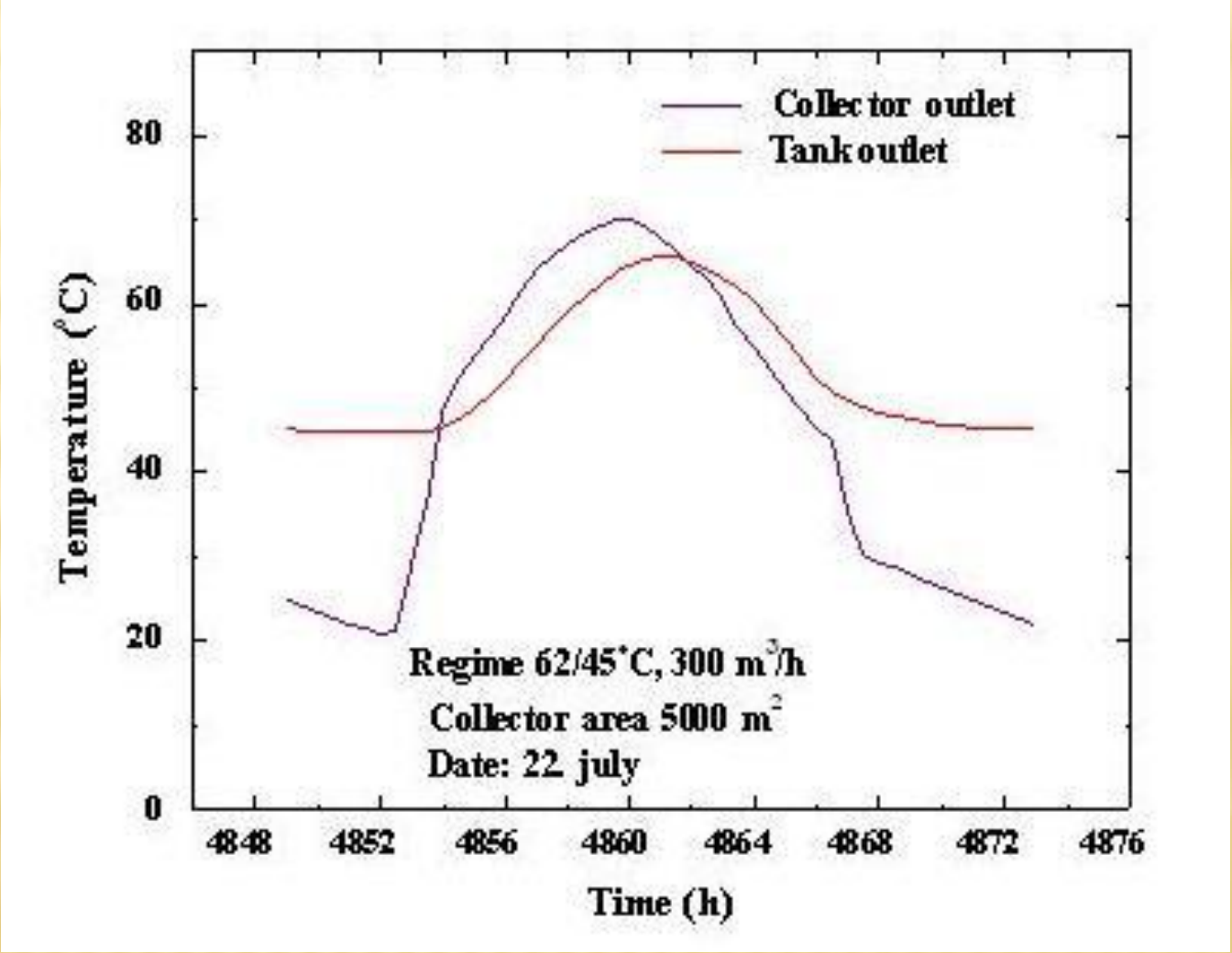
TEMPERATURES OF OUTLET OF PANELS



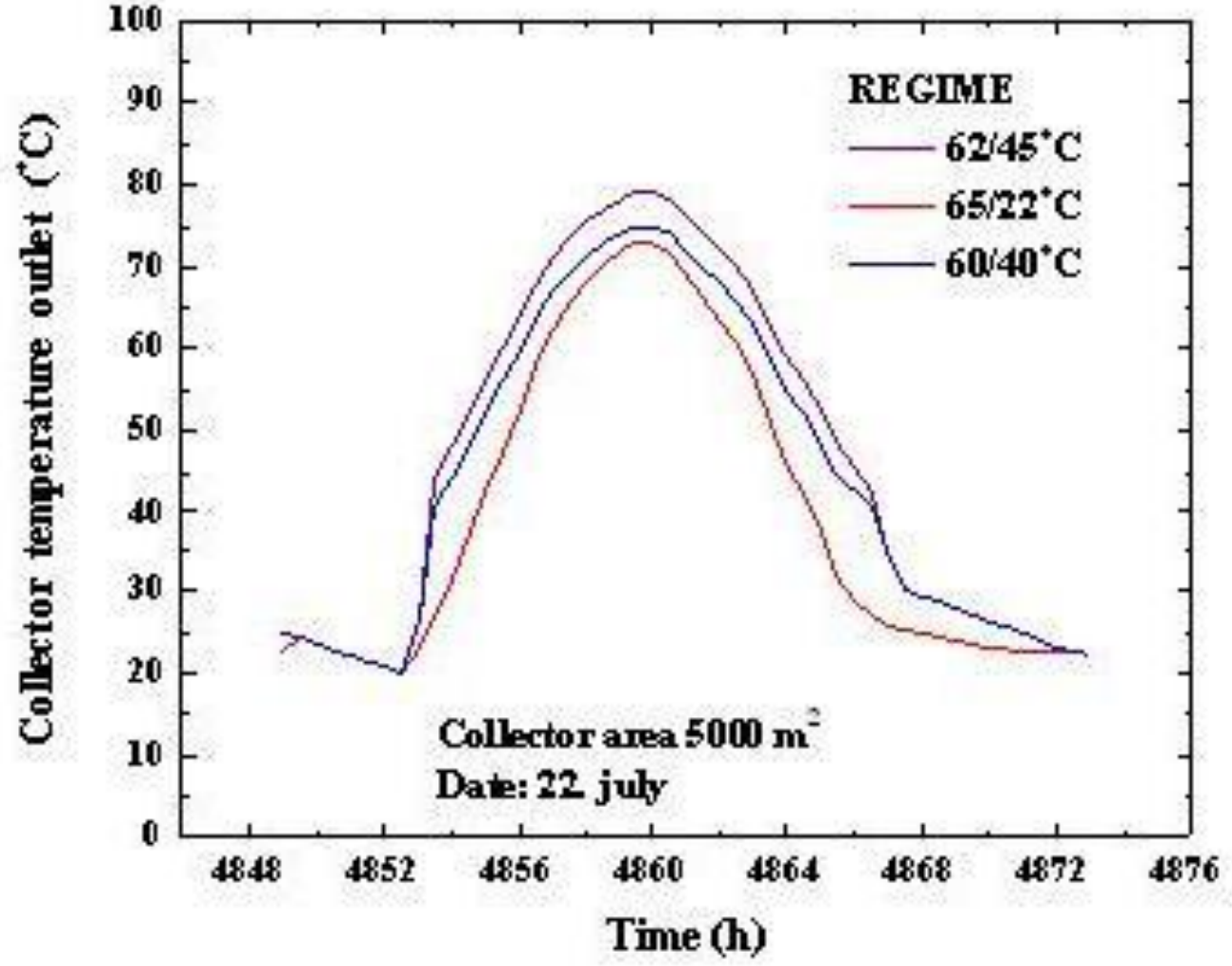
OUTLET TEMPERATURES BY PANELS



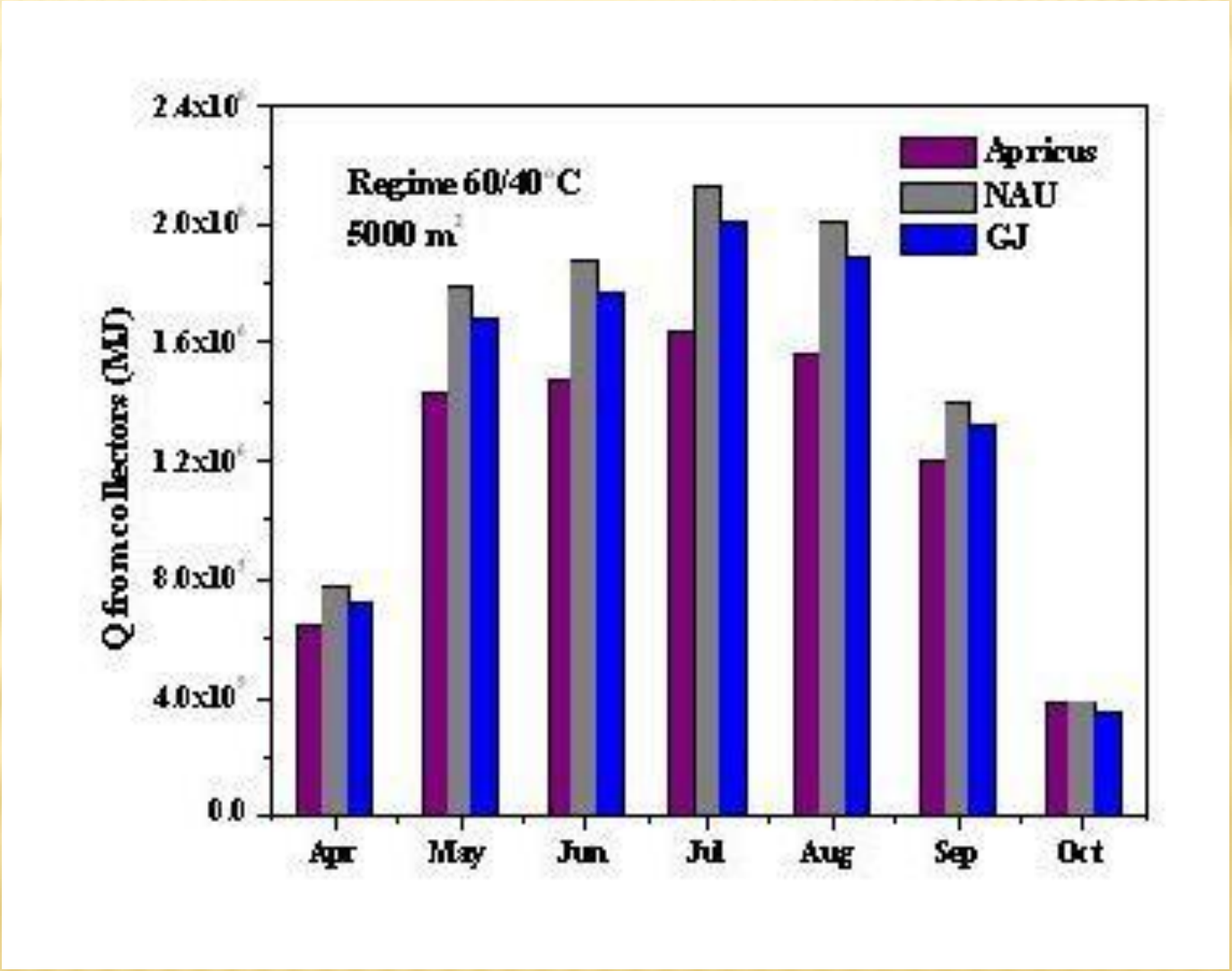
OUTLET TEMPERATURE FROM PANELS AND STORAGE TANK



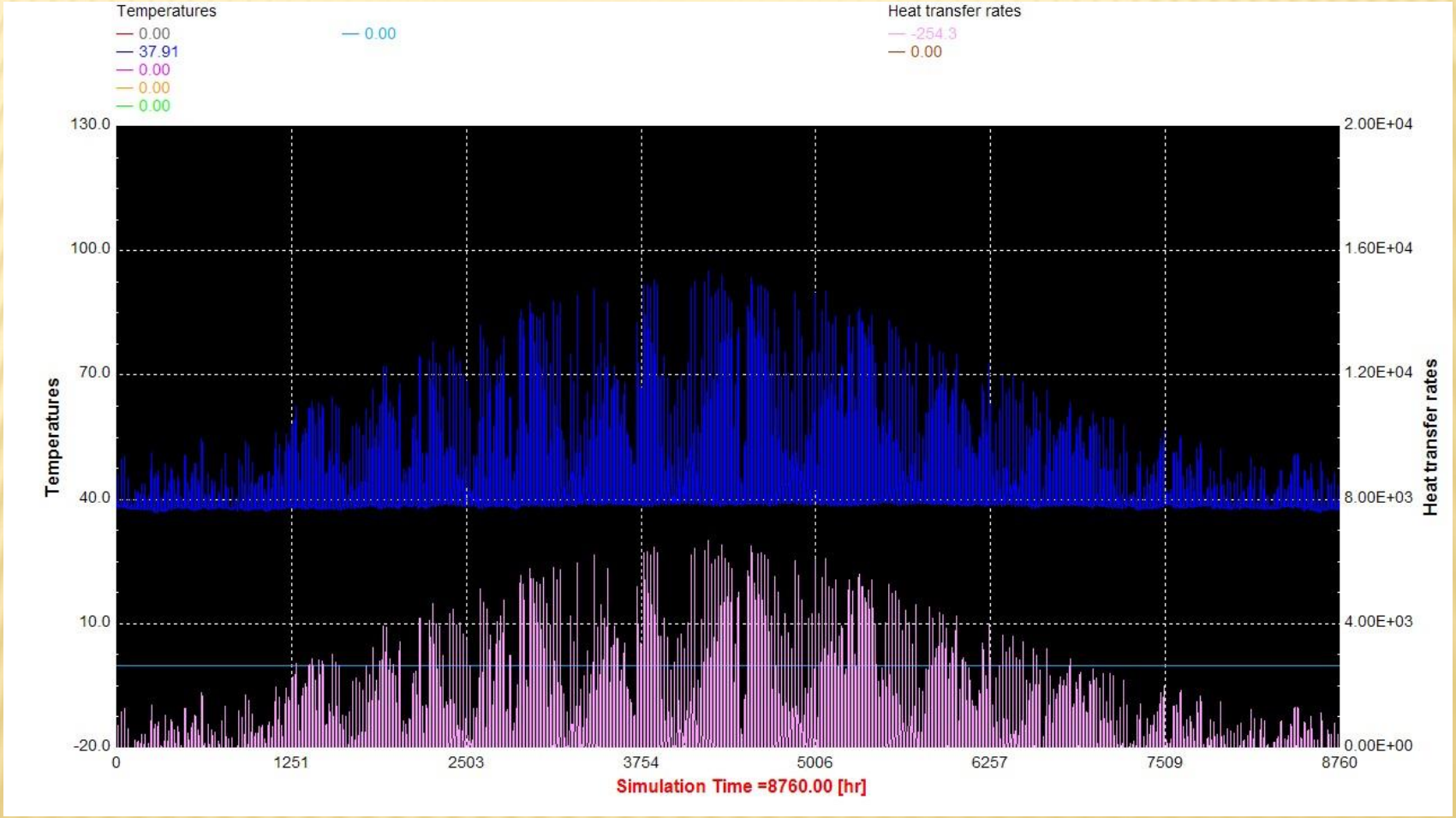
INFLUENCE OF OPERATING MODE



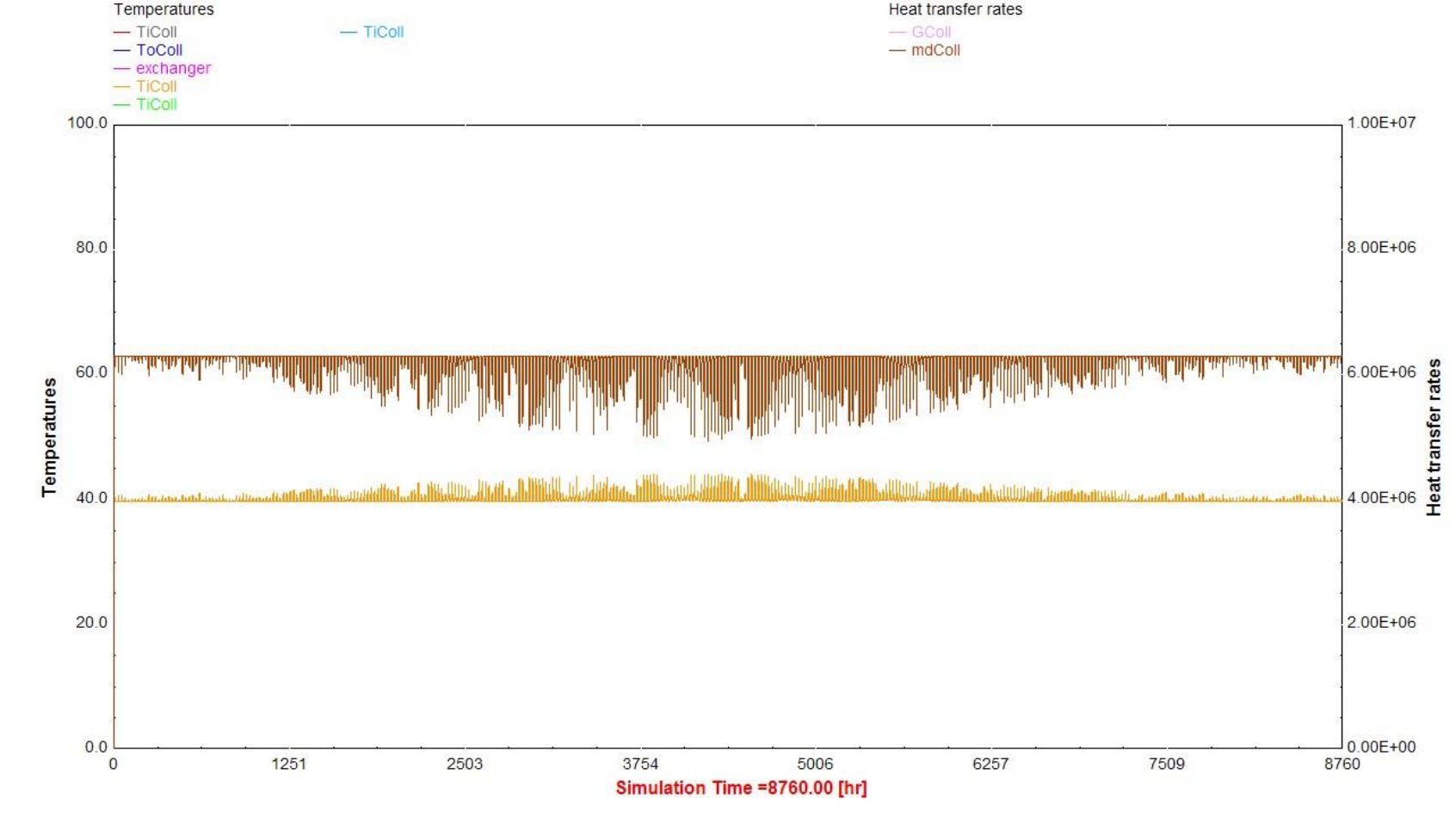
ENERGY SAVINGS PER MONTHS



OUTLET AND OUTSIDE TEMPERATURE FOR ALL YEAR – SIMULATION IN TRNSYS



SAVINGS IN BOILERS FOR ALL YEAR



TECHNO ECONOMIC ANALYSIS

- The calculations are made for total collector surface of 5000 m2 and 8000 m2.
- The heat quantity obtained from the selected collector and from the boiler in the combined system for heat energy production is given by simulation in the programme TRNSYS16.
- Total costs of combined system for heat energy production are calculated as a sum of necessary gas costs and operation and maintenance costs of solar thermal system.

TECHNO ECONOMIC ANALYSIS

- Additional expenses of solar thermo system construction are amounting roughly EUR 145.000.
- In case of previous production of heat energy (operating mode 62/45°C and flow of 300 m3/h of hot water, total collector area of 5000 m2), the achieved savings results show that the most profitable one would be the combined system with solar thermal system and Apricus collector type, whose total investment cost would pay out in 6,29 years.

TECHNO ECONOMIC ANALYSIS

- Likewise, the results have shown that the total investment costs for the solar thermal system with NAU collector type would pay out in 8,77 years, while with Sunmark collector type that period would be 7,50 years. The similar results are for the total collector area of 8000 m2.

REDUCTION OF CO2 EMISSION

- HERE WAS ALSO MADE AN ESTIMATION OF REDUCTION OF CO2 EMISSION.
- THAT EMISSIONS SAVINGS COULD BE CONTRIBUTE TO SHORTER PAY BACK PERIOD.
- EMISSIONS SAVINGS COULD BE PAID FROM THE COUNTRIES WITH CO2 EMISSIONS PROBLEM.

CONCLUSION

- SDH CAN CONTRIBUTED TO ENERGY SAVINGS IN SOME HEATING PLANTS.
- FOR BETTER PERFORMANCES IT IS NECESERY SUPPLY OF DOMESTIC HOT WATER FROM HP FOR ALL YEAR,
- ONLY ENERGY SAVINGS CAN FINANCE SDH APPLICATION – NO FEED IN TARIFE;

CONCLUSION

- SERBIA IS VERY ATRACTIVE FOR SDH APPLICATIONS BECAUSE THERE IS DEVELOPED DISTRICT HEATING SYSTEMS IN OVER 50 CITIES,
- SDH REDUCED CO2 EMISSIONS,
- NEW BUSSINES MODELS ARE ATRACTIVE FOR SERBIA,

CONCLUSION

- Simulation is made for combined system for DHW production for two collector areas: **5000 m2 and 8000 m2** during summer operating mode of Heating Plant Cerak.
- Three possible operating modes of combine system have been analyzed for the specified heat capacity of 6 MW.

CONCLUSIONS

- Simulation shows that gas savings are proportional to collector area, since significant advantages from solar radiation can be obtained during summer season.
- In accordance with type of collector and its operating mode, gas savings are ranging from 7,58% to 17,89%.
- Investment can be paid out in period between **5,2** and **8,8 years** depending on collector type and operating mode of combined system.

THANKS FOR ATTENTION

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