INTEGRATION OF RENEWABLE SOURCES OF THE THERMAL ENERGY IN CENTRALIZED DISTRICT HEATING SYSTEMS OF ORADEA MUNICIPALITY

A. C. BLAGA, University of Oradea, Universității no.1, Oradea, Romania cblaga@uoradea.ro, M. ROSCA, University of Oradea, Universității no.1, Oradea, Romania, mrosca@uoradea.ro, E. GLIGOR, University of Oradea, Str. Barbu Stefanescu Delavrancea nr. 4, Oradea, Romania, gligoremil13@yahoo.com, C. Panea, University of Oradea, Universității no.1, Oradea, Romania, pcrina@uoradea.ro

Abstract The thermal energy in municipality of Oradea is produced mainly by burning fossil fuels and natural gas. The limited reserves of fossil fuels worldwide and the negative environmental impact, leads to importance of careful analyzes regarding the renewable energy sources integration in the thermal energy producing of Oradea. The paper identifies the potential of renewable energies in area of Oradea and proposes principles of integration in thermal energy producing system.

Key words: renewable energy, thermal energy, biomass, geothermal, pollution, fossil fuels

1. THERMAL ENERGY NEEDS OF ORADEA MUNICIPALITY

At present in Oradea municipality are fed approximately 57,000 residential apartments from centralized system, 3,600 particular houses, 319 public institutions and 2,400 other consumers and economic agents. The number of served residents from the centralized system is 141,000. The most part of thermal energy acquisition is made by the habitants of Oradea (above 75% from the total consumption), the population become thermal energy as heat carrier – hot water for heating and to prepare the warm water for the whole year. The social – cultural institutes and of state administration have a lower weight, 12% respectively from the total. The same weight has also the commercial societies. In 2008, for consumers of thermal energy in Oradea municipality, where used 661,192 MWh / year, from which 500,367 MWh/year for heating and 160,825 MWh / year for domestic hot water.

In the last years the development in an accelerate rhythm of residential and industrial zones near Oradea, requires a careful analyzes of the consumers. It will take into account the estimations for the next 20 years (period 2009 – 2029), regarding the development in this area. The town Hall of Oradea Municipality in his master Plan of supplying with thermal energy, realized the following estimations regarding to enclose new consumers in 2009, 2012, 2013, and 2015, total 19.5 Gcal / h (22.7 MWt), that is based on real data (started and still unfinished homes and social culture endowment, or with high degree of realization). Also, in 2024 is considered to take consumers from the new created metropolitan zones, total of 6.3 Gcal / h (7.3 MWt), but only that consumers that are situated at maximum 6 km from de central, and 30% percentage from the possible consumers.

Thus, according to agree with Hall Oradea, in period of 2009 – 2029, there are taken into account the following new consumers:

- 2009 – an approximate increases with 3162 Gcal / yr;
- 2029 - an approximate increases with 2056 Gcal / yr;
- 2-13 - an approximate increases with 23330 Gcal / yr;
- 2024 – taken of adjacent zones.

It is considering taking over 30% of the population from these areas, resulting an increasing of 17341 Gcal/yr, by:

- Zone of Bors with approximate 419;
- Zone of Santandrei with approximate 477;
- Zone of Paleu with approximate 198;
- Zone of Episcopia Bihor with approximate 240.

In 2009 – 2029 the required thermal energy by the consumers has an increase of approximate 8%. This evolution is the result between the required increases due to the new connected consumers, that would lead to an increasing of 12% approximate, and reducing of consume due to the buildings thermal rehabilitation.

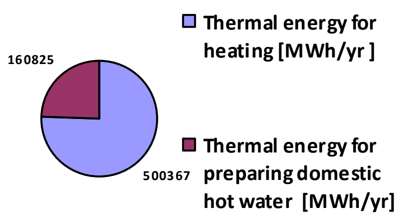


Fig.1 – Distribution of thermal energy consumption by the population of Oradea municipality in 2008

ISSN 2067 – 5534 © 2010 JSE

2. ACTUAL SITUATION REGARDING THE THERMAL ENERGY PRODUCING IN ORADEA MUNICIPALITY

In present, Oradea is supplied with thermal energy produced from four primary sources – coal lignite, natural gases, geothermal fluid, and biomass – wood -, which covers the whole requirements for heating and domestic hot water preparation.

Regarding the supply with thermal energy of the populations, the highest weight has SC Electrocentrale SA with approximate 70% operating on lignite and natural gases and delivers thermal energy into the centralized network of Oradea municipality.

A percentage of approximate 25% of the population produces local the thermal energy, through proper centrals with small capacities as primary sources having solid fuels or natural gas.

SC Transgex SA injects in the centralized system 5% of the total thermal energy mainly for production of hot water, in some case using also natural gases, aiming to satisfy the required parameters by the thermal agents through the consumers needs.

3. CENTRALIZED SYSTEM OF SUPPLYING WITH THERMAL ENERGY OF ORADEA MUNICIPALITY

The centralized system of thermal energy production for Oradea has the following basic components:

- Thermal energy production by CET I, and by the geothermal wells under the management of SC Transgex;

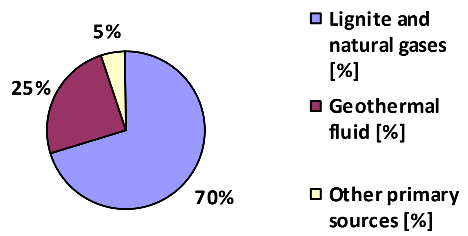


Fig.2 – Primary sources of thermal energy in 2008

- Primary thermal networks assures the thermal energy transfer between primary and secondary carriers;
- Secondary thermal networks – assures the thermal energy distribution to final consumer;
- Final consumer.

The produced thermal energy in the source (primary carrier) as hot water is transferred through primary thermal networks, to the heating points. At heating points takes place the exchange of heat between primary and secondary carrier, distributed through secondary thermal networks to the final consumers.

The centralized system from Oradea municipality has:

- A cogeneration source with two installations operating on natural gases and on lignite;
- Transport networks of 77 km;
- 146 thermal points;
- Distributed networks of 426 km pipelines;
- The system supplies with thermal energy 473 small thermal points through direct connection of transportation network;
- The operator of centralized system is SC Electrocentrale Oradea SA.

The scheme of actualized centralized system to supply with electric energy the municipality of Oradea is given in figure 3.

3.1. Oradea regarding its climate

The software Retscreen allows to identify the interest zone and to satisfy the characteristics regarding the climate. From climate analyze realized with software RETscreen (fig.4), results, that Oradea is situated in a geographic zone that imposes heating in period November – March and cooling in June – September.

Actually, in Oradea doesn't exist centralized cooling.

Regarding the maximum temperatures in the summer, respectively, the increased thermal comfort of the consumers, it is required a careful analyze regarding the possibility of centralized cooling (urban) of homes. In present, cooling is rare and individual realized, in most cases with air – air heat pumps as source of heat is used the ambient air source. These systems have some disadvantages, because in this period the air has the highest temperature, fact that defines relative low energy efficiency. The phonic and esthetic pollution must not be neglected. The cooling, in most cases, is realized using as secondary carrier also the air through a forced convection, but it creates another discomfort. All these, leads to a careful analyze regarding the future of thermal comfort and the necessity to study the heating and cooling system of Oradea.

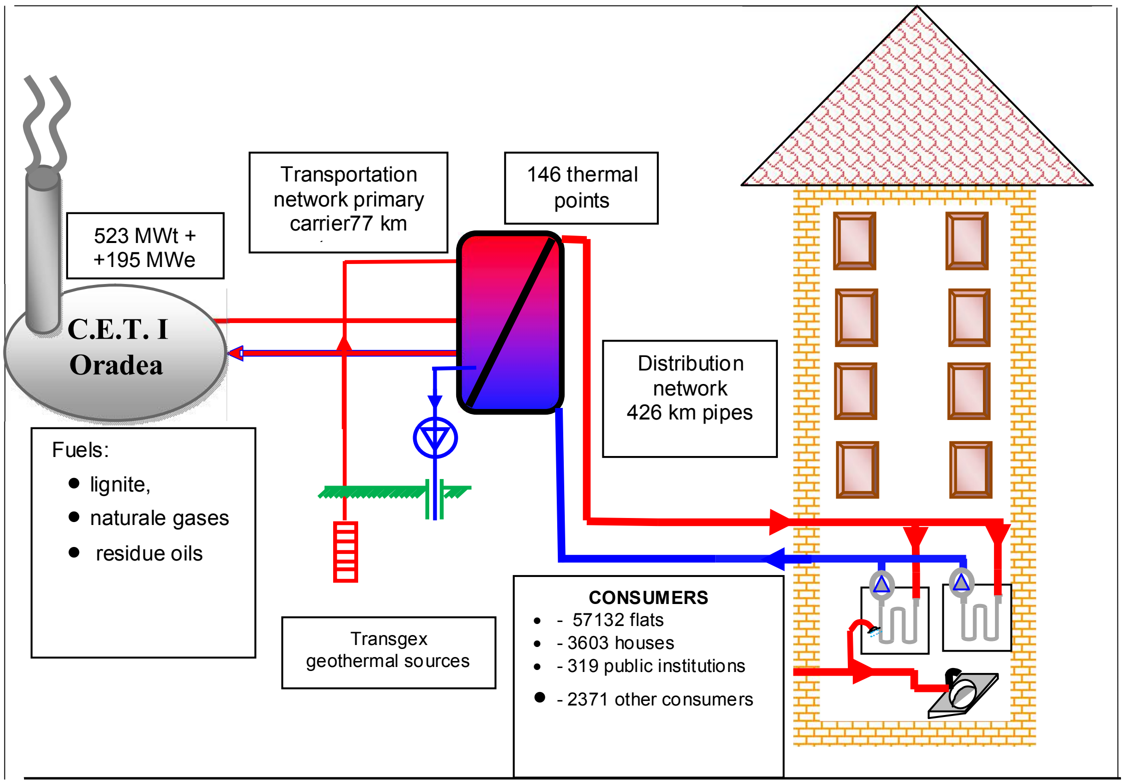


Fig. 3 – Centralized system of supplying with thermal energy

Climate data location: Oradea

Show data ☑

	Unit	Climate data location	Project location
Latitude	°N	47.1	47.1
Longitude	°E	21.9	21.9
Elevation	m	140	140
Heating design temperature	°C	-10.8	
Cooling design temperature	°C	30.6	
Earth temperature amplitude	°C	21.2	

Month		Air temperature	Relative humidity	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days	Cooling degree-days
		°C	%	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
January		-0.9	89.0%	1.25	99.3	2.8	-2.3	583	0
February		0.5	83.2%	2.12	99.1	2.9	-1.0	490	0
March		5.3	76.1%	3.17	99.0	3.1	4.4	394	0
April		11.0	72.8%	4.37	98.6	3.2	11.7	210	30
May		16.3	72.6%	5.35	98.7	2.7	17.9	53	195
June		18.7	75.1%	5.67	98.7	2.4	21.2	0	261
July		21.1	72.0%	5.66	98.7	2.2	23.9	0	344
August		20.8	72.6%	5.05	98.8	2.0	23.8	0	335
September		16.2	77.6%	3.69	98.9	2.3	18.3	54	186
October		11.2	80.0%	2.35	99.2	2.2	11.7	211	37
November		4.2	85.5%	1.33	99.1	2.4	4.1	414	0
December		0.1	89.2%	0.98	99.3	2.7	-1.0	555	0
Annual		10.4	78.8%	3.42	98.9	2.6	11.1	2,963	1,388
Measured at	m					10.0	0.0		

Fig. 4 – Meteorological data that characterizes Oradea aiming to calculate the need of thermal energy for heating and cooling

4. THE RENEWABLE RESOURCES POTENTIAL IN ORADEA MUNICIPALITY

The renewable sources which characterizes Oradea municipality, identified till now with high potential, according to Romanian Agency for Energy Conservation - 2006 (ARCE) are:

- Geothermal energy;
- Solar energy;
- Biomass.

Geothermal energy

Oradea municipality and its zone have significant geothermal energy. The geothermal deposit of Oradea is in concession by Society Transgex SA, estimated to have a potential of 100,000 Gcal/yr. From this potential it is used

ISSN 2067 – 5534 © 2010 JSE

only 47%, other part is in conservation or isn't made investment for exploitation.

Solar energy

Oradea municipality presents a relative high potential, localized in zone II of solar radiation, characterized by a solar radiation intensity of 1150 – 1250 kWh/m^2, and an average annual insulation of 1650 – 1800 m hours.

Biomass

Biomass may be considered a serious alternative for fossil fuels in Bihor County, as an unexploited potential also as the possibility to cultivate biomass with high calorific power.

4.1. Integration solutions of renewable resources to produce thermal energy in centralized system

The integration of energy sources in the centralized source is made in function with the type of enthalpy that characterizes the thermal agent. According to the diagram fig. 5, there are five levels of enthalpy that may be utilized in producing, transport and distribution of thermal energy used for heating.

Utilization of solar energy

Producing the thermal energy from the sun, may be realized only to prepare domestic hot water, because in winter for the geographical zone of Oradea the insulation level doesn't justify investments to produce thermal energy from solar source for heating of flats.

The thermal energy that may be produced through conversion of solar energy in thermal energy, in zone of Oradea it has medium – low enthalpy. In this interval, utilizing for modeling the RETscreen software, may be assessed the required thermal energy to prepare domestic hot water for 60,000 flats in Oradea municipality.

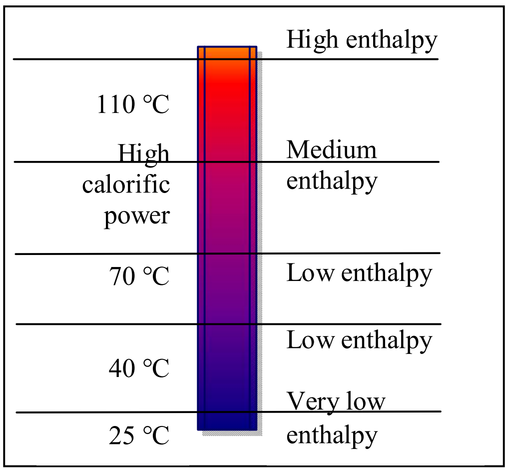


Fig.5 – Enthalpy characteristics of heat carriers

The required thermal energy to prepare the domestic hot water obtained by RETScreen, is 162,784 MWh/yr, energy, that may be produced using 76,556 sun collectors of Glazed type, with characteristics given in figure 6. The occupied total surface by captures is 176,644 m^2, with a capacity of 92,700 kW. This surface resulted after selection of solar capture type which characteristics are given by the manufacturer. The solar captures surface may be variable in function with the type and efficiency of its. Fixed plane captures were chosen with orientation toward South at 45^o. The domestic hot water temperature is 55^{o}C, enough temperature taking into account the thermal energy losses due to its transportation that are relative low because the captures are placed near the consumers.

The solar systems for producing domestic hot water needs to storage with high capacity the heat, allowing delivering warm water when the insulation is low or zero. The thermal energy is produced at level of thermal points. The thermal points must be equipped with gas or electric heaters, to may produce thermal energy when appears insulation decreases more under the estimated average value.

In figure 6, are given the results obtained by using of RETScreen software, after mathematical modeling of warm water preparation for Oradea municipality.

4.2. Utilization of geothermal energy from domain of medium and high enthalpy

This renewable resource is very simple to integrate in the centralized system. In present, at Oradea are 12 drillings, 11 for production and 1 for injection. The drillings have a total debit of 150 l/s. Since 1996 some drillings were equipped with submersible pumps at deep of 120 – 150 m, assuring to increase the exploited debit. The temperature of geothermal water is (70 – 106)^{o}C.

To estimate the available resources grows to 244,000 MWt / yr, according to exploitation license owners. This value must be corrected with the given limits by boring technologies and by regeneration capacity of exploitable perimeter.

From the utilized annual quantity, for the district urban heating are utilized approximate 54,651 MWt / yr as:

- Approximate 36,046 MWt / yr produced and distributed by SC Transgex SA;
- Approximate 18,604 MWt/yr – taken by SC Electrocentrale Oradea SA from SC Transgex SA and distributed through the distribution system.

For the future, it is estimated by SC Transgex the thermal energy production in medium – high enthalpy an annual quantity of thermal energy of approximate 200,000 MWt, representing 40% of required thermal energy for Oradea. This domain of medium and high enthalpy requires producing thermal energy from geothermal fluids, with return temperature of geothermal water of 60^{o}C; this is the temperature of water with now the water is discharged in Peta brook.

4.3. Utilization of geothermal energy from domain of low and medium enthalpy

The actual configuration of the centralized supplying heating system for Oradea has forked type, closed double tube system.

The system of heat carrier of Oradea municipality is a complex system. It contains 6 buses from which only one goes direct from the center of the city, ramifying in 3 buses:

M1 (9 km), M2 (6 km) and M3 (2.7 km). In the weight center of the city, from the branches ramifies other 3 buses (M4, M5, M6) through system of sectioning valves and intersection leg. The thermal point's supplying may be realized with many configurations through different maneuvers of section valves.

The 6 main buses and district heating connections have a total length of 77.04 km. They are placed in most cases underground (approximate 68.1 %) in concrete sewer as the others in the air (31.9 %).

The distribution networks have radial configuration with consumers grouped in branches compounding from 3 pipes, 2 pipes for turn / return heating 1 pipe for domestic hot water.

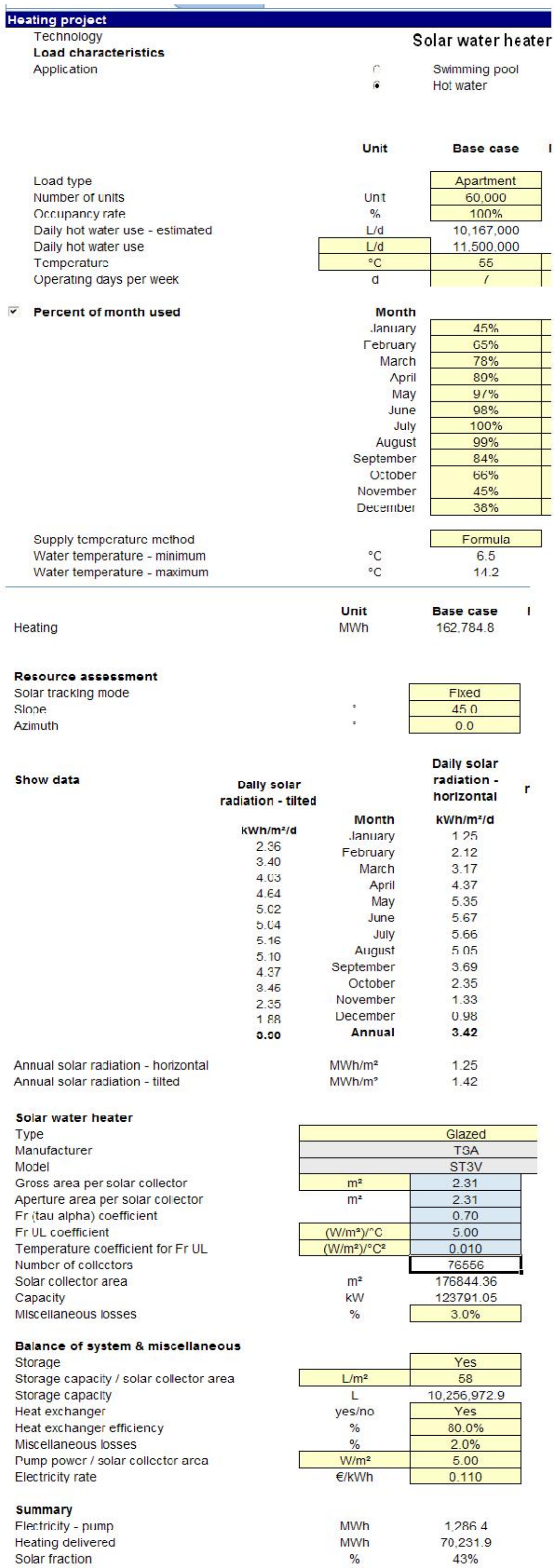
The secondary thermal network has a length of 142.456 km, from which 426 km are pipes with diameter of Dn 200 and Dn 40.

Taking into account the advanced state of wear of the pipes, it is foreseen to change the secondary buses and of heaters which are mostly iron radiators. If it is considered the geothermal fluid yield estimated by SC Trangex SA that may be exploited from Oradea deposit from domain of low and medium enthalpy may be estimated an approximate production of 200,000 MWt / yr, being 40% from required thermal energy for residential heating.

The possibility to use this type of thermal energy of low enthalpy, are required a series investment to final consumers. It is necessary to grow the insulation of secondary network, also, at flats the total changing of woodworks respectively, the enveloping of buildings. The main investments are necessary to new dimensioning of secondary circuit's and of heating radiators, changing the actual systems with low enthalpy thermal energy delivering capacity. The principal features of new heating radiators are given by a forced thermal convection or by an increased radiant surface in comparison with classical radiators by floor heating, radiant panels on the ceiling, etc.

The heat carrier of low enthalpy may be used by thermal point by direct deliver to consumer or by bus through heating of returning water.

These investments may be encouraged by lowering the price for Giga calories obtained from medium and low enthalpy. It is recommended that the price for a Giga calorie to be established so that the investment in a period of maximum 5 years.



Heating project

	Unit	Base case
Technology		Solar water heater
Load characteristics		
Application		Swimming pool / Hot water (selected)
Load type		Apartment
Number of units	Unit	60,000
Occupancy rate	%	100%
Daily hot water use - estimated	L/d	10,167,000
Daily hot water use	L/d	11,500,000
Temperature	°C	55
Operating days per week	d	7

Percent of month used	Month	
	January	45%
	February	65%
	March	78%
	April	80%
	May	97%
	June	98%
	July	100%
	August	99%
	September	84%
	October	66%
	November	45%
	December	38%

	Unit	Base case
Supply temperature method		Formula
Water temperature - minimum	°C	6.5
Water temperature - maximum	°C	14.2
Heating	MWh	162,784.8
Resource assessment		
Solar tracking mode		Fixed
Slope	°	45.0
Azimuth	°	0.0

Show data

Daily solar radiation - tilted (kWh/m²/d)	Month	Daily solar radiation - horizontal (kWh/m²/d)
2.36	January	1.25
3.40	February	2.12
4.03	March	3.17
4.64	April	4.37
5.02	May	5.35
5.04	June	5.67
5.16	July	5.66
5.10	August	5.05
4.37	September	3.69
3.46	October	2.35
2.35	November	1.33
1.88	December	0.98
0.00	**Annual**	**3.42**

	Unit	Base case
Annual solar radiation - horizontal	MWh/m²	1.25
Annual solar radiation - tilted	MWh/m²	1.42
Solar water heater		
Type		Glazed
Manufacturer		TSA
Model		ST3V
Gross area per solar collector	m²	2.31
Aperture area per solar collector	m²	2.31
Fr (tau alpha) coefficient		0.70
Fr UL coefficient	(W/m²)/°C	5.00
Temperature coefficient for Fr UL	(W/m²)/°C²	0.010
Number of collectors		76556
Solar collector area	m²	176844.36
Capacity	kW	123791.05
Miscellaneous losses	%	3.0%
Balance of system & miscellaneous		
Storage		Yes
Storage capacity / solar collector area	L/m²	58
Storage capacity	L	10,256,972.9
Heat exchanger	yes/no	Yes
Heat exchanger efficiency	%	80.0%
Miscellaneous losses	%	2.0%
Pump power / solar collector area	W/m²	5.00
Electricity rate	€/kWh	0.110
Summary		
Electricity - pump	MWh	1,286.4
Heating delivered	MWh	70,231.9
Solar fraction	%	43%

Fig. 6 – Mathematical modeling of solar energy conversion in thermal energy to prepare domestic hot water in Oradea municipality

ISSN 2067 – 5534 © 2010 JSE

4.4. Utilization of geothermal energy from domain of low and very low enthalpy

To may utilize thermal energy for heating from this domain of enthalpy, it is required to integrate some heat pumps batteries of water-water type. Also, are necessary investments by the final consumers, of thermal envelope and changing of radiators so that to may be utilizing thermal energy from heat carrier of low enthalpy (fan convectors, radiant panels, floor heating, etc.)

By descending the temperature of geothermal fluid, till 4°C, may be obtained yearly approximate 100,000 MWt h, representing 20% from required thermal energy for heating. Viewing the investments the implementation of this solution is most expensive it is the highest advantage because the same system with heat pumps for heating allows in summer also the cooling of homes in centralized system. Using RETScreen software may be modeled the covering of the 200,000 MWth requirements. The mathematical modeling is given in figure 7

Project information — See project database

Project name	Energie termica pentru preparare acm Oradea Romnia
Project location	România
Prepared for	CIE 2010
Prepared by	Blaga Casian
Project type	Combined heating & cooling

Base case heating system — Multiple buildings - space heating
See technical note on heating network design

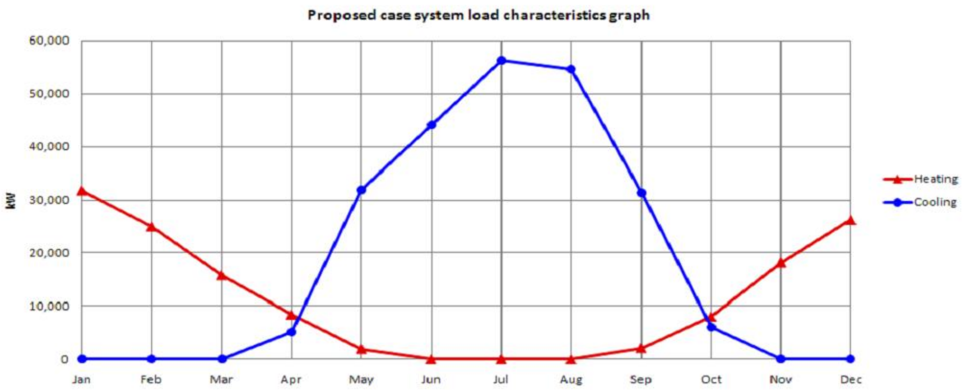
	Unit		Building clusters 1
Heated floor area per building cluster	m²	720,000	720,000
Number of buildings in building cluster	building	12,000	12000
Fuel type			Coal
Seasonal efficiency	%	-	78%
Heating load calculation			
Heating load for building cluster	W/m²	-	75
Domestic hot water heating base demand	%	0%	
Total heating	MWh	105,651	105,651
Total peak heating load	kW	54,000	54,000

Base case cooling system — Multiple buildings - space cooling
See technical note on cooling network design

	Unit		Building clusters 1
Cooled floor area per building cluster	m²	720,000	720,000
Number of buildings in building cluster	building	12,000	12000
Fuel type			Coal
Coefficient of performance - seasonal		-	70.00
Cooling load calculation			
Cooling load for building cluster	W/m²	-	145
Non-weather dependant cooling	%	0%	
Total cooling	MWh	181,047	181,047
Total peak cooling load	kW	104,400	104,400

Proposed case load characteristics

Cooling average load kW	Heating average load kW	Month	Cooling system load kW	Heating net average load kW
0	31,725	January	0	31,725
0	24,938	February	0	24,938
0	15,716	March	0	15,716
5,068	8,400	April	5,068	8,400
31,928	1,944	May	31,928	1,944
44,091	0	June	44,091	0
56,254	0	July	56,254	0
54,734	0	August	54,734	0
31,421	2,093	September	31,421	2,093
6,082	8,033	October	6,082	8,033
0	18,113	November	0	18,113
0	26,179	December	0	26,179
104,400	54,000	Peak load - annual	104,400	54,000



Proposed case load and energy — Heating — Cooling

Fig. 7 – Mathematical modeling of low and very low geothermal energy conversion]nti thermal energy for heating

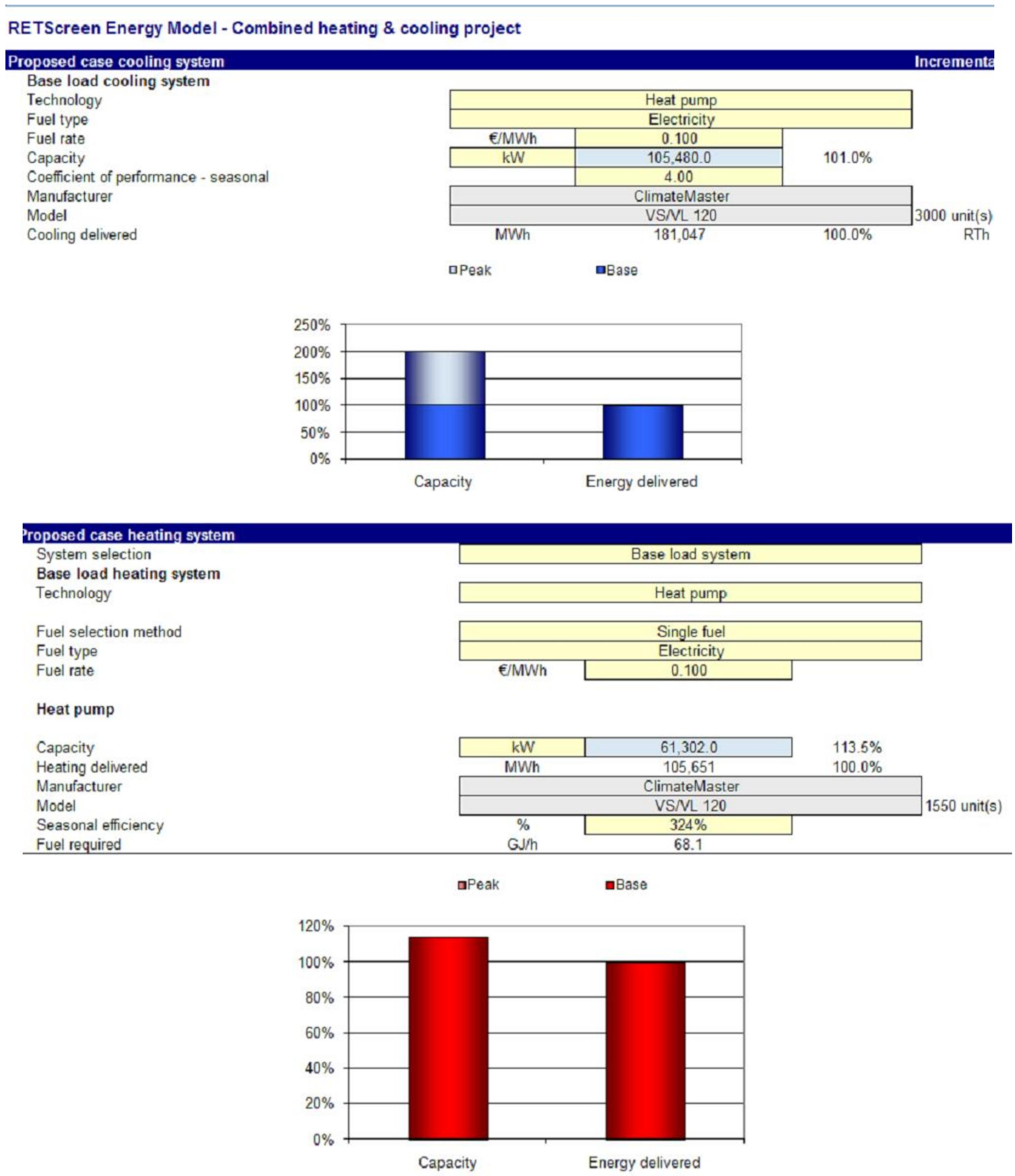


Fig. 8 – Heat pumps dimensioning for low enthalpy geothermal energy conversion into thermal energy

4.5. Utilization of thermal energy from biomass

All forms of renewable energy are limited in capacity, and solar energy is variable regarding for a year. To may assure the required safety level for a centralized system, it is necessary to over dimension the system with 25%, to cover the required thermal energy for Oradea municipality.

The thermal energy needs to cover the top loads for spatial heating and also for domestic hot water preparing, is recommended to be produced from biomass burning. The produced biomass, must cover the maximum values of load for heating, and must have capacity to produce at a moment the whole quantity of hot water for Oradea. In the cold periods, when the level of solar radiation is very low, many consecutive days the thermal capacity to prepare domestic hot water must taken from the conversion system with biomass.

ISSN 2067 – 5534 © 2010 JSE

See technical note on heating network design			Building clusters
			1
Heated floor area per building cluster	m²	70	70
Number of buildings in building cluster	building	60,000	60000
Fuel type			Biomass
Seasonal efficiency	%	-	95%
Heating load calculation			
Peak process heating load	kW	18346.0	18346.0
Process heating load characteristics		Standard	
Equivalent full load hours - process heating	h	8,760	8,760
Total heating	MWh	160,711	160,711
Total peak heating load	kW	18,346	18,346
Fuel consumption - unit		-	t
Fuel consumption - annual		-	33,019

Fig. 9 – Mathematical modeling of thermal energy production using as fuel the biomass

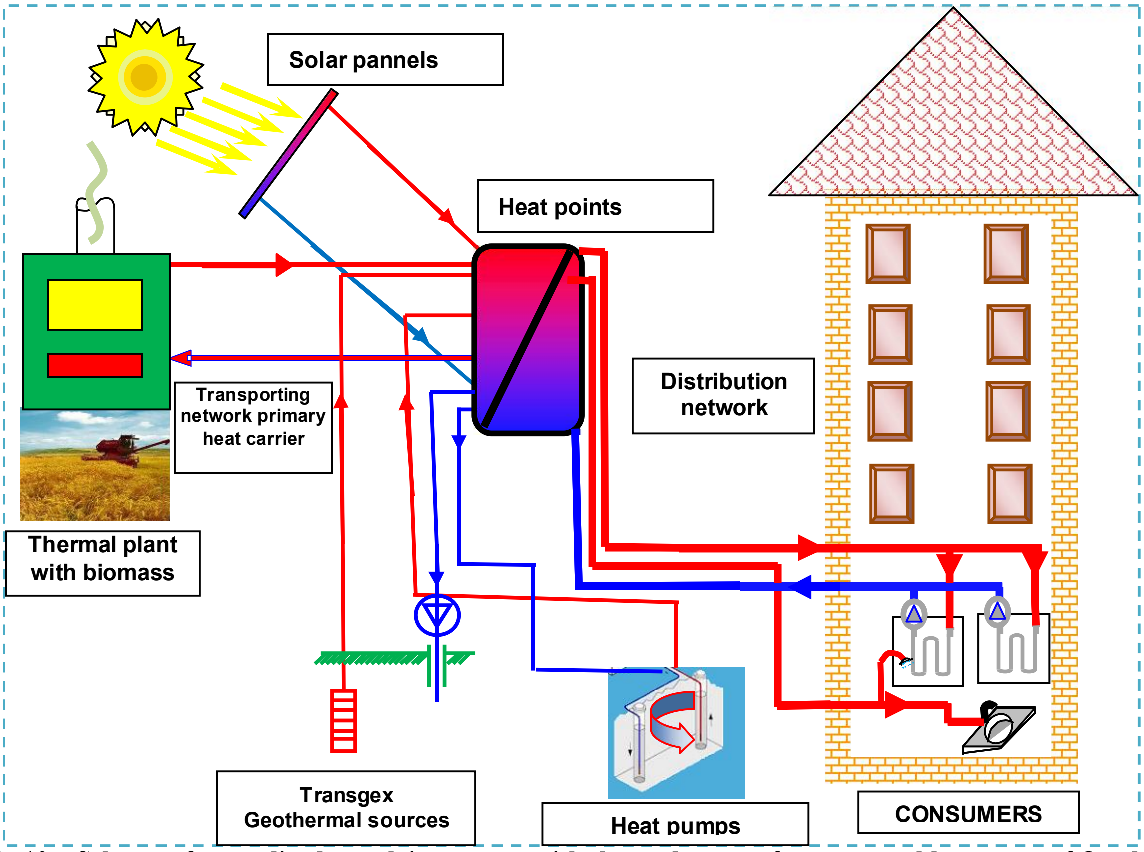


Fig 10 – Schema of centralized supplying system with thermal energy from renewable sources of Oradea municipality

The centralized system of thermal energy production for Oradea from renewable energy has the following basic components:

- The source of thermal energy production by conversion of solar energy into thermal energy to prepare domestic hot water;
- The source of producing thermal energy by the heat recovering from the geothermal fluid with low and very low enthalpy using heat pumps;
- Source to produce thermal energy by burning of biomass;
- Primary thermal networks that assures the thermal energy transfer between the primary and secondary heat carriers;
- Secondary thermal networks – assures the distribution of thermal energy to final consumers;
- Final consumer.

The thermal energy produced from renewable energy is transferred through primary thermal networks to the thermal points then, they are transported through secondary networks to the final consumers.

By thermal points is necessary to introduce a supplementary secondary circuit of low enthalpy, for consumers that may use this type of energy. The thermal energy with low enthalpy may be utilized by consumers and may be injected in primary circuit's return in function with the supplied consumers. The return of primary circuit may take thermal energy of low enthalpy only in zone where the temperature between the heat carrier and the obtained temperature allows a temperature difference between primary heat carrier and obtained temperature at the turn of the circuit renewable energy system. The thermal plant on biomass must transfer the thermal energy of high enthalpy so that by thermal points to exist the possibility to maintain the thermal parameters between the established limits in period of high load. The high load is imposed by the extern temperature and unfavorable meteorological conditions in period of 72 hours.

4.6. Impact on the environment

The actual activity of producing, transport and distribute the thermal and electric energy, has significant negative impact on the environment by the following elements.

- Generation of pollutant emissions resulted from the fossils burning. By burning of lignite are resulted emission of SO_2, NOx and dusts, as by burning of natural gases are generated emissions of NOx.
- Generation of wastes (slag and ash removal from lignite);
- Generation of gases by burning of fossil fuels with greenhouse effect (CO_2), contributing to global warming growing.

Due to the low global efficiency of thermal energy production in actual installations, these negative effects are amplified. Also, because the high losses of thermal energy in the transport and distribution system in source of consume a supplementary quantity of fuel, leading to pollutant emissions grow of waste quantity and of gases emissions with greenhouse effect.

Regarding the aimed maximum emissions, for 2008 the pollutant quantities substances are greater else the established for all three types of pollutant substances (SO_2, NOx and dusts) for IMA2. For IMA1 emission of NOx is small because the plant had operated in 2008 on coal.

Regarding the concentration of pollutant substances in the burning gases, these exceed the stabilized VLE for IMA1 and IMA2.

The slag and ash deposit is placed at a distance of 5 km from Crisul River having a surface of 141 ha.

In this deposit are allowed to be stored the slag and ashes, from the furnaces of steam boiler C4, C5 and C6, the ash dusts from the electro filters and the mud from the clearing of brute water from the station of chemical treatment.

In present, the storage of slag and ashes is realized by mixture with water (one part of slag and ash 9 part of water). This process is allowed till 2013 12. 31, when the slag and ash storage must satisfy the laws of environment, which prohibits this mode of transportation.

In 2008, the pollutant annual substances quantity, were greater as the established one for all three pollutant substances (SO_2, NOx and PM) for IMA2, as:

- SO_2: with31,8%
- NOx: with 19,6%
- Dust: with 34,7%

The yearly IMA1 maximums weren't exceeded because in 2008 the plant had operated on coal.

Regarding the pollutant substances concentration in the burning gases, these exceed the established VLE for IMA1 and IMA2, as:

- NOx (IMA1): 2 times
- SO_2 (IMA2): 19,5 times
- NOx (IMA2): 3,5 times
- Dust (IMA2): 14 times

For IMA emissions has affect on the population.

The sources of renewable energies have pollutant degree much smaller as the actual system.

The thermal energy producing from solar energy in exploitation is a pollutant factor only aesthetically point of view. It may be recalled pollution created by solar equipment manufacturer.

The exploitation of geothermal energy from deposits in correct conditions doesn't have any pollution degree. In utilization of geothermal energy, the concept of pollution occurs only in drilling operations and re-injection wells. The pollution appears due to geologic layers penetration with drilling gasket, till contacting the geothermal fluid. The pollutant effects are given by mixture of different level groundwater, as on the other hand by contamination of drilling zones with mud which is inoffensive for the environment, as compound elements having water, rocks of different geological era that assures to the bore the necessary density and stabilize the walls of the bore.

To produce energy from biomass has pollutant effects like the actual system, but it has advantage to be designed and build for actual norms of environment protection.

5. Conclusions

To produce thermal energy from renewable sources may be realized with lower costs as the actual systems for a MWh.

The total energy requirement in 2030 will be approximate to be with 50% higher as in 2003, as for oil with 46% in accordance with a published project of "Energy Information Administration".

The certain reserves of oil may sustain the actual consume only until 2040, as the gases until 2070, the reserves of the coal assures a period above 200 years, if the exploitation level growth. The previsions shows an economic increase that will imply a higher consume of energy resources, as its price will increase because the limited natural deposits global reserves decreases (coals, natural gases, oil), fact that will lead to increase of the prices for MWh_t. Also, the price of energy will be higher due to the imposed taxes for gases with greenhouse effect.

For the buildings thermal networks rehabilitation of, leads to a substantial decreasing of thermal energy requirement for Oradea.

The great investments, necessary to implement alternative mode from renewable sources for actual system of thermal energy producing are justified its low price, the low level of pollutant emission, respectively high safety level of the resources due to those ability to renew.

 ISSN 2067 – 5534 © 2010 JSE

References

[1]. **Gunnarsson A., Helgason Th., Gavriş M., Antal C.** (1996): "University of Oradea. The Geothermal Plant. SCADA System Description", Oradea, 1996.

[2]. **Gavrilescu O.**, (2005): - "Utilization of geothermal energy in industry. Thermal centres". *Oradea*, 2005

[3]. Cataldi R., (1994). "Environment Related Problems and Costs of Geothermal Development, Course Text Books, "Geothermal Energy – District Heating and Industrial Uses", University of Oradea, Romania, pp. 429÷452.

[4]. Rosca, M. (1993). „Economical and Technical Assessment of Some Geothermal Development Scenarios for Oradea, Romania. United Nations University Geothermal Training Programme", Report 13, Reykjavik, Iceland, 44 pp.

[5]. C. Blaga, M. Rosca, *Possible Geothermal District Heating in Sanmartin,* Romania Proceedings World Geothermal Congress 2005 Antalya, Turkey.

Master Plan (MP) privind reabilitarea sistemului de termoficare urbană la nivelul municipiului Oradea pentru perioada 2009-2028 în scopul conformării la legislaţia de mediu şi creşterii eficienţei energetice http://www.oradea.ro/