



Geothermal Energy in Romania

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1. Geothermal resources
2. Geothermal energy utilization
3. Relevant legislation
4. District heating systems
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Geothermal Resources

- Exploration drilling started in the 1960's
- Total: 250 wells \Rightarrow 450 MW_{th}
- Used at present: 80 wells \Rightarrow 180 MW_{th}
- Temperature: 40 – 120°C
- Annual production: 1,235 TJ
- Average load factor: 22% (for wells in use!)
- 7 new wells drilled during 2005 - 2010
- Main uses:
 - District heating
 - Health and recreational bathing
 - Greenhouse heating
 - Fish farming
 - Industrial uses (drying crops, ceramics, timber, etc)



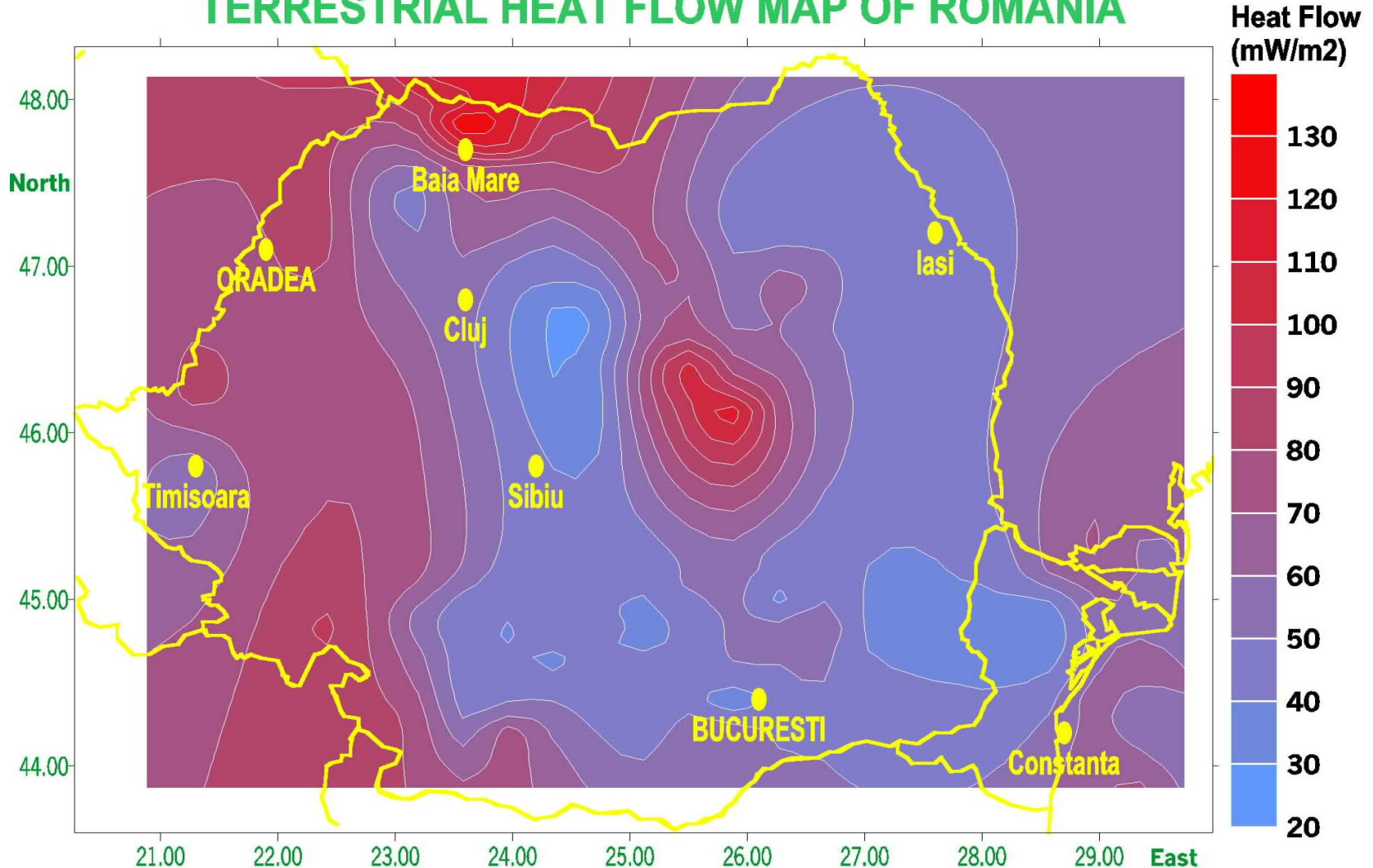
Geothermal Resources





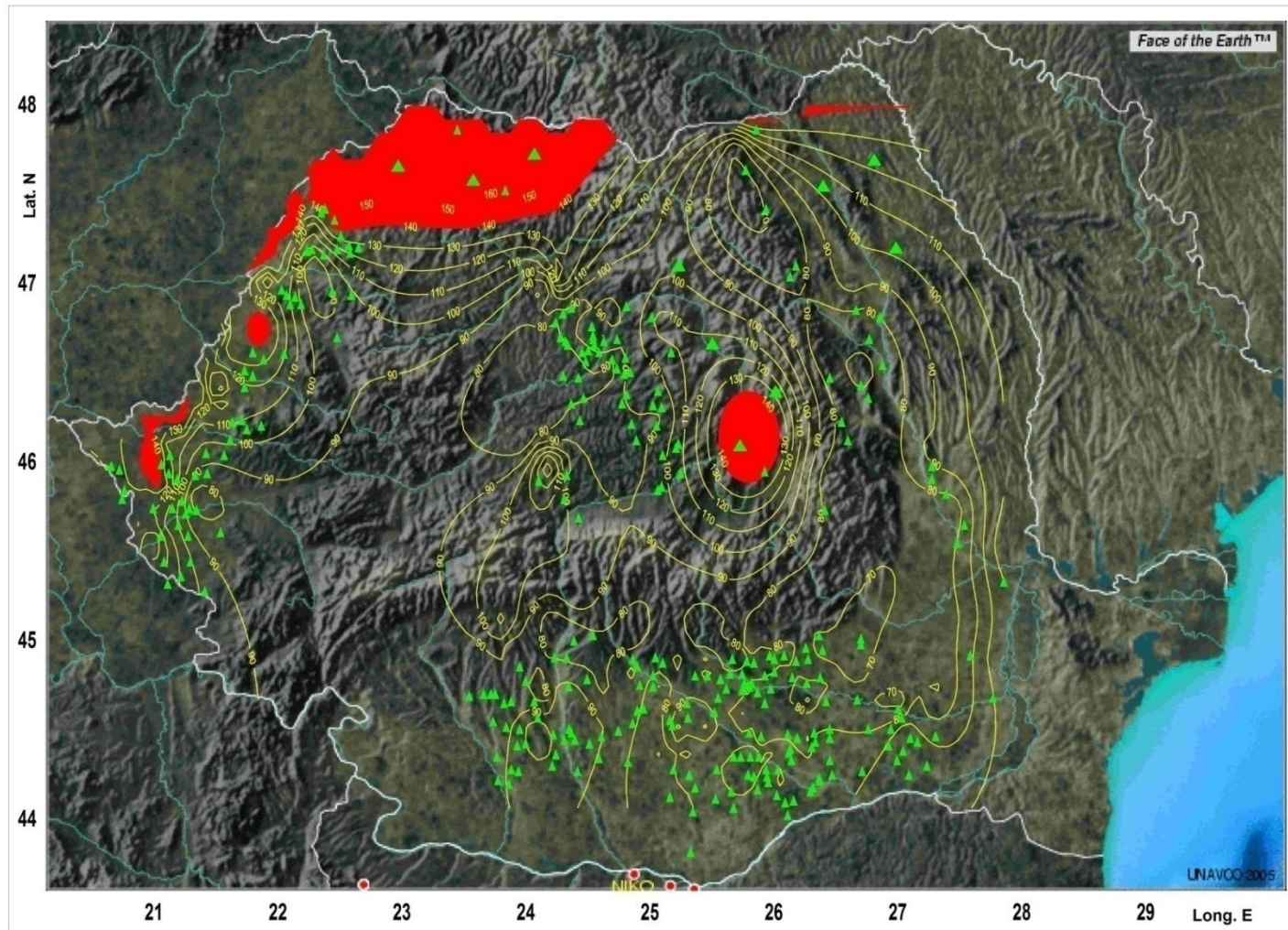
Geothermal Resources

TERRESTRIAL HEAT FLOW MAP OF ROMANIA



By Dr. Eng. Serban Veliciu, 2007

Geothermal Energy Utilization



LEGEND

Wells with thermal logs



Geo-isotherm at 3 km depth



Areas with temperature exceeding 140°C at 3 km depth



Geothermal Resources

Western Romania

Pannonian aquifer

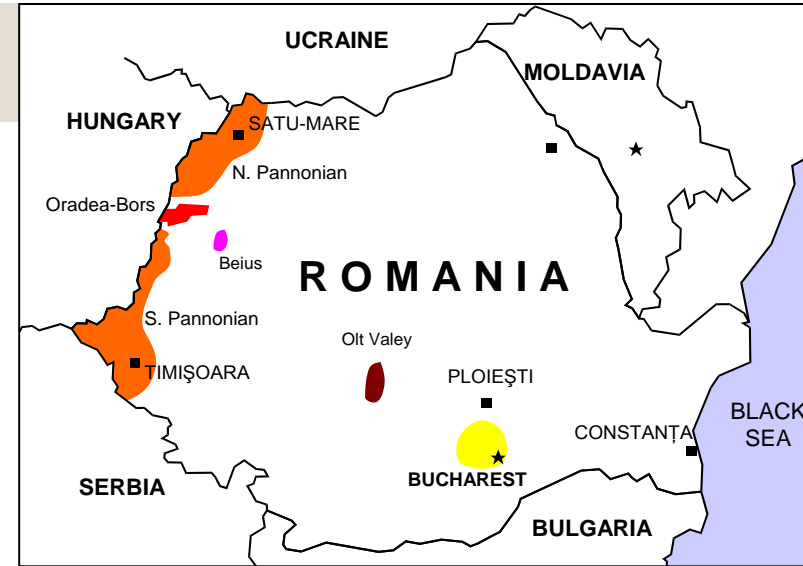
- 2500 km²
- basement Neocene sandstone
- 800 – 2400 m depth
- 50-85°C
- TDS 4-5 g/l, carbonate scale, CH₄

Oradea reservoir (310 l/s recharge)

- 75 km²
- Triassic limestone & dolomites
- 2200 – 3200 m depth
- 70-105°C
- TDS 0.9-1.2 g/l

Bors confined reservoir

- 12 km²
- Triassic limestone & dolomites
- 2500 m depth
- >130°C
- TDS 13 g/l
- 5 Nm³/m³ gas content (70% CO₂, 30% CH₄)
- very high scaling potential



Beius reservoir

- 47 km²
- Triassic calcite & dolomite
- 1870 – 2370 m depth
- 84°C
- TDS 0.5 g/l, CO₂, H₂S traces
- Depth: 2.5 – 3 km

Ciumeghiu reservoir

- 5 MW_{th} potential
- gritstone
- 2200 m depth
- 105°C
- TDS 5-6 g/l, 3 Nm³/m³ CH₄

Geothermal Resources

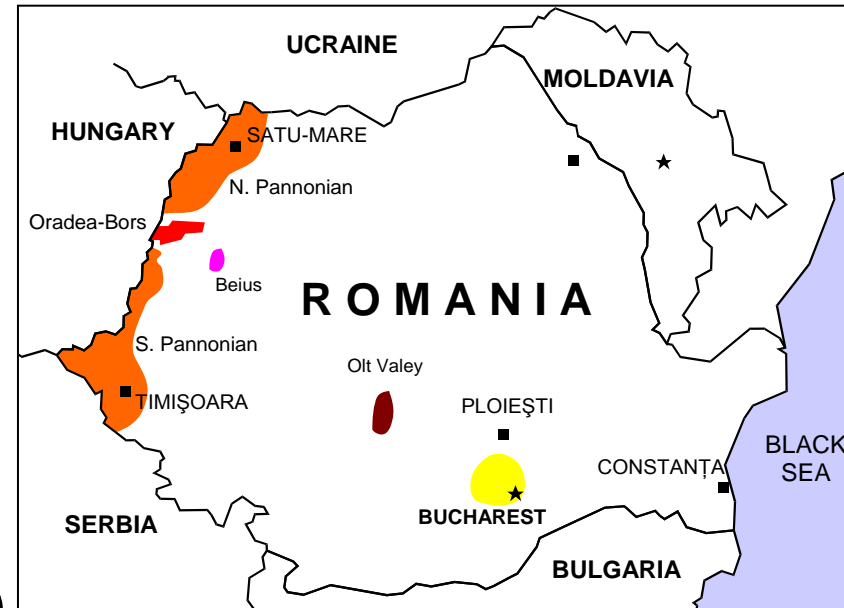
South & central Romania

Cozia-Calimanesti reservoir

- 28 km²
- Senonian siltstones
- 2700 – 3250 m depth
- 70-95°C
- TDS 15.7 g/l
- 1-2 Nm³/m³ CH₄

Otopeni reservoir (North Bucharest)

- 300 km²
- Limestone & dolomites
- 2000 – 3200 m depth
- 58-84°C
- TDS 1.5-2.2 g/l
- 30 ppm H₂S





Geothermal Energy Utilization

**SUMMARY TABLE OF GEOTHERMAL DIRECT HEAT USES
AS OF 31 DECEMBER 2009**

Use	Installed Capacity ¹⁾ (MWt)	Annual Energy Use ²⁾ (TJ/yr = 10 ¹² J/yr)	Capacity Factor ³⁾
Individual Space Heating ⁴⁾	13.28	164.83	0.39
District Heating ⁴⁾	58.95	531.72	0.29
Greenhouse Heating	4.18	20.78	0.16
Fish Farming	4.50	9.70	0.07
Agricultural Drying ⁵⁾	1.40	12.70	0.29
Industrial Process Heat ⁶⁾	0.75	6.84	0.29
Bathing and Swimming ⁷⁾	64.68	489.16	0.24
Subtotal	147.74	1,235.73	0.22
Geothermal Heat Pumps	5.5	?	?
TOTAL	153.24		



Relevant Legislation

- Geothermal water considered mineral resource (by the Romanian Constitution).
- The exploitation geothermal water resources (above 20°C, for any use) is regulated by the **Mining Law** of 1998 (like oil and gas):
 - Royalties have to be paid only on extracted water volume (not for all the resource capacity, as in the old Mining Law), even if re-injected;
 - Executive body – National Agency for Mineral Resources (authorisations, licences, permits, data base).
- Geological Institute of Romania (Geological Survey): geological and geophysical research, data base.
- Energy Department of the Ministry of Economy finances exploration and even drilling new wells (can be leased for exploitation).



Relevant Legislation

- The National Agency for Mineral Resources:
 - Authorises companies to carry out certain activities (exploration, exploitation, research, trade, etc.) related to each specific mineral resource (based on capability to carry out the activities, proven by documents);
 - Awards exploration and exploitation licenses for all mineral resources;
 - Issues regulations;
 - Receives annual reports on resource exploration and mainly exploitation (including “Reserves movement report”), based on which royalties are paid;
 - Has a data base (geological, geophysical, hydro-geological, etc.), available on reasonable fees, but only to authorised companies (public and private).



Relevant Legislation

- Required documents for exploration license (5 years):
 - Perimeter setting study;
 - Resource assessment study;
 - Technical and economic feasibility study;
 - Environmental impact assessment.
- Same documents required for exploitation license, main differences:
 - Concession applied for and awarded for a longer time, usually no less than 20 years;
 - Proposed project is usually larger size, designed to utilise the resource up to its maximum sustainable capacity;
 - All studies are supposed to be more detailed;
 - A very important item: the company applying for the exploitation licence to prove it has the financial capacity to complete the project.



Relevant Legislation

- Surface and ground water regulated by the Water Law (1996, modified in 2004).
- Executive body: National Administration “Romanian Waters”:
 - Issues permits for surface water, ground water wells, and large systems with vertical heat exchangers;
 - Has to only be notified for small systems;
 - Nothing required for horizontal heat exchangers.
- Geothermal energy exploited by ground source heat pumps not assessed in any way (the State has no way of knowing and reporting it).
- The Environment Protection Law (1995, modified in 2006): drilling and exploitation (noise, air and water pollution, storage and disposal of hazardous fluids).



Relevant Legislation

- Electric energy sales:
 - TRANSELECTRICA has to buy all green power;
 - “Price for the next day” fixed by the Romanian Authority for Energy Regulation (ANRE);
 - Green certificates (3 certificates for each MWh) can be sold on the free or regulated market (exchange).

- Thermal energy sales:
 - For a private companies, price fixed by the contract (can be negotiated);
 - For public companies, price has to be approved by the ANRE;
 - For population (district heating – public utility), the price has to be approved by the Local Council, the ANRE, and also by the National Agency for Local Administration Regulation.

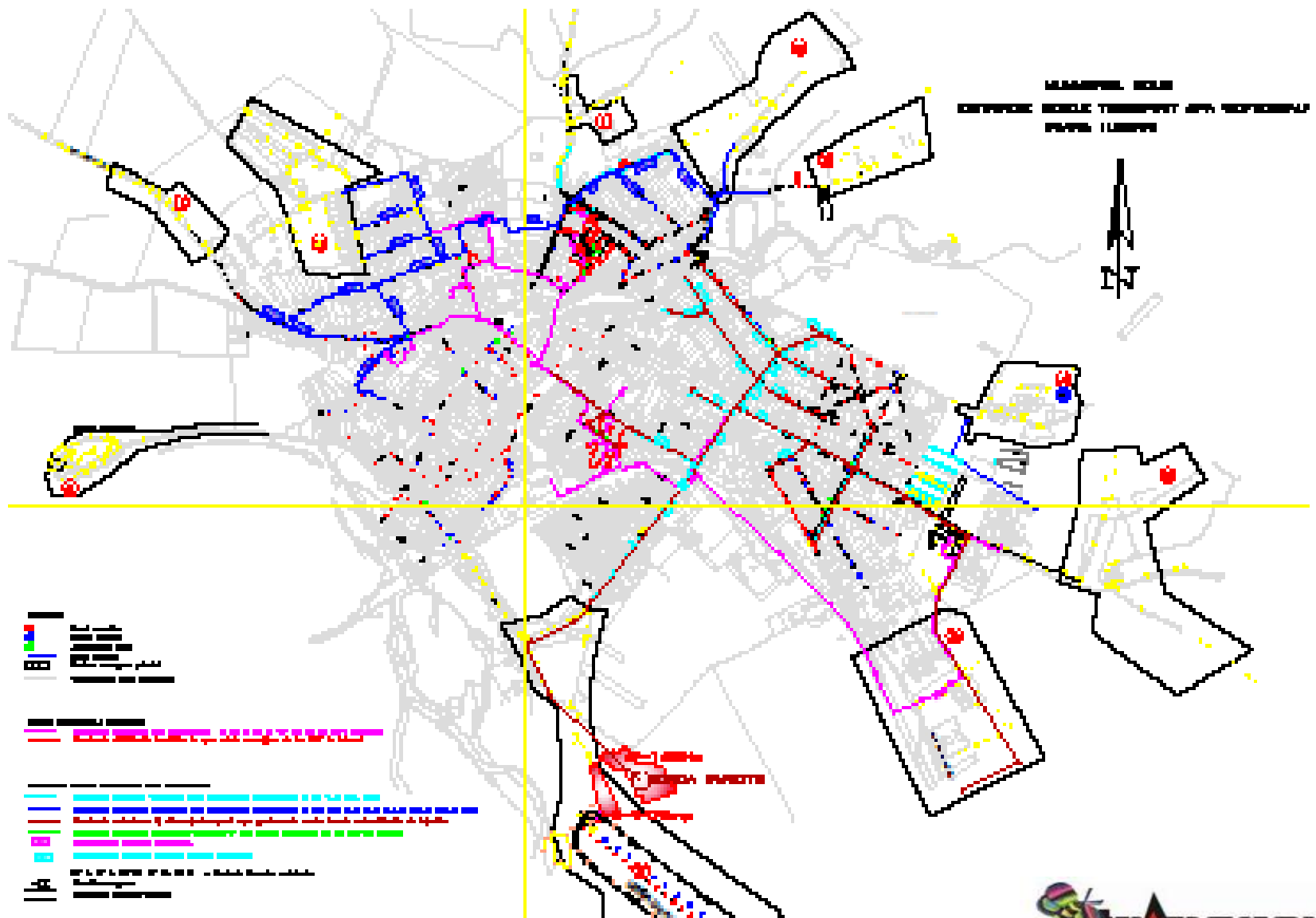
Geothermal District Heating in Oradea

- 12 wells drilled before 1990 (owned by TRANSSEX), all in exploitation;
- During the last 5 years 2 more wells drilled and leased by TRANSSEX, to be used in the near future;
- Exploitation license for 90 l/s (annual average);
- Wellhead temperatures between 105°C in the west (Iosia) and 70°C in the east (Nufarul);
- One doublet type system in Nufarul, one more in the near future in Iosia (extension of the current DHS);
- Total geothermal energy delivered: about 430 TJ/yr. (about 15% of total heat demand of the city);
- Annual average flow rate produced: about 57 l/s;
- Plans to develop exploitation in the near future.

Geothermal District Heating in Beius

- 2 wells drilled and leased by TRANSGEX;
- Injection well drilled at present;
- Wellhead temperatures 84°C;
- Maximum flow rate 90 l/s (line shaft pumps installed);
- Annual average flow rate produced: about 16 l/s;
- Total geothermal energy delivered: about 110 TJ/yr.;
- 3 light fuel oil heat plants converted to substations;
- Heat selling price about 15 €/Gcal (as compared to about 75 €/Gcal from light fuel oil);
- System extended with micro-substation modules for groups of smaller size consumers;
- Plans to develop exploitation in the near future.

Geothermal District Heating in Beius





Conclusions

- Romania is rich in proven geothermal resources of up to 120°C temperature, defined by 250 production wells.
- Reliable information on the resources and reasonable technical expertise are locally available in Romania.
- Current legal framework provides incentives to investments for geothermal energy utilization, but it is rather complicated.
- A rather small part of the geothermal potential of Romania is used, mainly for district heating, greenhouse heating and spas.
- Further geothermal development is technically and economically feasible in Romania (mainly for existing wells), even more at present (New Green Certificates Law in force, “Green House” program extended to private persons, geothermal being specifically mentioned).



Thank you for your attention!

