Project Title: Techno-economic evaluation of Qinranjeh village heating by geothermal energy

Department:	*Geothermal Technology Development Program*	***Employer:***	*Niroo research institute*
Project Manager:	*Javad Nouralie*	***Project Code:***	*PGEPN02-1*

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Project Summary:

Qinrajeh village, with a population of 875 people, is located 40 km north of Takab, West-Azerbaijan province, at altitudes above 2,000 meters above sea level. As the village is located in high altitude, it has eight cold months. The village has no gas distribution network, and therefore, its occupants have the heating problem in winters. There are three hot springs located in the upstream of the village. The primary purpose of this project was to study the possibility of applying this natural geothermal potential for heating the village.

Project Results:

The performed field research indicated that the springs have the temperature ranges of 30-40 degrees Celsius. Due to the low temperature of springs, the direct use of them for heating the village is not applicable. Most village buildings are made of thatch with single layer windows. Base on field investigation, only 33 percent of total building areas need heating, which is about 25052 square meters. The weather information and future weather data projection of the village are obtained using the Meteonorm software. The obtained results showed that the maximum heating load of the village considering future weather changes is between 3.31 to 3.42 MW, and the maximum capacity of domestic hot water is 940 kW.

Before designing the DH system, different scenarios of building envelope retrofit is studied, and the most economical one is chosen. The obtained results revealed that when all exterior walls are insulated, polyurethane insulation can reduce the heat requirement of the building by up to 59%. Then, different DH scenarios were examined, i.e., applying air-to-water heat pump, solar hybrid cycle, using hot water springs, water-to-water heat pumps. Simulation of proposed DH systems has been performed using programming in the FORTRAN environment combined with TRNSYS and GENOPT software. Operating parameters of each studied system were optimized using the

PSO method. The objective function of the performed optimization was considered to be the 30 years life-cycle-cost of the system. According to the obtained results, the best heating system from the economic point of view was heating with a gas fuel boiler system and the use of springs in a solar hybrid system with water-to-water heat pumps, respectively. The life-cycle-cost of this system is calculated to be 23, 031,758$. For this system, the average annual COP of the primary heat pumps and the auxiliary heat pump for DHWS are 2.19 and 6.95, respectively.

Project Documentation:

- Report of the first and second phases
- Report of the third and fourth phases