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ScienceDirect

Energy Procedia 116 (2017) 403–406

Energy Procedia

www.elsevier.com/locate/procedia

The 15th International Symposium on District Heating and Cooling

COMPARATIVE ANALYSIS BETWEEN DISTRICT HEATING AND GEOTHERMAL HEAT PUMP SYSTEM

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Abstract

In Seoul, most of the new private buildings were mandated renewable energy installations more than 12% of total energy use in 2015. There are solar power, solar heat, geothermal, sunlight collecting, fuel cell, and small cogeneration systems in applicable renewable energy. Accordingly, some reconstruction apartments want to apply geothermal heat pump systems as heating and cooling. This has resulted in reducing the demand for district heating since district heating had been supplied in these areas. From the point of view of district heating suppliers, new competitor such as heating by geothermal heat pump system seems to appear in district heating market. District heating system is considered preferentially to apply in heating area abroad due to its high efficiency. However, district heating isn't recognized properly as a renewable energy in domestic situation. Therefore, in this study, we analysed primary energy use and greenhouse gas reductions of district heating and geothermal heat pump system. As a result, primary energy use and greenhouse gas reduction of district heating system are bigger than them of geothermal heat pump system.

Peer-review under responsibility of the Scientific Committee of The 15th International Symposium on District Heating and Cooling.

Keywords: District heating, Geothermal, Heat pump, Greenhouse gas reduction

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1876-6102
Peer-review under responsibility of the Scientific Committee of The 15th International Symposium on District Heating and Cooling.
10.1016/j.egypro.2017.05.087

1. INTRODUCTION

Aside from of environmental impact assessment of the government, Seoul city established its own standards for management systems complement of the high-density urban development in Korea. For the introduction of its own environmental impact assessment, Seoul city enacted and performed an Environment, Traffic and Disaster Impact Assessment Ordinance in 2002. Other municipalities also expected to introduce the same level of future environmental impact assessment.

Most of the new private buildings should implement more than 12% renewable energy installation obligation of the total energy usage in 2015. Public buildings is expected to expand step by step up to 30% renewable energy rate in 2020. Applicable renewable energy is photovoltaic, solar heat, geothermal, sun-light collecting, fuel cell and cogeneration (more than 10% recognition rate only) energy.

All new apartment of land area 90,000 ~ 300,000 ㎡(about 1,500 ~ 6,000 generations) is subject to Seoul environmental impact assessment. From the point of district heating system’ s view, new competitors appeared. Renewable facilities corresponding to 12% of total energy use, especially geothermal heat pumps, can supply heating and cooling autonomously. The introduction of geothermal heat pumps are increasing because of their technology development and low variable cost. In addition, the introduction of fuel cell is also increasing. The government abolished geothermal heating and cooling progressive electricity rates in 2009.

However, district heating systems are unappreciated renewable facilities properly. Thus, in this research, we analysed primary energy use and greenhouse gas reductions of district heating and geothermal heat pump system.

2. BACKGROUND

Geothermal heat pumps have been supplying heating and cooling to 180 generations of S apartment(located in Incheon, Korea) in 2012. Thus, using the operating data of S apartment in 2014, we calculated primary energy use and greenhouse gas reductions of district heating and geothermal heat pump system. Heating consumption of S apartment in 2014 was 989 Gcal/year and electricity consumption was 527 MWh/year.

However, geothermal heat pump system produces only heat, but district heating system produces heat and electricity simultaneously. Thus, we assumed, in geothermal heat pump system, common power plants produced electricity production amount of district heating system.

Primary energy use was calculated based on electricity production amount of each power source and greenhouse gas emission factor of 0.4428 tCO2e/MWh (Korea power exchange 2011 year data) was used.

3. RESULTS

We calculated primary energy use and greenhouse gas emission based on 2014 year operating data in Korea District Heating Corporation. If district heating system in Korea District Heating Corporation produces the heat of 989 Gcal/year, it produces the electricity of 689 MWh/year proportionally. Thus, in geothermal heat pump system and common power plants, we assumed common power plants produced the electricity of 689 MWh/year.

Table 1. Comparison of primary energy use and greenhouse gas emissions between district heating and geothermal heat pump system (COP=2.2)

Division	District Heating System		Geothermal heat pump + Common power generation System	
	Primary energy use (Gcal/year)	Greenhouse gas emissions (tCO2e/year)	Primary energy use (Gcal/year)	Greenhouse gas emissions (tCO2e/year)
Heat	1,090	254	1,088	234