Heating from Biogas Plants: an areal approach for enhanced environmental sustainability

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**Abstract.** The availability of renewable energy sources and highly efficient technologies are two critical issues when evaluating a sustainable low-carbon energy supply. At present, the efficiency of power generation in biogas plants is around 40%. The remaining energy percentage is mainly ascribable to heat produced in biogas combustion. Such heat is commonly implemented to supply the plant and the production facilities serving and surrounding the plant itself. However, this supply is only a fraction of the produced hat, which is mainly lost as waste. One possibility would be to recover the excess heat produced in biogas plants for the thermal needs of the buildings around the plants. This work analyses such a possibility, taking into consideration one province of the Veneto Region (Italy) as case study.

In the first phase of the research, data on biogas plants in the province of Padova have been collected. For each plant, the coordinates, the installed electric power, the produced thermal power and the days of effective work during the year have been defined. These data have been fed into the analysis software QGIS. Thus, it was possible to determine the location and potential of heat sources from anaerobic digestion. A total of 34 facilities were included in the analysis. Data on buildings located in the study area were collected in the second phase. Each structure was classified based on its size, location, height and intended use. A heat consumption per cubic meter of building per day was defined for each use category (based on bibliography). By combining the technical and geometric parameters of the structures, it was possible to calculate the daily heat demand for each building in the study area. Using the proximity criterion, it was possible to relate the heat production in the facilities to the heat demands of the buildings.

The analysis quantified a heat availability of 544 MWh/day. Preliminary results show that 41% of the plants can fully supply the heat demand of almost 100% of the buildings within 500 m. About 15% of them could offer full supply up to 800 m. Assuming that building heating is commonly done with natural gas, a complete conversion would save 89 t of CO2eq/ day.

The analysis demonstrated the feasibility of using the waste heat produced in biogas plants in the power generation process. The distances between the potential heat users and the production plants are compatible with those imposed by the technical constraints of a district heating grid. Further studies can optimize the network routes to maximize the number of buildings supplied.