Assessing the potential contribution of excess heat from biogas plants towards decarbonising residential heating

This paper analyses the technical potential for utilising excess heat from biogas plants, in order to supply local settlements through district heating. Based on a survey of around 600 biogas plant operators, the fractions of excess heat from the cogeneration units in these plants are analysed. A heuristic is developed to match biogas plants (heat sources) with local settlements (heat sinks) in order to determine a least-cost district heating supply for residential buildings. Two criteria are employed, namely the CO₂ abatement costs and the payback period, which represent the macro- and microeconomic perspectives respectively. Based on the survey, the mean fraction of excess heat is 40%, which is in agreement with other empirical studies. Extrapolating this fraction to the German biogas plant stock, which is selected as a case study, leads to technically feasible CO₂ savings of around 2.5 MtCO₂/a. Employing the criteria of CO₂ abatement costs and payback period yields about 2 MtCO₂/a below CO₂ abatement costs of 200 €/tCO₂ and below a payback period of 9 years. This represents about 0.25% of the total German CO₂ emissions in 2016 or around 2.5% of all CO₂ in residential buildings. Alternative threshold values of 80 €/tCO₂ and 5 years payback period reduce the carbon reduction potential to about 0.5 MtCO₂ and 0.75 MtCO₂ respectively. These relatively high average costs are related to the typically low population density in rural regions where biogas plants are located. These potentials are concentrated in around 3,500 of 11,400 municipalities, where district heating from biogas plants could reduce CO₂ emissions per capita by an average of 250 kgCO₂/a and cover 12% of the total heating demand. Apart from a methodology that can be transferred to any country with comparable data availability, the present study demonstrates that the use of excess heat in biogas plants can contribute to global decarbonisation.

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