Residual heat from district heating plants for forages drying in the Camonica Valley

Marco Fiala(1\*), Luca Nonini(1),Leonardo Colnago(2)

(1) Department of Agricultural and Environmental Sciences. Production, Landscape, Agroenergy (DiSAA), University of Milan, via G. Celoria 2, 20133 Milano; Mountain University (UNIMONT), via A. Morino 8, 25048 Edolo (BS); (2) Freelance agronomist, Via A. Costa 42, 21012 Cassano Magnago (VA). E-mail address: \*[marco.fiala@unimi.it](mailto:marco.fiala@unimi.it); 02 50316868; [luca.nonini@unimi.it](mailto:luca.nonini@unimi.it); [leocolny@gmail.com](mailto:leocolny@gmail.com)

**Keywords.** District heating plant, waste heat, forage drying, circular economy.

**Abstract.** The aim of the work was to evaluate the possibility to use the waste heat generated by District Heating Plants (DHP) for forages drying in mountainous areas. The Camonica Valley, located in the Alps of the Lombardy Region (Italy), and in which some DHPs are currently running, is particularly suited for dairy farms. During the late spring-summer time – when the users’ thermal demand is quite lower – these plants may have a lot of residual heat.

The study was performed in 2019 and focused on the cogeneration plant of the municipality of Ponte di Legno, which was – among the others of the Camonica Valley – the most interesting to investigate this possibility due to its particular location and technical characteristics. Additionally, natural forages drying for dairy farms located in this part of the Valley is quite difficult because of the altitude, fields slope, and climatic conditions.

The DHP of Ponte di Legno consists of 2 woodchips burners for heat production (thermal power: 5.8 and 4.6 MW), 1 woodchips burner (thermal power: 4.0 MW) linked to an Organic Rankine Cycle (ORC) unit for heat and electricity generation (thermal power: 2.95 MW; electric power: 0.73 MW) and 1 diesel burner (thermal back-up unit). The residual heat (MWh) over the spring-summer period was monthly computed as the difference between the total heat generated by the plant, the one sold to the local users, and the one lost through the distribution grid. In the three periods related to forages production, the total DHP residual heat amounted to: (i) 514 MWh in May-June (maximum hourly power: 351 kW); (ii) 314 MWh in July-August (maximum hourly power: 211 kW); (iii) 229 MWh in September-October (maximum hourly power: 156 kW).

The natural semi-dried forages (residual water content: 40%) locally available for a second drying step – by a centralized round-bales dryer (work capacity: 20 bales in 11 hours) operating inside the DHP – was computed for 8 dairy farms (i.e., 70% of the total farms in the area around the plant) and reached: (i) 840 t (May-June); (ii) 540 t (July-August); (iii) 107 t (September-October). Assuming a useful period for forages cutting equal to 20 days/cut, the current DHP residual heat allowed to dry 25% of the above mass of semi-dried forages. This limit could be solved by slightly increasing the DHP woodchips consumption during the months of haymaking, allowing the drying of all the locally produced forages mass. In this case, besides increasing the efficiency of the DHP, a high-quality cattle feed could be achieved, and this is a perfect example of circular economy.