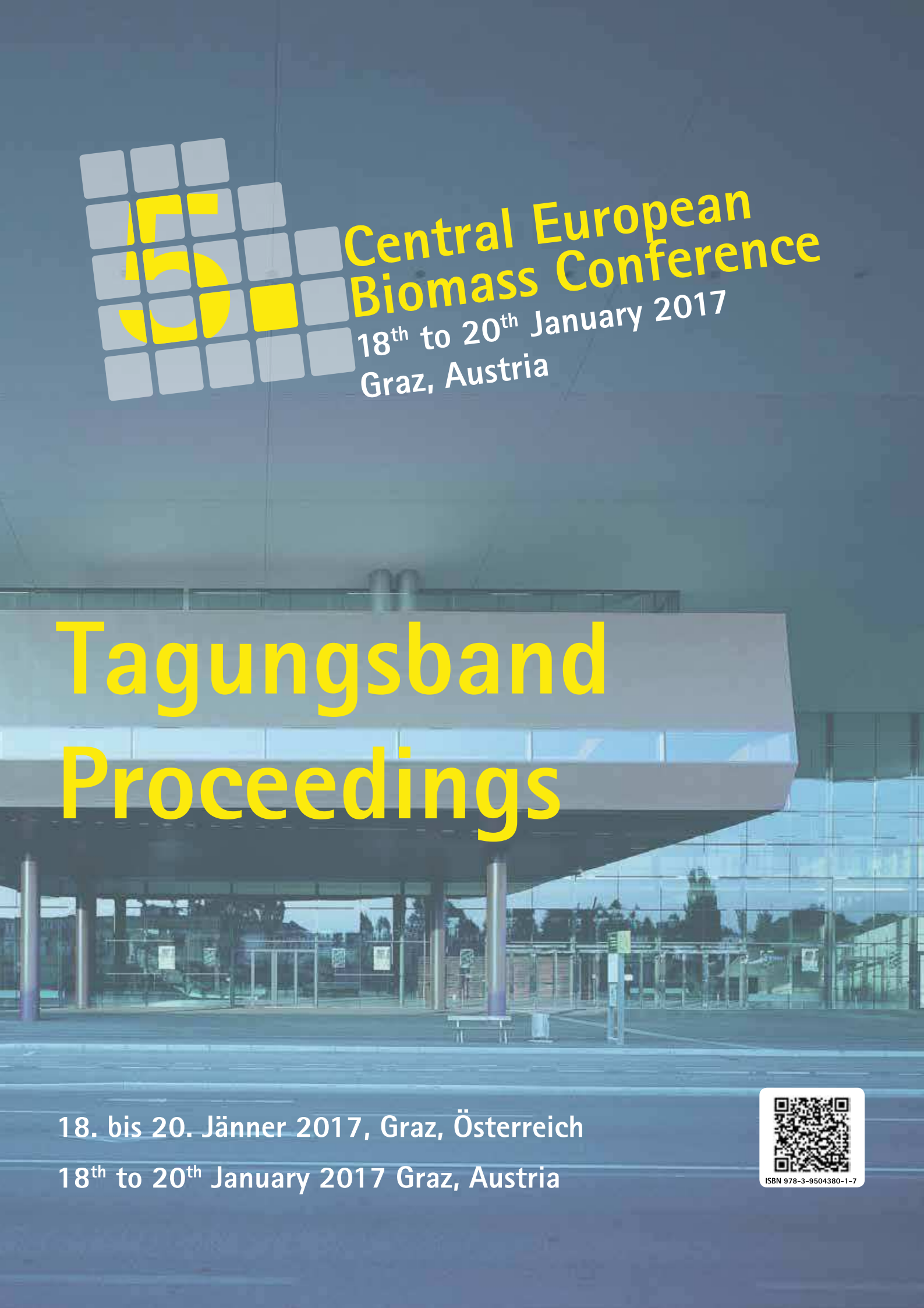

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Wood ash from district heating plants for the upgrading of biogas from anaerobic digestion

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Many technologies have been developed in the last decade for the upgrading of biogas produced during the anaerobic digestion (AD) of agricultural biomass as well as biowaste. The main aim is the gas cleaning from CO_2 with subsequent concentration of CH_4 up to minimum 95% to obtain biomethane for grid injection or/and transport use. In this way it is possible to diversify the final use of biogas and to contribute to the EU objectives of 10% of biofuel for transport within year 2020.
Most part of the upgrading solutions on the market are economic sustainable only for big plants (>300-500 Nm^3/hour of biogas), thus the development of low cost systems dedicated to small biogas plants or used for the exploitation of the surplus biogas which cannot be converted to power seems to be a topic to explore.
A previous project carried out by the Florence University (UniFI) in the years 2011-2013 showed the capacity of bottom ash from a waste burning plant to capture the CO_2 present in the landfill biogas. As an alternative to waste bottom ash, in alpine regions the availability of ash deriving from the combustion of wood biomass, carried out in district heating plants, represents an opportunity to better use this kind of waste before final disposal.
In the present work the bottom ash (BA) residuing from the combustion of wood in a central heating plant was used to convert the AD biogas in a high-grade gas rich in methane with the aim to evaluate its application for biomethane production.
Preliminary tests were carried out by the UniFI laboratory in a static single-stage reactor, made of a fixed bed of bottom ash (BA) crossed by a gas flow rate of 3.7 $Nm^3/(h \cdot MgBA)$. On the basis of previous results (Mostabuer P., Lombardi L. et al., 2014[1]) the gas used was a mixture of 45-48% CO_2 (in volume) and N_2 as remaining amount, to simulate the composition of biogas from AD. The gas flow rate and quality before and after the treatment and temperature above and under the BA layer (and room temperature) were measured in continuous. The results showed a good removal of CO_2, which was about 100% in the first 14-16 hours, in a first test, and up to 26 hours in a second test of the process accompanied by increase of temperature inside the reactor. With respect to other typologies of ash used in the cited previous projects the capacity of wood ash to capture the CO_2 seems to be higher, reaching in the reported test values up to 120 g of captured CO_2 per kg of wood ash. However, when the test was stopped, the volumetric concentration of CO_2 in the exiting stream was still below 0.5%, meaning that the ash capacity of capturing CO_2 to upgrade biogas was still available. On the basis of these preliminary encouraging lab results the project is continuing with a 2nd phase in a pilot plant. The AD process of source selected food waste is carried out in a dry-batch reactor (overall exploitable = 16 m^3) under mesophilic conditions. The biogas produced is monitored by means of a gas analyzer (EC 322, Eco-Control Milan, Italy) in order to continuously detect the amount of methane, carbon dioxide, oxygen and hydrogen sulfide produced. The biogas is sent to the single-stage static reactor containing moisturized wood ash. The main aims of this 2nd phase are the following: 1) to confirm the positive results obtained at lab scale; 2) to optimize the process parameters and the capture behaviour of ash; 3) to detect the environmental quality of ash after the treatment to identify

[1] Mostbauer, P., Lombardi, L., Olivieri, T., Lenz, S., 2014. Pilot scale evaluation of the BABIU process - Upgrading of landfill gas or biogas with the use of MSWI bottom ash. Waste Management. Waste Management, 34 (1), pp. 125-133