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## Global and local emissions of a biogas plant considering the production of biomethane as an alternative end-use solution

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The conversion of biomass to energy is a complex process whose environmental sustainability must be assessed. In the present work, global and local emissions of a biogas plant are evaluated considering two alternative end uses: Combustion of biogas in a combined heat and power unit or upgrading of biogas to biomethane and subsequent injection to the gas grid or use in transports. Global emissions are estimated by using the carbon footprint methodology comparing the scenarios on the basis of the same functional unit. The results show a CO<sub>2</sub> reduction for biogas combustion equivalent to that of biomethane used as fuel in transports. If the thermal energy produced by the biogas cogenerator is not used, the greenhouse gas balance approaches to zero. A second part of the work considers the contribution of methane losses from the upgrading process. The equivalent CO<sub>2</sub> saving raises considerably if methane slip is limited to 0.05% while the process results no longer sustainable for a methane loss of 4%. The evaluation of local impacts considers the emission of NO<sub>x</sub> and particulate matter (PM) generated by biogas combustion and its alternative solution. A Gaussian model of dispersion is applied and ground level iso-concentration maps are generated. The results show a variable extension of the plume which may cause non-negligible impact of these pollutants in the surroundings of the source. Adopting biomethane as the end use solution could partly or totally avoid these local impacts. In conclusion, this work points out that adopting the biomethane solution may result environmentally sustainable in terms of greenhouse gas emissions and reduction of NO<sub>x</sub> and PM local emission.

### Biography

Marco Ravina is a PhD student at Land, Environment and Infrastructure Department in Turin Polytechnic, Italy. He has recently published his first paper on environmental sustainability of energy systems. He is working on a project on global and local environmental assessment of district heating network in the Turin urban area.

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