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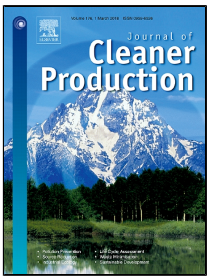

Optimization of an HT-PEM Fuel Cell based Residential Micro Combined Heat and Power System: A Multi-Objective Approach

Alireza Haghighat Mamaghani, Behzad Najafi, Andrea Casalegno, Fabio Rinaldi

PII:	S0959-6526(18)30146-X
DOI:	10.1016/j.jclepro.2018.01.124
Reference:	JCLP 11804
To appear in:	*Journal of Cleaner Production*
Received Date:	04 June 2017
Revised Date:	16 January 2018
Accepted Date:	17 January 2018

Please cite this article as: Alireza Haghighat Mamaghani, Behzad Najafi, Andrea Casalegno, Fabio Rinaldi, Optimization of an HT-PEM Fuel Cell based Residential Micro Combined Heat and Power System: A Multi-Objective Approach, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.01.124

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ACCEPTED MANUSCRIPT

Word Count: 8965

Optimization of an HT-PEM Fuel Cell based Residential Micro Combined Heat and Power System: A Multi-Objective Approach

Alireza Haghighat Mamaghani, Behzad Najafi*, Andrea Casalegno, Fabio Rinaldi

Dipartimento di Energia, Politecnico di Milano, Via Lambruschini 4, 20156, Milano, Italy

Abstract

This article presents multi-objective optimization of an HT-PEM fuel cell based micro CHP system under steady-state operation by employing the mathematical model of the plant previously developed by our group. Different optimization procedures have been carried out to find the optimal points while considering two sets of objective functions: I) thermal power generation and net electrical output and II) net electrical efficiency and thermal efficiency. In the first part of the work, optimization has been performed at full load operation with electrical and thermal generation as objectives. The obtained Pareto frontier shows the capability of the system to cater a broad range of electrical demand (21.0 kW-29.4 kW) while offering the maximum achievable thermal generation. In the next step, in order to find the optimal operating conditions of the system while addressing specific thermal and electrical load profiles, a series of Pareto fronts have been acquired at different fuel partialization levels. Finally, using the primary energy saving (PES) index, the best operating points, in terms of electrical and thermal efficiency, have been determined. It was observed that the net electrical efficiency up to 32.3% and thermal efficiency as high as 61.1% can be reached through the optimization.

*Corresponding author, Tel.: +39 02 2399 3840
E-mail addresses: alireza.haghighat@mail.polimi.it (A. Haghighat M.),behzad.najafi@polimi.it (B. Najafi), andrea.casalegno@polimi.it (A. Casalegno), fabio.rinaldi@polimi.it (F. Rinaldi)

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