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BUSINESS MODELS FOR AN EFFICIENT USE OF RESIDENTIAL MICRO-COGENERATION UNITS

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OVERVIEW

Combined heat and power (CHP) units simultaneously produce electricity and heat in a joined process and are therefore characterised by a superior resource efficiency compared to conventional power plants. Nevertheless, according to [1] the widespread diffusion of microCHP units, defined as units with an electric capacity of less than $15kW_{el}$ [2], is quite slow. Different possible business models when moving from a system to an actor perspective are described in detail and the benefits are assessed according to [3]. Furthermore, the 2009 framework for such small CHP units in Germany is thoroughly presented and an example of use is modelled and studied in depth. The paper with focus on residential CHP concludes with future prospects.

METHOD[1]

To assess the economical profitability of the different cases, an annual profit/loss calculation is performed according to [3]. The focus is thereby on the annualized earnings before tax (EBT) composed of the operating cash flow (OCF), the net capital costs (NCC) and the maintenance costs (MC). As the benefits are generated by the operation of the unit, the main point is to maximize the OCF. After setting up the equations for the different costs and revenues as well as the needed side-conditions, the following end function is constructed:

$$max(OCF) = \sum_{h=1}^{8760} R_h^{Spot} + \sum_{h=1}^{8760} R_h^{Feedin} + p_{el} Q_{El}^{P} + p_{fuel} \frac{1}{\eta^{B}} Q_{HT}^{B} - p_{fuel} \frac{1}{\eta_{El}^{CHF}} \sigma^{CHP} Q_{El}^{CHP} \quad (1)$$

with

R_h^{Spot}	hourly revenues from selling the surplus electricity to the spot market
R_h^{Feedin}	hourly revenues from selling the surplus electricity to the grid (feed-in tariff)
p_{el}	electricity price
p_{fuel}	fuel price
η^{B}	alternative boiler efficiency
Q_{El}^{P}	quantity electricity purchase
Q_{HT}^{B}	quantity heat production boiler
η_{El}^{CHF}	electric efficiency CHP
σ^{CHP}	heat-to-power ratio CHP
Q_{El}^{CHP}	produced quantity (electricity) CHP

After a thorough description of the possible business model configurations (Private Investor, Contractor, Virtual Power Plant (VPP) Operator and VPP Operator and Investor), differing by investor, operator and operation mode, four different scenarios in the sales aspect are identified: surplus sales to power exchange, surplus sales under feed-in tariff, surplus sales with choice of remuneration scheme and a market integration scenario.

[1] The method has been applied in business model 2 of the European project EU-DEEP (www.eu-deep.com).

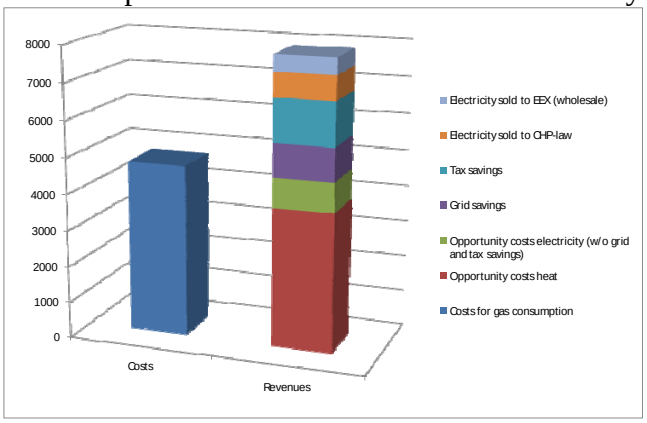
These scenarios differ in the way the produced electricity is used or remunerated. On the one hand, the produced electricity can be used for self-consumption to cover the electricity demand of the dwelling or on the other hand by selling the entity or parts of the produced electricity.
All in all, the benefits of the following business cases (combination of business models with sales scenarios) are assessed with the method described above:

	Scenario					
Configuration	0_{FIT}	0_{PE}	1_{PE}	2_{FIT}	$3_{PE/FIT}$	4_{MI}
Private Investor	A	C[2]				
Contractor	B	D				K
VPP Operator			E	G	I	L
VPP Operator & Investor			F	H	J	M

= Heat driven operation mode = Flexible operation mode

RESULTS

The described method is applied to a profoundly described and computed example of use that results in a positive OCF for a specific microCHP-unit in a multi-family dwelling.



CONCLUSIONS

Due to high subsidies and investment grants in the German framework, the operation of a microCHP unit is mainly profitable. Out of a macroeconomic point of view, the aggregation of small producers is very interesting in order to focus the electricity production to peak-price periods. An increased implementation of microCHP units would also lead to a decrease of fuel consumption and CO_2 emissions.

REFERENCES

[1]: Mueller, S. (2006): Missing the spark: An investigation into the low adoption paradox of combined heat and power technologies; Energy Policy, Volume 34, Issue 17, November 2006, Pages 3153-3164
[2]: Pehnt M. et al (2006): Micro cogeneration – towards decentralized energy systems, Berlin
[3]: Weber, C., Vogel, P.; (2007): Assessing the Benefits of a Provision of System Services by Distributed Generation; in: International Journal of Global Energy Issues 29 (2007) 1/2 ; S. 162-180

2 The cases C and D are not possible under the given regulatory framework but have been calculated for comparative purposes.