NACHHALTIGKEITSINDIKATOREN ZUR BEWERTUNG DER WERTIGKEIT VON ENERGIEVERSORGUNGS-SYSTEMEN AUF BASIS ERNEUERBARER ENERGIEN

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Introduction

The aim of this project was to define indicators to evaluate local heat supply systems based on renewable energy compared to fossil energy reference scenarios. With these indicators an assessment matrix was developed as a planning instrument for the realization of sustainable and energy-efficient local heat supply systems. Further inferences from single projects on regions can be done.

Methodology

In these project a method was developed to assess the sustainability of local heat supply systems with the focus on ecology under consideration of economically and social aspects. This method uses a set of indicators composed of Input-, Output-, Efficiency- and Balance indicators. To realize advancement in comparison to present situations, an environmental quality target to advance the environmental impacts of minimum 75% was defined. For the developing and application of the indicators different examples from projects and scenarios of combined heat production from Biomass, Biogas, Solar heat combined with near-surface geothermal storage; geothermal energy and fossil peak-load supply were calculated. These scenarios were related to a basis fossil energy scenario. Overall, two district heating projects at Speichersdorf and Mitterteich (Bavaria, Germany) were compared. In this case, the project Speichersdorf with different coverage areas and decrease heat densities was investigated. The lengths of electrical grid of two areas are 10,828 m and 6,027 m. Those were opposed to the biomass district-heating project Mitterteich with a grid length of 360 m and a higher heat density decrease. Furthermore, a scenario for heat supply was designed and calculated using a geothermal plant operating in duplicate to provide heat to the large coverage area. The calculation of the various processes and scenarios was performed with the program GEMIS 4.8 based on the total heat generated (final energy) by the respective supply type. The study examined the main system components; boilers, solar heat collectors, geothermal energy storage, geothermal heat system and the distribution network. For this purpose, a life cycle assessment / life cycle analysis based on using the above indicators of energy and the emissions were calculated. To determine what fraction of energy and emissions are caused of the district-heating network itself, the heat supply variants listed below were calculated with and without distribution network and geothermal storage.

Results

The variant V1Oil/Natural Gas is the reference scenario of decentralized plants on district heating supply based on oil and natural gas in comparison to the following variants:

- V2: biomass and fuel oil peak load
- V2a: biomass, biogas and fuel oil peak load
- V3 Solark40: biomass, 40% solar fraction, oil peak load
- Mitterteich: biomass, natural gas peak load
- V4Solar20: biomass, 20% solar fraction and oil peak load
- V4aBGSolar20: biomass, biogas, 20% solar fraction & oil peak load
- V6 Geoth: geothermal plant with fuel oil peak load

The results of the individual indicators were grouped under the collective term environmental impacts. For each indicator a weighted rating system was developed, normalized and scaled to kWh. Hence, the balance sheet indicator “avoided environmental impacts” was developed to demonstrate the overall results and for assessment the compliance with the environmental quality objective. The emissions therefore have positive values and both indicators efficiency and value creation have a negative value and therefore considered positive in the overall assessment. The results of the environmental impact of different heat supply scenarios based on the evaluation of the designed system will be presented.

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