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Primary energy factors for different district heating networks: An Estonian example

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Abstract

This paper examines the variation of the PEFs for DH networks in Estonia. The Estonian average DH PEF as well as for DH networks with different configurations are calculated based on principles described in EVS-EN 15316-4-5:2007. The initial data for calculation of Estonian DH PEF is from Statistics Estonia. The calculation results are analyzed and compared with the existing DH PEF. The conclusive part consists of the observed compliance of valid PEF value and its determination principles with the definition and nature of PEFs. The main discrepancies are highlighted and analyzed. The possibilities to minimize or avoid them are given.

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Keywords: Primary energy; PEF; EVS-EN 15316-4-5:2007; EPBD

1. Introduction

According to the Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings [1] (hereinafter EPBD recast), the Member States should draw up national plans for increasing the number of nearly zero-energy buildings. The nearly zero or very low amount of energy required should be mainly covered by energy from renewable sources, including energy from renewable sources produced on-site or nearby. The energy performance of a building shall be expressed in a transparent manner and include an energy

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performance indicator and a numeric indicator of primary energy use, based on primary energy factors (hereinafter PEF) per energy carrier, which may be based on the national or regional annual weighted averages or a specific value for on-site production. The methodology for calculating the energy performance of buildings should take into account the European standards and shall be consistent with relevant Union legislation, including the Directive 2009/28/EC [2].

Unfortunately, EPBD recast does not provide a strict definition of PEF and rigid adherence to the standard concerning how to calculate PEFs for different energy chains. This fact creates confusion in unanimous understanding of the PEFs nature.

According to the Estonian regulation Requirements to issuance of energy performance certificates and to energy performance certificates [3], the energy carrier conversion factors (PEFs) are such factors that take into account the consumption of primary energy required for the generation of delivered energy and the environmental impact involved.

For the first time the PEF values were published in the Estonian regulation in 2007, where PEF for district heating (hereinafter DH PEF) was 0.9 and valid so far [4]. At the same time, from 2007 until today a lot of significant changes in the Estonian district heating (hereinafter DH) networks have taken place. For example, (based on data obtained from the Estonian Power and Heat Association) from 2007 to 2014, a heat share produced from biofuels in DH more than doubled. Heat production in combined heat and power plants (hereinafter CHP) increased from 2007 to 2014 to 1 800 GWh. If in 2007 the share of renewable fuels, used in boiler plants and CHP plants, was respectively 26% and 6%, then in 2014 it already reached 34% and 50%. In spite of significant growth in share of renewable and local fuels used in DH and their effective use (CHP), those very positive changes did not reflect in DH PEF values.

Looking at the current DH PEF value, used in Estonia, and the PEF definition, several mismatches can be found. Some of them are given below:

- The DH PEF used in Estonia is fixed and valid for all DH networks. This solution does not take into account a combination of different fuels and technologies used for heat production in some specific DH networks. At the same time the primary energy consumption and environmental impacts in DH networks with renovated DH networks (low energy losses, heat load smoothing by heat storage systems), installed flue gas condenser, implemented cogeneration and high share of renewable fuels are lower.
- Benefits from the use of waste heat are not taken into account. At the same time, the reuse of the waste heat emitted during industrial processes in DH will allow to save a fuel in quantity which is needed to produce the same amount of reused waste heat.

The mismatches given above do not contribute to aiming of DH firms at use of the renewable energy and adoption of the energy efficient technical solutions. The experience of other countries in use of DH PEF shows that there are countries where:

- Similar to Estonia, there is a single fixed DH PEF. Among such countries, e.g. Finland [5], Denmark [6] and Bulgaria [7].
- Differentiated DH PEF is used, according to the fuels used and /or energy production technologies applied. For example, Latvia [8], Czech Republic [9] and Hungary [10]
- DH PEF is calculated for each DH network independently. For example, Poland [11], Germany [12] and Italy [13, 14].

In order to better understand practices of defining other DH PEFs (PEF calculation and differentiation) and evaluate topicality of the currently valid DH PEF value, the control calculations are carried out.

In chapter 2, the author describes the methodology of the DH PEF calculation. Chapters 3 and 4 handle, first, the average Estonian DH PEF calculation, and DH PEF for different configuration heating. In chapter 5, the main discrepancies revealed in chapters 3 and 4 are highlighted and analysed; the basic assumptions and guidelines concerning the possibilities of minimizing or avoiding such discrepancies are given.