2nd International Symposium on
Energy Challenges & Mechanics

19-21 August 2014
Aberdeen, Scotland, UK

Performance analysis of heating systems for low energy houses

Philippe Rivière

Center for Energy Efficient Systems, CES, Mines ParisTech, 60 bd St Miche 75006 Paris, France

Accepted for publication on 15th April 2014

The residential sector is responsible for more than 35% of the final energy consumption in the European Union, and is increasingly constrained by thermal regulations, resulting in a significant rise of new efficient heating technologies. This paper presents a comparison of the energetic and environmental performances of six heating systems installed in a low energy house: a gas-fired condensing boiler, a wood pellet boiler, a micro-combined heat and power (MCHP), an air-to-water electric heat pump, an air-to-water gas absorption heat pump and an exhaust air-to-air electric heat pump. The comparison is made with respect to the annual primary energy consumption and the annual greenhouse gas (GHG) emissions, and carried out under various climates and electricity generation mixes. The results indicate that, based on an ideal sizing, the MCHP and the absorption heat pump achieve the highest energy performances. However, both technologies suffer from small size unavailability, leading to significant oversizing which impacts their performances. Based on current size availability, the air-to-water electric heat pump benefits from the previous systems oversizing and thus appears as the most efficient technology. However, current sizing practice also causes significant oversizing which impacts the performances of thermodynamic systems. Without significant sizing practice improvements, the air-to-water electric heat pump merit decreases in favor of the MCHP. In terms of environmental impact, the wood boiler causes the lowest GHG emissions, whatever the electricity generation mix considered.

Keywords: Heating systems simulation; Low energy house; Primary energy; CO2 emissions; sizing