TRANSITIONIG TO HYDROGEN: A SUSTAINABLE SOLUTION FOR MUNICIPAL DISTRICT HEATING SYSTEMS – A CASE STUDY FOR THE CITY OF KOZANI, GREECE

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ABSTRACT

Decarbonizing the heating sector, which accounts for half of the EU's final energy use and relies on fossil fuels, will be crucial to reaching a climate-neutral economy by 2050. District heating (DH) systems, which account for roughly 4% of worldwide CO_2 emissions, are one of the primary infrastructures enabling decarbonization by combining renewable energy sources (RES)[1]. Hydrogen produced by RES-powered water electrolysis can be employed as a versatile energy storage medium to decarbonize DH networks through Power-to-Heat (P2H) approaches. Hydrogen boilers are a leading alternative to gas boilers, and fuel cell technology can replace thermal engines that are prone to Carnot limitations in order to enhance DH system efficiency[2].

The municipality of Kozani, the capital of Western Macedonia (WM), has traditionally relied on the waste heat produced by the coal fired power plants operating at the region, which is associated by a large carbon footprint. Today, the DH network at Kozani is supplied by 335 GWh_{th} annually and delivers 246 GWh_{th}/yr heat energy to users, resulting in a 75% efficiency. In light of the above-mentioned issues and acknowledging the municipality's endeavor to implement a regional-based hydrogen economy[3], the present study reports on a preliminary technical analysis and CAPEX and OPEX estimation of three H_2-based district heating approaches in Kozani. The H_2-based district heating setups' design and technical analysis focus on covering part of the thermal energy demands during the heating period (15/10–15/04). All scenarios use solar-powered alkaline water electrolysis to produce green H_2 from April 16 to October 14. Electrolytic hydrogen is stored in gaseous or liquefied form and employed for heat provision or cogeneration of heat and power using either solely a hydrogen boiler or a SOFC, or a combination of them during the heating period.

KEYWORDS: District Heating (DH) systems, Municipality of Kozani, Hydrogen, H_2-boiler, SOFC

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