

Title: Application of transcritical CO₂ heat pumps to boiler replacement in low impact refurbishment projects

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Abstract:

80% of current UK housing stock is expected to still be in use in 2050. Difficult, intrusive and expensive, refurbishment measures are required to achieve the level of insulation required for current low temperature heat pumps. Transcritical CO₂ heat pumps can achieve higher efficiencies, with higher output temperatures, than current, Carnot limited, synthetic gas heat pumps, with less environmental impact. Widely deployed in water heating and supermarket chilling systems, CO₂ heat pumps need heating return temperatures of 30 °C or less to function effectively. This has impeded their adoption with hydronic heating systems which have high return temperatures.

This study identified system modifications external to the refrigeration cycle that address return temperatures. It modelled a transcritical CO₂ air source heat pump with a hydronic heating system in a solid wall semi-detached house. Full year system coefficients of performance over 3 were achieved in four UK locations by using space heating return fluids to defrost the air source heat exchanger and to pre-heat inlet water, recovering any remaining excess return fluid heat as a source for the heat pump. Solar panels boosted this to 5.1. The levelized cost of energy for the system was calculated (with heat pump grant) at 22p/kWh, lower than a gas boiler, with 9.45 tonnes CO₂ emission savings over a fifteen-year life.

Biography

William Lambert is a research student at Brunel University London investigating decarbonization technologies for residential heating. He graduated in Electrical Sciences from Cambridge University in 1985. A Chinese speaker with 16 years working in China., he has an MBA, and has led business turnarounds and start-ups in a range of industrial and charity sectors. From 2020 he has re-engaged in academia, completing a Masters in Renewable Energy Engineering at Brunel University London, and publishing research into transcritical CO₂ heat pumps.

