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INTEGRATING SUSTAINABLE ENERGY TECHNOLOGIES INTO DISTRICT COOLING SYSTEMS: A REVIEW OF MODELLING AND OPTIMISATION APPROACHES

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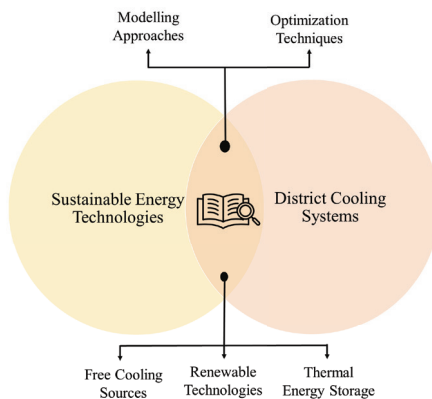
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Abstract – With the rising cooling demand and prevalent energy crisis, District Cooling (DC) is evolving as one of the sustainable energy solution worldwide. As per ‘EHP DHC Outlook, May 2023’, the sales in DC sector reached 3 TWh, covering more than 150 European cities. The centralised nature of the DC system offers such benefits as energy efficient operations, sector coupling, peak load management. Further, the feasibility of integrating renewable technologies (e.g., solar energy), free cooling sources (e.g., seawater heatpumps) and thermal energy storage (e.g., ice slurry) is also explored. These developments make the futuristic DC system quite complex, as it involves multiple energy transformations. In this regard, utilising computation tools for decision-making has become increasingly relevant. However, choosing the appropriate approach among the existing ones in this evolving field is an important task for energy practitioners. The aim of the study is to review the modelling and optimisation approaches in the context of innovative DC systems. Data collection and analysis is based on desk-review of scientific literature published in the recent past. Firstly, various possibilities of integrating sustainable energy technologies for DC applications are explored. Then, relevant modelling and simulation approaches are studied, focussing on the similarities and limitations. Finally, different optimisation methods are examined in terms of parameters such as objective functions, control variables, solving techniques. The contribution of the study involves overview of different integration pathways, identifying the strength and weakness of modelling approaches and insights into suitability of optimisation techniques. It is expected that this study will be a reference material for performing feasibility studies as well as developing digital-twins in DC context.

Keywords – Energy Storage; energy modelling; free cooling; optimisation algorithms; sustainable cooling



Pictorial representation of main topics considered for the proposed methodology.

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