A numerical tool for integrating renewable energy into total sites with variable supply and demand

Abstract

Total Site Heat Integration (TSHI) of multiple plants on a total site has recently been extended to include variable supply and demand of renewable energy. A graphics- based targeting procedure based on Time Slices (TSLs) was proposed recently to handle this variability. It has been based on the construction of Composite Curves (CCs), Grand Composite Curve (GCC) and the Total Site Profiles for each time interval. However, a dedicated numerical algorithm can offer more useful features. This paper introduces a numerical algorithm to efficiently address large-scale TSHI problems involving variable supply and demand. The tool is an extension of the Total Site Problem Table Algorithm (TS-PTA) published recently. Due to its numerical nature, it locates the stream origins conceptually and precisely and it can be embedded into larger algorithms. TS-PTA allows rapid and precise determination of the Total Site targets utilities and heat storage, while still preserving the ability to show the curves used by the graphical methodology (e.g. GCC and Site CC, which are better for visualisation). Heat storage facilities are used in solving variable supply and demand problem. Total Site Heat Storage Cascade (TS-HSC) is introduced in this work for analysing heat excess in certain TSL that can be cascaded to the next TSL during start-up and operation. This novel tool also could be used for estimating the heat storage capacity required. The procedure is illustrated on a previously published case study, confirming the advantages of TS-PTA to the graphics-based targeting methodology.