Energy demand flexibility in buildings and district heating systems – a literature review

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With the growing share of fluctuating renewable energy sources in our energy systems, providing sufficient flexibility on the demand side is becoming more and more important – also in the context of the emergence of Smart Grids. However, it will be difficult to achieve this by concentrating on electricity-only solutions. So, the next step is to focus on electricity-thermal solutions (e.g. heat pumps, electrical heating and cooling) and thermal system components. Here district heating and the building stock are important contributors due to their large share of energy demand. This literature review focuses on energy flexibility in context of heat demand in buildings and district heating systems. First, the theory regarding definitions of energy flexibility found in the literature, its quantification methods and indicators is discussed. Due to a lack of literature on the heating side, most of the theory in this review is based on electrical solutions. Then, the connection between electrical and thermal energy systems is described and the importance of integrated systems approach is explained. A schematic of flexibility sources in the built environment is proposed and technological solutions found in literature on buildings and district heating are presented based on the proposed framework.