Circular economy and bioeconomy are the policies adopted as a response to the unsustainable use of natural resources. It is argued that implementation of these concepts in tandem, through a systemic approach including design principles and process integration, would ensure resource efficiency and sustainability. Thermal treatment of waste materials for the recovery of energy or fuels (waste to energy or WTE), could stand as a strong link between these policy agendas that present common objectives and areas of intervention. Thermal treatment technologies can be included in a circular economy concept either as a final disposal step or as the core process unit able to produce a spectrum of marketable products. However, arguments against thermal treatment of wastes by environmental and other groups, are often creating obstacles on the deployment of such technologies in communities, e.g. Dublin, or even in few cases are cancelling the projects, e.g. Mexico City. The aim of this presentation is to provide evidence on the benefits of the recovery of energy and fuels from waste materials within the context of a circular economy. A review of the thermal treatment technologies is presented, evaluating their potential significance. An analysis of various types of thermal treatment technologies has been developed, including both pilot and large-scale applications. Future directions are highlighted.