Sustainability in electronic field is becoming an increasing concern for the environmental and social impact of device manufacturing, due to natural resources, raw materials exploitation and damages to the ecosystem. These worries led the industry to look for new solutions for electronic devices market.

In this context, additive manufacturing (AM) technologies were slowly introduced in electronics given to their characteristics, like design freedom, direct manufacturing, reduction in costs and waste generation, easy modification and reprinting in the prototyping phase, reducing the time-to-market of products, highly design customizations, lightweighting of final objects, decentralization opportunities for fabrication plants, reducing transportation need, simplifying the products supply chain and warehouse space requirements. Additionally, AM ensures reduction in critical raw materials exploitations, since it allows recycled and recovered resources to be easily reprocessed for obtaining new objects, as well as the possibility of redesigning parts for prolonged lifetime.

Selecting alternative shaping technique and material sources for electronics begins with defining the requirements based on devices' needs. In consumer electronics, Micro Electromechanical Systems (MEMS) and power electronic devices are the mostly widespread. The former are widely used in sensor development for physical – chemical monitoring of environmental parameters, such as water contamination. Looking at sensor development for water analysis, what emerged is the need for microfluidic system coupled with electrical or optical measurements techniques in order to guide the liquid flow through the monitoring site. Moreover, liquid filtration and separation from suspended particles is often required to avoid detection error. These microfluidic devices and filtration components can be made of polymers, easily shaped through replica moulding or light-based AM technologies.

Moving to power devices, involving the development of modules for high demand applications as automotive inverters, the main aspect that can be optimized are the materials used in the packaging system, given the limited scope for modification in the electrical components. Substrates in this field are predominantly ceramic based, utilizing materials like aluminium oxide to withstand high voltages, currents, and temperatures. Furthermore, ceramics ensure high recyclability and several alternative shaping techniques, from the most demanding in term of energy consumption, as hot isostatic pressing, to low demanding one, as AM.

This thesis investigates the potential of both polymeric and ceramic AM, in electronic devices fabrication, to develop new alternative manufacturing technologies and material sources. In the Introduction chapter, a first overview of the motivations behind the selection of AM as sustainable fabrication solution is presented, together with the polymeric and ceramic materials used for AM compatible to electronic sector. Five different case studies are introduced in the second chapter, Materials and Methods, reporting two different MEMS systems for water monitoring made through polymeric AM technologies, and three different examples of ceramic AM, starting from new alumina powder and from recycled one, to better explore the possibilities of fully recycle material in electronic field. Results of these evaluations are showed in the Results and Discussion chapter, where the performed characterizations data are described and commented. Lastly, open points and future developments are depicted in the final chapter.

The outcomes of this thesis project demonstrate the wide range of possibilities for recycled alumina powder through AM technologies, which can be easily introduced also for polymeric fabrication chain, reducing the need for extra costs and energy requirements.