Use of Heavy Metals Contaminated Industrial Hemp (Cannabis sativa L.) for Bioenergy Production

Giuseppe Toddea\*, Gianluca Carbonib, Serena Marrasa-c, Maria Cariaa, Costantino Sircaa-c

a Department of Agricultural Sciences, University of Sassari, Viale Italia 39a, 07100 Sassari, Italy

b Agris Sardegna, Viale Trieste 111, 09123 Cagliari, Italy

c Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC Foundation), IAFES Division, Via De Nicola 9, 07100 Sassari, Italy

\*Corresponding: gtodde@uniss.it, Tel. +39079229283

**Keywords.** Contaminated biomass; renewable electricity; soil remediation; phytoremediation; sustainability.

**Abstract.** Worldwide human-related activities, especially those of the industrial, smelting and mining sectors, have caused the heavy metals contamination of large areas. Heavy metals are characterized by their long persistence and serious health concerns in living beings. Nowadays, different soil remediation activities are undertaken to limit and ameliorate contaminated soils. Among the various soil reclamation technologies available, phytoremediation is considered one of the most cost-effective and eco-friendly practices, where the use of industrial hemp (Cannabis sativa L.), as a hyperaccumulator plant, has shown promising remediation potentials. However, the proper management and disposal of harvested contaminated biomass represent a key point of the sustainability of the entire remediation process. In fact, the valorization of the contaminated biomass is a crucial aspect to ensure the sustainability of the entire phytoremediation process. This study aims to assess and evaluate the energy and environmental burdens of using heavy metals contaminated industrial hemp for bioenergy production. Specifically, the cumulative energy demand and climate change impact categories were selected from the life cycle assessment methodology. The data sample comes from real heavy metals contaminated sites, located in Sardinia (Italy), which have been subjected to soil reclamation by growing industrial hemp (Futura 75 cultivar). The energy and environmental impacts of using the contaminated biomass as an energy resource were then modeled from a “field to wire” approach. The designed scenario analyzed the processes associated with field level, product transportation and combustion of the contaminated biomass in a biomass power plant for bioenergy production. The results obtained underlined that the field level represents the main impacting process, while the electricity produced from the contaminated biomass allowed to save about 25 GJ ha-1 of primary energy while avoiding emissions of 330 kg CO2e per phytoremediated hectare. The study highlights that the use of heavy metals contaminated biomass for bioenergy production, improved the sustainability of soil reclamation activities turning unproductive lands into productive areas.