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Abstract— There are presently more than 3 million contaminated sites all over EU, according to the EEA (report 25186 EN). Heavy metal contamination is of particular concern, as metals are not degradable. Soil remediation is becoming a priority and several methods are constantly being tested an implemented. From these, phytoremediation has proven to be an attractive low cost alternative as it acts by establishing a vegetation cover which will stabilize the target sites. However, the fate of harvested biomass is a common obstacle for its implementation. Nonetheless, it can also represent an opportunity for producing added value products.

This work presents a novel integrated strategy comprising the utilization of all plant parts for the generation of energy products. Combinations of sunflower and plant growth promoting microbiota were assessed growing in agricultural and metal contaminated soils.

Sunflower seeds were then used for oil extraction, with observable extraction efficiencies of up to 20 ml oil/m^2 ; plant stems were used for bioethanol fermentation with yields of up to 280 ml/m^2 ; finally, biodiesel was then produced via transterification of the extracted oil with the produced ethanol, allowing the complete production of a biofuel from this phytoremediation derived biomass. All the products were characterized and it was possible to observe that the presence of metals in the soils did not affect significantly the metal levels on either the oil, the bioethanol or the biodiesel.

Additionally, plant roots were used as carbon and energy source for biomethane assays (BMP) for the production of biogas via anaerobic digestion. Overall, it was possible to conclude that soil contaminated with metals was not found to have an important effect on the anaerobic biodegradability of the sunflower roots.

This study reports thus the successful energetic valorisation of plants grown in degraded soils as a whole.

Index Terms— energetic valorisation, soil phytoremediation, biomass production, biodiesel generation, anaerobic digestion

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