

Biomass, Remediation, re-Generation (BioReGen Life Project): Reusing brownfield sites for renewable energy crops.

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The Tees Valley, NE England, contains one of the largest heavy industrial clusters in W Europe, including oil refineries and petrochemicals, iron and steel, bulk inorganic and speciality chemicals. Recent industrial history included extensive coal-based heavy industry, while mining, smelting and metallurgy of ferrous and non-ferrous metals has been carried out over two millennia. The result is a legacy of derelict, "brownfield" (previously used), and contaminated post-industrial land. It is estimated that an area of 20,000 ha of contaminated land exists in North East England, some of which is likely to underlie the 3160 ha of currently derelict sites or vacant buildings. Development of the 30 MWe Wilton 10 biomass power station (SembCorp Utilities) has created a local market opportunity for energy crop production in Teesside. A consortium led by CLEMANCE has been formed to investigate the potential of derelict industrial sites for energy crop production to supplement production from agricultural land. The purpose of this paper is to present the initial results from our pilot sites and to announce the subsequent Life III Environment Programme demonstration project.

In April 2004 an experimental field trial of four potential energy crop species was hand-planted on a former industrial site near Bishop Auckland as part of the CLEMANCE European Regional Development Fund Bioremediation Programme. The brownfield site was originally a brick clay pit, backfilled over 50 years ago with domestic coal ash, privy waste and incineration residues. The resultant heavy metal contamination includes phytotoxic levels of Zn (400-1000 ppm), Cu (100-500 ppm) and Ni (100-200 ppm) and levels of Pb (300-2000 ppm) and As (50-200 ppm) which are significant for human health concerns. Soil preparation included rotavation but no amendments, weed killer or rabbit fencing. Duplicate experimental plots were planted with willow short rotation coppice (variety Tora), miscanthus (*Miscanthus x giganteus*), reed canary grass and switchgrass (variety Cave-in-rock). After plant establishment the plot was hand weeded and mulched with green waste compost. The results of the first season indicate that miscanthus rhizomes grow well in contaminated soils at these northern latitudes, and, unlike the willow cuttings, are not affected by rabbits grazing young shoots. Both reed canary grass and switchgrass were established from seed but suffered weed competition and grazing. After fencing two subsequent seasons have shown good survival and growth rates for miscanthus, reed canary grass and willow. This paper will compare the relative yields, ash composition and contamination results for samples of biomass fuel prepared from each of these three species from this pilot site, and from a contrasting brownfield site, an industrial and a rural greenfield control site.

The BioReGen project (www.bioregen.eu) will demonstrate the feasibility of reusing brownfield sites to grow biomass energy crops at a commercial scale on a variety of contaminated sites. In addition to generating heat and power from renewable energy sources this land use has a number of environmental benefits: Damaged land is restored with ecological and aesthetic improvement. Use of composted wastes as soil amendment achieves diversion from landfill, contaminant stabilization and promotes *in situ* bioremediation of organics. Long-term growth has the potential to achieve cost-effective remediation of metal contamination via phytoremediation. This avoids the need to resort to energy-intensive processed-based remediation or other practices, such as excavation and removal, which merely relocates and contains pollution as a challenge for future generations. Reusing derelict industrial sites provides an economic advantage, since the major capital cost of land is avoided compared to using productive agricultural land. Indeed, many contaminated sites have negative asset values reflecting the costs of future remediation, or ongoing maintenance costs, which can be offset provided that adequate growth can be successfully established. Consequently, the resulting biomass crop might be contaminated from plant uptake or soil adhesion, necessitating testing to establish adequate pollution control measures before firing. The project will conclude by examining the technical issues of embedded generation using local biomass powered CHP.