Linking Brownfields Re-Use for Bioenergy Crops with Beneficial Use of Compost-Like Outputs (CLOs)

Paul Bardos[1], Tony Chapman[1], Ross Cameron[2], Becky Wheeler[2], Hannah Bishop[2], Paul Hadley[2] and Stephen Nortcliff[2]
1 r[3] environmental technology ltd, www.r3environmental.com, 2 The University of Reading (www.reading.ac.uk)
Downloadable from www.r3environmental.co.uk

1 Introduction

A workshop was held 28th March 2007 at the University of Reading examining the use of compost-like outputs (CLOs) on brownfields for bio-energy production (biomass, bioethanol, biodiesel). This may be an important opportunity to combine materials recycling with land restoration, renewable energy and providing a "bankable", i.e. economically self-sustaining, means of managing degraded land. The workshop explored the feasibility of this idea from several perspectives: CLO production, the land manager; the bio-energy developer / grower; and the regulator. The workshop was based on a series of keynote presentations, followed by a series of discussions and involved 35 people from industry, service providers, land management and regulatory sectors.

This series of overviews summarises the papers offered and discussion findings. The workshop also included an update on the Grantscape project experimental work, which has been separately reported[1].

The workshop was the fourth in a series of workshops examining the possibilities for CLOs, supported by CIWM and organised by r[3] Environmental Technology with the University of Reading as part of a larger project funded by Grantscape (Market Development of Composts Derived from Different Organic Waste Streams. Entrust Registered Project 760828.300).

2 Bioenergy projects on Brownfields - A Plant Designer's Perspective, Dr John Mullet, CRS (www.crservices.co.uk)

CRS design, build and operate organic waste treatment plants and their interests encompass both composting of source segregated feedstocks, and feedstocks mechanically processed from mixed wastes.

Different countries make use of CLOs in different ways, for example Germany uses mechanical biological treatment (MBT) mostly as a pre-treatment prior to landfill, to partially stabilise biodegradable municipal solid waste (BMW). It does not use CLOs on land. Whereas in France there are 70 plants processing 1.9 million tonnes per annum (tpa) of municipal solid waste (MSW) with CLO outputs used on land. Other countries also have substantial MBT capacities and use

[1] Bishop, H.O., Wheeler, R.S., Nortcliff, S., Cameron, R., Hadley, P., Bardos, P. and Chapman, A. (2007) An evaluation of compost-like outputs. SEESOIL 17 In Press; Wheeler, R.S., Bishop, H.O., Cameron, R., Nortcliff, S., Hadley, P., Chapman, A. and Bardos, P. (2007) The influence of different waste-derived composts on establishment, growth performance and water relations of Salix cv. Tora cuttings when used as a growing medium. SEESOIL 17 In Press. SEESOIL is the Journal of the South East England soils discussion group (http://www.soils.org.uk/seEngland.htm) Integrated Waste Management Centre, School of Industrial and Manufacturing Science, Cranfield University, Cranfield, Bedfordshire, MK43 0AL

some of the CLO output on land, including agricultural land, such as Spain which has treatment capacity of 3 million tpa and Italy which has treatment capacity of 11.7 million tpa

In the UK there are a range of views on what applications are suitable for Clos. John's perspective is that he does not see CLOs being used in the UK for agricultural crops for food consumption, and indeed the current regulatory position precludes the use of CLOs from mixed waste sources for any agricultural land. CLOs *may be used* on brownfield land, under a Waste Management Licensing (WML) Exemption, as set out in Paragraph 9 – see Box 1. However, the exact nature of this land has not been well defined (for example, currently former gardens are "brownfield"). His personal view is that "Clos should only be considered for use on land which is so contaminated that the use of Clos would improve it".

Box 1: Extract from Guidance for registering an exempt activity: Reclamation or improvement of land, Paragraph 9A, WMX9yv041a

5.5 Previous land use
You cannot register a Paragraph 9A exemption for green field sites. The land must have been subject to a previous industrial or other man-made development. According to SI 1056 1994 "by reason of industrial or other development the land is incapable of beneficial use without treatment"

5.6 Improvement of the land
Wastes deposited on land under Paragraph 9A must be spread for the purpose of reclamation, restoration or improvement of that land. [Within the scope of the WML regulations at least one of two types of improvement must be shown: "agricultural benefit" or "ecological improvement".]

A question that might be asked is: why make CLOs at all? The Landfill Directive requires MSW to be pre-treated and organic matter to be diverted from landfill. Even with effective source segregation of recyclables, a residual waste remains of around about 45 % of the original arising (based on experience from Germany and Cambridge), which needs to be treated. Interestingly the organic content of the residual waste is similar to that of unsegregated MSW. Furthermore, source segregation is not ubiquitous and is not always possible. MBT treatment of this residual MSW will generate CLO. The only alternative to MBT is thermal treatment of the residual waste, which is not always a popular choice in the UK. If a usable CLO can be produced, surely it is better to recycle its organic carbon and fertiliser content to land, than to bury it in landfill where it will generate leachate and methane.

Another question that might be asked is: why not use composts from source segregated materials for all applications, or why should CLOs displace such composts from their markets? John's view is that PAS-100 compliant materials represent the "cream" of composts and are therefore best used for the highest added value applications. Of particular note is the state of agricultural soils. The European Thematic Strategy for Soil Protection has demonstrated a steady decline in the organic content of agricultural soils in the UK and elsewhere. In the UK, the greatest percentage loss is in the West Country. This is a serious problem because while yields can be maintained by inputs of artificial fertilisers and pesticides, in the long run it is organic matter that makes soils stable and productive. So certainly high quality source separated compost should be manufactured from as much of the waste stream as possible, but it should be used in the most demanding application first. Our agricultural soils need compost. CLOs may be able to contribute to improving and making

damaged / polluted soils more productive. A prerequisite is of course that CLO used is beneficial and not damaging. The specification of the output must therefore dictate the design and engineering of the facility – and not the other way round. CLO plant designers are confident that they can engineer process plants that will provide the necessary quality grade of CLO, but in the absence of any third party definition of the appropriate standard to be met, have no benchmark to specify suitable plant design.

While there is currently a focus on issues of contamination by trace elements and organic pollutants, John suggests that there are two over-riding quality constraints:

- The presence of plastics which can make a CLO aesthetically unpleasing, and
- The presence of sharps (glass and needles) which pose a risk to safety.

He used limit risks from needles and glass as an example of how an output quality requirement defines the engineering design approach. Hypodermic needles are difficult to separate. Being stainless steel and of small size they are hard to remove magnetically, or by size. Two possible approaches are by density separation in water (which is not practical for compost refining) or by very fine screening (4 mm), which is not possible unless the compost is dry (water content < 20%). A technical solution developed by CRS has been to dry MBT "compost" under cover so that it is more friable. The drying process utilises the heat produced by the ongoing composting of the materials after initial in-vessel composting. A first screening at 4 mm separates already fine material. The oversize is hammer milled which reduces the size of oversize organics and also glass to what is effectively sand or grit. Metals and plastics not size reduced by the hammer milling process, so a further screening at 4 mm increases the yield of CLO product, while plastics and needles remain in the oversize fraction which can be rejected (and landfilled as a low biodegradable organic matter content fraction). This approach has been used in a 40,000 tpa MBT facility at Ellington (near Newcastle) commissioned in 2005, where a <50 mm size fraction of MSW is composted. The CLO is intended for use as a soil forming material for restoration, and has a WML exemption for a local landfill restoration project. Figure 1 shows the glass / needle reduction segment of the process. Figure 2 shows upgraded material being dried in a windrow under cover, and the CLO product after milling and screening.

Figure 1 CRS "G2S Plant" for contaminants removal and glass treatment

	
Material Undergoing Drying	Graded Material

Figure 2 Comparison of G2S Graded and Ungraded Material

3 Two Land Management Perspectives, Robin Gray, Estates Manager, Land Restoration Trust (www.landrestorationtrust.org.uk) and Helen Rawlinson, Regeneration and Construction Manager, Envirolink North West (www. envirolinknorthwest.co.uk)

3.1 Land Restoration Trust

The extent of derelict land in *England* has been estimated to be 51,000 ha and increasing by 2,500 ha per year by the Urban Task Force (1999). The Urban White Paper (2001) estimated 58,000 ha, and the National Land Use Database (2001) estimated 66,000 ha of previously developed land. These are large areas in just one of the UK countries. While there is a turnover of derelict land through regeneration, some sites have remained unused for long periods. The *National Brownfield Strategy* identifies *hardcore* brownfield land as land which has been vacant or derelict since 1993 or earlier and *imminent hardcore* land which has been vacant or derelict since 1998 or earlier. The term is applied to sites more than 2 ha in size. Hardcore sites were estimated to occupy 17,000 ha in England in 2005.

Hardcore sites may be of particular interest to CLO producers for several reasons. Site restoration is often over extensive areas and involves revegetation of surfaces that require improvement, which offers possible applications of CLO for remediation and restoration. Restoration and remediation management may be required over long periods, providing stable outlets for CLOs.

Derelict land is a major social and political issues in communities. Polling suggests 80% say they should be involved in deciding what happens to derelict land in their neighbourhood. 6 out of 10 people want more open space for recreation; and 50% say the state of their local environment impacts on how they vote in local elections.

The Land Restoration Trust (LRT) is a new organisation to address the challenges of a post-industrial landscape. Its mission is "to act for the nation in the acquisition of land at the end of its economic life and to hold such land as trustee, working with the community to restore it to health and manage it for public benefit."

It aims to

- help address the 70,000 hectares of derelict land in England for which no obvious management mechanism exists through land acquisition
- maximise the benefits that the management of restored sites can bring to local communities
- ensure the sustainable management of sites.

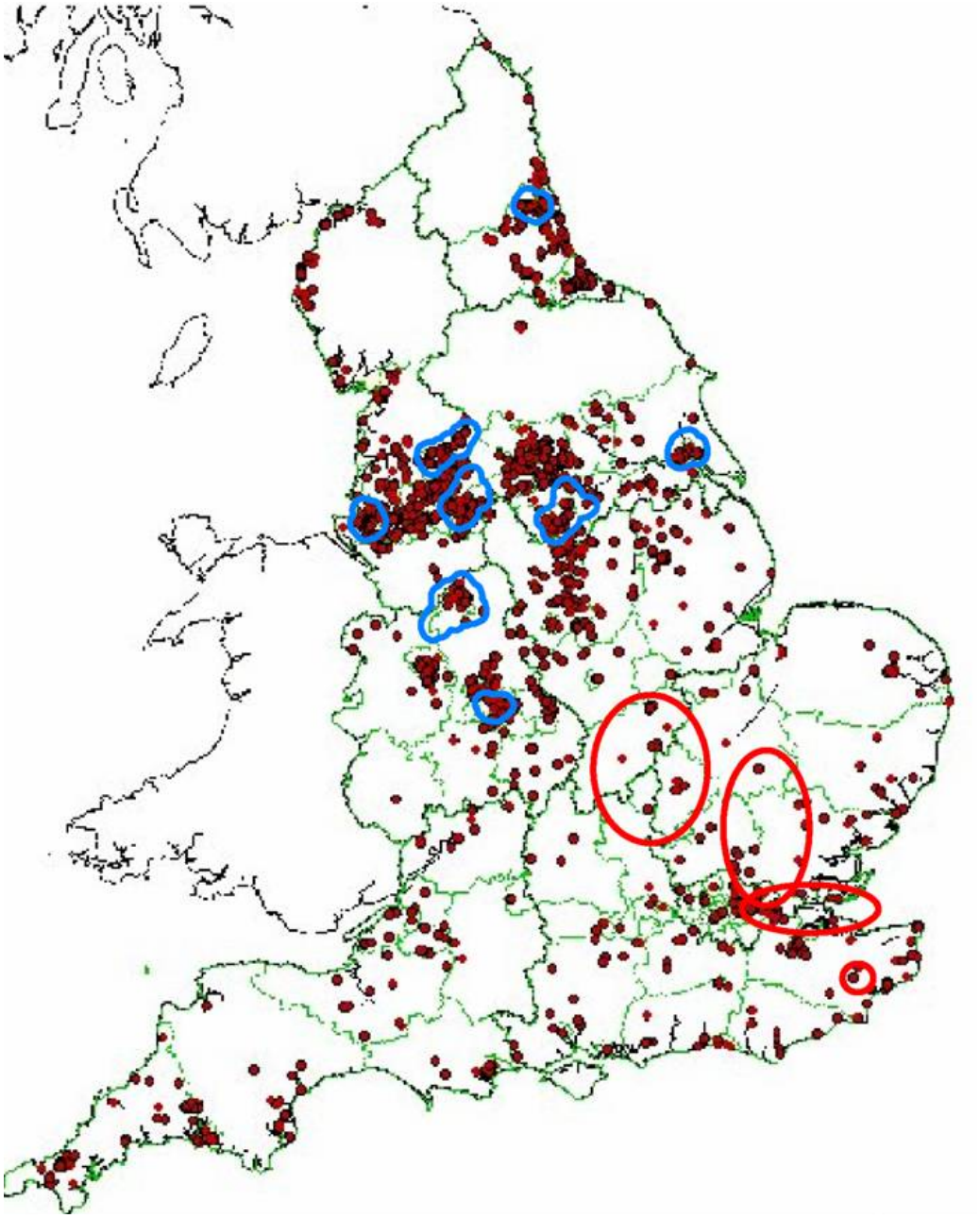

Figure 3 Hardcore Sites in England 2005 - 17,000 ha / 2,200 sites (English Partnerships and National Land Use Database)

LRT acts as a "strategic enabler". The delivery of restoration is, through partnerships on individual sites. A lead managing partner has overall responsibility for site management e.g. Forestry Commission, Wildlife Trust, Groundwork, local authority. LRT's intention is to manage sites to maximise local benefits and to facilitate long-term stewardship. English Partnerships and Government want a permanent legacy of managed green space. Management costs are covered by income from permanent endowments. LRT can add value by:

- resolving ownership blockages
- achieving benefits of scale while enabling local delivery
- addressing issues of long term risk management
- creating new approaches to maintenance
- realising the asset value of abandoned land

So far the LRT has acquired sixteen sites totalling over 600 ha. Its initial focus is on the English Partnerships led National Coalfields Programme, which is funded through endowments. LRT intends to acquire 10,000 hectares within 10 years and is also developing other areas of work with the Public and Private Sectors. LRT seeks to influence restoration in advance of property transfer, encouraging a good practice, i.e. a community-led, ecologically-informed approach.

A Forestry Commission audit in 2003 of woodland performance on brownfield sites found that only 7% of the sites surveyed met the restoration standard expected; 45% were judged to have failed. Generally the quality of restoration was found to be "disappointing", with negative effects on tree survival, growth and health[2].

Bioenergy projects may be feasible on LRT managed initiatives, but future implications of their large scale application remains largely unknown. Traditionally LRT has inherited sites as open space and community forestry. The use of organic amendments may form part of such restoration projects, but only in volumes that might be required in the restoration of a site for community open space rather than for a bioenergy project. Furthermore the organic amendment needed for these types of project may only be used on a one off basis and at fairly low levels determined by ecological/ geotechnical need rather than bioenergy production requirements. A major concern LRT shares with the remediation industry is about the quality and/or variability of any organic amendments or soil substitutes used in site restoration / regeneration. The information so far available about CLOs means that it would take a cautious approach to any project proposing their use. It would not support a project where the over-riding objective was to "merely get rid of" CLOs or any organic amendment where this did not support the remediation strategy for a site. However, LRT continue to watch the evolution of the supply and demand of CLO material with interest as a future stakeholder in derelict land in England.

3.2 Envirolink Northwest

Envirolink Northwest is a not for profit company funded by the North West Development Agency (NWDA). Set up in 2000, Envirolink Northwest aims to develop and support the Northwest of England's energy and environmental technologies and services industry. Its interest encompass: renewable energy, energy efficiency; contaminated land remediation; water and waste water treatment; environmental consultancy and recycling and waste management. The company also acts as the regional host for a number of other UK environmental initiatives such as the Carbon Trust, UK Forum for Environmental Industries and WRAP.

[2] Moffat and Laing, 2003, An audit of woodland performance on reclaimed land in England, Arboricultural Journal , vol 27, pages 11-25

The recycling and waste team is a recent addition to Envirolink Northwest and is organised into four main areas: research and development; technology commercialisation; sector development; and market development. Collection and reprocessing, development of the supply chain, manufacturing using recycled materials and end markets for recycled products are key activities within the market development and sector development teams.

The use of recycled organic matter in regeneration is seen as a major opportunity in the Northwest region, to demonstrate a "closed loop" approach between waste generation and recycled product use. Within the regeneration sector for example Envirolink Northwest aims to:

- Encourage increased use of recycled products
- Promote the use of recycled content materials in the construction of for example, new waste management facilities
- Demonstrate the use of compost in brownfield site reclamation and for higher value markets, for example Envirolink Northwest manages two WRAP "Trailblazer Sites" in the Northwest.

Significant capacity for the production of composts from source segregated materials already exists in the Northwest. Currently there are nine companies registered with the PAS-100 scheme in the region. Green waste composting capacity in Merseyside alone is approximately 150,000tpa. Whilst CLO's are not yet produced in the region a number of PFI contacts with local and sub regional authorities are set to manage wastes using MBT and AD technology. Global Renewables has recently been awarded a PFI contract for waste management by Lancashire County Council, based on MBT, worth £2billion over 25 years. Global Renewables will process 300,000 tpa of MSW at two facilities using anaerobic digestion with energy recovery. They anticipate production of 70,000 tpa of CLO, and in the region of 50,000 tpa green compost for which they will apply for PAS 100 accreditation. Part of the CLO output is planned to be used for at least 40 ha of tree planting each year. Figure 4 shows the locations of composting facilities on the PAS-100 scheme in the Northwest and the two planned MBT facilities.

From a study carried out in 2002/2003, on behalf of the Forestry Commission and NWDA, the Northwest has a detailed 'snapshot' of the area of the regions derelict, underused and neglected (DUN) land[3].

The original project aimed to identify all DUN Land in the Northwest region for sites $\geq$ 1 ha in size. 26,385 ha of land across 3,893 sites were identified as DUN Land. Of this area 14,915 ha (over 1,627 sites) was described as previously developed land. The study went on to consider the suitability of these sites to be reclaimed for soft end uses including community woodland. A total area of 22,116 ha over 3,113 sites was thought to have potential to be reclaimed for soft end uses (illustrated in Figure 5). To target limited funds available for regeneration a GIS based methodology was devised to assess each site to determine the public benefit delivered through regeneration. The Public Benefit Recording System (PBRS) considered a range of social, economic and environmental parameters to help inform site short listing thus allowing resources to be allocated strategically. The Newlands project, funded by the Northwest Development Agency and developed and managed by Forestry Commission, aims to reclaim 435ha of brownfield land to community woodland. This strategic site selection for Newlands was largely based on the results of the DUN Survey and PBRS to make the most of NWDA's £23 million investment over 5 years.

[3] TEP, (2003). *The Derelict, Underused & Neglected Land Survey of North West England, 2002: An unpublished survey report by TEP to the Forestry Commission and the North West Development Agency.*.

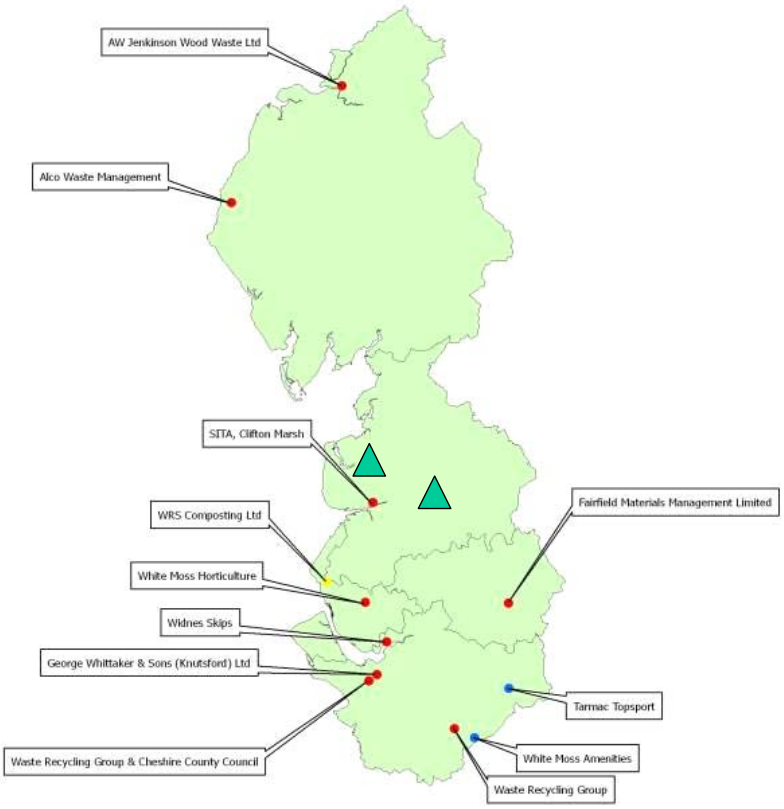

Figure 4 Composting facilities on the PAS 100 scheme, wholesalers and broker plus planned MBT facilities (green triangles) in the Northwest

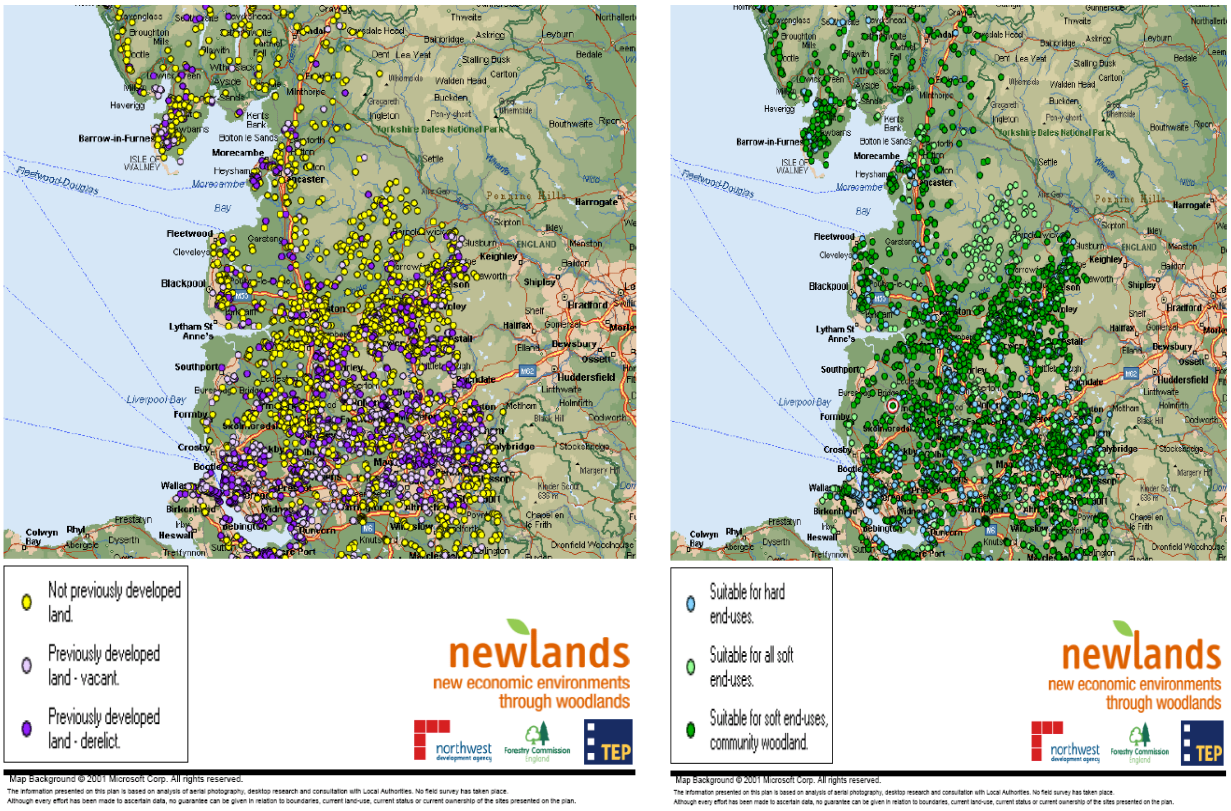

Figure 5 Distribution of DUN Land in the Northwest and Possible Land Uses[4].

The DUN Survey could provide a very useful basis for assessing the market potential for organic soil amendments (including PAS 100 and CLO's) to be utilised for energy crops. However, 5 years on, the rate of land use will have changed due to reclamation and land brought forward due to recent dereliction, underuse or neglect. Up to date information will be required to help identify DUN land potentially suited for bioenergy crops and the proximity of these sites to sources of organic amendments.

Restoration of DUN land to soft end uses tends to be seen as a major opportunity for beneficial use of organic matter, and significant cost savings may be possible by using organic amendments to support "soil forming" as opposed to importing topsoil. A recent project funded by WRAP and led by The Mersey Forest (in partnership with Liverpool John Moores University, BAE Systems and Envirolink Northwest), based at the Former Royal Ordnance Facility, in Chorley, demonstrates a clear commercial benefit to manufacturing soils from compost and site won subsoil[4]. Not only are savings possible in material costs, but maintenance and establishment costs may also be reduced due to a more controlled establishment of vegetation.

However, at least for projects restoring sites to community woodland, the total capacity for organic matter use may be rather more limited. Whilst there may well be scope for significant quantities of compost to be used in areas where manufactured soils can be produced of made soils imported, the sensitivity and quality of existing habitats and biodiversity brownfields should be considered and so minimal intervention and little or no compost use may be required. Helen estimated that within the Mersey Forest project area (Merseyside and North Cheshire), the largest community forest in the UK, part of the project planting plan is to restore 1450ha of brownfield land over 30 year. With 750ha of this target remaining the potential for compost use might only be 19,000t over several years. The Mersey Forest is a significant environmental project helping to regenerate DUN land though the compost tonnage estimate is a relatively small amount compared to the capacity of compost production within the project area.

4 The Use of CLO in Bioenergy Crop Production, Chris Hawkins, New Earth Solutions Ltd (www.newearthsolutions.co.uk)

New Earth Solutions (NES) are a waste management and recycling company with a special interest in bio-energy production. They compost both source segregated organic materials, and organic fraction of mechanically processed MSW. They have a established land bank and have begun bio-energy crop trials, including a 6.2 ha field trial of *Miscanthus* on poor quality agricultural land amended with CLO prior to July 2005 (when mixed waste origin materials were excluded from paragraph 7A exemptions). The site had been used for turf production and most of its topsoil had been stripped away. Monitoring of this trial is ongoing. The main agronomic objective of applying CLO to land for bio-energy crops is to improve soil organic matter content (as well as add useful amounts of plant nutrients). Enhancing soil organic matter content has a wide range of benefits for the agronomic use of soils as set out in Figure 6.

[4] WRAP, 2006. Restoring the Land with compost - Compost and the regeneration of the Royal Ordnance Factory, Chroley.

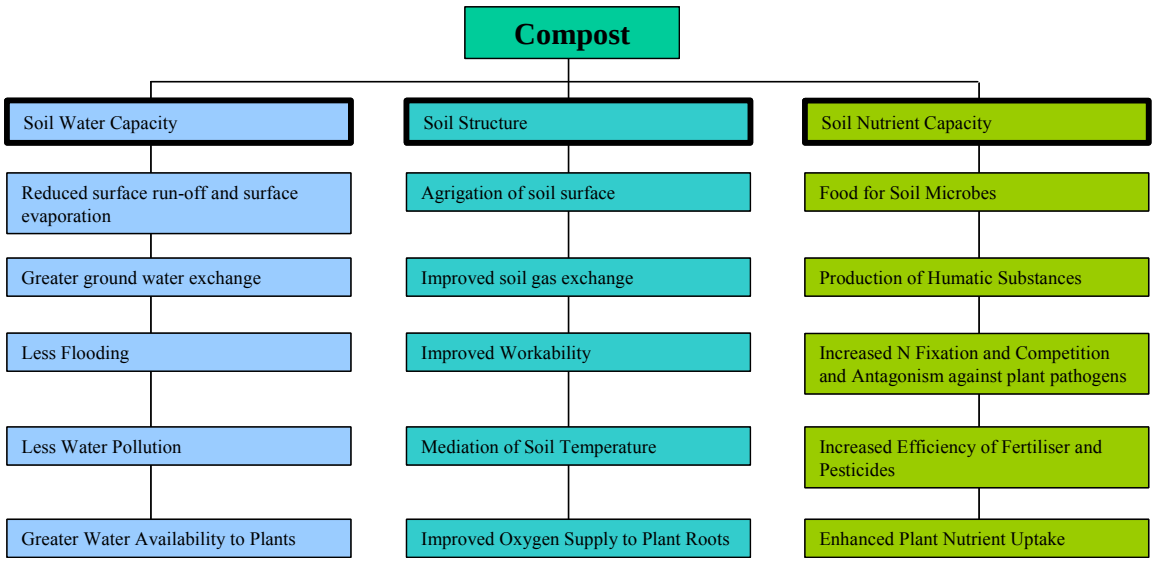

Figure 6: Benefits of Enhancing Soil Organic Matter Content for Agronomic Purposes

Currently the only WML exemption mechanism for CLO use on land is under Paragraph 9A, as described in Box 1 above. Few "Brownfield" sites would seem to be available in the South of England, where NES is operating at present. However, little information is available on the areas and locations of "DUN land" in the South. Of the sites that are available a pertinent question is whether they are sufficiently close to potential CLO sources to make transport economically feasible.

Assuming that Paragraph 9A relevant land is available sufficiently close to a CLO production site, a number of other factors influence the suitability of such land for a sustainable bio-energy + CLO project. These include:

- the available area, the length of time the area is available for – preferably 10 – 15 years
- the land condition – e.g. the site must be suitable for CLO application, for instance the slope must not be excessive for this purpose
- planning constraints including issues of timing
- end use constraints –for example the site may only be available for biofuel cropping for a limited period. Although raising soil organic matter levels would benefit the biofuel crop it would not be beneficial if the long term aim was reinstatement to heath land. Some crops limit the future use of the site, e.g. removal of willow short rotation coppice (SRC) would be very difficult and costly
- economic constraints, regulatory requirements (such as exemption renewal and site monitoring)
- crop constraints (e.g. will the crop grow on sites with high levels of contaminants)
- regulatory constraints (e.g. the exemption mechanism only gives 12 months of certainty before renewal is required).

There are significant incentives for the development of bioenergy crops, including grant aid for their establishment and the possible long term secure contracts. The principal UK bioenergy crop choices are: biomass (encompassing SRC, *Miscanthus* and Canary Grass) and fuel (encompassing oil seed rape – OSR for biodiesel and wheat, barley and possibly sugar beet for bioethanol).

Chris sees the main market for biomass as being the bulk supply of power generation. Potentially large quantities of CLO will require significant land banks and large secure outlets for biomass.

Production of biomass for this purpose has had a chequered past, with the "recent failure of the *ARBRE* project"[5]. Furthermore, woodchip and other biomass products are a relatively low priced commodity that compete with other secondary materials such as recovered wood. The effect of transport costs on this low value product mean that users need to be within a 25 mile radius of the site of biomass production. Figure 7 shows the location of current facilities using biomass and the resulting areas within which economic production is feasible. Hence there may be a "double whammy" for CLO + biomass projects in the South of England: availability of sites and availability of bulk biomass markets. Outlets for CLO need to be secured for the long term. Crops with short harvest intervals provide the best opportunity for reapplication of CLO. Crops with secondary uses such as Miscanthus which may also be used for animal bedding in large quantities would be advantageous if biofuel crop markets were to waver.

From a producers' point of view the best choice would appear to be production of oilseed rape for biodiesel production or wheat and barley for bioethanol production. There are major Public Sector incentives to support the inclusion of biodiesel and bioethanol in the national fuel supply as required by the Renewable Road Transport Fuels Obligation Other major advantages of using oilseed rape, wheat and barley for biofuel production is that production techniques and alternative markets are well established. Bioethanol production plants are planned for Teeside and Somerset. However, bioethanol does not appear to be as readily profitable, with existing production facilities in Spain running at less than capacity.

Overall CLO use for bioenergy crop production may be an option in some cases, but the long term security of markets may be open to a degree of questioning. Further work is needed to determine appropriate CLO quality, perhaps related to crop trials, and to deliver the appropriate regulatory framework.

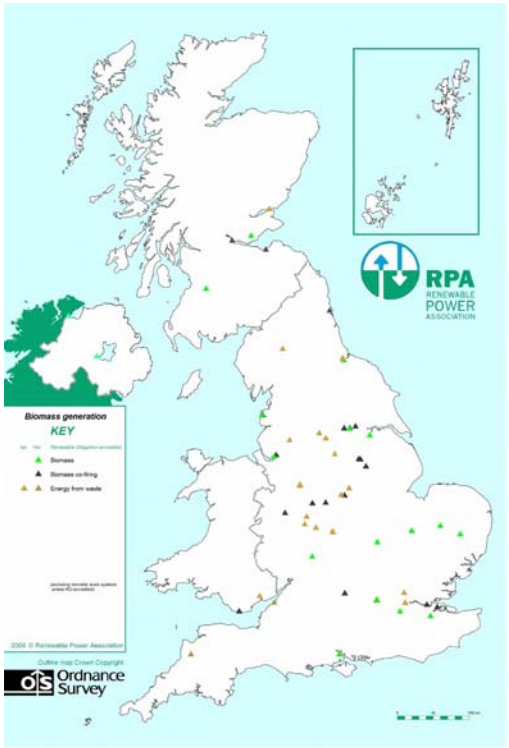

Figure 7: Current Availability of Bulk Biomass Markets for Power Generation (from Renewable Power Association.2004)

[5] The Royal Commission on Environmental Pollution, New Release 8/8/03

5 Exemptions and use of compost like output, Cormac Quigley, Policy Advisor, Environment Agency (www.emvironment-agency.gov.uk)

This overview sets out on a *without prejudice* basis the opportunities for WML exemptions for CLO use in support of biomass crops. For specific information refer to the guidance available at: http://www.environment-agency.gov.uk/subjects/waste/1416460/1334460/1416503/1418800/?lang=_e

The Environmental Protection Act 1990 establishes the UK's main permitting system. It creates a permitting system called Waste Management Licensing (WML). Generally you need a Waste Management Licence to dispose of waste or recover waste. There are some exceptions to this general rule. Some disposal or recovery is so minimal it would be disproportionate, for example "bottle banks" or the waste paper bins in businesses. These exceptions are called "exemptions" in the UK and there are currently about 50 of them, with a few more in development for the agricultural sector. All these exemptions are subject to rules contained within the exemptions themselves. Users do not have to apply for an exemption, but need to register it. The exemption either applies or it does not.

Moving to the specific case of CLOs, one possible use of CLO is to restore a site and grow biomass. This activity *could* be covered by a "Paragraph 9A" exemption (see Box 1). Paragraph 9A (of Schedule 3 of the WML regulations SI 1056) allows two things to happen without a licence. If what is being done does not fall into either of those categories, then Paragraph 9A does not apply. It allows:

- The spreading of wastes listed in "Part 1 of table 2AA" on any land. Compost / CLO is not listed in "Part 1 of table 2AA"
- The spreading of wastes listed in "Part 2 of table 2AA" on any land where it results in benefit to agriculture or ecological improvement. Part 2 includes "wastes from the aerobic treatment of solid waste" which would encompass CLOs.

The allowable uses of "benefit to agriculture" or "ecological improvement" are set by the Waste Framework Directive.

Hence in principle it is possible to spread CLO on land (subject to a previous industrial or other man-made development) for agricultural benefit or ecological improvement under Paragraph 9A. However, the Agency would use the Agricultural Act 1947 to identify what activities constitute agriculture. Growing biomass (e.g. SRC) is not listed in Agricultural Act 1947. Therefore from the Agency's point of view it is not agriculture. This logic means that an agricultural benefit rationale cannot be used under Paragraph 9A to spread CLO for growing biomass. Note this may not be the case for other bio-energy crops such as oil seed rape.

However, Paragraph 9A also allows the spreading of CLO for "ecological improvement". The Agency relies on guidance from Defra in deciding what is or is not "ecological improvement". "Ecological improvement is seen as achieved – "where the result is the maintenance of habitats and their biodiversity where these would otherwise deteriorate, the provision of new habitats for wildlife and the development or restoration of existing habitats to give greater biodiversity and sustainability". Hence under 3.10 "ecological improvement may therefore be assessed by reference to the extent to which wildlife habitats, that might otherwise deteriorate, are maintained or supported". From the point of view of registering an exemption, the key phrases in determining ecological improvement might be *otherwise deteriorate*, *are maintained*, *or supported*.

To register a 9A the user needs to provide the Agency with:

- the users name
- the location of the CLO use
- the amount of waste (CLO) that will be recovered
- a certificate showing that the CLO use will result in ecological improvement
- whatever plans and other documents that the Agency reasonably considers it needs
    - maps and plans need to be at least A4 size and show the area of land covered by the notification, based upon *Ordinance Survey* at a scale of 1:10,000 (or < 10,000)
    - Individual points of areas of significance need to be labelled, including: the boundary of the site; where CLOs will be applied and stored prior to use; watercourses within 10 metres; springs, wells or borehole within 250 metres of spreading areas (and if they are public or private drinking purposes or in food production); any properties where people work or live; public rights of way; any conservation or archaeological sites with 250m of where you intend to spread
    - If more than 2500 cubic metres of waste (CLO) will be used the Agency also require a plan showing: the depth waste will be applied to, and the contours of the current level of the land
    - The Agency also need to be notified of the following conservation sites if they are with 1km of the intended use of CLO: Special Protection Areas (SPA), Potential Special Protection Areas (pSPA), Special Area of Conservation (SAC), Candidate Special area of Conservation (cSAC), Ramsar (Waterfowl habitat), and also: sensitive sites covered by Wildlife and Countryside Act 1981; Sites of Special Scientific Interest (SSSI) and Areas of Outstanding Natural Beauty (ANOB). Note information on the location of sensitive sites can be found at: www.natureonthe map.org.uk/map.aspax for England, Wales: www.ccw.gov.uk/protected_sites/. ANOB are shown at www.anob.org.uk/ or can be identified by the Local Authority
- Soil analyses based on representative samples of the soil from where the CLO application will take place
- Recent waste analyses showing concentrations of potentially beneficial components and of contaminants that may be present
- Confirmation that the CLO application will not endanger human health or harm the environment and in particular without: risk to water, air, plants or animals; causing nuisance through noise or odours nor adversely affecting the countryside or places of special interest.

The certificate will need to show how the CLO application will result in ecological improvement without harming the environment/human health. It should confirm

- the sampling and analysis appropriate for the wastes to be spread
- results of analysis show no significant potentially harmful substances within the waste
- sampling and analysis of receiving soils is appropriate
- soils are deficient in the nutrients/properties required by the proposed spreading
- the waste will provide the above deficit.

The certificate must be supported by a risk assessment that identifies:

- the source of any hazards associated with the activity
- receptors likely to be affected
- the pathway
- the magnitude of the risk
- and mitigation methods.

The certificate must be prepared by or based upon someone with appropriate technical expertise with appropriate qualifications or vocational experience to support the claims within the certificate.

The completed registration form should reach the Agency at least 35 days before the intended start of the CLO application, with the required fees £546 (or £412 for renewal). It should be sent to the Environment Agency office closest to where the application will take place. Offices can be found by calling 087808 506506.

It is important to bear in mind that Paragraph 9A can only be used for the purpose of reclamation, restoration or improvement of the land, and that land must have been subject to industrial or other man-made development; and that the use to which the land could be put to would be improved by the CLO application. CLO applications must also be in accordance with any requirement under the Town and Country Planning Act 1990. If a planning permission is required, it must be obtained before the exemption is registered.

The maximum depth of CLO application is the lesser of two metres or the final cross- section provided to us in registration. In other words application is limited to the final cross-section applied for, but *not more than two metres depth can be applied*. Up to 20,000 cubic metres of CLO could be spread per hectare within an exemption. However, such a depth of application is unlikely to have demonstrable ecological improvement benefit, except perhaps in the case of an engineered wetland.

Application requires the consent of the occupier of the land or some other form of legal entitlement. If the exemption relates to more than 2,500 cubic metres of waste (CLO), records must be kept of the quantity, nature, origin, destination and method of recovery of the CLO applied. These records must be kept for two years and made available upon request (monthly totals are fine). CLO applications must comply with Nitrate Vulnerable Zones (NVZ) legislation where applicable. The NVZ regulations do not apply to former industrial land. However, regulations under the Water Framework Directive and its associated Directives may well encompass all land types.

A Paragraph 9A exemption allows the storage of CLO for six months on the site that is intended to be reclaimed or restored, but only the material that is intended for application under the exemption.

6 Discussion Session: Likely / desirable regulatory development, Rapporteur Tina Benfield, CIWM (www.ciwm.co.uk)

Focus: How could/should the brownfield market be regulated for possible use of CLO from mixed waste feedstock? How would this be achieved?

While this workshop had a focus on bio-energy + Brownfields + CLO use, there are of course a potentially wider range of CLO applications to former industrial land as defined in Paragraph 9 (see Box 1).

For all applications the absence of a generally used quality management approach for CLOs, outside Scotland, was seen as a major barrier to the development of CLO use by allowing the promotion of lower grade materials for unsuitable applications, so increasing both user and regulatory uncertainty. This is made manifest in the registration of Paragraph 9 exemptions which are seen as *complex* by the Agency, and seen as onerous by CLO producers. The development of an agreed quality management approach might ultimately lead to a *simple* exemption procedure. However, the view of regulators at the meeting was that a Quality Protocol for CLOs, similar to that

recently established for source segregated composts, was not feasible. Hence for the foreseeable future CLOs would be regulated as wastes until recovered on land.

The reliance of the Agency on the 1947 Agriculture Act was seen by many as an unnecessary obstacle to biomass cultivation with CLO on industrial land. Limiting the scope for beneficial use to ecological improvement for biomass may prevent projects taking place, particularly as the description of ecological improvement is couched in terms of habitats. The "ecological improvement" debate for many applications could be subjective, polarised and contentious. Given the role of organic matter addition to soil it was felt that the scope of "ecological improvement" should take into account improving soil condition, fertility or biological function. It was suggested that perhaps more recent European definitions of agriculture might be more appropriate, given in particular that the WML regulations are derived from The EC Waste Framework Directive. However, point 8 of Paragraph 7 of Schedule 3 of the 1994 Waste Management Licensing Regulations specifically defines agriculture in terms of the 1947. Consequently use of another definition would require a change to these regulations.

The 2005 call for waste research issued by Defra included an activity related to standards development in the broadest sense and research to develop an evidence base for fitness for purpose and environmental quality objectives for CLOs. This project was not launched because of the Defra spending moratorium. Defra is currently drawing up its waste research priorities for the next three years. The view of this meeting was that this research need remains an urgent priority that Defra should support as soon as possible, and that this work will need a strong European dimension and take into account the different planning and regulatory regimes that apply to land affected by "industrial or other development". The need was seen as particularly acute given the large and ongoing investment in MBT facilities under PFI, and the lag time between the development of a standard / quality management approach and its widespread adoption.

The regulatory approach to CLOs may well change in the near future following the development of Environmental Permitting (in place of WML). Exemptions will remain as a regulatory option under the Environmental Permitting Scheme, but this may not be an option that is applied to CLOs. A review of the exemption mechanism is currently underway and those with views are encouraged to contribute them to this review.
(Review link: www.defra.gov.uk/environment/waste/management/exemptions/index.htm)

A pictorial representation of regulatory options is shown in Figure 8. The exemptions review describes three broad regulatory options. Exemptions are seen as requiring simple management only. Standard permits are where a higher level of scrutiny is required, but a "one size" fits all text can be used for a particular material, such as a CLO, rather than a bespoke permit which requires a specific regulatory scrutiny for each application.

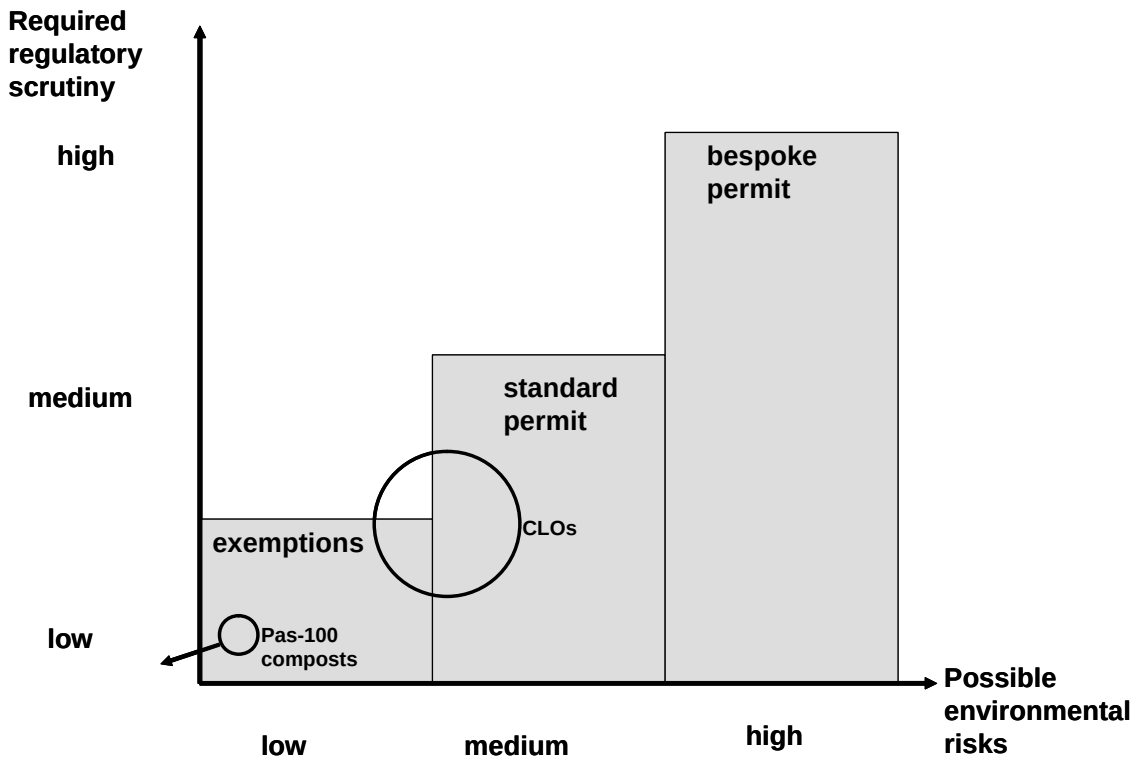

Figure 8 Regulatory Perspective for Composts and CLOs.

PAS 100 composts are seen as needing simple exemptions, and if complying with the Quality Protocol moving out of regulatory scrutiny. CLOs are seen by the Agency as more variable and requiring either a complex exemption approach or a standard permit. The "complex" exemption approach is felt to be inconsistent with the overall principles of exemptions where only "light touch" regulation is required, and therefore it is suggested they will be replaced by regulatory permits. Hence in the absence of a generally accepted quality management approach for CLOs, they are likely to be regulated by standard permits, based on the suggestions of the Defra discussion paper for the exemption review.

This potential development was viewed with concern by CLO producers since it will imply land managers requiring site based permits for CLO use. The meeting felt that land managers would be very reluctant to take on site based permits because they would perceive it as damaging to land value and ease of property transfer. It was pointed out that land managers are under duties even under the Compost Protocol, for example to keep records and carry out soil analyses. However, the fear at the meeting was related to the *perception* of standard permit use by those managing land where CLOs might be used. It was pointed out also that the standard permit mechanism offered advantages over the exemption mechanism in that a wider scope of beneficial use could be provided for, above and beyond agricultural benefit or ecological improvement, and, furthermore, that surrender conditions for site permits need not be onerous depending on the quality of the CLOs used. The Standard Permit could also support the use of a regulated CLO on multiple sites, whereas exemptions are site related. There is clearly a lot for the CLO industry and its clients to think about in this discussion. It also reinforced the need for developing an evidence base for UK CLO use and a broadly accepted quality management approach.

Discussion Session: Realistic opportunities, Rapporteur Mary Dimambro, Natural England (www.naturalengland.org.uk)

Focus: What kinds of CLO can be used in bioenergy projects on brownfields, regulatory restrictions permitting? What requirements would biofuel producers and site owners impose?

Opportunities for CLO + brownfield + bioenergy projects are dependent on the regulatory context. However, some of the definitions that this context is dependent on are unclear, for example regarding types of land, types of application and types of organic material. A further uncertainty is the feasibility of repeat CLO applications over the long term in such projects under current regulations. This is important as waste management authorities look for "the 30 year solution". Some form of agreed approach to CLO quality management could go a long way to addressing these uncertainties.

There is a major drive to increase bioenergy production (including biomass) in the UK, which has lower levels of production than many other EU Member States. However, bioenergy crops are commodities and subject to commodity price fluctuations. This is a major investment risk for bioenergy production projects. This investment risk may be reduced by creating interest in small scale biomass opportunities for example in supplying heat to schools, or combined heat and power to local authorities or agriculture.

Barriers to the re-use of CLOs for bioenergy on brownfield projects were seen as falling into four broad categories: (1) the current regulatory situation, (2) market interest, (3) the cost of haulage from sites of production to use, and (4) planning sensitivities. However, there are important opportunities for renewable energy and regeneration as well as wider opportunities for forest creation and carbon management, dependent on location. A range of policies act as drivers for these opportunities, such as the inclusion of biofuels (biodiesel, bioethanol and biogas) in the fuel stream. The underlying concerns giving rise to barriers stem from uncertainties over fitness for purpose and environmental impacts, hence agreed approaches to quality management could help unlock project opportunities.

Bioenergy opportunities may be large in terms of land area and tonnage requirements for organic amendment use. It is likely that mixes of organic amendments might be used depending on crop and land requirements. Should there be a cost premium for PAS-100 composts, this might create an opportunity for CLOs, and also a perceived competition between the two material types.

The discussion group felt that if CLO quality is deemed inappropriate for re-use to land, then this is likely to make alternatives to MBT + CLO attractive, for example MBT as a pre-treatment only, but perhaps have a more stimulating effect on the use of thermal treatments, including advanced thermal processes.

In summary, opportunities appear to be very specific to local circumstances, in particular the proximity of production to use. Constraints on them would be reduced by the existence of an agreed quality management approach for CLOs.

Discussion Session: Technical requirements for CLO production, Rapporteur Ben Harding, Sterecycle (www.sterecycle.com)

Focus: What level of sophistication is required in the production of CLOs from mixed waste to ensure that they are of a sufficient standard for this purpose?

The group agreed that there is a lack of standards and specifications for the waste management industry with respect to the production of CLO from mixed waste. This a major difficulty from a

process design point of view because the nature of the MBT processes used is largely dependent on the type of CLO output produced. A number of delegates were concerned that current regulations and standards (such as PAS-100) for composts are based on input waste criteria, which are seen as subjective, rather than being related to environmental quality or fitness for purpose criteria related to the material being produced for use.

Applications for composts, whether PAS-100, non PAS-100 or CLO are of course dependent on market needs and available revenue, with margins driven by these market needs and those markets prepared to pay to see them met. Opportunities for compost use are strongly influenced by local markets factors and short term needs, particularly because the transportation costs for composts determines the effective market radius for any given production site. Long term benefits of compost use can be hard to include in negotiations with clients because of their more limited economic cost horizons and stability. Market availability is strongly dependent on perceived compost quality, notably for CLOs and uncertainty exists over whether all markets are willing to pay for composts. It is conceivable indeed that some might charge some kind of "gate fee", which is likely to suit CLO recovery more than use of source segregated composts. It is also not certain how such markets might be regulated – standard permits perhaps?

It was felt that there were similarities between beneficial re-use of CLOs and beneficial re-use of sewage sludge, so that perhaps a similar approach to monitoring and assessment of use might be appropriate. It was also felt that there is much confusion in the industry about how CLOs can be used, and this confusion is not helped by the current regulatory position, which does not seem even handed. This confusion could lead to the possibility of driving the waste management towards energy from waste solutions which are seen as less "risky" in the long run. The point was made that if Defra is unable to provide the industry with suitable guidance on how CLOs can be used, then perhaps Defra should not be supporting PFI credits for long-term contracts on the basis of MBT production of CLOs for use.

The discussion group recommended the implementation of a new exemption / licensing / permitting procedure for operators considering CLO production which sets out clearly how CLO should be produced and used, providing a specification for operators to work towards. In summary, it will be increasingly more difficult for operators to produce a quality CLO which could secure suitable markets if no specification or guidelines are available on how to do so.

9 Conclusions

There is an enormous interest in the developing bioenergy crops driven by the requirements for renewable energy, in particular at the moment for biodiesel. There is some uncertainty about market opportunities for bioethanol and for biomass (as the revenue from wood chip is low and uncertain). Initiatives such as selling heat rather than biomass may provide a more flexible and profitable approach as demonstrated by a recent feasibility study for a former colliery site in Derbyshire[6].

The environmental sustainability of biofuels is beginning to be questioned both from land use perspectives, if it continues and expands the transfer of "natural" land to agricultural or "productive" land. This is seen as highly damaging by, for example, James Lovelock the originator of the Gaia Hypothesis (*The Revenge of Gaia*, 2006, ISBN 9780141025971, Penguin Books). Perhaps expansion of bio-energy should be directed towards "DUN land", although also recognising the possible value of such land for developing open space and "Nature". Furthermore,

[6] AEA Technology PLC and r3 environmental technology limited (2004) Markham Willows Masterplanning. exSite Research Ltd, Hillam, Leads, UK

perhaps the agronomy of bio-energy crops should be based on renewable resources such as CLOs rather than fertilisers produced by fossil fuels and / or non renewable and distant mineral deposits. The use of organic matter inputs and biomass crops may also help manage the environmental risks of deposits such as coal spoil, as suggested by the Derbyshire feasibility study.

This combination of beneficial re-use of CLOs, restoration and risk management of brownfield land and the delivery of renewable energy is attractive from environmental, economic and social perspectives. However, a number of crucial uncertainties appear to be preventing such projects. One of these uncertainties, the one discussed in greatest detail at this workshop, relates to the quality of CLO materials which are seen as potentially damaging by land managers and by regulators as needing stronger controls than materials from source segregated feedstocks. CLO producers counter that they can produce CLOs of suitable quality, but no-one is telling them what that suitable quality is. The issue of quality and regulation is exacerbated because it is not yet confirmed what is a suitable regulatory mechanism. The discussion at this workshop suggested that some form of standard permit might be a way forward, but it is not clear how land managers would react to their sites needing to be permitted (even although exemptions also carry obligations to land owners for soil sampling and record keeping). It was also felt that further research into the availability of "DUN" land across the UK would be beneficial.

MBT plants are now a fact of life in UK waste management, with billions of pounds worth of projects agreed, underway or in development. The most favourable economics of MBT depends on the beneficial use of CLO, rather than its use solely as a landfill pre-treatment. Indeed some would regard MBT solely for landfill pre-treatment as a wasted opportunity. However, possibilities for CLO use are constrained by quality control issues and a lack of consensus for what quality control is needed and how it should be regulated. Resolving this bottleneck through developing a wider scientific evidence base about CLO quality for UK materials and discussion by regulators, users and producer is an urgent priority to enable realistic use of MBT in the UK, and avoid the wasting of enormous sums of Public and Private money.

Bibliographic reference: Bardos, P., Chapman, A., Cameron, R., Wheeler, R., Bishop, H., Hadley, P. and Nortcliff, S. (2007) Linking Brownfields Re-Use for Bioenergy Crops with Beneficial Use of Compost-Like Outputs (CLOs) Report of a meeting with CIWM at University of Reading 28 March 2007. Report for Grantscape, www.grantscape.org.uk, Downloadable from www.r3environmental.com

Acknowledgements

The authors would like to thank all those who took part in the workshop as speakers and delegates, who kindly contributed to this report, and commented on it in draft form. We would also like to thank CIWM for their ongoing support in the organisation and promotion of workshops held to discuss and inform the work of the project as a whole. We would also like to thank Grantscape for their funding of this project.

Disclaimer

Nothing contained in the document will be construed as granting any rights by licence or otherwise to any person.

The views expressed in this report do not necessarily reflect those of CIWM or r^3 environmental technology ltd. As far as possible the authors have striven to provide an accurate record of the workshop, but cannot completely exclude the possibility of minor errors and inconsistencies. The views expressed in this document do not necessarily reflect the views or opinions of Grantscape, CIWM and r^3 Environmental Technology Ltd and its funders, officers, employees, servants or agents shall not be liable, to the fullest extent permitted by law, for any loss or damage arising from the interpretation or use of information contained in the document, or reliance upon views contained in the document.