

Introduction

ANAEROBIC DIGESTION AND COMPOSTING RESEARCH NETWORK – UK (ADCORN-UK)

Matrix of Research & Development work

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**For enquiries on this matrix, please contact:
Biogas@defra.gsi.gov.uk**

This matrix lists UK government-funded research into composting and anaerobic digestion. This includes any work examining composting and AD processes, as well as the outputs from these processes. Where appropriate, related research into topics such as Animal By-Products is also listed.

This matrix only lists research that is directly funded by government, and is not intended to present a comprehensive picture of all research that might be underway at (for example) UK research institutions.

On-going research

Defra, Evidence and Knowledge Base Core Function

- a. Implementation of anaerobic digestion in England and Wales balancing optimal outputs with minimal environmental impacts ([AC0409](#))

Defra, Waste Strategy – Policy and Processes

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Defra, Waste Strategy and Evidence

- a. [WR1119](#) European experience with small-scale and on-farm: to summarize experiences and lessons from the use of small-scale and on-farm AD systems in Europe, with a net rated thermal input of 0.15MW to 0.40 MW – report to be finalised shortly.

Defra, Animal By-Products Team (Food & Farming)

- a. Desk study to compare the environmental benefits of different ways of disposing of waste food within the context of risks to public and animal health by assessing the efficiency of recycling of food waste vs. composting and anaerobic digestion in terms of GHGs, energy and other food benefits e.g. protein production. The project being led by FERA started in May 2011 (funding is provided from Defra's Food Chain Programme) and is part of a wider EU research project (QSAFFE) on identifying future risks from new sources of animal feed. The draft final report is currently under internal and external peer review.
- b. No specific ABP research on composting or biogas is currently under way but advising on a project at Harper Adams University College on anaerobic digestion of fallen pigs.

Animal Health Veterinary Laboratories Agency/Veterinary Research Unit

- a. [SE4403](#) Project on microbiological standards for raw pet food, milk and milk derived products and other ABPs. Aims to review the microbiological criteria for ABPs and address the issue of applying absolute maxima.
- b. [SE1433](#) - looking at the persistence of TSE infectivity in soil using lysimeters. Results so far indicate limited spread of infectivity in two soils types over time. DUE TO CONCLUDE IN 2013.
- c. [SE1858](#) – looking at the persistence of TSE infectivity in soil biochemically and by PMCA. DUE TO CONCLUDE April 2012
- d. [SE1861](#) – investigation of persistence of scrapie on pasture land. DUE TO CONCLUDE END OF 2015

On-going research

- e. [SE1863](#) – investigation of different farm building treatments on TSE infectivity. STARTED April 2010. Due to end 2013

Defra, ELM Soils Policy

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NNFCC (National Non-Food Crops Centre)

- a. Farm Scale AD Plant Efficiency – scenario modelling on the impact of inclusion of crop feedstock in AD ([NNFCC 11-015](#))

WRAP (Waste & Resources Action Programme)

- a. [WR1212](#) - the joint WRAP / Defra *Digestate & Compost in Agriculture* project (DC-Agri), including field experiments with digestates and composts on sites across GB. Soil and crop quality, digestate N release to crops, emissions to atmosphere and ground water will be monitored. Field sites across GB expected to remain in place until March 2014. Includes knowledge exchange programme, providing a conduit for feedback to national governments on relevant policy considerations and an efficient mechanism for providing market facing information to key audiences of (1) farmers; (2) farmer advisers; and (3) agriculture students.
- b. A project is underway to develop Good Practice Guidance for the use of compost and digestate in agriculture. This will support a new 'Renewable Fertiliser Matrix' clarifying the suitability of PAS100 composts and PAS110 digestates in different cropping scenarios. The matrix is intended as a simple tool for adoption by farm assurance schemes. Publication is expected in 2013.
- c. Project examining the impacts of no, pre and post-digestion pasteurisation, and storage conditions on *Clostridium botulinum* in whole digestate products arising from mesophilic, wet AD systems. Also impacts of no, pre or post pasteurisation within such systems on *Alopecurus myosuroides* (Black grass) seeds, *Fusarium* spp., Clubroot (*Plasmodiophora brassicae*), brown rot (*Ralstonia solanacearum*), ring rot (*Clavibacter michiganensis* subsp. *sepedonicus*), and late blight (*Phytophthora infestans*) of potatoes. Results of experiments on all test organisms, except *C.bot*, currently being finalised. A complete final report is expected by summer 2013.
- d. Project to examine *Clostridium botulinum* spore loadings in a range of materials applied to agricultural land: compost (green and green/food), digestate (manure, food and purpose-grown crop-based), hen litter, cattle slurry, pig slurry is underway. Subject to results of testing organic materials (expected November '12), a second phase of testing spore loadings on a range of receiving agricultural soils may be required. Isolation of *C.bot* from these materials is not straightforward, and method development continues. A final report is expected by summer 2013.

On-going research

e. Re-visit of 2002 WRc catering waste / compost risk assessment, now including avian influenza, porcine parvo and circo-viruses. Awaiting final WRAP and FSA review.
f. Risk assessment for ABP (and other) composts in UK agriculture led by Cranfield University. Awaiting final WRAP and FSA review.
g. Risk assessment for green composts in Scottish livestock production. Update completed following feedback from ACMSF and CoT. Awaiting final WRAP and FSA review.
h. Persistent herbicides in AD. Previous desk based research concluded that there is no, or only a low risk of herbicide transfer to sensitive crops. However, there was insufficient information about a number of specific herbicides (2,4-D, MCPA, aminopyralid, clopyralid, fluroxypyr) to reach firm conclusions, further research was recommended. This work is currently being procured, with a final report expected in summer 2013.
i. Persistent herbicides in compost. This project looks at a number of questions relating to the possible presence of persistent herbicides in compost. In addition to sampling a range of composts and peat-free growing media for herbicide presence, the project looks at the impact of the herbicides on popular ornamental and vegetable plant species, as well as developing an effective methodology to screen for herbicide contaminated composts. This project now sits under the umbrella of the Sustainable Growing Media Task Force, and will be reported in due course.
j. Review of scientific literature on the application of digestates and composts to grazing land, their residence time at the soil surface or on grass sward and the rate of their incorporation into soils by natural processes. Report currently being finalised, although review confirmed that there is little relevant literature.
k. Review of scientific literature on the impact on soil quality of "accepted" physical contaminants (ie <2mm) in BSI PAS 100 composts and BSI PAS 110 digestates. The review has a particular focus on small plastic fragments and their impact on soil physical properties and soil fauna. Report currently being finalised, although review confirmed that there is little relevant literature.
l. A review of European literature and experience to investigate (a) how crop quality requirements / crop assurance schemes impact on the use of organic materials in agriculture; and (b) other applications for compost which are used in Europe, but not currently practised in the UK. Reports currently being finalised.
m. Citizen's Guide to Compost – technical and web document communicating numerous aspects of commercial composting including size of industry, regulations, how to use compost etc. to a range of audiences. Publication dependent upon agreement and release of supporting reports (three compost risk assessments, described above).
n. Field experiments (OMK004) to examine the use of digestate outputs in brownfield regeneration with particular focus on establishing biomass crops and creating wildlife habitats; and in sports turf maintenance where the liquid fraction is used as a biofertiliser. Preliminary data are expected in summer 2013, with projects due to complete in 2014.

On-going research

o. 'Product or Service? The benefits of different digestate distribution models' (Project Number OMK006-001). A report is in preparation which describes a range of current and potential distribution models for digestate produced in the UK, together with a series of case studies to highlight different models used by AD operators and other organics' recyclers.

p. 'Digestates from Anaerobic Digestion: A review of enhancement techniques and novel digestate products'. This work focuses on digestate produced from AD processes and covers both non-waste and waste-based digestates, whether or not they are compliant with PAS110 or the ADQP. The report is currently in preparation.

q. 'Market expectations and requirements for digestate – what are the options?' Project number OMK006-003. The aim of this project is to define the quality expectations of different markets for digestate and provide data on this expected quality for use by the AD industry & associated industries/markets. The project concluded at the end of June and the report is currently in preparation.

r. 'Annotated bibliography: Evidence for digestate use in different UK markets' Project number OMK006-005. The aim of this project is to obtain and publish empirical evidence from the UK for the benefits of different kinds of digestate in different markets such as landscape and regeneration or horticulture. This is expected to be achieved through the publication of an annotated bibliography (or similar structured approach) that effectively summarizes and signposts existing research on the characteristics and use of different digestates in the UK. The project is expected to conclude at the end of 2012.

s. A project is underway to examine the current PTE limits in PAS110, to understand whether they are appropriate, and if not, to suggest alternative approaches to limiting PTE loadings to soil from PAS110 digestates. Such loadings are expected to be extremely low, due to the nature of feedstock materials processed through AD. This project also examines the possible impacts on the UK AD sector of current EU proposals for digestate end-of-waste criteria (which include different test methods and different PTE limits than are currently listed in PAS110). A final report is expected by the end of 2012.

t. A project is underway to examine the PAS110 RBP (stability) test to determine whether it remains fit for purpose now that the industry has developed so significantly (compared with 2009, when the PAS was originally published). It also examines whether separate process and use tests are needed, to ensure that feedstocks have been recovered and that digestates will not cause unacceptable environmental harm in use. Whether or not the test is suitable for aerobic digestates will also be considered. A final report is expected by the end of 2012.

u. A scoping study is underway, examining current and potential PAS100 compost use on Scottish Golf courses. This will be followed by a programme of dissemination work within this sector.

On-going research

v. Driving Innovation in AD - Programme to challenge specific areas of AD, namely:

- The optimisation of processing and product manufacture at all scales of AD
- The reduction of costs and complexity of small scale AD

The programme will take a number of projects to full scale demonstration, helping them to show the attributes of their technology to the wider industry.
www.wrap.org.uk/content/driving-innovation-ad

w. Community Benefits: With a focus on community composting (CC), this project has examined the wider benefits of community projects and sought to monetise them. A final report is expected before the end of 2012.

x. A short-term study into the effects of prolonged compost use on gross soil structural properties (shear strength and pore size distribution) has been undertaken on one site in Scotland, with a view to examining the impacts on fuel use during cultivation. The final report is currently under review.

Department for Agriculture and Rural Development (DARD) Northern Ireland Climate Change and Renewable Energy Branch

a. A research project on the effects of various input and control factors on the performance of a mesophilic on farm Anaerobic Digester. Timeline unknown.

DARD / Invest NI and Department of Enterprise Trade and Investment NI

a. A review of the magnitude and extent of organic and food waste in Northern Ireland: present uses and destination of waste. Work to be completed mid 2010.

Scottish Government – Animal Health & Welfare Division

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Scottish Government – Agriculture and Rural Development Division

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Scottish Government – Environmental Quality Division

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Scottish Government – Rural and Environment Science and Analytical Services Division (RESAS)

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On-going research

Scottish Government – Energy Division

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Completed research

Defra, Sustainable and Competitive Farming Strategy

- a. Implementation of anaerobic digestion in England and Wales balancing optimal outputs with minimal environmental impacts ([AC0409](#))
- b. Physical assessment of the environmental impacts of centralised anaerobic digestion ([CC0240](#))
- c. Assessment of Methane Management and Recovery Options for Livestock manures and Slurries ([AC0402](#))
- d. The optimisation and impacts of expanding biogas production ([AC0406](#))
- e. Agronomic and environmental impacts of organic materials applied to agricultural land ([WQ0206](#))

Defra, Waste Strategy – Policy and Processes

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Defra, Waste Strategy and Evidence

- a. Rapid and responsive monitoring network for bioaerosol emissions ([WR0605](#)).
- b. Exposure-response relationship for bioaerosol emissions from waste treatment processes ([WR0606](#)).
- c. Emissions from waste management facilities including composting & AD – Frameworks for Assessment of Data Quality and Research Needs ([WR0608](#)) – not published yet.
- d. Optimising Inputs and Outputs from Anaerobic Digestion Processes ([WR0212](#)).
- e. Optimising processes for the stable operation of food waste digestion ([WR1208](#) – a follow-on to WR0212).
- f. Unlocking the Potential of Community Composting ([WR0211](#)).
- g. Rejuvenate Crop Based Systems for Sustainable Risk Based Land Management for Economically Marginal Degraded Areas ([WR1306](#)).
- h. Agronomic Benefit of Spreading Industrial Biowastes on Land ([WR0214](#)).

Completed research

Defra, Animal By-Products Team (Food & Farming)

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Animal Health Veterinary Laboratories Agency/Veterinary Research Unit

- a. [SE0255](#) – Quant risk assessment of TSE risk with wastewater from premises handling SRM directly applied to land.
- b. [SE0256](#) – Quant risk assessment of TSE risk associated with land treated with manure from infected animals.
- c. [SE1797](#) and [SE1798](#) – detection and presence of species specific processed animal proteins in feed.
- f. [SE4401](#) – Assess if thermo-resistant viruses are a relevant hazard in Category 3 ABPs used as incoming materials in biogas and composting plants.
- g. [SE4402](#) Quantitative risk assessment on the use of animal by products as fertiliser.

Defra, ELM Soils Policy

- a. Assessing the potential for the upstream control of contaminants present in organic materials spread to land ([SP0578](#)).
- b. Metals in Soil – to investigate the impact on the agricultural landbank available for the recycling of organic and inorganic materials of potential changes in soil metal loading rates and limit values ([SP0569](#)).

NNFCC (National Non-Food Crops Centre)

- a. A detailed economic assessment of AD technology and its suitability to UK farming and waste systems ([NNFCC ref. 10-010](#)) and associated [AD Calculator](#).

WRAP (Waste & Resources Action Programme)

The following reports are available in the WRAP website:

- a. [OAV033-004](#) Summary of previous WRAP-supported research on compost for growing potatoes (soil quality, crop quality etc).
- b. [OAV031-003](#) Field project examining the fates of coniine and taxine compounds during PAS100 windrow composting of hemlock and yew material.

Completed research

c. OAV021-012 Field project examining the fate of grayanotoxin compounds during PAS100 windrow composting of rhododendron material.
d. OAV023-xxx Trials with ABP compost on potatoes, strawberries, apples, oilseed rape, bedding plants, winter and spring barley, winter wheat, sugar beet – some reports already available on WRAP website, with others to follow.
e. OAV030-001 Survey project examining on-farm composting sector. Looked at: Types and quantities of feedstocks; Permitted / exempt status; PAS / non-PAS status; Markets; Membership of crop QA schemes.
f. OAV032-004 Analysis of samples of source-segregated digestates and composts (for a wide range of determinands (nutrients, PTEs, POPs), including faecal indicators and some plant pathogens).
g. Examination of flavour and odour taints in malting barley and milling wheat, with particular reference to use of compost and digestate. Publication intended summer 2011. Code OAV036-010. Available on the Zero Waste Scotland website .
h. OAV036-210 Examination of digestate stability and odour – examining linkages between the two, the appropriateness of the PAS110 RBP test (and its limit) and presenting best digestate spreading practice to minimize odours and maximize agronomic benefit of ammonium in the material. This report is accompanied by guidance on digestate use.
i. Examination of the PAS100 plant response test, to ensure that it is sufficiently sensitive to persistent herbicide concentrations of known concern, and to calibrate plant symptoms against these herbicides. Code OAV035-003
j. Good Practice Guide for the Use of PAS100 Compost in Landscape and Regeneration. This brings together information and advice on how to source, use and specify compost in various landscaping applications including soil manufacture in brownfield regeneration, erosion control, landscape maintenance, sports ground construction and maintenance, inclusion in Sustainable Urban Drainage Systems, and landscape maintenance. www.wrap.org.uk/landscapepgp
k. Community funding landscape report specifies the methods which should be used to find funding support for both composting and AD projects at the community scale. It also includes an excel spreadsheet of those funds currently available: http://www.wrap.org.uk/content/funding-community-composting-and-ad-projects
l. A draft 'market-based risk assessment framework' has been developed to inform future reviews of the ADQP. This is intended to deliver a mechanism by which any new waste-derived 'products' can (potentially) be screened for use in a range of defined markets. The draft framework is currently being trialled, ahead of potential publication on 2013.
m. A scoping study into edible horticultural crops in Scotland has been undertaken – with particular reference to the agronomic requirements of these crops, and consideration of how PAS100 compost and PAS110 digestate could help fulfil these requirements.

Completed research

Final drafts of all following reports circulated to WRAP agriculture stakeholder group during August 2011. Publication expected in 2013, following final feedback from FSA's independent technical committees.

- n. Investigation into the fate of *Clostridium botulinum* during AD and composting, and subsequent risks to livestock and humans. Code OAV035-001
- o. Risk assessment project to: 1. Examine and quantify the risks from using different kinds of (wet) digestates in different agricultural sectors; 2. Develop a draft 'Biofertiliser matrix' based on the understanding of risks; 3. Develop best practice guidance on how best to use digestates in different agricultural sectors. Code OAV036-008
- p. Investigation into the fate of persistent herbicides during AD and subsequent risks to sensitive crops. Code OAV035-002
- q. Examination of allergens in primary food production systems, with a particular emphasis on contextualising the perceived risks associated with composts and digestates against current conventional and organic practices. Code OAV036-009
- r. ALLOWANCE-Scotland has been published. This is an online GIS tool to help producers identify possible land-based markets for quality PAS110 digestate within their local area. <http://www.zerowastescotland.org.uk/AllowanceScotlandTool>

Environment Agency

- a. **International workshop on bioaerosols from green-waste composting:** Bioaerosols workshop summary
- b. **Full-Scale Composting Experiments at Morpeth:** The results from four large scale composting experiments undertaken as part of a wider project to produce guidance on
- c. **Review of methods to measure bioaerosols from composting sites:** This report discusses the advantages and drawbacks of different methods used to monitoring bioaerosols on composting sites in terms of collection efficiency
- d. **Monitoring the Production of Compost from Wastes on a Continuous Basis:** The report presents information on the resources necessary to operate a commercial waste composting plant for those involved in monitoring schemes
- e. **Review of In-Situ Composting to Accelerate Waste Stabilisation:** A review of the effectiveness of using insitu waste composting in landfills to accelerate the stabilisation of waste is presented
- f. **Health Effects of Composting A Study of Three Compost Sites and Review of Past Data:** The health effects of the composting process have been assessed through a literature review of past work
- g. **Waste Pre-treatment: A Review-**The results of a review of the different options available for pre-treatment of waste prior to landfilling are presented
- h. **Processes and Plant for Waste Composting and other Aerobic Treatment:** The report presents the findings of research into waste composting. The role of composting, the composting process, optimising the composting process and a classification system

Completed research

for composting systems are described
i. Development of Amenity Risk Assessments at Organic Waste Treatment Facilities: This report describes a programme of work exploring innovative risk and amenity impact science for waste management, to underpin policy development and improve process and operational decision-making within the Environment Agency
j. Bioaerosols in waste composting: deriving source terms and characterising profiles: There is little information available about how far bioaerosols can spread from waste sites, and how much of a risk they pose to human health. This report looked at ways to measure bioaerosols and whether they are likely to affect local populations
k. Monitoring the Environment Impact of Waste Composting Plants - N/A research projects to: <ul style="list-style-type: none">• assess the environmental impact of the composting operations
l. The use and application to land of MBT compost-like output – review of current European practice in relation to environmental protection: A comprehensive review of how the compost-like outputs of mechanical-biological waste treatment plants are used across Europe. Compost standards and standard-setting methodologies varied considerably between countries, as did regulations on their use
m. Veterinary Risk Assessment: Exposure of cattle to fungi and yeasts arising from green waste composting units; mycotic abortion and mycotic mastitis- Risk assessment for exposure of cattle to fungi and yeasts from composting units
n. Assessment of MBT input and output quality: This report details further monitoring and assessment of compost-like output from municipal waste mechanical-biological treatment and mechanical-heat treatment plants
Department for Agriculture and Rural Development (DARD) Northern Ireland Climate Change and Renewable Energy Branch
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