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Institute Inc

Australian Government
Department of Education, Employment
and Workplace Relations

# Accelerated Production of Composted Humus with Long-Chain Carbon Polymers

**Joe Garnham**

International ISS Institute/DEEWR Trades Fellowship

Fellowship supported by the Department of Education, Employment and Workplace Relations, Australian Government

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# Executive Summary

Three million tonnes a year of organic waste is currently composted in Australia. Compost Australia estimates up to 20 million tonnes of organic material could be made available for composting each year. This suggests that around 17 million tonnes of organic waste created in Australia is going to landfill. Instead of being used to produce compost to enrich our soil, organic waste in Australian landfill sites is producing methane and nitrous oxide.

Increasing the proportion of organic matter in crop production soils would, over time, deliver substantial improvements in soil structure, greater moisture retention in the soil, improved water penetration and infiltration rates and greater structural integrity aggregation. Improved soil structure in turn means reduced sheet and wind erosion, reduced siltation and sedimentation of water courses, greater soil biological diversity, reduced leaching of nutrients into streams, lakes, oceans and aquifers, lower soil compaction and less need for inorganic fertilisers. Better national health outcomes can then be delivered through improved nutrient content in food products.

Humus is the highly decomposed and stable constituent of the organic fraction in soil. It can take many years to be produced via normal biological and chemical processes. Composting can produce this desirable material within weeks if the process is managed and controlled correctly. There are several ways for organic matter to be rapidly processed into quality compost containing long-chain carbon polymers. Windrow production is used in an agricultural context because of its adaptability to terrain, the volume and availability of feedstock, and reduced complexity in the management of the composting materials. In-vessel production is better suited to situations where a production facility is closer to population centres as it allows for improved management of odour.

A number of key skill deficiencies currently hold back the development of a large-scale accelerated composting industry in Australia. Inadequate knowledge exists to be able to select the specific materials suitable for blending in order to deliver high quality humified compost. Best management practices need to be adopted in accelerated humus production, in particular bulk storage management, accurate interpretation of laboratory analyses of composting material and related microorganisms, and care and maintenance protocols for plant and equipment used in large-scale production.

To help redress these skill deficiencies the Fellow visited Germany, Austria, France and Italy to access the latest composting scientific research, practical techniques and methodologies, and regulatory regimes relating to organic waste recycling and composting production.

The recommendations flowing from the insights and new learnings gained through the Fellow’s experience in Europe are aimed at ensuring that over time a significantly increased proportion of the estimated 20 million tonnes of organic waste produced annually in Australia is converted into a value-added, quality assured product that will help reverse the current trend of declining soil structure and fertility in crop production soils across Australia.

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# Abbreviations and Acronyms

| | |
|---|---|
| AACC | Australian Agricultural Colleges Corporation |
| ACG | Australian Citrus Growers |
| AFSA | Australian Fertiliser Services Association |
| AHEA | Australian Horticultural Exporters Association |
| AIH | Australian Institute of Horticulture |
| AQTF | Australian Quality Training Framework |
| AVETMISS | Australian Vocational Education and Training Management Information Statistical Standard |
| BFVG | Bundaberg Fruit and Vegetable Growers |
| CEC | Cation Exchange Capacity |
| CMC | Controlled Microbial Composting |
| DEEDI | Department of Employment, Economic Development and Innovation, Queensland |
| DEEWR | Department of Education, Employment and Workplace Relations |
| ECN | European Composting Network |
| FIFA | Fertilizer Industry Federation of Australia |
| FNADE | Fédération Nationale des Activités de la Dépollution et de L'Environnement (The National Federation of the Activities of Pollution and Environment) |
| GmbH | Gesellschaft mit beschränkter Haftung (Limited liability Company) |
| GRDC | Grains Research and Development Corporation |
| HAL | Horticulture Australia Limited |
| MIDO | Marketing and Industry Development Officer |
| OHS | Occupational Health and Safety |
| ROI | Return On Investment |
| RIRDC | Rural Industry Research and Development Corporation |
| RMB | Rhein-Main Biokompost (Rhine-Main Bio-compost) |
| RTO | Registered Training Organisations |
| SRDC | Sugar Research and Development Corporation |
| VET | Vocational Education and Training |

# Definitions

### Agitated Bay

A technology that can be best suited to the composting of 'clumpy' materials that have high odour generation potential. The premix of composting ingredients is generally contained in an elongated walled structure that can be situated above or below ground. A turning machine is mounted above the mix and travels along the walls as it turns the mix, predominantly to cause mechanical break down and homogenisation of the mix. Air is forced through the mix via a fan and an under-floor distribution system. The systems are genrally enclosed, hence the exhausted air can be collected for treatment if required. Subsequently the air can be scrubbed through water curtains and biological filters to reduce the odour potential.

### Anaerobic

Requiring the absence of, or not dependant on, the presence of oxygen.

### Biogas

A mixture of gases present, primarily methane and carbon dioxide, resulting from the fermentation of landfill waste in the absence of air (anaerobic fermentation).

### Bio-waste

Organic waste that is liable to decay or spoil. This can include food waste, some agricultural wastes and some sludges (treated sewage). There are two main sources of bio-waste: municipal and industrial/agricultural.

### Cation Exchange Capacity (CEC)

The capacity of soil to exchange positively (cations) and negatively (anions) charged ions between the soil and the soil solution.

### Compost

Broken down organic matter that may, or may not, have been through the humification process to produce the long-chain polymers characteristic of humus.

### Composting

The biological conversion of organic waste under controlled conditions into a hygienic, humus-rich, relatively bio-stable product that improves land and plant nutrition uptake, as well as stabilises and improves soil condition.

### Design

Design is problem setting and problem solving.

Design is a fundamental economic and business tool. It is embedded in every aspect of commerce and industry and adds high value to any service or product—in business, government, education and training, and the community in general.

Reference: 'Sustainable Policies for a Dynamic Future', Carolynne Bourne AM, ISS Institute 2007.

# Definitions

**Feedstock**

Raw material used for chemical or biological processes. The Feedstock that is used for making compost could include any or all of the following: grass clippings, leaves, food scraps, plant trimmings, straw, manure, and solid sewage sludge.

**Fit for purpose**

A 'fit for purpose' product must enhance and improve the soil condition in relation to the crop requirements and soil nutritional requirements while not compromising either, as this could potentially create an additional environmental problem.

**Green waste**

This is urban landscape waste, containing vegetation and plant matter from household gardens, parks and commercial gardens.

**Humification**

Humification is the process of producing humus.

**Humus**

Organic matter that is so decomposed that it can no longer be recognised by its individual components.

**Inoculant**

Bacteria or fungi added to soils in order to improve plant growth.

**KOMPOFERM**

KOMPOFERM is a trademarked anaerobic digestion system that processes dry fermentation with the moistening of input material during digestion of solid substrates.

**Leachate**

A liquid solution that forms as water percolates through waste.

**Long-chain polymer**

A large molecule comprising repeating structural units connected by covalent chemical bonds.

**Microbial environments**

Optimal environments for aerobic (beneficial) microbes to thrive and multiply.

**Organic matter**

Compounds containing carbon from flora and fauna deposited on or within the earth's structural components.

# Definitions

**pH**

Potential Hydrogen: an algorithmic measurement of soil acidity or alkalinity.

**Soil aggregation**

The clumps of soil particles held together by humus, as well as by moist clay and organic matter, such as roots and fungal hyphae.

**Soil compaction**

Soil compressed by livestock or heavy machinery, thereby reducing pore space.

**Skill deficiency**

A skill deficiency is where a demand for labour has not been recognised and training is unavailable in Australian education institutions. This arises where skills are acquired on-the-job, gleaned from published material or from working and/or studying overseas.

Reference: ‘Directory of Opportunities. Specialised Courses with Italy. Part 1: Veneto Region’, ISS Institute, 1991.

There may be individuals or individual firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the intellectual property to themselves. Over time these individuals retire and pass away. Firms likewise come and go.

**Sustainability**

The ISS Institute follows the United Nations for Non-Governmental Organisations’ definition on sustainability: *“Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.*

Reference: http://www.unngosustainability.org/CSD_Definitions%20SD.htm

**Windrow composting**

A process, by which rows of organic material are mixed, managed and, when required, turned to aid in the decomposition of the organic material.

# Acknowledgements

Joe Garnham would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide him throughout the Fellowship programme.

## Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the Institute are our Fellows. Under the **Overseas Applied Research Fellowship Programme** the Fellows travel overseas. Upon their return, they pass on what they have learnt by:

1. Preparing detailed reports to government departments, industry and education institutions.
2. Recommending improvements to accredited educational courses.
3. Offering training activities including workshops, conferences and forums.

Over 180 Australians have received Fellowships, across many industry sectors.

Recognised experts from overseas also conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

> Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.
>
> International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.[1]

In this context, the Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the Institute's work.

For further information on our Fellows and our work see www.issinstitute.org.au.



[1] Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010', pp. 1-2 http://www.skillsaustralia.gov.au/PDFs_RTFs/WWF_strategy.pdf

# Acknowledgements


## Fellowship Supporter

This Fellowship has been sponsored by the Department of Education, Employment and Workplace Relations (DEEWR).

DEEWR provides national leadership and works in collaboration with the States and Territories, industry, other agencies and the community in support of the Government's objectives. DEEWR aims to touch the lives of all Australians in a positive way, working towards a vision of creating a productive and inclusive Australia. Joe Garnham would like to thank them for providing funding support for this Fellowship.

## Supporters

- AgriFood Skills Australia
- ARGE Kompost & Biogas, The Austrian Compost & Biogas Association
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## Individuals and Organisations Impacted by the Fellowship

### Government

- Department of Climate Change – Land Based Sector Consultative Group
- Department of Environment, Water, Heritage and the Arts – On-Farm Infrastructure Land and Water Australia, Native Vegetation and Biodiversity Research and Development Program Management Committee
- Environmental Protection Agencies (Federal and State)
- Regional and Local Governments
- DEEDI Queensland
- Sugar Research and Development Corporation (SRDC)
- Grains Research and Development Corporation (GRDC)
- RIRDC
- Horticulture Australia Limited (HAL)

### Education and Training

- Australian Agricultural Colleges Corporation
- Charles Sturt University
- Horticultural Skills Australia
- Institute of Trade Skills Excellence
- Institute of Trade Skills Excellence Rural Industry Reference Group
- National Industry Reference Group Trade Training Centres Program
- National Industry Skills Committee
- Rural Education Forum Council
- Tocal Agricultural College
- University of NSW – Recycled Organics Unit

### Industry and Professional Associations

- AgForce
- Almond Board of Australia
- Apple & Pear Australia
- Australian Banana Growers Council
- Australian Blueberry Growers Association
- Australian Citrus Growers (ACG)
- Australian Custard Apple Growers Association

# Acknowledgements


- Australian Dried Fruits Association
- Australian Fertiliser Services Association
- Australian Horticultural Exporters Association (AHEA)
- Australian Institute of Horticulture
- Australian Macadamia Society
- Australian Mango Industry Association
- Australian Mushroom Growers Association
- Australian Landcare Council
- Australian Olive Association
- Australian Processing Tomato Research Council
- Australian Society of Horticultural Science
- Australian Vegetable and Potato Growers Federation
- Avocados Australia
- Biological Farmers Association
- Bundaberg Fruit and Vegetable Growers
- Cane Growers Australia
- Cherry Growers of Australia
- Chestnuts Australia Incorporated
- Compost Australia
- Dairy Industry
- Farmsafe Australia
- Fertilizer Industry Federation Australia
- Hazelnut Growers of Australia
- Growcom
- International Federation of Agricultural Producers Climate Change Working Group
- Irrigation Association of Australia
- Lot Feeders Association
- Meat and Livestock Authority
- National Farmers Federation
- Northern Victoria Fruitgrowers Association
- Olive Producers (North East Victoria)
- Olives South Australia
- Organic Farmers of Australia
- Rural Skills Australia
- Summerfruit Australia
- SITA Environmental Solutions
- Vegetable Growers' Association of Victoria
- Veiola Environment
- West Australian Nut and Tree Crop Association

# About the Fellow

**Name:** Joe Garnham

### Employment

- Lead Instructor in Production Horticulture, Environmental Work Practices, Quality Assurance and Chemical Usage at the Dalby campus of the Australian Agricultural Colleges Corporation.

### Qualifications

- Associate Diploma In Horticulture/Business Management, Orange Agricultural College 1994
- Certificate Level IV Workplace Training and Assessment, Dalby Agricultural College 2002
- SmartTrain Chemical Risk Assessment (renewal), North Coast Institute of TAFE 2008
- Commercial Operator's Licence for ground distribution of herbicides – Unrestricted Class 2009

### Memberships

- Australian Institute of Horticulture (National Secretary)
- Compost Australia

The Fellow is also a successful flower grower and has designed a range of training packages incorporating course materials and management strategies for various sectors of the horticultural and agricultural industry.

The Fellow operated his own flower production facility on the Western Darling Downs for almost 10 years using horticultural production principals and technology to successfully grow crops that would otherwise be alien and unsuccessful in that region. He has spent the last 10 years delivering training to the production horticulture sector as an instructor and travelled extensively throughout Queensland, Cape York and the Torres Strait Islands as a consequence of this work.

Because of this work and the travel involved, he has held discussions with producers and observed first hand the difficulties with declining soil structure and fertility.

# Aims of the Fellowship Programme

The aim was to study world-best-practice accelerated composting technology through the production of long-chain carbon polymer humus to enhance soil structure and performance.

Specifically, the international experience component of the Fellowship was structured to facilitate both deeper theoretical knowledge of composting technology as well as the application of new knowledge in the following areas:

- Source materials and mix ratios.
- The processes required to reliably separate bio-waste and green waste at-source with contaminants reduced to a level acceptable for a product to be used on crops destined for human consumption.
- Understanding the supply chain that delivers compost to crop producers in countries such as Germany, Italy, France and Austria.
- Legislative and regulatory frameworks in which composting industries operate in those countries.
- State-of-the-art management practices, equipment and infrastructure and the latest advances in microbiology technologies required for a successful accelerated composting operation.
- The capacity for overseas technologies and methodologies to be adapted in Australia.

The following specific learning and knowledge objectives were identified prior to the Fellow's departure to Europe:

## Equipment and Machinery

- Compost production by windrow, in-vessel and static pile.
- Stockpile management.
- Anaerobic digestion with methane extraction.
- Storage and use to produce electricity for feeding into the main power grids.
- Commercial management of small, medium and large production facilities.

## Production Issues

- Quality assurance procedures.
- Application of product.
- Quality of production facilities—both farm and commercial complexes.
- Product marketing.
- Perceived product 'value' within the various communities.
- Community education.
- Workforce standards and occupational health and safety issues.
- Legislative and regulatory compliance issues.
- Existing and emerging research and technology.
- Separation and control of municipal waste product.

# The Australian Context

The majority of Australian soil is low in nutrients, heavily leached, highly decomposed and predisposed to structural degradation. The best soils for crop production are found along the eastern coastal strip and adjacent southeastern inland regions. However, continued population growth and expanding urbanisation in these regions has resulted in horticultural and agricultural industries increasingly utilising marginal soils for crop production. The outcome is a decline in organic matter and reduced soil fertility.

Higher yields from marginal soils are achieved initially through the use of artificial fertilisers. However, this is not a sustainable solution because marginal soils lack the organic matter to provide the mechanism for binding and retaining nutrients. Furthermore, the excessive tillage required to increase yields in marginal and poor soils further undermines the soil structure.

The more intense the crop production, the faster and more complete the breakdown is in soil structure. One consequence is the stripping of nutrient-rich topsoil by severe dust storms and flash floods. Such cropping practices have the potential to produce Australian regional dust bowls of the kind experienced in the Untied States in the1920s and 1930s.

Increasing the proportion of organic matter in crop production soils would deliver substantial improvements in soil structure over time through greater moisture retention, improved water penetration and infiltration rates and greater structural integrity and aggregation. Improved soil structure would result in less sheet and wind erosion, reduced siltation and sedimentation of water courses, greater soil biological diversity, reduced leaching of nutrients into streams, lakes, oceans and aquifers, lower soil compaction and less need for inorganic fertilisers. Better national health outcomes can therefore result from improved nutrient content in food products.

A number of factors have to date limited the application of compost to agricultural and horticultural crop production. There is a perception that because organic waste is unhygienic, it should not be added to soils in which food is grown. The lack of appropriate locally manufactured composting equipment and the high cost of imported machinery is another limiting factor. There is also limited understanding amongst primary producers about the processes involved in composting and the long-term benefits increased composting would bring to their businesses.

Australia currently has two sets of standards in respect to composting: one for mulches and the other for soil conditioners. However, Australia’s regulatory regime needs to be reviewed and updated to better reflect current scientific understanding of the diverse range of uses of composted products. For example, the New South Wales Environmental Protection Authority’s legislation was adopted in Queensland. It allows manufacture of up to 200 tonnes per year for personal use without having to comply with the standards. Production of more than 200 tonnes mandates a facility capable of coping with a one-in-twenty-five-year rain event, as well as complying with a long list of other requirements and the payment of an annual licensing fee.

Even if 100 per cent of the estimated 20 million tonnes of Australian organic waste were composted each year, this would still not be enough to rectify soil degradation. Policy makers need to consider where composted product is most needed and where it would be used most effectively.

# The Australian Context

For example, some evidence is beginning to emerge that the zero-till approach being taken up by an increasing number of farmers in eastern Australia is resulting in a steady build-up of organic matter. Areas where this is happening would be a lower priority compost production uptake.[2]

Australian conditions favour on-farm windrow composting. This process is simpler and can be integrated into a farm's soil health management operation. The challenge is how material could be source-separated and delivered to the on-farm composting process in a safe, economically viable, and timely fashion.

An important issue for composting in Australia is contamination arising from contractor-separated waste. Source-separated organic waste has lower contamination levels compared to contractor-separated waste. Separation of organic waste at source and its transport is a significant public health challenge. Many local and regional council's have existing long-term agreements with waste management processors that do not accommodate separated waste collection.

Increasing the proportion of organic matter in soil, however, involves more than spreading additional organic matter across the landscape. The natural decomposition of organic matter into humus takes a long time. Depending on particular environmental conditions, the decomposition process can take decades or centuries.

Improving soil structure through the addition of organic matter requires overcoming a number of challenges. The first is to identify the process best able to accelerate the time taken to produce humus suitable for use in different soil environments. The second is sourcing reliable supplies of organic matter to produce on-farm humus in a cost effective manner. Third, having a logistics infrastructure capable of transporting humus from a point of production to various crop production areas. Fourth, educating horticultural and agricultural producers about the economic and environmental benefits of organic matter being added to their soil. Fifth, having in place an effective regulatory regime that mandates production standards.

## Current Education and Training Competencies

Although there is a Commercial Composting Training Package covering Levels II to V embedded within the current Rural Production Training Package, it needs to be updated. Training resources, instructional and assessment tools, learner guides and better access to composting facilities need to be incorporated into a single Training Package.

This is currently being addressed by the composting industry in Queensland. Compost Queensland is working with the Australian Agricultural Colleges Corporation (AACC) and the industry to collect relevant data and information to improve competency, skill and knowledge requirements for a Level III Training Programme qualification that can be offered to both the commercial and on-farm composters. Once this Level III programme is embedded into the AACC curriculum and established as an industry quality assurance requirement, then development of further training programmes will follow.

The Recycled Organics Unit at the University of New South Wales also offers a training programme focused principally on commercial composting.

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[2] Organics Recycling In Australia – Industry Stastics 2008, www.recycledorganics.com

## SWOT Analysis

### Strengths

- Growing community interest in reducing reliance on chemicals for the production of food.
- Research supporting the practice of returning organic matter to the soil.
- Increased awareness by National, State and Local Governments of the benefits of composting.
- Potential to lower agriculture and horticulture production costs.
- Delivers improved environmental outcomes.

### Weaknesses

- Lack of formal training and understanding of composting technology, processes and compliance requirements.
- No ‘on farm’ composting infrastructure.
- Distance between collection and processing hubs.
- Insufficient cost/benefit analysis to provide accurate measure of economic value of large-scale composting.
- Lack of marketing campaigns that promote composting.

### Opportunities

- Increasing community pressure on local councils to reduce landfill programmes.
- Better realisation of the completion of the nutrient cycle.
- Potential investment in high value cropping technology and infrastructure.
- Niche product production to meet specific application requirements.
- Lower crop production costs through substitution of inorganic fertilisers with organic composting.
- Greater crop diversification leading to increased demand for compost.

### Threats

- Low population densities in rural centres.
- Lack of community awareness about the underlying importance of maintaining national soil fertility and productivity.
- Marketing of inferior compost product.
- Increases in compost processing and production costs as source feedstock begins to establish a market value.
- Multinational monopolies.

# Identifying the Skills Deficiencies

The skill deficiencies confronting Australia in being able to create and maintain a large-scale accelerated composting industry are:

1. Inadequate skill sets in the selection of specific materials suitable for blending in order to deliver high quality humified compost.
2. Inadequate knowledge of best practices in accelerated humus production, in particular bulk storage management, accurate interpretation of laboratory analyses of composting material and related microorganisms, and care and maintenance protocols for plant and equipment used in large-scale production.
3. Occupational Health and Safety (OHS) issues particular to the accelerated production process.
4. Environmental Risk Assessment and evaluation protocols to record changes in environmental impact.
5. Underdeveloped capacity to establish, determine and measure carbon sequestration credits.

# The International Experience

Systems have been developed in both North America and Europe that convert organic waste products into humus-rich compost in little more than eight to ten weeks.

The two systems used principally to accelerate the composting process are the Luebkes Controlled Microbial Composting (CMC) system and Midwest Bio Systems. Both produce humus containing a high proportion of long-chain polymers which, when added to soil, increase its surface area and pore space.

The processed humus has higher cation and anion exchange capacity, improved moisture holding and soil aggregation capacity, provides more effective support for microbial environments and populations, has reduced leachate and delivers sustained release of nutrients for optimal plant and crop growth.

Both the Luebkes and Midwest Bio Systems are similar in that they aim to actively manage the chemical, physical and biological requirements of the chain of decomposition reactions. Both require frequent monitoring and recording of moisture, oxygen, carbon dioxide and temperature within the windrows.[3]

Frequent turning of the windrows is a standard practice in the early stages of decomposition of the organic waste. On the basis of temperature, moisture and carbon dioxide data collected, inoculant is introduced into the production process in some instances.

The Fellowship provided Garnham the opportunity to visit a range of facilities in Germany, France, Italy, Belgium and Austria to observe the application of world-best-practice large-scale accelerated composting techniques.

At the European Composting Network (ECN) in Germany the Fellow was given access to the most recent research on accelerated composting. In Brussels the Fellow attended a series of European Union sponsored seminars on waste management seminars. The seminars enabled the Fellow to significantly expand his professional networks.

## Germany

Germany operates a nationwide household waste collection system where households pre-sort organic waste, aluminium, glass, paper and plastic into five separate receptacles. Contractors collect the waste and deliver the product to appropriate facilities.

### Da-Di-Werk, Weiterstadt[4]

**Contact:** Pertl, Manager

Da-Di-Werk treats 8,000 tonnes of organic waste annually. It operates a decentralised system producing high quality compost products employing simple technology that includes a shredder, screen and a mixing shovel for wheel loader and turning. Composting boxes are covered by a Biodegma coretex membranes system.[5]

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[3] The required parameters for moisture (depending on the feedstock being composted) is 45–50 per cent and oxygen concentrations approximately 12 per cent. Temperature needs to be maintained at a minimum of 55–65oC for three days to pasteurise and sterilise. Carbon dioxide concentrations are managed by monitoring and responding to the other parameters.

[4] www.da-di-werk.de

[5] www.biodegma.de/biodegma/english/4/41.html

# The International Experience

### Kompostwerk Nieheim, Nieheim – Oeynhausen[6]

**Contact:** Angela Nottelmann, Manager

Kompostwerk Nieheim produces compost using combined tunnel composting together with partial stream anaerobic digestion.

The annual 85,000 tonnes capacity of bio and green waste tunnel composting plant was enlarged recently by 24,000 tonnes with the addition of a partial stream percolation digestion system. Known as KOMPOFERM, the system can enlarge the processing capacity of existing composting plants through the addition of a digestion step. Alternatively, it can be used as a means to increase the capacity of a biological treatment site that generates biogas. The addition of a digestion step adds value to the process. As methane is produced during digestion, the biogas is scrubbed and used to generate power.

### Rhein-Main Biokompost GmbH (RMB), Frankfurt[7]

**Contact:** Greg Hartung, Manager

Rhein-Main Biokompost GmbH (RMB) was established in 1999. It has a modern treatment plant for separated bio and green waste product sourced from residential and commercial locations across Frankfurt.

A combined aerobic and anaerobic scheme treats 30,000 tonnes of organic waste annually. The subsequent high quality compost and biogas is used to produce power and heat. The process used is the *Kompogas* dry digestion system. Post-composting is located in tunnels. The utilisation of a negative pressure atmosphere in the production process together with expelled air first passing through a biological filter system results in the elimination of odours.

### Humuswerk Main-Spessart GmbH, Alte Ruhe[8]

**Contact:** Thomas von der Saal, Manager

Humuswerk Main-Spessart is a relatively low technology plant that produces 15 varying compost products and mixtures. It processes 25,000 tonnes of bio and green waste annually. The main decomposition phase occurs in boxes. Post-composting is in open piles under a roof. Of particular interest at this site was the environmental monitoring equipment that was installed to monitor odour in the immediate vicinity. This is important to the complex because of its close proximity to medium/high population concentrations.

### Kompotec, Kompostwerk Gütersloh[9]

**Contact:** Sebastian Bohme, Manager

Kompotec, Kompostwerk Gütersloh is a large scale composting plant using agitated bays to produce high quality product. Around 50,000 tonnes of separated bio-waste is processed annually using *Bühler Wendelin* turning technology.

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[6] www.kompotec.de/standort_ni/fset_ni.htm

[7] www.rmb-frankfurt.de

[8] www.humuswerk.de

[9] www.kmopotec.de/guetersloh

# The International Experience

The company also operates a garden products supermarket. In addition to their compost product, the Kompotec, Kompostwerk Gütersloh supermarket sells gardening equipment, growing media, bark, sand, stones and gravel.

## France

French households put all their waste in one bin. Collection contractors are responsible for separating the waste. Non-separation at source results in contamination when items like batteries, plastic, and syringes fall through sieves used to separate the bulk waste. Plastic shredded during the composting process contaminates the end product and creates an additional hazard.

### Fédération Nationale des Activités de la Dépollution et de L'Environnement (FNADE)[12]

*The National Federation of the Activities of Pollution and Environment, Paris*

Fédération Nationale des Activités de la Dépollution et de L'Environnement (FNADE) is the principal organisation representing the waste management industry in France.

The Fellow participated in a two-day seminar as part of the Federation's National Conference. Three waste management companies hold 80 per cent of France's waste management contracts with a collective annual turnover of □1.6 billion.

As well as attending the seminar, the Fellow visited five waste management sites around Paris. The first was an aerated composting facility that processes annually more than 300,000 tonnes of sewage sludge from Paris and the surrounding areas. The Fellow observed farmers lined up to five tractors deep waiting to collect and transport the processed product to their farms. The use of negative pressure and filtration at this facility significantly reduced odour.

Two other municipal solid waste disposal sites were visited. These catered for householders delivering pre-sorted waste for deposit into specific bins: building and construction waste, green waste, electronic waste, white goods, metals and glass. A fee is levied to use the facility. Entry is refused if the waste is not pre-sorted correctly.

### Veolia Waste Treatment Centre, Cergy-Pontoise[11]

**Contact:** Yves Coppin, Environmental Research and Innovation Division, Boris Efremenko, Technical and Investments Division

This multi-treatment site processes 250,000 tonnes of organic waste annually. The Fellow observed the digestion process, accelerated composting, source-separated municipal solids, and the commercial, industrial and recycling drop-off centres. The Veolia Waste Treatment Centre also operates a multi-treatment site in Champagne-sur-Oise that processes waste using incinerators as well as composting.

The Fellow was invited by the Veolia Waste Treatment Centre to consult on the development of regional collection strategies associated with five Veolia Waste Treatment Centre waste collection centres established recently in Perth, Melbourne, Port Stephen, Sydney and Cairns.

[10] The Federation of Waste Management and Environmental Sciences,<www.fnade.com>

[11] www.veolia-proprete.fr

# The International Experience

## Italy

Milanese households separate their domestic waste prior to collection. Bio-waste is placed in smaller containers and is collected by contractors two or three times a week in summer and once each fortnight in winter. The waste does not go to landfill. The collection of organic waste operates in conjunction with, but on a different rotational cycle, to the collection of general refuse. People can also take their bio-waste to a council disposal centre where a gate fee is levied.

### Fertil, Milan[12]

**Contact:** Enzo Favoino, Interpretor

Fertil is contracted by local councils in the Milan area to take up to 80,000 tonnes of green waste, municipal solid waste and bio-waste each year. A significant percentage of processed product is sold in the retail market. The Fellow observed the delivery, processing and treatment of community green waste.

## Austria

In Austria (as well as in Germany) farmers under contract to receive organic material undergo an annual audit to measure organic matter content levels in their soil. Incentives operate for farmers who maintain or increase their soil's organic matter content. Audits showing a decline in content; however, can put a farmer at risk of losing his or her contract.

### Komptech International, Frohnleiten[13]

**Contact:** Markus Maierhofer, Sales Manager

Komptech International is an internationally recognised innovator in mechanical processing of solid waste. Its biomass and mobile composting equipment is used worldwide. The Fellow was given an intensive tour through the organisation and had the opportunity to meet with and discuss latest industry trends and technological developments with Komptech staff involved in marketing and sales, assembly, research and development, and design.

Quality assurance is the major driver of this successful business. Komptech customers inform the company of the feedstock they are using and their anticipated production volume. Komptech then determines the most efficient combination of machinery to meet customer requirements and makes recommendations on the proportional mix of ingredients required to deliver the highest quality product outcome for the customer.

### ARGE-Kompost and Biogas, Graz[14]

ARGE-Kompost and Biogas is the umbrella organisation for five existing national organisations representing more than 430 installations in Austria in the compost and biogas sector.

The Fellow visited two of the company's operations. The first was a dairy farm that is contracted by the local council to collect separated kitchen waste from the local area. The waste is mixed with dairy manure to produce around 200 tonnes of product a year.

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12 www.fertil.it

13 http://www.komptech.com

14 www.kompost-biogas.info

# The International Experience

The farm has produced and used this humus for 20 years. Over that time there has been sustained improvement in soil and pasture performance, together with a consequent improvement in milk quality.

The second farm visited produces compost in windrows. Originally a dairy business, the commercial success achieved from the growth of compost production to 50,000 tonnes a year has resulted in the closure of the dairy operations. The farm now has an exclusive contract with the local council for all municipal waste, including treated sewage. Unfortunately, because the waste is not separated at source, plastic is a major contaminant. Hand sorting the plastic as it comes to the surface after each turning compromises the overall efficiency of this operation.

Agricultural composting associations were established initially as cooperatives in four federal Austrian provinces to collect and process bio-waste into compost. Subsequently the cooperatives evolved into the Association of Compost and Biogas Plants as a quality assurance organisation. The Austrian Compost Ordinance specifies the required quality standards for compost production.

In Austria (population 8 million) some 300,000 tonnes of organic waste is provided for composting each year—an average of 36 kilograms per person. By comparison, Australia (population 22 million) contributes around three million tonnes of organic material for commercial composting each year—an average of 136 kilograms per person.

Compost Australia estimates up to 20 million tonnes of organic material could be made available for composting each year.[15] This suggests that around 17 million tonnes of organic waste created in Australia is going to landfill. Instead of being used to produce compost to enrich our soil, organic waste in Australian landfill sites is producing methane and nitrous oxide. See Attacment 1 for Compost Australia's detailed analysis of the Australian composting industry.

*Primary green waste feedstock material—Urban Public Waste Collection facility—Oelde, Germany, July 2009*

[15] Compost Australia National Marketing and Industry Development Officer Angus Johnstone

*Municipal, separated, green waste feedstock materials that have been delivered to a contracted composting facility—Gütersloh, Gemany, June 2009*

*Domestic seperated food waste that has been delivered to a commercial composter—Austria, July 2009*

*The self-propelled windrow turner—used for mixing and blending—Komptech, Frohnleiten, Austria, June 2009*

*An on-farm windrow—where the decomposition takes place—Lower Austria, June 2009*

*Mature and stable compost—ready for mixing and retail bagging—Fertil, Milan, Italy, June 2009*

*A 30,000–37,000 tonne stockpile of mature and stabilised compost—Fertil, Milan, Italy, June 2009*

# Knowledge Transfer: Applying the Outcomes

Florian Amlinger is a key strategist driving the development of large-scale on-farm composting activities in central and Eastern Europe. Where previously farmers composted materials produced solely on their particular farm, Amlinger has overseen the establishment of infrastructure where organic matter from major population centres can be returned to farms, thereby completing the nutrient cycle.

An invitation was issued by the Fellow for Amlinger to provide a series of seminars in Australia. The seminars were subsequently held in October 2009 at Dalby, Warwick, Emerald and Mackay. More than 200 farmers attended the seminars.

The interest generated among Queensland farmers arising from the initial one-day seminars has led to the development of a non-Australian Quality Training Framework AQTF accredited three-day training course dealing with on-farm composting. Accreditation of course content was subsequently achieved and the training course has been registered for national delivery.

In March 2010 a pilot course was conducted for the Queensland wet tropics primary producers involved in the cane, horticulture, cotton and pasture industries. The goal of this training programme is to provide the necessary tools to improve soil fertility and clod aggregation while simultaneously facilitating a reduction in the use of inorganic fertilisers that can contaminate regional water tables and marine environments.

Since his return from overseas, the Fellow has also been active in expanding his professional networks to ensure that Regional, State and National Governments and relevant government agencies, primary industry associations and educational institutions become more engaged in promoting composting as a means of enhancing environmental and farm sustainability.

The Fellow has also devoted considerable time and resources to working with the commercial composting sector to promote the development of relevant training packages and the benefits to industry in establishing a composting Quality Assurance system.

Progress in the Queensland commercial composting sector is being made in a number of areas including curriculum development, better self-regulation, enhanced working relationships with regional councils and the employment of a Marketing and Industry Development Officer (MIDO). A number of industry representatives are now actively engaged in the promotion of their sector in both Information delivery seminars and the Pilot ‘On Farm’ workshop.

A great deal of time has also been spent encouraging composters and compost users to develop a better knowledge base in relation to product and product quality requirements, as well as work together to increase the profile of compost as a soil conditioner and ameliorant.

Work is also progressing in preparation for a comprehensive training programme for on-farm humification of compost. A steering committee comprising eight individuals from various regions and industry sectors has been established and meets monthly by teleconference. These meeting are followed by update teleconferences with a wider industry group.

This training package will be implemented in 2011. Curriculum development will be finalised in the second half of 2010 for submission and subsequent registration. Once accredited, the training package will be marketed nationally to relevant educational and training institutions and industry associations.

# Knowledge Transfer: Applying the Outcomes

The proposed training package under development is outlined below:

**PACKAGE: RTE32107: Certificate III in Commercial Composting**

**Units of Competencies**

- RTC3701A Respond to emergencies (CORE)
- **RTE3322A** Operate compost processing plant, machinery and equipment
- **RTE3323A** Dispatch materials and composted product
- **RTE3512A** Prepare raw materials and compost the feedstocks (CORE)
- **RTE3513A** Prepare value-added compost-based products
- RTE3713A Carry out workplace OH&S procedures
- RTE3714A Maintain and monitor environmental work practices
- **PMLTEST300B** Perform basis tests
- RTC2301A Undertake operational maintenance of machinery
- RTC2309A Operate tractors
- RTC3705A Transport, handle and store chemicals
- **RTE3319A** Ground spread fertiliser and soil ameliorant
- RTE3801A Provide on-job training support
- RTE3904A Keep records for a primary production business
- RTF3012A Implement a plant nutrition program
- RTF3503A Sample soils and analyse results

The competency units shown in bold above will be able to be credited to participants who have learnt those skills on site in commercial composting operations. These competencies will provide a national qualification for both on-farm and commercial composting. Over time, the training package will drive improvements in compost production standards.

Instructional materials, learner resources, assessment tools, industry moderation and content mapping are required to be compliant with the AQTF and the Australian Vocational Education and Training Management Information Statistical Standard (AVETMISS) requirements prior to submission for registration of the curriculum and relevant Registered Training Organisations (RTOs) being given approval to deliver the content.

# Recommendations

## Government

Increasing the collection, conversion and utilisation of organic waste will help stabilise and improve the fertility and structural integrity of Australia's crop production soils.

A nationally coordinated action program to boost the recycling of organic waste would deliver the following beneficial outcomes:

- Reduce the area required for landfill.
- Increase the total organic matter content of Australian crop production soils.
- Reduce the amount of carbon dioxide and methane released into the atmosphere.
- Reduce leaching and sedimentation of waterways.
- Improve soil moisture holding capacity.
- Reduce surface crusting, soil compaction and leaching of nutrients.
- Restore microflora and microfauna populations in depleted soils.
- Increase the spectrum and profile of productive soil nutrient elements without the need to add inorganic fertilisers.

### Recommendations

- That the Australian Government work with State and Territory Governments to raise public awareness of the value of recycling organic waste products.
- That the Australian Government work with State and Territory Governments, the composting industry, and farmer representative organisations to develop better management practices that will deliver increased use of composted product in crop production operations.
- That Local Government authorities—both municipal and regional—work with the composting industry and local environmental interest groups to create new supply chains for municipal and urban organic waste in order to reduce reliance on landfill operations.

## Industry

Education and demonstration is crucial to achieving a greater volume organic waste conversion into composted product for incorporation into degraded crop production soils.

### Recommendations

- That a national steering committee be established to develop and oversee the implementation of a suite of strategies to generate greater community understanding of the importance of at-source organic waste recycling. The steering committee should comprise: representatives of the Australian Agricultural Colleges Corporation, the Australian Institute of Horticulture, Compost Australia, commercial compost producers, the Recycled Organic Unit at the University of NSW, representatives of national and state primary industry departments and local and regional councils responsible for the management and operation of landfill facilities.
- That the national steering committee establish research sites in a variety of crop production areas to validate the claim that the addition of composted product both improves soil health and fertility, and positively impacts the profitability of the organisation whilst employing the 'fit for Purpose' principals.

# Recommendations

## Industry Associations

**Recommendation**

- That compost producers utilise the resources of Australian farmer and horticultural industry associations to disseminate information on the commercial and environmental benefits of organic matter recycling for composting.

## Education and Training

Commercial composting operators have learnt their trade principally by trial and error. There are no formal training programmes for primary producers in compost production for delivery on-farm. Current curricula in Vocational Education and Training (VET) and tertiary level courses do not satisfactorily explain the role of organic matter in soil or its importance to society.

Although a Commercial Composting training package is available within the Rural Production Training Package (RTE32107: Certificate III in Commercial Composting), no student or instructor resources have been written to accompany this package. The Australian Agricultural Colleges Corporation has the expertise to develop an accredited training programme in composting. This can be developed and delivered in association with national and state composting industry peak bodies. A great deal of work has already been undertaken and it is anticipated that the first training Level III programme will be ready for delivery at the commencement of the 2011 training year.

**Recommendation**

- Implement accredited training and education programmes to up-skill industry participants at all levels in the science and technology of organic waste recycling.

## ISS Institute

**Recommendation**

- That the ISS Institute facilitate an international symposium focused on organic waste recycling and use its extensive industry and government networks to engage with relevant public policy and industry decision makers to help drive greater uptake of organic waste recycling in Australia.

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# Attachments

## Attachment 1. Compost Australia[16]

### A National Plan for the Conversion of Organics from Urban Environments into Compost for Agricultural Soils

#### Background

Carbon and nutrients currently flow from the country to the city mainly as food and fibre. A large proportion of that material takes just a few days to be consumed (and digested) or is simply wasted, almost immediately becoming food waste and sewage. Urban landscapes also produce hundreds of thousands of tonnes of plant matter from homes, businesses and public spaces. This is an enormous wasted resource that Australia has barely tapped.

In the past most of this material has been disposed to landfills, rivers and oceans. More recently some of it has been recovered and used in gardens, roadsides and other public spaces. Over 4 million tonnes of organics generated in cities, mainly garden organics, is already being used to make composts and mulches. It is estimated that there is at least another 16 million tonnes of organics, including plant matter, untreated timber, bio-solids and food that are still being wasted.

Even now very little of the carbon or nutrients taken from the soil gets back to the agricultural land from which it came. In effect Australians have been mining the top-soil [sic] for carbon and nutrients, and in most cases the land didn't have much of either to begin with. In excess of 75% of Australian agricultural soils now contain less than 1% organic material.

Commercial composting represents a huge opportunity to convert a perceived waste problem into an organic resource for Australian agriculture. Land degradation, greenhouse gas emissions, reliance on irrigation water, and reliance on expensive imported inorganic fertilizers can all be ameliorated by application of recycled organic products to agricultural land.

Due to market and policy failures, economic incentives and changes to government policy settings are required to transition to a more sustainable system where it becomes common practice to return carbon and nutrients from cities to agricultural land.

#### The Case for Government Intervention

Many of the environmental benefits associated with the use of compost products flow to the broader community not solely to the prospective compost buyer; they are in effect public goods. For example the environmental services provided by compost as it stores carbon in the soil or reduces nutrient run-off into a local stream is of no direct financial benefit to a farmer but is good for the community as a whole. This market failure is a crucial barrier to the use of compost in finely tuned production based agricultural systems like vegetable growing or viticulture.

The two main barriers to greater uptake of compost product have been identified as *price* and *lack of product knowledge*.

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16 This paper is re-printed with the kind permission of Compost Australia. Compost Australia is a division of the Waste Management Association of Australia and the peak national body for the organics processing and recycling industry. www.wmaa.asn.au/director/divisions/compost.cfm

Compost products are relatively expensive to transport over long distances due to their relatively low density and high moisture content. Agricultural markets are often distant from the urban areas where large quantities of organic waste are generated and compost products are made.

The majority of state governments in Australia are encouraging the diversion of organic matter from landfill by levying fees on each tonne of waste disposed. The resulting pressure on the supply of recovered organics without a matched emphasis on creating demand for compost and mulches is limiting the growth of organic recycling in Australia.

The application to land of most agricultural wastes, such as animal manures, is not currently regulated. This means they can be applied to land without incurring treatments costs such as pasteurisation or composting. Despite the environmental and agronomic risks associated with these untreated wastes they are often sold in direct competition with properly treated quality composts and mulches. Untreated wastes can be provided to the farmer at a lower cost because the costs of environmental damage have been externalized. This is another major barrier to composts and mulches being used in agricultural applications.

Without appropriate assistance from Australian governments these barriers may never be overcome, meaning the benefits quantified below will not be realised.

**Benefits to the Environment and Agriculture**

*Climate Change*

Composting diverts organic material from landfill where it is responsible for generating methane, a greenhouse gas 25 times the potency of carbon dioxide. Saving one tonne of organic material from landfill saves in the order of 0.9 to 2.7 tonnes of carbon dioxide equivalents. Increasing and maintaining soil carbon in agricultural soils can sequester atmospheric carbon. One tonne of composted mulch applied to land can sequester approximately 0.25 tonnes of carbon dioxide equivalent.

Fertiliser production is very energy intensive and applying fertiliser results in nitrous oxide losses to the environment; substituting composts for fertiliser thus results in greenhouse gas abatements. Compost offers Australian agriculture a way to reduce its reliance on chemical fertiliser, adapt to climate change and respond to any increase in costs resulting from a CPRS.

Compost also increases resilience in agricultural systems thus providing Australian agriculture with the necessary tools to adapt to climate change impacts via measures such as; buffering of soil temperature fluxes (to deal with temperature extremes) and improving the water holding capacity of soils (to increase drought tolerance).

*Landfill Pollution*

Composting diverts organic material from landfill where its high water content generates liquids (leachate) which mobilize other pollutants in landfills and then disperses them into the environment. In addition appropriate space for landfill is becoming limited. Given that organic materials represent approximately half of the waste disposed to landfill, composting significantly extends the life of existing landfills.

*Agricultural Production*

Compost use in agricultural production can take several years to realise its full agronomic benefits. However, an average 1–2% increase in yield can be expected per tonne of compost applied. While much larger increases in yield have been observed in specific circumstances (for example where soils are highly degraded) this range offers a conservative basis for calculating agricultural production benefits.

Australian organic waste generation from all sources is in the order of 20 million tonnes per year. Using conservative nutrient levels of 1.0% nitrogen, 0.4% phosphorus and 0.75% potassium, reusing organic wastes has the potential to replace 240,000 tonnes of urea, 525,000 tonnes of super phosphate and 225,000 tonnes of potassium sulphate (calculated on a dry weight basis assuming average 40% moisture content in compost). Given the high cost of local and imported fertilisers and the increasing scarcity of key nutrients internationally this offers Australian agriculture an amazing resource for the future.

Depending on application rates and contexts, composts can save more than 30% of irrigation water. This translates to a saving of between 0.13 and 0.95 ML of water per hectare per year, depending on crop and soil types.

*Land Conservation*

Declining soil productivity is associated with reduced organic carbon levels. Since the industrialised era began it is estimated that around 15% of the increased atmospheric carbon dioxide level is due to agricultural activity. Organic carbon, because of its influences on fertility, biological health and physical properties is centrally important to soil productivity.

Soil in poor physical condition is subject to erosion leading to the loss of valuable topsoil. Savings of between 2.3 and 17 tonnes per hectare of soil loss due to erosion can be achieved with recommended mulch applications.

**Economic and Policy Instruments Suitable for Diverting Compost to Agriculture**

Compost Australia recommends five steps to realising the benefits to the environment and Australian agriculture described above:

1. Provide a level playing field for competition by negotiating with the state governments to extend existing regulations to cover land application of all organic wastes (not just composts and mulches derived from urban wastes). At a minimum this should require pasteurisation of all putrescible organic material before it is applied to land. This will have the effect of making composted materials, including composted agricultural residuals, more economically attractive to growers.
2. Having removed a relatively low cost source of nutrients for growers, provide a per tonne rebate to growers who apply approved composts in appropriate manner to agricultural land. This may be funded by state governments through their waste their levies or directly by the federal government as a complimentary measure to the Carbon Pollution Reduction Scheme. The rebate offers an ideal way to assist Australian agriculture in transition to a low carbon economy.
3. Using the existing Australian Standard for Composts, Soil Conditioners and Mulches as a starting point, work with the industry to define the compost that qualifies for a rebate. The rebate must provide sufficient incentive for growers to trial compost in their situation and integrate it into their production system.

4. Support R&D programs focused on compost use in agriculture by providing matched funding for money raised by the Recycled Organics Industry. Knowledge, and the conversion of knowledge into practice, is necessary to reap the full benefits of composts in agriculture.
5. As the uptake and availability of quality, 'fit for purpose', composted products reach target levels reduce or phase out the rebate whilst monitoring the impact on compost use. In the medium to long term there is sufficient agronomic value in 'fit for purpose' products to justify the cost of production and transport.

It is crucial that this plan does not result in more unsuitable, poorly treated organic wastes being disposed of to agricultural land. Delivering the rebate to growers ensures that they are in control of what they purchase and that compost manufacturers must still compete to supply the market with 'fit for purpose' products.

This is a transitional plan not an ongoing program. A small number of compost manufacturers around Australia have successfully differentiated their products in the marketplace and command prices of more than $100 per cubic meter ($140 per tonne) in agricultural markets. This is a real world demonstration of the value that compost can deliver to agricultural production. This plan gives both growers and manufacturers the opportunity to realise that value on a large scale.

**Logistics of Production and Transport**

Nationally organic recyclers are in a position to deliver and spread at least 2 million tonnes of quality, 'fit for purpose', composts and mulches on agricultural land each year from 1 July 2010. Application rates vary depending on compost use, however 20 tonnes per hectare represents an average suitable application rate across a range of uses. Under this plan a limited amount of compost would qualify for the rebate each year.

*Recommended Quantities Available for Application to Agriculture*

| State | Compost and Mulch (tonnes) | Coverage (hectares) |
|---|---|---|
| Queensland | 400,000 | 20,000 |
| New South Wales | 500,000 | 25,000 |
| Australian Capital Territory | 100,000 | 5,000 |
| Victoria | 400,000 | 20,000 |
| South Australia | 300,000 | 15,000 |
| Western Australia | 300,000 | 15,000 |
| National | 2,000,000 | 100,000 |

Note: The Northern Territory and Tasmania have been excluded from the plan because production capacities and capabilities are unknown at this time.

The program should provide sufficient time to allow growers to experience the benefits of compost use and integrate it into their growing systems. It is then recommended that, as agronomic value is demonstrated, the rebate be phased out over time. Trials have shown that the full benefits of compost use are realised over a three to five year period.

| Financial year ending 30 June | Rebate ($/tonne) |
|---|---|
| 2010 | 0 |
| 2011 | 30 |
| 2012 | 30 |
| 2013 | 30 |
| 2014 | 20 |
| 2015 | 10 |
| 2016 | 0 |

Industry experience suggests that a rebate of $30 per tonne (applied) would provide sufficient incentive for most growers to use compost. Composted soil conditioners suitable for agriculture currently sell for anywhere between $30 and $150 per tonne (applied), with the majority of sales at the lower end of this scale. Costs to produce, transport and apply such products start at approximately $50 per tonne and are greatly influenced by the cost of transport.

Assuming the rebate is fully taken up by growers, the cost of the scheme to governments would be $60 million per year or $240 million over five years. This is offset by average tangible benefits to agriculture and the environment of $165 million per year, a 275% annual ROI (see table over page). This calculation ignores the value of reduced erosion and sediment flow, reduced nutrient flow into rivers and oceans and the long term improvements to soil health and productivity, which ware not yet quantifiable.

Based on existing economic activity created by the Recycled Organic Industry, the manufacturing of an additional 2 million tonnes of compost products would create at least 500 new jobs (1 job per 5000 input tonnes) and stimulate direct economic activity of over $250 million ($90 per input tonne). This plan will guarantee ongoing growth of organic recycling as compost becomes a mainstream product in agriculture.

*Value of Tangible Benefits by State Each Year*

| | Cost | Water saving | Value of irrigation water saved | Carbon abated or sequestered | Value of carbon | Value of yield increase |
|---|---|---|---|---|---|---|
| | **$** | **ML** | **$** | **t CO2-eq** | **$** | **$** |
| **QLD** | 12,000,000 | 21,000 | 21,000,000 | 600,000 | 6,000,000 | 6,000,000 |
| **NSW** | 15,000,000 | 26,250 | 26,250,000 | 750,000 | 7,500,000 | 7,500,000 |
| **ACT** | 3,000,000 | 5,250 | 5,250,000 | 150,000 | 1,500,000 | 1,500,000 |
| **VIC** | 12,000,000 | 21,000 | 21,000,000 | 600,000 | 6,000,000 | 6,000,000 |
| **SA** | 9,000,000 | 15,750 | 15,750,000 | 450,000 | 4,500,000 | 4,500,000 |
| **WA** | 9,000,000 | 15,750 | 15,750,000 | 450,000 | 4,500,000 | 4,500,000 |
| **National** | 60,000,000 | 105,000 | 105,000,000 | 3,000,000 | 30,000,000 | 30,000,000 |

# Attachments

*Assumptions*

| Parameter | Value | Units | Notes |
|---|---|---|---|
| Average gross yield value | 20,000 | $/ha/yr | Intensive irrigated agriculture |
| Average yield increase | 1.5 | % | |
| Carbon price | 10 | $/t | |
| Carbon abated or sequestered | 1.5 | t CO2-eq/ tonne compost | Excludes carbon abated through reduced fertiliser use |
| Average irrigation water demand | 3.5 | ML/ha | Intensive irrigated agriculture |
| Average water saving | 30% | | Not realised where natural rainfall meets or exceeds plant requirements |
| Average cost of irrigation water | 1000 | $/ML | High security water costs up to $3000/ML in MDB and is not always available |
| Rebate | 30 | $/t | |
| Average application rate | 20 | t/ha | |

**Defining Compost**

It will be important to define ‘compost’ for the purpose of administering the rebate, realising the pubic and private benefits, and ensuring that unsuitable products do not undermine the value of compost into the future.

Compost is defined by the Australian Standard for Composts, Soil Conditioners and Mulches (AS4454) which was updated in 2003 and will be updated again during 2009. Compost can be manufactured from a number of organic materials including many organic wastes. Compost is defined by its physical, chemical and biological properties.

*Compost Categorised by Particle Size (Physical Property)*

| Category | Particle size | Common use and action |
|---|---|---|
| Soil conditioner | <8 mm | Incorporated in soil to add carbon and nutrients, increase biological activity and increase water holding capacity. |
| Fine Mulch | 8–16 mm | Delivers a compromise between the properties of mulch and soil conditioner |
| Mulch | >16mm | Provides a long-term (3+ year) physical barrier to reduce evaporation, improve soil water holding capacity, buffer soil temperature and gradually add carbon to the soil. |

# Attachments

Particles >30mm are generally considered oversize and must either be ground into finer materials or used to produce energy or, through pyrolysis, energy and bio-char. In this way composting and pyrolysis can be complimentary activities.

Guidelines and standards exist for both physical and chemical contamination of composts and can be applied to set maximum contamination levels for use in agriculture when implementing this plan. Guidelines have also been developed by Compost Australia to assist manufacturers produce ‘fit for purpose’ products.

Compost most often fails in agricultural applications due lack of attention to its biological properties of stability and maturity. A more stabile and mature compost takes more time and effort to produce (and more process control) and therefore has a higher production cost. As most growers don’t understand the risks of unprocessed or poorly processed organic materials they are unwilling to pay more for stable, mature products.

The 2009 revisions to the Australian Standard will provide the tools to measure and set minimum standards for stability and maturity in a variety of agricultural applications. The stability of an organic material falls into the follow four broad categories:

1. Raw or untreated products
2. Pasteurized products
3. Composted products (stable)
4. Mature products (stable and mature)

In most cases agricultural applications require more stable and mature products (category 3 and 4).