

Waste 2 Gold
*Deconstruction Technologies for
Organic Waste Utilisation*



The Challenge

New Zealand discards 1,272,000 tonnes/year of organically-based waste (food wastes, putrescibles, timber, paper, textiles, nappies and sanitary products) and 253,000 tonnes of sewage biosolids to municipal landfills. A further 560,000 tonnes of industrial organic waste is disposed to company landfills. These organic solid wastes create some of the greatest concerns regarding landfill operation:

- represent a high proportion of wastes entering landfills in New Zealand;
- high moisture content makes transport costs high;
- under landfill conditions, organic wastes generate large volumes of methane, a potent greenhouse gas;
- nutrient run-off from the landfills contribute to algal blooms in waterways; and
- some organic wastes, such as wastewater treatment plant biosolids, contain hazardous pathogens or heavy metals, creating health and safety issues.



Significant diversion of these wastes from landfills remains a considerable challenge, despite legislative and economic pressures and voluntary efforts. For example, available technologies for organic waste are only partially successful due to a range of factors including:

- inability to achieve required volume reductions (e.g. anaerobic digestion);
- significant land areas required (e.g. vermicomposting);
- odour generation (e.g. windrow composting);
- inadequate energy balances (e.g. incineration or drying);
- lack of sufficient quality control and markets for diverted products (e.g. compost); and
- contain contaminants that preclude substantial re-direction (e.g. heavy metal limits for land application of biosolids).

The challenge is to turn these seemingly intractable management problems into compelling economic opportunities. NZ's organic wastes can be a valuable, high volume source of energy, biomaterials and fertilisers. Exploiting these resources in a sustainable manner is the opportunity addressed by the Waste 2 Gold initiative.

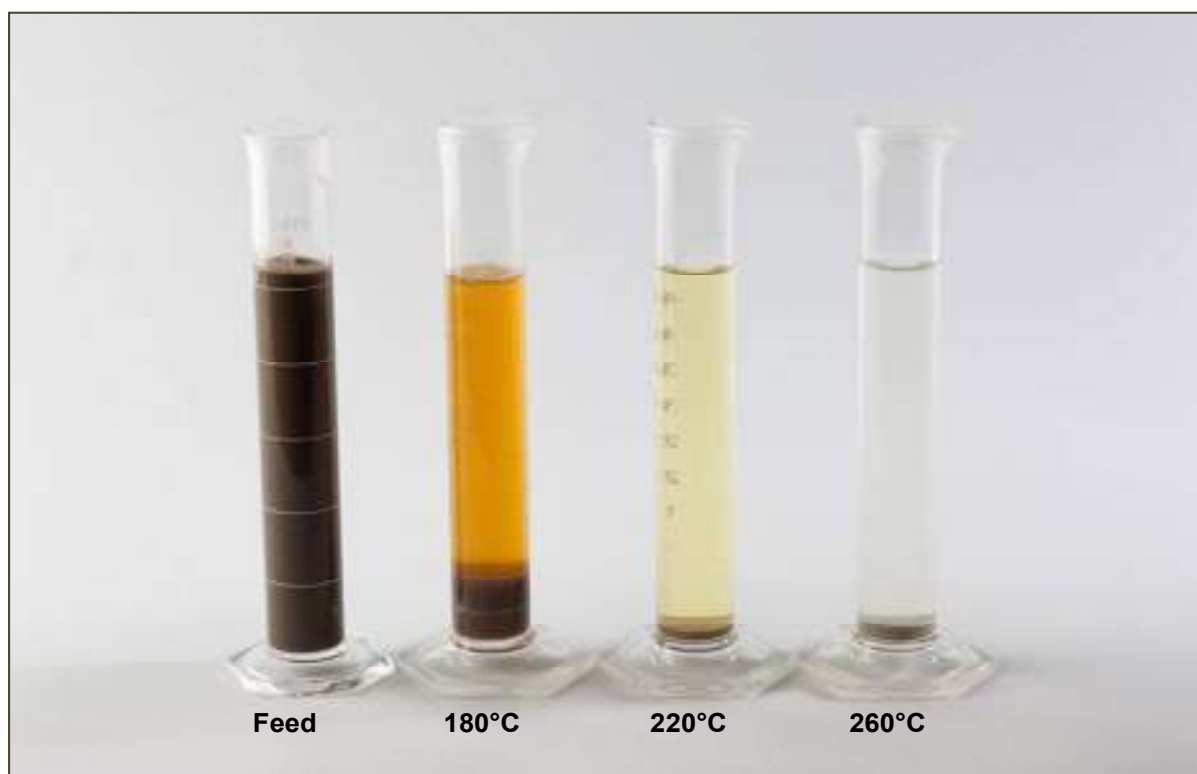
The Solution

The Waste 2 Gold initiative is developing innovative technology platforms that address political and operational drivers for more efficient diversion of organics from landfills by:

- achieving substantial volume reductions;
- maximising energy recovery from these negative-value materials;
- generating added value co-products wherever possible; and
- ensuring that pollutants are destroyed or segregated.

Scion's thermal oxidation process deconstructs wastes to combine substantive volume reduction with maximum value recovery. A combination of biological and chemical steps generate carbon-rich by-products (essentially a vinegar solution) and recover nitrogen and phosphorus (low cost fertilisers) with the following benefits:

- Landfill costs: 96% reduction;
- Greenhouse gases: 76% reduction;
- Wastewater treatment plant costs: 36% reduction;
- Eutrophication: 40% reduction;
- Ozone generation: 90% reduction.



Results of deconstruction – original sewage biosolids on left; final product on right

Organic wastes amenable to the technology represent 53% of the total waste volume entering public landfills, plus wood waste currently entering cleanfills and company landfills and sewage biosolids from wastewater treatment plants.

The primary customers for the process are seen to be Territorial Authorities and specific primary industry operators (e.g. dairy, meat, pulp and paper, food processing) which generate large volumes of organic waste.

Current status

Rotorua District Council has identified sewage biosolids as their key waste issue due to handling, downstream impacts and disposal constraints. The proportion of biosolids composted by RDC has decreased from 90% to 10% due to product quality and market development difficulties. Incineration and drying have been discounted as alternative options.

Phase 1 of the project has been completed by Scion with funding support from Rotorua District Council. This project has addressed the key technical barriers (at laboratory scale) to using the Waste 2 Gold concept for RDC sewage plant biosolids. This has shown that there is a potential to achieve a 30-fold reduction in final disposal volumes of biosolids from their plant and the capacity to substantially offset current carbon supplementation costs for nutrient management (RDC currently has to add ethanol to their sewage to ensure good performance). Economic and life cycle analyses confirm that such a process can provide a significant net commercial and environmental benefit to RDC (approximately \$1.4 M per year for biosolids alone).

Opportunities have been identified for a) novel segregation of carbon, nitrogen and phosphorus for efficient value recovery; and b) hybrid chemical-biological digestion systems, which has formed the basis for an international patent application. To our knowledge, no commercial technology cost effectively processes such a broad range of organic wastes with this level of economic and environmental benefits.

Phase 2 of the project will install a pilot scale system at the RDC plant. Successful completion of the Phase 2 project will lead to design specifications for a full-scale reference plant at the Rotorua District Council Wastewater Treatment Plant (WWTP) that can divert 8,100 tonnes of biosolids waste annually. This is expected to catalyse an inter-regional expansion of the technology commercialisation for a broader range of landfilled materials, encompassing municipal biosolids, domestic organic wastes, and primary industry organic wastes – we will effectively be able to “mine” NZ’s landfills for economic gain.

The net benefit of the process relative to landfilling is calculated to be \$490/dry tonne waste. This analysis does not include the opportunities for fertiliser production or converting the waste carbon to more advanced higher value biotechnology applications, such as bioplastics and biofuels manufacture (such applications are already subject to patents by Scion).

In summary, this technology offers the potential to divert 73% of all organic wastes in the Bay of Plenty from landfills within 10 years. To put this in perspective, this would see approximately 15% (398,000 tonnes) of NZ organic wastes transformed from an environmental negative into an economic positive worth at least \$25 million/yr.

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