

MUNICIPAL COMPOSTING SCHEMES

2016

Report prepared by Vivienne Altman

INTERNATIONAL
CASE STUDIES



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PREFACE

This report contains summaries of international examples of kerbside collection of compostables in urban environments. It was prepared as part of the CRC for Low Carbon Living project:

Carbon reductions from composting food waste for food production – fitting recycling models to urban form.

A diverse range of cities has been included to illustrate different strategies for implementation and for engaging citizens. The reasons these cities have undertaken kerbside food scrap collection and composting programs include landfill closure, environmental consciousness and cost savings. The cities compiled in this report were chosen and investigated through desktop internet research and each promotes source separation of compostable waste. In most cases the compostables are taken for off-site composting, but in several cases, this is preceded by anaerobic digestion. Although the focus is on cities in industrialised countries, several towns have been included as well as three cases from Asia and South America, in order to illustrate particular unique aspects.

In order to facilitate browsing, and to allow the reader quick access to relevant information, the summary for each city is structured using the following headings:

- Context
- Organizations responsible for implementing the scheme
- Method of introduction
- Publicity, information and education
- Policy/legislative changes contributing to success
- Waste-collection arrangements
- Composting process,
- Quality of product
- Use of end products
- Financial aspects
- Other benefits (where applicable)
- Problems (where applicable)
- Lessons learned (where applicable)

The report is designed to give an overview of, and introduction to, a range of food scrap collection/composting schemes. References and contact details for more information on each case are provided at the end of the report.

It is important to note that there may be limited information for case studies of cities in countries where English is not the native language. Also, unless specified otherwise, local currencies are used.

Dr Vivienne Waller
Project Leader
Carbon reductions from composting food waste for food production

BOULDER, USA

Boulder, Colorado (USA) covers roughly 66.5 km² and is home to around 105,000 inhabitants. It is a low density city with approximately 4000 people per square mile. The climate is semi-arid and predominantly sunny. Winters can get extremely cold with an average snowfall of 220cm per season.

Organisations Responsible: Boulder County, City of Boulder, Western Disposal (waste hauler servicing 95% of the city), Eco-Cycle (non-profit recycler)

Method of Introduction:

- The City hosted a pilot program to test the proposed system. The pilot included 400 households across two neighborhoods, beginning in April 2005 and running for 6 months. By April 2006 the pilot had expanded to include 2,400 households. The remainder of the rollout was staggered across the city and by 2009 the entire city was receiving the service.
- The proposed change to the system involved a restructure of existing practices. Prior to the change residents had 3 bins per household: 1 bin for plastic, 1 bin for paper and 1 bin for landfill. The new system involved combining all recyclable materials into the 1 bin freeing up the third to collect organic waste.

Publicity, Information and Education:

- The city is encouraging all citizens to compost and provides free workshops twice-weekly to those citizens who wish to participate in home composting.
- The waste haulers are responsible for the distribution of educational brochures provided by the city.
- Instructional videos and information flyers are available to all residents via the City's website.
- Eco-Cycle provides educational programs to Boulder Valley School District schools and these programs are also partly funded by the city.
- A twice yearly newspaper is produced by Eco-Cycle providing up-to-date tips and information on recycling and waste issues which is partly funded by the City.

Policy/Legislative Changes Contributing to Success:

- Since 2008, organic waste collection is mandated by the City.
- Since 2009 it is a requirement of the City that waste haulers must provide minimum level compost collection services as part of the standard service.
- The city defines 'compost service' as providing the citizens with a 32-gallon (120 litre) container as well as 3 paper bags for disposal of green waste.
- At the same time the city implemented a new PAYT system, in which the fees were set according to the amount of waste disposed.
- For multi-unit residences, haulers must provide both compost & recycling containers, with a minimum size of half the volume of a standard waste container, free of charge.
- Due to the threat of wildlife, such as bears, Ordinance No. 7962 was adopted which stipulates that all waste (excluding recycling) must be secured from bears at all times until collected by the waste hauler.

Waste-collection arrangements

- Since the implementation of Ordinance 7962, all organic waste can be collected from the kerbside, including meat and dairy items (previously excluded).
- All food scraps are accepted along with non-recyclable paper products including waxed products, food-soiled products, napkins and paper towels as well as any certified compostable product (bags, utensils etc.).
- Not accepted is plastic (of any kind), frozen food containers, construction debris, liquids, faeces or nappies.
- Compost and recycling are collected from the kerbside on alternating weeks.

- According to Boulder County an estimated 23,261 single-unit residences participated in kerbside organic waste collection in 2015.

Composting process

- In 2007 Western Disposal completed the upgrade of their facility, which is located 4 miles from the city centre, in order to accommodate the expansion of the initiative.
- Western Disposal uses the windrow method to process over 18,000 tons of organic material, equating to 20,000 cubic yards of compost each year.
- The combination of green waste and brown organic waste are combined through an industrial grinder, and this creates the required carbon:nitrogen balance for the micro-organisms to naturally break down the waste.
- Once the combined matter has been ground, it is formed into windrows and left to process. Temperature, air flow and moisture are all monitored and the windrows get aerated 5-6 times during the composting process. Matter remains in the windrows for 4-5 months.
- Once the temperature drops below 50°C it gets moved to a finishing pile where it cures for another 30 days.
- A final screening process removes any larger pieces or contaminants that failed to break down.

Quality of product

- All compost produced at the Western Disposal plant meets the standards set out by the US Composting Council's Seal of Testing.

Use of end products

- Residents of Boulder are able to obtain free compost materials at several compost facilities scattered across the city.
- Landscape professionals and larger local consumers can purchase products at Western Disposal.
- The compost products are suitable for application on trees, shrubs, flowers, lawns and vegetables.
- The Western Disposal website provides information on the proper use of the final product as well as the benefits.

Financial aspects

- In 2000 an ordinance in the city was passed which brought in the PAYT rates, as well as shifting the responsibility for the collection of recyclables into the hands of private haulers. This new system required haulers to provide free unlimited recycling services.
- The City of Boulder assisted the private sector financially using its \$1.8 million (USD) annual 'trash tax' revenue that was previously supporting the city-run recycling program.
- Haulers may not charge more than 75% of the standard trash service rate for extra compost collections incentivizing recycling over landfilling.
- Boulder waste collection operates within an open market, meaning residents may choose their own licensed hauler for their services.
- Rebates and financial incentives are in place to encourage multi-unit dwellings and commercial businesses to participate in composting their organic waste.

Problems

- The Western Disposal facility located 4 miles outside the city does not accept waste collected by other haulers. The remainder of the organic waste collected must be transported more than 30 miles outside the city to be processed at another facility.
- The City is having some difficulty distributing the final compost product and suggest this may be due to large consumers (such as farmers) lacking education surrounding the benefits of compost.
- Colorado State Law prohibits the City to legislate contract schemes between haulers and institutions (including multi-unit dwellings and commercial businesses), which is why there are rebates and financial incentives in place.

PORTLAND, USA

Portland, USA has a population of approximately 610,000 people in a city that covers an area of roughly 375.5km². While there are high-rise, multi-unit dwellings in the city centre, the majority of dwellings are single-unit dwellings. The climate is temperate.

Organisations Responsible: Metro (Regional Government Body), The City of Portland: Bureau of Planning and Sustainability, 37 privately owned haulers (15 franchised residential haulers) as well as more than 80 privately-run composting facilities

Method of Introduction:

- In May 2010 a pilot program was initiated involving 2000 homes around the city. The pilot ran for a period of 18 months.
- The city conducted customer surveys and focus groups of the pilot program. This feedback was vital to the success of the city-wide implementation.
- Based on the success of the pilot program, the initiative was rolled out to all the residential properties in the city on the 31st of October 2011 (the rollout to commercial properties and multi-unit residences occurred at a later date).

Publicity, Information and Education

- Information was distributed to all households prior to the commencement of the program; an official Government letter outlining the program as well as some colourful fact sheets.
- One week before the program was due to begin a 'tool kit' was distributed to all households. This included an information guide on the new system, a new collection schedule, a magnet and a 2-gallon (8 litre) kitchen pail in which to collect the organic waste.
- The city ran a "Portland Composts!" campaign involving radio, print and transit advertising, face-to-face communications at community events and a telephone hotline (ongoing).
- A composting newsletter produced by the city is distributed to all residents twice yearly with recipes, tips, and other related information.

Policy/Legislative Changes Contributing to Success:

- "Portland Recycles!" Plan (2007); outlines the steps towards a more sustainable city, focusing on waste procedures.
- 'Climate Action Plan' (2009); the city's plan to reduce carbon emissions into the atmosphere.
- It is against state law (Oregon) to charge higher fees for recycling services than garbage (landfill waste) collection.

Waste-Collection Arrangements:

- Landfill waste is collected every second week, while recycling and organics collection increased to weekly.
- All food scraps including soiled paper products, meat, dairy and bones may be mixed with green waste/yard debris.
- There are a limited number of approved compostable plastic products that citizens may use for compost collection.
- Plastic bags have been banned in the city since 2012. The use of polystyrene foam containers (for takeaway food services) has been banned since 1990.
- Since 2010 there has been a 17% increase in waste recovery (recycling & composting).
- In 2012 a field study showed participation rates are at around 80% (the City estimates that participation is currently above 90%).

Composting Process:

- As there are over 80 composting facilities surrounding the city of Portland, different processes are undertaken at different locations.

- The majority of facilities involved in composting residential food waste are using a combined method of anaerobic processes to generate energy followed by the aerobic windrow system.
- Food waste from businesses and multi-unit residences tends to be processed anaerobically in order to produce energy.

Quality of Product:

- Contamination rates recorded at Portland Metro's two transfer stations is around 1%.

Use of End Products:

- Compost may be purchased by the public at several facilities in the area.
- Different types of soils, composts, bark, rocks, stones, etc. are available.

Financial Aspects:

- Collection service fees are paid directly to the haulers by the residents.
- For residential services, fees are set by the city. In contrast, services to businesses are provided in a competitive market where businesses may choose their waste provider.
- Portland has implemented a PAYT system where residents are charged more if they request larger landfill bins.
- Composting is US\$40/ton cheaper to process than landfill disposal.
- There are no fines in place for those who do not participate; this is a voluntary initiative.

Other Benefits:

- Organic waste collected in 2012 was nearly 3 times as much as the amount collected in 2011.
- There was a 38% decrease in waste sent to landfill in 2012 compared to 2011.

Problems:

- Odor build up over the 2-week cycle (for landfill waste), especially for residents with babies and pets (excrement odours); some residents claim the green (compost) bins are difficult to clean.

Lessons Learned:

- Initially people were unhappy about the fact their normal garbage was only being collected every other week. Over time, as people became more educated about the benefits of composting, this dissatisfaction decreased.
- People were more responsive to the idea of composting when it was framed as turning their waste into something valuable than when it was framed as helping to address climate change.

SAN FRANCISCO, USA

San Francisco, USA has a population of over 860,000 people with the city covering approximately 121 km². The city is densely populated and is currently the second most dense city in the USA. The climate is similar to that of a Mediterranean climate with dry summers and moist mild winters.

Organisations Responsible: City of San Francisco: Department of the Environment, and Recology (employee-owned company responsible for the management of waste disposal and redistribution)

Method of Introduction:

- The current system is based on the results of a 1997 pilot which trialed different methods.
- Legislation passed in June 2009 outlined that all city residents and institutions must undertake waste separation into 3 separate kerbside containers for municipal collection.
- The scheme came into effect in October 2009 after several months of campaigning and ‘good press’.
- Education initiatives were implemented to highlight the use of ‘Fantastic 3’: colour coded bins.

Publicity, Information and Education

- The San Francisco Department of Environment provides environmental programs and curriculum to all private and k-12 public schools in the San Francisco area.
- Use of colour coded bins keeps the system simple and easy to understand for all citizens.
- Multilingual signage and pictograms were designed to communicate to all non-English speaking residents.
- A ‘Recycling Changes Everything’ campaign was launched and was run for a year.
- A resource centre is located at the Recology San Francisco site which also serves as a classroom and gallery (‘The Environmental Learning Center’)
- Tours of the composting facility as well as the Recycle Central® at pier 96 are available to the general public.

Policy/Legislative Changes Contributing to Success:

- California Assembly Bill 32 (2006); outlines the long-term approach to reducing GHG emissions.
- San Francisco’s Climate Action Plan (2004); regional plan for reducing GHG emissions.
- *San Francisco* Mandatory Recycling and *Composting* Ordinance (2009): bans disposal of food waste in landfill. Hence, all residents are actively participating in the program.
- California Assembly Bill 939/1989; dictates the organisation and structure of waste procedures.

Waste-Collection Arrangements:

- Each household receives three colour-coded 120L bins; black bins are to be used for landfill waste, green bins are to be used for food and organic waste, and the blue bins are to be used for co-mingled recyclables.
- Hazardous items may be dropped off at the plants for free disposal.
- The organic waste that can be placed into the green compost bins includes dirty paper, all food scraps, plants and garden waste, compostable plastic bags, corks, cotton balls/swabs and waxed cardboard and paper.

Composting Process:

- Two types of feedstock are processed at Jepson Prairie Organics; food waste and yard trimmings/green waste.
- Both feedstocks are fed into an industrial sized ‘grinder’ to both filter out contaminants and attain the correct carbon to nitrogen ratio.
- The Jepson Prairie plant has an Engineered Compost System (ECS) that actively composts the waste for a period of 30-45 days, with constant monitoring of oxygen levels and temperature.
- The compost is cured in windrows. Once the product passes screening tests it is ready for sale.

Quality of Product:

- There are three agencies that are responsible for ensuring quality compost: public works (issues the fines to those who contaminate); public health (authority to set liens on properties for service account non-payments); and San Francisco Department of the Environment (responsible for education and outreach).

Use of End Products:

- Recology plants produce compost, landscape materials and custom blends (available on request).
- There are 5 Recology plants spread across California and all are open to the public for the purchase of the end-products.
- Market demand drives how the compost is used, but generally half is used for landscaping, erosion control and organic gardening while the other half is used on vineyards in California

Financial Aspects:

- Residents pay a refuse fee (approximately \$34 per household/month) which fully covers the operational costs of the scheme
- Businesses that divert their trash away from landfill are eligible for a discount from the City
- In 2015 Recology generated a revenue of \$800 million (USD)

Other Benefits:

- The levels of Greenhouse Gas emissions in 2012 were 12% lower than the levels shown in 1990.
- The Recology centre in San Francisco has a unique 'Artist in Residence' program in which artists are invited to create art using recycled materials to further show the benefits of recycling.
- Due to the fact that sorting is done manually, over 186 jobs have been generated in the last 10 years

Lessons Learned:

- School education is proving successful and older generations are re-learning recycling and composting from their children.

SEATTLE, USA

Seattle is the largest city in the Pacific Northwest region of North America, with a population of roughly 685,000. The metropolitan area is the 15th largest in the USA and is home to 3.7 million inhabitants. It is a fairly dense city and many people reside in multi-unit dwellings. The climate is temperate with cool, wet winters and fairly dry, mild summers.

Organisations Responsible: Seattle Public Utilities, CleanScapes Inc. (part of Recology, waste hauler), Waste Management of Washington Inc. (transfer stations), Lenz Composting (compost facility), Cedar Grove (compost facility)

Method of Introduction:

- Due to local landfill sites closing during the 1980s, Seattle was forced to implement ambitious waste reduction targets. A new ordinance was implemented which stipulated the source separation of yard waste from recyclables and trash. The city began kerbside yard waste collection in 1989.
- Food waste collection began in 2005 when the city began replacing the existing yard waste bins with larger ones that could handle both yard and food waste. The newer bins were also more accessible for the haulers.
- In Seattle private companies are employed to collect and transfer all waste streams. This made the roll out of kerbside compostable collection easier.
- From 2009 all single-unit residences and food service businesses were required to participate in the compost collection service. Those who can prove that they compost all food scraps on site are exempt from the service. This service was extended to all multi-unit residences in 2011.

Publicity, Information & Education

- The Seattle Public Utilities Department distributed information material to all residents and provided free kitchen caddies.
- A wealth of information is available through the Seattle Public Utilities website, including flyers outlining what can/cannot be composted, information about food labelling (including what the dates printed on food actually mean), how to store food to prevent premature waste, recipes and information on the overall benefits of composting. Most of the information is available in several languages.
- The Utilities Department provides free two-hour training sessions devoted to building “cheerleaders” (a nominated representative responsible for further educating residents as well as monitoring a building’s recycling and food waste containers).
- Buildings that nominate a “cheerleader” receive a discount on their waste bill that applies to all residents.
- At Cedar Grove, the largest composting facility in Seattle, training is provided (in conjunction with the City) to the staff of participating commercial food waste generators. Cedar Grove also randomly audits 25% of clients within the first 6 months of training to ensure practices are in line with the original training. Monthly tours of the facility are also available.
- Larger businesses wishing to receive training for their staff can request a Cedar Grove representative visit the business to provide in-house training (free of charge).

Legislative/Policy Changes Contributing to Success:

- Seattle Municipal Code Sections 21.36.082 & 21.36.083 stipulate that food scraps, compostable paper, yard waste and recyclables are forbidden to be disposed of with landfill garbage. This was implemented as of January 1st, 2015.

Waste-collection arrangements

- All waste streams are collected weekly on the same day.
- All food waste, including dairy, bones and meat, is accepted into the compostable collection (except grease, fats and oils in plastic containers). Food soiled paper is also accepted as long as it is not coated

with plastic. Green waste (from the garden) is combined with the food waste. No animal or human waste is accepted.

- No plastic is accepted, unless it is BPI certified, meets ASTM D6400 or ASTM D6868 and has been tested and approved by Cedar Grove Composting Inc. Biodegradable bags are not accepted.
- Since 2015 all residents, both in single- and multi-unit dwellings, as well as commercial enterprises, are participating in the kerbside compostables collection, unless they are composting all organic waste onsite.

Composting Process

- There are several private composting facilities located around Seattle.
- The largest facility in the area is the Cedar Grove facility located in Everett. It is one of 2 facilities operated by Cedar Grove and is the largest facility in the world that employs the GORE™ Cover In-Vessel System.
- The feedstock is fed through a large grinder that breaks down the matter and then carries it away on a conveyer belt. A huge magnet extracts all metal contaminants from this belt.
- Batches of 450 tons are then laid out and covered with the GORE™ covers using mobile winders. Underneath these covers the microbes process the feedstock, while the air, moisture and temperature are constantly monitored for an optimal product.
- The matter is left to compost for 60 days under the GORE™ covers, which trap any odours being released into the air. Curing takes a further 60 days after which the compost undergoes testing to ensure all quality standards are met.

Quality of product

- During the first 6 months of the new initiative, instead of enforcing financial penalties, those found to have more than 10% of their waste contaminated received a red mark tagged onto the bin. It was considered that this public shaming would discourage contamination.
- All of the finished compost produced at Cedar Grove is sent for testing by certified third party laboratories to guarantee that the quality of the product meets all State and National Standards. Cedar Grove further tests the final product in compliance with the US Composting Council Seal of Testing.

Use of end products

- At Cedar Grove facilities there are a number of different products available for purchase by the public including mulch, bark, compost and soil products.
- Cedar Grove has coupons available on their website which provide discounts for product purchases.
- Local gardens receive donations from facilities like Cedar Grove through an initiative called the 'Big Garden Give!'.

Financial aspects

- During the 1980s many Seattle residents switched their service from two garbage bins to just one, which saw the revenue drop abruptly and resulted in a shortfall for the 1990 budget. Since then Seattle monitors this risk by assessing their finances on a quarterly basis.
- Seattle has a PAYT system in place; residents pay more the higher the volume of waste. Prices in 2013 varied from \$4.95 for a 13-gallon can to \$9.50 for a 95-gallon cart for compostables; and for landfill waste, the rates range from \$18.65 for a 12-gallon can to \$89.40 for a 96-gallon cart.
- Recycling in Seattle is not taxed.
- Composting gate fees are roughly half of the common disposal fees; compost facilities generally charge \$40-\$50 per ton whereas transfer stations generally charge \$80-\$100 per ton.
- For the first 6 months of 2015 no fines for contamination were imposed. Since then those who have more than 10% contamination rates receive fines; \$1 for single-unit residences and \$50 for multi-unit residences (the fines are levied on their next garbage bill).

TORONTO, CANADA

Toronto, Ontario is the 5th largest city in North America and the largest in Canada with a population of 2.7 million people and a land size of approximately 630.21 km². It is a fairly dense city with almost half of the residents living in high rise or multi-unit dwellings. It has a humid continental climate, but experiences four distinct seasons.

Organisations Responsible: The City of Toronto, Miller Waste Systems (waste management company part of The Miller Group)

Method of Introduction:

- In 2002, Keele Valley, the city's primary landfill site, closed. Disposal costs were estimated to increase by 300% and, as a result, the city was forced to transport their waste to a private landfill in Michigan. This prompted the city to re-evaluate the current waste management system.
- The City began rolling out the 'Green Bin' program in 2002, and by 2005, all single-unit homes were receiving kerbside compostables collection. The plan is to service all multi-unit dwellings by 2017.
- The city provided residents with kitchen caddies and new kerbside green bins free of charge.

Publicity, Information & Education:

- Prior to the commencement of the program the city employed students to liaise with the residents on a face-to-face basis, assisting with enquiries and distributing information brochures.
- An information calendar, which includes a hotline number, was distributed to all residents in multi-unit dwellings in 2009. In 2011 residents received further information about waste diversion.
- Public citywide advertising campaigns have been ongoing, primarily targeting multi-unit residences.
- A Customer Service and Waste Diversion Implementation Unit was developed by the City in 2013, the purpose of which is to assist those in multi-unit dwellings to correctly participate in the program.

Policy/Legislative Changes Contributing to Success:

- The Environmental Protection Act, 1990, and Regulation 347: regulates waste management.

Waste-collection arrangements

- As the City of Toronto was already providing the waste collection services, it was able to adjust the frequency of collection and free up resources by switching from dual- to single-stream recycling.
- Under the new system, garbage destined for landfill is collected once every 2 weeks, and compostables are collected weekly (free of charge).
- All single-unit homes are currently a part of the program, amounting to roughly 510,000 households.
- Allowing plastic bags and nappies in the organic waste bins has encouraged high participation rates (90% participation).

Composting process

- All organic waste is accepted in Toronto, including meat, bones, dairy, excrement and plastic bags.
- Two anaerobic digesters are located within the city limits. The Disco Road Facility is currently processing the majority of waste while the Dufferin plant undergoes expansion (due to be complete in 2018). Once capacity has been reached in the anaerobic digestors, excess waste is transferred directly to one of several privately owned aerobic composters. Upon completion of the second facility, the City of Toronto is hoping to process all of its organic waste itself.
- Toronto has specific pre-treatment technology known as the BTA™ Hydromechanical Pretreatment System patented by Germany's BTA International, which allows for products such as plastic and faeces.
- Within each of the BTAs is an impeller that spins to create a centrifugal force and forces open the plastic bags containing the waste. This separates the light and heavy contaminants. Once this separation has occurred the remaining organic material is screened out through the bottom of the waste pulper.

- Recycled water is added to the pulper which allows for the lightweight contaminants to rise to the surface. These are then collected using a rake-like mechanical arm. Heavy contaminants, such as glass or batteries, sink to the bottom and are removed using a gate valve.
- According to the Canadian Conservation Institute, the BTA system is able to capture 96% of the available digestible organics during the process.
- There are several privately owned composting facilities that receive the digestate from Disco Road (and eventually Dufferin) and process it with yard waste to create high quality fertilizer products.

Quality of product

- Initial contamination rates are generally between 12-14%. However, due to the technology of the BTA system, the end product is of an extremely high quality.
- Any compost sold in Canada must meet either Federal and/or Provincial regulations regarding the quality of the product.

Use of end products

- There are a number of fertilizer products available for direct purchase from the private aerobic composters.
- The digester tanks are fueled by the biogas produced during anaerobic digestion.
- Once the site at Dufferin is completed, it is estimated that 143,300 tons will be processed between the two facilities and this should generate enough electricity for the anaerobic digestors to be almost independent of the provincial grid.

Financial aspects

- Toronto has employed a PAYT system charging higher fees for higher amounts of landfill waste. Recycling and compostable collection services are provided free of charge. The PAYT system incentivizes building owners to encourage participation among tenants.
- The City switched collections from multi-unit dwellings from weekly to every second week. The financial savings resulting from this restructure are used to fund the compostables collection program.
- The 'Green Bin' program was allocated a budget of US\$56.2 million and a further US\$19.7 million was reserved for site-related services (such as waste removal).
- The city plans to implement fines for those who contaminate the waste, but will only begin issuing them once all residents are receiving the service.
- The original cost of the Dufferin facility was US\$10 million and it was completed in 2002.

Other benefits

- Toronto chose to use anaerobic processing for several reasons including; it requires much less land than aerobic windrow processes, it does not emit foul odours which means the facilities can be within residential areas; and the use of the BTA system means that otherwise non-compostable items may be included. This is thought to increase participation.

VANCOUVER, CANADA

The city of Vancouver, Canada has a population of roughly 600,000 inhabitants and covers 115km² of land. It is the densest city in Canada and has a moderate oceanic climate with heavy rain occurring from October to March. During the summer months of July and August the city endures drought-like conditions.

Organisations Responsible: Vancouver City Council in conjunction with Harvest & Fraser Richmond Soil & Fibre Ltd. (FRSF, the largest composting facility in North America)

Method of Introduction:

- An in-depth study was undertaken by the municipal government investigating different waste streams, with a particular focus on organic waste.
- In 2011 a pilot program was introduced to approximately 2000 single-unit homes and five to seven multi-unit complexes and businesses.
- Educational material was distributed to residents, property managers and building owners outlining the new system (educational flyers, tool kits, best practice guides, stickers etc.).
- Workshops were run with relevant stakeholders to identify the benefits and challenges of the new system based on previous outreach and engagement work.
- The initiative came into effect January 2015, with the first 6 months being a semi-trial period where no fines were issued for contamination; contamination was combatted through education.
- Over time allowable contamination rates will decline.

Publicity, Information and Education

- The school board of Vancouver has incorporated composting programs into the education system. These will eventually service all schools in the district.
- The city ran large-scale campaigns. These included distributing educational posters and stickers that highlighted the benefits of recycling and composting as well as the rules and regulations of the new system.
- A 2-minute educational video was developed that explained the new system and was released to the public in 7 different languages.
- A campaign called “Love Food Hate Waste” was also launched and was based on a UK campaign with the same name. The campaign is primarily web-based and includes tips for reducing food waste including education about product labelling, meal planning, recipes, etc.
- The Richmond plant offers educational tours through their visitor centre.
- The City hosts a number of free compost campaigns to highlight the end product while distributing it amongst the public.

Policy/Legislative Changes Contributing to Success:

- ‘2016 Tipping Fee Bylaw’ (#293, 2015); regulates the solid waste disposal practices.
- Waste Management Act (Amendment) (2001); extensive act that details the regulatory framework for overall waste management.
- Bylaw 11091/2 (2014); specifies the new composting procedures.
- Composting Facilities Regulation Bylaw (#2736, 2005); regulates the processes at the composting facilities.

Waste-Collection Arrangements:

- A new green bin was incorporated into the existing weekly waste collection system.

- A 'Waste Wizard' tool was developed and made available online (app also available) to help citizens determine which bin to use for a specific item.
- All food scrap items are accepted including food-soiled paper products and green waste (yard trimmings etc.). No plastic (including compostable or biodegradable bags) and no faecal matter is accepted.
- As there is a municipal ban on food waste to landfill, all residents and business are participating in the initiative.

Composting Process:

- The Richmond plant uses both anaerobic digestion and natural composting processes.
- Waste received at the plant is separated into batches and manually sorted to remove contaminants. It is then mixed into a secret company 'recipe' and left for 8 to 12 weeks, while oxygen is pumped into the waste in order to dry out the scraps as well as reduce the smell.
- The product is then screened and placed in windrows to 'cure'. Any imperfections found are re-composted.
- The Richmond plant has a capacity of 40,000 tons/year (mixed food and yard waste). Energy output is 2.2 MWCHP (1.1 MW Electrical, 1.1 MW Thermal).
- 5000 MT of high quality compost product is produced each year.

Quality of Product:

- The quality of the final compost product is in accordance with the standards stated in the Ministry of Environment's Organic Matter Recycling Regulation.

Use of End Products:

- Harvest provides a range of products including a range of different compost forms, mulch, rock, soil, bark and custom blends. These are designed to suit the needs of individual homes and business as well as individual agricultural and farming needs.
- The compost product can be purchased from several locations and delivery is also available.
- The energy generated produces biofuel.

Financial Aspects:

- The standard tipping fee for garbage is charged at \$107 a ton compared to only \$63 a ton for organic waste.
- These tipping fees go directly to Harvest who had revenue of \$145 million in 2014/15 financial year.
- Fines are imposed for landfill loads that contain more than 25% food scraps. Over time the percentage of allowable food scraps in landfill loads will be lowered.

Lessons Learned:

- Ongoing education and compliance are vital to success; planning is a very important aspect.
- Prior to the introduction of the initiative in 2015, nearly 6 in every 10 households had some sort of home composting system already in place.
- Dwelling type is directly associated with participation levels: multi-unit dwellings have a significantly lower participation rate than single-unit dwellings.

FLANDERS (REGION), BELGIUM

Flanders is the northern region of Belgium. The total area covers 13,522 km² and is generally flat and agriculturally fertile. The climate is a temperate maritime climate; generally cool summers and mild winters. There are several large cities in the region and the total population is roughly 5,500,000, making Flanders one of the most densely populated areas of Europe.

Organisations Responsible: VLACO (Flemish Compost Organisation), OVAM (Public Waste Agency of Flanders), 27 Inter-Municipal Waste Management Associations (from 308 Flemish Municipalities)

Method of Introduction:

- Between 1991 and 1995, Flanders began developing an initiative to combat increasing levels of organic waste being sent to landfill.
- In 1992 VLACO was established in order to encourage composting at all levels. It promotes organic waste prevention as well as regulates the quality of compost being produced. VLACO is also responsible for promoting and marketing the end product.
- During the late 1990s home composting was encouraged and 'compost masters' were educated to act as community leaders and assist other community members.
- In 2006 Flanders began using the process of anaerobic digestion of manure, energy crops and waste from feed and food processing industries.

Publicity, Information and Education

- OVAM works in conjunction with the separate municipalities to encourage education and waste prevention activities. They also provide financial assistance to specific campaigns for groups such as schools as well as providing subsidies for campaigns like home compost programs.
- The city have 'Master Composters', or trained volunteers, who assist citizens by providing information such, for example, through composting demonstrations or running composting courses.
- The region hosts a number of events and communication campaigns including 'June Compost Month' which raises awareness amongst the community.

Legislative Changes Contributing to Success:

- The incineration of recyclables and unsorted waste is prohibited, as well as sending unsorted waste, recyclables or pharmaceuticals to landfill.
- Source-separation is mandated by the regional Flemish Government (with fines up to €625).
- BE Flanders DECR 2011 stipulates the requirement to source separate waste (residential).
- The 'Non-Dilution Principle' states that polluted substances may not be processed at composting plants, only biowaste that meets the end product quality requirements may be processed.

Waste-Collection Arrangements:

- In 2010 there were 35 composting plants across Flanders (8 for food waste and 27 for green waste) and 29 anaerobic digestion plants (processing residential organic waste mixed with agricultural waste and manure).
- Through anaerobic digesting processes, approximately 4,900 tons is being processed daily.
- Approximately 50% of residential waste is collected at one of the 337 'recycling parks' or drop-off centres, at which residents can take their waste directly to the appropriate containers.
- In two thirds of the Flanders region bio-waste (food & garden waste) is collected from the kerb biweekly.

Composting Process:

- Roughly 50% of the composting facilities in the Flanders region are privately run. The remaining half are run by intercommunalities (co-operatives made up of representatives from several municipal governments).

- As there are several plants, there are several processes being undertaken.
- The largest plant in the region is located at Ieper, and uses the wet anaerobic process.
- Green waste is generally composted using the open air windrow system, sometimes employing aeration tubes and the re-use of leachate water.

Quality of Product:

- The facilities are regularly visited by professionals who monitor the quality of the product (number of visits per year depends on size of the plant).
- The compost product undergoes stringent quality analysis in order to receive the quality assurance label.
- VLACO have developed a 'Total Quality Control System' in accordance with ISO 9000 standards.

Use of End Products:

- In 2010 327,044 tons of compost was sold, predominately for application to gardens and landscaping.
- The Ieper plant produces enough energy to run self-sufficiently, but also produces enough surplus to generate electricity for 2000 homes, providing 'green' electricity to a select number of citizens in the local area.

Financial Aspects:

- Revenue is generated from higher taxes on residual waste treatment, in 2009 these revenues totaled €28 million (USD\$36 million).
- These taxes covered the cost of the waste processing (eg. maintenance of container parks etc.).
- In 2008, per capita spending on residential waste was €91.60 (US\$116.33).
- In 2009, subsidies to the amount of €5.5 million (USD\$7 million) were provided to implement PAYT systems and build new reuse and recycle centres.
- The price of high-quality compost fluctuates seasonally but is sold at an average of €14 p/ton.

Other Benefits:

- Flanders is a rare example of a society that has maintained a steady waste output (per/capita) level while simultaneously increasing their economic growth.
- In 2010 approximately 1,804,000 tons of organic waste were processed; 1 million tons were processed through anaerobic digestion, while the remainder was composted.
- According to VLACO, 480,000 fewer tons of CO₂e were released into the atmosphere due to compost production.
- VLACO estimates that in 2010 these composting processes saved 80,000 to 110,000 m³ of water.

Lessons Learned:

- One third (34%) of Flanders residents participate in home composting which reduces overall participation rates.
- In order for the system to be working efficiently, responsibility is divided between municipal, regional and national governments.

LJUBLJANA, SLOVENIA

Ljubljana is the capital of Slovenia. It covers an area of approximately 275 km² and is home to around 310,000 residents. There are approximately 1125 inhabitants/km² making this a fairly sparse city. The climate is continental and oceanic with moderately cold winters and warm summers.

Organisations Responsible: Ljubljana City Council & Snaga (public waste management company)

Method of Introduction:

- Ljubljana began its source separated recycling system in 2002, collecting paper, cardboard, glass and other packaging. It began incorporating an organics collection in 2006.

Publicity, Information and Education:

- Snaga runs a number of websites that promote the composting initiative, and is active on social media platforms (including Facebook and Twitter). These platforms not only explain the composting guidelines but also give tips on how to reduce overall waste.
- Residents have the option of subscribing to an SMS service that reminds them of collection schedules.
- At the start of the new initiative, participation was fairly low, so Snaga decided to enlist the traditional media to increase participation. Snaga invited the media to witness the amount of recyclables being deposited into residual waste bins and this resulted in both local and national media assisting Snaga by asking citizens to better sort their waste.
- The City of Ljubljana employed an intensive communication campaign over a 3 year period titled 'Separate Collection' (2011-2014) including; school contests; community debates; information points scattered around the city; publication of newspaper articles; school visits/activities; and an ongoing survey that kept the City up to date with community sentiment about waste collection arrangements.
- Education and promotion are an ongoing aspect of this initiative.

Policy/Legislative Changes Contributing to Success:

- Official Gazette of the Republic of Slovenia, no. 32/2010; Decree on the management of organic kitchen waste and garden waste.
- The Decree on the Landfill of Waste limits the amount of biodegradable components allowed in municipal landfill waste.
- Source-separated waste is mandated by Slovenian law and has been in place since July 2011. This means that all residents in Ljubljana participate in some form of composting. According to the European Commission, 82% of residents participate in the organics kerbside collection initiative with the remaining 18% practice home composting.

Waste-collection arrangements

- Once the new system had been established the City changed the frequency of collection according to the population density of the area. For higher density areas (including areas of multi-unit dwellings) residual (landfill) waste is collected weekly and both recyclables and compostables collected several times per week. Lower density areas have their residual waste collected every 3rd week and compostables and recyclables collected weekly.
- Beginning in 2008, the City of Ljubljana has been replacing the bins within the city with new underground collection points. Anyone may deposit paper, glass or general packaging into these collection points but to avoid contamination of the organics (and reduce the amount going to landfill) a swipe-card (free of charge to residents within the area) is required to access both the organics and residual bins.
- The organic collection points are emptied daily to ensure odour control.
- Most organic waste is accepted but items such as bones, human/pet faeces and spent kitchen oil are not accepted.
- Biodegradable bags are encouraged, but no other plastic is accepted in the organic waste stream.

Composting process

- Across Slovenia there are currently 11 composting facilities and 2 anaerobic digestion facilities.
- The largest facility is the RCERO anaerobic digester located on the outskirts of the city. It receives waste from 37 municipalities and services nearly one third of Slovenia's total population.
- RCERO uses anaerobic processes to produce biofuel and digestate. The first step in the process is the mechanical separation of the mixed waste, which is then prepared for anaerobic digesting. After the feedstock has anaerobically processed, biogas and heat is extracted and collected.
- The digestate is transported to the 'ripening' area where it processes aerobically and over time becomes a quality compost product.

Quality of product

- The Decree on the treatment of biodegradable waste does not distinguish between compost and digestate in its classification of quality.
- Class I can be spread on agricultural land without restrictions.
- There is currently no external quality certification for compost (or digestate) in Slovenia. It is the producer who determines the class of the compost or digestate produced.

Use of end products

- The facilities have the capacity to produce: 60,000 tons of solid fuel; 35,000 tons of digestate; 6,000 tons of wood, 7,000 tons of compost; and 25,000 tons of recycled waste generating raw materials.
- The biogas produced is equivalent to 17,000 megawatt hours (Mwh) of renewable electrical energy and 36,000 Mwh of heat energy. This energy is fed back into the facility and used to fuel some of the collection trucks.
- Compost products are used in horticulture and agriculture as well as non-agricultural purposes.

Financial aspects

- The average yearly cost to households in Ljubljana is under €100 and these are among the lowest fees in Slovenia (average across the country is around €150).
- The initial investment into the new underground collection points was approximately €3 million.
- The recent upgrade of the RCERO facility cost around €127,048,772 and was co-financed from the EU Cohesion Fund. Municipal and state budgets provided funding and the remainder was supplied through the environmental tax on environmental pollution caused by waste disposal.
- Ljubljana has implemented the 'polluter pays' and PAYT systems; the more trash you dispose of the more you will pay.
- Biowaste disposal is not charged for the first 4 collections per month. Residents are charged for subsequent collections but are not charged if they take their extra waste to the underground collection points.

Other benefits

- As an indirect result of this new waste management system, Ljubljana has been deemed the European Green Capital for 2016.

MILAN, ITALY

Milan, Italy has a population of 1.36 million people, and a further 800,000 daily commuters. The city itself covers an area of 182 km² with the majority of the inhabitants living in high-rise multi-unit dwellings within high density neighborhoods. The climate is temperate.

Organisations Responsible: Milan Municipal Government & Azienda Milanese Servizi Ambientali (AMSA, Milan's waste collection and street cleaning company)

Method of Introduction:

- In 2011 a new municipal government was elected and decided that the city's recycling rate of 35% was unsatisfactory. They began research into specific district conditions, which included communications with building managers and owners.
- After much research and investigation, a pilot program was launched in November 2012 to a limited number of residents. This was slowly rolled out across the city and by June 2014, 100% of the citizens were receiving the service.
- Each household received a 10L vented kitchen caddy as well as 25 compostable bags (which are also available to purchase). These items were delivered by a government representative, giving citizens the opportunity to discuss any issues directly with the representatives.
- The role of building owners and property managers was also important as many of the citizens reside in multi-unit dwellings.

Publicity, Information and Education

- A new website was developed and materials distributed to the residents included: leaflets, bin stickers, posters (for use at bus stops and public buildings), a smartphone app, information guides (printed in 10 languages) and a toll-free information hotline
- The city held community outreach meetings, and used well-informed employees who were able to assist the citizens on a face-to-face basis.
- External experts were consulted on particular issues, such as the use of compostable bags.
- Composting is incorporated into school education through a program run by AMSA.

Policy/Legislative Changes Contributing to Success:

- Italian General Waste Act (Digs 22/1997) outlines a reorganisation of the waste management procedures in Italy including targets of reduced waste.
- The launch of the 'Family Bag' project, includes a campaign to de-stigmatise 'doggy bags' and encourage families to reduce waste by taking home restaurant leftovers.
- Incentives are currently in place for businesses and farmers who donate food to charities.

Waste-Collection Arrangements:

- For commercial enterprises and institutions with large amounts of waste, collection occurs daily, whereas domestic properties receive the service twice weekly.
- Italy banned the use of plastic bags in 2011. All bags provided by supermarkets are approved compostable plastic, which the citizens may reuse for the compost collection.
- All cooked or uncooked food scraps, including food-soiled paper towels and napkins, are accepted.

Composting Process:

- All food waste is transferred to the Montello facility, located 60km outside the city, which uses a combination of anaerobic digestion and aerobic composting.
- The composting facility, Montello, contains 8 anaerobic digestion silos and generates 9MW of energy which is fed back into the plastic processing plant and used as fuel for some of the collection vehicles.
- Montello is entirely automatic including automatic separation of contaminated products.
- Up to 369,000 tons of organic waste is being processed at Montello per year
- Due to the location and the layout of the plant, odorous emissions are kept to a minimum and bio-filters are used to treat the exhausted air.

Quality of Product:

- To ensure optimal quality AMSA analyse samples every 6 months and conducts regular monitoring of the facilities.
- The average contamination levels since induction are 4.06% (mainly non-compostable plastic bags) but this rate is shown to be decreasing over time.
- Areas of the city that show higher levels of contamination receive further education and outreach.
- Residents must use clear bags for disposal. This is vital for the visual checks performed by inspectors prior to pick up.
- Fines are in place for those who contaminate waste.

Use of End Products:

- The subsequent aerobic composting phase aims to produce quality organic fertiliser ('composted mixed soil improver')
- Most of the compost generated is sold to farmers for land application.
- AMSA organises compost give out days to provide compost to the general public.
- Subsidy programs are in place to promote the use of organic fertilisers over mineral fertilisers.

Financial Aspects:

- Stakeholders involved: AMSA, 9 Area City Councils, Parco di Monza Agronomy School, CIC (Italian Composting Consortium), city residents and commercial and public entities
- In Lombardy (region of Milan) it is 30€/ton cheaper to compost food waste than dispose of it in landfill.

Other Benefits:

- Montello estimate that the plant saves the equivalent of approximately 90,000 tons of CO₂ being released into the atmosphere.
- By January 2015 53.5% of compostables were being separated, an increase from 35% at the end of 2011.
- 90% of citizens involved in the program are satisfied and actively participate.

Problems:

- The biggest challenge was the logistics behind the roll out: preparation, co-ordination and delivery of the merchandise required extensive planning.

Lessons Learned:

- Full engagement with the public has proved a vital component of the success of this initiative.

SOFIA, BULGARIA

Sofia is the capital of, as well as the largest city in, Bulgaria. Home to approximately 1.5 million people (greater functional urban area), many of the residents live in apartments rather than single-unit dwellings. It has a continental humid climate, with extremely cold winters and warm and sunny summers.

Organisations Responsible: Sofia Municipal Council, Bulgaria Ministry for the Environment and Water (body responsible for development and implementation of decisions relating to waste management), Executive Environment Agency (responsible for controlling and monitoring legal compliance). There are also a number of private waste haulers contracted by the municipal council.

Method of Introduction:

- The closure of the main landfill site in Suhodol in 2005 prompted the council to re-evaluate their existing waste management processes.
- In order to determine a new solution for the future, extensive research was undertaken in conjunction with the local council, the Bulgarian Association of Municipal Environmental Experts (BAMEE) and the Ministry of the Environment.
- Although previously waste management had been the responsibility of the municipal mayor, surveys suggested that a regional scheme would be the most effective.
- In 2009 several pilot programs were introduced and the Bulgarian Government also made changes to legislation and policies (see below).

Publicity, Information and Education:

- Public relations promotion was important in instituting the new system as financial incentives were not established enough to encourage the citizens.
- Brochures and leaflets are provided to citizens on a regular basis outlining why source-separation of waste is important and what services the municipality provides.
- Public lectures and 'practical separation training workshops' are offered to all residents and take place in public spaces such as schools and public gardens/parks.
- An educational campaign is in place in Sofia's schools and kindergartens, as the Council believes that children will help older generations to implement this new system in a natural fashion.

Policy/Legislative Changes Contributing to Success:

- Framework Directive and Bulgarian Waste Management Act: outlines targets for re-use and recycling of waste and provisions for establishing a competent bio waste management system.
- Landfill Directive and Corresponding Bulgarian Ordinance: outlines targets for bio-waste diversion and stipulates that landfill waste must be pre-treated.
- Ordinance on the Treatment of Bio-Waste and Ordinance on the Separate Collection of Bio-Waste: outlines the separate collection targets (both domestic and commercial), quality criteria of biological treatment of bio-waste (to ensure quality compost output).
- Bulgarian Regulation No. 7: introduction of landfill tax.
- National Strategic Plan for Diversion of Biodegradable Waste going to Landfill 2010-2020.

Waste-collection arrangements

- The frequency of kerbside collection varies depending on seasons and dwelling type.
- As well as kerbside collection there are a number of locations where residents and other generators of waste can bring in their extra green or organic waste. These include municipal recycling centres, garden waste collection sites and directly at the municipal composting facility.

Composting process

- Currently in Sofia there is a Mechanical Biological Treatment plant (MBT) as well as the Han Bogrov composting facility (anaerobic and fermentation processes).

- Two types of waste are treated separately at the Han Bogrov facility; green waste (capacity of 24,000 tons/year) and bio/organic waste (capacity of 20,000 tons/year).
- Pre-treatment of waste is the first step of the process. This involves manual sorting to ensure minimal contaminants.
- The matter is then processed in the anaerobic treatment zone using a method of fermentation which results in the creation of bio-gas and a partially stabilized fermentation product.
- The partially stabilized fermentation product is then heated to a temperature of 70°C (pasteurization) and dried out to prepare for the composting process.
- The matter is then taken to the corresponding composting cells to further mature. After about 3 weeks the matter is finely processed to ensure top quality compost.

Quality of product

- Currently in place there is a Quality Assurance Scheme (QAS) as well as the National Quality Assurance Organization (NQAO) that moderates the quality standards of compost.
- The minimum standard of quality is stipulated by the European Quality Assurance Scheme (ECN-QAS).

Use of end products

- Between 2014 and 2016, 9,737 tons of compost was produced at the Han Bogrov facility.
- The compost is used in agriculture and green spaces, in the restoration of terrain that has been impacted by mining and quarrying, and in repairing landfill sites.
- Residents are able to request free compost direct from the facility (limited amount per resident).
- The electricity generated through the above process is fed back into the electric distribution network, and any thermal energy generated is used at the site.

Financial aspects

- Since the restructure of the waste management system, Sofia has allowed investment and services from private enterprises, thereby increasing capital flow and reducing outgoing costs of the municipality.
- Due to a reduction in collection, disposal, and landfill construction costs, more money is available for other services.
- By making waste management a regional responsibility rather than that of individual municipalities, construction costs are shared and therefore reduced.
- A landfill tax was introduced in Bulgaria in 2011. The fees are due to increase by €5/ton each year until 2020 when the fee is set to €47/ton.
- A new PAYT system has been in place since the end of 2015 to further encourage source separation of waste.

Other benefits

- The Han Bogrov Facility, which began its operations in 2014, was also awarded “Building of the Year-Bulgaria”.

Lessons learned

- Bulgaria found that transparency of information between municipalities was a key factor to the success of the programs and stresses the importance of inter-municipal workshops and engagement.
- Opening up the market to allow private enterprise assistance was also a key to the success of this initiative.

LISMORE, AUSTRALIA

Lismore is a regional city in NSW, home to approximately 29,000 residents (44,200 including the surrounding rural population). It covers an area of 1,290 km² and encompasses a number of rural towns and villages that are within the regional governance of the Lismore City Council. The city is sparsely populated with 84% of the population living in single-unit dwellings. It has a fairly humid subtropical climate, and receives approximately 1,300 mm of rainfall annually.

Organisations Responsible: Lismore City Council, Northern Rivers Waste (Council business unit responsible for waste management),

Method of Introduction:

- Lismore was the first municipality in Australia to begin kerbside organics collection.
- Kerbside organics collection began in Lismore in 1999, in conjunction with Tryton Waste Services (previously contracted waste management haulers) who operated the largest worm farm in the southern hemisphere.
- Increasing costs and decreasing availability at landfill sites encouraged the council to undertake an extensive investigation into their current waste management system, including a review of the existing waste streams and auditing of the transfer/drop off stations.
- Beginning in 2006, a new system was introduced which saw kerbside recycling (paper/plastic/metals/glass) introduced alongside the existing organics and residuals. New colour-coded bins were distributed to residents alongside an extensive education campaign.
- From 2009 residents were entitled to claim free kitchen caddies as well as biodegradable liners.

Publicity, Information and Education:

- “Red, Yellow, Green – Lets Keep it Clean!” campaign was developed alongside the rollout of the new kerbside collection. This campaign highlights the source-separation of waste; red bin for residual waste; green bin for food and green waste and yellow bin for (mixed) recyclables.
- Education came through several forms including production of a brochure, rebranding of the website and logos, repainted collection trucks and the introduction of a contamination management program.
- Lismore sees education as a key point to the success of their initiative and have resources, training and information available to schools, local councils, industry and culturally and linguistically diverse communities.
- Ongoing education involves updated information through the council website, a schools program, local media advertising as well as site tours of the facilities.

Policy/Legislative Changes Contributing to Success:

- NSW Waste Avoidance and Resource Recovery Strategy 2007: prioritises the intention of reducing waste generation and turning waste into recoverable resources.
- Waste Avoidance and Resource Recovery (WARR) Strategy and policy: this is basically about making recycling easier for both businesses and residents, increasing producer responsibility for problem wastes, increasing investment in waste and recycling infrastructure and reducing littering and illegal dumping.

Waste-collection arrangements

- Currently the standard sizes of bin for residents are 140L for residuals, 240L for organics and 360L for recycling (residents have the option of opting for different sizes- fees may be involved).
- Both recycling and residuals are collected fortnightly, and only the organics are collected on a weekly basis (again residents can change the frequency of their collection- fees may be involved).
- Lismore is currently servicing 1,314 businesses who have the option of choosing the appropriate sized bins and services to suit their needs.
- All food scraps, soiled paper/cardboard and green waste are accepted in the organics bin. Council-approved compostable bin liners are also accepted, but degradable and standard plastic bags are not.

Since 2012 the council has also begun to accept compostable nappies.

Composting process

- Between 2005 and 2010, the City Council overtook the waste management contract and began providing the collection services, as well as operating the facilities.
- Currently the Lismore Recycling and Recovery Centre is a central hub for most waste management services within the regional area. The facility includes a Material Recovery Facility (MRF), a Resource Recovery Facility (RRF), the composting facility, the Lismore Revolve Shop, a construction and demolition recovery area, Environmental Education Centre, Community Recycling Centre and the Lismore Rainforest Botanic Garden.
- The new facility uses the Mobile Aerated Floor (MAF) system which supplies airflow through a system of pipes underneath the compost piles. This airflow reduces the need to turn the compost piles therefore reducing processing time as well as fuel, electricity and water costs.
- The final step in the process is grading and screening the output to ensure optimal quality.

Quality of product

- Currently contamination rates are maintained at around 1% and the compost is certified organic.
- Residents who choose to use compostable bags must register their details with the council who will then provide them with a sticker for their bin. This is to show the haulers that bags within that particular trash have been approved and will breakdown during composting. Similarly, users of compostable nappies are given stickers for their bins that say 'bionappy user'.
- To combat contamination the council has introduced a bin rejection system. Waste collectors are responsible for placing a sticker on bins that have contaminants; the resident also receives a letter explaining the breach and how to resolve the issue. Upon receiving 3 rejection stickers a resident's service (organic or recyclable) is suspended and they receive further education and training from council staff.

Use of end products

- There are 2 product outputs: BIOcycle Compost available in 10mm (\$35 per m³) and 20mm (\$15 per m³). Both of these products are certified organic.
- Compost is available for purchase from at the Lismore Recycling & Recovery Centre.

Financial aspects

- Residents receive a free kitchen caddy and 4 rolls of compostable liners (yearly). Should residents need to replace their kitchen caddies or purchase more liners there are several locations around the region where they may be purchased: caddies are \$8 and a roll of compostable bin liners is \$5.50.
- The recent upgrade and introduction of the new composting system at the Lismore facility was made possible with a \$350,000 grant from the NSW Environmental trust. The Lismore council matched the grant bringing the total investment to \$700,000.

Other benefits

- Due to the organic certification of the compost, Lismore received a Local Government Excellence Award for Environmental Leadership and Sustainability.
- The expansion of the facility means that neighbouring councils will begin processing their waste there, providing income and further strengthening Lismore's reputation as a recycling hub of northern NSW.
- Given the overall success of the system, the compost facility itself is becoming a tourist attraction of Lismore.

Problems

- As there is no legislation to enforce participation, Lismore has reported that commercial and industrial sectors have low performance rates.

TIMARU, NEW ZEALAND

Timaru is located on the South Island of New Zealand with a population of 28,500 people. Including the rural towns surrounding Timaru, the population is roughly 46,300. It covers a land area of approx. 2,736 km². Timaru has an oceanic climate, with warm summers and cold winters. Like much of New Zealand, Timaru is not a densely populated city and residences are generally single-unit dwellings.

Organisations Responsible: Timaru District Council, Transpacific Waste Management (under contract until 2021)

Method Of Introduction:

- In the period leading up to the renewal of the kerbside collection contract (2000), the Timaru Council began a comprehensive investigation into the existing waste management system.
- Audits of the waste stream were conducted between 1993 and 1998 with the finding that organics made up 50% of the waste from residential properties going into landfill.
- Direct consultation with the community was seen as a vital step in order to engage the community and win their support. During these consultations, it was found that 89% of Timaru residents preferred alternative solutions to landfilling the majority of the waste.
- A trial period was introduced from December 2004-January 2005 in order to test the new system. Participants received one 240-litre organics bin (green lid), one 240-litre recycle bin (yellow lid) and one 120-litre rubbish bin (red lid). All participating residents received clear instructions from the council.
- The trial proved successful and the Council implemented the new 3-bin system from 1 July 2006.

Publicity, Information and Education:

- A range of methods were employed to educate and inform the Timaru residents about the new system, including newspaper and radio advertisements, brochures and information sheets. In addition, waste staff members gave talks in the community and visited both residents and businesses.
- Council regularly updates the information it distributes as well as the information available online.
- The composting facility, which is owned by the Council, offers tours and other activities. It is visited by many people every year, including school tours.

Legislative/Policy Changes Contributing to Success:

- Timaru District Consolidated Bylaw 2013 Chapter 14-Solid Waste; stipulates that residents must source separate their waste, including organic & green waste and recyclables.
- The New Zealand Waste Strategy 2010; outlined new goals for reducing overall waste.

Waste-collection arrangements

- Both landfill and recyclables are collected fortnightly on alternating weeks while the organics is collected weekly.
- Timaru recognized that there is no 'one-size-fits-all' and residents can choose the size of their bin. 92% of residents currently have a 240-litre organics bin (green lid).
- Residents are allowed to deposit any extra waste at local transfer stations.
- There are two trucks that service the Timaru area (collecting roughly 840 green bins per truck per day), and one truck that services the surrounding rural suburbs (collecting a further 606 green bins per day). Each of the bins weighs roughly 18kgs.

Composting process

- The Timaru compost facility (Redruth Resource Recovery Park) is owned by the Council and is the first of its kind in the Southern Hemisphere. The composting process used at this facility is the windrow method using Gore™ technology covers.

- The facility has the capacity to process 16,000 tons per year, and is currently processing around 14,000 tons per year. It accepts all food waste, soiled paper products, leaves and yard waste, untreated wood and animal waste.
- Once waste has been collected at the kerbside, it is transferred to the facility where it is manually sorted before being broken down using a ‘Crambo’ shredder.
- Water is added to the mix which is then laid out into windrows; generally 50m long, 8m wide and 3.8m high. The volume of each pile reduces by 30% during the composting process.
- Two air channels below the blow air into the compost to ensure the process remains aerobic.
- The Gore™ covers are then laid over the top using specific winding machines. These covers help to contain odours and maintain moisture, as well as allowing the matter to ‘breathe’ and process aerobically.
- Once the matter has processed for 4 , it is then moved to a new location where it completes the curing phase for a further 2 weeks (no cover).
- Ongoing monitoring of moisture, air and temperature are vital for a quality product and the facility has a computer system connected to help maintain correct levels.
- The overall process can take between 8-10 weeks after which the product is sent for testing to ensure it meets the New Zealand Composting Standards.

Quality of product

- All compost output must meet the New Zealand Composting Standard (NZ 4454).
- Due to the contamination of some piles by the herbicide Clopyralid, the compost does not meet organic certification requirements.
- According to the Council, contamination rates are currently less than 1%.
- A survey conducted by the Council in 2011/12 recorded that 91% of citizens were satisfied with the service.
- Timaru have implemented a three-strike approach for those who contaminate. The first two strikes serve as warnings, and the Council provide further information to those residents who appear to be struggling. On the rare occasion that a resident receives a third strike, their bin is then removed.

Use of end products

- Bags of compost (\$5), trailer loads (\$25 scoop) and compost in bulk (for trucks and trailers) are available for purchase at all of the transfer stations.

Financial aspects

- Timaru Compost facility cost \$3.5 million (NZD), not including the cost of land (already available).
- The average annual cost to operate the Timaru facility is \$1,150,000 (NZD), roughly \$82/ton. This does not include collection rates.
- Composting organic waste costs around \$100/ton compared to \$192.50/ton to send waste to landfill.
- Residents are currently paying \$2 per organic bin per week equating to \$318 per year.

Problems

- A one-time odour issue was raised in the first months of operation due to improper carbon/nitrogen ratios. This was quickly dealt with and since then there have been no issues with odour.

DHAKA, BANGLADESH

Dhaka, Bangladesh is one of the most densely populated cities in the world with a population of 10 million covering a land area of approximately 270 km² (Greater Dhaka: 17 million inhabitants over 1530km²). It has a tropical humid climate, with a distinct monsoon season from May to September.

Organisations Responsible: Waste Concern (social enterprise collective involving both for-profit and not-for-profit organisations), Dhaka City Corporation (responsible for managing the waste), ALPHA Agro (largest fertiliser company in Bangladesh), World Wide Recycling B.V (a private Dutch company) & community based NGO's (responsible for many operational aspects)

Method of Introduction

- The initiative is based on a decentralized community private-public partnership model.
- In order to understand the existing system better and to develop a better system, a sample of approximately 20,000 residents were surveyed.
- Once the land for the compost facility was acquired the first pilot program took place in 1995, funded by private enterprises.
- Different composting processes were trialed during the pilot.
- Marketing was an important tool to support the sales of the final composting products.

Publicity, Information and Education

- A public awareness campaign was started in the community to promote source separation of waste.
- Posters and training programs were developed to educate the citizens about the initiative.
- Existing rickshaw owners were employed to meet the increasing need of waste collectors.

Legislative Changes Contributing to Success

- There is no legislation in place to enforce composting in Bangladesh.
- Draft National Solid Waste Management Handling Rules (2005); highlights the 3R principal.
- Dhaka Environment Management Plan (2005); promotes waste recycling and waste diversion.
- National Environmental Management Action Plan (NEMAP) (1995); National plan by the Government of Bangladesh.
- Dhaka Declaration on Waste Management (2004); (SAARC countries encourage the use of private companies and NGOs to establish community based initiatives with an emphasis on composting).

Waste-Collection Arrangements

- Residents are responsible for separating their waste (source-separation).
- Home collection occurs daily and the waste is transferred to either roadside bins and collected by the municipality or taken directly to the transfer station.
- Waste is manually checked before the composting process begins.
- There are currently 5 composting plants surrounding the Greater Dhaka City.

Composting Process

- The largest composting facility processes 100-130 tons/day. With a total capacity of 700 ton/day across all the local facilities.
- The facilities in Dhaka use the aerobic windrow system in which oxygen is forced into the piles of waste from the bottom up through an aerator rack made of bamboo.
- All waste is manually checked prior to composting to ensure no contamination.
- Both the pre-treatment and the composting areas are housed in wall-less structures in order to minimize the release of odours while encouraging airflow.
- Plastic bags have been banned in Bangladesh since 2002.

Quality of Product

- All final products meet the compost standards set out by the Government of Bangladesh.
- Constant monitoring of moisture, temperature and oxygen levels ensures a top quality product.

Use of End Products

- Waste Concern worked with the leading fertilizer distributor in Bangladesh and used their existing networks (mainly farmers and agricultural enterprises) to distribute their product.
- Extra nutrients are added to the compost product to enhance their quality.
- Products are available for different types of crops including tea, wheat, potato, onions, and fruit.
- Waste Concern has a nursery and a farming demonstration site that both use the compost.
- To highlight the benefits of the end product Waste Concern launched an information campaign which made use of their demonstration site.
- Compost is also available for direct purchase from the composting facility.

Financial Aspects

- This initiative is the world's first Carbon trading based composting project, with investment coming from the German Government's development bank.
- Revenue is generated through the sale of compost and the sale of carbon credit.
- Each year approximately 15,000 tons of compost is being produced.
- The initial investment into the project was €2.5 million (land, construction, machinery & upfront investment for registration etc.). The local government connected the water and electricity free of charge.
- The cost of compost roughly equates to €90-105 per ton.
- The Bangladesh government does not add a VAT/sales tax on the sale of compost and have reduced taxes for business needing to import relevant equipment for the facilities.

Other Benefits

- An international recycling training centre is located at the Waste Concern facility in Katchpur, Dhaka which is open to local residents and international entrepreneurs. This facility often runs demonstrations and events.
- The use of the self-produced, high-nutrient compost is enhancing the topsoil across much of Bangladesh helping to achieve higher agricultural yield.
- Approximately 6% of the operational expenditure is put towards workers welfare, including a day care centre, free meals as well as healthcare for the employees.

Problems

- Obtaining land for the compost facilities as well as general financing proved difficult in a poor country.
- The lack of low interest credit facilities means that the initiation of the project would have been impossible without the assistance of government or private investments.

Lessons Learned

- During the pilot program, Waste Concern focused on both the supply and demand aspects of composting. Marketing the compost was seen as vital to the success of the initiative
- Working in conjunction with already established businesses also led to the success.
- The initiative in Dhaka has proven so successful that it has since been replicated 47 times in 26 cities in conjunction with the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

SURABAYA, INDONESIA

Surabaya is Indonesia's second largest city with a population of around 3 million people. The city itself is highly urbanized and covers a space of roughly 375km². The climate is tropical wet/dry with a distinct rainy season that runs from November through to June.

Organisations Responsible: Surabaya City Government: Department of Cleanliness and Landscaping (DKP), Kitakyushu City (Japan), Japan Fund for Global Environment of the Environmental Restoration and Conservation Agency, PUSDAKOTA (Centre of Urban Community Empowerment University of Surabaya, NGO), Environment Facilitators and Cadres, JAWA POS & Unilever (Media), PKK (Family Welfare Guidance, Women's group), Rukun Warga (RW/neighbourhood association)

Method of Introduction:

- In 2001 the Keputih landfill site closed down which led to an influx of waste piling up in the streets. This led to an investigation into the existing system by a team of experts from Kitakyushu City. This was undertaken in conjunction with staff from Surabaya City and a new MSWS was set up in 2004.
- PUSDAKOTA (NGO) was responsible for running public awareness campaigns in schools, communities, markets and office buildings including promotion of the 3R's (Reduce, Reuse, Recycle) and source separation of waste. This was regarded as 'socialisation of the community'.
- Members of the community were recruited to the roles of environmental cadres and facilitators to assist with further education of the citizens as well as the responsibility of distributing composting tools (compost caddies, Takakura baskets, bins)
- The cadres were also involved in the construction of the regional compost facilities.

Publicity, Information and Education

- The Surabaya city have organized community competitions to encourage the new waste management system including 'Cleanest District Award', 'Green and Clean Competition' and the 'Free from Waste Competition'. These are regarded as having been successful in encouraging communities to see the benefits of their new waste management system.
- Many schools around the city have incorporated environmental education programs into their curriculum.

Legislative Changes Contributing to Success:

- There are no laws in place that mandate this initiative and indeed it was the lack of regulation that led to the crisis that inspired this system.
- Due to the success of this program, community-based composting is a key part of the national Solid Waste Management Law (2008).

Waste-Collection Arrangements:

- Residents separate waste at source into wet (organic) and dry (inorganic). Organic waste is collected 1-3 times weekly by PUSDAKOTA from those residents who cannot compost themselves. This is transported to the transfer depots.
- Waste from the transfer depots is collected by the City government and taken to the composting facilities.

Composting Process:

- Composting occurs at a community level (a decentralised model)
- Initially the open windrow method was used but residents close to the facility complained about the odour. The Takakura Method (both Susun/Windrow & Home methods) were adopted after a period of trial and error.
- The Takakura Method is a simple technology that is low energy, and low cost and uses materials and resources from the local community.

- Local products (tempe/tape combined with rice bran/hull waste) are used to produce a culture (Native Microorganism/NM) that will facilitate composting.
- Once wet waste has been collected from the storage containers, NM is added to the waste. This begins the fermentation process while the waste is in transit to the composting facilities.
- Once at the composting facilities, the waste is placed into well-ventilated containers that are lined with grain bags and then stacked on top of one another to complete the fermentation.
- When fermentation has been accomplished, the waste is placed into piles with regulated temperature and oxygen levels to complete the composting process.
- The Takakura Susun/Windrow Method takes 10-14 days to produce a high quality compost.

Quality of Product:

- Unofficial waste pickers are a key aspect of waste prevention in Surabaya and constantly scour through the transfer depots.

Use of End Products:

- Much of the compost produced at the community plants has been used in public green spaces. It is believed that the observable physical change in the city has contributed to the success of the program.

Financial Aspects:

- Average cost to establish a compost facility is IDR\$194,000,000 (USD\$20,000).
- Residents pay one fee to the RW (neighbourhood association) responsible for home collection and another to the City for disposal and transport fees.
- The rates are collectively decided and set by the community members and these fees are generally paid as a lump sum payment in conjunction with other community fees (local taxes).

Other Benefits:

- 30% decrease in waste being sent to landfill and an increase of 10% of green spaces within the city between 2005 and 2010.
- For their environmental efforts, Surabaya City has received several international awards including: EGA (Energy Globe Award), 2005 (Water & Environment category); Green Apple & Green Organisation, 2007; UNESCAP Award for Urban Environmental Improvement, 2007.
- One compost facility is located next to the city's largest markets and collects organic waste direct from the markets several times daily. This facility also operates as a educational centre which is open to students and residents.

Problems:

- Low-income neighborhoods took a longer time to adjust to the new system compared to middle-high-income areas.

Lessons Learned:

- Community engagement is important and Surabaya have enlisted the help of 400 environmental facilitators and 27,000 environmental cadres who volunteer to assist their communities with their environmental efforts on a face-to-face basis.

LA PINTANA, CHILE

La Pintana is one of the poorest communes (municipality) within the city of Santiago, Chile. It covers an area of approximately 30.31 km² and has a population of roughly 210,000. The climate is cool and semi-arid with Mediterranean patterns; summers are typically warm and dry and winters are cool and humid.

Organisations Responsible: Dirección de Gestión Ambiental (DIGA/Environmental Management Agency of La Pintana) & Directorate for Environment Management (DEM)

Method of Introduction:

- The first step was an analysis of the existing waste system, including a characterization by source, as well as identifying different waste streams.
- Based on the findings, a program centred on waste streams rather than the source of waste was developed.
- Using the existing infrastructure, the program was launched in December 2005.

Publicity, Information and Education:

- Communication with the residents occurs through door-to-door visits by outreach workers (typically environmental students and graduates) where source separation is emphasized.
- Communication campaigns are ongoing to increase participation rates (subject to funding).
- DEM also provides free educational training to citizens, which encourages a stronger relationship between citizens and the municipal government.
- “Eco Tours” are available through the management offices of the compost facility to highlight the positive impact of the scheme and highlights the best environmental practices for the home.

Policy/Legislative Changes Contributing to Success:

- Framework Environmental Law (‘Ley de Bases del Medio Ambiente’) 1994: established the use of controlled landfill for the disposal of municipal solid waste.
- Source separation is not mandated by law.

Waste-collection arrangements

- The local council provided the residents with new 35-litre bins for their vegetable and fruit waste.
- The existing collection system was modified and continues to collect waste 6 days a week; with 3 out of the 6 days being for organics collection.
- By rescheduling the existing collection routes, there was no increase to the costs of collection as the number of trucks being used remained the same.
- At the moment only vegetable and fruit wastes are accepted. Meat and dairy products cannot be processed in the existing system. Due to the low economic status of the majority of the community, the consumption of meat and dairy products is typically low.

Composting process

- Approximately 44 tons of organic waste is being processed daily; including yard trimmings from public green areas and residential & street market vegetable waste.
- Source-separated waste arrives at a treatment plant that covers an area of 7,500 m² and is located within the commune.
- The local compost site covers 5,000m² and processes up to 18 tons of vegetable waste per day.
- A separate vermiculture site which contains 136 worm beds (each 15m long using Californian red worms/Eisenia Foetida) covers an area of 2,000 m² and processes a further 19-20 tons per day.

Quality of product

- Contamination is low at approximately 0.04% (mostly plastic bags and animal products such as bones).

Use of end products

- Both high quality compost and humus are produced at the plant.
- Free compost is available to the residents, and is also used by the municipality plant nursery to improve community green spaces.

Financial aspects

- 80% of the Environmental Agency's budget is put towards collection and disposal of solid waste.
- The residents pay for the system through their local taxes, businesses have a PAYT scheme in place and street markets must employ their own waste collection system.
- As the new system used existing routes and collection vehicles, initial investments were low.
- The original plant consisted of a small compost piles containing some worms. As the program picked up momentum new piles have been added and the worms have been naturally reproducing.
- Because each trip is to the compost plant rather than the landfill site, travel distance is reduced by 22kms, resulting in the new system actually costing less than the previous system.
- Use of biodiesel produced by the municipality is estimated to save approximately \$100 (USD) per day.
- The Global Alliance for Incinerator Alternatives suggests that the municipality is saving \$754 (USD) daily in disposal costs using the new system.

Other benefits

- Quality of life is improved with the increase of green spaces within the community.
- As well as the compost facility La Pintana has a mulching plant, a nursery and an "urban silviculture" program that includes a woodshop.
- Approximately 1,000 litres of used kitchen oil is collected daily, then turned into biodiesel and used by the existing collection trucks. Industrial grinders also produce woodchips to be used as mulch.
- The municipality has received several national and international awards such as "The Peace House" (2009) & "The AVONNI" (2010)

Problems

- Current participation levels are fairly low (approximately 19% of organic waste is recycled) with the government focusing on increasing participation with the use of outreach workers.
- The municipality has suggested that low participation rates are due to the bad experiences residents have encountered with the collection service (ie. late trucks etc.) as well as lack of space for the extra bins for multi-unit residences.

Lessons learned

- After assessing the previous waste disposal system the municipality identified that organic waste was the largest section of solid waste and began to view waste as a resource that could earn them money. They identified the waste type as being the key factor, rather than looking at who was producing the waste.
- The municipality also recognized that the further waste has to travel the bigger a problem it becomes. Therefore it was vital that the compost facility was not located too far from the municipality.
- La Pintana shows how with a clear analysis of the existing situation, efficiently using available sources and setting clear goals, even very poor communities can succeed in diverting waste away from landfills into a valuable resource.
- The community is setting an example for the rest of the country and the national government is looking into integrating this further around Santiago and the rest of the nation.
- The local government is currently investigating the use of *Hermetia Illucens* (black soldier fly) so that animal products, such as bones and dairy, may be processed in the future.

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GLOSSARY

- Caddy - A small container for the kitchen bench in which to collect the organic waste prior to kerbside collection.
- Compostables - That which can be composted. This is a relative term as what can be composted varies according to the composting process to be used.
- GHG - Greenhouse Gas
- MSWS - Municipal Solid Waste System
- PAYT - 'Pay-As-You-Throw'
- Windrow - A long heap of composting material