AN AFFORDABLE SOLUTION FOR MAXIMUM ORGANICS AND RESOURCE RECOVERY

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Executive Summary

Curbside collection of organics give poor results

Typically 2/3 of the organics are left in the garbage bins and Cities have to pay to landfill these forever

In Europe: No country gets good results, not even Germany

Collection costs are VERY high/T:
Easily $300/T collected in semi-rural areas
Executive Summary

// Much of the recyclable material in the garbage can be recovered and sent to a recycling plant
// ± 90% of the organics are extracted from the garbage
// The clean organics are sent to composting or digestion
// All of this for ± $5/T (plus manpower)
// The rejects are dry and can be thermally oxidized to produce heat and kW
Who are these companies?

**MABAREX**
- Founded in 1983
- Over 1000 projects in wastewater and organics
- Delivered more biological organic process capacity (BOD) than all competitors combined in our area
- Process integrators: We are technology agnostic

**Anaergia**
- Founded in 2006 by Dr. Andrew Benedek, also founder of Zenon Membranes
- Integrators of unique technologies for the treatment of organic waste
- Invest more than $4 M per year in R & D

**NORARC**
- Founded in 1975
- Manufacturer of equipment (mining, forestry)
- 35 years of experience making energy from waste
- Produce heat and electricity from waste
Saint-Hyacinthe

255 000 T/yr of organics
12,000,000 m³ biogas to grid
Anaergia operates on 4 continents

Recycling plants + OREX™

Cape Town, South Africa

San Francisco, USA

More than 1600 Hi-Solids digesters

Shropshire, UK

Orlovanjak, Croatia
Difficulties in achieving high organics diversion rates

- Low participation & Capture rates
- High Cost – separate bins, compostable bags, special or dedicated collection trucks
- Difficult to implement in multifamily
- High contamination
- Processing challenges due to varying contamination level
Survey of people with access to curbside collection

Source: Recyc-Quebec 2015
First things first: increase collection of recyclables & yard waste

A very inexpensive method: Put a chip on each garbage bin and charge a small amount ± $2 for additional bins after nominal, say 26/year

In Beaconsfield (population 20,000) Quebec, results were immediate:

- Landfilling was reduced by 50%
- Green waste to composting increased by 71%

The city reduced its costs by $200,000 ($10/capita)

Implementation cost = ZERO
Garbage content

Of which ± 20% should have gone to the recycling bin

Total: 285 kg

- **Recyclables**: 57 kg (20%)
- **Organics**: 162 kg (57%)
- **Others**: 66 kg (23%)

From « Residential characterization 2012-2013, Recyc-Quebec, Chamard Report – August 2015 »
1st Step – Open bags – Split in > 6” and < 6”

1. Composting
2. Bag opener
3. Extraction of organics from under 6”
4. Digestion

Over 6” to recycling

Cleaning of organics

OREX™
1\textsuperscript{st} Step – Extraction of recyclables (Option)

Bag opening and sorting
1st Step – Mechanical of recyclables (Option)

Extract some recyclables

Metals – Plastics: Have value
Dirty paper / cardboard sent to composting

Go to organic extraction
2\textsuperscript{nd} Step – Press organics from 150 mm and smaller

// Simple: open bags, send 150 mm and over to recycling and/or waste

// Press smaller than 150 mm

// Extract 85-95\% of the organics

// Inexpensive: less than $5/T with energy & maintenance
Extracted organics
2\textsuperscript{nd} Step - Mechanical extraction of organic materials
What’s left after this?
After organics and part of recyclables removed

BEFORE
- Recyclables: 57 kg (20%)
- Organics: 162 kg (57%)
- Others: 66 kg (23%)
Total: 285 kg

Reduction: 58%

AFTER
- Recyclables: 66 kg
- Organics: 24 kg
- Others: 66 kg
Total: 66 kg
The organics can be composted or digested to make power

The capacity of existing digesters may be DOUBLED or TRIPLED without building new digesters
## Is this proven?

<table>
<thead>
<tr>
<th>Application</th>
<th>Country</th>
<th>System Design Capacity (MTPY)</th>
<th>In Operation (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSW</td>
<td>Germany (Kaiserslauten)</td>
<td>100 000</td>
<td>2006</td>
</tr>
<tr>
<td>MSW</td>
<td>Italy (Alessandria)</td>
<td>100 000</td>
<td>2007</td>
</tr>
<tr>
<td>Bio-Waste</td>
<td>Italy (Castelceriolo)</td>
<td>25 000</td>
<td>2008</td>
</tr>
<tr>
<td>Bio-Waste</td>
<td>Italy (Viareggio)</td>
<td>20 000</td>
<td>2008</td>
</tr>
<tr>
<td>Bio-Waste</td>
<td>Italy (Fossano)</td>
<td>50 000</td>
<td>2011</td>
</tr>
<tr>
<td>Bio-Waste</td>
<td>Italy (Cesar)</td>
<td>35 000</td>
<td>2012</td>
</tr>
<tr>
<td>MSW</td>
<td>Latvia (Vereco)</td>
<td>50 000</td>
<td>2012 / 2013</td>
</tr>
<tr>
<td>SSO</td>
<td>Italy (Mantova)</td>
<td>24 000</td>
<td>2013</td>
</tr>
<tr>
<td>MSW</td>
<td>USA (Recology, CA)</td>
<td>70 000</td>
<td>2016</td>
</tr>
<tr>
<td>MSW</td>
<td>India (North Goa)</td>
<td>37 000</td>
<td>2016</td>
</tr>
<tr>
<td>MSW, Food Waste</td>
<td>South Africa (Wastemart)</td>
<td>150 000 (MSW) 16 000 (POW)</td>
<td>2016</td>
</tr>
<tr>
<td>Food Waste Processing</td>
<td>UK (Cardiff)</td>
<td>35 000</td>
<td>2016</td>
</tr>
<tr>
<td>MSW</td>
<td>Cyprus (Limassol)</td>
<td>140 000</td>
<td>2016</td>
</tr>
<tr>
<td>Source Sorted Organics (SSO)</td>
<td>Canada (Dufferin-Toronto, ON)</td>
<td>55 000</td>
<td>2018</td>
</tr>
</tbody>
</table>
Cape Town, South Africa (600 TPD)

// Project: New Horizons Waste to Energy (Wastemart)

// 150,000 MTPY Municipal Solids Waste (MSW) and Wet Trade Waste (WTW)

// 16,000 MTPY Pure Organic Waste (POW)
Limassol, Cyprus (140,000 T/Yr)
Recology - San Francisco

± 35% organics left in garbage AFTER brown bins

The organics are sent to Oakland for digestion
Anaergia  Toronto Reference

OREX™ Press – Construction Plant Project

Reconstruction of the Dufferin Plant, Toronto

- 2 OREX™ lines
- 55,000 T/yr of brown bins
- Extract organics
- Produce and purify gas
A lot of energy is available in the waste landfilled.

In Canada, nearly 30 million tons of waste are put landfilled every year.

We put in the landfill 130,000,000,000,000 of BTU energy.

In Sweden, as in several countries around the world, 100% of municipal waste is used for electricity production.
Energy recovery of municipal waste has 4 stages

3rd Step – Incineration and energy recovery

Stage 1 - Reception of municipal waste

- Transhipment pit
- Oven feed by grapple
- Operations can be manual or automatic

Stage 2 - Incineration

- Good combustion is essential for the removal of harmful gases from the environment. NOx, furans, etc.
- In addition, this combustion step allows to reduce ultimate waste by 90% intended for landfill.
3rd Step – Incineration and energy recovery

Energy recovery of municipal waste has 4 stages

Stage 3 – Energy recovery

- The boiler makes it possible to recover energy generated by the combustion of waste
- The energy transformed into steam is recovered and valorized in an industrial process or for electricity production

Stage 4 – Treatment of gases and particles

- Active carbon = capture of dioxins and heavy metals
- Lime is for the uptake of acids, dusts and heavy metals
- Recovery of fly ash, transport to specialized companies for this treatment
3rd Step – Incineration and energy recovery

Benefits

// Reduces landfilling waste by 90%
// Can be less expensive than landfill
// Eliminates the risk of soil contamination
// Produces lots of energy
// The energy produced by the municipal waste becomes a factor in the economic development of a city
Incinerator for 4 T/hr +
Incinerator for 4 T/hr +
Our experience near Toronto: Incineration and Energy recovery

**Ajax Project**

- 100,000 T/yr of Residual Derived Fuel (RDF)
- Electricity: 18 Mega Watts
- Norarc manufactured the equipment
- Norarc installed the equipment

Combustion burning furnaces
Moving grates
Stack
Cyclone
Your benefits

Extraction of Recyclables: 100 000 T
- Extraction of organics: 90 000 T
- Digestion or composting: 42 000 T
- Energy recovery of ultimate waste: 48 000 T
- Landfill: 10 000 T

Your benefits:
- 4 800 T kW
What is left after this

Summary

> Recovered 90% of the organics from the garbage
> Recycled most of what should have been in the blue bin in the first place
> Made a lot of energy with the rest
> Profit for the citizens and the environment
> Extended the life of the landfill
> Happy taxpayers

From: 285 kg to 12 kg

REDUCTION: 95%
Specifically for Winnipeg

// The extracted organics could be digested or composted
// The capacity of existing digesters might DOUBLED or TRIPLED without building new digesters
// Thermal oxygenation with Nor-Arc clean burn Technology would burn dry fuel

Benefits
// Selling “blue” gas to the grid at + $20/GJ or making power to drive the plant blowers
// Sale of electricity and heat for industrial processes
// Incinerating garbage will produce ± 10 MWe
Thank you!