Multi-Phased Advanced Thermal Conversion Resource Recycling and Processing Facilities

Modernizing Solid Waste Resource Management

Nova Waste Solutions Inc.
**Position:** Advanced Thermal Conversion, its just another name for incineration and burning garbage, right?

**Response:** There are several critical process, technical, cost and outcome differences. Lets discuss a few.
PHYSICAL PLANT COMPARISON
Incineration Plants

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ATC - Plasma Gasification Plants

Note the absence of huge smoke stacks
FRONT-END PROCESSING
ATC Multi-Stream Processing
ATC Front-End Processing
WHAT’S GOING IN - RESOURCE PROCESSING
Over 70% of MSW is viable latent caloric content containing resources that can be converted into syngas to power generators to produce clean renewable energy and offset coal and other fossil fuel energy.
Source Separated Garbage Bags
Clear Bag MSW Resources in HRM

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CI & MSW on ATC Tip Floor
WHAT COMES OUT BEFORE IT GOES IN - RESOURCE PROCESSING
Fuel Resource Processing Systems
Screened Out Resources
Metals for Recycling
WHAT RESIDUAL DERIVED FUEL LOOKS LIKE BEFORE IT GOES FOR THERMAL PROCESSING
RDF In Storage Bunkers
RESOURCE TO ENERGY PROCESSING
Incineration = Landfill Dependency

~30% of original weight by volume of toxic ash needs to go to Class II and Hazardous Waste Landfill cells
Advanced Thermal Conversion

Waste resources processed, recyclables removed, remaining resources shredded, dried and sent to gasifier.

There is a small quantity of bottom slag (similar to lava rocks) which is recyclable and useable as a civil construction aggregate.

Ending Active Landfill Dependency!

Nova Waste Solutions Inc.
This is glass slag residue from the plasma gasification process which can be recycled and used in civil engineering and construction projects.
Thermal Technologies

Plasma Arc Gasification is the most efficient thermal waste conversion process. The process can achieve up to ~35% energy efficiency rating.

<table>
<thead>
<tr>
<th>Type of Thermal Process Technology</th>
<th>Net Energy Production to Grid</th>
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</thead>
<tbody>
<tr>
<td>Mass Burn (Incineration)</td>
<td>493 kWh/tonne MSW (544 kWh/ton MSW)</td>
</tr>
<tr>
<td>Pyrolysis</td>
<td>518 kWh/tonne MSW (571 kWh/ton MSW)</td>
</tr>
<tr>
<td>Pyrolysis/Gasification</td>
<td>621 kWh/tonne MSW (685 kWh/ton MSW)</td>
</tr>
<tr>
<td>Conventional Gasification</td>
<td>621 kWh/tonne MSW (685 kWh/ton MSW)</td>
</tr>
<tr>
<td>Plasma Arc Gasification</td>
<td>740 kWh/tonne MSW (816 kWh/ton MSW)</td>
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</tbody>
</table>

Note: Except for plasma arc gasification, these processes present environmental issues in the disposing of ash and slag.

Table 1. Thermal Process Technology(s)
Pyrolysis

• Three Types:
  • Rotating Kiln - Typically operate at temperatures of between 300 - 850oC. Unit can accommodate large size feed material (200 mm). Kiln is heated externally and waste is fed in from one end of the kiln which slowly rotates creating a tumbling action. This mixes the waste and ensures contact with the heating surface and gases inside the kiln.
  • Heated Tube - The tubes are heated externally and temperatures as high as 800oC are used. The process can accommodate large size feed material. The waste passes through the tube at a set speed to ensure the pyrolysis process is complete.
  • Surface Contact - Small size feed material required and therefore significant pre- treatment is necessary. Process operates at high temperatures and the small size of the feed gives high heating rates. The application of this technology is to maximise the rate of pyrolysis.
Pyrolysis

1. Coarse Refuse Bunker
2. Rotary Shaker
3. Fine Refuse Bunker
4. Overhead Crane
5. Feeding System
6. Pyrolysis Kiln
7. Discharging System
8. Hot Gas Filter
9. Combustion air fan
10. Combustion Chamber
11. SNCR
12. Evaporator
13. Superheater
14. Economizer
15. Turbine
16. Generator
17. Condenser
18. Feed Water Tank
19. Additive Metering Hopper
20. Fibrous Filter
21. Filter Dust Discharging
22. Induced Draught Ventilator
Gasification

- **Fluidized Bed:** Fluidized bed technology may be used for gasification or combustion processes. The bed is a mass of particles (typically alumina) that has similar characteristics to a moving fluid. This is achieved by blowing hot gases through the bed of particles. This system provides good mixing and heat transfer to the incoming waste. Waste is pre-treated to remove large sized material. This technology is well suited to the gasification of refuse derived fuels.

- **Fixed Bed:** There are a range of different reactor types that come under this heading. A typical example is a grate system where the feed passes along the grate and hot gases pass through the bed of waste heating it.
Plasma Gasification

Plasma gasification

• *Plasma gasification is preferred for mixed waste such as MSW or hazardous waste (asbestos and radioactive) where high temperatures are used to produce syngas and a melt arising from inorganic species of feedstock.*

• A distinctive feature of plasma process resides in its ability to produce very high temperatures that are not achievable with conventional gasification and combustion.

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COSTS OF DEVELOPING THE PLANTS
Durham Facility - $300,000,000.00

- WTE Incineration Plant for 140,000 tonnes
Durham Facility Cost

• A report to Durham council’s committee of the whole on Jan. 27 noted the project, which carried a $272-million price tag, will now cost $296.05 million. Jan 30, 2016

ATC Facility designed for HRM:

- For 150,000 tonnes/year

- Based on Feasibility Study to develop a facility for two fuel-to-syngas-to-energy production lines

- Including Front-End Processing and Recyclables Recovery
ENVIRONMENTAL IMPACT OF LANDFILLING
Climate Impact of an Active Landfill

Green House Gas Methane Landfill Plume (25X more harmful than CO2)
Climate Impact of Landfilling

• Methane is 25 times more potent than carbon dioxide in terms of its global warming potential.

• Emissions from Canadian landfills account for ~20% of national methane emissions.

• Estimates have shown that approximately 27 Mega-tonnes (Mt) of carbon dioxide equivalent (eCO2) are generated annually from Canadian landfills, of which 20 Mt eCO2 are being emitted annually.

Waste Sites in NS

9 MSW Sites, 7 Asbestos Sites & 23 C&D Sites
Nova Scotia Landfills

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Recent Landfill Fires in NS

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C&D Landfill Fire
“With the average landfill site having a 60% statistical risk of fire each year, it's critical that operators have an emergency plan in place. Immediate and decisive action can be the difference between a minor incident and a multi-million dollar environmental disaster.”


Recent landfill fires in NS & Canada:
- Kentville, Otter Lake, Colchester, Chester, Fredericton, Duncan BC, Delta Vancouver, Medicine Hat, Katepwa Regina, Kindersley Sask. etc....
ECONOMIC IMPACT OF LANDFILLING FOR MUNICIPALITIES
Municipal Spending Trend

Chart 19
Local government waste management, financial characteristics
millions of dollars

Source: Statistics Canada, CANSIM table 153-0045.
Exhibit 8: Municipal Government Per Capita Expenditures on Waste Disposal and Diversion, 2010

Note(s): Data for Newfoundland and Labrador, Prince Edward Island, Yukon, Northwest Territories, and Nunavut are not included in order to meet confidentiality requirements of the Statistics Act. For the same reason, the government expenditures related to the operation of organics processing facilities for New Brunswick and Alberta are not included.

As a result of regulatory changes in China, recycling value, options and costs have dramatically changed, creating a new cost burden on the waste resource management system in North America.

Recycling waste resources for the sake of recycling is no longer a viable option, with several jurisdictions ending their recycling programs all together as fiscally unsustainable.
Source Separated Recycling Bags
CHANGING REGULATORY LANDSCAPE IN NOVA SCOTIA
Recommendations:

1. That the federal government continue to work with all levels of government and stakeholders to ensure that best practices in waste management are shared and utilized, while respecting provincial and territorial jurisdiction in this area.

2. That the federal government encourage all Canadians to incorporate the 3Rs – Reduce, Reuse, and Recycle – into their daily routines.

3. That the federal government continue to support the efforts of the Canadian Council of Ministers of the Environment to promote the use of waste management best practices, including through the Canada-wide Action Plan for Extended Producer Responsibility and the Canada-wide Strategy for Sustainable Packaging.

4. **That the federal government encourage scalable solutions for waste management that will work throughout Canada.**

5. **That the federal government continue to support the commercialization of new technologies that will improve waste management.**

6. **That the federal government consider potential incentives to support the adoption and implementation of new technologies in waste management.**

7. That the government continue to encourage the use of cellulosic fuel.
Nova Scotia is allowing new solutions to reduce the amount of waste going into our landfills. The province has amended its solid waste regulations to allow thermal treatment facilities to accept banned materials, such as plastic, cardboard and newsprint, and use them to create energy.

"Nova Scotians are national leaders in waste diversion, but there is still more we can do to keep waste out of our landfills," said Environment Minister Margaret Miller.

"We want Nova Scotians to continue to recycle and compost, but we also need to ensure we're doing all we can to reduce our footprint. This will give new businesses the chance to create something useful from waste destined for landfills."
The Environment Department said the changes to solid waste regulations are about "allowing new solutions" to reduce waste in landfills, and also clarify that the province considers energy recovery as waste diversion.

Recyclable materials will still be banned from landfills, while waste-to-energy facilities will still need all of the required environmental assessment and industrial approvals.

Andrew Murphy, the department's executive director of sustainability and applied science, said there would be no burning associated with the thermal facilities.

- "Thermal treatment facilities are not about burning waste," said Murphy. "Rather these are new emerging technologies that turn waste into a fuel could be a liquid fuel or a gaseous fuel that can be then used again in the economy."
Impact on Solid Waste Programs

- Clarity and distinction between incineration and advanced thermal conversion (ATC) processing
- Preference for ATC processing over landfilling and incineration for end of life resource management
- Delivery of waste resources to ATC facilities will count as diversion
Waste Pyramid Hierarchy

Reduce

Reuse

Recycle

Recover (Energy)

Residuals Management / Disposal

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Solid Waste Program Implications

- The Province’s Environmental Goals And Sustainable Prosperity Act (EGSPA) uses diversion is a performance metric.
- Current diversion is at ~55-60%.
- MSW delivered to ATC facilities will now count as diversion, which can result in raising diversion levels to ~85-90% from active landfills.
Public Support to Improve Waste Management

August, 2013 by CRA, 526 metro residents over 18 were polled

Importance of the Issue of Waste Management in Nova Scotia

Q. NAT4: Nova Scotian politicians are going to have to make a number of decisions on how to deal with landfills being full. Knowing this, and taking into consideration all issues facing governments, how important is the issue of garbage or solid waste management in Nova Scotia? Is it critically important, important, but not critical, not very important, or not at all important? (n=526) *Due to rounding.
Public Support for Plasma Gasification

August 2013 by CRA, 526 metro residents over 18 were polled

Opinion of the Development of Plasma Gasification in Nova Scotia

Support = 79%

31% Completely support
48% Mostly support
5% Mostly oppose
2% Completely oppose
14% Don't know/No answer

Q. NAT5: There are a number of alternatives to manage garbage or solid waste. Nova Scotia is currently investigating technology which breaks garbage down into simple molecules through a process called plasma gasification. This process does not burn garbage but rather heats it to break it down to synthetic gas and reusable materials that can be used to generate energy, or used for construction, agriculture and manufacturing. Knowing this, do you completely support, mostly support, mostly oppose, or completely oppose the development of plasma gasification in Nova Scotia? (n=526)

*Due to rounding.
Thank you