Edmonton Composting Facility Review

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Introduction

In 1994 the City formally tendered for a waste disposal capacity system and received five submissions. A multidisciplinary team reviewed these submissions and recommended TransAlta's composter proposal as being economically, technically, and environmentally superior to the other four. The City entered into a 30-year operating agreement with TransAlta to deliver a minimum of 180,000 tonnes of municipal solid waste and 22,500 dry tonnes of biosolids per year at a cost of about $16 million plus per-tonne tipping fees for any additional waste sent to the facility. The City accepted responsibility for future changes in environmental legislation and waste composition. The City and TransAlta were to share equally in the net proceeds from marketing and selling compost. TransAlta was responsible for the financing, design, construction of the composter, for obtaining all environmental regulatory approvals and for accepting one million tonnes of compost for use on its property.

In December 2000, TransAlta announced plans to sell the composter when it decided to return to its core business. TransAlta engaged an independent investment banker to manage a two-stage sale process consisting of pre-qualification and formal bidding. The City of Edmonton was short-listed as one of two possible buyers. A multidisciplinary team consisting of City staff and outside consultants conducted the review, evaluation and negotiation on behalf of the City. In April 2001, City Council approved an expression of interest in an amount ranging from $95 million to $105 million, and authorized the negotiating team to proceed with a firm offer to purchase within this range. The City submitted a final bid of $97 million, which was subsequently accepted by TransAlta. City Council approved the purchase in May and the City assumed ownership of the composter in June 2001.

In February 2002, the Audit Committee requested that the City Auditor include an operational review of the composter in its 2003 Annual Work Plan and that the City Auditor provide Council with terms of reference for this project prior to commencement of work. The Terms of Reference for the Edmonton Composting Facility were presented to and accepted by Council in April 2003.

Objectives

The goal of this review was to assess the economic reasonableness and value of City ownership of the Edmonton Composting Facility. The objectives of the review were:

- The City's purchase price for the composter was a reasonable representation of value.

- City ownership of the composter is forecast to be economical given the purchase price and realised savings based on the actual cost of capital, operation expenses, and revenue.
- Appropriate actions are being undertaken to maximize the value of the City's ownership of the composter.

Scope and Methodology

The scope of this audit included a review of the key financial and engineering assessments used in making the purchase decision. The OCA also reviewed current financial, operating, engineering information, as well as new initiatives being undertaken by management to enhance the value of the composter.

During the course of the audit, the OCA reviewed the logic, assumptions, and methods of valuation presented in the following consultants' reports:

- *City of Edmonton – Edmonton Compost Facility Assessment – Final Report*, 2001, Associated Engineering Alberta Ltd.
- *Final Report – Valuation of the TransAlta Co-composting Facility*, 2001, KPMG LLP Chartered Accountants.

The OCA also conducted a series of interviews with the people involved in determining the City's bid price to gain a better understanding of the rationale underlying the City's assumptions and calculations.

The OCA obtained current and re-forecasted financial information on the composter's revenues, operating expenses, and capital expenditures to assist in determining the composter's economic status. Additional information was also obtained and evaluated on the Administration's plans to enhance the value of composter through the initiation of marketing projects, productivity improvements, synergistic projects, and the pursuit of non-financial benefits previously mentioned in reports to Council.

Observations and Analysis

Purchase Price of Composter

The KPMG report provided the basis for helping to determine the City's final bid for the composter. KPMG provided the following definition of "fair market value":

> Fair market value is defined as the highest price available in an open and unrestricted market between informed and prudent parties, acting at arm's length and under no compulsion to act, expressed in terms of money or money's worth. The determination of fair market value in a notional context must be differentiated from the determination of price in an open market. Many different prices may exist for a particular business, due to

> differing negotiating strengths among the parties to a transaction, differing perceptions of each of the parties involved as to the future prospects of the business, and other factors. Moreover, potential special purchasers may enjoy certain benefits peculiar to them including costs savings, expected increases in income and other synergies. As a result, the ultimate price of a business may be higher or lower than its notional intrinsic value.

KPMG made an important distinction between “fair market value” and “purchase price.” They assumed that the City is a special purchaser, which enjoys certain benefits not available to alternative purchasers. These benefits include:

- The City is a non-taxable (income tax) entity.
- The City has a favourable credit rating.
- The City is likely the most knowledgeable prospective purchaser of the composter.
- By acquiring the composter, the City would obtain ownership/operating control, thereby no longer being dependent on a third party for future development/operation of the composter.

The OCA agrees with KPMG’s assumption that the City was a “special purchaser” for purposes of determining a value range for the composter. Under these circumstances KPMG estimated a “fair market value” ranging from $121.8 million to $138.9 million. Essentially this “fair market value” represents the maximum price the City would consider paying for the composter under any circumstances.

KPMG also determined a value for the composter from the prospective of a third-party purchaser. KPMG assumed a prospective third-party purchaser would:

- Be a national/international company that owns or manages waste management facilities.
- Be subject to income tax.
- Finance the purchase with an 85%/15% debt/equity mix at a slightly higher interest rate (7.50%) charge for the financing component compared to the City (6.25%).
- Require a 20% after-tax rate of return on the equity component.
- Not likely incur capital costs and management fees as identified by the City and its advisors. (The plant would incur sufficient maintenance expenditures to enable the plant to operate over a thirty-year period, but would be operated using the same operating assumptions and methodology used by TransAlta.)

Using the above-mentioned assumptions, KPMG estimated a value ranging from $81.7 million to $91.7 million. A final value of $90 million was established to reflect the 195,000 tonne capacity level at which the City wanted to operate the composter.

KPMG also anticipated that a prospective third-party purchaser would likely pay from $5 million to $15 million for potential “synergistic values.” KMPG defined “synergistic value” as the amount a prospective purchaser would pay to acquire rights/knowledge/ experience/plant design/technology to generate more profits by managing similar facilities in other jurisdictions. As a result, KPMG estimated the maximum that a third-party purchaser would be willing to pay for the composter from $95 million to $105 million.

The OCA agrees with the assumptions used by KPMG in determining the value range for a prospective third-party purchaser ($95 million to $105 million). This value range represents the minimum price range the City would have needed to consider if it were to make a successful bid to obtain the composter.

The OCA verified calculations contained in the KPMG report in support of the above-mentioned values to ensure mathematical accuracy (except for the synergistic value). KPMG chose the synergistic value range based on their professional judgement. Essentially the synergistic value range represents an additional “cushion” the City needed to consider in order to make a successful bid. The OCA was not able to independently validate the synergistic value range ($5 million to $15 million) used by KPMG but finds it to be reasonable based on the potential synergistic projects identified.

The Associated Engineering report also provided support for the assumptions used to determine the final purchase price of the composter. The cost calculations for the value of the composter used by Associated Engineering were based on several standard practices in the engineering profession:

- The historic cost of the composter’s construction from TransAlta’s records, being depreciated to arrive at the current year’s book value;
- Use of equipment vendor pricing information along with historic engineering information on the construction of industrial plants to derive a cost for building a new plant; and
- Conducting a cost comparison with existing plants in the USA, using these plants’ historic costs and adjusting them for differences in capacity, currency conversion, and inflation.

The calculated value for the plant based on the engineering cost approach was $107 million for plant replacement, $86 million for the depreciated value of the existing plant, and $92 million based on a comparison of plants in the United States. These values generally coincide with the values generated by KPMG using the discounted cash flow approach to valuation.

The above-mentioned reports did not incorporate the positive financial impact to the City of delaying the requirement for significant capital expenditure to acquire a new landfill site by at least 5 years. Furthermore, if the City continues to pursue technologies in diverting municipal solid waste from the landfill, the potential exists to postpone the need to acquire a new landfill site indefinitely, thereby permanently saving the City significant capital expenditure. The City could be in a position to become the first municipality in North America to eliminate the need for additional landfill space.

The OCA concluded that the purchase price for the composter was a reasonable representation of value, given the information available and the assumptions used at the time the purchase was made. The OCA also determined that the stated logic and assumptions inherent to the determination of the composter's value were valid and reasonable at the time the purchase was made.

Composter Economics

In determining the operating economics of the composter, the OCA analyzed actual capital outlays, expenditures, and revenues for 2002, re-forecasted results for 2003, and projections for 2004 to 2010 that were provided by management. The revised financial information was inserted into the original KPMG model to calculate a revised Net Present Value (NPV) and Internal Rate of Return (IRR) at the current production level of 180,000 tonnes.[1]

The revised Net Present Value for the composter was $92 million and the IRR was 5.33%. As a result, the OCA concluded that the composter is uneconomical compared to the original $97 million purchase price[2] and the cost of capital at 6.38%, unless changes are made. The OCA believes that ownership of the composter could become economical in the immediate future by taking appropriate actions to increase production to full capacity, increase revenues, and decrease expenditures.

KPMG's original estimation of maximum value of the composter at the 180,000 tonne production level was $121 million. The $29 million decline in potential maximum value (from $121 million to $92 million) is largely attributed to higher management fees and operating and maintenance expenses than those originally forecasted and lower than forecast revenues for 2002. Capital outlays for repair of some processing equipment were also higher than originally anticipated.

Management fees in KPMG's report were forecasted to be at least $321,000 per annum. Actual management fees for the operation of the composter are around $500,000 per annum (excluding salaried staff). In discussion with the Administration, the OCA established that the management fee variance is the result of changes in operating and maintenance priorities to maximize production of quality compost available for sale to the market place. This necessitated a change in management approach with due-diligence pursued to making improvements in operations and maintenance and eliminating inherent deficiencies in the design and construction of the composter. This change in management priorities requires greater effort on the part of

[1] Determination of the revised NPV was based on current production levels with reforecast operating and capital budgets as of June 9th. Since then changes have been made to the capital budget plan that will positively affect the composter's NPV.

[2] Determination of the purchase price was based upon the composter operating at its full capacity of 195,000 tonnes per year.

the contractor, which in turn necessitates higher-than-forecast management fees. A more comprehensive business strategy and strategic plan that seeks to improve the economy of the Edmonton Composting Facility by increasing revenues and decreasing operating and maintenance expenditures would enhance composter economics (*Recommendation 1)*.

Operating and maintenance expenses (excluding management fee and utility costs) were originally forecasted to be about $5.7 million per annum. Based on actual and re-forecasted expenditures, operating and maintenance expenses (excluding management fee and utility costs) are now projected to be about $8.2 million per annum. The operating and maintenance expenditure variances are a result of the change in management priorities designed to improve the quality of compost and the dependability of processing equipment through improved preventative maintenance.

In 2002, the repair of major mechanical problems (such as the composter's drums) and a series of smaller mechanical problems (repair of back screening equipment, auger gearboxes, biofilter media, etc.) pushed maintenance expenditures over budget. A curing site also had to be developed separate from the municipal solid waste to keep up with increasing biosolid production from the wastewater treatment plant. Significant improvements to the existing curing site were also made to accommodate the increase in biosolid processing within the composter that was the result of another process improvement project. This process improvement project had exceeded its planned implementation budget and was further compounded by a shortfall in biosolid recoveries. However with the new system in place, Drainage Services has agreed to pay for extra amounts of processed biosolids over the next few years.

An additional $5 million in financing has been requested in the 2004 capital plan for capital expenditures and system upgrades[3]. The debt financing of these capital expenditures will add additional interest payments over the next ten years. All future marketing, operational improvement, and preventative maintenance projects need to be analyzed and prioritised using engineering economic analysis with a Minimum Acceptable Rate of Return (MARR) (*Recommendation 2)*.

As noted above, our analysis did not incorporate the positive financial impact of delaying the requirement for significant capital expenditure to acquire and develop a new landfill site by at least 5 years or possible synergistic projects that could be implemented.

[3] About $6.5 million of upgrades and repairs were identified and included in the valuation of the composter prior to purchase. These identified upgrades and repairs were budgeted for implementation over the first few years of ownership. Having gained some operational experience, management decided to complete some of the upgrades and repairs earlier to avoid continued higher operational costs. This combined with the unexpected expense of the drum crack repairs has led to the need for additional borrowing.

There has been a shift in priorities since the composter was acquired from TransAlta. A follow up audit in 2006 will re-evaluate the economy of the composter using updated actual and forecast financial data.

Opportunity for Enhancing Value of Composter

Current Actions to Enhance Value

The composter's operator has presented the City with seven options to eliminate previously identified deficiencies in the design, construction, and operation of the composter and to improve production, productivity and compost quality. Some aspects of these options have been implemented or are being investigated further.

Operational improvements made to the composter include installing new drum seals and internal components, re-construction of biofilters, repairs to the roof and wall envelopes, and upgrading of the curing pad and composting process to handle more biosolids. The upgrading of the facility's heating, ventilation, and air conditioning system has been studied in detail with recommendations made by engineering consultants. Upgrades to the heating, ventilation, and air conditioning system would improve the work environment by improving odour control while reducing operating costs.

Mechanisation of the tipping floor to improve front-end sorting and compost quality has been studied in detail, complete with drawings of the proposed system. Potential costs and savings associated with tipping floor mechanisation and replacement of compost screening equipment in the finishing circuit have been calculated. The financial benefits of improved compost quality for either project have not been calculated, but given the low value of compost, the economics of these projects would not change significantly if they were included.

The facility layout design has not been optimised and changes to it are being considered. Three to five potential facility layouts should be generated for the mechanisation of the tipping floor using industrial engineering facility design methods. Each potential facility layout should also be simulated to quantify the benefits of each layout and provide assurance regarding its functionality. This would aid in selection of a final facility design *(Recommendation 3)*.

Once the facility layout for the mechanised tipping floor is finalised and replacement equipment for the compost screening and finishing process is selected, management will review potential means of reducing the consumption and cost of electricity. This will entail a comprehensive energy audit of the final configuration of the composter's processes. One project that may be investigated is the use of landfill gas to generate electricity. This would require consultation with EPCOR since they own and operate the landfill gas facility. The generation of electricity using this gas could be sold to the grid with savings being reflected in the overall purchase price offered to the City by EPCOR.

Optimising biosolid input by taking in municipal solid waste from other communities is currently being pursued with the County of Strathcona. Some waste from the County of

Strathcona was processed in 2003 for a fee. It is expected that the amount of waste from Strathcona will increase and that in time other municipalities will also participate. Private sector companies have also shown interest in having their organic waste processed by the composter. Yard waste is currently being composted in windrows[4] on the curing pad less expensively than processing it through the composter.

Two marketing studies for compost have been conducted. The first study, *Market Analysis and Marketing Plan for a Compost Soil Amendment Product*, 2000, done for TransAlta and the City of Edmonton, identified 'volume markets' and 'value markets.' The identified volume markets are agriculture, reclamation work within the oil & gas industry, roadside reclamation, and reclamation of gravel pits. The identified value markets are topsoil blenders, sports turf and grounds maintenance (includes golf courses and parks operations), greenhouses and nurseries, and landscapers. This report describes the product attributes required for each particular market as well as the potential market size in terms of sales. The priority markets to be pursued according to this report are topsoil blenders, landscapers, oil & gas reclamation, and field nurseries.

The second study, *City of Edmonton Compost Market Action Plans*, 2002, re-evaluated current compost markets and presented a series of 'action plans' to assist in approaching the most promising markets. Target volumes of compost were established for primary and secondary markets for both the short-term and the long-term. This report identifies long-term primary markets as oil, landscape supply/topsoil, in-city use, landscape/turf, and garden centres/retail sales. Long-term secondary markets are identified as agriculture, reclamation, nurseries/greenhouses, and golf courses. The estimated potential revenue from these long-term markets is about $2.3 million per annum. The report also identifies a potential market of 50,000 to 60,000 tonnes of fertiliser that could be produced from 67,000 to 80,000 tonnes of compost. The compost would be dried, granulated, and pelletised when turned into fertiliser. Management is currently conducting a review of the opportunity to produce granulated products for high value speciality markets such as golf courses, sod farms, and horticulture. This review will look at the size of the potential markets, suitability of the City's compost, and existing technologies, costs and revenues. Further analysis will be conducted if significant potential revenues exist for the product.

At present, the existing five-year market plan is in its second year. Under this plan, management expects to sell all of the compost produced through strategic partnerships with the private sector and a focussed marketing effort.

Management is currently investigating the economics of using a gasification process to dispose of residual waste[5] as a synergistic project. The *Review of Opportunities to Utilize Residues from Edmonton's Waste Management System*, December 2000, conducted by the Alberta Research Council, examined incineration, gasification, pyrolysis, and thermal degradation for generating liquid fuels as possible means of

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[4] Windrows are rows of material raked or swept together to dry.

[5] The residual waste from the composter is primarily plastic with organic residue. Residual plastic waste also exists at the Materials Recovery Facility, which is currently being disposed of in the landfill.

disposing of waste stream residuals. The Alberta Research Council recommended further sampling of the residual waste stream, further investigation of gasification and pyrolysis, and possible use of incineration.

Another intermediate report, *Gasification and Fluidised Bed Waste Conversion Technologies*, February 2003, reviewed the costs associated with gasification, pyrolysis, and fluidised bed combustion processes. The OCA estimated from preliminary figures in this report that a boiler and turbine gasification plant processing 80,000 tonnes per year of residual plastic may have a negative cash flow. However, the OCA's cost estimates are based on a broad range of technologies and are not definitive. A more detailed calculation of the costs and benefits of a gasification facility will be completed later this year by management and presented in a finalised report on gasification technologies. The definitive financial figures for gasification will be based on the particular technology and capacity selected.

Management is also pursuing other synergistic projects, one of which is the sale of greenhouse gas credits. A study conducted in April 2003 indicates that the market value of greenhouse gas credits could range from $0.5 million to $2.5 million per year depending on the means of measurement used. Greenhouse gas credits arise from the elimination of methane that would be generated by landfilled waste and the use of compost to offset the use of fertiliser. Management is actively monitoring the status of this market as it develops.

Management is considering separately processing selected material streams to produce high-grade compost that would be sold to select markets such as golf courses, which may be willing to pay a premium for the product.

Management is also investigating the potential of using the low-grade heat produced by the biological processes in the composter to melt snow cleared from city streets or using this heat in a greenhouse.

Using the City's composting technology expertise in a consulting practice is another possible synergistic activity that could generate some revenue for the Edmonton Waste Management Centre. City staff members have already participated in an advisory role in one international project sponsored by a development bank.

The Waste Management Branch and the Drainage Services Branch are discussing means to reduce the overall costs of managing biosolids. This could be accomplished by installing additional equipment to thicken the biosolids for more efficient processing in the composter, which could avoid future capital and operating costs of additional sludge digesters at the waste water treatment plant.

GEKO GmbH, a German corporation, has formed an Alberta subsidiary and has entered into a lease agreement for a parcel of land at the Edmonton Waste Management Centre. GEKO intends to build a $20 million plant to process scrap electronics and metals from end-of-life manufactured goods. Development of a mechanised tipping floor will both improve the quality of compost and divert scrap electronics and metals to GEKO. The agreement with GEKO provides for some profit sharing with the City, providing an additional revenue stream.

In the area of non-financial benefits of composter ownership, construction of GEKO's plant represents a step towards the development of an Environmental Technology Park or Resource Recovery Park. The Edmonton Composting Facility and Materials Recovery Facility are the existing basis for expansion of Edmonton Waste Management Centre's efforts to develop an Environmental Technology Park on the surrounding land. In March 2001, a consultant conducted a conceptual feasibility study outlining the possible development of an Environmental Technology Park. The project to complete the next stage of concept development for the Environmental Technology Park was unfunded for both the 2002 and 2003 Capital Project Plans.

Business plans also exist for the Edmonton Waste Management Centre of Excellence. The centre's 1999 business plan presents a strategy to leverage the breadth and diversity of Edmonton Waste Management Centre's partners (the City of Edmonton, Agra Earth and Environmental, the Northern Alberta Institute of Technology (NAIT), Olds College, the University of Alberta, and the Alberta Research Council). The vision for the centre is to provide research and training facilities for its partners and other researchers and users from around the world. The cross-fertilisation of knowledge and ideas are to be a source of innovation for Edmonton's consulting and environmental industries.

Of the centre's planned facilities, the Clover Bar education and training facility is currently operational while the exterior facilities (biofilters, covered storage bunkers, mobile sludge tanks, and landfill test cells), wet treatment wing, and dry treatment wing are currently under construction. The planned greenhouse for research into soils, compost, germination, and feedstock is currently not funded but is planned during a future expansion of the centre.

Potential Actions to Enhance Value

The Waste Management Branch has several plans in place to enhance the value of the Edmonton Composting Facility and the Edmonton Waste Management Centre. These plans need to be drawn together into one comprehensive business plan to maximize the value of ownership. During this audit, the OCA identified additional potentially synergistic projects that would allow Waste Management to reach its goal of complete diversion of municipal solid waste from landfill, while significantly increasing potential revenues.

Since compost is a low-value product and its sales to the identified markets would result in only modest revenue, direct sale of compost has limited potential to enhance the value of the composter. Other means of enhancing the composter's value need to be employed. The OCA identified nine business strategies or 'profit models'[6] that could be employed for either the Edmonton Composting Facility and/or the Edmonton Waste Management Centre, which could significantly enhance the value of ownership. The use of these strategies or profit models would require investment in economical, synergistic projects downstream in both the compost and residual plastic value chains.

Potential economical, synergistic projects downstream in the compost value chain include a sod farm and nursery and an integrated greenhouse and granulation plant. As noted in one of the marketing studies, compost is an effective medium for growing sod. For example, one patented system is able to produce marketable sod in approximately 10 weeks. Compost can also be used to grow trees and shrubs, and in the production of 'blended soil.' Other land available in the Clover Bar area may be suitable for a low-intensity development and could be put to productive use in conjunction with compost to produce sod, trees, shrubs, and blended soil, which could be sold to the Community Services Department and to landscape wholesalers *(Recommendation 4)*.

An integrated greenhouse and granulation plant could also make use of residual heat from the composter and methane from the landfill to heat the facility and produce pelletised fertiliser and horticultural, agricultural, and aquacultural products. The greenhouse portion of the facility could utilise an ecologically based technology such as that developed by Ocean Arks International to create an integrated food production system *(Recommendation 5).*

Compost not being used in the downstream value-added processes could be sold to the most valuable markets: nurseries, greenhouses, garden centre retailers, and oil field reclamation. Expertise could easily be developed in the use of compost in oil field reclamation based on the growing body of knowledge the Edmonton Waste Management Centre has with its strategic partners.

A subsidiary corporation could be created with three divisions: Landscape Supplies, Food Production, and Land Reclamation to manage all downstream value-added processes in the compost value chain and ultimately privatised. Proceeds from the company's privatisation could be used for additional funding of capital projects required for the development of the Environmental Technology Park. The elimination of additional borrowing would result in significant savings from the elimination of additional interest payments.

In reviewing potential synergistic projects, the OCA found that the residual plastic from the Edmonton Composting Facility and the Materials Recovery Facility is potentially of high value. The Thermal Depolymerization Process developed by Changing World Technologies, Inc. emulates Earth's own processes, using temperature, pressure, and time in a completely enclosed process to reform organic materials into gas, oil, and carbon. With the Thermal Depolymerization Process, the reformation process is accelerated in a refining process using standard industrial equipment. All process by-

[6] See *Table 1, Profit Model Definitions and Applications* in the appendix for a full description of these models.

products are commodities that can be sold on the open market. The gas produced could be used for running a co-generation plant to produce electricity for internal use and for sale to the grid. The yield typically derived from plastics is 70% oil, 16% gas, 8% water, and 6% carbon solids. At an input of 80,000 tonnes/year of residual plastic, 56,000 tonnes of light oil, 12,800 tonnes of gas, 6,400 tonnes of water, and 4,800 tonnes of carbon solids could be produced. Using the gas in a co-generation power plant could generate 104,000 MWh of electricity. The revenue generated from the sale of electricity, oil, and carbon solids could be as much as $28 million per year. The Thermal Depolymerization Process plant and the power plant would likely have an operating cost of approximately $7.5 million per year, leaving an estimated profit of $20.5 million.[7]

A Thermal Depolymerization Process plant with an 80,000 tonne capacity would cost approximately $34 million to build and a co-generation plant to produce electricity from the gas would cost approximately $18 million. The total combined cost of $52 million is considerably less than the $80 million required for a boiler and turbine gasification plant[8], resulting in a potential capital saving of $28 million.

The OCA also conducted a cost comparison of building a new landfill in both urban and rural locations based on information provided from a 1993 Sanitary Landfill Analysis. Projected costs to build a new landfill in urban or rural locations would be about $84 million or $27 million respectively. The annual operating cost for the new landfill would be approximately $3 million for an urban location or $3.5 million for a rural location. Since no revenues are associated with landfill, these annual operating costs translate into operating losses. Including the costs of capital recovery, the net cash flow to the City for owning and operating a landfill would be about -$10 million for an urban location or -$5.6 million for a rural location. The net cash flow for a Thermal Depolymerization Process plant could be $16 million. Given the clear economic advantage in terms of capital cost, revenue, operating cost, operating profit, and positive net cash flow, a full investigation into the potential of thermal depolymerization processes is warranted. A Thermal Depolymerization Process plant also appears to fulfil all six essential criteria and four desirable criteria that were established by the City for its consultant's review of gasification, pyrolysis, and fluidised bed combustion processes[9] *(Recommendation 6).*

With the construction of a Thermal Depolymerization Process plant, co-generation power plant, integrated greenhouse and granulation plant, sod farm and nursery, and GEKO's facility, all residuals and compost from the Materials Recovery Facility and Edmonton Composting Facility could potentially be utilized. Accomplishing this goal would establish a comprehensive Environmental Technology Park with profits available

[7] Composter residual waste is primarily but not exclusively plastic. Testing would have to be conducted to determine the actual yield of oil and gas from the residual waste. Revenue and cost calculations are based on information taken from published articles, the CWT's website, and e-mail correspondence.
[8] Management's report to Council in April (file: 2003PWW052) indicated that a future gasification facility receiving 80,000 to 100,000 tonnes per year of residual material would have a capital cost ranging from $80 million to $120 million and an associated operating cost of $60 to $100 per tonne, net of revenue from energy sales and including debt service.
[9] See *Table 2, Evaluation Criteria for Gasification and Fluidised Bed Waste Conversion Technologies for Edmonton* in the appendix for further details.

for expansion. Inclusion of companies such as Changing World Technologies and Ocean Arks International as partners in the centre could bring unique engineering and ecologically-based knowledge to the centre that would benefit existing partners in Edmonton Waste Management Centre of Excellence and future business in the Environmental Technology Park.

The City of Edmonton could be the first metropolitan area to eliminate landfilling of municipal solid waste on a basis that is both economically and environmentally sound. Under terms of the Kyoto Accord, the Edmonton Waste Management Centre could likely achieve additional greenhouse gas credits beyond what is currently estimated for the elimination of methane generated from landfill use. Greenhouse gas credits may be granted for the production of oil, carbon, gas, and electricity from renewable resources and decreased use of fossil fuels. Greenhouse gas credits may also be available for a greenhouse and granulation plant since it could use existing landfill methane and produce no offsetting environmental wastes.

Conclusion

Overall, the OCA found that the purchase price for the composter was a reasonable representation of value, given the information available and the assumptions used at the time of purchase. Upon examining current actual capital outlays, expenditures, and revenues for 2002, re-forecasted results for 2003, and projections for 2004 to 2010 as provided by management, a revised Net Present Value of $92 million was calculated. Since the revised NPV is less than the $97 million purchase price it is concluded that the composter is uneconomical, unless changes are made. The OCA believes that the composter can become economical by taking mitigating actions to increase production, increase revenues, and to decrease expenditures.

The OCA observed that management is currently pursuing several options to improve the value of the composter and its economics. Other possible synergistic projects were identified that could significantly enhance the value of the Edmonton Composting Facility and Edmonton Waste Management Centre and were presented to management for further evaluation. Other technologies may also become available over the next few years that could also provide synergistic benefits, which should also be investigated.

The OCA would like to thank the management of the Waste Management Branch for its co-operation and insight provided during the course of this review.

Recommendations and Action Plans

Opportunity for Improvement	Management Response
Business Strategy	
1. That the Waste Management Branch update and develop a more comprehensive business strategy and strategic plan that seeks to improve the economy of the Edmonton Composting Facility by increasing revenues and decreasing operating and maintenance expenditures.	**Accepted** *Target Date*: To be determined following approval of 2004 budget. *Responsible Party:* Waste Management Branch. Management will update and develop a strategic business plan for the Edmonton Composting Facility.
Capital Improvements	
2. That all future marketing, operational improvement, and preventative maintenance projects be analyzed and prioritised using engineering economic analysis with a Minimum Acceptable Rate of Return (MARR) set at the composter's calculated annual Internal Rate of Return (IRR), plus a premium of 1% to 2%.	**Accepted** *Target Date:* To be determined following approval of 2004 budget. *Responsible Party:* Waste Management Branch. Management has been actively pursuing ways to increase revenue and reduce operating and maintenance expenses and will continue to do so with the recommended techniques when appropriate.
Facility Layout	
3. Develop three to five facility layouts for the mechanised tipping floor using industrial engineering facility design methods and simulation to optimize operations.	**Accepted** *Target Date:* To be determined following approval of 2004 budget. *Responsible Party:* Waste Management Branch. Recommendation 3 will be pursued bearing in mind the need to remain flexible. Since the layout and function of the tip floor must reflect the needs of key synergistic projects.
Synergistic Projects	
4. Investigate the potential to develop a sod farm and nursery on land that is expected to become available using compost as a growing medium.	**Accepted** *Target Date* To be determined following approval of 2004 budget. *Responsible Party:* Waste Management Branch. Management concurs that there are potential revenue generating synergistic opportunities and notes that the timing for investigation will depend on budget approval for travel and consultant fees.
5. Investigate the potential to develop an integrated greenhouse and granulation plant utilising an integrated food production system or bio-system similar to that developed by Ocean Arks International.	**Accepted** *Target Date:* To be determined following approval of 2004 budget. *Responsible Party:* Waste Management Branch. (Comment same as recommendation 4.)
6. Investigate the potential of Changing World Technologies' Thermal Depolymerization Process and other potential technology to process residual materials from the Edmonton Composting Facility and Materials Recovery Facility in co-operation with regional partners.	**Accepted** *Target Date:* To be determined following approval of 2004 budget. *Responsible Party:* Waste Management Branch. (Comment same as recommendation 4.)

***Appendix:* Table 1, Profit Model Definitions and Applications.**

Profit Model	**Definition**	**Application for Edmonton Composting Facility**
Product Pyramid	Meeting customer preferences of style, colour, price, etc. is of utmost importance for the product pyramid model. The variations in customer income and preferences make it possible to build a product pyramid ranging from low-price, high volume products at the base of the pyramid, to high-priced, low volume products at the apex of the pyramid.	• Granulation of compost/fertiliser – higher price for finer granulated fertiliser. • Higher price for high quality compost & small-specialised compost markets. • Lower price for mass volume markets.
Multi-component	There are multiple components within an enterprise, and several of the components represent a disproportionate share of the profits. Examples of the multi-component profit model apply to industries as diverse as beverages (the profit is in fountain and vending), hotels (the base business has low margins, the corporate meeting and high-end restaurant business is highly profitable).	• Sod farm and nursery – producing turf, trees, blended shrubs and soil from the same section of land. • Greenhouse (Ocean Arks Technology) – producing plants, flowers, mushrooms, lettuce, tomatoes, fish and crayfish. • Granulation plant producing fertiliser from the same facility as the greenhouse. • TDP process – producing oil, gas, water and carbon solids.
Entrepreneurial	As companies grow, diseconomies and dysfunction occur, including unnecessary overhead and direct expense, ineffective decision making, customers become remote. To counteract these forces, some companies have organized themselves into very small profit centres to maximize accountability and customer proximity.	• Spin-off Greenhouse as Company. • Spin-off Sod Farm/Nursery as Company. • Spin-off Land Reclamation as Company. • Spin-off above mentioned Companies as a bundle or separately.
Specialisation	In many industries, specialists are several times more profitable than generalists are. The specialists' superior profitability derives from a multitude of factors, including lower cost, higher quality, stronger reputation, shorter selling cycles, and better price realisation.	• Compost and fertiliser product blending. • Horticulture mixes.

Profit Model	Definition	Application for Edmonton Composting Facility
Brand Profit	Over a period of years, a brand-building company expends significant marketing investment in order to build awareness, recognition, trust and credibility. Customers are happy to pay a price premium for these products.	• Use in conjunction with the product pyramid profit model along with extensive advertising campaign to promote a brand name.
Value Chain Position	In many industries, profit concentrates itself in certain parts of the value chain and is absent in others. In general merchandise, it is distribution, not in manufacturing. In automotive, it is in downstream activities such as financial services and extended warranty, not in assembly or distribution.	• Using compost in greenhouse for horticulture, agriculture, and aquaculture. • Using compost in granulation plant to produce fertiliser. • Using compost in sod farm and nursery to produce landscape supplies.
After Sale	In some industries, such as manufacturing it is not in the sales of the product that generates the profit, but in the after sale financing or service of the product.	• Selling service and using compost for land reclamation projects. • Horticulture consulting. • Compost and bio-systems consulting.
Experience Curve	As a firm becomes more experienced at manufacturing a product or delivering a service, its price per transaction decreases.	• Through steady application of Industrial Engineering principles and Engineering economics on ECF and MCF.
Low-cost Business Design	You can trump cumulative experience with low-cost business design (West Jet's business and industrial processes to deliver air services compared to Air Canada's processes)	• Using integrated system between the Composter and other synergistic plant alternatives (power station, TDP, Greenhouse/ sod farm & nursery etc.…) to avoid the need to build another landfill site on a permanent basis.

Appendix: **Table 2, Evaluation Criteria for Gasification and Fluidised Bed Waste Conversion Technologies for Edmonton.**

Essential Criteria	**Measure**	**Applicable to TDP process**
Waste type/suitability	Technology must be capable of handling and processing Compost rejects and RDF.	Yes
Status	Process must be fully commercial based on consultant's current classification method (Tier 1), or	No - Tier 2
	Process must be currently operating as a demonstration facility at a scale of 50 kTpa or at a scale, which would require a maximum scale-up of 3 times (Tier2).	Yes
Environmental impact	Process must be able to meet the most stringent European emission requirements (WID), if applicable.	Yes
	Process must not produce hazardous residue, which is difficult to handle and dispose of.	Yes
Supplier credibility	Potential suppliers must be credible organisations with the necessary engineering and financial resources to design, construct, and commission and warrant such a process.	Yes
Exclusions	Process must not be a combustion process or be perceived as combustion.	Yes
	Use of the syngas to generate steam as the final product for sale to potential over-the-fence customers.	Yes
Energy recovery/utilisation	Process must be a net producer of energy.	Yes
	Combination of dirty syngas is acceptable if it is part of an integrated process.	N/A
Desirable Criteria	**Measure**	
Flexibility	Flexibility of feedstock acceptability	Yes
	Amount of further pre-processing required (front-end simplicity).	Yes
Environmental impacts	Amount and types, if any, of emissions to air, liquid effluents and solid residues.	Yes
Economics	Capital costs.	Yes
	Operating costs.	Yes

Reference plants	Availability of reference facilities to visit and assess.	Yes
Criterion	**Definition**	
Fully commercial (Tier1)	Multiple full-scale plants have been built, for more than one customer, and have been operating satisfactorily for more than 2 years on a relevant feedstock and at appropriate scale.	No
Semi-commercial (Tier2)	A full-scale commercial plant for a similar application has been handed over to a customer, or is operating satisfactorily under a Build, Own, Operate (BOO) contract, and further opportunities are being pursued.	Yes
Demonstration (Tier2)	A semi-commercial installation has been completed at a scale beyond a pilot plant. This plant is being commissioned or is already being operated as a first reference installation, often by the developer themselves.	No