6.0 TASK 5: ECONOMIC POTENTIAL OF FULL RESOURCE RECOVERY

6.1 Scope of Economic Analysis and Assumptions

6.1.1 Analysis Methodology

The economic analysis was developed according to the steps outlined below.

a. Waste composition and quantity were estimated based on work carried out in Task 1.

b. Outline CAPEX and OPEX costs were assumed for Scenarios 2 and 3 on the basis of the following:
    i. Zero land acquisition cost (e.g. assumed facility would be developed on lands owned by OC); and
    ii. Typical CAPEX/OPEX costs for similar sized facilities (i.e.handling 20kta-30tpa waste), were derived from a combination of published data and SLR experience, adjusted for currency exchange. For estimating purposes the plant was based on:
        - 10tph throughput;
        - operating on a single shift basis;
        - housed in an 80m x 40m x10m building;
        - eight operational staff employed.

c. Project approvals, permitting costs and financial costs were excluded at this stage based on the following rationale:
    i. Costs would be similar for both Scenarios 2 and 3; and
    ii. Permitting costs were assumed to be small relative to CAPEX and OPEX costs and were thus not estimated at this stage.

d. At this initial stage of the study, details of potential funding sources were not known and therefore potential financial costs could not be identified and thus were not included at this stage.

e. Potential revenue was considered from the following:
    i. recovered materials;
    ii. power sales;
    iii. heat sales; and
    iv. avoided landfill costs.

6.1.2 Specific Assumptions

The key assumptions used in the analysis are as follows:

a. Waste composition is based on 2017 survey results[31]:

Material	Composition (2017)
Non-acceptable materials	21%
Organics	31%
Glass	4%
Metals	4%
Plastics	13%
Paper Packaging	28%
Total	**100%**

b. Revenue and cost assumptions:

Revenue Type	Assumed Value	Source/Rationale
Electricity Sales	$0.08/kWh	Current pricing for electricity from York Durham Energy Centre
Hot Water Sales	$0.0081/kg	Reasoned to be similar to steam sale; rate from Peel Region Study[32]
Sale of Recyclables (prior to transport)	$120/te	Current OC average revenue per tonne
Avoided Landfill Cost	$38/te	Current OC cost per tonne for landfill operation

c. Exchange rate assumed as CAN$ = £0.60.

d. Biogas production was assumed as an average of 100m^3/te organic feedstock, with 55% methane content. The value based on a conservative mixture of household food waste and some non-woody leaf and yard waste.

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2017 Oxford County Waste Management Facility and Curbside Waste Composition Study Waste Composition Study Report. Prepared by AET Group, May 2017.

32

Peel Energy Recovery Centre Long Term Waste Disposal Study, April 2012.

e. Gas engine generator conversion efficiency was taken as 40% of the input energy. Modern gas engines operating on biogas can achieve 42-43% conversion efficiency but at a larger output scale, typically 1MWe output. Smaller capacity gas engines are not as efficient and can be a low as 38% efficiency.

f. Efficiency of gas engine recoverable heat was assumed as 45% of the input biogas energy. The value is associated with 40% electrical conversion efficiency; the higher the electrical conversion efficiency the lower the percentage of recoverable heat.

g. Heat recovered is assumed to be as hot water at approximately 70-800 deg C. The engine exhaust heat can be recovered as low pressure steam but for a plant of this output the costs are not usually considered appropriate.

h. Parasitic electrical use for the MRF was assumed as 60kWh/te. The value of the parasitic electricity for an MRF varies with the design and plant capacity. A modest degree of electro-mechanical equipment has been assumed and the estimate of the parasitic electrical demand derived from a similar MRF reviewed by SLR.

i. Similar to the MRF above the estimated parasitic electrical load of the AD plant of 12% is based on the average value derived from a number of AD projects reviewed by SLR and assumes a typical AD plant design.

6.2 MCA Scenario 2

The CAPEX for a 20ktpa MRF plant producing recyclables and RDF (for thermal treatment outside OC) is estimated as **CAN $6.6M - $6.9M**.

The estimated OPEX for the plant is estimated on the order of **$26 - $31/te**.

The CAPEX and OPEX will vary depending on the complexity of the MRF plant, which in turn will impact on both the quantity and quality of the recyclates recovered.

For this initial, high level assessment, a conservative degree of plant complexity has been consumed, with a modest degree of manual sorting to enhance both a higher recovery rate and higher quality recyclate.

Based on the above assumptions the estimated revenue stream and avoided landfill costs are shown in **Table 6-1.**

Table 6-1:
Potential Revenues Scenario 2

ANNUAL REVENUE	Available Quantity	CAN$
Electricity Sales (less 60kWh/te MRF parasitic load)	304,237kWh	24,339
Hot water sales	1,692,266kWh	13,538
Sale of recyclables (prior to transport) @ $120/te	1,320te	158,400
RDF price (assume avoided landfill cost) @$38/te	6,370te	242,060
Avoided landfill cost @$38/te	4,200te	159,600
Total Potential Annual Revenue		**$597,937**

6.3 MCA Scenario 3

The CAPEX for a 20ktpa MBT plant using a wet AD to process the approx. 7,400tpa recovered organic fraction and generating electricity and hot water at about 70 deg C, is estimated as **CAN $7.7M-$9M**.

The estimated OPEX for the plant is of the order **$64 – $79/te**.

The CAPEX and OPEX will vary depending on the complexity of the MRF plant, which in turn will impact on both the quantity and quality of the recyclates recovered.

For this initial, high level assessment, a low degree of plant complexity has been assumed, with minimal manual sorting, which enhances both a higher recovery rate and higher quality recyclate.

Based on the above assumptions the estimated revenue stream and avoided landfill costs are shown in **Table 6-2**.

Table 6-2:
Potential Revenues Scenario 3

ANNUAL REVENUE	Available Quantity	CAN$
Electricity Sales (12% AD and 60kWh/te MRF parasitic load)	123,728kWh	9,898
Hot water sales (15% parasitic use)	1,438,426kWh	11,507
Sale of recyclables (prior to transport) @ $120/te	7,690te	922,800
Avoided landfill cost @$38/te	4,200te	159,600
Total Potential Annual Revenue		**$1,103,806**

6.4 Discussion

The results for the two highest scoring MCA Scenarios 2 and 3 are presented in **Sections 6-2 and 6-3**, and these illustrate the sensitivity of the outputs to the key assumptions. Our specific findings from this assessment are provided as follows:

Waste Composition

Waste composition is the key parameter that determines both the quantity of organics available and the quantity of recyclates available for recovery. The subsequent design of the MRF will impact on both the quality and quantity of recyclates recovered and available for sale, with high quality recyclates securing a higher price, especially for paper and plastics that can be easily contaminated and produce a lower value output.Refinement of the waste composition to identify the different types of plastic (and thus the higher recyclate prices achievable) could result in some changes to the potential revenue. However this is most likely modest.

RDF Price

The assumed RDF price is taken as equal to the $38/te avoided landfill cost but subject to the distance needed to travel may result in a reduced price if Oxford County are liable for the transport costs.

Heat Recovery

The parasitic electrical demand for the AD plant in Scenario 3 reduces the electricity available for sale and similarly the quantity of surplus heat available for use. The heat recovered is assumed to be as hot water at approximately 70-80 deg C, which is suitable for space heating purposes.

It is possible to recover half the total engine heat from the engine exhaust as low pressure (LP) steam, with the balance recovered from the engine cooling water circuit. However the overall quantity of heat is modest and it is unlikely that recovering the exhaust heat as LP steam would be financially worthwhile.

The total quantity of recovered heat is considered to be suitable only for onsite space heating use.

Income and Revenue

A simple payback calculation based on this initial high level assessment suggests the following:

- Scenario 2: estimated OPEX $26 - $31/te and annual revenue of $0.598M gives a net income of **$(-)22k to $78k**.

- Scenario 3: estimated OPEX of $64 – $79/te and annual revenue of $1.104M gives a net income of **$(-)176k to $(-)476k**.

On this basis only Scenario 2 could provide a small positive net income and results in a simple payback period of approx.. 80 years, which is clearly unacceptable financially. It is clear that the simple payback assessment is very sensitive to the CAPEX/OPEX and revenue assumptions and that modest changes in these values could have a significant impact on the final results. A more detailed assessment of the top two potential technology options and associated costs/revenues is needed if a more accurate result is required.

It must be noted that the assumed CAPEX and OPEX values are generalised, average values and should be viewed as being of the order +/- 20%. Together with the assumed mix of recyclates, price for recyclates, RDF price, and the avoided landfill cost, the above factors are sufficient to impact significantly on the high-level financial assessment above.

Due largely to the lower CAPEX involved, Scenario 2 would most likely have the lower simple payback period of the two technology scenarios considered.

6.5 Facility Development Considerations

The implementation of a waste treatment facility along the lines of those considered in this study would likely include the following elements:

- Selection of facility type and its main elements. This may include conceptual design studies to refine facility elements, size, and costs.

- Consideration of how such a facility would integrate with Oxford County's waste management system now and in the future. This would include identification of a planning horizon for facility implementation, changes that may be needed to waste services provided by Oxford County, and consideration of new regulations anticipated under the new Waste Free Ontario Act and related legislation.

- Consultation with the appropriate stakeholders including the public, First Nations, local businesses, and special interest groups.

- Preparation of a 'business case' for the project going forward. This would include a more detailed consideration of costs and revenues, as well as review and selection of a preferred financing and procurement process.

- Commencement of the regulatory approvals process with the MOECC.

- Obtaining relevant municipal approvals.
- Procurement, construction, and commissioning.