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Memorandum

To:	Jay Heaman Manager, Strategic Initiatives	**From:**	Mark Sungaila, Ben Arnold SLR Consulting
Company:	Oxford County		
cc:		**Date:**	August 4, 2017
Subject:	**ASSESSMENT OF WASTE REDUCTION AND RECOVERY TECHNOLOGIES TECHNICAL MEMORANDUM 1B: STAGE 2 - TECHNOLOGY OPTIONS (INCLUSIVE LIST)**		

1.0 INTRODUCTION

Oxford County operates a very successful municipal solid waste management program having achieved a ranking of 6th out of 230 Ontario municipalities for diverting residential waste from landfill, as well as a ranking of 1st in diversion for municipalities within its grouping[1]. The County has also embarked on an ambitious program to achieve two significant long term Sustainability goals, being 1) achievement of 100% renewable energy by 2050[2], in accordance with the County's June 2015 resolution; and, 2) achievement of Zero Waste, as articulated in the September 2016 draft Zero Waste Plan[3]. Oxford County's renewable energy commitment provides a mechanism for linking the two goals outlined above and recognizes that residual waste can form a useful feedstock for generating energy from waste. As part of its program toward achieving Zero Waste and other related goals, OC has undertaken this ***Assessment of Waste Recovery and Reduction Technologies*** (the Project). The Project is being undertaken amidst the development of recent climate change and waste management legislation (and related policies, strategies, and emerging programs), intended to dramatically reduce waste generation and disposal, and intended to drive the 'Circular Economy'.

The County has retained the consulting team of SLR Consulting (Canada) Ltd., in association with Love Environment to assist them in carrying out the Project, which will consist of five main tasks described in following **Sections 1.1** through **1.5.**

[1] Full Report County of Oxford Waste Management Strategy, Oxford County, August 2014.

[2] Draft 100% Renewable Energy Plan, Oxford County, June 22 2016.

[3] Draft Zero Waste Plan, Oxford County, September 22, 2106.

1.1 Task 1: Assessment of Existing Waste Recovery Technologies

Task 1 is a comprehensive review of existing approaches to the reduction of residual waste, leading to identification of technologies that are relevant to Oxford County. This will be undertaken in three stages:

- *Stage 1: Setting the Scene*: This is an analysis of the current waste management situation in Oxford County aimed at characterising the County's waste management situation in terms of scale, current approach, types of waste, barriers and opportunities.

- *Stage 2: Technology Options (Inclusive List).* Stage 2 is identification of a long list of technology suppliers under each material type and technology class. This long list would subsequently be screened against a set of criteria which would be agreed with the County.

- *Stage 3: In-depth Evaluation.* Stage 3 is a more in-depth analysis of the individual technologies using the County's Multi Criteria Analysis Tool (MCA).

1.2 Task 2: Case Studies of Implemented Technologies

Task 2 will result in the documentation of case studies of technologies implemented in other jurisdictions, as well as highlighting of those technologies which have been successfully implemented and which have highest likelihood of successful implementation in Oxford County.

1.3 Task 3: Review of New and Emerging Technologies

This task will be the documentation of new and emerging technologies as identified in Task 1, as supplemented by gathering of additional data as required and prepare meaningful commentary.

1.4 Task 4: Relationship of EPR and Resource Recovery with Current Waste Stream

Task 4 will examine and assess the impacts of recent climate change and waste management legislation, namely:

- Bill 151 – the *Waste Free Ontario Act* which includes both *Resource Recovery and Circular Economy Act* and the *Waste Diversion Transition Act;*
- The *Strategy for a Waste Free Ontario* (through which topics like the future of organics, disposal bans, new material designations and ICI diversion are prominent); and,
- The *Ontario Climate Change Action Plan* (and it potential impact on municipal waste operations).

This legislation will be examined in the context of several key questions, including the County's role in the delivery of waste management services in areas where producer responsibility is significantly changing, and the County's role in ensuring that expanded EPR programs that are implemented are well integrated with the overall waste management system.

1.5 Task 5: Economic Potential of Full Resource Recovery

This task will seek to identify the net economic benefits of implementing the preferred technology solutions identified in Task 1, considering the outline Capex and Opex costs of

technologies, and accounting for the value within recovered materials, the potential sale of power and/or heat from certain categories of technology, and avoided costs of landfilling and long-term management of impacts.

1.6 Study Documentation

Documentation generated during this study will be presented in technical memoranda covering each task. Following review and agreement by the County, the technical memos will be combined into a final report with an overarching introduction and conclusion section.

2.0 DOCUMENT OBJECTIVES AND ORGANIZATION

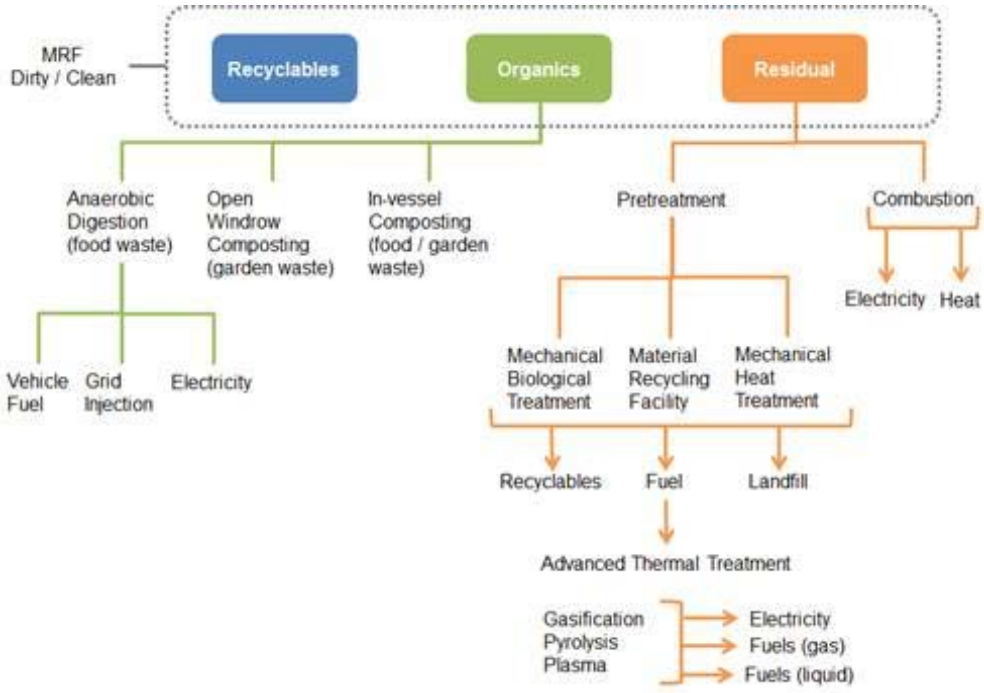
This document is **Technical Memorandum 1b (TM1b)**, which summarizes Task 1, Stage 2 work. The content of TM1a is based on Oxford County's Task 1 scope definition contained in their Request for Proposal (RFP), as further informed by discussions with OC since commencement of the Project.

3.0 REVIEW OF WASTE TREATMENT TECHNOLOGY PROVIDERS

3.1 Introduction

Waste treatment technologies comprise a wide range of largely mechanical and electrical equipment components configured to undertake particular processes, as shown in **Figure 1**.

Figure 1: Waste Treatment Technology Schematic



Sections 3.2 through **3.5** provide a non-exhaustive list of potential providers for each of the main technology types, based on the use of mechanical, biological and thermal treatments. The identified firms have been selected on the basis of the following criteria:

- all of these providers are known or understood to have operations, manufacturing facilities or at least a registered office in North America, unless specifically stated;
- all providers have one or more current operational reference facilities, although this/these may not be in North America.

3.2 Materials Recovery Facility (MRF)

An MRF is a set of primarily electro/mechanical equipment used to separate the different materials in waste collected for recycling, either as materials or as a refuse derived fuel (RDF) or higher quality solid recovered fuel (SRF), for use in an energy production process. The individual equipment items are made by a number of providers but the design and construction of an MRF plant is typically undertaken by a company that manufactures a significant number of the key equipment items and undertakes to provide the MRF plant on an 'engineer procure and construction' i.e. EPC, contract basis. Other forms of contractual arrangement are also used and will be considered further in Task 5. **Table 1** provides a list of MRF technology providers.

Table 1 - MRF Technology Providers

COMPANY	LOCATION
CP Group	CP Global, 6795 Calle de Linea, San Diego, CA 92154, USA
Eggersmann Anlagenbau	Max-Planck-Straße 15, 33428 Harsewinkel, Germany
Entsorga North America	ENTSORGA USA INC, 1904 Eastwood Road, Wilmington NC, 28403, USA
Greenstar North America	3411 Richmond Avenue, Suite 700, Houston, TX 77046, USA
Machinex	Machinex Industries Inc, 2121, Olivier Street Plessisville, QC, G6L 3G9, Canada
Stadler	P.O. Box 910, Colfax, NC 27235, USA
Sutco Recycling Technik	Britanniahütte 14, 51469 Bergisch Gladbach, Germany

3.3 Mechanical Biological Treatment (MBT)

Similar to MRF, MBT is a hybrid process that uses a combination of electro/mechanical treatment processes to separate out the predominantly organic fraction of the waste from the recyclable material fractions, for use as a feedstock in an AD plant. In such circumstances, the AD technology provider usually takes on the main contractor role for the MBT plant. **Table 2** provides a list of MBT technology providers.

Table 2 – MBT Technology Providers

COMPANY	LOCATION
Eggersman Anlagenbau	Max-Planck-Straße 15, 33428 Harsewinkel, Germany
Entsorga North America	ENTSORGA USA INC, 1904 Eastwood Road Wilmington NC, 28403, USA
Organic Waste Systems (OWS)	OWS Inc, 7155 Five Mile Road, Cincinnati, OH 45230, USA
Stadler	P.O. Box 910, Colfax, NC 27235, USA

3.4 Biological Treatment

3.4.1 Composting

Both green wastes and food wastes can be composted. Green wastes are usually composted in static windrows but food wastes are typically composted in an 'enclosed' vessel (i.e. in-vessel composting, or IVC) or an enclosed building, to provide conditions to control vermin access, ensure sterilisation of the compost and to provide the ability to control odours. Windrow composting can also be undertaken using forced aeration (i.e. aerated static pile) and can also be undertaken within a container or a building.

Table 3 provides a list of enclosed composting technology providers, as 'windrow' composting is not technology specific.

Table 3 – Composting Technology Providers

COMPANY	LOCATION
Backhus Kompost-Technologie	Rothenschlatt 18, 26203 Wardenburg, Germany
BioSystem Solutions	7 Ellery Lane, Westport, CT 06880, USA
Christiaens Group	Christiaens Group B.V, Witveldweg 104 - 106 5961ND Horst, The Netherlands
Engineered Compost Systems	4220 24th Avenue West, Seattle, Washington 98199, USA
NaturTech® Composting System	Renewable Carbon Management, PO Box 7444 Saint Cloud, MN 56302, USA
Transform Compost Systems	3911 Mt.Lehman Road, Abbotsford, BC, V4X 2N1, Canada
VCU Technology International Ltd	VCU Europa Ltd, 5a Harewood Yard, Harewood Leeds, LS17 9LF, UK

3.4.2 Anaerobic Digestion (AD)

AD falls typically into 'wet' and 'dry' AD processes and in both technologies can be further divided into mesophilic (30-40°C) or thermophilic (50-60°C) regimes. Some manufacturers are able to provide either wet or dry AD systems. **Table 4** provides a list of AD technology providers.

Table 4 – Anaerobic Digestion Technology Providers

COMPANY (DRY AD)	LOCATION
BEKON Energy Technologies	BEKON GmbH, Feringastrasse 9 85774 Unterfoehring, Germany
GICON Engineering North America	Representative: Main(e) International Consulting LLC 32 Blueberry Lane, Bremen ME 04551, USA
Hitachi Zosen Inova KOMPOGAS	Hitachi Zosen Inova U.S.A. LLC, 3740 Davinci Court, Suite 250, Norcross, GA 30092, USA
Organic Waste Systems (OWS)	OWS Inc, 7155 Five Mile Road Cincinnati, OH 45230, USA
Viessmann Group & BIOFerm Energy Systems	Viessmann Manufacturing Company Inc, 750, McMurray Road, Waterloo, ON, N2V 2G5, Canada

COMPANY (WET AD)	LOCATION
BIOFerm Energy Systems	BIOFerm TM Energy Systems, 440 Science Drive, Ste 300 Madison, WI 53711, USA
Doosan Enpure (formerly RosRoca)	912 Chad Lane, Tampa, Florida 33619, USA
Eisenmann Corporation	Eisenmann Corporation, 150 E. Dartmoor Drive, Crystal Lake, IL 60014, USA
GICON Engineering North America	Representative: Main(e) International Consulting LLC 32 Blueberry Lane, Bremen ME 04551, USA
Organic Waste Systems	OWS Inc, 7155 Five Mile Road Cincinnati, OH 45230, USA
PlanET Biogas USA Inc	PlanET Biogas Solutions Inc, 56-113 Cushman Road, St. Catharines, ON, L2M 6S9, Canada
Urbaser SA	21550 Oxnard Street. 3rd floor, Woodland Hills, CA 91367, USA

3.5 Thermal Treatment Technologies

3.5.1 Combustion

Conventional combustion forms the basis of the majority of the global incineration and Energy from Waste (EfW) processing capacity. **Table 5** provides a list of Combustion technology providers.

Table 5 – Combustion Technology Providers

COMPANY	LOCATION
B&W Volund	Babcock & Wilcox Enterprises, Inc, 13024 Ballantyne Corporate Place, Suite 700, Charlotte, NC 28277, USA
Doosan Lentjes	Doosan Power Systems SA (Atlanta), 1050 Crown Pointe Parkway, Suite 1200, Atlanta, GA 30339, USA
HZI Inova	Hitachi Zosen Inova U.S.A. LLC, 3740 Davinci Court, Suite 250, Norcross, GA 30092, USA
Keppel Seghers	Keppel Seghers UK Ltd, 1 Euston Square, 40 Melton Street London NW1 2FD, UK Keppel Seghers Belgium NV, Hoofd 1, 2830 Willebroek Belgium
Martin Engineering	Martin Engineering World Headquarters, One Martin Place Neponset, IL 61345, USA
Steinmuller Babcock	Fabrikstraße 1, D-51643 Gummersbach, Germany

3.5.2 Advanced Thermal Treatment – Pyrolysis and Gasification

Advanced thermal treatment (ATT) has been in use in industrial processes for almost as long as combustion, but their application in waste management has until recently been relatively limited.

While some of the established combustion equipment manufacturers also offer advanced thermal process equipment, the sector is characterized by a much larger number of potential suppliers many of whom have however only progressed to pilot-scale operations. **Table 6** provides a list of ATT technology providers.

Table 6 – ATT Technology Providers

COMPANY	LOCATION
Doosan Lentjes	Doosan Power Systems SA (Atlanta), 1050 Crown Pointe Parkway, Suite 1200, Atlanta, GA 30339, USA
Entech	Entech Technical Solutions Ltd, 111 Marlowes, Hamilton House, Hemel Hempstead,, Herts, HP1 1BB, UK
HZI Inova	Hitachi Zosen Inova U.S.A. LLC, 3740, Davinci Court, Suite 250, Norcross, GA 30092, USA
JFE Engineering	JFE Engineering America Inc. 301E. Ocean Blvd., Suite #1750 Long Beach, CA 90802, USA
Kobelco	Berliner Allee 55, 40212, Düsseldorf, Germany
Nippon Steel & Sumikin Engineering	NIPPON STEEL & SUMIKIN ENGINEERING USA INC. 2000, Alameda de las Pulgas, Suite 159 San Mateo, CA,94403, USA
Outotec	Outotec (Burlington), 1551 Corporate Drive, Burlington, Ontario L7L 6M3, Canada Outotec (Vancouver), 955-789 West Pender Street. Suite 955, Vancouver BC, V6C 2X1, Canada
Steinmuller Babcock	Fabrikstraße 1, D-51643 Gummersbach, Germany

4.0 NEXT STEPS

On the basis of the technologies identified in Stage 2, a more in depth analysis of the individual technologies will be conducted Stage 3, including assessment using the County's Multi Criteria Analysis Tool (MCA).

SLR notes that the County's MCA, as it stands, does not identify sufficient criteria to identify the relative pros and cons of the different technologies. There are also a number of criteria for which the score would be the same for all technologies. SLR has therefore identified several adjustments to the MCAto enable it to fulfil the intended purpose of identifying a preferred technology. These include:

1. Remove any criteria which are unaffected by the selection of a technology type;
2. Introduce some additional Evaluation Criteria. These could either be added to the existing criteria, or could be secondary criteria which sit behind and feed into one or more of the primary criteria;
3. Modify the weightings, so that the criteria that are most relevant to the differentiation of technology types are given a greater emphasis.

These proposed adjustments will be further developed in Stage 3, and will be reported in Technical Memo 1c (TM1c).