Discussion Paper

Developing an Advanced Resource Recovery Framework for Canada

November 2018

Prepared for Distribution by the

Resource Recovery Partnership

PURPOSE OF THIS DISCUSSION PAPER

This Discussion Paper was prepared by the Resource Recovery Partnership (RRP) and was initially developed as a Primer for starting and stimulating discussion in the pursuit of an advanced resource recovery framework to support a waste-free Ontario. It was a starting point and quite often used details, policy and legislation from Ontario. The goal was to place items on the table for the **5th annual Resource Recovery Partnership Conference** (June 21-22, 2018) at the University of Waterloo located in Waterloo, Ontario. The feedback and engagement by Conference attendees was excellent and their contributions have now been included as the additional content of this updated, living document. Attendees were from Ontario, other parts of Canada, the United States and Europe.

The feedback and comments of Conference participants during the four Workshop sessions have been added as an Appendix to this revised document to highlight the messages that the Partnership has received from participating academics, entrepreneurs, researchers, government and industry attendees.

The Primer has previously identified many of the inconsistencies that exist in definitions and terminology, and the gaps (Table 1) in the current approach to move towards a circular and Zero Waste economy in Ontario and suggested that resource recovery technologies can close these gaps. It is likely that this is the same across Canada. Resource recovery is essential to managing and reducing the full life cycle cost of material consumption in our society and to achieving not only a circular economy, but most importantly, a sustainable economy.

Current models have relied upon traditional approaches to achieving high levels of waste diversion from landfill, which are reduce, reuse and recycle (includes composting). Resource recovery should be also viewed as an essential approach to diversion from landfill, as its fundamental processes are intended to eliminate the loss of value laden waste resources from the current disposal system by producing higher value outputs for the circular economy.

Table 1 – Gap to achieving a Circular or Zero Waste Economy in Ontario

Approach	2018	2030	2030
		Estimated Percentage	Estimated Tonnes Managed
New Waste Reduction		5%	800,000
Recycled/Organics Diverted	23%	45%	7,800,000
EFW	2%	2%	300,000
Landfill	75%		
What Approach???		**48%**	8,300,000
Total	100%	100%	17,200,000

* source - City of London 2017. Based on details provided in Ministry of the Environment & Climate Change, Strategy for a Waste-Free Ontario: Building the Circular Economy, February, 2017. Scenario estimates suggest that even with significant increases in reduction, reuse and recycling/composting (effectively doubling traditional waste diversion activities), a substantial portion of resources/waste would still need to be landfilled in 2030.

Currently, most Canadian jurisdictions (including Ontario) do not recognize the majority of resource recovery technologies as equivalent, acceptable mechanisms for recovering the intrinsic resource value in non-recycled waste. There is little evidence available to suggest why this is the case. The current evidence, discussion and new evidence needs to be at the forefront.

Resource recovery must be supported with sound public policy to promote investment in innovation, commercialization and installations that will meet municipal, provincial, Canadian and/or Canadian Zero Waste goals in the near term and into the future. In Ontario, with the recent change in provincial leadership, changes are already underway at fundamental policy levels and the Resource Recovery Partnership is excited to participate in this discussion going forward using science based, life cycle analysis and peer reviewed, research from leading academics and researchers in this field.

The Resource Recovery Partnership continues to gather feedback and information through consultations with Conference participants and seeks further input through the December 2018 Webinar and other sessions on the proposed Advanced Resource Recovery Framework that expands the available end-of-life options to close the current gap that exists in solutions to achieve Zero Waste.

At the end of this document is the outline of a process for adding to this discussion and joining together the fragmented voices and efforts of many researchers, industry leaders and policy makers into a unified movement towards sound environmental policy. Your voice continues to be critical to this discussion. To become part of this solution we need your commitment to provide input and support to this discussion through your official participation and putting your name behind the development of this policy.

Please visit the newly established website of the Resource Recovery Partnership (RRP) at resourcerecoverypartnership.ca to engage with others in this space, access topical research, stay current on RRP activities and connect with academics, entrepreneurs, government and researchers.

Please take a moment to register on the website and add your name to the ranks promoting the high value recovery of waste resources and a future with Zero Waste.

This Discussion Paper contains nine sections:

1.0 Feedback and Stakeholder Input
2.0 Primer Introduction and Background
3.0 Some Important Terms/Definitions and the Need for Consistent Terms/Definitions
4.0 What are Traditional Waste Diversion and Waste Management Practices?
5.0 What are Advanced Resource Recovery Practices?
6.0 Why is there a Need for an Advanced Resource Recovery Framework?
7.0 Components of a Framework
8.0 Potential Steps to Build the Framework
9.0 How to Get Involved

1.0 Feedback and Stakeholder Input

Feedback solicited through engagement and conference sessions is provided in the attached Appendix A in a summarized format. This feedback from stakeholders is presented as participants input to the policy development process and will assist and inform the RRP Committee as it prepares, refines and evolves the policy statement.

The RRP Committee values the important contributions, perspectives and experiences of all of its critical stakeholders including government, academia, entrepreneurs and innovators and industry (both stewards and downstream processors). Consequently, the engagement of the many stakeholders within these diverse groups has been a fundamental and essential component of this policy development process.

2.0 Primer Introduction and Background

2.1 Introduction

Jurisdictions locally and globally with businesses, environmental groups and consumers have become aware of the challenges of the world's growing pressures on the environment and economy due to waste caused by increasing living standards and expanding population. With increased living standards and expectations for healthier and better life styles comes increased pressures on resources including economic, environmental and social – the three pillars of sustainability.

Demands on waste management and resource recovery include the protection of human health but must also address sustainability needs of present and future generations. Demands on sustainable systems must include conservation of resources and minimizing or eliminating the pollution of the environment (i.e., land, water, air) through toxins and greenhouse gases that contribute to global climate change.

These concerns have resulted in concepts such as Circular Economy (CE) and Sustainable Materials Management (SMM) to be at the forefront as frameworks to manage waste resources and address Sustainable Waste Resource Management in the economies of the world. These concepts, depending on how they are defined, are both complementary and different, but have the core value of efficiently capturing the highest value from waste resources to create a more sustainable economy and society.

2.2 Background

To eventually create a policy paper for an advanced resource recovery framework that all concerned organizations can ultimately recognize key principles that need to be identified, debated, adjusted and eventually agreed to. The following is a starting point for the conversation with a focus on waste prevention and maximizing the benefits of resources generated in various waste streams as part of a broader advanced resource recovery framework:

1. Reduce waste and emissions generated is the first objective of any system.
2. Manage the waste resources remaining in a sustainable way by minimizing the economic (i.e., affordable systems) and environmental (land, water and air pollution) burdens associated with the waste and resource recovery systems.
3. Recognize that "Life Cycle Considerations" to managing waste resources sustainably are critical to achieving the reductions needed to minimize economic and environmental burdens. The

application of treatment options after source reduction should be guided by "Life Cycle Thinking" and a hierarchy of technologies starting with traditional/conventional and then advanced technologies that produce products of value.

4. Have the appropriate target(s) that will define the end goal(s) and how to achieve them.
5. Establish a waste resource recovery system objective to recover and produce the highest value product, as possible, for use in the economy, using the best available technologies that also protect the environment and meet society's choice of strategic targets.
6. Establish principles that recognize local, regional and provincial (and national) jurisdictions' needs and do not be prescriptive or pre-determine resource recovery systems for these jurisdictions.
7. Remain open to new, innovative ideas, encouraging flexibility that permits bridging and transitioning to new technologies and systems as the foundation and commitment to continuous improvement.

References:

1. Maximizing the Benefits of Circular Economy and Sustainable Material Management Models for Product-Packaging, September 19, 2016, Ameripen
2. Circular Economy & Sustainable Materials Management: How they are different and why does it matter? Presentation to NAPRA February 23, 2017, Ameripen.
3. Integrated Solid Waste Management: A Life Cycle Inventory, 2nd Edition, Forbes R. McDougall, Peter R. White, Marina Franke, Peter Hindle.
4. Circular Economy, Ellen McArthur Foundation.

3.0 Some Important Terms/Definitions and the Need for Consistent Terms/Definitions

The field of solid waste management has a plethora of definitions that fall into different categories including:

- Regulatory definitions usually defined at the provincial level although some are defined at the Federal Government.
- By-law definitions usually defined by municipalities (and not always consistent from one municipality to the next).
- Definitions created by waste management, recycling and other related organizations that have no legal foundation; however, they are often used by the members and adopted by others.

Some definitions often have a historical basis and have not been modernized; although the technologies within the definition are different than in the past. The inconsistency in legal definitions can be problematic when different provinces are compared. In addition, different technologies can be lumped together in some definitions with little understanding as to why that is the case. The remainder of this section highlights a number of terms and some different definitions.

3.1 Integrated Solid Waste Resource Management

Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program which works cohesively to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment. ISWM considers local needs and conditions, and then applies the most appropriate combination of waste management approaches for that situation. The major components of ISWM activities are waste prevention & reduction, recycling and composting, resource recovery, and, disposal in properly designed, constructed, and managed landfills.

> * source - based on the USEPA definition noting that determining a date of this definition is difficult because many current documents are now archived on the USEPA website.

> * Environment Canada does not have specific definitions; however, many provinces and municipalities in Canada have created definitions to meet their needs.

3.2 Sustainable Waste Management

"Sustainable waste management …aims to reduce the quantity of natural resources consumed by ensuring that any resources already taken from nature are reused many times and that the amount of residual waste produced is kept to a minimum and treated in an environmentally safe way. The processing of waste plays a key part in this."

> * source - excerpt from "Sustainable Waste Management" published by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (German Federal Ministry for Economic Cooperation and Development)

Sustainable Materials Management. **Sustainable materials management** (SMM) is a systemic approach to using and reusing materials more productively over their entire life cycles. It represents a change in how our society thinks about the use of natural resources and environmental protection. By looking at a product's entire life cycle, new opportunities can be found to reduce environmental impacts, conserve resources and reduce costs. (https://www.epa.gov/smm)

3.3 Resource Recovery and Resource Recovery System

Resource recovery means the extraction of useful materials or other resources from things that might otherwise be waste, including through reuse, recycling, reintegration, regeneration or other activities. This includes the collection, handling, and processing of *food and organic waste* for *beneficial uses*. In 2017, the Ontario MECP* stated that although energy from waste and alternative fuels are permitted as waste management options, these methods are not considered *resource recovery*. The recovery of nutrients, such as *digestate* from *anaerobic digestion*, is considered *resource recovery*.

Resource recovery system means any part of a *waste management system* that collects, handles, transports, stores or processes waste for *resource recovery* purposes, but does not include disposal.

> * source – Ministry of the Environment & Climate Change (MOECC), Food and Organic Waste Policy Statement, April 2018, https://www.ontario.ca/page/food-and-organic-waste-framework

> NOTE: MOECC is now called Ministry of the Environment, Conservation & Parks (MECP)

3.4 Zero Waste

“Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them.

Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health.”

> * source – Zero Waste International Alliance http://zwia.org/standards/zw-definition/

“Zero Waste Ontario is a visionary goal that provides the guiding principles needed to work toward the elimination of waste. It is a new approach that focuses on preventing waste in the first place rather than relying on traditional end-of-life waste management solutions.”

> * source – Ministry of the Environment & Climate Change, Strategy for a Waste-Free Ontario: Building the Circular Economy, February, 2017 https://www.ontario.ca/page/strategy-waste-free-ontario-building-circular-economy#section-4

3.5 Zero Greenhouse Gas (GHG) Emissions

“Climate neutral”, “carbon neutral” or zero greenhouse gas emissions refer to achieving net zero GHG emissions by balancing a measured amount of GHGs released with an equivalent amount sequestered or offset or buying enough carbon credits to make up the difference.

The best practices seeking zero GHG emissions is to reduce or avoid GHG emissions first so that only unavoidable emissions are offset.

> * source – very few definitions exist with respect to solid waste management

“The visionary goal of eliminating greenhouse gases from the waste sector will guide our priorities for resource recovery and waste reduction. It will help the province meet its climate change commitments and build a low-carbon economy while protecting Ontario’s natural environment.”

> * source – Ministry of the Environment & Climate Change, Strategy for a Waste-Free Ontario: Building the Circular Economy, February, 2017 https://www.ontario.ca/page/strategy-waste-free-ontario-building-circular-economy#section-4

3.6 Sustainable Materials Management

Sustainable Materials Management (SMM) is a systems approach to serving human needs by using/reusing resources in the most productive and sustainable way across their entire life cycle, from the point of resource extraction through material disposal.

This systems approach seeks to:

- conserve resources,
- reduce waste,
- slow climate change,
- minimize all the associated environmental impacts, and
- recognize economic considerations.

> * source - US EPA and OECD website sources

3.7 Circular Economy

The circular economy (CE) is a framework that embraces the concept of cradle-to-cradle management of resources by the elimination of the concept of waste, maximizing the utility of resources and renewable energy, and, integrating the considerations of social responsibility into decision making. CE promotes the "closed loop" approach to production including the concepts of:

- product life extension,
- long life goods,
- reconditioning activities, and,
- waste prevention.

CE considers natural capital restoration in process design such that the by products of one industrial process become the input for additional processes.

* source - based upon concepts and content published by the Ellen MacArthur Foundation

3.8 Life Cycle Assessment (LCA)

"A life cycle assessment (LCA) is a tool that can be used to evaluate the potential environmental impacts of a product, material, process, or activity. An LCA is a comprehensive method for assessing a range of environmental impacts across the full life cycle of a product system, from materials acquisition to manufacturing, use, and final disposition.

LCA study results help to promote the responsible design and redesign of products and processes, leading to reduced overall environmental impacts and the reduced use and release of more toxic materials. LCA studies identify key materials and processes within the products' life cycles that are likely to pose the greatest impacts, including occupational and public toxicity impacts. These assessments allow businesses to make product improvements through environmentally sound process, material, and design choices."

* source - US EPA website, no date provided https://www.epa.gov/saferchoice/design-environment-life-cycle-assessments

4.0 What are Traditional Waste Diversion and Waste Management Practices?

Generally, in Ontario, waste management systems include variations on the following practices:

- Waste avoidance/prevention/minimization (not created in the first place)
- Reuse/refurbish/repurpose (for use again)
- Source separated recyclables (to be collected, processed, marketed and re-manufactured)
- Source separated leaf and yard waste (to be collected, processed and marketed)
- Source separated organics (food and other organics wastes) (to be collected, processed and marketed). Processing technologies generally include aerobic composting and anaerobic digestion (AD) technologies
- Mass Burn - energy from waste
- Landfill

Similar to the discussion in Section 3, there are legal definitions for most of these practices. In addition, there are non-legal definitions created and used by many. These seven practices generally have a proven track record in Ontario, other parts of Canada and in other parts of the world.

5.0 What are Resource Recovery Practices?

Resource Recovery practices, as used within the framework of this discussion, refers to those approaches to resource recovery that extract value from waste materials beyond the primary or traditional approaches identified in Section 4. They are usually much more sophisticated and complex approaches to managing resources and materials. For some they could also be considered new, emerging or next generation resource recovery technologies; the latter referring to world-side evidence of bench scale, pilot, demonstration and commercialized projects at different points in time. Resource recovery offers the capability to extract value at the end-of-life of a wider range of feedstocks; such as materials that are not source separated and may be complex and multi layer materials or non-recycled materials which are not accepted within a traditional recycling system.

In addition to robust feedstock processing capability, resource recovery technologies typically provide various flexible options on the formats for derived value for the output products such as chemical production, heat, electricity and fuels. The corresponding increased feedstock flexibility, value retention and volume reduction provide a highly effective mechanism for achieving zero waste in a world where the content profile of the waste 'Tonne' is constantly shifting and evolving.

The following sections provide some examples of resource recovery technologies or categories of resource recovery technologies and some common definitions currently recognized.

5.1 Anaerobic Digestion (AD - Biogas)

AD facilities can be listed under both traditional (as noted above because it is a proven technology in Ontario) and advanced in the case of Ontario as most AD experience has been associated with farm operations. With respect to AD as part of Mechanical-Biological Treatment (MBT) or as part of a mixed waste processing (MWP) system, this would be considered advanced and belongs in this section.

"Anaerobic digestion means the decomposition of organic matter by bacteria in an oxygen-limiting environment (as defined in *Regulation 347* under the *Environmental Protection Act*). The biogas generated through *anaerobic digestion* can be used to fuel electrical generators, or it can be further processed into renewable natural gas. The *digestate* may also be used as a soil amendment that is most commonly used in agricultural operations."

> * source – Ministry of the Environment & Climate Change, Food and Organic Waste Policy Statement, April 2018, https://www.ontario.ca/page/food-and-organic-waste-framework

"What is Biogas? Biogas is a renewable source of methane, the main ingredient in natural gas. It can be used for heating and cooling, or to generate electricity that can be used on-site or fed into the distribution grid. It can be refined into renewable natural gas that can be injected into gas pipelines or compressed and used as a vehicle fuel. The entire system, including the energy generating components, is typically referred to as a biogas facility or a biogas plant.

Biogas is produced when organic materials — anything from municipal organic wastes or bio-solids, food processing by-products, or agricultural manure and crop residues — break down in an oxygen-free environment. The process is called anaerobic digestion (AD) and usually occurs in a specialized tank or vessel – the anaerobic digester. AD is also the process that generates biogas or landfill gas (LFG) within landfills.

Anaerobic digesters have a number of end products, including digestate, a nutrient-rich slurry that can be applied directly on agricultural land, or material that is composted and then used for a range of purposes. Digester solids are materials from after de-watering that can be composted, and are well suited to be mixed with leaf and yard waste."

*Source - Canadian Biogas Association, Municipal Guide to Biogas, March 2015
https://www.biogasassociation.ca/

5.2 Mixed Waste Processing

"Mixed-waste processing involves no generator separation of waste, with all waste processed at what's been called a "dirty" material recovery facility (MRF).[1] Recyclables are then pulled out at the MRF through a combination of manual and mechanical sorting. The sorted recyclable materials may undergo further processing required to meet technical specifications established by end-markets while the balance of the mixed waste stream is sent to a disposal facility such as a waste-to-energy facility or landfill".[2]

* source(s)
[1] Waste 360 http://www.waste360.com/mrfs/10-points-explain-mixed-waste-processing
[2] Wikipedia https://en.wikipedia.org/wiki/Materials_recovery_facility

Mixed waste processing means *resource recovery* processes that recover *food waste* or *organic waste* from waste streams where *food and organic waste* is co-mingled with other wastes.

* source – Ministry of the Environment & Climate Change, Food and Organic Waste Policy Statement, April 2018, https://www.ontario.ca/page/food-and-organic-waste-framework

5.3 Mechanical/Biological Treatment (MBT)

"Mechanical Biological Treatment (MBT) technologies are pre-treatment technologies which contribute to the diversion of MSW from landfill when operated as part of a wider integrated approach involving additional treatment stages. Mechanical Biological Treatment (MBT) is a generic term for an integration of several mechanical processes commonly found in other waste management facilities such as Materials Recovery Facilities (MRFs), composting or Anaerobic Digestion plant. MBT plants can incorporate a number of different processes in a variety of combinations. MBT therefore compliments, but does not replace, other waste management technologies such as recycling and composting as part of an integrated waste management system. MBT plants include the:

- Pre-treatment of waste going to landfill;
- Diversion of non-biodegradable and biodegradable MSW going to landfill through the mechanical sorting of MSW into materials for recycling and/or energy recovery as refuse derived fuel (RDF);
- Diversion of biodegradable MSW going to landfill by:
- Reducing the dry mass of BMW prior to landfill;
- Reducing the biodegradability of BMW prior to landfill;
- Stabilization into a compost-like output (CLO)2 for use on land;
- Conversion into a combustible biogas for energy recovery; and/or
- Drying materials to produce a high calorific organic rich fraction for use as RDF."

* source - Mechanical Biological Treatment of Municipal Solid Waste, February 2013, Dept. of Environment, Food and Rural Affairs, www.defra.gov.uk

5.4 Energy-from-Waste (EFW)

EFW is "A facility that generates steam and/or electricity through the combustion of municipal solid waste."

* source – Canadian Resource Recovery Council, http://www.resourcerecovery.ca/info/glossary/

For the purposes of these guiding principles, and by way of definition, we have defined:

"Energy-from-Waste is any technology, which recovers energy from the management/processing of waste materials. This includes Anaerobic Digestion, Mass Burn, Gasification, Plasma Gasification, and Landfill Gas Recovery.

Waste Derived Fuel is any technology designed to turn waste materials into a fuel product with the recovery of recyclables materials as part of the fuel development process."

* source – Ontario Waste Management Association, Guiding Principles Integrated Solid Waste Resource Recovery and Utilization (OWMA EFW/WDF Committee, November 2011) https://www.owma.org/articles/guiding-principles-on-integrated-solid-waste-recovery-and-utilization

Energy can be recovered from waste by various (very different) technologies. It is important that recyclable material is removed first, and that energy is recovered from what remains, i.e. from the residual waste. Energy from waste (EFW) technologies include:

- Combustion in which the residual waste burns at 850°C and the energy is recovered as electricity or heat
- Gasification and pyrolysis, where the fuel is heated with little or no oxygen to produce "syngas" which can be used to generate energy or as a feedstock for producing methane, chemicals, biofuels, or hydrogen (see also landfill gas and sewage gas)
- Anaerobic digestion, which uses microorganisms to convert organic waste into a methane-rich biogas that can be combusted to generate electricity and heat or converted to biomethane. This technology is most suitable for wet organic wastes or food waste. The other output is a biofertilizer.

* source – Renewable Energy Association, United Kingdom https://www.r-e-a.net/renewable-technologies/energy-from-waste

Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion and landfill gas recovery. This process is often called waste to energy (WTE).

* source - US EPA website, no date provided https://www.epa.gov/smm/energy-recovery-combustion-municipal-solid-waste-msw

5.5 Waste Conversion Technologies (WCT)

Waste Conversion Technologies (WCT) include the broad range of technologies which are applied to recover the inherent stored resource value of targeted waste feedstocks and/or MSW and to make these resources available for use rather than for disposal.

"There are a large number of technologies on the market at the moment and the use of many terms and definitions, with often different meaning. This reduces the possibility of comparing the different options. This chapter lists the most important concepts used in this field alphabetically.

- Gasification is the thermal breakdown of waste under oxygen starved conditions (oxygen content in the conversion gas stream is lower than needed for combustion), thus creating a syngas (e.g. the conversion of coal into city gas).
- Plasma gasification is the treatment of waste through a very high intensity electron arc, leading to temperatures of > 2,000°C. Within such a plasma, gasifying conditions break the waste down into a vitrified slag and syngas.
- Pyrolysis is the thermal breakdown of waste in the absence of air, to produce char, pyrolysis oil and syngas (e.g. the conversion of wood into charcoal)."

  * source - International Solid Waste Association (ISWA), Alternative Waste Conversion Technologies, 2013 https://www.iswa.org/home/news/news-detail/browse/29/article/new-publication-iswa-white-paper-on-alternative-waste-conversion-technologies/109

"New technologies to convert municipal and other waste streams into fuels and chemical commodities, termed conversion technologies, are rapidly developing. Conversion technologies are garnering increasing interest and demand due primarily to alternative energy initiatives. These technologies have the potential to serve multiple functions, such as diverting waste from landfills, reducing dependence on fossil fuels, and lowering the environmental footprint for waste management. Conversion technologies are particularly difficult to define because their market is in development and many of their design and operational features are not openly communicated by vendors. EPA's Office of Research and Development conducted research to evaluate and develop a "State of Practice" report for State and local decision-makers on the suite of emerging waste conversion technologies."

  * source - USEPA State of Practice for Emerging Waste Conversion Technologies, 2012 https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=305250

6.0 Why is there a Need for an Advanced Resource Recovery Framework?

In Ontario, The *Waste-Free Ontario Act* (WFOA) includes both the *Waste Diversion Transition Act 2016* (WDTA) and the *Resource Recovery and Circular Economy Act 2016* (RRCEA). The MOECC published the final Strategy for a Waste-Free Ontario: Building the Circular Economy (Strategy) in February 2017, a requirement of the *Waste Free Ontario Act, 2016*, which outlines a road map for resource recovery and waste reduction for Ontario. It also:

- sets a vision and goals including interim waste diversion goals for 2020 (30%), 2030 (50%) and 2050 (80%);
- articulates key government actions to support implementation of the vision and goals; and
- identifies performance measures to be used to assess progress towards achieving the vision and goals.

The Strategy focuses on moving Ontario towards a circular economy described as "a system where nothing is wasted and valuable materials destined for landfill are put back into the economy without negative effects on the environment." This approach – a circular economy – has the potential to reduce greenhouse gas emissions, save and better utilize scarce resources, as well as create jobs and financial opportunities.

Waste diversion has been defined by MOECC along with interim targets as noted above. These same interim diversion targets raise very important questions including understanding the magnitude of the amount not diverted; basically, millions of tonnes:

Table 2: Projected Ontario Waste Diversion Gap

By Year	Percentage of Waste Diversion (Total Solid Waste)	Amount Still Requiring Management
Today	25%	75%
2020	30%	70%
2030	50%	50%
2050	80%	20%

* source – Based on Ministry of the Environment & Climate Change, Strategy for a Waste-Free Ontario: Building the Circular Economy, February 2017

The challenge of tackling the percentage that requires management, and potentially help with the amount that must be diverted, highlights the need for the understanding and development of an advanced resource recovery framework. A framework that allows appropriate time to be spent on non-traditional recycling, composting and processing systems (because we still spend most of our time on traditional). Why? Not only will it be a challenge to get to these high levels of waste diversion; but, there may be better opportunities with advanced resource recovery systems that have not yet emerged due to the limited attention being invested.

Each province has different perspectives, numbers, percentages, etc. One common element is the amount of resources that are landfilled and wasted each year.

Below are some questions that appear to be unanswered, or if answered, perhaps without the rigour of appropriate analysis. This list of questions needs to grow, coupled with a commitment to answer them.

6.1 Lack of Information Available

a. How can data be collected and managed to provide industry, academia and entrepreneurs the information required to meet current and future waste diversion opportunities?
b. How do we evaluate the efficacy of resource recovery technologies? Are they all created equal?

6.2 Current Direction in Ontario and Other Canadian Jurisdictions has Limitations

a. How can government empower industry to realize the value of unrecognized waste resources?
b. Are resource recovery technologies engaging in waste management or production?
c. Do we need a paradigm shift to correctly classify waste materials as preprocessed feedstocks?

6.3 Medium and Long-term Goals Cannot be Achieved

a. How large is the gap between mechanical recycling and landfill? And what are the impediments to closing this gap?
b. Should the recovery of end-of-life material resources be mandated during the manufacturing process and design of goods or at the end of life of the goods through flexible and innovative technologies?
c. Can mandating recycling content in new materials production drive progress towards medium and long term goals?
d. Should government require all landfilled waste to be preprocessed for value recovery?

6.4 Confidence Challenges in Technologies

a. Does society have the requisite technologies available to meet the challenges of the diversity and complexity of waste as it is generated today and for what will come tomorrow?
b. Can resource recovery technologies meet the challenges of the different jurisdictions, geographies and demographics unique to urban and rural residents?

6.5 Investment in Ontario and Canadian jurisdictions, not Supported

a. How should government support the research and development of new and innovative technologies which require access to feedstock, financing and end markets?
b. How can society be made aware of the advantages of a robust resource recovery system that inclusively manages current and yet to be developed packaging and waste materials?
c. Should government mandate domestic resource recovery capacity for diversion programs? Are we exporting our waste problem or are we losing our resource recovery opportunity?

6.6 Research and Demonstration Projects

a. How should government support the research and development of new and innovative pilot projects which require permitting for operations not previously considered?
b. How should regulations empower stewardship organizations to incorporate new technologies to meet their mandates – how can innovation be de-risked?

6.7 Increase Conversations on Opportunities

a. How can government leverage the advantages of recovery technologies to protect the environment in the near term, rather than in the maybe distant future?
b. Should the government legislate standards and outcomes instead of processes and market access?
c. How can resource recovery reduce our carbon footprint? Reduce greenhouse gasses?
d. What wastes are the greatest contributors to landfill volumes? To greenhouse gas production?

7.0 Components of a Framework

The transition to a circular economy, the transition to a sustainable materials management economy, the transition to some hybrid system, etc. will need to be supported by policies and operational decision-making practices based on evidence. It will become more challenging, not less challenging as we try to address values that span the social, environmental, economic and technical domains.

With respect to advancing resource recovery, a framework is required that has been designed from many different viewpoints. Over the years, for example, Ontario has had a number of different waste management frameworks (or framework-like approaches).

Key areas of an Advanced Resource Recovery Framework would include, but not be limited to:

- Government Polices, Incentives, Practices, Backstop Legislation
- Industry Policies, Practices
- Feedstock Supply, Management
- Consolidation, Transportation
- Pre-processing Technologies
- Processing Technologies
- Markets, Products

8.0 Potential Steps to Build the Framework

Frameworks are best developed by a group that has a broad cross section of interests and expertise; operations and policy development experience; and with access to well-founded research and science. A framework should be viewed as the beginning and not necessarily the end.

Framework steps may include these areas (and others):

- Determine who should be involved
- Establish and agree to code of conduct for participation
- Determine and agree on where we are
- Identify and understand the need(s) and gaps
- Develop a Policy Working Group(s)
- Engage others, seek broader input
- Assimilate information
- Draft policies, directions, provide insight

9.0 How to Get Involved – Policy Development Timeline

The successful development of a framework and sound public policy requires the engagement and commitment of all affected stakeholders. The success of resource recovery will impact the lives and environment of Canadians for generations to follow. Every stakeholder group that is engaged in the production, consumption and end of life management of goods needs to have their voices heard as we take the next step in environmental protection and resource recovery.

The following tentative timeline presents how you can become involved and join with the Resource Recovery Partnership.

Step 1 - June 18, 2018 – issuance to interested stakeholders of ***A Primer - Developing an Advanced Resource Recovery Framework to Support a Waste-Free Ontario***

Step 2 - June 21-22, 2018 – Resource Recovery Partnership Conference 2018 – topical presentations, discussions, debate and consultation with academic, industry and policy makers to work towards consensus and the foundations to start the work on an advanced resource recovery framework

Step 3 - June – September 2018

- Develop Framework based on RRPC comments and input
- Grow the Resource Recovery Partnership membership across all sectors, building upon science-based members, industry and policy makers.

Step 4 - December 2018

- Hold the first session in the process to present the draft Policy Guidance Document on the Advanced Resource Recovery Framework

Step 5 - Q1 2019

- Release of *DRAFT Policy - Developing an Advanced Resource Recovery Framework for Canada*

Step 6 - Q2 2019

- ARRP advocacy and engagement at Federal level
- ARRP and Partners advocacy and engagement at Provincial level
- 2019 Resource Recovery Partnership Conference

For further information and to join the Resource Recovery Partnership, please contact Fergal McDonough at fergal@resourcerecoverypartnership.ca or 905-941-2174.

Appendix A

Workshop - Question and Answers

Resource Recovery Partnership Conference – June 21-22, 2018

During the RRPC 2018, attendees participated in four Workshop sessions, which coincided with context specific panel presentations and speakers. Below are the questions that participants were asked to address and their summarized responses.

Workshop 1, Question 1

What role should Resource Recovery practices (including mixed waste processing, MBT, solid recovered fuel, waste conversion, energy-from-waste), play in helping provinces, like Ontario, achieve their diversion and recovery goals…and why?

<u>Resource Recovery should:</u>

1. Divert waste from landfill to assist society progressively and continuously achieve Zero Waste; by closing the increasing number of gaps left by the '3 Rs', traditional recycling technologies and the "evolving tonne".
2. Provide scalable solutions to localize waste management and provide distributed power solutions to remote communities.
3. Support the recovery of mixed waste residuals and difficult to recycle materials.
4. Commoditize feedstocks to increase the resource value and social capital of clean, source separated waste streams.
5. Act as a processing system to manufacture bio-gas and clean fuel for the entire diversion system.
6. Produce the highest value/recovered resources through end product design and optimization – products/fuel/energy – syngas allows for return to original product use – when financially feasible.
7. Act as a secondary, complementary practice, to source separation, to maximize the life-cycle of recyclable products.
8. Provide a "beneficial end use" – but not count as diversion as MBT organics are really only water loss.
9. Provide flexibility of the recovery system to be sensitive to the needs of the local community – demographics, geography, access to markets/market conditions, access to traditional recycling and landfill.
10. Provides cost effective, incremental diversion beyond the optimal point of recovery/recycling.
11. Fit into a diversion system which optimizes recovery based on government guidelines.

Why?:

1. Resource Recovery is essential to diversion from landfill.
2. Recovery goals are impossible to achieve without a robust system design that includes resource recovery technologies.
3. Jurisdictions should have a 'Primary Recovery' goal for traditional diversion systems and an overall recovery goal, including resource recovery, for 'Total Recovery' – this must recognize diversity of demographics and geography.
4. GHG emissions will be reduced as recovered resources are reintroduced at a higher stage to the manufacturing process.
5. Supports the commoditization of waste - paradigm shift.

Workshop 1, Question 2

How should government prioritize the application of resource recovery practices in their waste diversion and resource recovery strategies, in order to most quickly maximize both resource value and diversion from landfill?

Government should:

1. Provide science based, clear information and exhaustive resources to government staff and citizens to educate and build support for the broad range of recovery options
2. Provide clear guidelines and outcome-based standards in order to allow for the market to respond in the most competitive and cost-effective manner.
3. Incent companies to overcome barriers to entry such as financial risk, access to pure research, access to feedstocks and regulatory hurdles.
4. Streamline and consolidate complex and onerous approval processes.
5. Support innovation and academic research – think Beyond the Blue Box.
6. Encourage and promote multi-stakeholder collaborations across academia, business, government.
7. Create a regulatory and legislative framework that aligns waste diversion, with innovation, investment, sustainability and EPR. Require EPR for all products.
8. Prioritization of the 4Rs – Reduce, Reuse, Recycle, Recover in order.
9. Include the 4th R – Recovery (molecular recycling) as diversion.
10. Prioritize source separation, source reduction (design for recycling) and technology application to recover resources.
11. Dis-incentivise landfill use, through taxes and fees, to supporting diversion program sustainability such as innovation and R&D.
12. Create a centralized data repository for waste and resource related data – municipal, provincial and federal data.
13. Recognize the impacts of demographics and unique regional areas – stocks and flows affect optimization.
14. Utilize Recovery within a sustainability circle, not as part of a pyramid.
15. Support end use demand - require greater recycled/recovered content in products and services.
16. Engage in greater consultation with industry as the drivers of innovation and growth.

Workshop 2, Question 1

Which player(s) should lead the way in the pursuit of a sustainable economy…and why? How should they lead? What are the two most important principles when pursuing this goal?

Who Should Lead the Way?

1. Government should lead by example and develop legislation to support their priorities.
2. Civic society, industry and academia should support government efforts.
3. Industry should lead a Sustainable Economy, with a collaborative approach with government and the public.
4. Sustainability includes roles for all – Government, Manufacturers, Collectors, Processors, End Users.

How should 'they' lead?

1. Government should set policy goals, priorities, limits, guide and enforce standards.
2. Change needs to be driven by industry, through innovation - in material design, product design, processing/recovery, end use application.
3. Promote collaboration between all levels of stakeholders.
4. Visionaries in many sectors are required to achieve breakthrough innovations.
5. Develop a fair and informed distribution of shared responsibilities at all levels of the material life cycle – any break in responsibilities interrupts the sustainability of the system.

Principles to Follow:

1. Sustainable Economy
2. Collective Responsibility
3. Urgency
4. Clarity and Communications
5. Assessment using science based, quantitative processes that take into consideration all of the burdens identified by the LCA.

Workshop 2, Question 2

Is Life Cycle Analysis an important consideration or essential to a Sustainable Economy? How should society balance the pursuit of innovation and environmental considerations?

1. Life Cycle Analysis (LCA) is a tool used to evaluate products/processes sustainability and needs to be science based.
2. Innovation should use LCA as a measure of effectiveness.
4. LCA helps support 'design for environment' and intelligent life-cycle design.
5. A regenerative economy must satisfy a full and comprehensive LCA
7. LCA is a complex tool which is useful at the technical level but must be more simply communicated to different categories of stakeholders.
8. LCA must include transparency, agreed upon terminology and standards.

Society must:

1. Balance the priorities of innovation, sustainability and environment.
2. Take into consideration unintended consequences.
3. Not let 'the perfect' be the enemy of 'the good'.

Workshop 3, Question 1

How should feedstocks supplies be directed or encouraged towards resource recovery facilities? Whose role is it to encourage or require this shift in material feedstocks?

Feedstock should be directed:

1. By the market – be policy driven, demand driven.
2. By incentives/revenue – enforcement. Eg. landfill bans.
3. At source separation, in order to maximize quality and optimize end use application.
4. by the creation of a Waste Exchange Marketplace where municipal waste commodities can be posted and traded.

The role of directing feedstocks should be:

1. Led by the producer, with guidance from the government.
2. Led by government as they can require minimum recycled content in all products to encourage end use market development.
3. Led by standardized recovery practices across all municipalities to ensure maximized feedstocks and consistent messaging to all stakeholders.
4. Evolutionary…first by government, then as markets mature and the value of feedstocks rise; market demand drives up value and commoditization occurs.

Workshop 3, Question 2

Should recycling and resource recovery compete for the same feedstocks? What are the greatest opportunities for accessing potential feedstocks available today?

Should recycling and resource recovery compete for feedstocks?

1. Recycling and resource recovery are the same, so they are not competing.
2. Yes. We should refer to a waste hierarchy to determine the priority direction of feedstocks.
3. Feedstock allocation/competition should depend on the value of end products.
4. Recycling at any cost is not optimal – processes should be evaluated.
5. No, there should be a national, standardized approach to processing feedstock with zero waste to landfill.
6. Recycling should be preferred, however some feedstocks are more amenable to resource recovery than recycling.
7. They should complement each other not compete.
8. Decisions on end of life should be based upon carbon reduction/avoidance/mitigation value.
9. Selection of end of life should take into considerations the unique demographics and geographies of feedstocks generated and what the optimized available options are.

The best opportunities for accessing potential feedstocks are:

1. IC&I, Multi Residential, and Public spaces where source separation is challenging.
2. Improved source separation.
3. Better sorting technology.
4. More flexible end markets.
5. Increasing the value of the waste such that greater effort will be placed on securing it.
6. Applying incentives for using wastes.
7. Post processed / residual materials for recovery.
8. Agriculture and forestry biomes.

Workshop 4, Question 1

What kind of innovative opportunities exist for government to support Ontario/Canadian leadership and development of resource recovery technologies?

1. Public Private Partnerships (PPP).
2. SRED and MITACS loans, grants, investment for R%D, pilots and commercialization.
3. Innovation competitions.
4. Funding of internships/Co-op programs.
5. Redirections of Carbon Tax/Cap and Trade funding to R&D - GHG reduction and resource recovery technologies.
6. Government funded innovation hub/research center to develop commercializeable technologies – incubators and accelerators.
7. Government mandate for domestic recycling/recovery capacity.
8. Connecting technology with feedstock source/access.
9. Simpler approvals for pilots and test facilities.
10. Incentives for progressive companies in resource recovery areas.
11. Landfill bans or taxes to act as a dis-incentive for use.

Workshop 4, Question 2

How can emerging technologies be de-risked in order to support resource recovery sector investment and development from base technology research all the way through pilot projects to full commercialization?

Emerging technologies can be de-risked in order to reach commercialization by:

1. Funding and support from government.
2. Validation by 3rd parties.
3. Establishment of long term priorities by government, that are bi-partisan.
4. Provide a forum for connecting venture capitalists, researchers, entrepreneurs.
5. Design for scalability.
6. Software simulation support.
7. Provide access to feedstocks to achieve proof of concept through to commercialization.
8. Acceptance of R&D data by regulators.