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<b>TO:</b>	<b>CHAIR AND MEMBERS CIVIC WORKS COMMITTEE MEETING ON FEBRUARY 3, 2015</b>
<b>FROM:</b>	<b>JOHN BRAAM, P.ENG. MANAGING DIRECTOR, ENVIRONMENTAL &amp; ENGINEERING SERVICES AND CITY ENGINEER</b>
<b>SUBJECT</b>	<b>MEMORANDUM OF UNDERSTANDING WITH GREEN SHIELDS ENERGY (EXAMINING THE ROLE OF A WASTE CONVERSION TECHNOLOGY)</b>

<b>RECOMMENDATION</b>
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That, on the recommendation of the Managing Director, Environmental & Engineering Services and City Engineer, with the support of the Director, Environment, Fleet and Solid Waste, the attached proposed by-law (Appendix A) **BE INTRODUCED** at the Municipal Council meeting to be held on February 9, 2015 to:

- a) authorize and approve a Memorandum of Understanding with Green Shields Energy with respect to advancing our joint waste conversion, resource and energy recovery objectives with the mutual understanding that the combined expertise, influence and commitment are better applied together to support common goals attached as Schedule "A" to the by-law; and
- b) authorize the Mayor and the City Clerk to execute the Memorandum of Understanding authorized and approved in a), above.

<b>PREVIOUS REPORTS PERTINENT TO THIS MATTER</b>
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Relevant reports that can be found at [www.london.ca](http://www.london.ca) under City Hall (Meetings) include:

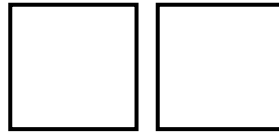
- Update – Key Solid Waste Management Initiatives (December 16, 2014 meeting of the Civic Works Committee (CWC), Item #12)
- Interim Waste Diversion Plan (July 21, 2014 meeting of the CWC, Item #18)
- Timeline for Major Environmental & Engineering Reports (February 25, 2013 meeting of the CWC, Item #3)
- Updates – Proposed Waste Reduction Act and Related Matters for Financing the Blue Box Program (February 3, 2014 meeting of the CWC, Item #8)
- Waste Diversion and Garbage Collection Updates (November 25, 2013 meeting of the CWC, Item #7)
- Status Report: Update of Road Map to Maximize Waste Diversion 2.0 (July 22, 2013 meeting of the CWC, Item #14)

<b>BACKGROUND</b>
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**PURPOSE**

The purpose of this report is to provide Civic Works Committee and Council with a non-binding Memorandum of Understanding (MoU) to be signed by the City of London and Green Shields Energy (GSE) to collaboratively take the initial steps towards:

- developing a mutually beneficial relationship for a potential waste conversion technology that could assist municipalities in addressing waste diversion, renewable energy and waste disposal needs, and
- identifying and addressing the requirements, as part of the General Arrangement noted in the MoU, to satisfy the Ministry of the Environment & Climate Change for a pilot demonstration project proposed to convert household garbage and related materials into a biofuel known as synthetic gas (syngas) using a technology called Gas Phase Reduction.



In brief, the MoU sets out the mutual intentions of the City and GSE to advance their joint waste conversion, resource and energy recovery objectives. The MoU is based upon the mutual understanding that the combined expertise, influence and commitment of the parties are better applied together to support their common goals. This particular MoU is for a General Arrangement (Step 1) noting that a Formal Agreement (Step 2) would come back through Committee and Council.

## **CONTEXT:**

In November 2013 Council received the document Road Map 2.0 – The Road to Increased Resource Recovery and Zero Waste (Road Map 2.0) which looked at program changes, initiatives and new measures to divert waste. The document noted:

*Staff continue to review developments with aerobic composting, anaerobic digestion, mechanical biological treatment (MBT) processes, advanced thermal treatment (ATT) and other technologies (including new, next generation and emerging technologies) that could assist in optimizing materials recovery and creating renewable energy while moving from the City's current diversion rate of approximately 44% towards the Provincial goal of 60%.*

The above mentioned review of solid waste conversion technologies serves two purposes. Firstly, it will assist staff in determining whether or not to recommend implementing a Green Bin Program and what technology is most appropriate for managing organics if a Green Bin program is implemented. Secondly, it will assist in undertaking an Environmental Assessment (EA) to determine the best way for the City to meet its long term Solid Waste Disposal and Resource Recovery/Conversion requirements.

### **Status of Green Bin**

One of the key components of the Road Map 1.0 and the follow up report *Interim Business Plan for the Green Bin Program and Zero Waste Initiatives* (2010) was to undertake a one year pilot project in London to obtain local knowledge and determine the feasibility of implementing a city-wide Green Bin program. The pilot study found participation and capture rates were similar to programs in other Ontario cities. Overall, the Green Bin program has many benefits and is a proven way to divert waste but comes with significant capital and operating costs and, on average, a 50% to 65% participation rate (compared to the recycling program at participation rates above 90%). Considering this, City staff recommended in Road Map 2.0 that any decision on the Green Bin program be delayed until the review of alternative technologies is completed.

In addition, in December 2014, City staff were directed by Council to prepare a status report on the use of Green Bins to divert food scraps and other organics in Ontario and selected Canadian municipalities and potential next steps for London.

### **Environmental Assessment Requirements for Long Term Resource Recovery, Waste Conversion and Waste Disposal**

The W12A Landfill Site which opened in 1977 (38 years ago) is one of the most important assets owned by the City as it ensures that garbage from residents and businesses of London can be managed within our boundaries and at an affordable cost. The key to protecting this asset is the need to meet or exceed all environmental requirements and maintaining an open and positive relationship with the neighbourhood around the W12A Landfill area and Material Recovery Facility (MRF).

Waste quantity projections suggest that the W12A Landfill has between 8 and 15 years of capacity remaining depending on how residential and business waste is managed in the future. Under existing conditions, it is estimated that the W12A Landfill has approximately 9 to 10 years of capacity remaining.

The EA process, as prescribed by the Provincial Government, to develop new waste disposal/resource recovery capacity often takes several years to complete and obtain approval. The EA process will require public input throughout the process and the City to examine resource recovery, waste conversion and waste disposal alternatives to determine the most appropriate option(s) for managing the City's waste for the next forty to fifty years.

The first step in the process will be the development of a Terms of Reference which set the parameters for the EA including which resource recovery, waste conversion and waste disposal alternatives will be studied in detail.

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## DISCUSSION

Green Shields Energy (GSE) has approached the City about entering into a working relationship to explore the viability of as Gas Phase Reduction (GPR) technology for managing solid waste. This technology has already been proven to manage a range of material including pesticides, soil, sediment, sludge, high-strength oils, tar, watery wastes, wood wastes, brominated fire retardants, CFC refrigerants (Appendix B). It has not been thoroughly tested to handle mixed solid waste (household garbage), source separated organics (Green Bin) materials, mixed plastic waste, etc.

GPR is a process for the conversion of organic material to methane rich gas also known as synthetic gas or syngas. The process comprises heating vaporized organic material in the presence of an excess amount of hydrogen gas and superheated steam to produce a methane rich fuel syngas. The syngas can be converted to various fuels or burned directly to create energy.

### **Step 1 – Memorandum of Understanding – General Arrangement**

The first step in developing a working relationship with GSE is to enter into a non-binding Memorandum of Understanding (MoU). The MoU sets out short term objective of the collaboration between the City and GSE which would be to undertake testing and develop data/information on the viability of Gas Phase Reduction technology to manage various non-hazardous waste streams including household garbage.

GSE has proposed to build and operate a pilot scale facility. This will be at their cost and capable of processing up to one tonne per day of material. The facility would be located in the special policy area (Waste Management Resource Recovery Area) located around the landfill. This is the type of facility that the Official Plan allows to be located in the Waste Management Resource Recovery Area.

The proposed MoU is provided in Schedule A of Appendix A. The responsibilities of GSE listed in the MoU include:

- Obtain all necessary approvals and licenses
- Construct and operate the pilot scale facility and all associated costs
- Evaluate and report the results of the research and development work.
- Provide overview report quarterly to the City of London highlighting activities undertaken, key non-proprietary results and related matters noting that such reports are subject to the requirements of the Municipal Freedom of Information and Protection of Privacy Act

The responsibilities of the City listed in the MoU include:

- Assist with all approvals (e.g., Ministry of the Environment & Climate Change MOECC, City of London zoning, etc.)
- Provide land in the special policy area (Waste Management Resource Recovery Area) for three years with an option to renew for additional years
- Bring services (water, sanitary and hydro) to the location of the of the pilot scale facility
- Provide access to the boardroom room and education room in the Material Recovery Facility (MRF)
- Participate, when available, in discussions, tours and related activities
- Provide solid waste materials for waste conversion
- Assist with reporting, being available for media interviews and related matters
- Keep London Municipal Council informed

### **Step 2 – Formal Agreement for Demonstration Pilot Project**

The City and GSE will work together to develop a formal agreement to undertake the approval, design, construction and testing and develop data/information on the viability of Gas Phase Reduction technology for solid waste materials. The Formal Agreement will be presented to Civic Works Committee and Council for final approval. Timing on this activity is not known at this stage.

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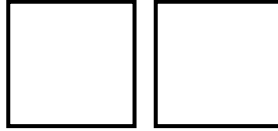
<b>PREPARED BY:</b>	
<b>WESLEY ABBOTT, P. ENG. DIVISION MANAGER SOLID WASTE MANAGEMENT</b>	
<b>PREPARED AND RECOMMENDED BY:</b>	<b>RECOMMENDED BY:</b>
<b>JAY STANFORD, M.A., M.P.A. DIRECTOR, ENVIRONMENT, FLEET &amp; SOLID WASTE</b>	<b>JOHN BRAAM, P.ENG. MANAGING DIRECTOR, ENGINEERING SERVICES &amp; CITY ENGINEER</b>

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Appendix A A by-law to authorize and approve a Memorandum of Understanding between Green Shields Energy and The Corporation of the City of London and to authorize the Mayor and the City Clerk to execute the Memorandum of Understanding.

Appendix B Primer – Gas Phase Reduction

c Jeffrey Shields, President & CEO (Founder), Green Shields Energy, 1316 Gainsborough Road London Ontario N6H5K8



## Appendix A

Bill No.  
2015

By-law No. A.-

A by-law to authorize and approve a Memorandum of Understanding between Green Shields Energy and The Corporation of the City of London and to authorize the Mayor and the City Clerk to execute the Memorandum of Understanding.

WHEREAS section 5(3) of the *Municipal Act, 2001*, S.O. 2001, c. 25, as amended, provides that a municipal power shall be exercised by by-law;

AND WHEREAS section 9 of the *Municipal Act, 2001*, S.O. 2001, c. 25, as amended, provides that a municipality has the capacity, rights, powers and privileges of a natural person for the purpose of exercising its authority under this or any other Act;

AND WHEREAS it is deemed appropriate for The Corporation of the City of London (the "City") to enter into a Memorandum of Understanding with Green Shields Energy Inc. to undertake testing and develop data/information on the viability of Gas Phase Reduction technology to manage various non-hazardous waste streams, including household garbage;

AND WHEREAS it is deemed appropriate to authorize the Mayor and the City Clerk to execute the Memorandum of Understanding on behalf of the City;

NOW THEREFORE the Municipal Council of The Corporation of the City of London enacts as follows:

1. The Memorandum of Understanding between The Corporation of the City of London and Green Shields Energy, attached as Schedule A to this by-law, is hereby authorized and approved.
2. The Mayor and the City Clerk are hereby authorized to execute the Memorandum of Understanding authorized and approved under section 1 of this by-law.
3. This by-law shall come into force and effect on the day it is passed.

PASSED in Open Council February 9, 2015

Matt Brown  
Mayor

Catharine Saunders  
City Clerk

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## Schedule A

# Memorandum of Understanding

Between

The Corporation of the City of London ("City")

And

Green Shields Energy ("GSE")

Whereas the City has established a special policy area in the City's Official Plan, referred to as the Waste Management and Resource Recovery Area, that plans for the continued evolution of the W12A Landfill and nearby lands into an "Integrated Waste Management Centre" that utilizes environmentally responsible and sustainable operations and practices and achieves a high standard of compatibility with its environs and neighbours;

Whereas the remaining life expectancy of the W12A Landfill as of January 1, 2015 is approximately ten years or less;

Whereas the City wishes to examine, support, conduct research and/or implement projects under the broad classification(s) of resource recovery, energy recovery and/or waste conversion within the special policy area, in other locations in London, or in collaboration with others outside of London as part of its continuous improvement system for solid waste management. The continuous improvement system is described in several public documents including City of London Continuous Improvement System for Waste Management (1997), A Road Map to Maximize Waste Diversion in London (2007) and Road Map 2.0 The Road to Increased Resource Recovery and Zero Waste (2013);

Whereas the City wishes to pursue projects, relationships and partnerships for the purposes of innovation, creativity, best practices and excellence in solid waste management and is proposing to operate, subject to final Municipal Council approval, under a banner known as the London Waste to Resources Innovation Centre (L-WRIC); and

Whereas Green Shields Energy hereafter known as GSE, have developed a proprietary technology that has successfully converted a range of materials into energy and inert materials, now wants to determine the viability of this technology on solid waste materials, including mixed solid waste, commonly known as household garbage.

### 1.0 Purpose of the Memorandum

This Memorandum of Understanding ("MoU") is intended to set out the mutual intentions of the City and GSE to advance their joint waste conversion, resource and energy recovery objectives. The MoU is based upon the mutual understanding that the combined expertise, influence and commitment of the parties are better applied together to support their common goals. The MoU establishes the non-legally binding framework and set of principles for enhanced and focused coordination and collaboration to support their shared interests in waste conversion and resource and energy recovery.

The parties to this MoU acknowledge that if they wish to jointly carry out specific initiatives that may arise out of this MoU, they will have to engage in further discussion



and prepare necessary agreements to define, authorize and execute, among other things, each party's roles and responsibilities, resource allocation and other details.

The MoU is not an exclusive arrangement and does not restrict either party from pursuing their mandates either on their own or in collaboration with any other party.

## 2.0 Short Term Objective

The short term objective of the collaboration between the City and GSE is to undertake testing and develop data/information on the viability of Gas Phase Reduction technology to manage various non-hazardous waste streams including household garbage.

This will be done by constructing and operating a pilot scale facility containing a Gas Phase Reduction unit designed for demonstrating the effectiveness of the process on the conversion of various wastes and waste matrices. The facility will process less than one tonne of material per day and is expected to significantly reduce the volume/weight of the material being processed while generating methane gas.

Complementing the technical processes is the ongoing development of the potential role for this technology to handle non-hazardous materials from the residential, institutional, commercial and industrial sectors and to contribute towards policies and programs established by the various levels of government (Municipal Provincial and Federal) as well as and other Governmental agencies outside of Canada.

## 3.0 General Arrangement

This MoU sets out the General Arrangement between the parties that will be the basis for working together.

The responsibilities of the City are to include:

- Assist with all approvals (e.g., Ministry of the Environment & Climate Change MOECC, City of London zoning, etc.)
- Provide land in the special policy area (Waste Management Resource Recovery Area) as a host site for three years with an option to renew for additional years
- Bring services (water, sanitary and hydro) to the location of the of the pilot scale facility
- Provide access to the boardroom room and education room in the Material Recovery Facility (MRF)
- Participate, when available, in discussions, tours and related activities
- Provide solid waste materials for waste conversion
- Assist with reporting, being available for media interviews and related matters
- Keep London Municipal Council informed

The responsibilities of GSE are to include:

- Obtain all necessary approvals and licenses
- Construct and operate the pilot scale facility and all associated costs including utilities
- Evaluate and report the results of the research and development work
- Provide overview reports quarterly to the City of London highlighting activities undertaken, key non-proprietary results and related matters noting that such reports are subject to the requirements of the *Municipal Freedom of Information and Protection of Privacy Act*

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**4.0 Formal Agreement**

The parties agree to work together to develop a formal agreement to undertake the approval, design, construction and testing and develop data/information on the viability of Gas Phase Reduction technology as outlined above.

The Formal Agreement will follow the same approval processes as this General Arrangement.

**5.0 Effective Date and Duration**

This MoU will come into effect upon the date it has been signed by all signatories and will remain in effect until December 31, 2017.

This MoU will be reviewed two months prior to the anniversary date and any agreed to changes added to the MoU. Substantive changes will trigger the approval process for the MoU and this determination is at the sole discretion of the City.

A participant may withdraw from this MoU by providing a sixty (60) written notice to the other parties.

This MoU is subject to approval processes required by each of the parties.

DATED this \_\_\_\_\_ day of \_\_\_\_\_.

IN WITNESS WHEREOF:

THE CORPORATION OF THE CITY OF LONDON

By:  
Name: Matt Brown  
Title: Mayor

By:  
Name: Catharine Saunders  
Title: City Clerk

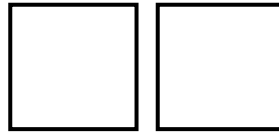
I/We have authority to bind the City.

GREEN SHIELDS ENERGY

By:  
Name: Jeffrey Shields  
Title: President & CEO (Founder),

I/We have authority to bind the corporation.





## Appendix B

### PRIMER – GAS PHASE REDUCTION (based on details provided by Green Shields Energy [www.greenshieldsenergy.com](http://www.greenshieldsenergy.com))

#### High Level Overview of Gas Phase Reduction Technology

Gas Phase Reduction is built on a premise that in essence all organic molecules can be reduced, as they are enzymatically in nature, to form methane gas if there is an excess of hydrogen donors or electrons present. In chemistry this is best accomplished in a gas phase. In organic chemistry, gas phase chemistry is also known as plasma chemistry. All organic chemicals are known to volatilize at 440 degrees Celsius.

Gas Phase Reduction does not allow condensation reactions which form dangerous compounds such as polyaromatic hydrocarbons (PAHs) some of which are the carcinogens in cigarette smoke and the well-known environmental problems Dioxins and Furans. These chemicals are destroyed in Gas Phase Reduction and cannot form.

Condensation reactions occur when aromatic hydrocarbons or fragments of aromatic hydrocarbons are allowed to cool in an oxidizing atmosphere such as the scrubber in an energy from waste (EFW) facility. They form on the surfaces of particulates which is why EFW ash and fly ash is a problem. They also are well known to form in coal gasification forming coal tar. Other simple gasification techniques also form tar for the same reasons. However if the aromatic and partial aromatic molecules are eliminated by completely mixing every molecule with enough electrons to saturate all of the carbon bonds forming methane, there is no possibility of tar formation. This is the theory and practice of Gas Phase Reduction. Excess hydrogen gas which is the ideal reducing agent is present at every stage of the process. In the end 80% of the hydrogen is removed from the gas stream and recycled back into the reaction leaving 20% in the fuel gas.

Hydrogen is produced from the methane formed through catalyzing the water shift reaction with metal catalysts that are imbedded in the walls of the reactor. This is why moisture is left in the waste and in some cases steam is added at various points in the reaction. The method is well described in the new Canadian patent which has been published.

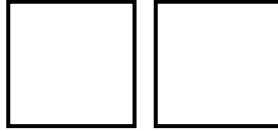
In Gas Phase Reduction the gas formed from all runs as been continuously analyzed and shown to be a very clean burning gas comprised of methane with about 20% hydrogen, 10% CO and 5% CO<sub>2</sub>. Regulatory analysis has shown that benzene and monochlorobenzene have been below ppm levels as measure on a continuous basis.

The combustion power of this gas is 92% of the combustion power of natural gas. The content of hydrogen at 20% has been shown to reduce the greenhouse gas production or CO<sub>2</sub> by 50% after combustion.

#### **GPR Has Been Demonstrated to Destroy or Convert Many Different Non-hazardous and Hazardous Materials**

Gas Phase Reduction (GPR) is the result of twenty years of development beginning with the chain of events that began when Dr. Douglas J Hallett (Natural Energy Systems Inc.) invented a non-incineration process for the destruction of PCBs and other hazardous organic waste. Dr. Hallett went on to create a company that moved his patented invention from lab-scale, to pilot scale, to a commercially viable venture. In 1986 ELI Eco Logic was established. This company went on to build processing plants in Canada, the USA, Australia and Japan. Eli Eco Logic was taken public on the Toronto Stock Exchange in 1994.

The first pilot scale demonstration of the technology occurred in 1991 and involved the remediation of coal tar contaminated sediment from a “hot-spot” in Hamilton Harbour. This project received both provincial and federal support from both Environmental Canada and the Department of Defence (DoD).



The USEPA created a report through their Cincinnati lab and this then became the record of verification to match vendor claims as to efficacy. This was laborious and time consuming, but ultimately gave Eco Logic the USEPA “gold seal” of approval.

In 1994, Eco Logic was awarded the contract to build a plant for General Motors in St. Catharines, Ontario Canada.

The successful operation of plants conducting real hazardous waste destruction led to extensive evaluation by the US Army and various prime contractors within the US Defense arena for future work on various chemical inventories and wastes within their domain, domestically and internationally. Eco Logic did extensive testing with the US Army and proved that the GPR process could successfully and safely destroy chemical warfare agents, rockets, suits and packaging waste associated with these programs.

GPR plants successfully treated many different types of organic wastes including chemical warfare agents, explosives, pesticides, brominated fire retardants, CFC refrigerants, HCB, and dioxins. The technology is proven suitable for the destruction of organic wastes in all matrices including soil, sediment, sludge, high-strength oils, tar, watery wastes, wood wastes, and bulk solids such as electrical transformers and capacitors, equipment casings, and drums of crystalline chemical.

Wastes that have not been thoroughly tested include mixed solid waste (household garbage), source separated organics (Green Bin) materials, mixed plastic waste and shredder fluff from automotive industry.

According to GSE, the technology has been found acceptable by NGOs such as Greenpeace and the Sierra Club as well as regulators in Canada, the U.S.A., Australia, and Japan. A paper written by Pat Costner, Senior Science Advisor for Greenpeace International dated 9 June 2004 states “Greenpeace still finds that, among those technologies regarded as commercially available, gas phase chemical reduction (GPCR) remains the only technology that meets the 1998 Greenpeace criteria.”