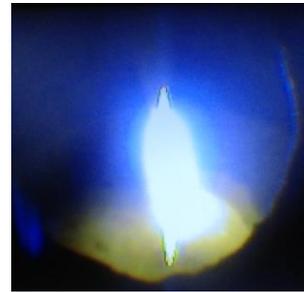


Green Technology Solutions for Hamilton

**Low Tech
Waste**



**High Tech
Fuels**



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Introduction and Summary Description

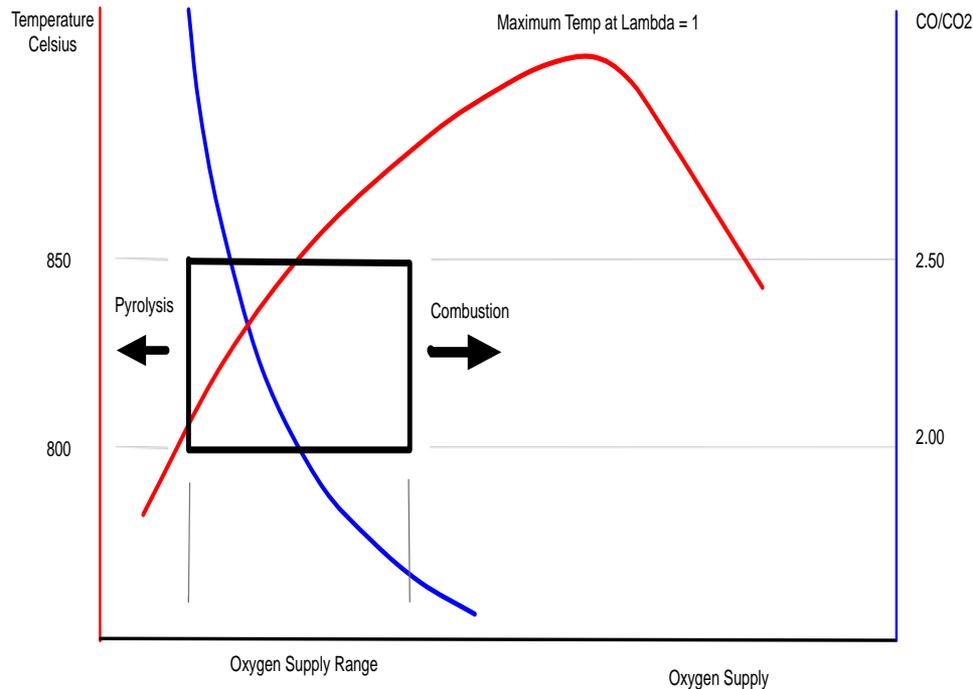
Port Fuels & Materials Services, Inc. is a proposed waste processing facility that uses the most energy efficient gasification and plasma process (Gasplasma®) available globally for transformation of organic waste into electricity, heat, synthetic gas as a substitute for natural gas and other useful commercial products.

- *“An average efficiency of 84.8% was achieved for conversion of chemical energy in the RDF to chemical energy in the syngas.”*
- *“An average efficiency of 99.1% was achieved for conversion of carbon in the RDF to carbon containing species in the syngas.”*

From a local solutions perspective, the proposed undertaking will utilize a majority of the waste feedstock from the properties within and adjacent to the Port of Hamilton as well as providing heat and energy back to these Port properties. This is a “Best Practice!”

This is a major local capital investment, providing numerous construction and operation related employment, expanded business opportunities for local materials and services while bringing the best global technology to Ontario. Property taxes are estimated at approximately \$500,000 annually.

Gasification is NOT Incineration!



A common misunderstanding!

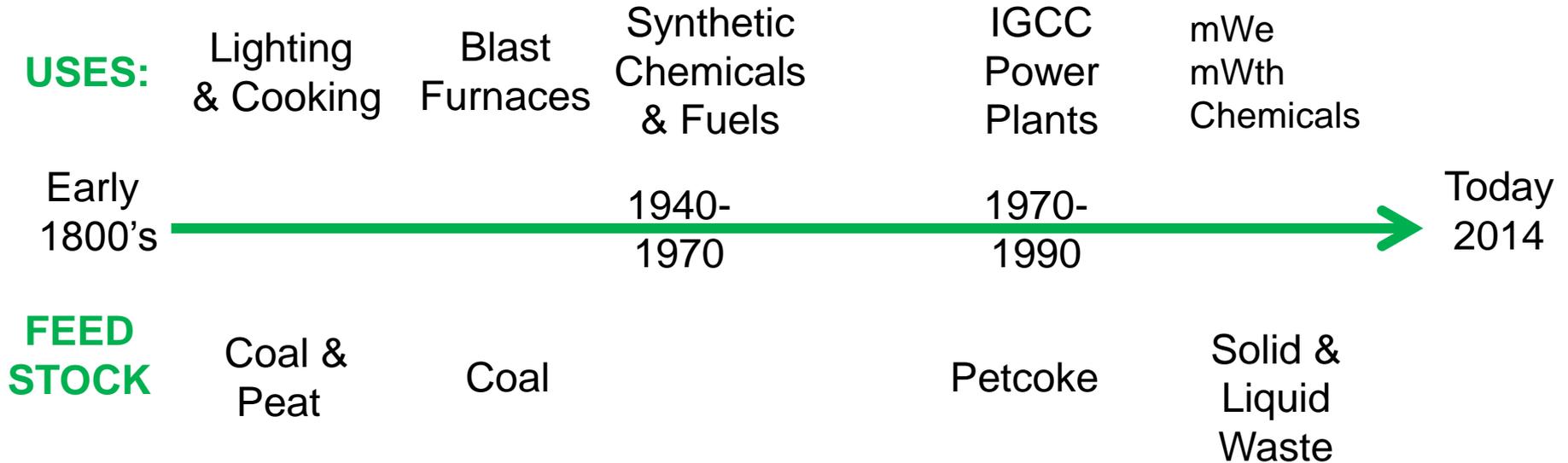
- Depending on the amount of oxygen introduced into the process, it can be pyrolysis, gasification, combustion or a combination of them.
- A surplus of oxygen leads to combustion and a shortage leads to gasification and pyrolysis.
- When water/steam is added as in our process, the water gas reaction is initiated and provides more H₂.

Incineration (combustion) uses waste as a *fuel that* burns with high volumes of air to form CO₂ and heat. Emissions can only be removed *after* combustion

Gasification uses waste as a *feedstock* for the gasification *process* utilizing high energy feedstock that would end up in landfills. There is no flame! The waste is *not* combusted but converted to an extremely clean syngas free of particulates.

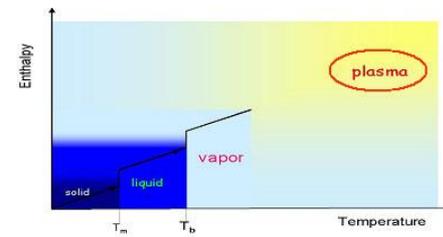
Gasification

“A process that converts organic or fossil based carbonaceous material into CO, H and CO₂ by reacting the material at high temperatures (>700C) without combustion with a controlled amount of oxygen and/or steam.”



Gasification is a well proven technology → over 180 years old (town gas from coal and peat), 70,000 MWth worldwide of syngas (chemicals, liquids, power), 400 operating installations (mostly coal and petroleum with some biomass/waste facilities)

Plasma



“A process that cracks the compound molecular bonds transforming them into simple molecules thereby cleaning and conditioning the raw synthetic gas (syngas) from the gasifier, increasing the calorific value and resulting in a very versatile syngas fuel.”

USES:

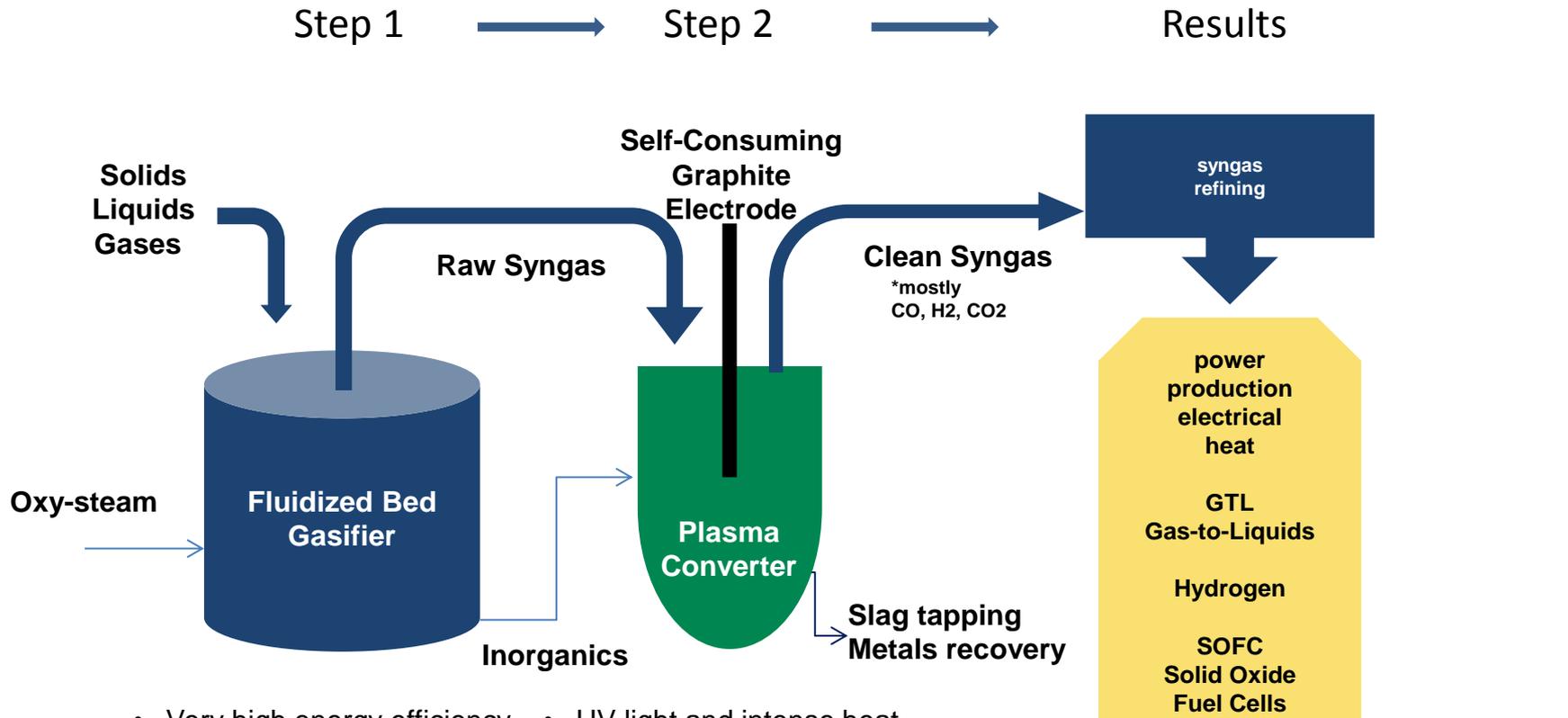
High heat applications	Acetylene Fuels	Cut, Weld, Plasma Spray, Aerospace	Power Increase	WTE MSW HAZ	mWe mWth Nat'l Gas Supplement Chemicals Fuel Cells
Early 1800's	Early 1900's	1950s-1960s	1970s-1980s	1990s	Today 2014

INDUSTRY

Metals	Chemical	Materials Processing	Ind.App. Pilot Plants	Pilot Plants	Solid, Liquid & Gaseous "Fuels" Industry
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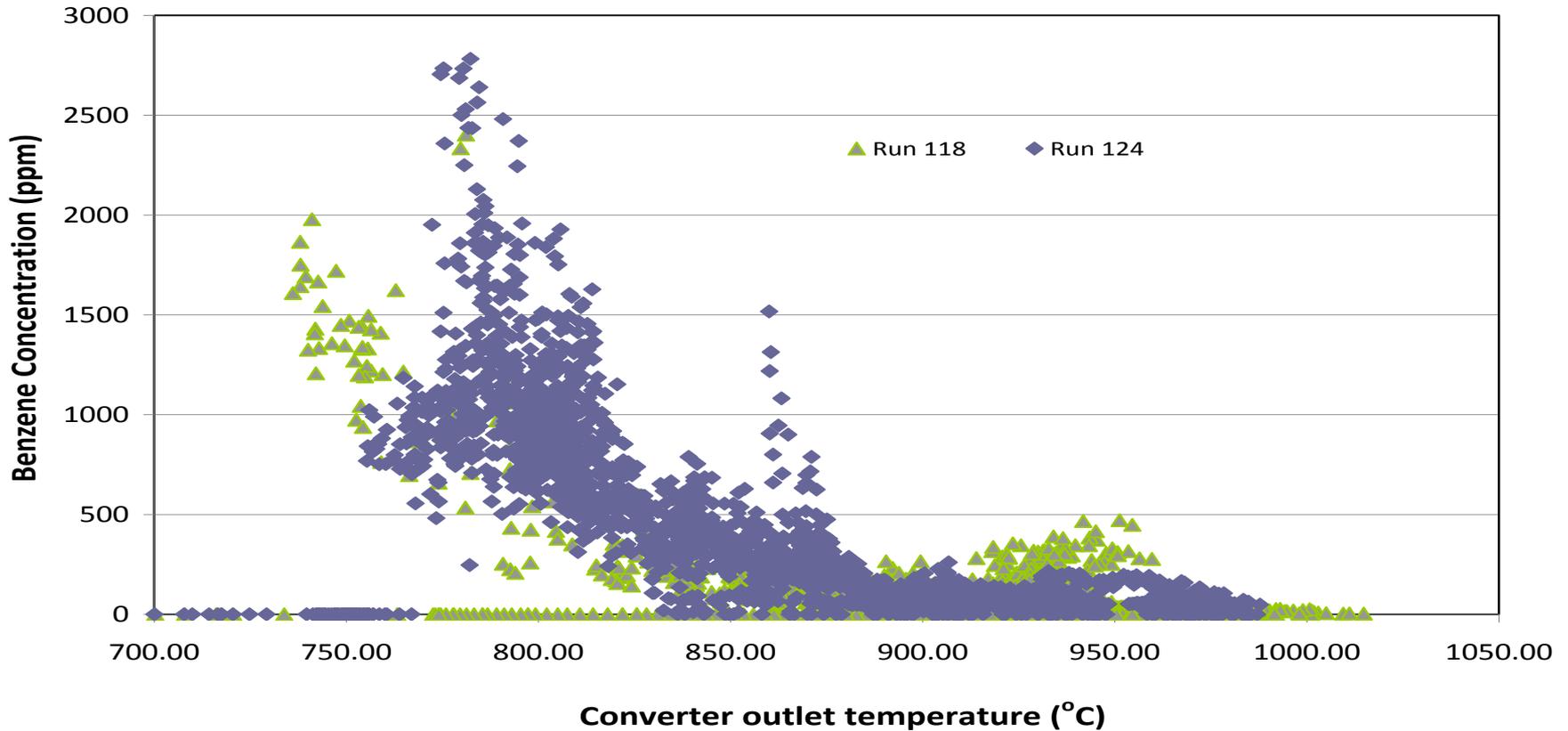
We are at the threshold of extraordinary growth through the technological adaptation to broader uses of renewable energy, supplement to natural gas and the lowering of our dependence on petroleum.

Gasplasma® - How does it work and why is it different?



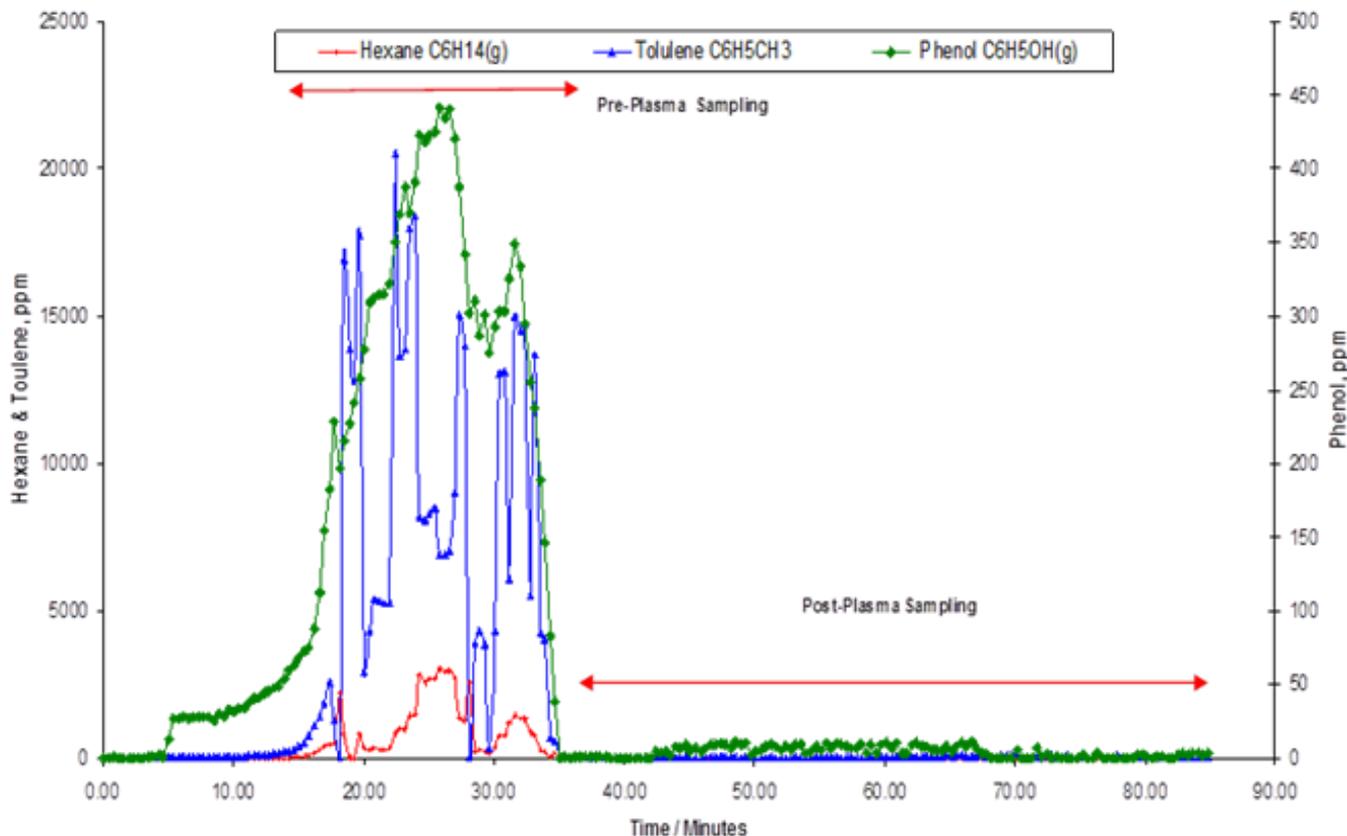
- Very high energy efficiency
- Not air – 78% inert nitrogen
- Lower volume to process
- Self-sustaining process
- No fossil additives
- Improves CV
- Higher quality syngas
- Flexible – any organic
- UV light and intense heat
- Cracks/reforms molecules
- No chars, tars, dioxins/furans
- Works only on raw syngas
- Graphite not water-cooled
- Inorganics are commercial product
- Smaller footprint downstream
- Landfill diversion
- Virtually no emissions to air, water, land
- Multiple applications
- Very low profile facility
- **Validation by Fichtner Engineering, Technikon (RETC – US DOD), Gas Technology Institute**

Effect of Temperature on Tar Levels in Syngas



Tar levels are negligible at temperature

Cracking of Organics with Plasma

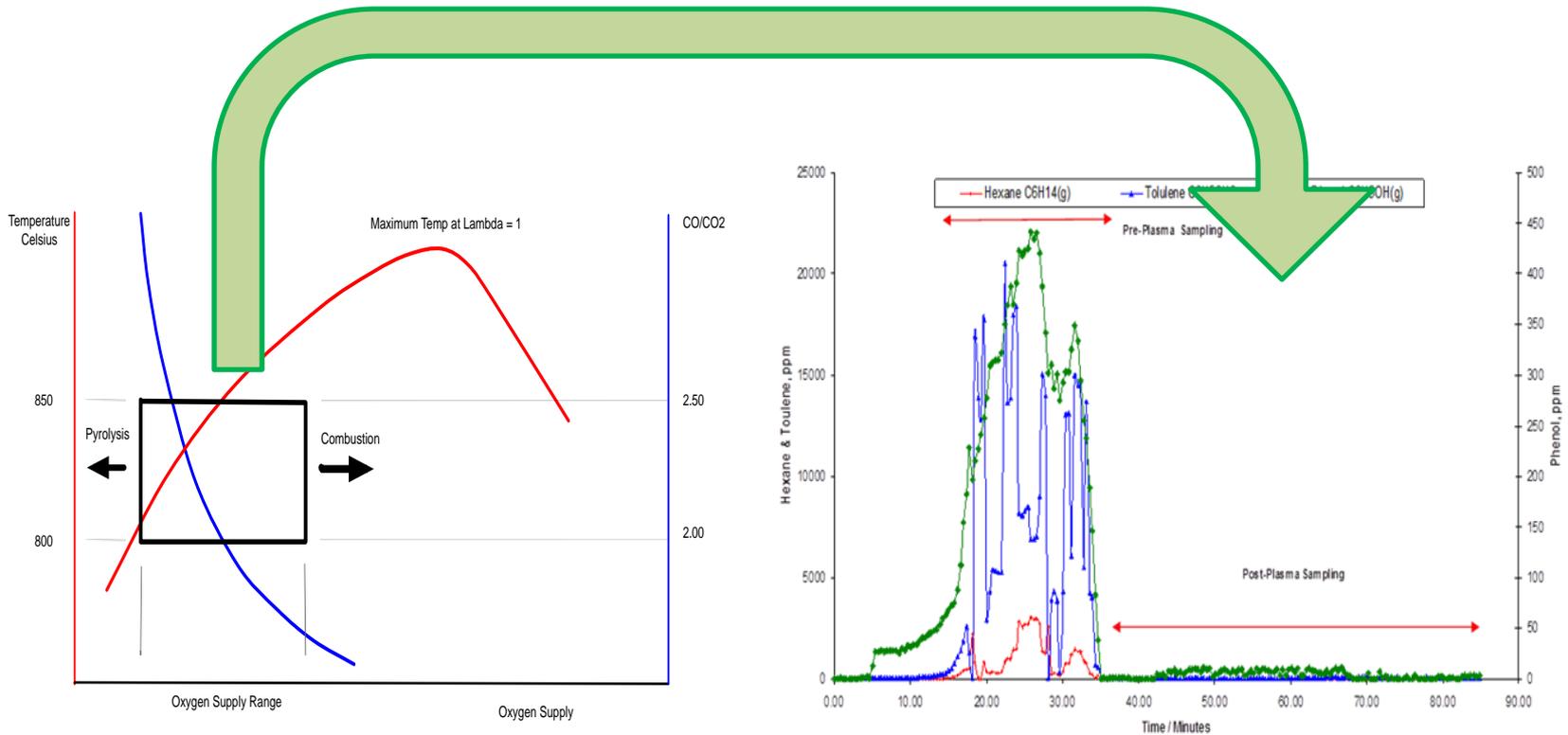


Typical Syngas Composition Ranges

- H₂ 35-50%
- CO 31-47%
- CO₂ 10-18%
- N₂ 3-5%
- H₂O 4-5%
- CH₄ <2%

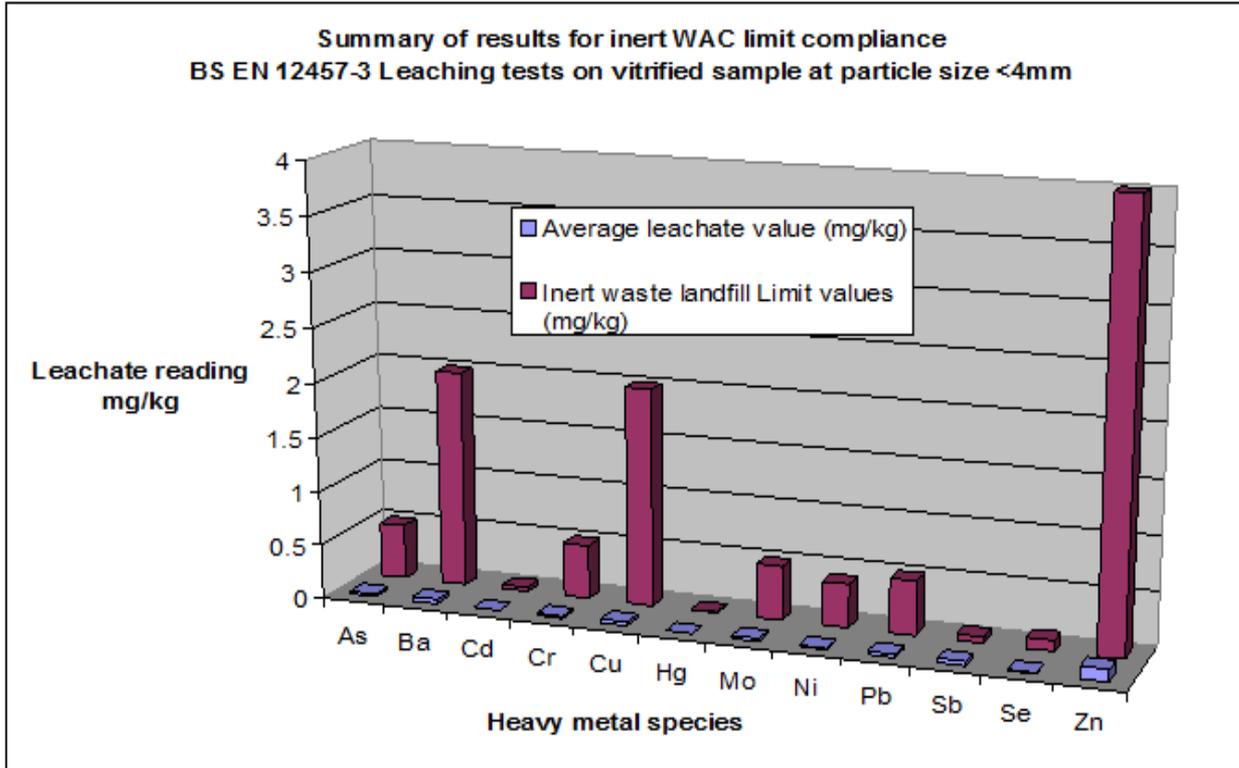
Compound molecules are transformed to simple molecules

Step 1 followed by Step 2



Plasma cleans and conditions the syngas produced by the gasifier

Gasplasma[®] solid output is vitrified Plasmarok[®]



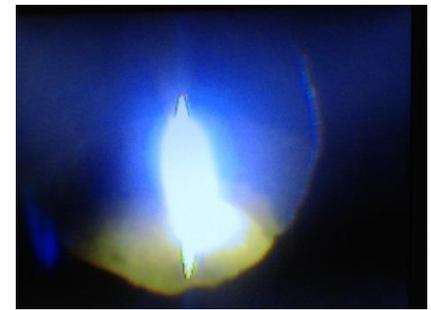
**Mechanically strong,
extremely leach resistant**

**Accepted by EA
as a product –
not a waste**

Main constituents: Silica; Lime; Alumina
Others include: Iron Oxide; Titania; Magnesia; Sodium Oxide; Potash; Phosphate

Swindon UK Facility

- The Gasplasma® Pilot Plant was first built in 2005, then relocated and upgraded in March 2007 to Swindon UK.
- It has been operating successfully since 2008 with various organic and inorganic waste fuels.
- A Liebherr gas engine is used for power production.



Waste Gasification is “Best Practice”

Embraced by US EPA and European Commission

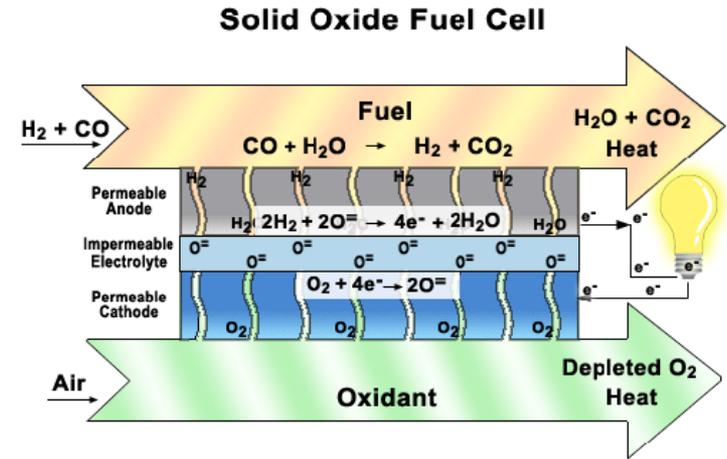
- In December 2013, US EPA confirmed that gasification was materially different from incineration and would be granted in certain applications for a fast-track regulatory approval.
- The European Commission has long differentiated between incineration (combustion) and gasification (transformation), recognizing the superior energy capture and environmental performance offered by gasification.
- The European Commission has included considerable resources and incentives for developing gasification projects in the Horizon 2020 program that are tied to process industries in order to improve the competitiveness of the industry and reduce the carbon emissions in EC.



**EUROPEAN
COMMISSION**

Additional Improvement

SOFCpower is a world leader in design and manufacturing of second generation (low temperature) SOFC's a power generation technology that can utilize as fuel any of: natural gas, syngas, liquids, coal, biofuels, hydrogen and ammonia

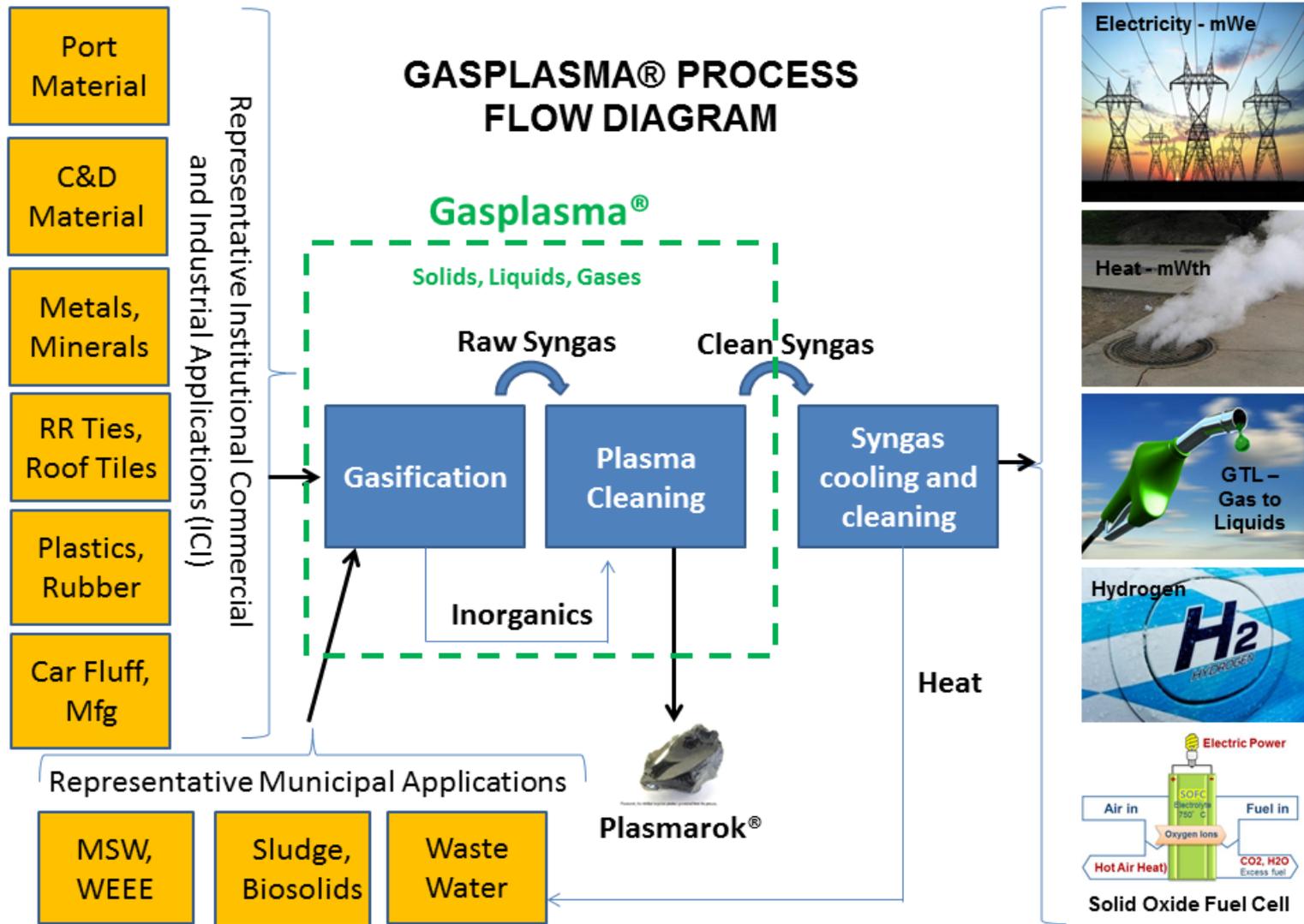


Power Islands

Steam Turbine
Gas Engine
Gas Turbine
Fuel Cell

Electrical Conversion Efficiency (%)

18-25% Conventional approach but inefficient
37-41% Proven. Higher efficiency from Organic Rankine Cycle
42-50% Proven. Higher efficiency in combined cycle
70-90% **Next step is underway.** Established within next 2 years



Status of Activities

- Meetings with Ministry of Environment – Provincial/Local – Ongoing
- Co-Sponsor Conference with McMaster University – September 2013
- Publish Notice of Commencement – 3 April 2014
 - Environmental Screening Assessment
 - Environmental Compliance Approval Application
- Open House #1 to announce start of Permitting Process – 17 April 2014
- Various Meetings with Civic Organizations, Community Hubs, others.
- Meeting with Hamilton City Council, Board of Health – 10 July 2014
- Current ongoing studies:
 - Geology and Hydrogeology
 - Surface Water
 - Site Development Plan
 - Design & Operations
 - Traffic
 - Socio-Economic Conditions
 - Natural Heritage Conditions
 - Cultural Heritage Conditions
 - Human Health Risk Assessment
- Community Liaison Committee (CLC) Meetings - Ongoing
- Open House #2 to announce results of various site-specific Studies supporting the Permitting Process – TBD 2014

Air Shed and HHRA

The PMFSI Facility is not a significant source of air contaminants relative to existing sources in the area.

The Air Quality Study will demonstrate that the air emissions from PFMSI meets the Ontario Regulation 419 air quality standards.

The Human Health Risk Assessment (HHRA) study will demonstrate that there are no significant additional risks to human health from the PFMSI.

The Air Study and HHRA study will consider Cumulative Effects (that means we will include existing air quality in addition to the PFMSI Facility).

Results of the ongoing Studies will be completed by the end of the summer and a 2nd Open House is planned for the fall in addition to the ongoing CLC Meetings.

Sensors and Bio-Markers

We are interested in the transformation of waste into useful Gasplasma® Fuels as an environmental mitigation concern and it is our commitment to do so with this technology.

We are also involved in environmental de-risking of human activities and improving our habitat by way of avoiding pollution and/or mitigating existing health hazards in the air, water or soil.

- Our current program with McMaster University is interdisciplinary research and development (R&D) in the domains of green-energy fuels (Gasplasma® Fuels) and of highly efficient 2nd generation fuel cells (Solid Oxide Fuel Cells)
- We also are working to develop low-cost (hand held) sensors to measure levels of contamination anywhere and the determination of levels of bio-markers that indicate exposure of organisms to contamination and their effect on health

By measuring contaminant levels before, during and after the treatment, the efforts, process-control, optimization and prioritization of activities becomes totally transparent and, public-policy-wise, acceptable.

CLC - Community Liaison Committee

Mission: To provide, encourage and facilitate open communication between local stakeholders and PMFSI on environment, social and economic issues of mutual concern associated with the PMFSI proposed Hamilton facility to be located on Pier 15 on Hamilton Port Authority property.

Visit: www.PFMSI.com for more details
