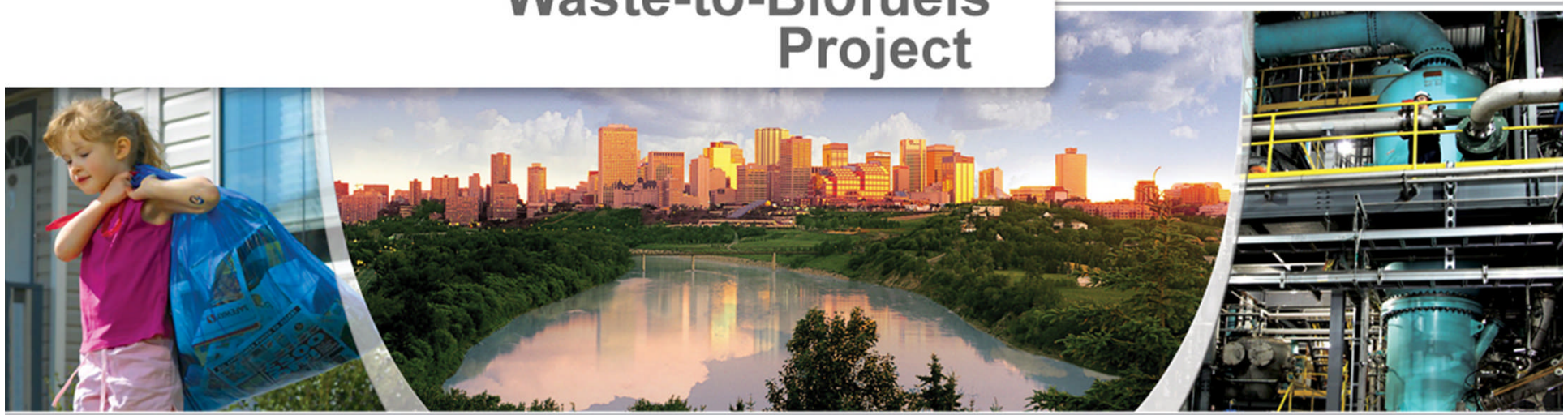


# Edmonton Waste-to-Biofuels Project



## *The Edmonton Waste-to-Biofuels Project From Research to Reality*

January 4, 2013





## Edmonton Waste-to-Biofuels Project

### Outline

- Overview of the Edmonton Waste Management Centre (EWMC)
- Edmonton's Journey to Biofuels Production
- The Edmonton Biofuels Project
  - The Partnership (COE, EAB & AIEES)
  - The 3 Components (Integrated Processing and Transfer Facility (IPTF), Waste to Biofuels Facility & the Advanced Energy Research Facility (AERF))





## Edmonton Waste-to-Biofuels Project

### Over 15 Years of Development



1995



2010



## Edmonton Waste-to-Biofuels Project

- 550 acres
  - Twelve waste processing facilities
  - Two major research facilities
  - Closed Landfill
  - Sewage biosolids storage/recycling lagoons
- Nine contractors, partners, tenants
- Over 400 employed today; 500 by 2013





## Edmonton Waste-to-Biofuels Project

# Direct Services

## Community Relations / Events

- **School Grade 4 Tours / engaging the community**  
(presentations to over 13,000 Students/year & 3,000 adults)
- **EWMC Visitors**





## Edmonton Waste-to-Biofuels Project

# Direct Services

## Eco Stations

>200,000 customers (in 2011)



- 1<sup>st</sup> South Eco Station opened August, 1995
- 2<sup>nd</sup> NW Eco Station opened December, 1999
- New 3<sup>rd</sup> Southwest Eco Station opened Fall, 2009







## Edmonton Waste-to-Biofuels Project



## Co-Composting Facility (for MSW & Biosolids)





## Edmonton Waste-to-Biofuels Project



## Materials Recovery Facility (MRF) for recyclables





## Edmonton Waste-to-Biofuels Project

- >13 million tonnes of waste disposed between 1975-2009
- The Clover Bar landfill is now closed



- Gas recovery in operation 1992
- Leachate treatment plant in operation 1996



## Historical - Search for a Solution

- The City knew the landfill would be closing and that it would have to be hauling waste offsite (at higher costs!)
- City has very established recycling and composting programs, so it had maximized the 3-Rs currently diverting 60% of the waste (wanting to process the remaining 75,000 tonnes/yr of Composting residuals and 5,000 tonnes/yr of MRF residuals)
- Specific targets included:
  - Increase Edmonton's landfill diversion rate from 60% to 90%
  - Reduce Edmonton's need for landfilling, without going to traditional combustion systems





## Edmonton Waste-to-Biofuels Project

### The Journey to Biofuels Production

- Starting Premise - There is a better solution than landfill
- Review of global conversion technologies (2003)
- Enerkem was chosen:
  - Flexible and innovative technology platform (low temp fluidized bed)
  - Demonstrated ability to produce clean syngas from waste feedstocks
  - Ready for commercialization
- Research / Pilot Project – confirm key performance parameters (2004-2006) Grant from AERI (1<sup>st</sup> Pelletization of RDF and then 2<sup>nd</sup> RDF fluff feeding system re-design)
- Grant Support (Alberta Innovates) (2006)

### Project Officially Announced



## Edmonton Waste-to-Biofuels Project

### The Journey Continues...

- Contractual Agreements & Environmental Permitting (2007-2008)
- Regulatory Approval (2009)
- Construction start - August 2010
- Commissioning in 2013





## Edmonton Waste-to-Biofuels Project

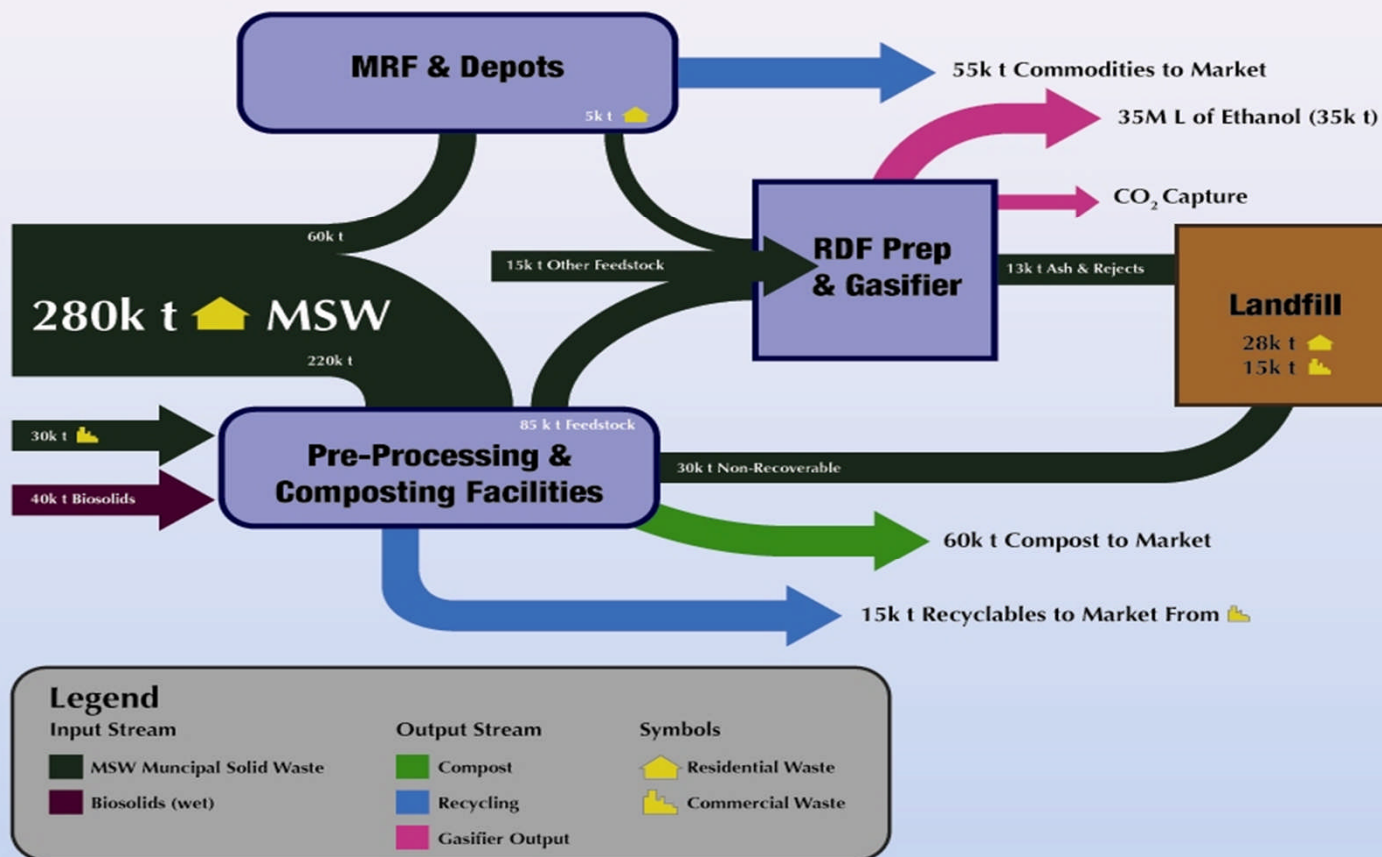
# The Journey to Biofuels Production

- There is a better solution (than landfill or conventional incineration)
  - Review of global conversion technologies (2003)
  - Pilot Project – confirm key performance parameters (2004-2006)
  - Grant Support (Alberta Innovates) Announced (2006)
  - Contractual Agreements & Environmental Permitting (2007-2008)
  - Regulatory approval (2009)
  - Construction start - August 2010
  - Commissioning in 2013
- 10 YEARS!



## Edmonton Waste-to-Biofuels Project

### 90% Diversion of Residential Waste Stream







## Edmonton Waste-to-Biofuels Project

### Overview of the New Project – Three Components, Three Partners

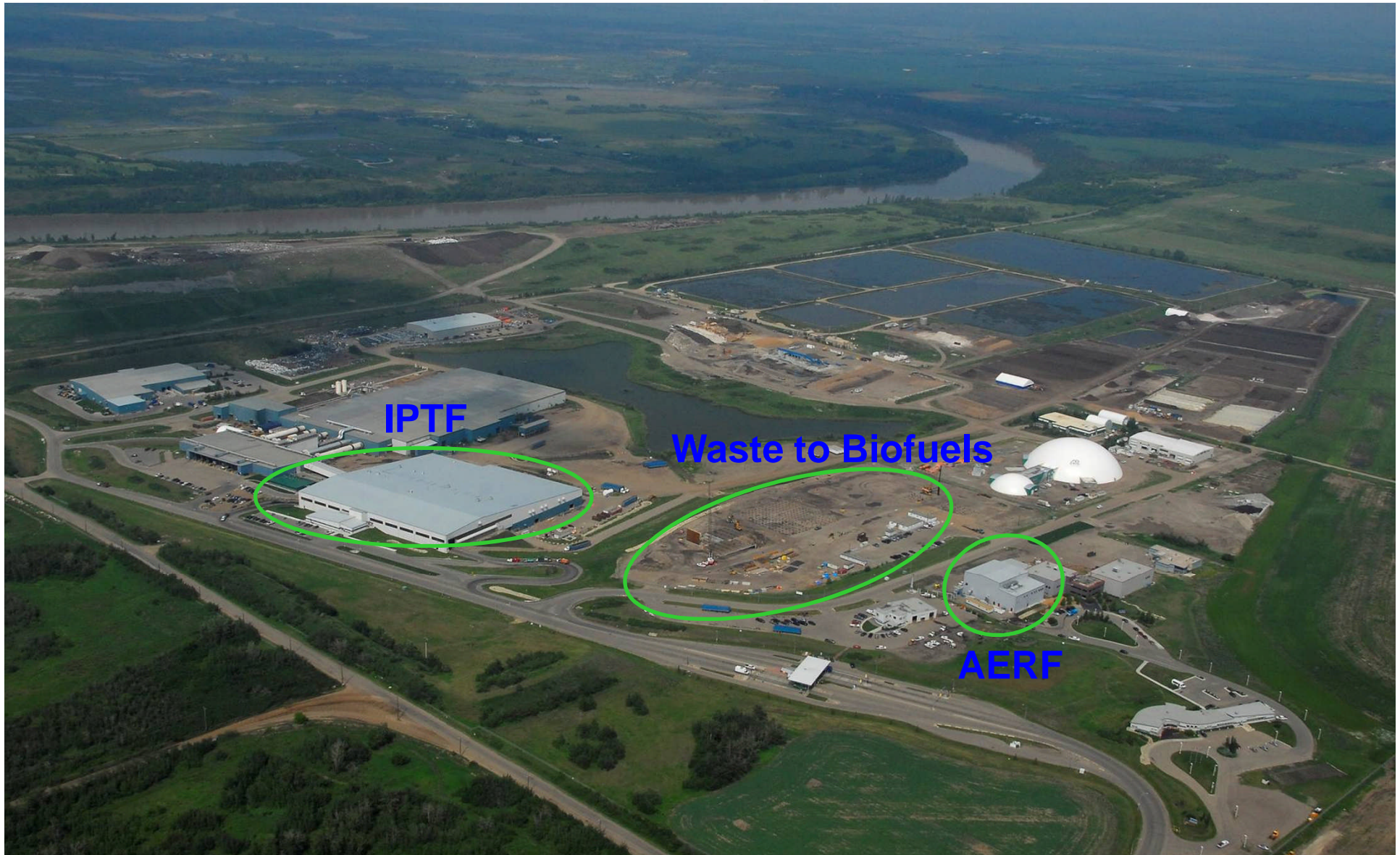
Facility	Primary Operator	Role	Cost
<b>Integrated Processing and Transfer Facility (IPTF)</b>	<b>City</b> owns and operates	<ul style="list-style-type: none"> <li>Produces RDF (Feedstock)</li> </ul>	\$90 M
<b>Waste-to-Biofuels Production Facility</b>	<b>Enerkem</b> owns and operates	<ul style="list-style-type: none"> <li>Produces 38M litres of biofuels/year from provided feedstock</li> </ul>	Approximately \$105 M (construction)
<b>Advanced Energy Research Facility (AERF)</b>	City owns. City & <b>AIEES</b> will direct activities	<ul style="list-style-type: none"> <li>Ongoing R&amp;D activities</li> <li>Higher value products</li> <li>Process optimization</li> </ul>	\$12.5 M

*AIEES = Alberta Innovates Energy and Environment Solutions*





## Edmonton Waste-to-Biofuels Project





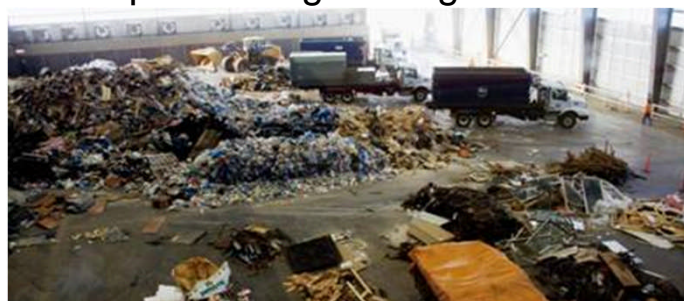


## Edmonton Waste-to-Biofuels Project

### INTEGRATED PROCESS AND TRANSFER FACILITY (IPTF)

Designed to optimize and enhance waste processing through mechanical and manual sorting:

- Waste transfer station
- Pre-processing system
- Refuse derived fuel plant



**Owner/Operator:** City of Edmonton







## Edmonton Waste-to-Biofuels Project

### IPTF with Tip Floor Pre-Processing and Refuse Derived Fuel Areas

Compost Facility Footprint:  
38,690m<sup>2</sup>

IPTF Footprint: 19,100m<sup>2</sup>

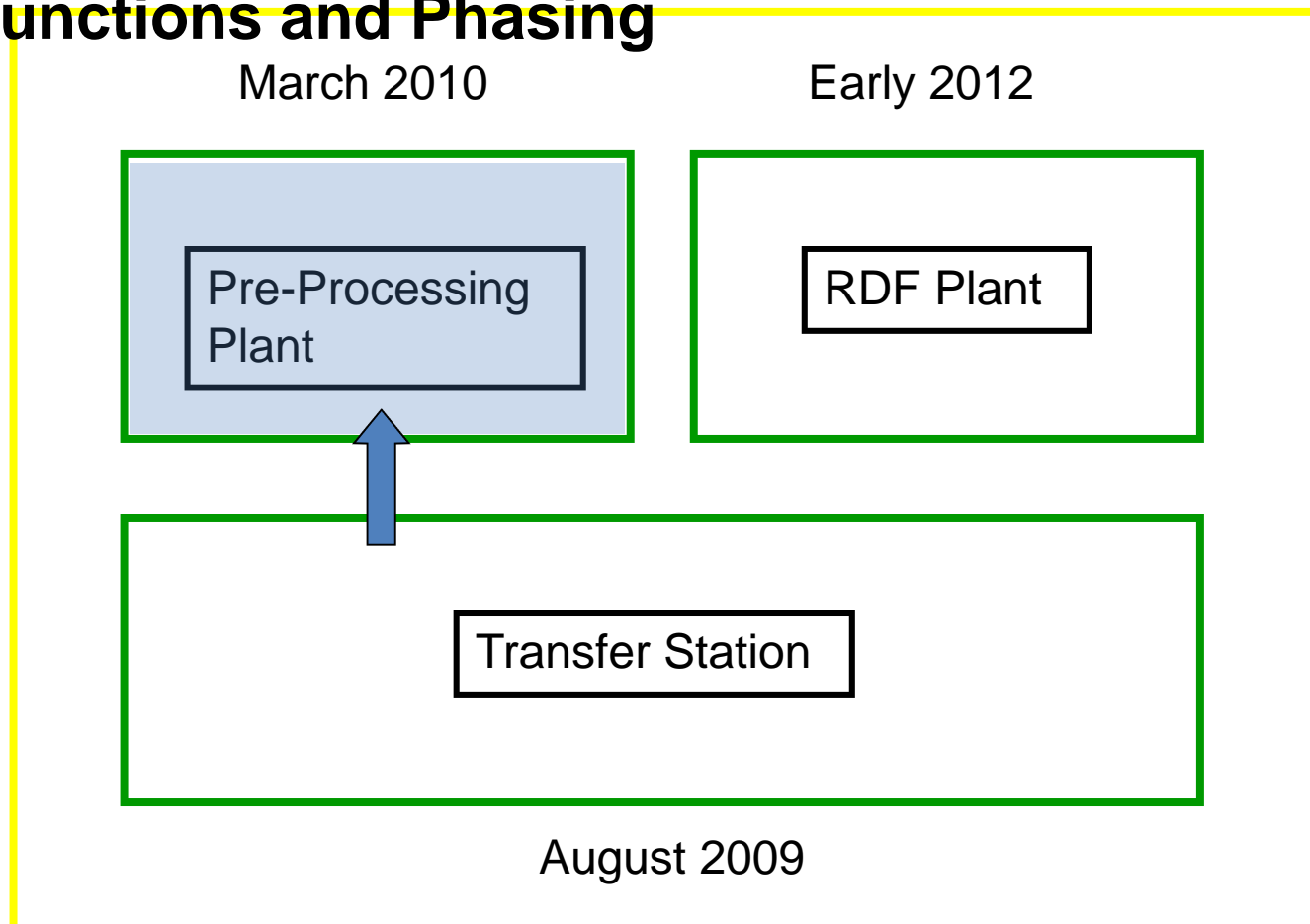






## Edmonton Waste-to-Biofuels Project

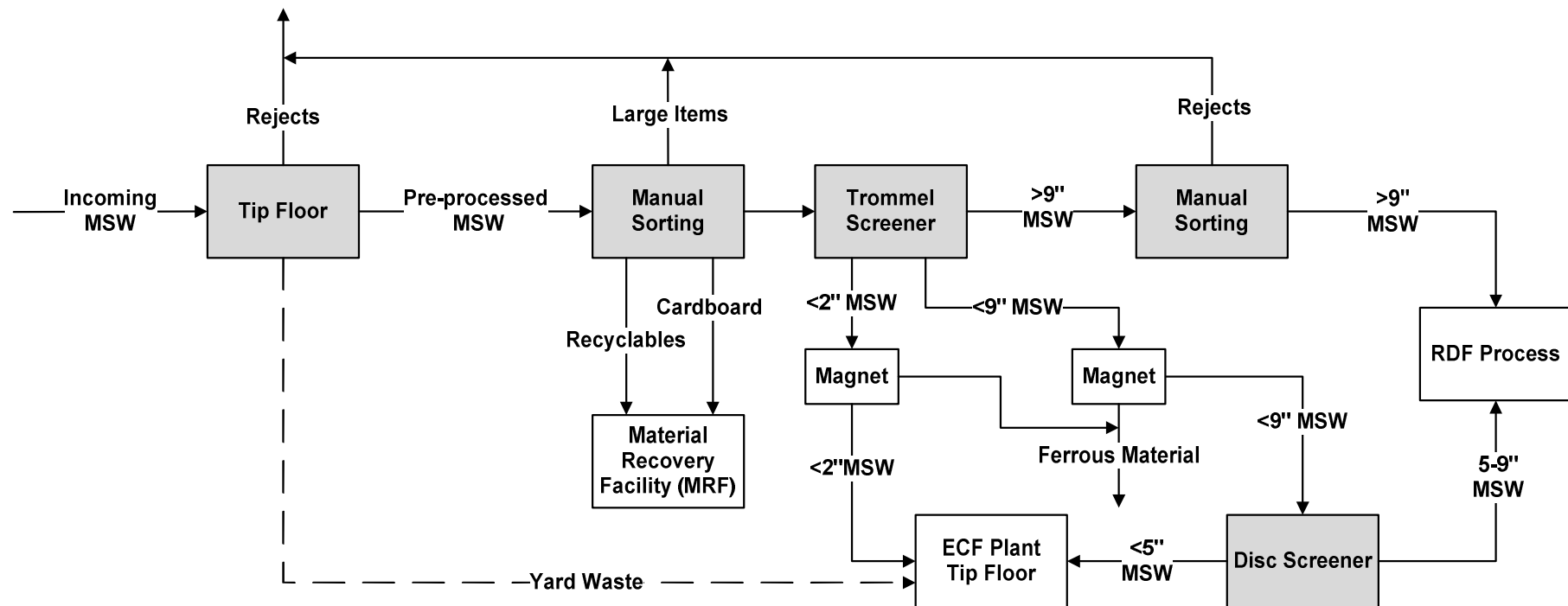
### IPTF Functions and Phasing





## Edmonton Waste-to-Biofuels Project

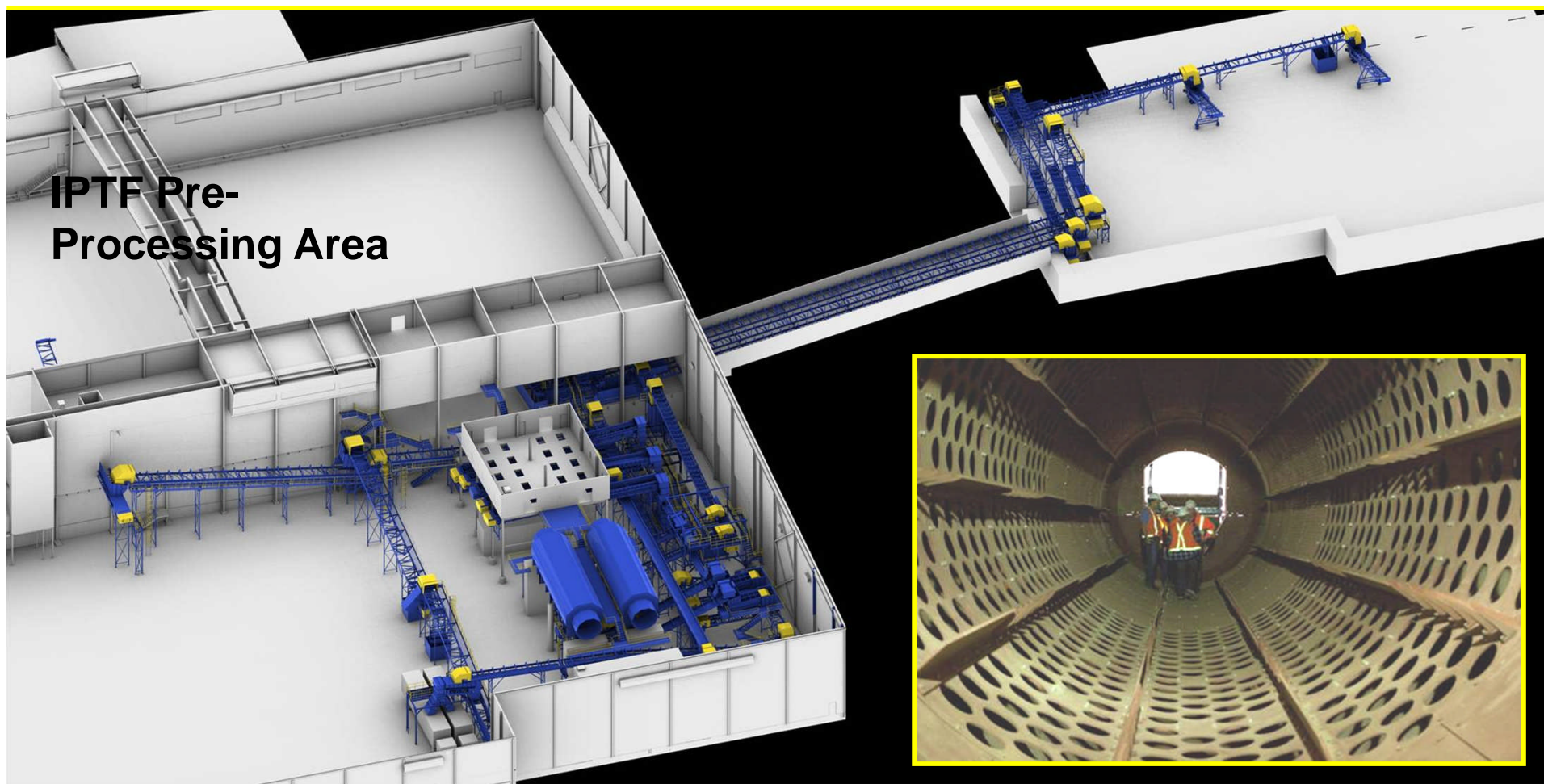
### Pre-Processing System







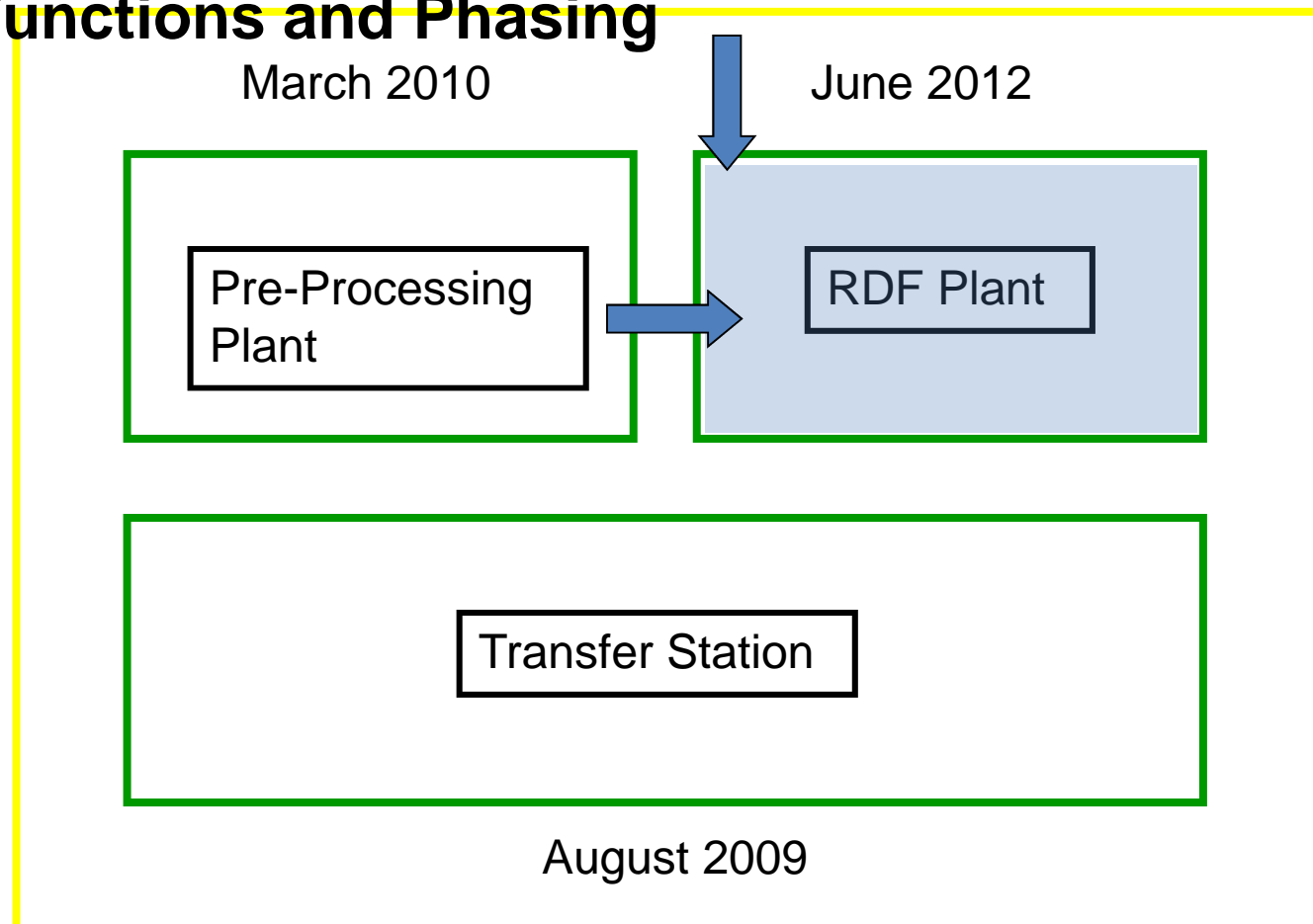
## Edmonton Waste-to-Biofuels Project





## Edmonton Waste-to-Biofuels Project

### IPTF Functions and Phasing



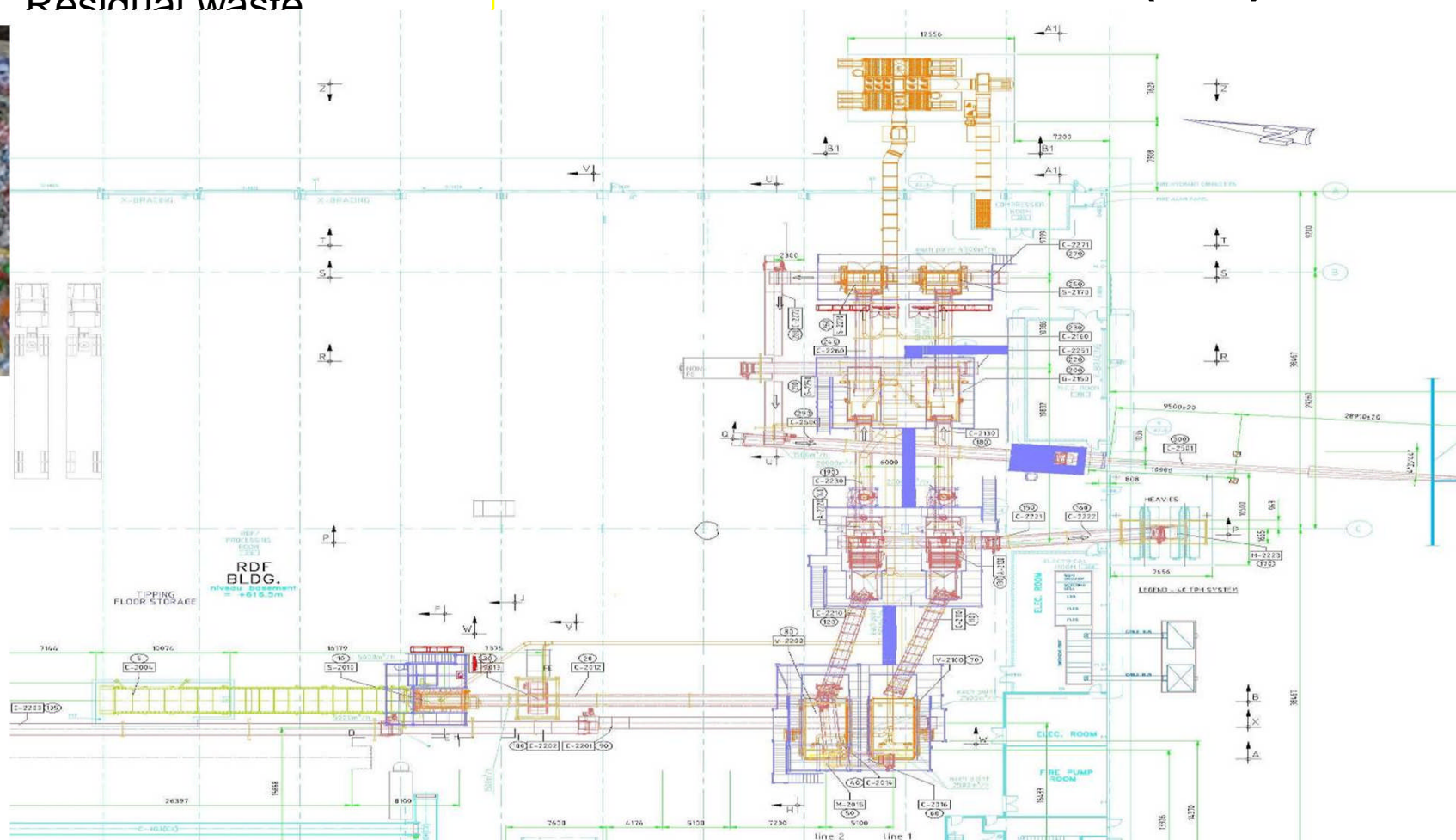
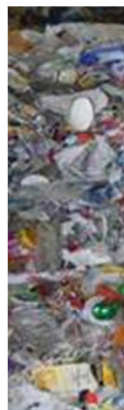




# Edmonton Waste-to-Biofuels Project

## Refuse Derived Fuel (RDF) Process

Residual waste







## Edmonton Waste-to-Biofuels Project







## Edmonton Waste-to-Biofuels Project

# ENERKEM OVERVIEW: WASTE-TO-BIOFUELS PROJECT



## Edmonton Waste-to-Biofuels Project

# MSW IN NORTH AMERICA



**166 MILLION**  
METRIC TONS OF MSW  
SUITABLE FOR ENERKEM'S  
TECHNOLOGY PLATFORM

**505 MILLION**  
METRIC TONS OF MSW  
GENERATED PER YEAR

THE POTENTIAL:  
**60 BILLION**  
LITRES/16 B GALLONS  
USING ENERKEM'S TARGET YIELD\*

\* 100 GALLONS OF CELLULOSIC ETHANOL PER METRIC TON





## What is Gasification?

- Chemical conversion using heat on solid materials to produce:
  - Synthesized gas (syngas)
  - Solid char residue
- Takes place in a reactor
- Process is endothermic (needs heat)
- Process heat in gasification is created by combusting a small portion of the waste (partial oxidation)



## How is Gasification Different from Waste To Energy (WTE)?

### ● WTE / Incineration

- Converts feedstock to  $\text{CO}_2$  and  $\text{H}_2\text{O}$
- Releases heat, whereby the heat normally can only be used onsite or short distances
- >100% excess air

### ● Gasification

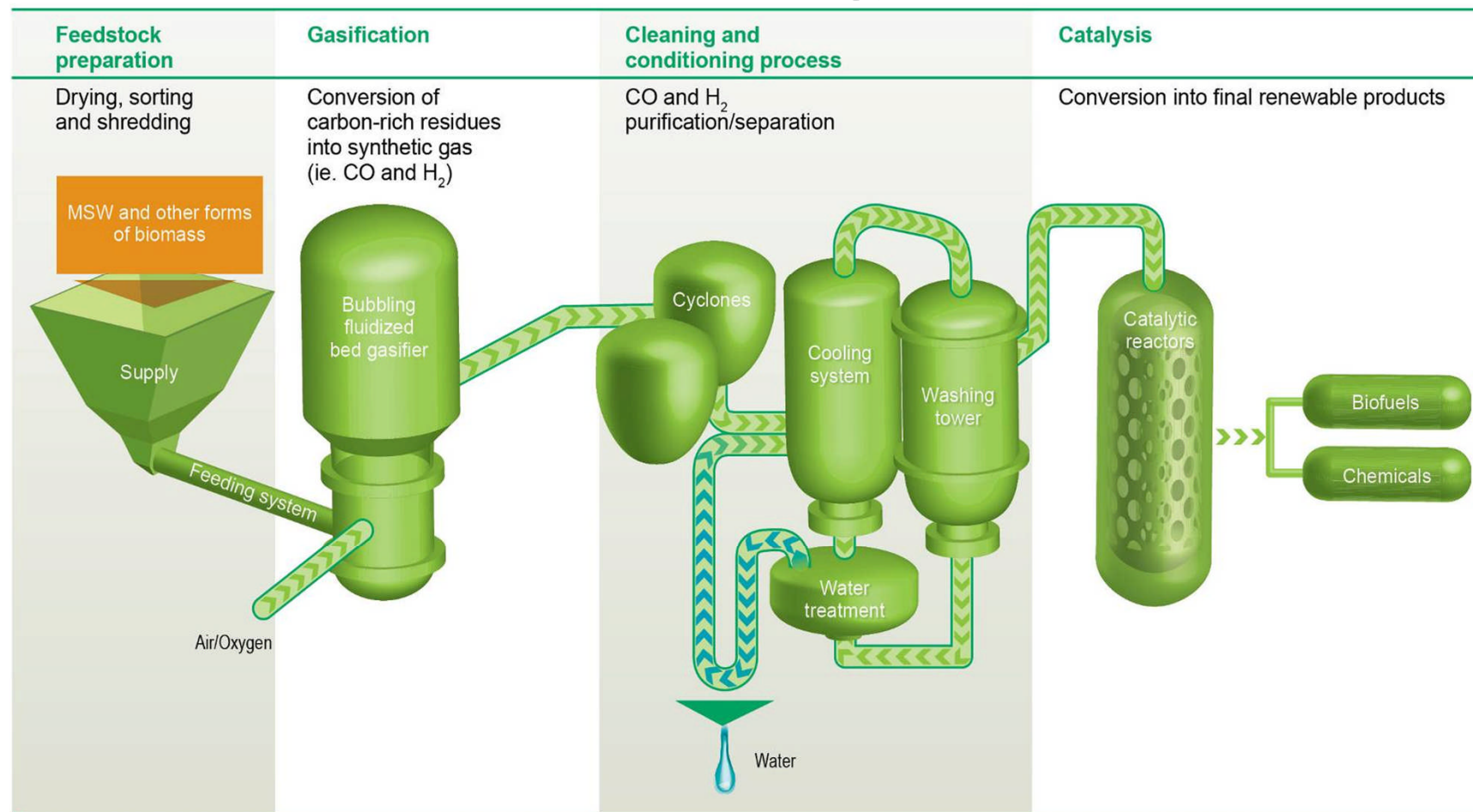
- Converts feedstock to CO and  $\text{H}_2$
- Releases a burnable gas (syngas) & that can be used anywhere, or converted to chemicals
- Reducing environment (1/6 volume of air)





## Edmonton Waste-to-Biofuels Project

### Enerkem's proprietary technology platform





## Edmonton Waste-to-Biofuels Project

### WASTE-TO-BIOFUELS PRODUCTION FACILITY

Will produce biofuels and renewable chemicals from the city's non-recyclable and non-compostable waste:

- Uses Enerkem's proprietary technology
- Under construction
- Government of Alberta support



**Owner/Operator:** Enerkem Alberta Biofuels







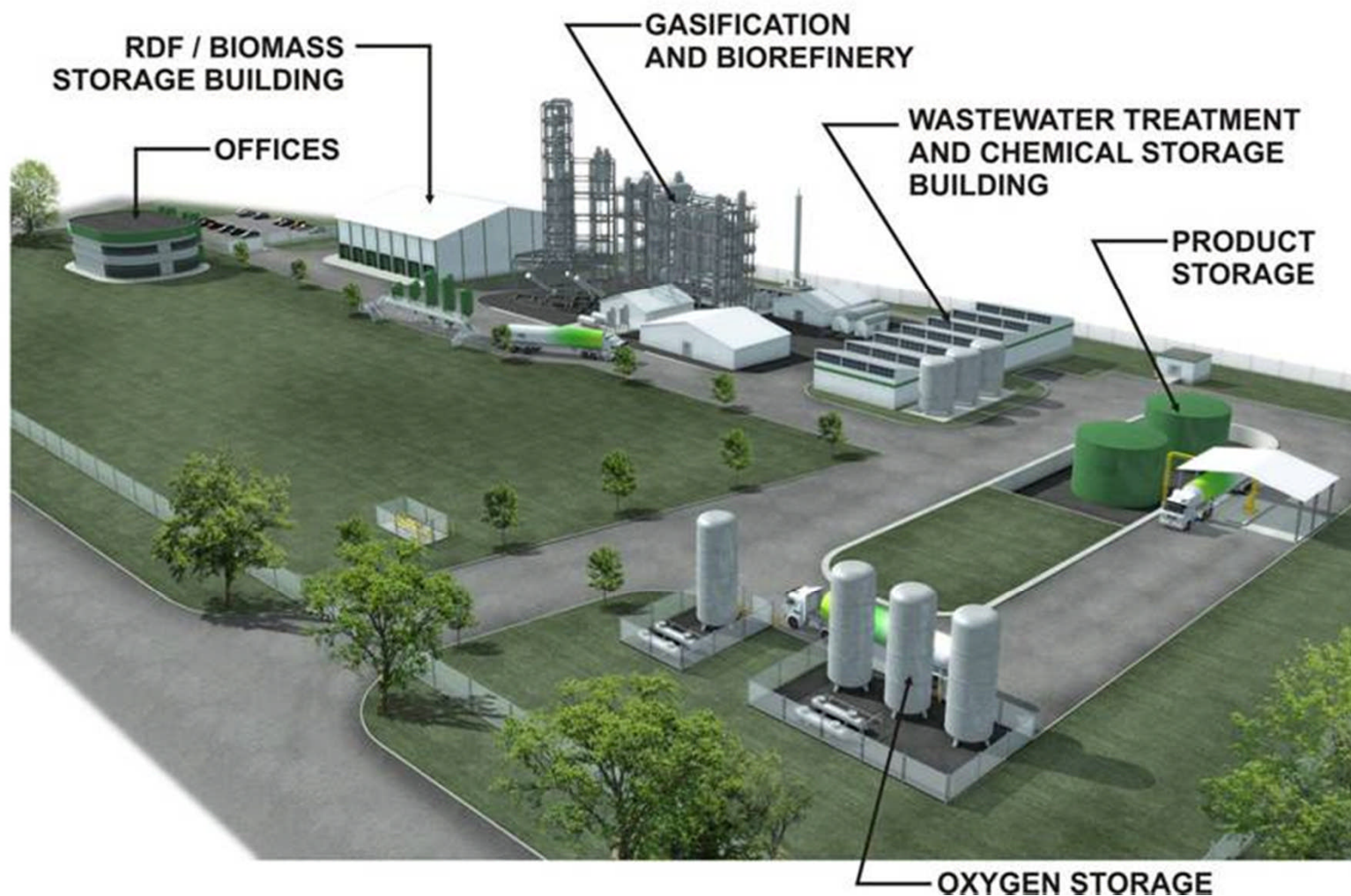
## Edmonton Waste-to-Biofuels Project







## Edmonton Waste-to-Biofuels Project





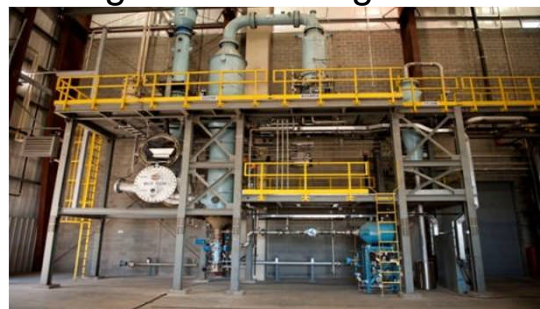


## Edmonton Waste-to-Biofuels Project

### ADVANCED ENERGY RESEARCH FACILITY (AERF)

To develop and demonstrate innovative technologies converting residual biomass or waste feedstock into clean energy and products.

- Uses Enerkem's proprietary technology
- Joint steering and technical committee
- Government of Alberta support



Owner/Operator: COE







## Edmonton Waste-to-Biofuels Project

<b>Type:</b>	300 kg per hour throughput pilot facility
<b>Partnership:</b>	<ul style="list-style-type: none"> <li>▪ City of Edmonton</li> <li>▪ Alberta Innovates – Energy and Environment Solutions (AIEES)</li> <li>▪ Enerkem (<i>provides its proprietary technology</i>)</li> </ul>
<b>Status:</b>	Commissioning started in 2012 and completion anticipated in Q1 2013.
<b>Location:</b>	Edmonton, Alberta, Canada <i>Adjacent to Enerkem's Commercial facility</i>
<b>System:</b>	Fully integrated for gasification, gas conditioning and alcohol production
<b>Focus:</b>	<ul style="list-style-type: none"> <li>▪ Feedstock Variety</li> <li>▪ Reforming optimization</li> <li>▪ New Pilot Processes: ATR, DMC, Membranes</li> </ul>







## Edmonton Waste-to-Biofuels Project

### The Advanced Energy Research Facility







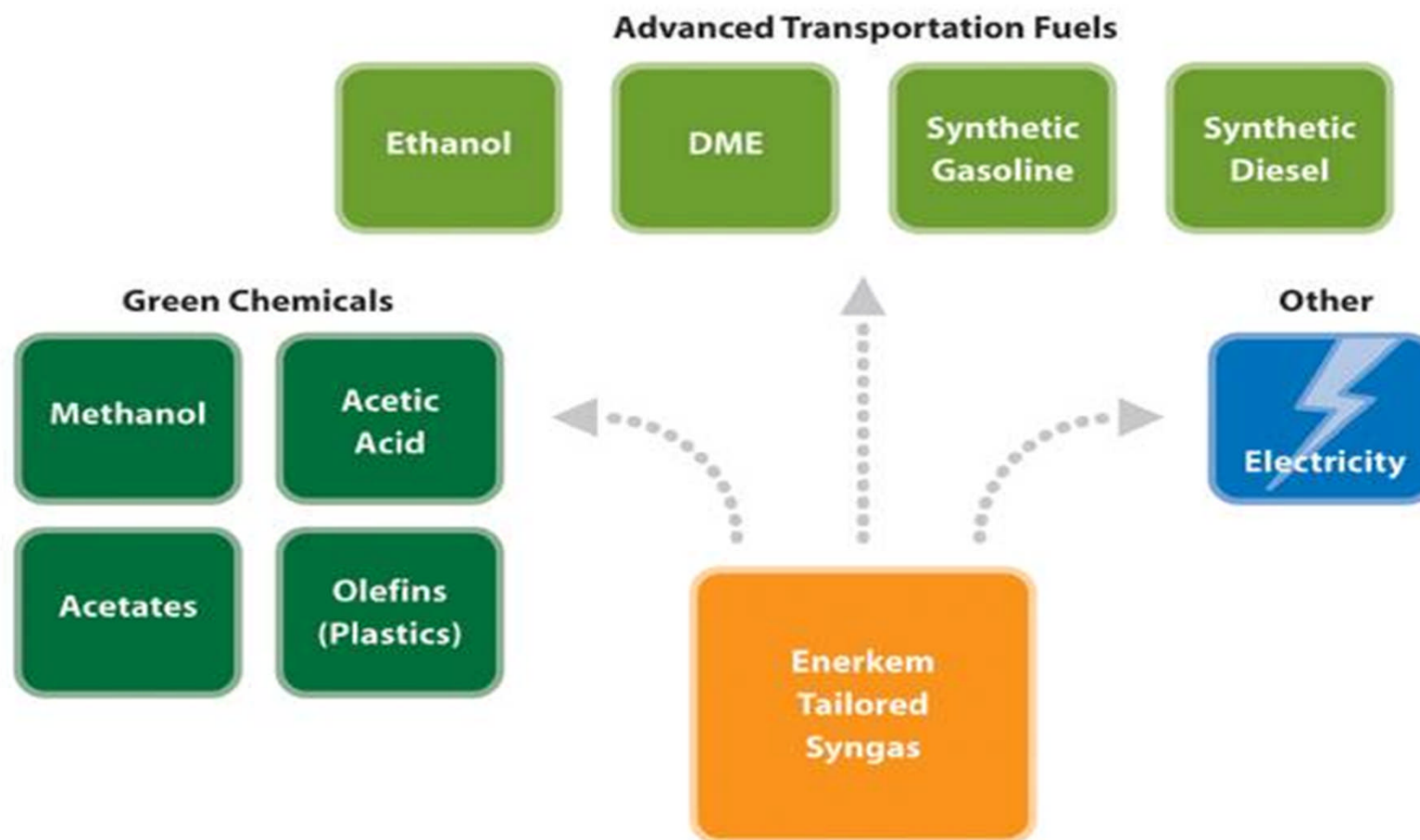
## Edmonton Waste-to-Biofuels Project







## Edmonton Waste-to-Biofuels Project





## Edmonton Waste-to-Biofuels Project

# AERF Commissioning Work and Testing Completed

- Air gasification (May- August, 2012)
- Steam and oxygen gasification (September – October, 2012)
- Steam and oxygen gasification, followed by reforming (October – November, 2012)
- Methanol synthesis (November, 2012)







## Edmonton Waste-to-Biofuels Project The R&D Bench Scale Laboratory

<b>Owner(s):</b>	<ul style="list-style-type: none"> <li>▪ City of Edmonton</li> <li>▪ Government of Alberta (AIEES)</li> </ul>
<b>Activities:</b>	Managed by Enerkem EAB Analytical Support
<b>Technology:</b>	N/A
<ul style="list-style-type: none"> <li>▪ Advanced catalytic and dry reforming</li> <li>▪ Next Gen Bio-product research</li> <li>▪ CO2 utilization and GHG reduction</li> <li>▪ EAB Feedstock Evaluation</li> <li>▪ To be used for U of A collaborative research</li> <li>▪ Funded by Alberta Innovates</li> </ul>	





## Edmonton Waste-to-Biofuels Project



**Fixed-bed reactor for syngas and chemical production**





## Planned testing and research

### City of Edmonton Test support:

- Construction and Demolition waste
- Residual Plastics
- Auto Shredder Residues

### CCEMC: Greenhouse Gas Reduction Implementation

- Feedstock diversification: Biogenic feedstocks
- Optimization of CO<sub>2</sub> reintegration
- DMC synthesis and pilot demonstration

### DOE CRADA

- Dry Reforming
- Iodide-free Carbonylation

### U of A collaboration

- Dry Reforming Catalyst Optimization
- Iodide-Free Carbonylation



## Edmonton Waste-to-Biofuels Project

### Potential testing and research

#### Membrane Technology and Research:

- CO<sub>2</sub> and Sulfur removal coupled with H<sub>2</sub> separation and MeOH enhancement
- IGCC Demonstration: Tailgas to LTS reactor. Separate H<sub>2</sub> for IGCC use and Capture CO<sub>2</sub> retentate.

#### Eco-EII Power Generation:

- Demonstrate power generation and feedstock pre-processing for remote community use. Q1 2013

#### Terra Verdae: Bio-Plastic synthesis from Bio-Methanol

- AI-Bio Funding: Start MeOH characterization Q1 2013.

#### U of A Pilot DME Collaboration

- Di Methyl Ether Synthesis via Reactive distillation
- Next Steps DMC synthesis

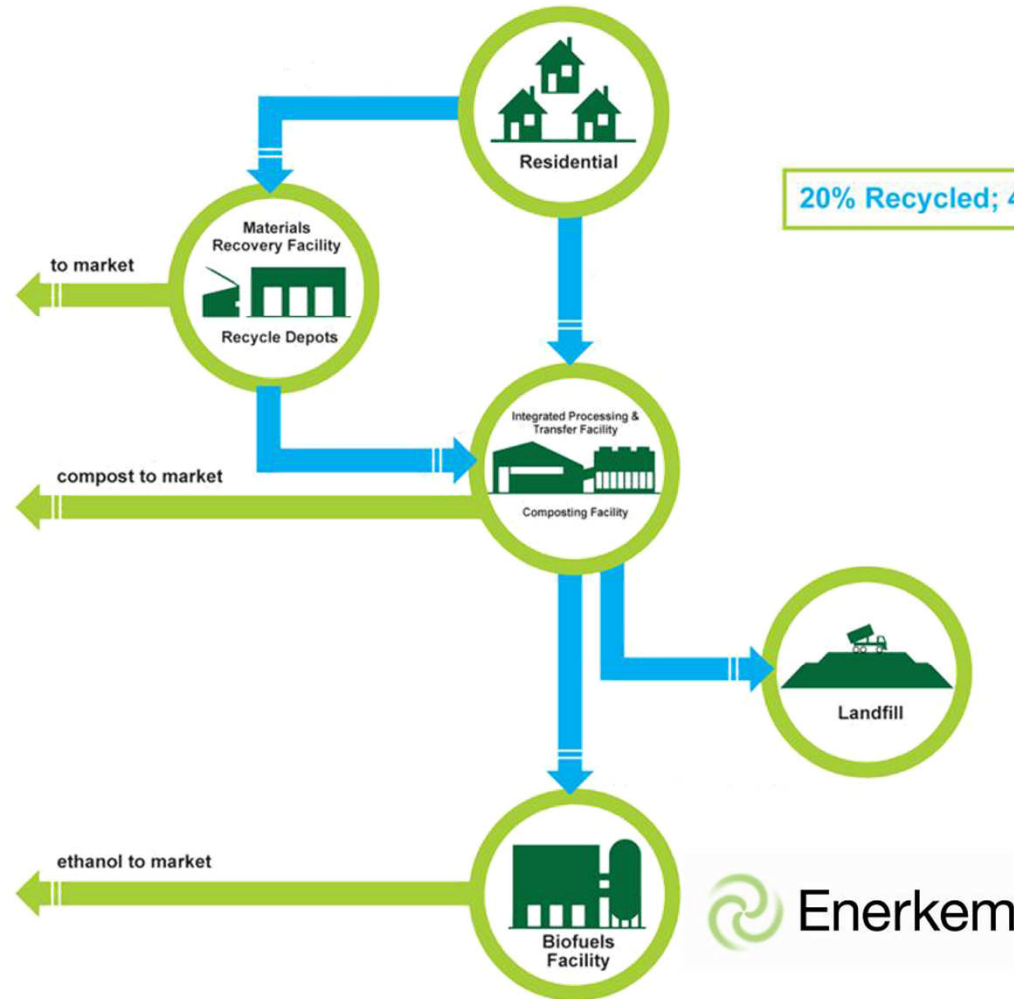




## Edmonton Waste-to-Biofuels Project

THE CITY OF  
**Edmonton**

20% Recycled; 40% Composted; 30% Biofuels; 10% Landfill



**90%  
WASTE  
DIVERSION**



## Edmonton Waste-to-Biofuels Project

Thank you !



Jim Schubert

*G.S. Conversion Technologies*

*Waste Management Services*

[jim.schubert@edmonton.ca](mailto:jim.schubert@edmonton.ca)

[www.edmonton.ca](http://www.edmonton.ca)

[www.edmontonbiofuels.ca](http://www.edmontonbiofuels.ca)

Ibrahim Karidio

*Sr. Thermochemical Engineer*

*Waste Management Services*

[ibrahim.karidio@edmonton.ca](mailto:ibrahim.karidio@edmonton.ca)

[www.edmonton.ca](http://www.edmonton.ca)

[www.edmontonbiofuels.ca](http://www.edmontonbiofuels.ca)