Waste-to-Biofuels: Options for Municipal Waste Disposal

Integrated Biofuel Complex Overview

HAMPTON ROADS REGION

Confidential & Business Proprietary
Integrating Complementary Waste-Reduction Technologies
MSW & Construction Waste to Fuel: How It Works

**Process and Description**

**Step One: Waste Delivery**
- MSW feedstock comes in
- Tipping Revenues Earned

**Step Two: MRF -- Waste Recycling**
- MSW is sorted
- Recycled Commodities Sold
  - Cardboard, plastics, PET, steel cans, aluminum, etc.

**Step Three: Gasification**
- Residual organics gasified, cleaned up, turned into Synthesis Gas

**Step Four: Biofuels Production**
- F-T Conversion / Liquefaction to End Products
  - Renewable Diesel Sold
  - High-Quality Industrial Waxes Sold
Step One: Waste Feedstock Supply

Unlike other commodities or the fossil fuels that are used to create energy, CIBC is paid to take its raw materials, which increases its profitability.

Management projects that it will receive substantial revenue each year in tipping fees from the waste streams it processes. These will include used tires and C&D wastes in addition to MSW.

- MSW
- Vegetative
- Plastics & Fiber
- Organics from C&D
- Railroad Ties & Tires

Approximately 500 tons per day of commodities, including aluminum, plastics, cardboard, and glass, generates revenues by selling these materials into the commodities recycling market.
CIBC is developing two materials recycling facilities, one for MSW and one for Construction & Demolition waste, with a total processing capacity of ~1,250 dry tons per day.

CIBC’s MSW recycling system will use a series of separators and sorters to process MSW and recover valuable commodities, including OCC/cardboard, HDPE plastics, PET, steel cans, and aluminum.

Equipment for the MSW recycling facility is being provided by Bulk Handling Systems of Eugene, Oregon, a worldwide leader in the innovative design, engineering, manufacturing and installation of sorting systems and components for the solid waste, recycling, waste-to-energy, and construction and demolition industries.

BHS has built some of the largest and most durable MRFs in the world – and they are achieving the highest throughput, recovery, and purity rates in the industry.
Step Three: Gasification

The technology at the heart of CIBC’s drop-in biofuels project is an innovative, indirectly-heated steam-reforming gasification system developed by ThermoChem Recovery International (TRI), headquartered in Baltimore, Maryland. The process has transformed MSW, wood waste, agricultural residues and other organic materials into gasoline, jet fuel, renewable diesel, chemicals, green power and other renewable energy.

TRI built and operated its first commercial (500 ton-per-day) gasification steam reformer (the same scale as planned for each of the CIBC gasifiers in this project) in 2003, processing waste from a Canadian paper mill. It operated successfully until the paper mill’s closing due to economic conditions. TRI subsequently built a four-ton per day integrated Process Design Unit (PDU) in Durham, North Carolina, which has successfully operated for more than 10,000 hours and has converted multiple feedstocks, including forest residuals and municipal solid waste (MSW), to Fischer-Tropsch (F-T) liquids.
Step Four: Sustainable Fuels & F-T Waxes

Sustainable fuels made from biomass and municipal solid waste significantly reduce CO₂ emissions on a lifecycle basis as compared to conventional fuels.

CIBC’s biorefinery will incorporate an advanced fixed bed (AFB) Fischer-Tropsch reactor, catalyst and product upgrading technology. The process produces “drop-in” renewable fuels and waxes that meet ASTM specifications from virtually any carbon-based feedstock.

Many companies have worked on gas-to-liquids, biomass-to-liquids and coal-to-liquids projects around the world.

Laboratory scale reactor stations that can be configured as fixed-bed, trickle bed or continuous stirred tank reactors (CSTR). Full commercial scale tubular (fixed-bed) FT reactor at TRI’s demonstration facility in Raleigh Durham, NC.
Chesapeake Highlights

CIBC BUSINESS COMPONENTS:

- CIBC MRF Layout on Bainbridge Site – A Materials Recovery Facility which processes 350,000 dry tons of waste per year, approximately 20% of which will be recyclable, with the remaining organic materials to be used as feedstock for the Bio-refinery plant.
Chesapeake Highlights (Continued)

CIBC BUSINESS COMPONENTS:

- CIBC MRF Site Depiction – This facility will mark a substantial change in the former NOVA Chemical Plant site. 48 structures have been removed and the former chemical plant location has been repurposed as a world class environmentally sensitive alternate energy plant.
Chesapeake Highlights (Continued)

CIBC BUSINESS COMPONENTS:

• The biorefinery: a facility which produces 20 million gallons of liquid fuels and F-T waxes annually from Municipal Solid Waste feedstock.

• C&D – MRF: a facility which produces recyclable metals, sand & aggregates, soil amendments, recyclable plastics and residual organics used to produce fuel & wax.

• Inorganics Processing: A high temperature inorganics conversion technology – producing rock wool insulation from gasification ash, glass & aggregate residuals.

FUTURE REVENUE OPPORTUNITIES:

• An E-recycling component to capture plastics for the TRI processing into liquid fuels & F-T wax.

• The destruction of other organic wastes and their conversion into valuable products.

CIBC’s goal is that only ~60 pounds out of every ton of waste processed will remain once the eco-park is fully developed.
Environmental Benefits: Significant Landfill Diversion

Golder Associates estimates that the CIBC project will reduce CO₂ emissions by 1,000,000 tons per year as compared to using landfills—40 million tons over the project’s lifetime—and that it will reduce by 35 million tons that amount of solid waste that will be placed in landfills.

Renewable diesel, when produced by CIBC from biomass, has the potential to be carbon negative when evaluated on a life-cycle basis, due to:

- Significant reductions in the consumption of fossil fuels and their related pollution.
- Diverting 350,000 tons per year of solid waste from landfills.
- Every ton of waste processed by the plant avoids the creation of a ton of landfill gas—methane which is at least 20 times more powerful than CO₂.
- Gray water is reused in plant operations.
- Organic wastes are disposed of without being combusted or placed in landfills.
- The emissions reductions achieved by recycling of all classes of materials.

Production of clean drop-in fuel provides multiple benefits including the significant reduction of principal pollutants targeted by the EPA. The project will eliminate the need for producing, transporting and consuming 800 million gallons of virgin petroleum-based fuel.

The Plant will be a minor source emitter of regulated pollutants. All mist, odor, emission controls, spill prevention, contaminant systems and product handling are designed to hold process wastes well below regulated threshold limits.
CIBC is partnering with Tidewater Community College to create an on-site Science, Technology, Engineering and Math (STEM) center that will be used to train students in cutting edge technologies and prepare renewable energy trade craft employees for jobs created in this project and other projects in the region and nationally.

• It is estimated that the CIBC project will create more than 400 new jobs to staff the ventures to be located on the contiguous 78-acre site, also enhancing the regional job growth.

• The Tidewater Economic Development staff estimates that four positions will be created in the broader community for every job created on the site.

• CIBC expected to generate more than $762 million in direct and indirect benefits for the region in the first 10 years of combined operations.

**Tidewater Community College** embraces the second largest undergraduate student body in the Commonwealth of Virginia, enrolling almost 40,000 students annually. It has served South Hampton Roads — both students and employers — for nearly 50 years, growing from one campus into a regional educational and economic force, of four campuses and five regional centers. TCC offers 12 nationally accredited programs.
Considerations for Federal Agencies

ENVIRONMENTAL & SAFETY

• Substantially improve the environmental profile of DoD emissions.
• In collaboration with FEMA/United Nations, be prepared to assist in cleaning up natural disasters and using the organic materials to produce additional fuel/power for DoD.
• Re-commissioning an aircraft carrier with an IBC plant on the deck and the on-board fuel tanks used as product storage – could be deployed near the lines of an active engagement to reduce the time/cost of providing fuel to the front lines. During non-conflict periods, it could be used to clean the ’waste island’ in the Pacific.

DIPLOMACY & JOBS

• Deploy technology on foreign bases to assure fuel needs and serve local communities.
• In collaboration with the Department of State, provide jobs/power/energy to global trouble spots to reduce tension and conflict over oil/energy.
FUEL & SECURITY

• On base production of fuel on military facility(ies).
• Production of fuel on military bases that reduces risk of attack on U.S. pipeline/strategic reserve infrastructure.
• Reducing and/or eliminating the important role of the strategic petroleum reserves with a series of facilities on military bases throughout the U.S.

• Any number of other potential applications.
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Ray Crabbs, President & CEO
RCrabbsIBC@gmail.com – (202) 253-5953