



# RTP GREEN FUEL: A CASE STUDY

## YOUNGSTOWN THERMAL



The district steam system in Youngstown, Ohio has operated continuously for 115 years as a public utility serving the downtown business and educational community. The system was acquired from Ohio Edison in 1980 and doubled its business during the first few years of the 1980's. The system serves approximately 50 buildings in the downtown area.

Youngstown Thermal, LLC owns and operates the steam production facility located at 205 North Avenue in Youngstown which is just west of the central business district. The Plant consists of three 100,000 lb/h field erected coal fired boilers and a 100,000 lb/h natural gas fired boiler which produce steam for the approximately 6 miles of underground pipelines that heat office buildings, retail stores, banks, government buildings, laundries and educational institutions.. The plant delivers steam through two systems. One steam system operates at 150 psig and the second system operates at 15 psig. The plant also supplies hot water to nearby hot water customers.

Youngstown Thermal cooling company operates a 1,000 ton absorption chiller adjacent to the west end of the central business district and serves four customers via a 900 foot distribution system that supplies 42 degrees of chilled water in a closed recirculating system. A second chiller, that has a 250 ton capacity, is used in the winter time for winter cooling needs. The steam for the chiller plant comes from waste heat delivered from turbines at the main steam plant.

The mission of Youngstown Thermal is to provide low cost, energy efficient heating and cooling to buildings in the downtown area as well as nearby educational facilities and governmental offices. Low cost heating and cooling services in a market like downtown Youngstown encourages and supports business growth. In addition, Youngstown Thermal strives to be an environmentally responsible business and has been working diligently to reduce its carbon footprint. After investigating many options, Youngstown Thermal determined that Renewable Fuel Oil (RFO) from Ensyn Fuels is the fuel that best meets their desire to reduce their greenhouse gas emissions in the most cost effective manner.



### YOUNGSTOWN THERMAL: A HISTORY OF INNOVATION

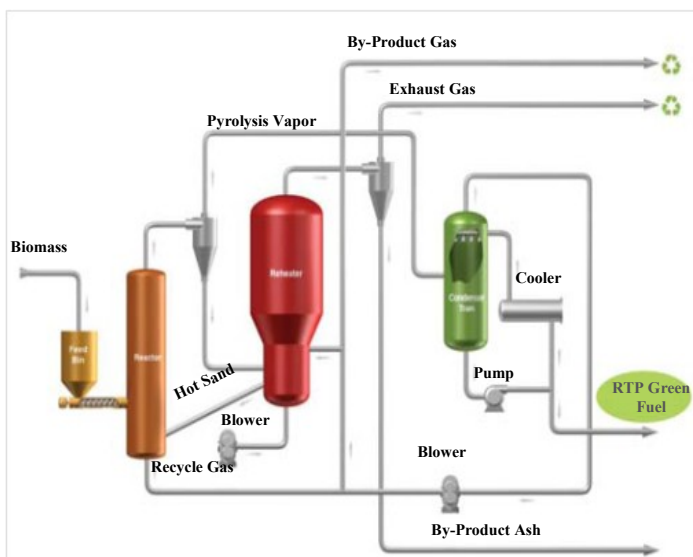
Youngstown Thermal has always been at the cutting edge of innovation when it comes to district energy. Carl Avers, Youngstown Thermal's CEO dreams of a future energy network with district heating, district cooling and micro-grid electricity throughout the city. The conversion to Renewable Fuel Oil (RFO) from Ensyn Fuels, Inc. just the latest innovative project that will aid Youngstown Thermal in providing low cost energy to the city of Youngstown while reducing the carbon footprint by 81% from the natural gas that the RFO displaces.

In October 2015, Youngstown Thermal was selected as the site by the Department of Energy and Energy Industries of Ohio for the design, procurement, construction and testing of the prototype \$75 million Advanced Ultra-SuperCritical Component, or AUSC, steam turbine and related components. The project aims to run steam at higher temperatures and pressures with materials that can handle it to decrease emissions and increase efficiency.

These two projects demonstrate Youngstown Thermal's commitment to providing low cost energy in the most environmentally friendly manner possible.

### RFO: A RENEWABLE SOLUTION

RFO is manufactured using Ensyn's RTP process. RTP is a thermal conversion process known as fast pyrolysis, which is the rapid heating of biomass in the absence of oxygen. The process, shown in the figure below, utilizes a circulating transported bed reactor system in which sized and dried biomass is contacted with circulating hot sand in the reactor. The pyrolytic vapor is rapidly quenched to produce a high yield of liquid fuel.



RTP Process Flow Diagram

## RFO FEEDSTOCK REQUIREMENTS

In order to qualify under the EPA’s Renewable Fuel Standard, Ensyn Fuels must use “Renewable Biomass” as defined by the RFS. The credits generated as a qualified renewable fuel are critical to Ensyn Fuel’s economics so all **RFO** is manufactured using feedstock that meets the “Renewable Biomass definition. “Renewable Biomass” is defined as follows:

- Slash and pre-commercial thinning from non-federal forest lands.
- Planted trees and tree residue from actively managed tree plantations on non-federal lands.
- Biomass obtained from the immediate vicinity of buildings, public infrastructure and areas regularly occupied by people that are at risk of wild fire.
- Other activities, including planted crops and crop residue from non-forested agricultural land that is either actively managed or fallow.

## GREENHOUSE GAS REDUCTIONS

Since **RFO** is manufactured from “Renewable Biomass” as defined by the EPA, it provides a significant reduction in life cycle greenhouse gases when compared to fossil fuels. **RFO** provides a 87.6% reduction in life cycle GHGs when compared to oil and a 81.7% reduction in life cycle GHGs when compared to natural gas.

### GHG Emissions – Wood Feedstock

Fuel	Heating Oil	Natural Gas	PyOil (i.e., RFO)
Feedstock	Crude Oil	Natural Gas	Wood Residues
g CO <sub>2</sub> eq/GJ			
Fuel Dispensing	402	0	874
Fuel Distribution & Storage	698	2,063	361
Fuel Production	8,412	1,376	9,555
Feedstock Transmission	1,401	0	0
Feedstock Recovery	8,081	1,708	0
Land-use Changes, Cultivation	25	0	0
Fertilizer Manufacture	0	0	0
Gas Leaks & Flares	1,900	3,540	0
CO <sub>2</sub> , H <sub>2</sub> S Removed from NG	0	642	0
Emissions Displaced	-128	0	0
<b>Sub-total Fuel Production</b>	<b>20,790</b>	<b>9,330</b>	<b>10,790</b>
Fuel Combustion	68,718	51,432	301
<b>Grand Total</b>	<b>89,508</b>	<b>60,762</b>	<b>11,091</b>
% Change Compared to Heating Oil		-32.1%	-87.6%

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## CONVERSION PROCESS

A typical conversion to **RFO** from natural gas or oil will include a tanker unloading pump, storage tank, pump and heating skid an a new or converted burner plus all interconnected piping.

RFO is slightly acidic with a pH of approximately 3 which is similar to vinegar or red wine. Because of the acidity, the pre combustion fuel train and piping are constructed of stainless steel. Post combustion, no changes to the boiler are necessary.

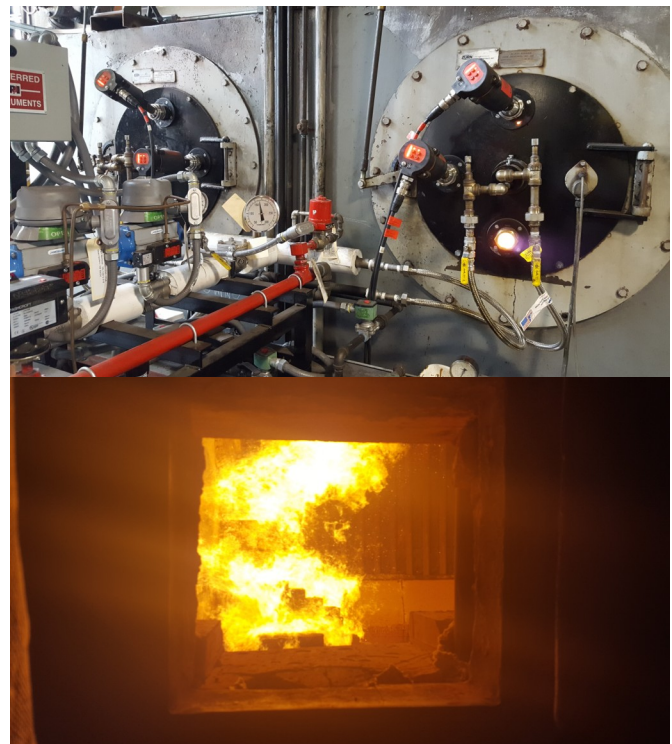


*RFO Pump and Heating Skid*

**RFO** can be stored in either above ground storage tanks or underground storage tanks. A new stainless steel tank can be installed or an existing tank can be lined if it is not constructed of stainless steel.

Youngstown Thermal converted one 100,000 lb/hr natural gas boiler from a natural gas only burner to a burner that can burn natural gas, RFO or can co-fire natural gas and RFO. The conversion has provided Youngstown Thermal with a fuel redundancy that did not exist before the conversion.

Preferred Utilities of Danbury, CT built the dual fuel burner that allows Youngstown Thermal to burn RFO.



*Preferred Utilities RFO/Natural Gas Burner*