

## **Green Fuel Nordic – The Smart Way**

# **Utilising RTP™ technology to produce sustainable 2<sup>nd</sup> generation bio-oil from local feedstocks**

### **Abstract**

Transitioning to a low-carbon economy is one of the major global megatrends of our time. This development trend unlocks new business opportunities for open-minded, responsible companies that have operations based on e.g. technology developments leveraging innovative, renewable raw materials or on the commercial implementation of these technologies.

Green Fuel Nordic Oy is a Finnish biorefining company. Company's business idea is to utilize the already commercially proven RTP™ technology for production of second-generation bio-oil from local, renewable forest-based biomass.

The Rapid Thermal Process (RTP™) unit is at the core of the rapid pyrolysis-based biorefinery. Biomass is fed into the reactor and then gasified by a circulating fluidized bed of hot material (sand). The gas that is generated is led to a cyclone, where the bed material and char are mechanically separated from the gas stream. The gas moves from the cyclone into a condenser, where it is cooled and condensed into bio-oil. The off-take is a liquid, low-carbon and sulfur-free bio-oil that can directly replace light and heavy fuel oil in renewable energy applications.

### **Operating environment for renewable liquid biofuels**

Dependence on exhaustible, non-renewable fossil natural resources and the climate change caused by their use are significant forces driving political, social and business development. Transitioning to a low-carbon economy is one of the major global megatrends of our time. Reducing energy consumption and replacing the use of fossil natural resources with renewable raw materials are important means for realizing this development process.

The aim to reduce energy consumption is very challenging. The energy need in developing economies will grow as industrialization increases and the consumption by populations with rising affluence grows. As population growth continues, a shortage of food will emerge and food prices will rise. The food shortage can be partially attributable to environmental disasters and the industrial utilization of the food chain's raw materials for non-food production.

Dependency on fossil oil is related to its utilization not only as an energy source and fuel for transportation, but also as a raw material for chemical industry products like plastics.

The scarcity of fossil oil that can be utilized cost-effectively increases its price. At the same time, the competitiveness of new bio-oils is improving, and progress is being made in the development efforts to utilize them in applications beyond energy production, e.g. in the chemical industry. The CO<sub>2</sub>-neutrality of second-generation bio-based fuels, eliminating the need for CO<sub>2</sub> emissions allowances, also boosts competitiveness.

This development trend unlocks new business opportunities for open-minded, responsible companies that have operations based on e.g. technology developments leveraging innovative, renewable raw materials or on the commercial implementation of these technologies.

The EU's intention of mitigating climate change has led to several directives and incentives guiding the activities of member countries. These include the so-called 20-20-20 target and the related Renewable Energy Sources (RES) target of 38% for Finland. They unlock attractive business opportunities for renewable bio-oil in Finland and elsewhere in Europe.

The growing forest assets also favor Finland as a location for biorefineries. The growth of well managed forests significantly exceeds the industrial use of sustainably utilizable wood. The conventional forest industry's structural distress also releases more wood for new types of applications, e.g. for use as feedstock for biorefineries.

## **Green Fuel Nordic Oy**

Green Fuel Nordic Oy is a Finnish biorefining company. Its business concept is based on utilizing commercially proven, innovative RTP™ technology to produce second-generation bio-oil.

Utilizing existing technology accelerates the start-up of refinery operations and the commissioning of commercial bio-oil production and it enables distributed energy production. In the near future, the company plans on building several biorefineries close to Finnish feedstock. In doing so, it is contributing to the achievement of the targets set for Finland's renewable energy production and supporting energy self-sufficiency.

The chosen technology can be used to produce liquid, low-carbon and sulfur-free bio-oil from local, renewable forest-based biomass. Bio-oil can be utilized directly in industrial and municipal electricity and heat production, replacing light and heavy fuel oil.

## **The Smart Way**

The need to build an increasingly lower-carbon society that is less dependent on fossil energy sources will grow the demand for renewable biofuels, among other things. This strong development path is also one of the drivers of Green Fuel Nordic's bio-oil refining business. Another significant driver is the decision to utilize existing, commercially proven technology.

This RTP™ technology can be used to produce second-generation liquid, sulfur-free bio-oil from local, renewable forest-based biomass. Finland's sustainably managed and widely certified forests grow over 100 million cubic meters per year. Industrial wood use amounts to about 50 million cubic meters per year. However, sustainable use would allow the utilization of 70 -75 million cubic meters of wood on a yearly level.

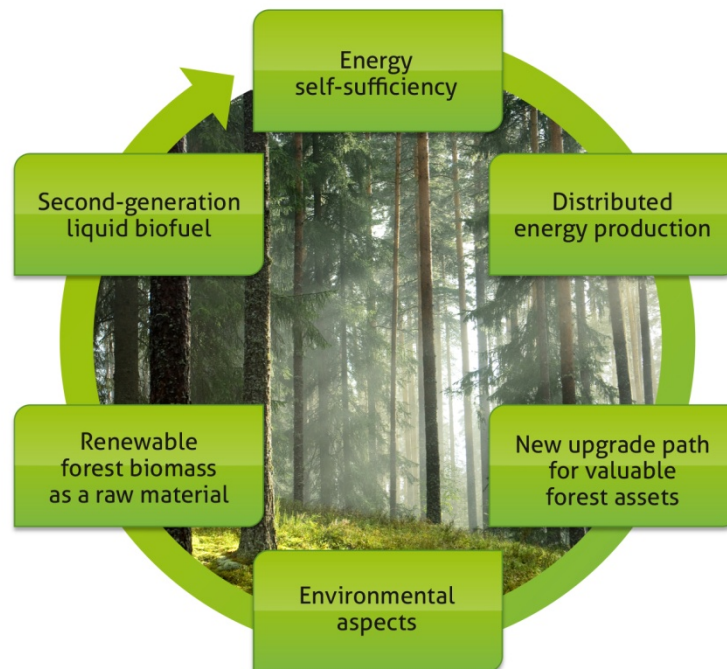
So there is no shortage of forest biomass suitable for bio-oil production, especially since the conventional forest industry is not increasing its use of wood in Finland. RTP™ technology also makes it possible to use sawmill and pulp industry by-products as feedstock.

Green Fuel Nordic's biorefinery investments support distributed energy production, which is strategically important for Finland, and strengthen energy self-sufficiency. Moreover, the company's operations support the achievement of Finland's RES target. At the same time, it offers employment opportunities for local communities affected by forest industry restructuring as well as a new, local refining path for forest biomass.

The storage and transportation properties of RTP™ Green Fuel bio-oil support flexible energy distribution.

Bio-oil can be utilized directly in industrial and municipal electricity and heat production, replacing light and heavy fuel oil. Emerging alongside of these applications is the use of bio-oil to power marine diesel engines.

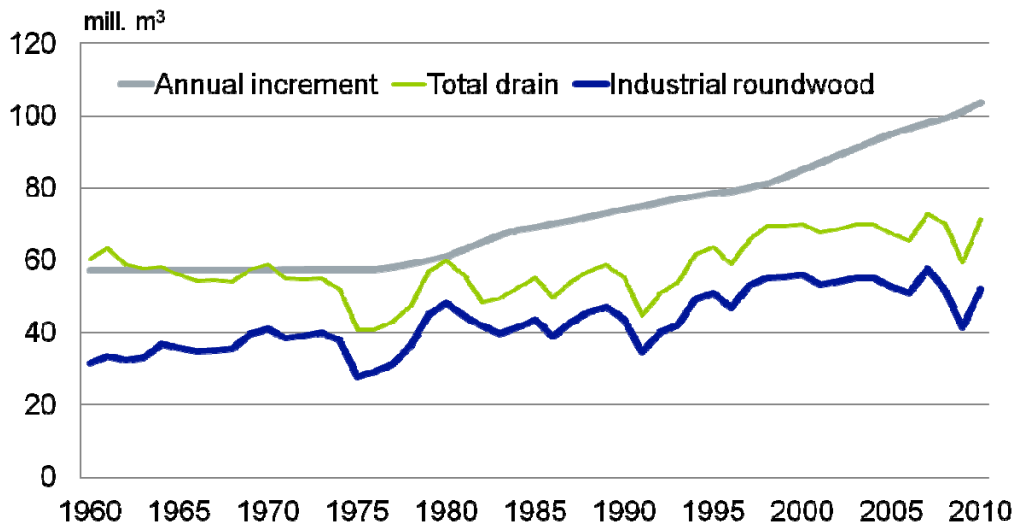
In the near future, it will be possible to upgrade bio-oil also into products comparable to normal transportation fuels. Interesting applications in the longer term are found in the chemical industry.



**Figure 1.** Some main steps of the Smart Way of Green Fuel Nordic Oy.

## Renewable, local feedstock

Finland's sustainably managed and widely certified forests grow more than 100 million cubic meters per year. Industry uses about 50 million cubic meters of wood annually. Sustainable use would enable a significantly higher volume of wood to be used, i.e. industrial utilization of 70–75 million cubic meters annually.



**Figure 2.** Forest balance in Finland 1960 - 2011. Sources: Metla, Finnish Forest Industries

The raw material Green Fuel Nordic uses for bio-oil is renewable biomass directly from forests or in the form of wood-based by-products of sawmills and the pulp industry. Bio-oil refined using RTP™ technology is a second-generation liquid biofuel that doesn't use any raw materials from the food chain.

Bio-oil production is a new and sustainable refining path to put the yield of Finnish forests to good use. This is particularly significant in the communities hit by structural changes in the conventional forest industry and where the forest has always been a significant source of jobs and income.

## RTP™ Production Technology

Green Fuel Nordic Oy's bio-oil production process consists of several parts that together form a functioning biorefinery. In the biorefinery, renewable wood-based raw material is converted into second-generation bio-oil.

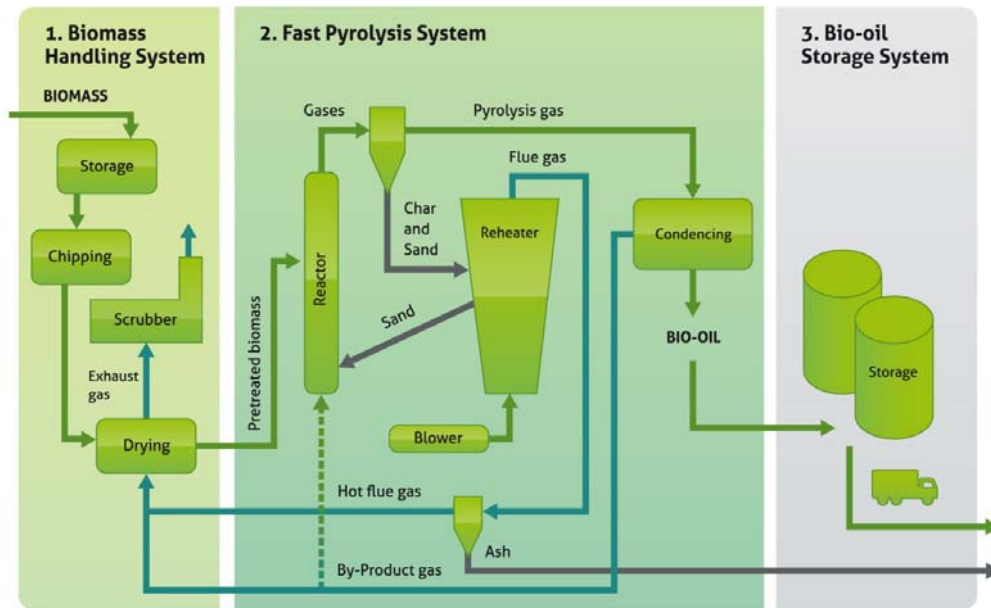


Figure 3. Green Fuel Nordic's RTP™ production process.

The Rapid Thermal Process unit is at the core of the rapid pyrolysis-based biorefinery and is where the preprocessed biomass is converted into bio-oil. Bio-mass that has been preprocessed to the correct particle size and moisture content is fed into the reactor and then gasified by a circulating fluidized bed of hot material (sand). The gasification takes place in virtually oxygen-free conditions and thus no combustion occurs.

The gas that is generated is led to a cyclone, where the bed material and char are mechanically separated from the gas stream. The gas moves from the cyclone into a condenser, where it is cooled and condensed into bio-oil. Finally, the bio-oil produced is filtered before exiting the RTP unit.

The char (biocoal) that is produced as a by-product returns from the cyclone to the boiler to heat the reactor's bed material; this is where it is burned and generates the thermal energy required by the process. The product gas generated as a by-product in the condensing process is used in the drying of the biomass.

Before reaching the RTP unit, the biomass is processed into the correct particle size and moisture content. Feedstock processing requires numerous screens and grinding equipment. Drying

takes place in a drying drum that uses the thermal energy of the RTP unit's hot flue gases. After drying, the moist flue gas is led to the flue-gas scrubber, where the majority of the environmentally harmful substances are separated from the flue gas.

The filtered bio-oil produced in the RTP unit is fed into day tanks and the quality is analyzed before being piped to storage tanks.

## **RTP™ Green Fuel Applications**

The main applications for liquid biofuel are industrial boilers, district heating and lime kilns that can utilize bio-oil with only minor modifications to the existing systems. Other feasible applications are marine applications, particularly slow- and medium-speed diesel engines. Future applications can be found in upgrading bio-oil into transportation fuel and extraction of chemicals for the use in chemical industry, pharmaceuticals, cosmetics, and many more.

## **References**

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