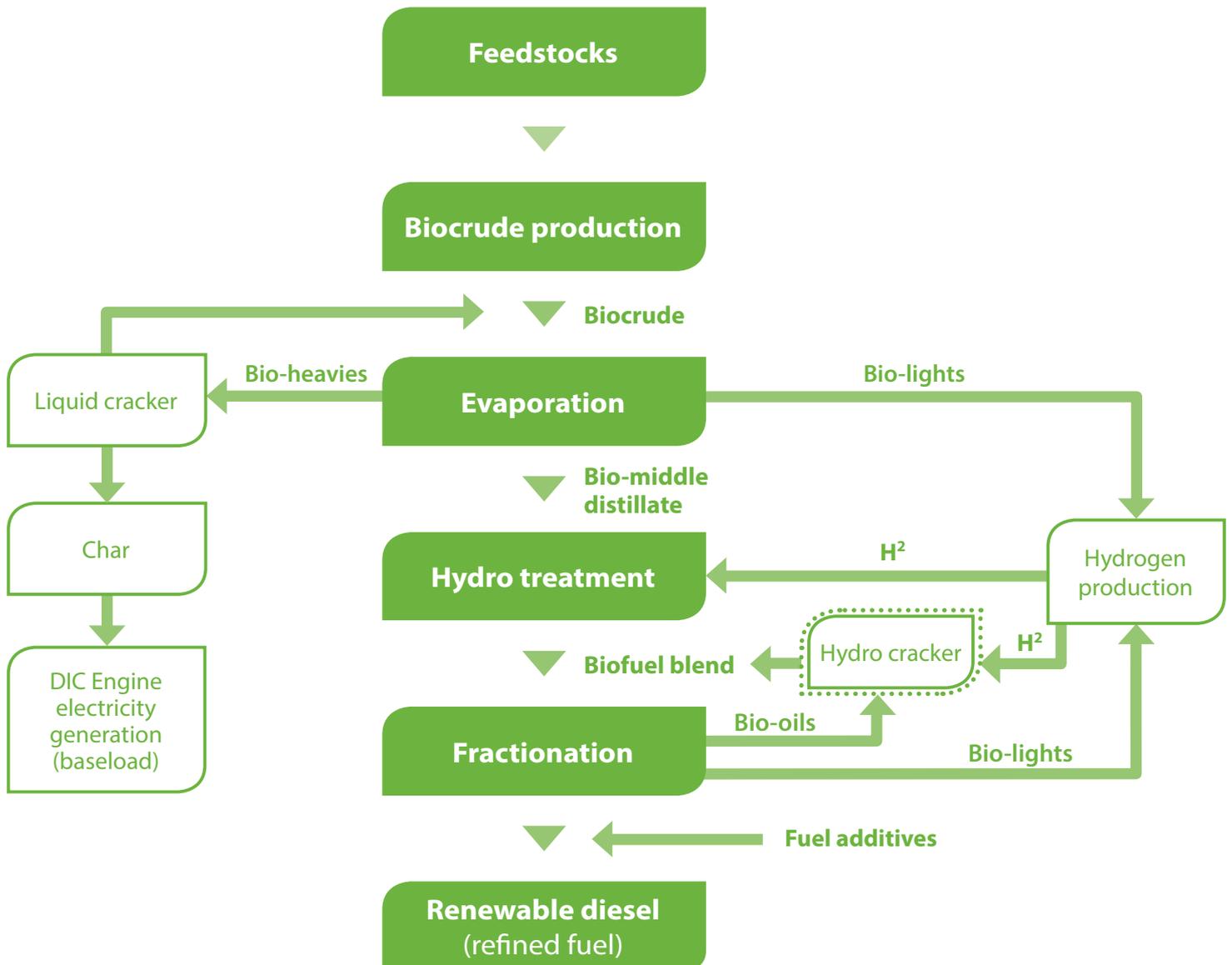


Northern Oil Advanced Biofuels Refinery



..... Future project

The Southern Oil renewable fuels refining process is not a re-invention of how fuel is refined. It is a re-imagining of how industry standard refining equipment, such as hydrotreaters and fractionators, can be designed and utilised. Using well understood, industry standard equipment will ensure that the quality of our fuel will always meet diesel specifications.

Liquid cracker

Bio-heavies are sent to be re-cracked and then injected back into the process for further refining.

Char

One product from the liquid cracker is char, which has multiple uses, including as a soil improver, as a coal supplement for electricity generation, or for use in Direct Injection Carbon Engines to generate baseload power.

DIC Engine

Char from the refining process can be used as fuel in a Direct Injection Carbon Engine (DIC Engine) to generate baseload power.

Feedstocks

Waste products, whether from primary sources (sugar cane trash, forest waste), primary processing (cotton gin trash, sawmill waste), end of life products (tyres, plastics) or biological wastes (food waste, biosolids).

The Northern Oil Advanced Biofuels Pilot Plant will take an array of feedstocks and test them sequentially to determine the best and most economic processing methodology.

Biocrude production

The process of liquefying solid feedstocks and converting liquid streams into biocrude through specific conversion technologies such as pyrolysis or hydrothermal liquefaction (HTL). The biocrude is then stabilised through a deoxygenation reactor and sent to a biorefinery for refining.

The pilot plant has multiple technologies (pyrolysis, HTL and a gasifier) to convert feedstocks into biocrude. This will determine the most efficient and economic process for each feedstock.

Evaporation

The refining process first applies recirculated flash evaporation to separate the biocrude into fractions:

1. Bio-lights, that are too light to be fuel,
2. Bio-heavies, that are too heavy to be fuel, and
3. Bio-middle distillate, that can be upgraded to biofuel.

The bio-middle distillate is sent for processing into fuel.

Hydro treatment

Bio-middle distillate (BMD) is first hydro treated, where the BMD is reacted with high pressure hydrogen over a catalyst. This process removes impurities (oxygen, nitrogen, sulphur and metals), stabilises chains that would otherwise break down in storage and in engines (olefins), and manages molecules that may be harmful to human health and the environment (aromatics). The resultant biofuel blend is then sent for fractionation.

The hydro treater has been specifically and uniquely designed for the Northern Oil Advanced Biofuels Refinery for the sole purpose of upgrading bio-oils.

Fractionation

In the fractional distillation column, the biofuel blend is split into renewable AvTur (aviation fuel), renewable diesel and renewable lubricants.

Renewable diesel (refined fuel)

As per standard fuel industry processes, after fractionation the renewable diesel is blended with various fuel additives to meet the performance specifications of end users. These may include industry-standard additives such as metal deactivators, lubricant enhancers and cold flow improvers.

The end product (after blending) is a drop-in renewable diesel – a refined fuel that can be used in motors and engines, including cars, heavy road transport, aircraft and ocean craft.



Hydrogen production

The bio-lights from the fractionator are used for energy generation or hydrogen production. Hydrogen produced through this process is used in the hydro treatment phase of refining and may also be used in the hydro cracker (a future project).

Hydro cracker

Depending on market demand, the heavier fractions can be sent to a hydro cracker that breaks the oil molecules into shorter fuel chains for re-fractionation.