Marine Biofuels

Introduction

The shipping sector consumes more than 330 million tons of fuel per year. Marine fuels are primarily produced from crude oil, with heavy fuel oil (HFO) and marine diesel oil (MDO) being the main fuels used. Higher quality distillate fuels are primarily used in emission control areas (ECAs) and are known as ULSD (Ultra Low Sulfur Diesel).

Emission control areas have been created in coastal areas in North America and Europe, and enforce strict limits on SO_X, NO_X, and particulate matter emissions. To fulfil these, ULSD or other low-polluting fuel alternatives or exhaust gas cleaning systems must be used within ECAs.

Marine Engines

Modern merchant ships are propelled by two-stroke or four-stroke diesel engines. They use HFO, MDO and LSHFO (low sulfur heavy fuel oil). Spark ignition engines, petrol- or gas-fired, are more commonly used to propel smaller vessels. LNG fueled engines are slowly gaining more use, because of their lower CO_2 and sulfur emissions, and also methanol is being introduced, but both are still a small segment of the merchant fleet.

Biofuel alternatives

Figure 2 shows an overview of biofuel production technologies. Many of these produce diesel-type hydrocarbons that can be used as substitutes for marine diesel engines. Methanol, ethanol, methane and butanol can be used in spark ignition engines, while DME is a good fuel for Diesel engines. It is expected that most biofuels can be utilized in ship engines. However, use of such fuels would require major changes to the engines and the on-board storage, and require a secure bunkering logistic for such fuels at ports. Such logistic is expected to be first introduced for local (port) traffic or two-point traffic by e.g. ferries.

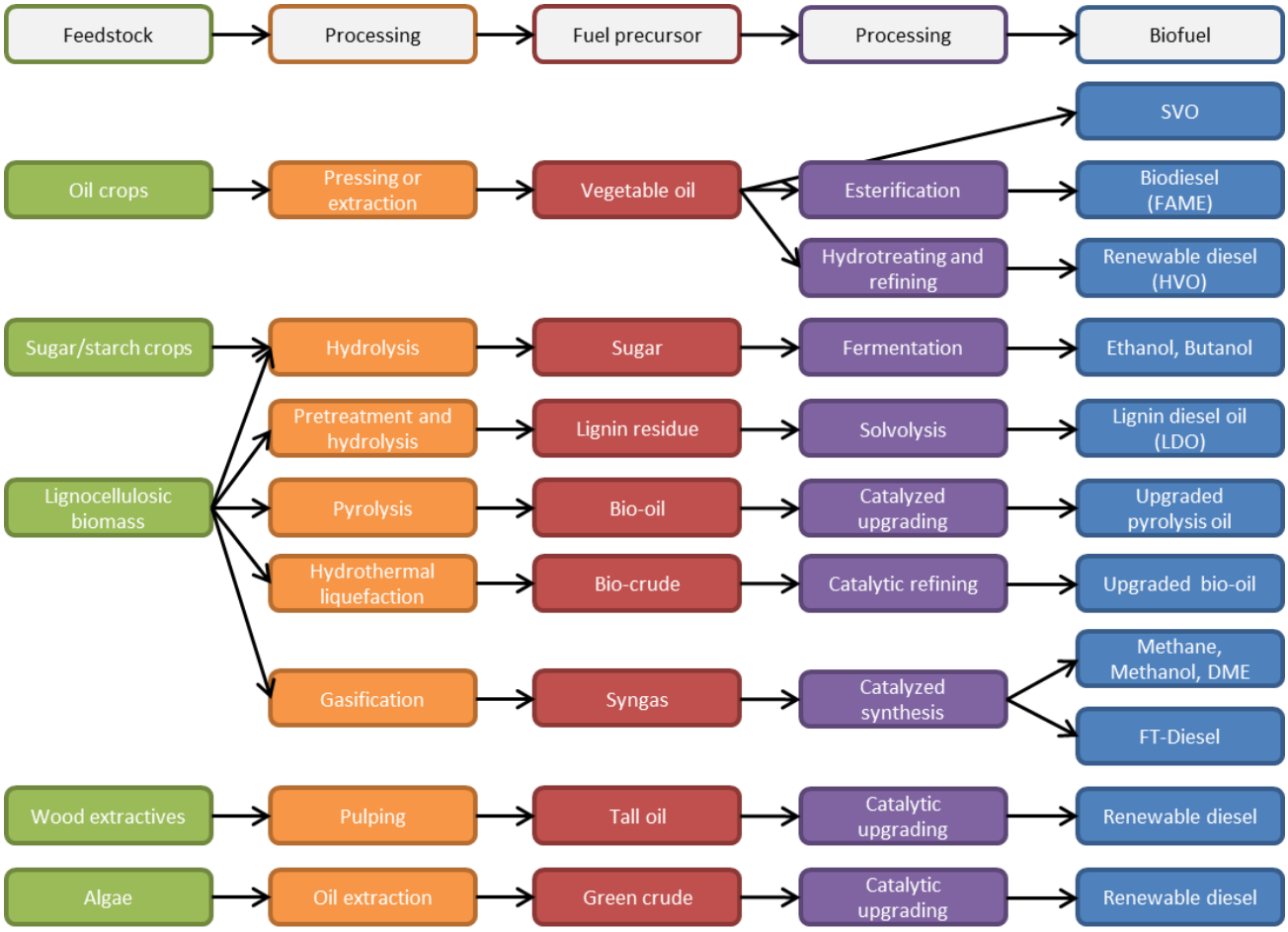
Figure 1: Ocean-going vessel

Marine engines (working principle)

2-stroke slow speed (Diesel)
4-stroke medium speed (Diesel)
Diesel electric
Dual fuel (diesel + LNG or methanol)
Spark ignition engine (Otto)
Gas engine (Otto)
Steam turbines
Gas turbines

The technology readiness levels of the biofuels production processes depicted in Figure 2 vary from low (lab or pilot scale facilities) to high (commercial production of conventional biofuels). While SVO, biodiesel (FAME), renewable diesel (HVO), ethanol and butanol from sugar and starch, and tall oil renewable diesel are available commercially, the other production technologies are still under development.

Figure 2: Biofuel production technologies



Barriers to marine biofuels

Biofuels contain little or no sulfur and could be used in ECAs. However, utilizing biofuels is not yet common practice. Main barriers to the deployment of marine biofuels include:

- higher price of biofuels as compared to other marine fuels
- insufficient logistic support at ports for fuels not compatible with diesel type fuels
- limited expertise within the shipping sector with the handling of some biofuels, including long-term stability thereof
- lack of long-term fuel test data to guarantee the safety and continued reliability of the selected fuel
- reduced cargo space when using less energy-dense fuels such as methanol and gaseous fuels
- safety requirements when using methanol or gaseous fuels

Further information

Read further information about marine biofuels at:

http://www.etipbioenergy.eu/value-chains/products-end-use/end-use/water

http://www.etipbioenergy.eu/value-chains/products-end-use/products

http://www.iea-amf.org/app/webroot/files/file/Annex%20Reports/AMF_Annex_41.pdf

Report IEA Bioenergy, Task 39: Biofuels for the marine shipping sector (upcoming)