MAPPING BIOENERGY RETROFITTING IN EUROPE'S INDUSTRY - BIOFIT FIRST RESULTS

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1 Bioenergy retrofitting: the BIOFIT project

Bioenergy has evolved in the last decades from relatively simple heat and power production to a vast array of technologies for advanced biofuel production, intermediate bioenergy carriers, etc.
Retrofitting – which means replacing a part of a factory or installation with state-of-the-art equipment – is a good alternative to new plants for replacing fossil fuels, upgrade outdated technology, or produce additional output from biomass. Bioenergy retrofitting provides significant benefits compared to building new plants, notably lower capital expenditure, shorter lead times, faster implementation, and less production time loss.
The BIOFIT project (www.biofit-h2020.eu) aims to facilitate the market uptake of bioenergy retrofitting concepts in several specific industrial sectors in Europe, namely **first-generation biofuels, pulp and paper, fossil refineries, fossil firing power and Combined Heat and Power (CHP) plants.**

2 1G Biofuels

Options for retrofitting in the first-Generation biofuels sector (bioethanol, biodiesel) production:
1. **Cellulosic ethanol add-on to first generation bioethanol**. This involves the coupling of the 1G bioethanol with the 2G technologies that use lignocellulosic feeds.
2. **Alcohols for aviation (the ATJ process)**. Via various chemical processes (see figure) Jet fuel is produced.
3. **Multi-feedstock biodiesel add-ons.** Biodiesel plants built for processing vegetable oils can be retrofitted to multi-feedstock biodiesel plants that can also process used cooking oil (UCO) and waste animal fats.

Option 1 and 2 are investigated as BIOFIT case studies.

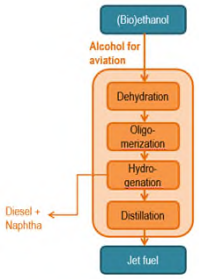

Fig. 1 The Alcohol-to-Jet retrofit route

3 Pulp and paper

There are many options for retrofitting in the pulp and paper sector. Some examples:
1. **Ethanol production from brown liquor.** Fermentation of the hemicellulose part of wood to produce 2G Ethanol.
2. **Raw methanol purification and black liquor gasification to DME.** DME can be produced from the methanol, but also via the gasification route.
3. **Hydrothermal carbonization (HTC) of sludge.** Production of a solid combustible product from wastewater sludge.

Fig. 2 Methanol plant at Södra Cell's mill in Mönsterås, Sweden. (Photo: Södra Cell)

Options 1 and 3 are investigated as BIOFIT case studies.

4 Fossil refineries

It is – also within the fossil refineries sector itself - accepted that a main challenge of the refining sector is how to manage the transition to a low-carbon economy. Main options for retrofitting are:
1. **Hydroprocessing of renewable liquid oils.** Use of vegetable oils to produce green transport fuels (HVO). Already practiced in several refineries.
2. **Pyrolysis oil integration into refineries.** Pyrolysis oil is a renewable liquid that can be produced from lignocellulosic residues. Co-feeding of pyrolysis oil in fossil refineries yields green transport fuels.

Both options are investigated as BIOFIT case study.

5 Power production and CHP

20% of EU power is from coal-fired power stations. 12 EU states – containing 40% of coal-fired capacity - have set a date for coal phase out. Options for retrofitting:
1. **Co-firing of biomass** in many forms. Less applied in EU now.
2. **Biomass repowering (full bioenergy retrofitting)** using pellets or thermally pre-treated material.

Both options are investigated in BIOFIT case studies.

Fig. 3 The Greek Ptolemaida V 615 MWe power station (under construction)

6 BIOFIT activities

A core activity of BIOFIT is to develop 10 concrete case studies together with industrial partners. This work is underway.

The Mapping activities of BIOFIT are now completed. Tangible results are:
1. An **interactive map of retrofitted installations in Europe** is online (https://www.biofit-h2020.eu/biofit-industry-map/)
2. Several **Fact sheets** showing before/after characteristics of succesfull bioenergy retrofits.
3. A **handbook** detailing options for retrofitting in the target sectors. Options detailed in this poster are elaborated in the handbook. The handbook will be translated in several languages besides English.
4. An overview of **framework conditions** in the EU and the BIOFIT target countries.
5. A concise **summary for policy** makers.

Fig. 4 Interactive map of retrofits

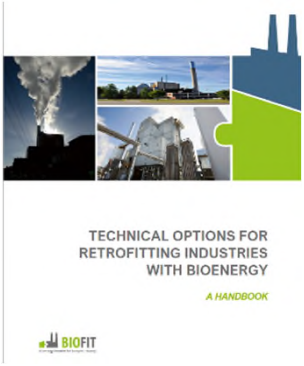

Fig. 5 BIOFIT handbook with options for retrofitting

All these results can be seen and/or downloaded from the BIOFIT website (https://www.biofit-h2020.eu/).

Many other activities are carried out in the BIOFIT project, most notably the sector-specific Industry fora. These are physical and virtual meetings in which we inform, engage and support industry with respect to bioenergy retrofitting. On our website there is information for stakeholder participation.

7 Observations

Even though the five BIOFIT target sectors have quite different characteristics and bioenergy retrofitting options vary substantially, two general observations can be made:
1. There are **many new technological options** for bioenergy retrofitting, leading to a wide spectrum of high-value products, higher efficiencies and lower cost, which justifies continued support for RD&D as well as dedicated policy development.
2. **Biomass availability and mobilization** play an important role in all sectors and require due attention.

BIOFIT
Bioenergy Retrofits for Europe's Industry

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