BIOFIT
Bioenergy Retrofits for Europe's Industry

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CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

ETIP Bioenergy
European Technology and Innovation Platform

BIOFIT project: Bioenergy Retrofits for Europe's Industry: Challenges and Opportunities

9th Plenary meeting ETIP Bioenergy, The fast way forward: Bird's eye view of the role of biofuels, technological options, implementation, barriers and financing opportunities

21 November 2019, Brussels, Belgium

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817999.

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BIOFIT Project Overview

BIOFIT
Bioenergy Retrofits for Europe's Industry

- BIOFIT - Bioenergy Retrofits for Europe‘s Industry
- Coordination and Support Action (CSA)
- Co-financed by the European Commission (Horizon 2020 / Grant Agreement No: 817999)
- Topic: LC-SC3-RES-28-2018-2019-2020 (Market Uptake support)
- Project duration: October 2018 – September 2021
- Budget: 2.6 million EUR
- Coordinator: BTG Biomass Technology Group BV, The Netherlands

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BIOFIT Overall Objective

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Support and initiate bioenergy retrofitting opportunities in five industry sectors


combined heat and power


fossil firing power


first-generation biofuels


fossil refineries


pulp and paper

leading to an increase in the share of renewable energy in the final EU energy consumption

BIOFIT Objectives

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- The bioenergy retrofits studied in the BIOFIT project are technical measures applied to existing production plants that support bioenergy utilization as an alternative to fossil energy.

- The retrofit measures can result in either of the following:
  - Using additional biomass as an input to the production plant
    - for primary bioenergy products
    - for process energy
  - Producing additional output from biomass at the production plant
    - Transport biofuels
    - Intermediate bioenergy carriers
    - Heat and/or electricity

- **Retrofitting often means lower capital expenditure, shorter lead times, faster implementation, less production time losses and lower risks**

BIOFIT Activities

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- Develop **10 concrete proposals (Case Studies)** for bioenergy retrofitting together with industry and market actors
- Obtain an overview of **options for bioenergy retrofitting**
- Involve, engage and support **stakeholders and market actors**, providing opportunity for dialogue, and developing best practices and tools
- Evaluate **framework conditions (legal, institutional and political)** to identify - generic and industry-specific - barriers and enablers
- Provide **advice to policy makers** at national and regional level to serve as input for more informed policy, market support and financial frameworks

BIOFIT Case Studies

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1G biofuels:
1. Biocarburantes de Castilla y Leon (ES)
2. Swedish Biofuels (SE)

Pulp and Paper:
1. AustroCell Hallein (AT)
2. C-Green (FI)

Fossil refineries:
1. Hellenic Petroleum / Thessaloniki Refinery (GR)
2. Preem / Lysekil (SE)

Fossil power:
1. EPBiH / Tuzla (BA)
2. EP Produzione / Fiume Santo (IT)

Combined Heat & Power:
1. EPBiH / Kakanj (BA)
2. Sölvesborgs Energi (SE)

BIOFIT: Retrofitting in fossil refineries

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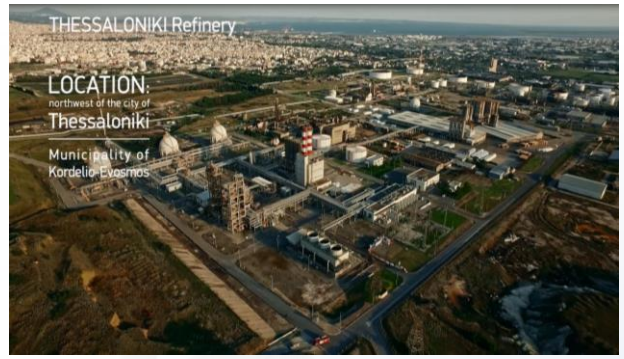
Integration of new equipment for the production of hydrotreated vegetable oil (HVO) into the Thessaloniki refinery of Hellenic Petroleum in Greece. The expected production capacity is 22,000 tonnes of biofuel.



HVO characteristics

- premium "drop-in fuel"
- replaces diesel without modifications to existing refueling systems and/or vehicles
- negative interactions with engine components (e.g. filters, injectors, engine oils)
- adjustable to regional specifications wrt. cold flow properties by modifying process severity or through additional catalytic processing
- high cetane number ensures efficient and clean combustion, whilst providing extra power compared to conventional biodiesel (FAME)
- many well-proven processes for HVO production have been developed by various technology providers (e.g. Axens, Neste, Haldor Topsoe, Honeywell-UOP, Eni)
- **HVO benefits**
- does not require investment in infrastructure for supply to the final customer because the existing infrastructure and logistics schemes are already suitable
- depending on the feedstock, HVO can deliver up to 90% lower GHG emissions compared to petroleum-based diesel
- renewable diesel can reduce PM emissions by 33%, NO_x by 9% and CO_2 emissions by 24%
- can be distributed in a blend with petroleum-based diesel as high as 15% v/v, more than double the maximum conventional biodiesel content allowed by EN590 diesel fuel standard (7% v/v)
- most heavy-duty engine manufacturers and an increasing number of passenger car manufacturers have certified their vehicles for pure renewable diesel (RD100)

BIOFIT Coal to biomass case studies

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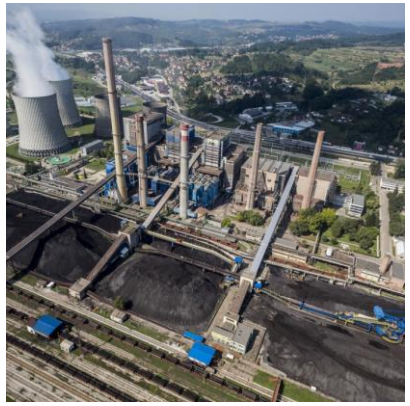
- Elektropriveda BiH / Tuzla power plant - Unit 6 (215 MWe)
  - Up to 30 % (mass basis) co-firing with local biomass sources (sawdust, agricultural residues)
- Elektropriveda BiH / Kanakj CHP plant Unit 5 (118 MWe)
  - 100 % biomass conversion
- EP Produzione / Fiume Santo power plant Unit 4 (320 Mwe) in Sardinia
  - 100 % biomass conversion



Interest in co-firing / conversions

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- ✓ Industrial demonstrations of co-firing since the '90s, possibly earlier
  - Gelderland (NL): co-firing with waste wood (3 – 4 % heat input) since 1992
- ✓ Coal-to-biomass conversions:
  - Les Awirs Unit 4 (BE): conversion to 100 % biomass (80 MWe) in 2005
  - Rodenhuize Unit 4 (BE): conversion to 100 % wood pellets (200 MWe) in 2011
- ✓ **Opportunity fuels (cheaper than coal)**
  - Waste wood, RDF / SRF, exhausted olive cake (occasionally)
- ✓ **Financial incentives for bioenergy production**
  - Feed-in tariffs / premiums, Green Certificates
  - Country specific rules: types of biomass, minimum fuel ratio, sustainability / traceability….
  - RED II…
- ✓ **Emission Trading Scheme: cost of CO_2 to utilities**
  - From 4 €/t in mid-2017 to ~ 22 €/t in August 2018
  - Projections for 30 €/t

Technology options

Direct co-firing: Biomass and coal combusted in the same furnace, using same or different mills and burners as appropriate. Adv: Easy to implement, Dis: limited substitution rate (20%), mixing of ashes

Indirect co-firing: Biomass gasifier to produce syngas, combustion of syngas in coal boiler (up to 40%) Adv: no mixing of ashes, utilization of “difficult” fuels, less strict requirements for quality of syngas. Dis: Higher cost (installation of new gasifier)

Parallel co-firing: Separate biomass boiler, coupled with coal boiler on steam side Adv: no mixing of ashes, utilization of “difficult” fuels, higher efficiency than stand-along biomass Dis: Higher cost (but not as high as stand-alone biomass)

Conversions: complete retrofit of coal boiler / mills to accommodate very high shares of biomass co-firing. Adv: equivalence with dedicated bioenergy installations. Dis: Handling of large biomass volumes, safety issues

Thermally-treated biomass:thermally treated biomass is used to directly substitute coal. Adv: minimum plant retrofitting/investment required, handling of biomass similar to coal. Dis: development of infrastructure for thermal treatment of biomass.

Why conversions and not co-firing?

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- Political will to phase-out coal
- Directive (EU) 2018/2001 / Article 29: Sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass

11. Electricity from biomass fuels shall be taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1 only if it meets one or more of the following requirements:

(a) it is produced in installations with a total rated thermal input below 50 MW;

(b) for installations with a total rated thermal input from 50 to 100 MW, it is produced applying high-efficiency cogeneration technology, or, for electricity-only installations, meeting an energy efficiency level associated with the best available techniques (BAT-AEELs) as defined in Commission Implementing Decision (EU) 2017/1442 (1);

(c) for installations with a total rated thermal input above 100 MW, it is produced applying high-efficiency cogeneration technology, or, for electricity-only installations, achieving an net-electrical efficiency of at least 36 %;

(d) it is produced applying Biomass CO_2 Capture and Storage.

For the purposes of points (a), (b) and (c) of the first subparagraph of paragraph 1 of this Article, electricity-only-installations shall be taken into account only if they do not use fossil fuels as a main fuel and only if there is no cost-effective potential for the application of high-efficiency cogeneration technology according to the assessment in accordance with Article 14 of Directive 2012/27/EU.

EU-28: Coal power & biomass conversions

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Country	Share in power production / 2018		Phase-out date	Coal installed capacity (GWe, net)		Coal to biomass conversions
	Lignite	Hard Coal		2019	2030 (draft NCEPs)	
Austria	--	3.1%	2020	0.6	--	No information
Belgium	--	--	Coal free since 2016	--	--	Les Awirs 4 (2005), Rodenhuize 4 (2011)
Bulgaria	41.3%	2.2%	No phase-out discussion	4.7	4.7	No information
Croatia	--	14.3%	No phase-out discussion	0.3	0.2	No information
Czech	42.5%	4.6%	Phase-out under discussion	9.2	7.2	No information
Denmark	--	18.8%	2030	2.6	0	Herning (2009), Avedore 1 (2016), Studstrup 3 (2016), Ostkraft (2016), Asnæs 6 (2019), Esbjerg 4 (2024)
Finland	4.4%	8.8%	2029	2	0	No information
France	--	1.2%	2022	3	0	**Cordemais (2022) – under discussion**
Germany	22.7%	12.9%	2038 (option 2035)	44.4	17	No information
Greece	30.9%	--	2028	4.1	2.7 (??)	**Public discussions**
Hungary	15.6%	--	2030	1	0.2 (??)	Pécs (2004)
Ireland	6.5%	12.9%	2025	0.9	--	**Moneypoint – public discussions**
Italy	--	9.3%	2025	8.1	--	**Fiume Santo – under discussion**
Netherlands	--	29.8%	2029	4.8	--	Amer 9 (2020), Maasvlakte 1 – ARBAHEAT project
Poland	29.0%	47.3%	No phase-out discussion	26.9	22.9	Polaniec Green Unit (2012)
Portugal	--	20.3%	2023	1.9	--	No information
Romania	24.6%	--	No phase-out discussion	5.5	3.2	No information
Slovakia	3.7%	3.7%	2023	0.6	0.6 (??)	No information
Slovenia	25.0%	0.0%	No phase-out discussion	1	1	No information
Spain	--	13.9%	Phase-out under discussion	9.4	0 - 1.2 (??)	**As Pontes – public discussions**
Sweden	--	0.0%	2022	0.1	--	Helsingborg (2006), Västhamnsverket (2006)
UK	--	5.1%	2025	11.6	--	Tilbury (2011), Ironbridge (2012), Drax (2013 – 2018), Lynemouth (2018), Uskmouth (2021)
EU-28	**9.2%**	**10.0%**	**N/A**	**142.7**	**< 60.9**	

Data sources: (1) Share in power production: Agora Energiewende and Sandbag (2019), (2) Coal phase-outs: Europe Beyond Coal (Oct. 2019), (3) Coal installed capacity: CAN Europe and Sandbag (2019), (4) Coal to biomass conversions: various company reports & websites

- Installed coal capacity by 2030 projected to be less than 42 % of the 2019 one
- 7 member states coal-free; 1 (BE) used coal-to-biomass conversions
- For 3 member states (DK, NL, UK) conversions appear to be key in coal phase-out
- Negotiations, investigations or public discussions about conversions in 4 member states (FR, IE, IT, ES)
- Only 1 major lignite producer member state (GR) announced coal phase-out before 2030 / do conversions fit into the strategy?

RED II: impact on co-firing / retrofits

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- ✓ Bioenergy can a) be accounted towards the overall RES-target and sectorial sub-targets, b) be eligible for public financial support
- ✓ Biomass is carbon neutral for ETS only if compliant with sustainability criteria
- ✓ Specific sustainability criteria for different types of biomass
- ✓ Specific requirements for electricity-only installations
  - No use of fossil fuels as "main fuels" (acceptable share not clarified yet)
  - No cost-effective potential for highly efficient CHP (Article 14 of Directive 2012/27/EU)
  - Requirements based on size (fuel input)
    - < 50 MW: no additional requirements
    - 50 – 100 MW: Best-available technology associated energy efficiency levels or use Biomass CCS
    - > 100 MW: Electrical efficiency of 36 % or applying Biomass CCS
- ✓ GHG emissions saving criteria
  - > 70 % for installations starting operation after 1 January 2021
  - > 80 % for installations starting operation after 1 January 2026
- ✓ Member states can apply stricter sustainability criteria or higher energy efficiency requirements

Barriers and Opportunities

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Barriers

- ✓ Constant legal framework, recognition of co-firing / repowering as RES, adequate support to cover cost difference between coal and biomass
- ✓ Mobilization of huge biomass volumes
  - Sourcing (e.g. involvement of producers)
  - Infrastructure (especially for thermally treated biomass)
  - Sustainability issues
  - Public opposition
- ✓ Technical limitations under RED II (efficiency)

Opportunities

- ✓ Coal power is on decline
  - Several utilities plan to be coal-free in a 10-15 year location
  - Utilization of capital assets (coal power plants) that would otherwise have to be abandoned
- ✓ Non-stochastic renewable or low-carbon back-up plants needed to stabilize an electricity grid with high shares of intermittent RES (wind, solar)
- ✓ Towards harmonized EU framework with RED II

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Thank you for your attention!

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