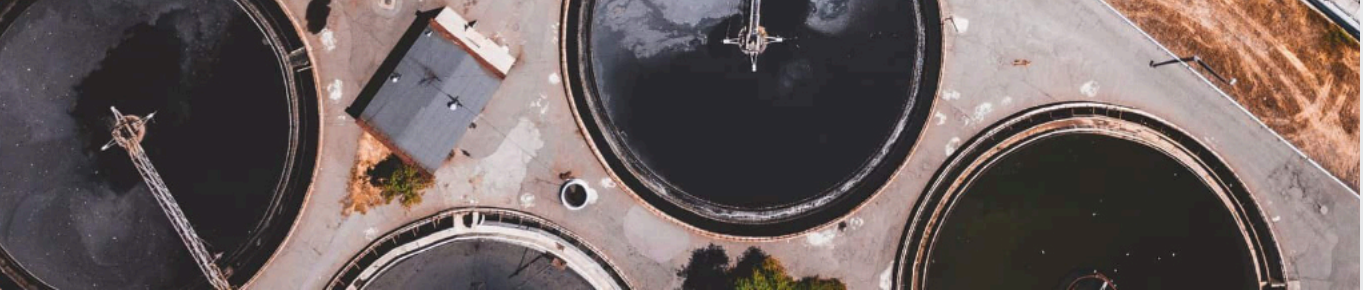

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HyCon

Catalytic Direct Hydrothermal Conversion of Biomass and Lignites to Liquid Fuels and Value-added Chemicals

Funding Programme: Research Fund for Coal and Steel (RFCS call 2019)

Grant Agreement No: 899471-19

Duration: 1 September 2020 – 30 June 2024

Budget: 3 038 034 €

Max. EU contribution: 1 822 820 €

Project Coordinator: Główny Instytut Górnictwa – National Research Institute (GIG-NRI)

Project Partners

Główny Instytut Górnictwa
Katowice, Poland
gig.eu

Imperial College of Science, Technology and Medicine
London, United Kingdom
imperial.ac.uk

Technische Universität Bergakademie Freiberg, Germany
tu-freiberg.de

Institute of Researches on Catalysis and Environment in Lyon
France
ircelyon.univ-lyon1.fr

Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, CIEMAT
Madrid, Spain
ciemat.es

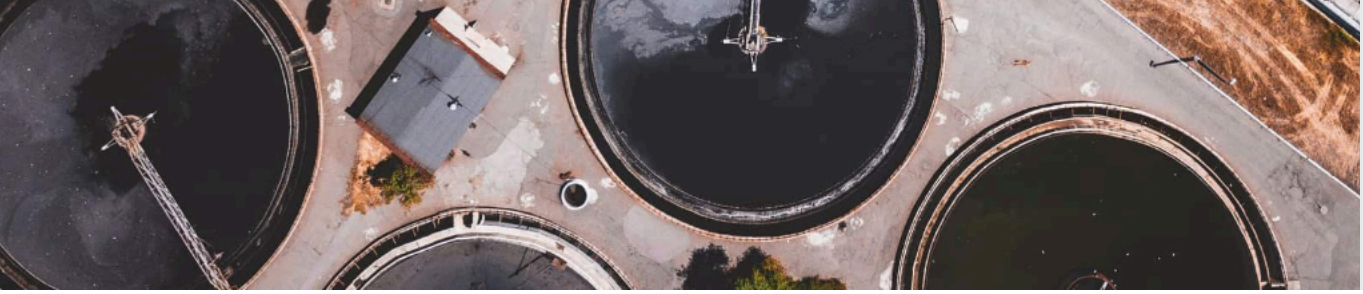
University of Lyon 1 Claude Bernard
Lyon, France
univ-lyon1.fr

PGE Górnictwo i Energetyka Konwencjonalna
Poland
elopole.pgegiek.pl

Ellinika Petrelaia SA
Athens, Greece
helpe.gr

Project main objective:

The main aim of this project was to develop the basis (TRL 3-4) for an industrial process of hydrothermal liquefaction (HTL) for the conversion of biomass and low-grade and high-moisture lignites in subcritical and supercritical conditions to liquid fuels and value-added chemical products. This objective was realized through an intensive experimental programme of catalytic HTL under inert (N_2) and reactive (H_2, CO) atmospheres in batch and continuous mode laboratory experiments.



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Specific objectives:

1. To develop suitable catalysts for the HTL of biomass and low-grade lignites.
2. To optimise the process conditions for the maximum yields and quality of liquid products by means of extensive laboratory batch-scale HTL testing of selected kind of biomass and Polish lignites.
3. To scale up the HTL process gradually from batch, through small scale continuous tests, to continuous process at 2 kg/h scale.
4. To elaborate separation and analytical procedures for a complex physicochemical characterisation of liquid products and by-products (solids, gas and spent water).
5. To characterise HTL by-products (char, gas) and establish options for their use in integrated plants.
6. To design handling and treatment options for the HTL spent water.
7. To develop a process for upgrading of liquid products using catalytic hytrotreatment (both conventional and in supercritical water) to remove heteroatoms (O, S, N) from the hydrocarbon products.
8. To perform a process analysis leading to a preliminary plant design to support future upscaling to an integrated demonstration scale installation and evaluation of its economy.
9. To carry out a life cycle assessment (LCA) of the HTL of selected kind of biomass and Polish lignites, including carbon footprint of the whole production chain, from feedstock preparation to the upgrading of the HTL products, and options for CO2 capture, and storage or utilisation.
10. To perform economic assessment of energy storage by hydrogen production from excess electricity for the HTL process.

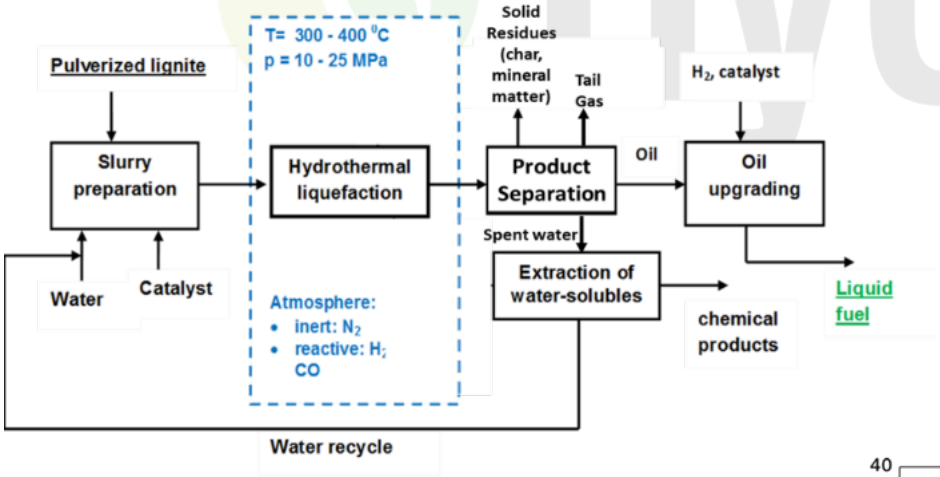
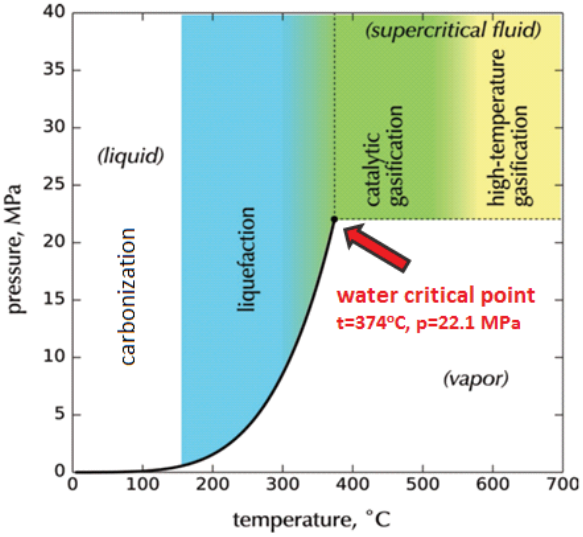
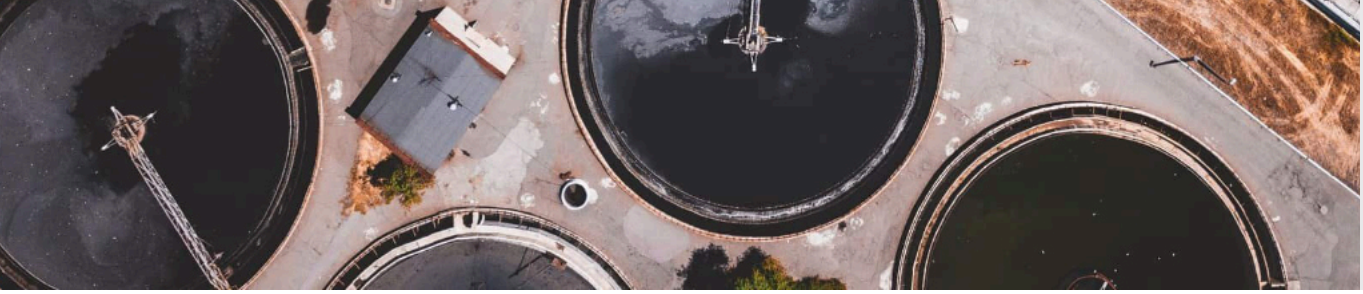


Fig. 1 Simplified flow diagram for hydrothermal liquefaction process.

Hydrothermal technologies are chemical and physical transformations of carbon raw materials (coal, biomass, waste) taking place in an aqueous environment at high temperature (200-600°C) and high pressure (5-40 MPa) - water in a sub- or supercritical state.



Source: Peterson, A.A., Vogel, F., Lachance, R.P., Fröling, M., Antal Jr., M.J., Tester, J.W., 2008.Thermochemical biofuel production in hydrothermal media: a review of sub- andsupercritical water technologies. Energy Environ. Sci. 1, 32–65.



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Work package's leaders:

WP1: Coordination, management and dissemination, prof. Krzysztof Stańczyk, GIG-NRI.

WP2: Feedstock selection, characterization and processing, Stefan Thiel, Technische Universität Bergakademie Freiberg.

WP3: Laboratory batch mode HTL testing and process optimization, dr Marcos Millan-Agorio, Imperial College of Science, Technology and Medicine.

WP4: Development of continuous mode HTL process (at 2 kg/h scale), dr Krzysztof Kapusta, GIG-PIB.

WP5: Characterisation and classification of HTL products, dr Jose Maria Sanchez, Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas.

WP6: Upgrading of liquid products, dr Christophe Geantet, Centre National de la Recherche Scientifique.

WP7: Techno-economic and environmental process assessment including CO_2 efficiency and energy storage, dr Piotr Krawczyk and dr Anna Śliwińska, GIG-PIB.

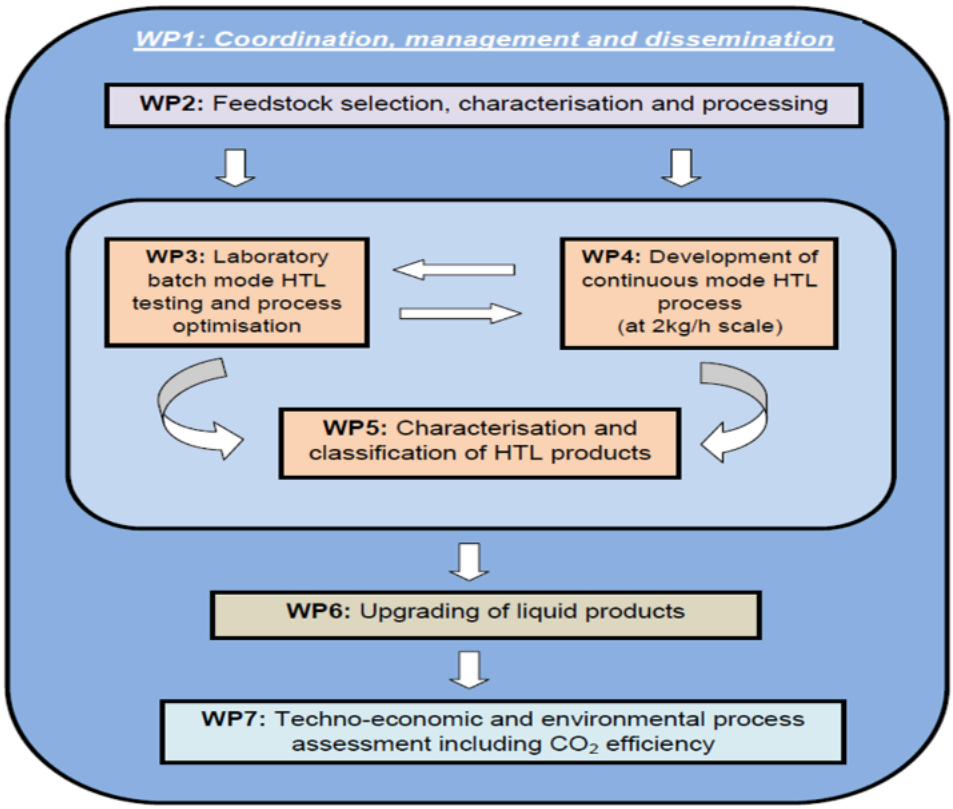
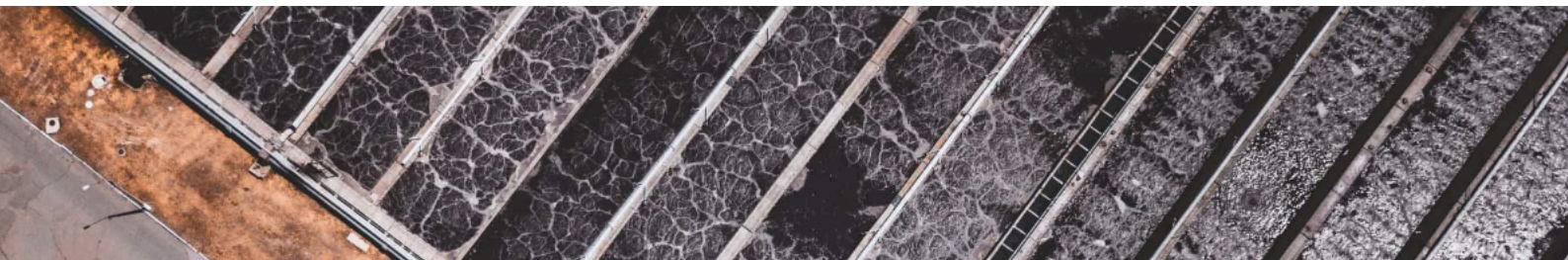


Fig. 2 Project structure and dependencies between work packages.



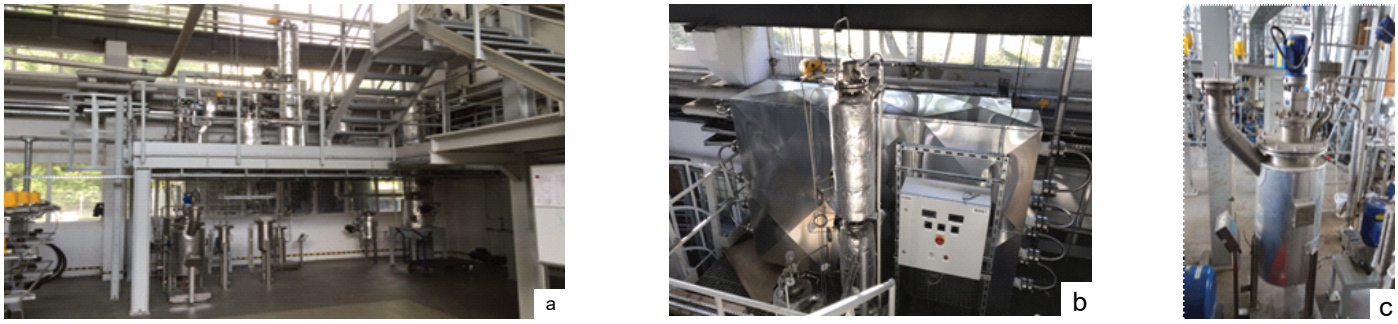


Fig. 3 Adaptation and development of continuous flow installation for pilot scale HTL experiments at 2 kg/h (GIG-NRI): (a) continuous flow installation at GIG-NRI's Clean Coal Technology Centre; (b) constructing of HTL reactor; (c) constructing of slurry pumping system.

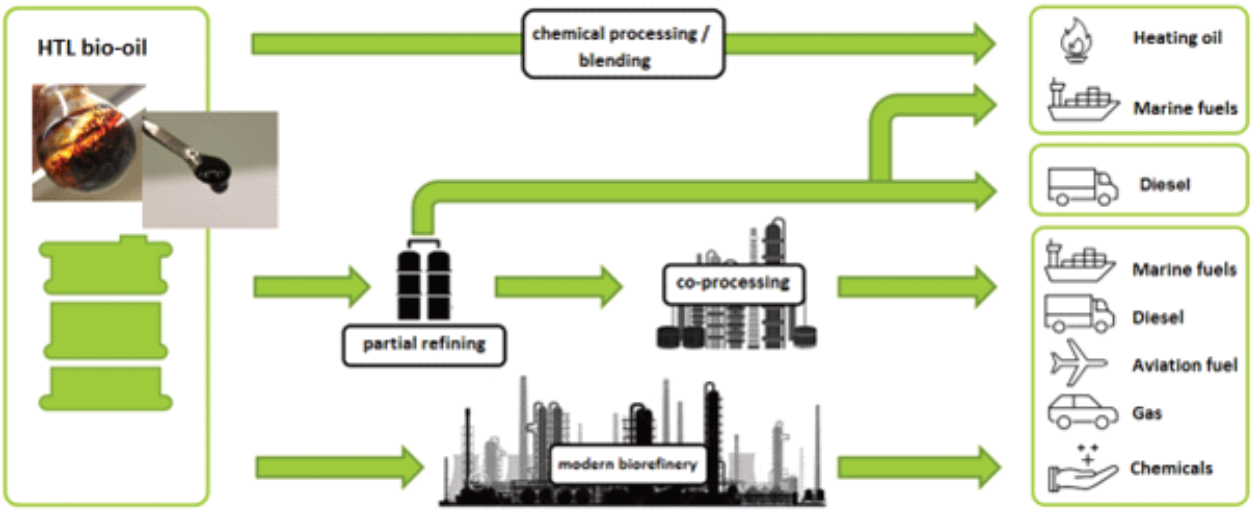


Fig. 4 Possibilities of introducing HTL bio-oil to the market.

Project coordinator from GIG-NRI:
prof. Krzysztof Stańczyk
kstanczyk@gig.eu

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