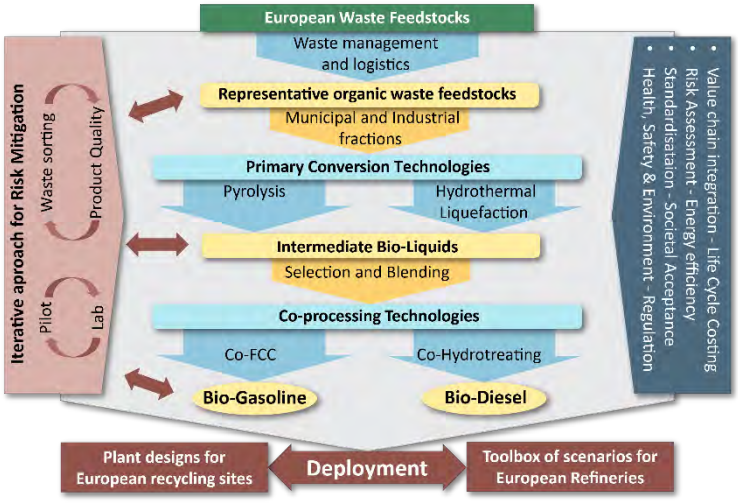
WASTE2ROAD

Biofuels from WASTE TO ROAD transport

NEWSLETTER No. 1, October 2021

Foreword

WASTE2ROAD is an EU H2020 project which aims at the development of cost-effective biofuels from a range of low-cost biogenic and locally sourced waste fractions. The project addresses the whole value chain from feedstock supply via conversion of waste to intermediate bio-oils, their integration in existing refinery processes to produce a bio-based fuel with subsequent testing in road vehicles. The project has 11 partners from 6 European countries. The two Norwegian partners are *SINTEF,* the project coordinator, and Oslo's Renovasjons- og gjenvinningsetaten (*REG*) who lead the work package on feedstock supply and logistics.



WASTE2ROAD concept

WASTE2ROAD generates a number of interesting results about waste management and biofuel production from waste and residues. With supplementary funding from the Research Council of Norway (the MANAGEWASTE project), *SINTEF* and *REG* would like to introduce WASTE2ROAD to the Norwegian stakeholders with interest in finding new innovative ways for waste utilization and valorisation. You can read more about the current research in biofuels and our planned dissemination activities on the following pages of this Newsletter.

WASTE2ROAD receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818120.

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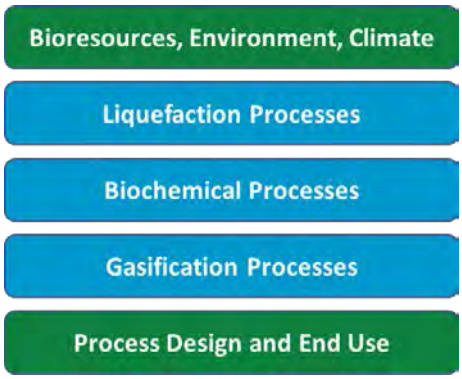
Duncan Akporiaye, *Research Director at SINTEF, Centre Leader of FME [Bio4Fuels]*

Bio4Fuels is one of several Norwegian Centres researching on environmentally friendly Energy. As shown below, the central pillar of the Centre is research on the technologies relevant for the three main value chains in Norway. In addition, the Centre also focusses on Sustainability issues (Climate, Environment, Economics) as well as Techno-economics and End use in the engine.



With over 40 partners, the Centre involves Stakeholders with an interest in all aspects of the Biofuels value chains – from regional authorities with forestry resources to vehicle producers. An important ambition of Bio4Fuels is to stimulate the development of European network and European projects. **WASTE2ROAD** represents an important project, complementing Bio4Fuels focus on Lignocellulosic feedstock, with it's focus on **Municipal Waste**. The consortium also involves 2 of the Centre's partners – BTG and REG.

Johnny Stuen, *Technical Director at REG*

REG (Waste Management Agency, City of Oslo) is working to develop all the potential that lies within waste from the City of Oslo. We have been in the forefront since the establishment of circular waste treatment was introduced in 2009 with sorting plants for municipal waste and start-up of the biogas plant in 2012.

Producing biomethane and biofertilizer is a good and very sound treatment of biowaste, with a very good climate mitigation. However, we see that still 20 % of the food waste coming to the biogas plant is returned to incineration. To avoid this and being able to use this, making the waste treatment even more circular, is the primary motivation for REG to be a part of **WASTE2ROAD**.

We are very pleased with the work that has been undertaken and the project results so far. Starting the biogas plant has taught us that the development of new processes takes time and needs to be taken step by step to make the processes viable and relevant for the future. It is important that all the steps are tested and well documented before launching it in industrial scale. REG is happy to be part of the project and is looking forward to the next steps.

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MORE ABOUT WASTE2ROAD

With the growing world population and rapid depletion of natural resources, there is an increasing focus on sustainability and reduction of waste. The three R's – Reduce, Reuse and Recycle – are the essential domains of the waste management hierarchy now being implemented across Europe. The researchers and industry are looking for innovative ways of increasing material reuse and recycling and more effective solutions for energy recovery.

This is also the core idea of WASTE2ROAD (2018-2022), aiming at the development of advanced biofuels from selected low-cost, widely available and diverse biogenic residues and waste fractions. The two bio-conversion technologies under development in WASTE2ROAD are fast pyrolysis and hydrothermal liquefaction. The use of waste materials in bio-conversion is associated with challenges. To name a few: the inhomogeneous and variable composition of waste, fast deterioration, high level of contaminants that may negatively affect the process and product quality. How to work around these challenges is one of the questions studied intensively in WASTE2ROAD.

Examples of waste tested in the project (AD = anaerobic digestion, MSW = municipal solid waste).

Contaminated wood, roadside grass, food waste collected from households are examples of waste materials with relevance to Norway. Appropriate waste management techniques for sorting, collection and pre-treatment of waste are needed for increased waste valorisation.

With MANAGEWASTE, we would like to open discussion about how this type of waste can be best utilized in Norway, what are the current solutions, is there a need for alternative solutions like biofuel production, and what are the challenges and obstacles. We would like to engage especially with waste management agencies in Norwegian municipalities, but also biogas producers and others with interest in urban organic waste valorisation and biofuels. See *Page 8* in this Newsletter for an overview of our planned dissemination activities.

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Pyrolysis research at BTG

Biomass Technology Group (BTG) is a partner in WASTE2ROAD and a pioneer regarding development of new projects, programs and business opportunities in the field of bio-energy with a strong expertise in pyrolysis.

Small (5 kg/h) and pilot scale (200 kg/h) pyrolysis units are used to convert biomass residues into liquids. Several hundred feedstocks have been tested in the last decades, generating data for commercial roll-out. Specific feedstocks within WASTE2ROAD are clean wood, contaminated wood, sunflower husk and roadside grass.

Dedicated cleaning processes are under development, including filtration, water removal, sulphur removal, and control of ash levels through dedicated alkali and chlorine removal processes.

Specific attention is to transform the reactive liquids into more stable products. Next to other technologies, hydrotreating of those liquids is topic in WASTE2ROAD. Dedicated small (100 ml volume) and large (6 L volume) continuous operated units are available, able to operate on hydrogen at 200^{+}bar and 400^{+o}C.

BTG's pilot plant for pyrolysis of biomass (200 kg/h)

BTG's 50 kg/day hydrotreater (4-6 L catalyst)

- 24/7 operation
- Ease of operation
- 200^{+}bar; 400^{+o}C; hydrogen
- Each system consists of up to 4 reactor segments (up to 4 or 6 kg catalyst)
- Used in contract research for third parties

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Commercial pyrolysis plants

BTG Bioliquids (BTL) is a partner in WASTE2ROAD and a provider of fast pyrolysis technology to turn biomass residues into a renewable fuel. BTG Bioliquids have built three commercial plants since 2015.

Empyro / Twence (the Netherlands)

Since 2015 our commercial pyrolysis plant Empyro in Hengelo the Netherlands converts 5 tons/hour of wood residues into Fast Pyrolysis Bio Oil (FPBO) on a 24/7 basis. The Fast Pyrolysis Bio Oil is used in a boiler to produce heat at another's customer production site. The sustainable heat is used for producing dairy products and the switch from natural gas to Fast Pyrolysis Bio Oil provides 90% GHG reduction. In 2019 Empyro was sold to Twence, which focuses on the recovery of raw materials and the production of renewable energy.

Green Fuel Nordic (Finland) a true trailblazer

Fuel Nordic in Finland produces Fast Pyrolysis Bio Oil since the end of 2020. Sawdust serves as raw material for the oil production, and the steam released as a result is used sustainably for the internal plant processes. With this first plant in Finland the customer will produce 20 million litres of oil per year that will be used for various offtake customers in Finland and Europe. The customer announced the demand for further Fast Pyrolysis Bio Oil capacity expansion.

Pyrocell (Sweden) from sawdust to tank

In addition to the project in Finland, we started production at another commercial plant at our customer Pyrocell in Sweden. This Fast Pyrolysis Bio Oil will be used at a refinery in co-processing in a fluidized catalytic cracker (FCC) unit for gasoline fuels. Production start is scheduled for the second half of 2021.



From left to right: Empyro plant, Green Fuel Nordic FPBO transport, Green Fuel Nordic plant.

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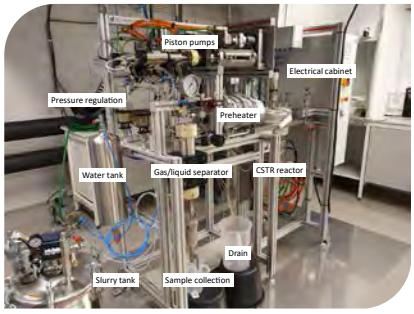
HTL at SINTEF Energy Research

Through the Norwegian national infrastructure project, **NorBioLab2**, SINTEF Energy Research has invested in a continuous lab-scale HTL mini-pilot system, that is installed at the end of 2019 and commissioned in 2020. The mini-pilot has a capacity of maximum 2 L/h slurry feed and operates at state-of-the-art conditions, i.e. up to 500 °C and 350 bar. The reactor is built with a research focus, for studying operational issues, such as fate of inorganics, corrosion and the effect of depressurization on those. The system has the possibility to include stress loaded corrosion samples for material and weld testing under real HTL environment. The mini-pilot is equipped with dual piston pumps and a two-stage depressurization system to study the depressurization effect on the product composition and distribution.



From left to right: Reactor with its parts, Sampling, Aqueous phase obtained in sub- and supercritical conditions

Bio4Fuels:

Bio4Fuels is a cross disciplinary research centre, within the Norwegian FME (Environment-friendly Energy Research) programme. The HTL activities include establishment of a simple and easy-to-operate continuous research reactor, studying feedstock effects and inorganic chemistry as well as samples production for the catalytic upgrading activities.

BL2F:

BL2F (Black Liquor to Fuel) is a 3-year Horizon 2020 project that will use the Black Liquor produced by pulp-and-paper mills to create an end-to-end production chain, producing a biofuel ready to be used in plane and ship engines. SINTEF Energy Research activities include study the corrosion of metal alloys and welds in real HTL environment.

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Webinar on Life Cycle Costing

WASTE2ROAD has recently organized a webinar on **Life Cycle Assessment, Life Cycle Costing and Techno-Economic Assessment** of bio-based processes. Four expert speakers from academia and industry were invited. If you are interested, the presentations from the webinar are available at the WASTE2ROAD website under News and Events.

PROGRAM

09:00 Introductions and overview of Waste2Road

09:00 Welcome and introductions, *Mieke Nieder-Heitmann, Chair and WP5 leader, Process Design Center*

09:05 Overview of Waste2Road, *Jana Chladek, Waste2Road Project Manager, SINTEF*

09:20 Workshop Presentations

09:20 Bio-based value chains in LCA, *Matthias Stratmann, Head of sustainability, Nova- Institut*

09:45 Techno-economic analysis – essential guide in sustainable process development, *Hank Vleeming, Chief Technology Officer, Process Design Center*

10:10 WASTE2BIO project: Valorization of urban wastes to new generation of bioethanol, *Marcos Latorre, Innovation Project Manager, Perseo Technology*

10:35 *Coffee break*

10:55 Integrating Life Cycle Costing and LCA: a focus on food waste prevention and valorization, *Fabio de Menna, Researcher, University of Bologna*

11:20 Panel discussion

11.20 Life Cycle Costing, *Hans Keuken, Chief Executive Officer, Process Design Center*

11:55 Concluding remarks

12:00 End of Workshop

Life Cycle Costing Webinar, September 22nd 2021

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MANAGEWASTE – Project Identity

The project is funded by the Research Council of Norway, through the programme "Supplementary Funding for Norwegian Participants in Horizon 2020 projects". Its aim is to share findings of WASTE2ROAD with the Norwegian community to achieve greater impact of the project in Norway

Duration

February 2021 – January 2023

Partners

SINTEF and Renovasjons- og gjenvinningsetaten (REG) in Oslo Municipality

Contact

Jana Chladek, jana.chladek@sintef.no

Planned activities

- Establishment of network of Norwegian stakeholders with interest in waste management and biofuels
- Newsletters
- Organization of workshops
- Participation at national conferences
- Project video

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WASTE2ROAD – Project Identity

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Renovasjons- og gjenvinningsetaten

Website https://www.sintef.no/waste2road/

Consortium

SINTEF, btg bioliquids, PDC Process Design Center, cnrs, TU WIEN, CRF, Oslo, btg biomass technology group, cea, OMV, VTT

Advisory Board of WASTE2ROAD

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