

REQUEST FOR PROPOSALS

HYDROTREATING TEST ON HYDROTHERMAL LIQUEFACTION BIOCRUDE SAMPLES

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RE-CORD

Viale Kennedy 182

50038 Scarperia (FI) - ITALY

VAT n. 06099990480

www.re-cord.org

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1 BACKGROUND

RE-CORD is partner of the H2020 HEAT-TO-FUEL project (www.heat-to-fuel.eu). The project started in 2017 and focuses on combining different technologies for producing biofuel for the transport sector. Figure 1 depicts the block diagram of the whole HTF process: residual biomass is thermochemically converted via a dry and a wet route. The dry route consists in gasification and Fischer-Tropsch, while the wet one involves hydrothermal liquefaction (HTL) and aqueous phase reforming (APR) of the HTL aqueous phase. The purpose of APR is to produce H₂ from the water-soluble organics trapped in the HTL aqueous stream for biocrude upgrading. Leveraging the synergies between technologies, total process efficiency is optimized.

During the project, RE-CORD has carried out a thorough experimental campaign for the hydrothermal conversion of lignin-rich material from a demo cellulosic ethanol plant, producing a biofuel precursor (biocrude) for upgrading and aqueous phase for aqueous phase reforming.

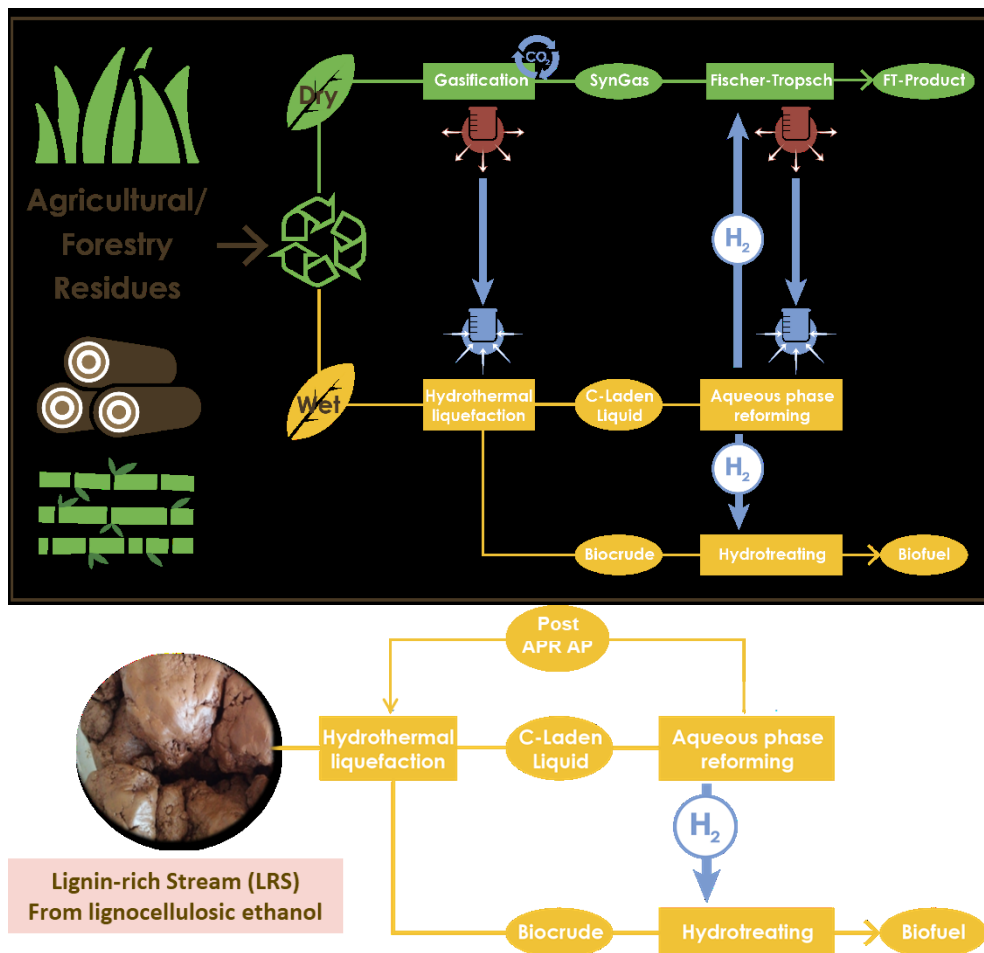


Figure 1: Heat-to-Fuel process and detail of the HTL+APR section.

2 OBJECTIVES

Within the HTF project, RE-CORD is tasked with the hydrothermal conversion of lignin-rich residues from cellulosic ethanol (ultimate feedstock: poplar) into a fungible biofuel precursor for the production of a slate of transportation fuels.

To determine the biofuel production potential, RE-CORD is seeking a third-party CONTRACTOR (either individual research institutions, SME or associations thereof) to perform the upgrading on its biofuel precursor (the SERVICES) by means of a high-pressure, high temperature catalytic process in the presence of hydrogen (hydrotreatment), in order to maximize the production of biofuel’s components for the transportation sector.

3 SCOPE OF WORK

The SERVICES will involve all activities related to the selection of a reference catalytic formulation for the hydrotreating of biocrude from lignin-rich co-product, identification of two additional catalyst formulations, batch hydrotreating tests with the three catalysts and scale up of the test with the better performing one in a continuous pilot unit.

A list of detailed specific SERVICES, including additional information and requested due date for presentation of deliverables is given in Table 1.

Table 1. Specific SERVICES, additional descriptions and due dates.

Item No.	Services Required	Additional Description	Due date (from start)
1.	Catalysts identification	<ul style="list-style-type: none"> The CONTRACTOR is required to identify and facilitate the acquisition by RE-CORD of a minimum of 3 catalyst formulations for hydrotreatment of HTL biocrude (1 reference catalyst + 2 additional formulations). Catalysts should be selected with the aim of maximizing the yield of products in the range of transportation fuels. The amount of catalysts shall suffice for the conduction of batch hydrotreating trials (item n.2), and also for the test covered by item 3 for the selected catalyst (continuous trial for the better performing catalyst). The CONTRACTOR shall advise on which catalyst will be used to benchmark the catalysts formulations covered by item 1. Characterization of catalyst before and after tests shall include at least the following: XRF/XRD, SEM-EDX, ICP-OES, BET, TPR, unless prohibited by the catalyst(s) manufacturer(s) by their adhesion contracts with the CONTRACTOR or RE-CORD. 	End of month 2

Item No.	Services Required	Additional Description	Due date (from start)
2.	Batch hydrotreating test	<ul style="list-style-type: none"> • Aim of batch testing is the identification of optimal operating conditions; • Testing of a reference HT catalyst (e.g. sulfided NiMo or CoMo) as benchmark and additional catalysts shall be performed. • Conversion products shall be characterized to assess performance and yield; given the reduced amounts generally available in batch testing and the complex recovery procedures, analyses providing insight on C balance and boiling point distribution of liquid products shall be prioritized. • Characterization of products shall include at least the following: 1. yield of liquid organic phase 2. hydrogen consumption (in terms of H₂/feed or H/C) 3. deoxygenation of the organic phase (in terms of O/C) 4. HHV of the main product. • In addition to the point above, and whenever technically possible, also CHNOS (on solid, liquid), SIM-DIST (on liquid), gas analysis shall be carried out on products. • Catalyst characterization for heteroatom detection (XRD, SEM-EDX, ICP-OES) and surface measurements (BET and TPR) will be carried out to provide assessment on catalyst stability, leaching and poisoning, unless prohibited by the catalyst(s) manufacturer(s) by their adhesion contracts with the CONTRACTOR or RE-CORD. • Minimum of 3 HT experiments in duplicate in batch reactor, for a minimum amount of 2 g of biocrude processed in each replicate. • Any deviation from the above lists shall be agreed with and authorized beforehand by RE-CORD. 	End of month 4

Item No.	Services Required	Additional Description	Due date (from start)
3.	Continuous hydrotreating test	<ul style="list-style-type: none"> Following the batch experiments, validation of the process will be done by testing in a continuous HT set-up. Conversion products will be characterized to assess HT performance, process yield and properties of liquid product. Catalyst characterization for heteroatom detection (XRD, SEM-EDX, ICP-OES) and surface measurements (BET and TPR) will be carried out, which are used to estimate catalyst stability, leaching and poisoning, unless prohibited by the catalyst(s) manufacturer(s) by their adhesion contracts with the CONTRACTOR or RE-CORD. Minimum of 1 HT experiment in duplicate in continuous reactor for a minimum amount of 40 g of biocrude processed in each replicate. Any deviation from the above lists shall be agreed with and authorized beforehand by RE-CORD. 	end of month 5

The CONTRACTOR shall be required to provide all the internal and external human resources to fulfil the services required, at its own cost.

The CONTRACTOR may use external services for laboratory analysis or any other service need to the execution of the services required. In such a case, confidentiality on information and results shall therefore be extended at the contracted external parties under CONTRACTOR's responsibility. Prior approval of external parties shall be granted by RE-CORD in writing.

The CONTRACTOR shall be required to provide its own tools and equipment for the satisfactory performance of the SERVICES indicated above.

For the experimental activity covered by item n. 2 and n. 3 of Table 1, the CONTRACTOR is required to elaborate an experimental plan that shall be discussed with and approved by RE-CORD before execution.

RE-CORD will supply the biofuel precursor samples in sufficient amount for all the stages of the work (up to 700 g of biocrude), and will cover the costs for catalysts for the upgrading work up to 8000.00 € (eight thousands/00) excl. VAT. The CONTRACTOR shall facilitate the acquisition of the three catalysts for the experimental work that will be paid for by RE-CORD and support with its know-how and expertise the selection of the catalysts as part of item 1 of the scope of work.

4 DELIVERABLES

The main deliverables of the project are:

- Report on the selection of catalysts formulations, to be delivered by the end of the 2nd month;

- Results from batch HT test, to be delivered by the end of the 4th month, including characterization of HT products;
- Results from continuous HT test, including characterization of HT liquid product and spent catalyst, to be delivered by the end of the contract (end of the 5th month);
- Minutes of each meeting held in person or remotely with RE-CORD, to be delivered within 3 days from the conclusion of each meeting.

5 TIMELINE

The contract has a duration of up to five (5) months, commencing at signature of the contract and ending on the 30th of March 2022 the latest.

The CONTRACTOR will be required to discuss the project progresses by mail and/or joint video or telephone conference with the project team at RE-CORD. Note that primary deliverable and all communication with RE-CORD is to be in English. The CONTRACTOR will be required to have regular calls (every other week) with RE-CORD to exchange views, discuss draft products and update on the advancement of the work. Drafting of minutes of meetings will be under the responsibility of the CONTRACTOR.

6 RESPONSES TO THE RFP

CONTRACTOR must provide an all-in, fixed cost proposal in the prescribed format below in respect of the services to be provided for, from the commencement of the contract. Respondents are requested to submit the following as part of their proposals:

- High-level technical proposal (not to exceed four (4) pages) detailing the scope of work and deliverables including a work plan. Applicants are encouraged to describe any innovations/added value propositions that they feel would enhance the scope of work requirements. All the materials received will be treated as confidential and won't be disclosed.
- Cost proposal/budget, divided in: 1) batch hydrotreating experiments, 2) continuous hydrotreating experiments, 3) miscellaneous. For each member of the consultant's team, the total expected person months allocated to the proposal shall be duly indicated.
- Description of how the consultant would avoid any potential conflict of interest in undertaking the described scope of work.
- Description of the hardware, software and facilities that will be used in the implementation of the proposed workplan.
- 1-page summary of qualifications of consultant or consulting team and management, and separately appended resumes/CVs (not to exceed two pages each).
- The service proposal shall include a confirmation that the CONTRACTOR is in the position to meet all of the RE-CORD's requirements as set out in this scope of work, together with details of all equipment being provided for the performance of the services.

Respondents should feel free to submit clarifying questions to andreamaria.rizzo@re-cord.org on any of the above, mentioning in the subject the text "[RFP 01-21]".

All application materials submitted to RE-CORD will be kept confidential, and must be submitted via email to info@re-cord.org by Friday, 22 October 2021 17:00 CEST. RE-CORD will set up interviews of

short-listed candidates and/or request clarifying information by 27 October with the aim to finalize selection by end of October.

7 AWARD

An Evaluation Committee composed by Prof. David Chiaramonti (Polytechnic of Turin/RE-CORD), Prof. Samir Bensaid (Polytechnic of Turin), and Dr. Andrea Maria Rizzo (RE-CORD) will evaluate and rank the submitted proposals. The successful and unsuccessful tenderers will then be informed on the award decision on writing, simultaneously and individually.

Once the bidding process will be concluded, and tenderers will have received formal communication of the outcome, RE-CORD will provide the awardee with a draft contract that will have to be finalized within 15 days from the reception of the formal communication.

All documents submitted as part of this contract are confidential. The results from the CONTRACTOR's work could be published in open access papers or presented at conference events after approval from the Heat-to-Fuel project partners and discussion with the CONTRACTOR.

8 SELECTION AND EXCLUSION CRITERIA

The main criteria set out for the selection or exclusion of the tenderer are:

- Operational capacity to carry out the work, including declaration of operability of the specific installations and facilities at the time of submission of the proposal;
- Explicit commitment to complete the assignment on time and on budget;
- Demonstrable previous experience on comparable assignments;
- Relevant patents or publications;
- Capacity of the CONTRACTOR to organize the services required in full autonomy, with its own internal resources or contracting consultants and third-party companies for specific services required at its own cost.

9 LEGAL NATURE OF RFP

This RFP is an invitation for proposals and RE-CORD is under no legal obligation to accept any proposal nor proceed with the RFP. RE-CORD reserves the right to amend the requirements at any time.

10 OWNERSHIP OF RESULTS AND PUBLICATION POLICY

With the exclusion of the catalysts formulations and related IPR, ownership of the results obtained as part of the work carried out by the CONTRACTOR is of RE-CORD.

With the exclusion of the development of catalysts formulations, any patent application stemming from the work carried out by the CONTRACTOR will need to be authorized by RE-CORD, that under all circumstances will be the ultimate owner of the patent.

RE-CORD encourages the submission of joint scientific papers or conference posters/presentations stemming from the work covered by the present RFP; any initiative in this respect taken by the CONTRACTOR shall be authorized in writing by RE-CORD beforehand.

**11 INSURANCE/RESPONSIBILITY FOR INJURY TO CONTRACTOR'S
STAFF AND/OR THIRD PARTIES.**

CONTRACTOR shall bear responsibility for injury to CONTRACTOR's staff and/or Third Parties and hence, upon request, shall provide appropriate evidence of insurance as required by law to cover the risk of injury to the CONTRACTOR's staff and/or any third parties such as RE-CORD's staff who may be injured accidentally during the course of operations.