PYROBIOFUEL

LEAP-RE

Long-Term Joint EU-AU Research
and Innovation Partnership on Renewable Energy

The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

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Consortium

Project coordinator:

- *Cairo University, Egypt*

Project partners:

- *Cairo University, Egypt*
- *Ibn Tofail University – Research Institute for Solar Energy and New Energies (IRESEN), Morocco*
- *Uni. Witwatersrand, South Africa*
- *Brandenburg University of Technology, Germany*
- *CNRS PIMM, France*

Aim of the project

Create a unique knowledge infrastructure that supports decentralized, sustainable, and cost-efficient conversion of biomass to sustainable fuels, relevant to both Europe and Africa

Relevance vs MARs

MAR3: Smart stand-alone systems

PyroBioFuel will design and validate innovative processing technologies, including a compact catalytic Fischer-Tropsch synthesis (FTS) reactor and hydrocracking (HCR) reactor that will increase the efficiency of the fuel conversion process

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Key challenges addressed by the project

1. *Increase availability of advanced biofuels and energy in the EU and Africa through reliable, inexpensive, stand-alone system architectures that can be easily deployed in off-grid rural and remote areas*
2. *Introduction of tailored technologies, using local renewable sources and for local use of population and economy*
3. *Strengthen European and African technology base and accelerate development of sustainable fuels to replace fossil alternatives*
4. *Development of technical and managerial competences and capacities in the area of biomass conversion and renewable energy generation*

Expected results :

- ***Mid-term expected results (end 2023)***
  - *Optimization of pre-treatment techniques for palm waste in Egypt and Morroco*
  - *Synthesis, characterization and optimization of highly efficient catalysts for FTS, HCR and bifunctional FTS-HCR at small-scale*
  - *Development of a combined experimental-modelling approach for the microchannel reactors for integrated FTS-HCR*
  - *Techno economic analysis and Life cycle assessment launch*
- ***End of project expected results (2025)***
  - *Optimization of pyrolysis process conditions at bench scale focused on products' quality along with characterization of pyrolysis products*
  - *Valorization of the produced biochar in wastewater treatment*
  - *Synthesis and characterization of highly efficient FTS-HCR catalysts at meso-scale, able to reach 70% conversion to fuel*

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End of project expected results (2025) (Cont'd)

- *Implementation of designed catalysts into MCR at lab scale*
- *Experimentation of pyrolysis at the micro-scale and at the laboratory scale accurate material/products balance and kinetics determined and with scaling laws for large scaling projects.*
- *Numerical modeling of the processes that will allow optimal cost, products output and efficiency calculation for life cycle analysis (LCA)*
- *Validation of the integrated biomass to fuel conversion technologies on pilot scale*
- *Techno economic analysis (TEA) and LCA for European and African case studies based on region specific feed-stocks, costings, and scale impact*
- *Socio-economic impact study of biomass pyrolysis*

- *Successful completion of 1 PhD thesis*
- *Successful completion of 1 postdoctoral training*
- *Submission of at least 8 publications to high-impact peer-reviewed journals*
- *Successful hosting of 5 workshops on:*
  - *"Showcasing modelling in the Bioenergy Industry"*
  - *"Use of hybrid FTS/HCR technologies in the Bioenergy Industry"*
  - *"Environmental and LCA assessment of biomass pyrolysis"*
  - *"Bioenergy Industry promoting Gender equity and SMEs development"*
  - *"Integrated PyroBioFuel technology"*

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Expected outcomes in case of success of the project (2030)

What could be the impact of the project at 2030 on the economy and/or society in case of scaling up the results of the project ?

1. ***Development of technology advances that significantly contribute to increasing the viability of advanced biofuels and energy in the EU and Africa through reliable, inexpensive, stand-alone system architectures that can be easily deployed in off-grid African rural and remote areas***
2. ***Wider availability of energy, reduced time collecting fuel, reduced home labour for women who can pursue other activities, health benefits of clean energy***
3. ***Carbon footprint and reduction of GHG emissions***
4. ***New market opportunities***

Which main risks of failure during project implementation ?

Describe the main risks identified for project implementation

1. ***Delay in the acquistion of the experimental setup***
2. ***Low performance of equipment*** *– Operation will be modulated to boost performance*
3. ***Required data not available from within the project, e.g., composition of the pyrolysis products*** *– Use of literature data and gases from bottles for catalyst development. Once data is available from partners, stability and efficiency of the catalysts will be tested*
4. ***Capital cost of the WP5 demonstrator is higher than estimated in the proposal*** *– Cost breakdown will be revised and presented to the PyroBioFuel partners for decision proposing to contribute to cover unforeseen costs for this crucial activity, proportionally to their budget*
5. ***Failure to develop suitable multifunctional FTS-HCR catalyst*** *– Use of noble-based metals or separate FTS and HCR microreactors*

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Contribution of the project to AU – EU R&D cooperation

Exchange knowledge through targeted research activities between partners from the EU and Africa to develop the technology state-of-the-art, strengthen the European and African technology base and accelerate the development of sustainable fuels to replace fossil alternatives

Interest of Consortium members in participating in LEAP-RE clustering activities

- *Optimization of pyrolysis technologies for different feedstocks*
- *Combination of the microchannel reactors with other technologies for biomass valorization (e.g., gasification, anaerobic digestion)*
- *Use of microchannel reactors for the production of other types of energy carriers (e.g., hydrogen)*
- *Combination of PyroBioFuel technologies with renewable energy generation solutions*
- *Development of model-based decision-making tools to aid process assessment and increase operational efficiency, as well as through country-specific techno-economic studies and life cycle assessments for different feed-stock/product scenarios*