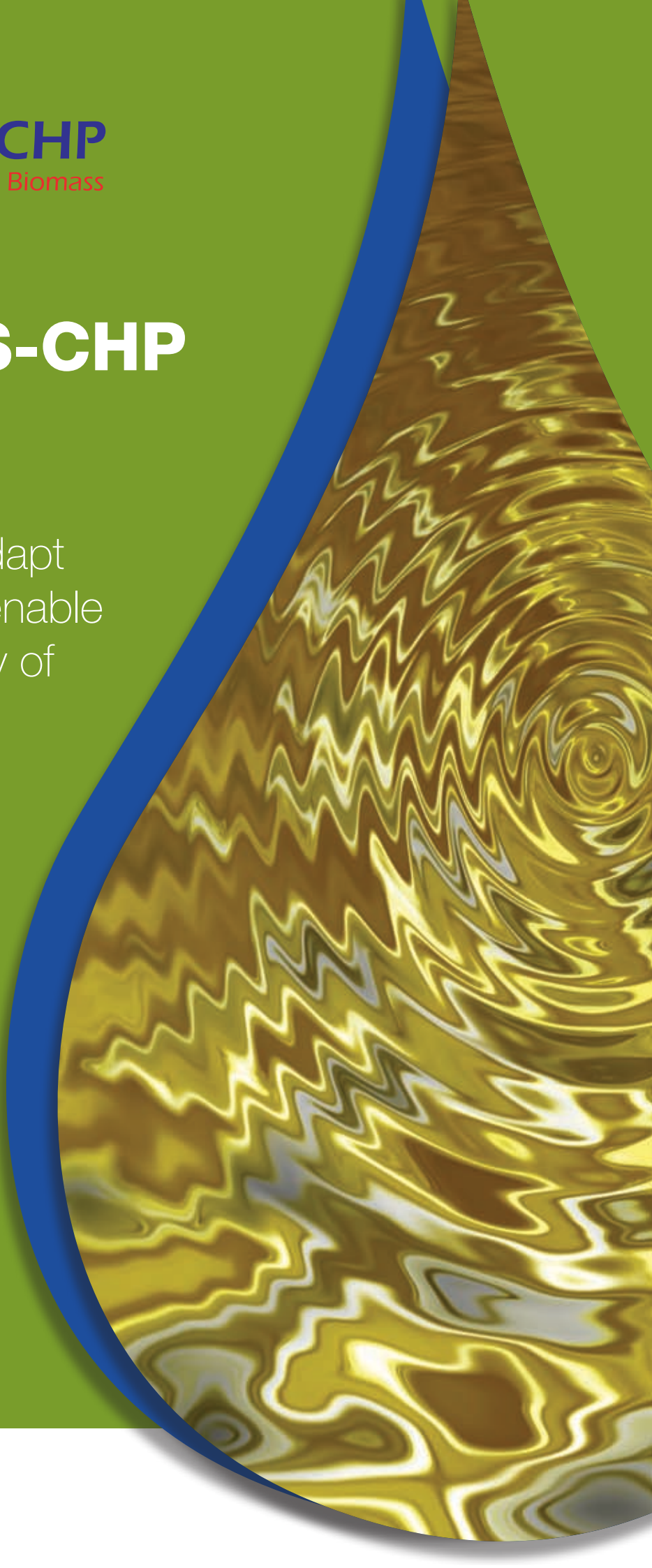
Bioliquids-CHP
Power generation from Biomass

BIOLIQUIDS-CHP



Our objective is to adapt engines/turbines to enable operation on a variety of bioliquids, including pyrolysis liquids.

PARTNERSHIP

BTG Biomass Technology Group BV
Netherlands (Coordinator)

Aston University Bioenergy Research Group
United Kingdom

Boreskov Institute of Catalysis of the Siberian Branch of the Russian Academy of Sciences (BIC)
Russia

Encontech BV
Netherlands

Federal State Unitary Enterprise, Central Scientific Research Automobile and Automotive Engines Institute (FSUE NAMI)
Russia

The Likhachev Plant (AMO ZIL)
Russia

University of Florence, CREAR (The Research Centre for Renewable Energy)
Italy

EUROPEAN COMMISSION
SEVENTH FRAMEWORK PROGRAMME

Coordinator – BTG Biomass Technology Group BV

CONTRIBUTIONS

Production of fast pyrolysis liquids for testing in engines and blending with other bioliquids.

Analysis of fast pyrolysis liquids to support the testing of bioliquids and blends.

Upgrading of fast pyrolysis liquids to improve their properties with respect to direct combustion in an engine or turbine, and to making blends and emulsions. Upgrading activities include filtration, dewatering, mild treatment, catalytic pyrolysis, production of blends and emulsifications.

Development of engine components that are tolerant to bioliquids mixtures and upgraded oil.

Project coordination.

Project dissemination and exploitation.

EXPERIENCE AND FACILITIES

BTG Biomass Technology Group BV is an SME, which for the past 30 years has specialised in the conversion of biomass into biofuels and bioenergy. BTG's two business units, Consultancy and Research and Technology Development (RTD), work in synergy and ensure innovative and commercially feasible activities.

BTG started its fast pyrolysis developments in the 90's with a new reactor concept, which has been continuously optimised in its dedicated research lab where several test facilities are available. BTG fast pyrolysis developments have resulted in several patents, which are now commercially exploited by its daughter company BTG-BTL.

BTG has extensive experience and is deeply involved in European bioenergy research and development (R&D) programmes, as it is or was project coordinator or partner of various biomass pyrolysis R&D projects since the Fourth Framework Programme.

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CONTRIBUTIONS

Awareness and dissemination plan for outputs from the project to publicise the project and results.

Exploitation plan for outputs from the project to accelerate the rate and success of key project results.

Production of fast pyrolysis liquids for testing and blending with other bioliquids.

Analysis of fast pyrolysis and other bioliquids to support the testing of bioliquids and blends.

Techno-economic assessment of CHP technologies up to 1 MWe including comparisons with other heat and power technologies.

EXPERIENCE AND FACILITIES

Aston University Bioenergy Research Group (BERG) was formed to focus on research in bioenergy. It is one of the largest academic research groups in thermochemical bioenergy in the world. Over £20 million of funding has been won for Aston University from a variety of sources including the European Commission, EPSRC, UK government and industry, and international organisations.

The most significant current activity is leadership of the SUPERGEN Bioenergy Consortium for a second term of four years to 2011. In addition there are a number of major European projects including a large integrated biorefinery project – Biosynergy – in which Aston is playing a core role; the Bioenergy Network of Excellence in which BERG is a core member; and a substantial EC sponsored collaborative project with Latin America – Dibanet.

Further major contributions to the subject area have been in the organisation and chairmanship of international conferences including the peer reviewed series on thermochemical biomass conversion in 1988, 1992, 1996, 2000 and 2004.

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Partner – Boreskov Institute of Catalysis (BIC)

CONTRIBUTIONS

Catalyst development and testing for pyrolysis oil upgrading.

Catalyst and reactor development for diesel oil and bio-oil ATR conversion in synthesis gas.

Catalyst research and screening for De-NOx.

Testing of selected ATR and De-NOx catalysts.

Catalyst manufacturing and exhaust gas cleaning system development.

Participation in diesel engine and exhaust gas cleaning system testing.

EXPERIENCE AND FACILITIES

With more than 1000 staff, BIC is the largest specialized catalysis institute worldwide; carrying out fundamental and applied catalysis investigations. It is experienced in the preparation and testing of catalysts, and in developing chemical reactors for synthesis gas generation by steam conversion; autothermal reforming and partial oxidation; hydrogen production from syngas; methanol and DME synthesis from syngas; and biofuel upgrading.

BIC's scope of work ranges from fundamental problems of catalysis, to the design of new catalytic processes and industrial-scale catalyst production. It also performs studies on fundamental catalysis, including studies of catalyst structure and formation mechanisms, kinetic studies and mathematic modelling of catalytic processes.

Its potential for applied catalysis enables the development of the next generation highly-efficient catalysts for the chemical industry and oil processing; catalysts and technologies for new application areas; new catalytic systems and processes for synthesis and composites with predetermined properties; and catalysts and technologies for detoxication of technogenic wastes.

MAIN CONTACT

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Partner – Encontech BV

CONTRIBUTIONS

Liaison between European and Russian project partners.

Development of a novel external combustion single-piston engine for combined heat and power production. The engine is coupled with an alternator and fuelled with pyrolysis oil. The development includes design and construction of the engine and experimental facilities for its testing, as well as experimental and theoretical study of the engine. The engine is expected to be a valuable alternative to Stirling engines.

EXPERIENCE AND FACILITIES

Established in 2008, Encontech BV is a high-tech company, engaged in the research and development of invented chemical reactors and prime movers.

The highly innovative reactors, known as pulsed compression reactors, are based on the principle of compressive heating and subsequent expansive cooling, and allow chemical reactions at plasma chemistry temperatures and very high pressure in a very energy efficient way. During the next five years (2010-2015), the company aims to breakthrough hydrocarbon cracking and reforming processes - the most energy and capital intensive processes in chemical and fuel industries.

The prime movers utilize the same reactor principle and are developed for combined heat and power production (CHP) systems in micro and small power ranges, and act as valuable alternatives to Stirling engines, gas engines, fuel cells and gas turbines.

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Partner – FSUE NAMI

CONTRIBUTIONS

Development of engine-based power plant for heat and power generation.

Modernization of primary engine generator for conversion of biofuels into energy.

Development of power plant for heat and power generation.

Manufacture of power plant for heat and power generation.

Testing of engine-based power plant for heat and power generation.

Feasibility study and estimation of the market potential of the product.

EXPERIENCE AND FACILITIES

FSUE Central Scientific Research Automobile and Automotive Engines Institute (FSUE NAMI) has all the necessary technical, technological and computer means to provide fundamental, theoretical and applied testing, construction, manufacture of automobile equipment, internal combustion engines, its units and assemblies, as well as traditional and alternative fuels and power generators.

Concentration of research based capabilities and highly skilled specialists inside NAMI allows the Institute to be a leader in the field of oriented fundamental theoretical developments, innovative developments and certification of automobile equipment against Russian and international standards.

Based on its experience, NAMI meets objectives which guarantee successful project implementation including: theoretical and experimental research to create high efficiency and low toxicity working processes of automobile engines with internal and external mixing; development of an improved scientific basis for vehicles and engines design; theoretical and experimental research to create feeding systems for diesel engines to operate on alternative fuels; analysis of the energetic and economic efficiency of alternative fuels; and creation of multi-purpose power plants, working on alternative fuels.

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Partner – The Likhachev Plant (AMO ZIL)

CONTRIBUTIONS

Execution of patent searches.

Testing of power plant units.

Participation in assembly of power plant for heat and power generation.

Participation in testing of engine-based power plant for heat and power generation.

EXPERIENCE AND FACILITIES

AMO ZIL (trademark 'ZIL') is the oldest Russian automobile plant. Since its establishment in 1924, ZIL has produced a wide range of vehicles including trucks, buses and high-class automobiles.

Nowadays, the company is developing dynamically. ZIL produces a wide range of trucks, vans, buses and limousines based on the ZIL chassis. The company also manufactures specialized vehicles and equipment including ambulance cars, fire trucks, emergency repair vehicles and cross-country 4x4 etc.

ZIL recognizes the importance of quality improvement and continuously implements new devices in its products. This has resulted in exponential growth over the last five years. Most vehicles have a complete range of modifications and options available to suit customers' needs.

The market for stationary diesel engines for power production is considered by ZIL to be a potentially huge, new market where their automobile engine expertise could be of high value. ZIL is looking forward to working with NAMI in developing new technologies and products.

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Partner – University of Florence, CREAR

CONTRIBUTIONS

Education & training: activities dedicated to students and technicians, addressing the research issues investigated during the Bioliquids-CHP project.

Gas turbine adaptation and testing: microgasturbines represent a promising and environmentally friendly technology for biofuel use, but minor/major adaptations are needed to assure proper operation.

Pyrolysis oil upgrading: among various options, emulsification is a possible method to improve the chemical-physical characteristics of pyrolysis oil. CREAR investigates this technique in collaboration with CSGI (Centre for Colloid and Surface Science).

EXPERIENCE AND FACILITIES

CREAR, directed by Prof. Ing. F Martelli, merges several Departments of the University of Florence into a single multidisciplinary research body (led by the Energy Engineering Department). Through its members, CREAR is active in biomass and bioenergy research, as well as in other renewable energies, and currently coordinates and participates in several EU and national supported projects.

Research work is undertaken in the field of biomass production: lignocellulosic bioethanol (e.g. lignin rich stream energy valorization); small scale biomass power plants (either combustion, pyrolysis or gasification based); pure and reconstructed (esterified) vegetable oils; and algae biofuels (technologies for algae cultivation and energy conversion). In 2011, CREAR will complete the set up of a laboratory almost fully dedicated to bioenergy.

CREAR is involved with various national and international renewable energy organisations including EABA (European Algae Biomass Association); ISES-Italia (Italian Section of the International Solar Energy Society); IEA-Bioenergy (International Energy Agency); SIBA (Italian Society of Bioenergy and Agroindustry), as well as the EU and Italian platforms on biofuels.

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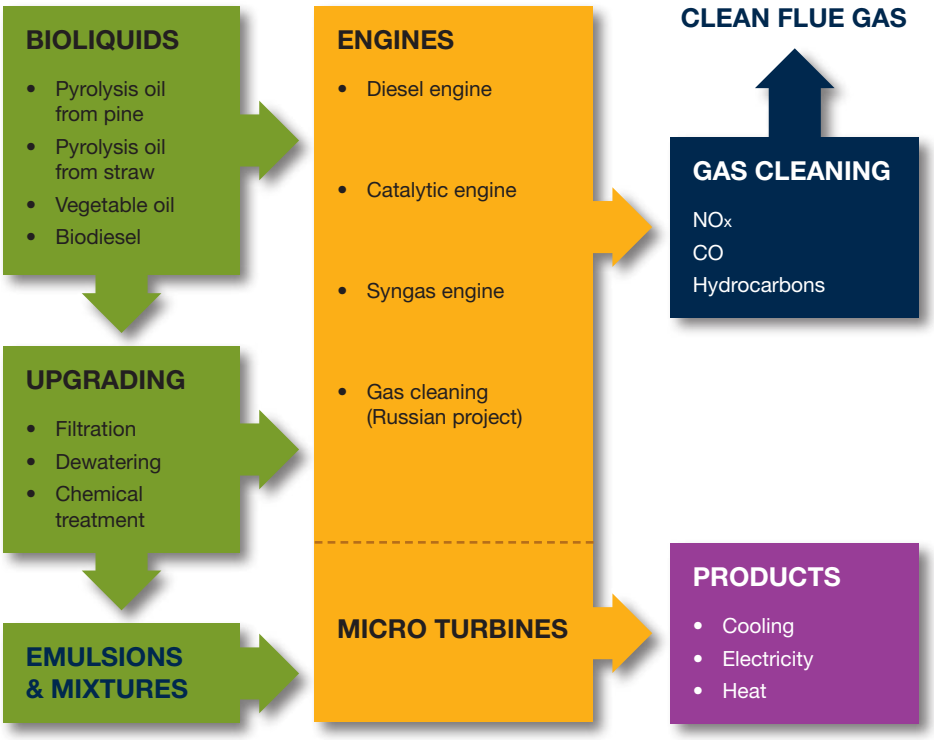
PROJECT OBJECTIVES

- To upgrade bioliquids and to prepare blends/emulsions of bioliquids to enable their use in engines/turbines;
- To find a technical and economic optimum between fuel upgrading and engine/turbine modification;
- To develop methods/techniques to control exhaust emissions (NOx, CO, particulates);
- To evaluate the complete chain (sustainability, economics, technology, environment, market opportunities) for application in EU & Russia.

EXPECTED STRATEGIC IMPACTS

- Increase in cooperation between Europe and Russia in the field of power generation from biomass;
- Increase in electricity production from biomass by reducing bio-oil production prices and by improving bio-oil quality;
- Reduction of costs of electricity production from biomass;
- Adaptation of existing technologies (bio-oil production, diesel engines and CHP-units) so that they can be used together;
- Improvement of the environment, quality of life, as well as health and safety.

PROCESS DIAGRAM



Bioliquids-CHP is implemented by the European-Russian consortium through the federal programme 'Research & Development in the priority areas of Russia's science and technology 2007-2012'. It is co-funded by the European Commission through the Seventh Framework programme and the Federal Agency for Science and Innovation (FASI), with each party providing approximately EUR 2 million. The project started in January 2009 and will end in December 2011.

Funding Organisations

FEDERAL AGENCY FOR SCIENCE AND INNOVATION (FASI)

The Federal Agency for Science and Innovation of the Russian Federation (Rosnauka or FASI) is a governmental funding agency responsible for the practical implementation of state policy in the field of science and technology (S&T). Rosnauka's functions include forecasting and planning S&T development, funding R&D and innovation activities, creation of R&D and innovative activity infrastructure, as well as development of relevant international cooperation on both a bilateral and multilateral basis. It coordinates the activities of the federal centres for science and advanced technologies, joint research centres and leading scientific schools.

On the government's behalf, FASI runs a number of national programmes, including the Special federal programme 'R&D in priority areas of Russia's science and technology for 2007-2012', which provides support to all stages of the innovation cycle: from knowledge generation through development and demonstration, to market deployment activities. The priority thematic areas are: energy and energy saving; nature management (including climate change); information and telecommunication systems; live sciences; and industry of nanosystems and nanomaterials. It facilitates the collaboration of researchers with industry and business, including public and private partnerships, as well as the cooperation of the Russian organizations with their foreign partners.

EUROPEAN COMMISSION

European Commission - the Seventh Framework Programme for Research and Technological Development (FP7) is the main instrument for funding energy research in the EU and paves the way for implementing the objectives of the Strategic Energy Technology Plan (SET-Plan). FP7 runs from 2007-2013, and EUR 2.35 billion of its 50.5 billion budget is dedicated to non-nuclear energy research. The objective of research projects funded under FP7 is to make energy production and consumption patterns sustainable and secure. This contributes to reducing Europe's dependence on imported fuels and to diversifying its energy mix through the increased use of renewables.

Research funded under FP7 focuses particularly on the following areas: hydrogen and fuel cells; renewable energies for electricity; fuel production and heating and cooling (PV, wind, biomass, geothermal, CSP, ocean and hydro); CO_2 capture and storage technologies from zero emission power generation; clean coal technologies; smart energy networks; energy efficiency and savings; and knowledge for policy making. International cooperation is a key feature of FP7 and is a particular priority in the energy theme, with a variety of instruments used to support collaboration with third countries. A prime example is the EC-Russia Coordinated Call in the field of power generation from biomass, which resulted in the Bioliquids-CHP project.