



## **BIOCLUS – Developing Research and Innovation Environment in five European Regions in the field of Sustainable Use of Biomass Sources**

**Western Macedonia**

**Project 245438**



### **Model for sharing RTD facilities**

**Western Macedonia**

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## 1.1. Model for Sharing Laboratories of the Chemical Process & Energy Resources Institute

### 1.1.1. General Information



Name of research facility, environment of equipment	<p><b>“Laboratories of the Chemical Process &amp; Energy Resources Institute (CPERI)”</b></p> <ul style="list-style-type: none"> <li>• Laboratory of Environmental Fuels and Hydrocarbons (Thessaloniki)</li> <li>• Laboratory of Solid Fuels Technology (Ptolemais)</li> </ul>
Keywords	Solid fuels, liquid fuels, biomass, coal, waste
Address	See below
Tel.	See below
Email:	See below
Description of the research facility, environment or equipment	<p>On March 30, 2012 the Chemical Process Engineering Research Institute merged with the Institute for Solid Fuels Technology and Applications to establish the Chemical Process &amp; Energy Resources Institute (CPERI).</p> <p>Chemical Process Engineering Research Institute, a non-profit research and technological development (RTD) organization was founded in 1985 in Thessaloniki, Greece. CERTH until today is the sole research center existing in Northern Greece,</p>

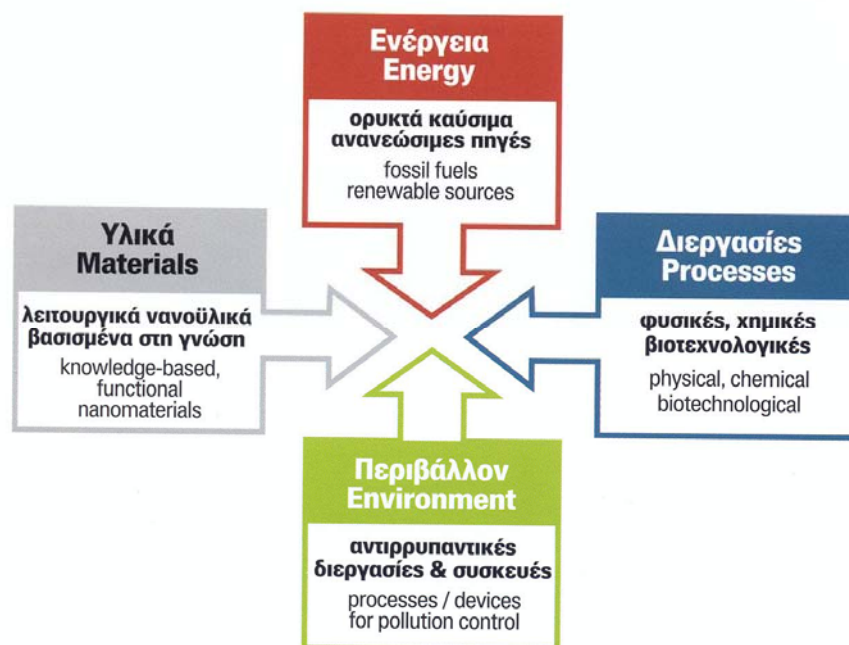
within the regions of Macedonia and Thrace.

The development strategy of CPERI has been based on establishing strategic collaborations with leading international industrial corporations, developing strong links with Research Centers and Universities within the European Research Area (ERA) and contributing to the training of young scientists and engineers in state-of-the-art technologies. Acting as a catalyst of regional development CPERI is also consistently pursuing strong interactions and collaborations with small and medium size enterprises (SMEs) in Northern Greece.

CPERI today extends over 4.989 m<sup>2</sup> of office and laboratory space and possesses 1.797 m<sup>2</sup> of storage space. Throughout its lifetime CPERI has acquired excellent analytical instrumentation and developed state-of-the-art experimental units and setups, valued at several million Euros.

The former Institute for Solid Fuels Technology and Applications (ISFTA) is the main Greek organisation for the promotion of research and technological development aiming at the improved and integrated exploitation of solid fuels and their by-products.

Since its foundation, ISFTA was located on the facilities of an old factory of nitrogenous fertilizers - formerly known as AEVAL - in the area of Ptolemais, Greece. It was in 2007 that the Institute moved finally in its own building – also in the area of Ptolemais.



Main research topics where equipment is

Research Areas

Currently, six laboratories in Thessaloniki (T) and one laboratory in Ptolemais (P),

used	<p>organized into three research and development divisions, are in full operation at the Institute. The activities of the laboratories are supported by a horizontal technical division, which involves the large pilot-plant units and the analytical department. More specifically, the following two laboratories will be described in detail:</p> <ul style="list-style-type: none"> <li>• Laboratory of Environmental Fuels and Hydrocarbons (T)</li> <li>• Laboratory of Solid Fuels Technology (P)</li> </ul>
Special features of the equipment	See below
Techniques and application	See below
Standards used for measurements	See below
Selected R&D references	See below
Access Policy	See below

### 1.1.2. Detailed Information

- **Laboratory of Environmental Fuels and Hydrocarbons (LEFH) (T)**

### Areas of Research and Development



The Laboratory's research activities fall into the following areas:

- Development of an eight reactor pilot scale system for evaluation of hydrocracking catalysts
- Developments of new methods for FCC catalyst deactivation
- New process reaction schemes (catalyst, reactor, operating conditions) for producing fuels from biomass derived feedstocks
- Development of effective separation scheme for the extraction of useful chemicals from bio-oil
- Construction and operation of a prototype multi-fuel processor including biofuels for hydrogen production
- Development of advanced electrode materials for PEMFCs
- New catalytic materials for reactions/processes related to hydrocarbons and biomass conversion, hydrogen production, catalytic abatement of NO<sub>x</sub>, and oxidative dehydrogenation of alkanes
- Novel synthesis routes for the preparation of advanced catalytic materials

## Equipment

The infrastructure and the existing equipment of LEFH can be divided in the following categories:

1. Analytical equipment and methods
2. Laboratory Units
3. Pilot Plant Units





A. ANALYTICAL EQUIPMENT AND METHODS		
	Equipment	Analytical Method
1.	Gas Chromatographer / Mass Spec	CPERI method
2.	H PLC	IP 391
3.	Gas Chromatographer with chemiluminescence detector	ASTM D 5623
4.	Gas Chromatographer for qualitative analysis of hydrocarbons in gasoline	ASTM D 5443
5.	Refinery gas analyzer	ASTM D 5134
6.	Gas Chromatographer for GASOLINE analysis	UOP 539
7.	GC-Simulation Distillation	ASTM D2887
8.	Atmospheric distillation ASTM D 86	ASTM D 86
9.	Distillation at reduced pressure ASTM D 1160	ASTM D1160
10.	Crude oil distillation ASTM D 2892	ASTM D 2892
11.	Elementary Analyzer (C,H,S,N)	ASTM D 5291
12.	Elementary Analyzer (C,H)	ASTM D 5291
13.	Determination of density and specific gravity	ASTM D 4052
14.	Automatic Titrator	ASTM D 1744
15.	Refractometer	ASTM D1218
16.	S-N Analyzer	ASTM D 5453, ASTM D 5762
17.	S Analyzer	ASTM D 4294
18.	Viscometer	ASTM D 445
19.	Determination of vapor pressure of petroleum products	ASTM D 5191
20.	Isoperibol Bombcalorimeter	ASTM D 4809

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21.	Determination of flash point	ASTM D 93
22.	Determination of pour point, cloud point and cold filter plugging point	ASTM D 2500, ASTM D 97 IP309
23.	Micro Carbon Residue Tester (MCRT)	ASTM D 4530
24.	Determination of furfural by UV	Pr EN 214
25.	Laboratory centrifuge	ASTM D 1744
26.	Colour Determination	ASTM D 1500
27.	Stability determination during diesel oxidation	ASTM D 2274
28.	Stability determination during gasoline oxidation	ASTM D 525
29.	Sediment Tester	ASTM D 4870
30.	Determination of Copper Corrosion	ASTM D 130
31.	Aniline Point	ASTM D 611
32.	Existent Gum Analysis	ASTM D 381
33.	Rotary Evaporator	GRACE method
34.	Inductively Coupled Plasma Analyzer (ICP)	-
35.	Hydrogen determination by Nuclear Magnetic Resonance NMR	-
36.	Upgrade of high pressure Liquid Chromatographer	IP 391/95
37.	Upgrade of Gas Chromatographer with chemiluminescence Sulfur detector (sulfur speciation)	-
38.	X-Ray Sulfur Determination	ASTM D 4294
39.	S-N Analyzer	-
40.	Automatic Titrator	-



<b>B . BENCH-SCALE UNITS</b>		
	<b>Equipment</b>	<b>Analytical Method</b>
1.	MicroActivity Testing, MAT unit	ASTM-D32
2.	Fixed bed reactor for evaluation of cracking catalysts at short contact times (SCT-MAT)	CPERI Technology
3.	Steam deactivation of FCC (Steamer)	CPERI Technology
4.	Continuous cyclic deactivation unit (CDU)	Akzo Nobel
5.	Cyclic Propylene Steaming (CPS) deactivation unit	-
6.	Fixed and fluid bed batch reactor systems for DeNOx and DeSOx studies	-
7.	Attrition Unit	-
8.	Gas flow calibration control system	-
9.	Gas low flow calibration control system	-
10.	Portable multifunctional calibrator	-
11.	Small-scale hydrodesulphurization unit	-
12.	A fluid bed (ACE type) Microactivity test (MAT) unit (Automat unit)	-

C. PILOT PLANT UNITS		
	Equipment	Analytical Method
1.	A riser based continuous pilot plant unit for catalytic cracking	CPERI Technology
2.	A two stage high pressure hydrogen processing pilot plant	
3.	Four parallel reactor hydrogen processing pilot plant	BP / AMOCO
4.	FCC cyclic deactivation unit	Grace Davison
5.	A high pressure unit for natural gas conversion to synthesis gas and hydrogen	CPERI Technology
6.	Cold Flow Alkylation unit	CPERI Technology
7.	Cold Flow FCC unit	CPERI Technology
8.	A retort unit for studies related to the upgrading of biomass for bio-fuels and production of organic chemicals	-
9.	A special designed bench scale unit for catalytic biomass flash pyrolysis studies	-

## Services

The Laboratory of Environmental Fuels and Hydrocarbons (LEFH) in collaboration with the Laboratory of Analysis and Characterization of Solids is able to carry out collaborative or contract research on applied catalysis based on the following key competencies derived from the following knowledge base:

- Analytical methods for physical and chemical analysis of gaseous and liquid organic mixtures (GC, GC/MS, PIONA, S speciation in gasoline).
- Analysis and characterization of heterogeneous catalysts.
- Operation and data analysis from bench and pilot scale batch and continuous fixed and fluid bed reactor system.

Based on the above core competencies unique technology has been developed (LEFH is used by BP, HAR, OMV, Akzo/Nobel among others for outsourcing key research and technology services) in the following main areas:

- Fluid Catalytic Cracking (FCC) catalyst evaluation studies
- FCC additives evaluation studies
- Hydrogen Desulfurization (HDS) catalyst evaluation studies

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## Laboratory of Solid Fuels Technology (P)

### Areas of Research and Development

**The Laboratory of Solid Fuels Technology** has as main target the characterisation of solid fuels (coal, biomass and waste).

### Equipment

Equipment	Main research topics where equipment is used	Analytical Method	Photo
Elemental Analyzer (C, H, N, S)  Perkin Elmer Series II CHNS/O Analyzer	Elemental Analysis is employed to determine the C, H, N, S and O content of solid fuels	EN 15104	 A photograph of a Perkin Elmer Series II CHNS/O Analyzer. It is a large, white, rectangular machine with a control panel on the right side. To the left of the machine are two green gas cylinders with various gauges and valves.
Atomic absorption / Shimadzu AA-6300 Atomic Absorption Spectrophotometer with GFA – EX7i Graphite Furnace Atomizer	Atomic Absorption Spectroscopy is a technique for determining the concentration of a particular metal element in a liquid sample. The technique can be used to analyze the concentration of over 70 different metals in a solution.	EN 15290	 A photograph of a Shimadzu AA-6300 Atomic Absorption Spectrophotometer. The machine is white and has a control panel on the right side. A computer monitor is connected to the machine, displaying a software interface. The monitor is on a desk with a keyboard and mouse.
LECO AC-350 isoperibol calorimeter	Determination of the HHV of solid fuels	EN 14918	 A photograph of a LECO AC-350 isoperibol calorimeter. It is a white, rectangular machine with a control panel on the left side. The machine is used for determining the HHV of solid fuels.

<p>TGA Thermostep, ELTRA</p>	<p>TGA is commonly employed in research and testing to determine the absorbed moisture, volatiles and ash content of solid fuels</p>	<p>EN 14774 EN 14775 EN 15148</p>	
<p>Microwave assisted digestion Berghof SW-2</p>	<p>Digestion of solid samples prior to measurements at the AAS</p>	<p>EN 13656</p>	
<p>Durability Tester Andritz, pellet tester</p>	<p>Determination of the durability of pellets</p>	<p>EN 15210-1</p>	
<p>Amandus Kahl, Pelleting Press, for small scale applications</p>	<p>Production of pellets at 100kg/h</p>		

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1.1.3. Sheets to be completed for good cooperation and sharing of RTD facilities

In this section, the information is compiled in 5 chapters by means of a survey. The objective of this survey is to reinforce the efficient use of RTD facilities, and this background information is considered very important for this sharing objective.

1.1.3.1. Part 1: General Information about the Research Group

**A. Name of the Research Group of the applicant:**

**B. Institution/Company**

**C. Address:**

**D. Contact person in the applicant institution:**

1.1 First name	1.2 Last name	1.3 Title and Role	1.4 Gender	1.5 Phone	1.6 Email
			M <input type="checkbox"/> <sub>1</sub> F <input type="checkbox"/> <sub>2</sub>		

**E. Other contact person in the applicant institution:**

1.1 First name	1.2 Last name	1.3 Title and Role	1.4 Gender	1.5 Phone	1.6 Email
			M <input type="checkbox"/> <sub>1</sub> F <input type="checkbox"/> <sub>2</sub>		

**F. Owner of the facility: Company/**

Institution and contact name:

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**G. Main scientific domains of the research group:**

a) Forest biomass	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
b) Agricultural Biomass	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
c) Sustainability	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
d) Waste Biomass	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
e) Supply Chain	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
f) Energy Conversion	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no

g) Biomass Certification. Quality Standards	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
h) 2 <sup>nd</sup> Generation Biofuels	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
i) Liquid Biofuels in general	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
j)	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
k)	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no
l) Other (please specify):	1 <input type="checkbox"/> yes
	2 <input type="checkbox"/> no

**H. Specific dominant scientific domain of the applicant research group:**

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**I. Website of the applicant research group (or research unit or institution):**

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**J. Number of persons employed in the applicant research group, -research, technical, and administration, in July 2012, in headcount units (please tick a box below):**

0-10 <input type="checkbox"/> <sub>1</sub>	10-25 <input type="checkbox"/> <sub>2</sub>	25-50 <input type="checkbox"/> <sub>3</sub>	> 50 <input type="checkbox"/> <sub>4</sub>
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1.1.3.2. Part 2: Uses and Needs of the RTD facility

USES	Which of these techniques does your research group use?		NEEDS	Which of these techniques would your research group like to access? (techniques which are not used or which access is difficult)
	Internal access	External access		
1 <input type="checkbox"/> Pelletizing 2 <input type="checkbox"/> Gasification 3 <input type="checkbox"/> Solid biomass characterization 4 <input type="checkbox"/> 1 <sup>st</sup> Generation Biofuels: sucrose, starch based bioethanol and sunflower, rapeseed oil based bioester 5 <input type="checkbox"/> Other: Pyrolysis	1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/>	<p><b>A.2 What does your research group use these techniques for?</b> Please explain, specify if it is a regular or an occasional need.</p> <p>LEFH is dealing with (4) 1<sup>st</sup> Generation Biofuels on a regular basis.</p> <p>The Laboratory of Solid Fuels Technology is dealing with 1 &amp; 3 on a regular basis and with 2 &amp; 5 occasionally.</p> <p><b>A.3 Please specify how does your research group access these techniques</b> <i>Please explain: i) internal or external access; ii) public or private structure; ii) in your country or abroad</i></p>	<p>1 <input type="checkbox"/> Torrefaction                      2 <input type="checkbox"/> Gasification                      3 <input type="checkbox"/> Fermentation                      4 <input type="checkbox"/> 1<sup>st</sup> Generation Biofuels: sucrose, starch based bioethanol and sunflower, rapeseed oil based bioester                      5 <input type="checkbox"/> 2<sup>nd</sup> Generation Biofuels: cellulose based bioethanol                      6 <input type="checkbox"/> 3rd generation (microalgae oil based bioester)</p> <p><b>A.5 What does your research group need these techniques for?</b></p> <p>In order to enhance the knowledge area and know how of the research group, it was considered as essential to get access to the aforementioned techniques.</p> <p><b>A.6 What are the barriers to access these techniques?</b> <i>Please explain</i></p>

Detailed motivation for using the facility

A. Do researchers, engineers or technicians from your research group have training needs regarding techniques and related skills?

Yes, especially what gasification and gas chromatography is concerned

No

B. Does your research group have other needs for the advance of R&D activities?

Yes - Please explain

No

### 1.1.3.3. Part 3: R&D Collaboration

A. In 2011, did your research group collaborate with other institutions/enterprises in biomass R&D?

(Collaboration involves the active participation of two or more partners in research)

1.1 Local/Regional within your country	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
1.2 National	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
1.3 Other European Union (EU) countries, EFTA, or EU candidate countries*	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
1.4 All other countries	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>

\* Include the following countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.

B. Is your research unit part of one or several technological networks - which one(s)?

Yes, the research group of the **Laboratory of Solid Fuels Technology** in Ptolemais belongs to CPERI, the Chemical Process and Energy Resources Institute with headquarters in Thessaloniki. Currently, six laboratories, organized into three research and development divisions, are in full operation at the Institute in Thessaloniki. The activities of the laboratories are supported by a horizontal technical division, which involves the large pilot-plant units and the analytical department. More specifically, the present organisation of CPERI in Thessaloniki has as follows:

- Laboratory of Environmental Fuels and Hydrocarbons
- Laboratory of Polymer Reaction Engineering
- Laboratory of Natural Resources and Renewable Energies Utilization
- Laboratory of Environmental and Energy Processes
- Aerosol and Particle Technology Laboratory
- Laboratory of Inorganic Materials
- Laboratory of Process Systems Design and Implementation
- Analytical Services Unit

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No

**C. Describe one or two relevant research collaborative projects (possibly involving companies) that your research group has implemented:**

	C.1 project 1	C.2 project 2
a) Main purpose:	Demonstration of biomass co-firing at local power plants	To maximize the efficiency of domestic burners and to lower their emissions
b) Date or period:	2008-2012	2011-2014
c) Partners:	CERTH Greek Public Power Corporation	CERTH Windhager Technik (Austria) DBFZ (Germany) CIEMAT (Spain)
d) Advantages:	Cultivation of energy crops in the region for the co-firing trials	Low emissions of domestic burners Maximum efficiency
e) Disadvantages:	Problems at the power plant (milling, handling of the biomass) Problems with the subsidies and the cost of cultivation (low subsidies – high cost of cultivation)	-

**D. Please describe one or two technical services (outsourced R&D) that you have recently requested: Date, service supplier, purpose, advantages/disadvantages**

	D.1 project 1	D.2 project 2
a) Main purpose:	Ash fusion temperature measurements	
b) Date or period:	2012	
c) Partners:	CERTH Greek Power Corporation	
d) Advantages:		

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e) Disadvantages:	The analyses were performed at non-certified laboratories, thus the results were not reliable.	

1.1.3.4. Part 4: Patents

A. Does your research group have any registered patent?

Yes

No

B. If no, would researchers at your research group consider patenting in the future?

Yes

No

1.1.3.5. Part 5: Additional Information about your Research Group (Optional)

#### 1.1.4. Facility Sharing Agreement Model

No Facility Sharing Agreement model has been included at this stage.