Outline of granted projects in 2010

Programme " Efficacité énergétique et réduction des émissions de CO2 dans les systèmes industriels "

Programme '' Efficacité énergétique et réduction des émissions de CO2 dans les systèmes industriels ''

Call 2010

Project Title	**CERES-2 - Energy Pathways for heat recovery in industrial processes**

Abstract

The CERES-2 project (CERES stands for "Energy pathways for industrial systems energy recovery") is an answer to the need of the energy efficiency and reduction of greenhouse gas emissions in the industry through waste heat recovery.

The project is aimed at identifying the "energy pathways" for energy recovery in industrial processes. "Energy Pathways" is used for a set of technologies (e.g. heat exchangers, heat pump) allowing to transfer or transform energy from a source (e.g. exhaust gas from a boiler) to a sink point (e.g. water).

Indeed, industrial waste heat recovery requires a good knowledge of industrial processes as well as technologies to be applied and methodologies to optimise the solution (based on technical and economical criteria). At the present time, this knowledge can be found in research laboratories but has not spread in industry, which faces difficulties to promote heat recovery.

To meet this challenge, CERES-2 will provide four deliverables :

- the building up of a methodology to identify industrial waste heat recovery potential as well as the most adequate technology to valorise this heat (inside ou outside the process) based on technical, economical and environmental criteria.
- the development of a software platform including process and technological databases that will allow to apply the methodology.
- case studies to define waste heat recovery strategies for selected industrial processes, serving as demonstration for the use of the platform.
- the building up of technological roadmaps that will support the priorization of future technological development based on market opportunities.

CERES-2 is an industry-oriented project. The software platform and the strategies for waste heat recovery will be used by research centers or energy managers of industrial groups, also by consulting companies or technical centers to perform technico-econonomic studies. Research laboratories will benefit from the platform to diffuse methodologies or optimisation algorithms they develop and use it for teaching purposes. Last but not least, CNRS may use the roadmaps studies to prioritise technological developments according to promising markets.

The project will enable the gathering, capitalisation and comparison of a large set of technical data coming from know-how of several experts. Its strength will come from the synergies between industrial and academics partners and their will to promote rational use of energy.

Consortium	EDF-R&D ARMINES CMI ARJOWIGGINS IFP Energies nouvelles Institut National Polytechnique de Lorraine - LEMTA Grenoble-INP - Grenoble INP Centre National de la Recherche Scientifique - CNRT Université Henri Poincaré : Nancy I - LERMAB Université de la Rochelle - LEPTIAB SOREDAB
Coordinator	Mme stéphanie JUMEL - EDF-R&D stephanie.jumel@edf.fr
ANR Grant	1009 k€
Kick off and duration	December 2010 - 36 months
Reference	ANR-10-EESI-001
Competitivenes Cluster	

Programme '' Efficacité énergétique et réduction des émissions de CO2 dans les systèmes industriels ''

Call 2010

Project Title	**CHIC - Low cost industry utilities monitoring systems for energy savings**

Abstract

The main purpose of this project is to create and experiment new solutions to measure, at the lowest cost possible, industrial processes energy consumption (in terms of electricity, gas, compressed air, water, vapour). New sensors will be developed during the project, some of them being real sensors, others being software based sensors, and all of them being cheap to buy, install and maintain in operating conditions. The project aims at dividing by 10 measurement costs (by 50 in the case of gas flow measurements).
Only the following sensors will be considered : I, U and P sensors for electrical energy management, and liquid and gas flow rate sensors for thermal energy and compressed air management (other sensors like temperature sensors, … that are already cheap enough will not considered).

This project addresses important challenges both scientifically and technologically. The main challenges come from the hard part of the sensors : in order to decrease costs, the new sensors need to be based on clamp on technologies.
Nevertheless, clamp on measurement of I and U has not been achieved so far. The project will study clamp on measurements of I and U, through
the following methods :
-for I, the magnetic field around the electrical cable will be measured (there exist several technologies to do that, and a bibliographical study will determine which to use).
-for U, crystals which optical properties are modified by the electrical field they are submitted to will be used.
Regarding flow rate measurement, the project will aim at a very important decrease in costs : water flow rate measurement costs should be divided by 10 and gas flow rates by 50. Software based flow sensors will be investigated during the project.

Generally speaking, the project aims at offering, for all 4 types of measurement that are to be considered :
-low cost (and extra low cost if possible) for both probe and electronics
-plug and play systems
-low energy consumption systems
-efficient systems, even in the case of low energy signals, with noise and perturbations

In order to achieve all 4 of the above, competences in the following fields will be needed : energy efficiency in Industry, industry processes and monitoring systems, measurements, experimental testing, signal processing, electronics, electromagnetic fields modelling, electrical perturbations,

electro-optic crystals, physical phenomenon modelling, automatics, identification, inverse problems, MEMS, NEMS, nanotechnologies, ...Most of these competences are familiar to the project partners.
Every partner in the project will contribute by offering to the others an insight on the best available technologies and methodologies in his field of interest that can be used for the project.

This project deals with industrial research because it focuses on creating decreasing costs dramatically (by a factor of 50 for gas flow rate measurement), it aims at creating 6 new sensors (2 of them being real sensors, 4 of them being software based sensors) and testing them in industrial like experimental conditions (EDF R&D industrial systems testing facilities will be used for that purpose).

Consortium	EDF R&D Université Claude Bernard : Lyon I - AMPERE KAPTEOS Université de Poitiers - LAII SOCOMEC SUPELEC CEA - LETI
Coordinator	M Gilbert SCHMITT - EDF R&D retd-epi-chic@edf.fr
ANR Grant	1050 k€
Kick off and duration	December 2010 - 36 months
Reference	ANR-10-EESI-002
Competitivenes Cluster	AXELERA, MINALOGIC

Programme '' Efficacité énergétique et réduction des émissions de CO2 dans les systèmes industriels ''

Call 2010

Project Title	**CO2 EnergiCapt - Integration of oxygen-enriched air combustion and CO2 capture for existing industrial boilers: development of a demonstrator**
Abstract	The fast industrial spreading of carbon capture and storage technologies (CCS) is a requirement in order to ensure a very effective lever effect on the emissions at a planetary scale; consequently, almost all of the current CCS projects at a pilot scale in many countries deal with the issues of considerable emission tonnages (thermal plants, steel industries and cement factories in particular) and use technologies of first generation (amine washing for post-combustion and oxycombustion captures). The issues of the emissions of the sectors producing between 25,000 and 100,000 CO2 tonnes per year, which represent a significant proportion of the whole tonnage, have never been studied on a pilot scale. The objectives of the project “CO2 EnergiCapt” is to fill this gap by developing the first pilot realization of carbon dioxide capture devoted to the production of urban heat distribution system like first application. A technical solution of first generation was adopted for capture, with a minimization of the ratio CO2 eq emitted/kWh. The steps of storage and valorisation of CO2, which are specific research objects, are not included in the proposed program. However, they will be taken into account in the global strategy of this study. The main lines of development and research will deal with: the increase of energy efficiency of the installations and the optimization of the separation and the capture.
Consortium	LLT POLYMEM Centre National de la Recherche Scientifique - CNRS/ICARE Centre National de la Recherche Scientifique - CNRS/LRGP CPCU
Coordinator	Mme SOFIANE ZALOUK - LLT SOFIANE.ZALOUK@LLTCOM.COM
ANR Grant	1261 k€
Kick off and duration	December 2010 - 36 months
Reference	ANR-10-EESI-003
Competitivenes Cluster	

Programme '' Efficacité énergétique et réduction des émissions de CO2 dans les systèmes industriels ''

Call 2010

Project Title	**Ferroenergy - Waste Heat Colloidal Pyroelectric Conversion**

Abstract

Ferroenergy is a collaborative research project aiming at developing a recently patented energy conversion process, converting waste heat into electricity (Pat. no 09 57776). The radically new concept used is based upon the utilization of ferroelectric colloidal suspensions. Pyroelectric energy conversion is already known since the middle of the 1980's. However the existing conversion process concepts are unlikely to be transposed to an industrial environment. The process using colloidal suspensions, developed in this project could however well reach that objective.

This process is targeting applications where the temperature difference between the hot source and the cold sink is too small (a few tens of degrees C is enough) for common conversion systems using a steam thermodynamic cycle. It is targeting an application in heavily energy-consuming industries, allowing an increase of the energy conversion
This process is completing the alternative conversion systems (Organic Rankine Cycles, thermoelectricity …), focusing on high power applications. The targeted scale-up units could reach of a few MW.
This process would help to recover waste heat. Thus, for an equal final energy consumption, the need for fossil fuels would be reduced, as well as the consequential of emission of green-house CO2.
The purpose of this project is to investigate the various scientific and technological issues raised by this process. The research activities will be conducted under close multidisciplinary interactions, this being a key element for successful innovation.

The research program is forecasted for a duration of 36 month. Apart from a synthesis and coordination activity, the activity will be divided into 6 work packages in various scientific areas :

· synthesis of metallic oxide nanoparticules
· synthesis of polymer and polymer/oxide hybrid nanoparticules
· structural characterization and study of electric behavior of ferroelectric colloidal suspensions under electric field
· simulation of the coupled of flow, heat transfer and electrical interactions in the conversion process, including the tuning of its parameters from laboratory experiments
· conception of the integration of the process within existing systems, together with a technical and economic evaluation of the overall system

The research activities will be focused on the main scientific and technological issues necessary for the development of the process. The model integrating all required information will allow to assess the overall conversion process yield.

	Besides, the installation cost of such a unit will be evaluated. These two pieces of information will then allow to have a first idea of its true economic potential. This project is an essential step in a long term perspective aiming at bringing this new technology to the market.
Consortium	ARMINES Université C.Bernard : Lyon I - C2P2 CNRS, dDR IDF - SPMS Centre National de la Recherche Scientifique - LPS Eifer
Coordinator	Mme Thierry DELAHAYE - ARMINES thierry.delahaye@mines-paristech.fr
ANR Grant	781 k€
Kick off and duration	December 2010 - 36 months
Reference	ANR-10-EESI-004
Competitivenes Cluster	AXELERA

Programme '' Efficacité énergétique et réduction des émissions de CO2 dans les systèmes industriels ''

Call 2010

Project Title	**VALOGAZ - Valorising low heating value gases in industrial furnaces**
Abstract	Residual gases with low heating values resulting from steel production plants are presently poorly valorised, although they represent an important energetic reservoir. These gases exhibit specific combustion characteristics as compared to conventional gases. These untypical properties make necessary transposing the combustion techniques which are presently used. The proposed project aims at identifying, by means of experimental and numerical techniques, technological solutions for exploiting in an optimal way these gases in steel reheating furnaces, over a large spectrum of operating conditions. Experimental databases will be acquired at laboratory and semi-industrial scales. In parallel, fundamental numerical studies will allow characterising the interactions between chemistry and turbulence for these gases. This will feed the development of a micro-physical model, which will be validated and implemented in a three-dimensional simulation code used for designing and optimising industrial installations. The obtained numerical tool, which will be able to characterise in detail the interactions between chemistry, turbulence and radiation will be used by the industrial partner for identifying technological evolutions of burners and industrial furnaces, with the final objective of minimising pollutant and greenhouse gas emissions.
Consortium	IFP Energies Nouvelles CNRS - EM2C AMMR
Coordinator	Mme Olivier Colin - IFP Energies Nouvelles olivier.colin@ifp.fr
ANR Grant	931 k€
Kick off and duration	December 2010 - 36 months
Reference	ANR-10-EESI-005
Competitivenes Cluster	MATERALIA

Programme '' Efficacité énergétique et réduction des émissions de CO2 dans les systèmes industriels ''

Call 2010

Project Title	**VITESSE2 - Industrial and Energy value of CO2 through Efficient use of CO2 free electricity Electricity Network System Control & Electricity Storage**

Abstract

The project VItESSE², as a whole, aims to develop a process to convert CO2 emitted by industries such as cement industry, steel mills, incinerators, etc., into methanol (MeOH) by reduction with hydrogen produced by electrolysis of water using electricity from low CO2 production means such as renewable energy (wind, solar, hydro) and nuclear energy.

Beyond the recovery of CO2, this process does not only store low CO2 electricity produced relatively cheaply as a chemical intermediate (methanol is a chemical intermediate in easily recoverable fuel, chemicals, in polymers, etc.) but also ensure, through the flexibility of the electrolytic hydrogen production, electric system management and stabilization functions. Indeed, the production of electrolytic hydrogen would be correlated with the availability of electricity on the electricity system and it would reach its maximum capacity during off-peak hours and would be reduced to a minimum during peak hours.

The project VItESSE² will therefore develop a breakthrough process, though complementary with the current processes of methanol production (units whose capacity exceeds several hundred thousand tons per year, operating at full capacity the maximum hours per year). The project is based on a concept of CO2 into MeOH conversion units, with lower production capacity, decentralized and distributed on the territory close to emitting industries, modular, flexible and subservient to the availability of electricity on the electrical system. These CO2 into methanol conversion units will be able to adjust their level of production variability in quality and quantity of their inflows.
The project VItESSE² will proceed in three stages, each focusing on flexibility and transient operation to identify its limitations:

• Step 1: R&D project (the subject of this request for financial support)
Study and development of a diluted and containing impurities CO2 in methanol conversion breakthrough flexible process, at laboratory scale.
Development of new catalysts constraints resistant (transient and impurities) and new configurations of reactors (process intensification and optimization based on fluctuating inflows constraints).

• Step 2: R & D demonstration project
Demonstration of the concept of CO2 into methanol conversion assisted by electrolytic hydrogen (from low CO2 electricity) on a pilot demonstration unit combining a nominal production capacity of 20 Nm3/h electrolyzer pilot to a conversion of methanol reactor.

	• Step 3 : significant scale Demonstration project Design, construction and operation of a semi-industrial scale CO2 in MeOH conversion unit, coupled with a CO2 industrial flow. The project VItESSE² helps to reduce energy and local "carbon" dependence. It does not only federate partners to create a new industrial sector but also create value in existing strategic industry clusters.
Consortium	RHODIA AREVA AIR LIQUIDE VERI SNC EDF RTE CEA/LITEN CNRS - LRGP - ENSIC CNRS - CNRS-LMSPC HELION
Coordinator	Mme Robert GRESSER - RHODIA robert.gresser@eu.rhodia.com
ANR Grant	1494 k€
Kick off and duration	December 2010 - 36 months
Reference	ANR-10-EESI-006
Competitivenes Cluster	AXELERA, CAPENERGIES