

iets

Industrial Energy-Related Technologies and Systems

An Implementing Agreement established under the auspices of the International Energy Agency



2008 ANNUAL REPORT

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1. INDUSTRIAL ENERGY-RELATED TECHNOLOGIES AND SYSTEMS (IETS)

INTERNATIONAL ENERGY AGENCY

IEA BACKGROUND

The IEA was founded in 1974 to reduce dependence on imported oil by developing a system of sharing oil supplies, researching alternative energy sources and improvements in energy efficiency. More recently, due to environmental concerns, the IEA broadened its mandate. The shared goals of IEA members are energy security, economic growth and environmental protection.

The IEA conducts a broad programme of energy research, data compilation, publications and public dissemination of the latest energy policy analyses and recommendations on good practices.

INTERNATIONAL COLLABORATION, IMPLEMENTING AGREEMENTS

Through the Technology Collaboration Programme, the IEA provides a framework for more than 40 international collaborative energy research, development and demonstration projects known as Implementing Agreements. It enables experts from different countries to work collectively and share results, which are usually published. The programme deals with technologies for fossil fuels, renewable energy, efficient energy end-use and fusion power, as well as electric power technologies and technology assessment methodologies.

The R&D activities are mainly financed through national energy research programmes. The IEA provides the framework that enables international collaboration and the resulting synergy effects.

WHO CAN PARTICIPATE?

The IEA technology collaboration programme is open to IEA member and non-member countries. Typically, participants are Governmental or energy technology entities representing governments, research institutes and universities, energy technology companies and industry.

IETS INTRODUCTION

IETS is an international cooperation Programme (Implementing Agreement) dealing with new industrial energy technologies and systems. The Programme was established in 2005 as the result of merging, revamping and extending activities formerly carried out by separate industrial IEA Programmes (Process Integration, Pulp and Paper, Heat Exchangers and Heat Transfer). This was done to facilitate development of both industry-specific as well as crosscutting technologies and ease participation by countries in a broad range of industrial areas.

IETS will be evolving continuously with the aim to include other energy-intensive sectors such as iron and steel, cement, non-metallic materials, aluminium, petrochemicals, chemicals and food, as well as manufacturing industries and small and medium-sized enterprises.

Through its activities, the program will increase awareness of technology and energy efficiency opportunities in industry, contribute to synergy between different systems and technologies, and enhance international cooperation related to sustainable development.

Additional information about IETS and its different activities can be found on: www.iea-iets.org

IETS MISSION

The mission of IETS is to foster international cooperation among OECD and non-OECD countries for accelerated research and technology development of industrial energy-related technologies and systems.

In doing so, IETS seeks to enhance knowledge and facilitate deployment of cost-effective new industrial technologies and system layouts that enable increased productivity and better product quality while improving energy efficiency and sustainability.

IETS PROJECTS (ANNEXES)

As of December 2008, IETS had 4 ongoing projects (Annexes):

- Annex IX: Energy Efficient Separation Systems
- Annex X: Energy Efficient drying and dewatering technologies
- Annex XI: Industry-based Biorefineries
- Annex XII: Membrane Technologies

As the work of IETS proceeds, more Annexes will be added to the list - the IETS is continuously developing new projects in order to meet the arising needs of its members.



IETS MEMBER COUNTRIES

IETS Member Countries and Contracting Parties as of December 2008:

Brazil	UFRJ- Universidade Federal do Rio de Janeiro
Belgium	FPS economy, SMEs self employed and Energy
Canada	National Resources Canada
Denmark	Ministry of Economy and Business Affairs, Danish Energy Authority
Finland	Tekes- National Technology Agency of Finland
Korea	Korean Institute of Science and Technology (KIST)
Norway	The research council of Norway/Enova SF
Portugal	Instituto Superior Técnico, Universidade Técnica de Lisboa
Sweden	Swedish Energy Agency
Netherlands	Government of the Netherlands
United States	U.S. Department of Energy, Industrial Technologies Program (ITP)

INTERNET SITE - WWW.IEA-IETS.ORG

The IETS Internet site was established during 2006. It has two layers, one open part and one password protected. The open part contains background information about IETS, describes the projects (ongoing, new initiatives, completed) and how to participate, lists events (upcoming and completed) and publications (some can be downloaded) and has a feature for signing up as a subscriber to the IETS Newsletter.

The closed part consists of one section for each annex, controlled by the annex manager, and one section for the ExCo delegates. The IETS Secretariat is Webmaster for the Internet site, and is responsible for all up-dates.



2. HIGHLIGHTS OF 2008

CHAIR'S REPORT



IETS Chair Prof. Thore Berntsson, Sweden

In 2008 the IETS work has been extensive with consolidation of newly started Annexes and discussions on possible new annexes. Due to the broad scope of IETS, these activities cover many different R&D scientific and application areas. In fact, the work included in IETS ranges from specific developments of process or energy technologies to overall system aspects, in which energy efficiency is an important part, for practically all types of industry types. For the moment the pulp and paper, iron and steel, petrochemical, oil refinery, aluminium and SME types are included in ongoing or planned annexes (projects).

The ongoing Annexes during 2008 have been:

- Gasification Technologies for Black Liquor and Biomass (finished and formally closed during 2008)
- Energy Efficient Separation Technologies Systems
- Energy Efficient Drying and Dewatering Technologies
- Industry-based Biorefineries
- Membranes Technologies (the first part starting 2008 directed towards separation of hydrocarbons)

The new Annex proposals, in which initiating work has been going on, were:

- Process Integration and Energy Efficiency for the Steel Industry
- Industrial CO₂ Separation
- Industrial Combustion/Excess heat
- Process Integration in Small and Medium Enterprises
- Application of Industrial Heat Pumps, workshop on process integration methods and tools for SME:s, originally planned for 2008, has been postponed until 2009.

During 2008 two executive committee meetings have been held, one in Istanbul in May and one in Seoul in November. Furthermore, two IETS workshops have been held in connection with the ExCo meetings, the first one on Cooperation between Government Research Programmes and Industry in the IETS Countries and the second one on New Industrial Energy Related Areas for International Collaboration.

During 2008, the number of participating countries has been 12.

“In fact, the work included in IETS ranges from specific developments of process or energy technologies to overall system aspects, in which energy efficiency is an important part, for practically all types of industry types.”

HIGHLIGHTS - ONGOING ANNEXES

Highlights of the work of the IETS projects during 2008 are presented below. For further details, please see the individual project summaries later in this report.

Annex IX - Energy Efficient Separation Technologies Systems.

The work and scope of the annex was developed during 2008 and a new work plan will be proposed during 2009.

Annex X - Energy efficient drying and dewatering technologies

Some of the objectives of this Annex are to highlight ongoing research projects in the drying area, compile relevant information about legislation and how to increase the dry matter content for products like sludge and biofuels.

During the first year the work has started in subtask A. This implies compilation of data on energy use for drying in different countries and contact with dryer manufacturers to involve them in the annex. In subtask B dealing with drying and dewatering of sludges, biowastes and solid biofuels, data and results from ECSM 08 about dewatering and drying of sludge have been reviewed and compiled.

Annex XI - Industry-based Biorefineries

The Biorefineries Annex was developed during 2008. Some important actions taken were to define the framework and structure of the Annex, define tasks leadership, establish contacts with Bioenergy IA and identify projects/areas to include in the PoW. Three subtasks are included in the Annex: Task 1 Bioenergy Biofuels; Task 2 Biochemicals New Fibre Materials; Task 3 Sustainability Integrated Systems.

Annex XII - Membrane Technologies

During the fall ExCo meeting it was decided to start a new multi-task Annex of Membrane technologies – Annex XII - and the first task: Membranes as Energy-efficient technologies for the Separation of Hydrocarbons (task 12.1). The objectives of task 12.1 is to coordinate research efforts and to organize a discussion platform for the dissemination of results in membrane separation.

EVENTS 2008

WORKSHOPS

November 2008, Seoul: IETS Workshop on New Industrial Energy Related Areas for International Collaboration. An in depth presentation on Korean energy situation and R&D projects, discussions on ongoing and new Annexes.

May 2008, Istanbul: IETS workshop on Cooperation between Government research programmes and industry in the IETS countries.

EXECUTIVE COMMITTEE MEETINGS

7th IETS Executive Committee Meeting in Seoul, South Korea 12-14th of November 2008

6th IETS Executive Committee Meeting in Istanbul, Turkey, 12-14th of May 2008

PLANNED MEETINGS 2009

8th IETS Executive Committee Meeting in Paris

9th IETS Executive Committee Meeting, location TBD.

COORDINATION WITH OTHER ORGANIZATIONS, IEA AND IEA IMPLEMENTING AGREEMENTS

IEA Bioenergy IA – Biorefinery task

The IETS Biorefineries Annex has established and maintained contacts with the Bioenergy IA.

A meeting was arranged between the Biorefineries Annex and the IA for Bioenergy to avoid possible duplication. The Bioenergy IA focuses on the chemical aspects and not directly on integration with industry and process. The Bioenergy IA is more biomass-related. On long term a joint Annex with Bioenergy IA is possible.

Heat Pumping Technologies

A meeting with the IA for Heat pumping Technologies was arranged during the ExCo meeting in Seoul in November 2008 - resulting in a kick off meeting about a new joint annex Industrial heat Pumps 7 and 8 April 2009.



3. FEATURE – UPCOMING TASK:

TOWARDS AN ENERGY-EFFICIENT MOLECULAR SEPARATION PROCESS: MEMBRANE TECHNOLOGY

Responsible authors: Jaap Vente, Energy research Centre of the Netherlands, and Madelon de Ruiter, SenterNovem, and Dutch IETS ExCo delegate.

Worldwide, separation processes are major consumers of primary energy in the (petro)chemical industry. It has been estimated that up to 40% of the final energy consumption is consumed by separation processes. A wide range of technologies ranging from distillation, adsorption, crystallization, to membranes, and extraction, are applied in a very diverse field of applications. Distillation, the separation of liquids by subsequent evaporation and condensation, is by far the most commonly used separation technique in the chemical and refinery industries. It is also the largest consumer of energy. Especially, the exergetic efficiency of distillation is, at ~10%, very low. Furthermore, the investment and operational costs of these separation technologies range from 40 to 70%. In the Netherlands only, the capital investment for separation technology equipment in the petrochemical industry is estimated to about 1 billion €/year, which is only a small number compared to the investments in separation technology in the USA.

PROMISING TECHNOLOGY

Membranes function as a selective barrier for the transport of matter under the influence of a driving force. The separation technology based on membranes is widely considered as one of the most promising and energy-efficient separation technologies with an estimated exergetic efficiency of 90%. However, in practice a reduction of 40-60% of primary energy consumption is anticipated in key molecular separation. State-of-the-art membranes and membrane systems are applicable in a limited number of applications and the implementation of this technology is still limited. To further the proliferation, membrane materials, modules, systems and processes should be developed hand-in-hand.

NEW IETS TASK

Regular assessments of R&D priorities and gaps, as well as comparative analysis of individual technologies are important to identifying the barriers that hamper implementation of these technologies. The new IEA IETS task 12.1 Membranes as Energy-efficient technologies for the Separation of Hydrocarbons, that will be developed starting 2008, aims to be a facilitating platform for these activities. The task is led by the Energy research Centre of the Netherlands, which specialises on the development of energy efficient alternatives for energy-intensive molecular separations. The research, development and demonstrations are application driven.

OBJECTIVES AND SCOPE

The objectives of the task are the organisation of a discussion platform for the dissemination of results in membrane separation. To enhance focus and priorities in the field of energy efficient membrane separations, road mapping exercises will be stimulated. This will lead to technology assessments and initial estimates of energy savings potential. A second main focus is the coordination of research efforts. Based on an initial screening, olefin/paraffin separation and natural gas and biogas production were selected as focal point for this platform.

The task is divided into three subtasks:
Subtask A. Road mapping and focusing activities
Subtask B. Natural gas and biogas production
Subtask C. Olefin/paraffin separation

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4. IETS PROJECTS

ANNEX IX: ENERGY EFFICIENT SEPARATION SYSTEMS: METHODOLOGICAL ASPECTS, DEMONSTRATIONS AND ECONOMICS

Responsible author: Dr Alan Legault, Natural Resources Canada, Canada.

BACKGROUND

Separation systems can represent 40-70 % of both capital and operating costs in industry. They also account for 45 % of all the process energy used by the chemical and petroleum refining industries every year.

More efficient separation technologies and systems are critical factors for industries' long-term sustainability; they reduce waste and greenhouse gas emissions, improve energy efficiency and increase throughput. This has led IETS to initiate the "Separation Systems" annex.

DESCRIPTION OF ANNEX IX

Subtasks

There are four subtasks in Annex IX:

- A Methodologies
- B Selected application technologies or area
- C Economics
- D Dissemination

Objectives and scope

The annex wishes to promote a mode of investigation where the focus is not limited to deep understanding of individual physical phenomena, but covers the broad understanding of how complex, multi-phenomena, multi-scale separation systems are constituted, behave and how their components interact and interrelate.

The goal of the annex is to take stock of the state-of-the-art of separation systems analysis tools and concepts and:

1. Extend/combine previously developed methods and tools to address advanced separation systems design or retrofits
2. Automate or guide the design/retrofit process to the extent practicable
3. Quantify and improve the costs and benefits of these approaches

The Separation Systems Annex is concerned with processes that use one or more forms of energy such as thermal, chemical or electrical to isolate and/or recombine selected constituents from an initial ensemble of materials or mixtures to produce a useful and improved end-product with an acceptable environmental footprint. More precisely it is concerned with the "systems" aspects of these separation activities.

One of the Annex IX subtasks is making a preliminary selection of interesting technologies for focus. The ongoing level of interaction the Annex establishes with the industrial sector will depend on well chosen fields of technology, bearing in mind that well established industrial applications optimized in the field through years of testing and development may already be operating very close to the achievable thermodynamic "optimum". A first set of technologies identifies those where industrial partners' design procedures already focus on energy efficiency and where the prospects of further energy savings to reduce corporate operating costs and enhance environmental profile are attractive.

ACTIVITIES

Since 2007 the participants of the annex have been working to enable effective and practical design/retrofit of separations systems. By the end of the project period, hopefully the annex will have succeeded in defining what is an optimal combination of physical/ mathematical/ engineering concepts and tools that will effectively guide the search for an appropriate separation system given an initial set of requirements.

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ANNEX X: ENERGY EFFICIENT DRYING AND DEWATERING TECHNOLOGIES

Responsible author: Prof. Stig Stenström, Annex manager, Department of Chemical Engineering Lund University, Sweden.

BACKGROUND

The work in the Annex started in May 2008 and the work in the Annex will continue over three years until April 2011. Presently four countries are participating in the Annex but the Netherlands only have funding for the first year. It is hoped that industrial involvement from dryer manufacturers together with funding from Senter Novem will enable the Netherlands to continue to participate in the Annex. Contributions to the Annex are also received from Canada without signing a formal contract to participate in the Annex.

The objectives of this Annex are the following:

- (A) Make available information about ongoing research projects in the drying area, present a survey of the energy used for drying in the participating countries and establish methods for benchmarking of different dryers.
- (B) Present state of the art for drying of sludges, biowastes and solid biofuels. Compile information about new more energy efficient drying processes such as drying in superheated steam as well as obstacles limiting the introduction of such technologies.
- (C) Compile available information about how the dry matter content can be increased for mechanical dewatering of sludges, biowastes and solid biofuels.

ACTIVITIES

The work has started in both subtask A and B. The most important work in subtask B has been the compilation and review of a number of papers from the ECSM 08 conference related to dewatering and drying of sludge. The work in subtask A to establish a searchable database for ongoing projects and dryers has been delayed. The main reason is the problem to get funding for this work in the Netherlands but it is hoped that this issue can be solved during the coming months.

During 2008 two meetings have been organized in the Annex. This first meeting was held during the ExCo meeting in Istanbul in May 2008 and the second organized by Université de Liège in September 2008.



WORK PLANNED FOR 2009

The anticipation is that the work with the internet based database can be started during the first half of 2009. This will to a very large extent depend on the continuous participation of the Netherlands in the Annex.

The work in subtask B during the 2009 will concentrate on compiling data for superheated steam drying of sludge and mechanical dewatering of biofuels.

The next meeting in the project will be organized by Ola Jonassen and take place in Norway during August 2009. Possibly some of the participants will also have an informal meeting during the meeting with the EFChE Working party on drying in Lyon in May 2009.

PARTICIPANTS

Four countries have formally signed the agreement to participate in the project. The participants consist of two universities, one research institutes and one industrial company as given by the list below. Contributions to the tasks are also received from Canada but without any formal engagement in the Annex.

Belgium	Université de Liège, Prof. Michel Crine and Dr Angelique Leonard
Netherlands	TNO, Dr Henk van Deventer
Norway	Reinertsen AS, Dr Ola Jonassen
Sweden	Lund University, Prof. Stig Stenström
Canada	National Resources Canada, Dr Tadeusz Kudra

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ANNEX XI: INDUSTRY-BASED BIOREFINERIES

Responsible author: Isabel Cabrita, INETI - National Institute of Engineering Technology and Innovation
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ANNEX DESCRIPTION

The general objective is to provide a sound basis for the integration of biorefinery concept in different industrial sectors where biomass is used as resource or biomass based waste is available, which could be used for fuel/energy production, also considering opportunities of bio-products generation with added value.

Synergies are considered with other Implementing Agreements, namely the Bioenergy, aiming at combining the knowledge of industrial technologies with energy efficiency, and the biomass conversion processes, aiming at:

- Providing a global forum for participants to exchange information, disseminate knowledge gained and lessons learned in an atmosphere that promotes interaction and collaboration (not a conference format) and the formation of collaborative working groups;
- Encouraging participants to engage in truly collaborative, value-adding research and development activities and to promote demonstrations;
- Focusing the research efforts by regularly updating a prioritized list of research needs and knowledge gaps;
- Involving industry and communicating progress apart from industry, government representatives and other appropriate people.

Three major types of industry-integrated biorefineries using biomass can be identified: bioenergy, biofuels and biochemicals oriented. A biorefinery can be a mix of these three concepts. The scope of this annex is to develop technology pathways to promote the production of bioenergy, biofuels and biochemicals.

Work Scope

The scope of this Annex is the integration of the biorefinery concept in industry, integrating with an existing plant (e.g. pulp and paper mill) or other, either individual or a complex of industrial companies.

The scope includes economic evaluation, energy efficiency and technical integration of processes that provide energy and higher value-added products.

Technologies to be considered include:

- Biomass gasification, including waste and black liquor gasification;
- Pyrolysis;
- Biogas production and integration;
- Biological conversion;
- Combustion;
- Gas clean-up processes, including CCS techniques (e.g. using microalgae for CO₂ fixation producing hydrocarbons and/or hydrogen);
- Fuels and chemicals synthesis.

Also included in the scope is the impact of the above technologies on the environment.

Proposed end products/outcome

As a result of development, it is envisaged as products the following:

- pilot and demonstration plants;
- progress reports;
- technical and technological brochures;
- publication of information by creating a specific website area within the IETS;
- identification of research needs and gaps for future projects through brainstorming sessions and workshops.

ACTIVITIES DURING THE YEAR

The work has started with compilation of information on R&D programmes and demonstration/industrial installations to be able to produce an Inventory leading to the definition of the State-of-the-Art and Benchmarking. The information obtained will be compared to that obtained through Task 42 of Bioenergy Implementing Agreement and the opportunity of a joint publication will be assessed.

Analyzing the information obtained so far, one can identify areas still needed to be addressed in terms of clarification or even cases that the information obtained is not sufficient or complete.

In 2009, further efforts will be developed to complete this information.

Description of completed and ongoing activities

For better coordination of the activities, the annex was divided into 3 areas, each one with a team leader with expertise in that area. The diagram below shows the structure given.

In this first phase, data obtained through a questionnaire sent to delegates has been compiled and treated. With this work it is aimed to publish an inventory of industrial units and research / pilot projects existing namely in the participating countries.

Meetings

Presentations were given in the following workshops:

- Workshop on “Cooperation between Government research programmes and industry in the IETS countries”, 12th May 2008, Istanbul, Turkey.
- IETS Workshop on “New Industrial Energy Related Areas for International Cooperation”, 12th November 2008, Seoul, Korea.

No detailed technical reports have been published yet about the project.

WORK PLANNED FOR 2009

In order to ensure cooperation with Task 42 of Bioenergy Implementing Agreement, within the same scope of activity, discussions will be held to define a framework for collaboration. Another initiative that is proposed to be organized in 2009 is a workshop for discussion of R&D areas for the implementation of specific projects within the annex. This, in principle, will be organised in Lisbon, Portugal, in the 2nd semester.

With regard to the performed inventory, which has been started in 2008, it is aimed to carry out the work and refine the information already received for the inventory of existing projects and plants, to identify industry integrated plants, R&D projects and overlaps among countries, which could lead to cooperation.

Apart from the above stated domains, new proposals for projects need to be considered for implementation, namely consolidating cooperation on one case study, on Process Integration.

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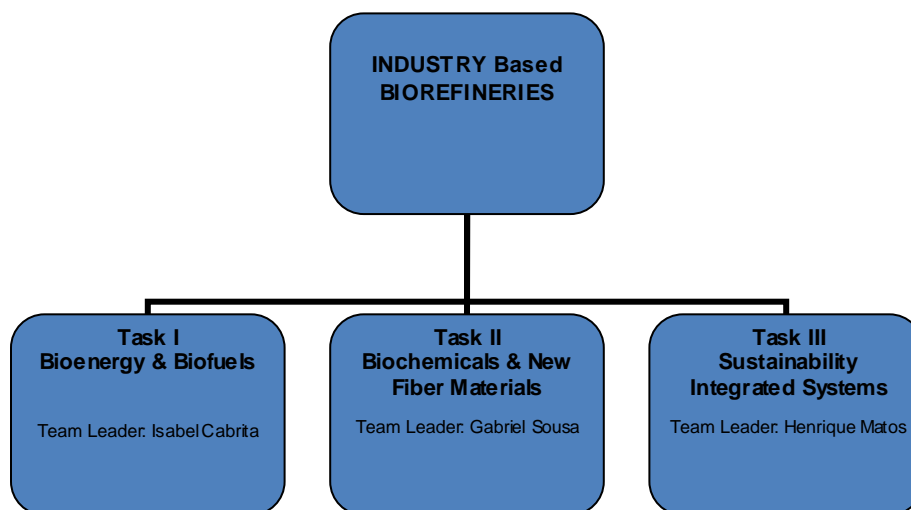


Diagram 1. Annex XI areas

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