Post-academic course

Energy efficiency in industry

Scientific coordination

Prof. dr. ir. Michel De Paepe
Department of Flow, Heat and Combustion Mechanics, Ghent University

> With hands-on exercises!
> Possibility to follow these lessons via streaming video!

Module 0: Basic concepts
11, 18 and 25 May 2011

Module 1: Heat production and transport
8, 15 and 22 June 2011

Module 2: Thermal energy recovery
21 and 28 September, 5 and 12 October 2011

Module 3: Drives and control
19 and 26 October, 9 and 16 November 2011

Module 4: Energy management and policy
23 and 30 November and 7 December 2011

3rd edition

This programme allows to obtain a certificate granted by Ghent University

UNIVERSITEIT GENT

INSTITUUT VOOR PERMANENTE VORMING

Introduction

Why this course?

Tackling climate change is one of the biggest challenges we face. There is likely to be irreversible and catastrophic damage, unless global action is taken quickly to stabilize the rising temperature of the earth's surface.

The EU adopted an integrated energy and climate change policy in December 2008, including ambitious targets for 2020. It hopes to set Europe on the right track – towards a sustainable future with a low-carbon, energy efficient economy – by:

- cutting greenhouse gases by 20% (30% if international agreement is reached)
- reducing energy consumption by 20% through increased energy efficiency
- meeting 20% of our energy needs from renewable sources.

One of the European targets is clearly increasing the energy efficiency.

Reaching energy efficiency requires a complex mix of technological measures. Care must be taken that several measures do not annihilate each other and an overall view has to be kept.

This course aims at providing the participants this overall view. The course treats a wide scope of topics : from heat to power, control and the economical and legislative context of energy. New energy technologies emerging in the market are treated and the link with renewable energies has been added (the second European target).

Each topic starts with the scientific fundamentals and ends with industrial examples. Evaluation after the two previous successful editions showed that this approach was strongly appreciated. More time though has been added for hands-on training by allowing the participants to solve industrial cases during the course.

People who want to complement their background are invited to follow an introductory module (module 0), where time is spent on recapitulating the basic training courses in Energy Engineering.

After attending the course, participants will be able to apply the gained knowledge in energy projects in their company.

Who should attend?

This advanced course is intended for all energy intensive industries and will cover the possibilities for energy recovery and efficient energy use. Everybody involved in energy related projects or energy management in an industrial context will find attractive topics in the course. Not only the process engineer or energy manager, but also auditors and consultants will take benefit of this course.

Basic engineering skills are required to enrol.

Post-academic Course Certificate granted by Ghent University

This programme is part of Ghent University's post-academic courses. To receive a certificate, one should subscribe and attend to at least 3 of the 4 modules (module 0 not included) and succeed for the final exam.

Course certificates are a personal merit: participants who aspire a certificate cannot be replaced, others can.

Streaming video

There is the possibility to follow these lessons via streaming video. For more information, please contact us. A demo of this method can be found on:
http://www.ivpv.ugent.be/energyefficiency

Programme

Module 0: Basic concepts

Module 0 aims at revising and extending basic concepts of thermodynamics, combustion science, heat exchangers and electrical energy systems. This module starts with the formulation of the First and Second Law of Thermodynamics, and develops them to useful methods to assess energy quality. The laws are thereupon applied to combustion processes, thermal energy systems and heat exchangers. There is also special attention to the transport and use of electrical energy.
Concepts introduced in module 0 will be used in the other modules.

Basic concepts 1
> The laws of thermodynamics
> Combustion chemistry
> Energy conservation in combustion

Basic concepts 2
> Energy conversion cycles
> Heat exchangers: types and use
> Heat exchangers: sizing

Basis concepts 3
> Refrigeration cycles
> Electrical drives
> Electrical power grids

Teachers: M. De Paepe, B. Merci and L. Vandevelde
Dates: 11, 18 and 25 May 2011

Module 1: Heat production and transport

In module 1, heat as a manifestation of energy is treated. Attention is paid to new trends in combustion technology for fossil and bio fuels. Recent advances in burner technology will be dealt with in relation to the emission reductions.
Besides heat production, the use of heat is also studied. Heat exchangers, as used in process industry for air, water and steam (steam boilers), will be discussed. Transport of heat is as important in lots of processes (water and steam network, thermal oil).
Finally this module ends with pinch technology for heat exchanger network optimization. The participants will have the opportunity to apply their acquired knowledge in a hands-on exercise.

Recent developments in combustion technology
> Solid combustion
> NOx emission reduction
> New combustion technologies

Heat exchangers and heat transport
> Recovery heat exchangers
> Steam/heat boilers and heaters
> Steam networks
> Heat transport and networks

Pinch technology
> Pinch technology
> Exercise pinch technology

Teachers: R. Bosch, M. De Paepe, M. Derksen, P. de Smedt, B. Merci and G. Verkest
Dates: 8, 15 and 22 June 2011

Module 2: Thermal energy recovery

In this module installations with both thermal and electrical energy flows are discussed. A first topic is cooling technology using either electricity or heat. A distinction is made between low temperature cooling (< 0°C) and high temperature cooling (>0°C), the latter not always needing cooling machines.
A second topic is cogeneration (Combined Heat and Power, CHP) and trigeneration. New and old possibilities for energy recovery as Organic Rankine Cycles (ORC) are considered.
Every lesson day ends with case studies and hands-on exercises presented by lecturers from industry. The purpose is to demonstrate the benefits and difficulties of some technologies and how some projects were realized.

Industrial chilling and cooling circuits
> Compressor chillers and ice water production
> Cooling water and cooling towers
> CASE 1: Saflex
> CASE 2: Cooling

Heat and Power
> Absorption chilling
> Combined Heat and Power
> CASE 3: Electrabel/Fluxis expansion station
> CASE 4: Heat recovery in steam boilers

Heat recuperation
> Organic Rankine Cycle
> CASE 5: ORC in an incinerator
> Exercise Organic Rankine Cycle

Process optimization
> CASE 6: Heat transfer oil network
> Exercise process optimization

Programme

Teachers: S. Aerssens, S. Blockerye, M. De Paepe, D. Goovaerts, X. Martens, A. Stroobandt, F. Van de Geuchte, N. Vanden Broeck, J. Vanden Eynde, S. Van Heule, K. Van Overberghe and B. Vanslambrouck

Dates: 21 and 28 September, 5 and 12 October 2011

Module 3: Drives and control

Module 3 summarizes the influence of electrical energy flows and control on the energy consumption of a company. First electrical drives are treated, discussing the recent evolution in engine technologies, and their potential. Attention is also paid to the choice of the correct drive in order to match the load (pumps, compressors, start/stop behaviour). Secondly the construction, stability and control of power grids are described in detail, with special attention to decentralized production grids. The relation between energy use and control of continuous processes is lectured later. Next to the theoretical background, attention is paid to industrial aspects by presenting cases of daily industrial practice.

Electric drives and grids

> Distributed generation and smart grids
> Selection of drives
> Power quality and losses in installation devices

Pumps and compressors

> Selection of pumps and compressors
> Exercise VSD

Pneumatics

> Pneumatic grids
> CASE 1: Pneumatics
> CASE 2: Selection of pumps and pump types + exercise

Control

> Model based predictive control
> CASE 3: Energy saving in a distillation column
> CASE 4: Energy saving in a paper mill

Teachers: L. Cosijns, R. De Keyser, J. Desmet, T. Neven, K. Stockman, L. Vandevelde, J. Vanden Eynde, P. Vandenkerckhove and P. Van Dorst

Dates: 19 and 26 October, 9 and 16 November 2011

Module 4: Energy management and policy

The last module handles energy management and energy economy. Experience shows that projects which are often technically promising, fail at the management level.
The first lectures are dedicated to energy management systems, monitoring and sustainable energy. In the second part of the module project management and financial aspects of energy management are discussed. The setting up of an energy accountancy system and data analysis is treated. The last part of the module treats the policy and legislation framework of energy on an international scale. The impact of policy instruments on cost-effectiveness and project feasibility is dealt with.
Again, practical cases and industrial experience are highlighted by case presentations.

Energy management systems, monitoring and sustainable energy

> Energy management systems
> Sustainable energy
> CASE 1: VOLVO Trucks
> CASE 2: Energy savings in an industrial furnace

Financial management

> Project financial analysis
> Cost benefit analysis
> Examples and exercises

Climate change and legislation framework

> Climate change and IPCC
> European legislation framework
> CASE 3: Benchmarking agreement
> CASE 4: Auditing in chemical plants

Teachers: F. Behaegel, M. Dams, P. Herbosch, R. Stiens, M. Van den Bosch, J. Vanden Eynde, A. Verbruggen and G. Verkest

Dates: 23 and 30 November and 7 December 2011

Reference books

The course is supported by 3 reference books. The books 'Fundamentals of Engineering Thermodynamics: SI version' by M.J. Moran and H. Shapiro (€ 45,00 incl VAT) and 'Heat exchangers. Selection, Rating and Thermal Design' by S. Kakaç and H. Liu (€ 71,95 incl VAT) are mandatory for the participants of modules 0, 1 and 2 and are optional for the participants of modules 3 and 4. The book 'Fundamentals of Power Systems' by M.A. Salam (€ 32,80 incl VAT) is mandatory for the participants of modules 0 and 3 and is optional for the participants of modules 1, 2 and 4.

Teachers

Scientific Coordination:

Prof. Michel De Paepe

Department of Flow, Heat and Combustion Mechanics, Ghent University

Teachers:

- Sabine Aerssens, ArcelorMittal
- Frank Behaegel, Laborelec
- Serge Blockerye, Laborelec
- Ralf Bosch, Laborelec
- Luc Cosijns, Laborelec
- Mieke Dams, DNV Belgium
- Robain De Keyser, Department of Electrical Energy, Systems and Automation, Ghent University
- Michel De Paepe, Department of Flow, Heat and Combustion Mechanics, Ghent University
- Marco Derksen, Stork Thermeq BV
- Philip de Smedt, Total Petrochemicals Research Feluy
- Jan Desmet, Dept. PIH, Labo LEMCKO, HOWEST
- Dirk Goovaerts, Johnson Controls Brand York
- Pascal Herbosch, ArcelorMittal
- Xavier Martens, Verificatiebureau Benchmarking
- Bart Merci, Department of Flow, Heat and Combustion Mechanics, Ghent University
- Thomas Neven, Laborelec
- Randy Stiens, Laborelec
- Kurt Stockman, Dept. PIH, HOWEST
- An Stroobandt, Siemens
- Frank Van de Geuchte, Electrabel
- Mark Van den Bosch, VOKA-VEV
- Nico Vanden Broeck, Laborelec
- Johan Vanden Eynde, Bayer
- Pierre Vandenkerckhove, Siemens
- Lieven Vandevelde, Department of Electrical Energy, Systems and Automation, Ghent University
- Paul Van Dorst, Bayer
- Stefaan Van Heule, Solutia
- Koen Van Overberghe, Mirom Roeselare
- Bruno Vanslambrouck, Dept. PIH, HOWEST
- Aviel Verbruggen, Department of Environmental and Technology Management, University of Antwerp
- Guy Verkest, ENI-Distrigas

Subscription form

Preferably via www.ivpv.ugent.be/energyefficiency OR by using this form:

- **by mail:** Ghent University- Institute for Continuing Education (IVPV) – attention of Els Van Lierde, Technologiepark 913, 9052 Zwijnaarde, Belgium
- **by fax:** IVPV +32 9 264 56 05

	Fee
☐ Module 0: Basic concepts	€ 540
☐ Module 1: Heat production and transport	€ 625
☐ Module 2: Thermal energy recovery	€ 800
☐ Module 3 : Drives and control	€ 800
☐ Module 4: Energy management and policy	€ 625
☐ **Modules 0 to 4**	€ **2.700**
☐ **Modules 1 to 4**	€ **2.280**

☐ I want to follow this course via streaming video.

Reference Books

☐ 'Fundamentals of Engineering Thermodynamics: SI version' by M.J. Moran and H. Shapiro (€ 45,00 incl VAT) (mandatory for the participants of modules 0, 1 and 2)

☐ 'Heat exchangers. Selection, Rating and Thermal Design' by S. Kakaç and H. Liu (€ 71,95 incl VAT) (mandatory for the participants of modules 0, 1 and 2)

☐ 'Fundamentals of Power Systems' by M.A. Salam (€ 32,80 incl VAT) (mandatory for the participants of modules 0 and 3)

Date: Signature:

Return completed and signed form (use capitals):

Name:

First name: ☐ M ☐ F

Private-address:

Street: N°:

Zip: City: Country:

Telephone:

Company:

Function:

Company address:

Street: N°:

Zip: City: Country:

Telephone: Fax:

E-mail:

VAT n°:

Invoice: ☐ Company ☐ Private

Practical info

Practical information

The programme consists of different modules. Each module can be followed separately. The lessons start at 16:30 and end at 21:00. Due to hands-on exercises, some lessons will end at 22:00. Each lesson is provided with a sandwich and a coffee break.

A detailed schedule can be found on:
http://www.ivpv.ugent.be/energyefficiency

Location

Ghent University, Institute for Continuing Education, Campus Engineering Faculty, Building Magnel, IVPV classroom A, Technologiepark 904, 9052 Zwijnaarde, Belgium.

Language

English is used in all presentations, exercises and documentation, so a good knowledge of this language is required.

Streaming video

All lessons can be attended via streaming video. For more information, please contact us. A demo of this method can be found on http://www.ivpv.ugent.be/energyefficiency

Participation fee

The participation fee includes the tuition fee, course notes, soft drinks, coffee and sandwiches. Payment occurs after reception of the invoice. All invoices are due in thirty days. All fees are exempt from VAT. Travelling expenses and accommodation are at the expense of the participant.

	Fee
Module 0: Basic concepts	€ 540
Module 1: Heat production and transport	€ 625
Module 2: Thermal energy recovery	€ 800
Module 3: Drives and control	€ 800
Module 4: Energy management and control	€ 625
Modules 0 to 4	€ **2.700**
Modules 1 to 4	€ **2.280**

When a participant of a company subscribes for the complete course, a reduction of 20% is given to all additional subscriptions from the same company, even on single modules. Invoicing is then done by one company invoice. For larger numbers of subscriptions, additional reductions can be envisaged.

Reference books

> "Fundamentals of Engineering Thermodynamics: SI version" by M.J. Moran and H. Shapiro (€ 45,00 incl VAT), mandatory for the participants of modules 0, 1 and 2.

> "Heat Exchangers. Selection, Rating and Thermal Design" by S. Kakaç and H. Liu (€ 71,95 incl VAT), mandatory for the participants of modules 0, 1 and 2.

> 'Fundamentals of Power Systems' by M.A. Salam (€ 32,80 incl VAT), mandatory for the participants of modules 0 and 3.

Reference books are billed directly by the bookshop.

Cancellation policy

When cancelling up to 10 days before the start of the course or module, 25% of the participation fee will be charged. When cancelling less than 10 days before the start of the module, the full fee is due.

Training cheques

Ghent University has been recognized as an official training supplier within the framework of the training cheques of the Flemisch Community. Thereby you can save on the participation fee of this training:
http://www.vdab.be/opleidingscheques/werknemers.shtml.
For employers we refer to the KMO-portefeuille:
http://www.kmo-portefeuille.be; use authorization ID:
DV.0103 194.

Information & Documentation

All the information of this course can be found on:
http://www.ivpv.ugent.be/energyefficiency

Institute for Continuing Education
Instituut voor Permanente Vorming (IVPV)
Secretariat: Els Van Lierde
Technologiepark 913, 9052 Zwijnaarde, Belgium
Tel: +32 9 264 55 82, Fax: +32 9 264 56 05
E-mail: ivpv@UGent.be

Dates may change due to unforeseen reasons.

Scriptics 09 225 52 02