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## SYLLABUS

# Exergy Analysis

200 HOURS

## SUBJECT/LEVEL

Energy engineering graduate level.

## LEARNING OUTCOMES

After completion of the course you will be able to:

- Analyze real energy and material conversion systems from an exergy point of view
- Reflect on sustainable use of physical resources

## COURSE CONTENTS

The course is divided into three parts:

*Part 1. Exergy Analysis Fundamentals, 70 hrs:* Exergy concepts and methods, Life Cycle Analysis, Energy Systems, Life Cycle Exergy Analysis (LCEA), sustainable resource use.

*Part 2. Exergy Calculations, 60 hrs:* LCEA of different systems and process.

*Part 3. Individual project report, 70 hrs:* LCEA of real systems.

## RECOMMENDED REQUIREMENTS

Knowledge of thermodynamics or exergetics.

## TYPE OF TEACHING

The course is given as an Internet based academic course in English. Exercises and assignments are submitted on line and participants get personal feedback from the teacher. A forum for discussion is also available.

## EXAMINATION AND GRADES

Examination by hand in exercises. Grades will be given according to the scale A to F, where A is highest and F is failed.

## LITERATURE

Cutler J. Cleveland, *Net Energy From the Extraction of Oil and Gas in the United States* 17 p.

[http://www.bu.edu/cees/people/faculty/cutler/articles/Net\\_%20Energy\\_US\\_Oil\\_gas.pdf](http://www.bu.edu/cees/people/faculty/cutler/articles/Net_%20Energy_US_Oil_gas.pdf)

Gong, M. and G. Wall, *On Exergy and Sustainable Development, Part II: Indicators and Methods* (2001) 17 p.

<http://www.exergy.se/ftp/gw2exij.pdf>.

Muileman and Blonk, *Towards a sustainable use of natural resources* (2001) 18 p. <http://ec.europa.eu/environment/enveco/waste/pdf/muileman.pdf>.

*The Eco-indicator 99 A damage oriented method for Life Cycle Impact Assessment* (2000) 144 p.

[http://www.pre.nl/download/EI99\\_methodology\\_v3.pdf](http://www.pre.nl/download/EI99_methodology_v3.pdf).

The Exergoecological Portal, [http://www.exergoecology.com/excalc/index\\_html/new\\_calc\\_exergy](http://www.exergoecology.com/excalc/index_html/new_calc_exergy).

Zvolinschi, Anita. *On exergy analysis and entropy production minimisation in industrial ecology*, (2006) 216 p.

PhD Theses, NTNU, <http://ntnu.diva-portal.org/smash/record.jsf?pid=diva2:122541>.

Wall, G. and M. Gong, *On Exergy and Sustainable Development, Part I: Conditions and Concepts* (2001) 18 p.

<http://www.exergy.se/ftp/wg1exij.pdf>.

Wall, G., *Exergy Flows in Industrial Processes*, Energy, Vol. 13, No. 2, pp. 197-208 (1988)

<http://www.exergy.se/ftp/paper3.pdf>, <http://www.exergy.se/ftp/paper3fig52.pdf>, and

<http://www.exergy.se/ftp/paper3fig62.pdf>.

Wall, G., *Exergetics* (2009) 151 p. <http://www.exergy.se/ftp/exergetics.pdf>.

Göran Wall August 30, 2010