Quarterly Report 1/2007
January - March

Production:
Alexandra Priatna, Chalmers AGS Office
Executive Summary

The research continues to follow the original plan. The mapping of the energy infrastructure during this period has completed the survey of the international oil market in the perspective of the European energy markets (e.g. security of supply and relation to the other fuel markets). Research on the global coal market has been initiated. With respect to the modeling and analysis work a co-operation with the Energy Research Centre of the Netherlands (ECN) and Universität Stuttgart (IER) has been initiated in order to compare and assess technology descriptions in energy systems modeling. The analysis of how to treat the demand side continues.

There is finally a positive decision on two of the three applications developed by the project management team: Swedish Energy Agency (STEM) and Intelligent Energy Europe (IEE). As for the third application (ABB), there are positive signs and a meeting will be held in the next period to, hopefully, decide on the start up of activities.

We are unable to identify any severe and immediate risks for the project at this stage. It is of course very positive with the decisions from STEM and EU. Yet, most of the fundraising in the project was carried out by the project management team and the possibility for support for fundraising should be investigated.

Prof. Filip Johnsson
Project manager of the Pathways project
Project status

The work with the key questions for 2006 is now fully integrated in all of the ongoing activities for 2007. This is hopefully an efficient way of working and keeping a clear focus of the project. The plan is that the results of 2007 will provide good answers to the key questions. There is of course also a constant refining and development of the methods used for analysis. In addition, several different methods are used for the analysis (modeling toolbox), which is a pre-requisite in order to answer the project questions in a solid way.

The research continues to follow the original plan. The mapping of the energy infrastructure during this quarter has completed the survey of the international oil market in the perspective of the European energy markets (e.g. security of supply and relation to the other fuel markets). A paper is being prepared which summarizes the work. Work on the global coal market has been initiated. When completed, the mapping of the global markets for natural gas, oil and coal will serve as a solid basis for the scenario work of the project. With respect to the modeling and analysis work a co-operation with the Energy Research Centre of the Netherlands (ECN) and Universität Stuttgart (IER) has been initiated in order to compare and assess technology descriptions in energy systems modeling. These two institutes are leading in European energy systems modeling. The analysis on how to treat the demand side continues.

Ongoing reporting of results comprises papers on resources and future supply of oil with implications on the European Energy System and the summary of the EU demand side data and methodology (somewhat delayed and to be completed in the second quarter of 2007). A recent paper from the technology assessment activities presents a new scheme for polygeneration of electricity and transport fuel with subsequent capture of CO$_2$, including co-firing of biomass.

A list of ongoing activities is given on page 7. Pages 14 and 15 list the Work Packages of the project and the Key Questions.

There is finally a positive decision on two of the three applications developed by the project management team, namely those of the Swedish Energy Agency (STEM) and Intelligent Energy Europe (IEE). As for the third application (ABB), there are positive signs and a meeting will be held in next period to, hopefully, decide on start up of the activities.

Upcoming activities

The main activities of the next period will be to start up the activities funded by the Swedish Energy Agency ("Pathways – svenska systemlösningar"). A first meeting with the partners is planned in April. With respect to the project within Intelligent Energy Europe (IEE) the next period will include Contract Negotiations. An application on European Energy Systems modeling will be submitted to the European 7th Research Framework (FP7) within a consortium containing ECN and IER and with Fondazione Eni Enrico Mattei (FEEM) as coordinator.

The above mentioned papers are planned to be completed during the period.

Risks and Risk management

Red flags

We are unable to identify any severe and immediate risks for the project at this stage.

Yellow flags

As the two applications from STEM and IEE were approved part of the yellow flags indicated in previous reports can be removed. However, most of the fundraising in the project was carried out by the project management team and the possibility for support for fundraising should be investigated. In theory the
above mentioned contract negotiations for the IEE project could result in that this project is not approved, but the risk for this should be low. With respect to ABB they have claimed that they will join the project.

A general challenge is to maintain a good focus for the overall project, including the new STEM and IEE projects.

Open questions

There is still somewhat of a question with respect to the development of the other regional projects within the overall AGS energy pathways program, but as indicated in previous report, there seems to be some progress with the MIT/Portugal Initiative and in that MIT is progressing on mobility with the PSI in Zurich. No details are available as yet on the projects in India and Africa, since these were recently funded.

Budget

The budget of 2007 has been followed.

Papers from the project

The list below concerns the entire project duration and will be updated in each quarterly report:

• “Biomass co-firing potentials for electricity generation in Poland - matching supply and co-firing opportunities”, Biomass and Bioenergy, in press.
• “The prospects for large-scale import of biomass and biofuels into Sweden – a review of critical issues”, Energy for Sustainable Development, 10 (1), 2006, pp 82-94
• Bioenergy expansion in EU – cost-effective climate change mitigation, employment creation and reduced dependency of imported fuels. Energy Policy, accepted for publication.
• The following papers were presented at the AGS Annual meeting in Barcelona, May 18-21, See proceedings (ISBN 978-91-976534-2-8).
  o “Bridging to a Sustainable Energy Future – Examples from the Stationary Energy System”
  o The development of the electricity-supply systems in Germany, the UK and the Nordic countries under
 string CO2 reduction commitments
  o Dispatch modeling of a regional power system - integrating intermittent power generation
  o Oxyfuel power plant with co-production of DME - a bridging technology
  o Integrating biomass in natural gas fired combined cycles as a bridge to a sustainable energy system
    - a method for technology assessment
  o Linking mobile and stationary systems – plug-in hybrid electric vehicles
  o Energy use in European buildings - Monitoring the pathway towards a sustainable built environment
  o International bioenergy trade - The prospects for large-scale import of biomass and biofuels to Sweden
  o Bridging to a sustainable energy future – EU energy policy

**Reports from the project**

Ongoing project activities

The ongoing work has been broken down in activities in order to structure and follow up the work. The nomenclature of the activities is given below followed by the list of activities according to the nomenclature. There are currently 23 activities.

Nomenclature

<table>
<thead>
<tr>
<th>Activity number (continuous numbering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>Activity</td>
</tr>
</tbody>
</table>

**AXX-XX**

**TITLE OF ACTIVITY**

Researcher: Name of researcher

Contact: Name of contact if other than researcher

Short description of activity

---

Colored boxes and numbers refers to the list below

<table>
<thead>
<tr>
<th>Type of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Continues activity</td>
</tr>
<tr>
<td>2- Larger activity</td>
</tr>
<tr>
<td>3- Smaller activity</td>
</tr>
<tr>
<td>4- Monitoring of / interaction with research outside the Pathways project</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated manpower requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- More than two man year</td>
</tr>
<tr>
<td>2- More than half man year, but less than two man year</td>
</tr>
<tr>
<td>3- More than three man month, but less than half a man year</td>
</tr>
<tr>
<td>4- More than one man month, but less than three man month</td>
</tr>
<tr>
<td>5- Less than one man month</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status of project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Initializing</td>
</tr>
<tr>
<td>2- Ongoing</td>
</tr>
<tr>
<td>3- Finalized</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Related work package or work packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Description of European energy infrastructure</td>
</tr>
<tr>
<td>2- Energy systems modeling</td>
</tr>
<tr>
<td>3- Technology assessment of Best Available Technologies on production side</td>
</tr>
<tr>
<td>4- Technology assessment of Best Available Technologies on demand side</td>
</tr>
<tr>
<td>5- Technology assessment for innovative and intermittent technologies</td>
</tr>
<tr>
<td>6- Land use and infrastructure modeling</td>
</tr>
<tr>
<td>7- International fuel markets</td>
</tr>
<tr>
<td>8- Social and political implications of energy futures</td>
</tr>
<tr>
<td>9- Management and Fundraising</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Related key question or questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Definition of “pathways”</td>
</tr>
<tr>
<td>2- The current “pathway”</td>
</tr>
<tr>
<td>3- Two-three pathways to sustainable European energy systems</td>
</tr>
<tr>
<td>4- Key technologies and systems</td>
</tr>
<tr>
<td>5- Will a European deregulated market path the way for sustainability?</td>
</tr>
<tr>
<td>6- Political action and decisions</td>
</tr>
<tr>
<td>7- Acceptance of society?</td>
</tr>
</tbody>
</table>
**A06-01**

**DATABASE CONTAINING EXISTING POLICY MEASURES IN SELECTED EUROPEAN COUNTRIES**

Researcher: Thomas Unger

The aim of this activity is to collect data for existing policy measures in selected European countries, besides the EU ETS, with emphasis on carbon and energy taxes, and support schemes for renewable electricity. The purpose is to complement the existing Chalmers Member State Database that includes energy and climate targets and policies but, generally, lacks the policy measures.

**A06-02**

**VINTAGING OF PRESENT EU-25 ELECTRICITY GENERATION CAPACITIES**

Researcher: Mikael Odenberger

Using a vintage approach to estimate and analyze ageing of present European capacities, listed in CSS Db, until the year of 2050. This enables identification of expected generation shortages in terms of size, as well as when and where such shortages will occur.

**A06-03**

**LONG TERM DEVELOPMENT OF THE NORDIC ELECTRICITY SUPPLY SYSTEM**

Researcher: Mikael Odenberger

In this activity future investments in the Nordic electricity generation system are investigated with MARKAL-Nordic including a detailed vintage study of the present system. The vintage study is based on Chalmers Supply Side Db (CSS Db).

**A06-04**

**POWER PLANT, FUEL, CO₂ STORAGE AND MEMBER STATE DATABASES**

Researcher: Jan Kjärstad

In order to have an accurate, detailed and up-to-date description of the infrastructure of the European power system, available information is collected into four databases with a European or global coverage (Power Plant, Fuel, CO₂ Storage and Member State Databases). The databases are continuously developed and updated, in order to provide essential information to the other activities.

**A06-05**

**CO₂ STORAGE**

Researcher: Jan Kjärstad

In this activity the aim is to understand the impact of Carbon Capture and Storage (CCS) on the continued use of fossil fuel, foremost coal and lignite, in the context of climate change and security of supply.

**A06-06**

**FUEL INFRASTRUCTURE**

Researcher: Jan Kjärstad

The interaction between fuels, fuel prices, security of supply, greenhouse gas emissions and other fuel related factors that have an impact on the future electricity production structure are analyzed in this activity. The analysis is mainly based on the information collected in the Fuel database.
A06-07  
**INDICATORS ON GHG EMISSION REDUCTION POTENTIAL AND SECURITY OF SUPPLY**

Researcher: Jan Kjärstad

In this activity a number of key parameters that illustrates CO₂ reduction potential and/or the level of security of supply, both for the separate member state as well as for the whole EU, will be identified.

A06-08  
**PROCESS INTEGRATION OF BIOMASS CONVERSION IN EXISTING GAS COMBINED CYCLE PLANTS**

Researcher: Erik Pihl

A major part of the power capacity installed in Europe during the last years and will be installed in the near future is or will be generated in gas combined cycle plants. Stronger restrictions on CO₂ emission will also impose restrictions on high efficient natural gas plants. One option is to replace some of the natural gas with biomass and in this activity possible options to energy efficiently and cost effectively integrate conversion of biomass in the gas combined cycle in order to take advantage of investments already made, will be investigated.

A06-09  
**CO-FIRING POTENTIAL OF BIOMASS AND FOSSIL FUELS IN EXISTING EUROPEAN POWER PLANTS**

Researcher: Erik Pihl

Co-firing biomass with fossil fuel in already existing heat and power plants is a near term bridging technology. In this activity the co-firing potential in the European power sector will be analyzed by matching biomass resources or potentials to existing power plants.

A06-10  
**PROCESS ANALYSIS OF A CO-FIRED OXY-FUEL POWER PLANT**

Researcher: Fredrik Normann

Co-firing of biomass with lignite in an oxy-fuel power plant is an option to reduce the CO₂ emission even further than in a regular oxy-fuel process. The aim of this activity is to investigate how co-firing of biomass can be integrated into lignite fired oxy-fuel plant.

A06-11  
**WHAT IS A SUSTAINABLE EUROPEAN ENERGY SYSTEM? - A WORKSHOP SERIES**

Researcher: Filip Johnson

Contact: Bo Rydén

The aim of this workshop series is to create a broader picture of the conception sustainable development of the European energy system – what shall be included and how shall it be applied in the Pathways project. These workshops are attended by professors, experts from the industry and persons from the government. As a base for the discussions a literature survey of relevant publications is used.

A06-12  
**MAPPING AND MODELING OF EUROPEAN DISTRICT-HEATING SUPPLY SYSTEMS**

Researcher: John Jonsson

Contact: Thomas Unger

The objective of this activity is to provide a thorough overview and understanding of the district heating systems in selected European countries. This includes both an aggregated view of most of the European countries in which district heating plays an important role today, and assembly in the future, and specific and in-depth modeling of selected European cities or municipalities with district heating. Thereby, this activity may generate data on the potential for combined heat and power, geothermal solutions and the potential of using biofuel and/or natural gas for district-heating supply.
A06-13

DEVELOPING THE EPOD (EUROPEAN POWER DISPATCH) MODEL

Researcher: Thomas Unger

The objective of this activity is to develop a dispatch model including a significant share of the European electricity-supply system in order to visualize and analyze the European electricity-supply system of the future and compare it with today’s system.

A06-14

MULTIFUNCTIONAL BIOENERGY SYSTEMS - A POPULAR REPORT INTRODUCING THE CONCEPT AND PRESENTING EXAMPLES FROM SWEDEN

Researcher: Göran Berndés

An introduction to the concept of multifunctional bioenergy systems and present examples of applications of the concept in Sweden is given in this activity. The purpose is to present and explain the concept of multifunctional bioenergy systems, including the methods used for their assessment. The focus in the report is on systems established on agricultural land and the examples from Sweden concerns systems based on willow cultivation.

A06-15

FUTURE COST AND POTENTIAL SUPPLY OF ENERGY CROPS IN EUROPE

Researcher: Göran Berndés

Further develop and apply methodologies for consistently estimating potentials and the present and future costs for energy crop production in Europe will be done in this activity. Although the focus is on energy crops from cropland, estimates will be made also for forest biomass supply, based on a less comprehensive methodology.

A06-16

INTERACTIONS BETWEEN THE TRANSPORT SECTOR AND STATIONARY ENERGY SECTOR - THE ROLE OF BIOMASS

Researcher: Göran Berndés, Julia Hansson

The aim of this activity is to analyze the role of biomass in the interaction between the transport sector (transport fuel demand, policies and fuel choices) and the stationary energy sector. For the analysis an existing modeling tool will be used and further developed. Complementary methodologies will also be applied.

A06-17

GLOBAL AND REGIONAL BIOENERGY POTENTIALS AND INTERNATIONAL BIOENERGY TRADE

Researcher: Göran Berndés

The aim of this activity is to produce estimates on global and regional bioenergy potentials, and prospective trade patterns. Also, clarify how the data depend on variations in critical parameters, such as future food demand and productivity growth in agriculture. The data produced can be used for specific model based analyses in the Pathways project as well as for constructing a database that gives a picture of prospective availability of fossil as well as renewable energy sources in the world.

A06-18

DISPATCH MODELLING OF A REGIONAL POWER GENERATION SYSTEM - INTEGRATING INTERMITTENT GENERATION

Researcher: Lisa Edqvist

The aim of this activity is to develop an energy systems model, which can investigate the effect of intermittent power generation on the dispatch of a regional power generation system. The model should be developed by using Jylland as an example. Thus, since, Jylland currently has a large share of wind power and constitutes a limited region with a few well defined connections to neighbouring regions (transmission cables). Jylland is also a limited region in terms of the number of large thermal power plants. This enables a direct and relatively straightforward link to the Chalmers Power Plant Database.
POSSIBILITIES AND LIMITATIONS OF CO-FIRING OF BIOMASS IN EXISTING HEAT AND POWER PLANTS

Researcher: Bo Leckner
Contact: Henrik Thunman

During many circumstances the fastest, most economic and most effective way to increase the share of biomass in the heat and power sector is by co-firing the biomass in already existing heat and power plants. In this activity the possibilities and the limitations of co-firing documented in the literature and experienced gained from Chalmers own research boiler will be summarized.

SURVEY OF AVAILABLE STATISTICS AND METHODOLOGIES APPROPRIATE FOR THE ANALYSIS OF THE DEMAND SIDE WITHIN THE PATHWAY-PROJECT

Researcher: Anders Göransson, AG Energidata
Contact: Bo Rydén

The aim of this activity is to make an inventory of the sources and describe what type, quality and accessibility of data that is already available for the description of the energy demand in Europe. The work also includes suggestions on methodologies on how the demand side should be treated in the Pathways project and what kind of input data that are needed for these methodologies.

ENERGY MODELS IN EUROPE

Researcher: Clas-Otto Wene, Wenergy
Contact: Bo Rydén

This project concerns three basic questions; which are the energy system models that include a high quality database of the European energy infrastructure and are available today? Which institutes or departments own these energy system models? Is it possible for Chalmers to purchase specific runs from these institutes or department and/or to which of these departments is it possible to establish a closer co-operation?

WASTE AS FUEL IN EUROPE, PART 1

Researcher: Johan Sundberg
Contact: Bo Rydén

In this activity the European potential of wastes to be used as fuel is quantified together with its possible contribution to the share of renewables in the European energy system. Further on, the potential of energy recovery from waste will be mapped; the mechanisms that control the development will be analyzed and possible pathways for the use of waste as an energy source suggested.

PROCESS ANALYSIS OF AN OXY-FUEL POWER PLANT WITH CO-PRODUCTION OF METHANOL

Researcher: Fredrik Normann

Oxy-fuel combustion includes a large number of new energy streams, which can be used to produce steam, heat power and additional products. In this work the integration of methanol production into the oxy-fuel combustion process will be investigated.
A06-24

THE POLITICAL ECONOMY OF RENEWABLE ENERGY SUPPORT INTEGRATION IN EUROPE

Researcher: Patrik Söderholm

Contact: Bo Rydén

The purpose of this activity is to outline a number of scenarios for the future development of policies implemented to support renewable electricity in Europe, and briefly analyze the consequences of these developments on investment behaviour and policy implementation in the electric power sector. The project is primarily a pilot study and an important task is therefore to identify important areas and approaches for future research in the field, but this does not exclude that the study will generate tentative conclusions on pathways (and perhaps also “blind alleys”) towards a harmonized European policy in the renewable energy field.

A06-25

SURVEY OF AVAILABLE STATISTICS AND METHODOLOGIES APPROPRIATE FOR THE ANALYSIS OF THE INDUSTRIAL ENERGY USE WITHIN THE PATHWAY-PROJECT

Researcher: Per-Åke Franck

Contact: Bo Rydén

In this activity a survey of available statistics and methodologies appropriate for the analysis of the industrial energy use within EU is to be carried out. The aim is to get an identify how industrial energy use should be treated in the pathways project.

A06-26

FEASIBILITY STUDY OF METHODOLOGICAL PREREQUISITES FOR DETERMINING THE POTENTIAL SUPPLY OF WOOD FUELS FOR CO-FIRING IN EUROPEAN COUNTRIES

Researcher: Björn Vikinge

Contact: Bo Rydén

This activity is a feasibility study of methodological prerequisites for determining the potential supply of wood fuels for co-firing in European countries is to be carried out.

A07-01

USE OF AVAILABLE STATISTICS AND METHODOLOGIES APPROPRIATE FOR THE ANALYSIS OF THE DEMAND SIDE

Researcher: Eoin ó Broin, Chalmers and Anders Göransson, AG Energidata

Contact: Eoin ó Broin

The aim of this activity is to use the inventory made in activity A06-20 to develop a methodology on how the demand side should be treated in the Pathways project and select proper input data from available sources.

A07-02

ENERGY MODELS IN EUROPE

Researcher: Bob van der Zwaan (ECN) and Markus Blesl

Contact: Filip Johnsson

Resulting from A06-21 on mapping energy systems models in Europe, a co-operation with Energy research Center of the Netherlands (ECN) and Universitaet Stuttgart (IER) has been initiated in order to compare and assess technology descriptions in European energy systems modeling. ECN and IER are leading in European Energy systems modeling (mainly MARKAL/TIMES and the aim of the co-operation is to assess and evaluate these models from the perspective of the research questions of the Pathways project.
INCREASED ENERGY EFFICIENCY AND DECARBONIZATION OF EUROPEAN INDUSTRY: A PILOT STUDY

Researher: Stefan Wirsenius
Contact: Filip Johnsson

The aim of this pilot study is to explore the possibilities of pursuing research topics related to energy efficiency and decarbonization in European manufacturing industry. The pilot study will focus mainly on energy intensive industry sectors, such as pulp and paper, metals, chemicals and non-metallic minerals. This study continues activity A0-25, and expands this to an energy systems perspective.

DISPATCH MODELING OF POWER GENERATION SYSTEM / INTEGRATING INTERMITTENT GENERATION

Researher: Lisa Edqvist
Contact: Filip Johnsson

The aim of this activity is to further develop the energy systems modeling developed in A06-18. Thus, the aim of the modelling is to find a methodology which can investigate the effect of intermittent power generation on the dispatch of a regional power generation system. The aim is to build on the experiences gained in the modelling of A06-18 and to develop a more general methodology.
The Pathways project is divided into ten defined work packages which have been set for the whole project. A development during the second quarter has been to relate the work packages to the scales of questions. This will allow a full integration of European pathways as the project progresses.

**WP1**
Description of European energy infrastructure

**WP2**
Energy systems modeling

**WP3**
Technology assessment of Best Available Technologies on production side

**WP4**
Technology assessment of Best Available Technologies on demand side

**WP5**
Technology assessment for innovative and intermittent technologies

**WP6**
Land use and infrastructure modeling

**WP7**
International fuel markets

**WP8**
Social and political implications of energy futures

**WP9**
Management and Fundraising

**WP10**
Communication
Key questions for 2007

The work with the key questions for 2006 is now fully integrated in all of the ongoing activities for 2007. The plan is that the results of 2007 will provide good answers to the key questions. There is of course also a constant refining and development of the methods of analysis. In addition, there are several different methods used for the analysis (the modeling toolbox of the project), which is a pre-requisite in order to answer the project questions in a solid way.

The questions are:

1. Definition of “pathways”
   What are the criteria for definition of “pathways to sustainable energy systems”?
   How will the choice of criteria influence the design of the pathways towards a sustainable energy system?
   Which are the pathways that do not lead to a sustainable energy system?

2. The current “pathway”
   Will the current “pathway” lead to a sustainable energy system?

3. Two-three pathways to sustainable European energy systems
   How can pathways to a sustainable energy system be characterized and visualized and what are the consequences of these pathways? (“Pilot scenarios”)

4. Key technologies and systems
   What are “key” technologies and systems for the identified “pathways”?
   Where are the greatest uncertainties in technology choices?
   • What is the critical timing for decisions to ensure that a pathway to a sustainable energy system can be followed?
   • What role will the stationary systems (such as power systems and district heating) play in the different pathways?
   • Where are the critical regions with respect to CO₂ emissions and investments?
   • What is the role of renewables and energy efficiency?
   • Where and when are the risks for technology lock-in effects?

5. Will a European deregulated market path the way for sustainability?
   Are the deregulated energy markets suitable to facilitate a development towards a sustainable energy system?
   Are the present market conditions suitable for a development along a pathway towards a sustainable energy system and, if not, can these conditions be changed to facilitate this?

6. Political action and decisions
   What kind of political action is necessary?
   What can and should the EU and/or the Member States do politically?
   What issues have to be addressed at an international level?

7. Acceptance of society?
   What possibilities and obstacles can be foreseen?
   What are the choices that consumers would like to make which lead to sustainability? How will these affect political decisions, and vice versa?
ORGANISATION 2007

Board

Standing members:
Lennart Billfalk, Vattenfall AB
Karin Markides, Chalmers
Filip Johnsson, Chalmers

Associate Members:
Karl Bergman, Vattenfall AB
Göran Svensson, Vattenfall AB
Bo Rydén, Profu AB

Project Management

Filip Johnsson, Energy Conversion, Chalmers
Henrik Thunman, Energy Conversion, Chalmers
Greg Morrison, Water Environment Technology, Chalmers
Bo Rydén, Profu AB

Administration

Alexandra Priatna, GMV, Chalmers

Faculty

Göran Berndés, Physical Resource Theory, Chalmers
Lena Gipperth, Department of Law, Göteborg University
Thomas Unger, Profu AB
Stefan Wirsenius, Physical Resource Theory, Chalmers

Postgraduate

Jan Kjärstad, Energy Conversion, Chalmers
Michael Odenberger, Energy Conversion, Chalmers
Julia Hansson, Physical Resource Theory, Chalmers
Klas Andersson, Energy Conversion, Chalmers
Fredrik Normann, Energy Conversion, Chalmers
Erik Phil, Energy Conversion, Chalmers
Lisa Edqvist, Energy Conversion, Chalmers
Eoin ò Broin, Energy Conversion, Chalmers

Master Thesis Students

Johannes Lundvall
Fanny Gravalon