



TECHNISCHE  
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Vienna University of Technology

Institut für Energiesysteme und Elektrische Antriebe  
Energy Economics Group (EEG)

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# **DIPLOMARBEITSTHEMEN**

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## Vorwort

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Dieses Dokument beinhaltet Diplomarbeitsthemen, die am EEG von Prof. Reinhard Haas angeboten werden. Die Hauptbetreuung der Arbeiten in diesem Katalog übernehmen jeweils Assistant/inn/en in Kombination mit Postdocs. Die Arbeiten sind im folgenden spezifischen Themengebieten zugeordnet.

Wenn Sie an einer Diplomarbeit interessiert sind sollten sie:

- die wichtigsten Kenntnisse der Energiewirtschaft haben.
- vom Institut angebotene Lehrveranstaltungen absolviert und
- den Großteil Ihrer Prüfungen absolviert haben um eine rasche Bearbeitung Ihrer Diplomarbeit zu garantieren.

Falls Sie interessiert sind, schicken sie eine E-mail an eine/n der dem jeweiligen Thema zugeordneten Betreuer.

Herzlichst,

Reinhard Haas

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# 1. Energiepolitik / Energy policies

## 1.1. Lessons learned from and the effects of CO2-taxes on the energy system in selected countries

- **Motivation:** In the public discussion on fighting against Global Warming CO2-taxes are considered as a very important mean. In many countries (such as Sweden, Switzerland, ) CO2-taxes are already implemented. Of interest is what are the lessons learned of these countries and what were their effects so far?
- **Objective:** The core objective of this work is to analyse in which countries CO2-taxes are already implemented, since when, in which design and what their effects were so far.
- **Method of approach:** A comprehensive literature review as well as a data collection and analysis has to be conducted. An economic model simulating the effects of CO2-taxes has to be developed in Excel. Some databases e.g. ODYSSEE are already available.
- **Supervisors:** Prof. Reinhard Haas, Jasmine Ramsebner

## 1.2. An analysis of the effects of different types of policies in the energy system (world-wide)

- **Motivation:** In most countries (world-wide) several energy policies are implemented in different countries, taxes, subsidies, standards.
- **Objective:** The core objective of this work is to analyse which major policies were implemented in major countries since the 1970s and what their effects were.
- **Method of approach:** A comprehensive literature review as well as a data collection and analysis has to be conducted. An economic model simulating the effects of policies has to be developed in Excel. Some databases e.g. ODYSSEE are already available.
- **Supervisor:** Prof. Reinhard Haas

## 1.3. Eine (weltweite) Analyse der Effizienz und der Effektivität handelbarer Zertifikate zur Förderung von Strom aus EET

A (world-wide) analysis of the efficiency and the effectiveness of tradable certificates for electricity from Renewable energy sources

- **Motivation:** Electricity from renewables is promoted in many countries. One instrument to do this are tradable Green Certificates.
- **Objective:** How effective (deployed quantities) and efficient (costs) are trading systems in different countries? Which role play the potentials of different sources (hydro, wind, biomass)
- **Method of approach:** Analysis of quantities and costs of various Renewable portfolio standards in the USA. Creation of a database and a simple model in EXCEL.
- **Supervisor:** Prof. Reinhard Haas, Dr. Gustav Resch

## 1.4. Eine (weltweite) Analyse der Effizienz und der Effektivität von Ausschreibungen zur Förderung von Strom aus EET

A (world-wide) analysis of tendering/bidding systems for electricity from RES

- **Motivation:** Electricity from renewables is promoted in many countries. One instrument to do this are tendering/bidding systems.
- **Objective:** How effective (deployed quantities) and efficient (costs) are trading systems in different countries? Which role play the potentials of different sources (hydro, wind, biomass)?

- **Method of approach:**
  - Analysis of quantities and costs of various Renewable portfolio standards in the USA
  - Creation of a database and a simple model in MATLAB or EXCEL
- **Supervisor:** Prof. Reinhard Haas, Dr. Gustav Resch

## 1.5. Ein Vergleich von Subventionen für Energie in unterschiedlichen ökonomischen Systemen

### A comparison of energy subsidies across different economic systems

- **Motivation:** Often it is argued that energy subsidies warp the energy prices and thus impede completion, energy intensity reductions and many other salient energy-systems improvements. However, one third of the global population cannot afford modern energy services and they are a pre-requisite for human development and well being. Subsidies to a part help make some minimal levels of energy services affordable and indispensable in some sectors such as transport and agriculture. Yet, often it is the rich who benefit more from energy subsidies than the poor who are supposed to be targeted. All told, global energy subsidies are estimated to be in the regions between 300 and 1000 billion USD per year, a sum comparable to the total annual energy investments. The main objective is to collect from the literature estimates of subsidies across different countries and regions based on the published literature and undertake a comparative analysis of the benefits and disbenefits generated by energy subsidies.
- **Objective:** Collect energy-subsidies data from different sources in the literature:
  - Collection of data on subsidies, costs and prices fuels and electricity across the world.
  - Assessment of economic consequences of energy subsidies.
  - Analysis of possible alternatives to energy subsidies.
  - Comparison of subsidies with other energy-price instruments such as feed-in tariffs.
- **Method of approach:** Literatureresearch, collection of energy price data in different countries and sectors, analysis or resulting prices and economic and social implications.
- **Supervisor:** Dr. Gustav Resch , Prof. Reinhard Haas

## 2. Strommärkte und -preise / Electricity Markets and prices

### 2.1. Design von Kapazitätsmärkten in Spotmärkten ausgewählter Länder (USA, Europa, Asien, Australien)

#### An analysis of capacity markets design and major features in spot markets in selected countries world-wide (USA, Europe, Asia, Australia ...)

- **Motivation:** In recent years in many countries the idea of capacity payments for power generators in addition to revenues from the energy-only market, has gained attention in the energy economic discussion, e.g in Germany, USA, France and UK. The reason for this is that a significant number of market players claim that the long-term reliability of the electricity system is at risk, as long as there is no politically organized mechanism for capacity payments in place. Indeed, however, in many countries such CPs have been introduced.
- **Objective:** The goal is to document currently implemented capacity mechanisms world-wide in a systematic way and to analyse the lessons learned regarding costs, excess capacities and so on. This analysis should mainly be based on literature research.
- **Method of approach:** Systematic approach for analysing different features of CM, Analysis of historical data Econometric model, Regression analysis
- **Supervisor:** Prof. Reinhard Haas

## 2.2. Eine Analyse von Market-Coupling und Market-Splitting in europäischen Strommärkten

### An analysis of Market-Coupling and Market-Splitting in Western Europe

- **Motivation:** In recent years the aspects of market coupling and market splitting gained attention. An indicator in this context in Austria are interruptions in trading in intraday markets.
- **Objective:** The core objective of this work is to analyse reasons/frequencies for market coupling and market splitting based on intraday market disruptions in CWE electricity markets (basierend auf Unterbrechungen des Intraday-Markts)  
How did intraday cross-border trade develop, how many interruptions took place?
- **Method of approach:** Analyses of historical data provided by APG, Econometric model, Regression analysis
- **Supervisor:** Prof. Reinhard Haas

## 2.3. Ein Vergleich verschiedener Ansätze zur Modellierung des Strompreises in day-ahead-Märkten

### An analysis of different approaches for modelling electricity prices in day-ahead markets

- **Motivation:** Modelling future electricity prices is currently one of the most challenging tasks in energy economics and different methods of approach exist. In addition in recent years temporarily large quantities of renewable electricity have influenced the wholesale electricity market prices.
- **Objective:**
  - An analysis of different approaches for modelling electricity prices incl. the impact of Renewable Energy Sources (RES-E) on prices in day-ahead electricity markets
  - To review the literature
  - To compare different approaches and their major impact parameters
  - To develop a simple own model for Austria
- **Method of approach:**
  - Conduct a comprehensive literature and internet survey
  - Data collection and putting together a database for Germany and Austria
  - Compare/use a fundamental approach (Price=marginal costs) to model the price in the electricity market on an hourly basis based on scarcity (and an Econometric approach)
  - Creation of a simple model in MATLAB or EXCEL.
- **Supervisor:** Prof. Reinhard Haas

## 2.4. Lessons learned from regions with zonal vs nodal pricing in selected countries

- **Motivation:** Regarding efficient pricing in the transmission grid two basic approaches are implemented in different countries: zonal vs nodal pricing.
- **Objective:** The goal is to document currently implemented zonal vs nodal pricing approaches world-wide in a systematic way and to analyse the lessons learned regarding costs and effectiveness. This analysis should mainly be based on literature research and specific data for some countries.
- **Method of approach:** Systematic approach for analysing different features of zonal vs nodal pricing, Analysis of historical data Econometric model, Regression analysis.
- **Supervisor:** Prof. Reinhard Haas

## 3. Energienachfrage / Energy demand models

### 3.1. Ökonometrische Untersuchung des Stromverbrauchs unterschiedlicher Länder

#### Econometric analysis of the electricity consumption of different countries

- **Motivation:** Um den Einfluß von Preisen, Einkommen und anderen Parametern auf den Stromverbrauch zu ermitteln, werden ökonometrische Modelle verwendet. Speziell im Strombereich gibt es allerdings auch möglicherweise beträchtliche Unterschieden zwischen Regionen und Ländern, z.B aufgrund unterschiedlicher Kulturen und Life-styles.
- **Aufgabenstellung:** Im Rahmen dieser Arbeit ist ein geeignetes Statistikprogramm zu nutzen um eine ökonometrische Panel data –Analyse für den Stromverbrauch in einzelnen EU-Ländern durchzuführen. Dabei geht es eben neben den Effekten innerhalb eines Landes auch um Unterschiede zwischen den einzelnen Ländern.
- **Methode:** Die Daten sind weitgehend vorhanden, einige Zusatzrecherchen sind aber notwendig. Auswahl und Anwendung eines geeigneten Statistikprogramms ist eigenständig durchzuführen.
- **Betreuer:** Prof. Reinhard Haas

### 3.2. Pooled Data Analyse des Energieverbrauchs unterschiedlicher Länder weltweit

#### Pooled data analysis of energy consumption in various countries worldwide

- **Motivation:** Um den Einfluss von Preisen, Einkommen und anderen Parametern zu bestimmen kommen ökonometrische Analysen zum Einsatz. Allerdings kann es - möglicherweise - beträchtliche Unterschiede zwischen Regionen und Ländern geben.
- **Aufgabenstellung:** Im Rahmen dieser Arbeit ist ein geeignetes Statistikprogramm zu nutzen, um eine ökonometrische Analyse für den gesamten Energieverbrauch ausgewählter Länder weltweit durchzuführen. Dabei geht es eben neben den Effekten innerhalb eines Landes auch um Unterschiede zwischen den einzelnen Ländern. Das heißt, es geht darum herauszufiltern, welche Effekte in den Ländern gleich sind und welche unterschiedlich. Ein spezifischer Aspekt ist, ob zwischen einzelnen Ländern signifikantere Einkommenselastizitäten ermittelt werden können als innerhalb einzelner Länder. Weiters ist das Modell auf Strukturbrüche zu testen.
- **Methode:** Die Daten sind weitgehend vorhanden, einige Zusatzrecherchen sind aber notwendig. Auswahl und Anwendung eines geeigneten Statistikprogramms ist eigenständig durchzuführen. Weiters wird die Durchführung der Pooled Data- im Vergleich zu Panel Data Analyse mit klarer Dokumentation der schrittweisen Vorgangsweise verlangt.
- **Betreuer:** Prof. Reinhard Haas

## 4. Erneuerbare Energie / Renewable Energy

### 4.1. Repowering Wind

- **Motivation:** Renewables such as wind energy are considered to contribute to an environmentally benign electricity supply. Yet, land areas are limited and techno progress is made. Repowering maybe an important strategy to contribute to an sociaetally optimal development and to a reduction of subsidies.
- **Objective:**
  - Analysis of the dynamic potential of wind repowering

- Comparison of some European countries (data available)
- **Method of approach:**
  - Analysis of the development of the performance of wind power over time and the deployment in Austria, Germany and other selected countries
  - Creation of a database and a simple model in MATLAB or EXCEL
- **Supervisor:** [Dr. Gustav Resch](#) , [Prof. Reinhard Haas](#)

## 4.2. An analysis of the /optimal market penetration of PV in different countries

- **Motivation:** Electricity from PV systems is promoted in many countries. However, PV generates most electricity in summer. Over a year it is distributed quite uneven
- **Objective:** Analysis of the maximal/optimal market penetration of PV in different countries (Austria, Germany, Nordic, Italy, Africa . . . )
- **Method of approach:** Analysis on an hourly base over a year (8760 hours) using demand profiles and solar insolation numbers. Creation of a database and a simple model in EXCEL.
- **Supervisor:** [Prof. Reinhard Haas](#)

## 4.3. The economic effectiveness of land use for generating energy/electricity

- **Motivation:** The use of all energy sources is associated with the use of land. Despite Renewable Energy Sources are considered to be an environmentally benign energy supply they may also use considerable land areas. The open questions is what are the real quantities and where are the limits.
- **Objective:**
  - Analysis of efficiency and effectiveness of various Renewable portfolio standards in the USA
  - Comparison with European countries (data available)

## 4.4. Analyse der Förderung erneuerbarer Energie in den USA

**An analysis of promotion strategies for renewable energy sources (RES) (Renewable portfolio standards) in the USA.**

- **Motivation:** Renewables are considered to contribute to an environmentally benign electricity supply. Yet due to high costs still subsidies are necessary
- **Objective:**
  - Analysis of efficiency and effectiveness of various Renewable portfolio standards in the USA
  - Comparison with European countries (data available)
- **Method of approach:**
  - Analysis of quantities and costs of various Renewable portfolio standards in the USA
  - Creation of a database and a simple model in MATLAB or EXCEL
- **Supervisor:** [Dr. Gustav Resch](#) , [Prof. Reinhard Haas](#)

## 4.5. Wechselwirkung der Förderung Erneuerbarer Energie vs CO2-Emissionshandel in verschiedenen Ländern

**An analysis of interactions between promotion strategies for renewable electricity (RES-E) and carbon emission trading countries**

- **Motivation:** Renewables are considered to contribute to an environmentally benign electricity supply. There is discussion to what extent it impacts CO<sub>2</sub>-emission trading. And there are critical voices that claim that promotion of renewables distorts the CO<sub>2</sub>-emission trade.



- **Objective:**
  - How does the promotion of renewables currently influence the price for CO2 certificates?
  - Analysis of efficiency and effectiveness of various promotion schemes for RES-E in Europe and how it impacts the CO2-emission trading
  - How should emission trading systems and promotion strategies for renewables be linked?
  - How would corresponding optimal allocation plans look like e.g. for Austria and Germany?
- **Method of approach:**
  - Analysis of quantities and costs of various promotion schemes for RES-E and the parallel CO2 emission allocation plans
  - Creation of a database and a simple model in MATLAB or EXCEL
  - Comprehensive Data collection and analyses, Literature review, develop a simple market model (static and dynamic) in Excel or MATLAB and conduct econometric approaches.
- **Supervisor:** [Dr. Gustav Resch](#) , [Prof. Reinhard Haas](#)

## 4.6. **Ökonomische, ökologische und energetische Bewertung verschiedener Biomasse-Umwandlungstechnologien und biomassebasierter Energieträger**

### **Economic, ecological and energetic assessment of different biomass technologies, energy carriers and fuels**

- **Motivation:** The use of biomass as a renewable energy carrier is of high relevance for the future energy system. Increasing demand for biomass in the EU-28 (and other world regions) and the continuing exploitation of locally available biomass resources, also puts economics and environmental aspects in the core of the discussion.
- **Objective:**
  - The core objective of this work is to assess the economic, ecologic and energetic properties (costs, greenhouse gas emissions, specific energy consumption etc.) of various biomass conversion technologies and fuels.
  - Identify the most efficient ways/ energy carriers for the use of biomass by end use.
  - The focus of the assessment should be on different types of biomass technologies and fuels (e.g. wood chips, biogas, pellets, SNG, liquid biofuels).
  - Analysis whether TL (Technological Learning) did take place?
  - The results should provide insight into the economic feasibility and the ecologic and energetic efficiency of biomass supply chains under various framework conditions.
- **Method of approach:**
  - Literature and internet research (cost data, specific emissions and energy consumption)
  - Analyses of cost effectiveness
  - Implementation of a computer model / calculation tool suitable for analyzing different scenario settings (transport distances, fuel types, supply chains etc.)
- **Supervisor:** [Prof. Reinhard Haas](#) , [Dr. Lukas Kranzl](#)

## 5. Energieverbrauch für Heizen, Warmwasser, Kühlen / Energy demand for Space, Water Heating & Cooling

### 5.1. Analyse der empirischen Effizienz von Wärmepumpen mit unterschiedlichen Wärmequellen

Comparison of centralized vs. decentralized heat supply of different regions and classification of these regions in Austria and selected EU countries

- **Motivation:** Heat pumps are considered to be an efficient method for the reduction of CO<sub>2</sub> emissions. Therefore both the European Union as well as local authorities seek further expansion of existing district heating systems or construct new ones in feasible areas..
- **Objective:**
  - Identify empirically monitored efficiencies (SPFs) of heat pumps depending on the heat source and evaluate their thresholds for the feasibility of a district heating system vs. local heat supply technologies.

### 5.2. Vergleich zentraler und dezentraler Wärmeversorgung verschiedener Regionen in ausgewählten Ländern.

Comparison of centralized vs. decentralized heat supply of different regions and classification of these regions in Austria and selected EU countries

- **Motivation:** Heat pumps are considered to be an efficient method for the reduction of CO<sub>2</sub> emissions. Therefore both the European Union as well as local authorities seek further expansion of existing district heating systems or construct new ones in feasible areas. A classification of regions into certain types allow for a first estimation of the feasibility of a district heating system.
- **Objective:**
  - Identify empirically monitored efficiencies (Seasonal performance factors) of heat pumps depending on the heat source and the design temperature
  - Develop a model to compare the feasibility of central vs. local heat supply structures
  - Classify areas according to the evaluated parameters into different types feasible for district heating or for local heat supply
- **Method of approach:**
  - Literature review of relevant parameters for the economic feasibility and of existing classifications of district heating systems;
  - Develop a model to compare central vs. local heat supply technologies
  - Sensitivity analysis of the relevant parameters
  - Classification of regions into district heating areas or areas suitable for decentralized heat supply
- **Supervisor:** DI Richard Büchele , Dr. Lukas Kranzl

### 5.3. Analysen zur Nutzung industrieller Abwärme

Analysis on the use of industrial excess heat

- **Motivation:** The use of industrial excess heat increases the efficiency of the overall energy system remarkably. However, many aspects of economic efficiency and potentials for its use still remain unclear. Within this topic different research questions can be worked on in course of the master thesis, some of them are stated in the following.
- **Objective:**
  - Analyse the influence of different load profiles and temperature levels of available/usable

excess heat streams on the economic efficiency of excess heat projects on the basis of detailed technical modelling of excess heat systems

- Derive comprehensive cost data for excess heat integration projects for different types of projects (internal vs. external, combination of heat sources and sinks) and show the sensitivity to various influencing factors

- **Method of approach:**

Literature research, Technical modelling of excess heat systems on hourly basis including a storage tank, Techno-economic analysis, Sensitivity analysis

- **Supervisor:** Dr. Lukas Kranzl , Prof. Reinhard Haas

## 6. Energieverbrauch im Verkehr / Energy Economics in Transport

### 6.1. Optimizing the interaction between a decentralized PV-system, a battery storage and an Electric vehicle

- **Motivation:** Electric vehicles as well as Photovoltaics electricity are considered to contribute to an environmentally benign future electricity system. However, it is not yet clear how these technologies could interact in an optimal way.

- **Objective:** The core objective of this work is to analyse for a single-family dwelling how the own consumption of a household of electricity from a PV system with a (stationary) battery including a Electric Vehicle can be economically optimized, considering with and without a stationary battery storage. Different sizes of the PV system are analysed. Finally the analysis has to be conducted in a dynamic framework taking into account possible Technological Learning effects of the EV, the (stationary) battery and the PV system.

- **Method of approach:** A combination of a static and a dynamic model has to be developed. The static model simulates on an hourly basis over a year the solar insolation, the corresponding electricity generation from the PV system, the charging demand from the EV and the possibilities of the stationary battery. The dynamic model considers the possible Technological Learning effects of PV, the battery and the EV.

In addition, a comprehensive data collection and analysis has to be conducted as well as a literature review. The simple simulation market model (static and dynamic) has to be developed in Excel or MATLAB.

- **Supervisor:** Priv.-Doz. Dr. Amela Ajanovic, Prof. Reinhard Haas

### 6.2. On the effectiveness of policies for promoting alternative powertrains in Transport (world-wide)

- **Motivation:** Alternative Powertrains such as Fuel Cell vehicles, CNG vehicles or Battery Electric vehicles (BEVs) are considered to contribute to an environmentally benign future transport system. Targets for increasing their number exist in different countries and several policies for promoting these types of Vehicles are implemented in different countries.

- **Objective:** The core objective of this work is to analyse which monetary and non-monetary promotions systems for Alternative Powertrains exist in selected countries (world-wide) and what were their effects on the market penetration of these types of Vehicles.

- **Method of approach:** A comprehensive literature review as well as a data collection and analysis has to be conducted. The data collection should encompass the specific number of every vehicle category, GDP of the country, electricity price, types of subsidies (or tax relief) and maybe some others. An econometric model simulating the effects of policies has to be developed in MICROFIT, Excel or MATLAB.

- **Supervisor:** Priv.-Doz. Dr. Amela Ajanovic, Prof. Reinhard Haas

## 7. Extern

### “Hydrogen Demand – prioritisation of users”, or “Hydrogen Production – how to identify focus-regions”

Hydrogen will shape the energy future in a decarbonised 2050. In order to further develop this technological trend, Pöyry supports local research in this area. Interested students are invited to explore this emerging topic with our support and cooperation for a Master Thesis.

§ Start:	As soon as possible
§ Duration:	About 6 months, extension can be agreed
§ Support:	One of our consultants will directly provide you with guidance and support
§ Network:	Exchange knowledge and ideas with our experts from all areas of the energy industry
§ Payment:	We offer a full-time internship with a EUR 1,310.- gross salary for a period of six
§ Organisatio	50% of the time is reserved for your thesis, 50% of the time is project work for Pöyry
§ Output:	We expect valuable output, sound research and collaboration with our international
§ Language:	The Master's Thesis (Diplomarbeit) should be written in English

Academic support (official thesis advisor at the university) has to be organised by the student.

We expect you to independently develop and research a more precise description of your potential topic for the thesis in the area of hydrogen demand or production. However, these two general topics may be used as a framework:

- **Hydrogen Demand – prioritisation of users:**  
Decarbonisation efforts raise the demand for public support in order to enable increasing fuel-switching to hydrogen. In a zero-carbon perspective for 2050, which potential or already existing users of hydrogen should be prioritised over others and how can adverse competition be avoided (e.g. cars vs. industry)?
- **Hydrogen Production – how to identify focus-regions:**  
Progressing decarbonisation will push the demand for hydrogen from electrolysis, and increasing capacities will be installed in European power systems. Where should these capacities be built and which properties does an ideal site have, in order to maximise benefits for the electricity-grid and avoid imposing challenges to it?

However, we are open for any suggestion on other topics from your side, given they are related to hydrogen technology and its application within the energy sector.

#### How to apply

Interested? Then please send a short description of your potential thesis (including the proposed timetable), your CV and a short motivation letter to Eva Maria Burghofer: [mc.at@poyry.com](mailto:mc.at@poyry.com). We will get in touch with you soon after.

You will be provided with excellent learning and research opportunities across a broad range of experts and clients within a stimulating and friendly environment.

Your application will be treated strictly confidential.

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EURO PLAZA, Building J, Kranichberggasse 2, 1120 Vienna, Austria  
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#### Pöyry Management Consulting

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