

## IAEE French and Swiss Student Chapters Initiative for Common Workshops in 2010

### FRENCH CHAPTER SPRING WORKSHOP

May 3<sup>rd</sup>, 2010

Université Paris - Dauphine

**9:30- 9:45 Welcome & Opening**

**9:45- 10:00 Presentation of the French and Swiss Students Chapter activities**

**10:00- 10:45**

**Location-Dependent Valuation of Energy Hubs with Storage in Multi-Carrier Energy Systems**

**Florian Kienzle , Power Systems Laboratory, ETH Zurich**

**PhD Supervisor: Prof. Göran Andersson**

**Thesis title: Evaluation of Investments in Multi-Carrier Energy Systems Applying Methods from Financial Economics.**

**Abstract:** In this paper a valuation method for energy hubs containing storage devices is presented. An energy hub is an integrated system of units, e.g. a combined heat and power (CHP) plant and a battery, which allows the conversion and storage of multiple energy carriers. To determine the economic value of an energy hub, its operation is modeled as a series of call options. Taking into account the hub's flexibility to change its output power(s), this series of call options is valued with a Monte Carlo simulation method that calculates an optimal dispatch of the hub for a large amount of possible price paths of the input and output energy carriers. Using the nodal prices from an optimal power flow analysis (OPF) of a system of interconnected energy hubs, each hub can be valued depending on its location. By means of the proposed energy hub real options model, integrated systems of conversion and storage devices can be valued considering both their position in the network and their ability to flexibly adapt their operation to volatile market prices.

**Keywords: Power generation investment, real options analysis, optimal power flow, nodal prices, energy storage, multiple energy carriers.**

**10:45- 11:00 Coffee Break**

**11:00- 11:45**

**Interdépendance des marchés de l'électricité et coût de la non coopération des pays européens en matière de politique énergétique**

**Morgan Villette, Université Paris – Dauphine (CGEMP)**

**PhD Supervisor: Prof. Patrice Geoffron**

**Thesis title: Le coût de la non coopération des pays européens en matière de politique énergétique**

**Résumé :** Dans ses Conclusions du Sommet Européen des 8 et 9 mars 2007, la présidence du Conseil européen a rappelé les 3 axes principaux qui doivent guider les politiques énergétiques à l'échelle nationale et européenne, à savoir, accroître la sécurité des approvisionnements, assurer la compétitivité des économies et promouvoir la soutenabilité des systèmes énergétiques. Les pays membres de l'Union européenne ne s'étant toutefois pas dotés d'une politique énergétique globale commune, ces objectifs n'ont pas été hiérarchisés. L'ordre préférentiel reste du ressort des politiques nationales. On aboutit donc à une situation où la réalisation d'objectifs européens dépend de décisions nationales déterminées en fonction d'ordres de priorités différents par rapport à ces objectifs, tout en sachant, d'une part, que les décisions en vue d'atteindre un objectif prioritaire peuvent entrer en contradiction avec les autres objectifs et que, d'autre part, les choix des uns ont un impact sur les performances des autres et sur les performances globales de l'UE. Cette interdépendance est encore plus flagrante dans le cas des énergies de réseau.

A partir d'un indicateur composite de performance énergétique des marchés nationaux de l'électricité que nous avons construit par rapport aux 3 objectifs de l'UE, nous tenterons de mettre en évidence le coût de cette non coopération des pays en matière de politique énergétique.

**11:45- 12:30**

**Will more competition at the retail level of the European natural gas industry necessarily drive down prices for final consumers?**

**Bertrand CHARMAISON, Toulouse School of Economics (LERNA)**

**PhD Supervisor: Prof. Norbert LADOUX**

**Thesis title : Long term supply contracts in the liberalised European natural gas industry**

**Abstract :** We consider a vertical industry where a dominant upstream producer (or a cartel of producers) sells an homogenous good to retailers who serve the final market. Using an industrial organisation approach, we show that if at an initial stage the final market is supplied by a single incumbent firm holding long-term contracts with the dominant upstream producer, then an excessive entry of competitors on the retail market leads to an increase of the price paid by final consumers. Our model illustrates the existence of a trade-off between alleviating the double marginalisation issue thanks to additional competition at the retail level and limiting the market power of upstream producers on the wholesale market through long-term contracts.

Our results still hold if the dominant upstream firm faces a competitive fringe, provided firms of the fringe face substantially higher costs of production. The counter-intuitive

outcome of our model could be of particular relevance for the European natural gas industry, in case the recently settled organisation grouping the largest gas exporters was to turn into a cartel of producers.

**Index Terms - Long-term contracts, vertical industry, entry, European natural gas markets (L13, L42, L43, L95).**

**12:30- 13:30 LUNCH**

**13:30- 14:15**

**Technical and economic analysis of a solar thermal power plant in Switzerland**

**Thomas Geissmann, CEPE (Centre for Energy Policy and Economics, Swiss Federal Institutes of technology)**

**Bachelor thesis Supervisors: Prof. Massimo Filippini and Silvia Banfi**

**Abstract:** Within this study it is analyzed, whether and under which conditions a solar thermal power plant can be operated economically in Switzerland. Such an analysis is an interdisciplinary task, which necessitates the inclusion of topographical, meteorological, energy political and economic aspects as well as PC-driven simulation tools. The first part of the work gives an overview of the current and future Swiss energy policy and describes the market failures and barriers, which today affect many forms of renewable energy production in Switzerland. Political programs and instruments are described, with which the Swiss government tries to remove these barriers. One of these measures, which strongly affects the profitability and therefore viability of a solar thermal power plant in Switzerland, is the statutory compensation for renewable electricity fed into the grid. Subsequently, the various concepts of high-temperature solar thermal systems are treated. The Dish-Stirling (DS) system turns out to be the most suitable technology to produce solar thermal electricity in Switzerland. In the third part of the work, a suitable area, where the construction of a power plant made of Dish-Stirling systems is economically the most promising, is identified with a site analysis. A central variable for the location decision is the value of the annual direct normal insolation, as only this type of radiation can be focused by a mirror. The choice finally fell on a piece of land in the Upper Engadine, near the village of Celerina. A dataset is generated, including the meteorological ambient conditions of the site. With this dataset and the technological parameters of the previously determined Dish-Stirling system type, the quantity of the electricity generated by the plant is calculated. The simulation delivers an annual net electricity generation of 31.4 MWh per DS unit. After an explanation of the economic foundations upon which the economic efficiency calculations are based on, a costing is done and the provision of energy and financial ratios using calculations of different cash flows is finally made. The reference scenario yields electricity production costs of 0.57 CHF/kWh. In the form of a sensitivity analysis, the influences of various factors on the calculated ratios of the reference scenario are described.

**14:15- 15:00**

**Impacts of oil product demand and CO<sub>2</sub> price uncertainties on investment in biomass pre-treatment units to supply second generation biofuel units: the French case study**

**Elodie Lecadre, IFP, Université Paris Ouest Nanterre**  
**PhD Supervisors: Prof. Frédéric Lantz and Prof. Pierre-André Jouvét**  
**Thesis : Stratégies d'investissement dans la filière biomasse pour l'approvisionnement des unités BTL (Biomass To Liquid), biocarburants de seconde génération.**

**Abstract:** The development of second generation biofuels leads to study its biomass supply in terms of quantities and return on investment for the producers. In this context, we analyse the investment in biomass pre-treatment units to supply the Biomass To Liquid (BTL) units which are integrated to the refining industry. Torrefaction is a crucial pre-treatment step to make this process economically attractive. Biocoal pellets produced by the torrefaction process could be a substitute of coal and have also strong appeal for other additional markets: the steel industry and electricity generation. Thus, we study how could be developed such industry which is a key step between the biomass supply and several major players: refining industry, power and steel industries. We also analyze the interactions between this biofuel supply and the refining industry which provides the oil products derivatives. For this purpose, we use the aggregated refining model (named OURSE) integrating torrefaction units in the supply of oil products.

**15:00- 15:45**

### **Burden Sharing: Estimating Global Demand and Supply Flows of Carbon Emission Reductions for 2020 and 2050**

**Iva HRISTOVA, Université Paris – Dauphine (CGEMP)**  
**PhD Supervisor: Prof. Jan Horst KEPPLER**  
**Thesis : The Kyoto Protocol and CDM: impacts on developing countries**

**Abstract:** Created under the Kyoto Protocol, the CDM mechanism represented a lower-cost solution for developed countries to reduce their GHG emissions. It is also believed to have positive spill-over effects for supplier countries, in general developing countries. In addition to receiving monetary transfers, the latter would benefit from technology transfers and energy efficiency improvements, which in the long term could help foster a more important commitment of developing countries and a fairer burden sharing.

On the basis of Marginal Abatement Cost Curves (MACCs) for different regions, our model assumes different possible evolutions of demand and supply of CO<sub>2</sub> emission reductions for the next four decades and their potential price, under two types of hypothesis. A first set of assumptions concerns the global reduction effort and a corresponding level of CO<sub>2</sub>e concentration by 2020/ 2050. The second set of assumption is focusing on the sharing of the reduction effort between developed (Annex I) countries and developing countries. We develop two scenarios in this context: a more important role of the Annex I countries in mitigation and their financial support for its spread within developing nations and a more balanced sharing of emissions reductions regarding to each countries' population and its evolution by 2050.

According to the MAC curves constructed for the first scenario and the estimations for the second one, we can observe that for 2020, the second scenario is less demanding for the developing countries. Some can even increase their emissions. Potential flows are quite important. For 2050 instead, a great part of developing countries are obliged to import allocations in both scenarios.

**Keywords: CDM, MACCs, developing countries, burden sharing.**  
**JEL classification: O16, Q56.**