Wolfang Pauli Institute (Vienna) – Special Year on Energy Finance
Investment Decision in Power Markets: Problems and Methods
Speaker: Dr René Aïd, EDF R&D
Organizer: Pr. Fred E. Benth, Oslo University
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The intention of these lectures is to provide an overview of the problems raised by investment dynamics as well as the mathematical methods used to study them. As an application field, these lectures will focus on investment decisions in electricity production. The course will be divided in four sessions of two hours each.

In the first session, I will describe the nature of the problem of electricity production investment in the current context of deregulated markets, global warming and fossil energy resource scarcity. This first session will also be devoted to decision rules (Net Present Value and Real Option methodology) as well as a description of practical investment decision processes used by corporates.

The second lecture will provide the main mathematical tools needed to tackle investment decisions, presently optimal stopping time problems and free boundary problems. I will say also a few words on numerical methods, in particular Howard's algorithm or policy algorithm. An important part of economic literature on investment decision deals with the ambiguous effects of both uncertainties and time-to-build. The third lecture will bring first an overview of the economic discussion on those parameters. Then, I will focus on specific mathematical models offering explicit solutions of an investment decision model taking account uncertainty and time-to-build. Some numerical simulations will be provided to illustrate the behaviour of the investment process.

Finally, the aspect of strategic behaviour will be treated in the last lecture. This will allow us to reconsider the discussion on decision rules introduced in the first lecture.

Lecture 1 & 2 : *Investment decision in electricity generation problem description*
- technical difficulties, energy and intitutional contexts
- firts look at decision rules : NPV and real options
- Main available models for expansion planning analysis
- Point of view of this course

Lecture 3 & 4 : *Crash course on free boundary problems*
- mathematical setting and optimal strategy
- examples
- More on analytical solutions
- Howard's algorithm

The effects of uncertainty and time-to-build
- seminal works
- literature review

Lecture 5 & 6 : *Dynamic equilibrium model with analytical solutions*
- Aguerrevere (03)
- Bar-Ilan, Sulem and Zanello (06)

Lecture 7 & 8 : *The case of non-competitive markets*
- Baldurson (98)
- Grenadier (02)
- Grasselli & Leclerc (11)

Conclusions in the form of research perspectives