

# Stochastic Control for the Management of Renewable Energies

## Portail de cours électroniques pour l'enseignement de l'optimisation stochastique

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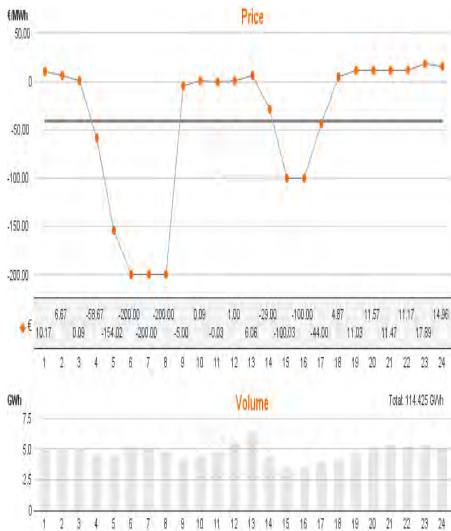
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# Thanks

These courses videos benefited from the support of the *FMJH Program Gaspard Monge in optimization and operations research* and from the support from EDF

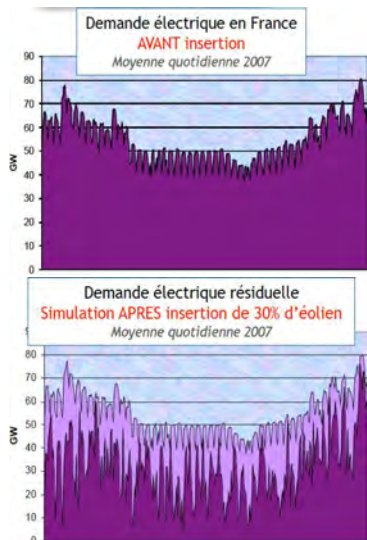
Ces vidéos de cours ont bénéficié du support du *Programme Gaspard Monge pour l'optimisation et la recherche opérationnelle de la FMJH* et du soutien d'EDF

# During the night of 16 June 2013



- During the night of 16 June 2013 on the French electricity market, we observed negative prices
- What happened is that, without warning, wind energy was available when no one needed it

# Integrating such erratic energies



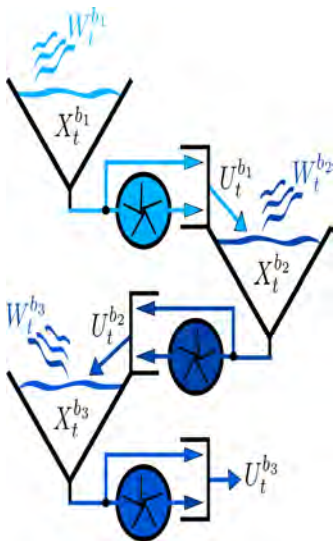
- Integrating such erratic energies, like wind or sun, has become a serious concern for electricity networks managers
- especially as their share is expected to rise up to 20% in 2020 in the European Union

# The question is



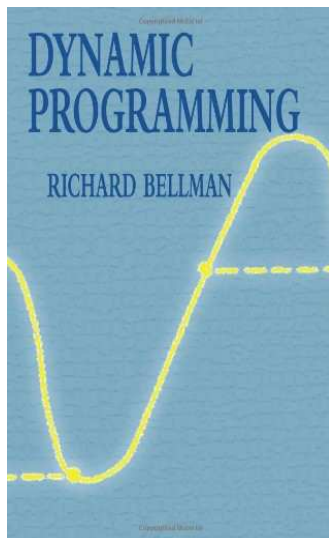
- The question is: how to match uncertain energy supply and demand at all times and at least cost?
- In order to buffer the intermittency and the variability of renewable energies, storage is expected to develop

# Now, when you have stocks



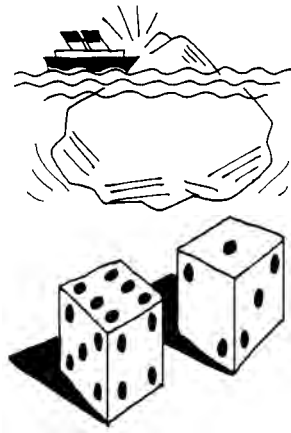
- Now, when you have stocks, trade-offs between time periods materialize
- Indeed, take a dam for example. Should you turbine now, and shrink your water stock? Or keep it and accumulate water for better days where energy prices are high?
- This is where dynamic optimization is relevant
- And when problem inputs, like the rain, are random, we enter the realm of stochastic dynamic optimization

# In introduction



- In introduction to the course *Stochastic Control for the Management of Renewable Energies*, we present how smart power systems, renewable energies and markets are a challenge for optimization
- Then, we lay out the dynamic programming method for the optimal control of deterministic dynamical systems in discrete time

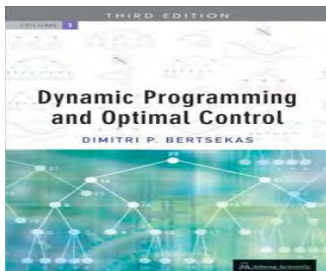
## But what about rain, wind, sun



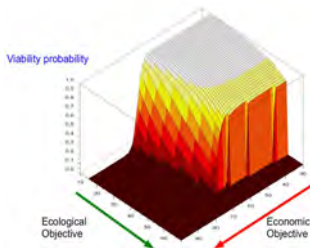
- But what about rain, wind, sun, so unpredictable?
- When some data is uncertain, two questions arise
- What is and how do you express your risk attitude? Indeed, you can be more or less pessimistic, or think that Nature plays at random
- What is and how do you express the online information available before making a decision? Indeed, no one can see ahead and make decisions knowing the future



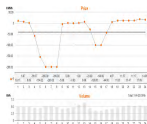
# To end, we lay out



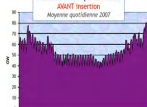
- To end, we lay out the stochastic dynamic programming method
- Then, we present more advanced material like
- stochastic viability
- and decomposition-coordination methods under stochasticity



# See you soon with Optim' Planet



Demande électrique en France  
AVANT insertion  
Moyenne quotidienne 2007



Demande électrique résiduelle  
Simulation APRES insertion de 30% d'éolien  
Moyenne quotidienne 2007

