

# MODELING BIOMASS AVAILABILITY IN MARKAL/TIMES ENERGY SYSTEM MODELS

Edi Assoumou  
Nicklas Forsell  
Valérie Roy

Centre de Mathématiques Appliquées, MINES ParisTech  
Chair de Modélisation Prospective  
au Service du Développement Durable



Chaire ParisTech Modélisation prospective  
au service du développement durable



4 – 5 April 2011

Séminaire sur la Géoprospective – Ile Sainte Marguerite, France



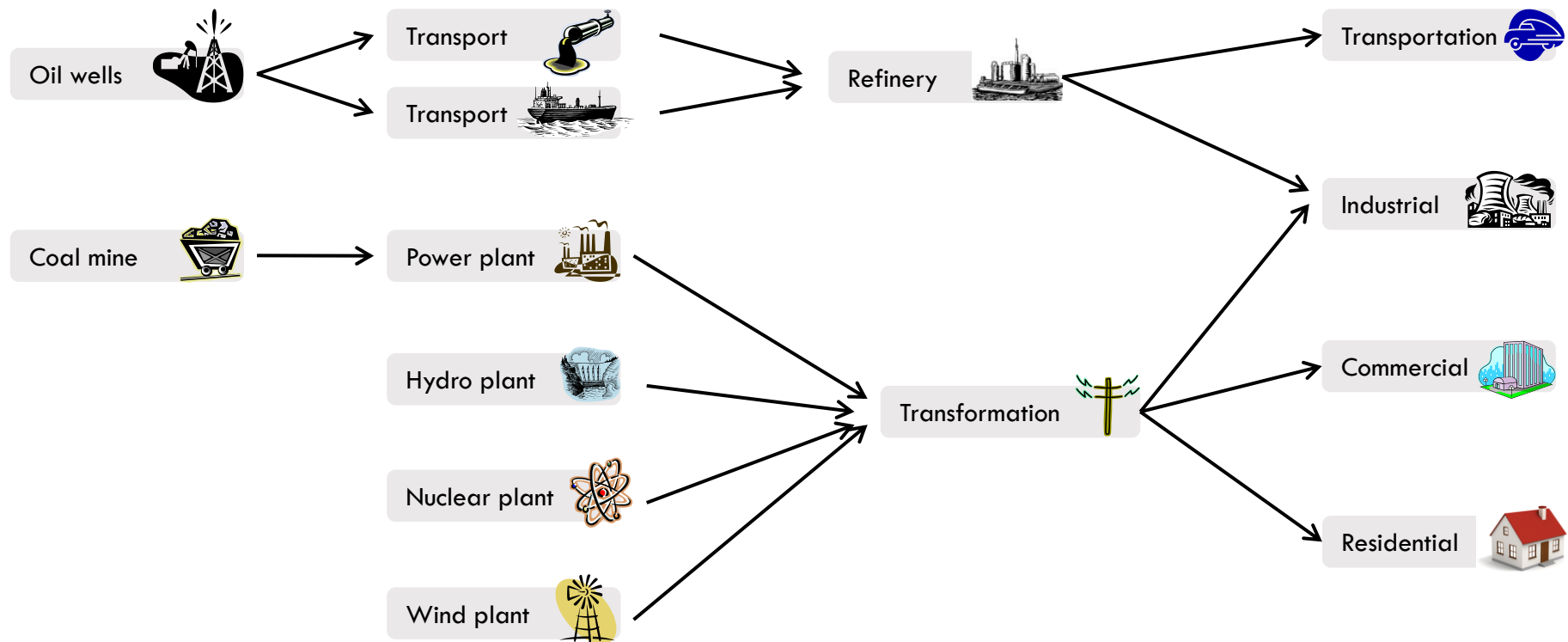
# Outline of the presentation

- ❑ Prospective energy system models
- ❑ Spatial energy systems models
- ❑ Conclusions



# Prospective energy system models

- Energy system models represent the production chain of energy sources





# Prospective energy system models

4/10

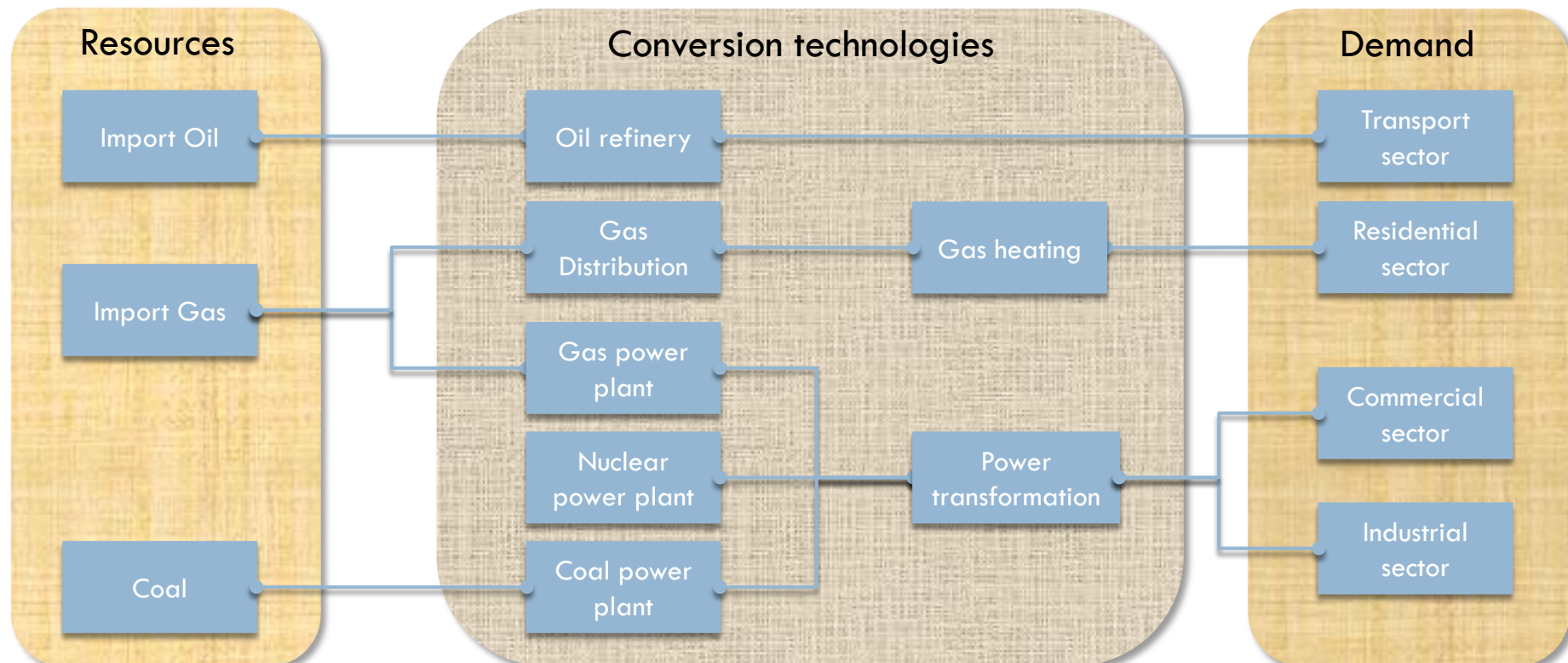
Séminaire sur la Géoprospective – Ile Sainte Marguerite, France – April 4 - 5 – 2011

Prospective energy system models

Spatial energy systems models

Conclusions

- TIMES/MARKAL is a family of prospective energy system models developed by the ETSAP organization





# Prospective energy system models

5/10

Séminaire sur la Géoprospective – Ile Sainte Marguerite, France – April 4 - 5 – 2011

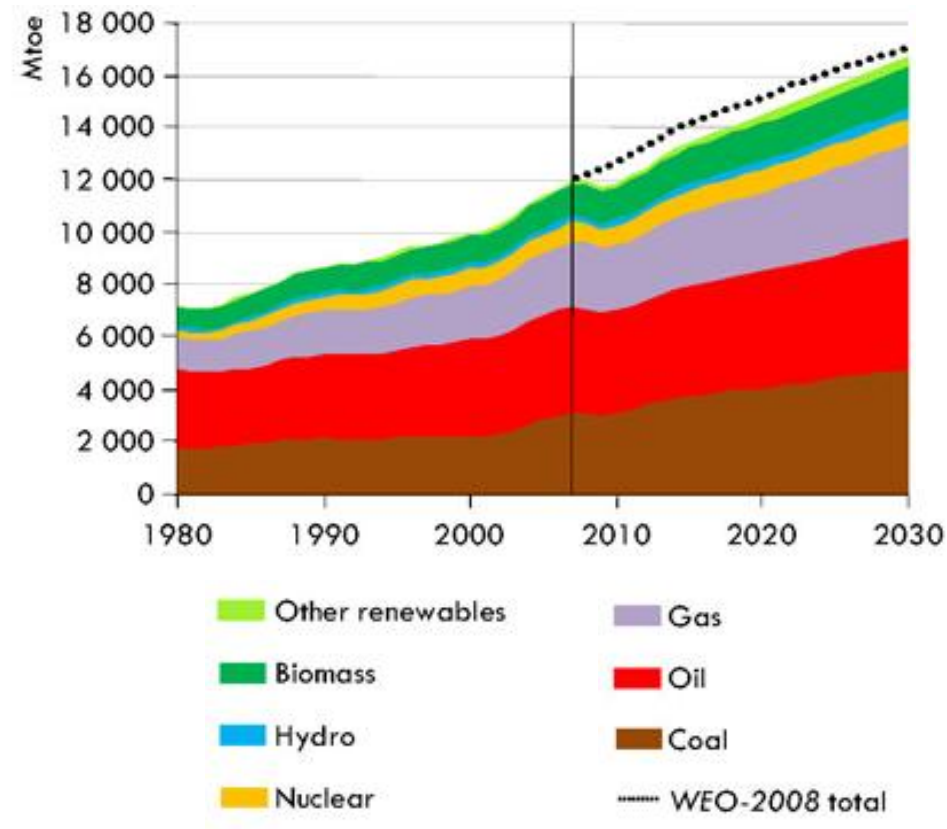
Prospective energy system models

Spatial energy systems models

Conclusions

- Allow us to study:
  - ▣ Utilization of technologies
  - ▣ Future energy mix
  - ▣ Future integration of developing technologies
  - ▣ “Least cost” solutions for reaching climate targets

World Energy Outlook - 2008 (IEA)





# Prospective energy system models

6/10

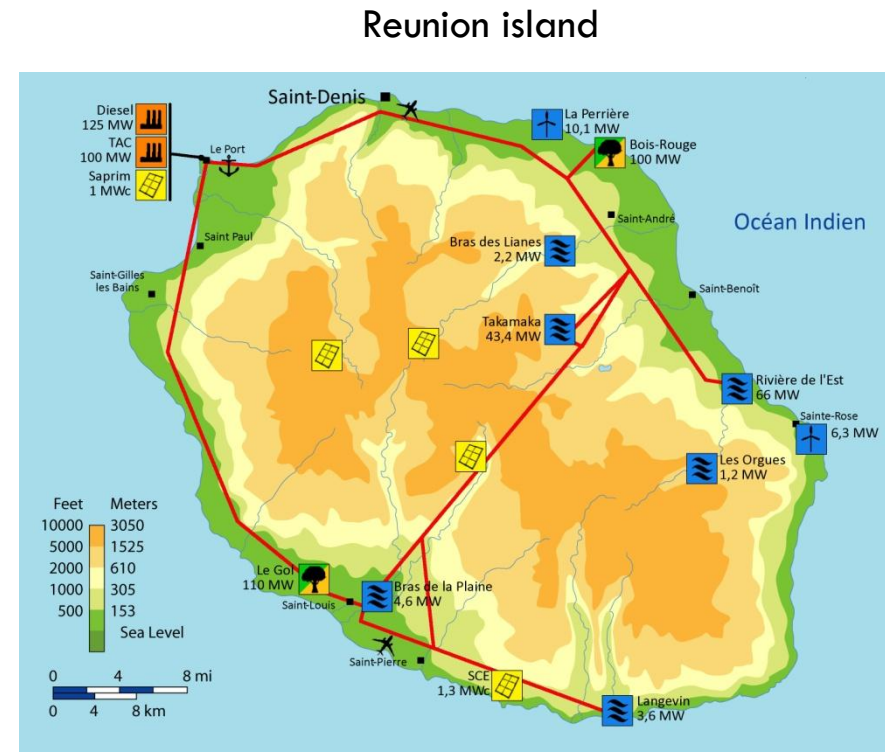
Séminaire sur la Géoprospective – Ile Sainte Marguerite, France – April 4 - 5 – 2011

Prospective energy system models

Spatial energy systems models

Conclusions

- Most energy system models are non-spatial
- They do not consider:
  - ▣ Location of supply of energy sources
  - ▣ Location of power production
  - ▣ Location of demand
  - ▣ Transport distances



G. Guerassimo, N. Maïzi et al., "Iles et Énergie: un paysage de contrastes." Les Presses-MINES ParisTech, 2008.



# Spatial energy systems models

7/10

Séminaire sur la Géoprospective – Ile Sainte Marguerite, France – April 4 - 5 – 2011

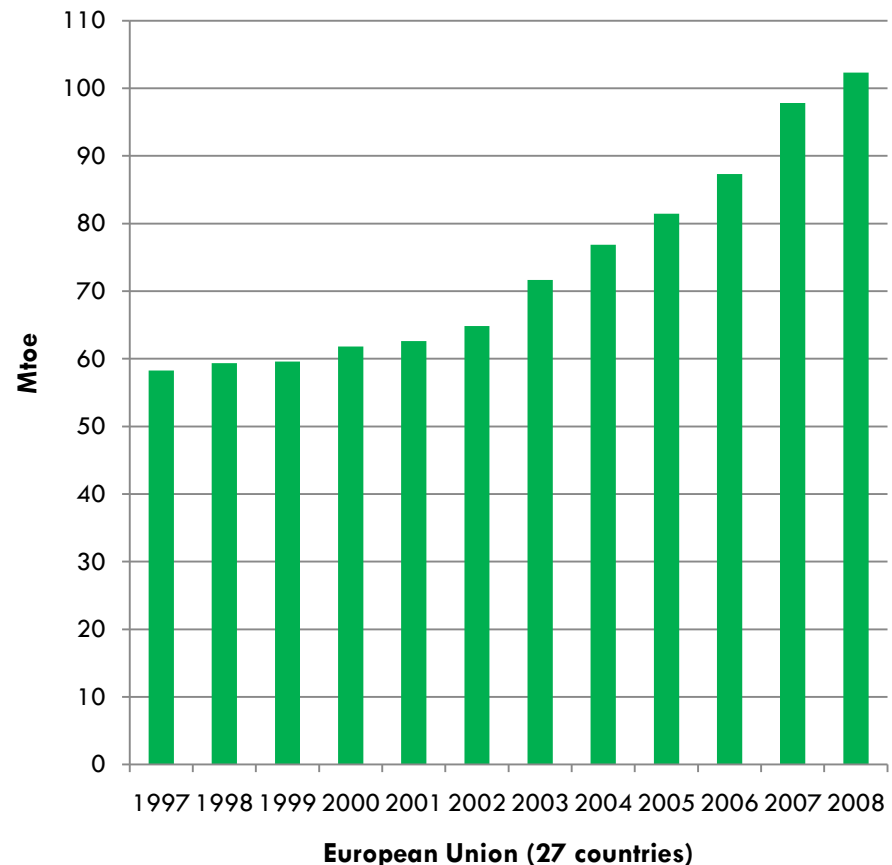
Prospective energy system models

Spatial energy systems models

Conclusions

- Analyzed the bio-energy system in:
  - France
  - Sweden
- Biomass is a vital source of renewable energy
- Cost and supply of biomass sources is highly spatial

Primary energy production Biomass & Renewables (EUROSTAT)





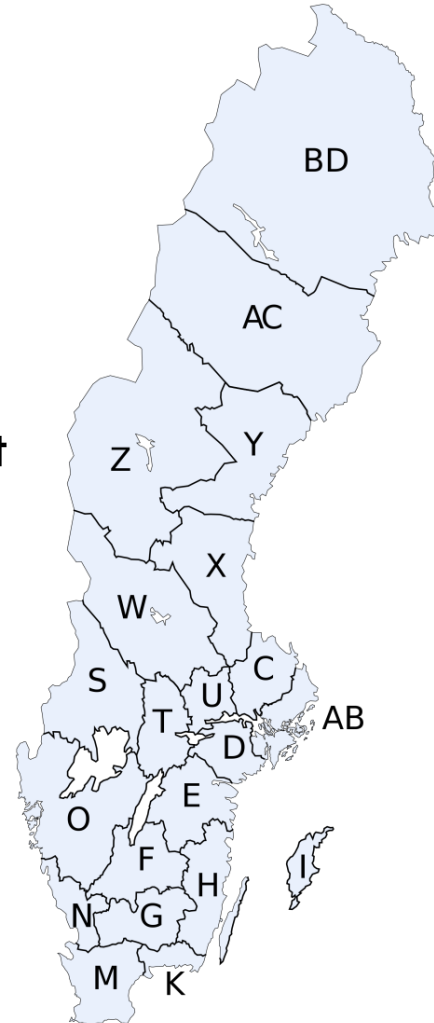
## □ Spatial aspects in BIO-SE model:

### ▣ Regional division

- Supply of biomass sources
- Separate mountainous and flat regions

### ▣ Biomass division

- Apply highly detailed GIS data
- Accurate harvest costs
- Accurate transport distances



- AB** – Stockholm
- C** – Uppsala
- D** – Södermanland
- E** – Östergötland
- F** – Jönköping
- G** – Kronoberg
- H** – Kalmar
- I** – Gotland
- K** – Blekinge
- M** – Skåne
- N** – Halland
- O** – Västra Götaland
- S** – Värmland
- T** – Örebro
- U** – Västmanland
- W** – Dalarna
- X** – Gävleborg
- Y** – Västernorrland
- Z** – Jämtland
- AC** – Västerbotten
- BD** – Norrbotten



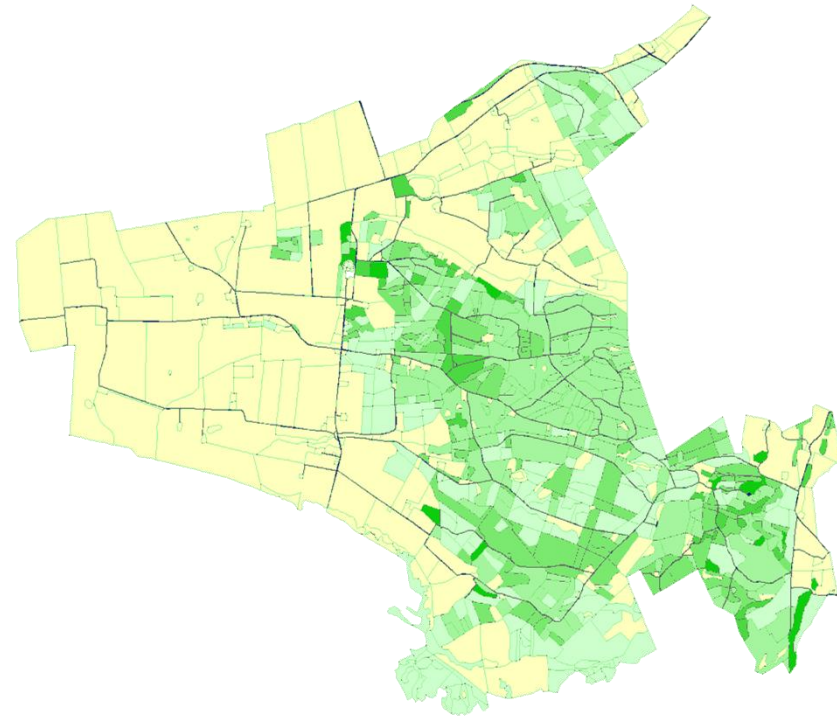
## □ Spatial aspects in BIO-SE model:

### ▣ Regional division

- Supply of biomass sources
- Separate mountainous and flat regions

### ▣ Biomass division

- Apply highly detailed GIS data
- Accurate harvest costs
- Accurate transport distances





# Conclusions

- Prospective energy system models can be used to analyze the development of energy systems
- Spatial information may be integrated into prospective energy system models
- Increases model accuracy and the scope of analysis
- Opens up for further multi-disciplinary studies