Adaptation Scenarios for the European Energy Conversion Sector

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2nd of July, 2008

Presentation Outline

1. Research Objective

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2. Methodology
3. Scenario Analysis
   - Base scenario
   - Adaptation scenario
   - Mitigation Scenario, preliminary

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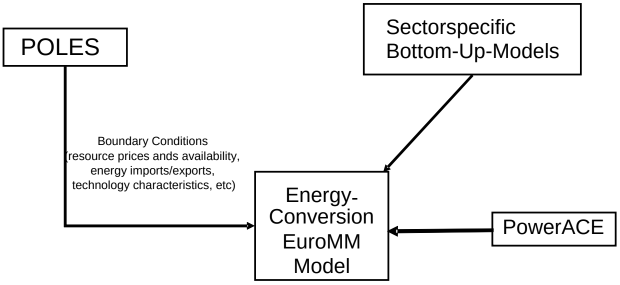
4. Conclusion

Research Objective, ADAM-project

- To assess, how EU mitigation and adaptation policies can achieve a transition to a world with a global climate no warmer than 2°C above pre-industrial levels, and to identify their associated costs and effectiveness.
- The analysis of adaptation technologies including their cost and impact
- Scenario-development in the framework of the European ADAM-project
  - Special focus on influence of climate change on the European electricity sector

ADAM M1-project setup



Technology mix, emissions, investments on new technologies in the energy conversion sector for EU-29

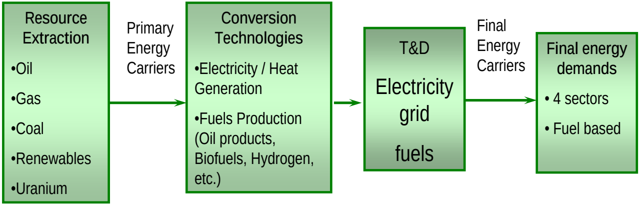
Model description, EuroMM

- MARKAL-class model
- "bottom-up" energy-system model with detailed representation of technologies
- cost-optimization model: identifies least-cost solutions for the energy system under given sets of assumptions and constraints
- represents the energy system of EU-29

EuroMM features

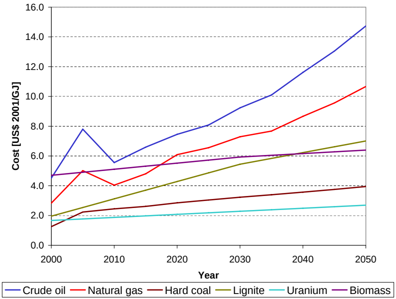
- Detailed representation of electricity and heat production
- 18 aggregated European regions for EU-29
- Bilateral trade of electricity between regions
- 3 level electricity grid
- Trade, production and conversion of primary energy carriers

Reference energy system



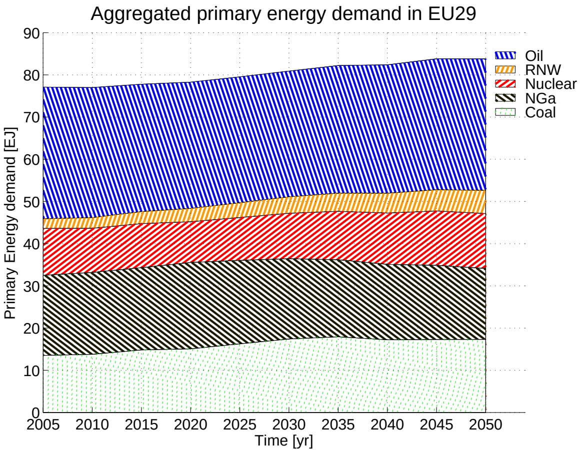
Each Technology is represented by its costs and efficiency!

Base scenario, assumptions

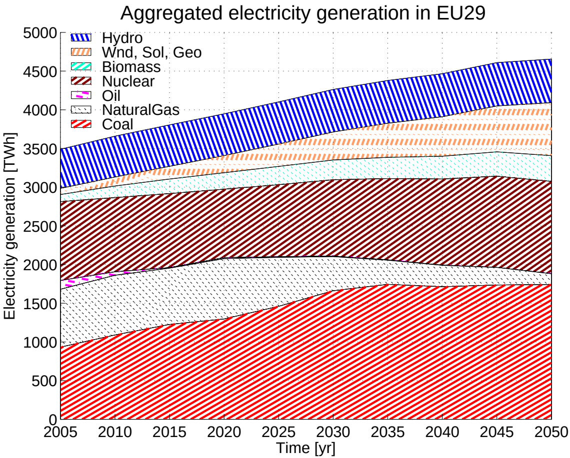


- Business as usual
- Low CO_2-tax ($10\ US\$/tCO_2$)
- No impacts of climate change on electricity sector assumed

Primary energy demand, base scenario



Electricity generation, base scenario



Adaptation scenario, assumptions

- Changes in energy demands and renewable power generation
- Low CO_2-tax (10 $US\$\backslash tCO_2$)
- Climate change: temperature $+2°$C in 2050
  $\rightarrow$ **lower power-plant efficiency and availability**

Modeling the impacts of climate change

- Submodule to estimate effects of climate change on cooling capacity of rivers
- Threshold of 25°C in water temperature which allows for use in cooling

→ lower availability, if threshold is reached

- Reduced power plant efficiency for ideal Rankine cycle (0.1% efficiency reduction per 1°C higher cooling water temperature, [Durmayaz A. & Sogut O.S., 2006.])

Technology options for adaptation of electricity generation[1]

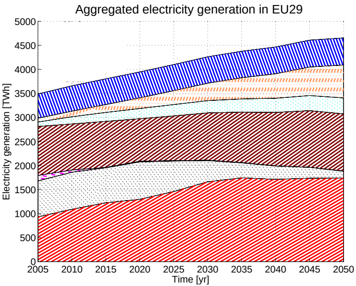
- Installation of wet cooling tower
- Installation of dry cooling tower

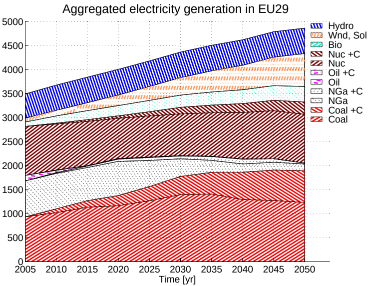
Cooling system	Additional INVcost [$US\$/kW$]	water demand [m^3/MWh]	FIXOM [$US\$/kW$]	Losses [%]
Wet cooling tower	6 - 8	0.95	0.7	-
Dry cooling tower	40 - 100	0.038	-	0.2-1%

- Analysis of influence of temperature change on power plant efficiency and availability

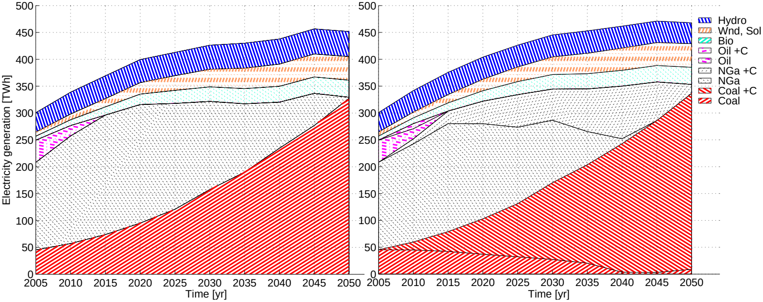
1 [CEC, 2002]

Aggregated electricity generation for EU-29





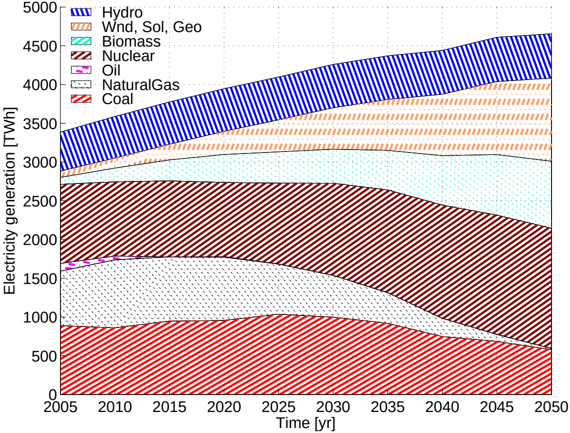
Comparison for Italy between base and reference case



Assumptions mitigation scenario

- Identical demands as in Base Scenario
- Increasing CO_2-tax, up to 50 US$ / tCO_2 in 2050 (according to POLES 550ppm-scenario)
- EU29 biomass potential of 7.2EJ/*year*
- 4.7EJ wind power potential (World Energy Assessment, 2000)

Electricity generation, mitigation case



Conclusions

- Adaptation scenarios are important to depict critical states for electricity production
- Adaptation requires some important changes in the electricity sector
- Shift of peak electricity demand from winter to summer
- Electricity sector can only contribute to 30% of emission reduction in a mitigation scenario

Further research

- Seasonal variability of electricity demand and generation should be included
- Update of the demand side for mitigation case
- Including solar electricity generation in Africa

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Thank you for your attention