

## Some elements of the TIMES-Morocco model and scenarios

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### Why TIMES-Morocco?

#### Starting point: COMET project

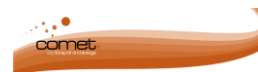
- Where, when and what amount of CO<sub>2</sub> emissions?
- What role for CCS in the portfolios of mitigation?
- What CCS infrastructures (sources-sinks)?



**Modelling the energy system of Morocco with a geo-referenced representation of CCS infrastructure**



with the support of  
LNEG (coordinator of the project), University Mohammed V, University Mohammed Premier, and ONE (electricity utility of Morocco) for data and validation



## Several other interesting applications

① **COMET** ⇒ Focus on CCS

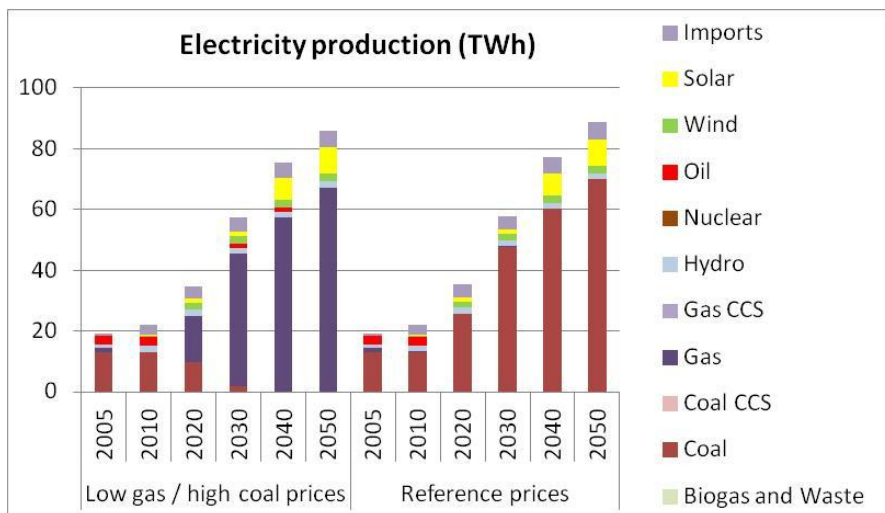
② Maybe more important: **energy planning challenges in Morocco**

- Economic growth >5% until 2020
- Electricity demand +8% per yr (total almost x2 from 2005 to 2020)
- Solar and wind plans of 2 GW solar + 2 GW wind by 2020
- Morocco quite active in the CDM markets. New opportunities for CDM projects?
- Future role of gas in the energy mix: pipeline, possible LNG terminal, contract with Algeria
- Nuclear?

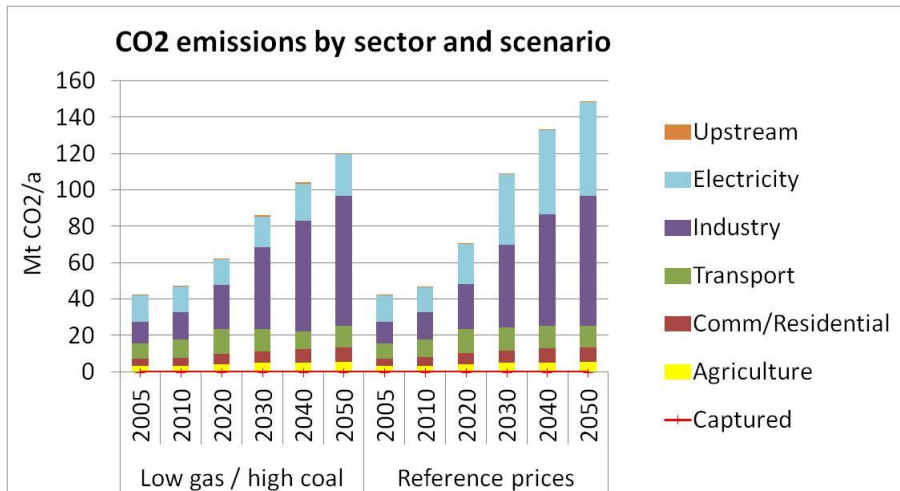


## Ref case: impact of future gas/coal prices on electricity generation

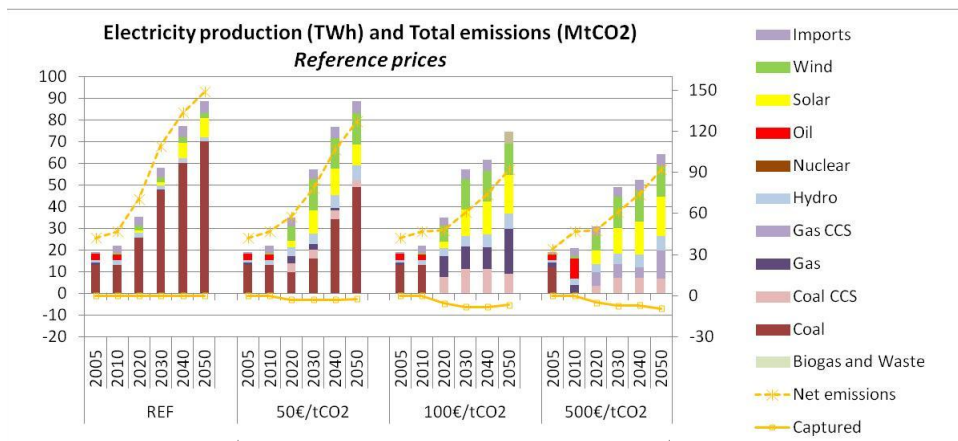
€/PJ	Reference		Low gas / High coal prices	
	Coal	Gas	Coal	Gas
2005	2.2	4.1	2.2	4.1
2010	3.2	4.2	3.2	4.3
2020	3.6	6.2	5.2	5.1
2030	4.1	7.1	5.5	5.9
2040	4.5	7.7	5.8	6.5
2050	4.7	8.5	6.1	7.1



## Ref case: impact of future gas/coal price on emissions

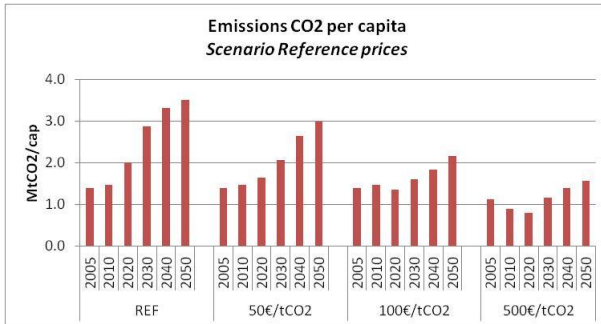


## CO2 mitigation potentials



*Hypothetical CO<sub>2</sub> tax (Morocco does not have to reduce its CO<sub>2</sub> emissions)*





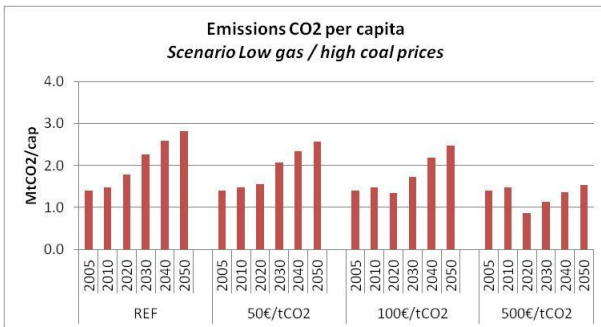
## Emissions per capita

For comparison:

8.9 & 7.4 tCO<sub>2</sub>/capita in ES et PT in 2005

4.2 tCO<sub>2</sub>/capita World average 2005

Long term World target: 1 tCO<sub>2</sub>/capita?



## Morocco in COMET scenarios

### Assumption

- Morocco has no CO<sub>2</sub> mitigation target.
- Spain and Portugal can purchase up to 20% of their required reduction target in Morocco (CDM)

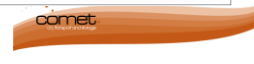
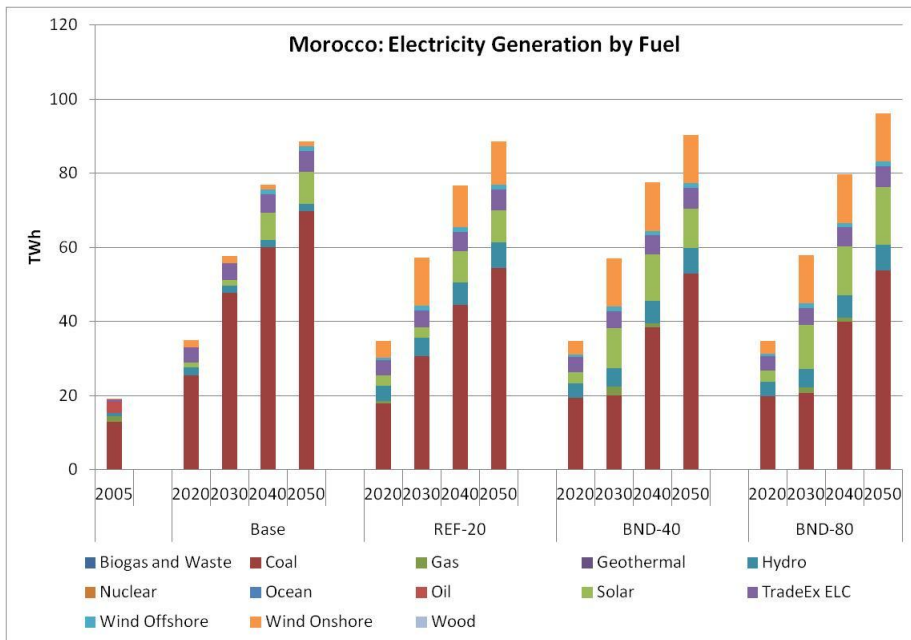
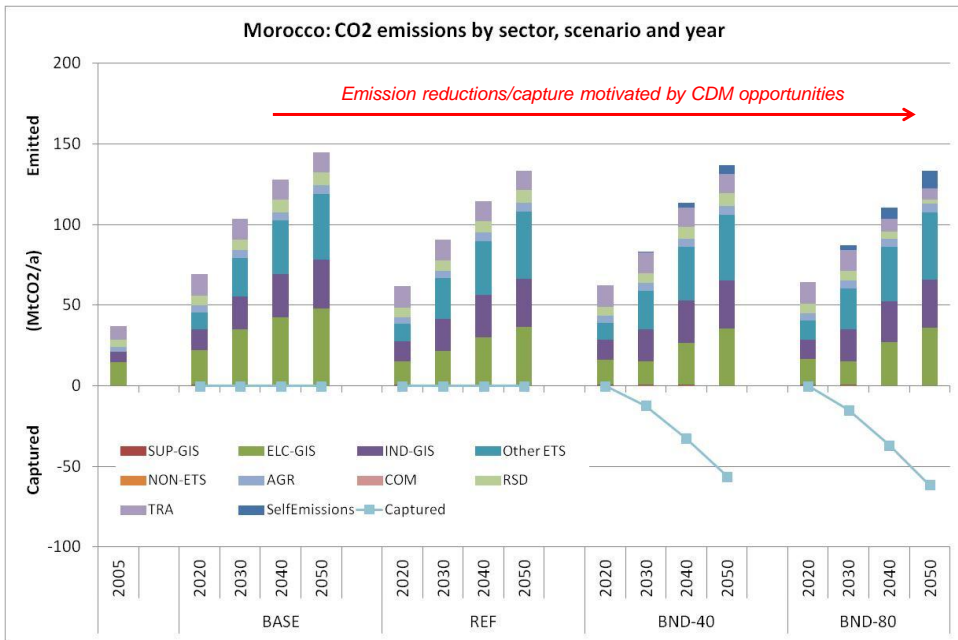


*In this exercise, mitigation in Morocco is motivated by CDM only*

### Main insights

- CDM opportunities offered by Morocco are used by ES and PT.
- Reduction by CCS represent up to 70% of the emission credits (CDM) sold to ES+PT in the more severe case.
- If CCS is not available, credits sold to ES and PT are slightly reduced. Mitigation for CDM relies only on energy substitution and efficiency.





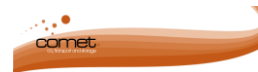
# Conclusion

## Modelling perspective

- The model is ready
- Data for Morocco were quite numerous, although some of them would deserve enhancements
- To promote the application of the model with local stakeholders

## Possible enhancements

- Commercial sector
- Biomass potentials
- Electricity from waste
- Possible role of nuclear



# Some references

## COMET project

<http://comet.lneg.pt>

Technical Note 5.2.1. Description of the Moroccan energy system and policies.

Technical Note 5.3.1. Description of the TIMES-Morocco model.

## Some energy statistics

IEA energy balances: [http://www.iea.org/stats/balancetable.asp?COUNTRY\\_CODE=MA](http://www.iea.org/stats/balancetable.asp?COUNTRY_CODE=MA)

ONE (electricity sector): <http://www.one.org.ma>

MEMEE (ministry of energy): <http://www.mem.gov.ma/WIREC2008.pdf>

CDM and Morocco: <http://www.cdmmorocco.ma/>

2<sup>nd</sup> National Communication UNFCCC: <http://unfccc.int/resource/docs/natc/mornrc2f.pdf>

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