Quantifying the contribution of different exogenous assumptions on the uncertainty of GHG emission scenarios: case-study of the 2020 estimates for Portugal

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FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE NOVA DE LISBOA

IEW June 2010

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16 FTE Researchers (PhD)
4 Other Researchers (PhD)
28 Researchers (non-PhD)

Research Groups:

- Information and communication technologies,
- **Climate change and sustainable energy,** → 1 FTE Researchers (PhD); 1 Other Researchers (PhD); 5 Researchers (non-PhD)
- Environmental assessment, monitoring and remediation
- Ecological economics and environmental management

CENSE Research agenda on energy-environment-economy modeling:

• **Integrated modelling** of energy, environment & economy to assess **low carbon scenarios** (2020, 2050) regarding mitigation and adaptation to climate change

• Integrated assessment of **interactions** between environmental and energy policy instruments

→ Bottom-up optimisation model **TIMES-PT**[a] [ETSAP-IEA]

→ Top-down model **GEM-E3-PT**[b] [Univ. Leuven]

[a] Simões, S., Cleto, J., Fortes, P., Seixas, J., Huppes, G. (2008). Cost of energy and environmental policy in Portuguese CO2 abatement-scenario analysis to 2020. *Energy Policy*, vol 36, 3598-3611

[b] Fortes, P., Simões, S., Seixas, J., van Regemorter, D., 2009. Top-down vs. Bottom-up Modelling to Support Climate Policy: Comparative Analysis for the Portuguese Economy. Energy, Policies and Technologies for Sustainable Economies - 2009 *International Association for Energy Economics European Conference*. Vienna, 7-10 September 2009. Austria.

CENSE's E³ modelling work

- **EU**
  - **NEEDS**, New Energy Externalities Developments for Sustainability, 2004-2009
  - **RES2020**, Monitoring and Evaluation of the RES directives implementation in EU 27 and policy recommendations for 2020, 2007 – 2009
  - **COMET**, Integrated infrastructure for CO2 transport and storage in the west Mediterranean, 2010-2013
- **FCT-MCTES**
  - **E²POL**, Integrated Environmental and Energy Policy approaches to manage electricity Production and Consumption, 2005-2007
  - **HybCO2** - Hybrid approaches to assess economic, environmental and technological impacts of long term low carbon scenarios - The Portuguese case (ongoing)
  - **AdaPT** - ADApting Key Economic Sectors to Climate Change – Integrated assessment of vulnerabilities and cost-effective adaptation (submitted)
  - **MitigAIR** - Link GHG mitigation and air quality goals (submitted)
- **For public organisms & companies**: **CLIMA2020**, Impact Assessment of EU Energy-Climate Policy Package for Portugal, 2008-2009 (Ministry of Environment) | **End-use energy demand** scenarios for Portugal for 2030, 2009 (REN, SGPS) | Portuguese **energy technology roadmap** (on-going – Ministry of Economy)

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TIMES-PT | the origins

- Built during the participation of the CENSE - FFCT team in the EU-NEEDS project (2005-2008) with several updates
- 2 +1 PhD thesis | 5 Master thesis (finished)

next steps

- Soft-linking with the economic GEM-E3-PT model;
- New Energy technologies (renewable and smart grids) assessment
  - Smart-grids (requires annual demand split in daily slots period and seasonal demand)
  - Incentives to new energy technologies (e.g. electric cars, national solar technologies)
- Expand TIMES_PT by including water as a new commodity, for integrated mitigation and adaptation cost effective measures
- Consider Iberian electricity market (or coordinated assumptions on electricity import/export between Portugal and Spain)

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Quantifying the contribution of different exogenous assumptions on the uncertainty of GHG emission scenarios: case-study of the 2020 estimates for Portugal

- Objectives & context
- Methods
- Results & discussion
- Conclusions

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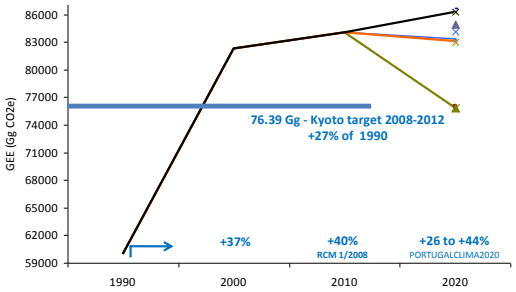
Objectives & context

Context

- external energy dependency (87%)
- increasing GHG emissions

stepped up efforts on

- -RES (double 2005 capacity by 2020)
- -NEAAP (10% final energy by 2015)
- - expansion of CCGT capacity (73% increase of 2005 capacity)



Objective

- Assess the contribution of a number of different exogenous parameters on national GHG emission scenarios → **Portugal 2020**
  - penetration of end-use energy efficient equipments;
  - socio-economic growth rates;
  - rate of implementation of policy incentives & investments for promotion of renewable electricity;
  - availability of water resources for hydropower
  - primary fossil energy import prices

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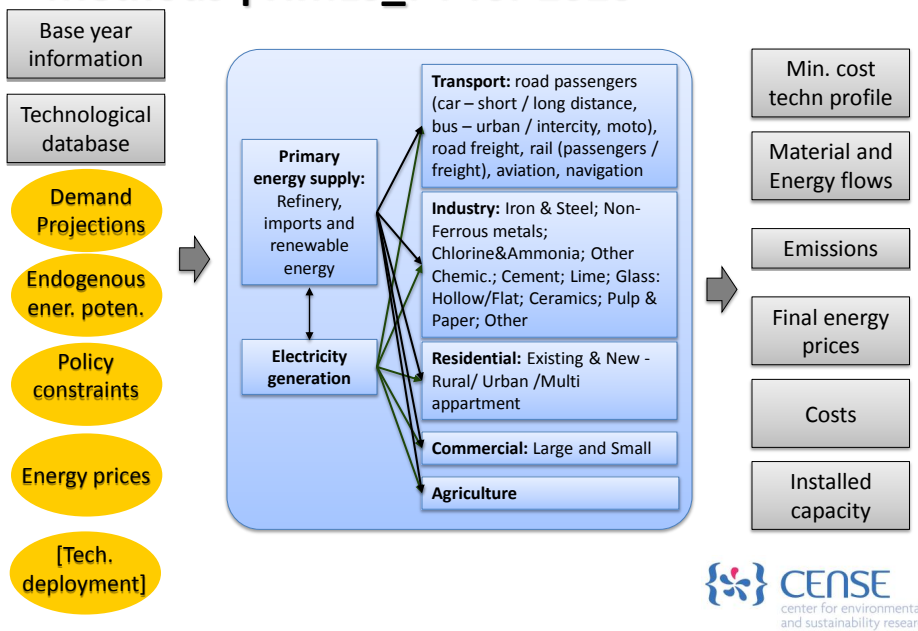
Methods |TIMES_PT for 2020



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Methods | PT GHG scenarios for 2020

	BASE	EFF	DEM	nEFRE	LowH	HighH	100$
Penetration of end-use energy efficient equipments		Cost effective			2005-2005 trends up to NEEAP targets		
Socio economic growth			Change (high)		Tendency (Medium) GDP growth 2.1%/yr		
Implementation of policy incentives & investment for E-FRE				On-going 5.75% biofuels	Expected investments & 10% biofuels		
Availability of water resources for hydropower					Dry year	Wet year	Average year
Primary fossil energy import prices					58 $/bbl in 2020		101$/bbl

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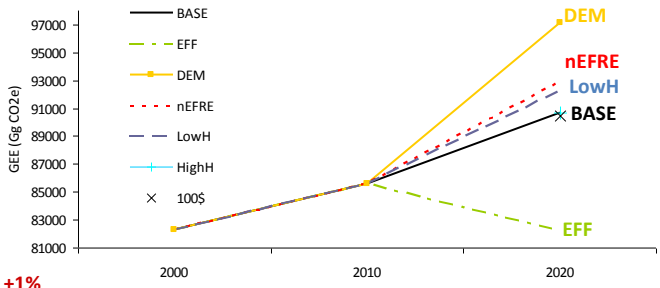
Results | Compliance with energy climate policy package (2020)



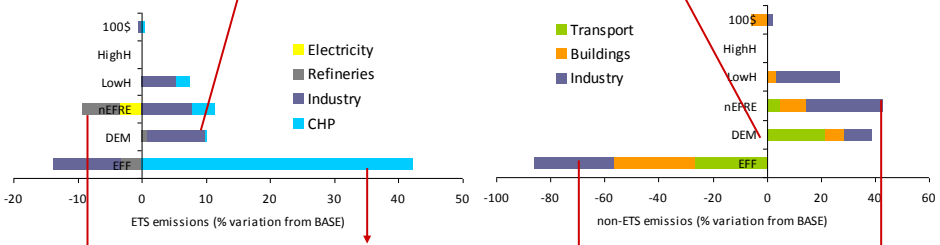
Targets
GHG non ETS +1%
RES +31%

GHG emission estimates for 2020 (Gg CO2e)

Scenario	2005	2020						
		BASE	EFF	DEM	nEFRE	LowH	HighH	100$
% Variation from 2005								
EU ETS		16	13	19	15	18	16	16
Non EU ETS		-4	-19	6	0	-3	-4	-5
Total		4	-6	11	7	6	4	4
% Variation of total emissions from BASE		_	-9.3%	7.1%	2.5%	1.7%	0.0%	-0.3%

Results | Compliance with energy climate policy package - sector GHG emissions

Higher emissions due to higher demand for energy services



more 42% emissions from higher activity of new gas CHP

less 60% emissions from buildings & transport and industry due to the faster substitution of existing equipments

delay in implementation of E-FRE incentives & infrastructures is not translated in an increase in emissions for the power sector BUT the demand sectors do increase emissions as less electricity is used

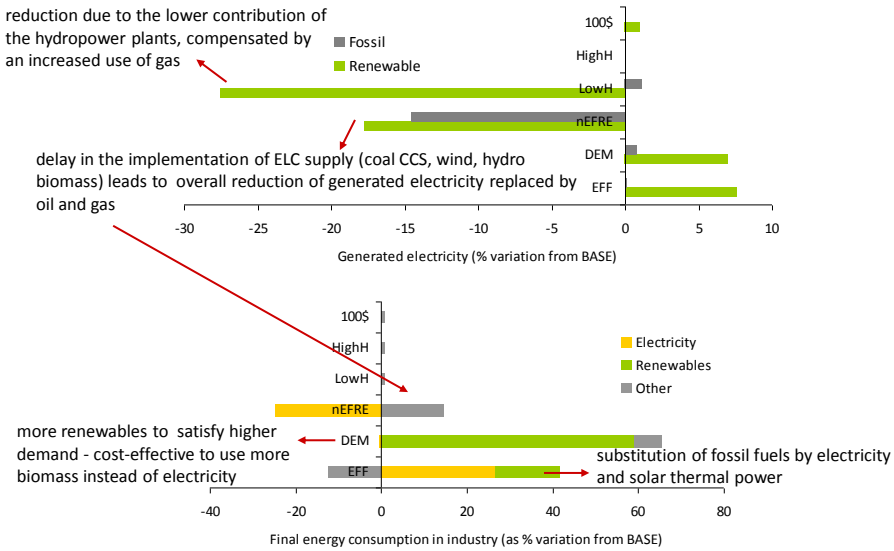
Results | Compliance with energy climate policy package - RES share

Targets
GHG non ETS +1%
RES +31%

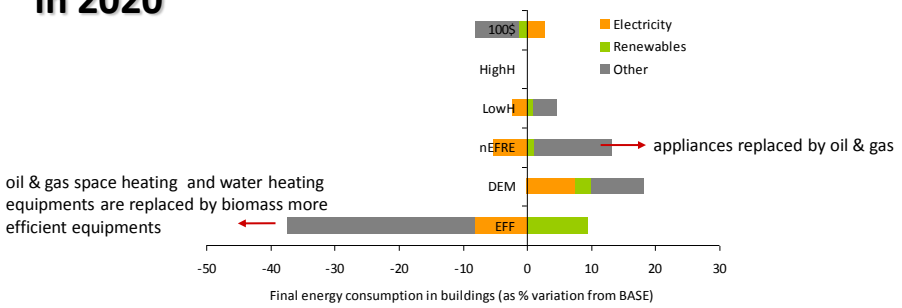
RES share of final energy consumption in 2020 (PJ)

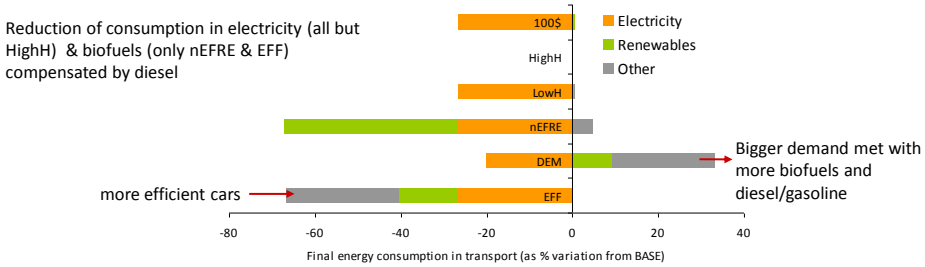
Sector/ Scenario	BASE	EFF	DEM	nEFRE	LowH	HighH	100$
Electricity	136	142	145	112	101	147	145
Heath & cooling	100	99	105	101	102	71	76
Residential	48	51	49	49	49	24	20
Commercial	10	14	13	10	10	11	13
Industry	43	34	43	42	43	36	43
Transport	31	26	33	18	31	27	27
Final Renewable Energy (a)	267	267	284	232	234	245	248
Total Final Energy (b)	976	866	1072	974	973	846	853
% Renewables (a/b)	**27**	**31**	**26**	**24**	**24**	**29**	**29**
% diff of a/b from BASE		4	-1	-4	-3	2	2

Results | Sector analysis - power & industry in 2020



Results | Sector analysis - buildings & transport in 2020





Conclusions

- GHG emission estimates are never more than 9% different from the BASE scenario, thus in overall terms it seems that the emission changes are not significant.
- BUT, these relatively small differences in GHG emission scenarios have an impact in compliance with the energy-climate policy package, especially regarding the RES target of 31% for 2020.
- The most relevant assumptions for overall uncertainty are the ones related to the socio-economic assumptions (DEM), followed by the assumptions on technology deployment (EFF).

- Caveat - Up to what extent the larger differences between these scenarios and the BASE scenario are simply because some assumptions have a wider variation range than the others?

↓

Assumptions made within an actual policy driven process - such a wide range is intrinsic to the climate policy formulation process

Thank you!

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