CENSE - Center for Environmental and Sustainability Research, Department of Environmental Sciences and Engineering of the Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa 2829-516, Caparica. Portugal

THE IMPACT OF CLIMATE CHANGE MITIGATION OPTIONS ON AIR POLLUTANTS EMISSIONS IN PORTUGAL

Luís Dias[1], João Gouveia[2], Bárbara Mauricio[3], Patrícia Fortes[4], Júlia Seixas[5]

ETSAP Workshop - Sthocolm, June 2010

[1]**luisdias@fct.unl.pt**, [2]jplg@fct.unl.pt, [3]barbara.mauricico@fct.unl.pt, [4]p.fs@fct.unl.pt, [5]mjs@fct.unl.pt

OUTLINE

Context

Methodology

Results

Conclusions

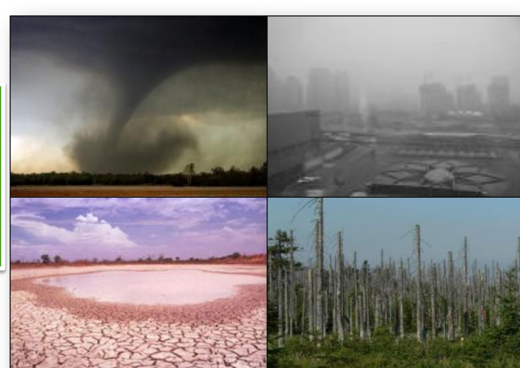
Source: AirClim.org

Source: AirClim.org

INTRODUCTION

Climate change (CC) and **air pollution (AP)** are serious threats to sustainable development, causing a variety of adverse impacts on **human health** and the **environment**;

Extreme weather events; Increase of average sea level



Acid Rain Cardiovascular and respiratory symptoms and diseases

INTRODUCTION

FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE NOVA DE LISBOA
CENSE center for environmental and sustainability research

Strong linkages between greenhouse gases (GHG) and traditional air pollutants:

- Common emissions sources;
- Atmospheric interactions;
- Environmental impacts local, regional and global scales

Growing field of research addressing the linkage between GHG and atmospheric pollutants.

Elevated potential at policy levels because strategies that simultaneous address AP and GHG can lead to more a efficient control of both pollutant emissions.

INTRODUCTION

FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE NOVA DE LISBOA
CENSE center for environmental and sustainability research

Climate change policies implemented to achieve the EU climate objectives are estimated to reduce the costs of existing air pollution abatement policies in **10 billion€** per year and to reduce emissions by **10% for SO_2** and **8-10% for NO_x and PM** (EEA, 2006).

Study the impact of the different mitigation strategies to enhance **synergies** and avoid **negative trade-offs.**

Present the modeling approach and respective results on the evaluation of the impacts of different levels **GHG mitigation** options on the **SO_2**, **NO_x** and **$PM_{2.5}$** emissions by 2030

METHODOLOGY

TIMES_PT

Portuguese energy system [2005 - 2050]

Validated:
- 2005 energy consumption
- 2005 GHG and AP emissions

+

Acidifying pollutants **SO_2** and **NO_x** (Dias, 2009)

Particulate matter **$PM_{2.5}$** (Maurício, 2009)

– Introduction of control technologies (data from GAINS, IIASA)
– Introduction of emission factor (combustion and process) per technology per fuel consumption (data from GAINS, IIASA)

METHODOLOGY

Baseline Portuguese policy assumptions

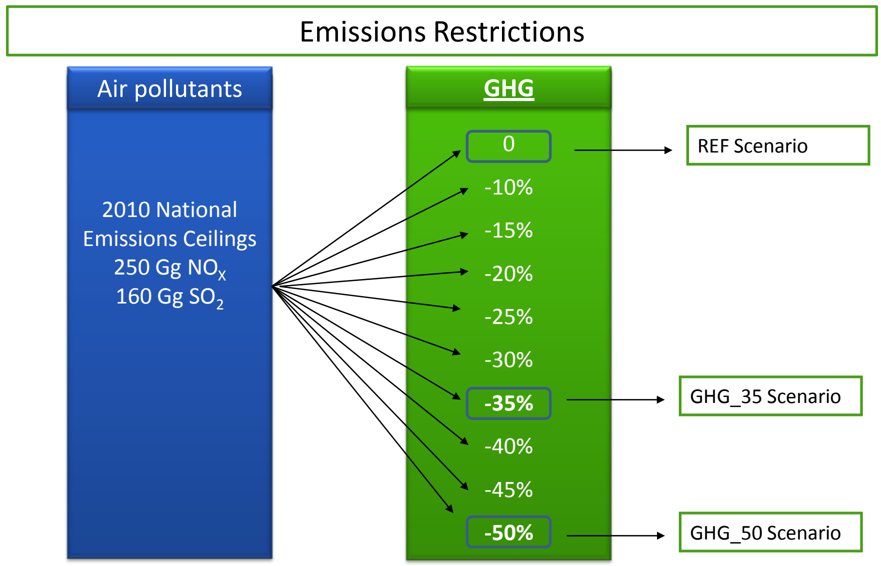
Hydro installed capacity included in the National Plan for High Potential Hydropower Infrastructures (PNBEPH) (9700 MW)

>10% biofuels in diesel and gasoline in road transport consumption, from 2010 onwards;

>5% electric private cars from 2015 onwards;

Accomplishment of **energy efficiency targets** from the National Action Plan for Energy Efficiency (PNAEE, 2008) in the year 2015;

METHODOLOGY



RESULTS

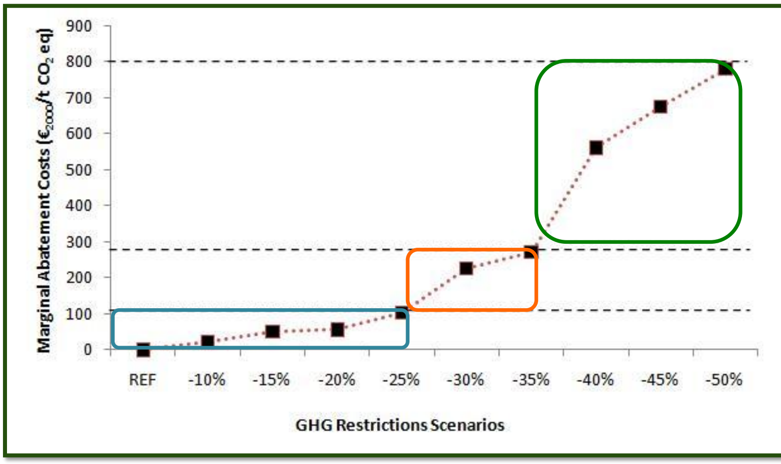
The REF scenario indicates a **reduction of 7%** in GHG by 2030 when comparing with 2005 values. Consequence of the **Portuguese policies and measures** and increase of **efficiency** in energy supply and demand.

GHG emissions reductions in 2030 in selected scenarios, comparing with the REF Scenario

Main Sectors	GHG_35	GHG_50
Industry	-44%	-54%
Transport	-62%	-60%
Electricity generation	-4%	-11%

RESULTS

GHG marginal abatement cost curve for the Portuguese energy system in 2030



RESULTS

Power sector: the most cost-effective options are similar in all scenarios, the introduction of renewable is proportional to the increase of the restrictions of the GHG emissions.

Solar energy (PV plant size and solar thermal)

Wind energy rising **26%** to **28%** comparing to REF

RESULTS

► Coal: an option considered differently, comparing with the REF scenario:

Increase by 81% in the GHG_35 scenario → CCS

Decrease by 100% in the GHG_50 scenario → Renewable energy

► At -50%, the increase of the share of renewable is more cost-effective than to implement CCS technology

RESULTS

De-carbonization of the electricity production higher efficiency of electric equipments
►key elements for high electricty share in the **final energy consumption.**

↓

Residencial sector : more **19% electric consumption** in GHG_50 scenario than in the ref scenario

Industry sector: natural gas is replaced by **biomass**

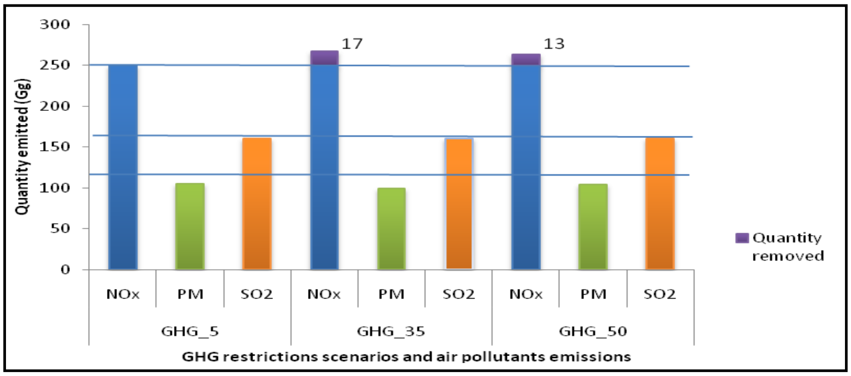
↓

Extremely high cost (importation)

.

RESULTS

Impact on Air Pollutants Emissions in 2030



RESULTS

The introduction of a CCS thermoelectric power plant **increase AP emissions** as a consequence of an increase of coal use.

SO2 emissions reaches, in all scenarios, the ceiling.

The use of some specific fuels neutralize the expected benefits of the measures and options for the mitigation of GHG. Ex: Use of black liquors in Co-generation (paper and pulp)

RESULTS

PM emissions in 2030 in all scenarios are below the ceilings, →GHG mitigation options have a **co-benefit** in the reduction of this pollutant.

However, it should be noted that the reduction is minimized be the increase of the consumption of biomass and black liquors.

NOx emissions: The compliance with the celing in GHG_35 and GHG_50 scenarios → NOx abatement technologies:

Combustion modifications
Selective (non) Catalytic Reductor (SCR)

Cement and Glass industry

Conclusions

• Main option to comply with the GHG constraints is the increase of electricity from renewable resources, manly **solar** and **wind energy;**

•The introduction of **CCS abatement technology** in less restrictive scenarios shows that is more **cost-benefit** to **increase renewable** electricity production than invest in **end-of-pipe solutions,** at **more restrictive GHG levels;**

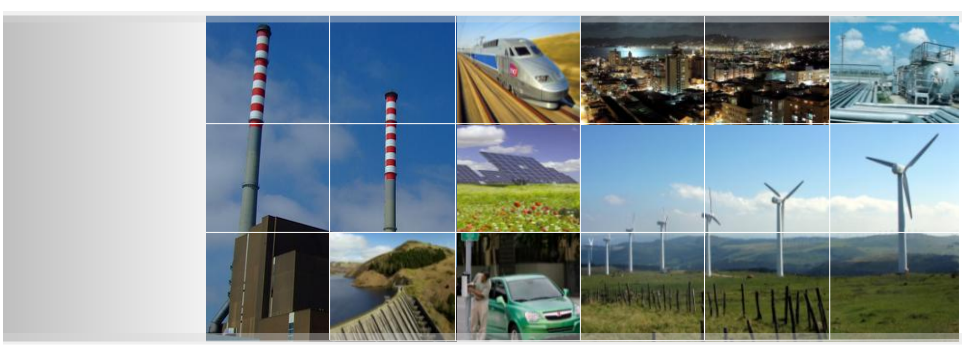
•The improvement of **energy efficiency** and **fuel switches** are sufficient in all scenarios to **comply** with the **SO2** and **PM** emissions ceilings for 2020 without using control technologies;

•NOx emissions comply with the ceiling through the introduction of abatement technologies in the industry sector;

Conclusions

Generally, options to mitigate air pollution and GHG tackle the same sources, but **do not** result always in **win-win situations**.

For Portugal, specific cost-effective choices for fuel switches lead to neagtive trade-offs, weakening the reduction of both air pollutants and GHG emissions



FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE NOVA DE LISBOA

CENSE center for environmental and sustainability research

Thank you for the atention

[1]**luisdias@fct.unl.pt**, [2]jplg@fct.unl.pt, [3]barbara.mauricico@fct.unl.pt, [4]p.fs@fct.unl.pt, [5]mjs@fct.unl.pt