CESAM
Centre for Environmental and Marine Stu
www.cesam.

MACROECONOMIC AND SECTORAL IMPACTS OF ENERGY EFFICIENCY TARGETS

A GENERAL EQUILIBRIUM APPROACH FOR PORTUGAL

Carla Teotónio
Miguel Rodrigue
Peter Roebelin
Patrícia Forte

MILAN, 1 DECEMBER 201

OUTLINE

1. Context
2. Objective
3. Methodology
4. Scenarios
5. Results
6. Concluding remarks

CESAM
Centre for Environmental and

CONTEXT(I)

Energy efficiency and economic development

Resource efficiency is a key tool to decouple economic growth and resource use:

"The economic efficiency and the environmental effectiveness with which an economy or a production proces
is using natural resources"

This encompasses:

- A quantitative dimension - the quantity of output produced with a given input of natural resources
- A qualitative dimension - the environmental consequences per unit of output produced with a given natural resource input

The concept is closely linked to the concept of **resource productivity:**

"The monetary value-added of output per physical unit of resource input"

CESAM
Centre for Environmental and

CONTEXT(2)

Energy efficiency and economic development

Energy efficiency improvements

Lowering the absolute consumption of primary and/or final energy needed to deliver certain process or product

Benefits

- Increases security of supply
- Improves trade balance
- Reduces GHG emissions
- Fosters economic competitiveness
- Reduces final energy demand
- Reduces the resource use for energy-related activities
- Reduces pollution
- …

CESAM
Centre for Environmental and

CONTEXT(3)

EU Energy and Climate policies promoting energy efficiency

Energy efficiency is one of the cornerstones of the EU political action towards a low-carbon economy:

- 2020 Energy and Climate Package
- 2030 Climate & Energy Framework
- Roadmap for 2050

2020 Energy and Climate Package | 20-20-20 goals

- 20% reduction in greenhouse gas emissions as compared to 1990 levels
- 20% of renewable sources in final energy consumption
- 20% improvement in energy efficiency

Portuguese goals for 2020

- 20% reduction in greenhouse gas emissions as compared to 1990 levels
- 31% of renewable sources in final energy consumption
- 25% reduction in primary energy consumption

CESAM
Centre for Environmental and

CONTEXT (4)

EU Energy and Climate policies promoting energy efficiency

But energy efficiency is also the worst performing dimension of energy and climate policies:

- **EU-28**
  - Energy savings will fall short of the target by around 2 percentage points
  - 2/3 of the progress derives from improved efficiency – the remainder results from the low economic growth
- **Portugal**
  - Primary energy intensity is in line with the EU average – this is not the case for final energy intensity
  - The weak performance derives, above all, from the high energy intensity of economic activities
  - This hampers economic competitiveness and highlights the importance of final energy-oriented policies.

Energy intensity of the economy

CESAM
Centre for Environmental and

OBJECTIVE

Objective

To assess the macroeconomic impacts of complying with energy efficiency targets set for Portugal in the scope of the EU 2020 Energy and Climate Package

How

- Analysis of the effects of a 25% reduction in final energy consumption on the Portuguese economy
- Economic structure as of 2008
- Computable general equilibrium model (CGE)

CESAM
Centre for Environmental and

METHODOLOGY

Computable General Equilibrium model

- Static CGE model for a small open economy
- 31 production sectors: 4 energy sectors and 27 non-energy sectors
- 3 institutional sectors: private sector, public sector, and foreign sector
- Competitive labour market with involuntary unemployment
- Technological disaggregation of the power sector: 8 technologies
- Physical consumption of final energy per energy product and by institutional sector
- Calibrated to base year 2008
- Programmed in GAMS-MPSGE

CESAM
Centre for Environmental and

SCENARIOS

Simulated policy: Energy savings in absolute terms (TOE)

- A. 25% reduction in final consumption
- B. 10% reduction in final consumption

Policy instrument: Environmental tax on final energy consumption

- 1. Covering all forms of final energy (non-renewable and renewable energy)
- 2. Covering only fossil fuels (only non-renewable energy)

Scenarios:

- Scenario A.1.: 25% reduction achieved by a tax on all forms of final energy (tax of 82€/bbl)
- Scenario A.2: 25% reduction achieved by a tax on fossil fuels (tax of 102€/bbl)
- Scenario B.1: 10% reduction achieved by a tax on all forms of final energy (tax of 27€/bbl)
- Scenario B.2: 10% reduction achieved by a tax on fossil fuels (tax of 34€/bbl)

CESAM
Centre for Environmental and

RESULTS (I)

Macroeconomic impacts

	Unit	Scenario A: 25% reduction		Scenario B: 10% reduction	
		1. All energy	2. Fossil fuels	1. All energy	2. Fossil fuels
Gross domestic product (GDP)	%	-3,6	-3,4	-0,9	-0,7
Consumer price index (CPI)	%	4,0	3,5	1,1	1,0
Real GDP	%	-7,6	-6,9	-2,0	-1,7
Real wages	%	-4,8	-4,7	-1,4	-1,3
Unemployment rate	p.p.	4,6	4,5	1,1	1,1
Trade balance (energy products)	%	17,6	10,6	7,0	5,2

The effects of a tax on all final energy products on real GDP are stronger than if only on fossil fuels

Taxes on energy inputs increase production prices and inflation occurs

Due to the decrease in GDP and the increase in prices, real GDP decreases considerably

As the economy slows down, wages decrease. Given the rise in prices, real wages decrease significantly and unemploymen
rates increase

The trade balance for energy products improves, but the national balance deteriorates as exports decrease more than imp

CESAM
Centre for Environmental and

RESULTS (2)

Sectoral impacts in the energy sectors

	Scenario A: 25% reduction		Scenario B: 10% reduction	
	1. All energy	2. Fossil fuels	1. All energy	2. Fossil fuels
Refined petroleum	-14,6	-18,3	-5,4	-7,1
Natural Gas	-24,8	-36,7	-11,0	-17,5
Electricity	-25,7	-25,3	-11,4	-10,6
Oil		-21,2		-8,1
Gas		-29,3		-12,4
Coal		-41,4		-19,6

- A tax on fossil fuels has the advantage of favouring electricity generation from renewable sources
- This strenghtens the national commitment with other energy and climate goals: reducing GHG emissions and increasing the share of RES in final energy consumption

CESAM
Centre for Environmental and

RESULTS (3)

Energy intensity

- Energy intensity decreases in all production sectors across scenarios
- In absolute terms (kgoe/1000€), manufacturing of non-mineral products, transportation and manufacturing of paper products record the largest decreases
- In relative terms, the greatest changes occur in the manufacturing of metals and food products
- The energy intensity of the economy decreases by 20% in the A.1 scenario and by 8.4% in the B.2 scenario

CONCLUDING REMARKS

- Macroeconomic and sectoral impacts of simulated policies show that imposing environmental taxes to achieve energy efficiency targets may hamper the national economic performance significantly
- Results (even in the 10% reduction scenario) highlight the importance of succeeding in the implementation of energy efficiency measures defined in the National Energy Efficiency Plans
- This would allow that the eventual fiscal policies needed to achieve national targets could be smoother and, consequently, produce less severe impacts in the economy
- A tax on fossil fuels only appears to be a more cost-effective instrument than a tax on all final energy products
- Beyond less severe economic impacts, such a tax is aligned and reinforces other energy policies and objectives, namely regarding GHG emissions and renewable energy sources

CESAM

Centre for Environmental and Marine Stu

www.cesam.

CARLA TEOTÓNIO[1] (CARLA.TEOTONIO@UA.P

MIGUEL RODRIGUEZ MENDE

PETER ROEBELIN

PATRÍCIA FORTE

[1]CESAM – DEPARTMENT OF ENVIRONMENT AND PLANNING, UNIVERSITY OF AVEI

[2]DEPARTMENT OF APPLIED ECONOMICS, UNIVERSITY OF VI

[3]CENSE – NOVA UNIVERISTY OF LISB

CESAM

Centre for Environmental and Marine Stu

www.cesam.

CARLA TEOTÓNIO[1] (CARLA.TEOTONIO@UA.P

MIGUEL RODRIGUEZ MENDE

PETER ROEBELIN

PATRÍCIA FORTE

[1]CESAM – DEPARTMENT OF ENVIRONMENT AND PLANNING, UNIVERSITY OF AVEI

[2]DEPARTMENT OF APPLIED ECONOMICS, UNIVERSITY OF VI

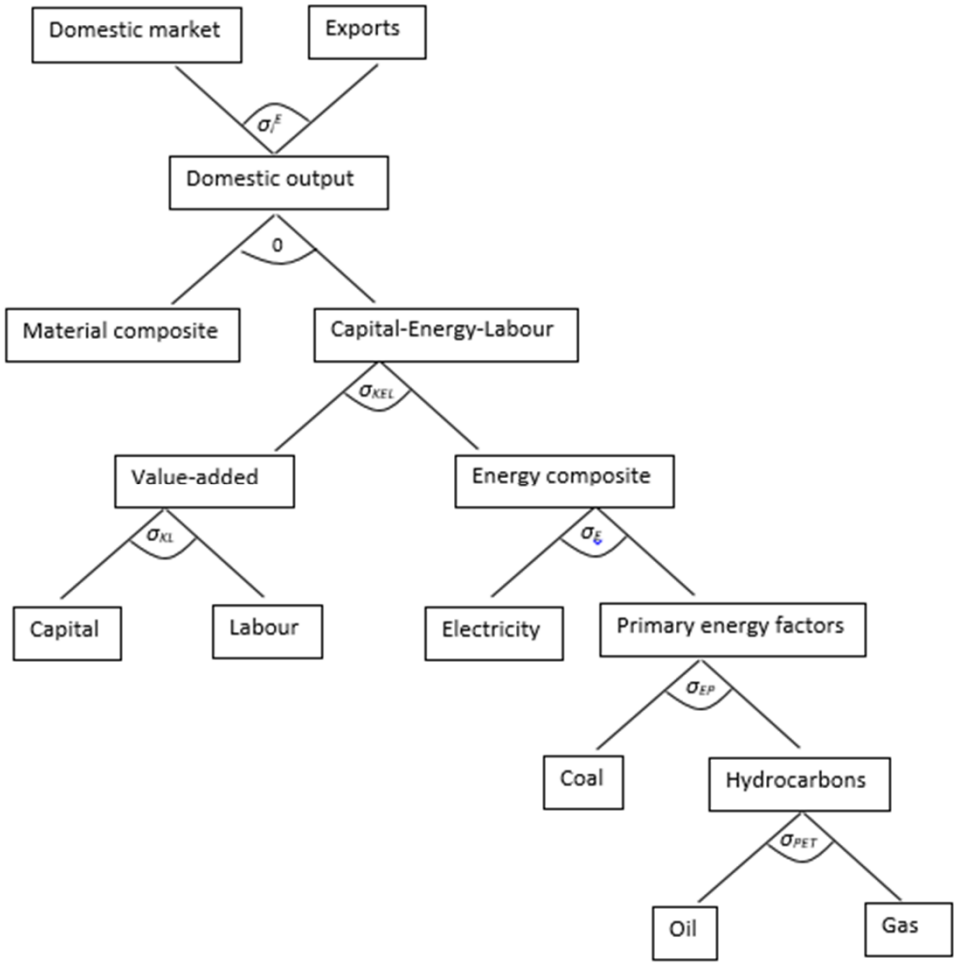
[3]CENSE – NOVA UNIVERISTY OF LISB

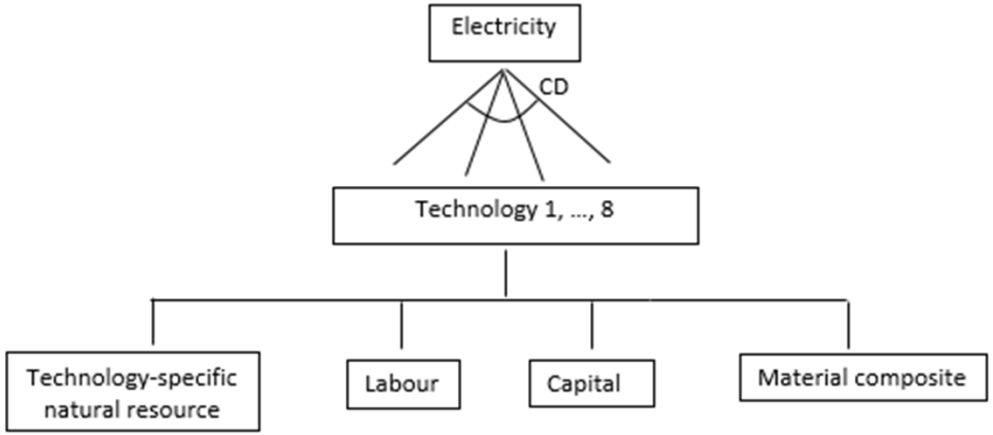
CESAM
Centre for Environmental and Marine Stu
www.cesam.

ANNEXES

METHODOLOGY

Production structure





METHODOLOGY

Consumption structure