
# Is economic optimism hampering long term energy efficiency goals?

## The role of energy system models

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# Objectives

**To what extent economic optimism affects long-term energy efficiency goals set by energy models?**

# Outline

- Context
- Looking back into two decades of energy projections for Portugal
- Model effects of economic optimism with TIMES_PT model
- Results
- Conclusions & limitations

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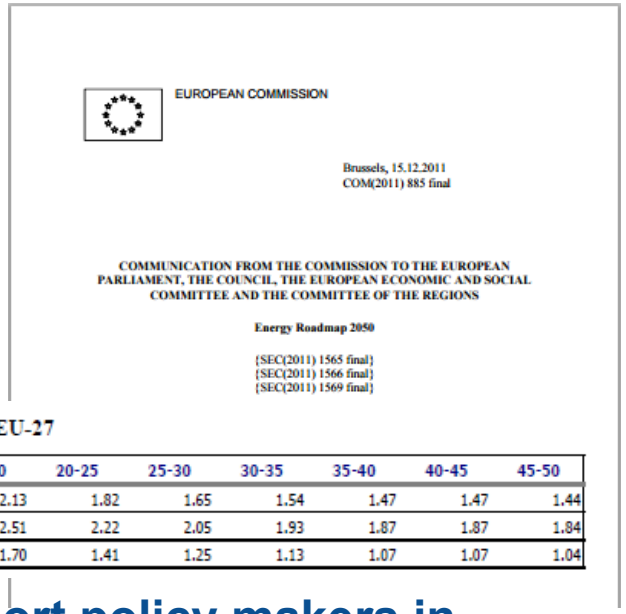
# Context



EUROPEAN COMMISSION

Brussels, 15.12.2011
COM(2011) 885 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Energy Roadmap 2050

{SEC(2011) 1565 final}
{SEC(2011) 1566 final}
{SEC(2011) 1569 final}

Table 2: Average annual growth rate for the EU-27

| | 05-10 | 10-15 | 15-20 | 20-25 | 25-30 | 30-35 | 35-40 | 40-45 | 45-50 |
|---|---|---|---|---|---|---|---|---|---|
| Reference | 0.58 | 2.29 | 2.13 | 1.82 | 1.65 | 1.54 | 1.47 | 1.47 | 1.44 |
| High economic growth | 0.58 | 2.37 | 2.51 | 2.22 | 2.05 | 1.93 | 1.87 | 1.87 | 1.84 |
| Low economic growth | 0.58 | 1.89 | 1.70 | 1.41 | 1.25 | 1.13 | 1.07 | 1.07 | 1.04 |

**Energy system models (e.g., TIMES,PRIMES) support policy makers in energy and climate change mitigation policies → EU-wide energy efficiency goal of 30% by 2030**

- models' outputs are determined by assumptions
- long term economic growth is assumed in the energy scenarios for policy support in the EU (e.g. 2050 Energy Roadmap) and in most scientific literature (national, regional models)
- it might not be politically acceptable to consider an economy that is not growing
- substantial body of work that challenges these economic growth assumptions, stemming from the degrowth economics literature
- to our knowledge there are no studies combining degrowth assumptions with long-term energy system scenarios from energy system models


# Past two decades of energy projections in Portugal

**Past energy scenarios vs real values of Final Energy Consumption**
**Highlight the uncertainty associated with long term scenarios and the importance of the macro-economic assumptions.**

**8 studies developed for energy and climate policy support in PT**

- 4 cover the period from 1990-2020 (PEN84, CCE, ED20 and GHG) based on simulation
- 4 (PT20, NETR, LCR and NCCP) energy scenarios for 2020-2030 using the TIMES_PT energy systems technology model
- typically use **two distinct macro-economic scenarios: high growth (H) and low growth (L)**

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PortugalClima2020

Impact Assessment of 20-20-20 policy package

novastecnologiasenergéticas RoadmapPortugal2050

New Energy Technologies Road Map till 2050

RNBC

Low Carbon Road Map till 2050

Green Tax Reform till 2030

no nuclear, coal

natural gas

TIMES_PT

1982 1984 1995 1999 2000 2008 2011 2012 2014

PEN 82 2010

PEN 84 2010

CCE 1995-2015

Energy Demand 2000-**2020**

GHG Emissions 2020

First National Energy Plan

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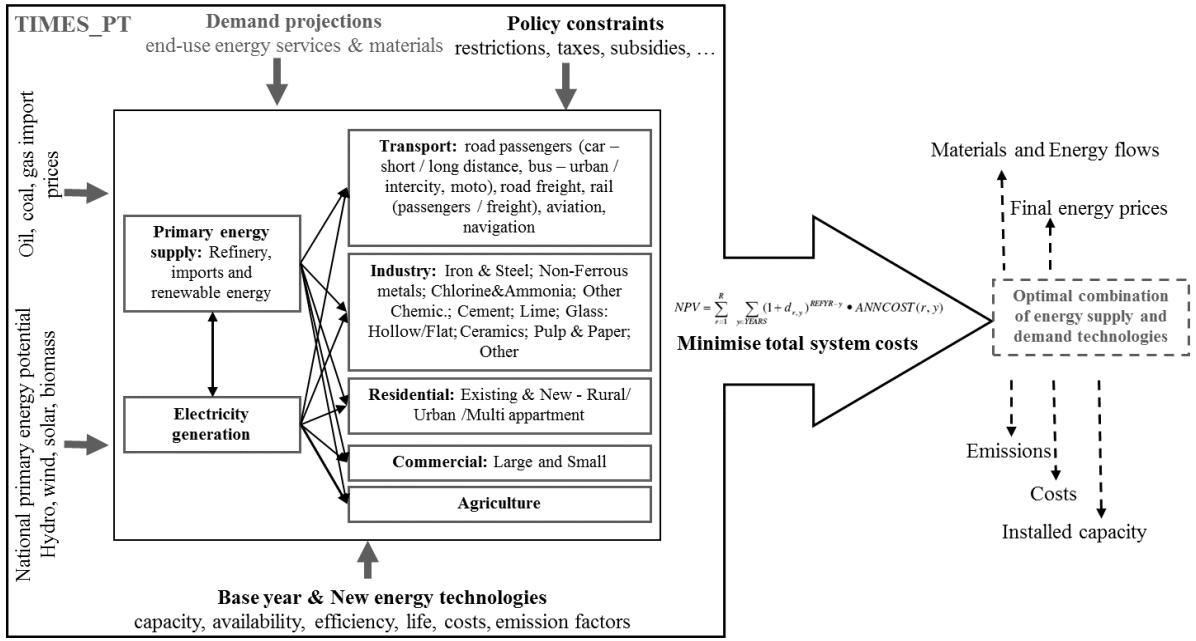
# TIMES_PT model

- Cost minimization linear optimization bottom-up model generated with the TIMES model generator of the IEA-ETSAP.
- Describes the Portuguese energy system from 2005 to 2065.
- Ultimate goal of satisfaction of energy services demand at the minimum total system cost, subject to technological, physical ad policy constraints.




***Overview of the TIMES_PT energy system model and its main inputs and outputs.***

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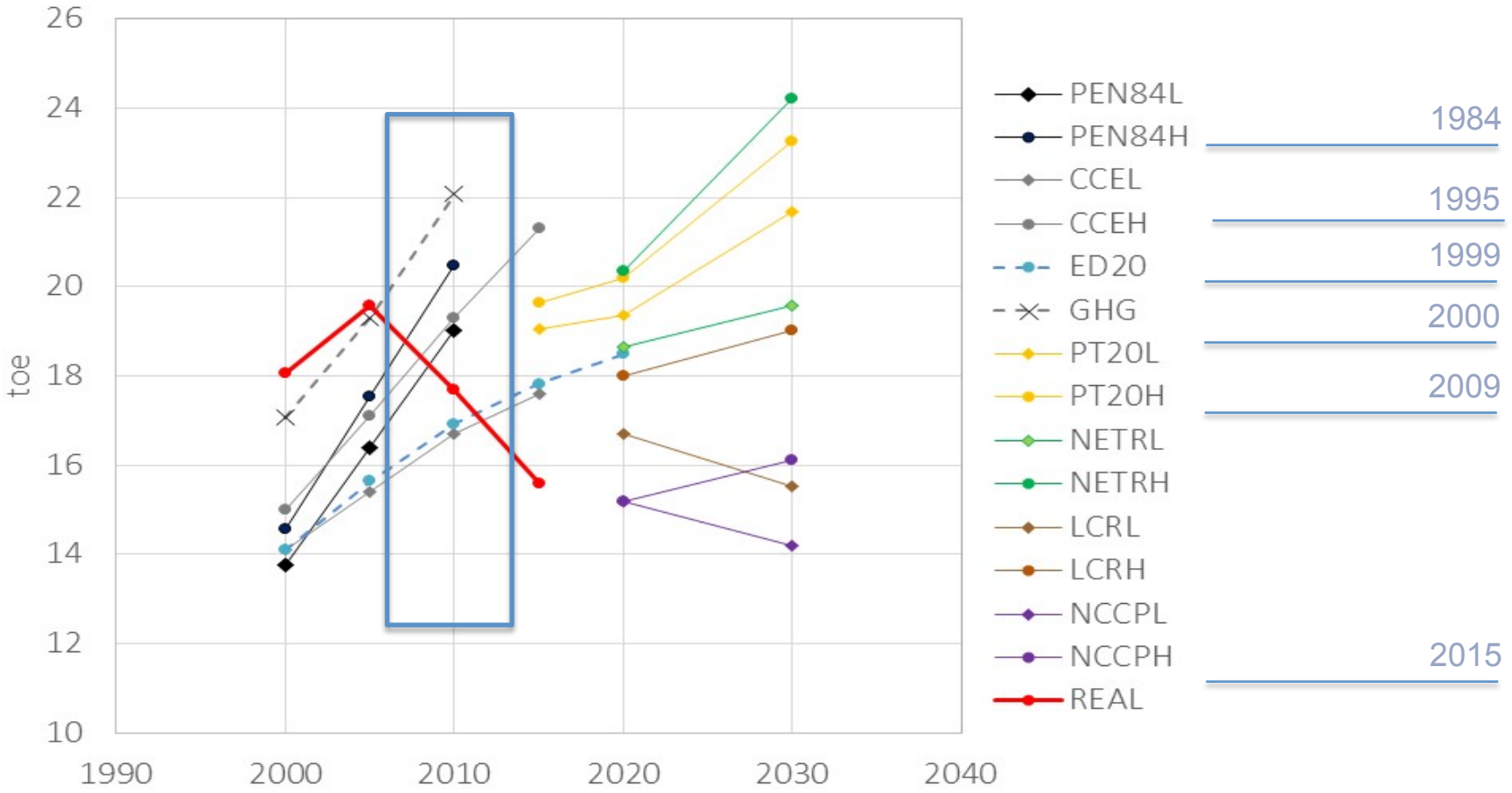
# Final Energy Consumption 2000-2030




- **4 to 35% difference** from **2010** real values - differences increase with age of studies. (for real data 2015 shows in fact 2012 values)

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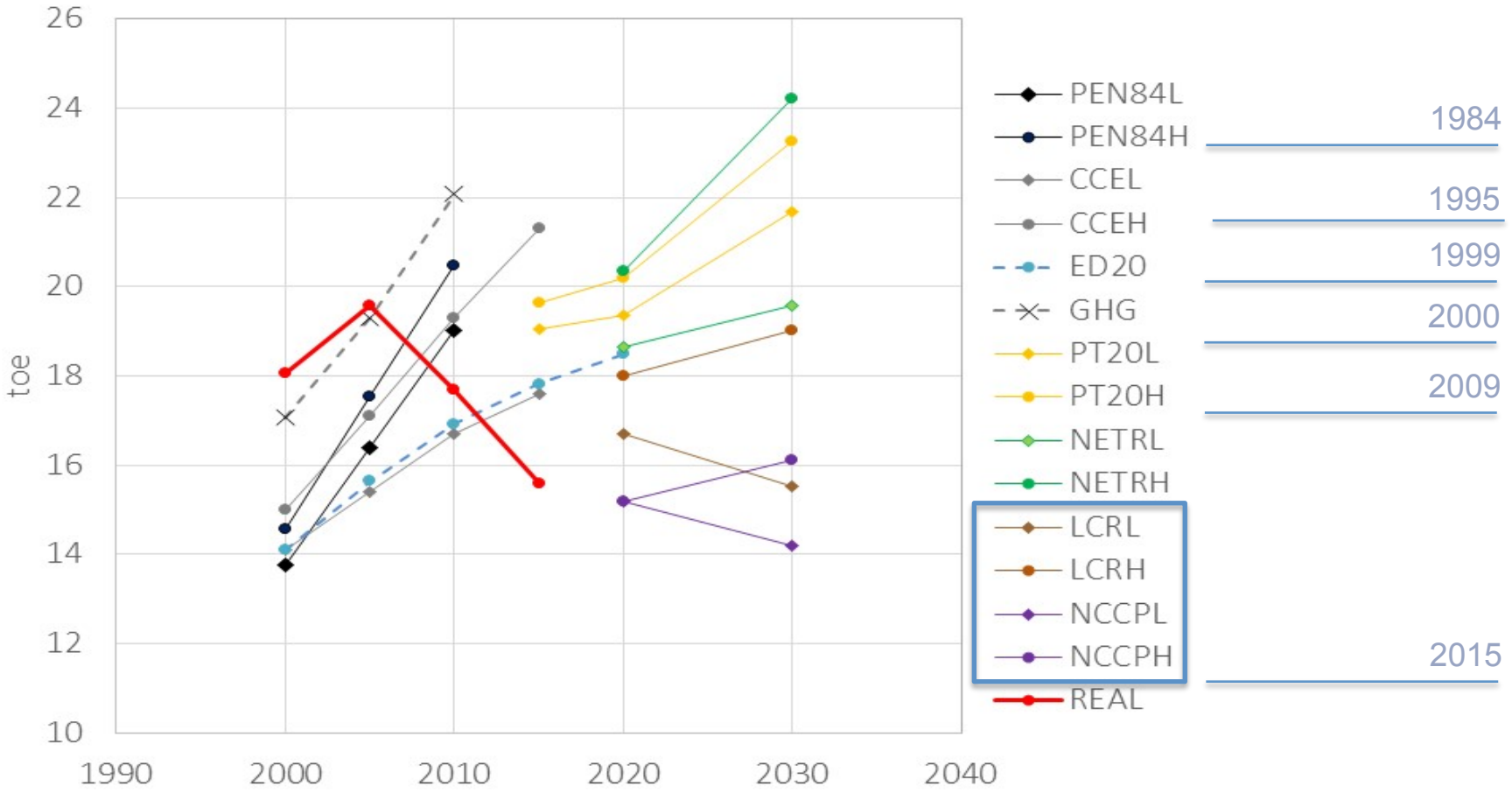
# Final Energy Consumption 2000-2030




- 2012 (LCR) and 2014 (NCCP) - substantially more conservative than previous studies (2010 and 2008) for 2020 and 2030

↓ FEC 25-31% lower than 2008 study respectively.

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# Model Assumptions and difference on results explained

- Energy projections and scenarios include assumptions on:
  - Reviews of energy demand forecasts
  - Different levels of GDP structure
  - Level of implementation of policies and measures according to established policy goals (e.g. NPEE)
  - Primary energy prices
  - Electricity trade with Spain
  - Hydrological availability
  - techno economic aspects of energy supply and demand technologies
  - Sectorial discount rate changes

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- Most influential factor for this FEC changes are the expectations **on macro economic growth**
  - Supported on our knowledge gathered along several projects with the model
  - Relative importance of each assumption (Simões et al., 2014)

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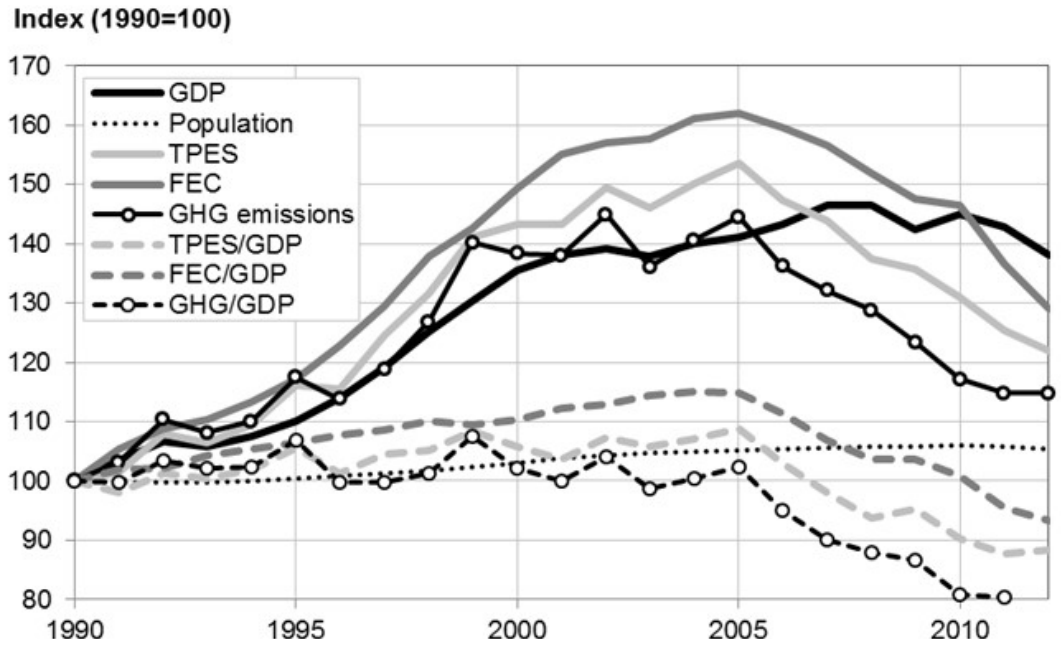
# Changing economic optimism?

- energy scenarios rely on continuous update of the data which in the recent years reflect the economic crisis in Portugal
- the expectations on future macro-economic growth and demand for energy services even as far as 2030 are affected by the current situation
- before the economic crisis the macro-economic scenarios were more optimistic than the ones developed after 2010, using the same process and involving same stakeholders
- The same stakeholders that, in 2007, were not open to consider a GDP growth from 2020-2050 <1.5%, in 2012/2013 validated a GDP growth of <0.39% (although maintaining a “high growth” scenario)

# Changing economic optimism?

- Impressive changes in the economy and Portuguese energy system during the period 2007-2013

- GDP reduced by **7%**
- FEC reduced by **20%**
- Final energy intensity of GDP **13%** lower
- Primary energy intensity of GDP **15%** lower




**Evolution of main energy indicators for Portugal from 1990 until 2012**

**Can BAU optimistic assumptions on economic growth used by energy system models blind us for setting long term energy efficiency targets?**

# Modeling effects of economic optimism

- 6 macro-economic trajectories → energy services and materials demand scenarios to be input into TIMES_PT (2010-2050)
- demand projections: bottom-up approach for buildings (Gouveia et al., 2012) and a top-down approach for industry and transport based on GDP structure and evolution, and on demographics

| High | Base | Sufficiency | Revolution | Base_Transport | Base_industry |
|---|---|---|---|---|---|
| **+3.0% GDP pa**<br>Weight of industry in GVA up to 25%<br>-0.2% population pa | **+1.5% GDP pa**<br>Weight of industry in GVA up to 19%<br>-0.4% population pa | **Demand** for energy services is **constant** from 2014 until 2050 | **Demand** for energy services **decreases 7% every 5 years** from 2014 until 2050 | As BASE but demand for **mobility decreases 7% every 5 years** from 2014 until 2050 | As BASE but demand for **industry decreases 7% every 5 years** from 2014 until 2050 |

# Results I

| Final Energy Consumption (FEC) | Energy carriers |
| --- | --- |
| variation in total FEC (next slide)<br>- TIMES_PT outputs are the most cost-effective combination of energy technologies that allow satisfying the demand<br>- energy efficiency is inherent to the model | - do not vary substantially relative share in total FEC<br>- except relevance of heat pumps (ambient air) & solar that changes with economic optimism<br>- **different energy efficiency options** are cost-effective<br><br>**Showing how different assumptions on economic growth point to different ranking on the energy carriers** |

# Results I

Relevance of different sectors

- degrowth only of transport (**Base_transport**) leads to total 2050 FEC **very close** to the one of **Sufficiency**

- clear indication of the **relevance of transports** in the energy system and on role of a possible low-mobility future

- degrowth only of transport (**Base_transport**) leads to total 2050 FEC **only 7% lower than Base but, industry FEC less 21%**

-would represent the disappearance of the energy intensity industries in Portugal (cement, ceramic, glass and pulp and paper production)

not represent an energy efficiency gain but it serves to illustrate the point that variations in macro-economic assumptions should be considered in designing long-term energy scenarios .

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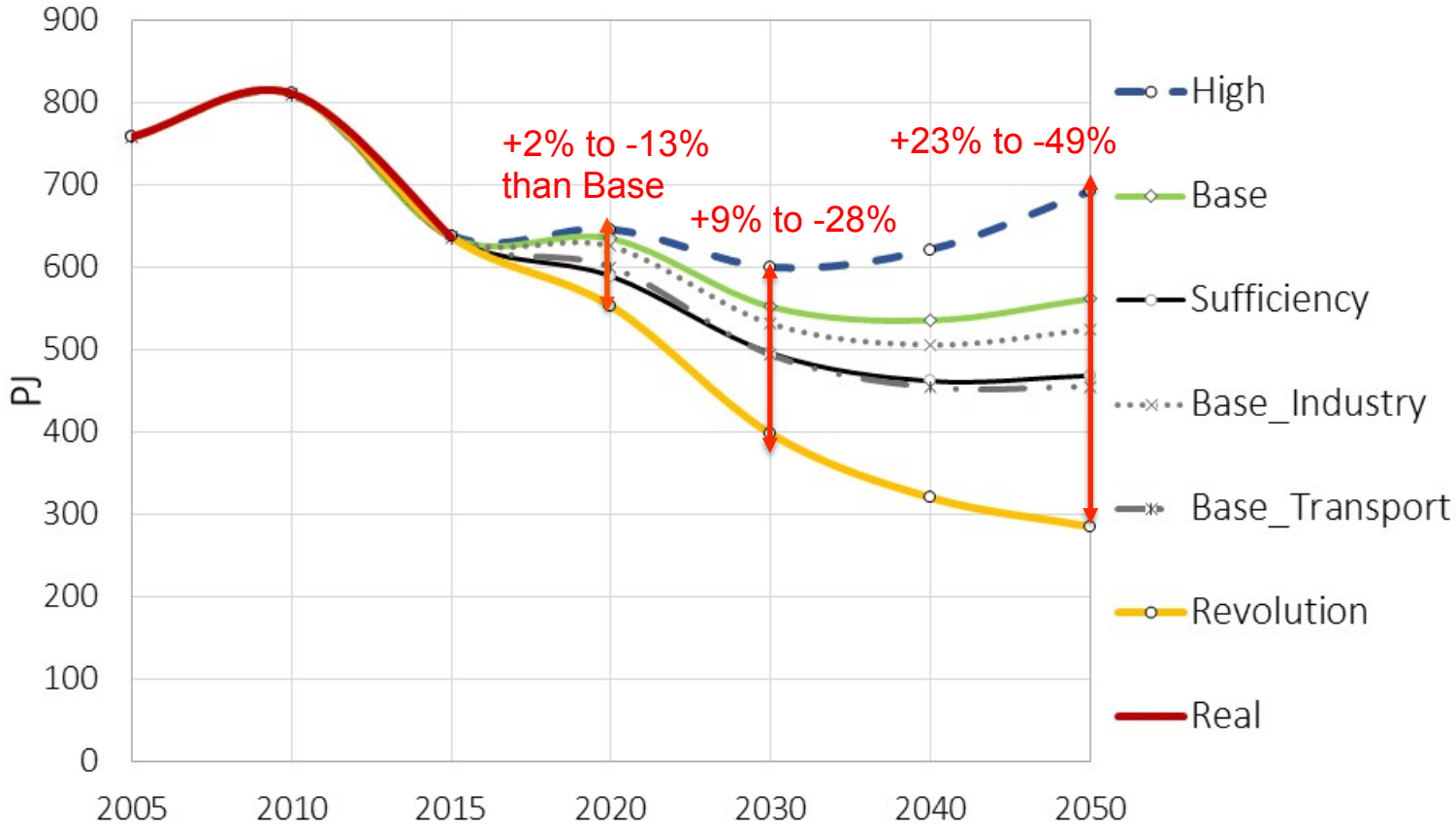
# Final Energy Consumption 2005-2050




With the economic optimistic vision, 2050 FEC is 31% less (Base) or 15% less (High) than in 2010. In Sufficiency and Revolution 2050 FEC is 42-65% less; In Base_Industry and Base_transport 2050 FEC 35-44% lower than in 2010.

If energy efficiency policy target based on a past consumption…

…the different economic assumptions might lead to substantially different energy efficiency targets

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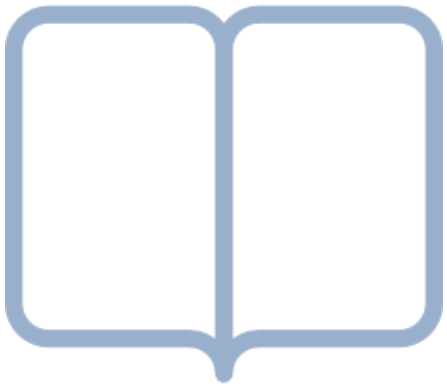

# Conclusions

- substantial difference for energy efficiency target setting depending on the considered energy demand scenario within the energy system model

- energy system models inherently consider all possible energy efficiency improvement due to deployment of more efficient technologies

- this is not enough when looking into long-term energy futures requiring an open mind frame and considering different economic structures and lifestyles

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# Further work and limitations

Methodological: only energy part of the economy; perfect foresight and rationality; most of the barriers to energy efficiency not considered - underestimates the costs for meeting the energy efficiency potential; lower FEC is due to both more efficient technologies and the lower demand inputs

What would the Revolution (a radical degrowth) scenario represent for the society? Could it be unviable for a country? Translate into such unemployment levels that would lead to economic and political collapse?

Nevertheless this allows to explore futures where the demand for energy services is not necessarily growing - highlighting importance of policies focused on demand drivers

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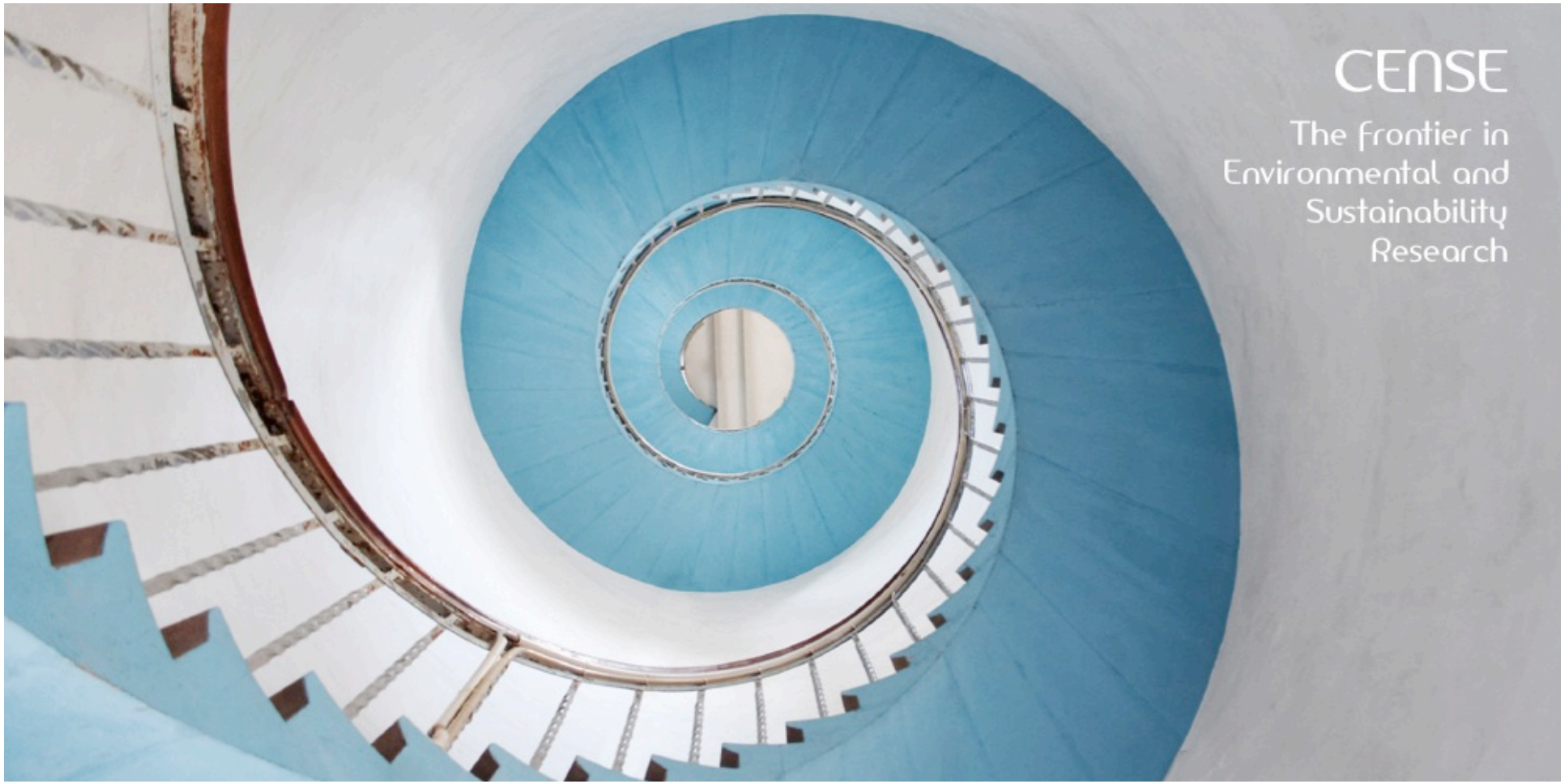


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