Will/would climate policy improve European energy security?

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Climate policy and energy security: two sides of the same coin?

- « *We must treat energy security and climate security as two sides of the same coin.* » – T. Blair (20 october 2006)
- Climate and Energy Package (EU, 2007) and the Energy Roadmap 2050 (EU, 2011)
  - Goals of "*reducing greenhouse gases emissions while at the same time ensuring security of energy supply*"

- A common root cause - the humanity increasing demand for (fossil) energy
- Solutions imply synergies or trade-offs:
  - energy efficiency or renewable technologies promote both goals
  - limiting coal use to reduce CO2 emissions could have negative impacts on the energy security of the many countries that have abundant coal reserves.
  - restricting the uptake of emission-intensive unconventional oil would increase the world's dependence on oil from the Middle East (Hartley, 2008)

→ Investigate (quantitatively assess) the question

Evidences in existing literature: synergies or trade-offs?

Synergies:

- Climate policies reduce the world vulnerability to peak oil (Rozenberg et al., 2010)
- Unilateral EU climate policy offers a protection against a scenario of exogenous oil price rise (Maisonnave et al., 2012)

Trade-offs:

- Trade-off between economic efficiency of climate policies and energy security for the EU (Kuik, 2003)

Mixed results:

- Synergy for oil supply, but trade-off for gas supply (Turton and Barreto, 2006)
- Different measures to reduce CO2 emissions can have positive or negative impacts on two indicators: **market concentration of fossil fuel market** weighed by country exposure, share of total energy demand met by gas imports (IEA, 2007)
- Complementarity at the level of the technology, trade-offs when selecting mix of technologies (Brown and Huntington, 2008)
- **Diversity of supply** mix increases, while **share of imports** can increase depending on region (van Vliet et al., 2012)

Two methodological points

- How to **measure** energy security?
- Confronting **uncertainties**

→What we did:

1. Develop a **set of indicators** to measure the **dimensions** of the energy security concept

2. Quantify the effect of climate policies on these indicators in a **database of scenarios** exploring key uncertainties

Energy security: what are we talking about?

- Tentative definition (by the negative) :

Energy insecurity is the risk of welfare impact of either the **physical unavailability** of energy, or **prices** that are unaffordable or overly volatile (IEA, 2007).

Energy security is about limiting this risk.

- Long-term – depletion of fossil fuels and the unequal distribution of resources in the world
- Polysemic concept

Indicators to measure energy security

- 4 dimensions, after Sovacool and Brown (2010), Kruyt et al. (2009) and Chester (2010)

Dimensions of the energy security concept	Selection of indicators
Availability and diversity	- Production/Resources (oil) - Diversity of Imports (oil) (Herfindahl-Hirschmann index –market concentration)
Dependence	- TPES/GDP - Imports/TPES
Affordability	- Households energy budget (share of revenues) - Energy import bill/GDP
Sustainability and acceptability	- Carbon content of TPES - Installed nuclear capacity

A methodology for a quantitative estimation, accounting for uncertainties

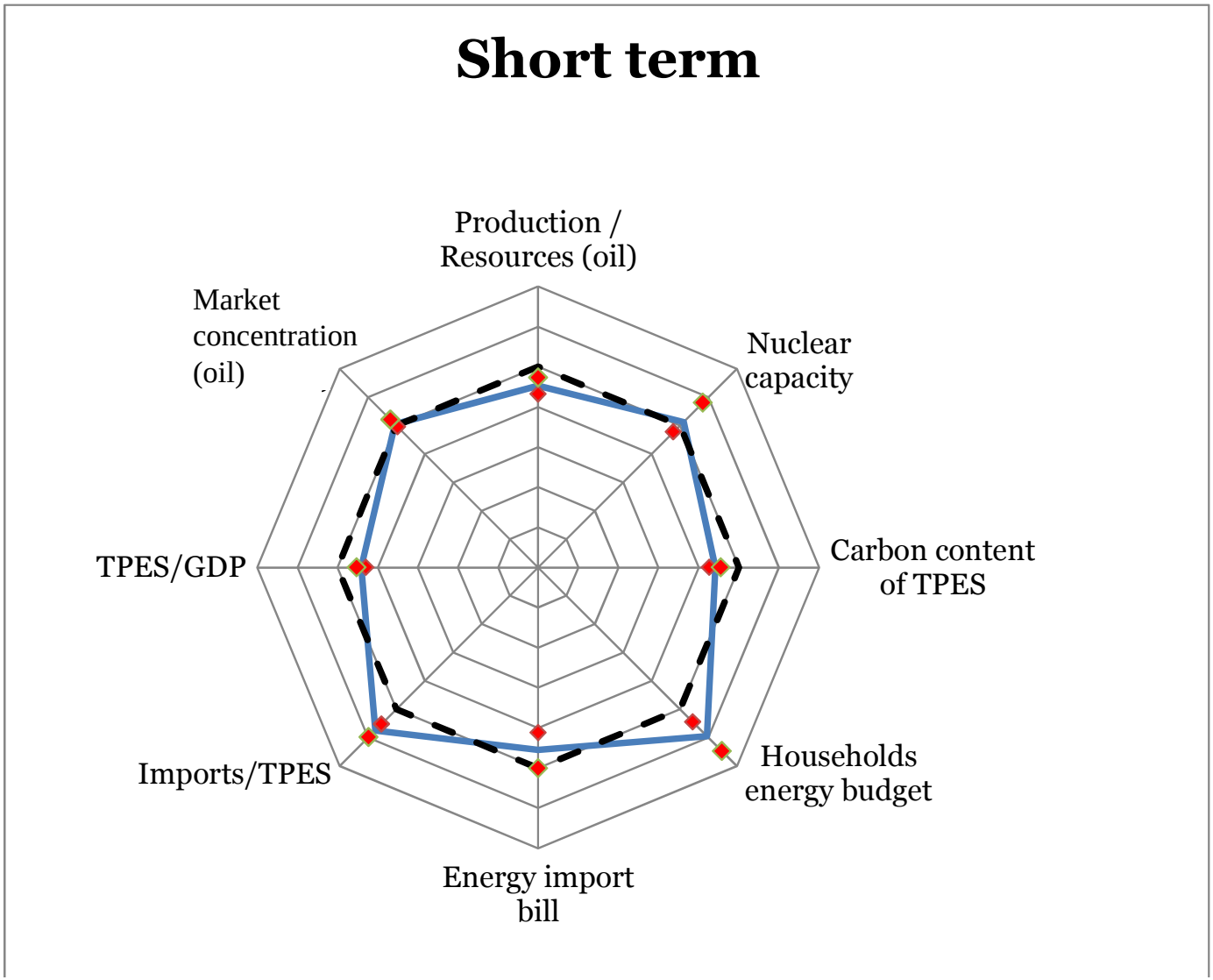
- A hybrid global CGE model, Imaclim-R
  - Europe is one of the 12 regions represented
  - Endogenous energy markets
  - Endogenous and induced technical change

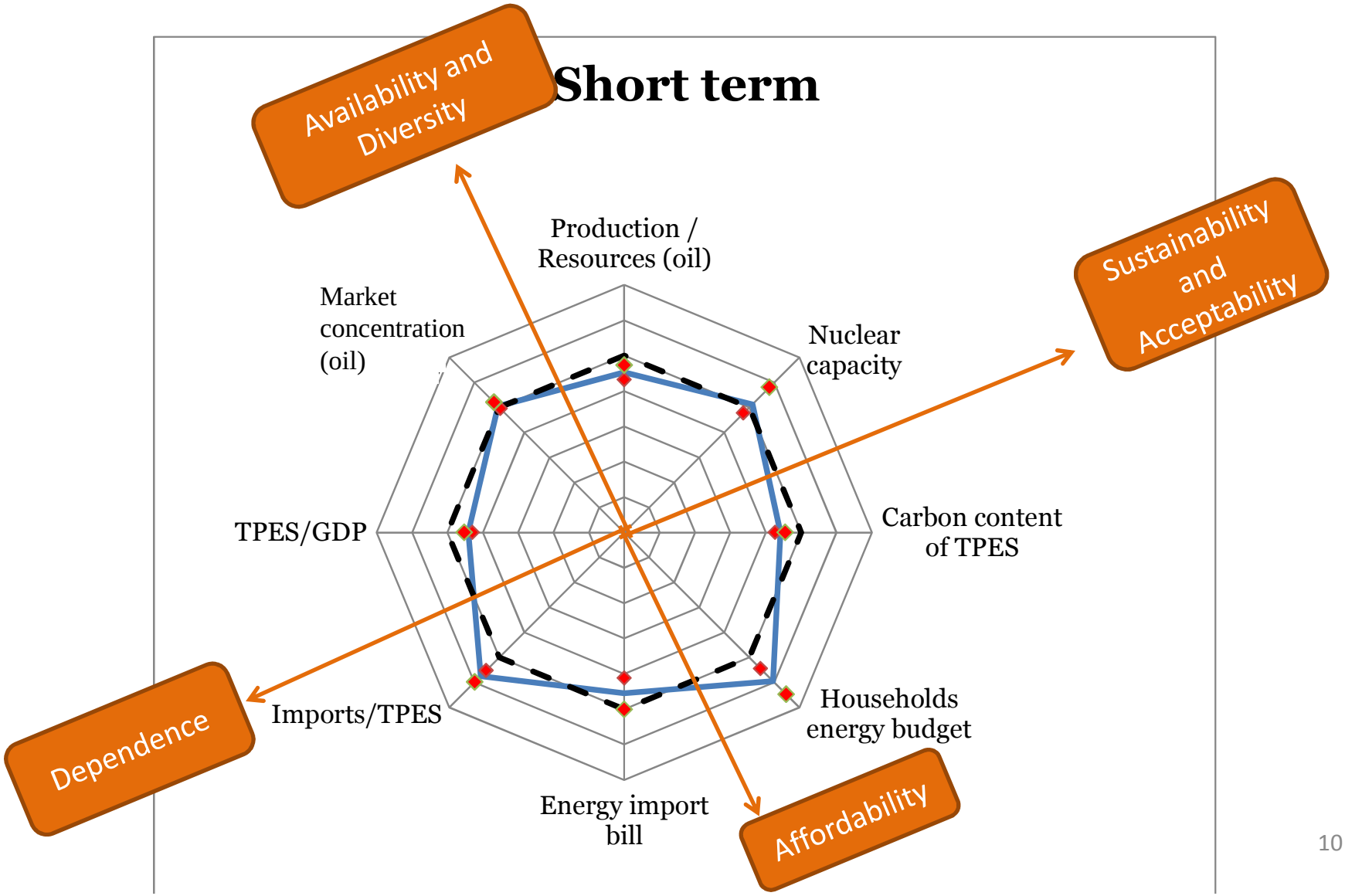
- A database of scenarios combining alternative assumptions on a large number of model parameters (Rozenberg et al., 2012)
  - Natural growth drivers (active population growth, labour productivity growth)
  - Fossil fuel reserves
  - Speed of induced energy efficiency
  - Cost and potential of low carbon power generation technologies
  - Cost and potential of CCS
  - Cost and potential of low carbon end-use technologies

→96 « baseline » scenarios, and 96 corresponding « climate policy » scenarios

RESULTS

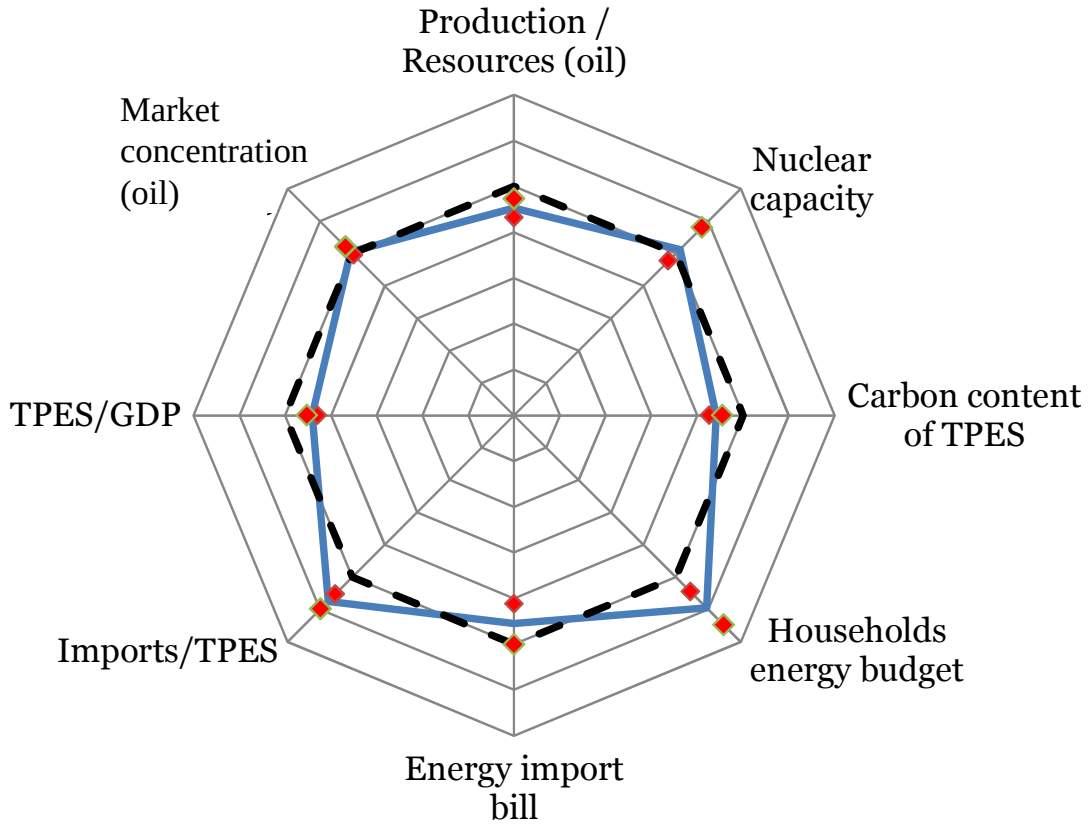
Will/would climate policy improve European energy security?




Short term
Availability and Diversity
Sustainability and Acceptability
Dependence
Affordability
Production / Resources (oil)
Nuclear capacity
Carbon content of TPES
Households energy budget
Energy import bill
Imports/TPES
TPES/GDP
Market concentration (oil)

Ratio between the value of the indicator in a climate policy scenario and its value in the corresponding baseline, **at the same date**.

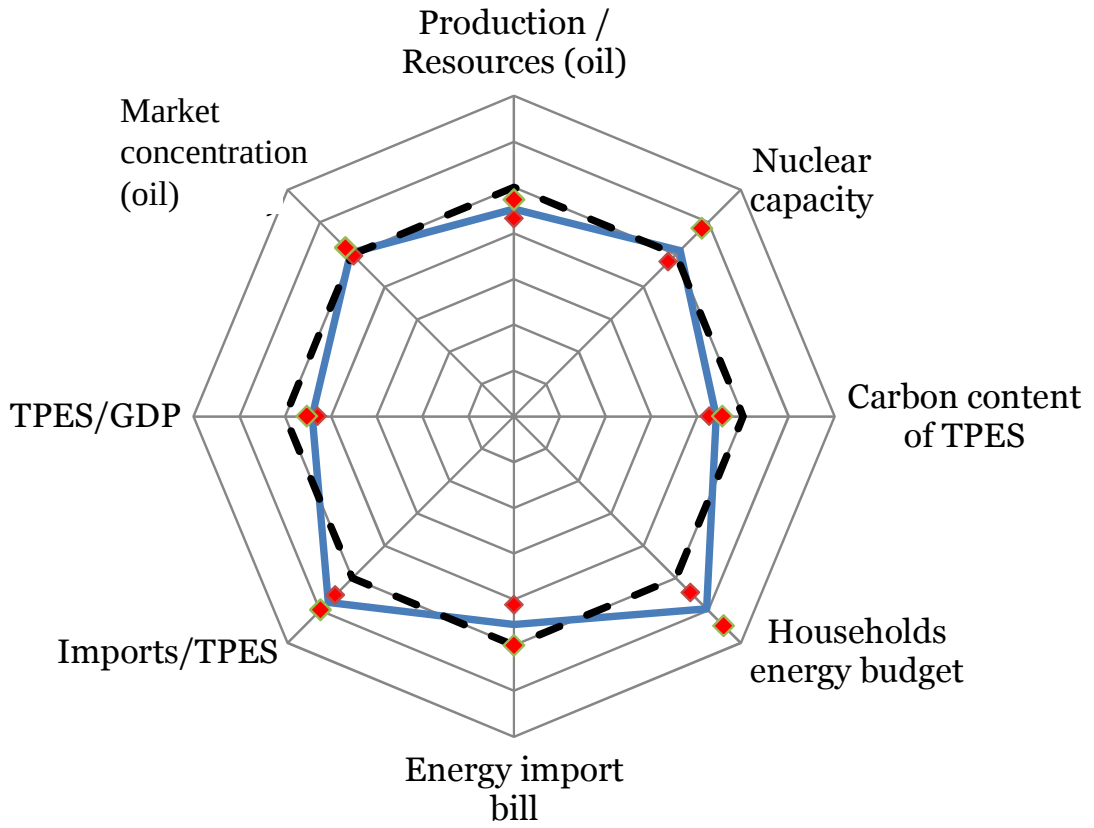
Short term 2025



Average over the 96 « alternative futur worlds »

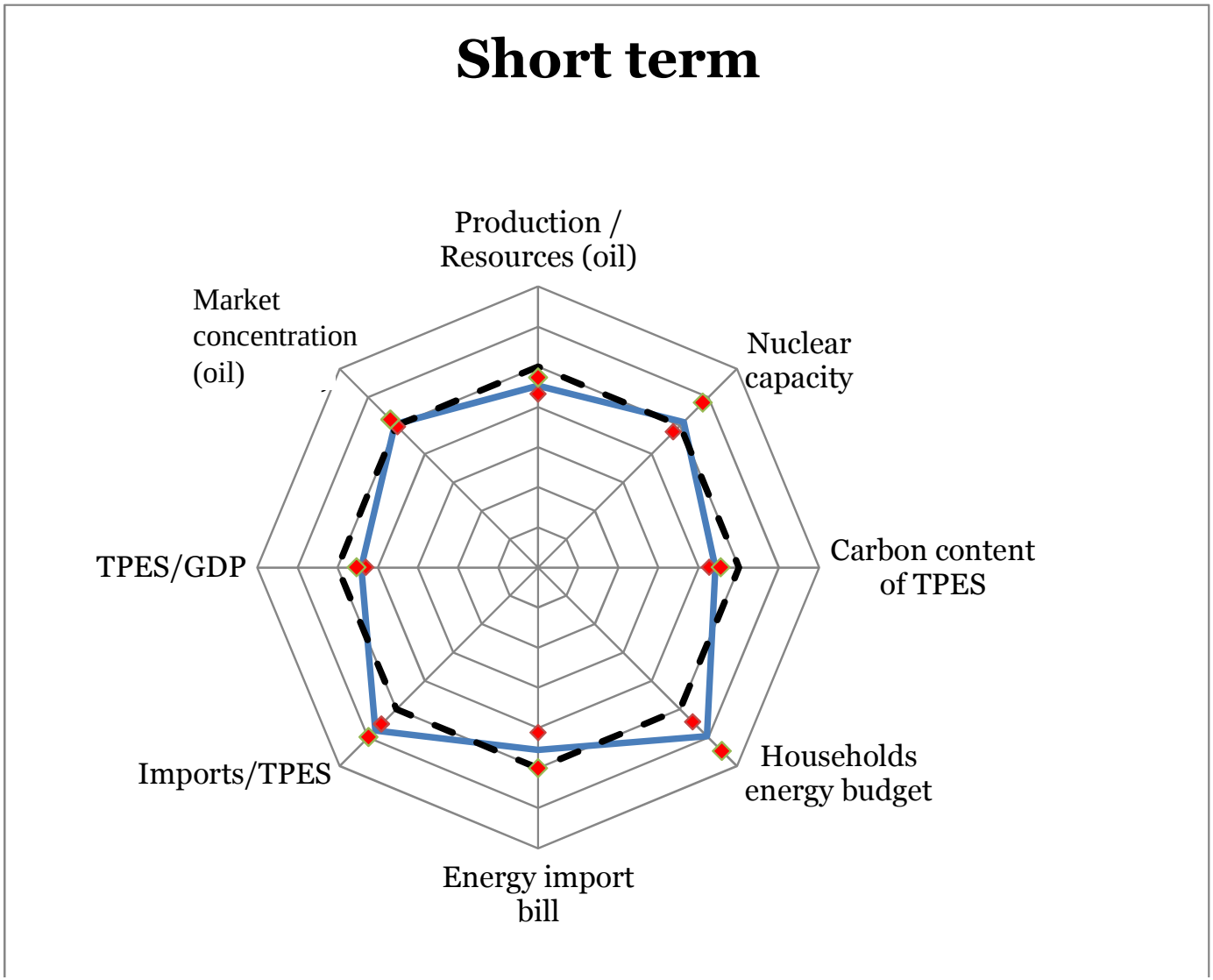
5th and 95th percentiles of the results distribution

Short term



- - - - - - - - No change of the value of the indicator between a « baseline » scenario and the corresponding « climate policies » scenario

- Outside: worsening of the indicator due to climate policies,
- Inside: improvement of the indicator due to climate policies.



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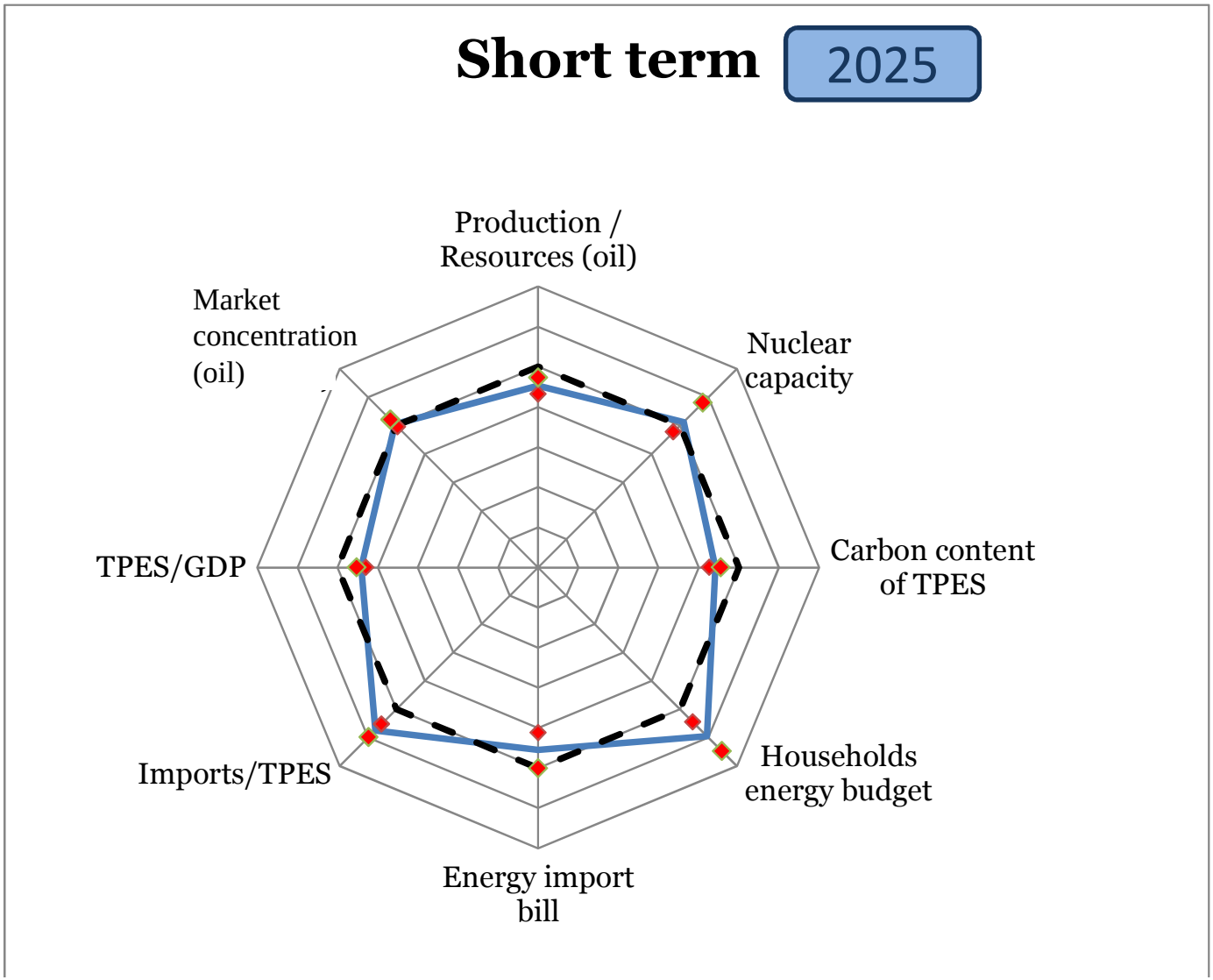

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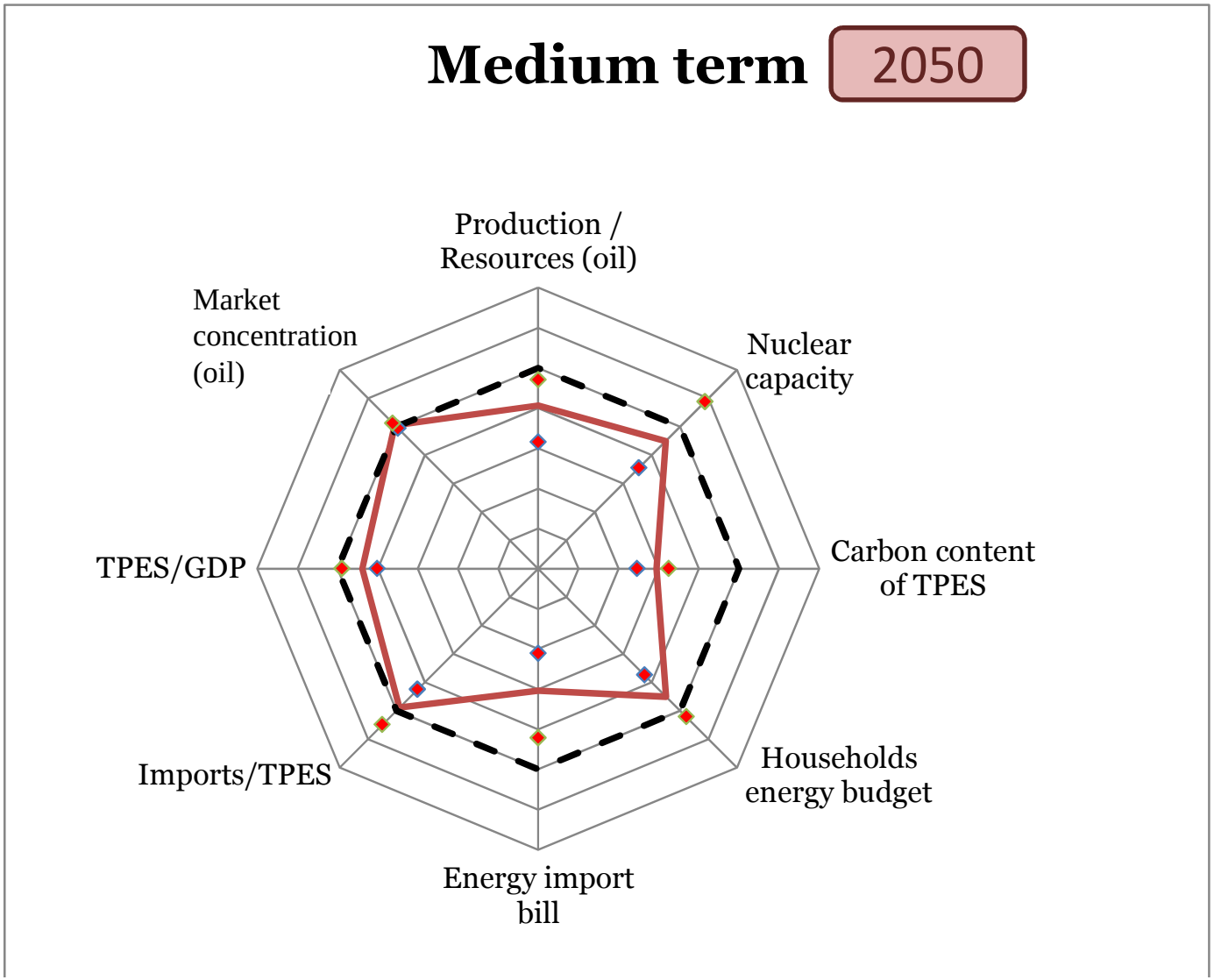

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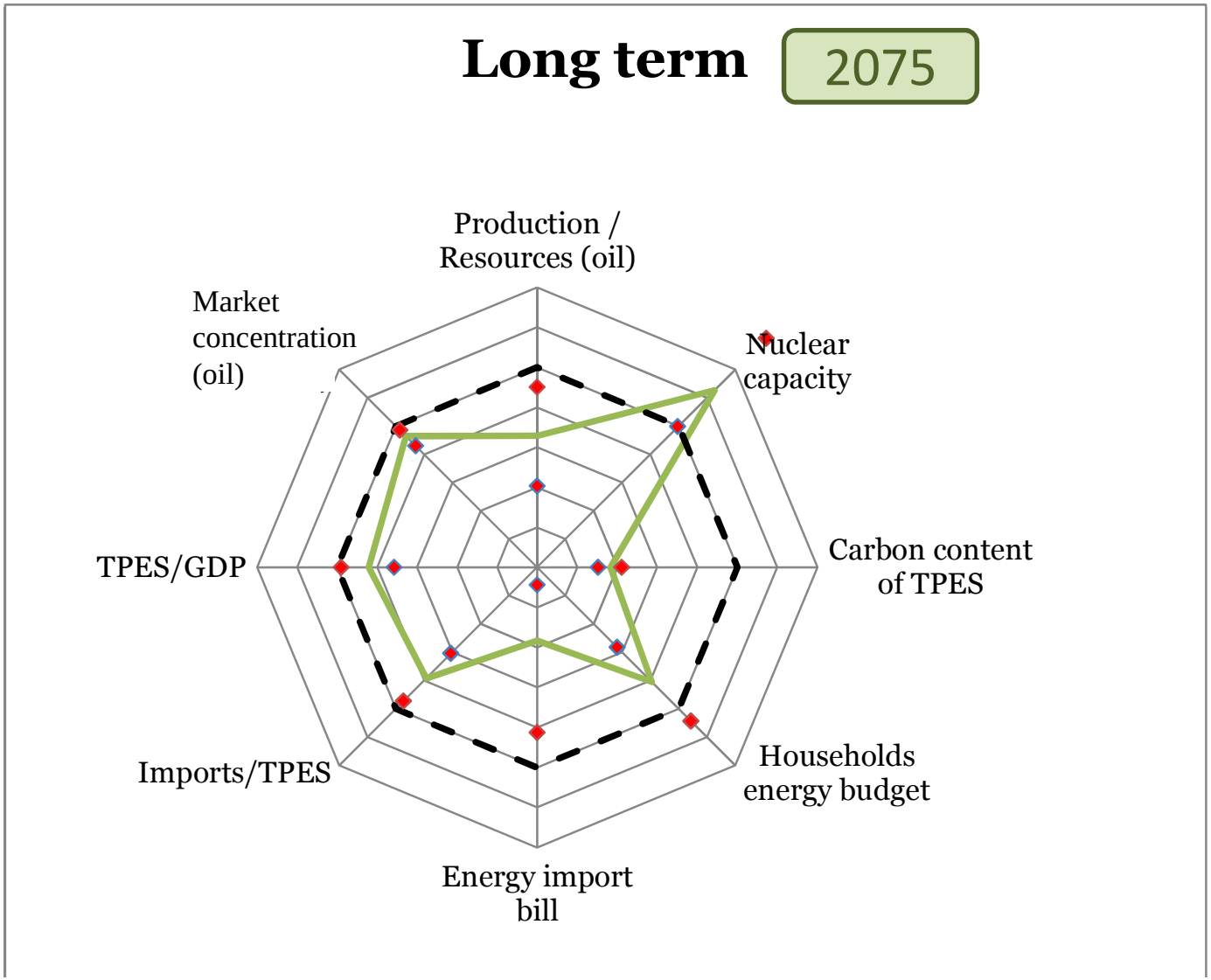
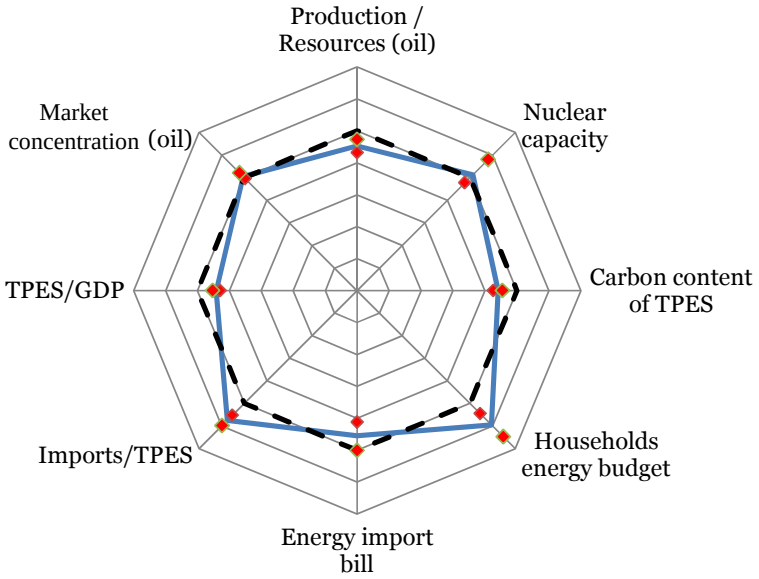
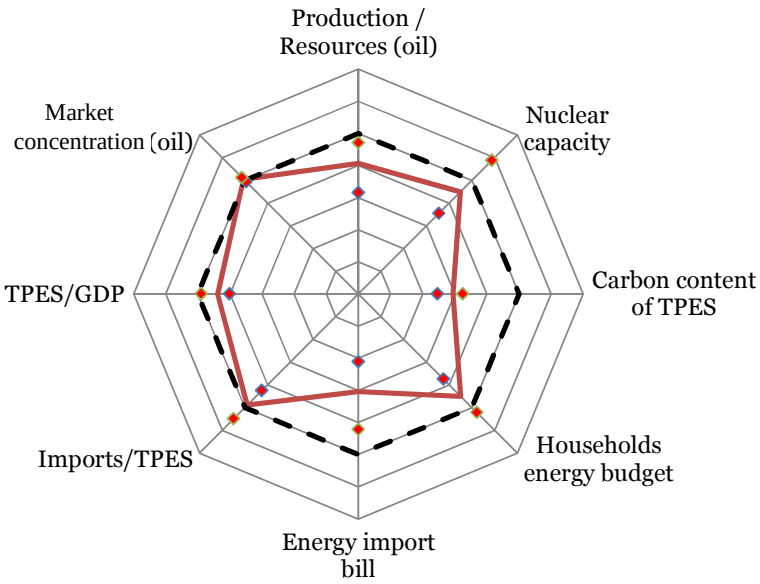


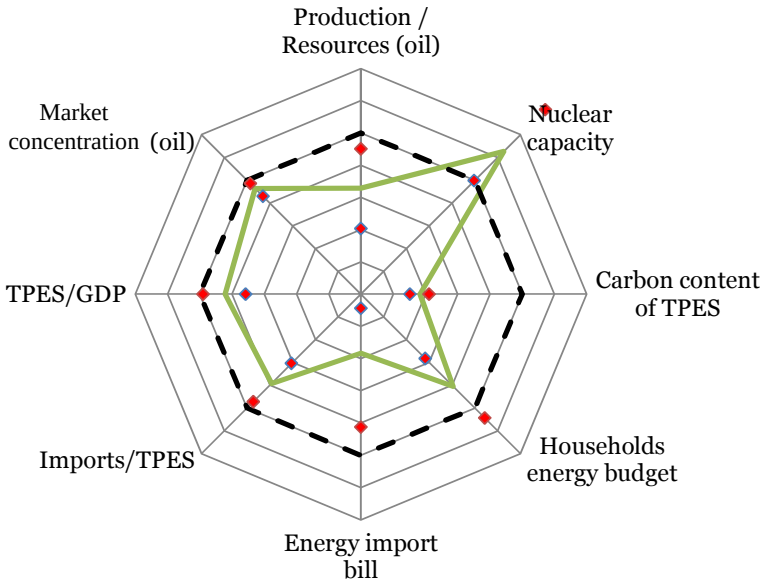
Short term



Medium term

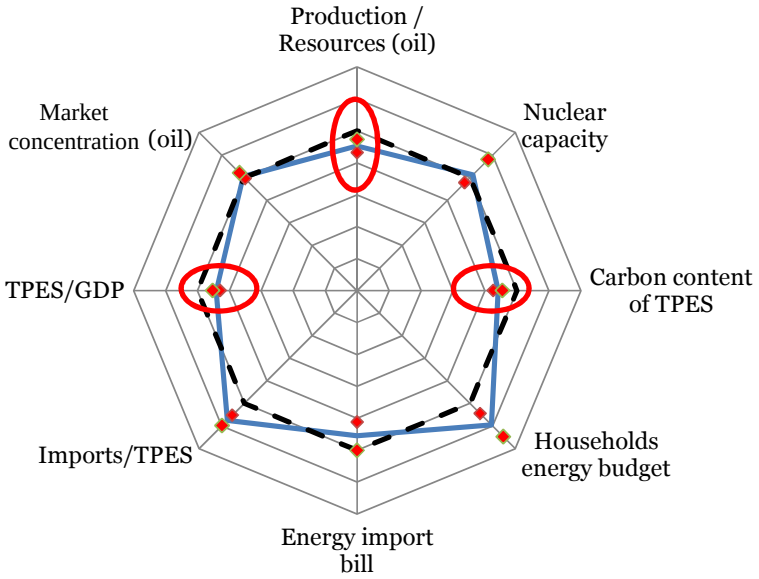


Long term



The time horizon changes the results.

Short term



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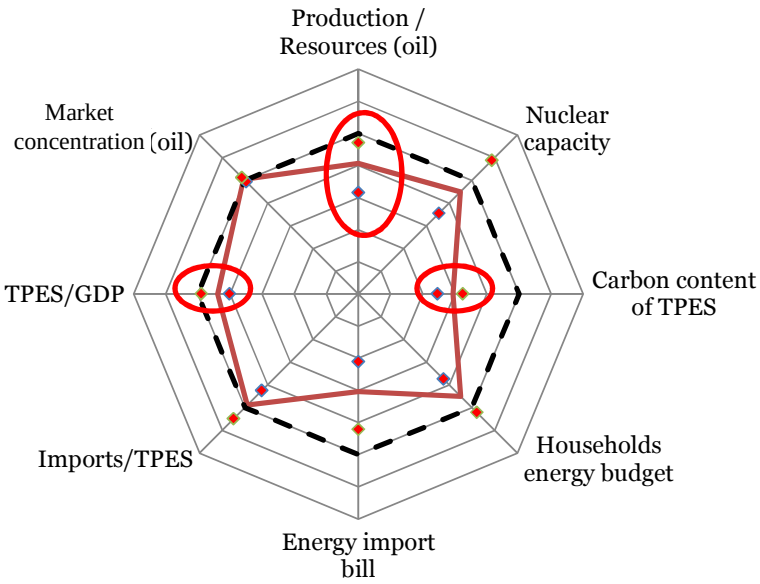

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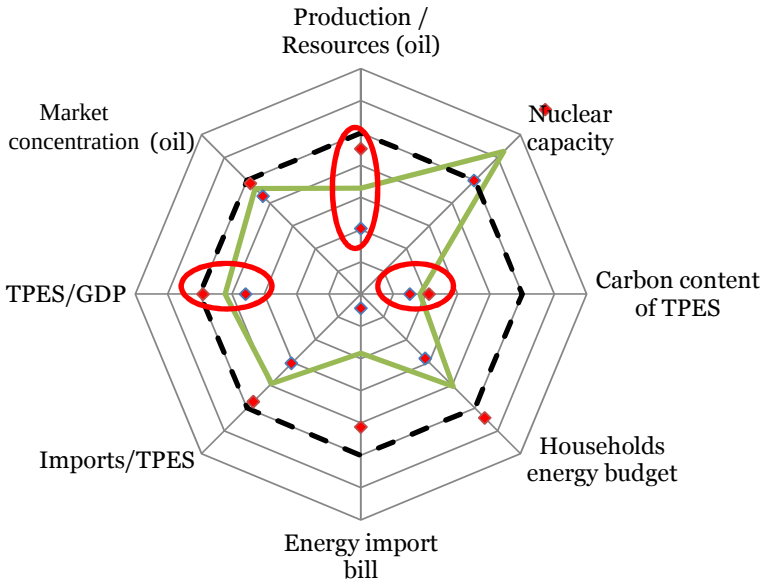
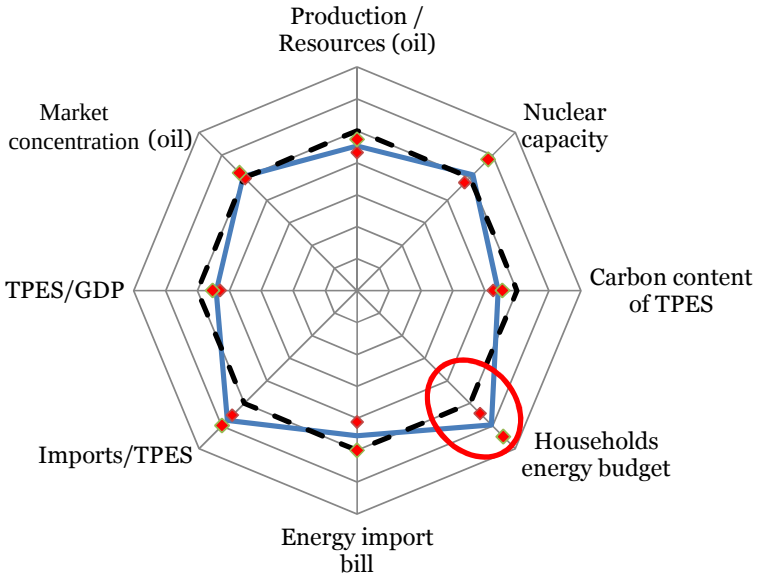


Production/resources, TPES/GDP and carbon content of TPES are always improved.

- Carbon price → substitutions and reduction of activity of fossil fuel intensive sectors

Short term



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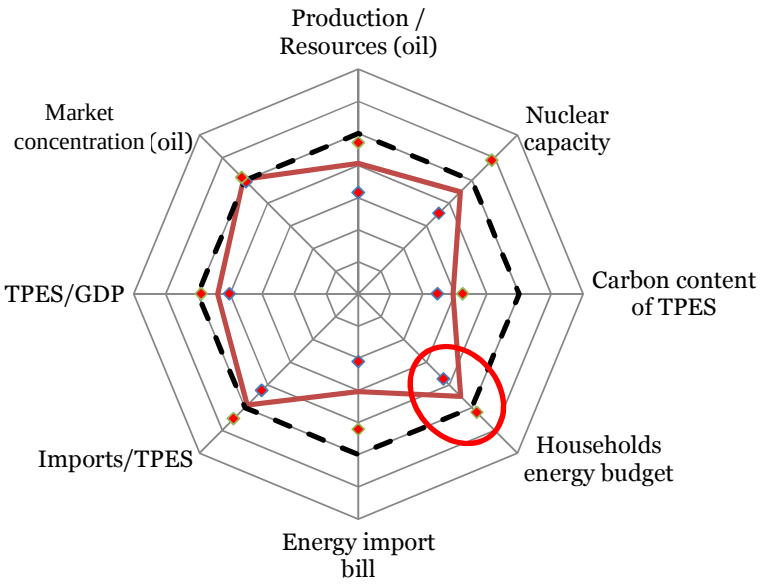

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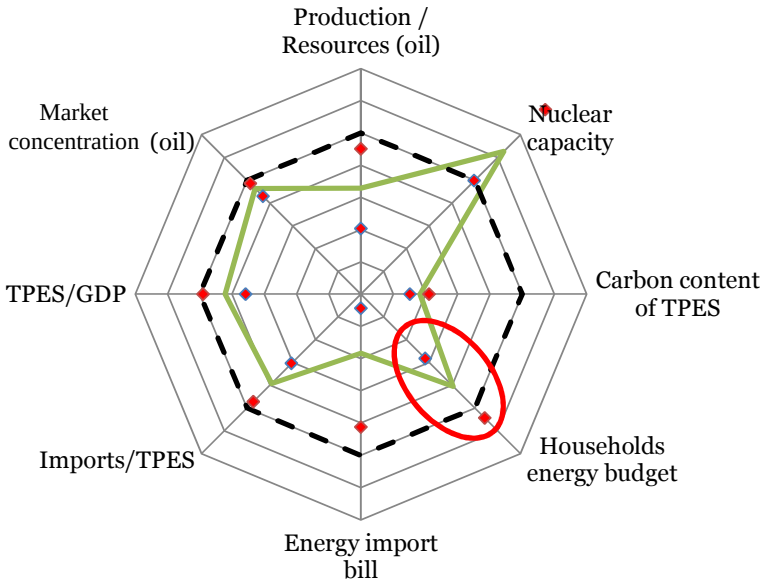


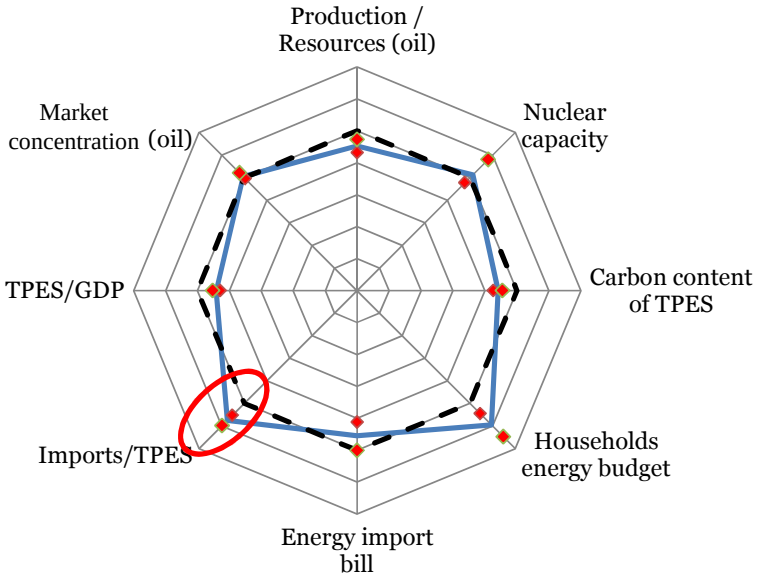
Energy share in households budget worsened on the short run…

- Inertia, higher energy prices

… but improved on the medium/long run.

- Technical change and energy efficiency

Short term



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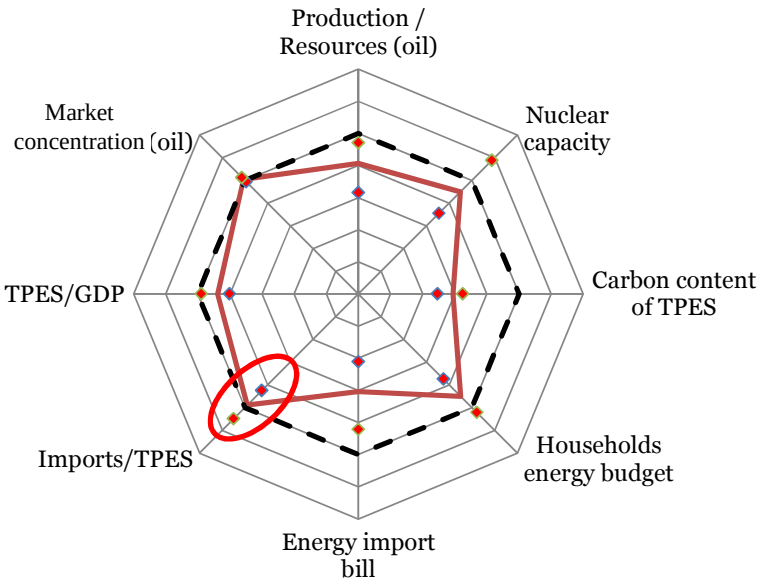

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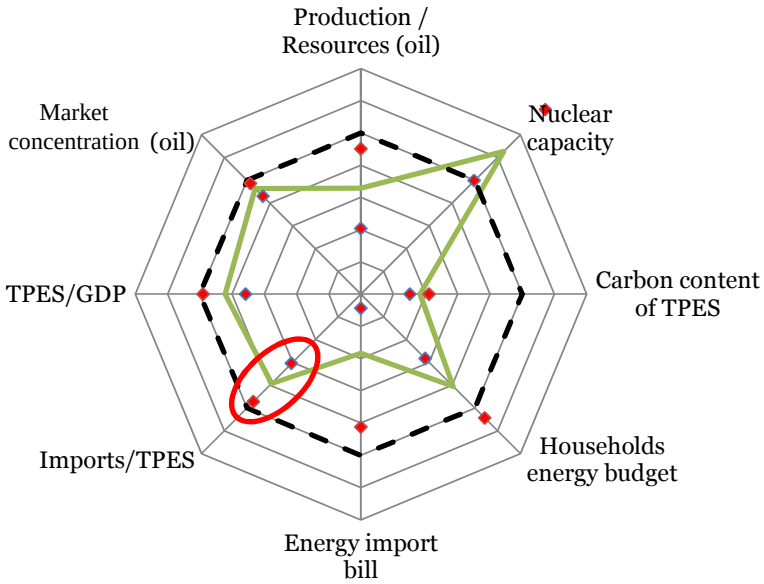
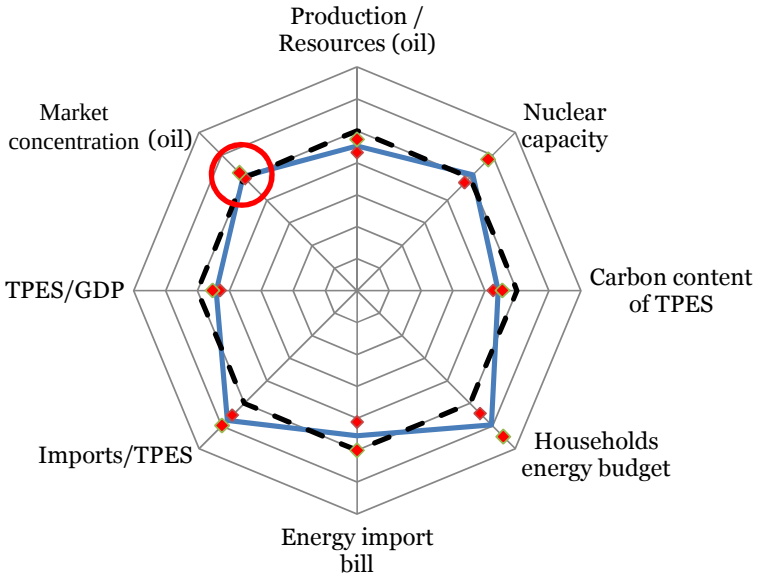


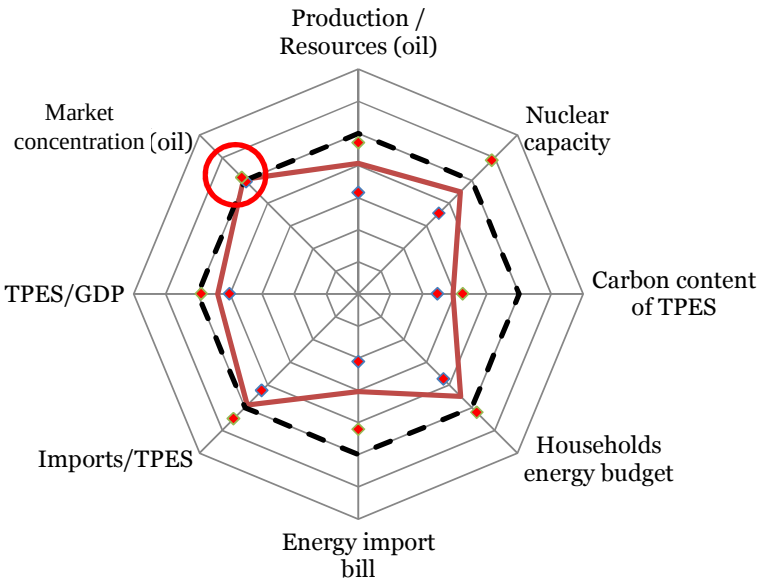
Imports/TPES worsened over the short term, but improved over the medium or long term.

- ST: substitution of coal (partly domestic) by gas (mainly imported). Role of myopic expectations (gas before renewable).
- MT or LT: increased share of renewables allows to reduce imports.

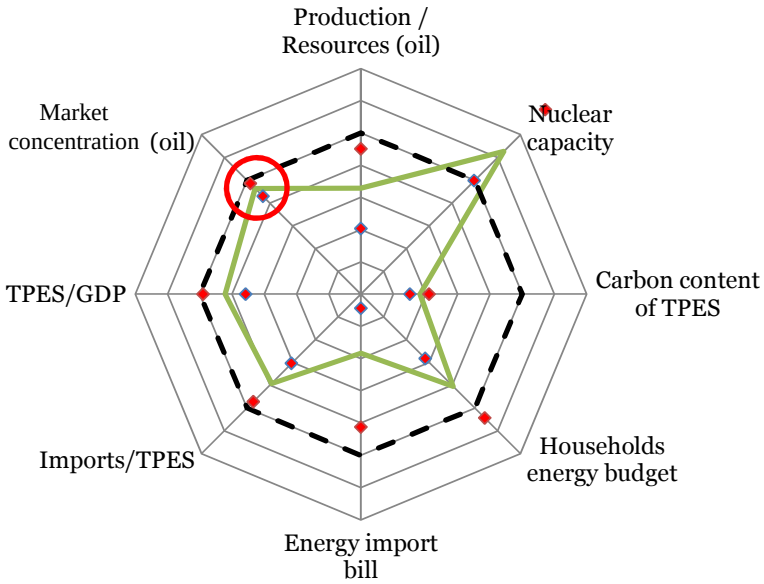
Short term



Medium term



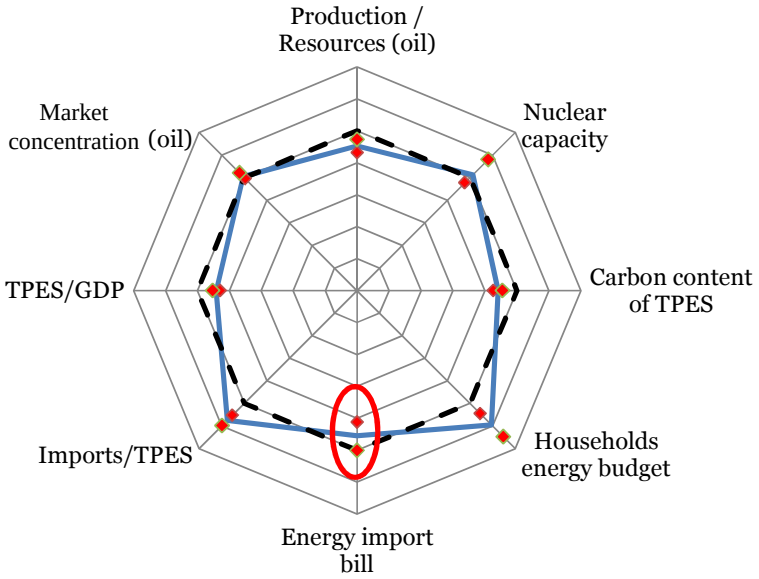
Long term



Diversity of oil imports worsened on short and medium term, improved on long term.

- Combination of lower global oil demand and lower use of unconventional oil.

Short term



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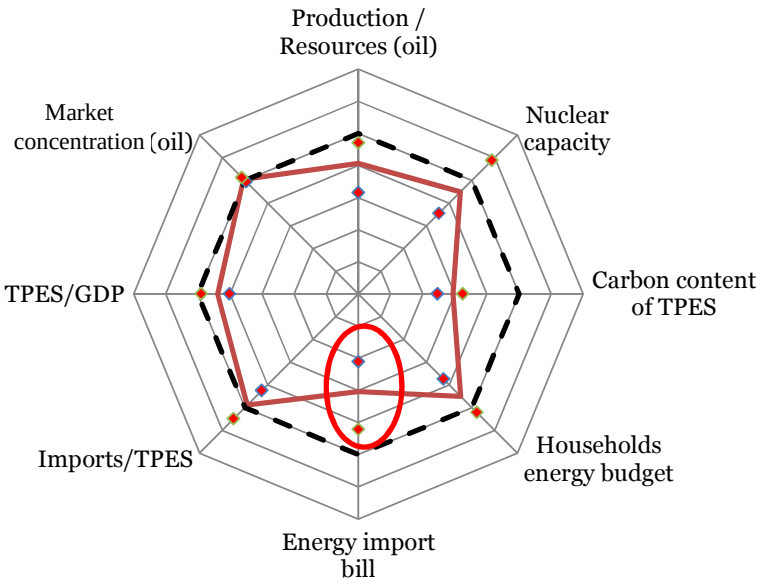

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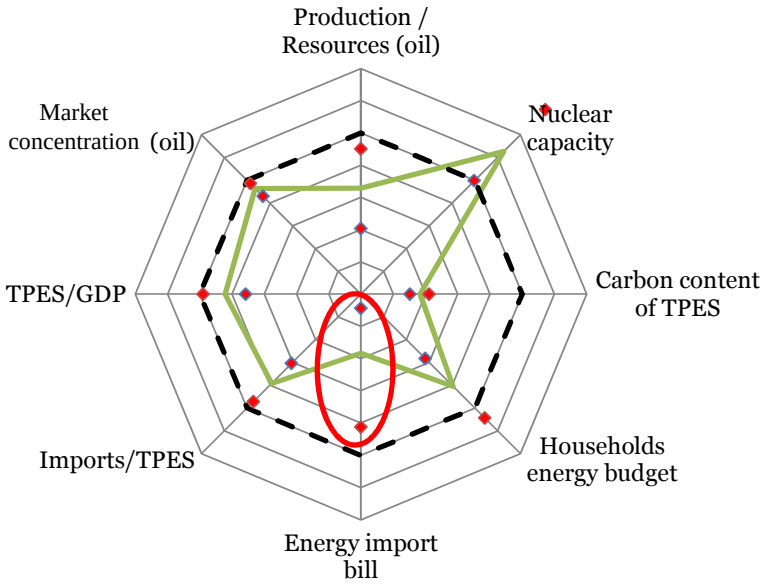
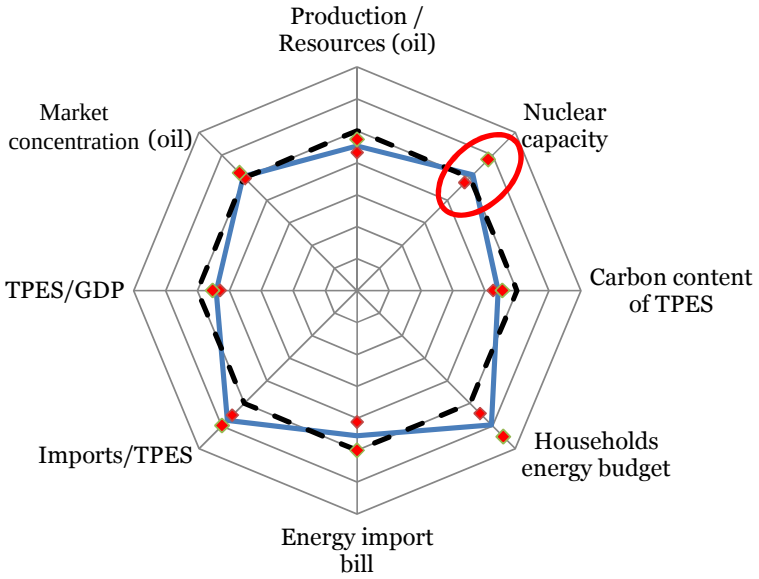


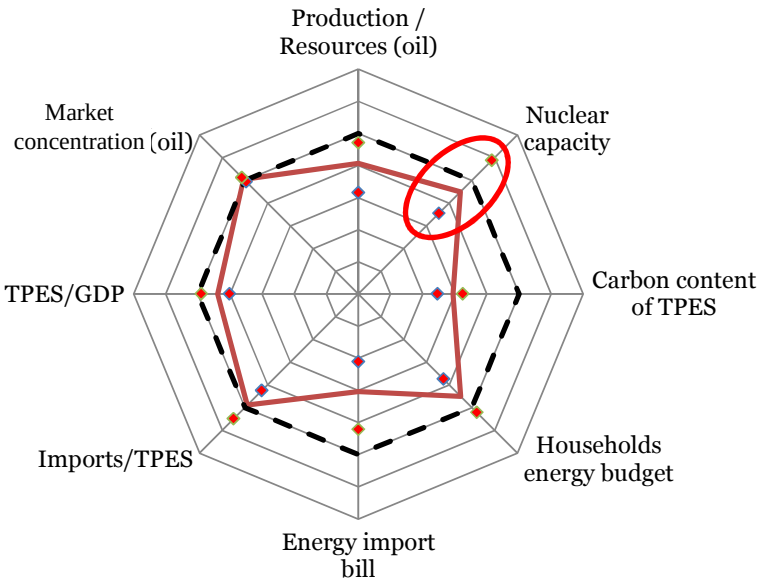
Energy import bill/GDP complex indicator, depends on interplay between climate policies effects:

- Energy imports volumes and structure between energy types,
- International energy prices,
- GDP.

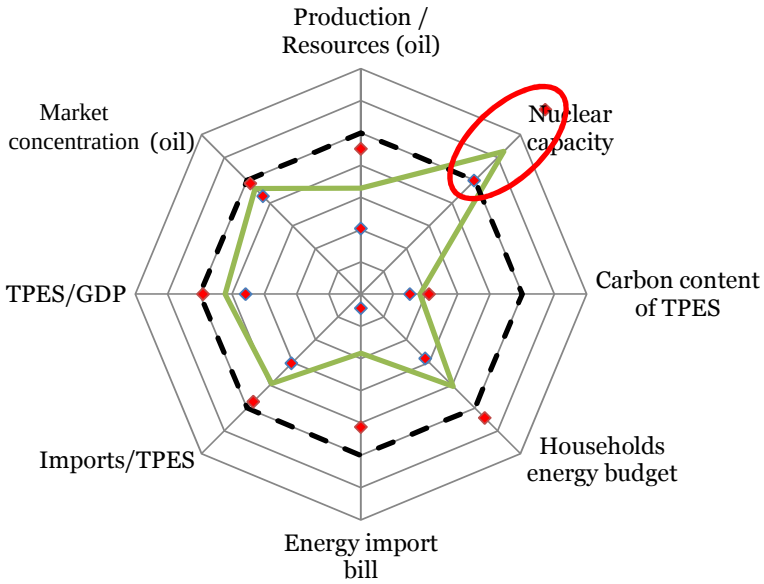
Short term



Medium term



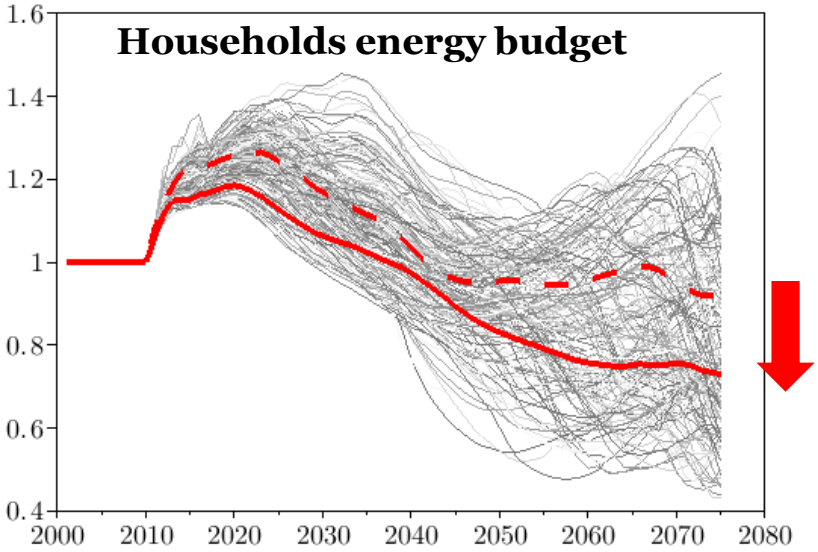
Long term

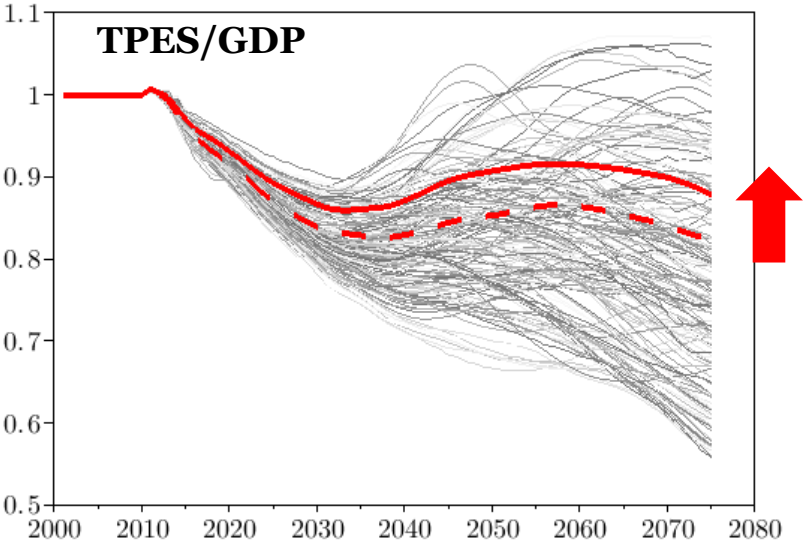


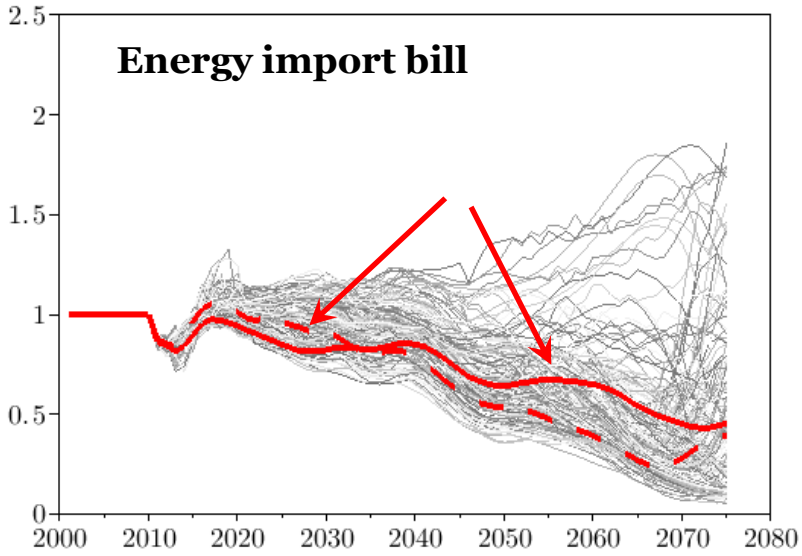
Nuclear capacities have more complex variations, resulting for the combination of effects:

- Substitutions in electricity mix (+)
- Effects on electricity demand:
  - Energy efficiency (-)
  - Substitutions (+)
  - Role of specific technologies (ex: electric vehicles)

Time trends and determining factors







Low fossil fuel reserves

High fossil fuel reserves

- Opposed effects on some indicators.
- Opposed effects across time.

Conclusion

- A methodology to explore uncertainties with a database of scenarios.
- Energy security is a polysemic concept.
- The effect of climate policy on energy security indicators depends on the time horizon considered.
- There is no unambiguous answer to the initial question, climate policy can improve some indicator while worsening others.
- Complementary policies can be necessary to reconcile both objectives
  - Risk of deterioration of the « affordability » dimension of energy security on the short term.

    → Targeted measures for modest households
  - Role of gas in the degradation of imports on the short term

    → Support policies for renewables/ measures to secure gas imports

Limits/further research

- Role of climate policies « design »
  - Unilateral policy in Europe vs. participation of other regions
  - Ambition of policies
- Role of shale gas?
- Study of the resilience to a shock on energy supply
- Comparison with other regions

Thank you for your attention.

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