CONSEIL GÉNÉRAL DE L'ÉCONOMIE
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The importance of macroeconomic assessment for energy transition

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MINISTÈRE DE L'ÉCONOMIE
ET DES FINANCES

Structure of the presentation

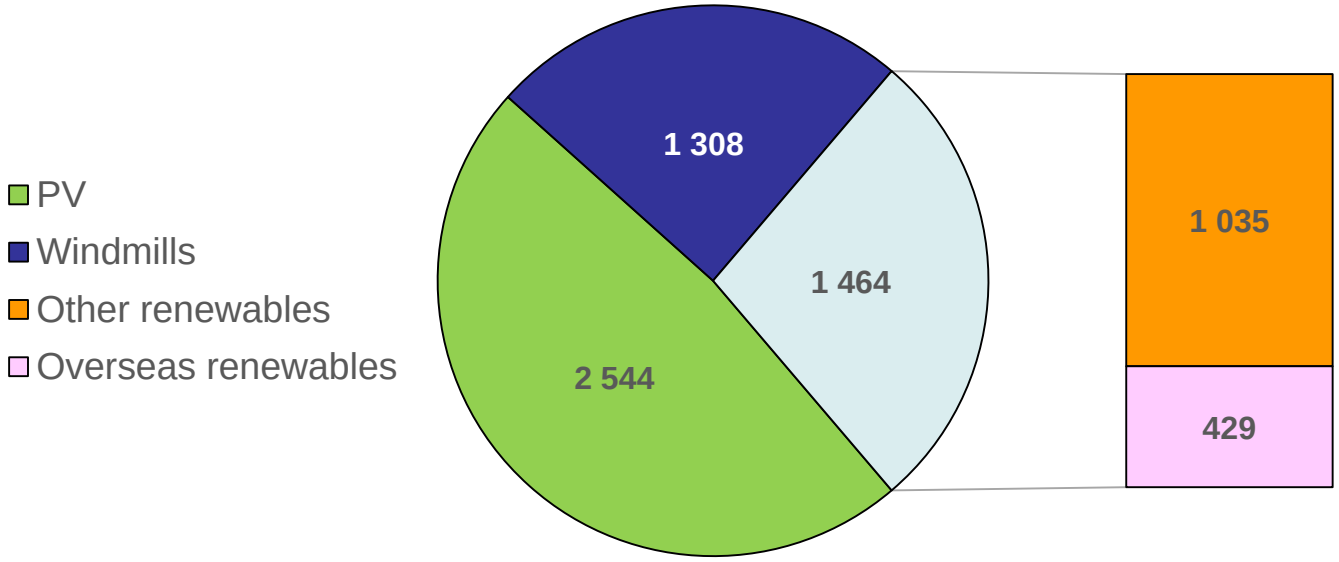
- Why macroeconomic assessment?
- The CGE project
- Main results
- Conclusion

Innovation for energy transition is financially risky on the short term - The case of the solar road (Wattway)

- **Opened on December 22nd, 2016, in Tourouvre-au-Perche (Normandie)**
  - *Built by Colas, 1 km, PV panels*
  - *5 M€ subsidies (> 3 500 €/MWh)*
- **Production weaker than expected, noisy, currently under repair, …**

Public expenses for energy transition

- **About 5 300 M€ : 2019 cost for French public service for electric renewables in France (CRE projection)**
  - *and more than 10 G€ in 2023 (according to PPE 2019)*
  - *2/3 of projected **public energy service** costs as defined by CRE (social expenses, tariff equalization, support to renewables and CHP, …)*



Source: CRE

Definition of macroeconomic assessment

- **The purpose of macroeconomics is to study the global dimensions of an economy: production (GDP), investment, consumption, unemployment rate, inflation, ..., GHG emissions, …**
  - *Some dimensions are not easy to quantify (happiness, social cohesion, …)*
  - *Some other are difficult to project (e.g. net jobs creation)*
- **Macroeconomic assessment of a dedicated policy aims to measure the impact of this policy on such global dimensions**

How can we make a macroeconomic assessment?

- **Various sophisticated models may be used to make a macroeconomic assessment of national energy policies …**
  - *Three-ME (ADEME-OFCE)*
  - *NEMESIS (Seuréco-ERASME, Ecole Centrale de Paris)*
  - *MESANGE (MEF-DG Trésor)*
  - *GEM-E3 (NTUA, Athens)*
  - *IMACLIM (CIRED), etc.*
- **… even if their results are not convergent and comparisons are difficult**
  - *More academic research is needed*
    - See for instance “Phillips curves” vs. “Wage setting” debate
  - *They are relying on different set of assumptions and different reference scenarios*
  - *Results and comparisons between scenarios on jobs creation, GDP growth, etc. have to be taken with caution*

CGE Project

CGE decided in 2017 to assess the impact of the French energy transition

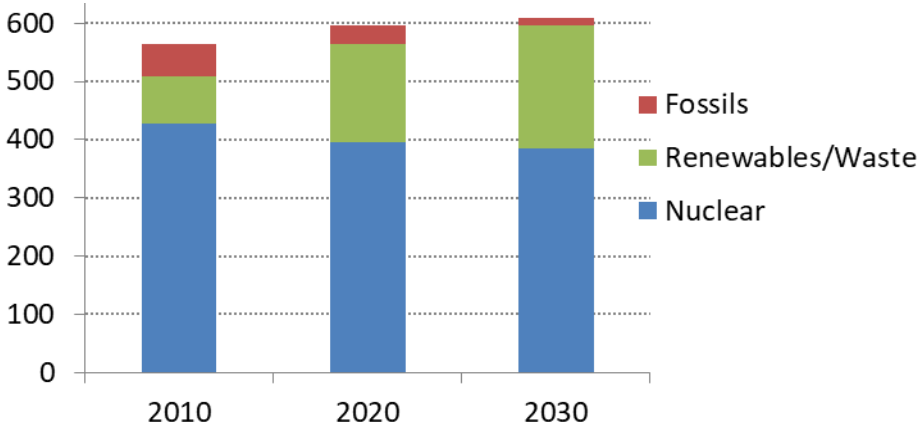
- *Assessment focused on electricity*
- *Time horizon is 2030*
- *Focus on 3 dimensions:*
  - CO2 emissions from the electricity sector
  - Power generation total cost (CAPEX, OPEX, incl. dismantling)
  - Foreign trade balance
- *Opendata from RTE for 2013-2016 (half-hourly power generation and consumption data, market prices, external trade of electricity, load factors,…)*
- *Optimization module in Excel -> robust but limited to orders of magnitude*
- *Reference energy scenario: EU reference energy scenario for France as published by the EU-Commission in 2016 (based on NTUA-Primes model)*

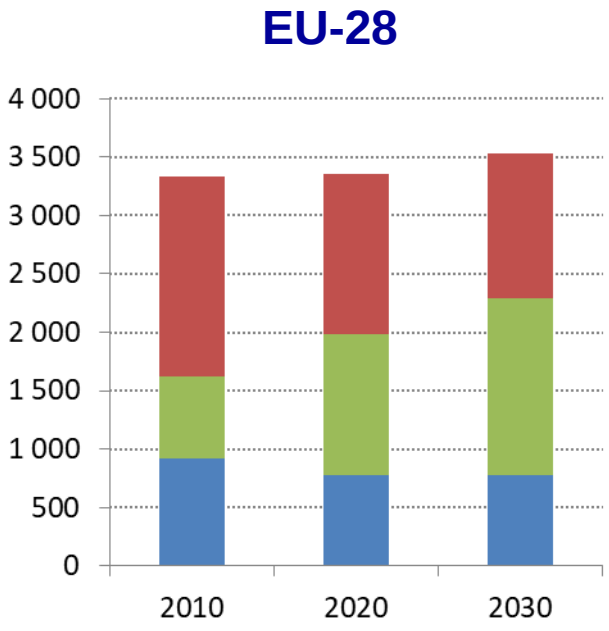
Main assumptions

- *The safety of nuclear installations in France is properly verified by ASN*
- *US dollar = 0.9 €, coal price 77 $/t, oil 52 $/bl, gas 3.1 $/MBtu, EU-ETS 5 €/tCO2*

EU Reference energy scenario (2016)

- Projection of trends up to 2050 assuming that policies adopted until end of 2014 are implemented (i.e. prior to the Paris Agreement and TECV law)
- Projection to inform about the effects of current policies - not a forecast!
- Consistent projections by Member-State and for the EU as a whole of interactions between the economy, energy, emissions and transport
- Evolution of power generation (in TWh):





CGE modelling main simulations

- **6 x 3 = 18 scenarios have been tested**

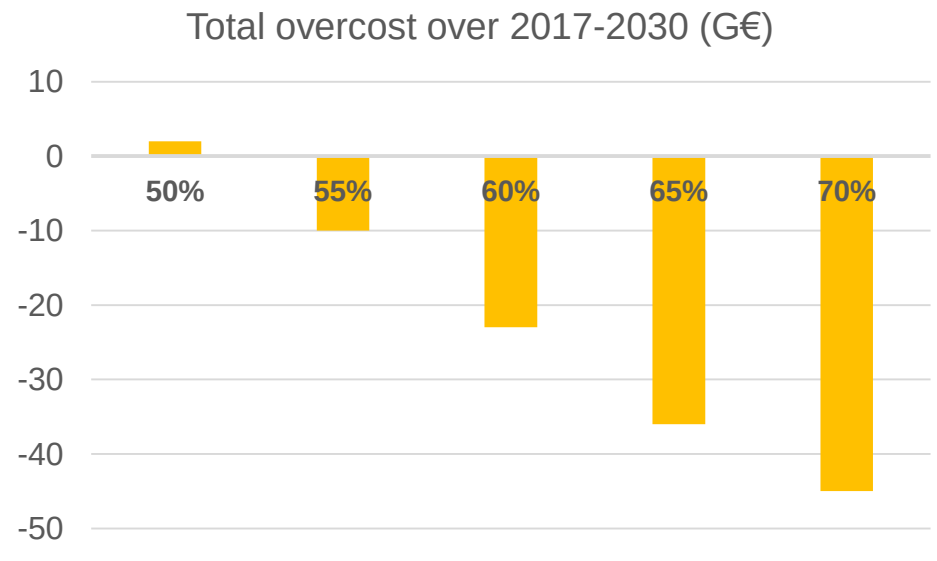
Electricity mix in 2030	Electricity consumption 2030 / 2015		
	-5%	0%	+5%
50% nuc, 40% ren, 10% therm		TECV law	
55% nuc, 35% ren, 10% therm			
60% nuc, 30% ren, 10% therm			
63% nuc, 31% ren, 6% therm			
65% nuc, 25% ren, 10% therm			
70% nuc, 25% ren, 5% therm			

- **Sensitivity analysis were conducted on EU-ETS and fossil fuel prices**

Examples of results (1/2)

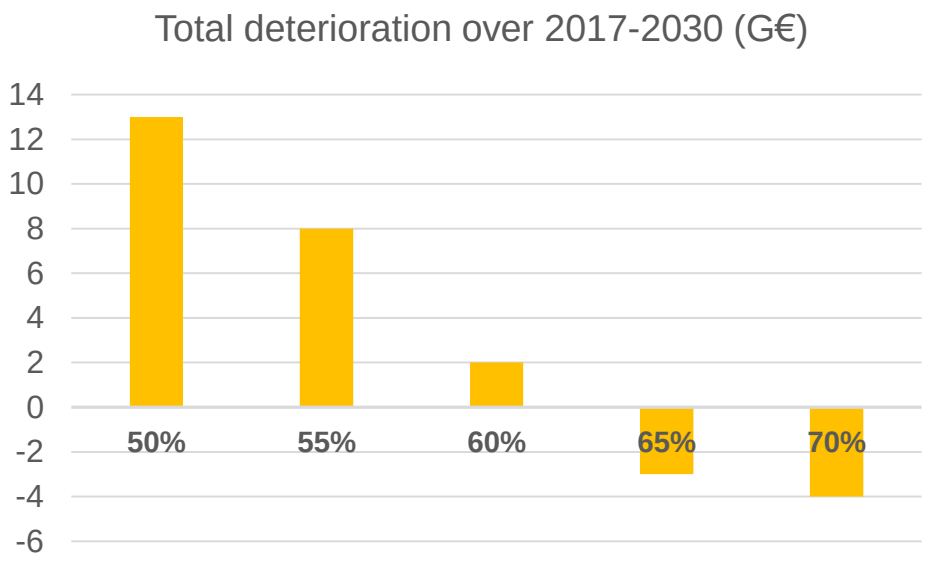
Additional levelised **COST** over 2015-2030 according to the share of nuclear in the 2025 French electricity mix

- **Compared to the reference scenario and with 0% growth assumption for the electricity demand**



Deterioration of the levelised **TRADE BALANCE** according to the share of nuclear in the 2025 French electricity mix

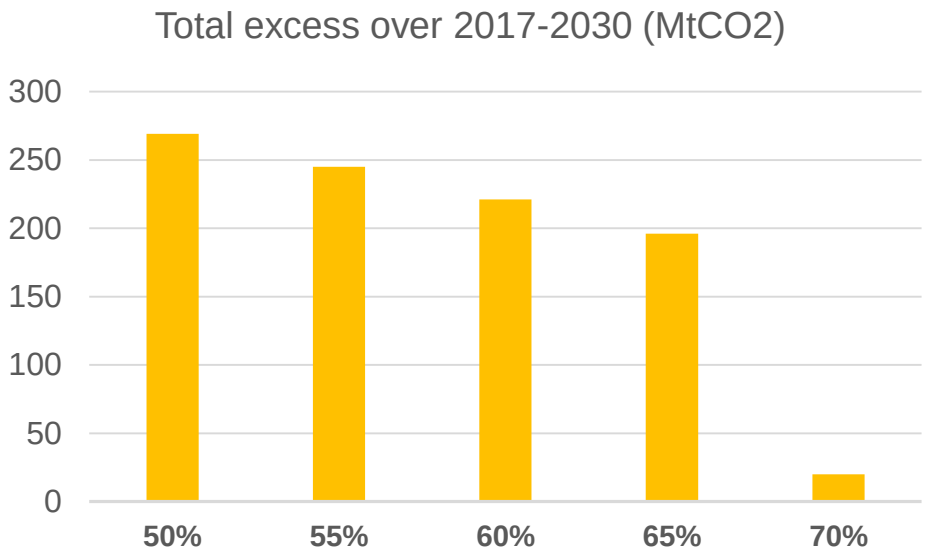
- **Compared to the reference scenario and with 0% growth assumption for the electricity demand**



Examples of results (2/2)

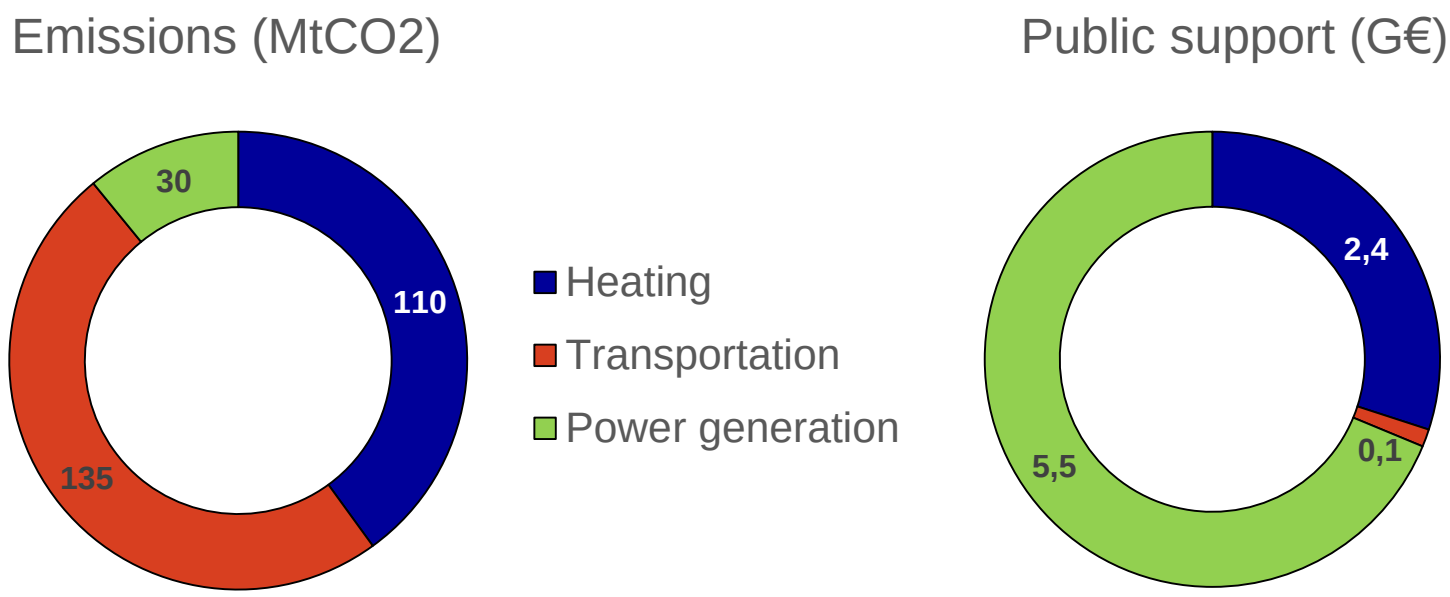
Increase of CO2 EMISSIONS according to the share of nuclear in the 2025 French electricity mix

- **Compared to the reference scenario and with 0% growth assumption for the electricity demand**



Further analysis: from the electricity transition to the energy transition

- **Priority could be granted to some key sectors and actions in order to:**
  - *Maximize CO2 reduction with a limited public spending*
  - *Limit external trade deficit*
- **Comparison between emissions and actions on 3 sectors:**



Source: CGE calculations (order of magnitude)

Main conclusions (1/2)

- **Without countermeasures, the increase of the share of renewables to 40% in the French electricity mix by 2030 could lead to:**
  - *A significant reduction in the nuclear fleet (because electricity demand is flat)*
  - *An increase of gas consumption to accompany renewables entry*
- **As a consequence:**
  - *CO2 emissions of the electricity sector could be up to 160% per kWh by 2030*
  - *Total cost of power generation could be up to 50% in €/MWh by 2030*
  - *The external trade balance could deteriorate of €13 billion in cumulative additional deficit over 2017-2030*
- **Socio-economic impact (jobs, GDP) should be modelled accordingly**
  - *Not assessed in the CGE study*

Main conclusions (2/2)

- **Which evolutions for the French electricity mix?**
  - *Thanks to nuclear and hydro, French power generation is already 90% carbon-free*
  - *The current electricity mix is reliable and relatively cheap*
  - *Life extension of existing nuclear plants, provided ASN approval*
  - *This is in agreement with the new PPE (currently under discussion)*
- **Priorities to decarbonise the French economy should go to:**
  - *Research and innovation + industrialisation in clean energy*
  - *Carbon footprint (supply chain incl.)*
  - *Dwelling, transportation and agriculture*

Thanks for your attention !

More details in an article of Annales des mines, R&E, January 2019 (N. Govillot, R. Lavergne, F. Valérian):
http://www.annales.org/re/2019/resumes/janvier/03-re-resum-FR-AN-janvier-2019.html#03FR

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