

Energy transition and the price of carbon in Europe

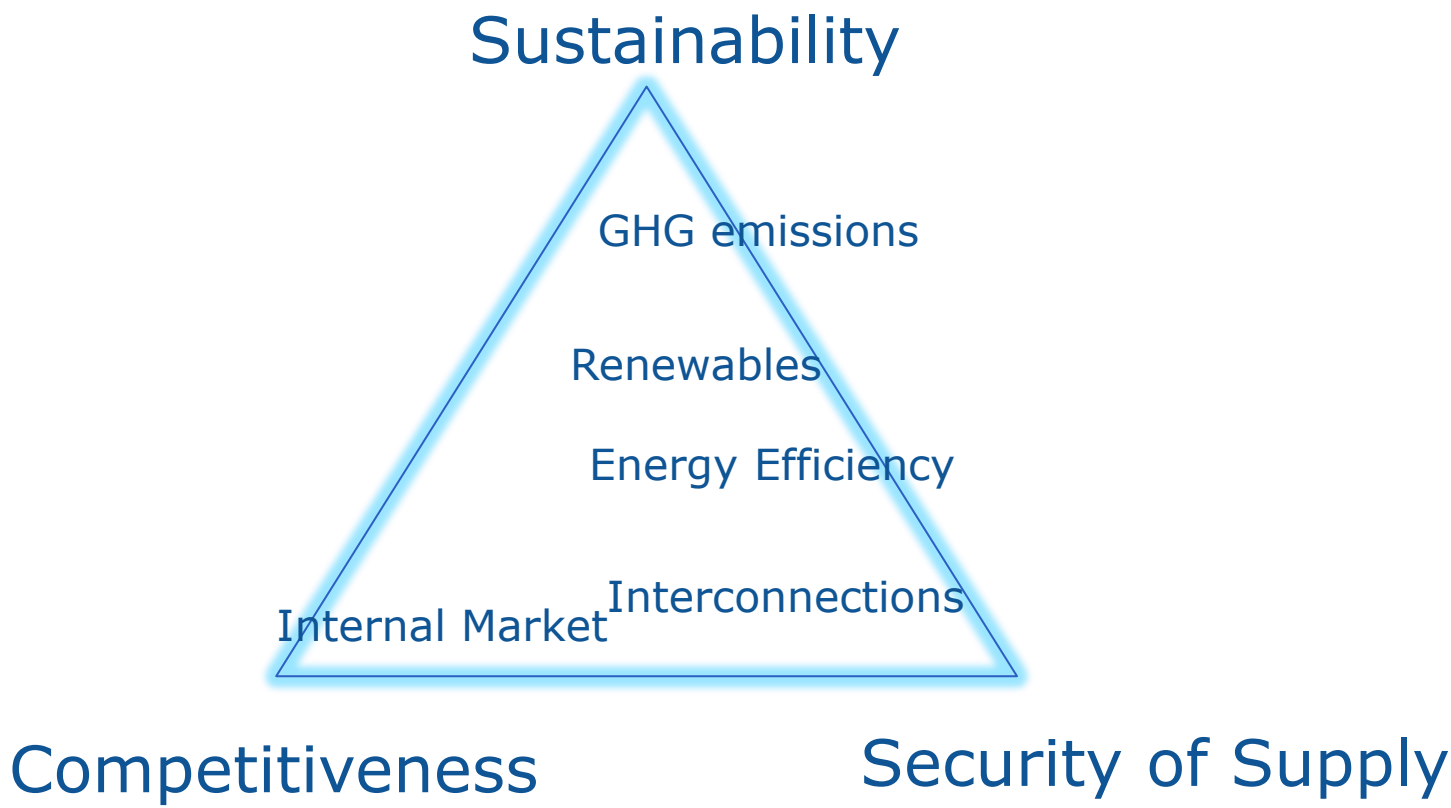
Dr Frédéric Reynès, TNO, OFCE

Mexico, 29/04/2015

- A. Energy transition in Europe**
- B. Transposition of the EU framework to France**
- C. Price of carbon: how to make it work?**
- D. An evaluation for France with the ThreeME**

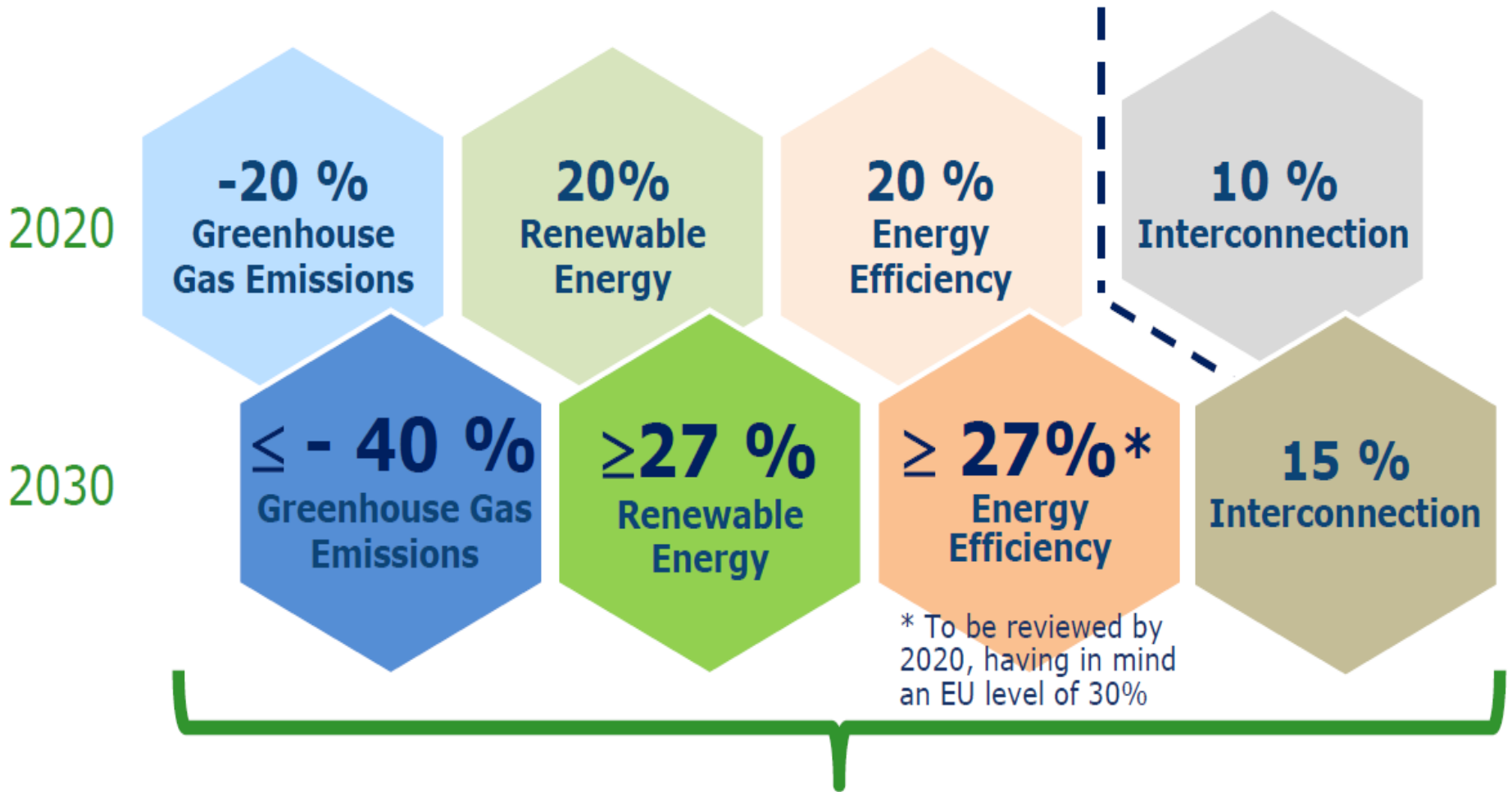
A. Energy transition in Europe

Balancing three objectives



Agreed headline targets

2030 Framework for Climate and Energy



New governance system + indicators

EU Policy Framework for 2020

- **Three Targets on Climate Change and Energy**
 - 20% reduction in total EU greenhouse gas emissions from 1990 levels by 2020
 - 20% share of renewable energy sources in gross final energy consumption by 2020
 - 20% improvement in the EU's energy efficiency by 2020
- **Interconnection**
 - 10% interconnection of their installed electricity production capacity by 2020
- **Internal Market**
 - Unbundling of monopolistic (transmission) and competitive (production/supply) activities (since 2011)
 - Stronger powers and independence of national energy regulators

B. Transposition of the EU framework to France

- **Targets**
- **Economic instruments**
- **Regulatory measures**
- **Transport and energy network infrastructures**

Key agreements and laws

- **1997 : Kyoto Protocol (constraining since 2005)**
 - Reduce greenhouse gas emissions of **5 % between 2008 and 2012, compared to 1990** for Annex B countries : objective of -8% for UE15
- **2005 : law POPE (planning law setting orientations for energy policy)**
- **2007 : Grenelle de l'Environnement ("Grenelle of the Environment")**
 - 2009-2010: planning laws Grenelle I and II set objectives to tackle the global warming, preserve biodiversity and reduce pollutions, including for example standards for building and transport
 - Other measures set by following financing laws (CIDD, Eco-PTZ, ...)
 - Enhance R&D on energy
- **2012-2013 : National debate on energy transition**

The National Debate on Energy Transition

- The new orientations in French energy policy have been prepared by a **deliberative process** (2013-I) with:
 - A coordination committee
 - A National Council (7x16 members from NGOs, Trade-Unions, Business, MPs, Mayors...)
 - A citizen and an industry group
 - A group of 45 experts in charge of producing relevant and validated analytical materials, including 16 representative scenarios...

French objectives defined in the “Law on Energy Transition for a Green Growth”

- **Greenhouse gas emissions:**
 - - 40 % between 1990 and 2030
 - - 75 % between 1990 and **2050**
- **Energy intensity: - 2,5 %/year up to 2030**
- **Final energy consumption: - 50 % between 1990 and 2050**
- **Total fossil energy consumption: - 30 % between 2012 and 2030**
- **Nuclear share in electricity production: 50 % in 2025**
- **Renewable share in final energy consumption:**
 - 23 % in 2020
 - 32 % in 2030: 40 % for electricity, 38 % for heat, 15 % for fuels, 10 % for gas
 - Renewable and recycled heat and cold: x 5 in 2030
- **Building thermal refurbishment: 500 000 housings / year**
- **Charging points for electric vehicles: 7 000 000 in 2030**
- **Ambitious objectives when compared to historical trends**

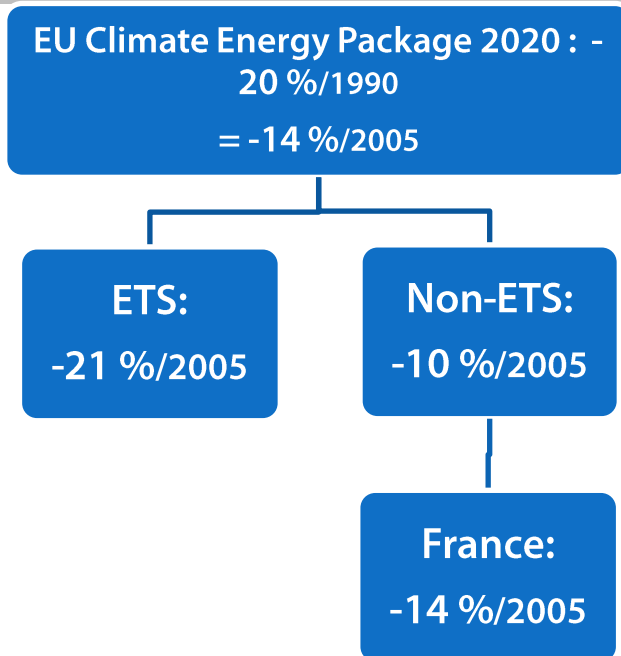
France's emissions targets and results

Non-ETS 2020 target for France:

-14 % / 2005

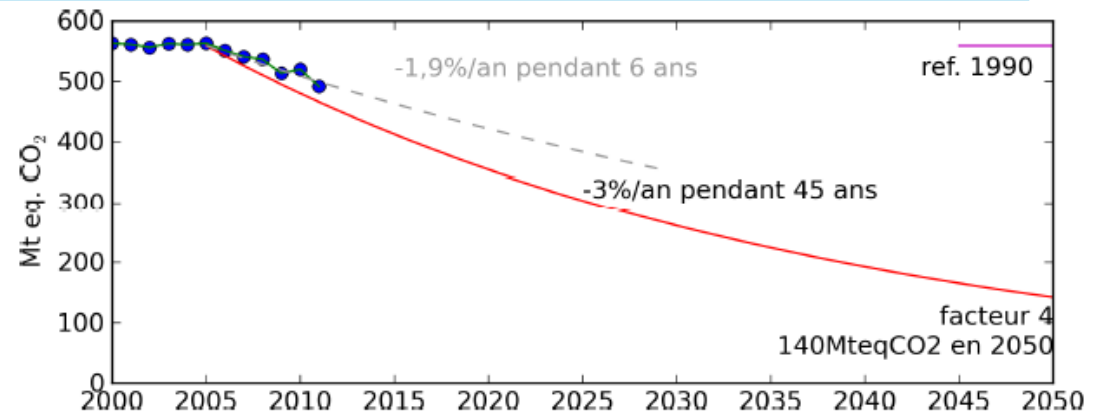


France's emissions reductions in 2012 :
- 8 % / 2005



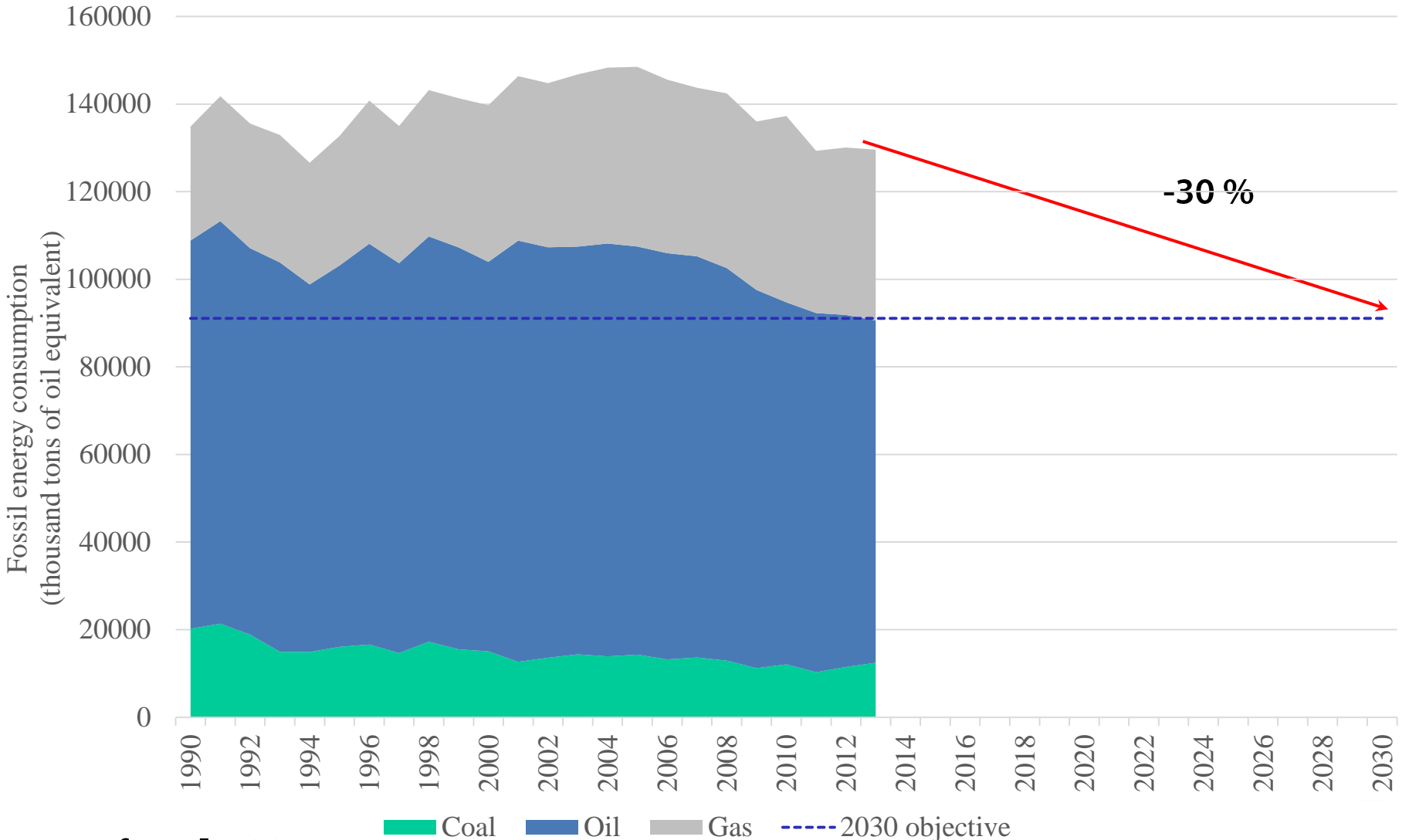
Source: SOES/DGEC

France's own objective (inscribed in national law):
to divide by 4 its GHG emissions between 1990 and 2050, through an annual decrease of 3% on average



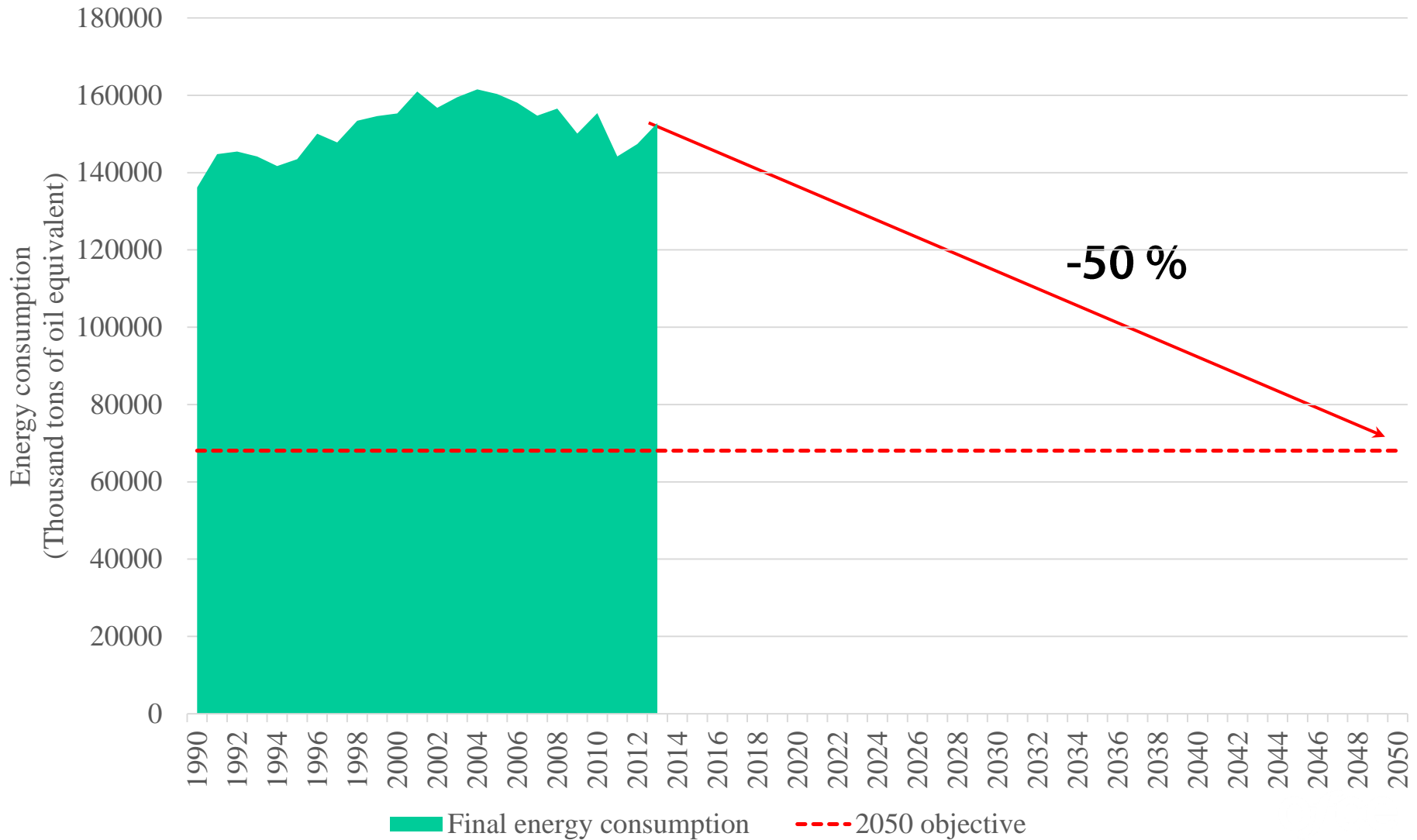
Source: DGEC

Objectives: Reducing fossil energy consumption



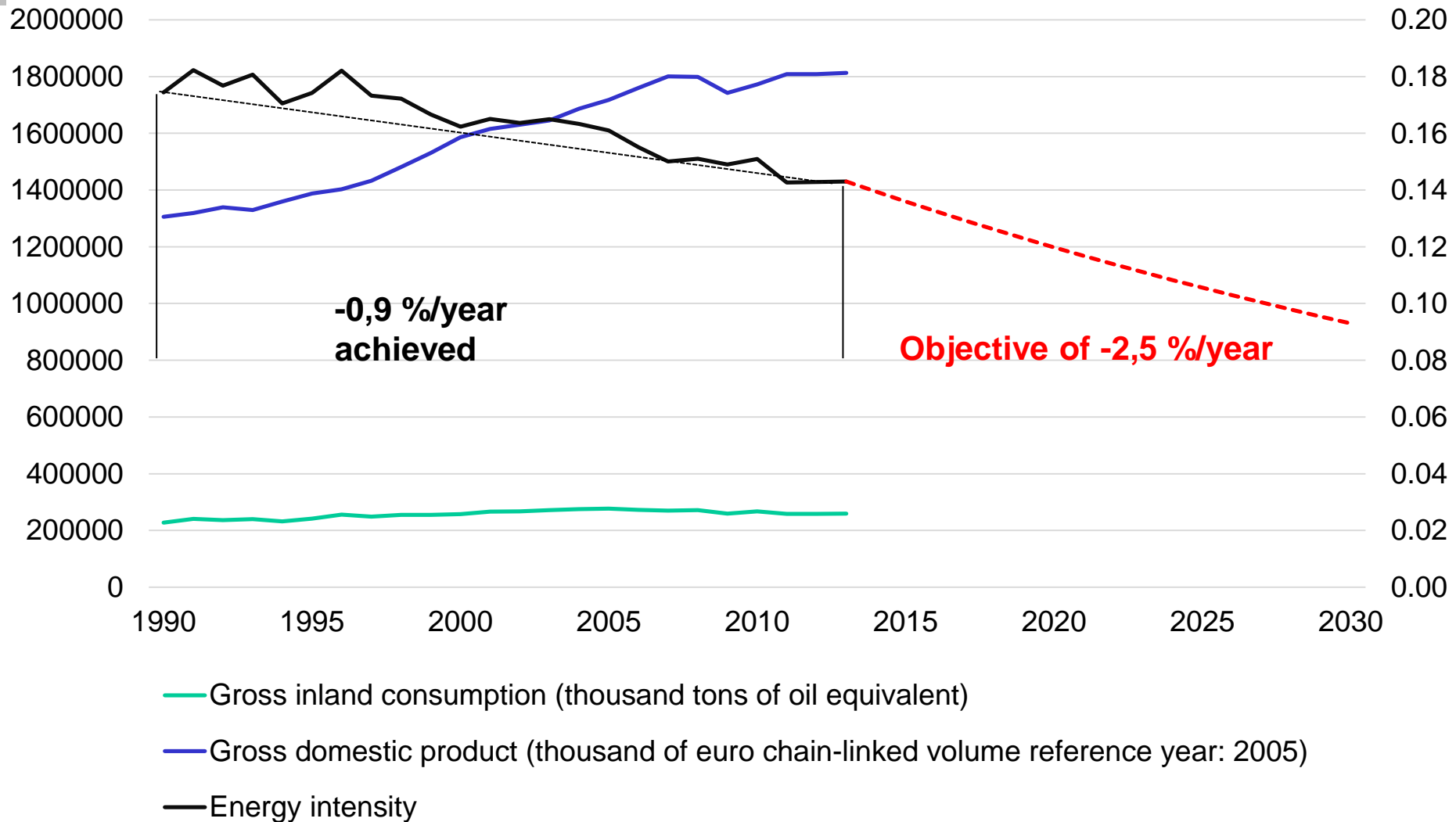
Source: Eurostat

Objectives: Reducing final energy consumption



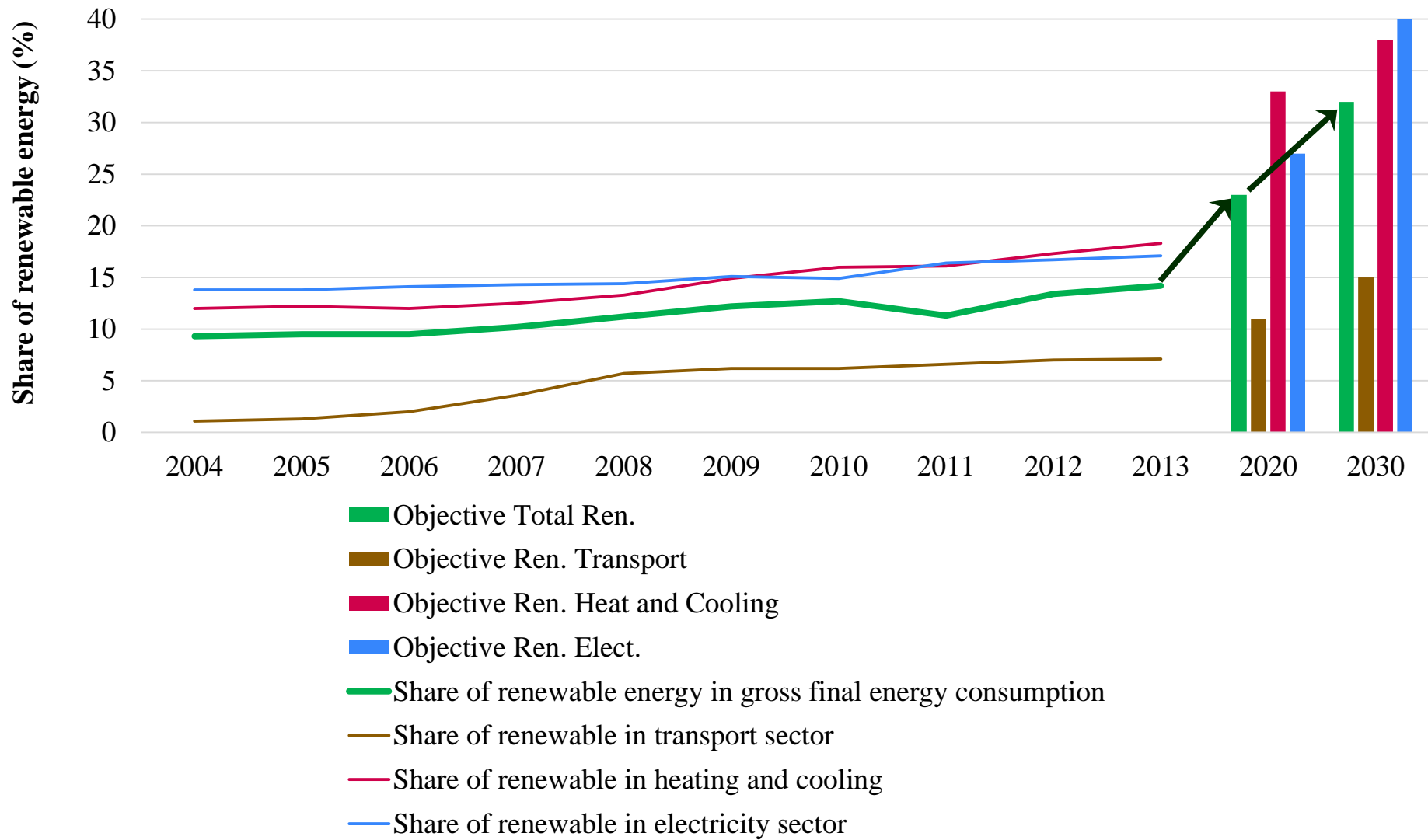
Source: Eurostat

Objectives: Energy intensity



Source : Eurostat

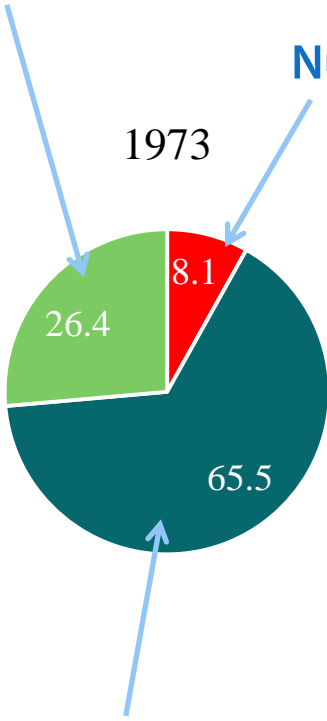
Objectives: Increase renewable share in the energy mix



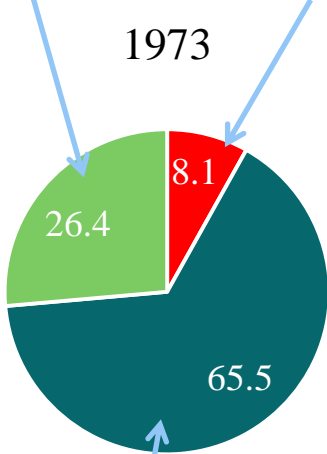
Objectives: nuclear & renewable in electricity generation

Renewables (hydro, wind, solar)

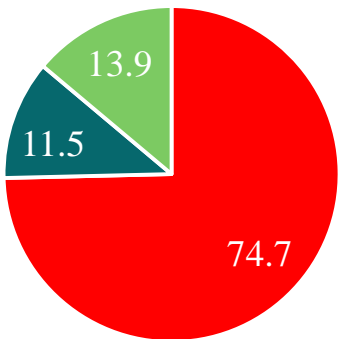
Nuclear



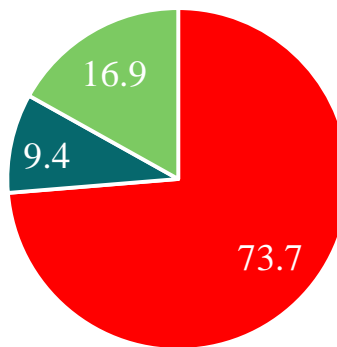
Fossil



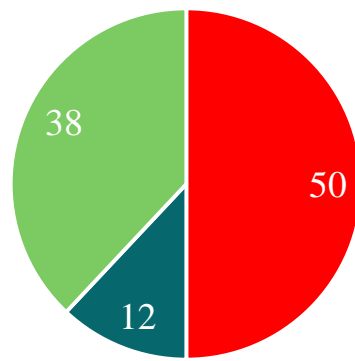
1990



2013



2030



Source : SOeS

B. Transposition of the EU framework to France

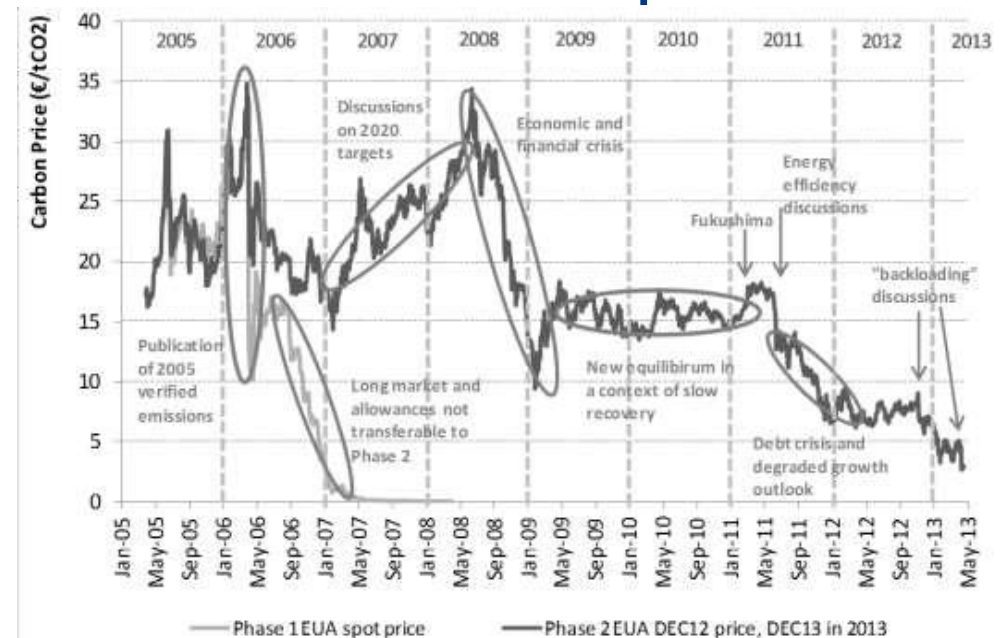
- **Targets**
- **Economic instruments**
- **Regulatory measures**
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The EU-ETS

- The **European Union Emission Trading Scheme** was set up to help the Member States achieve their targets by capping CO₂ emissions from the main emissions-producing industries.
- **Three phases:** 2005-2007 (launch period), 2008-2012 (second phase and first Kyoto Protocol commitment period), 2013-2020 (new European target set by the 2009 Climate and Energy Package)

- ▶ **Sectors under EU-ETS cover around 45% of the EU's greenhouse gas emissions (2013)**
- ▶ **It is possible to trade quotas, on the basis of a constant maximum allocation (Bilaterally or spot/forward)**

▶ Evolution of price



Carbon tax

- A CO₂ tax with an increasing path:



- ▶ Introduced on April 1, 2014 on use of gas, heavy fuel oil, and coal; extended to transport fuels and heating oil from 2015 onwards
- Taxation based on the carbon content of each fossil energy, added to the existing energy taxes (as a new component)
- Liables:
 - Applied to domestic use of energy products
 - Exclusion of the plants registered to the EU ETS
- In 2015 : carbon tax of ~4c€/L of fuel and 2,64€/MWh of gas
→ ~90€/year/household (30 € for transport and 60 € for heating)

Energy saving certificates (1/2)

- Created by the POPE law (2005)
- **Energy suppliers are committed to hold a certain number of energy certificates by promoting energy saving to their clients (households, companies, public institutions).** A 3-year goal is defined and spread among the suppliers according to the volume of their energy sales.

They can either:

- Achieve themselves certificated energy savings
- Buy certificates to non-committed actors (current price ~ 0,003 €/kWh cumac)
- Pay a penalty 0,02 €/kWh cumac

■ Objectives :

- 2006 – 2009: 54 TWh cumac (= cumulative and actualized)
- 2011 – 2013: 345 TWh cumac (achieved at the beginning of 2013)
- 2015 – 2017: 700 TWh cumac (~ 2Bn€ at current price)

Energy saving certificates (2/2)

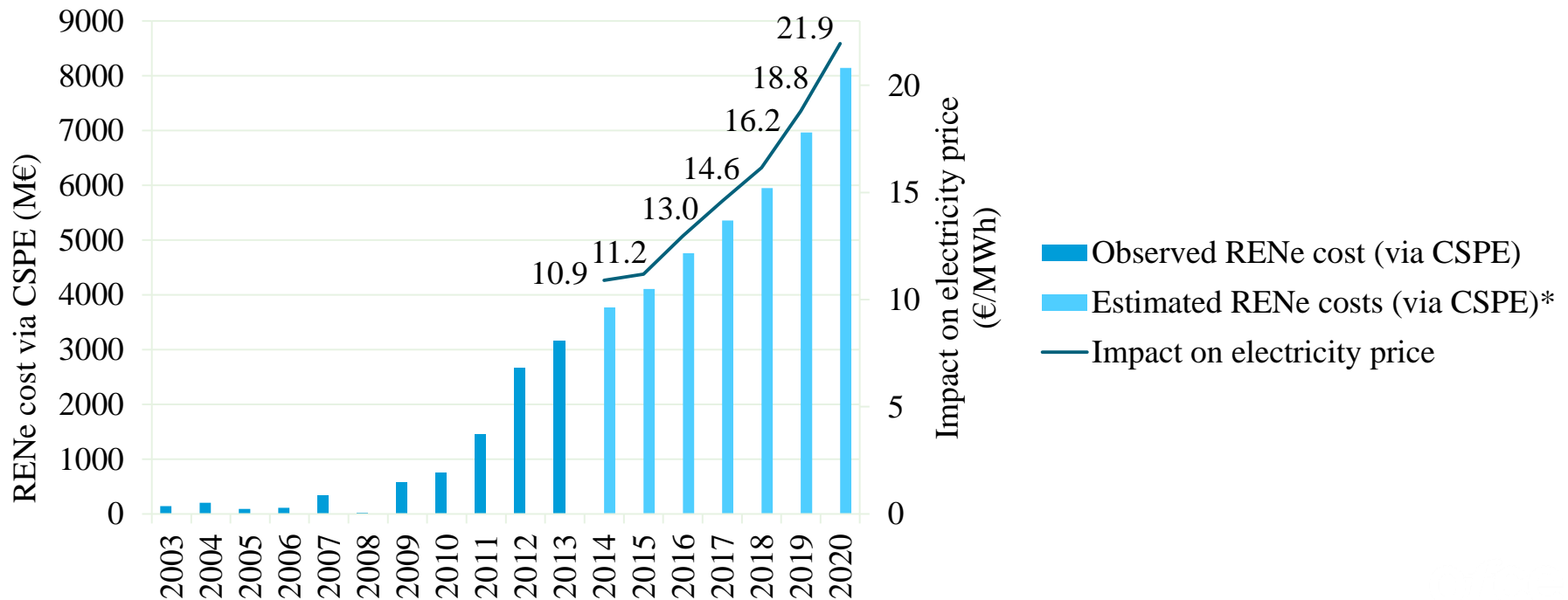
- Eligible energy saving actions (building, heating, equipment, services...) are defined for 6 sectors:
 - Agriculture
 - Residential building
 - Tertiary building
 - Industry
 - Networks (heat/cold, exterior lighting and electricity)
 - Transport

- **Examples**
 - Building: insulation of the roof or attic space, isolation of the walls...
 - Heating: heat pump, solar water heater...
 - Equipment: LED light...
 - Service: energy management system...

Renewable energy subsidies (1/3)

■ Feed-in tariff to support renewable electricity generation : electricity bought at fixed price to renewable producer by EDF

- Contracts granted through tenders or on demand
- Difference between feed-in tariff and market price supported by consumers (CSPE : Contribution au Service Public de l'Electricité)
 - ~ 4 Bn€ for 2015 i.e. ~7 % of consumer electricity bill and 7,6 Bn€ for 2020

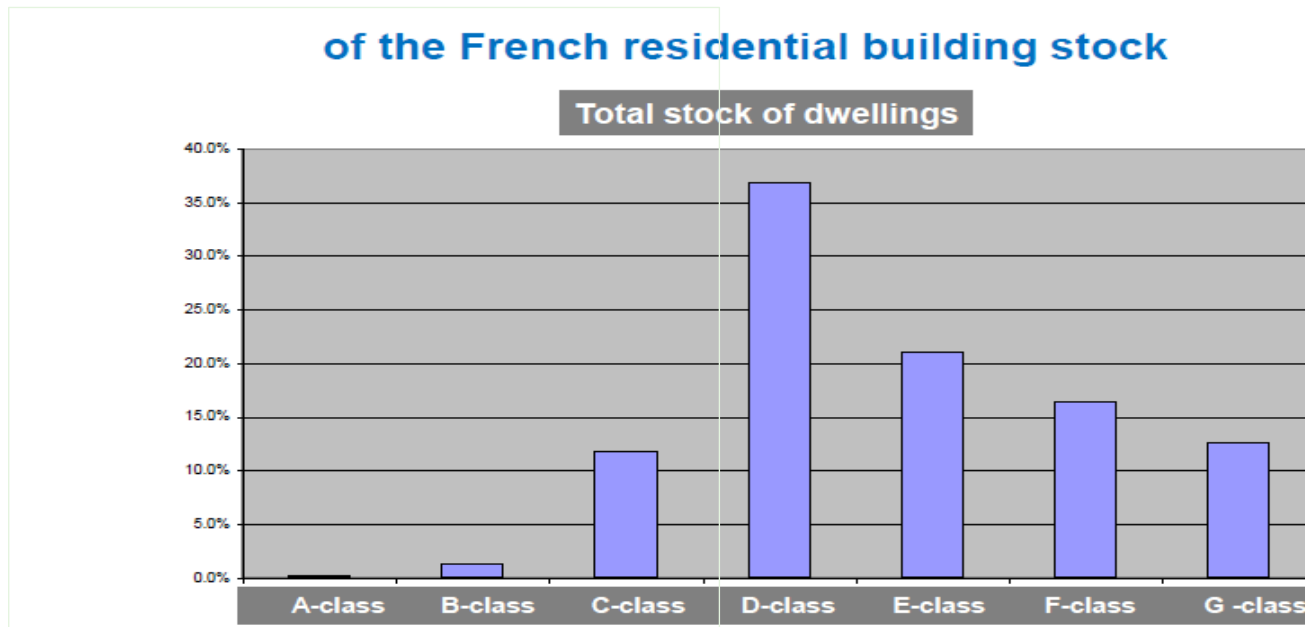


Source : Commission de Régulation de l'Energie and DGTrésor calculation

Public support for building renovation (housing) 1/2

- Energy consumption of buildings represents a large share of GHG emissions (**42% of France final energy consumption** in 2013)
- Investments in energy efficiency of buildings is a top priority for emissions abatement

Energy performance distribution of the French residential building stock



Source: Ademe

Public support for building renovation (housing) 2/2

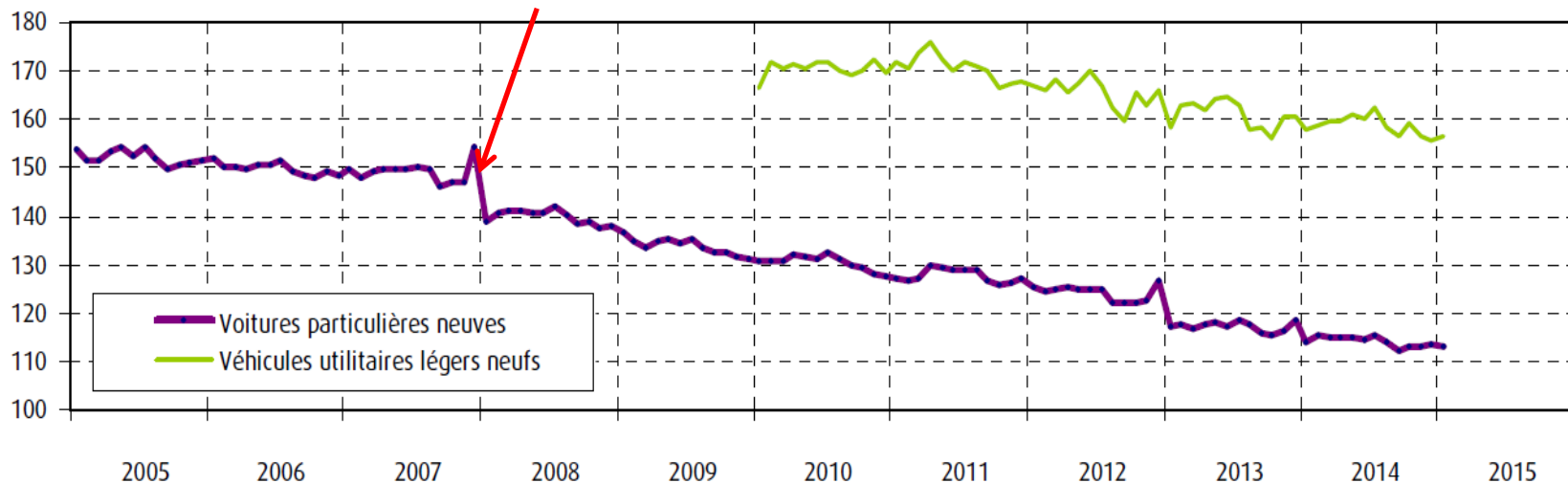
- ▶ **Major public subsidies for home energy efficient renovations** (insulation, high energy-performance equipment):
 - ◆ *Zero rated eco-loan (eco-PTZ) up to 30,000€*
 - ◆ *Tax credit for energy saving related works concerning the main residence (former CIDD, now CITE): 30% of private investments*
 - ◆ *Lower VAT rate (5.5%) for energy-efficient renovation works*
 - ◆ *Renovation housing program targeted at low income families: subsidies (50% of private investments), fixed allowance (€3,000 per household, previously €1,600) and micro-loans*

- ▶ **Public information desks: front offices to get personal information about energy efficient renovation works are to be implemented by each local council community**

Financial incentives for the purchase of low-emission cars

- **Ecological « Bonus-malus » scheme, enacted in 2007**
- Financial incentives for the purchase of cars with low CO₂ emissions
 - Transport: 40 % of total CO₂ emissions in 2013

Average CO₂ emissions (grams/km) for new registered vehicles (source : CGDD)



- In 2015, additional subsidy (« **superbonus** ») when the purchase of a low-emission car goes with the scrapping of an old diesel vehicle
 - **The total subsidy for the purchase of an electric car can reach 10 000€**

B. Transposition of the EU framework to France

- **Targets**
- **Economic instruments**
- **Regulatory measures (standards)**
- **Transport and energy network infrastructures**

Standards and requirements to sustainable construction

- Regulated sustainability targets for new buildings *via* thermal regulation
- Thermal regulation climate zones
 - H1 (ex. Paris): regions with continental climate
 - H2 (ex. Nantes): regions with mild climate
 - H3 (ex. Marseille): regions with Mediterranean climate
- Regulation steps of the new regulation implemented in 2012 (RT 2012)
 1. New constructions (housing and tertiary):
 - average energy performance 50 kWh_{ep}/m²/year (depending on the climate zone)
 - energy consumption cap-level
 2. Renovation of buildings built after 1948:

More than 1000 m², for major renovation: global energy performance targeted



Other case: element-by-element minimum performance levels

Emission caps for polluting plants

- European directive 2010/75/UE imposes to limit air pollutant emissions from **large combustion plants, waste incineration or co-incineration plants, and other polluting plants**
 - Sulfur dioxide (SO₂)
 - Nitrogen oxides (NO_x)
 - Particulate matter (PM)

- Article 55 of the draft law for energy transition allows to set a carbon dioxide emission cap for some thermal power plants.

Emission caps for vehicles

European emission standards set limits for exhaust emissions of new vehicles registered in EU member states:

- **Average CO₂ emission objectives:**
 - 95 gCO₂/km in 2021 for private cars
 - 147 gCO₂/km in 2020 for light commercial vehicles

- **« Euro » directives set limits for other exhaust emission pollutants:**
 - Nitrogen oxides (Nox)
 - Total hydrocarbon (THC)
 - Non-methane hydrocarbons (NMHC)
 - Carbon monoxide (CO)
 - Particulate matter (PM)

Biofuel blending mandate

- As part of the Energy-Climate package: intended purpose of 10% renewable energy in transport by 2020.

- French national implementation for 2014, minimum biofuels threshold :

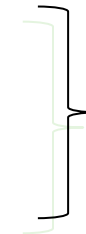
7,7% for diesel

7% for the petrol sector

+ Within the limit of 7% 1st generation biodiesel

+ Indicative target of 0,5% advanced biofuels

benefiting from double counting



**Inclusion of
ILUC effect**

- 2 support tools

- Partial exoneration of TICPE (domestic consumption tax on energy products) - ending in 2016
- Exoneration of TGAP (general tax on polluting activities) if minimum thresholds are met

B. Transposition of the EU framework to France

- **Targets**
- **Economic instruments**
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Investments in energy infrastructures

- **Reinforce electricity transport and distribution network in order to connect new renewable electricity production facilities**
 - Onshore wind turbines
 - Solar panels
 - Offshore wind turbines and marine renewable energies

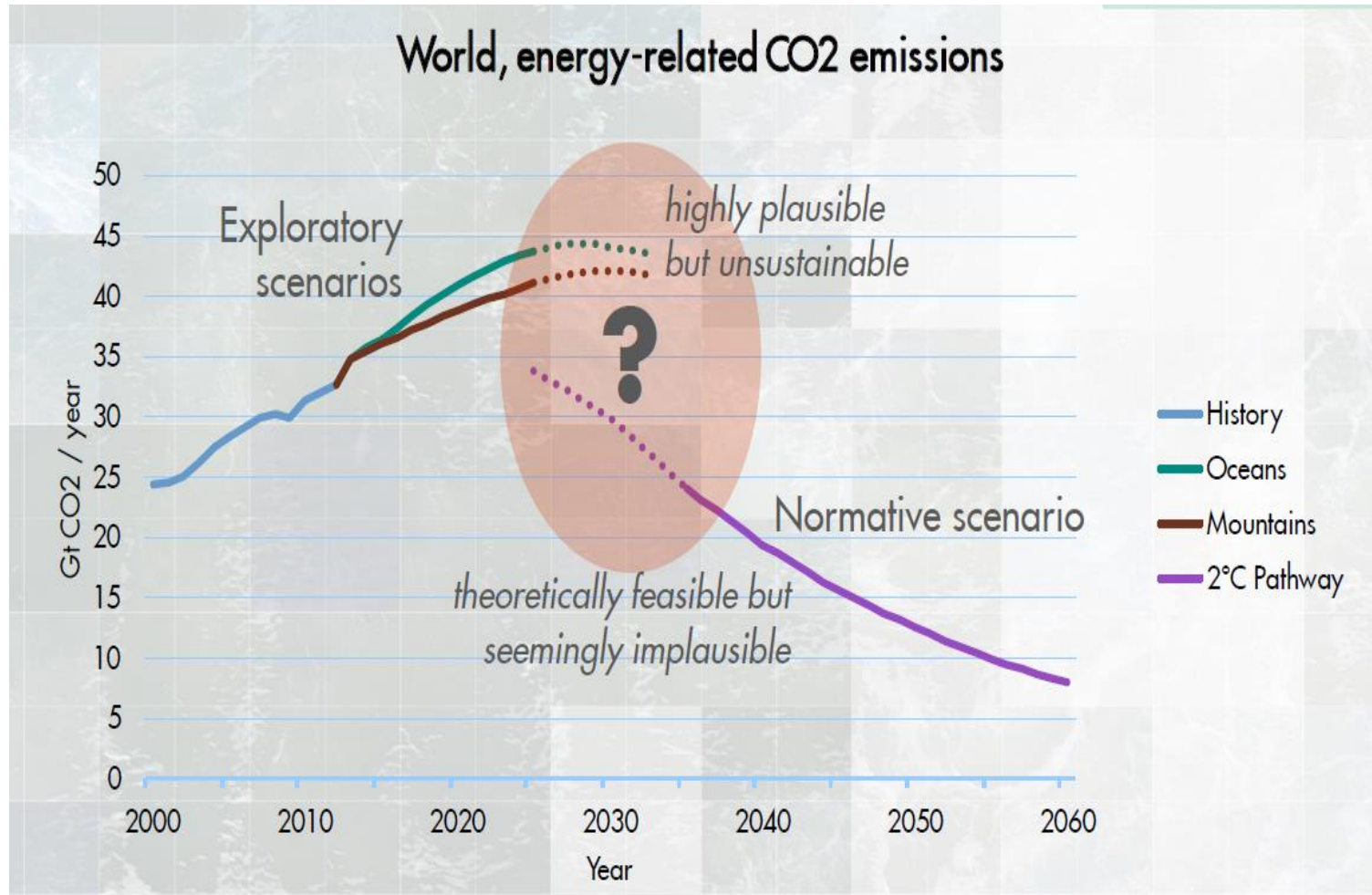
- **Develop electricity and gas interconnections**

- **Enhance smartgrids and demand response, especially by generalizing smart meters**
 - Linky
 - Gazpar

- **Electric vehicle charging stations**

C. Price of carbon: how to make it work?

Energy transition without a carbon price?



■ Source SHELL: Mountains and Oceans scenarios

■ <https://www.youtube.com/watch?v=abOIRSb6teM>

Energy transition without a carbon price?

■ Large consensus : no transition without carbon price

- Carbon price means ETS and taxes
- Today prices are at least 100€/t more than existing implicit or explicit prices
- Increasing every year, rapidly, due to depletion of carbon budget
- Decreasing oil price means higher carbon price (to achieve same goal, phasing out of oil and coal by 2050)
- Other tools can complement the carbon price, but generally they are seen as profitable or efficient if there is a carbon price
 - Public Investment, subsidies, norms

■ No carbon price will get to nowhere

- Planning the world economy and micromanaging billions of actors will not work
- The complexity of the cost of economic activities needs to be internalized

But many controversies around a carbon price

- It is top (down) in nature, hard to mix with a bottom-up governance
- Carbon price can encounter strong resistances
 - 2007 French carbon tax, EU ETS price collapse, Kyoto protocol failure
 - For good reasons : distributional consequences can be huge, carbon leakage, competitiveness issues, short term considerations
 - Who should make the most efforts? Developing or advanced countries?
- Should a country implement it alone?
 - Ideally no, since non global carbon price means carbon leakage and price distortion or need for complex adjustments (border, sectoral)
 - Global carbon prices prevents national (or continent) choice of pace.
 - But should we do nothing if there is no international agreement?
 - Carbon tax + tax on imports (needs for revision of WTO treaties?)
- Is a double dividend possible if a country starts unilaterally? Yes if:
 - Positive macroeconomic effect due to the demand increase (Keynesian multiplier)
 - The improvement of the fiscal efficiency : Reduction of fiscal distortions (labor and capital financed by a tax on carbon)
 - The improvement of the trade balance

Scenario after COP 21

■ Dream scenario: global agreement

- Price of carbon for advanced countries (ETS and/or tax)
- Temporary exemption for others (Based on development criteria)

■ Providence scenario: partial agreement & technical spillover

- Price of carbon for certain countries
- Investments made in these countries lead to major technical innovations
 - Huge decrease of the price of alternative technology
 - “Internet revolution” for energy

■ Threat scenario: partial agreement & frontier adjustment mechanisms

- Price of carbon for certain countries
- Frontier adjustment mechanisms to correct disequilibrium with non complying countries: tax on imports
 - To avoid to pay twice
- Revision of WTO treaties?

D. An evaluation for France with the ThreeME

Results from the ADEME scenarios

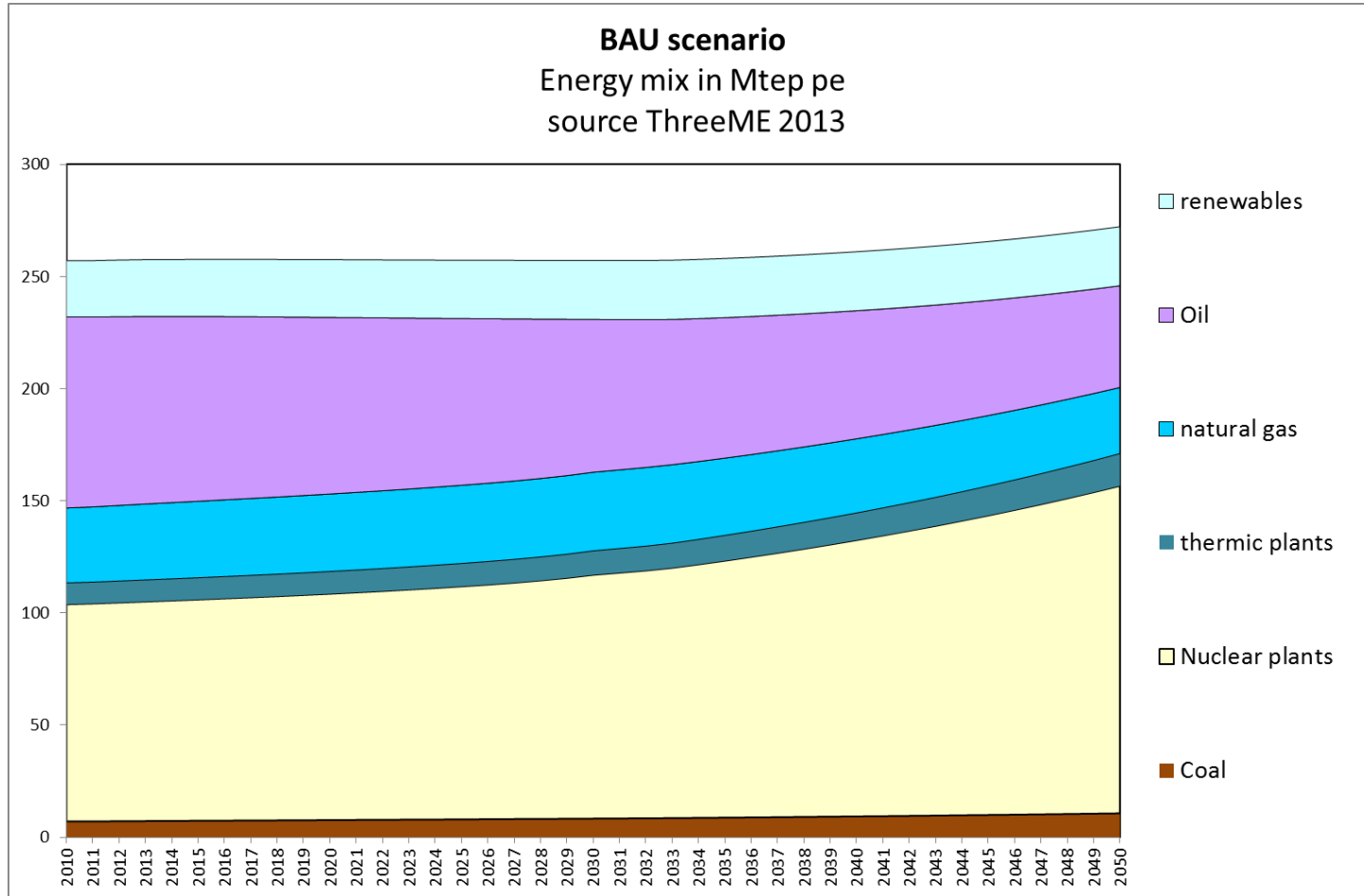
- ❑ **Current policies are not modified**
 - Subsidies
 - Energy taxes

 - ❑ The growth rate is equal to 1.8%
 - Sum of the productivity gain (1.4%) and the population growth (0.4%)

 - ❑ **Energy prices are the same as the IEA forecasting**

 - ❑ Virtual scenario, which allows to appreciate the modifications induced by the transition.
- ⇒ **Final energy consumption is equal to 156 MtepEf in 2030 and 138,5MtepEf in 2050.**

The mix Evolution in the BAU scenario



The BAU scenario is modified by exogenous shocks

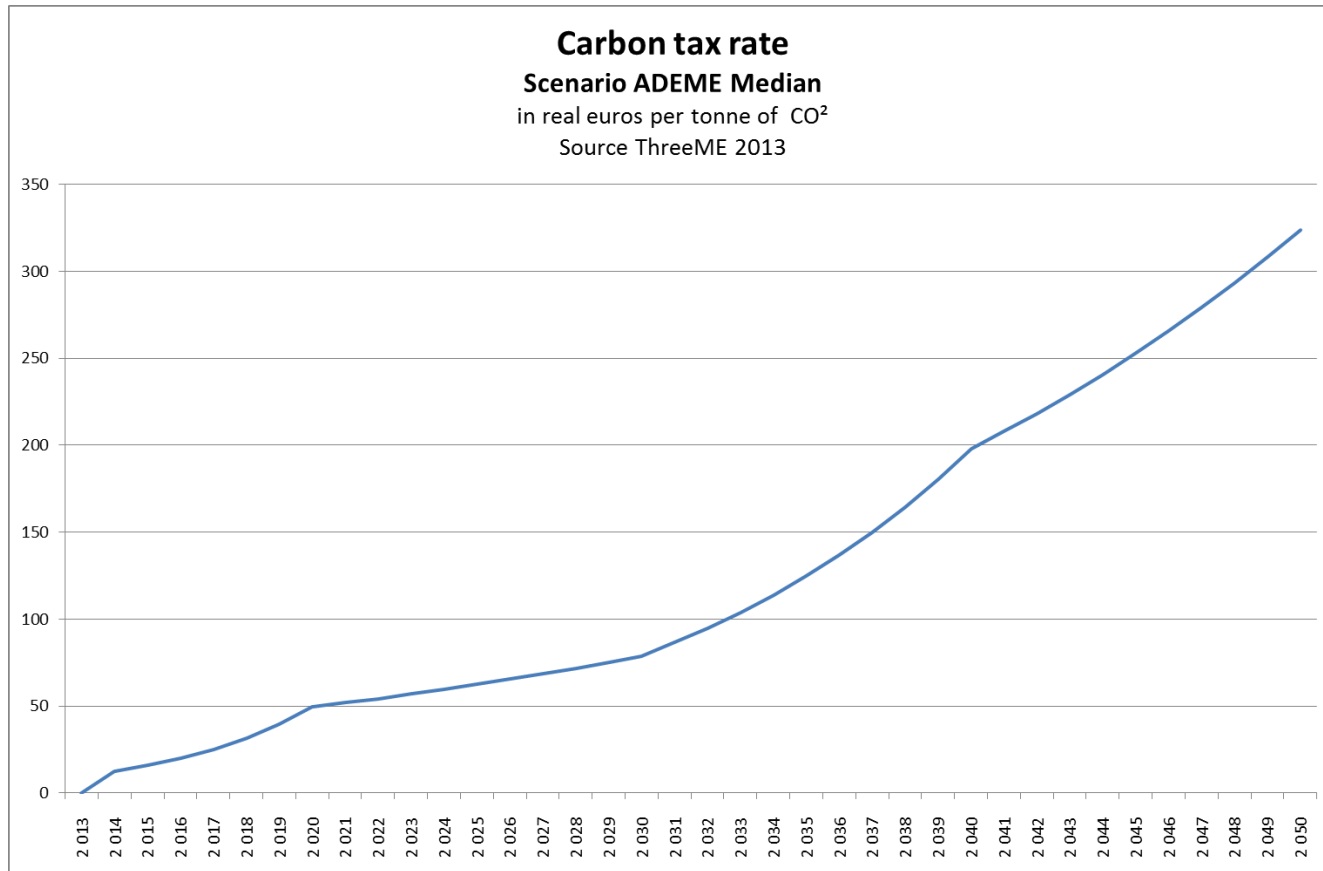
- *An electric mix modification*
 - The nuclear share reaches 50% in 2030, and 25% in 2050 in the median scenario, and 18% in the low scenario
 - The Coal and Oil electricity plants are closed in 2030
- *A heating mix modification*
 - The natural gas share declines from 77% to 25% in the heat distribution between 2006 and 2050
- *A taxes reform*
 - A carbon tax is implemented and calibrated to reach the desired level of each energy sources
 - (firms in the European CO2 trading system *ETS* are exempted)
 - The carbon tax incomes are distributed back to the households through a tax decrease and to the firms through a decrease in their labour social contributions
 - A increase in electricity and energy taxes
- *An electrical vehicles penetration (9,9M eq full elec in 2050)*

Three scenarios have been simulated by the ADEME

■ The nuclear share is different :

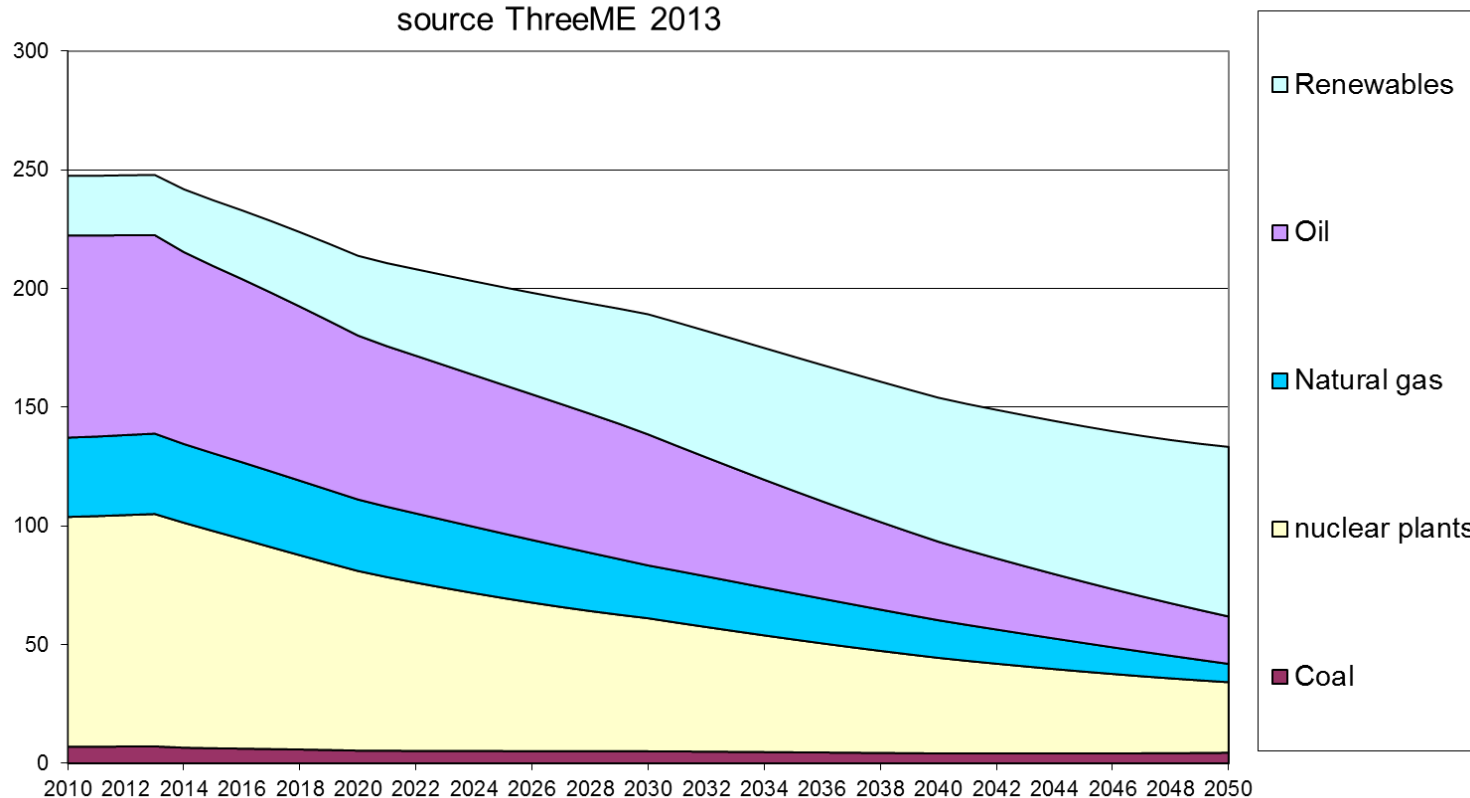
- Low Scenario : the nuclear share reaches **50%** in the final electricity demand in **2030** and **18%** in **2050**
- **Median Scenario** : the nuclear share reaches **25%** in the final electricity demand in **2050**
- High Scenario : the nuclear share reaches **50%** in the final electricity demand in **2050**.

The carbon tax rate in €/tCO₂

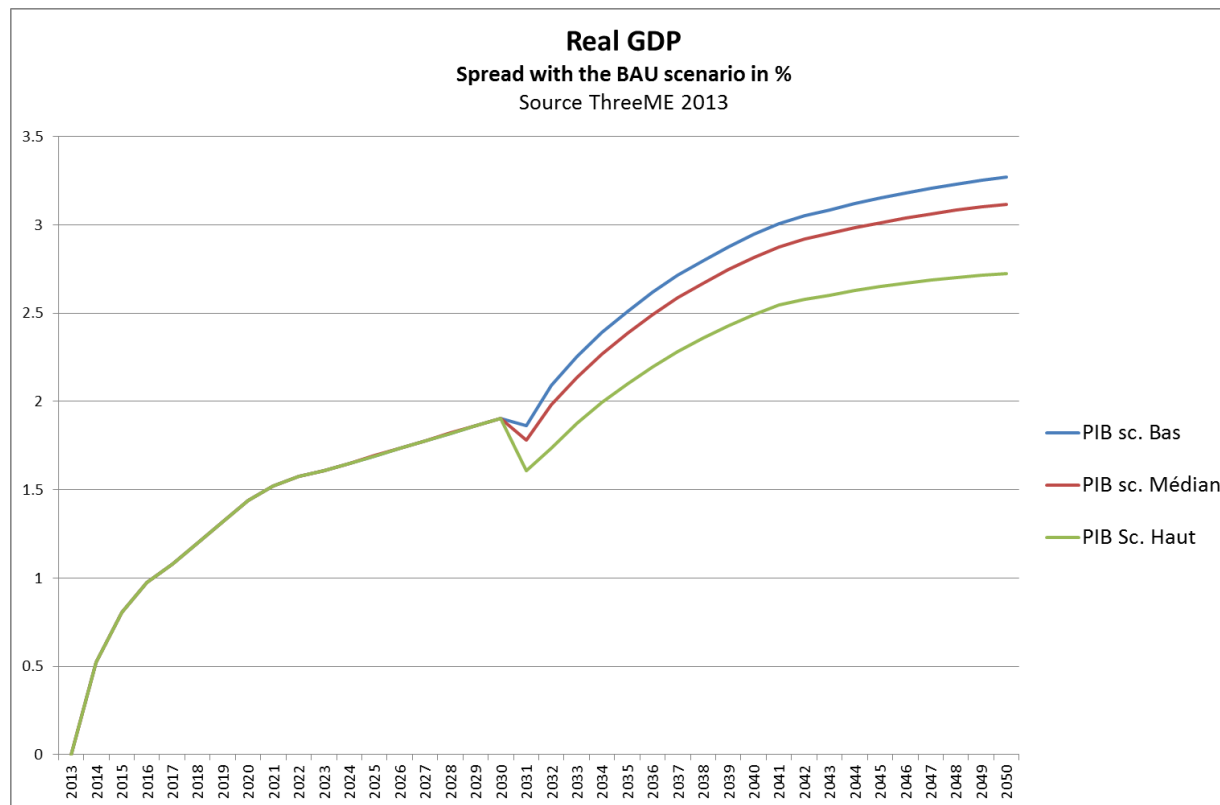


The energy transition by ADEME

ADEME Scenario Médian
Energy Mix in Mtep pe
source ThreeME 2013



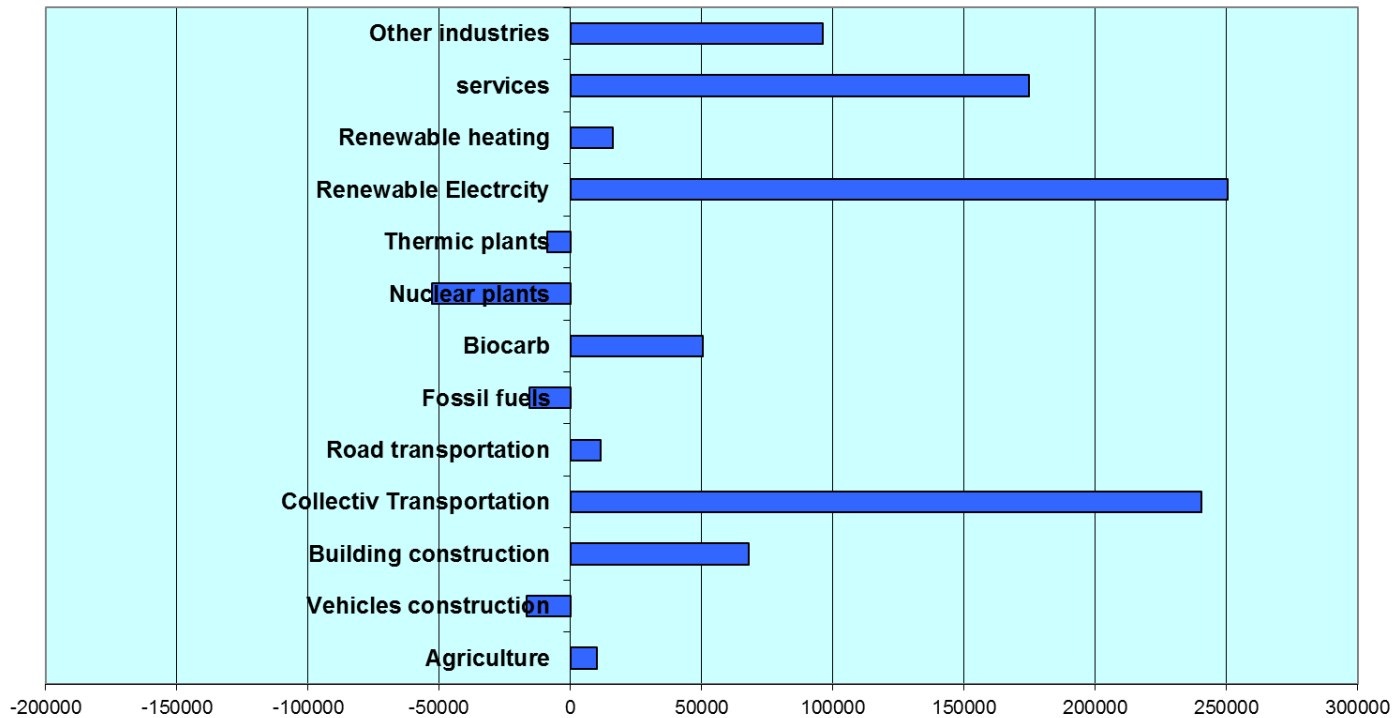
The energy final consumption reaches 126 MtepEf in 2030 and 78MtepEf in 2050



The GDP gains are quite the same because of:

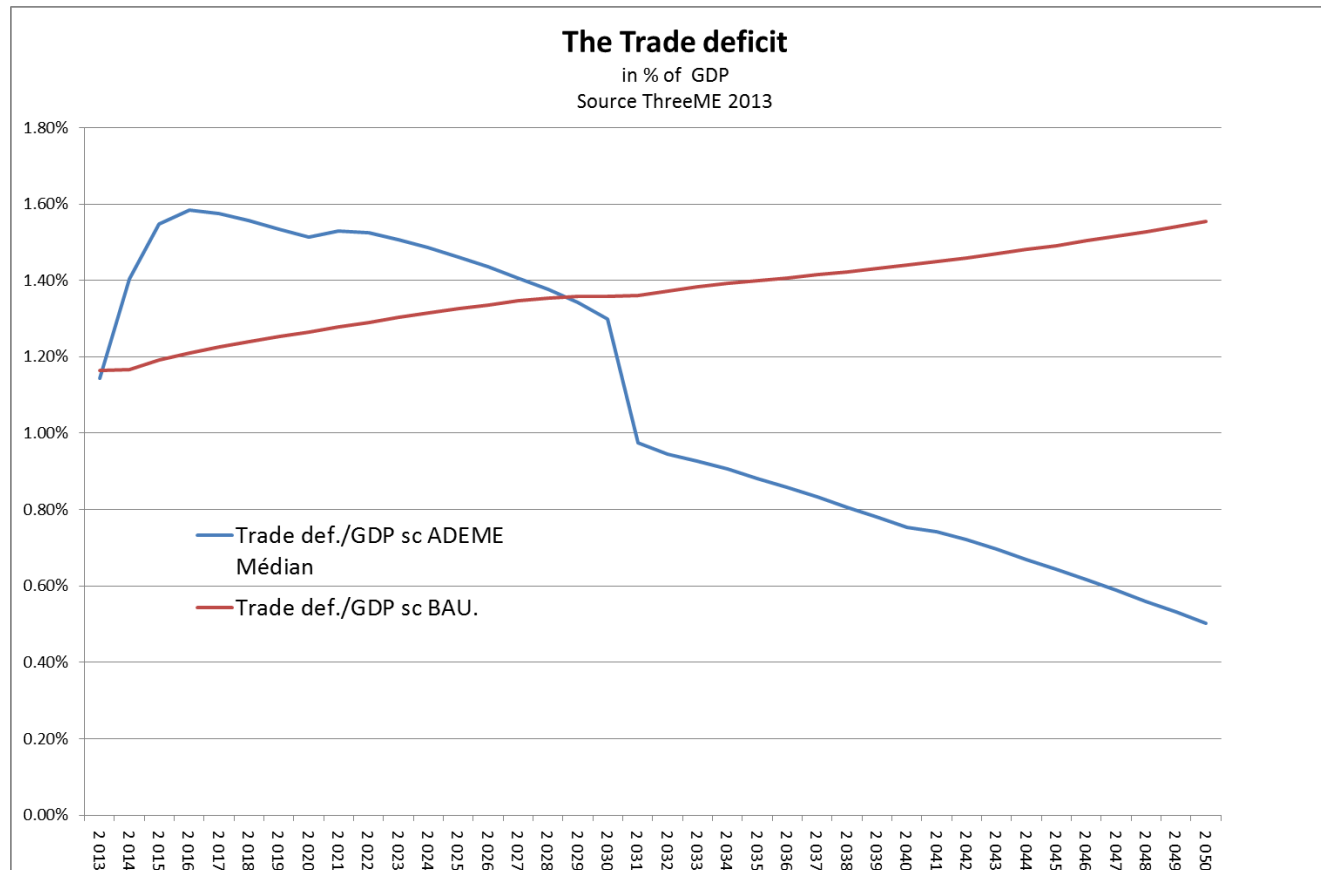
- *The decrease in the share of the energy sector in the GDP*
- *The relative convergence between the nuclear and renewables prices*

Jobs losses and gains by sectors in 2050
Sc. ADEME Médian
source ThreeME



+330 000 jobs in 2030 and +825 000 in 2050

The evolution of the trade balance deficit in % GDP



The trade-off deficit is lower in the scenario Haut since the propensity to import equipments is weaker in the nuclear sector than others.

The economic effects of a carbon tax in France

- **Without redistribution, the carbon tax has a negative effect on GDP**
 - Recessive shock

- **With a redistribution, the tax has a positive effect on GDP and employment in the long term :**
 - Decrease in labor cost
 - Growth of the sectors which do not consume a lot of energy
 - Increase in labor intensity and reduction in imports
 - In the long term, the net present value of investments is positive (the reduction in the energy bill is higher than the debt reimbursement)
 - The expansive effect of the tax redistribution is more important than the recessive effect of the tax increase.

A double dividend

- Increase in jobs and economic activity, decrease in GHG
 - GDP growth rate increases by **3% in 2050** with respect to the BAU scenario.
 - In absolute level, GDP X2 between 2012 and 2050
 - Decrease in unemployment rate of **1.6 points in 2050**, and the creation of more than **800 000 jobs**
 - GES emissions divided **by 4 since 1990**, reduction by 50% in energy demand
 - Carbon tax rate near **350€/tCO₂ in 2050**
 - The average rate of energy taxes reach **770€/tep**.