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CIRED, Paris - 16 March, 2012

Acceptance and Economic assessment of Low carbon scenarios

A participatory approach applied to France

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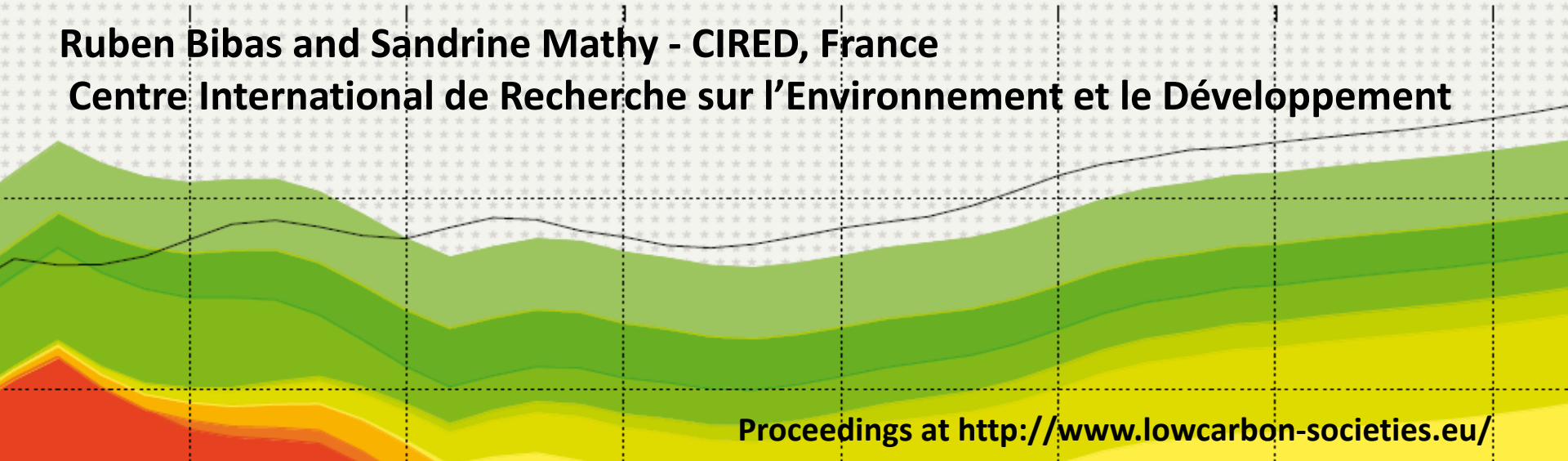


Proceedings at http://www.lowcarbon-societies.eu/

Acceptance and Economic assessment of Low carbon scenarios

1. Methodology: steps towards a “collaborative scenario design”
2. An acceptable low carbon energy scenario for France
   - Residential Sector
   - Transport sector
   - Electricity sector
   - Macroeconomic impacts
3. Reconciling stakeholders’ acceptance and ambitious climate objectives :
   Other determinants and Factor Four
4. Conclusion

The need for involving stakeholders

Standard modeling approach: “objective” expert-based arguments

Stakeholders: private companies, ministries, associations (NGOs as well as consumers associations), trade unions, banks

“Why is stakeholders involvement important when discussing energy scenarios?”

- To add other dimensions:
  - Political and social
  - Practical solutions

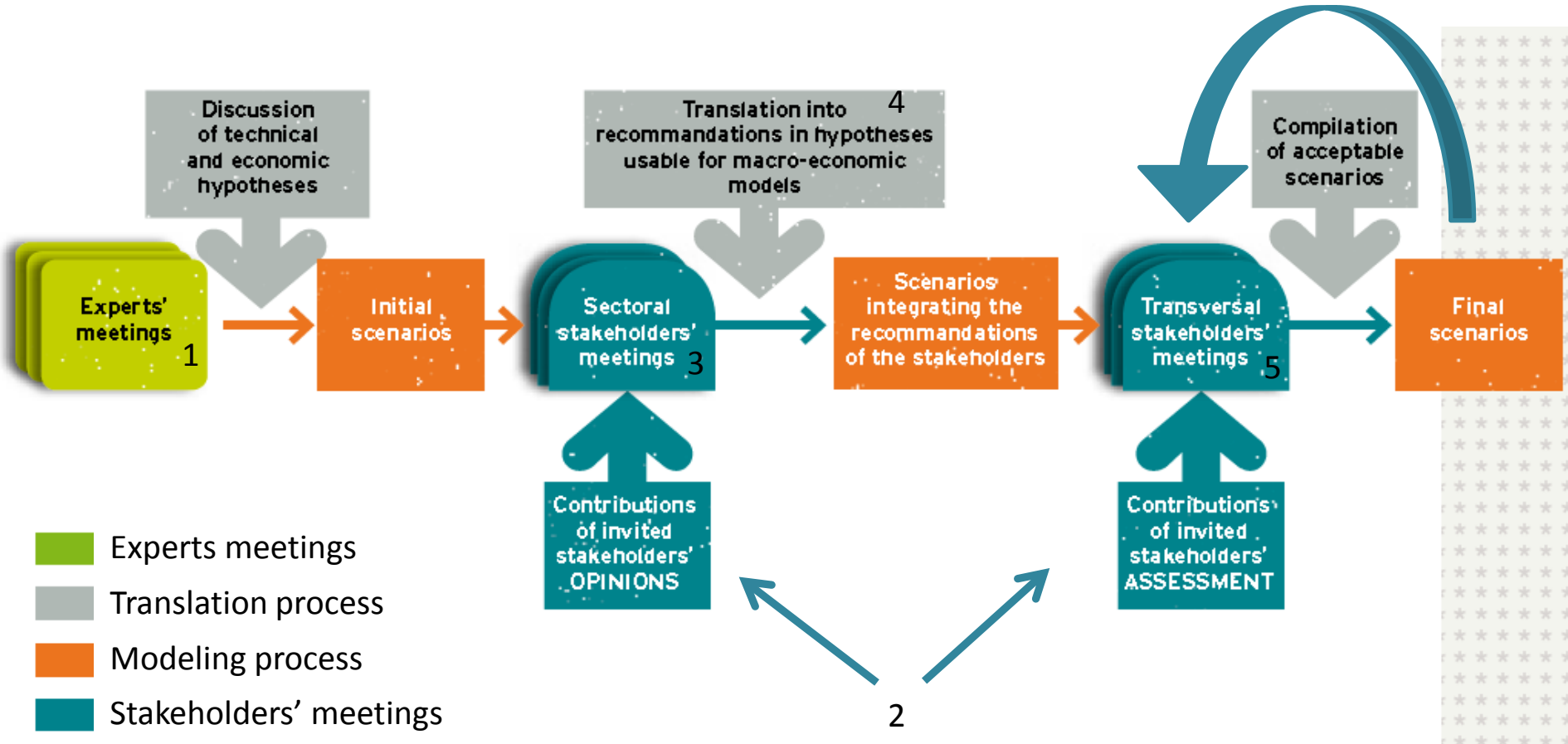
Two main principles:

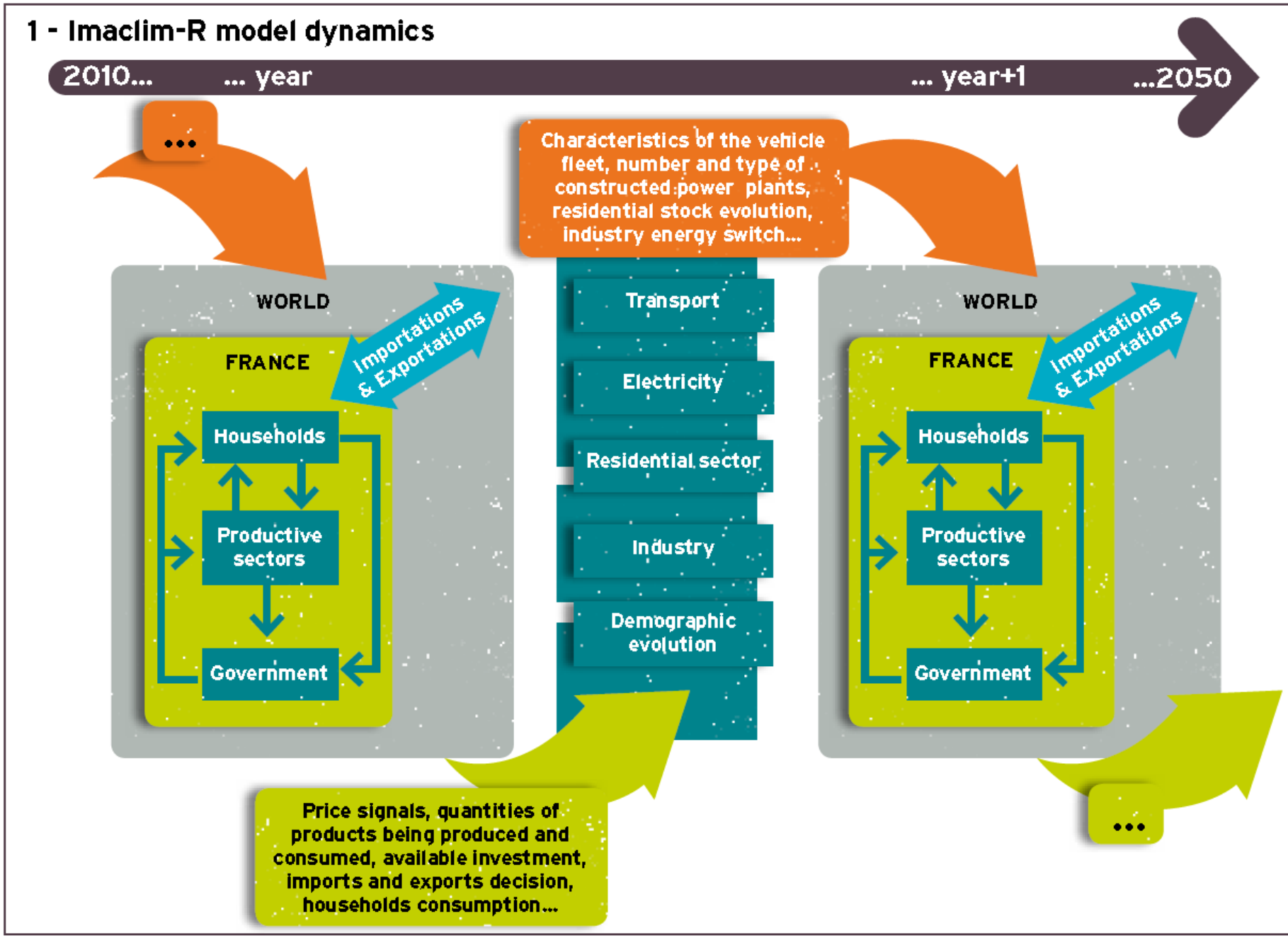
- **Realism**: Satisfying technical and economic limits
- **Acceptance:** Maximum degree of stakeholders’ acceptance

Project outline

1. **Experts**' meetings
   - Residential / Transport / Electricity
2. Identification of national stakeholders
3. **Sectoral stakeholders**' meetings
   - Residential / Transport / Electricity
4. **Translation** of stakeholders' contributions into model parameters
5. **Cross-sectoral** feedback seminar

Methodology:
Collaborative creation scenario process




1 - Imaclim-R model dynamics
2010...
... year
... year+1
...2050
...
Characteristics of the vehicle fleet, number and type of constructed power plants, residential stock evolution, industry energy switch...
WORLD
FRANCE
Importations & Exportations
Households
Productive sectors
Government
Transport
Electricity
Residential sector
Industry
Demographic evolution
WORLD
FRANCE
Importations & Exportations
Households
Productive sectors
Government
Price signals, quantities of products being produced and consumed, available investment, imports and exports decision, households consumption...
...

The big challenge: the translation process

Example of the translation process: residential sector – refurbishment

Obstacle to refurbishment:
Access to tax reductions and subsidies conditioned to high personal contribution
Access to zero-interest loan difficult without collaterals

Stakeholders' recommendation to overcome obstacle:
Obligatory refurbishment fund for jointly-owned buildings
Long-term third-party financing

Translation into the model parameters:
Reduction of "risk-aversion level" for refurbishment

An **acceptable** low carbon energy scenario for France

Global context and world visions
Benchmark assumptions

- Stability of **consumption** styles (preference among goods and origin)
- **Energy demand and fossil energy prices**
  - Crude oil prices reach **160 €/barrel** in 2050 (energy prices from World Energy Outlook, AIE 2011)

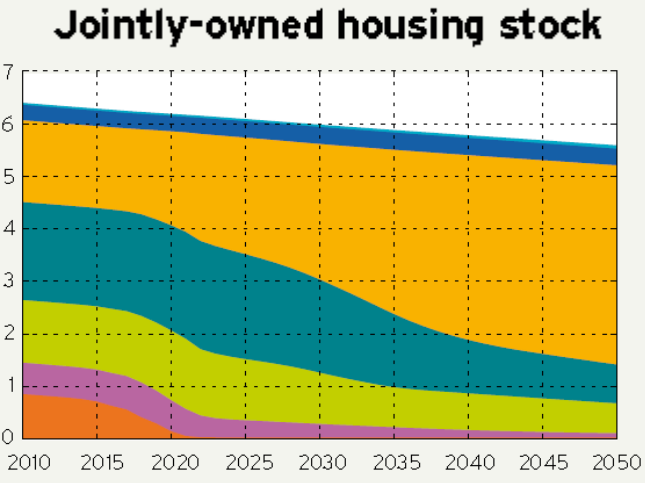
	2050/2010
Crude oil	x 2.38
Natural Gas	x 2.38
Coal	x 2.17

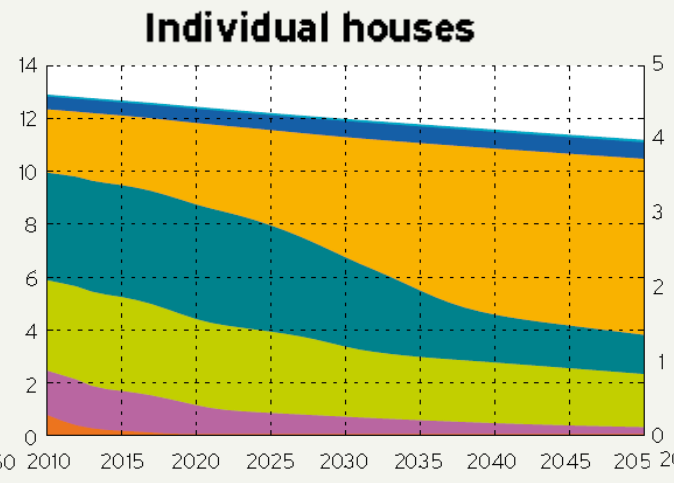
  - Technological innovation focuses
    - Renewables
    - Energy efficiency
    - Carbon Capture and Storage

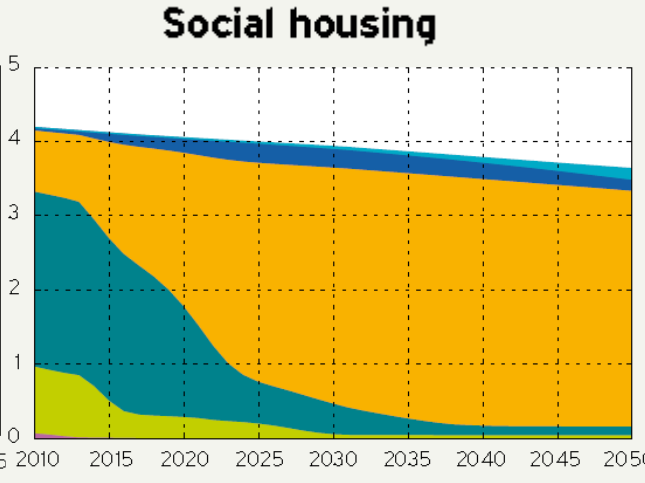
Residential sector

Tax credits for energy efficiency	Uniform tax rebate of 30% of investment
Zero-interest loans for retrofitting	Up to 30,000€/dwelling for 10-15 years
Thermal regulation for new buildings	50 kWh/m2 after 2012 Net producers after 2020
Obligatory renovation funds for jointly-owned buildings	Reduction of risk aversion
Third-party financing	Reduction of risk aversion
Biogas	Up to 17% of gas in 2050
Carbon tax (€/tCO2)	32 in 2012 56 in 2020 100 in 2030 300 in 2050
Progressive tariff	Consumption above 60 kWh/m2

Energy labels transitions

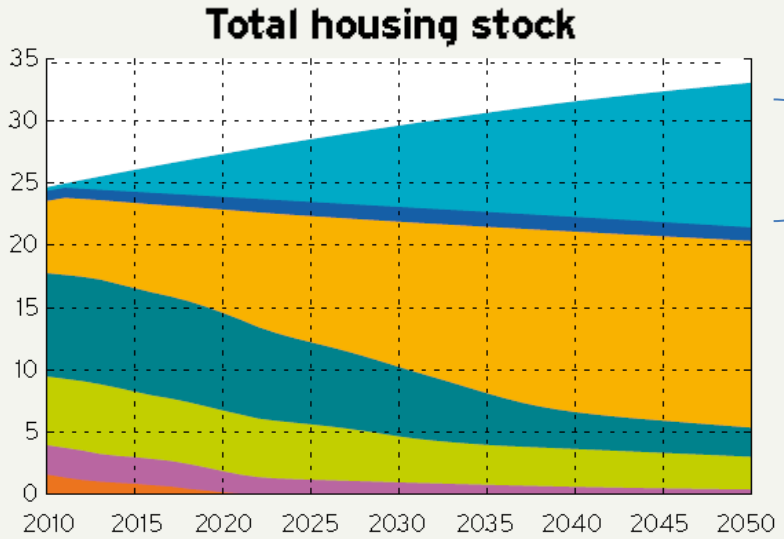






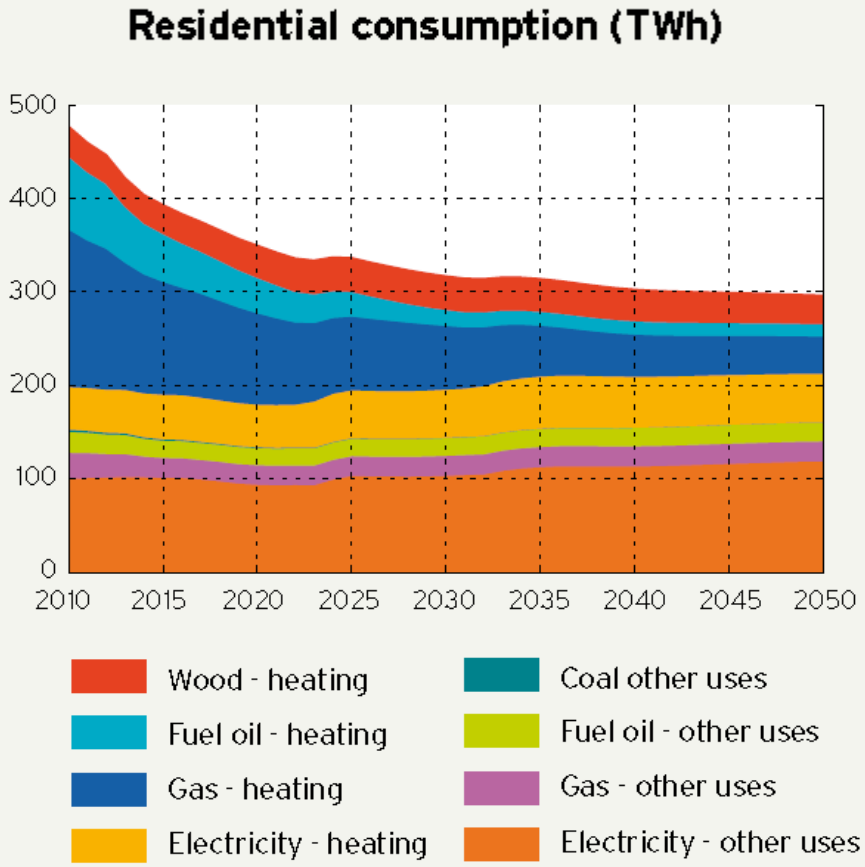
A (<50)
B (51 to 90)
C (91 to 150)
D (151 to 230)
E (231 to 330)
F (331 to 450)
G (> 450)

kWh/m2



Million dwellings

Built after 2010

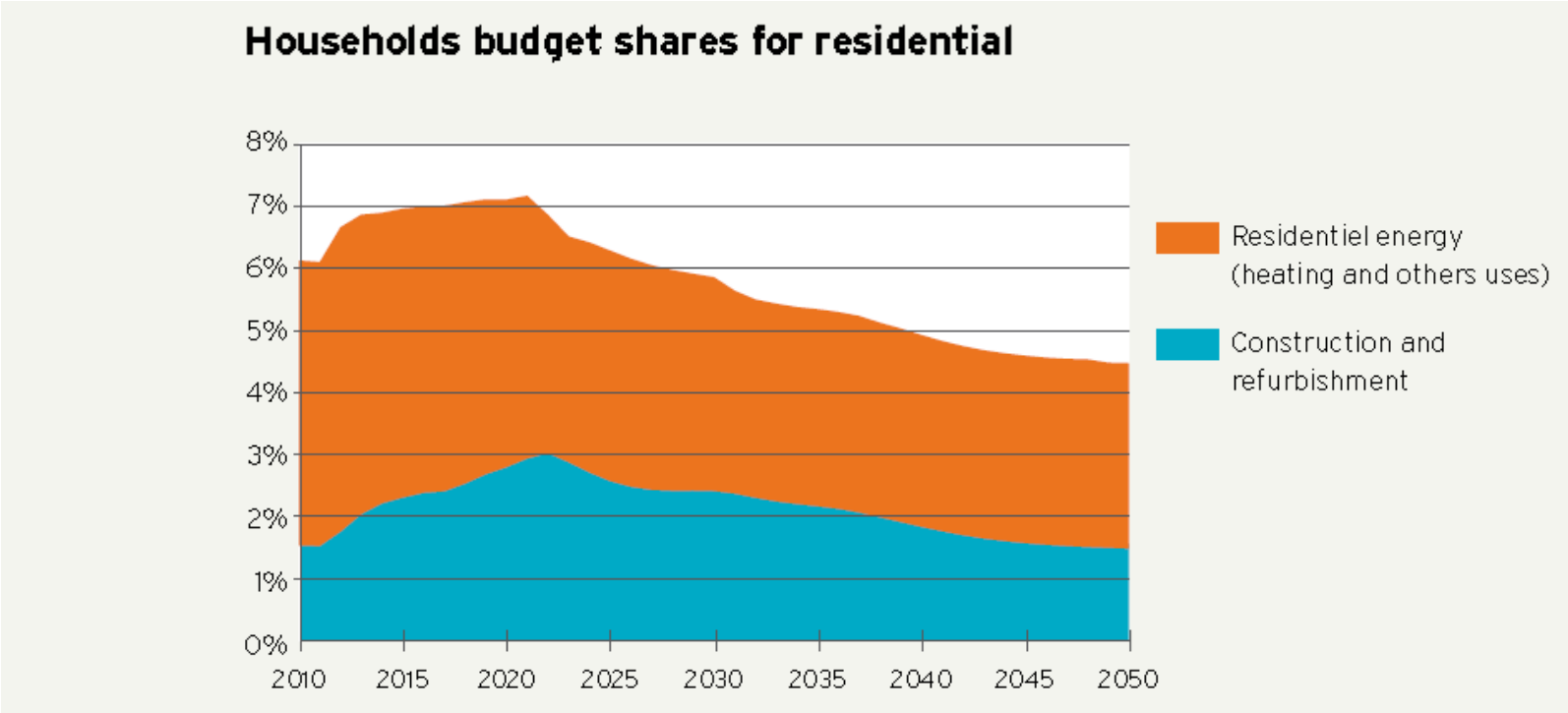


c€/kWh	2010	2020	2050
Electricity	12	16	15
Gas	6	11	18
Fuel oil	12	18	25
Wood	4	5	6

Between 2010 and 2050

1. + 37% total residential surface (m^2)
2. Total final energy consumption decreases : -37%
3. Final energy consumption (heating and other uses) per capita : -50%
4. CO2 emissions (excluding electricity emissions included in the power sector) : -75%

Investment and policy costs

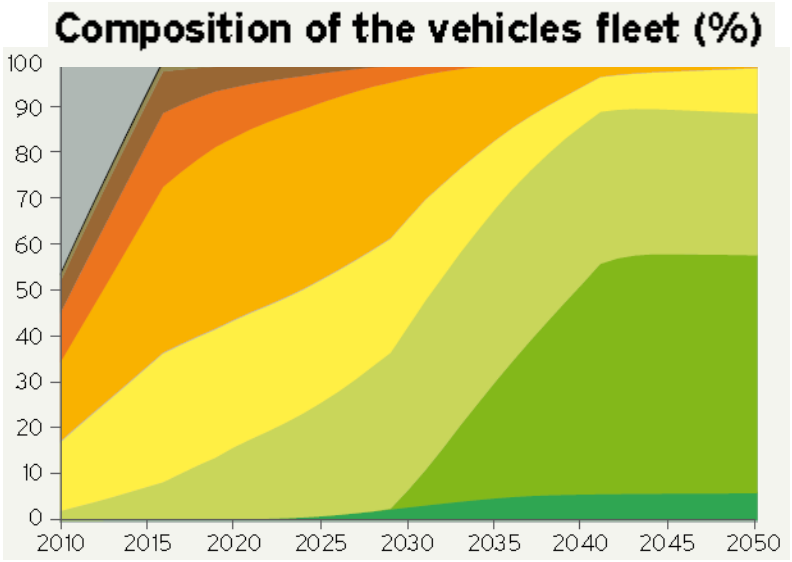


	2020	2030	2040	2050
Policy measures costs for the govenement (billion €)				
Tax credit	3.3	2.5	0.8	0.5
Eco-loan	3.3	1.9	0.6	0.4
Additional costs for households (Billion €)				
Construction	9.5	9.4	7.7	6.3
Refurbishment	14.9	10.3	3	1.8

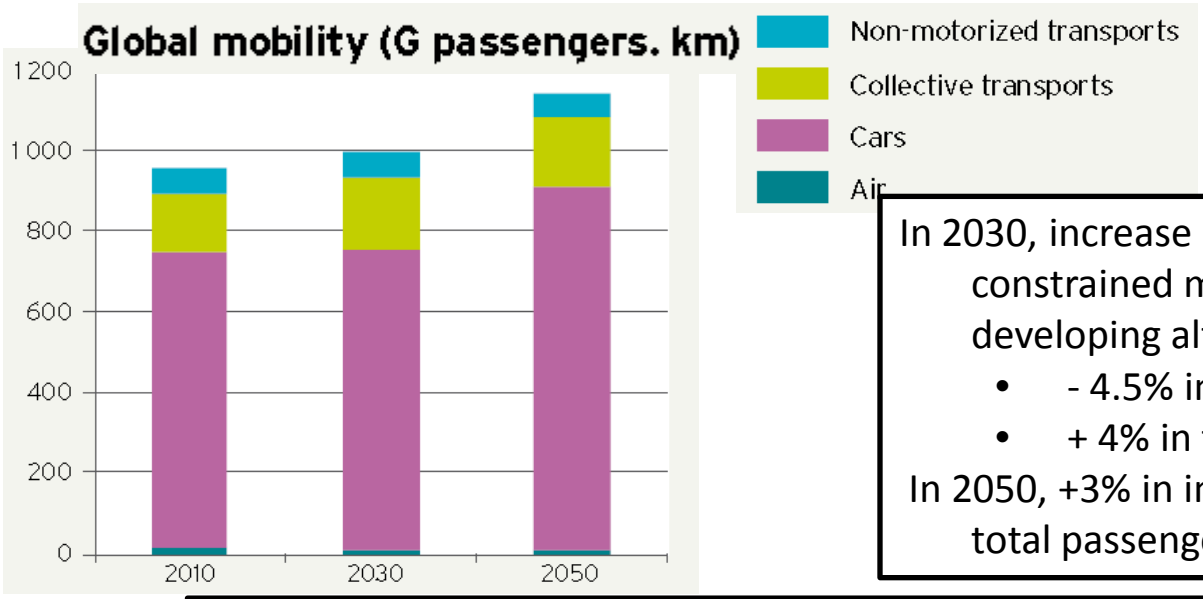
Transport sector

Urban planning	Slow down of urban sprawl until 2030 Urban density increasing after 2030
Teleworking	1 in 10 days: reducing constrained mobility (commuting)
Vehicles occupation rate	1.25 to 1.5 in urban areas
Kerosene tax	400€/toe from 2012
Heavy trucks eco-tax	1.2 bn € in 2012
Urban transports investment	Doubled for 20 years after 2012 (3 bn €/yr for 20 years)
Rail investment program	3 bn €/yr for 20 years
Road investment	Collective transports investment deducted
Bonus-Malus	Up to 2050 with neutral financial balance
Logistics	1% annual decoupling of freight transport needs
Infrastructures	20% modal share of rail transport in terrestrial freight in 2030
Biofuels	5 Mtoe in 2020 (9% share) 16 Mtoe in 2050 (39% share)
Carbon tax (€/tCO2)	32 in 2012 / 56 in 2020 100 in 2030 / 300 in 2050

Passengers transport



-70% in average CO2 emission per km for individual cars between 2010 and 2050



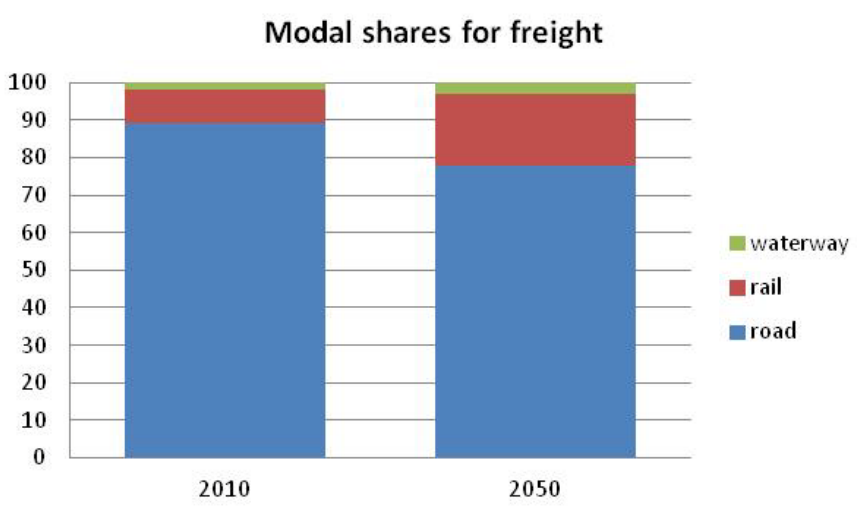
In 2030, increase of energy prices, decrease in constrained mobility (commuting) and inertia in developing alternative collective transports

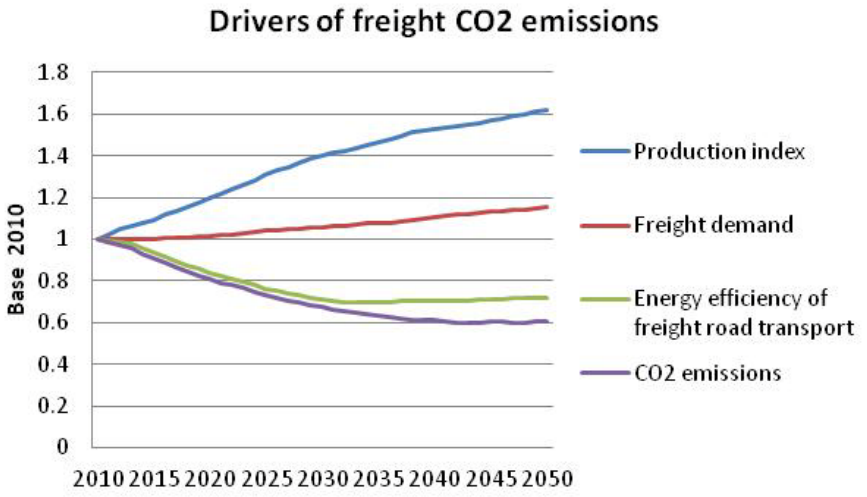
- - 4.5% in per capita mobility /2010
- + 4% in total passengers mobility /2010

In 2050, +3% in individual mobility and + 19% of total passengers' mobility /2010.

Emissions in passengers transports -66%

Freight transport





Emissions freight transports -40%

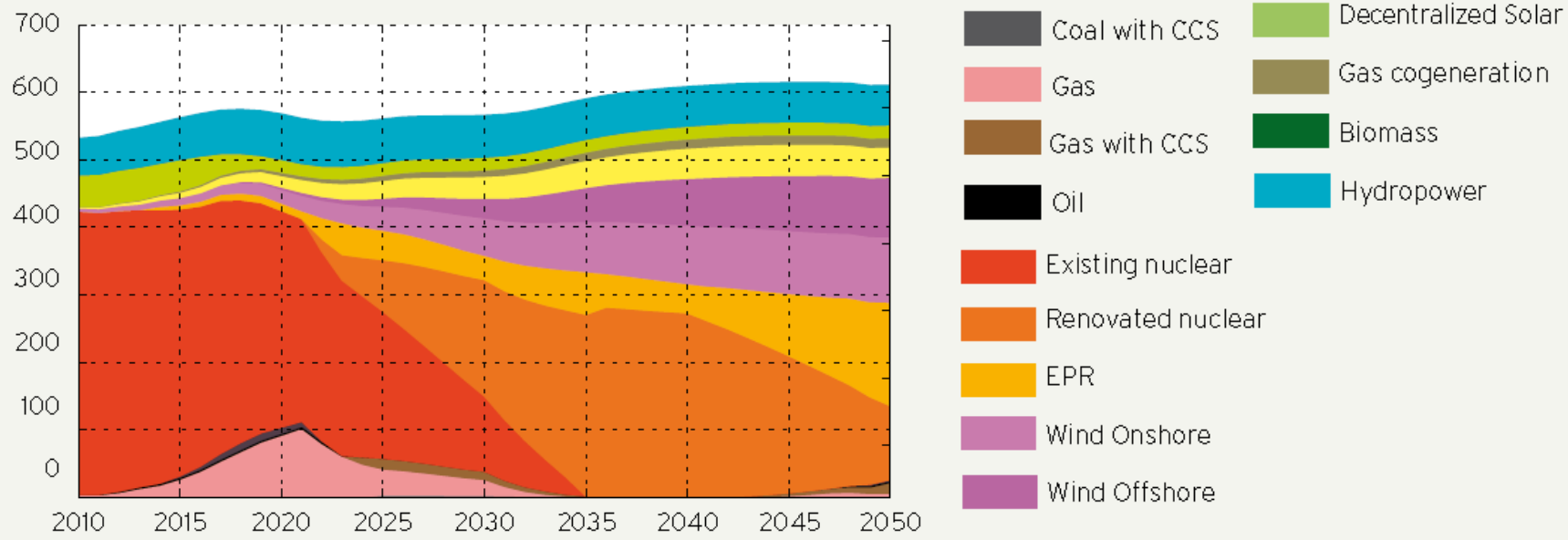
Investment and policy costs in the transport sector

	2010	2020	2030	2040	2050
Fiscal measures (billion €)					
Heavy trucks eco-tax	0	1.3	1.1	1.1	1.2
Kerosene tax	0	1.6	1.1	1.4	1.3
Impact on domestic consumption tax on petroleum products	23.8	21.4	17.9	13.4	12.9
Carbon tax	0	13.7	18.1	23.9	34.8
Investments on infrastructures					
Urban transports	+3 billion € each year from 2012 until 2030				
Railways	+3 billion € each year from 2012 until 2030				
Road transports	-6 billion € each year from 2012 until 2030				

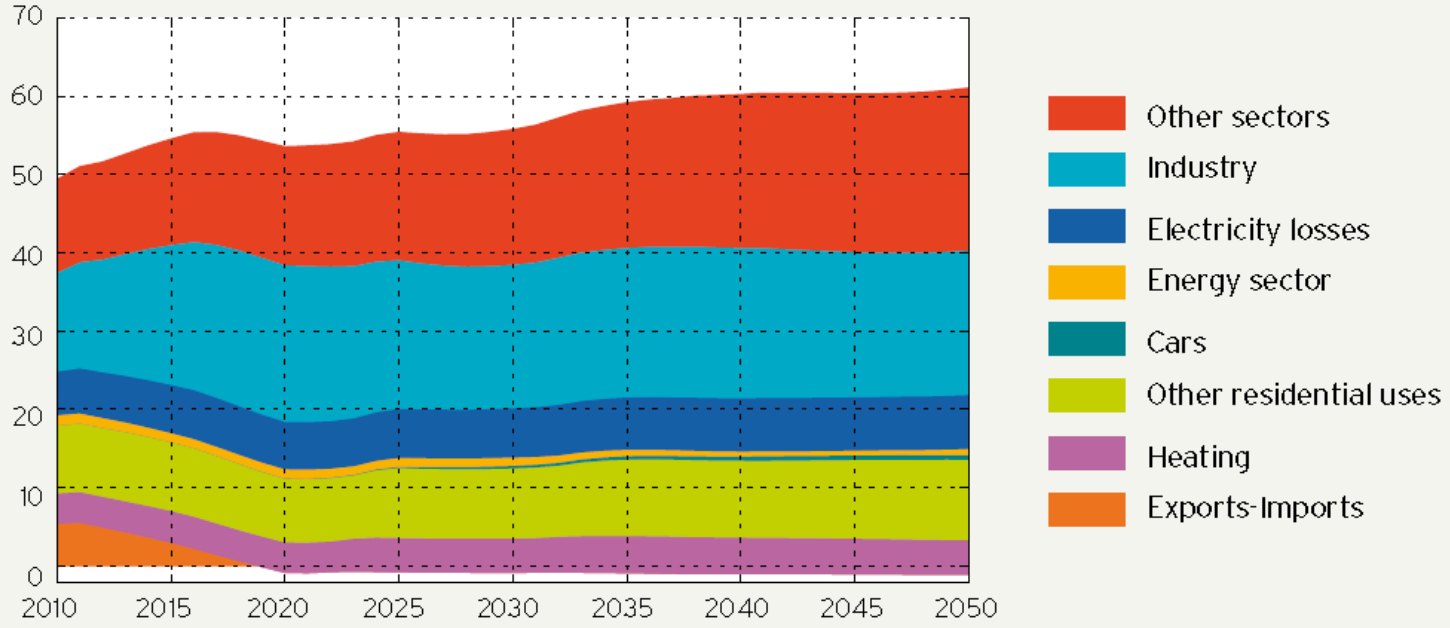
Electricity sector

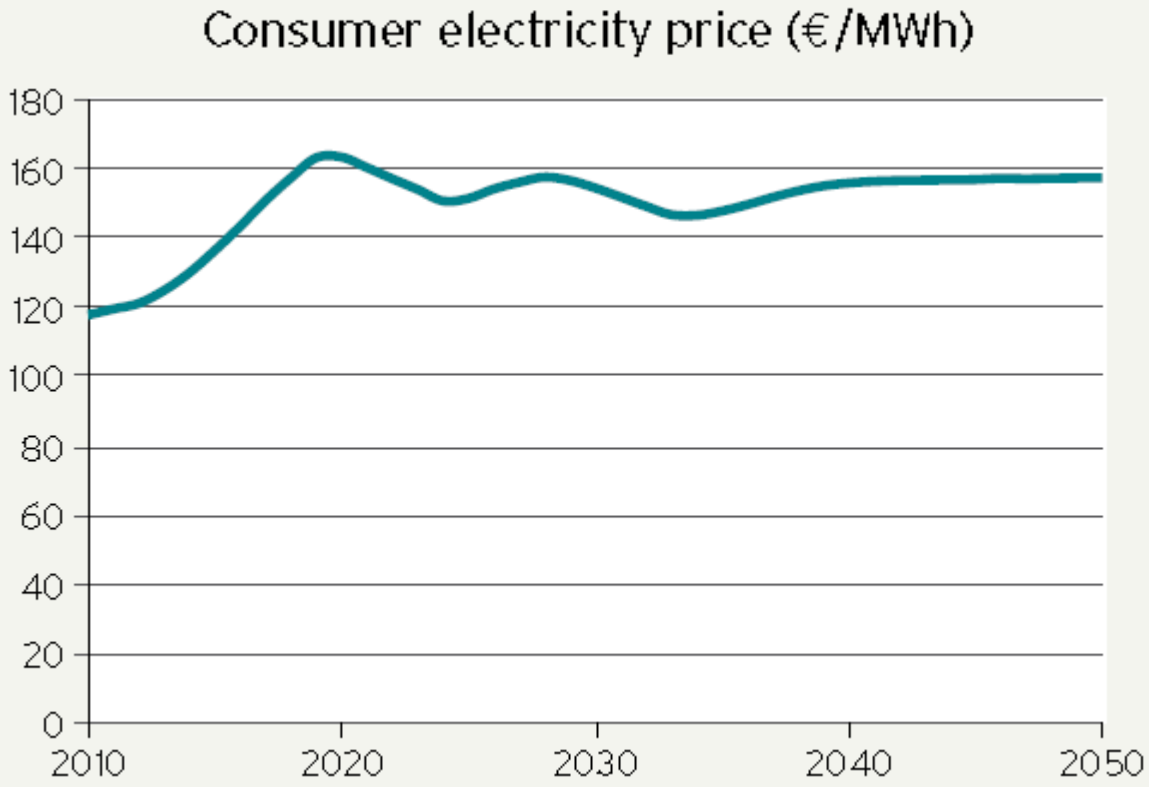
Feed-in tariffs	Decrease over time Until renewable competitiveness
Demand-side management	Implicit measures to flatten load Explicit measures for residential (heating)
Interdiction of electric heating	De facto after 2012 (for Joule effect)
Grid reinforcement	Additional 3€/MWh
Existing nuclear lifetime extension	+20 years for 40 GW existing nuclear plants
Technologies acceptance	All, but shale gas
Carbon tax (€/tCO2)	32 in 2012 56 in 2020 100 in 2030 300 in 2050
Progressive tariff	Consumption above 60 kWh/m2

33 - Electricity production mix (TWh)



31 - Electricity demand disagreggation (Mtoe)





Peak at + 41% in 2020 compared to 2010.
The peak in prices around 2020 is due to the combination of :

(i) the penetration of gas combined cycle replacing some of the nuclear capacities
(ii) the acceleration in the installation of renewable capacities
(iii) the oil-fuelled turbine to face the variability of renewables

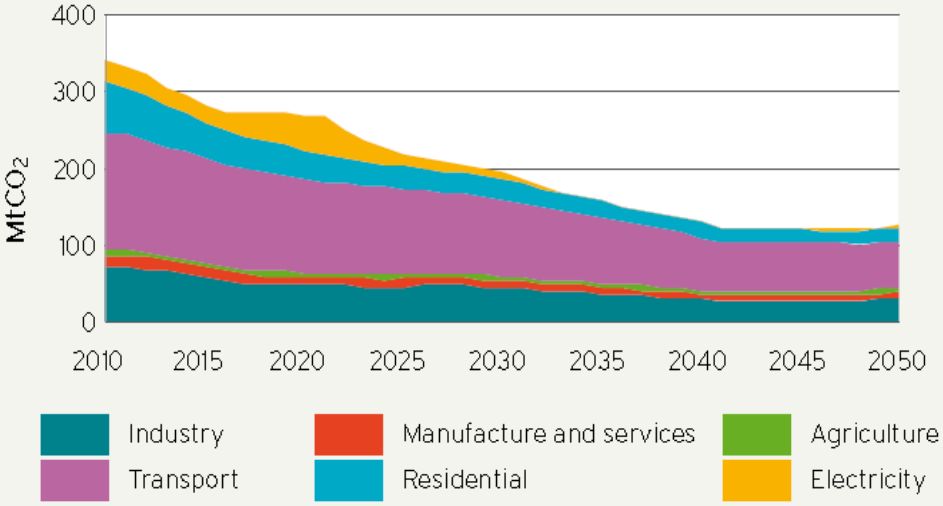
Stabilization around 160€/MWh (16c€/kWh), e.g. an increase of 34% compared to 2011

Investment and policy cost in the power sector

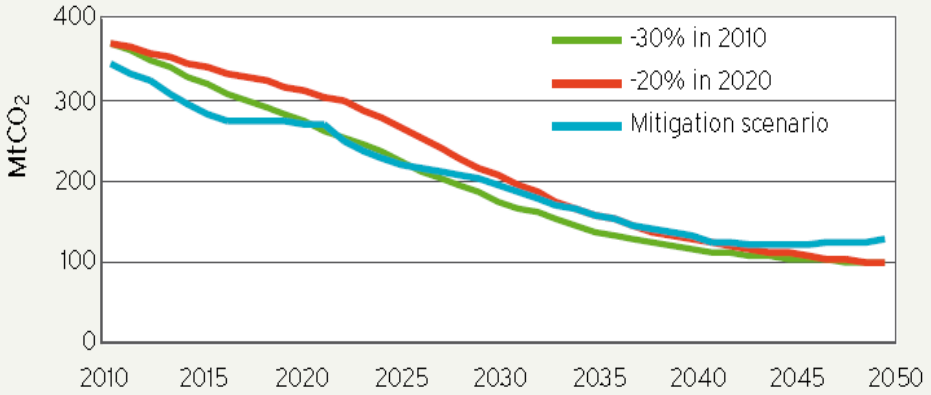
Average annual expenditures for electricity generation (Billion €)				
Period	2011-2020	2021-2030	2031-2040	2041-2050
Investment	12	15	9	6
Fuel costs	1	1.4	0.1	0.6
Carbon costs	8.7	10.9	2.8	3.5

Fiscal measures (Billion €)					
Feed-in tariffs	2010	2020	2030	2040	2050
Additionnal CSPE Income = feed-in tariffs expense	2.9	1.9	7.2	17.8	12.7
Carbon Tax	0	13.7	18.1	23.9	34.8

47 - Sectoral CO_2 emissions



48 - Comparison of the mitigation scenario emission trajectory to Factor Four trajectories

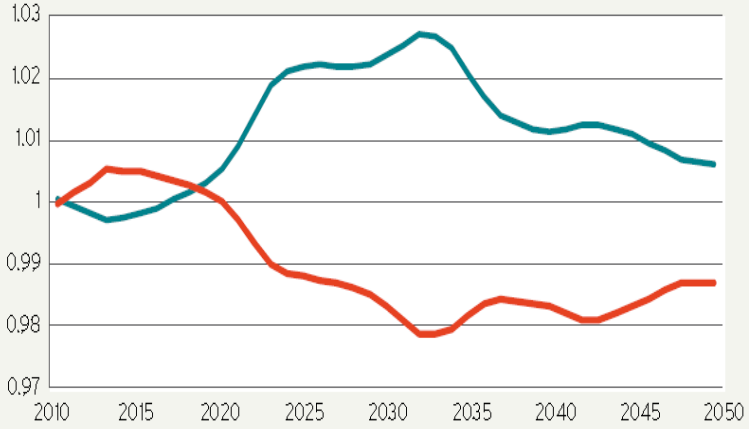


CO_2 sectoral emissions compared to 2010 (mitigation scenario)

	2020	2030	2040	2050
Industry	-33%	-37%	-59%	-57%
Manufacture and services	-36%	-39%	-49%	-49%
Agriculture	-24%	-30%	-42%	-40%
Transport	-19%	-35%	-55%	-60%
Residential	-44%	-62%	-72%	-75%
Electricity	49%	-68%	-100%	-86%
Total	-15%	-39%	-59%	-60%
Total (compared to 1990)	-31%	-50%	-67%	-68%

Macroeconomic impacts

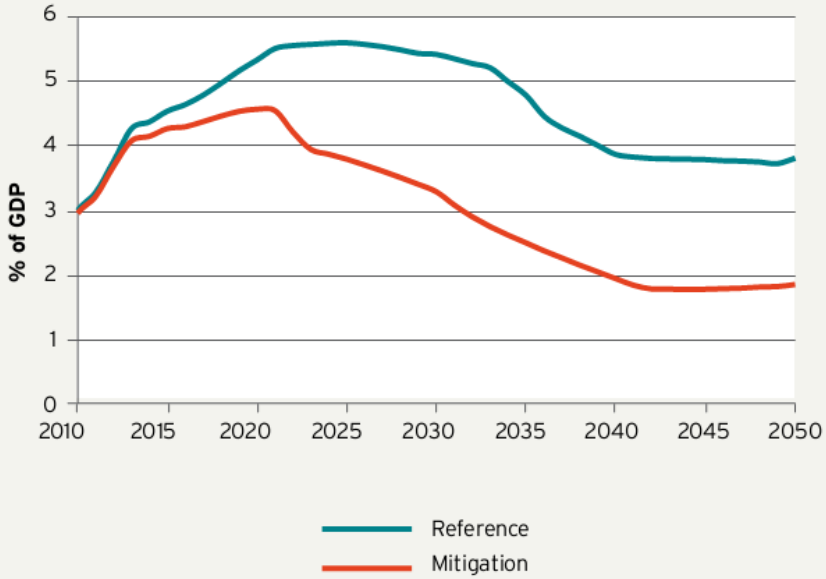
Macreconomic trends in Mitigation scenario / Reference (base 1 in 2010)



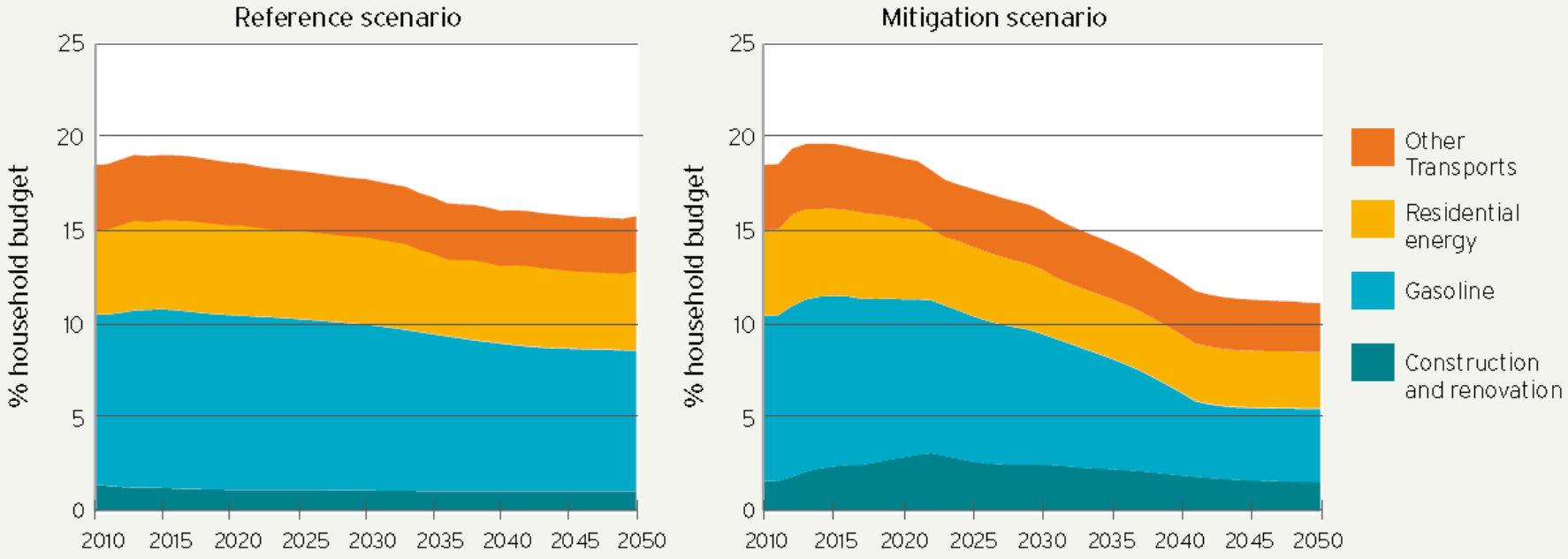
Annual average GDP growth rate

	2010-2020	2020-2030	2030-2050	2010-2050
Reference	1.19	1.29	1.2	1.22
Mitigation	1.24	1.47	1.11	1.24

40 - Evolution of the net energy import intensity of the GDP

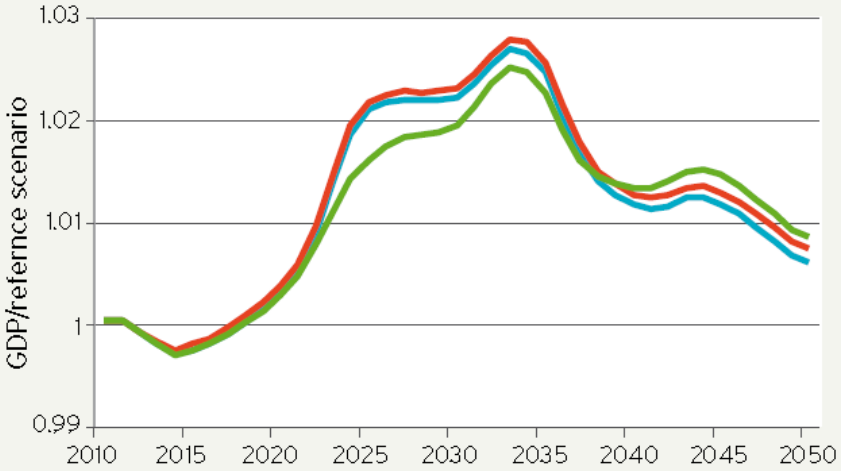


Households expenditures

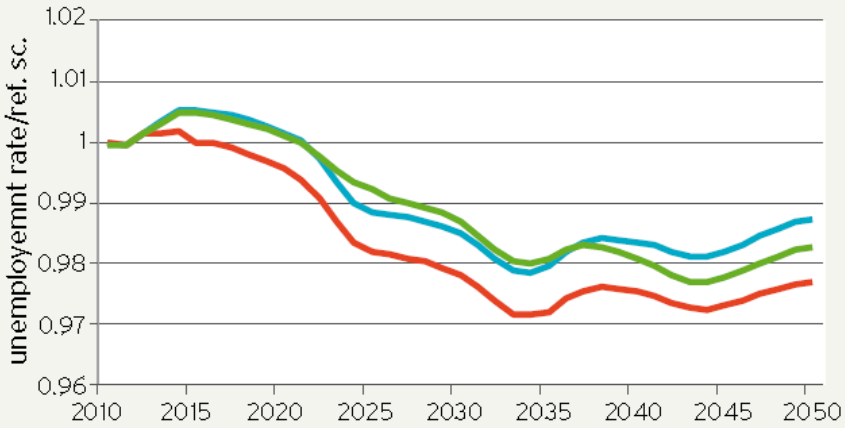


Recycling of the carbon tax incomes

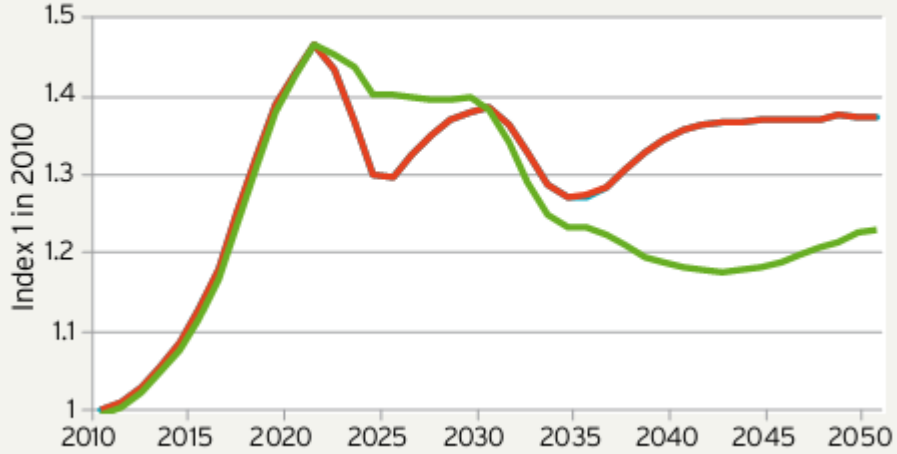
43 - GDP according to carbon tax recycling options



44 - Unemployment rate according to carbon tax recycling options



46 - Consumer electricity price according to carbon tax recycling options

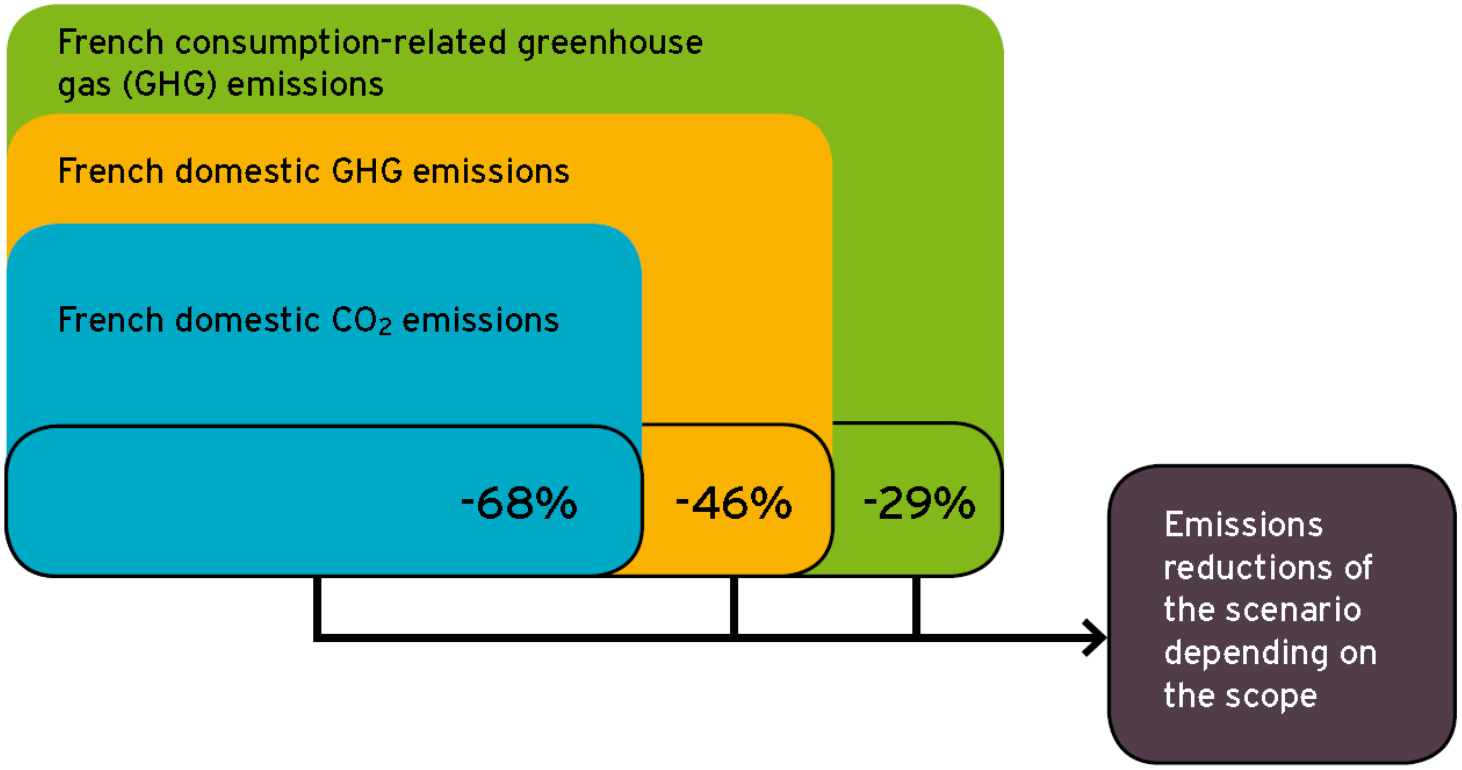


With comparable emissions reductions

- Transfer to households
- Payroll taxes
- Renewables and energy efficency

Emissions reductions and emissions scope

Emissions reduction scope (compared to 1990)



How to reach a Factor Four?

2 ADDITIONAL MEASURES

- **A carbon-energy tax (CET)**
- **Refurbishment obligation**

Sectoral emissions reductions / 2010		
	2020	2050
Industry	- 28%	- 59%
Manufacture and services	- 38%	- 69%
Agriculture	- 26%	- 66%
Transport	- 23%	- 62%
Residential	- 46%	- 83%
Electricity	13%	- 93%
Total	- 20%	- 93%
Total compared to 1990	- 36%	- 73%

How to reach a Factor Four?

GDP average growth rate		2010-2020	2020-2030	2030-2050
Reference scenario		1.19	1.29	1.2
Additional measures scenario	Transfer to HH	1.23	1.42	1.04
	Payroll taxes	1.24	1.42	1.05
	EE and RNE	1.23	1.42	1.04

1. Higher short/middle term GDP growth
2. Lower GDP growth on the long term
3. All recycling options equivalent

Average unemployment rate over the period / reference scenario		
Additional measures scenario	Transfer to HH	-0.2%
	Payroll taxes	-1.3%
	EE and RNE	-0.2%

1. Lower unemployment rate
2. Lowest unemployment with Payroll Taxes recycling

Total energy budget share / reference scenario	2020	2030	2050
	0%	- 4%	- 25%

1. Lower energy budget share after 2020
2. Even when taking into account construction and refurbishment overcosts

Other determinants

- Fossil energy prices

	Year	low (-30%)	central	high (+30%)
GDP/corresponding reference	2030	+1.2%	+2.2%	+3.5%
	2050	-0.3%	+0.6%	+1.9%
CO2 emissions/1990	2020	-25%	-31%	-31%
	2050	-60%	-68%	-74%

- Industrial and consumption styles variants

2050	Reshoring	Decoupling	BTA	BTA + reshoring + decoupling
GDP/mitigation scenario	+0.6%	+1.9%	+0.6%	+2.3%
Emissions/1990	1.6%	-1.5%	-0.6%	-4.9%

BTA: Border Tax Adjustement

Methodological conclusions

- Methodological innovation
  - Successful integration of stakeholders' contributions
  - Opens discussion on transition and necessary steps
  - Replicable for development of official scenarios?
- Limits
  - Stakeholders' representativeness
  - Would need further iterations between modelers and stakeholders
- Proof by example

Policy recommendations

- Our “acceptable” scenario: CO2 emissions reduction /1990
  - 2020: -33% more ambitious than the -20% European Objective
  - 2050: -68% close but fail in reaching the Factor Four
- Additional measures necessary but less acceptable to reach the Factor Four?
  - Carbon-energy tax
  - Refurbishment obligation
  - ➢ -38% in 2020 and -73% in 2050
- Policies time-dependency
  - ➢ Pathway dependency: inertia vs. energy efficiency
- Responsibility of the government
  - Implement the measures needed to achieve climate objectives
  - Define the required compensations to overcome identified cleavages