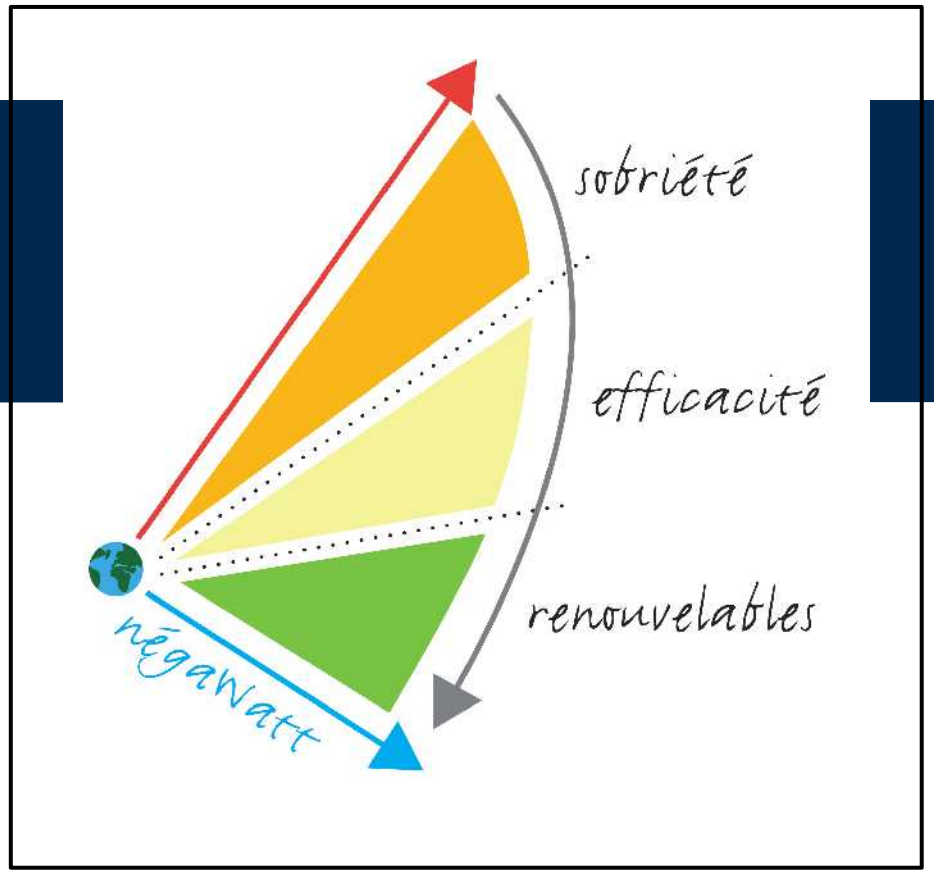
sobriété, efficacité, renouvelables

négaWatt 2011 scenario



Yves Marignac, néga Watt-France

Stakeholder Seminar : Engaging Civil Society in the 2050 EU Roadmap

25 October 2011, Brussels, Belgium

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

Low Carbon Societies Network

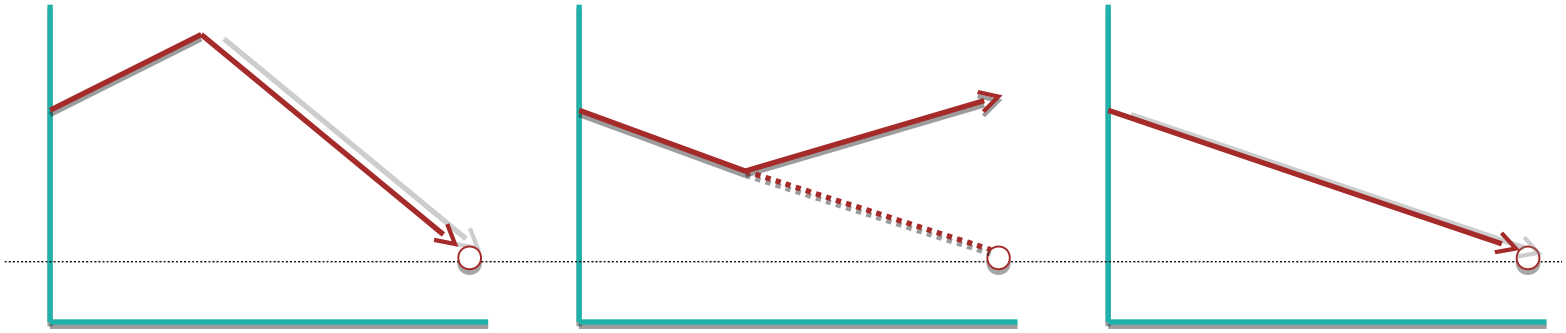
Fundamentals of the scenario

- A scenario of realistic and sustainable **energy transition**

- **1. Hierarchy of options**
  - First, action on energy demand through conservation and efficiency
  - Priority to the use of energies based on flows rather than stocks
  - Thus: no replacement of nuclear by nuclear, and no CCS
- **2. Techonological realism**
  - “Mature” solutions (i.e. at least industrially emerging)
  - Although knowing that ruptures will happen
  - A more robust trajectory still open to good surprises
- **3. Sustainable development**
  - Multicriteria analysis instead of “carbocentrism”
  - Aim for reducing the whole of risks and impacts arising from energy
  - *“Transfering revenues rather than debts to future generations”*

The need of a consistant trajectory

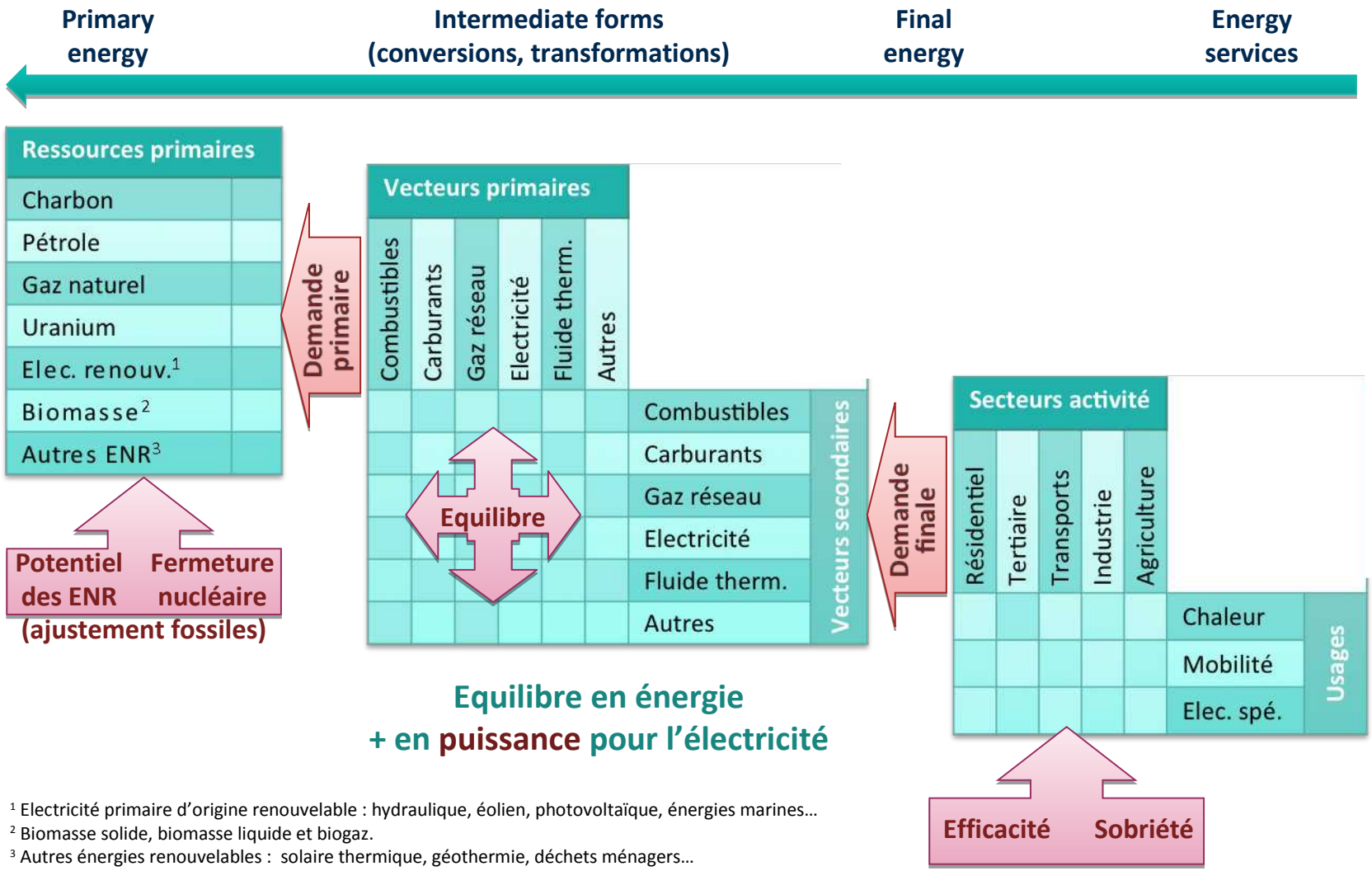
- A prospective analysis to bring long term concerns in short term decisions
- A combination of a long term vision
  and a trajectory to reach it starting with our current situation



Scénario type "Factor 4"- 2005 | **Scénario type "post-Grenelle"** | **Object of cohérence**

- A tool to project and quantify action:
  priorities, level of ambition, rhythm of policies
- An analysis consistant with physical constraints and realities:
  an energy model to question the economy and absolutely not the opposite!

Bottom-up energy and power model



Equilibre en énergie
+ en puissance pour l'électricité

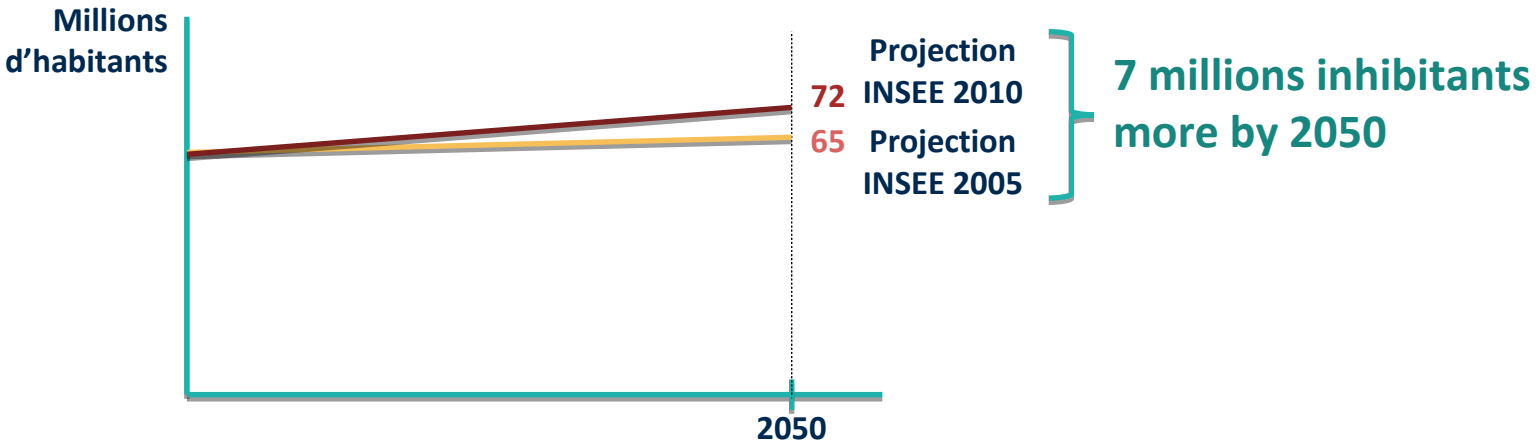
[1] Electricité primaire d'origine renouvelable : hydraulique, éolien, photovoltaïque, énergies marines…
[2] Biomasse solide, biomasse liquide et biogaz.
[3] Autres énergies renouvelables : solaire thermique, géothermie, déchets ménagers…

Framework hypothesis

- Base year (stats): 2010
  Horizon of the scenario: 2050

  5 years less to act while urgency grows

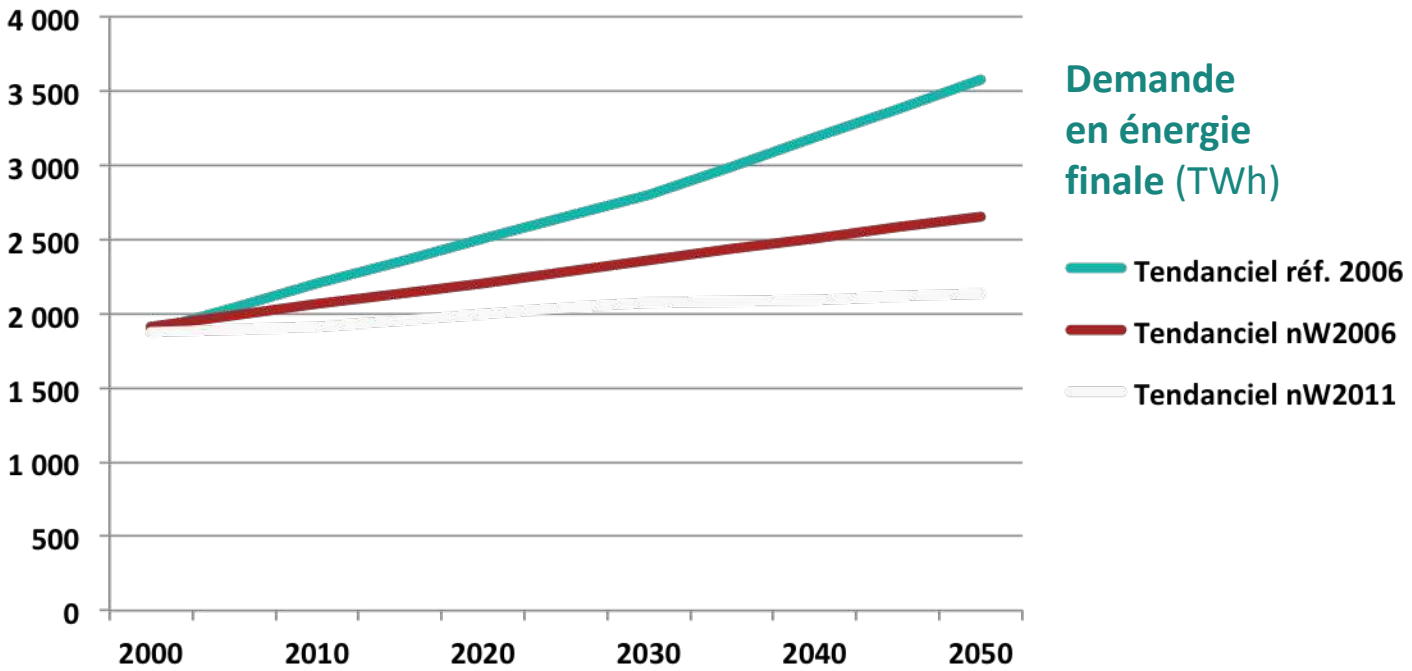
- No economic input (priority to analysing physical constraints and possibilities)
- Demography:



- Geographic basis:
  - Metropolitan France (Corse included, DOM-COM excluded)
  - Search for self-sufficiency / balance or excess of exchanges

Trend scenario

- A basis for comparison of the négaWatt 2011 scenario with the alternative
- Revised “trend” or “business-as-usual” scenario:
  - demand: quasi-stabilisation post economic crisis and post “Grenelle”
  - production: stability of nuclear capacity, slow development of renewables



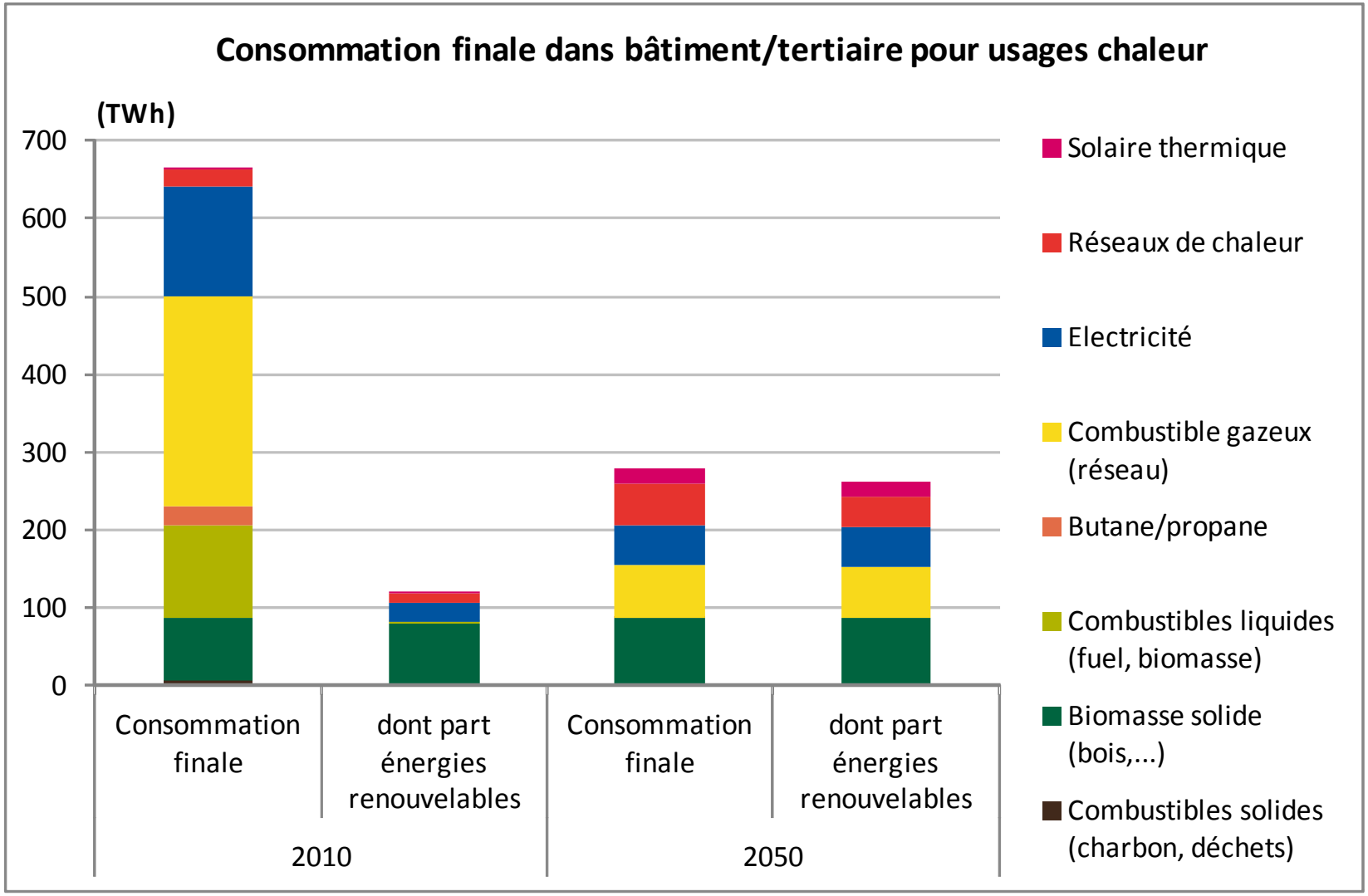
négaWatt 2011
Energy consumption

Buildings / heat
Buildings / specific electricity
Transports / people
Transports / goods
Industry
Agriculture

Heat in buildings

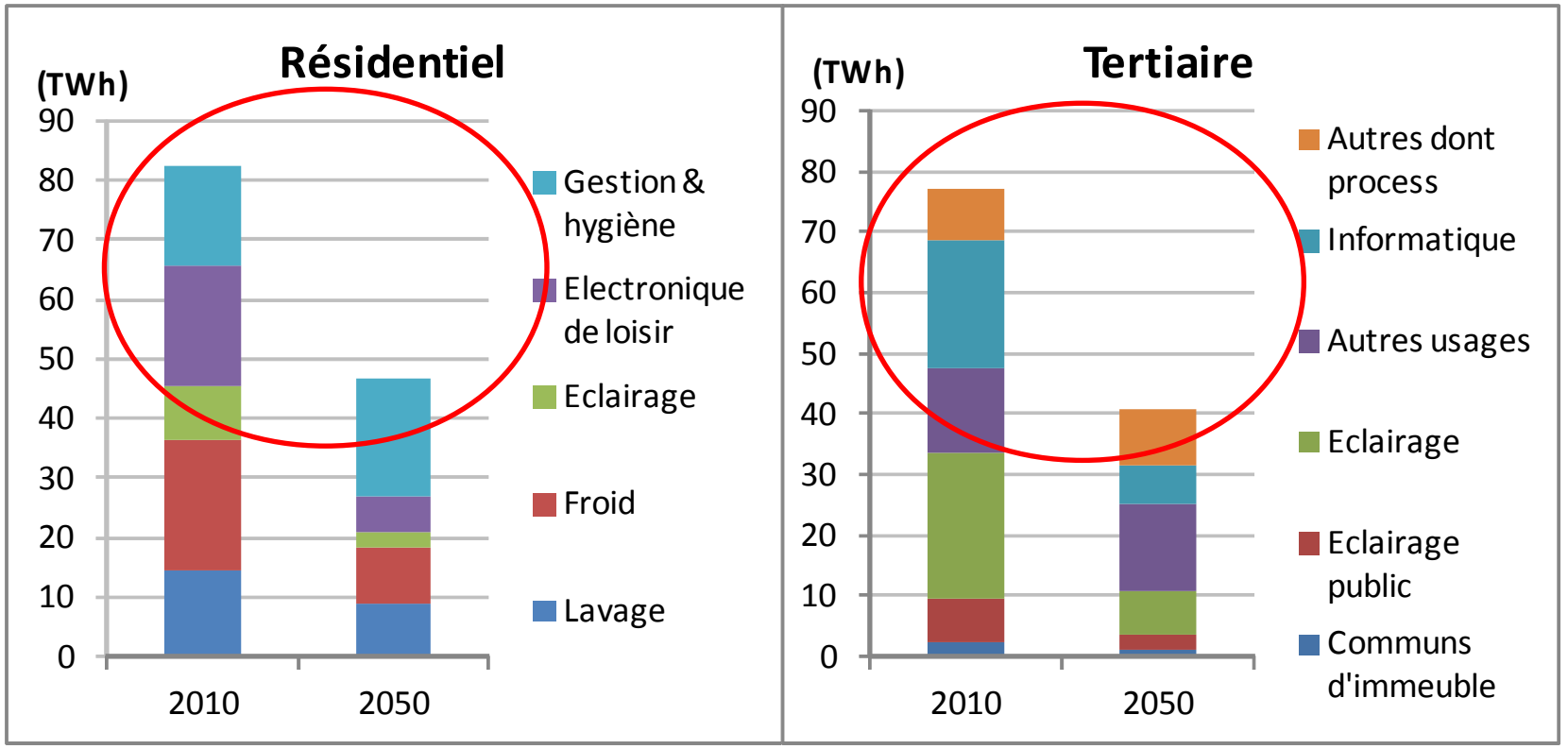
- Reduced increase of surface per person in housings (less de-cohabitation and priority to small collective housing) and tertiary sector
- For new buildings, application of best available technologies to reduce grey energy and reach less than 15 kWh/m^2 per year of primary energy for heat uses
- Progressive but massive programme of thermal retrofitting of existing buildings to reach the equivalent of 1 million operations per year by 2025 with a performance of:
  - 50 kWh/m2 (PE) per year for heating
  - 25 kWh/m2 (PE) for hot water
- Changes of heat and hot water systems, substitution by renewables when possible, reaching coverage of 94% of the needs by 2050, including solid biomass, biogas, renewable based heat pumps and thermal solar

Energy substitutions in heat for buildings



Specific electricity uses

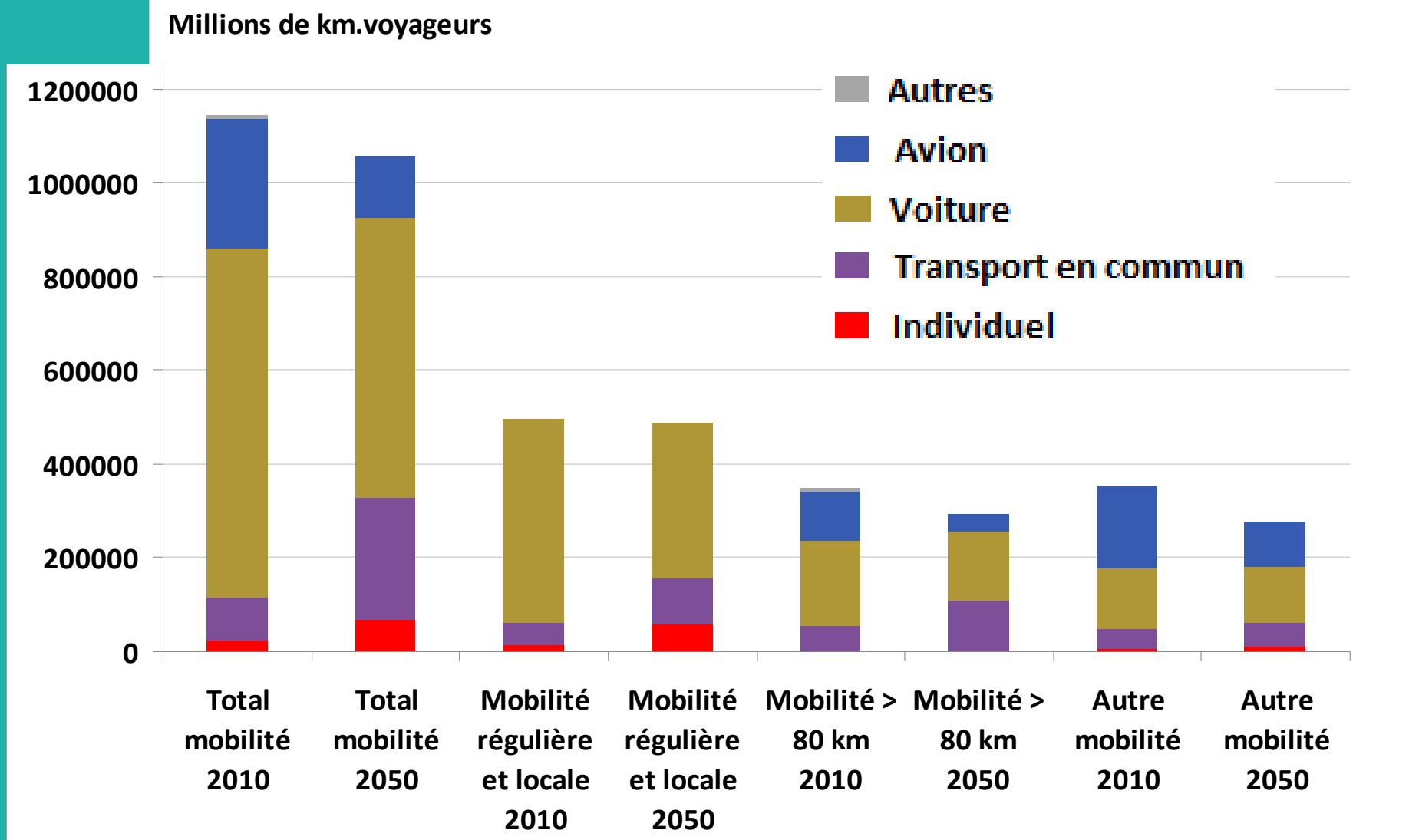
- Total electric consumption for specific uses can be divided by 2 by 2050 in residential and tertiary sectors:
  - based on generalisation of best observed current practices
  - including > 15% margin for unknown new uses



Sustainable evolution of transports

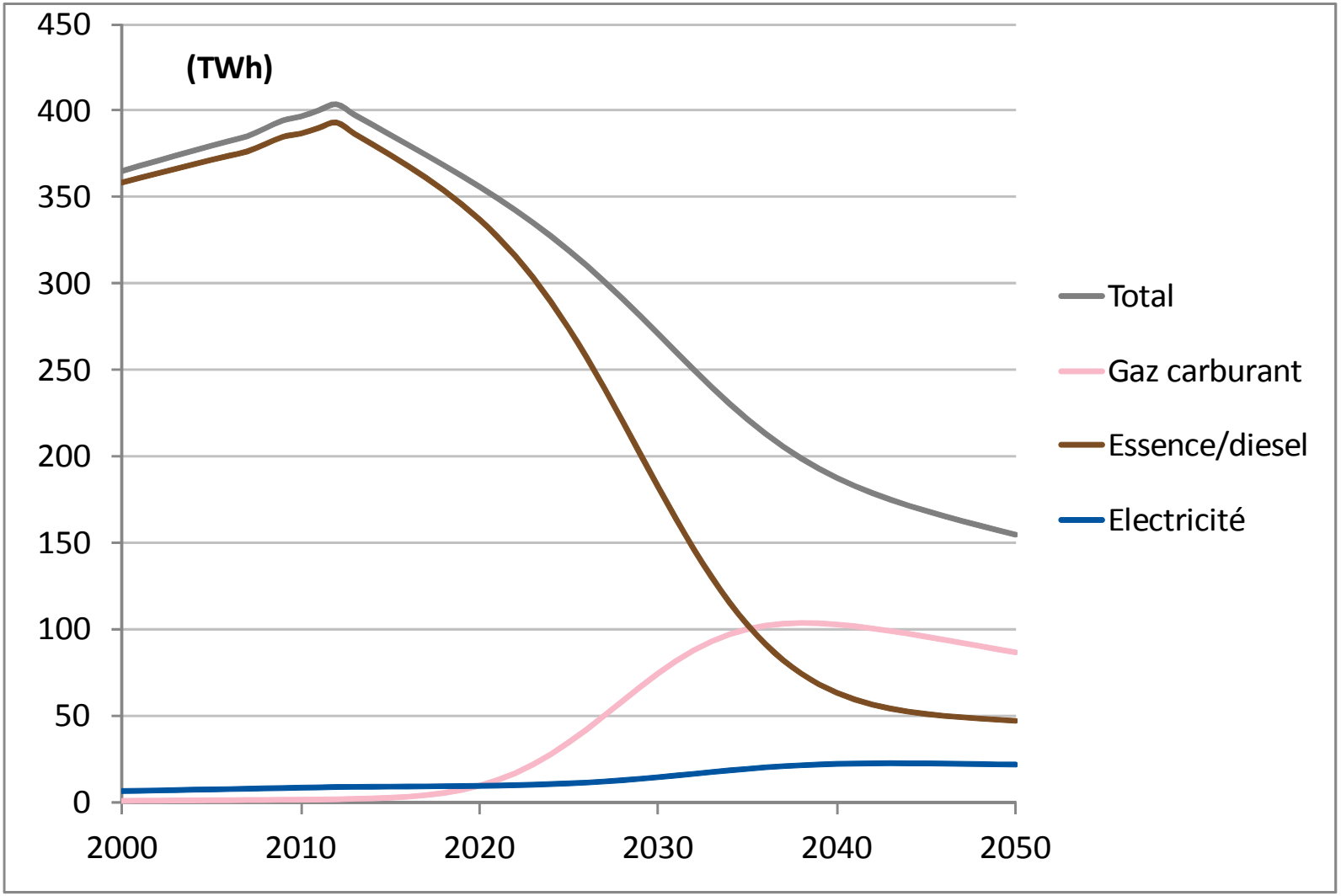
- Analysis of needs for mobility and solutions depending on the use, the distance, and the availibility of transports options (from most urban to most rural)
- Integration of factors for *sobriety*, including urban planning (reducing distances needed for the same service), reorganisation of services and production and distribution networks
- Modal transfer (individual car from 63% to 42% of km.cap, reduction of 38% of the share of road transport for goods)
- Evolution of cars towards electric cars for urban use and gas vehicle (fueled with biogas) for other needs
- Increased efficiency of engines and generalization of hybrid vehicles

Evolution of people's mobility



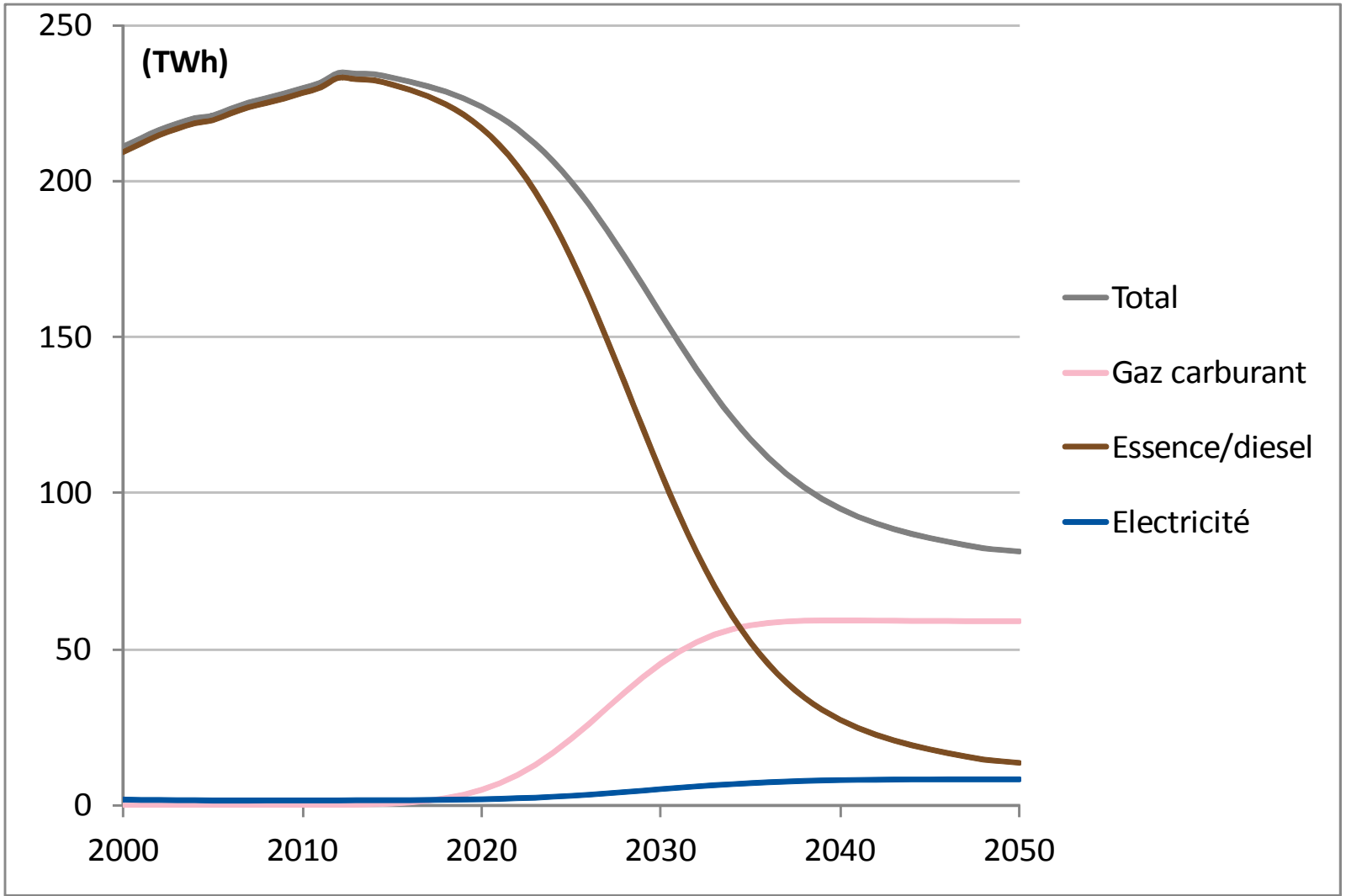
Energy for mobility of persons

Évolution des consommations d'énergie



Energy for the transport of goods

- Évolution des consommations d'énergie

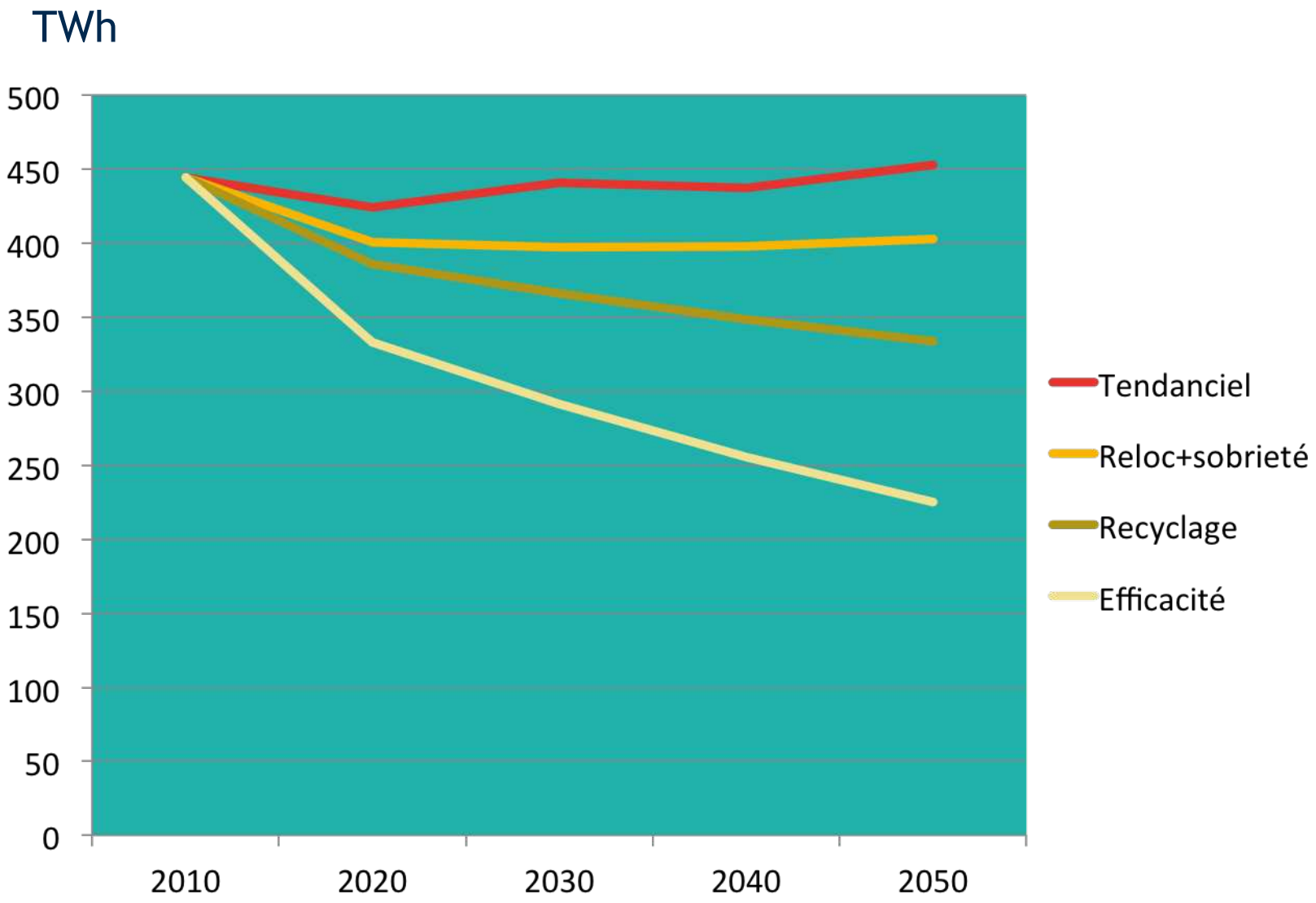


Sustainable reorganisation of the industry

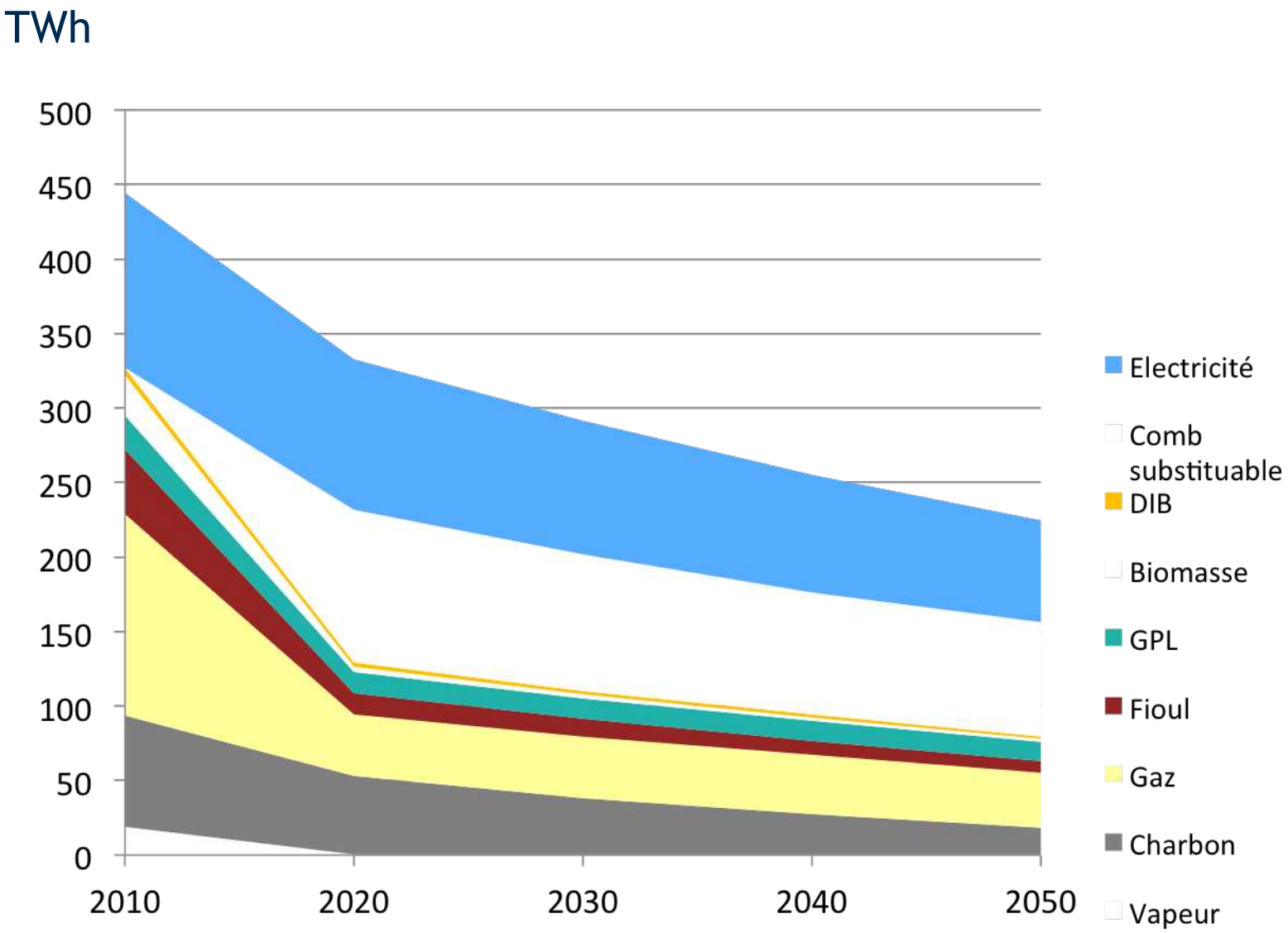
- Combining *sobriety* (level of consumption, use of goods, recycling…) and efficiency (processes, engines, CHP, recycling…) plus substituting renewables where it is possible
- Starting from needs of goods, then the needs of crude materials (connected to the evolution of other sectors)
- Relocate productions when possible, and adapt production to the needs
- Focus on recycling

	Taux de collecte 2010	Taux de recyclage 2010	Taux de recyclage prévu en 2050
Acier	74%	52%	90%
Aluminium	44%	37%	86%
Verre	35%	35%	90%
Plastiques	15%	4,5%	30%
Papier carton	70%	60%	80%

Eneergy consumptiom of the industry

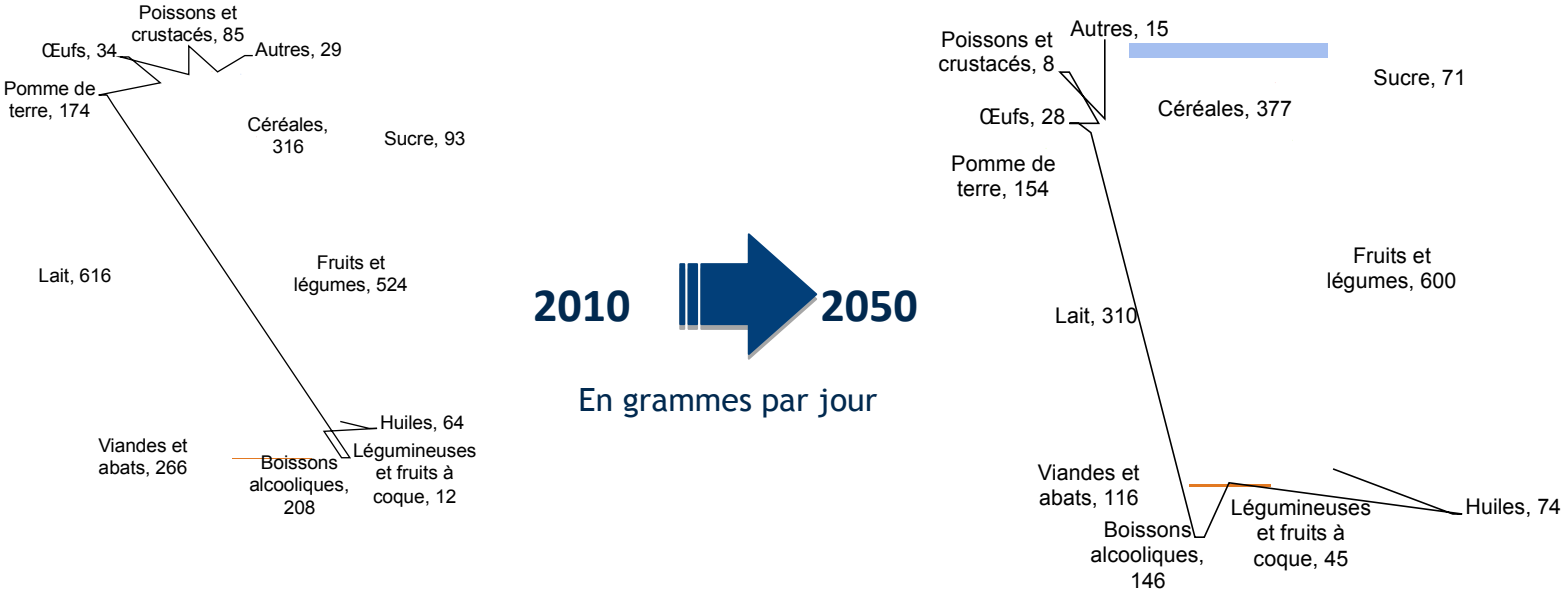


Energy substitution in the industry



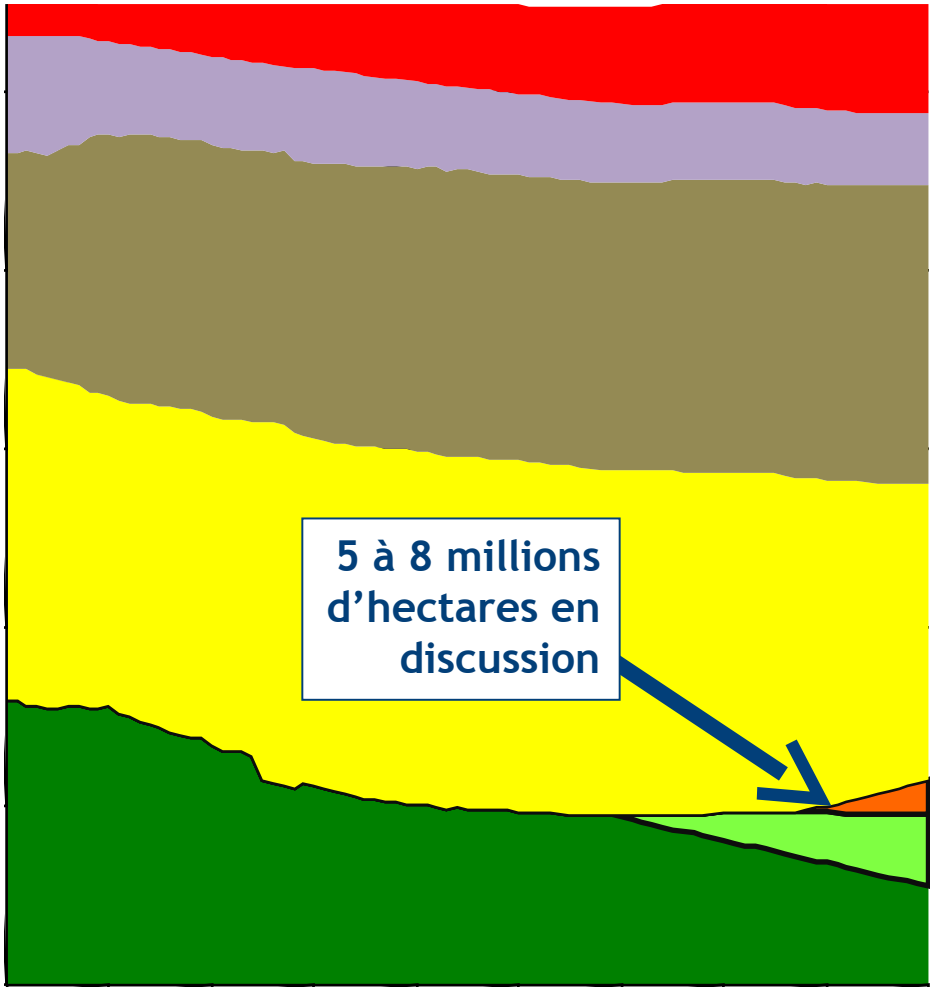
Sustainable agriculture scenario

- Combined approach with **Afterres 2050**, agriculture scenario by Solagro
- Sustainable approach to the uses of biomass (food, soil, energy, materials) starting with a change towards a better balanced everyday diet



- Development of integrated and biological agriculture (50/50% by 2050)
- Reduction of overconsumption, optimisation of uses, reuse of waste

Global approach of land use



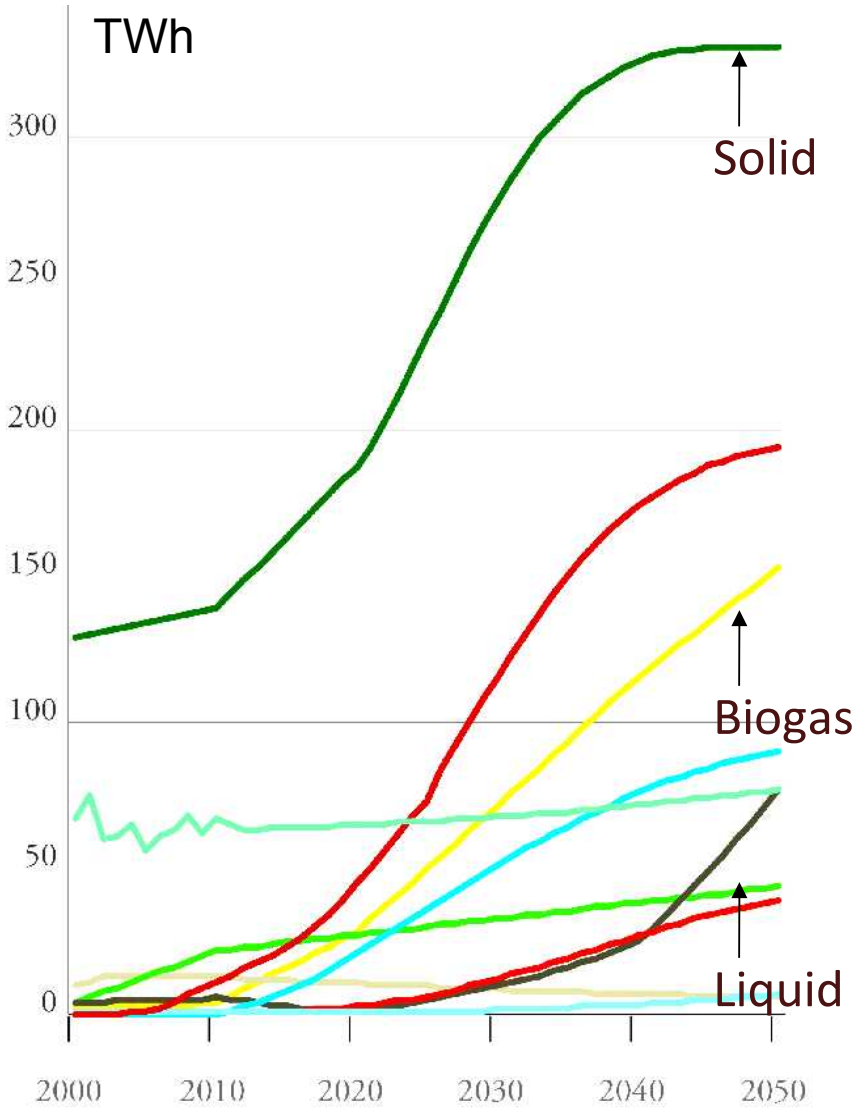
sobriété, efficacité, renouvelables

négaWatt

négaWatt 2011
Energy production

Biomass
Electric renewables
Nuclear
Fossil fuels
Balance of power

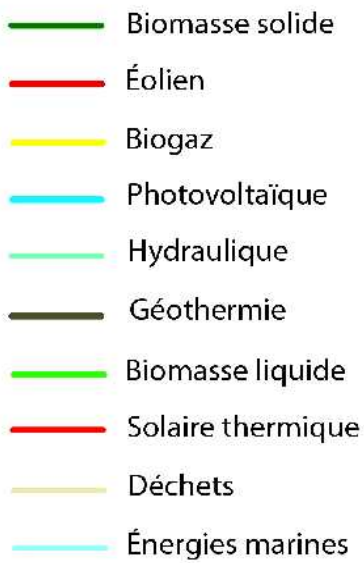
Energy from biomass



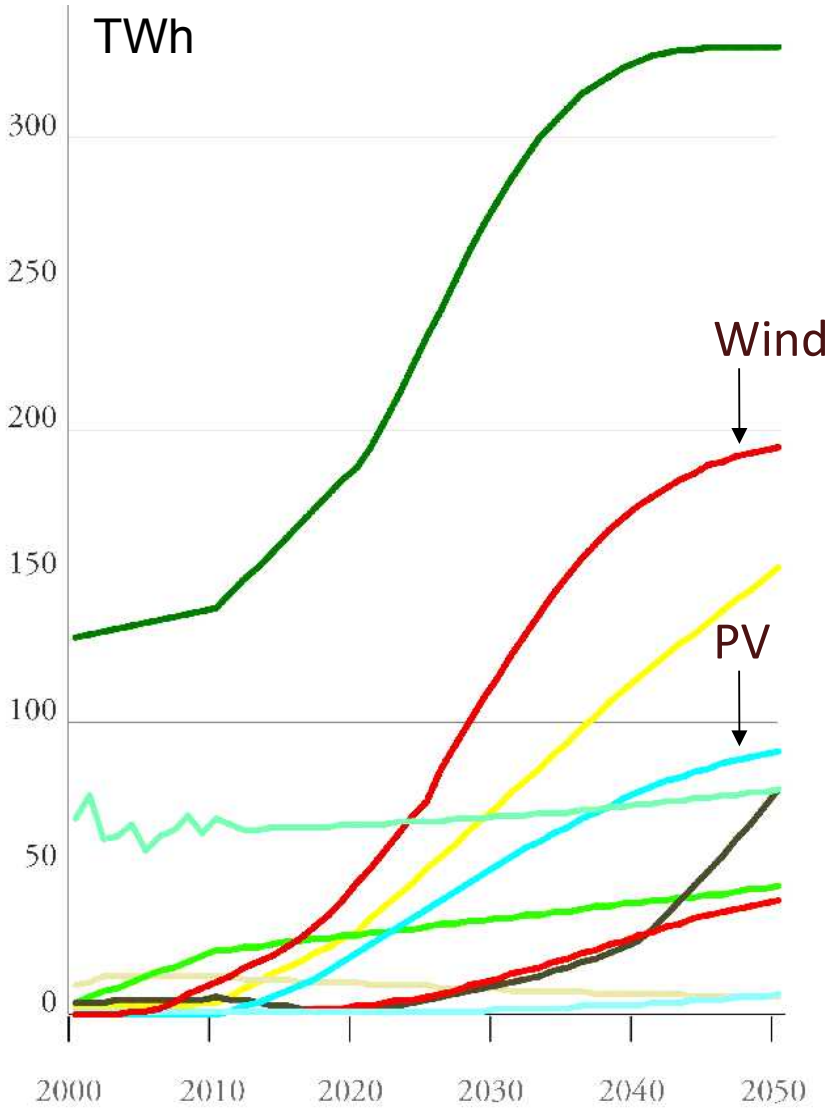
Total in 2050: 519 TWh

Includes:

- 296 TWh solid biomass
- 153 TWh biogas
- 44 TWh liquid biomass



Electric renewables



Total in 2050: 347 TWh

Includes:

- 194 TWh wind
  (½ land, ½ offshore)
- 90 TWh photovoltaics

Biomasse solide
Éolien
Biogaz
Photovoltaïque
Hydraulique
Géothermie
Biomasse liquide
Solaire thermique
Déchets
Énergies marines

Non replacement of nuclear reactors

- Role of nuclear power in the French energy balance
  - < 16% of final energy consumption
  - > 75% of electricity generation

  + risk of substitution by carbon electricity

  Energy constraint

- An energy with specific risks
  - major accident
  - accumulation of long-lived waste
  - proliferation and security

  + a growing problem with ageing of reactors

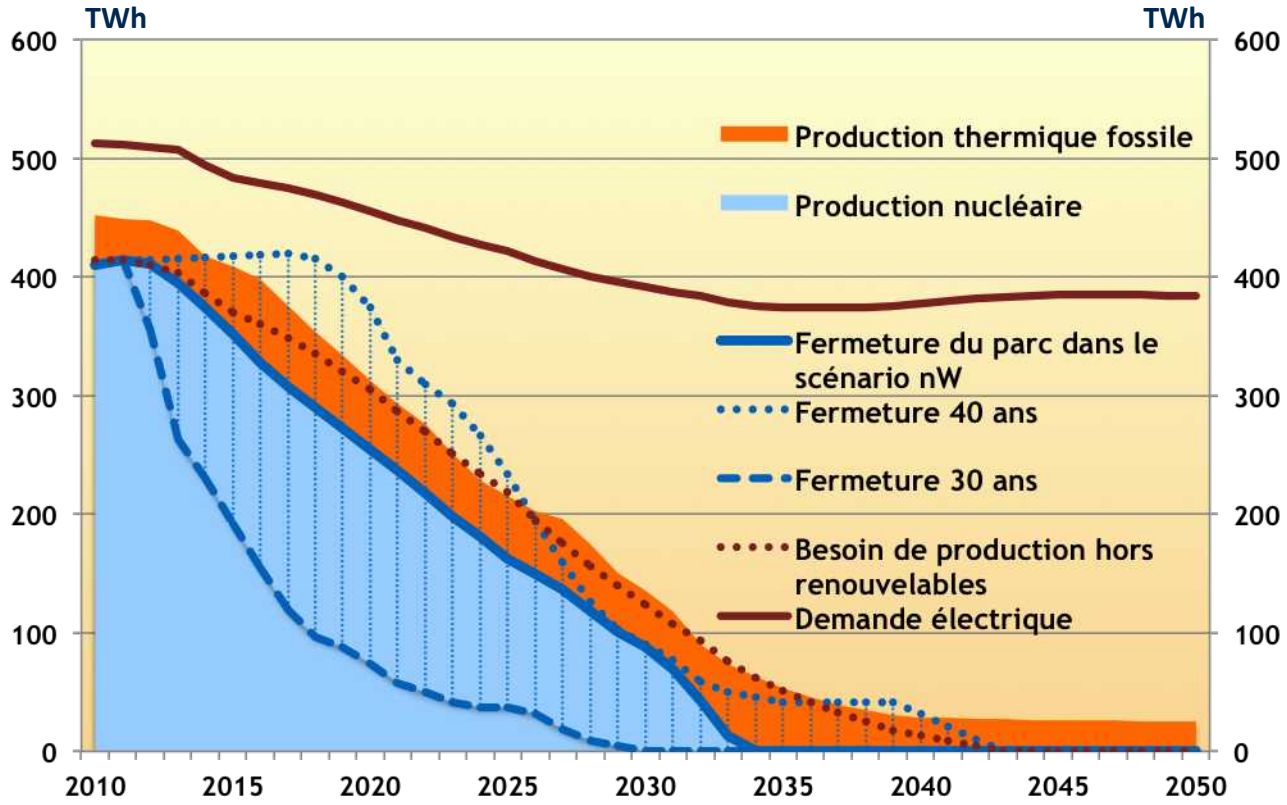
  Safety constraint

- 58 reactors and an industrial complex
  - fuel “cycle” plants
  - public R&D support
  - assessment and control system

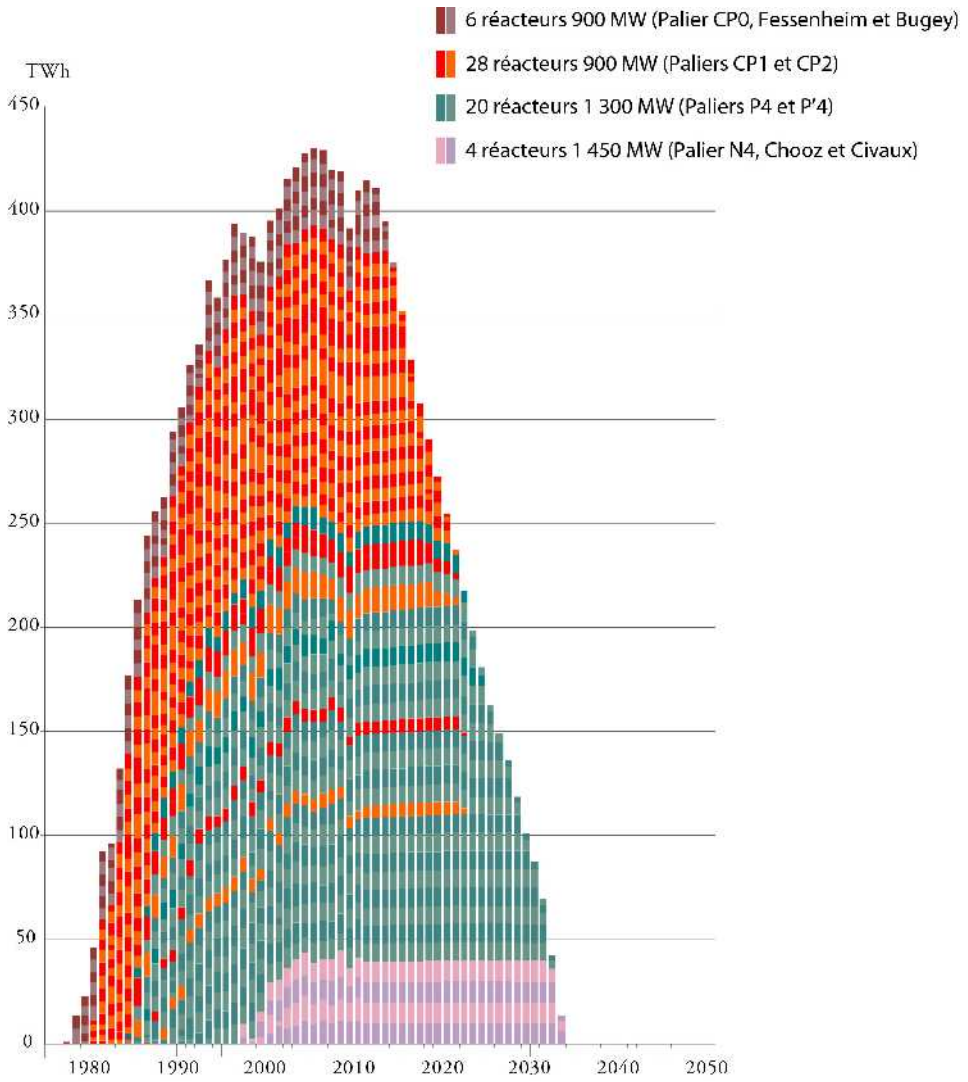
  Industrial constraint

Crossing of constraints

- Priority to energy shift then > 2025 safety “bottleneck”
- Moderate and regular use of gas for transition
- Phase-out of last reactors under industrial constraints



Nuclear phase-out in 22 years



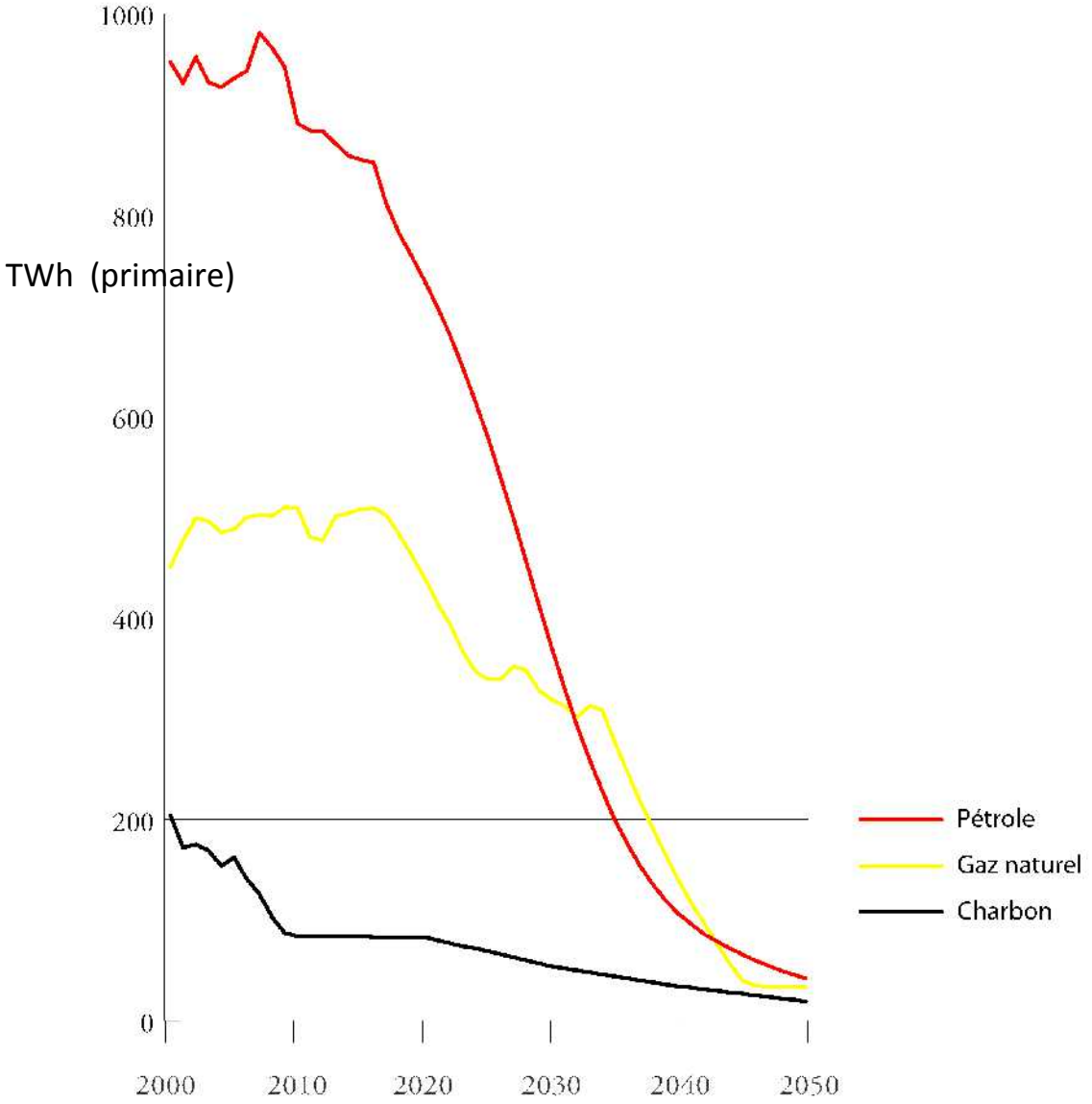
3 500 MW / year

2 500 MW / year

4 500 MW / year

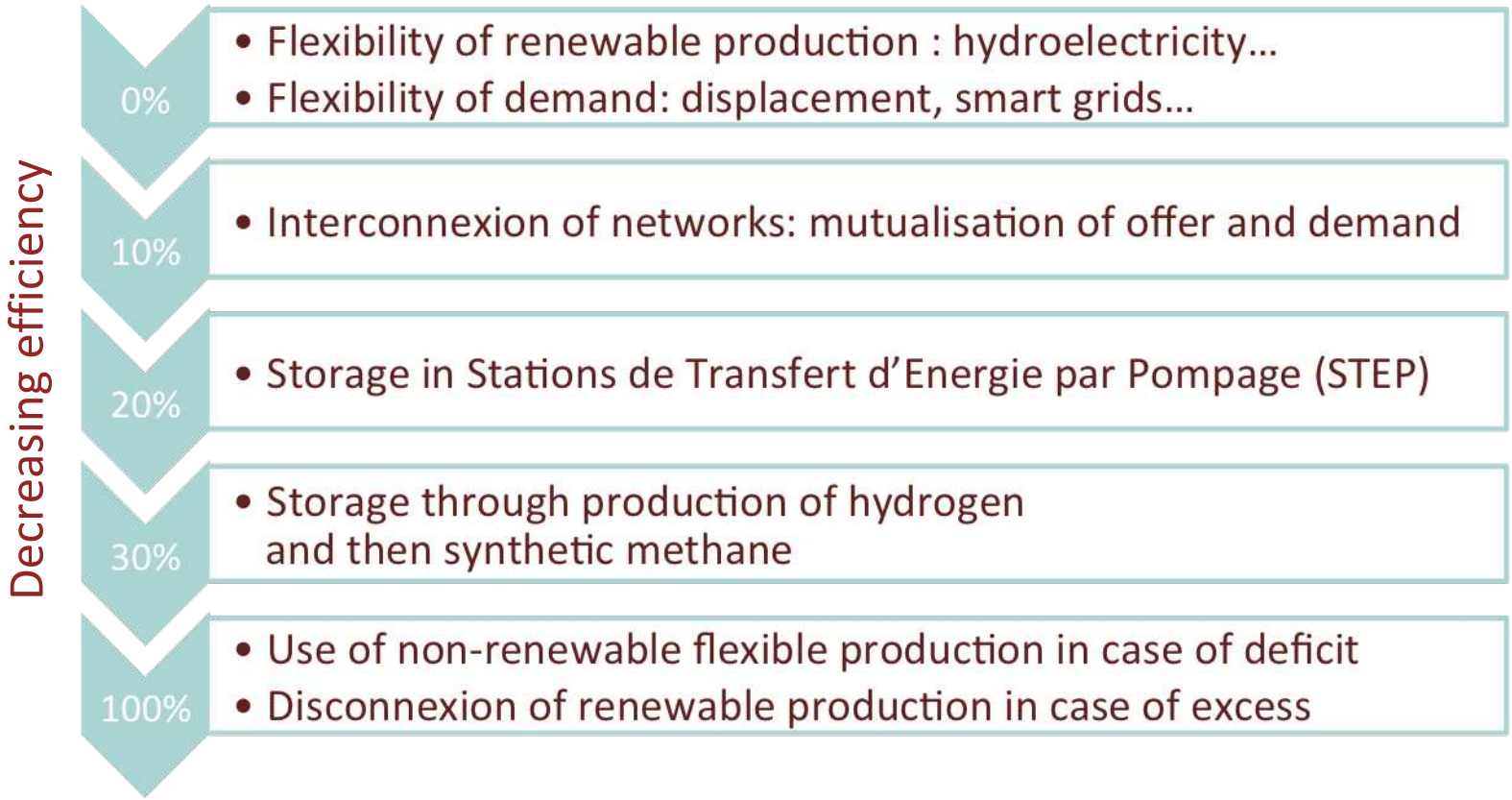
Reduction of fossil fuel

- Reducing the use of fossil fuel mostly to the hardliest replacable uses (e.g. chemistry, iron industry, planes…)
- Division by 14 of the total use of fossil energy



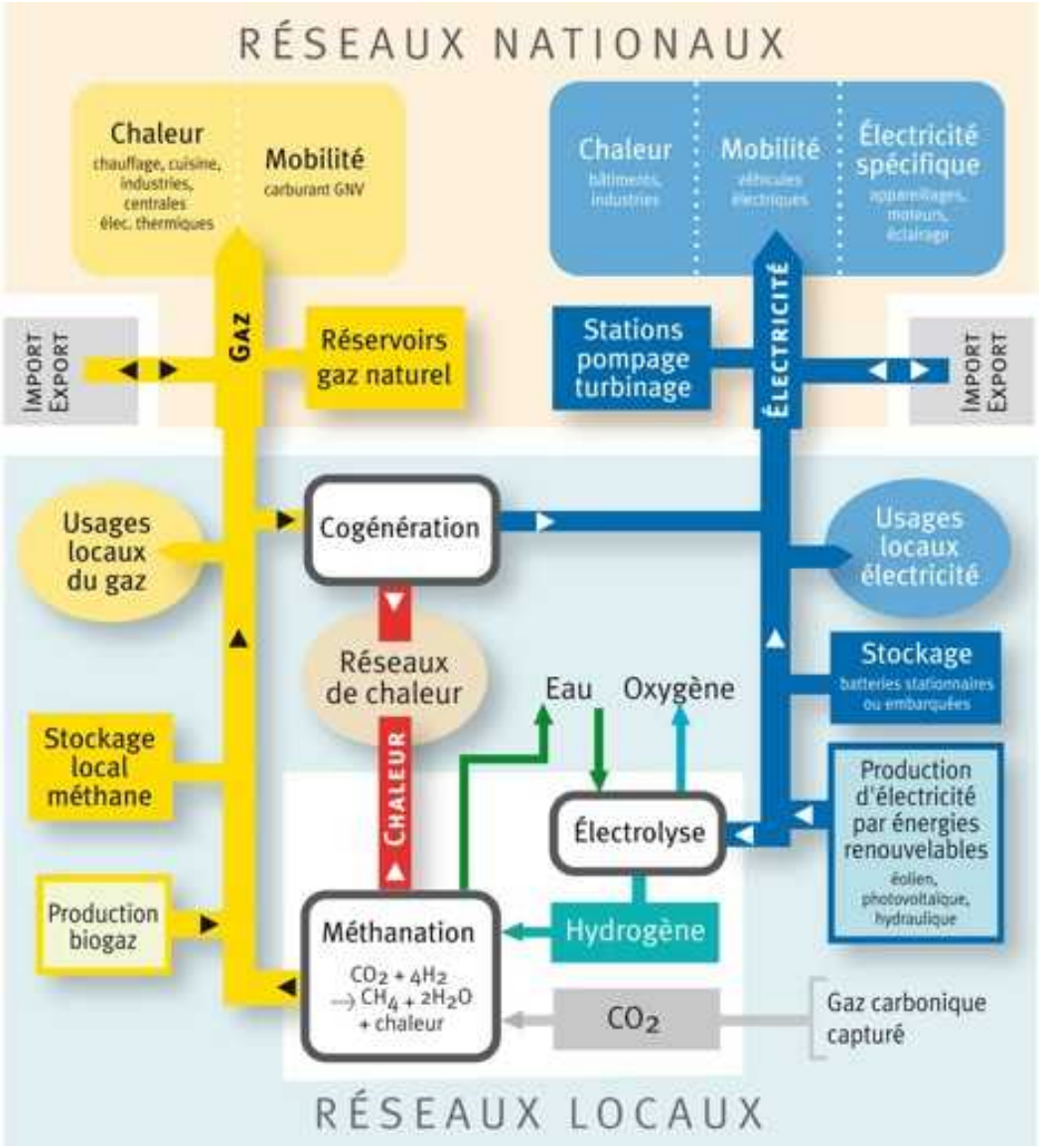
Keeping the electricity balance

- The model checks hour per hour, year by year, balance between electric production and consumption by combining various options, by order of merit:



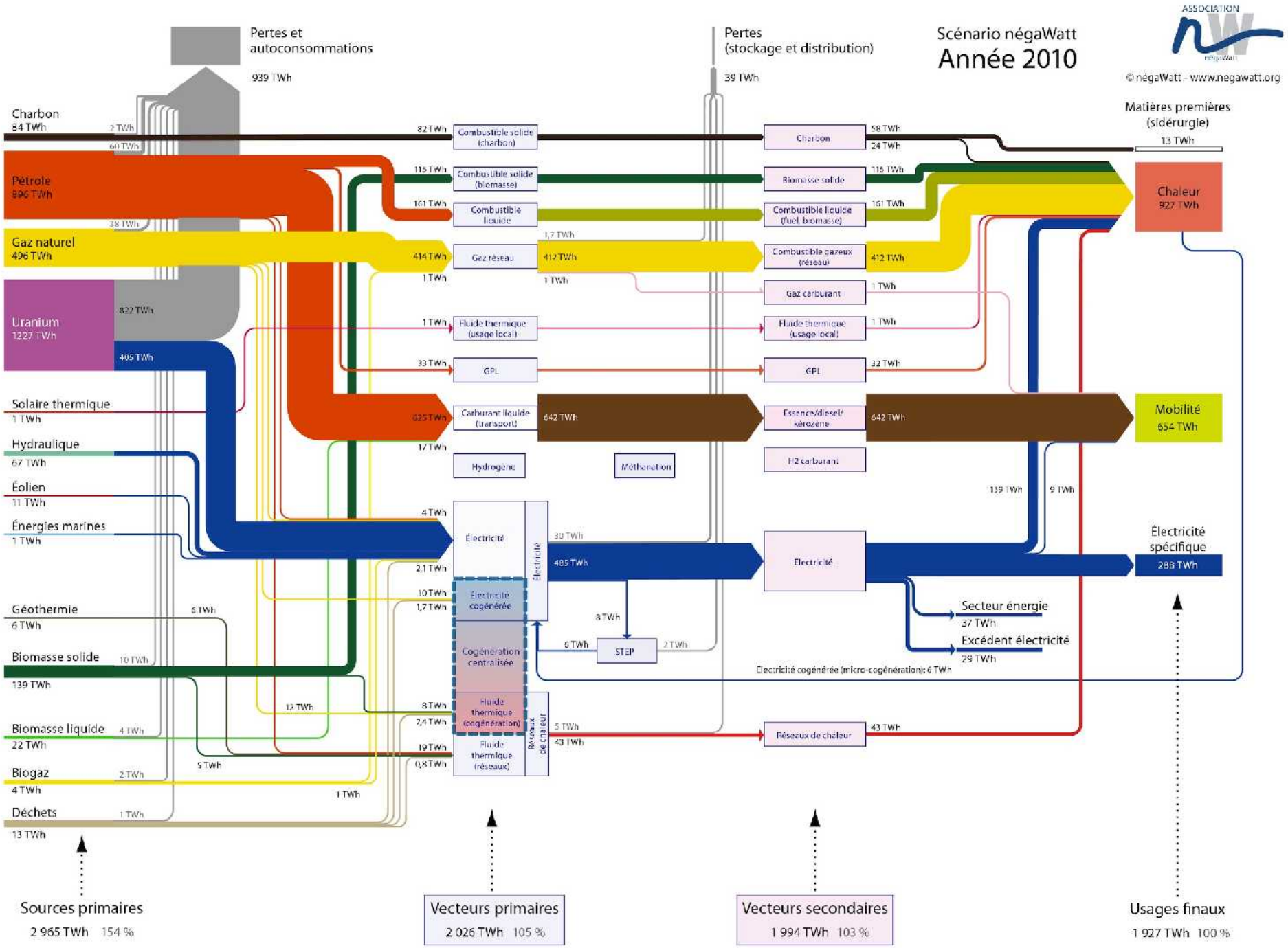
Smart use of networks

- Flexibility of sources and uses of electricity
- Flexibility of sources and uses of (bio)gas
- Combination of gas and electricity networks



négaWatt 2011
Global balance and conclusion

Balance per use
Primary energy balance
CO_2 balance
Conclusion


Scénario négaWatt
Année 2010
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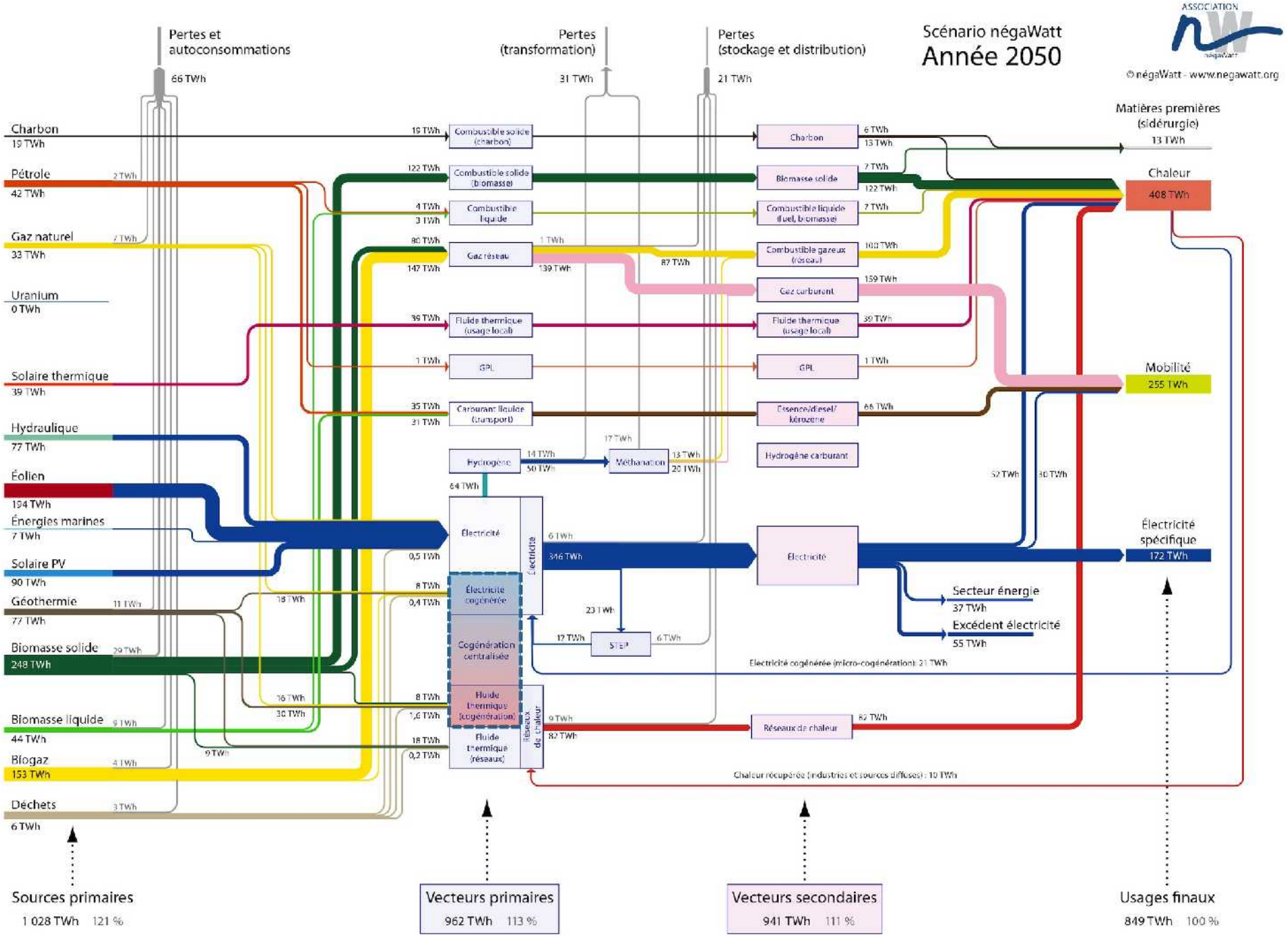
Pertes et autoconsommations
939 TWh
Pertes (stockage et distribution)
39 TWh
Charbon 84 TWh
Pétrole 896 TWh
Gaz naturel 496 TWh
Uranium 1227 TWh
Solaire thermique 1 TWh
Hydraulique 67 TWh
Éolien 11 TWh
Énergies marines 1 TWh
Géothermie 6 TWh
Biomasse solide 139 TWh
Biomasse liquide 22 TWh
Biogaz 4 TWh
Déchets 13 TWh
Combustible solide (charbon)
Combustible solide (biomasse)
Combustible liquide
Gaz réseau
Fluide thermique (usage local)
GPL
Carburant liquide (transport)
Hydrogène
Méthanation
Électricité
Électricité cogénérée
Cogénération centralisée
Fluide thermique (cogénération)
Fluide thermique (réseaux)
Réseaux de chaleur
STEP
Charbon
Biomasse solide
Combustible liquide (fuel, biomasse)
Combustible gazeux (réseau)
Gaz carburant
Fluide thermique (usage local)
GPL
Essence/diesel/ kérozène
H2 carburant
Électricité
Réseaux de chaleur
Matières premières (sidérurgie)
13 TWh
Chaleur 927 TWh
Mobilité 654 TWh
Électricité spécifique 288 TWh
Secteur énergie 37 TWh
Excédent électricité 29 TWh
Électricité cogénérée (micro-cogénération): 6 TWh
Sources primaires
2 965 TWh 154 %
Vecteurs primaires
2 026 TWh 105 %
Vecteurs secondaires
1 994 TWh 103 %
Usages finaux
1 927 TWh 100 %


Scénario négaWatt
Année 2050
ASSOCIATION négaWatt
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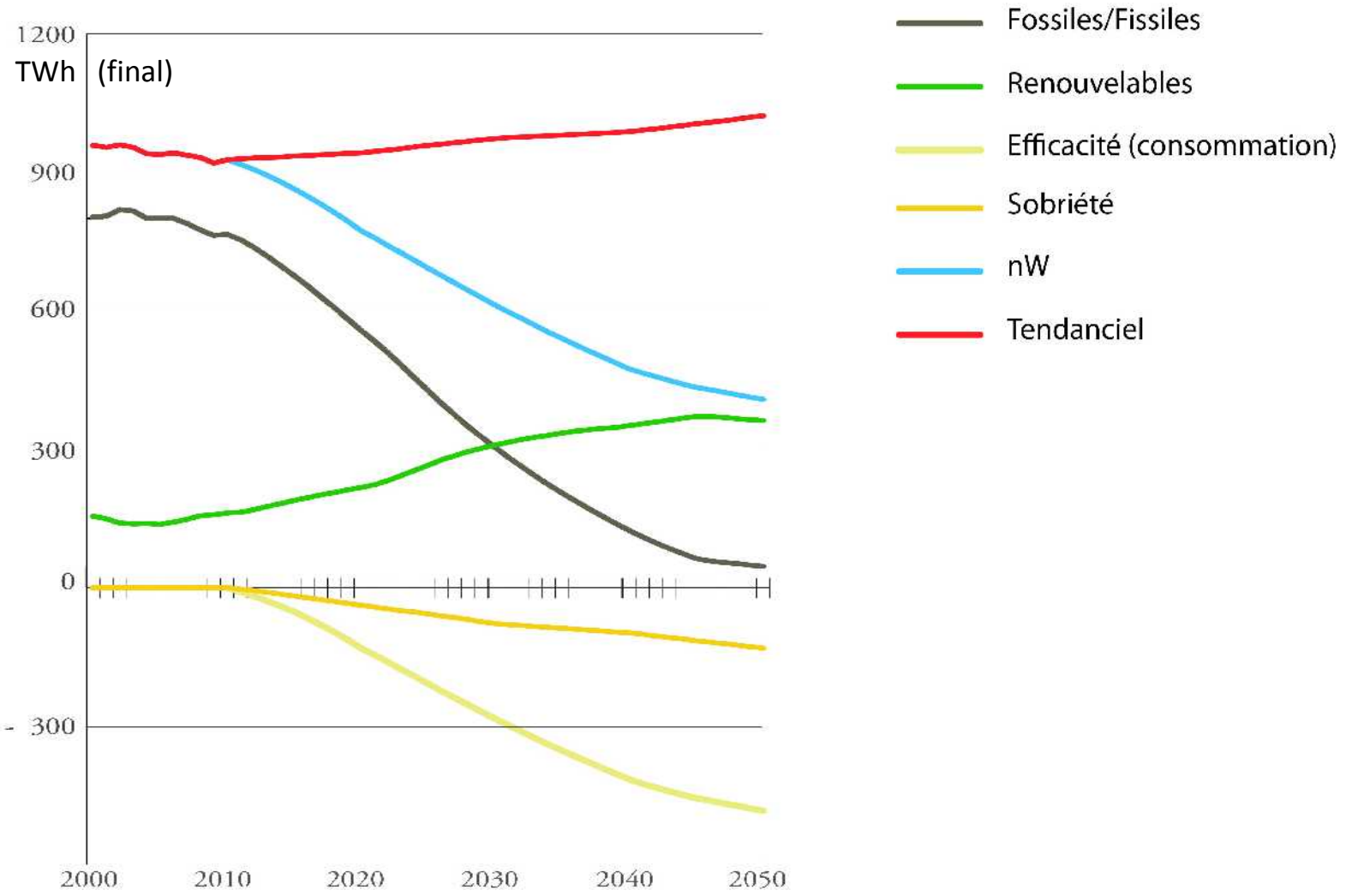
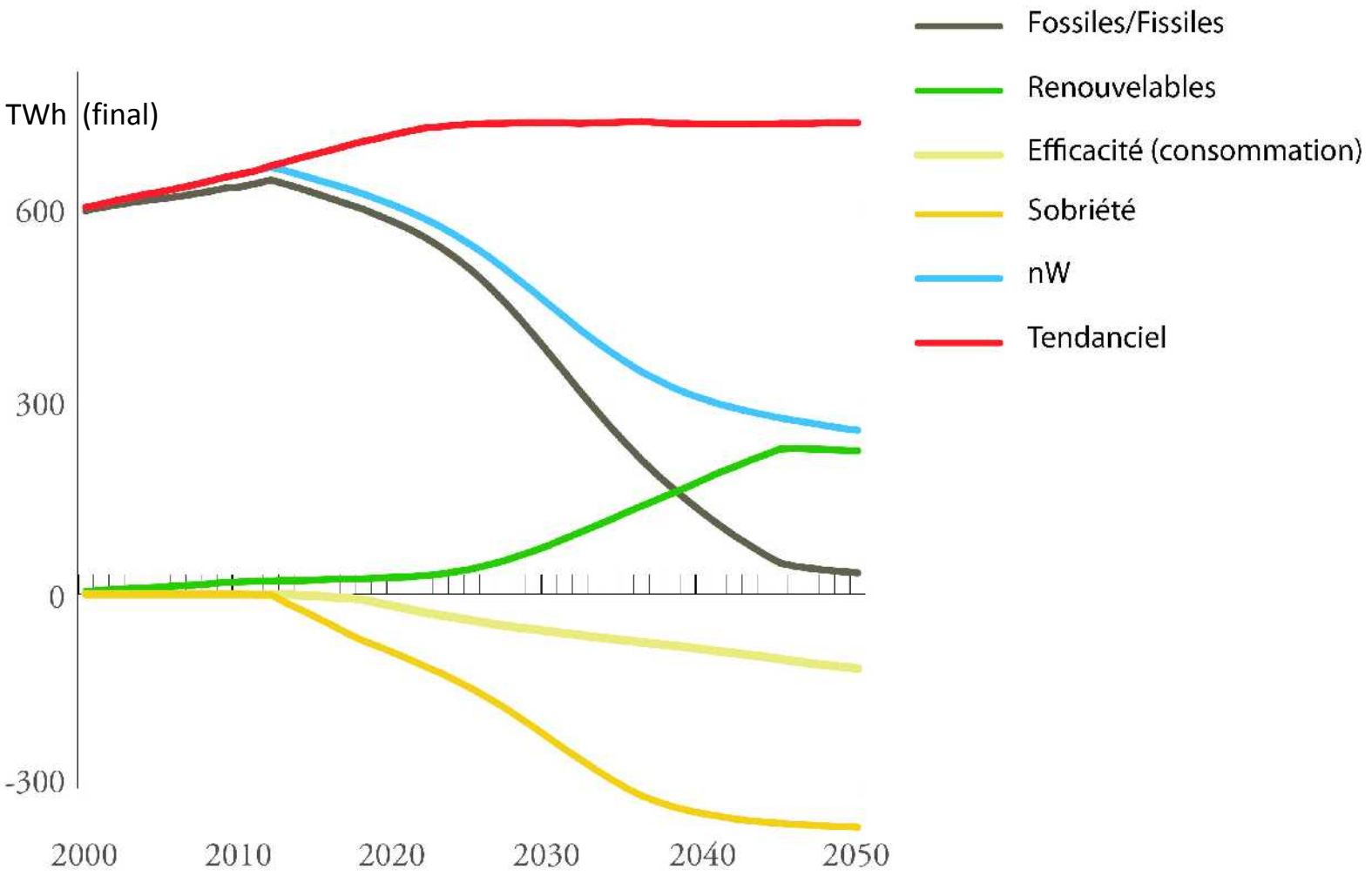
Pertes et autoconsommations
66 TWh
Pertes (transformation)
31 TWh
Pertes (stockage et distribution)
21 TWh
Charbon
19 TWh
Pétrole
42 TWh
2 TWh
Gaz naturel
33 TWh
2 TWh
Uranium
0 TWh
Solaire thermique
39 TWh
Hydraulique
77 TWh
Éolien
194 TWh
Énergies marines
7 TWh
Solaire PV
90 TWh
Géothermie
77 TWh
11 TWh
Biomasse solide
248 TWh
29 TWh
Biomasse liquide
44 TWh
9 TWh
Biogaz
153 TWh
4 TWh
Déchets
6 TWh
3 TWh
19 TWh
Combustible solide (charbon)
122 TWh
Combustible solide (biomasse)
4 TWh
3 TWh
Combustible liquide
80 TWh
147 TWh
Gaz réseau
1 TWh
139 TWh
39 TWh
Fluide thermique (usage local)
1 TWh
GPL
35 TWh
31 TWh
Carburant liquide (transport)
17 TWh
Hydrogène
14 TWh
50 TWh
Méthanation
13 TWh
20 TWh
64 TWh
Électricité
0,5 TWh
Électricité cogénérée
8 TWh
0,4 TWh
Cogénération centralisée
8 TWh
1,6 TWh
Fluide thermique (cogénération)
18 TWh
0,2 TWh
Fluide thermique (réseaux)
Électricité
Réseaux de chaleur
18 TWh
16 TWh
30 TWh
9 TWh
Charbon
6 TWh
13 TWh
Biomasse solide
7 TWh
122 TWh
Combustible liquide (fuel, biomasse)
7 TWh
Combustible gazeux (réseau)
100 TWh
87 TWh
Gaz carburant
159 TWh
Fluide thermique (usage local)
39 TWh
GPL
1 TWh
Essence/diesel/kérozène
66 TWh
Hydrogène carburant
6 TWh
346 TWh
Électricité
23 TWh
12 TWh
STEP
6 TWh
9 TWh
82 TWh
Réseaux de chaleur
82 TWh
Électricité cogénérée (micro-cogénération) : 21 TWh
Chaleur récupérée (industries et sources diffuses) : 10 TWh
52 TWh
30 TWh
Matières premières (sidérurgie)
13 TWh
Chaleur
408 TWh
Mobilité
255 TWh
Électricité spécifique
172 TWh
Secteur énergie
37 TWh
Excédent électricité
55 TWh
Sources primaires
1 028 TWh 121 %
Vecteurs primaires
962 TWh 113 %
Vecteurs secondaires
941 TWh 111 %
Usages finaux
849 TWh 100 %

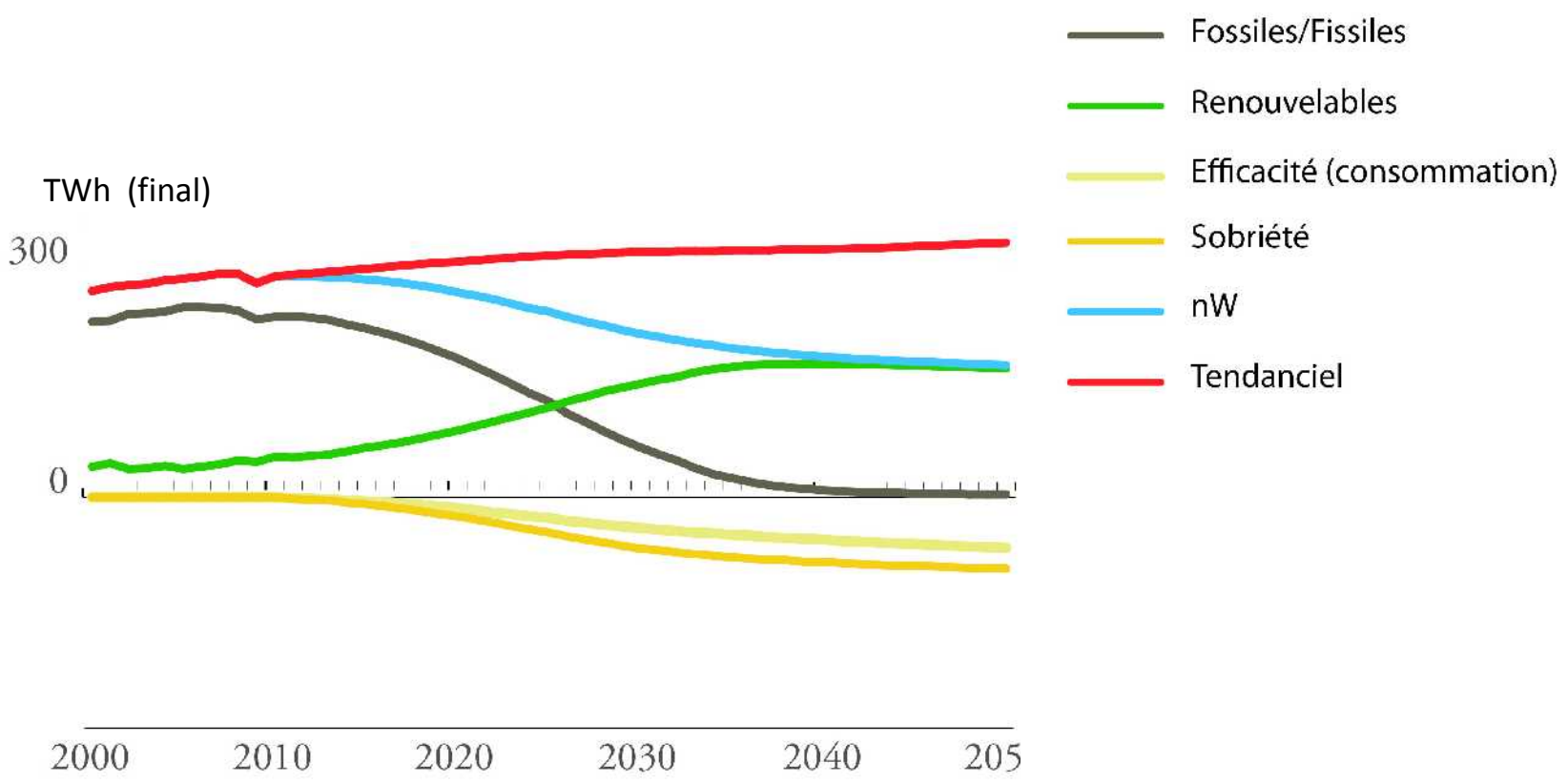
Heat services balance



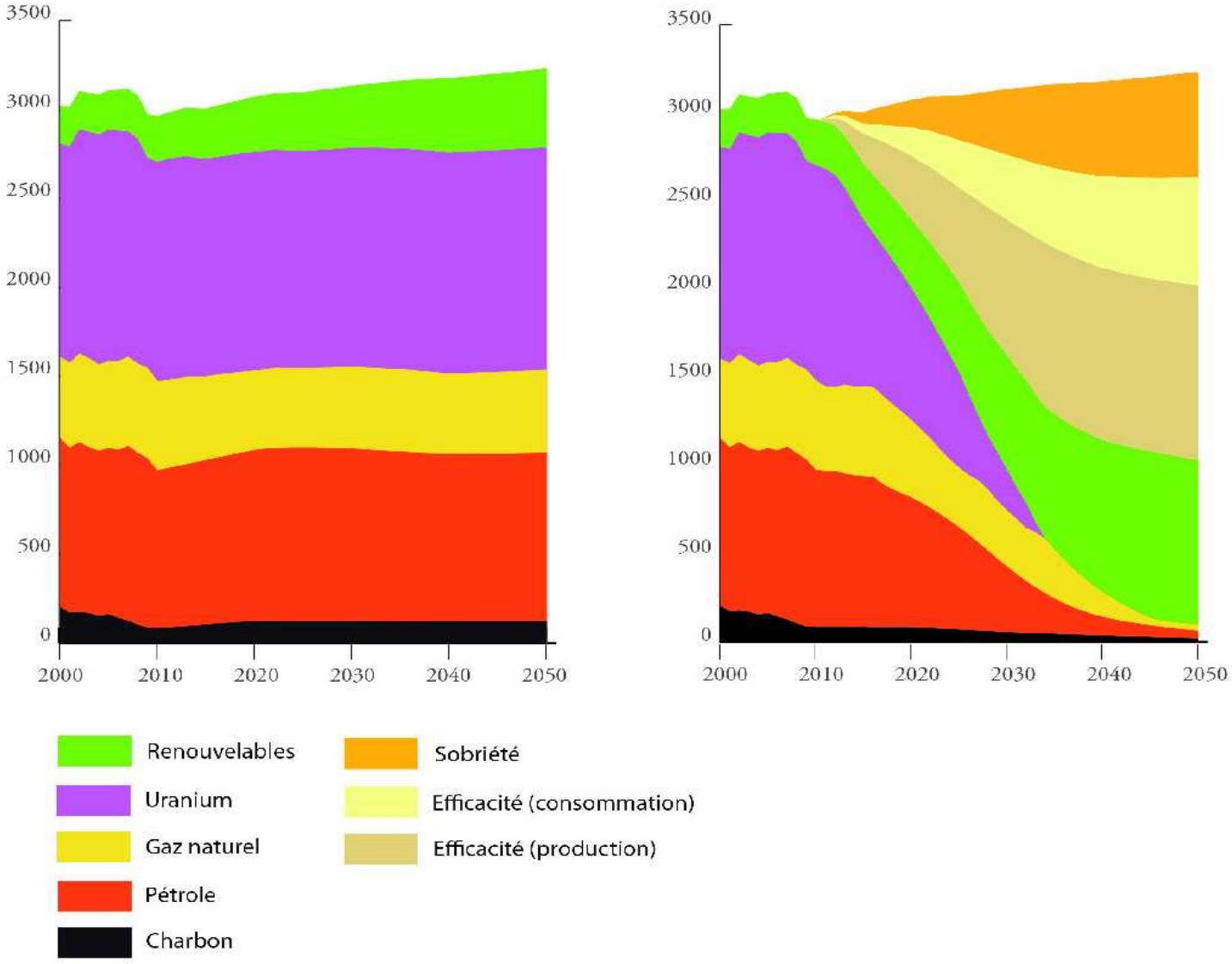
Mobility services balance



Specific electricity balance

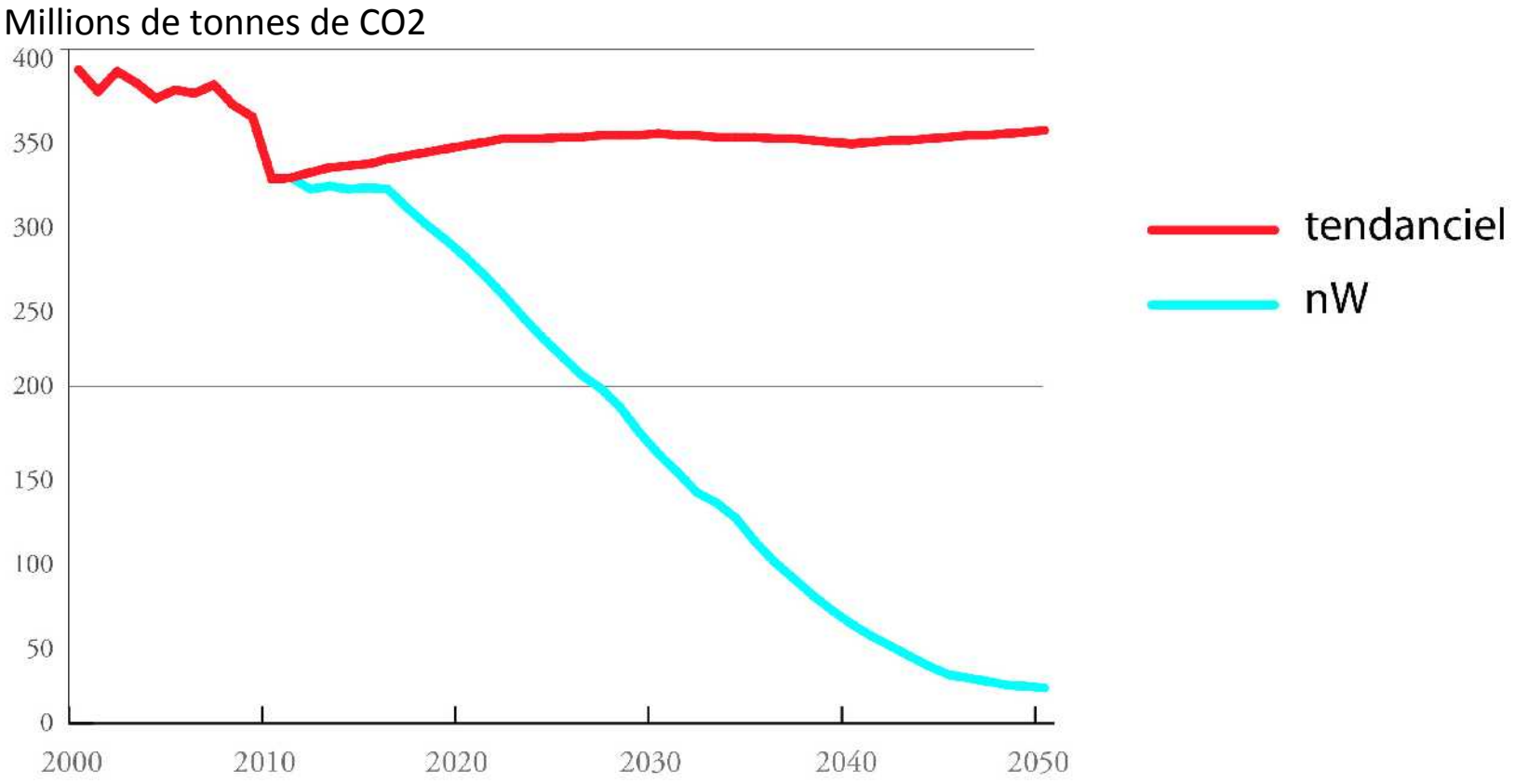


Primary energy balance



CO_2 and GHG balance

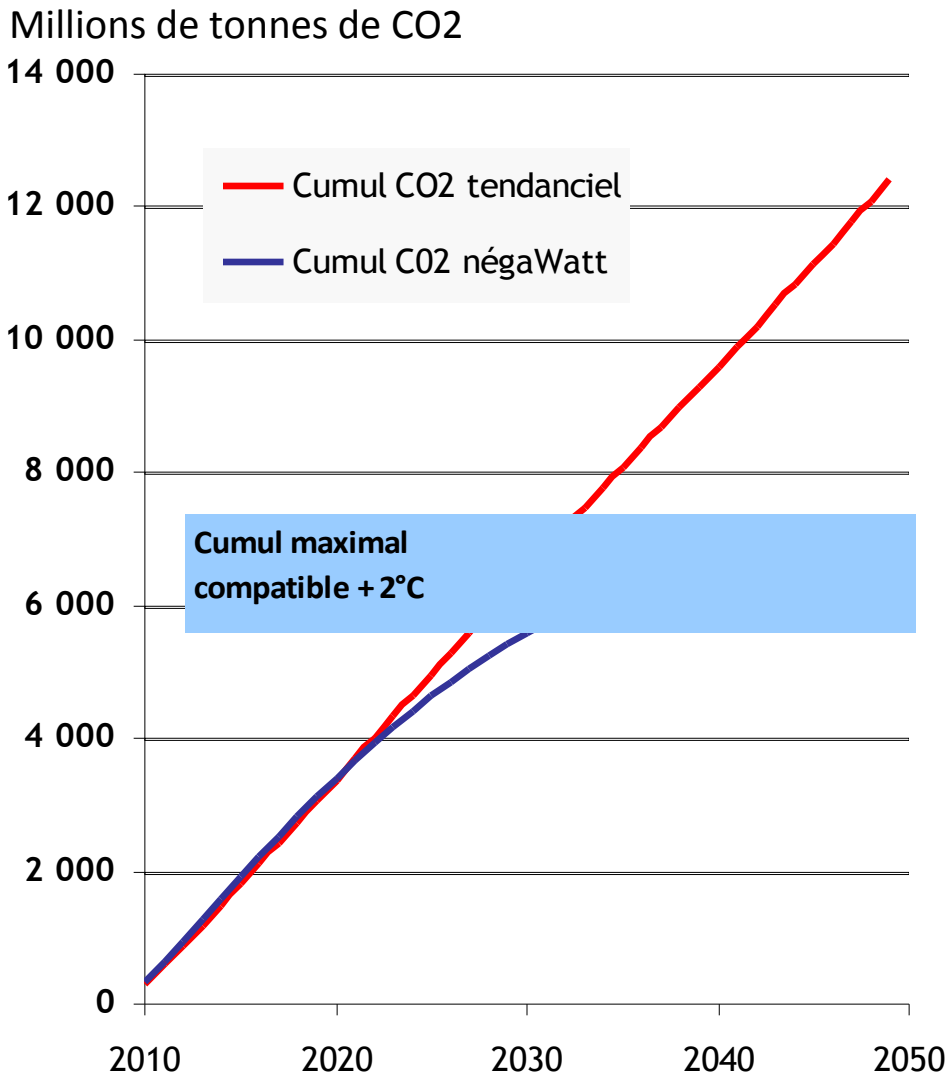
- Compared to 2010, CO_2 emissions from energy are divided by 2 by 2030 and **divided by 16 by 2050**
(and consistent with a division by 2 of agricultural GHG by 2050)



Cumulated CO_2 2011 - 2050

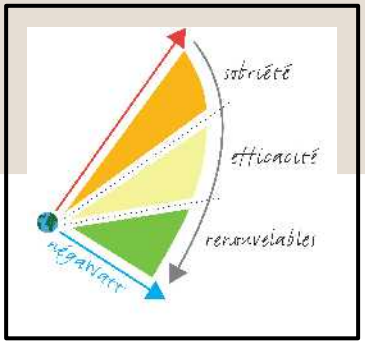
- Cumulated CO_2 emissions 2011- 2050

  are in line with France's equitable share in a global mitigation scenario (keeping global warming below 2°C by 2100, Postdam Institute)



Conclusion

- A positive change of society: consume less for better (less wasting, better quality), produce more local, reorganise urban and rural space, etc.
- High climate change performance
- Riddance of nuclear risks
- Strong reduction of fossil fuel use
- High level (>90% domestic production) of energy security
- An economic opportunity rather than an economic burden
  - Employment (> 600.000 net local jobs by 2020)
  - Energy bill (currently > 50 G€ per year)
  - Investment better paid-off than reinvesting in the same system



Thank you!

Scénario négaWatt 2011-2050

Rendre possible ce qui est souhaitable …

ASSOCIATION négaWatt

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