The response of the energy sector to Climate Policy

Gonzalo Sáenz de Miera
Director de Prospectiva Regulatoria

Climate Change: zooming on the problem and its solution

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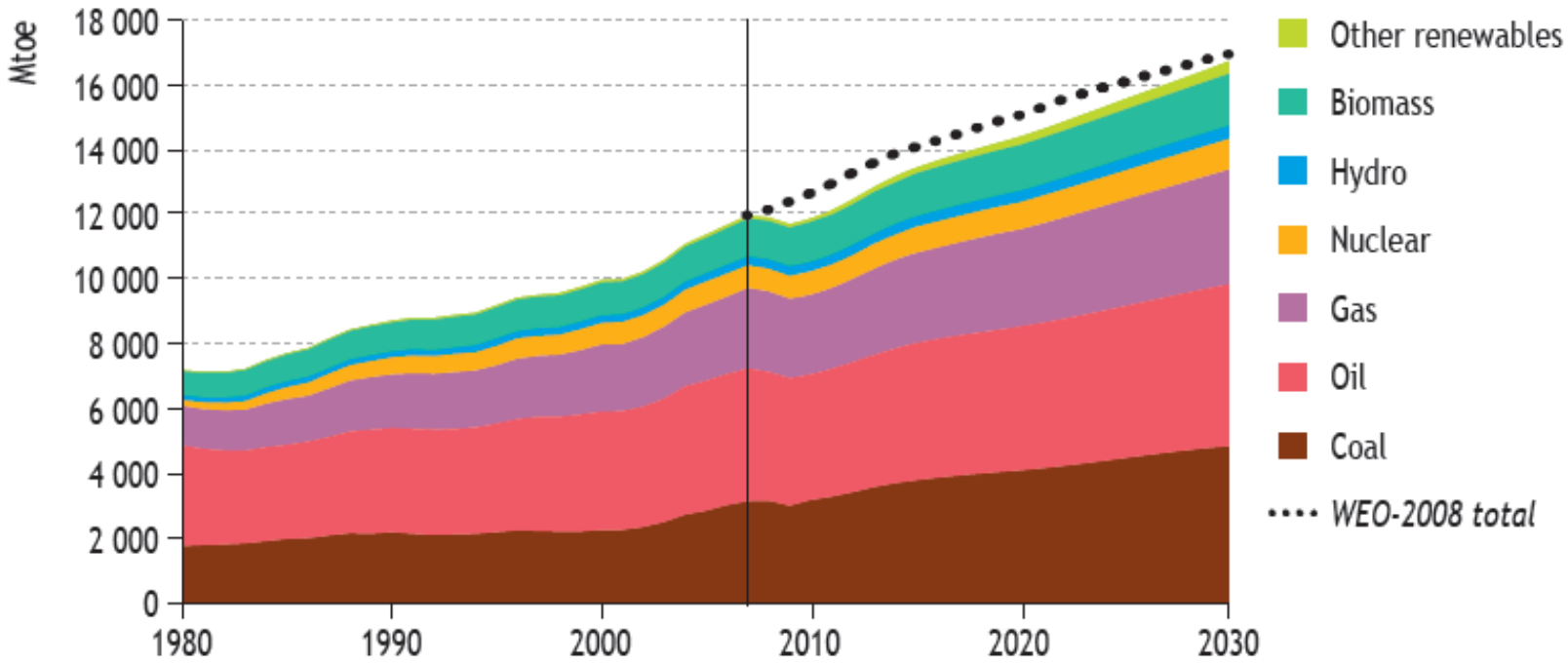
- Challenges of the current energy model.
- Energy sector's instruments to mitigate climate change: the role of electricity.
- “Zooming” on reponses: electricity sector in the Spanish context.
- Concluding remarks.

Global energy model is characterized by continuous growth in energy consumption, based on finite fossil resources.

World primary energy consumption in the reference scenario



Fuente: World Energy Outlook. 2009 International Energy Agency.

Global primary energy demand will grow at an annual rate of 1.5% until 2030.
Coal, oil and gas will represent 80% of the energy consumed in 2030.

Crisis of the current energy model.

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Based on fossil fuel resources

High energy dependency with consequent risks

Quantity

Risk of supply disruption.

Prices

17000 million Euros transfer from Spain to the oil-producing countries due to oil price increase in 2008.

Impact on climate change

Environmental effects

Increasing sea levels, biodiversity loss, erosion …

Economics effects

Loss of 5% of annual GDP, especially in LDCs.

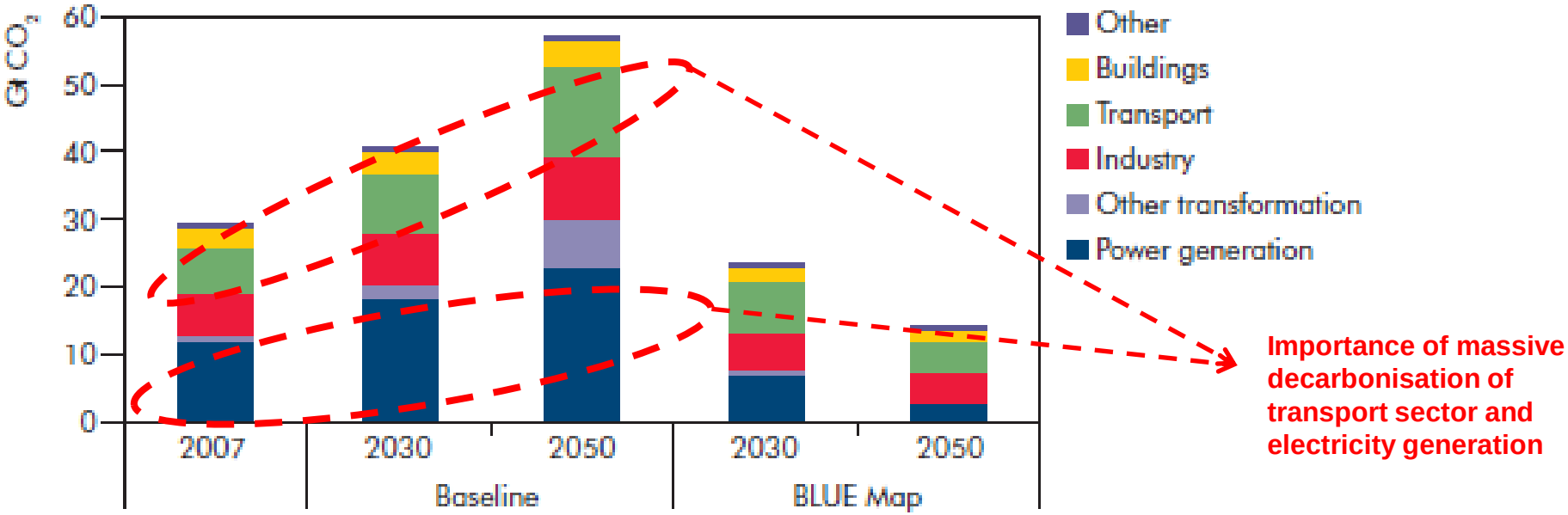
2000 million people lack access to advanced energy services.

World has not enough fossil resources to provide advanced energy services to all its inhabitants using the current energy model.

The baseline scenario leads to an unsustainable growth in CO_2 emissions.

A *BAU* scenario would lead to a 96% increase in global CO_2 emissions by 2050.
Global CO_2 emissions should be halved to limit temperature increase to 2 ºC by 2050 (BLUE scenario).

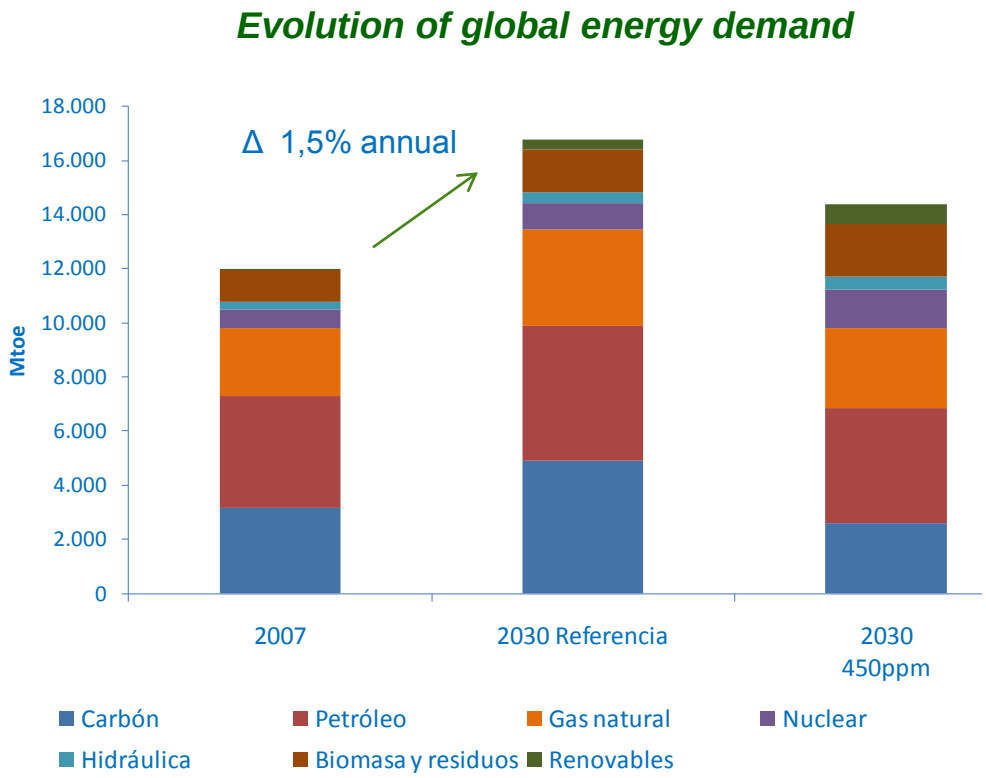
Global CO_2 emissions in reference scenario vs. BLUE scenario

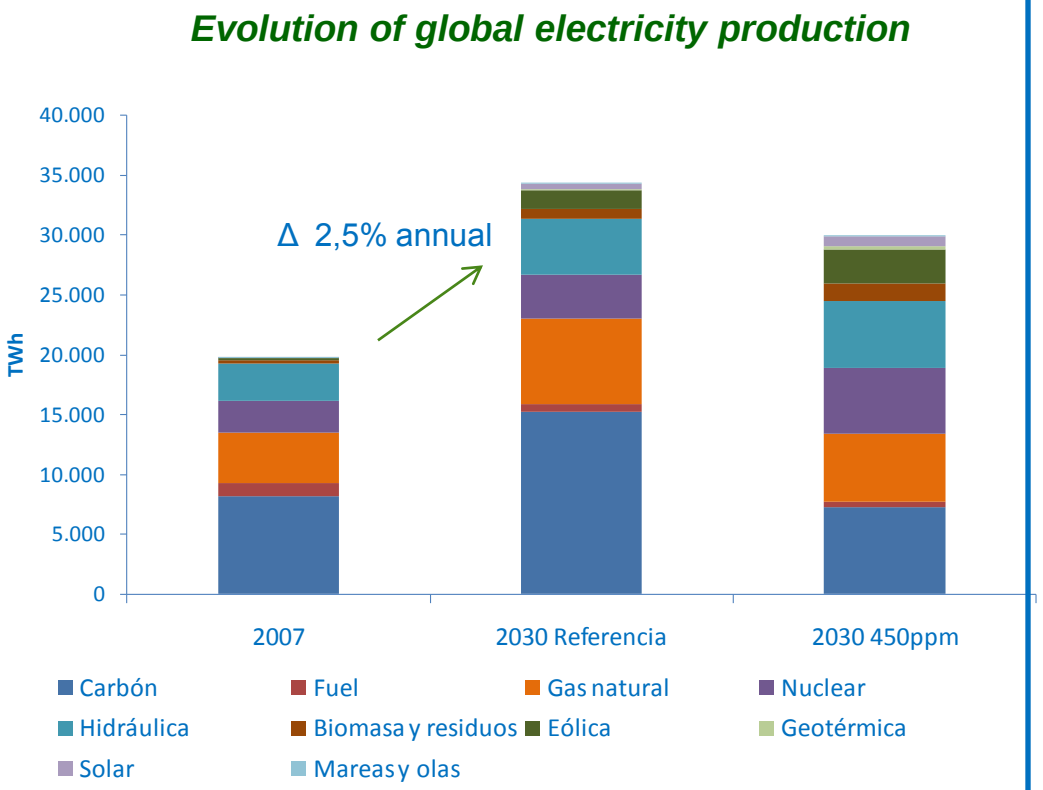


Source: Energy Technology Perspectives. 2010. International Energy Agency

Power generation industry and transport are key elements for the transition to a more sustainable energy model.

Increasing role of electricity in the energy sector.





Fuente: WEO 2009. International Energy Agency.

There is an electrification of the energy sector in all scenarios in the time frame of 2030. Technological developments needed for electricity decarbonization.

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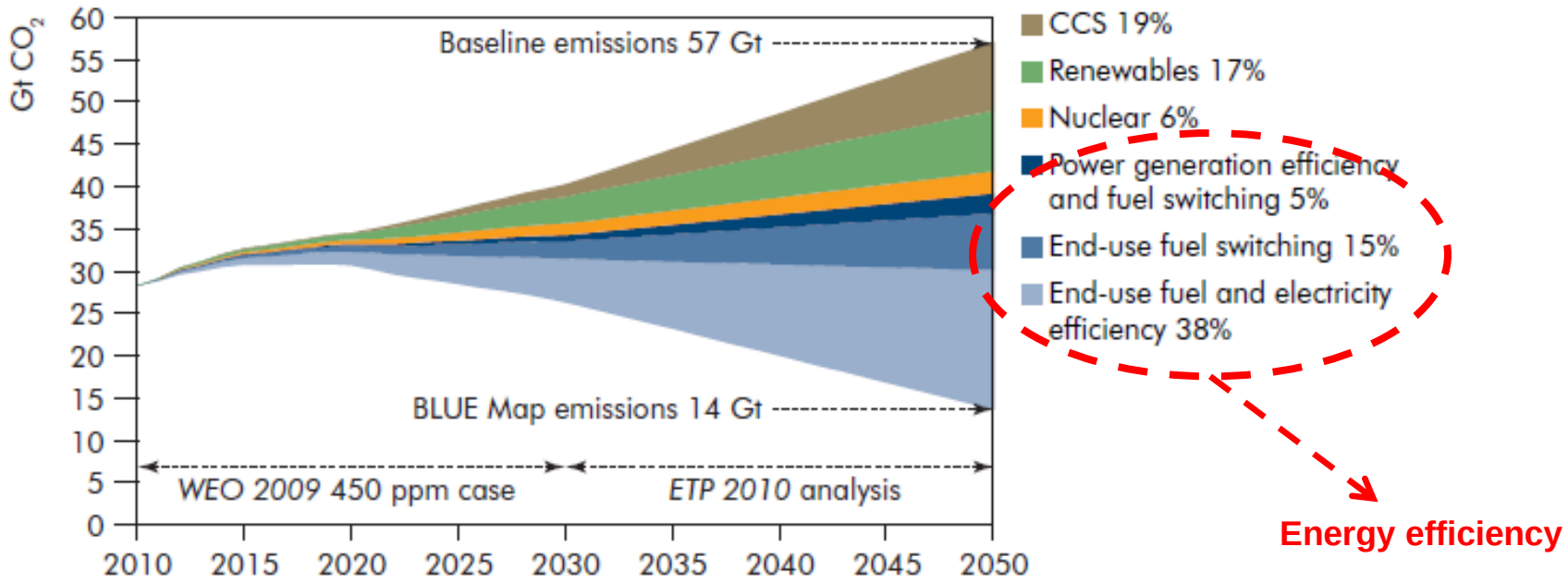
All technological options must be considered to address climate change challenge.

Energy efficiency (58%), renewables (17%) and CCS (19%) are the main technological options for mitigation of climate change.

Contribution of each technology option to reduce emissions under the scenario BLUE

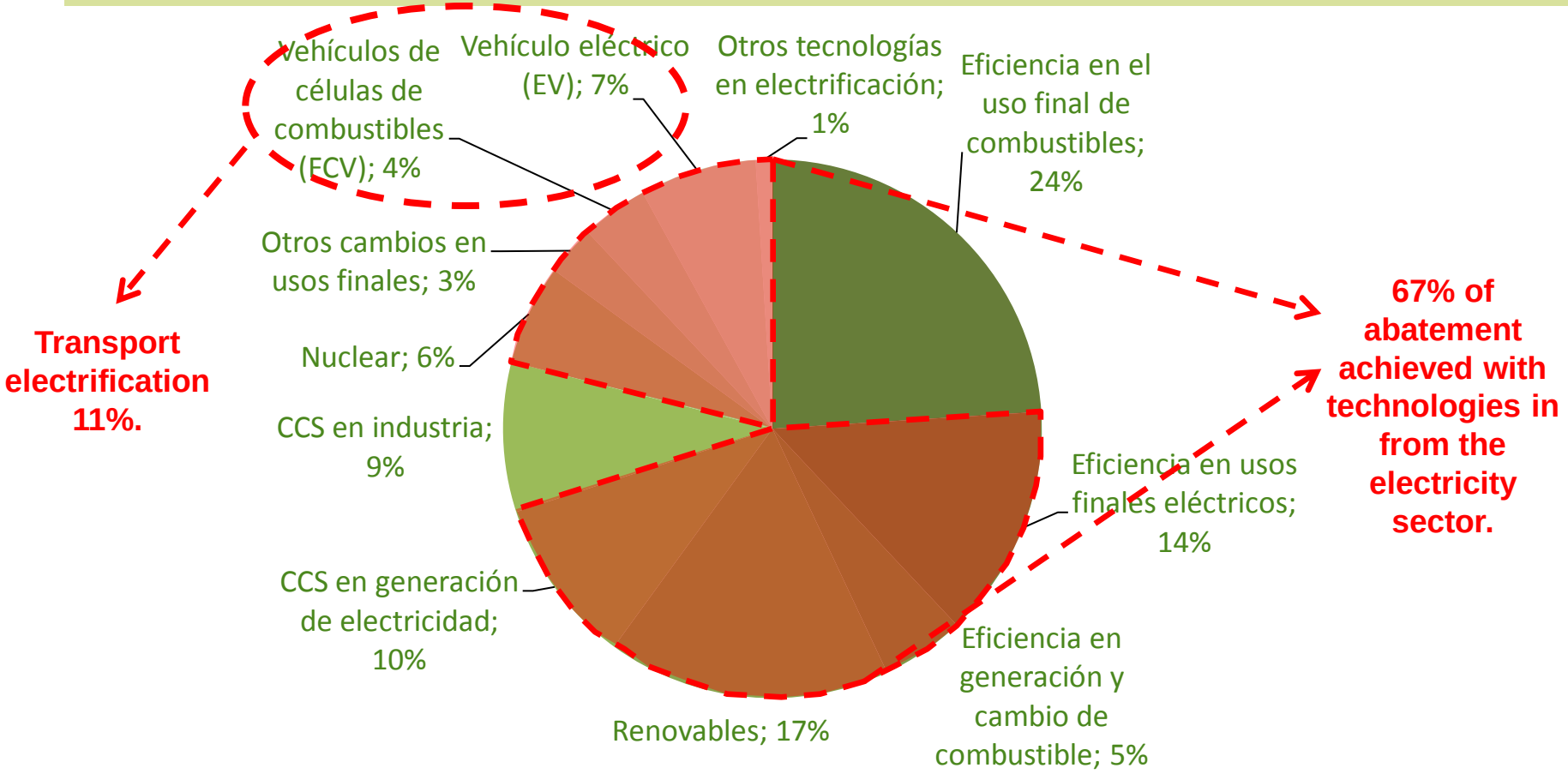


Source: Energy Technology Perspectives. 2010. International Energy Agency.

Compliance with the BLUE scenario is not possible without an important technological development, with the introduction of new technologies along with the improvement of existing ones.

Most of mitigation will come from technologies in the field of electricity sector .

Contribution of each technology to the emissions reduction under BLUE scenario by 2050



Responses in the field of electricity sector: Energy Efficiency & Renewables

Transport electrification.

Within electricity sector, energy efficiency is the lowest cost option and wind power the fastest growing renewable technology.

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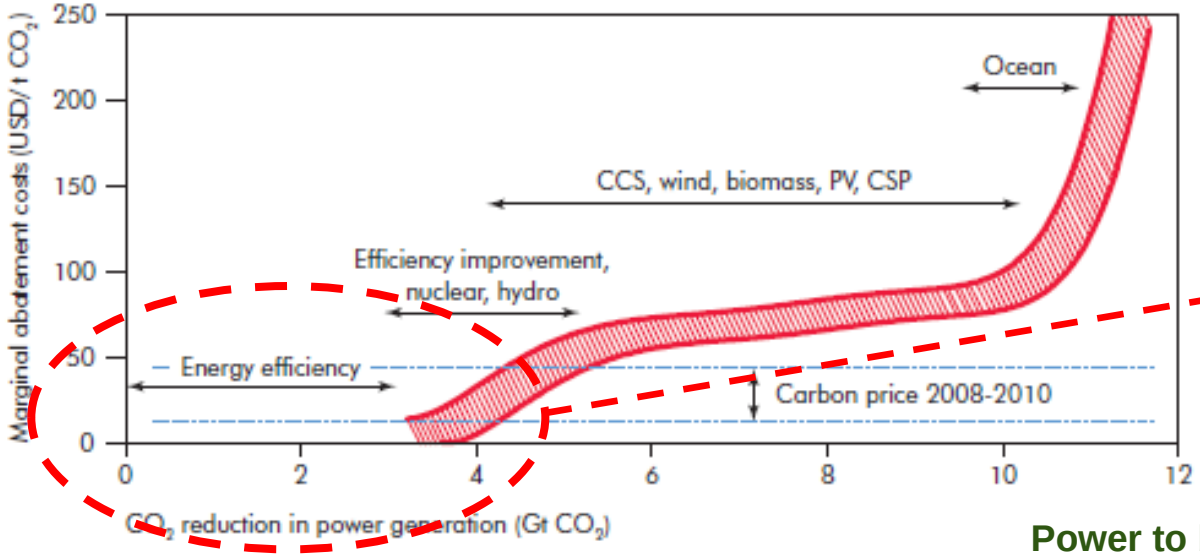
Marginal abatement cost within electricity sector (2010-2020)

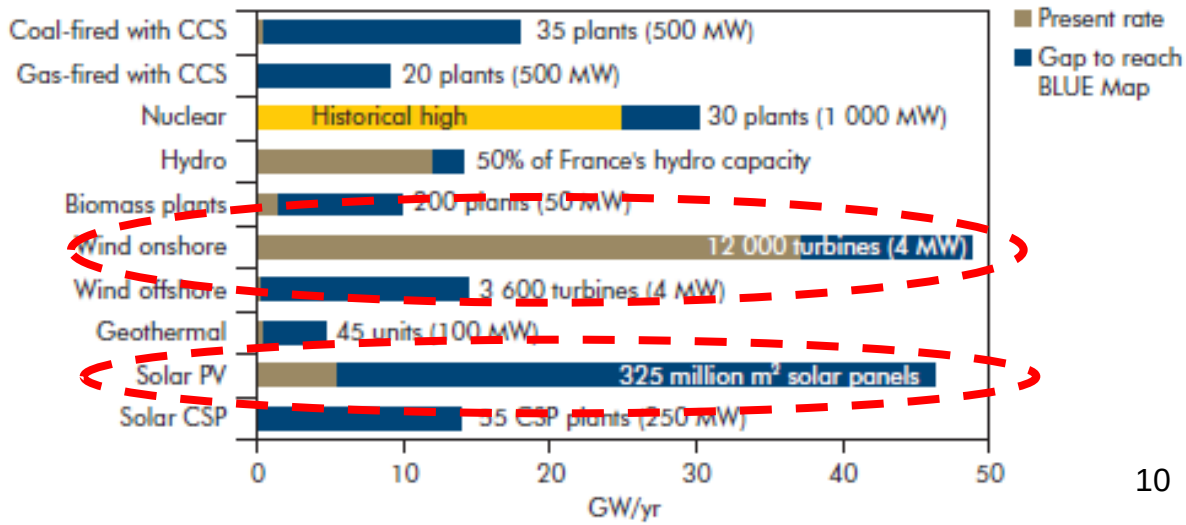


Source: Energy Technology Perspectives. 2010. International Energy Agency

Energy efficiency is the measure of mitigation at lower cost within the electricity sector.

Most of EE measures present net benefits.

Power to be installed to reach BLUE goals



Wind power generation technology shows the higher growth rate in the BLUE scenario, followed by solar photovoltaic.

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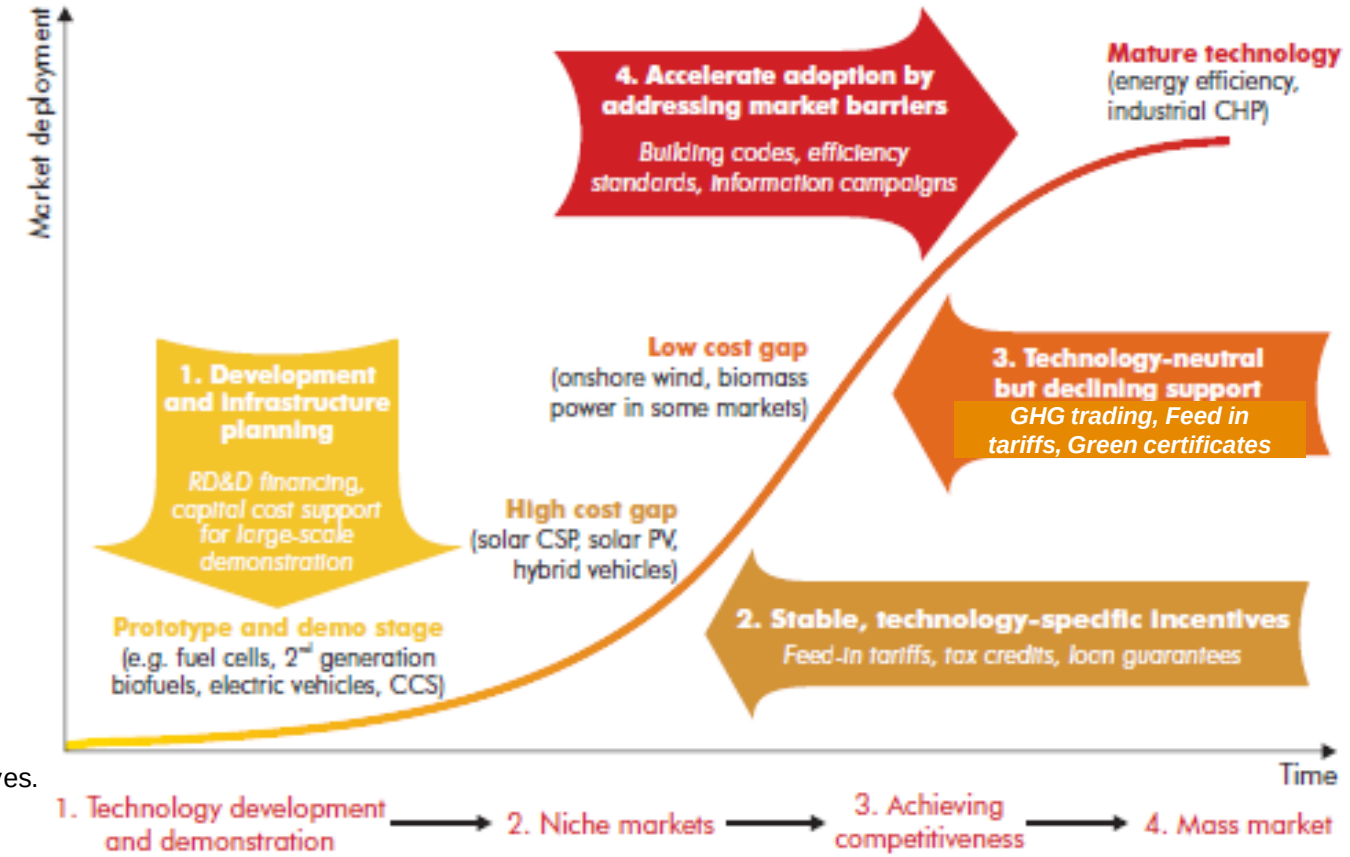
Policies to tackle climate change depends on market development of the different options.

Policies for supporting low-carbon technologies



Source: Energy Technology Perspectives. 2010. International Energy Agency

Along with this policy framework for climate change response, Spanish context requires "zooming" on a variety of issues.

Zooming in the Spanish context.

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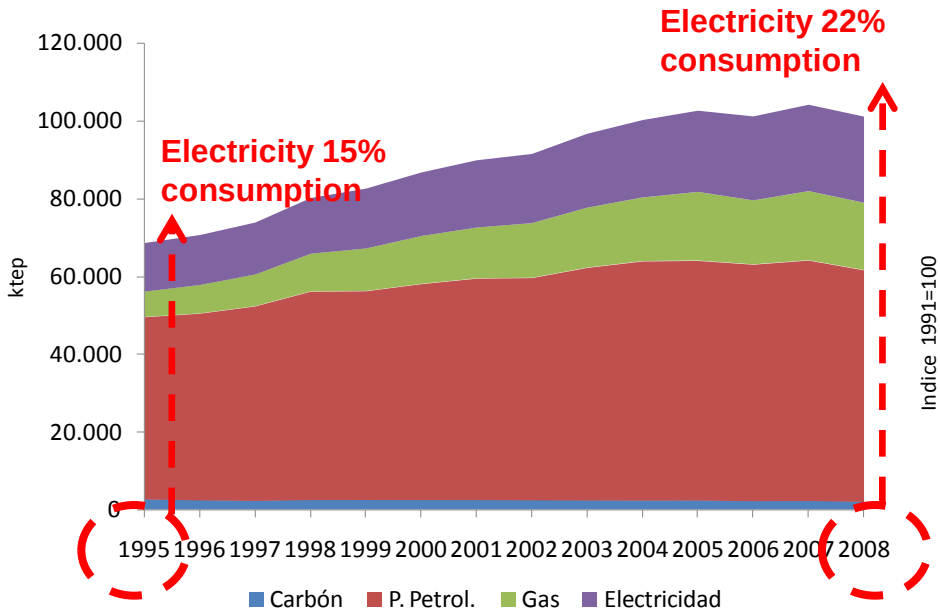
Energy efficiency	Renewable deployment	Other responses
1. Bad performance compared with EU 2. Regulatory tools needed	3. Regulation: Achievements Mistakes 4. Challenges: Technological Economical	5. Nuclear 6. CCS

The improvement of energy efficiency is one of the main challenges for Spanish energy model.

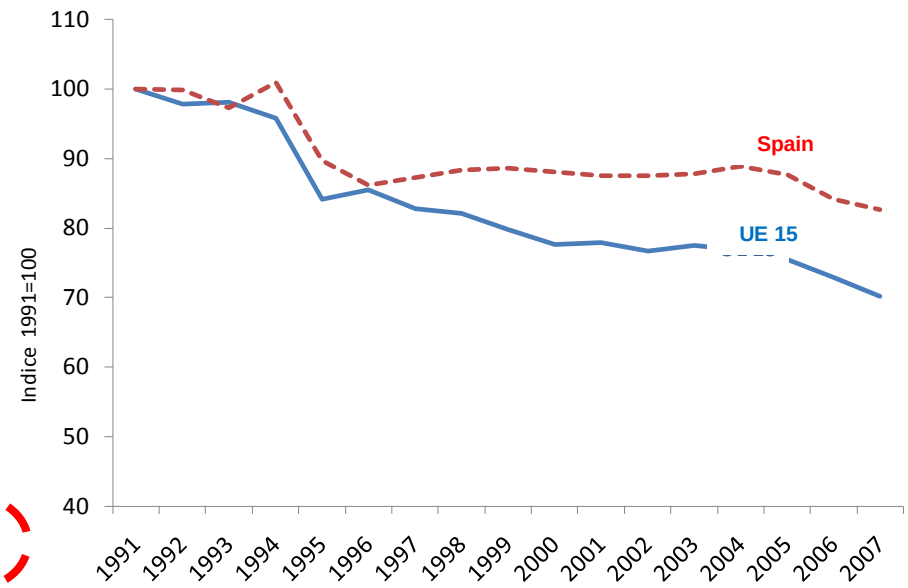
While Spanish economic structure remained constant, energy consumption has been increasing and **energy intensity** has shown a worse performance than UE's.

This results are greatly explained by the poor policy development in the field of energy prices, information and education measures...

Final energy consumption



Energy intensity



However, there is a trend for electrification of the economy, which will contribute to improve energy efficiency (Trend confirmed in the Spanish 2011-2020 Renewable Energies Action Plan).

There is an important variety of regulatory tools to promote energy efficiency.

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Standards

Rebound effect limited

Prices

Price elasticity of demand

Price elasticity of **10%** (Linn, 2006)**.**

Induce to technological change (Newel et al, 1999)

Measurement and certification system for savings

Educational measures

Whenever the rebound effect is less than 100%, there is reduction in consumption.

Estimations: **5-15%**, (Grubb, 1990) **19% for U.K** (Barker et al 2007)**…**

Improvements in energy efficiency does not come from a single measure but a combination of all available.
Behind this fact lies the complexity to advance in this field.

Zooming in the Spanish context.

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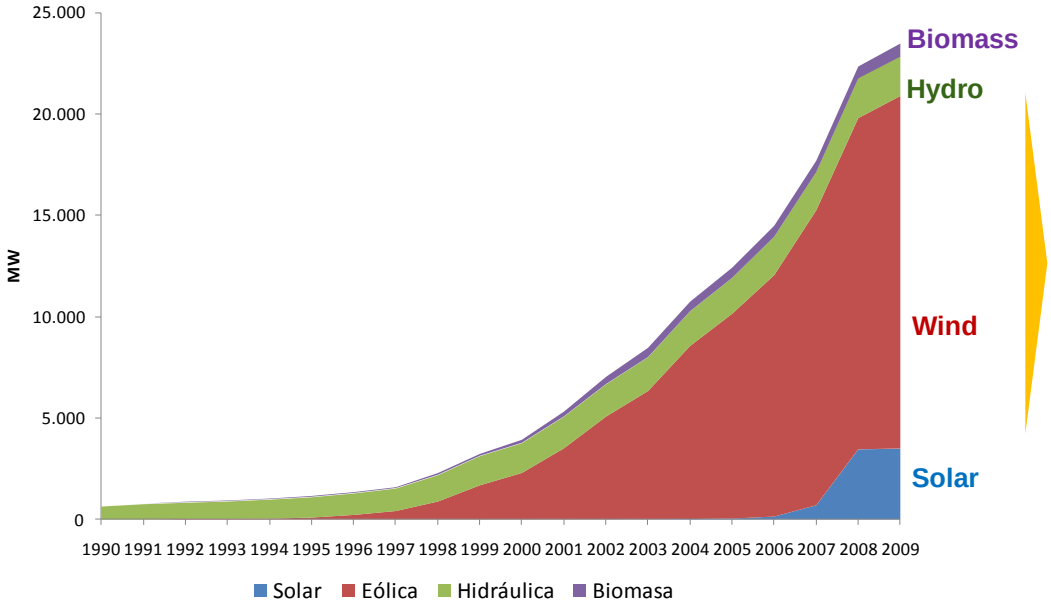
Context... International leadership in renewables growth.

Renewables represented more than 25% of electricity produced in 2009, showing wind the biggest share.

Growth path of renewables in Spain



Spain could be used as an experiment (useful for countries in a former stage) showing "lights and shadows" of a success story:

- **Wind development.**
- **"Solar bubble".**
- **Technological and economical challenges.**

Growing share of renewables implies a growing cost for electricity system in terms of supports.

This trend will increase in the future to comply with 20% renewables target by 2020.

Regulation… Planning on renewable energy has been overcome by "solar bubble"…

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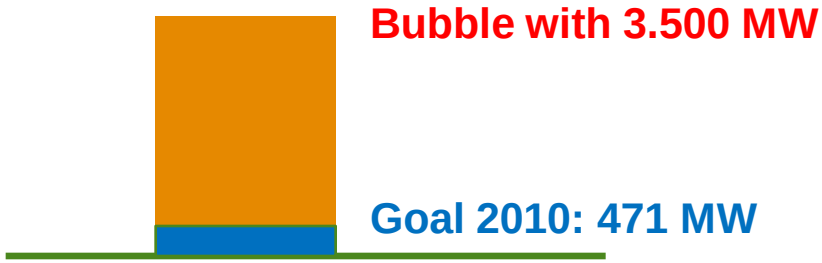
SPANISH SUPPORT FRAMEWORK FOR RE (Main elements):

- **Objectives defined by technology.**
- **Feed in Tariffs.**
- **Premiums differentiated by technology, updated every four years (no retroactivity).**

Control prices but no quantities.
Really effective and efficient system for a mature renewable technology (E.g. **Wind**)

Solar bubble

SOLAR PV→ High premium (440 €MWh) + Important foreseeable cost reduction and technological uncertainty:

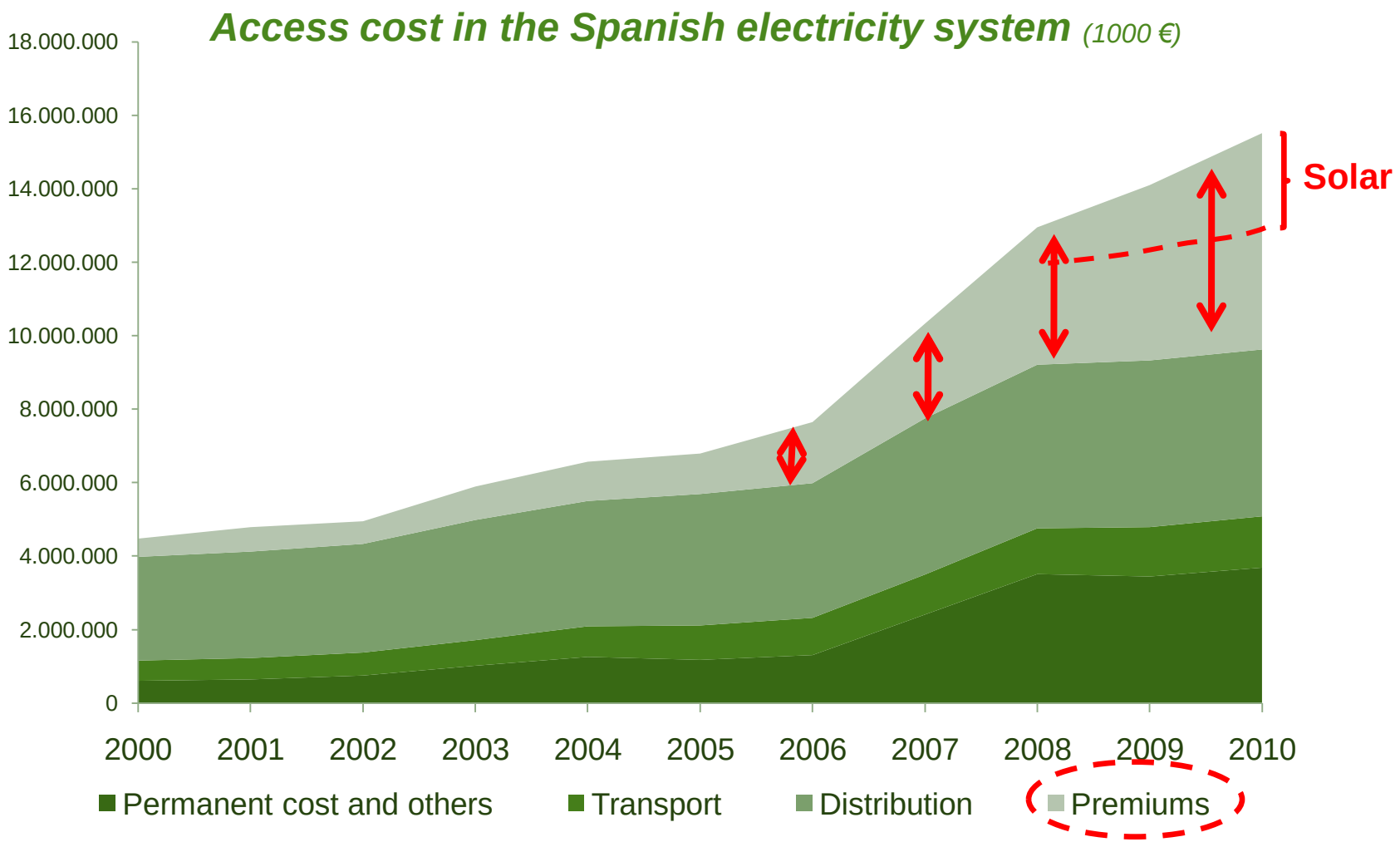


Economic impact for consumers!!! 2.500 M. € annually

CSP→ High premium (300 € MWh) + cost reduction and technological uncertainty.

Economic impact for consumers!!! 1.500 M. € annually

...jeopardizing economic sustainability of electricity sector.



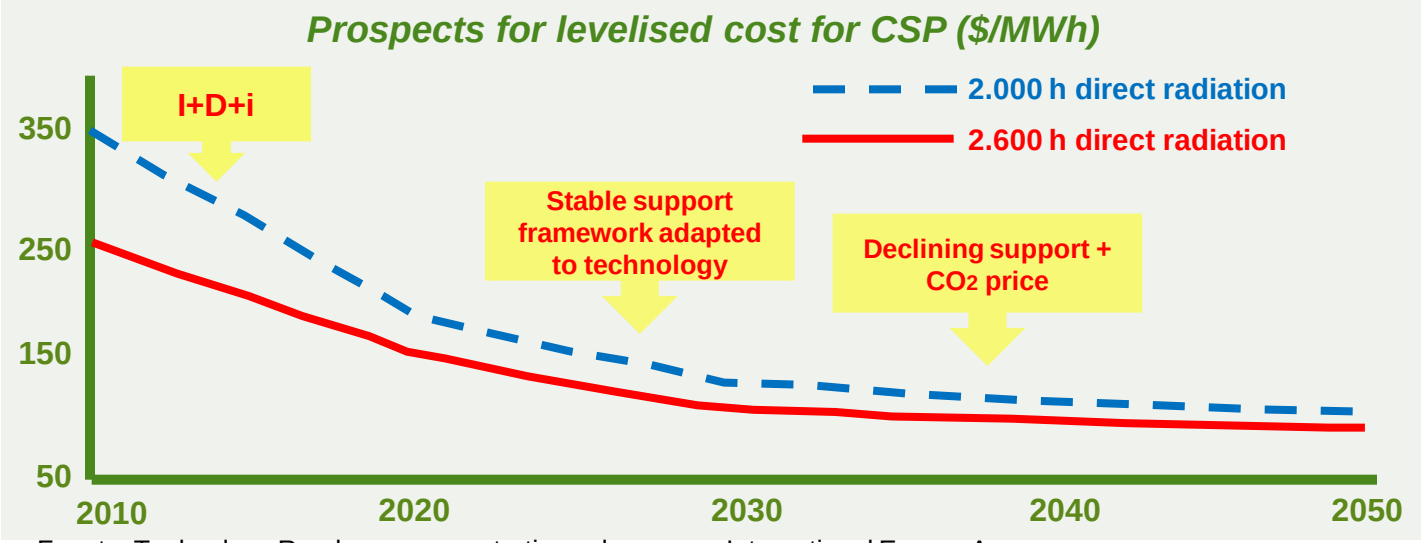
Premiums share on access cost has risen from 11% in 2000 to 38% in 2010, becoming the most important concept.

Each technology faces different challenges and regulation must adapt to them.

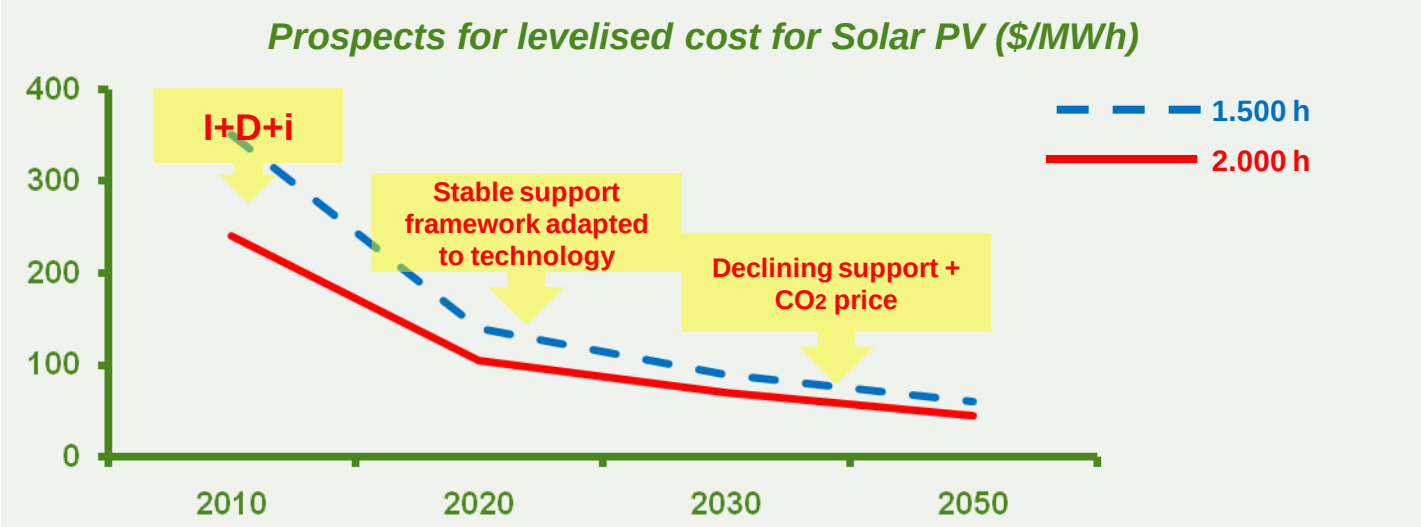
	Current situation	Support policies
Wind.	Mature technology. Near competitiveness	Market price + premium (until reaches competitiveness).
Solar PV.	Far from competitiveness but constant reduction of cost. High level of installed capacity.	R & D & i. Market innovation + Institutional development to benefit from economies of scale and knowledge.
CSP.	Slow tech. development in the past. No recent developments Technology uncertainty. Important competitive gap.	Demo projects R&D to reduce cost.
Biomass.	Logistic barriers in the raw material supply.	Market price + premium (until reaches competitiveness).. Sectoral policies.

A flexible support scheme must consider the level of technological development, costs and problems associated with each technology.

Strong reduction cost prospects for solar recommends to postpone mass deployment.



Fuente: Technology Roadmap: concentrating solar power. International Energy Agency



The prospects for significant cost reduction would recommend postponing large-scale deployment until solar technology has reached a more mature stage.

Current support should focus on R & D and technological development

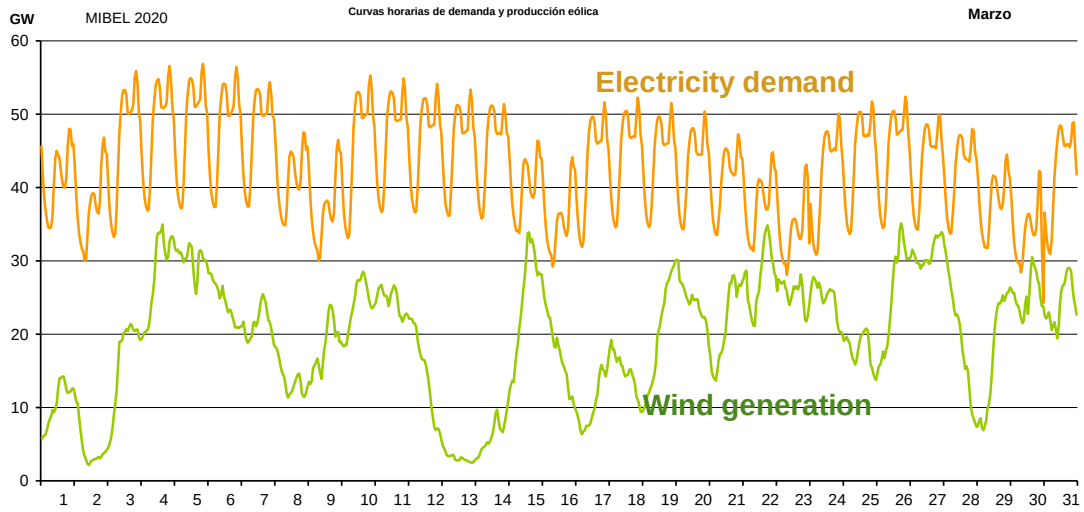
Fuente: Technology Roadmap: solar photovoltaic energy. International Energy Agency.

Technological challenges…The growth of renewable power does not reduce the need for firm capacity in the system.

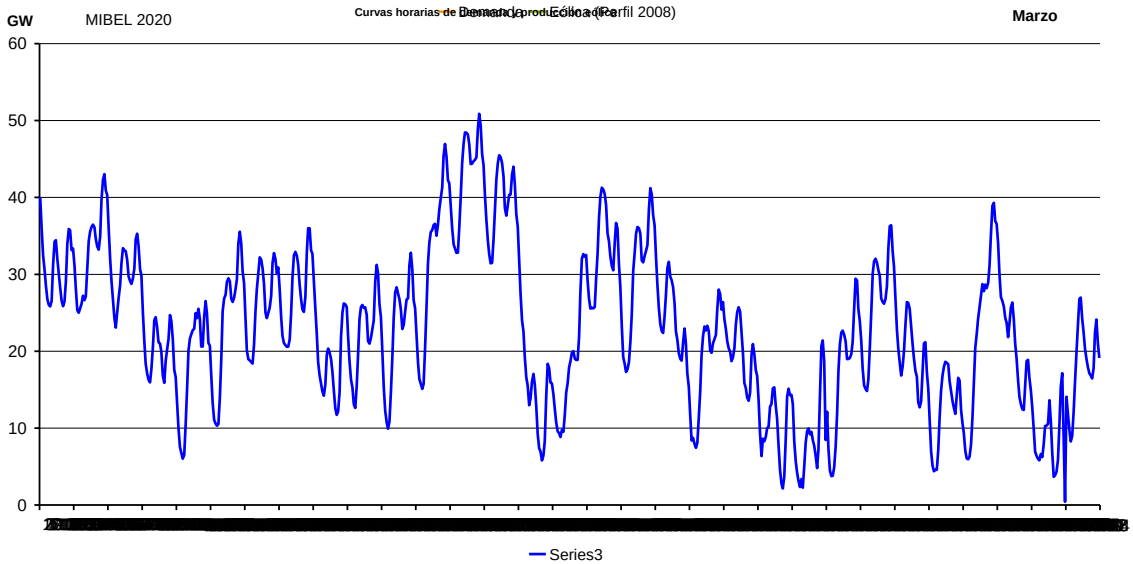
Technology	Firmness
Wind	7%
Nuclear, coal y CCGTs	90%
Hydro Pumping	60% 85%
Solar: - CSP - PV	 30% 0%
CHP	55%
Others	65%

Renewable production reduce GHG emissions and consumption of fossil fuels but contributes very little to reduce peak demand, which should be faced by firm capacity.

Estimation of contribution of wind to cover electricity demand in 2020



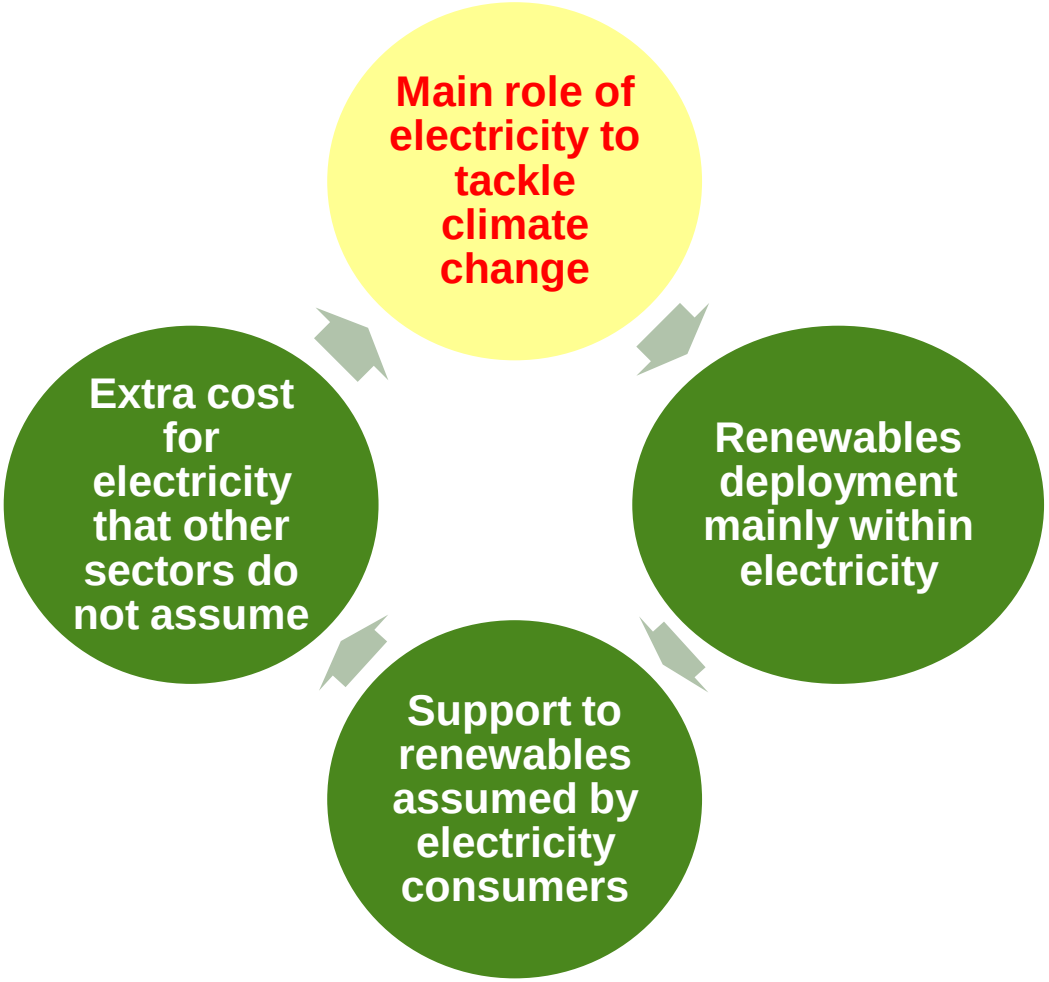
Electricity demand vs. wind generation in 2020



Net demand to be covered by firm capacity and dispatchable energy

Firm energy needed with a new function (back up).
Market should provide incentives for its availability.

Economical challenges… Important role of electricity in climate change abatement could lead to competitive disadvantage … A paradox?



Renewable support cost should be assumed by all energy consumers, the origin of the problem.

Zooming in the Spanish context.

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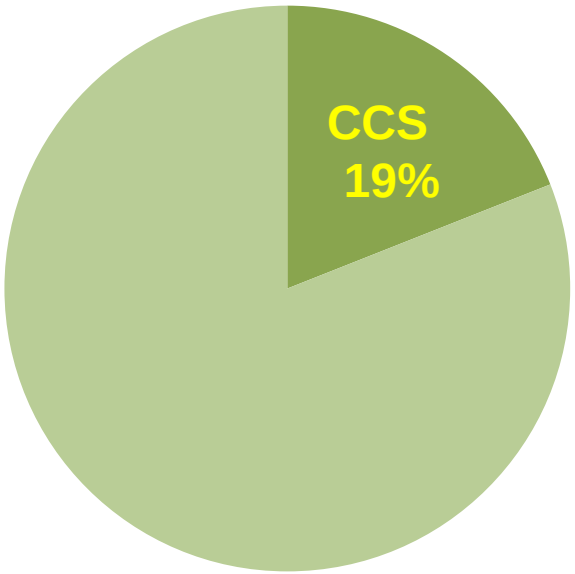
It is required significant technology and economic development in the field of CCS to meet the BLUE scenario.

Total CO_2 reductions in 2050



CCS is in an R & D stage.

There has been launched 12 pilot projects with European state aid.

Commercial system planned from 2030.
Its development will allow to exploit large reserves of coal.

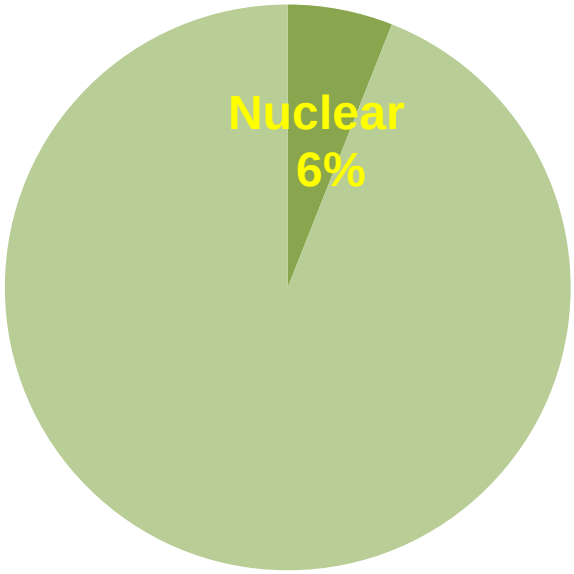
CCS will be used throughout the energy sectors (coal combustion, gas ...) but also in industry (chemical, cement, steel ...).

Source: Energy Technology Perspectives. 2010. International Energy Agency

However, CCS will not play an important role in the abatement strategy of countries with scarcity of suitable sites and quality coalfields (E.g. Spain)

Nuclear has an important role to play, but need regulatory certainty to carry it out.

Total CO_2 reductions in 2050



Source: Energy Technology Perspectives. 2010. International Energy Agency

Currently, nuclear power is the only way to provide baseload electricity without CO2 emissions.

New nuclear development deals with **economical and technological uncertainty**, which makes **necessary** certainty through **regulatory and political support.**

E.g.

UK→ CO_2 price floor

USA→ Tax incentives

In the future, uncertainty will be reduced and support won't be necessary.

In the Spanish context, a political decision should be taken on this issue, in short, to have available this option in the 2030 horizon.

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Concluding remarks

1. The paradigm shift in the energy sector has begun. An "energy revolution" is necessary to follow the right pace towards a sustainable model.
2. Electricity sector plays a leading role: decarbonization of electricity mix and electrification of transport.
3. Spanish experience, with "lights" for some technologies and "shadows" for others, can be used as an example for countries in an early stage of renewable deployment.
4. There are technological challenges derived from an increasing share of renewables in the system: back up and interconnections needed.
5. Renewable support cost should be assumed by all energy consumers to avoid penalizing electricity, which has the most important role in climate change mitigation.
6. All measures involve an increase in energy cost. However, they represent net benefits in the long term (security of supply, industrial development…).