Viability of deep decarbonization pathways

Miguel Ángel Muñoz Rodríguez
Head of climate policies and alliances
Iberdrola
1. **Energy model based on fossil fuels**

2. **Decarbonization pathways towards 2030 and 2050**
   - EU
   - Spain

3. **The role of technologies: current “state of art” & perspectives**

4. **Positive impacts of ambitious approaches to climate action**

5. **Some policy remarks**
The current energy model is one of the main drivers towards climate change.

80% of global energy consumption comes from fossil fuels.

Renewable energies have increased their participation, but still represent a small part of the global energy mix.

Fuente: IEA, World Energy Outlook, 2018
Climate change is consolidating its position at the top of risk rankings

Climate change and its side effects lead risk rankings in terms of probability and impact

Extreme events, natural disasters and failures in mitigation and adaptation to climate change
Air pollution is one of the main consequences of the current energy model

Ambient air pollution

91% of the world’s population lives in places where air quality exceeds WHO guideline limits

4.2 million deaths every year as a result of exposure to ambient (outdoor) air pollution

Household air pollution

3.8 million deaths every year as a result of household exposure to smoke from dirty cookstoves and fuels

- The highest ambient air pollution levels are in the Eastern Mediterranean Region and in South-East Asia
- In general, ambient air pollution levels are lowest in high-income countries, particularly in Europe, the Americas and the Western Pacific
- In cities of high-income countries in Europe, air pollution has been shown to lower average life expectancy by anywhere between 2 and 24 months, depending on the pollution levels

Source: WHO
The current energy model implies a high energy dependence for many European countries.

Reducing the consumption of fossil fuels improves energy security in externally dependent regions to meet their energy needs (e.g. EU).
The current energy model is one of the main drivers towards climate change

Global greenhouse gas emissions under different scenarios and the emissions gap in 2030

Source: UNEP Gap Report 2018
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### Main 2030 targets from European Commission and NECP

<table>
<thead>
<tr>
<th></th>
<th>European Union</th>
<th>Spain (NECP)</th>
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<tbody>
<tr>
<td>CO2 (eq)</td>
<td>40% reduction compared to 1990</td>
<td>20-21% reduction compared to 1990</td>
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<tr>
<td>Energy efficiency</td>
<td>32.5% reduction compared to PRIMES 2007</td>
<td>39.6% reduction compared to PRIMES 2007</td>
</tr>
<tr>
<td>Renewable energy</td>
<td>32% of final consumption</td>
<td>42% of final consumption</td>
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**Net – zero emission by 2050: debate at both EU and national level**
Deep decarbonization pathways for the EU in the 2050 horizon...

An illustrative EU scenario * aligned with a net-zero emission goal by 2050

* The creation of scenarios using the ClimateWorks/CTI 2050 Roadmap Tool, that has been developed by Climact sa/nv and the European Climate Foundation, does not imply endorsement of those scenarios by either Climact or the ECF, nor endorsement of any conclusions based on those scenarios.
An illustrative EU scenario * aligned with a net-zero emission goal by 2050

The drastic reduction of the weight of fossil fuels in the European energy mix is a necessary condition

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An illustrative EU scenario * aligned with a net-zero emission goal by 2050

Evolution of energy consumption at EU level. (All Energy)

Energy demand drops by 51% while electricity demand rises by 38% in 2050

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An illustrative EU scenario * aligned with a net-zero emission goal by 2050

Evolution of energy consumption at EU level. (Power: Demand)

There is a need for the improvement of energy efficiency and the replacement of fossil fuels by renewable sources.

Transport is the sector that most increases its electricity demand (44% of the demand)

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An illustrative EU scenario * aligned with a net-zero emission goal by 2050

Evolution of electricity generation and emissions at EU level. (Power Generation)

- Generation will be based mainly on renewables (74.5% wind and solar)
- Demand management measures will be required

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An illustrative EU scenario aligned with a net-zero emission goal by 2050

Evolution of dependence on oil and gas imports in the EU
(Oil and Gas import balance)

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Oil and gas consumption is drastically reduced in 2050, reducing energy dependence
Deep decarbonization pathways for Spain in the 2050 horizon...
EU energy model decarbonization is viable and a source of opportunities

An **scenario** exercise shows it is **possible** to achieve 80% **decarbonization** in Spain by 2050 through almost 100% RES electricity and “smart solutions” in final uses.

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1. **Reduce energy consumption**
2. **Phase out oil and coal**
3. **Maintain gas as a transition energy wherever electrification is not viable**
4. **Reach high penetration of renewables, through the electricity sector**

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1 Includes hydro capacity
EU energy model decarbonization is viable and a source of opportunities

RES and EE solutions in transport & buildings are key to meet climate goals in a cost effective way

Breakdown of final energy consumption by sector (Mtoe)

- **Transport**
  - Emissions (MtCO₂ equiv.):
    - 92
    - ~65
    - ~10
  - 2013: 27.4 Mtoe (95% RES, 3% Electricity, 8% Natural gas, 3% Fuels)
  - 2030: 22 Mtoe (81% RES, 3% Electricity, 8% Natural gas, 3% Fuels)
  - 2050: ~9 Mtoe (67% RES, 20% Electricity, 13% Natural gas)

- **Buildings**
  - 2013: 24.6 Mtoe (12% RES, 53% Electricity, 19% Natural gas, 17% Fuels)
  - 2030: ~25 Mtoe (10% RES, 66% Electricity, 21% Natural gas, 8% Fuels)
  - 2050: ~24 Mtoe (14% RES, 84% Electricity, 14% Natural gas)

- **Industry**
  - 2013: 20.8 Mtoe (7% RES, 44% Electricity, 13% Natural gas, 17% Fuels)
  - 2030: ~25 Mtoe (9% RES, 40% Electricity, 8% Natural gas, 4% Fuels)
  - 2050: ~29 Mtoe (12% RES, 52% Electricity, 8% Natural gas, 36% Fuels)

- Electrification ~100% of light vehicle fleet and increase of rail and electric trucks in freight transport (~85%) by 2050
- Electrification of Heating & Cooling in Buildings (important role of Heat Pumps)
- Different penetration depending on the characteristics of each industry
EU energy model decarbonization is viable and a source of opportunities

Electricity model will be almost fully based on renewable energy sources by 2050 (~95%)

Renewable Energy Sources (%)

- Nuclear: 55%
- CCGT: 29%
- Coal: 53%
- RES: ~40%
- Other: 35 TWh

Electricity demand by technology (TWh)

- 2015: 268 TWh
- 2030: ~385 TWh
- 2050: ~550 TWh

- Back up generation: ~25
- Mix balanced between Solar PV and wind to optimize the level of curtailment and investments
### Light vehicles park\(^{(1)}\) depending on the type of fuel (%)

| Emissions\(^{(2)}\) (MtCO\(_2\) eq) | ~60 | ~50 | ~40 | ~2 |
| Final energy consumption of light transport (Mtep) | 17,9 | 16,1 | 13,9 | 4,5 |
| Electric vehicles sales \(^{(3)}\) (%) | ~0% | ~60% | ~65% | ~100% |

It is assumed that the price of the electric vehicle is equal to that of a conventional vehicle in 2022 in Spain.

Electrifying light transport requires 65% of car sales to be electric vehicles by 2030 and 100% of sales by 2050.

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\(^{(1)}\) It is considered a constant fleet of light vehicles (<3.5t) of ~27 million; constant annual sales of 1.500.000 vehicles.

\(^{(2)}\) Includes the corresponding share of oil refining emissions. Emissions for a model vehicle over its useful life (10 years and 10.000 km per year) are: hybrid: 8tCO\(_2\) (5tCO\(_2\) without considering the emissions of electricity generation); electric: 4tCO\(_2\); gasoline: ~20 tCO\(_2\); diesel: ~18 tCO\(_2\). Average park consumption and the 2015 generation mix are considered.

\(^{(3)}\) Includes electrical and plug-in hybrids.

Source: DGT, own elaboration.
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Minimum price offered at latest auctions per country since 01/01/2016, USD/MWh

- **Canada**: Wind 28.3, PV 120.0, Hydro 135.0
- **United Kingdom**: Offshore 52.99 *
- **Spain**: Wind 26.1, PV 36.7
- **Germany**: Wind 41.1, PV 50.4, Offshore Without grant
- **China**: PV 78.0
- **Japan**: PV 155.2
- **USA**: PV 26.7
- **Mexico**: Wind 17.75, PV 13.74
- **Peru**: Wind 36.8, PV 48.0, Hydro 46.0
- **Morocco**: Wind 28.0, PV 19.2
- **Morocco**: Wind 28.0, PV 19.2
- **Brazil**: Hydro 54.4 (4-4), Biomass 64.5 (4-6), PV 32.9 (4-4), Wind 29.1 (4-4)
- **Argentina**: Wind 37.3, PV 40.4, Biomass 106.7, Biogas 128.0, Hydro 89.0
- **Saudi Arabia**: PV 17.9
- **UAE**: PV (Dubai) 29.0, PV (Abu Dhabi) 24.2

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* 2012 prices are indexed to the start date

** For Spain, the minimum income for the auction result has been estimated
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### Positive impacts from a net – zero emission goal by 2050 at EU level

<table>
<thead>
<tr>
<th>Positive impact on climate change</th>
<th>1 million additional jobs in 2050 in comparison to the baseline scenario</th>
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<tbody>
<tr>
<td>Job creation</td>
<td>With the 1.5°C ambition as opposed to the 2°C one:</td>
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<tr>
<td></td>
<td>• Reduce people affected by water scarcity problems by 50%</td>
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<tr>
<td></td>
<td>• Drop of 50% in the ecosystem area under threat</td>
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<tr>
<td></td>
<td>• Three times fewer losses related to the natural habitats</td>
</tr>
<tr>
<td>Positive impact on climate change</td>
<td>Premature deaths caused by 2.5 pm and ozone would fall by 40%</td>
</tr>
<tr>
<td>Air quality improvement</td>
<td>GDP would rise around 2.2% in 2050</td>
</tr>
<tr>
<td>GDP increase</td>
<td>Energy dependence could go down from 55% to 20% in 2050</td>
</tr>
<tr>
<td>Reduction of energy dependence</td>
<td>Households would spend some 5.6% less of their incomes in 2050 on energy</td>
</tr>
<tr>
<td>Reduction in the vulnerability of</td>
<td>Avoid a loss of 10 – 15% in outdoor labour productivity</td>
</tr>
<tr>
<td>households to energy price</td>
<td></td>
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<tr>
<td>variability</td>
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Source: EU long term emission reduction strategy. November 2018
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4. Full decarbonization advantages

5. Some policy remarks
Energy efficiency and RES deployment will play a key role to decarbonize economy

• A changeover to a **decarbonised energy model** is needed. One based on energy **efficiency** and **renewable** energies

• It is **economically feasible** to achieve an **80% reduction of emissions** with current technology by 2050.

• Reaching CO\textsubscript{2} neutrality will require the development of currently immature technologies

• Decarbonising the energy sector entails the **electrification** of **final energy uses** and the replacement of energy system based on fossil fuels
Clear goals & coherent and robust policy frameworks

To make the most of these economic opportunities, we need:

- **Medium** and **long term goals**: to 2020, 2030 and 2050
- The policies needed to meet these goals must include an **environmental tax reform** based on the “**polluter pays**” principle
- Industrial sector plans: analysing opportunities, threats, the competitive benefits of European industry and setting out intelligent strategies, information plans and public awareness
  - **Industrial strategies** aligned with a **net – zero** scenario
- A fair and orderly transition must be designed in **collaboration** with all stakeholders
- The development of cutting-edge and valuable technology will play a crucial role (R & D & i)
A CLIMATE NEUTRAL EUROPE
IT’S POSSIBLE AND WILL DELIVER HUGE OPPORTUNITIES

PARIS AGREEMENT
European Union long-term emissions reduction strategy proposal

CLEAR GOALS AND COHERENT, PREDICTABLE POLICIES
- Medium and long-term objectives
- Sectoral roadmaps
- Environmental tax reform
- Fair transition
- Adequate electricity tariff design
- R&D policies

RENEWABLES AND ENERGY EFFICIENCY AS MAIN DRIVERS OF A DECARBONIZED ECONOMY
- Available technologies
- Electrification is critical
- Economic viability and opportunities

ELECTRICITY SECTOR
Electricity provides business opportunities aligned with climate goals

POSITIVE IMPACTS
1. Climate change mitigation
2. Positive impact on GDP
3. Air quality improvement
4. Increase in labour productivity
5. Less energy dependency
6. Reduction in household vulnerability
7. Industrial development
8. Job creation

NET-ZERO EMISSIONS BY 2050