CURSO EJECUTIVO
TRANSICIÓN ENERGÉTICA EN ESPAÑA 2024

TITULO: The Energy Transition: Global, European and Spanish perspective

PONENTE: Álvaro Bau
Executive Summary

1. Energy Transition has slowed down globally, and even in the most optimistic scenario global emissions remain above a 1.5º pathway.

2. Spain has a privileged position to lead energy transition in Europe and has a good starting point to reindustrialize.

3. If we overcome the existing challenges, energy transition could have a substantial positive impact on the Spanish society.
Key trends in Energy in 2023
Synthesis of the key statistics in 2023

In 2023, global emissions reached new record level as fossil fuel demand is at an all time high...

- 2023 was the first year where global temperatures were ~1.5°C above pre-industrial levels as global CO₂ emissions reached an all-time high
- Fossil fuel demand reached new record level as:
  - Coal demand exceeded 8,500 Gt for first time
  - Oil surpassed its pre-COVID peak at 101.7 MMb/d
  - And Natural Gas returned to growth

...simultaneously, 2023 was a record year in low-carbon technology deployment, with investments exceeding fossil by 60%...

- Renewable investments increased by 8% to an all-time high of 1,740 bn USD, driven by renewables (+63 bn USD), Electric vehicles (+34 bn USD) and battery storage (+16 bn USD)
- Investments in fossil fuels grew for the 3rd consecutive year, but remained below 2015 values – majority still in Upstream O&G

...where China continued to lead as two-thirds of all new EVs, Solar panels, and Wind turbines was added in China

- Global EV sales surpassed 13.7mln last year, especially driven by China where 1 in every 4 new sold cars is electric
- Renewable capacity increased by 24% globally reaching ~2.5TW of installed capacity in 2023 with China contributing to 60% of global solar and 70% of global wind expansion
Investment in low-carbon technologies continued to grow in 2023 ...

Investment into low-carbon technologies was $1,740 billion in 2023

Solar capacity
GW

Wind capacity
GW

EV sales
%

Heat pump sales Europe¹
Millions

Liquids consumption
MMb/d

Coal consumption
Gt

Gas consumption
thousand bcm

Gross energy-related emissions²
Gt

2023 Actuals in Energy

... alongside a persistent demand in fossils fuels and increase in emissions

Fossil-fuel investment was $1,050 billion in 2023

1. EU 21
2. Gross energy related CO2-emissions excluding process emissions

Source: EHPA; BloombergNEF; IEA; McKinsey Energy Solutions’ Global Energy Perspective 2023
Faster transition scenarios show stronger energy-efficiency gains and a faster uptake of electrification and low-carbon fuels

Share of electricity and hydrogen in final consumption is projected to be 27–37% by 2035 and 35–60% by 2050 across our energy transition scenarios

**Final energy consumption by fuel, million TJ**

- **Achieved Commitments**
- **Further Acceleration**
- **Current Trajectory**
- **Fading Momentum**

**Overall energy consumption is flattening or even declining in more progressive scenarios as the share of electrification increases (to 31–49% of the total energy mix). Electrification includes more efficient technologies:**

- **An electric vehicle** is ~3-4x more efficient than an internal combustion engine vehicle
- **A residential heat-pump** is ~2-4x more efficient than a natural gas boiler
- **An industrial heat-pump** is ~3-5x more efficient than a coal or gas furnace for low to medium temperature heat
Global emissions remain above a 1.5°C pathway even if all countries deliver on their current commitments

Knock-on effects and regional differences could drive significantly higher temperature increases locally

Global CO₂ emissions from combustion and industrial processes

<table>
<thead>
<tr>
<th>Year</th>
<th>CO₂ p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>4</td>
</tr>
<tr>
<td>2000</td>
<td>4</td>
</tr>
<tr>
<td>2020</td>
<td>28</td>
</tr>
<tr>
<td>2050</td>
<td>36</td>
</tr>
</tbody>
</table>

Median average temperature rise that is exceeded with a likelihood of 83% (x₁), 50% (x₂), and 17% (x₃), respectively

Global warming projection

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Average warming projection (°C increase compared to 1850)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td>3.5</td>
</tr>
<tr>
<td>CT</td>
<td>2.9</td>
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<tr>
<td>FA</td>
<td>2.3</td>
</tr>
<tr>
<td>AC</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Global Energy Perspective 2023

Emissions are expected to peak in the mid-2020s across energy transition scenarios.

- Global warming estimates, suggest that even with significant emission reductions, all four bottom-up scenarios exceed the net-zero target needed for a 1.5°C warming pathway.
- These scenarios project average warming of 1.6°C to 2.9°C. To limit warming to 1.5°C, emissions need to decline much more steeply, especially in the next decade.
- Post-2030, the 1.5°C pathway envisions a more gradual reduction in emissions, aiming for net zero by 2050.

1. Includes process emissions from cement production, chemical production and refining, and negative emissions from applying CCUS
2. Warming estimate is an indication of global rise in temperature by 2100 versus pre-industrial levels, based on MAGICCv7.5.3 as used in IPCC AR6 given the respective energy and non-energy (eg, agriculture, deforestation) emission levels and assuming continuation of trends after 2050 but no net-negative emissions
3. The remaining emissions in 2050 (i.e., ~4Gt) are compensated by negative emissions from DACCs, BECCS, and Reforestation

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3. If we overcome the existing challenges, energy transition could have a substantial positive impact on the Spanish society.
7 forces are redefining competitiveness for Europe

- Innovation
- Energy
- Capital
- Supply chains
- Talent
- Size
- Competition & markets
Within Europe, Spain has a privileged position to lead energy transition and a good starting point to reindustrialize (1/2)

*Low renewable energy* prices as key to remain competitive in green industries

- **20%** Lower cost for renewable electricity generation in Spain vs. Central Europe

*Attraction of highly specialized talent* essential to drive innovation and deployment of projects

- **+1.4M** Engineers and scientists in Spain
- **4th** Largest pool in the European Union

*Capital deployment* as key to create value within the energy transition

- **2nd** Largest beneficiary in Europe of European Investment Bank energy transition fund in 2022

*Need to ensure supply chain* security as rising disruptions affect trade patterns

- **2nd** Largest car manufacturer in Europe
- **3rd** Largest steel producer in Europe

*Larger-sized companies* needed to enable economies of scale and drive profitability

- Several Spanish companies present on the Top10 for the largest utilities and O&G companies better prepared for the Energy Transition

*Lead on innovation* as tech innovations challenges current industrial models

- **12%** Increase in Spain’s R&D expenditure in 2022 compared to 2021 while the EU registered -4.5% decrease

*Regulation and industrial policies* as an enabler to empower competitiveness

- **9th** Rank position (out of 69) of Spain on the OECD FDI Regulatory Restrictiveness Index 2020, indicating low restrictions on international investments

Spain to lead the way, aiming at an industrial reemergence, thanks to its leading position to capture green growth and deliver its economic competitiveness
Within Europe, Spain has a privileged position to lead energy transition and a good starting point to reindustrialize (2/2)

<table>
<thead>
<tr>
<th>Competitiveness dimension</th>
<th>Indicator</th>
<th>Germany</th>
<th>Spain</th>
<th>Netherlands</th>
<th>UK</th>
<th>Denmark</th>
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<tbody>
<tr>
<td><strong>Energy</strong> OPEX</td>
<td>Renewables share</td>
<td>☐️</td>
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<td>☐️</td>
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<td></td>
<td>Solar LCOE</td>
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<td>Onshore wind LCOE</td>
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<tr>
<td></td>
<td>Cost of green hydrogen</td>
<td>☐️</td>
<td>☑️</td>
<td>☐️</td>
<td>☐️</td>
<td>☑️</td>
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<tr>
<td><strong>Input materials</strong> OPEX</td>
<td>Lithium mining capacity</td>
<td>☑️</td>
<td>☑️</td>
<td>☐️</td>
<td>☐️</td>
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<td></td>
<td>Biogenic CO2 supply</td>
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<tr>
<td><strong>Industrial base</strong> CAPEX</td>
<td>Steel production</td>
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<tr>
<td></td>
<td>Vehicles produced</td>
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<tr>
<td></td>
<td>Refining capacity</td>
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<td>☐️</td>
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<tr>
<td><strong>Existing infrastructure</strong> CAPEX</td>
<td>Annual container port traffic</td>
<td>☑️</td>
<td>☑️</td>
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<tr>
<td></td>
<td>Pipeline export capacity</td>
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<td>☐️</td>
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<tr>
<td></td>
<td>LNG terminals capacity</td>
<td>☐️</td>
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</tr>
</tbody>
</table>

1. Considering current LCOEs for the best locations within the countries | 2. Considering the maximum of exports and imports pipeline capacity | 3. Only considering large-scale LNG terminals

Spain could aspire to become a leader in 6 key areas in both existing and new industries

Energy play – Become Europe’s lowest cost energy provider

1. Scale Electrification and Renewables capacity
2. Become a leader of renewable molecules and circular materials
3. Build the lowest cost green Hydrogen ecosystem

Other…

Anchor move “Energy play”

Europe’s lowest cost of decarbonized energy

Scale-up “Value-chain play”

Value-chain play – Localize high added value verticals for decarbonization

4. Scale localized green heavy industries
5. Become one of the largest EV producers of Europe
6. Build the battery value-chain of Europe

Other…
Energy play – What is the size of the opportunity until 2030?

RES power capacity increase, to ~140-150 GW

Green H₂ production increase, to ~0.6-1.1 mtpa

Biomethane production increase, with total capacity of ~15-25 TWh per year

Biofuels supply increase, with total production capacity of up to ~2-3 mtpa

CAPEX needed to become Europe’s lowest cost energy provider ~160 Bn€

vs current capacity

- Up to 1.7X
- Up to 2.5X¹
- Up to 11X²
- Up to 3X

¹ Considering green (1.1 mtpa) and grey (0.4 mtpa) hydrogen production in 2030 versus grey (~0.6 mtpa) hydrogen production in 2023.
² Considering 0.5 TWh of operational capacity and 1.3 TWh under construction as current capacity.
³ Combined CAPEX required for both Biomethane and Biofuels opportunity.
Value chain play – What is the size of the opportunity until 2030?

Up to 4 p.p.:
potential EBITDA uplift in industries, due to ~20% lower RES costs

Up to 2X:
potential RES industrial consumption increase vs. 2022, +25-30 TWh

~40+ Bn€:
of CAPEX needed to deploy and scale 5 new industries: incl. green steel, ammonia, EVs, battery ecosystem
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2. Spain has a **privileged position to lead energy transition in Europe** and has a good **starting point to reindustrialize**

3. If we overcome the existing challenges, energy transition could have a **substantial positive impact on the Spanish society**
Challenges on bankability, regulation and system stability found across key areas

Energy play key areas cross-topics

Non-exhaustive

**Lack of cost competitiveness**
- x2-5 times costlier green H2 solution vs conventional fossil alternatives for some applications
- Slower-than-expected H2 cost reduction trajectories (exp. 4-5.5€/kg by 2030); limited tech maturity
- +1-4k USD/t costlier biofuels than current fossil alternatives

**System instability**
- Insufficient grid investments to handle the increase of both demand and RES
- Limited firm capacity availability and uncertainty of future RES profitability
- Power grid capacity constraints for new connections
- Lack of transparency over existing distribution grid and injection points

**Regulatory burden**
- Tax burden for decarbonization levers vis-à-vis other countries
- Long and complex permitting processes (up to 4 years) with +17 frameworks, one per CCAA
- Unclear HVO demand, uncertain regulatory outlook from new feedstock additions, and threats from non-EU markets
- Strict EU Delegated Act requirements for green H2 production and uncertain RFNBO non-compliance penalties

**Financing hurdles**
- High electrification upfront costs for industry and long lifetime of existing equipment
- 20-80% higher upfront costs of EVs vs ICE
- High uncertainty regarding long-term demand, feedstock availability, and technology maturity
- Limited willingness for long-term offtake agreements

**Highest relevance for:**
- Electrification
- Biofuels
- Biomethane
- Hydrogen

Biomethane
Biofuels

Highest relevance for:
- Electrification
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**Highest relevance for:**
- Electrification
- Biofuels
- Biomethane
- Hydrogen
5 key unlocks could accelerate Spain’s Energy-play leadership translated into specific actions across themes

Energy play key areas cross-topics

Non exhaustive list of examples

- **Effective incentives schemes**
  - Deploy effective incentive schemes to close the cost competitiveness gap between green solutions and fossil-based alternatives
  - Explore public guarantees for offtake agreements (e.g., CESCE fund in Spain for PPAs)

- **Clear and stable regulation**
  - Provide effective (simple and flexible) and stable (long-term certainty) regulatory frameworks to ensure projects’ predictability and robustness
  - Assess measures to increase PPA and futures market liquidity

- **Faster and smoother permitting**
  - Reduce administrative burdens and shorten permitting processes (e.g., one-stop-shops, homogenization) to minimize long permitting periods
  - Enable “fast track” permitting in areas with high feedstock density

- **Strengthen project bankability**
  - Develop strong project cases (e.g., long-term agreements, alliances) to ensure robust and stable financing schemes
  - Form alliances (e.g., technological partner, suppliers, equity partner) with capital contribution capabilities

- **Substantial grid deployment**
  - Plan and deliver efficient grid deployment programmes to ensure coordinated uptake between projects and electrification increase
  - Plan grid capacity enhancements (both for RES and electrolyzers) in line with advanced H2 announced projects

Highest relevance for:
- Electrification
- Biofuels
- Biomethane
- Hydrogen
This could have a substantial impact on the Spanish society...

**Impact on GVA** (% 2022 GDP)
- Up to **+15%**

**Total Jobs, #**
- ~1M

**Increased exports** (% 2022)
- Up to **+10%**

**…of which, qualified positions, #**
- ~200k

**Additional state income, (% 2022)**
- **+8-9%**

**GVA impact** of up to **15%**, depending on the level of reindustrialization or nationalization of local industry adding **+1Mn jobs** to the sector

**Exports could up to 10%**, fueled by an increase in the share of exports in high-value products

An **added impact** in the income for the **Spanish state** of up to **9%** of current state income, including **VAT, corporate, and individual taxes**
...creating ~1 million jobs, and generating ~15% of GDP by 2030

<table>
<thead>
<tr>
<th>Vertical</th>
<th>Impact on GDP % of GDP in 2022</th>
<th>Share of skilled and unskilled jobs %</th>
<th>Total jobs, #k</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVs</td>
<td>~6.0</td>
<td>85/15</td>
<td>720</td>
</tr>
<tr>
<td>Batteries</td>
<td>~1.6</td>
<td>75/25</td>
<td>290</td>
</tr>
<tr>
<td>Power³</td>
<td>~1.2</td>
<td>65/35</td>
<td>50</td>
</tr>
<tr>
<td>Green hydrogen</td>
<td>~1.0</td>
<td>70/30</td>
<td>35</td>
</tr>
<tr>
<td>Green heavy ind.²</td>
<td>~0.4</td>
<td>85/15</td>
<td>20</td>
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<tr>
<td>Renewable molecules and circular materials</td>
<td>~0.3</td>
<td>70/30</td>
<td>20</td>
</tr>
<tr>
<td>Lithium ref. &amp; min.</td>
<td>~0.2</td>
<td>90/10</td>
<td>20</td>
</tr>
<tr>
<td>NetZero reforms⁴</td>
<td>~2.2</td>
<td>N/A</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>~15%</td>
<td></td>
<td>1160</td>
</tr>
</tbody>
</table>

1. Including biomethane, biofuels, and synthetic fuels | 2. Composed of green ammonia and green steel production, as well as CCUS as a facilitator | 3. Implementation of renewables, mainly from solar photovoltaics, onshore and offshore wind, and battery storage | 4. Including renovations to buildings, transport infrastructure, electrification of industry, and upgrading of machinery

Impact of up to +15% in value created (GDP) by 2030

Main focus on battery and electric vehicle value chains with the reconversion of factories playing a decisive role

Creation of +200k qualified jobs in Spain as new green industries set up shop and traditional ones get reindustrialized.
¡MUCHAS GRACIAS!