The socioeconomic impacts of wind energy in the context of the energy transition

A KPMG study at the request of Siemens Gamesa

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About the report

Aim

To present the socioeconomic impact of wind/renewable energy at a global level, and in seven key countries in which Siemens Gamesa operates (China, Denmark, Germany, India, Mexico, Spain and United Kingdom).

Target audience

Media, broad public and experts (e.g. investors, industry, policymakers, academics), in the seven countries.

Methodology

- Measuring the socioeconomic impact of some form of energy in a sound manner is a complex task. There are large knowledge gaps, data issues and methodological challenges. This report follows the specific indicators that the most reputed and independent international organisations have used (see section “Conceptual Framework of the Report”), collecting such evidence while striving for neutrality. Then, it is presented as uniformly and consistently as data allows, but at the same time in an easy-to-communicate way.

- The project team has followed an exhaustive literature review and data compilation process, using public sources. It has also performed targeted expert interviews by email. Two scenarios are defined, aiming to present two possible futures: a Business as Usual (BaU) and a Sustainable Scenario (SUS). Each represents a compilation of information from the reference (current policies in place) and energy transition (ambitious policy action) scenarios of key organisations. These include IEA’s New Policies / Sustainable Development scenarios, IRENA’s Reference / REmap cases, official national-level energy plans, or IPCC’s projections. The sources used are listed in the annex.
Disclaimer

- This report has been done at the request of, and contracted by Siemens Gamesa Renewable Energy, S.A. (“Siemens Gamesa”). Siemens Gamesa had no role in the conduct of the study; the collection, management, analysis and interpretation of data; the drafting or editing; or the preparation of the final report. The work has been carried out by KPMG and is independent of the project sponsor.

- KPMG has been a facilitator of the study, compiling available evidence and interviewing experts. As such, KPMG is not responsible for the opinions of third parties such as institutions or experts cited or quoted in this report. The experts where not compensated for their quotes, and all of them were given the opportunity to review their respective citations (only one did).

- KPMG does not intend to provide any policy recommendation, it only compiles those from the cited organisations. Some analysis and results are based on previously published policy plans, but this does not represent KPMG’s endorsement to those plans or to the Administrations that published them.

- The boundaries shown in the maps used do not represent an official KPMG endorsement or acceptance. They have a purely illustrative purpose and aim to convey the specific messages addressed in this report, excluding any positioning on political or geographical issues.
“The energy transition is essential to achieve the UN’s 2030 Agenda for Sustainable Development. Universal and affordable access to electricity will empower millions of people around the world and their communities to enjoy a better life. But avoid the worst impacts of climate change, energy will have to be carbon-free.

In this context, renewable energy has a major role to play in putting the world on a sustainable path as it will cut emissions, improve air quality, save water, create good-paying jobs and save lives.

What’s required is a wholesale deployment of wind and solar technologies to meet the growing clamor from consumers and from investors for an energy mix that’s 100-percent renewable. And the economic feasibility of the energy transition is right before us.

Wind power is ideally positioned to lead that transition, as it is at the cutting edge of technological innovation, driving costs down and market penetration up. In recent years wind energy has become cost competitive with fossil fuels. That’s due to new manufacturing methods and bigger, better, more efficient turbines.

But even if the sector is ready for the challenge, more needs to be done to replace fossil fuels while ensuring a stable electricity supply.

Governments around the globe have already committed to the UN agenda and the Paris Agreement, but the political will is still lacking, as are long term strategies and investments to make those ambitious plans reality. Years of experience have taught us that clear emissions-reductions policies help low-carbon technologies grow and become more competitive, making it easier and cheaper to reduce more emissions in the future.

At Siemens Gamesa Renewable Energy we believe it is our responsibility to be a driving force behind this sweeping energy revolution. Insightful and comprehensive studies, like the one conducted by KPMG, are critical to understand the positive contribution of massive deployment of renewable energy for the overall welfare of the people, regardless of how advanced their economic development may be.”

Markus Tacke

CEO

Siemens Gamesa Renewable Energy
“One of the real positives in the fight against climate change is the way institutional investors and the wider capital markets have responded.

The investment community has embraced renewables as a highly attractive asset class and we are now in an environment where there are not enough investment-ready renewable projects to satisfy what has become an insatiable demand from investors globally.

Therefore, to address this investment mismatch, it is critical that governments continue to introduce favourable policies particularly in emerging economies. The investment community will respond in kind if policy certainty and stability can be achieved. However, the issue of government policy is not just about support systems - it is also critical to deliver certainty in other areas such as availability of grid, land ownership, and bankable PPA agreements.”

Michael Hayes
Global Renewables
Lead KPMG
“By contributing to the mitigation of climate change, the wind energy sector is already making a significant contribution to sustainable development. Furthermore, the wind sector represents more than 300,000 EU jobs, a number which will continue to rise as we move towards net zero greenhouse gas emissions. These are often high quality jobs, which contribute to local employment in rural or disadvantaged areas. Furthermore, replacing fossil fuel dependency with wind power will have a direct impact on the EU’s air pollution, which is estimated to cause almost half a million premature deaths per year.”

Miguel Arias Cañete
European Commissioner for Climate Action and Energy
A global energy transition is taking off

- Based on the most conservative estimates, low carbon sources and natural gas will cover at least 80% of the increase in global energy demand by 2040.
- Renewables have been the main source of new power capacity for the last six years.
- Investors are increasingly betting on “green” assets. The global sustainable debt market has increased from USD 5 billion in 2012 to USD 247 billion in 2018.
The window of opportunity is closing

However, the most prestigious international organisations agree that the transition should speed up significantly in order to achieve our common sustainability goals.
Over a ten-year horizon, environmental risk has increased 60%, where climate change and extreme weather are seen as the gravest threats.
Wind energy is key to achieving the energy transition

- Its role in power supply could be nine times larger: it could supply up to around 34% of global electric power demand in 2040 (up from 4% today). That is 14,000 TWh, equivalent to total power generation in China, Europe and USA today.

- It could provide around 23% of the carbon emission reductions needed in 2050: 5.6 billion ton CO₂ (equivalent to the yearly emissions of the 80 most polluting cities in the world, home to around 720 million people).

- Investment in clean technologies would approximately double by 2040 with respect current levels. Wind would move from a USD 110 billion to a USD 200 billion annual investment.
Wind power industry: a leading innovator

The wind industry is at the cutting edge of technological innovation, efficiency gains and cost reductions: turbine sizes and capacity factors have tripled, while generation costs have been reduced by 65% since 1990.
The advent of offshore wind

While onshore wind has been the dominant segment for years, offshore wind now grows faster, thanks to impressive technological advances and cost reductions. It presents important advantages, e.g. higher capacity factors, predictability, new economic opportunities in coastal areas (e.g. northeast of the UK) and, if floating foundations keep improving, it could supply large coastal demand centres (40% of global population lives <100km from the sea).
Wind and solar complement each other

Wind and solar PV tend to complement each other, providing higher security of supply, reduced price volatility, and a more diversified set of actors in the global power mix.
Wind is key for sustainability

The renewable energy industry is core to many Sustainable Development Goals (SDGs), especially SDG 7, which focuses on access to affordable, reliable, and sustainable energy and SDG 13, which centers on urgent action to fight climate change. Globally, in a Sustainable Scenario*:

- Total final energy consumption from renewable sources is expected to grow to 22% (from 10% in 2017) and universal access to both electricity and clean cooking would be achieved, by 2030.

- The benefits of CO₂ reductions from wind in 2050 are estimated at $386 billion (reduced social cost), similar to Norway’s GDP today.

- All renewables together would reduce air pollution enough to save up to 4 million lives per year in 2030.

- Wind power could save up to 16 billion m³ of water in 2030 (around 15% of the Dead Sea water). In Europe alone, it would avoid the use of 1,571 million m³ (the equivalent consumption of 13 million EU households).

- The wind industry could employ three times more people than today, from 1.1 to 3 million people (direct and indirect). Many of these jobs are local and qualified, adding significant economic value to most regions.

*Our Sustainable Scenario is a compilation of information from the energy transition scenarios from the most reputed, independent, international public sources such as IEA (Sustainable Development Scenario), IRENA (REmapCase) or Shell (Sky Scenario).
Spain: Current status and deployment of wind energy
The latest Spanish Government has set quite ambitious targets to pursue the decarbonization of the economy. These are in track towards its international commitments, but there is political uncertainty.

Current state/situation

Energy-related SDG Indicators, 2016:

- Access to electricity: 100% % of population
- Access to clean cooking: 100% % of population
- Renewable energy: 83% % of final consumption

Some hot topics in energy policy:
- Elections / new government / less ambitious targets?
- RE auctions: capacity/year? Technology neutral?
- Evolution of PPA market.
- EU reform of electricity market design.
Main pledges and targets

By 2030:
- 20% reduction (at least), of GHG emissions with respect to 1990 levels.
- 42% share of renewable energy* (at least) in final consumption.
- 39.6% improvement in energy efficiency*.

By 2050:
- 90% reduction (at least) in GHG emissions with respect to 1990 levels. Intermediate 2040 target consistent with NECP.
- 100% renewables share in power generation.

*In the draft bill Spain committed to a 35% renewable energy share by 2030. The formal commitment with the EU is 32%, but the most updated ambition announced in the 2019 NECP is 42% by 2030.
*35% is the formal target but 39.6% is the updated expectation/projection announced in the NECP.

Projections

Forecasted electricity mix

<table>
<thead>
<tr>
<th>Year</th>
<th>Wind share (%)</th>
<th>Renewables share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030 BaU</td>
<td>24</td>
<td>55</td>
</tr>
<tr>
<td>2030 SUS</td>
<td>34</td>
<td>74</td>
</tr>
</tbody>
</table>

Wind capacity additions needed (GW/year)

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030 BaU</td>
<td>1.8</td>
</tr>
<tr>
<td>2030 SUS</td>
<td>2.6</td>
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</tbody>
</table>

Spain: Aggregated economic effects of wind energy deployment
To achieve the deployment of renewable energy sources in the SUS additional investments are required. However, an improving business case is increasingly attracting private investors. The socioeconomic returns could overcome the costs.

The deployment of renewable energy has a crucial role in the attainment of the sustainable scenario, hence it requires 43% of the total investment in decarbonizing measures.

Due to the large reductions in costs and favorable future prospects for renewables, the vast majority of the funds already comes from private investors (instead of public subsidies like it used to be the case).

The expected return of such investments is positive and significant.

The development of renewable (in the scale necessary for the sustainable scenario) would increase GDP by more than 6000 million euros annually in the period 2021-2030, i.e. 130€ per capita per year.

It would sustain around 150 thousand jobs (direct and indirect) per year, 30 thousand of which just in the wind sector.

Moreover, it would imply additional reductions in the wholesale price, which represents 35% of the total tariff at present.

Recall that wind share within renewable energy is around 45%.

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**Investment by measure**

- 3% Other
- 43% Renewables
- 15% Power grid
- 2% Electrification

**Investment by source**

- 20% Public
- 80% Private

**Decomposition of the electric bill**

<table>
<thead>
<tr>
<th>Variable part</th>
<th>Fixed part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy generation and consumption price</td>
<td>35%</td>
</tr>
<tr>
<td>Access fee and commercialization margin</td>
<td>40%</td>
</tr>
<tr>
<td>Taxes</td>
<td>25%</td>
</tr>
</tbody>
</table>

**Short-term annual average marginal cost (€/MWh)**

Sources: REE. Spanish NECP (2019).
The level of development of wind energy needed in the Sustainable Scenario would entail an extra growth of 0.3% GDP with respect to the Business As Usual Scenario by 2030.

Sources: Basque Centre for Climate Change 2019.
Spain: Social and environmental effects of wind development

The deployment of wind and other renewable energies could have wide economic and health benefits for the Spanish society. It could also help to mitigate water scarcity problems.

In a Sustainable Scenario...

- 537 million $ CO₂ emissions avoided by wind energy by 2030
- 142 million m³ water use avoided by wind energy by 2030
- 0.2% GDP health-related cost saved up by renewable energy by 2030

Wind energy is projected to avoid 10.75 Mt CO₂ by 2030

Yearly emissions of a ...

- 1 million inhabitants Spanish city
- 1.1 million Spanish households
- 313 million $ savings

Equivalent to the annual consumption of

Water stress in Spain by 2030

- No water stress
- Moderate water stress
- Low water stress
- Severe Water stress

Ambient air pollution (PM2.5)

Air pollutants avoided by 2030 (%)
(compared to 2030 BaU scenario)

- PM2.5: -31%
- SO₂: -44%
- NOₓ: -29%

Premature deaths avoided by 2030 (persons)

- 2030 BaU: 8951
- 2030 SUS: 6729

Up to 2,222 premature deaths avoided by annually by renewable energy by 2030

*In a Sustainable Scenario, GDP should decrease due to the higher deployment of renewables, cleaner combustion of fossil fuels and reduced use of traditional bioenergy

** In a Sustainable Scenario, emissions should decrease due to the higher deployment of renewables, reduction of coal consumption, improved internal combustion engine efficiency and electrification.

Estimations: Exchange rate on 19/3/6: 1.1308 USD/EUR.

Spain: Social and environmental effects of wind energy deployment

Renewables could translate in savings for households, specially for poorer ones. The economic effects of local pollution would be reduced.

The development of renewable energies, combined with the other official commitments/plans included/contained in the NECP to move towards a sustainable scenario, would translate into savings in the electricity bill of citizens.

Said savings and resulting increase in disposable income of households would be progressive. The poorest households would save the most in relative terms (3.9% of their income). The richest households would have positive but lower savings in relative terms (1.1%).

Co-benefits in terms of public health are estimated to account for 67 (33 and 100) € billion in the NECP submitted by Spain.

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