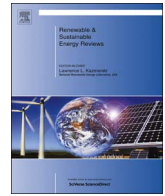




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Photovoltaics and wind status in the European Union after the Paris Agreement

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ABSTRACT

Over the last decade, the utilisation of renewable energy in the electricity sector, especially from solar and wind sources, is growing at a much faster pace than the rest of the economy in Europe and world-wide. The significant cost reduction of solar PV and wind power during this time and their zero fuel cost volatility have increased their attractiveness. Between 2005 and 2015, the installed solar PV power in Europe as increased 50 fold to reach 95 GW and wind power has increased three and a half times to 142 GW at the end of 2015. The fact that the Paris Agreement went into force on 4 November 2016 will be another accelerating factor for the use of electricity from renewable energy sources. This paper shows the deployment of photovoltaics and wind power in the European Union and the policy drivers behind this development. So far, the European Union is the largest economy with a legally binding target to reach 27% of its energy consumption from renewable energy sources by 2030. The data used for this publication are collected on a regular basis from statistical offices, stock exchange filings, press releases, public and commercial studies. The results are cross checked with personal communications and on-site visits as well as meetings with government officials and policymakers. In order to provide a timely coverage of the dynamic increase of solar and wind power this use of grey data is necessary. In 2016 slightly more than 12% of the Union's electricity demand was covered by solar and wind, but in order to reach the 2030 target a tripling of this contribution is needed.

1. Introduction

In December 2015, the 21st session of the Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris, France ended with a landmark agreement to keep the maximum global average temperature rise as close as possible to 1.5 °C.

There is general consensus that the Nationally Determined Contributions (NDC's) proposed by each country are only a stepping stone on the way to realise the goals of the Paris Agreement. In a recent publication Sir Robert Watson, former Chair of the Intergovernmental Panel on Climate Change (IPCC), and co-authors stated that global green-house gas (GHG) emission are not projected to decrease fast enough to stay below 2 °C [1]. According to this analysis the 1.5 °C would be reached by early 2030 and the 2.0 °C target by 2050. The authors urged all countries to revise their pledges by 2018 in order to really reach the targets of the Paris Agreement.

Decarbonisation of our energy supply is an important component to achieve the targets, because 65% of the world's current CO₂ emissions

are due to burning fossil fuels. In 2014, 81% of our total primary energy supply depended on burning fossil fuels, namely 29% coal, 31% oil and 21% natural gas [2]. In terms of final energy consumption electricity only accounted for 18.1%, but was responsible for 35.2% of the total CO₂ emissions [2,3].

Photovoltaics (PV) and Wind Energy are key technology options for implementing the shift to a decarbonised energy supply and can be deployed in a modular way almost everywhere on this planet. Solar and wind resources in Europe and across the world are abundant and cannot be monopolised by one country.

Despite the significant growth in non-hydro renewable energy usage over the last decade, there are obstacles of a structural nature concerning the use of all renewable energy sources. Especially in the electricity sector the current European system design, both on the economic as well as the political and social side still favours the centralised use of conventional energy (coal, oil, natural gas and nuclear energy), which has the risk of high stranded costs in a rapid energy transition towards a sustainable energy supply. In addition, the current electricity distribution system was designed for a one

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directional flow from centralised units to the consumers, whereas decentralised renewable electricity generation from solar and wind requires the capability of a bidirectional flow of electricity.

Another barrier is of financial nature and how the cost of the generated electricity is calculated. Different to conventional power plants, renewable electricity generation systems from wind and solar need only an upfront investment, but no fuel costs. In most cases, the standard net present valuation (NPV) method is applied. However, since the financial duration of the various power plant types are different, their cost structure is basically diverse (RE projects can be described with sometimes higher up-front cost but low operation cost, while fossil fuel-powered plants have in general lower investment cost but higher and variable operation costs), and they are characterised with distinct risks; therefore, standard NPV methods may not always deliver the correct comparison [4].

Especially in areas with a well-established infrastructure, dominant incumbent market players and no carbon tax, renewable energy markets cannot be expected to develop on their own without a defined policy framework, which defines mandatory renewable energy targets or renewable portfolio standards (RPS) to be reached at given dates.

2. Policy framework in the European Union

In 2009 Directive 2009/28/EC [5] established a common framework for the promotion of energy from renewable sources (amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC) [6,7].

The Directive set mandatory national targets for the

- overall share of energy from renewable sources in gross final consumption of energy and
- share of energy from renewable sources in transport.

The Directive established rules relating to the statistical energy transfers between Member States, joint projects between Member States and with third countries, guarantees of origin, administrative procedures, information and training, and access to the electricity grid from energy from renewable sources.

A key measure of the Directive was the establishment of mandatory targets and measures for the use of energy from renewable sources for each Member State. Every Member State had to adopt a standardised National Renewable Energy Action Plans (NREAP) and submit it to the European Commission. In the NREAPs the Member States had to provide a detailed roadmap how to reach their legally binding 2020 target for the share of renewable energy in their final energy consumption, transport, electricity as well as the heating and cooling sectors, taking into account the effects of other policy measures relating to energy efficiency on final consumption of energy. Member States had to specify a non binding technology mix they expect to use, a trajectory they will follow and the measures and reforms they will undertake to overcome the barriers to develop renewable energy.

Every two years the Member States have to submit a progress report and the last EU-wide one stated that for 2014 the projected share of renewable energy in the gross final energy consumption is 15.3%. Only 3 countries out of EU-28 were expected not to meet their 2014 targets [8].

With the signature of the European Union (EU) on 5 October 2016, the necessary number of at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession with the Depositar [9]. As a

consequence, the Paris Agreement entered into force on 4 November 2016 just 3 days before COP 22 (7–18 November 2016) started in Marrakesh, Morocco.

The contribution of the EU was defined during the European Council meeting on 23–24 October 2014, when the following Conclusions on 2030 Climate and Energy Policy Framework were adopted:

- The European Council endorsed a binding EU target of at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990.
- An EU target of at least 27% was set for the share of renewable energy consumed in the EU in 2030. This target will be binding at EU level.
- An indicative target at the EU level of at least 27% was set for the improvement of energy efficiency in 2030 compared to the projections of future energy consumption under a current policy scenario.

The European Council confirmed that the target will be delivered collectively by the European Union. To achieve this in a cost-effective manner, the reductions in the Emission Trading System (ETS) - and non-ETS sectors were set to reach 43% and 30% respectively by 2030 compared to 2005 [10]. However, with the current implemented policies, GHG emissions are not expected to sufficiently decrease to reach the European Union's target of at least 40% reductions on 1990 by 2030. Therefore, modified national reduction targets and policies are required to realise the necessary additional reductions.

In order to achieve the European Union's 2030 targets, the European Commission presented the Clean Energy for All Europeans legislative proposals on 30 November 2016. These proposals cover energy efficiency, renewable energy, the design of the electricity market, security of electricity supply and governance rules for the Energy Union. The package named the following three main goals:

- putting energy efficiency first,
- achieving global leadership in renewable energies
- and providing a fair deal for consumers".

As the market arrangements in place do not adequately incentivize all market participants to adjust their portfolios (supply and demand) on short notice various policy options are presented in the new proposals to introduce new market models. These proposals will now be discussed in the European Parliament and the Member States.

The Commission Staff Document (Impact assessment) accompanying the proposal for the new Market Design Directive [11] forecasts a share of 49% of renewable electricity by 2030. 62% of this renewable electricity share or almost 1 000 TWh is expected to come from solar photovoltaics and wind.

3. Introducing photovoltaics and wind in the European context

In 2015, a total of about 27.3 GW of new power generation capacity were connected in the EU and 18.2 GW were decommissioned, resulting in 9.1 GW of new net capacity (Fig. 1) [12–15]. Renewable energy sources (RES) accounted for 20.6 GW or 75.6% of all new power generation capacity.

Looking at new net capacity, wind power was first with 12.2 GW, or 44.6% of the newly installed capacity, followed by solar PV 6.86 GW, or 25.1% of the new installed capacity; new solar thermal power plants reached 370 MW, hydro 239 MW and other sources 127 MW. Net installation capacity for coal-, oil- and gas-fired power

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