International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
(Vol. 36, Issue 01) and (Publishing Month: November 2016)
(An Indexed, Referred and Impact Factor Journal)
ISSN: 2319-6564
www.ijesonline.com

THE NEW EUROPEAN RENEWABLE ENERGY DIRECTIVE OPPORTUNITIES AND CHALLENGES FOR PHOTOVOLTAIC

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***Abstract* — The principal European Renewable Energy Directive had a period skyline from 2009 until 2020. The impacts of this order were the drafting of guides depicting how the Member States of the European Union, wanted to arrive at their separate environmentally friendly power targets and made a trust in financial backers to put resources into the area. Photovoltaic establishments saw an extremely fast increment somewhere in the range of 2009 and 2013 and an exceptionally languid market circumstance thereafter. What can we presently expect of the second form with a period skyline until 2030? From the examples picked up during the most recent 10 years, obviously just sun oriented and wind have the important potential to understand the objectives.**

I. INTRODUCTION

Since the first European Renewable Energy Directive went into force in April 2009 grid-connected solar photovoltaic (PV) systems in the European Union have increased tenfold from 11.3 GW at the end of 2008 to over 116 GW at the end of 2018 [1].

Just before the last COP meeting in Katowice in December 2018, the European Commission published its Vision for 2050, A Clean Planet for all, in which it was outlined that the use of renewable energy sources has to exceed 60% by 2050 to reach an average of 1.5ºC or net zero emissions [2].

Already the 2016 European Commission (EC) initiative "New Deal for Energy Consumers: Empowering Consumers, Developing Demand Side Response; using smart technology; linking Wholesale and Retail Markets; Flanking Measures to Protect Vulnerable Customers" listed as one of the options the right to self-generate and consume self-produced electricity [3]. This right is now part of the new renewable energy directive, which was published on 21 December 2018 [4]. Together with various announced power tenders might lead to a revitalization of the sluggish European PV market.

II. CURRENT SITUATION

The latest New Energy Outlook (NEO) 2018 by Bloomberg New Energy Finance forecasts a slight electricity demand increase in Europe (EU-28, Island, Norway and Switzerland) from 3 454 TWh in 2017 to 3 566 TWh in 2030. The increase is driven by the increased use of electric vehicles (EV) but

Slowed by progress in energy efficiency [5]. This is in line with the estimates for the European Union that the net electricity generation will be around 3 400 TWh in 2030.

To realize the new renewable energy target of 32% by 2030, the European Union has to increase its use of renewable energy in the power sector to at least 65%. The main contributions have to come from solar and wind power. Different from a number of other scenarios, the NEO 2018 does not foresee an increase in electricity from renewable energy sources except for solar photovoltaic and wind, which will have to supply 440 TWh and 1 300 TWh respectively [3]. If we assume an averaged load factor of 14% this would require about 360 GW of PV power, about three times the current installed capacity.

In the EU total installed PV power was about 116 GW and about two-thirds of it was on rooftops – residential and commercial – at the end of 2018 [1]. The EU Governance Regulations of the energy union and climate action went into force on 24 December 2018. These regulations call for integrated national energy and climate plans (NECPs), which cover ten-year periods and provide a planning framework for the 2050 Net Zero objective. The first NECPs cover the period ranging from 2021 to 2030 and their drafts had to be submittedby the end of 2018.

After six years of a declining PV market in the European Union, a positive development could be observed for 2018 [6]. With over 9 GW of new PV system installations, the market expanded by over 50% compared to 2017 (Fig. 1). The increase was due to stronger than expected markets in Germany (3.1 GW), the Netherlands (1.5 GW), France (>1.3 GW), and Hungary (>0.5 GW).

After five years of very little new PV power additions in Spain, 2019 will bring some change. In July 2017, the Spanish Ministry for Energy and Tourism announced the winners of the second renewable energy auction and solar photovoltaic power projects had won 3.9 GW_{AC} in this auction [7]. The winning consortia have to connect the systems before the 1st of January 2020.

A number of European Member States have held auctions for solar energy over the last few years and the bids moved to levels in the range between EUR 50 and 70/MWh. The lowest

bids came in the Danish cross border auction in December 2016. The 9 winning tenders will get a fixed premium of 12.89 Danish øre per kWh (EUR 17.32/MWh) for 20 years on top of the Danish spot market price, which is fluctuating in the range of EUR 30 to 40/MWh [8].

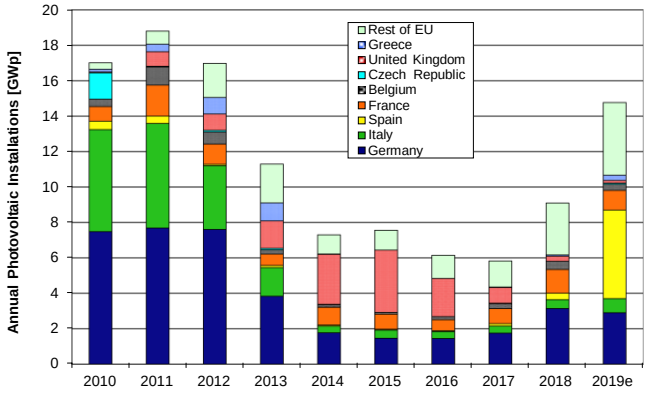

Fig. 1. Annual photovoltaic installations from 2010 to 2019 [1, 6]

III. Results

According to a report by the European Climate Foundation [9], the first series of reports are neither ambitious or credible nor do they describe a robust and Paris-compliant pathway for Europe. Despite this criticism that Europe is not on the right pathway towards Net Zero, the report stresses the fact that these drafts are only a first step, which can and need to be improved.

An analysis of the objectives for solar photovoltaic electricity generation in the draft plans revealed that only 19 Member States have either installed capacity or electricity generation targets for solar PV. Even more surprising is the fact that in three Member States the numbers given for 2020 are lower than the actual installed capacity at the end of 2018.

The current plans still fall short of the additional 240 GW needed until 2030. First of all, it would require more than a doubling of the European PV market compared to the 2018 figures of 9 GW to an average of 20 GW annually for a period of 12 years (Fig. 2). The trend for 2019 points in the right direction, but with a lack of long term policies in place across the European Union it is uncertain how it will continue. Unfortunately, most of the draft NECPs remain vague about the policy instruments under consideration to realise the required increase in renewable electricity generation in general and solar photovoltaics in particular.

On the positive side it should be mentioned that a number of ambitious announcements have been made like the one of the Hungarian Government to increase the solar capacity from about 0.5 GW at the end of 2018 to 30 GW by 2022. Another positive announcement came from the Spanish Minister of Energy, which announced a share of over 70 TWh solar electricity in the Spanish energy mix by 2030. This is slightly higher than the figure of 66 TWh given in the draft NECP and would require between 40 and 50 GW of new installations.

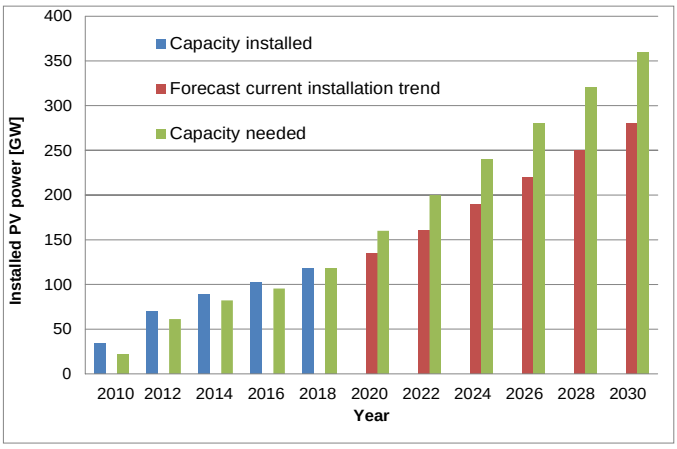

Fig. 2. Actual and projected photovoltaic installations from 2010 to 2030

The Netherlands plans to increase its capacity more than six-fold between the end of 2018 (4.4 GW) to reach 30 GW by the end of 2030. The current programme to stimulate sustainable energy production (SED+) has a pipeline of 8.5 GW, which were awarded but not yet realised.

It is interesting to note that the draft for the new "Polish Energy Policy until 2040" mentions a target of solar photovoltaic electricity of 9.6 TWh, which is about 60% higher than the figure given in the NECP [10].

In the Italian NECP renewable electricity generation is projected to reach 55.4 % in 2030. According to the plan, solar power would be the main source of renewable electricity with a 40% share and 50 GW (+30 GW) of installed capacity. However, only a moderate grow to 26 GW is foreseen until 2025. A low increase is also mentioned in the German plan, were merely 24 GW additions are foreseen within the next 12 years.

IV. Outlook

A number of studies show, that there is more than enough rooftop area available in Europe, even for the most progressive ones. In 2016, the International Energy Agency in its "Energy Technology Perspectives 2016" showed a technical potential of 470 GW of PV system capacity on rooftops in cities of the European Union by 2030 [11]. Like many other EU-wide studies the IEA relies entirely on population density data as a proxy. In order to use a more direct approach and to map actual buildings right across Europe using earth observation data, the JRC exploited data from the Global Human Settlement Layer (GHSL) initiative. With this, it is possible to estimate the available rooftop area in blocks of 10 m $_{x}$ 10 m across the entire EU in both urban and rural areas. Calculations show that if the suitable rooftop areas are used for PV generation this would result in more than 680 TWh of

electricity generation [12]. This represents a contribution of about 16% of electricity from PV in a possible 100% Renewable Power supply scenario [13].

Compared to the available potential, the 350 to 400 TWh electricity needed from PV systems to reach 32% renewable energy use by 2030 requires about two-thirds of the total area.

Despite the fact that PV generation costs are already now lower than residential electricity prices for almost 80% of the European Union's population, depending on the actual electricity price and the local solar radiation level, governments are still reluctant to empower consumers to take electricity generation in their own hands [12].

For a larger system, other artificial surfaces or inland water bodies could be exploited e.g. parking areas, roads, waste sites, lakes, reservoirs, and further analyses are needed to systematically address these. One example is a JRC study on the use of waste fill sites [14].

Economic factors also play a role: in general -integrated PV solutions require a substantially higher investment than ground-mounted systems. In this case, the EU average is 1.37% of the land required for the Lappeenranta model scenario and 2.84% for the JRC-RU-TIMES near-zero CO_2 scenario [12, 15]. As a comparison of impact, these values are below the share of land under the CAP set-aside scheme (3.12% overall for the EU).

A dual-use approach combining PV electricity and agricultural production [16] may offer interesting opportunities, and not least provide an additional means of keeping rural communities viable.

The need to decarbonise the European power sector has far-reaching consequences for those European regions, where coal and lignite are still mined and used in thermal power plants. Coal mining is still ongoing in 42 regions across 12 EU countries and accounts for significant economic activity. Coal-fired power stations represent about a quarter of the EU's electricity production and are used in 21 Member States. In late 2017, selected EU regions were designated as Coal Regions in Transition (CRiT) according to the relevant terms of reference [17].

In a recent study, the technical potential for solar photovoltaic electricity generation in those regions was analysed [18]. The results show that identified technical potential could contribute a total 730.3 GW of PV in the CRiT. This power capacity would almost replace the electricity output of the current operational coal power plants in the EU. The retirement of existing coal power plants could be compensated by a gradual installation of large-scale solar farms. These farms would be able to generate 874.3 TWh of electricity and can potentially compensate the retired thermal units if supported with proportionate storage-flexible units.

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