

Supplying Europe with Renewable Power: The **POINT OF NO RETURN** has been Passed



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Bad news from the European solar industry and sometimes heavy political conflicts should not take away the region's decisive success in renewable energy sources. The progress in reaching the European Union objective of 20 per cent renewables by 2020 - and therefore, a considerably higher percentage in the power sector - is being monitored closely and has led to considerable changes in policies over the last years which are profoundly changing the electricity system.

The financial crisis, however, has slowed down the transformation process in several countries. As a result of this, several governments in the European region have become more reluctant to fund support for renewables or to burden electricity consumers with financing such support. Moreover, it has become more difficult to get bank credits for renewable energy projects. While these trends have not been favourable, falling prices and growing widespread understanding of the current transformation have strengthened the expectation that the future of the power sector will be renewable energy.

This article does not focus on the ups

and downs of renewable energy policies and markets in different countries. However, before describing more general trends and experiences, here are some spotlights to illustrate the dynamics of developments in Europe:

- Renewable power now makes up for more than 25 per cent of electricity generation in Germany and (already in 2010) more than 21 per cent in Italy.

- In 2011, 7.5 GW of solar power was installed in Germany, bringing total installations to 24.8 GW; the solar boom in Italy resulted in a total of 12.8 GW installed capacity.

- Wind energy installations in Germany, the UK, Spain, Italy, France and Portugal together increased by 5.6 GW in 2011.

- The new French president has announced reduction in nuclear power from 75 per cent to 50 per cent of the power supply by 2025. The majority of this gap will have to be filled by renewables.

- The European Union has decided to cancel its present support programme for CCS (carbon capture and storage), taking stock of the abandonment of the key projects in several countries. This officially confirms that there will be no low carbon future for coal.

The development of renewable energies in some European countries - especially in Germany - has entered a new phase: Renewables have started to profoundly change the whole electricity system. This new phase can be characterised by four intertwined trends that are most interesting in nature and stretch well beyond Europe in terms of application.

- After many years of political push for renewable energy, technological and industrial dynamics are gaining influence and getting more independent from political support and control. In a growing number of markets, photovoltaics and onshore wind are starting to become competitive.

- A growing share of distributed fluctuating renewable power generation is changing electricity markets. As a result of which, providing flexible compensation for fluctuating generation is becoming a key issue. Distribution grids are getting more important and increasingly require active management.

- The rapid price decline of photovoltaic systems has changed the game much earlier than expected: For residential and commercial consumers in Germany

and Italy, rooftop photovoltaic power is now cheaper than electricity from the grid. This has opened considerable perspectives for self-supply and has given a completely different role to consumers in the system.

• Not only countries, but regions and municipalities are also discovering the opportunities in renewable energy.

Renewable Power challenging European Electricity Systems

European electricity systems essentially developed in the first half of the last century from local and regional utilities to national electricity systems, with large regional or national monopolies ensuring generation in large power plants as well as transmission and distribution. While municipal utilities and regional distributors survived in some countries, the electricity systems have fundamentally become top-down-controlled

centralised systems. National governments have strongly shaped the development, for example, nuclear power in the sixties was a political project, only reluctantly supported by utilities. Following the first (1996) and second (2003) EU energy legislation package, European electricity markets were partially liberalised since the beginning of this century. This resulted in increased concentration in the European power sector. As a result, grid operation and generation are now increasingly being separated, raising questions concerning the spatial co-ordination of grid and generation development. In this context, regulatory agencies at the national and European levels are gaining influence.

In the tradition of a strong State influence in the electricity sector, and pushed by climate policy and the anti-nuclear movement, some European countries, especially Denmark, Germany, Spain and Italy, started to develop support policies for renewable power in the nineties.

Ironically, this was undertaken without discussing the implications for the power industry and electricity system. The most successful approach was implementation of feed-in-tariffs (FiTs), regularly adjusted to falling renewable system prices. FiTs have, over the years, boosted wind and solar energy, especially in Germany, Spain and Italy. Meanwhile, Denmark has been very successful in promoting wind energy with a slightly different system. In Spain, exaggerated tariffs have led to a boom in ground-mounted photovoltaic plants, which has been stopped not only because of growing costs but also due to opposition from utilities having strongly invested in gas-based generation capacities.

Germany has been particularly successful in creating a globally leading PV market, pushing global production volumes and driving down technology costs at unexpected rates. The overall supplementary costs of German PV installations up till now - including the guaranteed tariffs for a 20-year runtime for every single installation - are estimated to run between €70 billion and €100 billion and are paid for by the electricity consumers. The cost can be considered to be not only for the transition to a sustainable national electricity system (lower than that for the partial transition to nuclear energy forty years ago), but also to be a contribution to global climate policies. Public opinion polls showed strong support not only for renewables but also for these payments in Germany until this year when the willingness to pay the supplement price for renewables on the electricity bill dropped. This was the consequence of a considerable increase of this supplement, mainly due to generous new exemptions for industry and heavy campaigning by



some industry associations against the "exaggerated" cost of renewables and favouring a slowdown of the transition.

The background of increasingly hefty discussions on the speed of transition to an energy system based on renewables is that renewables are starting to really transform the power industry. In a situation where electricity consumption is nearly stable, a renewable share of 25 per cent means a relevant loss for the incumbent large utilities, which started investing very late in renewable energies and then concentrated on offshore wind. Renewable energy generation plants are owned to an overwhelming extent by individuals and new small companies entering the market; and about three quarters of installed PV power capacity in Germany is rooftop. Moreover, solar power has flattened the price curve at the power exchange during the day, putting under pressure conventional power producers, who had made most of their money during peak hours around noon. As a result of this effect, conventional utilities are losing several billions of Euros per year.

While the development of renewable power was a policy-driven process, it is now becoming clear that with rapidly falling costs renewables are becoming competitive in an increasing number of markets - even under present market conditions which are not very favourable for renewables. Going forward, politics will soon start to lose control over the dynamic renewable market - we will see below why such a tendency may accelerate.

The German decision to effectively phase out nuclear power by 2022 after Fukushima disaster was not as sudden as many are presenting it now to be. Just six months before Fukushima, the conservative

government had extended the lifetime of nuclear plants, overthrowing a phase-out agreement negotiated by the red-green government ten years earlier. However, since the new phase-out law, the transition towards renewables is not being questioned anymore - only the speed of the transition and the kind of renewables to be favoured are being heavily debated. A lower speed and a high share of offshore wind energy would allow keeping larger parts of the incumbent top-down system for a longer time and the present government seems to support endeavours in this direction. However, despite the difficulties of the once hopeful European photovoltaic industry to resist the fierce competition from Chinese manufacturers, supported by a determined Chinese State strategy, a majority of German industry and society supports a transition towards renewables and wants Germany to play a leading role in the global transition to a low-carbon economy. A recent consultation on grid development plans showed a deep understanding and a high acceptance of the major transformations ahead.

Fluctuating Renewable Power requires Additional Flexibility

Wind and solar power generation are fluctuating in nature, and have nearly no marginal costs. The fact that the marginal cost is zero underlines the reason why they are the first to be consumed. However, these fluctuations must somehow be compensated by flexibilities in other parts of the system. This is the key challenge of integrating renewables into existing electricity systems. Basically, there are four ways to achieve this:

- (1) With very flexible additional generation (such as CHP plants running on gas that is coming increasingly from renewable sources);
- (2) With electricity storage (still rather expensive but interesting developments are going on);
- (3) With compensation between regions (transmission) or;
- (4) With more flexibility in consumption (demand-side management, requiring intelligent controls and/or storage of other forms of energy - heat or mechanical energy - for which electricity may be used).

Moreover, this balancing can occur at different levels. Optimal solutions will involve complex combinations for different time horizons, which also will depend on cost developments. Expanding transmission capacities is usually seen as a rather cheap option. All over Europe, transmission grid expansions are being planned. Recently, the four German Transmission System Operators (TSOs) have proposed an ambitious expansion plan with a volume of €20 billion. A public consultation, however, has shown that large parts of the power industry and the industry at large, fearing further increase of electricity prices, have called for an in-depth analysis of more options for ensuring flexibility and an increasingly active role of the distribution system.

The Changing Function of Grids

Renewable power generation is essentially distributed generation. While traditionally more than 90 per cent of electricity generation is fed into the transmission grid, over 97 per cent of the renewable production capacity is fed into the distribution grid. These

are German figures, but will not differ considerably in other countries - only offshore wind and some exceptionally large onshore wind farms may feed into the transmission grid. This changes considerably the roles of the different levels of the grid. In Germany, renewable power plants have now as much capacity as conventional ones (producing one quarter of overall electricity due to a lower capacity factor) and need corresponding connection capacities. In an increasing number of small regions, especially in rural areas, electricity production may be larger than consumption, leading to a need for managing bi-directional flows and supplementary efforts for maintaining grid stability. There is a general acknowledgement that a much more active management of distribution grids is needed, requiring also more distributed control intelligence (smart grids). The Danish power industry, having to deal with large amounts of distributed wind energy, even calls for local electricity markets, which

would allow to continuously balance generation and consumption of electricity at local and regional levels. Evidently, this leads to a shift in influence and responsibilities of grid operators at different levels.

Captive Power Generation as driver for a Coming Boom

Things are getting even more complex with the growing trend towards self-supply. Since the beginning of 2012, feed-in-tariffs for small- and medium-sized rooftop PV installations in Germany are lower than residential and commercial electricity tariffs from the grid. Assuming that PV system prices will decrease by 10 per cent a year (instead of 16 per cent p.a. during the last four years), rooftop power will cost only half as much as electricity from the grid. The relation in Italy is similar.

In an increasing number of markets

solar power is becoming competitive on the retail side of the electricity market. Usually, electricity generation prices are being compared at the wholesale side. Retail prices, however, are much higher than wholesale prices, especially in countries with highly reliable dense grids. Photovoltaics, and that is a disruptive innovation, is a new semiconductor technology, which, in contrast to conventional power generation, can produce power efficiently even at very small scales, directly where energy is being consumed. The problem, however, is that considerable amount of electricity is needed when the sun does not shine - especially for residential use. However, commercial consumption - depending on the sector - may correspond much better with the rhythm of solar radiation.

It is no wonder that under these conditions more and more solar companies are working on business models to provide self-supply



Despite the decrease of subsidies across the continent, Europe's use of solar power continues to increase

systems. The German minister for renewable energy is promoting self-supply systems as a means for containing solar support payments. With a growing price gap between self-generated electricity and electricity from the grid, more investments will flow into control and storage devices that can shift consumption into sunshine hours. Prosumers (producing consumers) are starting to deal with fluctuating solar power at their own premises. The first systems - although not yet competitive for residential use - are appearing on trade fairs. More interesting are commercial systems, such as those now being installed in a large number of retail stores of one of the best-known retail chains - fully competitive without any public support.

However, the boom that can be expected within two or three years on this basis, may have repercussions on the public grid: Traditional load profiles do not function anymore, the use of the grid as a buffer for remaining needs will require another tariff structure than today for not burdening normal consumers with excessive grid costs. Making full use of this growing flexibility at the consumer's side of the grid will require new tariff and market structures. The discussion on adequate market designs that would follow the simple feed-in-tariffs ideal for a start-up phase, is becoming more and more intensive.

Regions and Municipalities push for Renewables

Over the last thirty years, the environmental and anti-nuclear movement in Germany, which has strong local roots, played a key role in pushing for a more sustainable energy policy. Now, as renewable power is becoming affordable, local

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In Germany, observers are speaking about a "renaissance" of municipal utilities. Cities are buying back their local grids for getting the means to promote more determined renewable energy policies. Local co-operatives are playing an increasing role in financing local grid companies or renewable power plants. Local resistance against wind turbines has considerably weakened where external investors systematically involve local population not only in the planning process but also in raising and providing investment capital. Moreover, the interest for wind energy has spread all over Germany since the shutdown of nuclear power plants in the south and the considerable increase of wind turbine efficiency in southern hilly landscapes due to higher and larger wind turbines.

A growing number of regions are competing to reach 100 per cent renewable power as soon as possible. Regional governments in Germany have understood the importance of distributed renewable power for the regional economy and are setting increasingly ambitious goals. Meanwhile, their stated targets sum up to two times the federal government targets and the renewable energy minister has

announced talks for negotiating more moderate plans.

It seems that the tipping point in favour of renewable power has been reached.

Despite intensive conflicts over the way and the speed of transition towards renewables, big difficulties for the young industries in the segment and considerable new challenges in adapting a century-old industry sector to new technologies, the large majority of actors in most of the European countries are convinced that the future of the power sector lies in renewable energies. And this is not only for political reasons but mainly because many countries and industries have discovered the promising path of clean energy sources and believe that it will help bring energy security and economic success as technology costs decline.

Forecasts on how this self-reinforcing movement will speed up in the coming years are most difficult, but it is getting increasingly difficult to find somebody in Europe who would bet that it can be stopped. The case of Germany shows that new conflicts, challenges and difficulties arise in shifting towards a higher share of renewables, as they require a new functioning logic for the system and a modification of many roles. Actors in the energy sector should be prepared to navigate in a rather turbulent environment offering many new opportunities.