

Renewable Energy in Germany Faces NEW CHALLENGES

Author Ruggero Schleicher-Tappeser is working as a consultant in Berlin, Germany. He has been involved in the foundation process of the International Renewable Energy Agency (IRENA) and in promoting a European Alliance for 100 per cent renewables. Earlier, he served as Acting Secretary General of the Alpine Convention, an international treaty for the sustainable development of the Alps.



The views presented in the article are purely of the author.

The unexpected success of renewable energy policies in the electricity sector has led to new controversies worldwide. Germany, with its third highest wind power installed capacity, is fighting a hefty energy policy battle on its home turf. Based on a controversial governmental energy concept and against a vast majority in public polls, a thin majority in the Parliament has extended the permitted lifetime of nuclear power plants. The claim to provide a bridge into a renewable energy future with this decision has neither convinced the re-born anti-nuclear movement nor the growing clean-tech industry and smaller utilities investing in a renewable future.

Having the world's largest market for photovoltaics that is more than doubling, Germany is currently pondering over how to contain the costs of its frontrunner policy. The success of wind energy stirs discussions on nature protection and new landlines.

Behind all these issues, the main questions are: Who will control the future electricity system after the transition to renewable energy sources? How much time will it take to get there? Will there be a breakthrough towards decentralised structures? Many of these issues, stirring intense debates in this country, are of international interest.

Success of Renewables leads to New Questions

The German energy debate is entering a new phase. Year by year, renewable energy is gaining market share in the German electricity market. Last year, renewable energy provided 16.4 per cent of the overall electricity consumption, three years earlier it was only 11.7 per cent. For many years the large utilities have belittled decentralised power generation - now they are trying to fight back. Their business model, based on large centralised power plants and efficient distribution, is being put into question by new distributed generation technologies. On the other hand, the renewable energy promoters are not yet comfortable in their new role: They have grown out of a niche market and have to prepare to become responsible for the entire energy system - and this requires completely new answers as distributed and fluctuating power production from renewable sources involves a very different system design.

Two years ago, after a long discussion, the European Union decided to set a target of 20 per cent for the share of renewable energy in overall energy consumption by 2020. This has obliged Member States to think about how to achieve their specific targets and has triggered a discussion on the prospects for 2050.

In the last twelve months several scenarios have shown that, at least for the electricity market, 100 per cent renewables are achievable well before 2050 to bring economic advantages. In the course of about two years the focus of the discussion has therefore completely changed: It is not anymore a question whether renewable energy sources will play a major role, as undoubtedly they will in the new future. The new big issue is how fast will be the transformation, which technologies will dominate and who will control them. This is linked to the complicated question of how to design an energy system relying essentially on fluctuating energy sources such as the wind and sun.

Germany is one of the first countries where these questions undeniably emerge; Denmark with its islands has been a frontrunner on a smaller scale. However, in order to solve the question, co-operation at the European level is increasingly seen to be essential. Important financial, scientific and political resources are deployed in this debate which will surely influence discussions and decisions elsewhere.

Government favours Big Incumbent Utilities

A year ago, German Chancellor Angela Merkel from the Christian Democratic Party formed a new government in a coalition with the

Neo-Liberals instead of the Social Democrats with whom they had partnered before. They vowed to continue the support for renewable energy but announced to promote an extension of the permitted life-time of the existing nuclear power plants. The policy decision was a reversal of a previous decision of the Red-Green government (formed by the Social Democratic and the Green Party) in the year 2000, when it had reached an agreement with the four major utilities which stipulated a schedule for the step-by-step shutdown of nuclear power plants based on a maximum of allowed operation hours. Ten years ago, this compromise succeeded in ending thirty years of hefty anti-nuclear protests and encouraged smaller utilities to invest in flexible gas turbines for partially substituting the base-load mammoths in view of an optimal complementarity with wind and solar power.

The debate on an extension of nuclear power runtimes last year was intense wherein the proponents promised to use a part of the considerable windfall profits for investments in renewable energy. However, the opponents, which included the German Advisory Council on the Environment, argued that extended operation of refurbished nuclear power plants would severely hinder the integration of growing renewable power production into the electricity system. The Christian-Democrat Environmental Minister, responsible for renewable energy and nuclear power, pleaded for only a short extension but lost out to his opponent, the Neo-Liberal Minister of Economy and leading Conservatives in his own party. Ms Merkel's preferences were not transparent. She had (and has) a hard time with her second government – endless debates in the new coalition about a number of political issues weakened her role as a leader. After the summer she decided to get tough. Based on scenarios which assume very low full-load hours for onshore

wind (only feasible if the feed-in priority would be cancelled), high emphasis on offshore and very little additional PV, the Government decided an energy concept justifying a 12-year extension of nuclear power runtimes. The corresponding laws were accordingly pushed through the Parliament in a very short time, causing protests and petitions.

Whether this strategy will be successful is an open question. Important constitutionalists have questioned the constitutionality of the laws, the constitutional court will have to decide in 2011. The opposition has announced to come back on this issue as soon as they would regain power. The association of municipal utilities as well as other industry leaders have strongly warned and then protested against these decisions. Shortly after the vote in Parliament, on the occasion of a nuclear waste transport to an interim storage near to a planned final waste storage site, the anti-nuclear movement has had an impressive revival with tens of thousands of non-violent protesters for several days. Polls indicate that a majority of the population does not back the life-extension of nuclear power plants. They understand the decision as a favour to the incumbent energy business – an accusation that touches a delicate point as this government has been repeatedly accused of clientelism in the last months. Under these circumstances the government is set to be very prudent on touching renewable energy laws, at least until the elections in the State of Baden-Württemberg in March where the Christian-Democrat Prime Minister risks losing his job to his green party opponent. Baden-Württemberg, the country of Daimler-Benz, Bosch and a large variety of highly specialised medium-sized machine builders also strongly involved in renewable energies, has been governed by Christian Democrats since the war and always had a pro-nuclear policy –

the preceding prime minister was Mr Oettinger, the new commissioner for Energy Policies in the European Commission (EU administration).

The main interest of the incumbent energy oligopolies in the extension of nuclear power plant lifetime – besides welcome windfall profits – appears to be gaining time for developing a new strategy. Building new nuclear power plants in Germany is out of question, the phasing out of this technology is acknowledged as inevitable. In comparison to India, electricity consumption in Germany is rather stable and the grids are reliable – there is no prospective for growth with conventional approaches. Climate policy requires change. Loudly announced long-term plans to save the future of power production from coal and lignite through Carbon Capture and Storage (CCS) meet increasing technical, financial and political scepticism as generous funding from the European Commission for pilot projects has remained unused to a large extent. However, investment in renewable energies by the incumbent large utilities has remained rather limited – and focused on large schemes in other countries.

Regarding renewable energies, the incumbent large utilities have a clear preference for large offshore wind schemes – there is no interest in distributed photovoltaics. For harnessing solar power, they prefer large solar thermal power plants (CSP) on the southern edge of Europe and in northern Africa, although PV is getting cheaper than CSP. Such centralised approaches need many years to be developed. However, the German Association of Energy and Water Industries and the Federation of German Industries are having a hard time in trying to reach unanimous positions on energy policy. Growing parts of their membership are questioning the advantage of conserving established centralised structures.

Photovoltaics: A Disruptive Technology causing Hot Debates

Onshore wind and photovoltaics are changing the investment rhythms of the industry. Last year, \$27 billion were invested in renewable energy generation in Germany. Despite a reduction in feed-in tariffs, estimations for the new PV installations this year turn around 8 GW. Two-thirds of this new capacity is stemming from roof-top plants with a size under 100 kW. A completely new kind of investors is entering the market: House owners, farmers, industries, special investment funds. They want to contribute to the transformation of the electricity system and are attracted by feed-in tariffs, which guarantee fixed revenue for every electricity unit (kWh) fed into the grid during 20 years after installation. Following the considerable cost reduction in photovoltaics, these tariffs have been reduced considerably – not only with a regular mechanism every year on the 1st of January, but also in an extraordinary round this summer. Nevertheless, as all German utility customers have to pay for the feed-in tariffs, this boom leads to a rise in electricity prices.

By introducing the feed-in tariff ten years ago, Germany has succeeded

in triggering the take off of global renewable energy markets. As regards wind, even though Germany has the second largest installed capacity after the US, it has lost its dynamics. However, in photovoltaics, Germany makes up for half of the global market and till two years ago, German companies were also the dominating suppliers. Today, Chinese PV companies are producing the highest volumes – mostly with production equipment made in Germany.

In October, the transmission grid operators announced that in 2011 the extra charge for renewable energy will reach 0.035 Euro (\$ 0,047) per kWh (about half of this for PV, much less for wind). In reality, this figure is higher than the real additional costs due to the feed-in tariffs paid: Wind and solar power, produced at no marginal cost, are themselves driving down the spot market prices for electricity which are used as basis for the calculation. As a study by AT Kearny¹ has shown, for photovoltaics this leads to an overestimation of additional costs of about 25 per cent. Nevertheless, the relatively high costs for photovoltaics have caused an intense political debate. Hardliners have called for the abolishment of the feed-in tariff altogether. Others have called for a much stronger decrease of tariffs or even a cap. But according to public polls three quarters of the population are ready to pay a supplement of up to 2 Eurocent per kWh for supporting solar power generation.

The answer to the question “how much is too much?” cannot be calculated. It must be a political one. In its “PV - Roadmap 2020”, released in early November, the Solar Industry Association BSW-solar has proposed to limit the supplement

for supporting PV to 2 Eurocent and has presented corresponding scenarios which require that the German PV market be contained well below 6 GW while assuming that PV costs can be halved between today and 2020. This study is a milestone in the discussion, but has invited criticism from opposite sides.

A major problem is how to contain PV market growth in Germany. The Solar Industry Association has lost much of its credit, repeatedly trying to prevent additional tariff cuts predicting a collapse of the market, and regularly underestimating market growth. Also wind energy representatives have become nervous since they fear that exploding solar power costs could call into question the whole feed-in tariff system. The problems are specific to the German PV market: Due to short construction and permitting times, it reacts very rapidly to price signals – much more than the wind energy market. In times of overcapacity it is the only market worldwide that can absorb considerable quantities at discounted prices in a short time. Therefore, more sophisticated mechanisms will have to be developed to prevent a rapid overheating of the market when prices drop.

Another serious problem for market governance is the current structural change of the industry: Having much easier access to capital, Chinese companies have strongly expanded in the last years and can produce at lower costs than most medium-sized European producers. Seven out of the ten biggest gainers in the industry are Chinese, together they will increase their cell and module manufacturing capacity by 6.4 GW this year. A market shake-out has started in which many less innovative smaller European companies will not survive. The larger ones have started to produce in Asia too. The German Solar Industry Association, which has also hundreds of small installing companies among its members, is



The solar photovoltaics facility in Arnstein, Germany is the largest tracking solar facility in the world.

¹ <http://www.phoenixsolar.com/Press/Surveys/>

therefore in a difficult position: Different interest groups are calling for different strategies. Generally, European Industry is stronger in specific high-tech products than in mass production of standardised goods. The entrance of Bosch, a global leader in automotive, industrial and building technologies, into the market is characteristic for the transition in course. The company, which has a worldwide presence, also boasts of technologies needed to integrate photovoltaics into a wide variety of contexts.

As long as market volumes were small, it was not a problem for German support policies to stabilise a dynamic world market despite price and technology jumps. However, with growing international competition, heavy capital investment, global markets approaching three-digit billion volumes, this gets more difficult – and inevitably causes more political discussions. In the medium-term, it seems inevitable that the European Union with its larger dimension and coordination opportunities must gain importance.

Nevertheless, this debate on public support will not last long – the window of opportunity in which the opponents of photovoltaics can hope to seriously damage the industry will definitely close in a couple of years. Since 2006 the cost of photovoltaic systems has dropped by 45 per cent. A study by AT Kearney for Phoenix Solar² has calculated that in 2010 the balance of photovoltaics for the German economy is positive for the first time: The real value of PV electricity in the markets, avoided CO₂ emissions and tax incomes generated, all calculated over a 30-year lifetime, over-compensate the guaranteed feed-in tariffs for the PV installations this year. Considering the different voltage levels, the study claims, between

2015 and 2018 photovoltaics in Germany will become fully competitive with other power sources. The already mentioned roadmap-study presented by BSW-solar³ comes to a similar result with another calculation method: Competitiveness in Germany will be reached around 2017. These calculations are based on the expectation of strongly growing global PV markets and corresponding cost reductions. In countries gifted with more intense sunshine, PV electricity is cheaper. A recent report of the European Photovoltaic Industry Association (EPIA) has confirmed that in many regions of the world PV already constitutes a competitive form of peak power generation and predicts a hitherto unexpected growth⁴.

Wind Energy needs Transmission Grids – But How Much?

The development of wind energy in Germany has been much less dynamic, although it is by far the dominating renewable power source and will always maintain this role since it also delivers during the winters when solar power in Germany is very low. Rising prices of raw materials followed by the credit crunch, in combination with long lead times have led to a rather steady development after years of strong growth. In Europe, 39 per cent of the new electricity generating capacity installed in 2009 was wind energy – more than any other type of generation. Compared to 2008 the market grew by 23 per cent, in Germany the growth was only 15 per cent.

In densely populated southern Germany (Baden-Württemberg and Bavaria) where energy consumption is high and old nuclear power plants

have sooner or later to be substituted, pro-nuclear governments and landscape protection initiatives worked in a strange alliance for a long time: Wind energy development has thus remained very slow – with the excuse of weak winds in a hilly landscape. However, with taller turbines, the wind potential in these areas has become considerable too. Growing awareness for climate and energy issues has led to intense discussions concerning wind and nature conservation and eventually resulted in nearly doubling the areas dedicated to wind energy in spatial planning all over Germany. Nevertheless, harvesting wind power is most rewarding on the coast in the north, far from the big population and industry agglomerations.

Despite increased subsidies, progress of offshore wind in Germany is slower than expected. The four large utilities have shown more interest in offshore wind than in all other renewables, but prefer to invest in the offshore wind fields in Britain, as risks are lower since the water is less deep; and – most important – the electricity produced does not directly compete with German nuclear and coal power plants.



Erection of Enercon E70-4 WTG at Steinkopf island in Magdeburg, Germany in progress

² See footnote 1

³ Prepared by the consulting companies Roland Berger and PROGNOS : http://www.solarwirtschaft.de/fileadmin/content_files/roadmap_kurz_engl.pdf

⁴ http://www.epia.org/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/EPIA_docs/publications/epia/EPIA_Unlocking_the_Sunbelt_Potential_of_Photovoltaics_v2.pdf&t=1290860060&hash=b980a3bab7cea537e2dd5ffed1090918

However, the most intensely discussed obstacles for a further growth of wind energy in Germany are the limitations of transmission grids. Shortly after a document from the European Commission calling for Euro 200 billion investment until 2020 in European electricity and gas grid infrastructure, the European Wind Energy Association (EWEA) and the German Energy Agency (Dena) have published two important studies on this issue. The EWEA document⁵ gives a fundamental overview on opportunities and difficulties in Europe: Improved cross-continental connections would allow for considerable mutual compensation of fluctuations of wind power production in different regions and lead to an important reduction of operational costs.

However, besides the considerable investments required and the long planning times involved, the acceptance of additional power lines by local populations is a major problem. The Dena study⁶, elaborated in an important joint effort of a variety of stakeholders over more than two years, has calculated different scenarios for Germany which show the difficulties and conflicts. The calculated need of additional high-voltage power lines ranges up to 3800 km. A different geographic distribution of wind power or a more rapid growth of PV (Dena's figures for 2020 will already be reached next year) may reduce the kilometres needed. Round tables involving nature conservation organisations and local population have shown that acceptance of new power lines requires early involvement of the concerned and the proof that the line is really needed for a renewable power supply.

The Big Challenge: Adapting the Electricity System to Fluctuating Renewables

Germany has reached a high percentage of fluctuating renewable power production from wind and sun. On windy days last winter, high volumes of wind power caused negative electricity prices on the spot market: Operators of large base-load power plants, which need days for regaining full power after a having been turned off, paid high sums for getting rid of excess electricity. On hot weekend days next summer, it is expected that PV plants would deliver enough electricity for covering the entire needs of the country. A complete re-design of the electricity system is therefore required.

If really obliged to use renewables, the incumbent large utilities and their friends have a long-term vision: To construct cross-continental transmission lines for connecting large coastal wind farms, offshore wind fields in the North Sea, pump storage plants in Scandinavia and solar power generation in North Africa. Huge offshore schemes in the North Sea asking for special public support, the Desertec Industrial Initiative⁷ proposing a high voltage grid connecting Europe with solar thermal power plants on the southern side of the Mediterranean Sea, plans to convert Norwegian hydropower stations into huge pump-storage plants all fit into this vision. The approach is fascinatingly simple and basically follows the traditional paradigm of centrally produced electricity. But it has two difficulties: It will need a long time to be realised. And as the opportunities for affordable central electricity storage with present technologies are limited, additional efforts will be necessary to flatten the

load curve for which heavy investments in smart grid infra-structure and central controlling mechanisms will be needed.

Advocates of a distributed and decentralised power production in the hands of a much more varied ownership emphasise the opportunities of optimising the match between power generation, electricity load and energy storage at a local or regional level. This implies a new paradigm based on a system approach, involving many actors and many optimisation parameters at different levels.

At the end, neither local autarchy dreams nor a centralised European system will be the solution. The political battle on the setting of the regulatory framework will influence the balance in the resulting multi-level system and will determine the configuration of electrical grids and of the smart infrastructure needed. Technical innovation – allowing for cheap decentralised power production, for smart decentralised control and optimisation, for a smart coupling of electricity and heat and finally for a variety of new electricity and heat storage options – is clearly driving the development towards a more decentralised approach. Boston Consulting advises utilities to revise their strategies as soon as possible for being able to cope with the challenge of distributed generation⁸.

As one or the other form of smart grids and controls are on the agenda anyway, the IT and facility management industry is entering into the game. IBM, Google, Cisco, SAP, and a myriad of smaller companies are getting involved; established energy specialists such as Siemens or ABB are developing new kinds of approaches and systems. They hence start to invest expecting multi-billion markets. They have a system

⁵ EWEA: *Powering Europe: wind energy and the electricity grid*,

http://ewea.org/fileadmin/ewea_documents/documents/publications/reports/Grids_Report_2010.pdf

⁶ Dena Netzstudie II, until now only available in German: <http://www.dena.de/de/themen/thema-reg/projekte/projekt/netzstudie-ii/>

⁷ <http://www.dii-eumena.com>

⁸ <http://www.bcg.it/documents/file51254.pdf>

management perspective, have experience with multi-level governance approaches and are not bound to the centralistic paradigm of incumbent utilities.

A large number of studies have been published in the last months in Germany, every week there is a conference debating these issues. But the complexity of the challenge is such and the interests involved so strong, that it will take some time until different options and their pros and cons will emerge clearly. New technologies are emerging or getting much cheaper within months thus changing the picture. One example is a new process for combining CO₂ with hydrogen to produce synthetic methane: This would allow the use of excess electricity to produce hydrogen (by electrolysis) and then methane which can be stored and transported in the huge existing natural gas system. This could eventually be used for transportation purposes or reconverted to electricity and heat in CHP plants – costs and energy losses seem extremely interesting compared to other system options⁹.

Encouraged by the feed-in tariff laws, which were most efficient in promoting renewable energies, renewable energy companies in Europe have until now focused on solutions relying on intense exchange with the grid. This is now slowly changing. In southern Germany strong PV density in rural areas has led to capacity problems in distribution grids. Since the beginning of this year the German feed-in law gives an incentive for grid-independent consumption of PV electricity by the producer himself. This should and will lead to new business models, improving the temporal correspondence between production and consumption, thus reducing the reliance on the grid. A further development of this provision is being discussed – hoping that it might help to expand the PV market while containing renewable energy supplements on the electricity bill.

Perhaps the most important push towards more decentralised multi-level approaches might come from emerging Sunbelt economies with weak grids like India. High growth rates in electricity consumption make it difficult for public utilities in these countries to cope with the demand, frequent power cuts lead to a high share of captive power production and widespread use of backup diesel power generators. Substituting these systems and introducing electricity where there is no grid connection yet, is expected to create a renewable power generation boom in the coming years – based on different control logic and different business models. It may well be that countries such as India will be the first ones to experiment on a large-scale with the energy system architectures of the future.

Teaming up at the EU Level

Many of these challenges are rather new in the perception of the industry and of policy makers. Renewable energies have grown more rapidly than expected. Different options concerning grids, market design or captive power generation have not yet been analysed by detailed studies. Many policymakers in Germany have difficulties in keeping track of technological developments and acknowledge only now how important a European collaboration will be. Many producers of renewable power generation equipment have underestimated the challenge of integrating fluctuating renewable power production into the complex energy system. Successful pioneers have underestimated the international competition in mass production. It is a learning process in which old habits clash with new insights, powerful incumbents fight against innovative challengers. Municipal utilities are discovering new opportunities and IT companies explore new markets.

The liberalisation of European energy markets has also changed the role of

utilities. The request for unbundling power production, transmission grid operators and distribution grid operators, has led to dynamics in which the role of different actors is still strongly evolving. Many EU member countries have set up regulatory authorities only some years ago. They are all experimenting with slightly different approaches, and are now co-operating with each other through a new European coordination body.

Despite the resistance of German politics to the unbundling policy of the EU, German transmission grids have, to a large extent, been sold to new or foreign owners. While new kinds of investors have created the largest part of new electricity generating capacity in Germany, the incumbent large utilities are increasingly investing abroad.

The adoption of the European climate and energy targets (20 per cent CO₂ reduction, 20 per cent renewables, 20 per cent energy efficiency gains by 2020) have been an important international signal but even more a most important challenge for a joint European learning process and intensified collaboration. Despite all differences and experimentation with different approaches, single initiatives, markets, governance approaches and industrial endeavours are growing together. Europe is well aware that its future role in the world strongly depends on its ability to show a convincing way into a post-carbon society.

Today, India and Germany are probably two of the most interesting places for understanding where the transformation of global energy systems could lead. Enhancing the often difficult global learning process concerning the use of renewable energy, and intensifying international exchange, appears to be the most important opportunity for avoiding destructive dimensions of global climate change.

⁹ <http://www.fraunhofer.de/en/press/research-news/2010/04/green-electricity-storage-gas.jsp>