Vision 2020 and beyond

While integration – meaning electrical inter - connections of neighbours – on the one hand may enable cheap electricity, on the other, it can cause dependence. Therefore, to avoid a single source dependency, it might be seen as a better solution, to use less favourable resources inside a given country, and accept higher costs and other disadvantages. Another way out of this dilemma is diversification of interconnections. Therefore regional integration may be more attractive when the number of participating countries rises.

In some cases, regional integration is the only reasonable way of using known resources which are too big for a national approach.

An extreme example is the hydropower potential near Inga, by the Congo River, in the Democratic Republic of Congo. The African Power Pools have been formed in order to erect large scale regional integration projects – leading in a structure one may call an African Supergrid – to be able to handle the tremendous amount of electricity which could be produced here at very low prices, and which would be enough to deliver two thirds of the current African consumption. But the huge capacity makes it difficult to bring the different objectives together. Affordable, climate friendly and sustainable energy supply are objectives which can be met and which make the project attractive, but the sheer size of the single source counteracts the network security aspects, for a huge part of the current African electricity consumption would be produced at a single site in Inga. Strategies for diversification should mean that other sources used in the same system which would together exceed the size of Inga manifold. Such potentials are obviously available in Africa, but with this approach the combined production of all these capacities necessary in a diversified system, would exceed African demands for many decades. To be achieved rapidly, this diversification strategy would only be feasible with a partner that has a much higher demand for electricity than Africa.

Such a partner in fact could be found beyond continental African borders, in Europe. The consumption of the EU 27 is in the range of 3000 TWh and is therefore more than 5 times the African consumption. Diversification of sources is possible if the European electricity system was interconnected to the African system, while parts of the electricity from Inga and other African sources would be consumed in Europe, and could replace production from power plants that otherwise, would emit huge amounts of greenhouse gases. With growing demand in Africa the share of electricity – e.g. from the Congo River – consumed in Africa would rise, and other African renewable resources could be employed to serve for African and European needs. This approach would make it feasible to erect the Grand Inga hydropower station relatively quickly, and at the same time increase European and African investments in energy infrastructure in Africa, including the promotion of renewable energy, not only by Inga.

There is another development leading in the same direction towards a powerful integration of the European and African electricity system. There is a fixed date for the Mediterranean solar and wind energy plan, as a part of the Euro-Mediterranean Partnership which aims for imports of renewable electricity from Africa to Europe. Electricity from renewable sources in North Africa transmitted to the consumer in the EU is already taken into consideration by the EU Members, in order to reach the goal that 20% of the total energy used by the 27 member states be supplied by renewables by 2020. If these ideas become concrete it would mean that the Mediterranean Ring, consisting of conventional AC transmission lines planned to span around the Mediterranean Sea – even though important – will not at all be sufficient to deliver substantial parts of the electricity demand to Europe. But running one of the most powerful transmission systems available on the market i.e. HVDC at an average of half the rated capacity, would mean delivering roughly 1% of the annual EU consumption. The technology for high power transmission referred to is ±800 kV High Voltage Direct Current (HVDC) transmission. This technology can transport roughly 6.5 GW via a single bipole (i.e. two conductor bundles - one for each pole - on each electrical tower) overhead line system, and later, when redundant transmission systems are built, then, on a double bipole system, twice the power can be transported. At the moment there is a technical bottleneck. Cables – necessary for transmission over seas are not yet available for this highest voltage. Without the cables for these highest voltages, the transmission would make it necessary to go for further transformations, enabling the sea passage at lower voltages. This should be avoided to save extra costs and losses. But the required cables for ±800 kV HVDC transmission was debated in an expert hearing in the Federal Ministry of Economics and Technology of Germany. Prof. Heinrich Brakelmann from the Institute of Power Transmission and Storage at the University of Duisburg-Essen, declared it would be possible to develop such cables within three years. None of the other experts doubted this fact. Therefore it seems reasonable, in order not to face a chicken and egg situation, that the cable development be a focus of technical development activities in the EU. Two other components need to be adapted to the highest voltage that is available at present. First is the HVDC circuit breaker, which is an important component to run complex HVDC systems – even when not absolutely necessary. Up till now they are built and tested only for voltages up to 500 kV. The third component which needs to be adapted to the highest HVDC voltage available today is the tapping station in series connection in HVDC systems. This kind of tapping enables exchanging comparably smaller amounts of electricity between DC and AC systems. Therefore the series tapping would be very helpful for the large scale approach and at the same time serve to fulfil access, security and diversification objectives of the participating countries. This could be very supportive for African countries with relatively low electricity consumption, and the need for its rapid growth for development purposes.

Another incentive to adapt these components to the highest voltage available might already be driven forth in Germany, since here a new law was enacted – the “Energieleitungsausbaugesetz” – a law that was made to promote the erection of a powerful transmission system for German national purposes. Following the laws passing, Siemens – one of the leading HVDC producers – envisages four HVDC “electricity highways” for Germany which could later contribute to a European or transeuropean Supergrid. Even if only German purposes were considered, the adaptation of the three components mentioned above could be very reasonably achieved.

In order to achieve a fast development of renewable electricity imports, from Africa to Europe it makes sense that wind energy is a major source to concentrate on. This can be easily understood as follows. If the best wind sites are used, wind power is one of the cheapest forms of electricity, whereby the technology and the industry are ready to go for high growth rates. In the initial phase, large amounts of imported electricity could come from the best wind sites. For example in Egypt there is a well known region with extremely good wind sites at the Gulf of Suez, where an average annual load of nearly 60% of the rated wind power can be expected. These wind resource in total would be big enough to install approximately 20 GW. In the coming decades this would be too much for the Egyptian electricity supply system, but it could be relatively quickly harvested in cooperation with the EU as partner, and consumer of comparably cheap electricity from these sites. Similar approaches could be followed by making use of the tremendous wind potentials in Morocco. As a short term action it is then clear, that mapping of the African wind resources is a worthwhile task, since many of the best potentials are hidden due to lack of knowledge. This was also true for the Egyptian potentials as well as for many Moroccan wind potentials before the potentials of these two countries have been studied in more detail. The Moroccan wind potentials – according to the GTZ – sum up to an order of magnitude great than the total EU electricity consumption. Future mapping should not only be considered simply as a pure mapping of the potentials, but should also include the provision of knowledge of the short term and long term temporal behaviour of the potential production. Knowing this helps to decide on the best mix of sites for electricity generation, feeding into the transmission systems. In the northern hemispheres summer months, many wind sites in Northern Africa, have maximum wind speeds, while in Europe, winter wind maxima are generally the case. Therefore the use of production sites on both continents could be combined to give a smooth seasonal production considerably reducing the demand of back-up from other sources. Since the development of certain large wind potentials far away from national consumption centres can only be realized economically on a large scale, the cooperation between Africa and Europe at the same time opens up the domestic use of African potentials in African countries as a positive "by-product". This would allow gaining much larger shares of the domestic electricity from domestic renewable sources, than possible in national only approaches i.e. without substantial integration via strong interconnection and cooperation.

Another approach, which is also evident, is to include the use of flare gas into such an export system. Electricity produced from flare gas could be fed into the new transmission lines, guaranteeing maximum security and providing for smoothing of the electricity produced from wind power as well as producing electricity for some load following purposes for the European and African customers. Since this gas is currently flared without use, any electricity produced from it can be considered as being CO2-neutral. So the electricity produced from flare gas would enlarge the use of the transmission systems, and therefore reduce the costs of transmission. In this way renewable electricity from Africa could be delivered to EU countries at unrivalled low prices, which would then contribute another part to a multidimensional win-win situation for all participants.

The first step towards an African-European renewable Supergrid could be to build three transmission systems, in the west, in the middle and in the east of Africa together with the facilities for electricity production. These three systems could then be connected via an east west transmission line, building in system redundancy and facilitating the access to further good renewable production sites, and also flare gas power stations. Such a system could be available many years before 2020, together with the facilities for renewable electricity production, and thus deliver 3% of the electricity consumed in Europe, to contribute towards the 20% goal of the EU. At the same time, it could create the technical backbone for a strongly interconnected North African Power Pool, and could be seen as the first step towards an Africa-EU Supergrid, whereby Grand Inga and other interesting resources could also be included within a relatively short space of time.

The cooperation with Europe would make it possible to accelerate the use of the African potentials, and would allow use of potentials which might be too expensive for African countries, but reasonable as part of a highly diversified intercontinental generation system. It would, at the same time, help to overcome the fear of unidirectional dependency since the good potentials are used to feed into a strong international and intercontinental grid, building a backbone of security for all participants, therefore enabling an access to affordable electricity and eliminating fears which may otherwise be justified.

The entire process has to be supported by a favourable political and economic framework. A short term action would be to identify favourable international legal instruments – existing and new – and to put them into force.

Richer nations in the north should be involved in developing financial instruments, such as soft loans and guarantees for export and import, in order to accelerate the cooperation and the use of renewable energies in economically weaker countries. Among others the introduction of an international feed in law and associated feed in tariff system, based on existing legal instruments – such as the German Renewable Energies Act (EEG) – is an important issue (see ANNEX). Such ratifiable international agreements could create a sound basis for foreign investment in African renewable resources and future transmission systems. It would open interesting economic opportunities for many African developing countries and a new strategic path to sustainable growth. At the same time the new growing international community would significantly contribute to the stabilization of the greenhouse gas concentration in the atmosphere and reduce the climate change which would otherwise have enormous consequences for many Mediterranean and African countries. Due to its positive economic and social impact, the cross-border co-operation would most likely lead to a significant reduction of the current and future potential for conflicts.

ANNEX

Thoughts on an international feed-in law

In an investment concerning most renewable energies - pay back period, interest rate and return on equity – are the important cost factors. This is different to most conventional sources of energy, since here the variable costs contribute the biggest part, mainly fuel prices, such as for coal and natural gas. Security of investment is therefore an important issue in create a rapid growth in using renewable energies. Furthermore, in many African states the cost of financing (e.g. interest rates) is very high, because e.g. security of repayment is considered low. But one could overcome this problem by cooperating with partners regarded as financially trustworthy.

What is therefore important is to create a framework which provides long term security for return on investments, otherwise, the cost of capital will rise also due to low leverage effects, causing high shares of expensive equity capital, and the need for higher short term returns, to counteract the long term uncertainties. Missing long term security on volatile and unpredictable markets can even make it impossible to get investment in renewable energies started.

Different kinds of feed-in tariffs or similar support schemes therefore have been most efficient in creating a basis for the use of renewable energies. Such instruments are the German EEG – a feed-in law with definite long term feed-in tariffs – or the Spanish feed-in tariff as well as the US American Production Tax Credit (PTC), which also has to be considered as being a certain kind of feed-in tariff. All of these national instruments have been very successful in creating a rapid growth of the use of renewable energies – namely wind energy - on a national scale.

For a multilateral cooperation such as foreseen in the Africa-EU Energy Partnership, the national borders of these instruments have to be overcome. A fast growth of using renewable energies could be obtained by an “international feed-in law” as described in the following paragraphs, taking effect across national borders. Such support schemes could create a win-win situation for all participants as well as for the climate, and might be a core instrument for creating a real partnership beyond a development policy approach.
The German feed-in law EEG was one of the biggest success stories for creating new renewable energy supplies in the world. To create a similar success beyond national borders, an international feed-in law would be very helpful and if carefully arranged in all likelihood it might promote the use of renewable energies more than any other measures. Below, the concept will be detailed using the German EEG as a basis for further discussion.

The EEG commits the utilities in Germany to accept any feed-in of electricity from wind power and other renewable sources into the electricity grid. It furthermore commits the utilities to provide an appropriate electricity network sufficient to take the renewable electricity. The EEG also commits the utilities to pay a definite minimum feed-in tariff for the renewable electricity – depending on the kind of renewable source used for its production. The total bill is distributed accordingly to the end users electricity consumption of the utilities’ customers. One of its outcomes was the rapid growth of electricity production from wind energy, which made Germany into the world leading wind energy country for many years.

Such an instrument could easily be developed and used as a component of the international energy policy and should be improved in its effect. One possibility for an international approach would be to extend existing national feed-in tariffs and laws – as e.g. the German EEG – to agreements which can be ratified by other nations, or bring a similar arrangement in the international agenda – for example as a new instrument for the Africa-EU Energy Partnership. These agreements should come into operation as soon as two countries have signed. The cooperating states follow in common with the aim of developing rapid growth in using renewable energies and commit themselves on a long-term basis to change to a sustainable CO2-neutral electricity supply. The cost of electricity is to be distributed - as with the today's EEG – proportionately according to the respective electricity consumption of the final customers within each country. This would mean that most of the costs would be taken by the industrialized countries with high electricity demand. Deviating from the German EEG – as with the Spanish feed-in regulation – it seems sensible that only extra costs above a certain minimum are paid by the new community of responsible states. This minimum is to be agreed upon with each country signing the agreement for each source of electricity (wind, solar, hydro, biomass ...). The minimum should be covered by the country which consumes the electricity.

The international character of the contract – with strong economies as partners guaranteeing for the payment of the feed-in tariff to the producer – should be an incentive for world-wide investors and should be a basis for credits, offered with low interest rates and low demand of equity capital. Further instruments like soft loans of development banks or similar organisations and public guarantees might also be part of the concept, reducing the costs of financing and therefore the costs of electricity.

This international feed-in law should – at least in the longer run – contain three steps to create an appropriate internationally effective instrument. The first step is to pay for the electricity fed into the electricity network of each country, produced within the same country. Therefore it might be necessary to agree a supplementary treaty that the costs of the extension of the national electricity network are also included into the feed-in tariff. This is important if e.g. the good resources are far away from the existing network, and if the country might not be able to easily afford the expenditures. The feed-in tariff has to be built in such a way that the energy specific tariff is lower at better sites, but still stimulates the search for the best sites. The two next steps should incorporate the possibility to produce the renewable electricity within one country and consume it in neighbouring countries – as the second step – as well as in third countries – as the third step – which means the development of rules for a third party access. This third step aims to successively erect an international renewable electricity supply system. Following these steps it can be ensured that large favourable potentials of renewable energies can be used also in countries, which have small energy consumption or are economically not easily able to afford the use of their renewable potentials. Thus these potentials can be placed into the service of climate and resource policy, taken as an international task. This form of “EEG” can thereby either be started bilaterally, as a European and African approach within the Africa-EU Energy Partnership, or as an international agreement for international ratification, whereby in particular an anchorage in the UN appears advisable. The mechanism could eventually also developed as a new “kind of CDM”. The remuneration of renewable energy from abroad can be seen as entrance preparing the second step of the export.

Such an international “EEG” could become a kind of development assistance for states in the south and the east of the European Union and world-wide. It simultaneously would be of advantage for the richer industrialised countries involved since it enables use of highly economical potentials and thus guarantees cheap renewable electricity. Thereby a substantial effect of an international “EEG” should be to open for use particularly favourable locations for different renewable energies and to include them in an international system, acquiring more economical solutions for climate protection than could be found with single-handed national attempts.

This international co-operation in the field of electricity production and transmission opens up the possibility of a sustainable electricity supply from renewable energies only which would be – even if only current technologies where used – not more expensive or possibly even cheaper than our current electricity supply[1]. Thereto transnational electricity transmission via renewable Supergrids is important. Therefore such a conversion to renewable energies and a way of mitigating the climate change could most likely lead to economical savings instead of causing mitigation costs, as they are frequently taken as an inevitable fact if climate issues are discussed. Furthermore the savings will continually become larger since the renewable electricity generation becomes cheaper with further techno-economic progress. Such a concept opens up comparably huge investments in poorer countries with good renewable potentials and therefore creates a multiple win-win situation for all participants providing an economically and technically sound strategy, against climate change.

[1] Fundamental research has proven this and is published in all details in Czisch, G. (2005), Szenarien zur zukünftigen Stromversorgung – Kostenoptimierte Variationen zur Versorgung Europas und seiner Nachbarn mit Strom aus erneuerbaren Energien: Dissertation, Uni Kassel, https://kobra.bibliothek.uni-kassel.de/bitstream/urn:nbn:de:hebis:34-200604119596/1/DissVersion0502.pdf .
For a short English summary see also Czisch, G. (2006), Low Cost but Totally Renewable Electricity Supply for a Huge Supply Area, http://transnational-renewables.org/Gregor_Czisch/projekte/LowCostEuropElSup_revised_for_AKE_2006.pdf .