Making the World Economy Survive on RENEWABLE ENERGIES

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Renewable energies are a huge opportunity for the global, national and local economies. Climate talks, culminating in the Copenhagen conference in early December, are dominated by the ideas of burden sharing and bargaining about who must do what and pay how much. Without doubt, things must be done – and quickly. But doing them is not necessarily a burden; it can also be a great opportunity. Having overcome initial hurdles, switching to renewable energies can be, if done properly, a most rewarding strategy – in terms of business development, low energy costs, employment, local development, energy independence and security. Looking at the positive sides may help to avoid diplomatic deadlock. Some countries have already moved much more quickly in this direction than expected two years ago. The question is not whether the local, national and world economies can afford to switch to renewable energies, but rather how much it will cost them to wait.

Climate Change requires Determined Action

Business-as-usual risks causing disruptive deterioration of living conditions for hundreds of millions of people before the end of the century. Keeping global warming below 2°C, as strongly recommended by the scientific community, will require fundamental changes in the energy systems of all countries. When taking into account population growth and the considerable rise in emissions of emerging economies between the usual baseline year 1990 and 2008, the figures look much worse than the ones usually discussed: Compared with 2008, worldwide CO_2 emissions in 2050 will have to be reduced by 85 per cent. Even if the developed countries (Annex I countries) would immediately reduce their emissions to ZERO, developing countries and emerging economies (non-Annex I countries) would still have to reduce their CO_2 emissions by 76 per cent in 2050 compared to today. As population grows, the sustainable average per capita consumption decreases. If everybody on earth would be allowed to produce the same amount, per capita emissions in Annex-I countries would have to decrease by 97 per cent, and in non-Annex-I countries by 80 per cent.[1] This will not be feasible without a very rapid worldwide deployment of new energy and transportation technologies.

The worldwide installed wind capacity has seen an average annual growth of 25 percent in the last 12 years

Disruptive Technologies in the Electricity Sector

From the perspective of conventional thinking in the energy industry, such a rapid decline in greenhouse gas emissions seems absolutely impossible. The year 2050 is 40 years ahead, as near as 1970; large coal, hydroelectric or nuclear power plants have a lifetime of over 40 years and need at least 10 years for planning and construction. Fortunately, today we have new, disruptive renewable energy technologies which are completely changing the picture: Having very different characteristics compared to conventional energy technologies they are about to profoundly change the structure, the relevant actors and the dynamics of the established energy economy. In the electricity sector, especially wind power and photovoltaics are emerging as key future technologies characterised by rapid market growth, fast declining costs, short deployment times and short innovation cycles. With negligible CO_2 emissions, no dependence on fuels, no air pollution, efficient small units for distributed power generation and great opportunities for local economies these sustainable technologies open unprecedented development perspectives.

Over the last 12 years, worldwide installed wind power capacity grew on an average by more than 25 per cent annually. This growth allowed for rapid learning: With more than 10 per cent cost reduction for every doubling of installed capacity[2], wind power costs came down substantially. Mainly Denmark, Germany and Spain helped with subsidies and feed-in-tariffs to build growing markets while wind power generation costs were not yet competitive. Today, electricity from wind turbines is fully or nearly competitive in a growing number of countries. In Germany, wind power already delivered 7 per cent of the total electricity production in 2008. Worldwide installed capacity increased by 21 per cent in 2008, reaching 121 GW. Installing a wind turbine takes only weeks, planning duration depends on local legislation. Setting up a wind turbine factory takes only 20 to 40 months. According to recent studies, the wind power potential is much larger than earlier estimations have suggested: The European Environmental Agency calculates that in 2030 the economically competitive onshore potential in Europe will be six times higher than the predicted electricity consumption.[3] A more general study from Harvard University confirms similar figures globally[4].

Much less important until now is the worldwide installed generation capacity of photovoltaics. However, growth rates and decline in costs are very promising: In the last 12 years the installed worldwide capacity increased on average by 32 per cent each year, last year even by 70 per cent[5]. In Germany, where nearly half of the global capacity is installed, the average annual growth rate over the last eight years was 68 per cent, thanks to a determined support policy with feed-in-tariffs which has boosted innovation. The learning curve of PV over the last two decades is impressive: Costs have steadily decreased by more than 20 per cent for every doubling of installed capacity[6]. During the next decade electricity generated by photovoltaics will become cheaper than residential electricity from the grid in most electricity markets, even in northern countries. Photovoltaic installations can range

Wind solar streetlights

from some kilowatts to tens of megawatts; accordingly, installation time ranges from some days to several months. Setting up turn-key factories for most technologies only takes 15 to 30 months – a unique bottleneck in the last years has been silicon production for crystalline technologies with lead times of several years. With decreasing costs, the potential for PV is practically unlimited. The European Photovoltaic Industry Association presented a scenario for producing 12 per cent of European electricity needs by 2020.

Many politicians and senior managers in the electricity sector have not yet fully understood the radical acceleration in the rhythm of innovation brought about by these technologies. Real developments have outpaced even audacious forecasts year by year. Consumers, small and larger businesses are starting to produce clean electricity themselves. There are no signs that conventional fossil or nuclear technologies could solve their problems of cost, pollution, risk, waste and deployment rhythm with sufficient speed to catch up with the disruptive renewable technologies.

The Challenge: Matching Production with Demand

While competitive production of large amounts of clean electricity with adequate support seems to be only a question of some years, energy storage and grid management are challenges which require more determined efforts. Electricity production with wind and solar power occurs in a rather decentralised and necessarily fluctuating way. Where grids exist, the decentralised character of these sources entails less transmission and heavy loads, but requires bi-directional operations and a new logic of multi-level management of the grid. The fluctuating character of these sources makes heavy baseload power plants more and more useless – flexible co-generation with gas and biomass is ideal for complementing wind and solar, these both already tend to be complementary in many climates. Moreover, a better management of electricity demand as well as enhanced storage will be necessary for a good match of production and consumption. Smart grids, locally adapted mixes of different renewable sources and new storage technologies will be essential.

These system technologies will also be most useful for areas where strong and reliable conventional grids do not exist as yet. Mini-grids in rural areas, enhanced back-up and captive production for residential, business and industrial units with only a temporary connection to the public grid are becoming most interesting.

A solar power plant

As thermal storage (hot and cold) is cheaper than electricity storage, and as the automotive industry is at last making huge efforts to develop cheap batteries for electric cars, the bridges between the electricity sector, heating and cooling (co-generation, heat-pumps, refrigerators) as well as the transport sector (car batteries as buffers for the whole system) become more and more important.

Renewables for Heating, Cooling and Transport

With increasing comfort requirements, heating and cooling make up for a huge share of energy consumption in both cold and hot climate zones. This need not be so. Low-energy or even zero-energy buildings in most climate zones have shown that sophisticated and locally adapted building system design combining energy efficiency, energy storage technologies and different renewable energy sources can be very competitive. There are no single disruptive technologies which can solve the problem alone; the clue is a smart combination with a good understanding of the whole system. The use of heat pumps in combination with renewable electricity and smart grids will increase.

While rich countries have stuck to oil-based liquid fuels in road transport, countries such as India have managed to rapidly switch to natural gas in important areas. This will allow a seamless transition to biogas as it becomes competitive. Widely introducing electric cars when batteries become affordable will require smart grids and provide additional storage capacities for renewable electricity.

The Key Resource: Systemic Thinking

Integrating wind, solar and biomass power in small and large grids; combining electricity, heat and transport markets; integrating different energy sources, storage

opportunities, construction elements and user behaviour in a building – the real challenge for an optimal transition towards a renewable energy system consists in developing systemic approaches. Efficient systems must take into account the people involved and the specific local conditions, they must be able to flexibly manage varying energy flows, but at the same time they should consist of standardised, reliable and highly efficient components and procedures.

Training engineers, businessmen and craftsmen who are able to design, establish and run such systems will probably be the main bottleneck. There has been a noticeable progress in standardisation of components and approaches, but adapting system designs to specific circumstances requires a good overall understanding of energy systems. Every country or region that wants to widely deploy and maintain well-functioning systems will require a large number of skilled and experienced specialists. Building up capacities and qualifications in time will prevent delays and deceptions later.

Employment and Local Development are becoming Strong Arguments

Several studies have shown that renewable energy systems create more employment than conventional systems[7]. This is particularly true for planning, installation and operation of distributed energy generation systems. Compared to conventional energy systems, a higher share of the expenditure for construction and operation remains in the region – even when purchasing high-tech equipment from outside. Embarking on renewable energy strategies therefore strengthens local development and employment.

While global figures for employment in renewable energies vary considerably depending on definitions and the extent to which traditional biomass is included, the organised renewable energy industry gets increasing political weight on the basis of its increasing employment and turnover figures. The European renewable energy industries registered with the European Renewable Energy Council (EREC) already employ 4,50,000 people.

Getting over the Initial Hurdle with Financial Support

As energy supply is a central issue for all economies, nearly all new energy technologies have relied on public support for their introduction. Although often criticised, the financial support that is necessary for successfully introducing renewable energies is not particularly high.

With the introduction of attractive feed-in-tariffs for renewable energies, Germany has decisively contributed to creating world markets for wind and photovoltaics. The overall costs of this support until full competitiveness, estimated to range between 50 and 100 billion Euro, will remain far below the historical overall German support for nuclear energy: Subventions for nuclear energy from 1950 to 2008 amounted to 165 billion Euro, not including the 92 billion Euro predictable future costs and the exemption

This energy park in Geesthacht, Germany, includes solar panels and pumped-storage hydroelectricity.

from liability insurance for heavy accidents[8]. Considering the much smaller GDP 50 years ago, the difference is impressive.

Now, as prices have come down substantially, a large number of other countries have begun to follow the successful example and started developing serious support schemes of different kinds. The big new players are the US and China, which have outpaced Germany in new wind power installations, and are seriously starting with PV. India has been somewhat more hesitant, especially with the more expensive solar technologies, but is beginning to realise its enormous potential.

The Immediate Challenge: Business Models and Financial Instruments

As the optimal use of renewable energies requires new system configurations, new business models and market structures, it questions established roles and patterns. Incumbent industries and their political allies tend to be sceptical, new actors and neighbouring industries are entering the game. Supported by politics, the initial growth of a new industry has allowed for enormous progress in technology and competitiveness. Widely substituting established fossil fuel supply patterns is more of a challenge.

A key issue is inventing new business models: Instead of blocking change, incumbent industries in the energy sector would need to find transformation paths towards new roles in a changing environment. Especially emerging economies with high growth rates, weak infrastructure and abundant qualified engineers offer most interesting opportunities for developing new models. Offers for residential, commercial or industrial units combining a mix of renewable technologies with energy management and service functions can be most competitive where traditional power supply is unreliable or getting expensive.

As the use of wind and solar energy usually implies high capital and low running costs, financing issues become most important. In addition to a good return on investment, reliability, low risk, guarantees and control of the assets become key issues. New technologies and systems are often not sufficiently standardised, well-known or understandable for getting low-cost routine loans. Developing standard configurations, acquaintance with risk structures, appropriate guarantees and insurance is essential for channeling sufficient capital into this basically very attractive sector. Developing standard approaches, appropriate financial instruments, as well as expertise and trust in local banks all over a country takes time and requires special efforts.

Renewables and the World Economy

Without doubt – even not considering the climate challenge – the world economy would benefit from a rapid transition towards renewable energies: Lower cost, more skilled employment, local dynamics, less pollution, fewer monopolies, less conflicts over resources, considerable room for innovation. The combination of global competition for innovative technologies and components on one hand, and skilled local employment for intelligent system integration on the other, allows for balanced progress. However, this transition will require a deep transformation of existing structures and habits. And as in every transformation, some incumbents fear to lose advantages. Building bridges, developing transformation paths, inventing new models and roles to enable this vital transition will be an urgent task for leaders in industry and politics. Dynamic countries like India can be expected to play a crucial role. New institutions like the International Renewable Energy Agency (IRENA) are designed to facilitate the necessary global, mutual learning process.

The Nellis solar power plant, the largest photovoltaic power plant in North America

Foot notes:

1) Ziesing, Hans-Joachim (2009): Updated development of Greenhouse Gas Emissions - delusions and reality. 14th Annual Meeting of the Reform Group Schloss Leopoldskron, Salzburg, September 31.08.-04.09.2009, 2) Coulomb L. and Neuhoff, K., (2006): Learning curves and changing product attributes: the case of wind turbines. Cambridge Working Papers in Economics 0618, 3) EEA (2009): Europe's onshore and offshore wind energy potential, 4) Xi Lu, Michael B. McElroy, and Juha Kiviluoma (2008): Global potential for wind-generated electricity, Proceedings of the National Academy of Sciences of the United States of America, Published online before print June 22, 2009, doi: 10.1073/pnas.0904101106, 5)REN21 Renewables Global Status Report 2009, 6) Hoffmann, W., Wieder, S. & Pellkofer, T. (2009) Differentiated price experience curves as evaluation tool for judging the further development of crystalline silicon and thin firm PV solar electricity products. 24th European Photovoltaic Solar Energy Conference and Exhibition EU PVSEC. Hamburg, 7) See e.g. Rutovitz, J., Atherton, A. (2009), Energy sector jobs to 2030: a global analysis. Prepared for Green-peace International by the Institute for Sustainable Futures, University of Technology, Sydney. 8) Meyer, B., Schmidt, S., Eidems, V. (2009): Staatliche Förderungen der Atomenergie im Zeitraum 1950-2008. Prepared for Greenpeace Germany by Forum Oekologisch-Soziale Marktwirtschaft FOES, Berlin