Case 55 - Unabridged Version

The Exit of Nuclear based on Consensus and Cash

also on video: http://www.youtube.com/watch?v=rLNuF0CoYO4

This article introduces a creative approach to the financing of the exit of nuclear power as one of the innovations that shape "The Blue Economy". This article is part of a broad effort to stimulate entrepreneurship, competitiveness and employment. For more information please consult www.zeri.org or www.blueeconomy.de.

by Gunter Pauli

The Market

There are 442 nuclear power stations operational in 30 countries generating 375 GW of energy. There are 16 nations constructing 65 nuclear plants for an additional 63 GW. China is building 27 new plants, Russia 11. The United States operates with 104 the largest number of nuclear energy generators, well ahead of France (58) and Japan (48 taking the defunct plants in Fukushima into account). Some 212 plants are older than 30 years and while there is no absolute science on how long these nuclear centers are safe to operate, the German Chancellor Angela Merkel set the stage by ordering all plants older than 30 years closed indefinitely. The European Union operated in 2010 143 plants down from its peak of 177 in 1989.

The relative decline of nuclear had been cast in stone well before the Fukushima disaster. Lithuania and Italy decided to exit nuclear altogether, while Finland laments that the 1.6 GW facility being built by French (AREVA) and German (Siemens) suppliers is now 5 years behind schedule and has a +70% cost overrun. Solely the delays impose an extra annual bill of €1.3 billion on the consumers, without providing for the increased capital costs. The latest nuclear plant ordered by Georgia Power in 2010 is budgeted at $17 billion. The investment cost per kilo Watt hour (kWh) before March 11, 2011 was estimated at $7,000. However the additional safety measures that will be imposed are likely to increase the cost to $10,000 kWh. It is said that new nuclear plants will be capable of providing base load energy at 5.9 cents per kWh. The real cost - stripping nuclear of all its subsidies, depreciation advantages, insurance protection, financing support and waste disposal arrangements is closer to 25 or even 30 cents kWh. Nuclear energy not only enjoys limited liability covered by society, nuclear on top of this is not competitive.

Therefore it is no surprise that in spite of the massive subsidies and legal protection, in 2010, renewables, solely covering wind (193 GW), waste to energy (65 GW), hydropower (80 GW) and solar (43 GW) globally have a larger installed capacity than nuclear (375 GW), well before the trilogy of disasters demonstrated that the impossible does happen. Now that the Pacific and Indian Ocean rims are off-limits for any new nuclear power project, the question is how will the world go forward in its quest to generate renewable and affordable energy?

The Innovation

The Blue Economy proposes that we use what we have and that we study the competitiveness of each innovation without expecting subsidies. If in the end the subsidies are offered does not matter, the key is to succeed in the acid test: are there renewable energy solutions that are truly affordable. Over the past months I presented open source over the internet a portfolio of technologies through the Blue Economy Innovations program. These breakthroughs have not received much attention probably because these require a complex and new know-how. However if deployed as a cluster, this handful of sources of heat and electricity will redraw and strengthen the present landscape of renewables. The first three innovations retained in this initial approach are: (1) vertical wind turbines known as Wind-it, placed inside existing high voltage transmission masts (Case 11), (2) redesigning existing municipal waste water treatment (MWWT) plants to combine water treatment with organic municipal solid waste to produce biogas (Case 51), and the combined heat and power generation with double-sided PV wafers placed inside a recycled container equipped with tracking optics eliminating all moving parts (Case 53).

If we are serious about embarking on a renewable energy strategy without the caveat of incalculable risks related to nuclear, then we have to go beyond the present mix of solar, wind, hydro and waste to energy. Whereas these four energies spearheaded the renewables over the past three decades, we need to embrace additional opportunities that are immediate and cheaper. It is here that a creative approach to the use of existing facilities like MWWT, and pylons come into play. Let us jointly run the numbers and point out that this is only a first set of solutions - there are dozens more that could even replace fossil fuels in addition to kicking the temptation to embrace nuclear that - as Fritjof Capra eloquently explains - is not at all carbon emissions neutral as it wishes to claim.

Since the debate is most intense in Germany, let us study the opportunities in the powerhouse of the European economy. If Germany were to complement 500 of its 9,600 MWWT with highly efficient biogas generators based on the Scandinavian Biogas know-how benchmarked in Ulsan, Korea, then the potential base load supply could reach as much as 5GW at an estimated total investment cost of €10 billion. This capital expenditure is roughly 5 times lower than nuclear. The time between decision and on-stream electricity supply is limited to two years, compared to a decade for nuclear at its very best. This is also five times better offering a much better cash flow and return on

investment. Biogas is secure and predictable - no one doubts that organic waste and waste water will be in permanent supply - and therefore provides stability to the grid.

If in addition, Germany could install inside one third of its 150,000 high transmission masts vertical turbines designed by Wind-it (France), then it could generate another 5GW, at approximately one tenth of the cost of nuclear or €5 billion in total. There are 1,900 landfills in Germany. If only 20 HA hectares at 200 of these defunct portions of the landfills were covered with the combined heat and power generators from Solarus AB (Sweden) that generate per hectare equipped with 2,000 units (100 rows of 20) 1,830 kWt and 1.361kWe, then the potential energy supply increases with another 5.4 GWe and 7.2 GWt. The heat can be used to reduce the largest consumer of electricity in households: warming up water. If the life of these panels were more than 20 years, then the cost per kWh is under one Eurocent!

First Cash Flow

The daily demand for electricity in Germany is approximately 70 GW with peaks of 80 GW. Nuclear energy represents +20 percent, or about 15 GW. The calculations above indicate that even with only a fraction of productive use of the existing infrastructure it is possible to replace all nuclear (5+5+5.4GW). However, benchmarked analyses indicate that the cost of production for these three energy sources is at or below 2 cents per kWh. The present transfer cost in Germany for nuclear to the grid is 5.6 cents per kWh. At such low cost, financing of these innovative energy generation systems represents no problem and considering the speed with which these systems can be installed, one can even plan the phasing out of all nuclear within the next 3 to 5 years, provided one involves the local decision makers in charge of operating landfills and MWWT. There is even room to consider phasing our fossil fuels as well. The unions are all in favor.

The Opportunity

The obvious additional benefit is the generation of jobs. The three retained technologies are only a few from a broad portfolio of potential breakthroughs. Imagine that all railways and freeways were equipped with the Wind-it technology? Imagine that all major waste water plants of industrial food processing companies adopted a biogas strategy? Imagine that half of the German households were to substitute electric water heating with luminescent thermo-syphons, reducing total household consumption of electricity with 15 percent? Imagine that all drinking water towers would store excess electricity by heating up water to 40-50 degrees, instead of storing power through investing in toxic batteries at high cost? The energy would be recovered when the water flows into the distribution network, powered by gravity. We have barely started to uncover the real opportunities for renewable energies, based on what we have. This is exactly as the ending of Gunter's fables: "And it only has just begun ...".

Indeed, since most electricity from renewables is generated as direct current (DC), it has to be inverted to alternate current (AC). The growth in home and office demand for electricity is mainly in direct current, leading to an excessive amount of chargers which in fact are equipped with rectifiers, changing the AC back to DC. It is no surprise that the

AC standard, which made a lot of sense a century ago, now has become part of the problem. Indeed, by forcing the inversion of electricity from renewables to AC and rectifying is back to DC implies not only a major loss of efficiency, it also leads to a considerable additional investment in capital equipment which is borne by the consumer, and only partly alleviated through subsidies and guaranteed returns based on feeder tariffs. It is in this framework that a new set of rules of the game could permit the local producers of energy in cooperation with architects to design buildings solely operating on direct current. The few machines that need AC will be equipped with an inverter. The Blue Economy Building, expected to open its doors early 2013 will be the first DC building in Europe. This will unleash not only breakthroughs in efficiency, it will set new standards that lead to innovative engineering, product and system design.

Germany, already a world leader in the export of green technologies, could now position itself as the world's largest exporter of green energy, strengthening its metal, machinery and renewable energy sector which relies on a strong network of middle sized companies. However, the most powerful impulse to the design of a nuclear exit strategy is the generation of cash thanks to the price difference between 2 cents for the new forms of electricity and 5.6 cents (3.6 cents per kWh) for each the 15 GW that is paid to nuclear. This adds up each year to approximately €4.7 billion. This cash flow based on these efficiencies possible by an available infrastructure blended with simple technologies could be sufficient to finance the exit of nuclear and guarantee access to additional capital required to roll-out these innovations over the next decade.

Now that the cash seems available, a consensus could emerge whereby energy companies with a large exposure to investments in nuclear power are provided an exit based on the net present value of their assets - and actually get a pre-agreed payment for discontinuing nuclear energy. While the forced closure of the oldest plants already knocked 20-25 percent of their share value and the present uncertainty is likely to cause a further downward pressure on their shares (TEPCO - the owner of the Fukushima nuclear power stations already lost 75 percent of its market capitalization), it would not be difficult for financial engineers to come up with a package solution that permits the exit from nuclear through a win-win strategy, broadening benefits for all, reducing risks and embracing innovations that are mature for broad adoption.

Subsequently, Germany could even become the world's financial hub, financing the *exit of nuclear based on consensus and cash flow*. This is the ultimate objective of the Blue Economy: respond to the basic needs of all with what we have, offer the necessary products and services that are good for your health and the environment at a lower cost, while building up social capital. It seems like we see how this can be achieved - quicker than we ever thought.

For more background on the 100 cases: www.blueeconomy.de

For a brief video on The Blue Economy: http://www.youtube.com/watch?v=1af08PSIaIs

For a brief video on "The Exit of Nuclear based on Consensus and Cash"
http://www.youtube.com/watch?v=rLNuF0CoYO4