Energy transition and competitiveness: French models, German lessons.

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Trnaslated by *Jean-Charles Khalifa* (first draft).

In this month of May 2013, and for the first time in 2 million years, the concentration of carbon dioxide in the atmosphere in the northern hemisphere will exceed 400 parts per million. Carbon dioxide and other even more powerful greenhouse gases (GHG), such as methane, have for the most part over the past 150 years been emitted by human activity. Their greenhouse effect, suggested by Fourier and demonstrated in the laboratory by Arrhenius in the 19th century, must be added to the much slower and geographically sometimes divergent fluctuations of astronomic or volcanic origin. Compared to the present it was warmer in Europe during the first century AD, and warmer in Antarctica during the 6th century. But there has been a general cooling since 1200, with a minimum between 1600 to 1850, and then a brutal increase becomoing global around 1950 and which has continued since. The period 1970-2000 was generally warmer than the fourteen previous centuries, but colder than the first decade of the 21st century. [1]

The entire climate-skeptic argument, supported by industries which refuse energy transition costs, is based, when it accepts the reality of brutal contemporary global warming, on the assumption that other causes may contribute to this warming. This argument is irrelevant, because in any case the anthropogenic greenhouse effect must be added to these other mysterious causes and contributes to climate change in a direction increasingly dangerous for global geopolitics.[2]

At the same time, hopes placed in nuclear power in the middle of the last century have been broken by the absence of a solution to the problem of waste, by the risks of nuclear proliferation as illustrated in North Korea and Iran, and the frequency of accidents. A rule of three, applied to level 7 accidents (such as Chernobyl-Fukushima core meltdowns) when compared to the number of years-of nuclear operations, suggests that the probability of such an accident in France in the next 10 years is one-in-six![3]

Lastly, since the 2006 global food crisis, the FAO has continued to criticize the role of agrofuels. Their development, in addition to the spread of animal feed crops and urbanization, has been to the detriment of surface areas reserved for the safeguard of biodiversity (forests and wetlands) and, above all, to the detriment of surfaces directly available to feed humans which are also threatened by increasingly frequent climatic accidents which strike at one or other of the world's grain stores (Australia, Ukraine, Russia, North America and Brazil). All this is taking place during a period of population growth which is not due to abate before mid century. These first generation biofuels only increase the efficiency of the fossil energy they consume by 20%. The Academy of French science, in its 2011 report [4], recommends postponing biofuel production until the arrival of second generation, with lignin fermentation technology (already experimented in Brazil with sugarcane stalks, which increases yield to 8), or even until 3rd generation technology (microalgae oil production from sunlight and carbon dioxide). Biofuels, as a way to capture solar energy, are already efficient (but limited to waste fermentation) and have a bright future, but at the moment they are aggravating the food crisis.

Mankind is therefore currently stuck in the "energy threat triangle": climate threats, nuclear threats, conflict over land use. I won't go into the depletion of fossil fuels, since that is a debate largely dominated in the short term by the issue of shale gas and bituminous oil sands. Their exploitation

may defer the inevitable depletion of fossil fuels, but at a high cost. They will accelerate the production of greenhouse gases (even more than coal), and will be opposed by affected populations.

The solution would be to exit this triangle through the well-known triptych of reduced energy consumption/increased energy efficiency/and renewable energy (the latter being ultimately overwhelmingly solar). The Negawatt association recommends spreading efforts roughly equally along these three lines. What interests us, in terms of employment, investment and technological research (the so-called "energy transition"), are obviously the latter two, although reduced energy consumption also releases purchasing power for other goods... and the repayment of public and private debt.

There have been an increasing number of studies on energy transition employment gains in France converging towards a figure of 650,000 additional jobs over the next 20 years. This is clearly insufficient to overcome unemployment, but this objective is only a secondary dividend, the primary one being the exit from the energy threat triangle!

These figures are derived from two econometric models based on the hypothesis of lack of breakthrough technology (their technical coefficients being those of the present time). They are based on the ThreeMe model developed by Gaël Callonec and others for Ademe Ofce[5] and on the model created by Philippe Quirion (Cired-CNRS)[6]. They are multisectoral, work on the "net" (balancing out job losses against jobs created through energy transition), incorporating macroeconomic effects: savings on energy spending are "redirected" towards other expenses, with "induced" jobs. They distinguish direct job creation (renewable energy or efficiency producing activities) and indirect job creation (production of equipment and materials for these industries).

The results depend crucially on several assumptions: oil prices remaining at a high level, 20 year objectives (reduction of greenhouse gas emissions, shutting down nuclear power plants). The most favorable results correspond to variants which assume the closure of nuclear plants after 30 years of use, and a 40% reduction of GHG. But there is a third crucial factor which is financing conditions. The best results are obtained if half of the investment is financed on credit (otherwise tax increases nullify induced job creation).

Technically speaking, efficiency measures involve insulating buildings and developing public transport: these technologies have already come of age. The equipment and materials are available in France and cannot be delocalized. Implementation is by definition local, decentralized and carried out by SMEs. Such arguments should facilitate the spread of such measures, but there is one (major) obstacle, in addition to the aforementioned funding, and that is training the workforce.

As regards production of renewable energy, however, French industry has taken a sitting start following decades of nuclear electricity dumping by Edf. These renewables are mainly wind and direct solar energy (thermal or photovoltaic). Despite the fact that, since the late 1980s, environmentalists have argued that they would provide a major field of reconversion for the heavy boiler making, mechanical and electrical engineering associated with shipbuilding or arms manufacturing, very little has been done to provide the France with a wind turbine industry, or even a solar industry. The upshot is that the former has been monopolized by Germany and Spain, and the latter by Germany and more recently China, or even Turkey (for thermal solar energy).

This is not irreversible since these techniques are not yet mature. China has been caught out by its own dumping strategies, with huge production overcapacity compared to global demand which is growing strongly but still limited, and its largest solar panel producing firm is bankrupt! That said, it must be borne in mind that the main source of photovoltaic jobs is direct and local mounting and installation of solar systems. This explains the reluctance of French installers as regards European protectionist projects against cut price Chinese cells.

The last point concerns research and development into biogas, which has become even more important, since, as Negawatt points out, gas will also be a particularly convenient form of storable renewable energy, being produced mostly during summer and consumed mostly during winter. As regards biogas development, France is reasonably well placed, provided we stop wasting resources on first generation subsidies.

To measure the economic stakes of this revolution and the challenges faced by France, we should consider briefly the success of our German neighbours, who have opted in 2011 (after Fukushima antd ten victory of Günen in the Land of Bade-Wurtemberg) for an early exit from nuclear energy (in 9 years time, closing plants before full exploitation), and abandoning coal and lignite, by using gas to "smooth" the transition.[7]

Between 2010 to 2012, 8 nuclear reactors were closed in Germany and the proportion of renewable energies has gone from 17 to 23%. Curiously, for a northern European country where the cost of solar kwh is 3 times that in North Africa (€ 120 against 40), but which has a short coastline, investments are now mostly solar: 12 billion euros in 2012, against 3.8 for wind power and 2.6 for bioenergy. From almost zero in 2001, photovoltaic production reached 11.7 GWh (GigaWatt hours) in 2010 and 28 GWh in 2012. Between late 2008 and late 2012, the price of private rooftop photovoltaic system installations dropped from 4.4 to 1.7 euros per Watt (excluding tax and subsidies): this is one positive outcome of solar panel price collapse.

So, how does this translate in terms of jobs? Wind energy, which began earlier, has grown constantly from 64,000 jobs in 2004 to 96,000 in 2010; 101,000 in 2011 and 118,000 in 2012. Solar employment has increased from 25,000 in 2004 to 121 000 in 2010; 125,000 in 2011... and 100,000 in 2012. This decrease was due to the brutal but limited effect of the bursting of the Chinese photovoltaic bubble which halted the momentum of cell production in Germany, but not installation activities. As a result, wind employment, for which Germany exports equipment, which had been exceeded (in terms of jobs) by the solar industry in 2010, is now exceeding solar employment once again. However, biomass-energy is still the biggest employer with 129,000 jobs in 2012.

Another interesting aspect of German renewables is the predominance of small scale production. Of the 53GW installed in 2010, 40% belong to individual and cooperative installations, 11% to farmers, 14% to project investors and only 6.5% to the 4 main German energy firms.

As for energy price: from an average of € 64 per MWh on the eve of Fukushima, German prices jumped to €73 between April to September 2011, and then began a steady decline. In March 2013 prices are at 51 euros, well below the pre-Fukushima level.

Of course, renewables have not yet replaced nuclear and fossil energies! The question of energy transfer over time (and not only space) has become a crucial issue. For example, in mid-August 2012, during week 33, which is the most favorable, renewables only exceeded total electricity demand at mid-day on Tuesday (thanks to particularly strong offshore winds) and on Thursday (due to a sunshine peak). It should be noted that during week 33 the excess daytime demand, compared to night time demand, was more or less covered by solar energy production, at least during the morning. Solar energy is "unpredictable" and cyclical, but perhaps well adapted to human needs... unless it's been the other way round, since the dawn of humanity, with an inexorable drift towards the evening activities of urban civilization which can't be corrected by simply moving the clock back for daylight energy saving!

It should also be mentioned that during the night of Monday to Tuesday, renewables (mainly wind) exceeded demand around midnight, but this was far from the case during the weekly low, during the night of Saturday to Sunday... Then, as always, it was conventional energy sources that took over, with bio-gas and hydraulic energy only providing a limited top up, whereas they should theoretically provide the most natural form of energy storage...

German export success have, as usual, been even more impressive, and not only as regards materials. French jibes followed the German announcement, during summer 2011, of their intended exit from nuclear energy. French energy transition opponents rejoiced at the prospect of the imprudent German grasshopper coming to beg from the industrious French nuclear Ant, come the cold winter!

From low energy exports in early 2011 (1 to 2 TeraWatt-hours per month), Germany naturally suffered from the hurried shutdown of reactors during mid 2011, importing 2 to 3 TWh per month during the summer. But by February 2012 the situation had been restored (despite having 8 nuclear reactors less) and by March 2013, with more than 4 TWh sold, Germany beat its previous energy exportation record.

And on February 8, 2012, in mid-winter, German renewables beat French nuclear energy. On that date France reached a historic energy consumption peak (100 GW) and had to import 9 GWh from Germany, out of the 10 produced by German solar energy. That day, German electrical companies who purchase solar electricity at 240 euros per megawatt-hour from private individuals, resold it at up to 1,700 euros on the European market...

German competitiveness has come a long way. But in the present day there is also the choice of energy transition. For France, it may be later than we think.

[1] For the last two millennia, see Pages Consortium http://www.pagesigbp.org/products/latest/673-continental-scale-temperature-variability-during-the-past-twomillennia ; for the past 30 years the report of the World Bank 2012 http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf

[2] See my text *The decadence of the climate sceptics*, http://lipietz.net/spip.php?article2929 .

[3] See my book *Green Deal. The crisis of liberal-productivism and the ecologist response*, La Découverte, 2012.

[4] Academy of Sciences, *Demography, climate and global food*, 2011,

http://www.bibsciences.org/bibsup/ACAD-SC/common/articles/rapport12.PDF

[5] See http://www.ofce.sciences-po.fr/pdf/documents/threeme/doc1.pdf.

[6] See, on the site of Cired, studies conducted for WWF, or on the Negawatt scenario.

[7] All the digits that follow are taken from: Cedric Philibert, "Solar power poised to become competitive", *La Recherche*, June 2012, http://www.larecherche.fr/idees/entretien-dumois/energie-solaire-passe-devenir-competitive-01-06-2012-91053 , and Bärbel Höhn, « Germany's Energy Transition : a Success Story with Challenges Ahead", Greens/EFA conference *Energising Europe Sustainably*, Madrid, May 10th, 2013.