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Environment

Technological myths and realities, social challenges

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From time to time, the media report sophisticated projects like the placing into orbit of giant mirrors to reflect a part of solar radiation into space, or the manipulation of the genetic heritage of bacteria of the first stomachs of cows to reduce methane emissions in the farming sector - this, and better... In the face of climate change, the image is created of an extremely complex challenge, to which techno-science would not yet be in a position to respond.

This image is completely erroneous:

1) the fight against waste and for energy efficiency would allow the reduction of greenhouse gas emissions rapidly, in a very significant proportion and at through the use of perfectly well known techniques (that goes also, mutatis mutandis, for the reduction of emissions originating from the agricultural sector);
2) Technologies exist which would allow the complete or quasi-complete replacement of fossil fuels by solar energy (and geothermal energy as an accessory), in a few decades. It is about implementing them and perfecting them, not inventing new ones.

A wasteful and inefficient system

The term "waste" in fact has three distinct aspects: waste properly so-called (pointless use), lack of efficiency of equipment (the technical optimum possible at a given time is not realised everywhere), and that of the energy system as such (its more or less rational or irrational character). The political decision-makers often point to the individual dimension of the first aspect: consumers should use cars less, lower the thermostat by a degree, turn off the lights, cover pans when they cook and so on. The other manifestations of energy waste -the waste of resources in enterprises, because of blind market competition - and, above all, the fact that whole sectors of the productive apparatus are totally useless or damaging (the manufacture of arms, advertising and so on) - are generally passed over in silence (including by most of the environmentalist NGOs). The third aspect - the irrationality of the global energy system - is one we will return to later.

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The discussion on the possibilities of diminishing energy consumption focuses then most often on individual waste at the level of consumption, on the one hand, and on the improvement of the efficiency of equipments, buildings and so on, on the other. The messages which derive from this oscillatation between the ethical and the technical, leaving the overall political and social reflection in the shadows. Yet, even when reduced in that way, the waste of capitalist society remains impressive. It is believed that a combined policy of economy and efficiency would allow energy consumption - and thus greenhouse emissions - to be halved in developed countries.

In the United States, for example, 75% of the electricity produced could be economised at a cost lower than the cost of production of the KWh in the current power stations, and the energy demand in the sector of building could be reduced by 40% at a cost lower than the price of sale of electricity. [1] The Europeans are not (yet) "energyvores" like the Americans (for a GDP/inhabitant lower by a quarter, they use an average 4 tonnes of equivalent oil/person/year, or two times less than in the USA), but energy waste is far from being a US monopoly : more than thirty years after the first oil shock, 60% of buildings in the EU are not equipped with double glazing; by itself, the thermal isolation of existing edifices would reduce by 42% greenhouse emissions in this sector. [2]

In his interesting analysis of the energy challenge of the 21st century, Benjamin Dessus [3] recalls that the efficiency of equipment tends to grow spontaneously in the course of technological progress, in such a way that, beyond a phase of take-off, the energy intensity (the quantity of energy necessary to the production of a unit of GDP) of the capitalist economy falls regularly. It is true, except that this relative reduction is more than compensated for by the accumulation of capital in the new sectors and on the new markets, so that the overall dynamic remains oriented to the absolute increase of demand. Moreover, structurally, the energy system remains quite inefficient because it is based on the centralised production of high quality thermodynamic energy which is then transported long distances (leading to losses) and used in functions where it would be more rational to use lesser quality energy, produced on site. Written more than twenty-five years ago, this denunciation of the structural irrationality of the system by the US ecologist Barry Commoner remains fully relevant . [4] Commoner pleads that energy efficiency is judged at the level of the networks, not only at the level of equipment. Example: it is absurd that oil and coal are transported thousands of miles to produce electricity which, after transport, will serve to heat domestic hot water. [5] For such a use, it would be better to use solar energy, either directly (with the aid of thermal panels), or indirectly (by burning the biomass gathered locally, or through the intermediary of a heat pump exploiting thermal energy accumulated in the soil, or in water).

A flagrant example of inefficiency linked to energy centralisation and the competitive economy is the under-utilisation of the technique of cogeneration, or combined production of heat and electricity. The principle of this technique is very simple : it consists of recuperating and using the heat released during the production of current (without that, this heat is dissipated in the atmosphere). The systems of cogeneration allow a fuel saving of 30% to 40% in relation to separate production, thus a corresponding reduction of CO2 emissions. Cogeneration implies the decentralisation of electric production, which leads to numerous other advantages such as the reduction of losses through transmission, or the reduction of emissions of substances thinning the ozone layer (caused by leakage of cooling devices in the CFCs). We distinguish large-scale cogeneration (with industrial use of heat), medium scale cogeneration (with urban heating at the level of a neighbourhood, for example) and mini or micro cogeneration (at the level of a household).

In the European Union, on average, barely 11% of electricity production is done with combined heat production. [6] The main reasons for this low diffusion of cogeneration are:

1) the hostility of electricity producing companies in relation to decentralisation;

2) the lack of an integrated vision of urban development;

3) in cases of large scale cogeneration, the absence of coordination and long term economic planning between the energy sector and manufacturing industries which are users of moderate heat (the agro-alimentary industry, for example).

These capitalist rigidities are truly important in that the European Commission only envisages that the share of cogeneration rises from 11% to 18% in the course of the coming years (which would allow avoiding the rejection of 127 million tonnes of CO2 in 2010 and of 258 million tonnes in 2020) [7], whereas much more ambitious objectives could be adopted.

The solar revolution is possible

As to the replacement of sources of fossil energy by renewable sources, it does not depend above all on revolutionary scientific discovers, but on a political will to develop what already exists. The technical potential of renewable sources (that is the quantity of renewable energy usable in the current state of development of knowledge and processes), is equivalent to six to seven times world energy consumption [8]. A number of studies concretise the possibilities for specific regions or technologies (see box). However partial, their conclusions are impressive. Indeed, it should here be stressed: this technical potential could double or triple in about 15 years if the absolute priority in the area of energy research was at last given to the development of renewable sources.

This is not the case, very much the contrary: in spite of the two oil shocks, the share of renewable sources in the budgets for energy research and development of the member countries of the International Energy Agency (IEA) were only 8.1% on average between 1974 and 2002, or less than during the period 1974-1986, when it was 8.4%. Nuclear fission takes the lion's share of the budgets (47.3 %), followed in second position by technologies of fossil fuel conversion!

In these conditions, we can understand why the rate of growth of renewable sources (all sources together) - far from increasing in recent years as the media would have us believe - has slowed down (table 2) to the point that their share in the primary supply of energy has stagnated for more than thirty years - in 2001, it was barely 5.3% of the primary supply of energy (fig.1) [9]. The trend has begun to change - slowly - following the decisions of various governments to increase the share of renewable sources in energy production in general, electricity in particular [10]. But a lag of more than thirty years has accumulated. If the climate pays the price for it, the oil lobbies finger their profits.

Globally, between now and 2050, it is technically possible to satisfy the growing energy needs of the developing countries while mastering the greenhouse effect. In the longer term, whether or not the productivist frenzy is reined in and energy research is rapidly and radically reoriented towards renewable energies, the progress of knowledge should allow the exploitation of a bigger share of solar radiation [11]. The political decision is decisive. There is then no scientific basis to the neo-Malthusian discourse which rest on the so-called exhaustion of available energy resources to justify a regulation of the climate by the authoritarian limitation of births, for example. [12]

Not is there any scientific basis to the chorus of the nuclear energy lobby, which claims that only the atom could satisfy the energy needs of humanity without mortgaging the well-being of the North, or the development of the South, and without destabilising the climate. Currently, the nuclear sector covers barely 2% of the world's final consumption of energy and 16% of the production of electricity. To increase this share significantly would demand such truly gigantic investment that it would become unrealistic. We come up notably against the limits of the fuel stock : in the current state of the stock, the known reserves of uranium do not ensure more than 60 yeas of functioning of power stations [13]. The so-called power stations of the third and fourth generation would offer, ultimately, guarantees of energy supply in the very much more long term... but at the price of higher risks of dissemination from the use of plutonium.

The nucleocrats attempt to surmount social reticence by arguing that their technology fetish does not produce CO_2. But some studies show that if one takes into consideration the whole chain of nuclear production - from the manufacture of fuel to the dismantling of the power stations and the management of waste - this system emits more CO_2 per kWh product than a gas cogeneration power station, and around a third of the emissions of a performing gas power station [14]. Moreover, these emissions can only increase in the future, with the exploitation of ores less and less rich in uranium, which leads to an increase of the energy necessary for extraction and processing of the fuel. In any case, whatever the technology, the question of waste remains unresolved and the risk of radioactive leakage can never be totally excluded. Nuclear energy remains fundamentally a sorcerer's apprentice solution.

An example of a scenario for Europe

For Europe, an example with figures of and overall proposal combining energy economy, transition to renewable sources and abandonment of nuclear energy has been advanced by the researchers of the Institute of Thermodynamics in Stuttgart [15]. The proposition has been baptised "Energy Revolution" by Greenpeace, which commissioned the study. It is compared to a baseline scenario in which greenhouse emissions increase by 50% in 2050 in relation to 1990. With "Energy Revolution", on the other hand, emissions in the EU (25 states) are divided by nearly three: they go from 7.9 tCO2/person to 2.7 tCO2/pers (around 0.74t of carbon) in 2050.

The main hypotheses are the following :

– investment of 4.5 cents/kWh intended to increase the efficiency of installations of electric current production and to thus reduce the primary demand by 37%. According to the study, this reduction is indispensable in order to be able to do without nuclear energy;

– 30% of the heat produced by cogeneration with development of urban heating networks;

– multiplication by fifteen of the capacity installed in renewable energies (big hydraulic not included), in such a way that renewable sources ensure 50% of needs in heat and 70% of electricity needs in 2050;

– reduction by 50% of final demand in heat (by the renovation of existing buildings, on the one hand, and standards in favour of the "passive solar house" for new constructions, on the other);

– reduction by 40% of final demand in the transport sector (by the passage to more efficient vehicles, a shift from road to rail and a change of behaviour in the area of mobility);

– progressive abandonment of oil and coal, natural gas remaining temporarily the sole fossil fuel still used.

Beyond the 4.5 cents/kWh of investment to increase the energy efficiency of electric current production installations, "Energy Revolution" generates a slight lowering of cast in the event - logical - that the price of carbon encumbers the baseline scenario [16] . Given this investment, "Energy Revolution" would represent an overall annual extra cost which would climb to 6 billion euros in 2020 and would subsequently fall, because of the increase in oil prices and fall in the price of renewable sources [17]. Towards 2040, "Energy Revolution" will become less dear than the baseline scenario.

The extra cost of six billion deriving from investment in efficiency of electricity current production installations is "the price that the collectivity" must pay to save the climate while moving away from nuclear energy, write the authors of the study. This price is in fact derisory in comparison with the means of which society disposes. The aggregated GDP of the 25 countries of the European Union is currently around 9,230 billion euros. The sum which should be invested so as to make a great step in Europe towards the objective of 0.5 tonnes of carbon/person/year represents then hardly 0.065 % of the wealth produced. A sum all the more derisory in that this 0.065 % would be more than compensated for subsequently by the fall in the energy bill...

"Energy revolution" has the merit of showing concretely that the developed countries can reduce their greenhouse emissions in a Draconian fashion, in some decades, by domestic measures (without purchasing of emission rights), and that the necessary investment is far from outlandish. Bu that is only a scenario to debate, not the panacea. One can note for example - and it is typical - that this study essentially confines itself to seeking the technical means to continue to make the whole of the existing social structure function, without ever questioning the rationality of this latter or its mode of management. Indeed this questioning is unavoidable. We can see it clearly in the field of transport. The shift from road transport to rail transport, for example, is not primarily a technical question : it is a social challenge, which implies challenging the neoliberal mode of organisation of labour and lean production - not to mention the question of reclassification of road drivers. It is certainly not by chance that the thermo-dynamicists of Stuttgart have chosen not to enter into the detail of the conditions to be fulfilled to reduce by 40% between now and 2050 final energy demand in the transport sector. But, the feasibility of their scenario is therefore cleanly diminished. The struggle against climate change will not be purely technological : to revolutionise production and consumption of energy requires also revolutionising social relations and the behaviour which derives from them.

APPENDIX

Energy efficiency and renewable sources : facts and figures

– Equipping all the south-facing roofs in the European Union with photovoltaic solar panels would cover all European needs in electricity (European Commission, "A Vision for PV Technology for 2030 and Beyond", Preliminary Report by the PV Technology Advisory Group, 2004).

– The overall technical potential of small and very small hydraulic power stations (three types of installations of less than 10MW, less than 500 kW and less than 100 kW) is not known with precision but the indications by country show very significant possibilities. The Department of the Environment of the Philippines, for example, estimates the potential of the country at nearly 1300 MW, of which less than 90 are exploited. [18] The economic potential would vary between 210 and 310 TWh, according to the AIE. Very important for the development of the third world, this technology is completely under-utilised: the effective demand is insufficient and the system does not enter in the schema of centralisation of power and energy.

– Converted into electricity by means of tidal power (a kind of underwater wind generator), turbines and special buoys, notably, the marine energy potential of the coast of Scotland (waves, currents and tides), estimated at nearly 80TWh/an, would cover the electricity needs of the whole region (School of Energy and Electronics, University of Edinburgh).

– In the tropical regions, the difference in temperature between the hot water at the surface and the deeper waters allows the production of electricity according to the well-known principle of heat pumps, but on a very large scale (Ocean Thermal Energy Conversion: OTEC). OTEC would allow production of all the necessary electric current to an island like Hawaii (Pacific International Center for High Technology Research).

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[1] John J. Berger, "Renewable Energy Sources as a Response to Climate Concern", in "Climate Change Policy, a Survey", Stephen H. Schneider et al (ed), Island Press, 2002

[2] ECOFYS "Mitigation CO2. Emissions from the Building Stock. Beyond the EU-Directive on the Energy Performance of Buildings". Carsten Petersdorff et al. Report established for EURIMA

[3] Benjamin Dessus, "Energie, un défi planétaire", Belin 1996

[4] Barry Commoner, "The Poverty of Power", Bantam 1980

[5] Oil and coal constitute 38% of maritime transport of goods

[6] More than 30% in Luxembourg, Holland and Denmark

[7] Office of Science and Technology, Chief Scientific Adviser's Energy Research Group, Report of the Group, 2002, European Commission

[8] See for example Wolfram Krevitt, Uwe Klann, Stefan Kronshage, Energy Revolution. A Sustainable Pathway to a Clean Energy Future for Europe, Institute of Technical Thermodynamics (Stuttgart) & Greenpeace, September. 2005. The renewable sources taken into account in this estimate are solar energy in its different forms (thermal, photovoltaic, thermo-electric, hydroelectric, wind, marine) as well as geothermal.

[9] Rick Sellers, International Conference for Renewable Energies 2004, IEA Side Event

[10] The 11th five-year plan of the People's Republic of China fixes as objective 15% of energy of renewable origin within ten years. The European Union has decided that 20% of electricity will be produced from renewable sources in 2010.

[11] The rate of conversion of solar energy into electricity by silicon-based photovoltaic panels has gone from 5% some decades ago to 15%-20% today and could yet be increased. There is no reason to think that similar progress is not possible in the as yet experimental area of organic material based photovoltaic panels

[12] Estimating that their demography makes developing countries mainly responsible for greenhouse emissions, and noting that some of these countries present volumes of emissions per head higher than the developed countries, F. Meyerson, for example, concludes that an agreement on the climate “should integrate the concepts of growth or of decline of the population, of international migration, and of relative changes of levels of emission per capita.(...) The emissions of the developing countries will be the main factor in the 21st century, and a future treaty should respond to this emerging demographic reality (sic)” (Population Dynamics and Global Climate Change, Population Resource Center, 1999). Combined with the proposal for a market of rights of exchangeable individual procreation, this approach could have serious consequences (proposed for the first time in 1964, rights of procreation have been taken up by several authors since then See for example “Procreation, migration and tradable quotas”, David de la Croix & Axel Gosseries, CORE discussion Paper 2006/98)

[13] Christian Ngo, “L'énergie”, Dunod, 2004

[14] Storm Van Leeuwen, “Nuclear Power and Global Warming”, presentation at seminar on “Nuclear energy in the 21st century”, Brussels, October 19, 2006

[15] Energy Revolution, op. cit.

[16] The price of carbon will go from 15 to 50 euros/tCO2 between 2010 and 2050. It is logical to consider that this price will encumber the baseline scenario given that the EU has adopted a system of sanctions (40 euros/tCO2) against member states which do not respect their quota

[17] The increased cost of 6 billion is established on the basis of a price per barrel of oil clearly lower than the current price : a rather optimistic point of departure for the evolution of oil prices in the 20-30 years to come

[18] See www.aseanenergy.org/pressea/philippines/hydro/current.