Evaluation of EC Directives on renewable energy

A. de Callataÿ

(Working document. April 23, 2009)

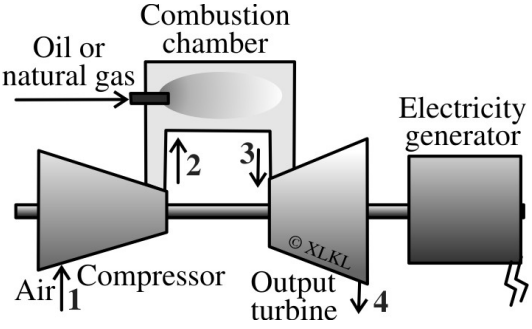
Summary

An historical background explains the evolution of the yields of gas turbines, CHP (combined heat and power system) and cooperative systems using CCGT (combined cycle gas turbines) and wind turbines. The petroleum industries produced more natural gas than what the market could absorb and are thus motivated to promote gas to generate electricity. The competitive battle for the power market was characterized by innovative and elaborate methods, including propaganda methods. This study computes some scenarios using various methods to harness energies. This approach gives quantitative technical results to compare the primary energy consumption and the emissions of GHG (greenhouse gas) and to check whether the best scenarios are supported by the energy policies of the European Commission (EC) Directives on renewable energy and on E-RES (electricity from renewable energy sources).

Historical background

Yield improvements in power plants

A short historical background is necessary to understand the evolution of the energy policies. Since 1950, technical progresses have allowed to produce twice more electricity with the same amount of fuel. The yields, 25% in the coal power plants in 1950, became 55% for the power plants combining gas turbines and a steam cycle (combined cycle gas turbine, CCGT). To produce the same amount of calories, the coal emits twice more CO_2 than natural gas. Combined with a yield twice better, this evolution has divided the CO_2 emissions of power plants by four. A cooperative system using CCGT and wind turbine, and a power plant based on CHP (combined heat and power) have even better yields.



Gas turbines

War research led to new ways to produce electricity. That is well-known for nuclear energy. That is less known for gas turbines. The jet engines were invented at the end of the war but were not very powerful until they got improved during the cold war. The air is compressed by an input turbine. The fuel (oil or natural gas) is injected into a pressurized combustion chamber and ignited. The hot gas powers the output turbine which turns the compressor, and, in the gas power plants, a generator. The blades of the output turbine did not resist to very high temperatures until efficient internal cooling of the blades and adapted materials were discovered (by 1965). This enhances the thermodynamic cycle and, with many others improvements, double the yield of the power plants generating electricity. In CCGT, the exhaust heat from the gas turbine is fed into a second cycle using a steam power plant. The global yield is then up to 55%. The hot gas has to be free from corroding chemicals and from products which might adhere to the blades. This is currently possible with clean natural gas but not with gas from coal gasification or from biomass.

Oil as a strategic stake

The Allies have won the war by depriving Germany and Japan of the access to oil wells. Oil thus became a strategic stake and got large military research funds to increase its availability. New technologies were developed to drill wells quickly and to maintain them in good condition by finding how to cover the wall with concrete, even thousands of miles below surface. That improves the sealing of the wells to lock natural gas under high pressure (500 kg/cm^2).

Integrated exploitation of oil and natural gas

The active wells produce often a mixture of oil and natural gas. The extraction of oil and natural gas is thus an integrated activity. Oil is sold easily but the natural gas is more abundant than what the market can absorb and it is still a production surplus today. The main historical events of the gas industry are thus operations to conquer markets against competition. The capture of the electricity generation is the main goal. The United States was the principal oil producer until 1970. To sell their natural gas, they have built gas pipelines between wells and gas power plants. As it is easier to transport and store oil or gas than electricity, they have built thousands of kilometers of gas pipelines connecting Texas, the principal producer of natural gas, to the main users in the periphery of the United States. For lack of local demand, natural gas was flared in the Middle East. The natural gas is now liquefied (-173°C) and transported in specially insulated methane giant ships.

Transport of the energy

Oil is a concentrated amount of energy and is therefore the best medium to transport energy. When the fossil fuels will be exhausted, energy, if it not produced in a

distributed way (as in nuclear power plants), would have to be transported by high voltage power lines, a method much more expensive. There are crown discharges into the atmosphere when the peak voltage is above, say, 765 kV. To transport the same energy than a pipeline system carrying one million barrels a day (136 kg/barrel or 155 l/barrel), equivalent to the primary energy imported into Belgium or to the energy produced by 16 EPR nuclear reactors (200 TWh), one needs one truck (15 t) of uranium each day or 4 trucks of plutonium each year.

To transport the same energy via electricity, one needs 13 HV (high voltage) power lines (pylons with 6 HV wires in 540 kV HVAC or 4 HV wires in 765 kV HVDC), i.e., as these lines cannot not normally be used daily at more than 25% of their maximum capacity, about 50 lines of giant pylons (60 m high). A lot of reactive energy is needed for long distance HVAC lines. The losses between the meters of the production plants and the meters of the consuming customers are currently above 10% due to heating in the power lines and in the transformers and to the electric consumption of the power plants and control stations themselves. The losses are proportional to the distance for a given voltage.

Presently, the rectifiers and inverters of HVDC lines have heavy losses and are expensive but one expects that the present researches in power electronics will reduce costs and improve efficiencies. The HVDC lines are currently preferred for submarines cables (which are needed for wind power) and for connecting independent non-synchronized grids. It might be better to wait until HVDC become a cost competitive solution to spend on grid improvements that are needed only for wind power.

33% of the world consumption of energy is now provided by oil (90 million barrels/day), 25% by coal, 20% by natural gas, 6% by hydraulic power, 6% by nuclear plants and 10% by biomass (mainly wood). The world electricity generation from these sources comes from 10% coal, 1% oil, 9% natural gas, 6% nuclear, 6% hydroelectricity, and, in 2012, 1% wind power, up to a total of 33% of the primary energy.

Gas pipelines

Since 1960, new technologies allow routine offshore drillings. The giant field in Groningen (Holland) has produced massive amounts of natural gas (since 1965) and a network of gas pipelines coming from the North Sea has distributed this gas into Europe. The already existing network of coal gas was fitted for natural gas. The European network of gas pipelines was connected early to the one of USSR, a large producer of natural gas but an enemy until 1991.

Natural gas prices after 1973 oil crisis

Turbine engines can run with gas or oil. Oil, easier to transport, was sometimes less expensive than natural gas, even sold as a waste. Oil was eliminated from the competition for power plants after the OPEC was allowed to double - and later to quadruple - the oil price after the 1973 oil crisis in the Middle East. The natural gas became a profitable industry as its price was thus increased.

Competitors: oil, coal and nuclear power

Covert promotion campaigns against competition

The deep wells produce more natural gas than what could be sold on the market. Thus, the oil companies had to launch large promotion campaigns to sell more natural gas. There is no way to prove that the events observed on the energy markets resulted of the Machiavellian competitive battle described in this paper but it is convenient to suppose that propaganda experts, trained during the cold war, have been asked to enlarge the gas market, even by covert and indirect communication methods. The reader should keep in mind that the followings are not stated truths but just convenient assumptions for a plausible explanation.

The nuclear competitor

As the oil price rises, the nuclear power plants become competitive. France undertook an ambitious nuclear program which provides now 82% of the power market (56% in Belgium). Since 1975, an antinuclear campaign (called an environmental campaign afterwards) slowed down or stopped most of the nuclear programs, especially in the countries having coal or gas resources. A few persisting skewed messages from this campaign are the followings. There are only 70 years of uranium reserves. Chernobyl nuclear accident could happen again in the democratic developed world. Nuclear electricity is much more expensive than with other fuels. As explained in the site referenced, the relative real prices (without subsides in 2007) are about: coal (100%), nuclear (107%), natural gas (144%), wind (244%). The nuclear power has the lowest price if the costs are computed with 90% utilization, 60 years lifetime, and a low discount rate (4% on constant costs, inflation deduced or 7% on real costs). Real prices depend on many factors and cannot be stated reasonably within the unscientific communication methods of lobbying.

Coal pollution: an argument for competitors

In 1950, coal was the main fuel to generate electricity and it is still used to generate half the electric power in the world in 2008. Coal is abundant and easy to extract and is thus a serious competitor on the electricity market. An information campaign, started in 1955, has made the public aware of coal pollution. Coal dust is responsible for many premature deaths as dust contains cancerous soot, radioactive elements and heavy metals (dangerous wastes with an infinite life). New systems for cleaning the fumes have reduced drastically this pollution but did not fully eliminate it. Later, antinuclear propaganda messages have disseminated the fear that radioactive wastes were even more dangerous and were freely released in the environment by nuclear power plants.

Climate warming to promote natural gas

Since 1997, the competition against coal took an unexpected path based on a neglected phenomenon. The greenhouse gases (GHG) warm the Earth, especially within the poles. The atmospheric CO_2 comes in a measurable way from fossil fuels extracted since the second industrial revolution. A coal power plant (35% yield) emits 3 times more CO_2 per kWh produced than a CCGT (55% yield). This fact has been exploited by the propaganda experts involved in the competition between coal and natural gas. Media campaigns are not neutral as they have informed the public of the many frightening consequences of climate warming but not of its few advantages.

Background of the 'Summits of the Earth'

As the actions to reduce Earth warming must be carried out at the world level, Maurice Strong, an oilman who became an executive at the United Nations at that time, has organized conferences on the environment (Summits of the Earth). The warming effect of GHG (evoked at Stockholm conference in 1972) was known since a long time but became a topic of concern in the medias since the publicity given to the Rio conference in 1997. These conferences led to the Protocol of Kyoto (2002) which constrains the participating industrialized countries to reduce their GHG emissions. The Protocol is enforced since 2005 when Russia was involved.

Supranational support for energy policy

Since 1998, the United Nations (UN) finance a group of experts (Intergovernmental Panel on Climate Change, IPCC) to proclaim that the climate warming is highly probable and that it will be a catastrophe. A 'consensus' is a method used in governments to conceal opponents. This technique was applied in the science of climate to summarize the scientific work and to conceal those who object that climatology is too complex for valid forecasts. The IPCC has thus concluded that the GHG emission shall be reduced by 50% to prevent the global temperature to climb more than 2°C above its level at preindustrial time and to prevent sea water rising after ice melts in the polar glaciers. The developed countries should reduce even more their GHG emissions, up to 80%, to allow the developing countries to use more fossil fuels to escape from poverty. The positive result of the commercial operation at the Summits of the Earth was to sensitize the politicians to the far away problem of climate warming.

Clean technologies and communication campaigns

Two types of researches could make coal more competitive. (1) The capture of CO_2 and its storage in depleted wells of gas and oil (or in aquifers). (2) The development of new power plants using liquefied or gasified coal injection in pressurized combustion rooms as in gas turbines (yields up to 45%). The future of these technologies is not known but Greenpeace already fights against the researches on the capture and storage of CO_2 to prevent that coal becomes an efficient competitor to natural gas. The main mission of Greenpeace is to fight nuclear power plants although these plants emit almost no GHG. Green activists are thus unable to find a valid mix of solutions to prevent global warming.

Achievements of the Kyoto energy policy

Which are the results of the Kyoto Protocol? The GHG emissions were reduced (up to 6%) in some industrialized countries which have replaced coal by natural gas. However the CO_2 emitted in the world (measured according to the fossil fuel consumption) has increased (3% per year from 2005 to 2008). This growth was expected and will continue since the Kyoto Protocol is not addressing the real problem. CO_2 emissions increase mainly because the burning of fossil fuel increases and because deforestation progresses. The amount of coal extracted increases because what is included in the category of renewable energy cannot provide enough useful energy in the right place at the right time.

European Commission Directives on energy

The European Union has added two new types of energy quotas to the Kyoto one.

- **Kyoto quota**: Reduction target of GES emissions.
- **E-RES quota**: Obligation to produce electricity from renewable sources(E-RES) up to a given ratio in relation to the sum of the nuclear and fossil fuel electricity produced (1st EC Directive in 2001 and 2004).
- **Quota of renewable**: Obligation to use renewable energy up to a given ratio in relation on the sum of the caloric energies for electricity generation, for heat and for transportation. (2d EC Directive in December 2008).

A first EC Directive (2001, revised in 2004) imposed a quota of electricity coming from renewable energy sources (E-RES). In the UK, the generators from fossil or nuclear fuel must purchase "Renewable Obligation Certificates" to reach a quota similar to the one of E-RES. In the United States, a quota similar to the E-RES, called RPS (Renewable Portfolio Standard), is applied in some States which are producers of natural gas.

A second EC Directive was launched (December 15, 2008) to impose a quota of 20% of renewable for the sum of the electric power, heat and transport (13% in Belgium which has almost no hydroelectricity and little land for biofuels; 15% in UK).

Increasing renewables while decreasing energy use

These new types of quotas incite to consume more renewable energy and thus do not tend to reduce the total energy consumed. They do not incite to improve plant efficiency or energy savings, the main methods of reducing GHG emissions. Instead, it would have been more logical if the criteria were just based on the CO_2 emitted or on the fossil fuels consumed. The three types of quotas and the 20% target of energy reduction are hardly com-

patible. The various possibilities of interpreting these poorly coherent rules allow politicians (assuming they work for the economy of their country and not for their political party or for themselves) to choose what is the most profitable for their national industries (represented by their lobbies) and not for the planet.

Biomass as a renewable energy

Vegetation that captures CO_2

In the temperate zone, the sustainable exploitation of the forests is the best way of collecting solar energy into the biomass, especially since the increase of the CO_2 in the atmosphere accelerates the growth of wood. Wood, pellets and solid biomass are used in coal power plants (steam turbines, from 25% to 35% yield) or in co-combustion plants which burn a mixture of fossil fuels and renewable biomass.

Biofuels

Selected biomasses can be transformed into liquid fuels (ethanol, biodiesel) or into gas fuels (biogas). Compressed natural gas or biogas can power city vehicles. Biofuels will allow transportation when the fossil fuels will be exhausted. The biofuels are less efficient than wood to produce heat. Since 1992, there is a surplus of vegetable oil and of sugar plants. Fields were in fallow. The powerful agricultural lobbies are used to ask for more money, for more subsides than taxes. They manage a relentless battle for biofuel subsides, happy to find two new arguments: fossil fuel depletion and climate warming. In the biofuel as in the wind industry, the real CO_2 savings were manipulated. The indirect consumption of fuels (from agricultural engines and from biomass processors) being sometimes higher than the caloric power of the biofuel produced.

Discarding wood from the renewables

The 2008 Directive seems to accept wood in its objectives (motivation 34) but not in its practical application. The wood used for construction and paper is doubly interesting because this wood is a carbon store which does not give back the CO_2 it had used for its growth until it is burned. Wood is widely used in Austria, Sweden, Finland and Canada and the US has plans to exploit it [180]. Should this carbon be counted when it is cut, when it is burned (hundred years later) or never? The EC Directive forgets to count it, except when it becomes a waste. The effectiveness of an energy policy can be destroyed by these unexpected details. The wood exploitation is profitable because the timber used in construction and the paper are easily sold and do not need subsidies. The biofuels could only be profitable if they receive as many subsidies as the wind power. The EC Directive skillfully devotes important sections to make legal the subsidization of the biomass for transport fuel and not of the wood biomass for heat.

Skewed definitions of ‘renewable’ and ‘clean’ energy

The Directive is muddled in its selective description of the biomass to satisfy only the influential biofuel lobbies but not the industries of wood and paper. Although the Directive is about ‘renewables’, it should be called a Directive on ‘wind power’ as this renewable is the main energy that can be produced in large amounts within a short delay but the intermittency problem is stubbornly ignored in the Directives.

Details of the Directive seem engineered to prevent solar heaters, gas CHG, heat pumps... from being counted as renewable. Photovoltaic is included in the renewable category because it provides almost no power for industrial use. Geothermic plants can only produce real renewable power in volcanic areas. The production of hydro electricity may decrease if a minimum river flow will become compulsory. Greenpeace activists ask EU to provide funds for “clean energies”, which, in their coded language, contain only one sizable category: ‘wind energy’.

Scenarios to compare the uses of energy

Are EC Directives technically justified? Practical scenarios which use energies in various ways are studied here. Their useful energy output is computed to evaluate and compare their efficiency and to verify whether the best scenarios are supported by the Directives.

Scenarios *Yields*	Electr.	Heat
1a. CCGT + wood heating	55 %	86 %
1b. Wood power plant + gas stoves	35 %	90 %
2a. Gas CHP + wood advanced boilers	86 %	82%
2b. Wood CHP + gas heating	78 %	82 %
3a. Gas CHP	86 %	-
3b. Cooperative CCGT + offshore wind	75 %	-
3c. Cooperative CCGT + onshore wind	65 %	-

1) Natural gas or biomass to generate electricity?

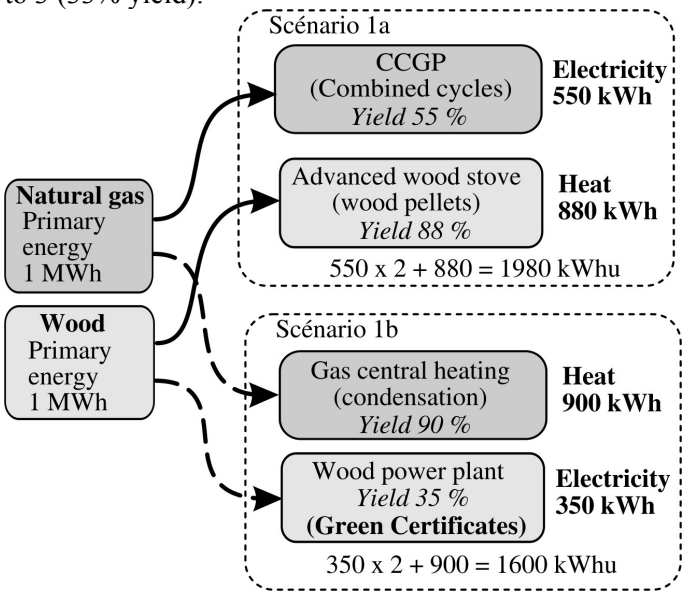
Each of the scenarios 1a and 1b uses two sources of energy with an equal amount of calories: natural gas and renewable biomass, but they use different technologies to produce electricity and heat.

Scenarios 1a and 1b

In scenario 1a, electricity is produced in CCGT (yield 55%) and heat is produced in wood stoves (yield 86%). In scenario 1b, the fuels supplied are swapped. Electricity is produced in advanced wood power plants (yield 35%) and natural gas is burned in stoves (yield 90%). The steam produced by the combustion of natural gas is condensed to recover this energy.

Units of useful energy

As electricity is a type of energy more useful than heat, a special unit kWhu (useful kWh) is computed with a weight doubled for the kWhe (electrical kWh) while the calories are measured in kWhc. Conventional conversion factors of IEA (International Energy Agency) vary from 1 to 3 (33% yield).

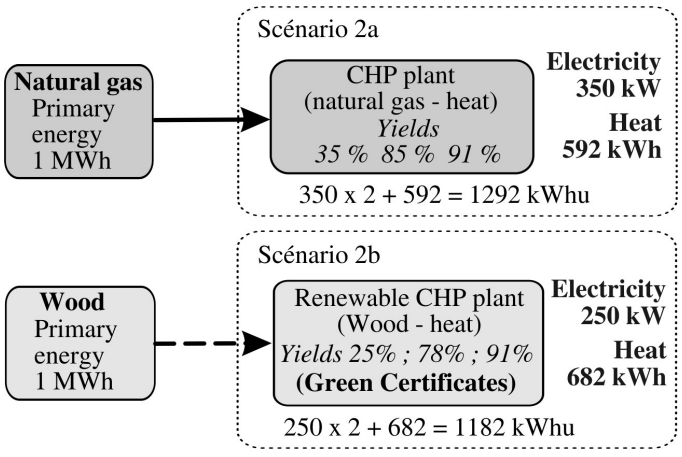


Scenario 1a is better than scenario 1b, since both use the same supply of energies but 1a produces more electricity, not because of environmental principles but because the gas turbines have a much more efficient technology than the steam power plants.

A good energy policy should support the most productive scenarios but the EC Directives favor the worst scenario which benefits from quotas of renewable energy (E-RES).

2) Cogeneration or separate production?

Scenarios 2a and 2b



In scenario 2a, CHP cogeneration uses a gas turbine to generate electricity (electric yield 35%) and recovers 65% of the exhaust heat in an exchanger. The global electric yield could be 100% if the heat recovery did not have a weaker yield in the CHP heat exchangers (82%) than in separate gas boilers (90%). The global electric yield is 86%. CHP can only operate when heat is needed, for example in buildings, for hot water every day and for heating during cold periods. A CHP works 30% of the time in average in Belgium (from 10% in summer to 90% in winter).

In scenario 2b, the CHP fuel is renewable biomass in steam power plants to generate electricity with a 25% yield because the steam technology is less efficient than for gas turbines. The global electric yield is then 78%. Remaining heat (75%) is used with an 82% yield.

As electricity is more useful than heat, scenario 2a is the best but the EC Directives deny the "renewable" status to the energy savings made possible by gas CHP and thus deny the associated subsidies.

Backup power plants for intermittent sources

Preheating of power plants

Like the engines of jet planes, the gas turbines of electric power plants can quickly change their output power. A 500 MW CCGT plant has the power of 10 000 cars (50 kW) but the comparison is more complex as, the more a system is large, the more it needs time to be preheated. A few hours are needed to bring up a CCGT plant to adequate temperature before it can produce its full power. Preheated CCGT can quickly adjust their production to the consumption imposed by the customers. As in vehicles, the yield is the best when operating at normal power but is strongly reduced when power is reduced or too high. Turbines are optimized for a given volume of gas flowing but their efficiency drops around this maximum.

Technological constraints on the electrical grid

The electrical grid is a very large integrated machine. It needs to be balanced, i.e., to be designed so that, in all nodes of the network, the production (imported in the power lines) is equal to the local consumption, while ensuring that the whole network is fully synchronized. The transport of electricity on very long high voltage power lines in alternative current (HVAC) requires specialized devices and alternators to produce enough reactive energy that nobody has to provide under the liberalized electric market imposed by bureaucrats against the engineers advices.

Different types of electricity (intermittent, base load, on demand) have been put into one single category to be traded on an electricity market. Finding this complex organization (called liberalization), separating grid management, transport and production, is an impossible task. The rules adopted had loopholes allowing energy traders to make fortunes from ratepayers, as the long-term contracts for electricity (such as those of nuclear power plants) were prohibited and the electricity had to be purchased on the spot at prices sometimes 10 times greater than average. As incentives for power plant investment were eliminated, the power outages became frequent

around 2000 in the US. Since a new US administration has replaced the previous one, one discovers not only how this market was operating, but who had organized it by studying the records of discovered with the scandalous bankrupt of Enron (the main trader). For instances, power plants were stopped to provoke penury, so that a selected transporter was the only one able to import power at a very high price. The electricity market for wind power seems to use some of the features evolved from those of this US experience.

The size of a regional grid is limited to a few thousand km because light requires a millisecond to travel up to 3000 km, and the grid frequency has to be tuned up to the millisecond for smooth operations. Unsynchronized independent grids can be connected through high voltage direct current lines (HVDC).

The base load and the variable load

The size of the grid fluctuations is the difference between the demand for peak time and the base load. (Difference called here the "variable load"). The base load is provided by power plants with a steady output: hydroelectricity produced by river flow, nuclear power plants and CHPs that depend on heat demand. A few thermal power plants (usually old coal power plants) are needed for seasonal peaks.

Forecast of production and consumption

Electric consumption is rather exactly foreseeable, so the problem of grid balancing, taking into account the consumption fluctuation, was well solved when power was produced mainly by coal-fired power plants. The wind fluctuations are much greater and less foreseeable than those of consumption because the wind can fall or become tempestuous in a few minutes. The wind can be strong on a whole area and stop blowing during the following hours, as it was observed in Germany. The wind fluctuations are almost equal to the wind power installed.

Required power of the thermal backup

The backup power plants must be ready to compensate for the wind fluctuations. In case of wind overproduction, a few wind turbines must be disconnected of the grid, although this was not allowed by the regulation of European bureaucrats (grid obligation to accept renewable energy when it is presented). The onshore turbines are disconnected first as they consume indirectly more gas than the offshore turbines which have a better load factor. If overproduction is frequent, the addition of too many turbines reduces the real load factor. These situations give a practical limit to the wind power in a saturated region. The average maximum capacity of wind in France (82% base load) is thus about 18% (variable load) of the average demand, or 4% of the consumption. In Belgium (56 % base load, which may increase to 66 % if the CHP potential is developed), the maximum power capacity of wind is 33% of the demand. The maximum energy is therefore between 6.6% (onshore case) of the consumption and 10% (offshore turbines only). On average days, the wind power installed above this limit would not be accepted into the grid. It is not clear whether the ratepayers, the wind promoters or the politician who has accepted the inefficient turbines will have to support these planning errors.

Gas turbines as backup power plants

As the gas turbines can vary their output power very quickly, they are a good backup system to compensate for the wind random fluctuations that can be ten times larger than those of the consumption. The technology of gas turbines allows avoiding power outages when wind production decreases or increases abruptly, making essential the availability of backup gas power plants. When the maximum wind power (100% of the demand) is installed, this state of affairs is convenient for the gas industry as it allocates 70% to 80% of the power market for the gas industry and keeps away the competitive systems (nuclear or coal) that cannot provide the variable backup. Hydraulic power from dams has a storage capacity to compensate the day and night consumption but which is hardly sufficient to store enough energy between windy and calm weather periods.

Required improvements of the grid for intermittency

If the wind power installed is important, the connection of wind farms to the electrical supply network (grid) requires that each zone is able to absorb the strong local variations of the intermittent wind energy or has the transport capacity to send it far away to the consummating regions The wind generators must stabilize the network instead of desynchronizing it as it happened with old models. The grid must be oversized so that the network is nowhere saturated. The wind lobbies claim that the grid capacity must be urgently improved but must also be paid by the ratepayers and not the wind industry.

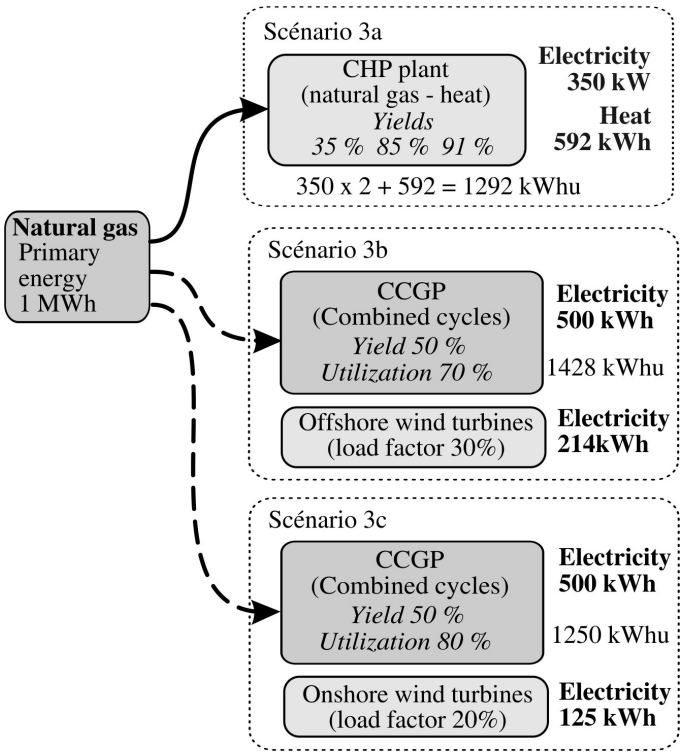
3) Cooperative CCGT and wind or CHP?

The wind power capacity should not be more than 100% of the total variable load of a country but thus the wind cannot produce more than 20% of the energy when the wind load factor is 20% (onshore wind turbines). The wind energy that a region can accept is larger when only offshore wind turbines are installed (30%).

Cooperative system; gas and wind

As the wind turbines cannot operate without backup plants, the integrated system is called here a *"Cooperative system associating gas and wind power"*, as the output of gas turbines must vary to compensate the amount produced by the wind due to the intermittency. The meaningful global yield is then: electric production divided by gas consumed (in compatible units).

Scenario 3a uses the electrical part of the CHP of scenario 2a. Scenario 3b is a cooperative system of CCGT and offshore wind farms.



Yield of cooperative systems

When the wind blows (up to 30% of time in the north-western maritime front of Europe), the wind production replaces the CCGT gas consumption and thus save natural gas. The theoretical yield of the cooperative CCGT and offshore wind is (0.55/0.7 =) 79%. The yield of the cooperative CCGT and onshore wind farm is (0.55/0.8=) 69%.

A sufficient number of power plants must be preheated to serve as backup if the wind wanes. The backup power should be equal to 94% of the wind power according to a study by E.On. If the grid is sufficiently powerful, one could have only one CCGT acting with a variable charge, the others operating at optimum charge or being a reserve of capacity in a preheated standby.

The real yield of the backup CCGT is then reduced for the three following reasons.

– 1) The yield is much lower for the gas turbines operating in variable mode (say, 50% instead of 55%).

– 2) If a gas turbine is preheated to serve as a capacity reserve, it burns some gas (say, 10% of what is burned at full power). That situation occurs each time the wind blows, i.e., during almost 30% of the time for CCGT associated to offshore wind turbines. The energy lost is thus 3%.

– 3) As the wind turbines are not usually located near the places of strong consumption, a large wind power installation needs more transport capacity on the power lines and causes more transport losses (say, 12% instead of the average 7%). In the absence of real figures, the total yield reduction of backup plants is estimated here from 5% to 15%. The wind industry hopes than the transmission losses will be reduced by using the new HVDC systems, but the investment cost remains as expensive as the HVAC systems.

The real wind load factor

The real load factor of the wind turbines can be deduced from two data: the turbine power installed and the energy produced. These results, when available, show that the real figures are 33% lower than the claimed factors which were thus wishful thinking of wind lobbies or planned disinformation. The enterprises using public subsides should be transparent. They must be inspected so that the real figures are published.

The real yield of backup power plants

Some countries (Denmark, Germany, and Spain) have a sufficient number of wind farms to measure experimentally the yield of the backup power plants but no measurement has been published, so it is probable that these data are embarrassing.

CO_2 savings with wind power

When the wind load factor is 17%, as in Germany (excluding offshore and littoral) and in the Ardennes, the theoretical yield is, depending on the CCGT yield (45% to 50%), between (0.5/0.83 =) 60% and (0.45/0.83 =) 54%. A cooperative system in poor wind conditions may thus consume as much gas as a simple CCGT operating at its optimum power (yield 55%) and may not reduce at all the CO_2 emission, as stated here:

"Running a conventional plant at part load to provide spinning reserve reduces efficiency which leads to higher emissions per unit of electricity actually generated at that plant. Some commentators, such as Campbell Dunford of the Renewable Energy Foundation, argue that this might have offset the CO_2 savings from renewable generation in Denmark". [181]. Of course, the wind lobbies contest this opinion but they have lost credibility when they have given grossly exaggerated wind load factors. The UK report has thus contradictory statements on the CO_2 savings of the wind industry.

Comparison of scenarios 3a, 3b and 3c

In winter, as shown in the above table of scenarios, a gas CHP (scenario 3a) produces, for the same amount of fuel, 11% more electricity than a cooperative (3b) CCGT and offshore wind farms. (21% more with onshore wind farms, 3c). If heat is stored into insulated hot water accumulators during a half-day, CHP can produce electricity during the peak hours, when it is the most useful and has the best price. As CHP power is produced within cities where power consumption is large, the losses in power lines are small. A detailed comparison of scenarios 3 must be done over annual periods and depends on the dominant technologies to produce the base power.

In real prices (i.e., without subsidies), the investment in wind turbines is much higher than the additional cost of CHP versus traditional boilers, even without counting the loss of real estate due to onshore turbines.

The gas CHP scenario has a better output than the cooperative system: CCGT and onshore wind turbines, but the EC Directives favor the worst scenario since the wind power receives subsidies contrary to the gas CHP.

Effectiveness of the scenarios

Verbal or technical reasoning

Those who do not have a technical training can understand that the word 'renewable' is applied to the energy produced by wind power, but they have difficulties to imagine that the additional energy produced by gas CHP is not different of the one produced by a cooperative system: CCGT and wind power. The extraordinary result of this handicap of the verbal thought compared to the technical thought is that the gas CHP (3a), which avoids more CO_2 emissions than the scenario 3b, does not receive the subsidies given to wind power.

EC Directives and the good ways to avoid GES

Simple ways to avoid CO_2 emissions are ignored by the EC Directives. A technological progress increasing the yield of a power plant, even if it is much more effective and less expensive than the addition of a wind turbine, does not receive any subsidy. Some countries give some incentives to the gas cogeneration but they cannot give internationally valid and thus exchangeable advantages due to the skewed EC Directives.

Objectives unreachable by the EC policies

As the Intergovernmental Panel on Climate Change (IPCC) says that it would be necessary to get, not a 30% reduction of CO_2 but a reduction of 80%, all scenarios are inadequate to prevent global warming and to delay the exhaustion of fossil natural gas.

Alternative scenarios against global warming

The world has not to follow supranational directives: A 2030 alternative scenario is suggested for industrialized countries (scenario applicable to other countries after they have acquired a technical expertise). This scenario supposes an increase in the consumption of electricity (including electric car and some heating). The energy comes from 45% nuclear electricity, 15 % biomass, 20% solar (heat requirements are halved due to better insulation) and 20% fossil fuel for industry, transport and special uses. Renewable intermittent sources are banished until new technological discoveries provide backup power or storage.

Modern methods of communication

Covert operations against competition

The external communications of an industry (or of a government) are filtered by a service in charge of checking that they are politically correct. Neither the employees of a company, nor most of its investors, know about the special operations of the directors. The manipulations against competition remain not only secret but are often camouflaged inside and outside the enterprise. For example, it was revealed that the antinuclear campaign of 1975 was organized by coal lobbies of Central Europe, but nobody believes that these lobbies had the means and the networks to organize the powerful antinuclear campaign that was observed in Germany and elsewhere in the world. The green movements got at that time a lot of financial support and of media coverage. As in a police investigation, one must guess who has interests in what happens and one must seek who is behind what is observed. A clue is to locate those who can finance a propaganda campaign.

NGO used for propaganda campaigns

A government which wants to promote an unpopular or expensive policy lets a few chosen NGOs (non governmental organizations) militate for the positive aspect of this policy. Covert operations help to diffuse these views. The government is then forced by these NGO, and the public pressure they have generated (as reported by friendly medias), to go on with this unpopular policy which it disapproves officially. Energy policies, as skewed as those of the European Communities, are also advertized by well supported environmental NGO.

The "civil society", made of all kinds of NGOs, has acquired a disproportionate importance in the modern circuits of information. The NGOs, supported by medias, replace the voices of the priests who formerly decided how one had to think. As for religion, the NGO themes might not be supported by science.

Financial sources of propaganda campaigns

It is almost impossible to know (and even more to prove) from where the financial contributions come to the NGO, to the medias and to the political parties. These organizations can claim that their workers are unpaid voluntary militants and that they receive generous anonymous donations. One can just observe that many NGO campaigns support the aim of several lobbies, especially in the environment domain.

Modern public relation methods

Communication agencies have experts knowing the best methods for undercover propaganda, for example those of Communism during the cold war. If an organization or a government can devote sufficient funds to its communications, it calls upon these agencies which have a broad network of operators, medias, NGO, and lobbies accepting difficult tasks to earn their living. No actor in this communication network has to be informed on the organism behind the official demand and the final goals of a joint action in which she/he is one of the wheels.

Official lobbies and manipulated organizations

It is exaggerated to call "plot" the operations (including the covered ones) to facilitate the development of an

industry. It is current practice that each industry has its lobbies and a network of relations to push its interests. In the vast network of those who influence the process of making policies, each one does its work for which he is paid and for which one has provided him with a simplified and politically correct justification. Each one acts thus according to the ethics of its trade. None thinks that it takes part in a plot as its job is to satisfy its customers and to have a positive attitude. Recent events have shown that, when the financial system was about to collapse, no one in a responsibility position had voiced a clear warning. The independent opinions were not diffused in the medias.

The wind lobbies

The powerful wind lobby has shown its effectiveness to influence policies, as can be inferred from the EC Directives which seem designed by the wind industry. The campaigns of the wind lobbies in the medias comfort the public opinion to believe that the countryside inhabitants love wind turbines. The wind lobby itself is manipulated by other lobbies which have much more money. The business of natural gas exceeds a trillion dollars. The strategic role of the supply security justifies that some nations intervene in a powerful hidden way, not always to protect the European countries. The results are that EC Directives become thus European decisions, accepted by misinformed Members of Parliament and by blinded public opinion. The two EC Directives give the largest advantages to the cooperative CCGT - wind turbines, the energy system which has the worst ratio cost/reduction of GES emissions.

The UN and the reduction of GHG

The United Nations (UN) were innovating when, together with the World Bank, they choose to communicate directly to the medias and to support many NGO whose mission was to participate in the conference of Rio and to transmit the fine words which they had just received towards the medias of their countries.

Greenpeace as an example of influential NGO

Since 1860, many pacifist NGO promote peace, i.e., are opposed to any expenses on armaments. Greenpeace is an NGO created in the 1972 to fight against nuclear arm testing by sending ships in the test areas. In 1975, Greenpeace draw global attention when it tried to prevent a Soviet whaling ship to kill a sperm whale by moving a rubber boat between them, while recording this scenery on videos that were given to the televisions, a propaganda medium new at that time. This initiative occurred when Greenpeace was accused to be a covert agent of the Soviets by fighting US nuclear tests. Later (1976), Captain Paul Watson left Greenpeace to create a rival NGO (Sea Shepherd) who really stopped whaling with a boat to ram those of whale hunters.

Most NGOs need rich donations to have an international presence in the medias. At the end of the cold war, Greenpeace lost most of its donators and was reorganized in 1985. The objectives of the movement were transformed into a battle against the civil nuclear power plants. It turned out that this new Greenpeace has then received large contributions from unidentified donators, officially because he continued receiving donations for saving whales while this task was done by another ONG (Sea Shepherd). Having a lot of financial backup, Greenpeace could thus also be active on several campaigns for reasonable environmental battles on which everybody agrees. These actions maintained its presence in the medias and increased its capital of respectability.

Partitions of the environmental opinions

The opinions of a left side political party or of a right side party are partitioned, each member of these clans being supposed to have the same list of opinions. Greenpeace has partitioned the opinions of the environmental movements when they said to activists to be at the same time for the wind power and against the nuclear power. The result of this dogmatism is that they deny that a company exploiting nuclear power can also produce green electricity.

Can renewables solve the energy crisis?

The power produced by renewable energy remains very low, as solar power is still far from producing significant amounts and as geothermic plants can only find renewable heat in volcanic area. In order to make credible the deep ecology, the environmentalists must make believe that the wind can produce so much energy that nuclear power is not needed, but these wishful thinking are not supported by the current technical reality. The wind power does not yet succeed to produce more than 10% of the electricity of an area, even in the best regions. Denmark produces 20% of its electricity with wind farms but this energy is distributed also into Norway and Sweden and thus in a zone many times larger than Denmark. The wind lobby claims that the current limitations are due to a grid unable to transport the wind power. The industries installing high voltages lines warn of power outages if these grid improvements are not made but do not say that the requirements for large expenses are only due to the wind power.

Scientific or idealist arguments

It is not essential that ecologists persuade their listeners of the virtues of renewables with good technical arguments. They send messages that confuse the issue by showing that the sun and the wind deliver a tremendous energy. They can provide scientific figures of this fact but these data are not currently relevant. They are not engineers who care about the important issues: how this energy can be practically harnessed, transported and how to remedy to the intermittency. More research is needed before such sources could be used.

Science or faith?

Some ecologists have a more convincing method in a world of wishful thinking. They celebrate a new religion whose wind turbines are the symbols, as were the church towers and the minarets. Dogmatic positions prevent scientific discussions on the choices between preservation of the forests or cutting them to cultivate biofuels, on the priorities between biofuels or food, on the preservations of the natural environment or on its conversion into wind and solar factories, on the relative risks of the wastes of coal, biomass or nuclear fuels, and on the best research options.

The wind farm neighbors

The wind power does not convince the neighbors of a wind farm who have their landscapes parasitized by these gigantic whirling insects and are forced to live in this noisy industrial ghetto, their real estate having lost 30% of its former value. For them, the wind turbines are markers of the level of corruption of a region.

The legal swindles

As Obama said about how to punish those who have produced the financial crisis: *"Their actions were perfectly legal"*. The solution is to vote new laws that will prevent people, banks and insurances to contract exaggerated debts. The EC Directives do the opposite as they create perfectly legal subsidies which increase the debts of the ratepayers.

The modern swindles are now designed to be perfectly legal, camouflaged under motivations coming from liberalism or environmentalism. The traditional method for technical development was to distribute generous research grants (to pay for salaries and expenses and not for profits of promoters) until a prototype system is sufficiently developed to become useful and profitable.

Bonus and other enrichment methods

As the nearly bankrupted enterprises helped by the stimulus should not give bonus to their managers, the wind promoters, who live on subsidies taken from ratepayers, should not be allowed to become rich. In the modern swindles, the promoters capture the resources of a region (and of its citizens) with the following legal method becoming more and more frequent since the cold war. The core of the swindle is to obtain subsidies not for a research but for a production, such as the payment of Green Certificates per MWh produced or per biofuel unit produced. The multiplication of these legal subsidies will disrupt the economy for the next 20 years.

Discarding the competitive tenders

The legal method constraining public authorities to ask for competitive tenders before to accept a wind farm had been legally suppressed for wind power and replaced by the methods used in the dictatorial countries. In most countries, the compensation for the real estate losses near a wind farm has been legally discarded by a legal loophole in which protection laws can be ignored when the system is categorized as "useful to the public".

Toxic quotas of E-RES

To satisfy increasing quotas of renewable, the electricity producers are incited to invest in wind turbines instead of using their capital in priority to increase the yield of the power plants or to save energy by insulating buildings or installing CHP or heat pumps.

Swindles amplifying EC policies

A few politicians hope to get votes by being good pupils of the deplorable European teachers. So their swindle is to set high quotas of E-RES whereas these toxic quotas are unnecessarily increasing the debt of the ratepayers without really curing the climate warming. (However subsidies thus collected seem to benefit fatly to the wind industry and to those who help it).

The Danish experience

In 2005, the Danes rejected the political parties which had destroyed their countryside with wind turbines. Denmark has not installed new wind farms since 2006. In almost all developed countries, the population is misguided by an insidious false propaganda on wind benefits, and may understand too late, as in Denmark, that these weapons of mass destruction of the landscapes are intended to enrich industries and intermediaries instead of curing global warming. A few politicians copy the methods used in Denmark, except that they have to import the wind turbines and to install them in a poorly vented region. One currently sees a race between the countryside destruction by wind turbines and the rejection reaction by the population. Many Internet sites show that the Walloons become aware of the carnage of their landscape but the medias are late to explain the risks to the countryside people who do not use Internet. The toxic quotas that poison the sectors of environment and energy are not yet made illegal.

Non neutral errors

Technical reasons or manipulations

The few examples quoted here show that the energy policies of the European Commission are not only inefficient to prevent global warming but instead prevent better strategies. These Directives were not designed by technical experts but were pushed by bureaucrats. The scenarios presented here show that they have everything wrong. No technical expert has even tested – as here - the effectiveness of the EC Directives on practical cases or, if he has done it, his results were not diffused.

Who benefits from the EC Directives?

However, it is obvious that the anomalies of the EC Directives benefit to some targeted industries, to the industries of natural gas and of biofuels and mainly to the wind industry, and disadvantage other industries, the gas

cogeneration, the nuclear and the wood exploited for construction and paper. Does that explain why the following rumor is successful? *"The energy policies are not intended to fight greenhouse gases but to take advantage of the diversion of energy policies presented as sacrifices for the environment."*

Solutions for climatic crisis and fossil fuel depletion

If the most important problem is to reduce the GHG, one should at least study the following most obvious solutions in the industrialized Europe.

1) *Improve the efficiency of the power plants*. This may be the most cost effective way to save fuel and prevent GHG emissions, even if it receives no subsides.
2) *Use as much solar thermal power as practically possible to heat or cool buildings*. These investments have too few subsides in comparison to those for inefficient wind and photovoltaic solutions.
3) *Reduce energy consumption, especially for heating* (by insulating houses and large buildings). The incentives for the solution accepted as the best one by all studies are lower than for bad options.
4) *Optimize land use to conserve or increase the forest area and to ensure food production* in priority to biofuel production.
5) *Generate the maximum of electricity by nuclear powe*r which produces almost no GHG. Civil nuclear plants have been safe in Europe and the rumors of the exhaustion of nuclear fuels are unfounded, based on a propaganda campaign.
6) *Conserve fossil fuels for where they are the most useful, i.e., for transport*. The use of compressed natural gas and nuclear electricity for newly designed cars, busses and trucks inside cities should be efficiently subsidized.
7) *Subsidizes researches until the prototypes become cost effective but do not subsidize production.* Wait until the development is sufficiently advanced. Do not produce devices which will be replaced soon by more advanced and less expensive systems.

Officials do not push obvious choices because some 'white papers' (written by lobbies promoting their own businesses), disqualify competitive options (such as efficiency improvements or nuclear power), discard scientific concepts (such as by confusing power and energy or by ignoring intermittency problems) and skillfully impose criteria (such as quotas of renewable and E-SER) that are not effective.

UK study on the energy policies

An UK study [181] had reached the same conclusion but is more careful in expressing it: The UK Lords *"note the following main points: EU targets have focused the spotlight on renewables rather than other means of reducing emissions such as energy efficiency or greater use of nuclear power"*.

"Harnessing renewable sources of heat is often cheaper than for electricity generation and offers a larger target area, as heat accounts for double the final energy demand of electricity. There is no intermittency problem with renewable heat. We recommend that the Government should lay at least as much emphasis on encouraging the development and use of renewable heat as on renewable electricity generation."

"We are also concerned that determination to meet the target may lead to an over-emphasis on promoting short-term options, simply because they are available, rather than because they offer the most effective and economical means of reducing carbon dioxide emissions over the longer term".

The additional costs of the wind power deployment

The UK study explains the additional costs associated with wind power (total power required for the backup power plants, required grid developments, losses in the power lines). The authors guess that the wind load factors they had received are wrong and they have studied an alternate scenario in which the loads are reduced.

Credibility of the supranational organizations

The credibility of the supranational organizations is likely to suffer from these anomalies, as the reputation of the green parties which have been manipulated to believe in skewed policies. For the success of the December 2009 Copenhagen conference, energy policies must urgently be redesigned.

References:

Explanations and references (in French) in the site: http://www.leseoliennes.be/

Table of contents