Letter n°55

The energy transition (1). Where do we stand?

"The past may not command the entire present; without it, the present remains unintelligible."
Marc Bloch, Strange Defeat (L'Étrange Défaite) page 187.

- In light of ***Marc Bloch's*** remarks, fossil fuels consumption is the major cause of global warming and the elimination of greenhouse gas emissions by 2050 is the only way to stop it. These are two of the messages from ***Bill Gates***, in his interesting book ***"How to Avoid a Climate Disaster".***

- Fossil fuels account for 3/4 of greenhouse gases. In transport, alternatives are costly and their development is sometimes hampered by the unavailability of sufficient rare metals such as cobalt or lithium.

- The desire expressed by the governments in the Paris Agreement to limit global warming to 2° often raises doubt and skepticism. Governments are not short of generous words, but actions remain insufficient. Admittedly, the two crises, Covid and Ukraine, do not help to achieve the objectives, but in the speeches, there is a lot of hypocrisy and procrastination.

- To better understand where we stand, let's look at the main sources of energy: renewable energies, 15% of the world's energy balance, are developing rapidly but can never replace fossil fuels because the latter generate more than 80% of primary energy.

Oil:

- ***Production trends***:

According to the IEA, the International Energy Agency, peak production has been reached or is close to being reached. Notwithstanding the potential of unconventional oil in Canada and Venezuela and shale oil in the United States, a decline in production seems likely.

There are three reasons for this: the low investments made by oil companies in recent years, the reluctance of banks to lend because they are under pressure from ecological pressures, and the selectivity of companies, less inclined to invest because profitability is not always assured.

For half a century, discoveries have been declining and today, half of the world's production comes from fields that have exhausted more than half of their reserves, and thus on the verge of declining. Since the fall in crude oil prices in 2015, investment by oil companies in exploration and production has fallen by almost half.

By 2030, maintaining production requires replacing one-third of current capacity, and in China, as in some African countries, Angola, Nigeria and Algeria, production is expected to decline by 3Mb/d. Among the "Majors", the Americans Exxon and Chevron have struggled to maintain their production for the past twenty years. And they, like their European counterparts, are under pressure from the evolution of public opinion and must invest in renewable energies.

Nevertheless, delays in the transition are encountered at all levels: firstly, among producers because, according to the UN environment agency, the fifteen main oil and gas producers will still produce twice as much oil, gas or coal in 2030 as would be necessary to limit the rise in temperatures to 1.5 degrees. Secondly, among the G20 member countries, because in 2020, they spent another $300 billion on hydrocarbons. Finally, among the

banks, because, despite their commitments, they still lend as much to finance fossil fuels as they do to finance renewable energies.

To better monitor the developments, let's look at the situation in a few key countries:

- ***Saudi Arabia***:

Despite a population of only 33 million, the country is the 4th largest emitter of greenhouse gases on the planet. As the leading exporter of crude, the country remains favorable to hydrocarbons even if it is active in solar, has a plan to produce half of its electricity with renewable energies in 2030 and wants to attract foreign investment and increase the share of the private sector by 35% of GDP to 65% within 10 years, in order to promote hydrogen and the desalination of seawater in particular.

- ***United States***:

Between 2010 and 2020, shale oil extraction allowed the United States to double its production but it is controversial because it uses a lot of water.

Today, shale oil production is 15% lower, at 1.5Mb/d, than its peak. At the main deposit, Permian, drilling peaked at 570 in 2014. It was only 420 before the pandemic and is still significantly lower now, although the current price of crude easily covers operating costs estimated at $50/barrel.

Oil companies' spending was $110 billion in 2019, $60 billion in 2020 and roughly the same in 2021. The recovery in production will be slow because companies, concerned about their cash flow generation, eager to control debt and faced with the growing reluctance of banks, are planning only a moderate increase in investment expenditure.

As a result, the current production is 11.6Mb/d, below the 13Mb/d achieved in 2019.

- ***Norway:***

The country claims it is concerned about the climate but will remain the 2nd largest gas supplier in Europe.

Hydrocarbon production still brings the state 50% of its export revenues and, even if the sovereign wealth fund is more selective, the government, in the name of energy security, is not willing to give up this windfall and is even open to granting new oil export licenses.

- ***Demand trends***:

According to the IEA, global demand in 2022, 99.6Mb/d, will be above the pre-crisis level as rising gas prices prompt many companies to switch from gas to oil. Thus, the additional demand would amount to 500,000 b/d.

The only temporary brake on the increase in demand is the lockdown in China because the country is the world's largest importer and the shutdown of many sectors of the economy means less consumption.

By 2030, according to the International Energy Agency, demand from emerging countries in Asia and Africa is expected to increase by 8 million barrels per day.

- ***Price trends***:

The price of a barrel of Brent was at $75/barrel at the beginning of the year, it is now at $102/barrel after having recently reached $140/barrel. Contrary to popular opinion, there is nothing exceptional because the price had reached $150/barrel on the eve of the 2008 crisis and, between 2011 and 2014, the average price was $110/barrel.

The situation is delicate. On the one hand, we must welcome a high crude oil price because it promotes the competitiveness of renewable energies. On the other hand, we must be concerned about the consequences for the poorest households, especially in emerging countries.

Coal:

Peak production, unlike oil, is far away and global production has risen by more than 60% since 2000. If we think about the energy transition, there is nothing sympathetic about this observation but there is nothing surprising. The increase in production is the result of the economic take-off of some major emerging countries, China, 52% of world consumption, and India, 12%, and everyone remembers the industrial revolution in England in the 18th century, initiated thanks to coal.

The benchmark price of coal on the Australian market was at $120/ton before the crisis, at $50/ton during the crisis, and is at $329/ton, a level close to the recent record at the beginning of March at $440/ton and well above the level at the beginning of the year, $170/ton, but it does not deter consumption.

Although coal is the most polluting energy, accounting for between 30% and 40% of global CO2 emissions, it is also the most used energy in the world and the most sought-after by many emerging countries.

In the energy balance, Australia, the world's largest coal exporter, still defends coal, even if it reaffirms a goal of carbon neutrality by 2050. Coal dependence is 90% in South Africa, 72% in India, 65% in China, 37% in the world, 32% in Japan, 25% in the United States, 17% in the EU and 15% in Russia.

Global production fell by 5% in 2020 but has been increasing since then. 8500 coal-fired power plants are in operation worldwide, with another 300 expected to come on stream, and the problem is that subsidies are still being paid, $18 billion in 2020, according to the World Bank, while a fifth of global greenhouse gas emissions come from coal.

A move away from coal is unthinkable because the world's four largest producers, China, India, the United States and Russia, account for more than 70% of the volume consumed, refuse to submit to a binding schedule and Germany continues to use lignite for electricity production.

The United States, the world's 3rd largest consumer and exporter, has closed 200 power plants since 2000 but is only slowly changing its policy.

Of the major coal producers, only Indonesia is considering a phase-out by 2040.

Coal is often essential in electricity generation – between 35 and 40% of the world's electricity, but 60% in China and India – and with rising gas prices, coal is a more economical substitute in electricity generation. Thus, in 2021, coal-fired power generation capacity increased by 9%.

Overall, 5 Asian countries (the two mentioned + Japan, Indonesia and Vietnam) are responsible for 3/4 of world consumption and 80% of coal-fired power plant projects. Since Fukushima, Japan, even if it is trying out less polluting technologies, has reintroduced coal and thus provides a third of its electricity production. Only Europe has managed to reduce dependence on coal in 2021, with the most remarkable of the 27 EU countries being Portugal because it stopped the production of electricity from coal.

Let's analyze the situation of some countries in more detail:

- ***China:***

It consumes as much coal as the rest of the world. In 2020, the addition of capacity was equivalent to all existing facilities in Germany. In 2021, more than half of the new mines opened in the world were in China and production capacity had increased by almost 6%. In 2022, China's coal production capacity will increase by 7%, or 300 million tons.

China's energy subsidies are mainly allocated to the development of fossil fuels. Dependent on coal for 60% of its electricity production, the country is forgetting its climate targets, has the political will to strengthen its level of storage and has asked each mine to produce as much capacity as possible to try to bring down prices.

China is only planning to reduce its coal consumption from 2025 onwards and therefore will increase it by then.

While China did reduce its purchases from Australia for a time as a sanction, this country has had no trouble finding other outlets in Asia and China has found substitutes in Russia, the United States, Indonesia and Colombia.

- ***India***:

India, the 2nd largest producer and consumer after China, consumes 12% of the world's coal.

The country faces power cuts and carbon dioxide emissions from coal that are twice as high as that of its European competitors because the facilities are dilapidated. To mitigate these problems, India has increased its solar energy capacity six-fold in five years. Solar energy contributes to 12% of electricity production and the target of 40% by 2030 is reaffirmed. But, at the same time, India auctioned off about 40 coal mines last year.

- ***South Africa***:

The country is Africa's largest emitter of greenhouse gases and the twelfth in the world. Coal-fired power plants are aging and highly polluting, and the country has one of the worst carbon footprints because 70% of electricity and a quarter of fuels in transport come from the use of coal. In addition, a third of the coal is exported and this represents a substantial inflow of foreign currency.

South African President Ramaphosa has reaffirmed his commitments to meet his emissions reduction targets but needs to find more than $25 billion in funding. However, the economic situation is poor with a third of the working population unemployed and frequent power cuts.

Ramaphosa, in order not to expose himself to a further contraction of foreign investment in the country and a green tax on its exports, is boosting investment in wind and solar power and, over the next ten years, will seek a dozen billion in financing from the West through the issuance of green bonds.

In the longer term, South Africa, a major platinum miner, useful in machines for separating oxygen from hydrogen, dreams of producing green hydrogen, but this will take time.

Gas:

The peak of gas production, according to IEA estimates, should be reached between 2024 and 2060 but this has less impact than for oil because gas provides only 20% of the world's primary energy needs against 30% for oil.

European stocks are low, Europe's gas supply is weakened by the imminent cessation of gas production in the Netherlands, the decline in reserves in Algeria and the North Sea and the desire to reduce dependence on Russian gas by two-thirds by 2022.

The price of gas, like the price of coal, is at its highest but volatile. The Rotterdam gas price was €13/MWh at the beginning of October 2020, it is €102/MWh after having reached a high of €335/MWh briefly this year.

For LNG, Europe benefits from growing supplies from the Americans and Qataris but is competing with demand in Asia and Latin America.

Renewable energies:

The United States wants to reduce greenhouse gas emissions by 50% by 2030 and nearly 50 major American companies such as Amazon, American Airlines, General Motors are ready for strong action. In 2012, in the United States, solar was twice as expensive as natural gas but costs have decreased by 80% in solar and 30% in wind and now the gap is closed. The decrease in costs is interrupted by the increases in freight and raw materials costs, but this is temporary.

The development of the electrical sector in the automotive industry continues and manufacturers will have to invest $330 billion within the next 5 years.

- ***Nuclear***:

Nuclear power accounts for only 5% of primary energy and 10% of electricity in the world, but we are witnessing a revitalization of the American, French, Canadian, Japanese and British nuclear programs.

Even if thermonuclear fusion is not yet perfected, ***Bill Gates*** advocates for the nuclear market because it is carbon-free and affordable energy. According to Forumnucleaire.be, 57 nuclear power plants are under construction in 16 countries and 147 reactors by 2040.

As part of the infrastructure plan, Biden is planning $6 billion in existing nuclear power plants.

In China, the first EPR was commissioned in 2018, the country, now strong in its technology, has decided to close its territory to Western-designed reactors and a Russian-Chinese duopoly is tending to be established on the 3rd and 4th generation reactors.

In France, the EPR project has been delayed but additional investments have been announced.

The development of nuclear power will not be hindered by uranium reserves because they are abundant, 15MT of which 40% in the OECD and 20% in the BRICS, and production is well diversified, 20% Niger, 20% Russia, 19% Kazakhstan, 18% Canada, 13% Australia.

- ***Hydrogen***:

Today 95% of the world's production is with natural gas and therefore greenhouse gases are produced.

The cost of alkaline electrolysis technology, green hydrogen, was four times higher than for grey hydrogen but, with rising energy prices, green hydrogen is becoming more competitive.

Its use is still marginal because storing renewable energy in the form of hydrogen today implies conversion losses of 70% so, to obtain 30 units of electricity from a fuel cell, it is necessary to use one hundred units of electricity to make hydrogen. But progress is expected.

In the short term, 80% of hydrogen is used in the chemistry industry for the manufacture of ammonia but improvements are needed to produce carbon-free hydrogen and the storage and transport problems need to be resolved.

In the long term, hydrogen is of interest in transport, especially trains, ships, planes and trucks because electric batteries do not offer a long range. But an Airbus equipped with fuel cells is not expected to be commercialized before 2035. On the other hand, green hydrogen should be viable, fairly quickly, in refining to remove sulfur from fuels or in steel.

Also, hydrogen could be chosen as a supplement in the electricity grid and in buildings to provide heating and electricity solutions.

After 2030, progress in high-temperature electrolysis, thanks for example to the joint venture formed by Vinci, Schlumberger and Vicat, should allow a real breakthrough in hydrogen.

- ***Other energy sources are still marginal:***

According to ***Bueno*** in a very interesting book ***"Future, our future from A to Z",*** geothermal energy, ocean energy, wind and solar energy provide only 1.7% of the world's primary energy and one of the obstacles to the development of wind and solar is obviously the intermittency of production.

As ***Benoit Cassorret*** notes, to produce the equivalent of the world's electricity consumption, it would be necessary to install the equivalent of 500 years of current production of solar panels.

In wind power, China has 4 players in the top ten, Goldwind, number 2 with nearly 14% of the market, Envision with 8%, Mingyang with 5% and Sewind, 2%.

Europe has two major players, the world leader in manufacturing, Vestas, with a market share of 20%, the 3rd and the Spanish Gamesa with 12%.

- ***The metals benefiting from the transition***:

With the energy transition, some minerals will benefit from a sharp increase in demand, notably copper, lithium, cobalt, manganese, nickel, and not forgetting rare earths.

A report by the president of Boliden, a company active in metals, goes in this direction and anticipates a 35-fold increase in lithium consumption in Europe by 2050, 7 to 26 times in rare earth consumption, as well as a 330% increase in cobalt needs, 100% in nickel demand and 35% in copper demand.

For some metals, the lack of available capacity could even be a hindrance to the development of renewables because mine development period can take 10 to 15 years.

Copper, aluminum and nickel stocks have fallen by 70% in 1 year as demand recovery has been rapid and rising energy costs are affecting the profitability of some mines.

In the short term, dependence on China will be maintained because it is the main producer of rare earths and refiner of lithium and for cobalt, it controls 15 of the 18 mines exploited.

In the long term, recycling should be a major source of supply for these metals.

Conclusion: let's remember 5 points, an observation, an urgency, financial and technological needs, and obstacles to overcome.

- ***The observation***: in recent history, greenhouse gas emissions have fallen only one year, -7% in 2020, because the global economy was halted due to Covid. In 2020, developed countries were responsible for 32% of greenhouse gas emissions, China 30% and therefore these countries are responsible for the bulk of the effort.

- ***The urgency***: global warming and the prospects of an imminent peak in oil production all contribute to accelerating investments in the energy transition. We now have forest fires in Siberia and forest fires in California in winter. In the 1980s, natural disasters in the United States cost insurance companies $3 billion annually, but today we are talking about $40 billion. Globally, annual economic losses caused by annual disasters have exceeded $170 billion since 2010 compared to $70 billion annually in the 1990s (according to the United Nations Office for Disaster Risk Reduction). Emerging countries are the most exposed. They lose 1% of their GDP annually due to these disasters and are often not insured.

- ***Financial needs***: to meet the objectives set for 2050 and limit warming to 2 degrees by 2100, it would be necessary to invest $4 trillion / year in energy transition, the equivalent of 4% of global GDP, an amount that will certainly be reduced as technology progresses and costs are lowered, but it is an amount four times higher than current spending.

- ***Technological needs***: according to the IEA, by 2050, oil production will have fallen by 75%, coal production by 90% and global energy demand should fall by 8% despite an expected increase in population of 2 billion. Renewable energy will represent 90% of the electricity mix with the remaining 10% devoted to nuclear power, but this horizon seems distant and requires technological breakthroughs.

  Certainly, if we think we are Prometheus, if we believe that technology brings solutions to everything, we run the risks of being Icarus and burning our wings before falling with the planet. But, without technological breakthroughs, there will be no emission-free meat or steel, no advance in nuclear fission, no breakthrough in green hydrogen, no know-how in electricity storage.

- ***Obstacles***: while a large majority of the population is in favor of the energy transition and sensitive to the hazards caused by pollution, a small percentage agree to pay the price, i.e. an increase in supply costs.

  For oil-producing states, the decline in production is a factor in weakening the regimes in place. We have seen it in Syria, in Venezuela, and we could see it in Nigeria, Russia and Algeria because it makes it more difficult to finance the welfare state, which guarantees social stability.

  China still claims to peak emissions before 2030 but for now, it is increasing them. At the recent Conference in Glasgow, the Chinese and Russians postponed the objective of zero net emissions, i.e. carbon neutrality, from 2050 to 2060, while the Americans are maintaining 2050 and the Indians have a 2070 horizon.

  The only good news is that in 2018, Europe had a 2030 target of reducing its emissions by 40% compared to 1990; now, the target is -55% based on emission credits while the Americans are banking on the progress of different technologies and in particular carbon capture in which many companies are working on, such as Exxon in the United States, Arcelor in France, the Canadian Carbon Engineering and the Swiss Climeworks. So many seemingly modest efforts but, while we wait for the next Letter that will allow us to project ourselves into the future, let us remember the words of ***Confucius "The person who moves a mountain begins by carrying away small stones".***

Geneva, 29th April 2022

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