Letter n°57

The Energy Transition (3). Developments in the major sectors.

"Remember, Time is a greedy player. Who wins without cheating, every round! It's the law. The daylight wanes; the night deepens; remember! The abyss thirsts always; the water-clock runs low."
Baudelaire in Les Fleurs du Mal (The Flowers of Evil). Spleen and Ideal.

Certainly, we can start this Letter 57 with a positive note because, at a global level, the amount of greenhouse gases per unit of GDP produced has decreased by a third since 1990. But, let us apply Baudelaire's warning to the urgent need to step up efforts to accelerate the energy transition.

In view of the stakes, the increase in demand and the growth of the population, we cannot be satisfied with a reduction in greenhouse gases per capita and, in this introduction, we can put forward 2 points of illustration:

- ***Excess emissions***:

In 2020, fossil fuel emissions fell by 7% but this was the consequence of the economic downturn.

In 1990, the planet emitted 35 billion tons of CO2. Today, the world's population, 7.8 billion, emits 52 billion tons, or 2.5 times the amount that must not be exceeded if we do not want a global warming greater than 1.5 degrees.

Over the past 10 years, greenhouse gas emissions have been increasing by 1.5% per year. However, if we want to limit global warming to 1.5 degrees in 2100, they should fall by nearly 8%/year.

- ***Insufficient investment***:

The goal of emission-free growth is therefore not in sight because only a third of energy investments are dedicated to renewable energies and this share is stable.

To date, 31% of global emissions come from industry, a third of which comes from steel and cement production, 27% from electricity production, 19% from agriculture and livestock, 16% from heating, 16% from transport and 7% from air conditioning.

In this Letter, we will analyze the environmental transition in each of the major sectors concerned by these emissions: agriculture, transport, industry, plastics and construction. The industrial transition will benefit from an increase in waste recycling, i.e. the development of the circular economy, but this will not be enough. Energy savings and the development of renewable energies are essential.

Agriculture:

According to the ***UN***, arable land represents only 10% of the surface of Earth's landmass and this surface is partially damaged by intensive exploitation because agriculture is one of the causes of soil and water pollution and even the deterioration of biodiversity.

An ***FAO*** study shows that nearly a third of the world's arable land, especially where the Green Revolution has unfolded, is threatened with extinction due to overexploitation. In other areas, rising sea levels are reducing the arable land.

There can be no decarbonization of the world without agricultural transition because agriculture and livestock are responsible for a fifth of greenhouse gases and we must add the indirect effects of deforestation.

3/4 of deforestation is used for agriculture and deforestation reduces the capacity of the biosphere to absorb greenhouse gases.

The objective to be pursued in agriculture is fourfold: to improve yields, reduce greenhouse gas emissions, reduce water consumption and combat deforestation.

- ***Improving yields***:

- The past:

Despite ***Malthus***' gloomy predictions in his "Essay on the Principle of Population" published in 1798, famines have remained occasional and local.

In recent decades, population growth has steadily slowed and productivity, thanks to machinery, fertilizer and land consolidation, has doubled since 1960.

- The present:

The productive capacity of agriculture can feed 10 billion people, a 25% surplus to the existing population and in Africa the potential for productivity gains is high. Thanks to improvements in yields/hectare, the area of land cultivated by humanity may soon decline, but this movement is hampered by the fact that almost a third of arable land is degraded by erosion or some other factor.

Cereal yields are dependent on heat waves and the use of fertilizers. Heat waves, depending on their intensity, can cause yield reductions of 20 to 40% but the use of fertilizers can reduce soil erosion. This is an advantage that developed countries enjoy over emerging countries and, unfortunately, there are no zero-carbon alternatives to fertilizers yet.

On this subject, we remember one of ***Schellenberger's*** conclusions in his very interesting book ***"Apocalypse Never***": fertilizers, tractors and irrigation are more important than climate change in determining crop yields.

Currently, because of the war in Ukraine, fertilizer prices are soaring and availability is declining. As much as the large listed fertilizer companies, Nutrien and CF Industries Holdings in the US, are fairly well protected from the effects of the war, the Yara International Group is penalized by the rise in gas prices and faced with rising production costs.

- The future: the challenge is fourfold.

On the one hand, we must try to eradicate the malnutrition suffered by more than 850 million people in the world and respond to the increase in the consumption of animal protein in regions that have recently emerged from underdevelopment.

On the other hand, by 2050, we need to be able to feed an additional 2 billion people as the farming population ages and declines.

If nothing is done, there will be an increase in land devoted to crops. In Africa and many emerging countries, yield per hectare of production could be greatly increased thanks to advances in irrigation and land concentration.

It is also clear that we must fight against waste because, according to the ***FAO***, 1/3 of the food produced in the world is lost, and this represents nearly 8% of greenhouse gas emissions. These gas emissions generated by unconsumed products rank 3rd in the world after emissions generated by China and those caused by the United States. It is therefore imperative to improve storage, transport and distribution conditions. In the United States, 40% of food ends up in a garbage can, in Europe and Southeast Asia, the percentage is 20%.

Finally, there is the question of the use or rejection of GMOs. In agriculture, we cannot be against GMOs as a matter of principle. To combat global warming, genetics could be effective thanks to a crop capable of absorbing CO2. GMOs are a promising pathway for improving food and protecting the environment as they enable the reduction of fertilizers and pesticides and they pave the way for the selection of plant varieties adapted to climate change.

- ***Reduce greenhouse gas emissions***:

By 2100, the world's population will increase by 40% but agricultural production will have to increase even more as the population becomes richer and consumes more meat and dairy products.

If nothing is done, agriculture, already responsible for 20% of greenhouse gas emissions, will increase its emissions.

Among the issues to be considered is animal feed and methane emissions because a third of the world's cereal production is used to feed animals and if methane emissions account for a quarter of global warming, there are three ways to reduce them:

- Firstly, we must reduce methane emissions from cattle, so we must abandon intensive livestock farming because one billion cattle produce 4% of global emissions each year.

- Secondly, it is necessary to remove the nitrogen oxide produced by fertilizers.

- Finally, downstream, it is necessary to reduce the consumption of red meat, increase that of poultry, and develop synthetic proteins, by promoting artificial meat.

- ***Reduce water consumption***:

Water covers 3/4 of the planet but less than 3% is consumable. 70% of it is used each year by agriculture and livestock, 22% by industry and 8% by households.

From the data provided by ***UNESCO***, we note 4 figures: the water market represents $600 billion/year, 2.2 billion people in emerging countries have little access to drinking water, 4 billion live in areas exposed to water scarcity and water consumption is increasing by 1%/year. From these figures, we can draw 3 conclusions:

- The agricultural world uses too much water for irrigation and livestock. It takes 790 liters of water to produce one kilo of milk, 1160 liters for one kilo of wheat and 13500 liters for one kilo of beef. Even if we can relativize these figures by recalling that the grass consumed can contain up to 80% of water and that ruminants return it all to the natural environment, large ruminants drink up to 50 liters of water per day, small ruminants about ten liters.

- China has only 7% of the world's drinking water and has great needs. In other emerging countries, drought is expected to displace 700 million people by 2030, according to the UN. In recent years, Brazil has developed a very profitable drinking water export business but this is not enough to meet international demand.

- By 2060, drinking water reserves will have to be doubled and water use must be reduced through improved irrigation techniques and, above all, the development of so-called hydroponic farming, i.e. above-ground agriculture, such as vertical farming which, according to PwC, requires ten times less water while offering much higher yields.

- ***Livestock: Better selection of species is needed***.

Methane is the main source of pollution in agriculture because it causes more substantial global warming than carbon dioxide.

To give an idea of the magnitude, livestock farming accounts for 7% of global greenhouse gas emissions, which is equivalent to all the gases emitted by the 4 major Western European economies (Germany, France, UK and Italy).

Therefore, several actions must be undertaken:

- Better selection of livestock: in Latin America, livestock emit five times more greenhouse gases than in North America and, in Africa, even more. It is therefore preferable to promote improved breeds such as those preferred in Europe. Otherwise, the more meat the world consumes, the more deforestation there will be.

- A necessary reduction in meat consumption.

- The development of artificial meat: it requires less water and emits less gas. Today, this artificial meat does not even represent 1% of meat consumption in the world but this percentage could be multiplied by ten by 2030. Today, artificial meat costs 85% more than normal meat on average and consumes a lot of energy but this should decrease. Meat produced from stem cells harvested without suffering from the best animals to produce meat of better quality than those produced by intensive farming is a way forward.

- A reduction in land dedicated to livestock: since the year 2000, according to the ***FAO***, land reserved for livestock farming throughout the planet has declined by 1.4m km2. This decline is observed in the United States, as well as India and Brazil, and is partly attributable to the substitution of chicken for beef and the development of industrial farms. Cows go to pasture less because grass-fed cows grow more slowly, produce more manure and methane.

- ***Combating deforestation***:

Subsidies must be considered to preserve forests because cutting down a tree means freeing up amounts of carbon from the ground and, unfortunately, since 1990, according to the ***World Bank***, the world has lost 1.3 million square kilometers of forests, or 3% of the total, including 60% of Nigeria's forest and 10% of Brazil's forest, bearing in mind that the Amazon represents 8% of the world's forest and 10 times the territory of France.

Nevertheless, even though the world's population has risen from 3 billion to 7.5 billion since 1960, there has been a decline in famine, to the credit of doubling of productivity and not to the rate of forest destruction.

The rate of deforestation is decreasing, with little encroachment of cultivated land on forests. Forests still cover 28% of the land surface. To be more precise, if we remove deserts and Antarctica from the land surface, forests cover 40% and agriculture land 14%.

In Europe, since 1995, reforestation has been equivalent to Belgium, the Netherlands, Switzerland and Denmark combined. This does not mean that we should not be concerned about the disappearance of primary old-growth forests in the Amazon because it takes 25 hectares of trees in tropical regions to absorb the emissions of an American during his lifetime.

The balance is not easy to find because if we remove a soybean field to plant a forest, the price of soybeans will increase and encourage deforestation elsewhere.

Industry:

It is responsible for more than 30% of greenhouse gas emissions, particularly in the production of cement and steel.

- ***Steel***:

It accounts for 8% of global emissions and the top three uses of steel are construction and infrastructure for just over half, mechanical equipment for 16% and automotive for 12%. The manufacture of one ton of steel produces about 1.8 tons of carbon dioxide. By 2050, the world will produce 2.8 billion tons of steel/year or nearly 5 billion tons of carbon dioxide.

Manufacturers produce this way because it is inexpensive. Producing green steel, using hydrogen, carbon-free electricity and metal recycling, has a cost one third greater than current costs. In other words, getting manufacturers to accept this conversion will require public subsidies.

- ***Cement***:

To make concrete you need gravel, sand, water and cement. It is the cement that affects the climate. To produce cement you need calcium. Limestone contains calcium as well as carbon. China is the world's leading producer, producing 7 times more than India, the 2nd largest producer. By 2050 global cement production will increase slightly.

For industry in general, the use of more efficient machinery did not lead to an overall reduction in energy consumption because the number of machines is increasing.

Transport:

Transport accounts for 16% of greenhouse gas emissions, including 47% from cars, 30% from trucks, 10% from boats, 10% from planes, 0.5% from rail but with noise pollution.

In Glasgow, the need to reduce travel and encourage car sharing was emphasized. Similarly, to reduce emissions, urban transport was advocated and $200 billion should be invested each year.

Notwithstanding these actions, emissions could worsen as a result of the increase in the number of vehicles in emerging countries.

- ***Automobiles***:

There are one billion cars in the world and the net figure is growing by 25 million each year.

According to ***Veltz***, the mass/power ratio has been divided by 8 in 50 years and therefore consumption has decreased a lot but it is necessary to change the paradigm, bearing in mind the better price competitiveness of combustion vehicles, still in the coming years.

- Electric cars:

Electric or hybrid cars in Western Europe accounted for an average of 22% of car sales in Q1. The Nordic countries are at the forefront with nearly 90% in Norway and more than 50% in Sweden and all-electric cars are gradually gaining market share over hybrids, which are certainly less polluting but have a small battery.

The 12 years lifespan of the petrol car fleet is such that switching to electric cars will take time and is costly for households. The United States has set a target of 50% electric cars by 2030. Europe is still thinking of banning petrol cars by 2035 and, according to projections, by 2050, 66% of the car fleet should be electric, 30% renewable gas (biogas and others), 4% hydrogen, but this is an ambitious goal.

As a priority, companies must be asked to make an effort as half of the annual registrations come from company fleets.

To support this development, 7 million charging stations should be installed in Europe but there are only 225,000! The priority is to install charging stations in supermarkets for daily use.

The price of electric batteries has decreased by almost 90% since 2010. But it takes 1 hour to charge a car, insurance is more expensive and, in the short term, battery manufacturers are faced with a lithium shortage that could shift the development goals of the sector.

In the meantime, if electricity comes from coal then electric cars are just exchanging one fossil fuel for another. To accelerate the transition, a carbon tax on gasoline prices would be needed, the proceeds of which would finance incentives to purchase electric vehicles.

In the stock market, selectivity prevails. The initial enthusiasm for Rivian in the United States has fallen since the price, which was $172 / share in November for a valuation of more than $150 billion, is now only $26/share and Tesla has recently fallen significantly.

- Biofuels:

They are expensive and are not viable solutions because they capture 10% of the crops. The production of corn ethanol emits 2x more greenhouse gases than gasoline.

Ethanol in Brazil occupies land for food, causes deforestation, requires fertilizers and generates emissions during refining.

If the US were to replace all of its gasoline with corn ethanol, it would require half the area of all the land currently under cultivation in the country.

There are potentially other biofuels made from agricultural waste but this is not yet developed. In the long term, the destruction of animal carcasses can be used to produce biogas, but in the shorter term, solar energy or wind turbines are an alternative.

- Hydrogen:

Hydrogen, produced by electrolysis of water, is not yet competitive. We need to speed up the shift to electric cars or develop biofuels produced from cellulose.

- ***Trucks***:

While electrically equipping an urban bus fleet is easy, converting heavy goods vehicles requires very heavy batteries and therefore does not seem to be a short-term solution.

- ***Air transport***:

Consumption per passenger has halved in 50 years but more needs to be done and, unfortunately, electric motors do not yet offer a solution because the batteries would be too heavy. It is currently impossible to equip a Boeing 787 aircraft that carries 300 passengers because the necessary electric batteries would be too heavy. Fuel represents 20 to 40% of the weight of an aircraft at take-off, so the necessary batteries would be so heavy that they would prevent the aircraft from taking off.

- ***Maritime transport***:

This is 90% of the goods traded in the world and 3% of all emissions but unfortunately fuel oil, made from the waste products of the refining process, is cheap and conversion to electric would require huge batteries. It should be possible to develop nuclear propulsion as for submarines and aircraft carriers, but this is not currently the case.

To conclude with transport, it should be recalled that if for 99% of the history of humanity we have not used fossil fuels to move around, it is well past time to reduce the use of fossil fuels.

Buildings:

Globally, buildings account for 16% of greenhouse gas emissions from heating and 7% from air conditioning. In developed countries, this percentage is higher and this requires investment in insulation.

Replacing boilers with electric heating will take time because boilers have a long service life.

There are 1.6 billion air conditioners in the world, there will be more than 5 billion in 2050 and air conditioning consumes a lot of energy. Ironically, air conditioning, essential for survival in a hot climate, aggravates global warming.

According to ***Bill Gates***, by 2060, the global housing stock will have doubled in square meters, which is equivalent to building a new New York/month for 40 years. To meet this demand, the objective is a reduction in individual housing and a move in favor of communal housing. This is already the case in cities that occupy only 1 to 3% of the earth's surface but are home to nearly 4 billion people.

In the building sector, it is better to renovate because renovation saves half of greenhouse gas emissions compared to a new construction. Increasing the longevity of products means prioritizing repair and renovation over purchase. Fortunately, many of the materials used in the building are indefinitely recyclable.

Plastic:

57% of the world's plastic production since 1950 has been achieved in the last 15 years. This shows the tremendous increase in the use of this material.

- ***Pollution***:

There are about twenty types of plastics: polypropylene in yogurt jars, acrylic in paint, microplastics in soap and shampoo, nylon, polyester... Plastic makes up almost half the volume of a car but only 10% of its weight.

These plastics contain carbon because it binds the elements together and companies obtain carbon by refining oil, coal or natural gas.

When we make plastic, almost half of the carbon remains in the plastic and plastic can take centuries to decompose.

- ***Recycling***:

In developed countries, only 1/3 of plastic is recycled. In the world, it is worse since only 9% of plastics are recycled. A lot of plastics are sent to developing countries but China doesn’t want them anymore, Vietnam and Malaysia are starting to close their borders. Fish and birds in the oceans are very affected. But, paper bags or glass bottles that replace plastic require more energy for their production.

- ***Distrust of bioplastics***:

According to the ***IEA***, if 4/5th of the energy used in plastic production today comes from fossil fuels, the percentage will have fallen to 20% by 2050.

But bioplastics may not be the right alternative. Their decomposition is often more polluting than the landfilling of ordinary plastics. And when they are made from sugar they have a big impact on land use like biofuels from corn ethanol or palm oil. Developing bioplastic implies an increase in the area of agricultural land and therefore in water consumption.

Digital:

According to ***Pitron*** in an interesting book ***"Digital Hell***", digital technologies mobilize 10% of the world's electricity and emit 4% of greenhouse gas emissions, twice as much as the global aviation sector.

- ***The acceleration of the digitalization of the world***:

With the explosion of e-commerce and the takeover of cyberspace by the United States and China, the growth in usage is rapid and the pollution caused by the billions of tablets and smartphones is increasing rapidly, as is the pollution caused by the data sent or stored on the cloud.

- ***The emissions footprint***:

In terms of water, material and energy consumption, the digital industry has a footprint that is triple the overall footprint of countries such as France and the UK. Many teenagers say they are concerned about the future of the planet, but, on average, young Americans use their screen 7h22/day!

- ***The solutions***:

The hope placed in quantum computing and the potential offered by the progress of digital technologies are immense but we must anticipate a carbon tax, a partially paid internet and promote solar energy to reduce the environmental cost of data.

Conclusion: ***"When you don't know where you're going, you have to remember where you came from." African proverb***.

Let's end with two notes of optimism and three touches of realism:

- Why always a Malthusian vision? Why convey fears sustained by images of floods or droughts? Life expectancy has increased and poverty has fallen everywhere.

- It's going to take a lot of ideas to produce 70% more food by making emissions disappear. We need to change eating habits, consume less meat, change the composition of livestock ...

- Our current energy technologies are by far the cheapest available. So, replacing our current technologies to achieve 0 carbon will come at a cost. This is partly because fossil fuels do not reflect the environmental damage they inflict. Biofuels cost significantly more. Are we willing to pay? Can emerging countries afford it?

- Subsidies on renewable energies are being put in place but they are not financed by a carbon tax at the borders.

- The energy transition has a cost, 2 to 3% of GDP each year, and its financing implies sacrifices for other investments but people are not sufficiently aware of this problem and the sacrifices of purchasing power that must be made.

Geneva, 25th May 2022

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