Session 14: What Energy to Power our Future?

The debate about the evolution of our energy systems encompasses both economics and geopolitics and goes far beyond traditional energy issues. Indeed, the Paris Agreement, signed in 2015 by more than 150 countries, reflects a global political will to limit global warming to below 2 degrees Celsius, which, in turn, implies a massive reduction in greenhouse gas emissions. However, if, following this agreement, we combine all the commitments made by the participating countries, we see that we are, in 2018, on a trajectory leading us to an increase in temperature of 3 or 4 degrees Celsius. This means that we are going to have to bear the brunt of the likely dramatic and highly variable effects of global warming. The key question is knowing what driving forces will push the global economy towards increasing or decreasing greenhouse gas emissions. These driving forces are those that will progressively modify the structure of our energy systems which are currently characterised by a significant amount of structural and behavioural rigidity.

The debate can be organised around six central themes: the availability and accessibility of resources - the possibility of technological breakthroughs - the expected evolution of costs - the principles of energy policy - the strength of resistance - the forces of change.

1. The availability and accessibility of resources

In terms of oil, coal and natural gas, the problem is two-fold: is there enough available and at what cost? Are they accessible and under what conditions? The different scenarios that exist do not necessarily indicate a scarcity of resources but rather fail to consider geopolitical changes that could lead to temporary or long-term accessibility issues for some supply sources. These questions raise a great deal of uncertainty. From an oil company perspective, hydrocarbon consumption continues to increase. In contrast, since the Paris Agreement was signed by a large number of investors and companies, including pension funds (in Norway for example), developments in the coal industry have slowed.

2. Can we expect technological breakthroughs?

This issue is also fraught with uncertainty. Unexpectedly, we have recently seen the tremendous macro energy impact brought about by horizontal drilling associated with hydraulic fracturing. Can the American model be extended to other territories and, if so, in what time frame, on what scale and at what cost? The list of areas in which major innovations could have an impact is endless. They include electricity and heat storage and nuclear technologies (small-scale and fusion reactors). We must also not forget the vast array of technological breakthroughs that can be achieved by finding alternative production and consumption combinations that encompass factors such as heat, electricity, storage, water, agriculture and transport. We should also consider the transformations that will result from the systematic integration of new intelligence in linking the various components of multiple value chains (digitalisation, blockchain, artificial intelligence, etc.). We can predict the notion of the word *smart* in: *smart grids* but also *smart homes, smart buildings, smart cities, smart producers* and *smart consumers.*

3. The expected evolution of costs

Cost dynamics is obviously a fundamental element for future investments. We know that the cost of renewable energies will continue to decline significantly; the same can probably be said for the cost of storage with different competing technologies. For fossil fuels, on the other hand, the costs are expected to rise for two reasons: a strictly mining reason, in that the next reserves exploited will

naturally be more expensive, and a social reason which expresses the idea that these energies must pay the social costs associated with their extraction and use. This payment of social costs will be generated progressively through general taxes or a carbon tax. With regard to nuclear power, we are dismayed by the evolution of the costs associated with reactors currently under construction, including Flamanville, whereby the actual cost will be more than three times higher than originally stated. Moreover, the Fukushima disaster (2011) resulted in increased costs due to safety reasons and again raised the problem of future costs, namely those related to the dismantling of reactors and the storage of radioactive waste. The future economic credibility of nuclear power may not be certain.

4. Principles of energy policy

In an environment marked by considerable uncertainty, the first two principles of energy policy are likely to be diversity and energy efficiency. Diversity is the choice of primary energies and sources of supply as well as the choice of production, transmission and distribution technologies. Energy efficiency is complementary to this; it is linked to the introduction of additional business intelligence at all value chain levels. This "superintelligence" is based on digitalisation in the broadest sense and the combination of value chains. Beyond these two fundamental principles, we can examine several options (or projects) that merit consideration and discussion: experimentation - encouraging decentralised and participatory initiatives, introducing taxes to discourage emissions and encourage low-carbon solutions.

5. The strength of resistance to change

Among the many forces of resistance to change, the first is related to the formidable rigidity of those energy systems already in place. More than 80 percent of our energy consumption comes from the three major non-renewable and polluting primary energies: petroleum, coal and natural gas. This manifests itself in fixed structures: reserves, pipes, terminals, refineries, service stations, all which control rigid behaviours and consumer habits. In addition, rigid cultures also exist amongst companies, administrations and consumers to some degree. This cultural rigidity reveals a huge global inertia which proves to be a powerful brake on change.

6. The forces of change

Innovation is the first force of change. We have seen its impact in the past and often wonder how it will shape and exert its power in the future. It is not limited to advances in technology; it also concerns industrial organisation methods, business models, the functioning of markets, methods of regulation and regulation of energy systems. In this dynamic of change, experimentation, local and regional initiatives and business strategies (of both major companies and start-ups) will all play a major role. Furthermore, it seems that the transformation of energy systems and the speed and magnitude of this transformation will largely depend on international public awareness of the seriousness of global warming and all the threats associated with it. The global health of the planet is deteriorating and will continue to deteriorate if more radical and active measures are not agreed upon. So, the question of our energy future is not purely about energy per se - it reveals itself to be an emergency situation, a dramatic call to action. The awareness of citizens to put pressure on their governments and on all driving forces (companies, local communities, NGOs and international organisations) is a fundamental element.