ENERGY SERIES

Geopolitics and Energy Transition 1

The Basics

Jean-Pierre Favennec
with the collaboration of
Matthew Van der Beeuren

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Foreword to *Géopolitique de l'énergie* Published in 2008 – A Tribute to Jean-Marie Chevalier

This book arrives just in time: energy has been in the headlines for several years. The sharp increase in the barrel price in the first six months of 2008, followed by its drop, the growing energy demand followed by its recent decline, the supply threats (due to tensions and attacks in some producer countries, accidents, etc.), the debates on reserves and, above all, the climate change threat are all in the news.

The energy range is broad (oil, gas, coal, nuclear, hydroelectricity, wind, solar), but these energies are often replaceable, and from now on all these energies will be needed. There is a rich literature dealing with oil and geopolitics. This book focuses on the geopolitical aspects of energy, in which oil obviously plays an important role.

This book presents a clear overview of various stakes of the energy sector: how various energies are generated, what their future is, who the players in the energy sector are, what the supply constraints are and what the significant characteristics of the various world regions are.

This book is organized into two volumes: Volume 1 presents the most important characteristics of the energy sector; Volume 2 includes a region-by-region analysis of the stakes and a detailed presentation of the political aspects.

Volume 1[1] is composed of four chapters.

The first chapter describes the major sources of energy, indicates the production and processing techniques, and provides a certain number of economic elements.

The second chapter covers the various aspects of the energy transition.

The third chapter focuses on an analysis of prices, demand and resources: while many geopolitical and financial factors (the role of pension fund investments, for example) influence prices, offer and demand remain fundamental elements. This chapter ends with an analysis of constraints related to environmental protection at the local, regional and global levels: climate change will heavily impact the global energy consumption and the structure of the future “energy mix”.

The fourth chapter is dedicated to the structures of the companies and organizations involved in the energy sector. There have been many spectacular evolutions. The oil sector was developed by a limited group of large private companies – the Majors – until 1960. The situation changed as result of the creation of OPEC, and of the nationalizations in the 1970s. The size of the large national companies in producing countries, which often have a quasi-monopoly over the resources on their territory, is equivalent to and even greater than the size of large international companies. The companies operating in the gas and electrical sectors have also been subjected to many structural evolutions. After World War II, small private companies operating on a limited territory were replaced by powerful national companies operating over large spaces in order to benefit from the advantages of natural monopoly. For over 40 years, Americans and Europeans, followed by many emerging economies, have been involved in policies aimed at establishing active competition, leading to the end of monopolies, the appearance of new players and a proactive deregulation policy.

The fourth chapter also deals with supply security and the means to ensure it. While in the 1990s, the best way to

ensure stable energy supplies seemed to be the improvement of market operations, current tensions justify the active intervention of the national states. The Americans and the Chinese, for example, have developed a strong oil diplomacy, and Moscow makes no secret of its willingness to use energy as a weapon in its relations with European and Asian neighbors.

Volume 2[2] deals with the situation of each large part of the globe, continent or region (such as the Commonwealth of Independent States (CIS)/Russia or the Middle East) that plays a particularly important role in the world energy scene.

North America stands out for its very significant energy consumption, high and increasing oil imports, significant gas consumption, high coal consumption for power generation, and significant needs for production facility renewal in the electrical sector. Due to its needs and power, North America is a key zone.

The energy sector in South America is dominated by several countries: with a barrel at over $100, Venezuela has recovered a power that was recently deeply altered. Brazil, the geographical and economic giant, is a key player in the oil and gas game. The nationalizations of the gas industry in 2006 in Bolivia did not cause significant stirs, as the wave that brought to power left-wing leaders (of very different orientations) in various countries banned too violent conflicts. However, the tensions between the ambitions of Venezuela, whose aim is to become the leader of South America, at least in the energy sector, and those of other countries are latent.

Europe consumes and imports a lot of energy, and its dependence will increase. The Middle East will eventually become once again a major oil supplier, which the European diplomacy will have to take into account. The

very important role of Russia in the European gas imports is a concern for the governments. Europe, the major partner in the Kyoto protocol, must also address its increasing needs by limiting CO_2 emissions, while some countries have decided to reduce their nuclear energy production.

The CIS – in which Russia plays an essential role – is once again a major player on the energy scene. Having extremely abundant reserves of oil, gas and coal, Russia is a massive exporter of oil and gas, and can arbitrate its supplies between Americans, Europeans and Asians, sometimes threatening one or the other to change the destination of exportations. The relations with the Europeans, the main gas purchasers, are especially critical. The Europeans expect the monopoly of Gazprom to be transformed – which the Russians refuse – while Gazprom would like to achieve participation in some European companies, which is opposed by European governments. Coal is still very widely used, and this does not allow the exportation of the maximum amount of oil and gas, which are more profitable.

Africa's weight in terms of energy consumption is very low. Only South Africa and, to a lesser extent, the North African countries are significant consumers. However, most sub-Saharan African countries have very low energy demands, with the exception perhaps of Nigeria, due to its huge population. In contrast, North Africa and West Africa are important producers of oil and gas. West Africa, which is undoubtedly the most open zone to foreign companies, has attracted many interests: Americans and Chinese are playing a wide poker game in that region, where most companies are present.

Asia, which has over half of the world population, is the region with the greatest increase in energy demand due to

the extraordinary economic growth in China and, to a lesser extent, in India and in neighboring countries. This increase is at the core of the energy issue: the needs of Asia weigh on the demand and on the production capacities and, consequently, on prices. However, it would be absurd to hold this region responsible for the current difficulties, as the consumption per inhabitant remains low there. It is consumption by Western countries that is incompatible with reserves and productions. Tensions are, however, high between the large consumers to secure their future supply.

The Middle East remains the key area for oil supplies and it covers the fuel needs of many countries, especially Asian ones. There are many geopolitical tensions in the region. The Israeli–Palestinian conflict is certainly at the core of these tensions: the Israeli intervention in Lebanon and the war with Hezbollah in 2006, as well as the events in Gaza in 2009, testify to the intensity of the conflict. In the short and medium term, the oil and gas of the Middle East will become increasingly important, as this region is the only one that can cope with the increasing needs of the planet.

The conclusion of this book is that energy will continue to be in the spotlight. While for several dozen years, there have been few significant transformations in this sector, revolutionary changes and even breakthroughs will be needed to meet, in particular, the needs of emerging countries and the climate change constraints.

Jean-Marie CHEVALIER
Director of the Centre de géopolitique de l’énergie et des matières premières
2008

Notes

Introduction

Why energy?

The main uses of energy are heating and transportation. Energy can be generated from oil, natural gas, coal, nuclear energy, hydroelectricity, biomass and renewable sources (wind, solar, etc.). The total global energy consumption (including firewood) reached 15 billion tons of oil equivalent (France consumes around 260 million tons of oil equivalent). Roughly speaking, nearly 20% of the energy is used for transportation, and nearly 80% of it, in various forms, is used for heat generation (for residential uses – heating, cooking, air conditioning – and for industrial uses, as well as for electric power generation).

To a large extent, the needs of the transportation sector are still met by oil products, but the energy transition is leading to a rapid development of electrical vehicles. Oil products have two advantages: they are liquid, and therefore easily accessible, and they have a high energy density. Filling a tank with gasoline or diesel fuel at the gas station takes two or three minutes, and provides autonomy for several hundred kilometers. Charging the batteries of an electric vehicle or filling the tanks with compressed gas takes a longer time. However, because of the necessity to reduce greenhouse gas emissions, searching for alternatives to fuel petroleum products is essential.

Heat can be generated from all the types of energy. In some cases, in order to limit the emissions of polluting products, less polluting fuels are chosen, such as gas or light petroleum products. In many cases, the choice will be dictated by practical and economic reasons (e.g. coal is no

longer used as fuel for residential heating because it is much easier to use heating oil and natural gas).

Brief historical review of energy uses

Due to scarce resources, energy consumption was at a low level until the 18th century. Energy was essentially generated by human force, animal force, watermills and windmills, and the energy released by wood combustion. Industrial development, whose needs exceeded the limited wood resources, led to the invention of the steam engine fueled with coal. Oil was discovered around 1860, but it had no significant use prior to the first decades of the 20th century (invention of heat engines, gasoline or diesel fuel engines, massive use of fuel oil after 1945). Nuclear energy came next. Wind and solar energy became significant in the 21st century.

Starting in 1945, there was a huge increase in energy consumption. Until 2000, this increase was concentrated in industrialized countries – members of the Organization for Economic Cooperation and Development (OECD), which included until 1990 the United States, Canada, Japan, Australia, New Zealand and Western European countries (Germany, Austria, Belgium, Spain, Finland, France, Greece, Ireland, Island, Italy, Luxembourg, Norway, the Netherlands, Portugal, the United Kingdom, Sweden, Switzerland, Turkey). At the end of the 20th century, the population of these countries counted 1 billion (the global population being 6 billion) people, but accounted for half of the global energy consumption. This trend was reversed by the rapid development of China and the progress of other emerging countries. Countries outside OECD now account for 70% of the global energy demand.

Energy and climate change

Global warming and the resulting climate change have been a major concern for several years. Already mentioned in the preface to the book *Géopolitique de l'énergie* published in 2007, of which this book is a continuation, climate change has become an undeniable reality. Most of the past few years have been the hottest ever observed since the beginning of meteorological records. In the summer of 2021, temperatures exceeded 50°C in Eastern Canada. California and Australia experienced extremely long periods of drought that led to rarely seen fires.

Global warming has now been accepted as a reality by all scientists, and only some conspiracy theorists are denying this reality. The works of the Intergovernmental Panel on Climate Change (IPCC) are no longer disputed. Only the magnitude of the consequences of climate change is still under debate.

Rising temperatures are obviously due to increasing greenhouse gas emissions that retain the heat which is normally reemitted to the space (in the absence of greenhouse gases, Earth's temperature would be –18°C). Also, energy is to a large extent responsible for these emissions. We use various sources of energy: wind energy, solar energy, hydraulic energy, nuclear energy, etc., but the main part of our energy consumption relies on fossil fuels – oil, coal and natural gas – representing about 80% of our total consumption. However, these energies are obtained from carbon-based fuels whose combustion generates heat, and carbon is then transformed into carbon dioxide (CO_2), the most important greenhouse gas. Methane (natural gas consists mainly of methane), another significant greenhouse gas, results essentially from gas leakages during the production or transportation of the natural gas we use.

The capacity of some gases to retain heat, and to possibly cause an increase in the Earth's temperature, had been identified since the 19th century by some scientists. However, it was only at the end of the 20th century that this phenomenon was effectively acknowledged and its effects were measured. The first Earth Summit was held in Stockholm in 1972, and resulted in the creation of the United Nations Environment Programme. It touched on climate. But the third Summit, which was held in Rio in 1992 (also known as the United Nations Conference on Environment and Development), led to the creation of the United Nations Framework Convention on Climate Change (UNFCCC). The signatory countries of this convention have been meeting annually ever since. The Kyoto Protocol, which established the policies for reducing greenhouse gas emissions, was signed in 1997. The Johannesburg Summit was held in 1992, and on this occasion the French president declared: "Our house is burning, but we are looking the other way". These various conferences have been important steps in the attempt to limit the effects of climate change.

Abundant energy?

Throughout history, energy has in fact been abundant, despite persistent fears of shortages. In the 1920s, the United States feared oil shortages. Significant discoveries on the American territory, then in the Middle East, put these fears to rest. Concerns were revived in 1970, when oil reserves were assumed to cover only 30 years of consumption. This prognosis undoubtedly inspired the Club of Rome to elaborate the famous report entitled "The limits to growth", the first warning of a possible shortage of energy, mining and even food resources. Without embracing an overly optimistic perspective, it is important

to mention that at that moment oil reserves were estimated at about 75 billion tons, while in 2022 they were estimated at 250 billion tons.

The situation changed at the beginning of this century.

Energy is now scarce and expensive

At the end of the 20th century, energy seemed still abundant and was therefore cheap. Oil, gas and coal reserves seemed significant. Oil price dropped to $10 per barrel by the end of 1998.

From 2000 to 2008 (the year of a major financial crisis), global economic growth was very strong (especially due to China's economic boom) and the prices of widely dominant fossil energies increased significantly. Oil prices reached $147 per barrel in 2008, then dropped and rapidly reached high levels after 2010.

The shale oil and gas revolution in the United States was a game changer. Started a little before 2010, this revolution produced its full effects by 2014 (virtually nonexistent before 2010, shale oil production represented over 5% of global oil production in 2014). Prices remained relatively low, especially because of the Covid-19 pandemic, but increased sharply in 2021 due to the economic recovery.

What about the future?

There is a proven link between economic growth and increasing energy demand. For a long time, and especially during the "thirty glorious years" (1945–1975), the rate of energy consumption followed that of wealth (measured by the GNP). The current rate of energy consumption is lower than that of wealth. At the beginning of the 1980s, the tenfold increase in oil price was followed by a significant

drop in oil demand and a reduction in the global demand for energy, while wealth increased.

The population growth (which should pass from 7.5 to 9 and even 10 billion people by 2050) and the increase in average living standards (recently reaching spectacular levels in Asia) should lead to an increase in energy demand. According to the most conservative scenarios, which rely on reduced economic growth to limit polluting emissions, there will be about a 30% increase by 2050.

According to other scenarios, in which the current tendencies will continue, there will be a twofold increase in demand. Two recognized organizations, the International Energy Agency (IEA) and the US Department of Energy (DOE), expect a strong increase in energy demand by 2030. This can be readily explained: economic growth is needed to reduce unemployment in developed countries and poverty in emerging countries. Also, economic growth requires energy.

Two constraints should lead us to modify our policies:

- by 2050, an inevitable depletion of gas and oil reserves;
- above all, the necessity to cope with climate change.

Therefore, the objective should be to reduce our consumption as much as possible and to make the best use of all the energies, while respecting environmental constraints (and especially by taking climate change into account). It is a challenging objective. Since 1945, energy consumption has increased tenfold and our needs have been met by increasing production of oil and gas in particular.

Our future will be very different. The measures proposed by many specialists are technically feasible, but difficult to accept in terms of policies. The educational effort to be

undertaken is huge. Let us hope that education will be sufficient, and no coercive measures will be needed.

Acknowledgments

There is a long history behind this book and its predecessors. It is an old project that started to materialize in the summer of 2002 when, encouraged and supported by Nadine Rouzaut, we made a detailed plan.

Many people contributed to the elaboration of this book. Many students, such as Julien Bassaler, Thibault Servan and Yann Balaÿ, took part in the 2007 edition of this book.

My former colleague Robin Baker contributed to the elaboration of the first English version in 2011.

Amit Garg, former student at IFP School, helped me write a new English version in 2017.

Finally, Aishwarya Dar, Juliette Guilbaud and Matthew Van der Beeuren brought their contributions to a more recent version (2021).

The present book was written in close cooperation with Matthew Van der Beeuren.

I am taking this opportunity to thank them all.

And of course, according to the usual disclaimer, all remaining errors are my own.

Tribute

I preserved in this edition the foreword written for the first version of the book *Géopolitique de l'énergie* by Jean-Marie Chevalier, a prominent energy specialist, who sadly passed away in October 2021.

This foreword is quite prescient, even though the expressed perspective has changed in the past 15 years.

1
Different Forms of Energy

1.1. Energy at the heart of the development of civilization

The term “energy” is taken from the Greek *energon*, which means “force in action”. Energy is the capacity to perform work, impart movement or raise temperature (heat a building, cook food, etc.). It is produced via the use of natural forces like wind or solar energy, from the combustion of fuels or combustible materials (oil, gasoline, diesel fuel, fuel oil, natural gas, coal, wood, etc.) or from electricity.

Energy has always been vital for humankind. Living organisms use a large quantity of energy, for which the main natural source is the sun. Human beings obtain their energy from food, which is transformed in the cells of their bodies during a multitude of biochemical reactions allowing them to maintain their body temperature, grow, multiply and move about.

Although the rest of the animal kingdom has always been content with what nature provides for it, humankind has been able to free itself from the weather variations and random food resources that threatened the demographic growth of its species. Through the discovery of fire, humans were able to cook food – leading to the development of agriculture and breeding – and produce heat, thereby promoting their longevity. In addition, this allowed them to forge tools and weapons to ensure their survival.

Much later, various energy innovations helped to shape society as we know it today. Energy is present at every moment of our lives. These innovations such as motors operate with petroleum products, gas or electricity.

In the same fashion, light has become indispensable to us. Light that once came from a candle, then from oil lamps and street lamps powered by town gas, today is mainly produced by electricity.

Therefore, energy, now essential to our well-being (reduction of physical effort, heating and lighting of premises, etc.) and economic development, has become a key element of progress.

However, energy needs continue to increase, although today nearly 2 billion people still do not benefit from even the simplest of modern energy resources.

Access to abundant and inexpensive energy sources and an increasing worldwide population are leading to an explosion in the demand for energy at the same time as humankind is becoming aware of the impact of its lifestyle on the environment. The survival of the human species now depends on its intelligence and creativity.

1.2. Energy: major stages and innovations in its history

In antiquity, the only resources available were manpower (it is estimated that one-third of the population of Rome was composed of slaves), animal traction (for transport) and biomass, in particular wood for cooking and heating. In Europe during the Middle Ages, the use of windmills was imported from the Orient, providing efficient energy, particularly for the industries of food (nuts and olives) and

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