
The North American Continent

1.1. Introduction

The three countries that make up the North American continent – Canada, the United States and Mexico – are linked by the North American Free Trade Agreement (NAFTA). Within NAFTA, the USA is predominant: its GDP amounts to 85% of the total.

The USA is the new Rome: a superpower for some, a hyperpower to others. American power – particularly its military power – remains dominant at the beginning of the 21st century despite repeated failures in conflicts such as Vietnam, Iraq and Afghanistan.

During the 1991 Gulf War to end Iraq's occupation of Kuwait, the US deployed an army of 600,000 men, 90% of the coalition forces. The Yugoslavian conflict in 1999 was settled by America even though, logically, the solution should have been found within Europe. Finally, the army that invaded Iraq in March 2003 was very largely American.

Rivalry with Russia remains strong. Until the 1980s, relations between the USA and the USSR were characterized as a Cold War, culminating in the Cuban missile crisis in October 1962, when the two countries came close to a nuclear conflict. Tensions eased somewhat before the collapse of the USSR (1991). They have escalated again, particularly since February 2022 and Russia's invasion of Ukraine. What's more, the USA is Ukraine's main arms supplier and supporter.

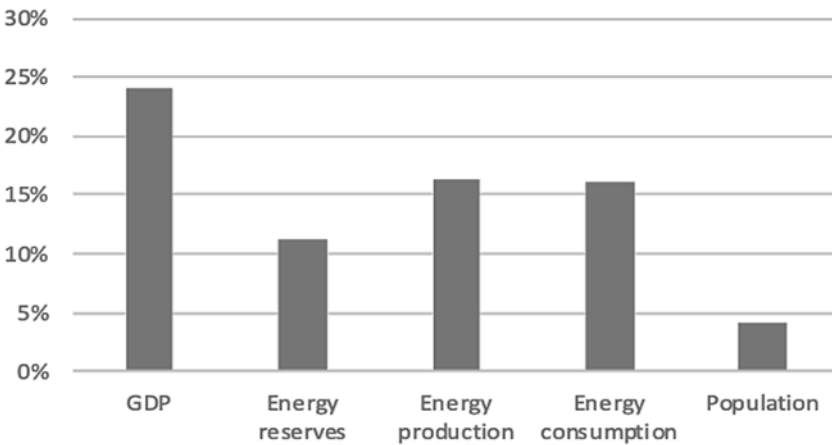


Figure 1.1. *The United States' share of world GDP, energy, population*

1.2. Very high energy consumption

Today, the US GDP (gross domestic product or simply wealth) represents 24% of world GDP, the US population represents 4.3% of the planet's population, and proven energy reserves represent approximately 11% of world reserves (Figure 1.1). US energy consumption is considerable: 17% of world energy consumption and half of the world gasoline consumption.

It accounts for 20% of the world's oil, 21% of its gas, 7% of its coal, 30% of its nuclear energy and 16% of its electricity. On average, each US citizen consumes about seven tons of oil equivalent per year. That is more than twice Europe's per capita consumption and around two and a half times China's (approximately 2.7 tons of oil equivalent per year); see Figures 1.2 and 1.3.

American power is largely based on intensive energy production and use: coal in the 18th century, oil after 1859 – the date of the first discovery of crude oil by Colonel Drake in Titusville, Pennsylvania – and more recently, gas and electricity. America's vast reserves of fossil fuels have enabled the country to develop its industry and transportation (Figure 1.4). Despite some progress in terms of energy optimization and use, the US has doubled its consumption over the past 40 years.

Canada has reserves of gas and heavy crude oil, and very large reserves of oil sands. It is the world's leading producer of hydroelectric energy.

It is a net exporter of crude oil, natural gas, uranium and hydraulic electricity, mainly to the US. The size of its resources means that Canada is also a large user of energy: despite a low population (38 million inhabitants), it is the sixth largest consumer in the world. It has the world's highest per capita electricity consumption – about 16,000 kWh – because of the availability of cheap hydroelectricity. Energy exports from Canada (oil, natural gas and electricity) are vital for the US. This dependency was highlighted on August 14, 2003 by the electricity blackout which affected large areas of the Midwest and Northeast of the US, as well as Ontario.

Mexico was one of the largest oil suppliers to the Allies during World War I. But when the Western companies there refused to accept new national regulations, the government reacted with a law that established the nation's ownership over all subterranean products, particularly oil (1938).

Following this nationalization, the international companies boycotted Mexican oil and increased exports from Venezuela. Oil production in Mexico collapsed and did not become significant again until the 1970s.

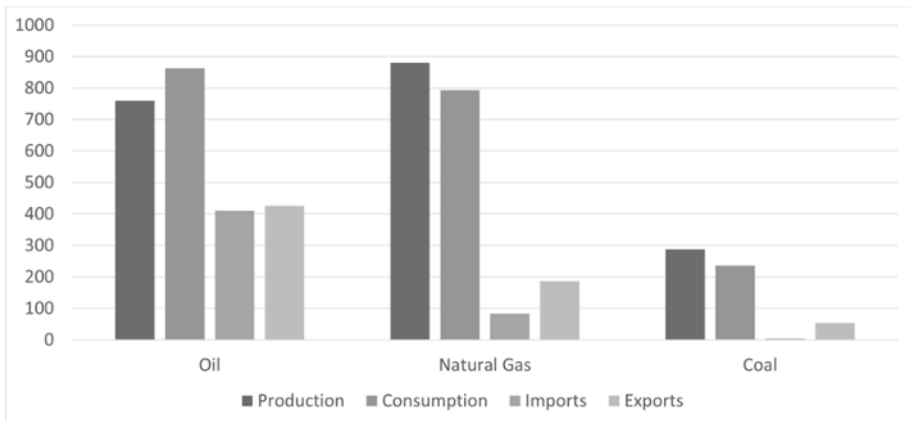


Figure 1.2. Total energy balance of the United States in 2022 (Mtoe) (source: *El Statistical Review of World Energy*, 2023)

The nationalization of oil and other industries in Mexico's energy sector had far-reaching consequences. With the absorption of a portion of oil revenues by the state, Pemex and the Comision Federal de Electricidad (CFE) found it extremely difficult to finance sufficient investment to maintain oil production or ensure the country's electricity supply. Aware of these difficulties, the government has recently attempted to open up the energy sector to foreign companies, with the introduction

of service contracts and production sharing contracts in the oil and gas sector. The government of President Enrique Peña Nieto finalized this opening-up; however, the latest presidents, Andrés Manuel Lopez Obrador and Claudia Sheinbaum, elected in 2024, have a more nationalist energy policy.

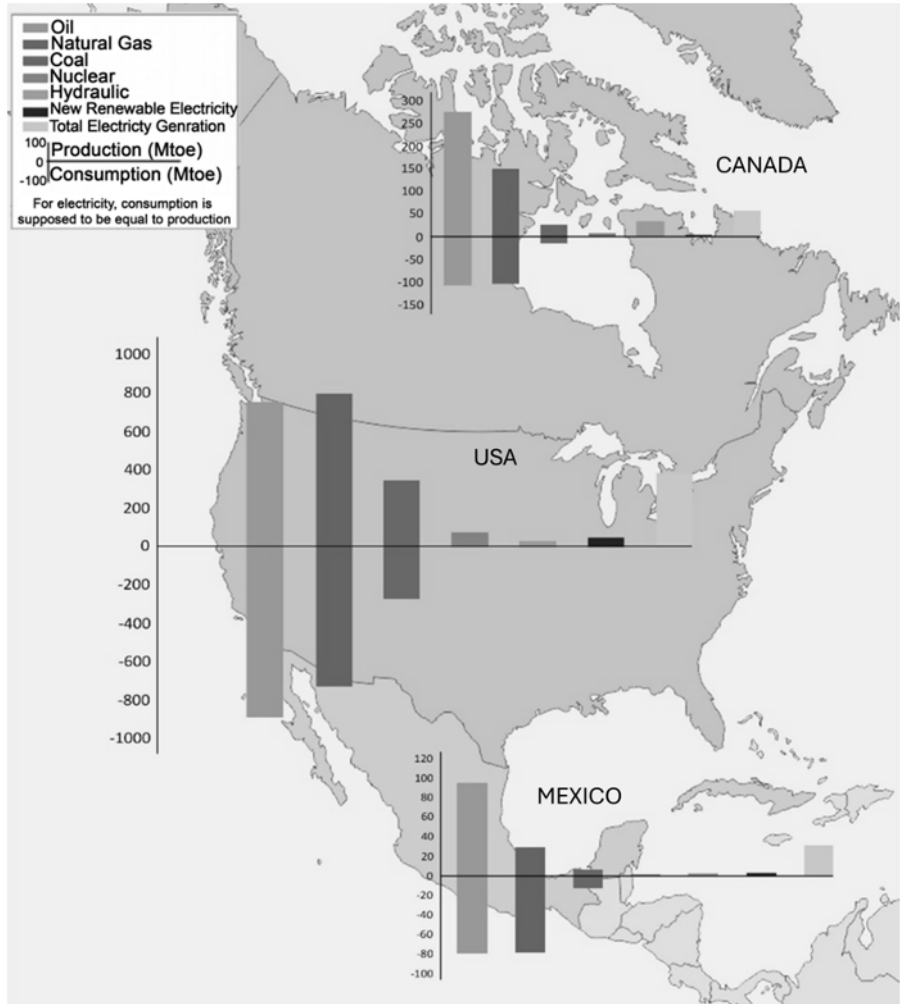


Figure 1.3. North American energy balance by country in 2022 (source: *El Statistical Review of World Energy 2023*). For a color version of this figure, see www.iste.co.uk/favennec/geopolitics2.zip

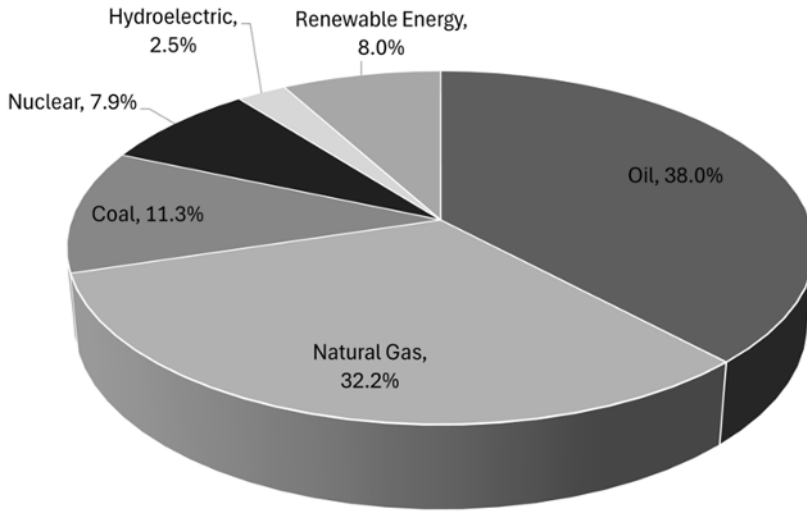


Figure 1.4. *US energy consumption by source in 2022*
(source: *EI Statistical Review of World Energy 2023*)

The free trade agreement between the United States, Mexico and Canada

Since 1994, Canada, the United States and Mexico have been bound by a free trade agreement, NAFTA.

Donald Trump, who came to the White House in January 2017, opposed several of its clauses deemed unfavorable to industry and employment in the United States. He denounced it and forced his two partners to negotiate a new agreement, signed on November 30, 2018, but not without difficulties: no consensus could be reached on the name of the agreement, referred to simply as USMCA in the United States, T-MEC by the Mexicans and CUSMA or NAFTA 2.0 by the Canadians.

This new agreement is based on the NAFTA agreement, but includes the introduction of a different system in the automotive sector.

The agreement has also introduced changes in the energy sector: the old provisions on energy and basic energy and petrochemical products are no longer part of the framework organizing trade between the signatory countries. However, the free movement of natural gas, oil and electricity is preserved.

In addition, the new agreement provides for the gradual elimination of customs duties on heavy oil containing diluent from Canada.

A chapter specific to Mexico, and desired by Andres Manuel Lopez Obrador, establishes Mexico's natural, inalienable and imprescriptible property rights over hydrocarbons.

In short, NAFTA 2.0 remains largely identical to the previous version in the energy sector.

Box 1.1. NAFTA 2.0 (new version of the free trade agreement between the United States, Mexico and Canada)

1.3. Energy transition in North America

North American greenhouse gas (GHG) emissions are among the highest in the world. The rapid development of the United States throughout the 20th century has made it the world's leading emitter of GHGs, surpassed only recently by China.

The situation is even starker if we relate these emissions to the number of inhabitants. According to Climate Watch, an organization that analyzes data on climate change, Canada and the United States emit 20.6 and 17.7 tons of CO₂ per capita per year respectively (the world average is approximately 4 tons). This is the result of very large oil, gas and coal resources, which have encouraged high levels of consumption.

The US Environmental Protection Agency (EPA) is highlighting the harmful effects of climate change on the region's flora and fauna. The southern United States has begun to lose barrier islands and wetlands, while states such as California, Nevada and Arizona are experiencing unusual levels of drought and water scarcity. Even regions not known for being hot, such as the northeastern USA and the Canadian province of British Columbia, were affected by a massive and unprecedented heat wave in July 2021. Temperatures reached over 50°C, causing the deaths of 500 people in Oregon, Washington and British Columbia, as well as 180 forest fires in the latter province. In 2023, 14 million acres burned in the boreal belt, twice the previous "record".

American oil companies have long opposed measures to prevent climate change. Due to the fact that Canada, the United States and Mexico are major producers of oil and gas, the energy transition has mainly been seen as an obstacle rather than a challenge and an opportunity.

Climate policy and the transition to clean energy are highly politicized in the USA. Many members of the Republican Party are climate skeptics, while the Democratic Party supports the energy transition. As a result, the US attitude has fluctuated over the years and between administrations.

Under Barack Obama, the country took part in COP21 in Paris at the end of 2015 and, like all signatory countries, submitted its Nationally Determined Contribution (NDC) to the fight against global warming. In 2017, however, Donald Trump, his successor in the White House, dismantled the climate and environmental policies of the Obama administration and pursued an energy policy that favored fossil fuels, pulling the United States out of the Paris Agreement. Joe Biden, elected in 2020 and inaugurated in January 2021, reversed this decision and reinstated the agreement as part of a large-scale climate change mitigation strategy.

The energy transition can offer many opportunities in the energy sector, particularly in renewable energy technologies. The White House estimates that solar energy could potentially account for 40% of U.S. electricity production, while creating 1.5 million jobs by 2035.

Although energy consumption is growing at a slower pace, and the share of fossil fuels in the primary energy mix has fallen, it will be difficult for the USA to meet its Nationally Determined Contribution to the Paris Agreement. US carbon emissions have fallen slightly in recent years, but this is due to the replacement of coal by cheaper natural gas for power generation, thanks to the abundance of shale gas. Recent US tariffs on Chinese solar panels have also slowed the growth of solar energy.

Anticipating the destabilizing effect of a rapid phase-out of fossil fuels on local economies dependent on extractive industries, Joe Biden has set a target of concentrating 40% of clean energy investment in areas where disadvantaged communities dependent on refineries and power plants live.

His ambitious climate plan is financed in part by eliminating subsidies for fossil fuel production and raising corporate taxes. Joe Biden has not banned the hydraulic fracturing needed to produce shale oil and gas – difficult to implement in a country where the subsoil is privately owned – nor created taxes or carbon markets as mechanisms for reducing CO₂ emissions. By transforming the Green New Deal, often associated with left-wing politics in American politics, into a pragmatic “Plan for Climate Change and Environmental Justice”, Joe Biden sought to increase his chances of winning the support of moderates and conservatives.

He can draw on the US Climate Alliance, which many governors formed in response to Donald Trump’s withdrawal from the Paris Agreement. As of July 1, 2019, a total of 24 states and Puerto Rico had joined this alliance. While cities and states can significantly reduce US carbon emissions by 2025, they cannot replace federal support for action against climate change. Alternation at the head of the federal administration facilitates the implementation of a new environmental policy.

In a reference scenario for the United States, the International Energy Agency (IEA) forecasts a slight increase in demand for oil and coal by 2030, and a rapid rise in natural gas consumption. There would be no reduction in greenhouse gas emissions in the absence of carbon capture and storage (CCS). However, the share of renewable energies is set to rise, reaching 23% of electricity production in the United States by 2030 and 27% by 2050.

Canada is strongly committed to the fight against climate change. However, not all its emission targets have been met. While the government aims to reduce CO₂ emissions by 30% by 2030 (compared with 2005) and achieve carbon neutrality by 2050, it provides the fossil fuel industry with approximately CAD 10 billion a year in assistance.

While Canada enjoys a certain credibility on the climate action front, as evidenced by the implementation of a national carbon tax in April 2019 and increased investment in clean energy research, it is worth noting the CAD 4.5 billion takeover of the Trans Mountain pipeline project to transport synthetic oil from Alberta's oil sands, from which Texas-based Kinder Morgan had withdrawn. Additional sums were invested in this project in subsequent years. Aboriginal and environmental groups opposed the takeover, but Justin Trudeau's federal government sees the pipeline as essential for adding value to Canada's natural resources, the revenues from which can then be invested in the transition to clean energy.

As in many other countries, North America is taking a keen interest in hydrogen, and there are many projects in the pipeline. However, it is difficult to predict how many of these projects will come to fruition.

The USA and Canada believe that hydrogen should play a central role in decarbonizing heavy industries such as steel and chemicals, which are crucial to the continent. North America has seen a very significant increase in hydrogen projects planned recently. While Europe remains the key region for hydrogen, the United States and Canada are catching up.

The United States is one of the world's biggest producers and consumers of hydrogen, accounting for 13% of global demand. Most of this hydrogen is still produced from natural gas. To achieve the targets proposed in the most ambitious "net-zero emissions" plan, the number of hydrogen production projects would have to be higher than currently planned.

Canada's hydrogen strategy, published in 2020, aims for 30% of end-use energy to come from clean hydrogen by 2050. Canada currently produces around 3 million

tons of hydrogen a year from natural gas. The strategy does not indicate how much hydrogen is to be produced from low-carbon sources.

Compared to the USA and Canada, Mexico still has a lot of work to do when it comes to hydrogen. Hydrogen was first mentioned in the Mexican Ministry of Energy's national development plan in early 2023 as a potential replacement for fossil fuels. However, there are as yet no concrete plans for research, technology transfer, financing or project development.

1.4. Electricity and renewable energies

North America is the world's second largest electricity market after China. Electricity consumption in North America is approximately 5,400 TWh, including 4,400 TWh in the United States (the USA alone accounts for 16% of world consumption).

The electricity production and transmission systems of Canada and the US are integrated within the North American Electric Reliability Council (NERC) and its 10 regional reliability councils. Thus, the continent can be divided into six major interconnected systems:

- Western Electricity Coordinating Council (WECC): which includes western Canada, American western states and Baja California in Mexico;
- Midwest Reliability Organisation (MRO): interconnection covering the central US states;
- South East Reliability Corporation (SERC): southern interconnection covering the southeastern states of the United States;
- North East Power Coordinating Council (NPCC): eastern interconnection, which includes the eastern U.S. states, the Canadian provinces of Saskatchewan and Manitoba; the Quebec area is interconnected;
- Electric Reliability Council of Texas (ERCOT): Texas interconnection;
- Reliability First (RF): interconnection covering all or part of 14 states from the Great Lakes region to the East Coast.

With implementation of the NAFTA agreement in 1994 and the move to greater deregulation in all three countries, electricity interdependency continues to grow.

In the USA, coal-fired power plants are being replaced by natural gas-fired combined-cycle power plants. These offer a number of advantages: quick and easy to build, higher efficiency and virtually zero emissions of pollutants other than CO₂.

In Canada, more than 60% of electricity production is hydroelectric. After China, Canada is the world’s second-largest producer of hydropower. Quebec is Canada’s largest electricity market, and 93% of the region’s installed capacity is hydraulic.

In Mexico, heavy fuel oil was the most widely used energy source for power generation for many years. Today, however, natural gas is the most widely used. Mexican demand for electricity is constantly on the rise, growing by approximately 6% a year. Renewable energies account for a growing share of production.

Current interconnection systems between Mexico and the United States are being improved.

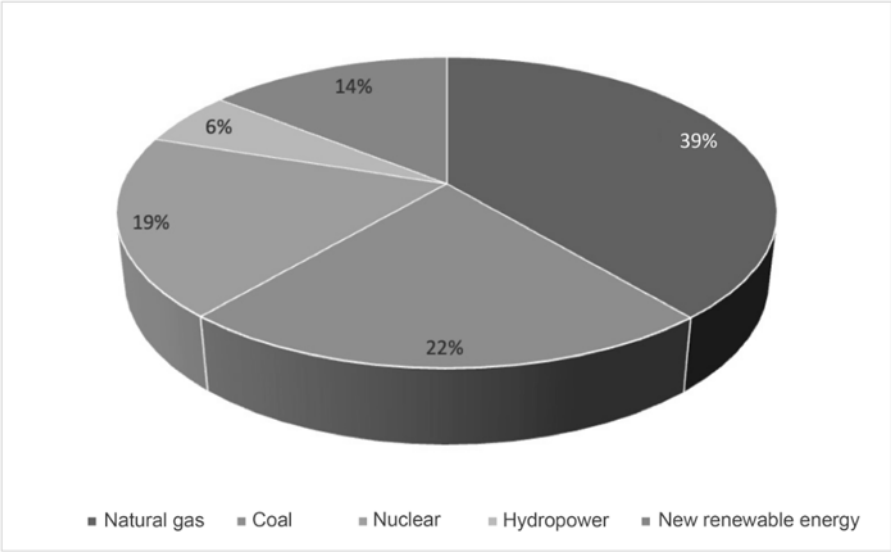


Figure 1.5. *US electricity generation by origin in 2022 (source: *EI Statistical Review of World Energy 2023*). For a color version of this figure, see www.iste.co.uk/favennec/geopolitics2.zip*

1.4.1. Organization and regulation of the American electricity market

For a long time, the American electricity industry was dominated by vertically integrated public monopolies, which were subject to state regulation. With the 1992 introduction of competition into the generation sector, this has changed. The market is totally deregulated in Texas, Pennsylvania, New Jersey, Maryland, but some

states (for instance Alabama), where prices have always been low, are resisting the change.

As the structure of operators and producers is highly varied, the coordination is complex. Control and regulation of the energy industry is divided between the federal level and the various states: the central (federal) government controls interstate commerce, while commerce occurring wholly within a state is controlled by that state. The main federal tool is the Federal Energy Regulatory Commission (FERC). At the state level, the regulatory institutions are Public Utilities Commissions (PUCs).

Deregulation has led to the break-up of public monopolies, but the growing number of mergers is leading to dominant positions for large private companies.

1.4.2. Nuclear energy

The United States has the world's largest nuclear fleet, with 93 reactors in 65 nuclear power plants. Two reactors are under construction, while 38 reactors have been shut down. The nuclear industry developed very early in the United States, with the first nuclear power plants dating back to the 1950s.

The accident at Three Mile Island in 1979 (when a reactor meltdown began) slowed development. In recent years, however, and despite the decommissioning of several units, nuclear power generation has increased. Reactors that have benefited from major modernization and upgrades are running at full capacity: although nuclear capacity accounts for only 9% of the total power generation capacity in the United States, nuclear generation represents 16% of total production.

In 2016, Tennessee Valley Authority's (TVA) Watts Bar Reactor 2 in Tennessee became the first new US reactor to enter service since the early 1990s. In February 2012, the Nuclear Regulatory Commission (NRC) validated the construction and operating licenses filed by Southern Company to add two new reactors to its plant in Vogtle, Georgia. Units 3 and 4 are the first reactors to receive construction approval in over 30 years. Unit 3 started up in March 2023. Unit 4 could start up in one to two years.

The construction of new reactors seems unlikely in the next few years. Capacity withdrawals and the decommissioning of certain reactors will lead to a reduction in nuclear power generation capacity by 2050 compared to 2020.

1.4.3. Renewable energies

In the United States, 10% of all electricity is generated by wind and solar power. A similar proportion of energy production comes from hydropower. However, reluctance to build large dams is strong, and there are no major hydropower projects in the USA. On the other hand, there are numerous electricity storage by pumping (STEP) systems.

The Southeast, Florida, California, the Southwest and Texas are the most promising regions for solar power development, accounting for around two-thirds of the solar capacity brought online since 2018. This amount remains limited in relation to the total amount of energy produced each year in the United States.

1.5. Oil

Oil is still the United States' main energy source. With the consumption of about 20 million barrels per day, it is by far the world's largest user. Until World War II, the USA produced over half the world's crude oil. But in 1949, the US became an importer and the share of imports grew from 10% of consumption in 1949 to 50% on the eve of the overthrow of the Shah of Iran in 1979.

US production reached a maximum of 11 Mbd (the famous "King Hubbert's" peak announced 10 years before) in 1970. This production declined first slowly, then more rapidly, down to less than 7 Mbd by 2005, making the US import two thirds of their oil requirements.

Production increased from this date, thanks to the development of offshore oil fields in the Gulf of Mexico, and of course because of the production of shale oil. Light tight oil (LTO) is oil produced from low-porosity rock, including shale oil. Production of oil – and similar liquids – in the United States has risen to over 17 Mb/d.

The US exports large quantities of LTO and refined products, while still importing heavy oil from Canada (the majority of US imports) and also from Mexico, South America, Iraq and Saudi Arabia. Many US refineries are complex, designed to produce a lot of gasoline from heavy oil. It is therefore more attractive for the United States to export light oil, such as shale oil, which requires only simple processing to be transformed into fuels, and to import heavy oil.

If we take into account Canada's large oil surplus, North America is now oil-independent.

Refining in the United States

In the end, what counts is the availability of end products (gasoline, diesel, fuel oil, etc.). Although the US was self-sufficient in crude oil and finished products for a long time, from the beginning of the 1980s, falling product demand linked to increased prices led to a reduction in refining capacity. Many refineries closed, particularly the small ones which could not survive in an industry where economies of scale are important. Several inland refineries closed when the local oil fields that supplied them became exhausted.

In total, there are now only 130 refineries operating in America, compared with more than 300 35 years ago. Due to the severity of the anti-pollution regulations and opposition from environmental protection organizations, no refineries have been built for nearly 50 years.

Box 1.2. Refining in the United States

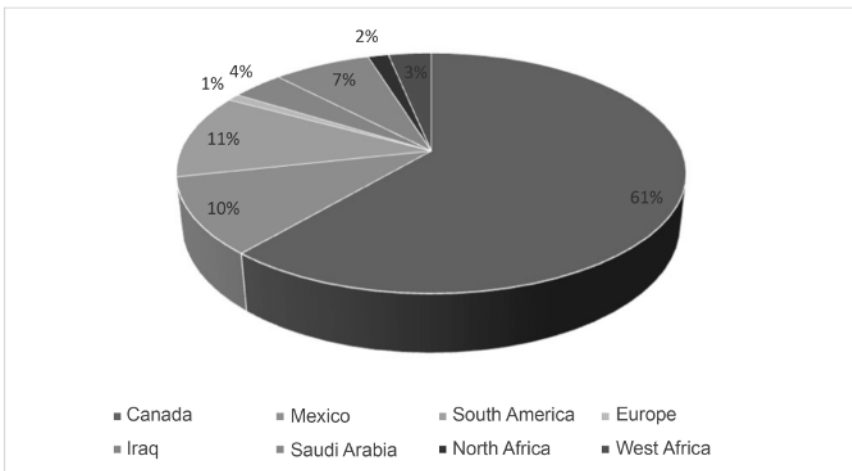


Figure 1.6. US oil imports in 2022 (source: *EI Statistical Review of World Energy 2023*).
For a color version of this figure, see www.iste.co.uk/favenne/geopolitics2.zip

1.5.1. Development of rail transport

In North America, oil pipelines are the main means of transport. However, rail transport has grown in parallel with the development of shale oil production, due to the lack of sufficient pipeline capacity. The Lac-Mégantic disaster in Canada in 2013 demonstrated the dangers of rail transport. In Lac-Mégantic, a freight train carrying crude oil rolled down a hill and derailed downtown, resulting in the

explosion of multiple tank cars; 47 people were killed and more than 30 buildings were destroyed.

Railroads also account for almost 70% of coal and ethanol transport in the USA.

In the USA, four railways dominate the market: two in the East (Northfolk Southern and CSX Corporation) and two in the West (Burlington Northern Santa Fe and Union Pacific). There are two transcontinental lines in Canada (Canadian Pacific Railway and Canada National Railway) and one that stretches from the Midwest to the Gulf of Mexico.

Rail transport will continue to play a key role in the transportation of crude oil in the United States, thanks to its flexibility and rapid turnaround times.

The use of pipelines – oil or gas – is essential, but opposition from environmental groups is holding back their development. A gas pipeline project by Duke Energy and Dominion Energy, planned to stretch over 1,000 km through Virginia, North Carolina and Appalachia, was abandoned in 2020. The project had become too costly and legally uncertain due to opposition from environmentalists, landowners and Native American groups.

1.5.2. *Canada and Mexico*

Canadian oil production currently stands at some 5.6 Mb/d. A network of pipelines transports oil from Western Canada to various parts of the United States. Canada's "conventional" oil reserves stand at approximately 5 billion barrels, but unconventional reserves, mainly from Alberta's oil sands, are in the region of 170 billion barrels. The synthetic oil obtained by processing "bitumen" requires enormous quantities of water and energy.

The province of Alberta is home to the world's third-largest oil reserves, totaling some 170 billion barrels. Over the years, Canada has capitalized heavily on its oil sands reserves and heavy oil development. In fact, these resources now account for more than half of Canada's crude oil production.

Excluding oil sands, Canadian oil is mainly of the heavy type, unsuitable for many uses and more difficult to transport than lighter oil. Canada imports a significant quantity of light oil and exports a portion of its heavy oil by land to the United States. The US has refineries capable of processing it. Very little (~2%) Canadian heavy oil is exported to other countries, mainly because it is not competitive with lighter, more easily transported oil from other countries.

It is interesting to note that while Canada is promoting widespread action on climate change on the international stage, the Canadian federal and provincial governments are pushing to expand oil sand development across the country. The economic benefits of the latter are substantial, but the opposition from environmentalists and indigenous populations is strong.

Pemex

The history of oil production in Mexico started at the beginning of the 20th century. The country rapidly became the main Latin America producer. In 1938, the oil industry was nationalized and the Mexican government created Pemex (Petróleos Mexicanos) which still has total control of the hydrocarbon industry.

Following nationalization, oil production collapsed since American companies refused to buy oil from Pemex and developed production in neighboring countries, particularly Venezuela. Mexican production did not return to levels sufficient for exports to become significant until the 1970s.

A total of 60% of Pemex revenue is paid to the Federal Government which is currently a third of the latter's budget. The size of these payments makes it difficult for the company to invest sufficiently to maintain production and increase the country's reserves. However, the Mexican government has recognized the problem this causes, since in 2004, the company's capital investment budget reached a record \$12 billion; 75% of that was for production facilities. At the same time, President Vicente Fox agreed to provide more opportunities to private companies in the energy sector, while excluding the possibility that government-owned companies – Pemex for oil and gas, and CFE for electricity – would be privatized. On August 11, 2016, laws were passed opening the door to private investment in the oil and gas sector. These allowed Pemex to partner with international oil companies to explore Mexico's deepwater and shale resources through service and profit-sharing contracts. As a result of these laws, Pemex lost its monopoly on the retail sale of gasoline and diesel, but taxes on its profits were reduced.

The United States has been pressing Mexico to stay out of OPEC. Mexico has, however, repeatedly shown its solidarity with OPEC to secure world oil supplies and maintain prices. In March 1999, an agreement between Mexico, Venezuela and Saudi Arabia gave credibility to a further reduction in OPEC quotas. This led to an increase in the price of crude oil, which was necessary to ensure the profitability of operations and to balance the budgets of producing countries.

Mexico is one of 10 countries (along with Russia, Kazakhstan, etc.) which, along with OPEC, make up OPEC Plus.

Box 1.3. Pemex, the Mexican government and OPEC

Mexico is the world's 10th leading oil producer so it is a major non-OPEC player. Its proved reserves are estimated at 11 billion barrels, after being reduced from 50 billion barrels to meet the restrictive evaluation standards of the Securities and Exchange Commission (SEC, New York Stock Exchange). Actual reserves are therefore probably larger.

Today, Pemex continues to experience major difficulties. Its crude oil production fell to 1.8 million barrels per day in 2022, compared with 3.4 million in 2004. Its debt is substantial, to the tune of USD 100 billion.

Andres Manuel Lopez Obrador, in power from December 2018, had a reserved stance on opening up the energy sector to foreign capital. Nevertheless, he has invested USD 10 billion in restoring the accounts of the oil company, considered a strategic asset for the country.

Most of Mexico's exports are destined for its American neighbor. In 2022, Mexico exported approximately 30 million tons of crude oil to the United States, but had to import 55 million tons of products from that country.

Mexican production is largely concentrated in the south of the country near the Gulf of Mexico. Two-thirds of production is from the Bay of Campeche region alone. It includes the giant offshore Cantarell deposit, commissioned at the end of the 1970s, which tripled national production in only a few years. But production from this field is in rapid decline.

1.6. Natural gas

Demand for natural gas in the United States has traditionally been very high. Gas resources are plentiful, facilitating consumption. Twenty years ago, the United States had a deficit, but in recent years, it has become a surplus thanks to the development of shale gas, which now accounts for more than 50% of total production: in 2022, the United States produced 979 billion cubic meters of gas to meet local demand of 881 billion cubic meters. In the same year, it exported 104 billion cubic meters of liquefied natural gas (LNG), mainly to Asia and Europe. The potential for US LNG exports is at least 150 billion cubic meters. The halt in gas deliveries from Russia to Europe has greatly boosted US LNG exports to Europe.

At the beginning of the 21st century, and before the development of shale gas, the USA anticipated a sharp increase in its gas deficit, due to a combination of growing demand and declining production. As a result, many LNG import and regasification terminals were built. With the development of shale gas, many of these import terminals have been transformed into LNG export terminals.

Canada is the world's sixth largest producer of natural gas. Consumption has risen slowly over the past decade, reaching approximately 120 billion cubic meters in 2022. Oil sand production in particular requires a lot of natural gas, as recovery and processing are energy-intensive. In Canada, natural gas is mainly found in the Western Sedimentary Basin.

Mexico's estimated gas reserves have, like those for oil, been revised dramatically downward. Ultimate Mexican gas reserves are probably far greater than those known today, but Pemex have not invested the resources necessary for a systematic study of the gas potential in the country's sedimentary basins. Mexico's gas production is less than its internal demand so limited quantities of gas must be imported from the USA.

The United States has a natural gas surplus, but in 2022, it imported 82 billion cubic meters of natural gas from western Canada and exported 26 billion cubic meters to eastern Canada.

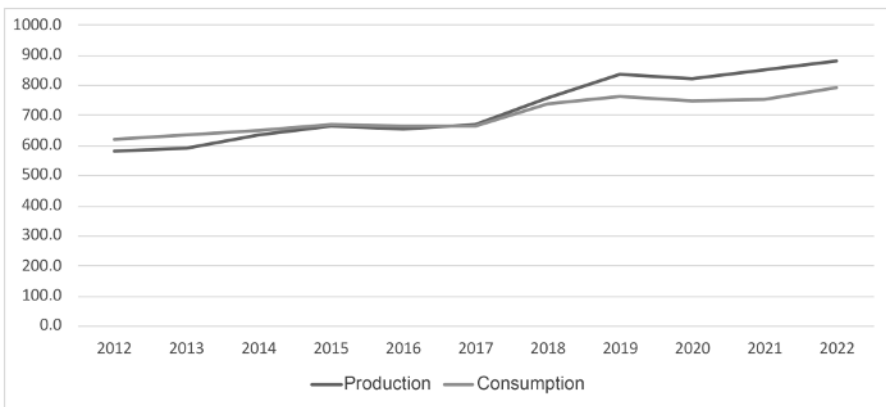


Figure 1.7. *Natural gas production and consumption in the United States in 2022 in Mtoe (source: EI Statistical Review of World Energy, 2023). For a color version of this figure, see www.iste.co.uk/favennec/geopolitics2.zip*

There are many pipelines connecting the American and Canadian markets. An example is the Alliance gas pipeline, which cost USD 2.5 billion and is over 1,200 miles (2,000 km) long, the longest gas pipeline ever built in North America. Its capacity is 35 million cubic meters per day and it delivers gas produced in Western Canada to the Chicago region.



Figure 1.8. *United States non-conventional gas reserves (source: Gastem.ca)*

Deregulation of the US gas industry started in 1978. Since then, the US has experienced a period of overproduction, referred to as the gas bubble, as well as times when supplies have been under pressure. Each of these different phases has highlighted particular problems. Most federal controls over the industry have been abolished, except for regulation of the transport and storage system. This ensures third-party access to the transport and storage system and mandates the separation of transport from marketing. Pipeline tariffs are in two parts, a fixed fee that entitles the user to capacity and a variable element based on their throughput.

Prior to deregulation, a producer had to sell to a transport company; following deregulation, they can now sell to an end user, local distribution company or broker. The selling price is no longer regulated. Previously, transport companies were responsible for supply security; it is now in the hands of purchasers. Users can purchase their gas from the seller that they choose and decide how delivery is to be arranged, i.e. they can contract for gas supply, transport, storage, etc., separately or they can purchase these services bundled. Deregulation means that many industrial and commercial customers who are served by a local distribution network can buy their gas directly from a producer or broker. It is possible to resell unused transport and storage capacity to the owner or on a secondary market.

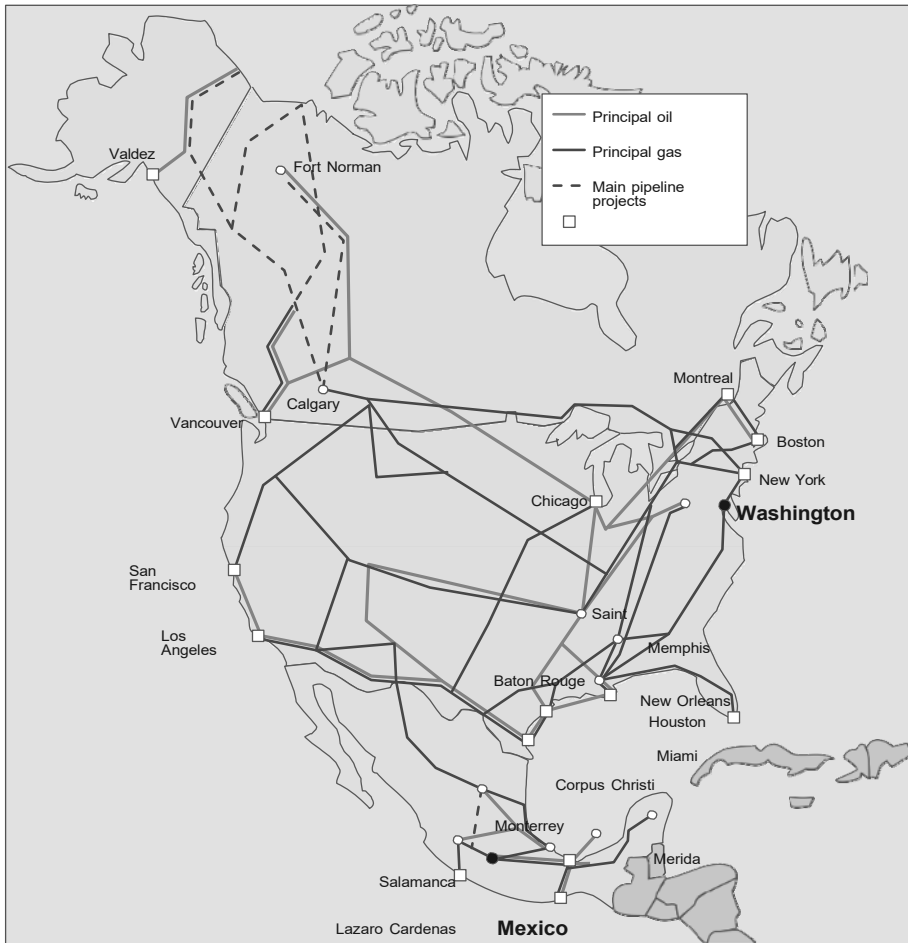


Figure 1.9. *Principal hydrocarbon supply infrastructure in North America. For a color version of this figure, see www.iste.co.uk/favenne/geopolitics2.zip*

Thus, the US natural gas market is open to all. Wellhead gas prices have been decontrolled since 1989. Interstate transport is regulated by the Federal Energy Regulatory Commission (FERC), which ensures non-discriminatory network access for all competing suppliers, controls rates and regulates the construction of new gas pipelines and storage sites. Distribution is regulated by commissions at the state level, which are also responsible for user rates.

1.7. Coal: an important energy source in the United States

The USA has the largest coal reserve in the world at 249 billion tons, which is more than one-quarter of the world total and at the current production level, the reserve could last for more than 350 years! It is also the second largest coal producer after China. A total of 40% of production is in the Appalachians and 50% in the country's western region, particularly in Wyoming, and 90% of national coal production is used in the electricity generation sector. Since the 1990 amendments to the Clean Air Act (CAA), coal's share of the electricity generation market has decreased while the development of cheap shale gas has also increased electricity production from gas.

Canada and Mexico are marginal producers and users of coal. Mexico's production does not meet all domestic demand; the balance is made up with imports from the US, Canada and Colombia. Imported coal costs less than national production. Canada exports its surplus production mainly to Japan and South Korea for steel manufacture.

Coal production in the United States was down almost 50% in 2008. Many mines have had to cease operations. Coal-fired power plants are on average 40 years old, and there is not a single coal-fired power plant project underway or planned at present. Over the past decade, some 500 coal-fired power plants have been closed or prepared for closure.

However, coal exports remain stable and are mainly destined for India, Japan and European countries.

1.8. Agro-fuels in North America

Ethanol production in the United States dates back to the early 2000s. In the wake of the September 11, 2001, terrorist attacks, then-President George W. Bush decided to reduce America's dependence on oil, particularly oil imported from the Middle East. This led to the development of ethanol production as a partial substitute for gasoline. This production is based on corn, but using corn to produce ethanol caused a sharp rise in the price of this cereal, and discontent among poor Mexican farmers whose diet is based on corn.

The United States produces more than half of all ethanol in the world, with over 500,000 barrels per day. It has replaced Brazil as the leading producer. However, this represents only a small percentage of US gasoline consumption.

The environmental benefits of corn-based ethanol are limited, if not negative. It does, however, reduce dependence on imports, and its production is encouraged by subsidies to farmers.

1.9. The United States' energy policy

The United States remains by far the world's biggest energy consumer.

In 2022, the United States became independent in the sense that its coal and gas production far exceeded local demand, and its crude oil production was close to demand (the USA–Canada bloc produced more than it consumed). However, this has not always been the case.

Up to the 1940s, the US produced more than half of the world's crude oil. However, this position very quickly changed and imports became necessary. As imported crude was far less expensive than local production, in 1949 the US established a system of oil import quotas to protect their high-cost domestic producers. Small domestic producers campaigned under the slogan of: “keep out cheap foreign oil”.

Whenever America is faced with the threat of shortages or an embargo, American energy policy yet again becomes a topic of discussion. Following the first oil shock in 1974, President Nixon launched “Project Independence”, a plan to enable the US to recover the energy independence it had lost at the end of the 1950s: “Let us set as our national goal... that by the end of this decade we will have developed the potential to meet our own energy needs without depending on any foreign source”.

This project was unrealistic. In January 1975, Gerald Ford, who had replaced Nixon as president, proposed an impressive plan for the opening of 250 coal mines and the construction of 200 nuclear power plants, 150 major coal-fired power plants, 30 oil refineries and 20 major new synthetic fuel production plants, all within 10 years. Shortly thereafter, Nelson Rockefeller, Vice President and grandson of the Standard Oil founder, proposed a \$100 billion program to subsidize synthetic fuels and new energies. However, in practice, these initiatives led only to the long-delayed construction of the Trans-Alaska pipeline, and fuel consumption standards for American cars requiring improved fuel economy over the total car sales of each manufacturer with tax penalties for non-compliance.

Following the oil counter-shock of 1986 and abundant energy production in the 1980s and 1990s, American concerns about supply security faded. They returned to the forefront with the California crisis in 2000: that was the result of a shortage of

electricity generating capacity in the western USA but it developed into an American energy crisis, with the price of electricity, and that of gas and home heating oil, skyrocketing. However, unlike the crises of the 1970s, which were caused by justified fears of shortages, the crisis of 2000 was more the consequence of poorly managed deregulation of the energy markets¹.

For a long time, the US has prohibited the development of hydrocarbon deposits located in federal National Parks and National Wilderness Areas. The quantities involved can be significant: one American geological study in 1998 estimated the technically recoverable reserves of the Alaskan National Wildlife Refuge (ANWR) at about 10 billion barrels, with a production capacity of up to, or even exceeding, 1 million barrels per day. So American policy faces a dilemma: to choose between environmental concerns and security of supply. Environmental concerns will prevail.

Energy type	Canada	Mexico	Latin America	Europe	Australia	China	India	Japan	Singapore	Other Asia – Pacific	Total
Oil (Mtoe)	16.8	–	10.6	77.7	1.1	7.9	16.9	1.3	10.6	30.0	172.9
Natural gas (Gm ³)	26.2	56.5	6.5	72.1	–	2.6	3.3	5.6	0.6	11.8	185.2
Coal (Mtoe)	3.2	0.4	5.7	21.3	0.0	2.9	6.9	6.1	3.1	0.2	53.7

Table 1.1. US energy supply in 2022: exports
(source: *EI Statistical Review of World Energy*, 2023)

Energy type	Canada	Mexico	Latin America	Europe	Russia and CIS	Iraq	Saudi Arabia	Gulf (excluding Saudi Arabia)	North Africa	West Africa
Oil (Mtoe)	188.9	31.7	35.1	2.9	2.1	12.2	22.7	1.9	4.8	10.0
Natural gas (Gm ³)	82.1	–	–	–	–	–	–	–	–	–
Coal (Mtoe)	No coal imports									

Table 1.2. US energy supply in 2022: imports
(source: *EI Statistical Review of World Energy*, 2023)

This situation was highlighted by the 2010 accident on the Deepwater Horizon platform operated by BP in the Gulf of Mexico at the Macondo site. The explosion on this drilling platform, triggered by gas leaks after an exploration well had been cemented (capped), led to the death of 11 people and the spilling of vast quantities of oil (5 million barrels) into the Gulf. It took four months to plug the hole. The oil spill led the government to attempt to impose a moratorium on offshore drilling.

¹ Failure by design: the main reason for the California crisis was the maintenance of price caps on retail electricity sales, while local operators had to buy their electricity wholesale at a prohibitive rate due to insufficient production.

1.9.1. American foreign policy and supply security

Despite the drastic reduction in oil imports from the Middle East, the concentration of global reserves in this part of the world means that the United States must pursue a foreign policy that ensures reliable long-term supplies for itself and the rest of the West.

At the end of the 1990s, a report by George Tenet, then head of the CIA, describing the increasing difficulties with the Middle East, particularly due to the Israeli–Palestinian conflict, and affirmed the need to reduce dependence on this zone by focusing efforts on the Caspian and above all the Atlantic: Latin America (Venezuela and Mexico), Africa (Gulf of Guinea) and the Maghreb. The objective was to find new resources in order to put pressure on Middle Eastern producers. This American energy policy was thus consistent with and a continuation of measures taken by Presidents Carter and Reagan: develop the global oil business and ensure it can function correctly by securing transport routes and developing new supply sources.

The spectacular development of shale oil has put an end to this diversification of supplies. Current crude oil imports come mainly from Canada (60%) and Mexico (10%). Imports from the Middle East, which were still very significant 10 years ago, now account for less than 5% of US crude oil consumption.

1.9.2. Donald Trump's energy policy

It is interesting to revisit the goals of Donald Trump, president from 2017 to 2021. Broadly speaking, the American president's energy policy was fivefold:

- supporting the Keystone XL pipeline (a pipeline designed to transport oil from Canada to the Gulf of Mexico);
- allow drilling on federal lands wherever it was restricted;
- revitalize the moribund US coal industry;
- lift existing restrictions on energy production;
- provide limited support for solar and wind energy production.

However, despite the Trump administration's attempts to revitalize the coal sector, demand for coal has declined as power companies increasingly turn to gas and renewables. Since 2015, nearly 40 GW of coal-fired power plants have been closed, and closures continue. Coal demand nevertheless remains stable among traditional importers such as Japan and South Korea.

Following his nomination, Donald Trump overrode President Barack Obama's veto of the Keystone XL pipeline project. This pipeline, over 1,900 km long and costing approximately USD 8 billion, was to transport 830,000 barrels of crude oil from Alberta's oil sands to the southern United States every day. The project was delayed, and the arrival in the office of Joe Biden brought it to a definitive halt.

During Donald Trump's tenure, the number of applications for drilling permits on federal and Indian lands quadrupled, particularly in New Mexico and Wyoming. The review of applications also accelerated: it took an average of 257 days to obtain a permit under the Obama administration, while under the Trump administration, it took just 108 days, according to the Department of Energy (DOE).

In 2020, the Trump administration proposed amending the Clean Water Act. This would make it easier to discharge water used by the coal, oil and gas industries by limiting constraints on polluting elements. Trump's defeat in the 2020 election prevented any amendments to the Clean Water Act. It should be noted, however, that almost 50% of water is not controlled.

1.9.3. Joe Biden's energy policy

Following his election in late 2020, President Biden pledged to take immediate action as soon as he took office. In his first week in office, January 2021, he signed a landmark executive order entitled "Addressing the Effects of the Climate Crisis at Home and Abroad". In it, he formulated a number of commitments aimed at reducing US greenhouse gas emissions while ensuring the security of American jobs. With this gesture, the new president placed climate policy at the heart of American politics.

Joe Biden ordered a freeze on new oil and gas leases on federal lands, cancelled the Keystone XL pipeline project and stepped up the development of renewable energies, especially wind and solar.

Joe Biden's executive order on climate action has several key elements, including:

- a goal of achieving a clean electricity sector by 2035;
- a goal of doubling offshore wind energy production by 2030;
- the elimination of fossil fuel subsidies;
- reaffirmation of the 2015 Paris Agreement and reinstatement of NDCs.

One of the cornerstones of this policy is financing. The administration is committed to promoting and securing the flow of capital to climate-friendly investments and, conversely, to eliminating investment in carbon-intensive projects. To achieve this, US contributions to the Green Climate Fund and multilateral climate organizations – such as the Adaptation Fund and the Least Developed Countries Fund – will be increased. This will help integrate climate constraints into all development financing, and encourage development banks to align with the goals set out in the Paris Agreement.

To make this effort a reality, a new position has been created: the President's Special Envoy for Climate. The Special Envoy is a member of the US National Security Council (NSC) and carries more weight than Barack Obama's former Director of the White House Office of Energy and Climate Policy. This reflects a recognition of the climate crisis and its impact on the country's national security. This new position is currently held by former US Secretary of State John Kerry.

From an operational point of view, the Biden administration envisages an all-of-government approach that engages all levels of governance in the country, involving federal, local and even tribal authorities.

1.9.4. *The regulatory framework: an overview*

The first US anti-pollution measures were enacted in 1955, but the principal air quality control measures started in 1970, with the Clean Air Act and the creation of the Environmental Protection Agency (EPA). The EPA is an independent US government agency whose mission is to protect the health of American citizens and preserve the environment. Its Administrator is appointed by the President and approved by the Senate. It produces and enforces regulations on activities likely to have an impact on the environment, and manages research centers specializing in these issues.

In 1990, the Clean Air Act Amendment (CAAA90) brought in a group of measures to decrease pollutant emissions for power plants and also proposed measures concerning acid rain and alternative fuels like ethanol.

Further measures (Clean Skies Initiative) have been taken to limit pollutant emissions from major coal-fired power plants.

The EPA has also decided to tackle the veil of pollution which affects the views at more than 150 of the country's National Parks, particularly the famous Grand Canyon and Yellowstone Park.

1.10. Geopolitics: relations with Saudi Arabia

In 1945, President Franklin Roosevelt met King Ibn Saud on the cruiser USS Quincy. This meeting laid the foundations for bilateral relations between Washington and Riyadh. It resulted in an informal pact guaranteeing Saudi Arabia military protection in exchange for Western access to the kingdom's vast oil and gas resources, in particular for the American companies that were to create Aramco. The Quincy Pact served as the basis for diplomatic relations between the two countries for decades to come.

Although Saudi crude accounted for less than 10% of US imports in 2022, compared with 15% in 2011, Saudi Arabia has not lost its status as an essential partner of the United States. It cooperates with American security policy and authorized three American military bases on its territory in order to reduce instability in the region and the impact this would have on oil prices.

Overall, the two countries are closely linked by common strategic and energy interests (see Chapter 7 on the Middle East). The American intervention in Kuwait in 1991 was designed to prevent Iraq from controlling 20% of the world's crude oil reserves (the total reserves of Iraq and Kuwait), and to threaten Saudi Arabia and the United Arab Emirates, which respectively hold 17% and 5% of the world's reserves. In addition to liberating Kuwait, the military intervention of a vast coalition was also intended to protect Saudi Arabia.

However, this alliance between the world's largest democracy and one of its most absolute monarchies is not always harmonious. The 9/11 attacks exacerbated the growing grievances between the two partners. Washington criticized Riyadh for using its oil wealth to finance terrorist groups (15 of the 19 terrorists who hijacked the planes and rammed them into the World Trade Center towers and the Pentagon carried Saudi passports, and Osama bin Laden himself was of Saudi origin). The regime's lack of democracy is an obstacle to the Greater Middle East project long cherished by the United States. The murder of journalist and opponent Jamal Kashoggi in 2018 in Istanbul cast a pall over relations between the two countries. Conversely, the Saudis are irritated by the criticism they receive in the American media (Kashoggi was a regular contributor to the Washington Post) and by the United States' unconditional support for Israel, the sketchy Israel-Saudi rapprochement possibly mitigating the latter.

As long as oil remains important, Saudi Arabia will continue to play the leading role in the black gold market. Physical independence (US imports of Saudi crude are now limited) does not make the USA immune to political upheavals in the Middle East: the oil market is international, and an incident at an oil field or refinery in the Middle East affects prices worldwide.

In the 21st century, the Washington–Riyadh axis continues to be an important element in oil geopolitics. However, the numerous visits by Chinese leaders to Riyadh and Saudi leaders to Beijing demonstrate the extreme importance Beijing attaches to the only country whose oil exports are large enough to meet China's needs. The rapprochement between Saudi Arabia and Iran, largely inspired by Beijing, bears witness to the transformation of geopolitics in the Middle East. Prince Mohammed bin Salman's main preoccupation is now the country's economic and cultural development, which requires a calming of conflicts with neighboring countries, and in particular with Iran. This could lead to a gradual end to the conflict in Yemen, where Saudi Arabia has been embroiled for many years.

The Hamas attack on Israel on October 7, 2023, and the ensuing conflict in the Middle East could change the situation, even if for the moment the position of the Arab countries in the conflict remains moderate.

1.11. Iraq: American intervention

The United States first supported the establishment of Saddam Hussein's regime as a bulwark against communism and then against Iran's Islamic regime (1980s). After August 2, 1990, and Iraq's invasion of Kuwait, the United States turned against the Iraqi regime (see Chapter 7).

A decade later, in March 2003, the United States invaded Iraq and overthrew the regime. The official reason was the threat of weapons of mass destruction, although the presence of such weapons has never been proven. The main reason was rather the desire to eliminate a dictatorial regime accused, wrongly, of aiding terrorism, and particularly Al-Qaeda. The US government, strongly influenced by neo-conservatives, abandoned the policy of multilateralism that had governed international relations since 1945 and sought to re-establish democracy in Iraq through the elimination of Saddam Hussein. This, by a reverse application of the domino theory², would lead to flourishing democratic regimes in neighboring countries.

Oil of course was relevant to this invasion. At the end of the 1970s, the Carter Doctrine, named after President Jimmy Carter, stated officially that the US would do everything possible, including the use of military force, to ensure that it would receive the energy supplies it needed and that the oil flow to the USA would

2 In the 1960s, the domino theory was used to justify US intervention in Vietnam. The Americans thought that if Vietnam fell to communism, neighboring countries would also fall. Neither the fall of the Vietnamese regime, until then supported by the Americans, in 1975, nor the fall of Saddam Hussein's regime in 2003 had the predicted results.

continue unhindered. So, an additional motivation for this armed intervention was to have an alternative favored partner to Saudi Arabia.

Clearly, the result of the US intervention was a disaster. Iraq has always been a complex country to manage. The country is split between an important Kurd minority, a Shia majority and a Sunni minority, and Saddam Hussein was relying on this Sunni minority to ensure his power. The decision of the US authorities directed by Paul Bronner to fire all the soldiers and the hierarchy of Saddam Hussein was a huge mistake. The creation of the Islamic State (Daesh) is one of the consequences of this decision. The Sunni generals fired by Bronner turned their feet towards Daesh.

However, after three years of fighting against Daesh, which had seized Mosul in 2014, territorial victory against the terrorist organization was proclaimed in December 2017. Iraq then entered a phase of stabilization, reconstruction and reaffirmation of its sovereignty.

Oil production remained low for many years after 2003 because of insecurity in the country. In 2009, the government allocated to various companies (IOC, Chinese companies) fields already discovered but which were never developed because of the political situation (war between Iran and Iraq, 1980–1988; embargo on Iraq exports after the invasion of Kuwait by Iraq on August 2, 1990, and the consequent sanctions which lasted up to the end of Saddam). Production could have been expected to grow to 10 Mb/d, based on the potential of the fields. Present production is only 4.2 Mbd, which is much higher than the production after the fall of Saddam, but much lower than the target. This is mainly because of technical problems as well as for geopolitical reasons: could Iran and Saudi Arabia accept Iraqi production rising to between 5 and 10 Mbd?

1.12. Tensions with Venezuela

Since coming to power in 1999, up to his death in 2013, President Chavez has increased his criticism of US policy, which even led to economic sanctions being imposed by the Clinton administration. The close relations between the Venezuelan President and the Castro regime in Cuba only made things worse.

The developments of LTO production in the US and the fall in the Venezuelan production have made the US much less dependent on Venezuelan crude.

In 2013, after the death of Chavez and the election of Nicolas Maduro, tensions with the United States increased. In 2019, the opposition between Nicolas Maduro

and Juan Guaido, president of the National Assembly since January 2019, seemed to have temporarily challenged Maduro's legitimacy. In January 2019, the United States imposed sanctions on PDVSA, Venezuela's state-owned oil and natural gas company, to put pressure on Maduro. These sanctions froze payment options and therefore oil exports to the United States (see Chapter 2). However, in March 2022, shortly after Russia's invasion of Ukraine, the sanctions were partially relaxed and Chevron was authorized to resume production activities in Venezuela. In 2023, the situation seemed stable but rather confused. Power remained essentially in Maduro's hands, and the opposition remained... the opposition.

1.13. Russia: complex relations

US–Russia relations have changed, at least for a period of time, since the September 11th attacks: Russia took advantage of the situation to emphasize its return to the concert of great powers. Criticism of the Russian government's actions in Chechnya abated and a coalition against terrorism was formed. However, George W. Bush's second term, which he devoted to the fight for democracy, including American financial support for peaceful revolutions in Russia's neighboring countries (Georgia in 2003, Ukraine in 2004, and Kirgizstan in 2005), marked a return to mutual mistrust.

The crisis in Ukraine (2014) and the attachment of Crimea to Russia have further deteriorated the situation.

Another source of tension was the Nordstream 2 pipeline (which doubled the Nordstream 1 pipeline commissioned in 2012). The pipeline had a capacity of 55 billion cubic meters and cost approximately EUR 10 billion. The United States was fundamentally opposed to the project, fearing that the pipeline would not only increase Europe's dependence on Russian gas, but also that Russian gas would compete with US LNG. Through the Countering America's Adversaries Through Sanctions Act (CAATSA), Washington had put in place several sanctions in 2017 to get the project abandoned. The Biden administration, which was also hostile to the project, finally accepted it under pressure from Chancellor Merkel, and the project was due to come on stream in 2022. However, Russian intervention in Ukraine in February 2022 led to the project being blocked by the German authorities. Russia gradually halted all gas pipeline exports to Europe, and in September 2022 the Nordstream 1 and 2 pipelines were sabotaged and out of action.

Russia's invasion of Ukraine in February 2022 of course further damaged relations between the US and Russia, with the US being Ukraine's main supporter through massive financial and military aid.

A conflict has also developed between Turkey and the United States over the Turkstream gas pipeline. This pipeline links Russia to Turkey via a pipe that runs under the Black Sea. Part of the gas continues via another pipeline to European countries such as Bulgaria and Hungary. This project is in competition with gas pipeline projects (not yet finalized) that could come from the eastern Mediterranean, where major deposits have been discovered (Israel, Egypt, etc.). Tensions have been heightened by Turkey's military intervention in Libya in exchange for the right to drill in resource-rich areas.

1.14. Caspian Sea: a good swing supplier

Although this area is no longer considered to be the “new Saudi Arabia”, the USA remains very active in this complex region, which is a good swing supplier. Their strategy is preventing the development of any project for the delivery of hydrocarbons via Iran, and not allowing Russia to maintain the monopoly it has always enjoyed over the pipeline infrastructure from the Caspian region. This policy led to the construction of the Baku–Tbilisi–Ceyhan pipeline, led by BP and inaugurated in 2006, which delivers Azeri oil to the west via Georgia and Turkey, carefully avoiding Iran and Russia. However, due to the region's limited oil production and the increase in liquid production on American soil, US interest in the region has waned. On the other hand, Europeans remain interested in Azerbaijan's resources, particularly following the cessation of Russian gas supplies. The TANAP pipeline (see Chapter 3) transports Azerbaijani gas to Europe.

1.15. The lifting of sanctions against some producing countries

On April 23, 2004, sanctions against Libya, imposed 20 years earlier because of the bombing of the Pan Am Boeing 747 over Lockerbie and the Libyan government's support of groups considered to be terrorists, were partially lifted. Libya probably has the largest oil and gas reserves in Africa, with the potential to increase its production substantially. Oil (and subsequently gas) production in Libya started in the 1960s with American companies participating. After the 1969 revolution, Libya's new strongman, Colonel Gaddafi, decided to restrict production, before driving the negotiations with the oil companies that resulted in the Tripoli Agreements. That led to a substantial increase in crude oil prices in 1971. Gaddafi subsequently nationalized the Libyan assets of all foreign oil companies.

American companies were the first to benefit from the new exploration–production contracts offered by the government when sanctions had been lifted. The experience they had gained from 40 years of working in Libya meant they had good

knowledge of the fields and they also have the favorable opinion of their former Libyan partners.

Since the “Arab Spring” and the death of Gaddafi in 2011, the situation in Libya has been chaotic. There is a conflict between the western part (Tripolitania around Tripoli) controlled by the General National Congress, the eastern part (Cyrenaica around Benghazi) controlled by the Libyan National Army, and Fezzan, in the south. A new government backed by international organizations came to power in March 2016.

On the oil front, the situation has remained uncertain. Oil production, which was close to 1.8 Mb/d before 2011, has declined and remained highly variable for several years. Due to the conflict between Marshal Khalifa Haftar and the government of national unity, oil production and exports were blocked several times over recent years by the pro-Haftar forces. They control most of the infrastructure and believe that the rent generated by the oil sector is not sufficiently shared between the two groups. For the past two years, production has been approximately 1 Mb/d.

1.16. Relations with Iran

Unlike the position in Libya, the D’Amato Law, enacted in 1996 and renewed in 2001 for a further five years, continued to provide for sanctions on Iran for several years (the law penalized any non-American company that invested more than \$20 million in Iran).

Iran’s nuclear program and Tehran’s support of Hezbollah were for a long time sources of tension between the two countries. Long negotiations on the nuclear program came to an agreement on July 14, 2015. In exchange for the freezing of the military nuclear program of Iran, the “5+1” (USA, Russia, China, UK and France – permanent members of the Security Council of the UN – plus Germany) accepted to progressively suspend the sanctions. Iran immediately announced that its oil production would increase quickly by 0.5 and then by 1 Mbd.

Relations between Washington and Tehran deteriorated again with the election of Donald Trump. In 2018, Trump withdrew the United States from the 2015 agreement and reimposed economic sanctions on Iran. The attacks on Saudi oil facilities in September 2019, no doubt inspired by Iran, came in retaliation for the resumption of these sanctions. In January 2020, the United States eliminated one of Iran’s most influential military leaders, Qasim Soleimani, in a drone strike at Baghdad airport, along with Abu Al-Muhandis, a figure from Iraq’s Shiite majority. The solemn funeral of Soleimani, who commanded the elite Revolutionary Guards,

helped to stir up strong nationalist sentiment in Iran and further deteriorate relations between the United States and Iran.

Renewed negotiations to bring the US back into the nuclear deal after Joe Biden's election could lead to a new agreement, but there are still many obstacles to overcome (e.g. the US has to drop its classification of the Revolutionary Guards as a terrorist organization).

Of course, the October 7th attack of Israel by Hamas, close to Iran, and the subsequent war between Israel and Hamas make the situation unclear.

1.17. Conclusion

The United States has enormous reserves of fossil fuels. It has large coal resources, and the shale oil revolution has made it a major gas exporter. The US imports only limited quantities of oil (mainly from Canada), but exports shale oil (LTO) and finished products. Together with Canada, which has a liquid surplus, they are now self-sufficient in fossil fuels.

The change of administration in early 2021 has transformed, at least in terms of objectives, US energy policy. This policy, very much oriented under the Trump administration towards protecting coal production and the workers who depended on it, as well as facilitating oil production, has been largely inflected by the Biden administration.

However, the interests of fossil fuel producers remain very important and will limit any reduction in fossil fuel production. The coal, oil and gas industries represent considerable interests. The workforce employed by these industries is very large. It is therefore difficult for American leaders (the situation in Canada and Mexico is similar) to implement policies that would rapidly reduce the share of fossil fuels.

This situation is very different from that seen in Europe, highlighting some of the difficulties involved in the necessary energy transition.

The United States, however, has vast potential for renewable energy production. After China, it has the largest wind and solar power production capacity in the world. A gradual, but perhaps slow, transition to renewable energies is inevitable.