SOVEREIGNTY THROUGH DECARBONISATION

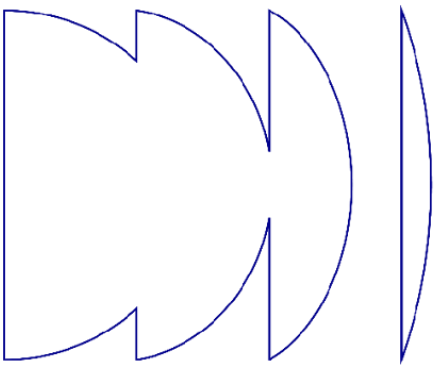
NECESSARY PATH FOR FRANCE AND EUROPE

Final report – november 2025

AS PART OF THE
ROBUST PLAN FOR THE FRENCH ECONOMY

THE SHIFT PROJECT

Texte source (inchangé)	*Traduction anglaise (institutionnelle, idiomatique, sans interprétation)*
LA SOUVERAINETÉ PAR LA DÉCARBONATION	*SOVEREIGNTY THROUGH DECARBONISATION*
VOIE NÉCESSAIRE POUR LA FRANCE ET L'EUROPE	*A NECESSARY PATH FOR FRANCE AND EUROPE*
Rapport final – novembre 2025	*Final report – November 2025*
DANS LE CADRE DE NOTRE	*AS PART OF OUR*
PROGRAMME D'ACTION POUR 2027	*ACTION PROGRAMME FOR 2027*
LE THINK TANK DE LA TRANSITION BAS CARBONE	*THE THINK TANK FOR THE LOW-CARBON TRANSITION*
THE SHIFTERS	*THE SHIFTERS (inchangé car nom propre)*
THE SHIFT PROJECT	*THE SHIFT PROJECT (inchangé car nom propre)*



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Editorial

France and Europe are rediscovering to their cost that any form of power requires adequate sources of energy. No form of power is as great or as versatile as the one brought by fossil fuels — provided that one has access to them.

The grip exerted by major fossil-fuel-producing powers over Europe stems from the fact that the continent imports almost all the oil and natural gas it consumes. By reducing its purchases of hydrocarbons from Russia, Europe has increased its dependence on the United States. Yet Europe's dependence on Russia has not been broken. Although France reduced its gas consumption by 24% between 2021 and 2024, one third of its liquefied natural gas imports still came from Russia last year. Moreover, both France and Europe remain dependent on the "embodied energy" contained in the goods they import, particularly from China, an industrial power built on coal.

European industry is threatened by recession because it has largely based its competitiveness on natural gas — a resource over which it has now been forced to relinquish control. Outside Russia, the only significant source of hydrocarbons in Europe, the North Sea, has been running dry for more than twenty years. Inexorably and unsurprisingly. Despite this depletion, and despite its decarbonisation objectives, the EU allowed its natural gas consumption to grow by 20% between the invasion of Crimea in 2014 and the eve of the invasion of Ukraine in 2021.

To regain its economic sovereignty and meet its climate objectives, Europe must cease to depend on fossil fuels that are largely exhausted on its own territory. It must rely on low-carbon energy sources over which it has local control: renewables and nuclear power.

Sovereignty and decarbonisation are therefore one and the same challenge. To meet this challenge, Europe must confront the limits to its power. For both physical and industrial reasons, our domestic low-carbon energy sources cannot, on their own, sustain the level of energy currently mobilised through fossil fuels.

For the sake of the climate and its strategic autonomy, France and Europe have no choice but to reorganise their vital economic functions — industry, agriculture, transport, services, and so on — so as to make them as independent as possible from coal, oil and gas. Combining electrification, efficiency and sufficiency offers a way to halt climate catastrophe while escaping the growing constraints on our access to fossil fuels.

The novel concepts of energy exposure and energy footprint shed light on a blind spot at the intersection of sovereignty and decarbonisation issues, and they bring encouraging news: the energy required by France is consumed overwhelmingly on French territory or by industries located in Europe (80%). France, thanks to its membership of the European Union, is therefore in a position to act. In this report, we propose a definition of these new concepts and detail their quantification for the specific case of France.

Matthieu Auzanneau, Director of The Shift Project

Introduction and key messages

Fossil fuels lie at the heart of the economy and our current ways of living. They expose France and Europe to **a dual carbon constraint:**

- Climate change, caused primarily by fossil fuels, exposes us to irreversible consequences: heatwaves, droughts, floods

- The downturn of fossil fuels exposes the European Union to risks in oil and gas supply over the coming decades. This is already manifesting itself through economic and geopolitical tensions…

Today, this dependency on fossil fuels also threatens the sovereignty of France and Europe. No form of sovereignty can be sustainably realised without sovereignty in the energy sphere. In the current uncertain international landscape, decarbonisation becomes an imperative for our sovereignty, in order to guarantee the long-term competitiveness and resilience of our society and economy.

Sovereignty is multidimensional. This report examines the vulnerabilities of our sovereignty in the domain of energy, from energy production to energy consumption, and the conditions underpinning it.

In 2024, The Shift Project published an initial analysis of the programmatic component of the draft law on Energy Sovereignty (PJLSE), which had been submitted and then withdrawn by the government at the time. The purpose of this text was to address a decisive issue for the country: the control of its energy, and therefore of its power. Indeed, access to and control over energy remain essential conditions for a country's economic security and for any energy strategy, particularly in the increasingly fragmented and uncertain geopolitical landscape we are facing today. They determine the country's capacity to act upon the physical world, to produce, build and maintain its infrastructure, to ensure the continuity of essential services, and to meet the needs of our businesses as well as the aspirations of its citizens. In other words: to gain greater control over our destiny.

For The Shift Project, this draft law left too many blind spots to enable the development of a long-term policy consistent with our strategic interests. Behind the words "energy sovereignty", the debate was in fact confined to narrow technical and political considerations, without questioning the physical foundations of our energy dependencies—limits that are nonetheless key to the country's sovereignty:

- most often limiting itself to energy produced on national territory — essentially nuclear electricity, which accounts for only 27% of the energy mix, thereby reducing the debate to an opposition between sectors

- at best focusing on energy that is directly imported and consumed domestically. It is this second perspective which, taken up in official statistics to objectively assess our degree of autonomy, leads to the "energy independence" ratio

calculated by the government at 50.6% and 56.3% for 2022 and 2023[1] respectively. As we shall see, the Shift proposes a different metric and a different scope for this energy independence ratio.

Both these approaches, however, overlook the true extent of the role of energy for France. Whenever we generate wealth, either imported or exported, energy is involved — whether it is consumed on our territory or elsewhere to manufacture what we consume. This energy may be used in our industries and our vehicles, but also in other countries to produce the goods and services we import. This is what we refer to as "embodied energy", not accounted for by traditional measurement tools and consumed in factories located abroad — in China, India, Russia or the United States. These production chains, on which we became heavily dependent over the course of the twentieth century, supply our markets and, implicitly, shape our exposure to energy-related risks. These dependencies, often invisible, represent potential vulnerabilities, exposing France to the uncertainties of its suppliers or to the strategies of its rivals ready to exploit our weaknesses in terms of sovereignty.

A year and a half later, while the third Multiannual Energy Programme (PPE-3) has still not been published and an increasing number of parliamentarians are calling for a national debate on energy policy, the current geopolitical context highlights the urgency of analysing our real energy dependence.

Measuring the energy required for France's operation: an unprecedented modelling through energy exposure

The Shift Project team has developed a modelling tool that tracks all stages of energy production and consumption, even accounting for the energy embedded in imported goods and services, known as 'grey energy[2]'. The calculations highlight our energy exposure — in other words, the energy required for the country to operate:

to sustain French lifestyles — powering a boiler for heating, cultivating and processing foodstuffs for nourishment, running private vehicle engines, ensuring the production — both domestically and internationally — of goods consumed in France, etc.;

to supply French economic activities — operating factories, maintaining networks, transporting goods, fuelling agricultural machinery, heating buildings, etc.

Energy exposure encompasses both lifestyles and economic activities. The activities of businesses and lifestyles in France require energy both within the territory (in our buildings, vehicles, factories…) and beyond (production of imported goods and services, freight transport…).

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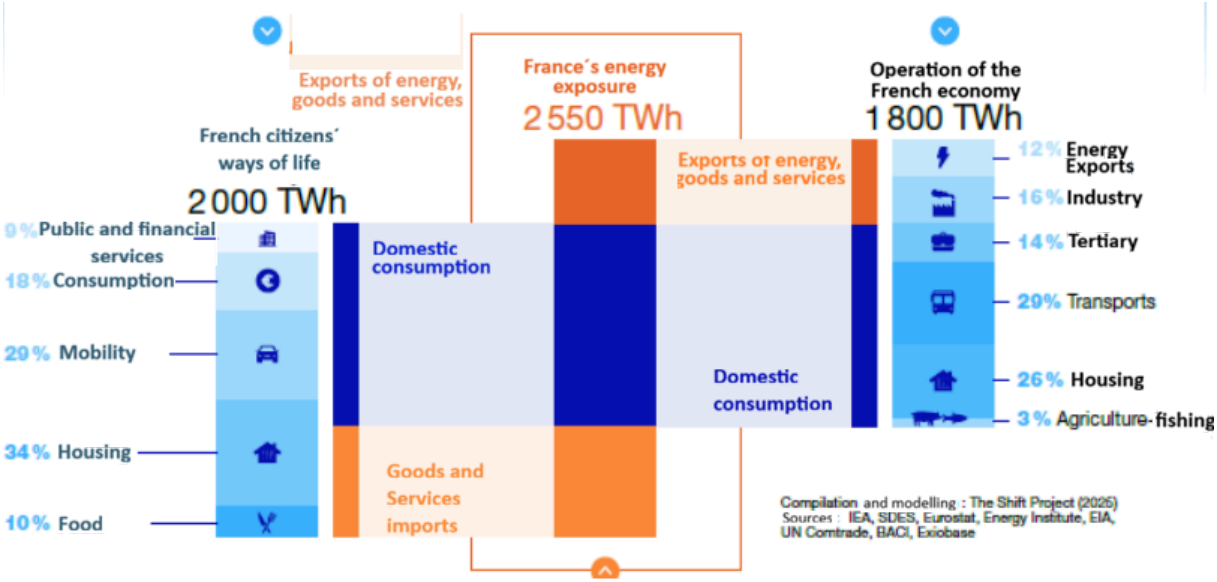
[1] *"The energy independence rate, defined as the ratio of primary consumption to primary production, increases by 5.6 points, reaching 56.3%."* Source: Statistique publique de l'énergie, des transports, du logement et de l'environnement (SDES). Bilan énergétique de la France pour 2023 [*France's Energy Balance for 2023], 2025.*

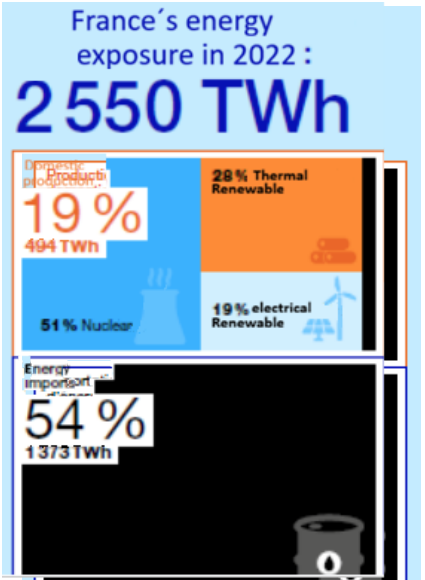
[2] Grey energy refers to the energy not accounted for in traditional measurement tools and consumed in factories located abroad, such as in China, India, Russia or the United States.

The concept of France's energy exposure includes energy consumed domestically, energy associated with our imports of goods and services, and energy embedded in our own exports. For us, this is the most comprehensive calculation method to reveal our energy dependencies.



Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Soutenir les modes de vie des Français	Supporting the ways of life of French citizens
L'ensemble des besoins d'une population repose sur de l'énergie : alimenter une chaudière pour se chauffer, produire des denrées alimentaires pour se nourrir, faire tourner le moteur des véhicules particuliers, etc.	All the needs of a population rely on energy: powering a boiler for heating, producing food to eat, running private-vehicle engines, etc.
Modes de vie des Français	Ways of life of French citizens
Consommation domestique	Domestic consumption
Importations de biens et de services	Imports of goods and services
Alimenter les activités économiques françaises	Powering French economic activities
Tous les secteurs d'activité ont besoin d'énergie pour faire fonctionner des usines, maintenir des réseaux, transporter des marchandises, alimenter des engins agricoles, chauffer des bâtiments, etc.	All sectors of activity require energy to operate factories, maintain networks, transport goods, power agricultural machinery, heat buildings, etc.
Exposition énergétique de la France	France's energy exposure
Fonctionnement de l'économie française	Operation of the French economy
Exportations d'énergie, de biens et de services	Exports of energy, goods and services
Compilation et modélisation : The Shift Project (2025)	Compilation and modelling: The Shift Project (2025)
Données : IEA, SDES, Eurostat, Energy Institute, IEA, UN Comtrade, BACI, Exiobase	Data: IEA, SDES, Eurostat, Energy Institute, IEA, UN Comtrade, BACI, Exiobase *(inchangés car noms propres)*

France's exposure to energy risk



2,550 TWh were required for France to operate in 2022, in order to support French citizens´ lifestyles and the national economy. This represents France's total exposure to various types of energy risks: fossil fuel supply, industrial dependency, geopolitical tensions and so on. It is:

- Five times more energy than that produced on French territory.
- 70% derived from fossil fuels (mainly oil and natural gas). Although France generally produces enough electricity to

cover its current electricity consumption, this does not account for the share of fossil fuels still used, both in France and abroad, for transport and heating, and for producing the goods and services we consume.

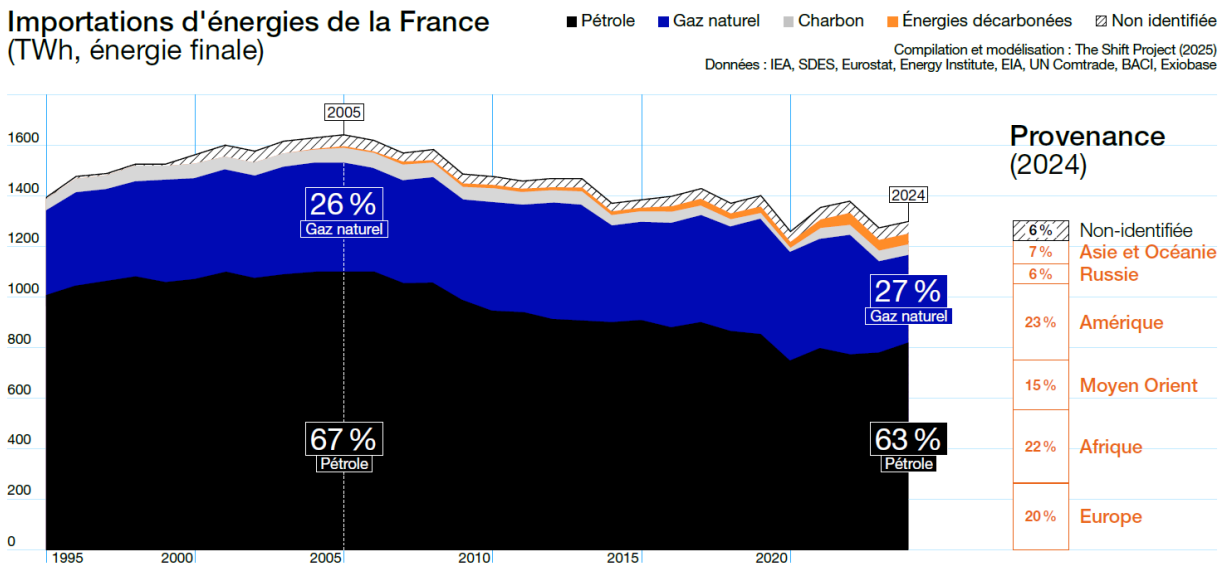
Also,

- 80% of the energy required for France's operations is used in France or in Europe. Decarbonising at the European level would significantly strengthen France's sovereignty.
- 25% of our energy exposure is linked to 'grey energy' embedded in goods and services imported by France — this is more than the total energy the country produces annually.

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Exposition énergétique de la France en 2022	France's energy exposure in 2022
Production domestique	Domestic production
Renouvelables thermiques	Thermal renewables
Nucléaire	Nuclear
Renouvelables électriques	Renewable electricity
Importations d'énergie	Energy imports
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Autres	Others
Importations de biens et de services	Imports of goods and services
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
É Nerf thermique	Thermal renewable energy *("Thermal RenE")*
É Nerf électriques	Renewable electricity *("Electrical RenE")*
Non identifié	Unidentified

Directly imported energy: imports composed of 90% oil and gas.

France imports three times more energy than it produces. Composed almost exclusively of oil and gas, France's energy imports have been declining since 2005, driven by a reduction in imported oil. At the same time, oil consumption has fallen across all sectors except transport.



Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Importations d'énergies de la France	France's energy imports
(TWh, énergie finale)	(TWh, final energy)
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Énergies décarbonées	Decarbonised energies
Non identifiée	Unidentified
Compilation et modélisation : The Shift Project (2025)	Compilation and modelling: The Shift Project (2025)
Données : IEA, SDES, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase	Data: IEA, SDES, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase *(noms propres inchangés)*
Provenance	Origin
Asie et Océanie	Asia and Oceania
Russie	Russia
Amérique	Americas
Moyen Orient	Middle East
Afrique	Africa
Europe	Europe

France's energy suppliers:

- Europe: In the early 2000s, three? European countries (the Netherlands, Norway, the United Kingdom) reached their peak oil and gas production and supplied 35% of the energy imported by France, mainly oil. Since then, their oil production has halved and gas production has fallen by one third, reducing these imports to 20%, now mostly gas.
- America: Since 2010, the boom in unconventional hydrocarbons in the United States has revived our imports from America. The opening of LNG terminals from 2017 onwards has leveraged our LNG imports, enabling the United States to replace Russia as our leading supplier as of 2022.
- Africa: Since the late 2000s, African oil production has fallen by one third. At the same time, French energy imports from Africa, mainly oil, declined before recently rising again to 22%, partly offsetting the drop in Russian supplies.

- Middle East: At the end of the 1990s, 25% of imported energy came from the Middle East. Since then, the region has intensified its trade with rapidly expanding Asia, reducing its energy exports to France to less than 15%, now including a small share of gas.
- Russia: During the last decade, Russia was our main supplier of oil and gas, accounting for 20% of our imports. Sanctions imposed since 2022 have cut our imports by more than two-thirds, mainly oil.

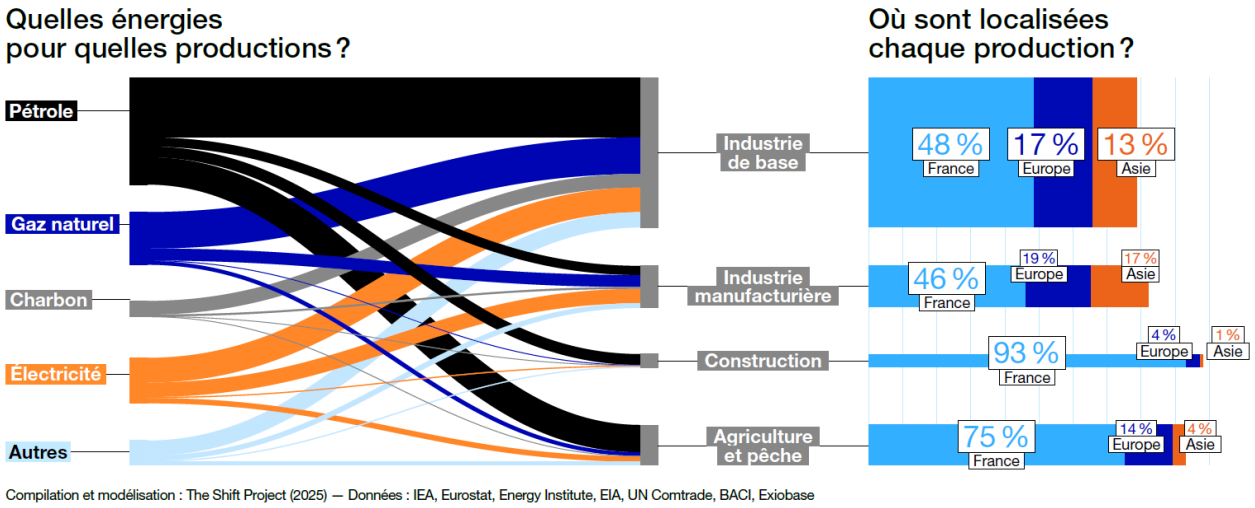
Imported goods and services: an invisible energy and industrial dependency.

The energy embedded in goods and services imported by France accounts for 27% of its energy exposure — more than its own energy production. Even by doubling its energy infrastructure (nuclear power plants, wind farms, hydroelectric dams…), France would still not have enough energy to produce all the goods and services it consumes.

Imported goods and services represent half of France's carbon footprint. 80% of their production is reliant on fossil fuels, revealing a persistent global dependency on oil, natural gas, and coal. Sourcing goods and services through value chains heavily dependent on hydrocarbons therefore indirectly exposes France to supply risks, price fluctuations, and geopolitical tensions, as well as worsening its climate impact.

France's leading supplier of goods and services is Europe, for key sectors such as basic industries (plastics, steel, cement…), manufacturing industries (agri-food, machinery, automotive…), agriculture and fisheries.

France's main non-European supplier is Asia, in both basic and manufacturing industries (textiles, technologies, consumer goods…). Notably, China holds a near-monopoly on many critical materials (rare earths, silicon…) and equipment (solar panels, batteries…) essential for the energy transition.



Compilation et modélisation : The Shift Project (2025) — Données : IEA, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Quelles énergies pour quelles productions ?	Which energies for which productions?
Pétrole	Oil

Texte source (inchangé)	**Traduction anglaise (institutionnelle, idiomatique)**
Gaz naturel	Natural gas
Charbon	Coal
Électricité	Electricity
Autres	Other
Industrie de base	Basic industry
Industrie manufacturière	Manufacturing industry
Construction	Construction
Agriculture et pêche	Agriculture and fishing
Où sont localisées chaque production ?	Where is each production located?
France	France
Europe	Europe
Asie	Asia
Compilation et modélisation : The Shift Project (2025)	Compilation and modelling: The Shift Project (2025)
Données : IEA, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase	Data: IEA, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase *(noms propres inchangés)*

France's exposure to oil

Seven of France's ten main oil suppliers are at risk of seeing their production decline sharply by 2050. The least exposed producers are located in the Middle East and Central Asia.

The production volume of six suppliers (Algeria, Angola, Libya, Nigeria, Norway, Russia) could fall below their own consumption levels, threatening their export capacity and thus France's supply. Furthermore, consumption in the Middle East, Africa and Asia could continue to rise by 2050, creating risks of supply diversion to France´s detriment .

In these scenarios, the widening gap between oil production and consumption could exacerbate tensions over global supply. This underscores that dependency on this resource can be used as geopolitical leverage..

France's exposure to natural gas

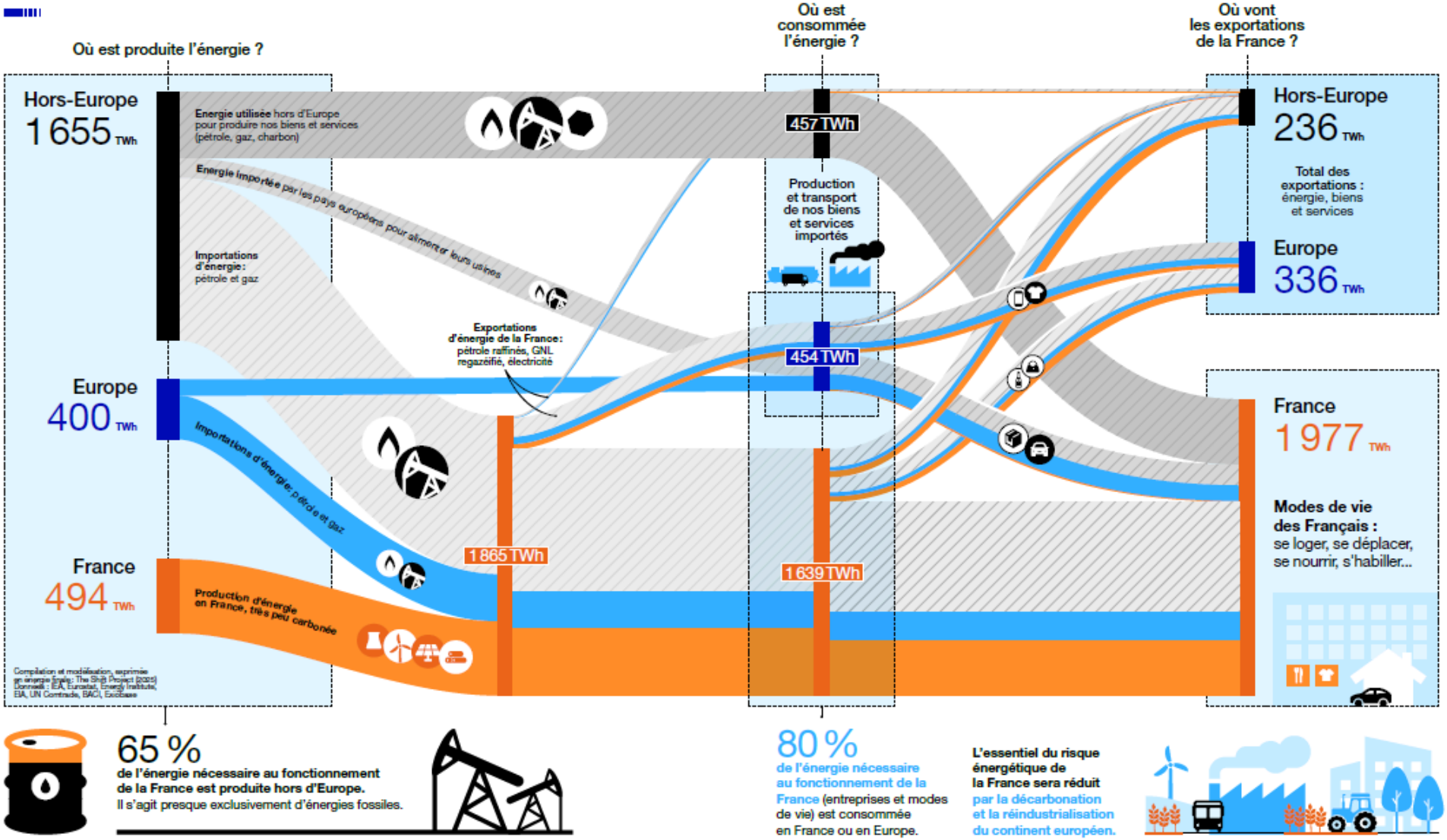
As of 2024, more than half of global natural gas production is concentrated in the United States, Russia and the Middle East. By 2050, this monopoly could become even more pronounced, as production in Norway, Africa and South America declines. It could therefore become increasingly complex to maintain a diversified supply and freedom of choice between natural gas suppliers.

Even Norway, Europe's last major producer and France's main supplier, could see its export capacity decline sharply. In 2024, Norway produced 33% of the natural gas available to France, directly or indirectly when embedded in imported goods and services.

With rising global demand for gas — particularly from countries in the Global South — there are risks of supplies being diverted from France by 2050. Added to this are the risks of our dependency being instrumentalised in the context of international power struggles between blocs of nations.

France's energy exposure: sovereignty and dependencies on Europe and the rest of the world

65% of the energy required for France's operations is produced outside Europe: this is almost exclusively fossil energy. 80% of the energy needed for France's operations (businesses and lifestyles) is consumed in France or in Europe: most of France's energy risk will be reduced through decarbonisation and the reindustrialisation of the continent.



Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Exposition énergétique de la France : Souveraineté et dépendances à l'Europe et au reste du monde	France's energy exposure: Sovereignty and dependencies on Europe and the rest of the world
Où est produite l'énergie ?	Where is the energy produced?
Hors-Europe	Outside Europe
Énergie utilisée hors d'Europe pour produire nos biens et services (pétrole, gaz, charbon)	Energy used outside Europe to produce our goods and services (oil, gas, coal)
Énergie importée par les pays européens pour alimenter leurs usines	Energy imported by European countries to power their factories
Importations d'énergie : pétrole et gaz	Energy imports: oil and gas
Europe	Europe
Importations d'énergie : pétrole et gaz	Energy imports: oil and gas
France	France
Production d'énergie en France, très peu carbonée	Energy production in France, with very low carbon content
Exportations d'énergie de la France : pétrole raffiné, GNL regazéifié, électricité	France's energy exports: refined oil, regasified LNG, electricity
Où est consommée l'énergie ?	Where is the energy consumed?
Production et transport de nos biens et services importés	Production and transport of our imported goods and services
Modes de vie des Français : se loger, se déplacer, se nourrir, s'habiller…	French citizens' lifestyles: housing, mobility, food, clothing…
Où vont les exportations de la France ?	Where do France's exports go?
Total des exportations : énergie, biens et services	Total exports: energy, goods and services
Compilation et modélisation : The Shift Project (2025)	Compilation and modelling: The Shift Project (2025)
Données : IEA, SDES, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase	Data: IEA, SDES, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase
65 % de l'énergie nécessaire au fonctionnement de la France est produite hors d'Europe.	65% of the energy required for France's functioning is produced outside Europe.
Il s'agit presque exclusivement d'énergies fossiles.	This consists almost entirely in fossil energies.
80 % de l'énergie nécessaire au fonctionnement de la France (entreprises et modes de vie) est consommée en France ou en Europe.	80% of the energy required for France's operationssg (businesses and ways of life) is consumed in France or in Europe.
L'essentiel du risque énergétique de la France sera réduit par la décarbonation et la réindustrialisation du continent européen.	France's main energy risk will be reduced through the decarbonisation and reindustrialisation of the European continent.

The Shift Project's Recommendations

1. Plan decarbonisation and reindustrialise at French and European level to achieve long-term competitiveness

By 2050, phasing out fossil resources is essential to address their decline, geopolitical pressures and climate change. This requires rigorous planning and no-regret decisions:

- A concrete operational plan to be launched as soon as possible, rather than risky technological bets.
- Realistic transformations rather than abrupt disruptions to our lifestyles.

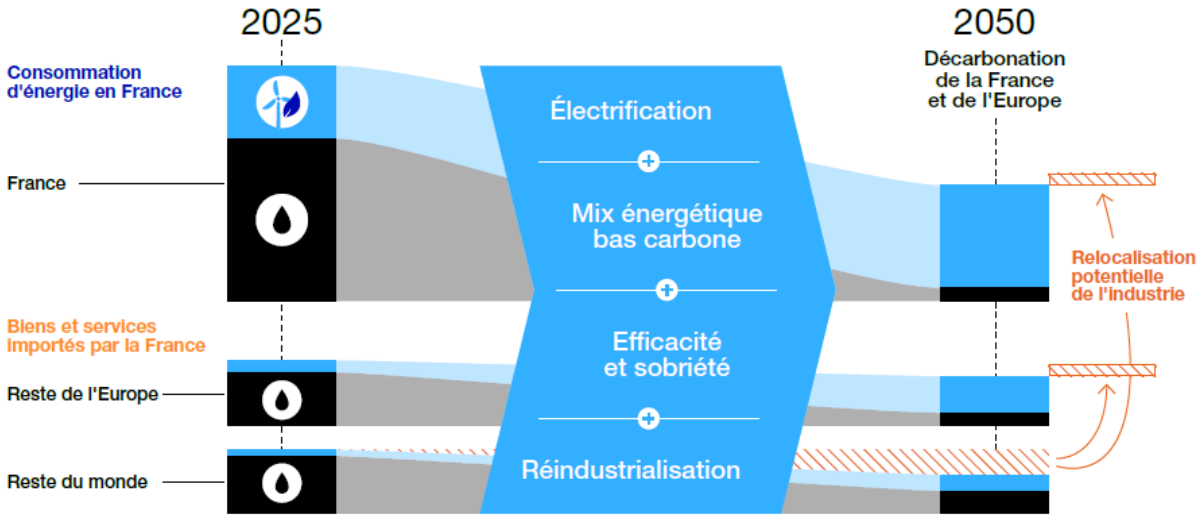
Decarbonisation is an indispensable condition for reindustrialisation, ensuring that European industries maintain sustainable control over their energy supplies at competitive costs in the long term.

2. Electrify uses and plan the phase-out of fossil infrastructures

- Scale up electrification across all feasible sectors:
    - Transport: electrify the vehicle fleet (cars and trucks) and encourage modal shift.
    - Buildings & heating: generalise heat pumps (HP) and comprehensive thermal renovations.
    - Industry: widespread adoption of low-carbon electric processes.
- Reserve low-carbon fuels for the hardest-to-electrify uses: heavy industry, defence, agriculture, maritime and air freight. Biofuels, biogas, hydrogen and synthetic fuels will only be available in limited quantities, requiring trade-offs.
- Organise the gradual phase-out of fossil infrastructures: elimination of gas and oil boilers, reduction of gas networks, conversion of fuel stations.

3. Support all low-carbon energy sectors — renewables (solar, wind, hydro, biomass…) as well as nuclear — for a robust and diversified low-carbon mix

- Respond to massive electrification and low-carbon reindustrialisation in France and in Europe: by 2050, nuclear will only supply half of our electricity; the remainder must come from renewable electricity, which is faster to deploy.
- Deploy all low-carbon production levers in parallel:
    - Renewable electricity and heat: deployment of photovoltaics (rooftops, ground-mounted plants, agrivoltaics), wind power (onshore and offshore), maintenance of hydroelectric production, structuring of biogas, biofuels, renewable heat and hydrogen sectors.
    - Nuclear: extend the life of existing nuclear plants as long as they remain safe, launch new reactor construction without delay, and consider depleted uranium fuel cycles.
- Adapt the electricity grid to rising demand and intermittency (interconnections, storage, flexibility solutions…).



Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Consommation d'énergie en France	Energy consumption in France
France	France
Biens et services importés par la France	Goods and services imported by France
Reste de l'Europe	Rest of Europe
Reste du monde	Rest of the world
2025	2025 *(inchangé)*
2050	2050 *(inchangé)*
Électrification	Electrification
Mix énergétique bas carbone	Low-carbon energy mix
Efficacité et sobriété	Efficiency and sufficiency
Réindustrialisation	Reindustrialisation
Décarbonation de la France et de l'Europe	Decarbonisation of France and Europe
Relocalisation potentielle de l'industrie	Potential reshoring of industry

4. Manage and reduce energy demand: efficiency and sufficiency

France's energy consumption can be halved by 2050, ensuring a sovereign and decarbonised energy system. This requires strong policies in terms of:

- Efficiency (thermal renovations, high-performance electrification, etc.)
- Sufficiency (adapted infrastructures, regulations, incentives, taxation, etc.)

5. Address energy sovereignty comprehensively and inform public debate

Public debate remains focused on electricity, often reduced to the opposition between renewables and nuclear, overlooking fossil fuels, which are the core of the issue.

Current energy balances, centred on national consumption, omit the grey energy of our imports and exports. Going forwards, assessments should integrate the "energy exposure" metric.

Because a country's power depends on controlling its energy flows, the low-carbon transition is not only a climate imperative. It is, in this sense, the very crux of sovereignty.

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About The Shift Project and The Shifters

The Shift Project is a think tank dedicated to informing and influencing the debate on climate and energy challenges. As a non-profit organisation serving the public interest, we are guided by the requirement for scientific and technical rigour, and our perspective on the economy is primarily material and systemic.

We conduct studies on key decarbonisation issues. We form working groups that produce robust analyses — both quantitative and qualitative — as well as pragmatic proposals. Our research approach is open, iterative and collaborative. Our publications are freely accessible to anyone interested. We disseminate them to professionals, decision-makers and intermediary bodies in the relevant sectors and issues. A network of experts is constantly mobilised to strengthen our work and help us raise awareness. We foster stakeholder discussions in a non-partisan manner.

The Shift Project was founded in 2010 by several business leaders with experience in both the non-profit and public sectors. It is supported by major French and European companies, public bodies, business associations and, since 2020, by dozens of SMEs, mid-sized companies and foundations. More rarely, it appeals to individuals, as in 2025 with the crowdfunding campaign "Décarbonons la France !" *[Decarbonise France!]* in which this work is included.

The Shifters is a non-profit organisation (under French law 1901), created in 2014 to provide voluntary support to The Shift Project. Initially designed as a structure to welcome anyone wishing to assist The Shift Project in its research, outreach or support work, we have now become a large-scale citizens' movement bringing together 20,000 Shifters, whose ambition is to "make France shift".

Our Action Programme for 2027: "Decarbonise France!"

Decarbonising the economy is essential — and possible. The climate and geopolitical storm is upon us. Europe is at risk. Our major competitors hold the weapons of power: oil and gas. Whether we like it or not, we are dependent on them. To regain our freedom and stop the climate catastrophe, we must phase out fossil fuels.

Global energy and material supply chains are entering a new era marked by instability and shocks. France must now maximise its chances of successfully decarbonising its economy to protect itself: how can this transformation be achieved in less than three decades, at scale, and above all, with certainty?

If France succeeds, it will prove to the world that climate disaster can be averted. And it will show Europe that we can rebuild our sovereignty through an economy freed from its greatest weakness: total dependence on imported oil and fossil gas. Together with Europe, France will be able to chart its own course, without answering to the major fossil powers that threaten it.

In 2022, The Shift Project launched the *Plan for the Transformation of the French Economy (PTEF, Plan de Transformation de l'Economie Française)*, which proposed a consistent and

pragmatic vision, sector by sector, aimed at making the economy carbon-neutral by 2050 and effectively compatible with the commonly accepted +2°C limit by 2100.

For 2027, The Shift Project is building the tools that will enable France to succeed in decarbonisation, guarantee the energy conditions for sovereignty and protect against shocks. The French presidential election of 2027 is a time for our country to face its destiny. We want to put decisive choices for timely transformation up for debate.

In line with the PTEF, our new programme *"Decarbonise France"* is based on five pillars:

1. Adopt a global and consistent approach from a physical, technical and economic perspective.
2. Focus on scarce resources — physical resources and skills.
3. Make pragmatic, robust, actionable, "no-regret" proposals that can be implemented immediately, leading to large-scale, timely and certain decarbonisation.
4. Prepare for shocks and crises affecting our economy.
5. Avoid relying on bets on GDP growth, unrealistic technological progress, or radical lifestyle changes.

The new programme also explores four major aspects of the necessary transformations:

1. Conditions for success in essential transition projects: scaling up small electric cars, installing heat pumps, shifting passengers and freight to rail, public transportation and bicycles for daily travel, deploying renewables, extending existing nuclear capacity and developing new nuclear programs.
2. Sectoral transformations: health, agriculture and food, lifelong learning, sport, digital, defence, textile and leather industries…
3. Quantified "alignments" (energy flows, greenhouse gas emissions, copper use, employment and training) between sectors, and concrete descriptions (professional skills, lifestyles).
4. The consequences of inaction: the impact on the French economy of poorly anticipated shocks or disorganisation during the transition.

This programme mobilises hundreds of engineers, scientists and professionals from a wide range of economic activities, all concerned by decarbonisation challenges. Numerous sectoral reports, a report offering an overall vision, and a book, will be published and widely disseminated. Broader and deeper, this new approach is better suited to a world in crisis. It aims to engage even more people, notably through large-scale consultations with relevant professionals.

Backed by its 90 member companies and funders, its 36,000 donors in the record-breaking 2025 crowdfunding campaign, and the 20,000 Shifters gathered in The Shifters organisation, The Shift Project accelerated its work in 2025 and is more determined than ever to influence the 2027 French presidential elections.

PART 1: MAPPING FRANCE'S ENERGY EXPOSURE

I. Reflecting on sovereignty in the era of decarbonisation: the centrality of the energy challenge

The Shift Project seeks to steer France and Europe towards a decarbonised economy, free from fossil fuels. Its analysis is based on the two dimensions of the "double carbon constraint":

- **climate change:** mitigation, meaning the reduction of GHG emissions, and adaptation to its impacts;
- **energy, in itself and particularly fossil energy**, because: it determines the prosperity and power of nations; it is the source of most GHG emissions; it is available in its fossil form in finite quantities on a human scale, almost exhausted in the case of oil and gas in European subsoils, and subject to intense competition and geopolitical tensions.

It therefore focuses on the concept of sovereignty through the lens of interconnections, risks and shared benefits between decarbonisation and sovereignty — decarbonisation leading in most cases to greater sovereignty, as detailed in this report.

True to its usual perspective, The Shift Project offers in this report a **physical interpretation of sovereignty**, through physical flows[3]. This means analysing the material foundation on which all forms of sovereignty rest — military, economic, industrial, energy, digital, food, etc. Energy, in particular, has been and remains an essential factor in the development of thermo-industrial societies. All our goods and services rely (directly or indirectly) on energy to extract, move and transform resources on which all sectors depend (from agriculture to industry, including transport).

This work therefore examines sovereignty from an energy perspective and **explores how decarbonisation can become its strategic lever.**

In this context, **sovereignty can be understood as the ability of a country or group of countries to preserve its freedom of decision by securing and decarbonising its vital functions within the physical limits of our environment.** The Shift Project proposes to measure it using the metric of "energy exposure", which sheds light on the energy-related risks to which a country is exposed and identifies opportunities to reduce these risks: concrete reduction of dependence on fossil fuels consumed on its territory, vulnerable supply chains, and geopolitical shocks. This enables a country to increase its ability to choose its partners — or even free itself from them if this aligns with its political objectives.

[3] A physical flow corresponds to concrete, measurable quantities: tonnes, kilometres, kWh, etc.

A. Energy sovereignty: context, definitions and scope of the study

1. Critical dependencies in an uncertain geopolitical landscape

Sovereignty. The word is on everyone's lips — and for good reason. Conflicts are increasing, and everyone wants control over their destiny in the face of uncertainty and adversity. The recent and very rapid evolution of the geopolitical landscape is forcing every State to question existing dependencies, forged over decades of globalisation.

Elevated geopolitical tensions, both on the European continent and globally, place the EU in a situation of high vulnerability to major powers (United States, China, Russia). It imports most of its energy and a significant share of the goods and services it consumes.

Indeed, over recent decades, the EU has de-industrialised and no longer controls critical links in its strategic industries. It is dependent across entire industrial value chains, from raw material extraction (minerals, rare earths, copper, etc.) to finished products (solar panels, batteries) or semi-finished goods (semiconductors, industrial components, etc.), including processing and refining stages. Its high-tech equipment is overwhelmingly produced outside Europe. Digital tools (software, data storage, etc.) are mainly designed and managed by American players, with the EU lacking any significant platform or leading company.

As far as defence is concerned, European countries' capabilities remain limited, notably due to their NATO membership and the predominant military capacities of the United States, leveraged by the latter to conclude unbalanced trade agreements, largely favouring American energy and defence industries.

Meanwhile, China continues to strengthen its strategic advantage and position itself as a monopolistic player in many key industrial sectors for energy transition and the digital industry[4]. Although not exclusively linked to physical energy flows, access to capital, governance conditions and data management constitute dependencies at different stages of our economy's value chains and are instrumentalised by other actors as means of leverage..

On the economic front, energy price instability — which may result from deliberate supply curtailments, as well as imposed taxes — has a destabilising effect on the economy, as highlighted by the Banque de France in a note from April 2025[5].

Thus, the health and competitiveness of the European economy suffer from this energy dependence, historically centred on fossil fuels.

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[4] Example involving export restrictions on Chinese rare earth elements: *Le Monde*, European industry caught in the trap of China's rare earths war [in French], 2025.

[5] The impact of oil price shocks on companies' margins, productivity and credit risk: a company-level analysis over two decades: Banque de France, *The impact of oil price shocks on companies' margins, productivity and credit risk: a company-level analysis over two decades* [in French], 2025.

All these multi-sectoral dependencies represent vulnerabilities that can be used by competing or hostile powers seeking to influence the economic and political trajectories of European countries. In other words, Europe's loss of sovereignty in strategic sectors raises the question of its ability to make autonomous political choices.

2. *Sovereignty: mastering one's destiny or pursuing a shared autonomy?*

The term "sovereignty" is multifaceted; its definition varies depending on the domain and context in which it is used. In the political sphere, sovereignty is defined as the exercise of supreme authority by a State over a given territory and population. In its national form, sovereignty implies the independence of the nation-State from any foreign or supranational authority.

This Westphalian conception (stemming from the Treaties of Westphalia of 1648) founded the modern international order on sovereign States, equal in law and masters of their own affairs. However, sovereignty has never been absolute in practice: it is limited by law and by the need to maintain relations with other nations. The sovereign State nevertheless retains, in theory, exclusive competence over its internal affairs and full capacity to make independent decisions on the international stage.

Since the second half of the 20th century, the growing interdependence between countries has redefined the concept of sovereignty. It is now challenged by several major trends: proliferation of international organisations, increasing regional integration, supranational commitments, economic globalisation, intensified cross-border exchanges, and the emergence of global technologies partly beyond State control. Today, no State — not even a major power — is fully self-sufficient or independent, meaning capable of sustainably meeting its needs without external inputs. They all depend on networks of trade, finance, human flows or digital systems that cross their borders. While the core of the concept of sovereignty remains the ability to control one's destiny, its practical exercise in the 21st century involves managing interdependencies rather than insisting on isolation. Thus, it is more relevant to think of sovereignty in terms of degrees of autonomy.

Strategic autonomy is the ability to decide and act without relying on third parties in a given domain (military, energy, industrial, digital, health, etc.). It is relative, gradual, sectoral, and can be a shared endeavour. Within the European Union, strategic autonomy has become a key concept in EU foreign and security policy.

Far from being synonymous with independence, sovereignty today should be understood as a means — compatible with the climate imperative — to gain autonomy, strengthen national resilience, and align the economy with a trajectory that is both sustainable and competitive.

Box 1: Strategic autonomy — Context and geographical scope

Strategic autonomy[6] is a concept that originated in France in 1994, initially as a national notion. The Defence White Paper of the time defined it in relation to the situation of dependence in which France would find itself if nuclear deterrence were left to NATO.

The concept became European in 2013 in the conclusions of the European Council: *"Europe needs a more integrated, sustainable, innovative and competitive defence technological and industrial base (EDTIB) to develop and sustain defence capabilities. This can also enhance its strategic autonomy and its ability to act with partners"*. Gradually, the notion also expanded beyond the military sphere to include the economic, digital and energy domains.

The Council of the European Union mentions strategic autonomy in the EU Global Strategy for Foreign and Security Policy: *"An appropriate level of ambition and strategic autonomy is important for Europe's ability to promote peace and security within and beyond its borders. We will therefore enhance our efforts on defence, cyber, counterterrorism, energy and strategic communications. Member States must translate their commitments to mutual assistance and solidarity enshrined in the Treaties into action".*

The President of the European Commission stated in March 2025 that European strategic autonomy is a necessity in the context of Russia's war in Ukraine and the evolving stance of the United States: *"Because the question is no longer whether Europe's security is threatened in a very real way. Or whether Europe should shoulder more of the responsibility for its own security. In truth, we have long known the answers to those questions. The real question in front of us is whether Europe is prepared to act as decisively as the situation dictates".*

3. Scope: a multidimensional energy sovereignty with complex sectoral interdependencies

The energy sovereignty of a State cannot be measured solely by the volumes of imported energy and raw or refined materials. It must be understood as a complex system, composed of sectoral layers that overlap and interconnect.

For the French energy sector to operate and produce, for example, the amount of electricity required for national consumption, it needs external supplies of primary resources (gas, uranium, etc.), transport infrastructures (terminals, networks), storage facilities, and an industrial apparatus capable of transforming imported raw materials into fuel, manufacturing power plants, cables, transformers, and technological components. Once electricity is produced, it is then distributed, sold and consumed.

Behind each of these activities lie human skills (which may be critical), companies, and shareholding structures composed of national or international players, all operating within a regulatory framework and the global economic system. All these economic and industrial activities rely on digital support (software, data sharing and storage). For France and the EU, the absence of European digital players creates a critical dependency on American technology giants, with severe consequences for sovereignty in all strategic sectors, such as energy, industry and defence.

[6] For further reading, see *Vie Publique*, European strategic autonomy in five questions [in French], 5 March 2025, of which this box is a brief summary.

The matrix below illustrates the multidimensional nature of a State's energy sovereignty. While not exhaustive, it aims to show that each link in the value chain (industries, companies, digital infrastructure, economic and regulatory framework) must be considered to achieve a complete and in-depth assessment of a sector's degree of sovereignty or autonomy.

This report, entitled *"Sovereignty through Decarbonisation"*, focuses primarily on direct energy imports (in liquid, gaseous, solid form, or electrons) and on grey energy embedded in goods and services imported by France (also referred to as indirect energy consumption). This methodological choice is explained by:

- The **fundamental nature of primary energy flows**, which form the backbone of the real economy. Energy is not a commodity like any other: it determines the production, transport and transformation of all other goods and services.
- The **use of a new metric: energy exposure**, presented below. This measures the level of dependence of the French economy on fossil fuels and aligns with The Shift Project's approach of identifying levers for decarbonisation.

In practice, this "imports" perspective is particularly relevant for assessing a State's energy sovereignty. It enables the establishment of robust and comparable indicators by energy type, whereas other layers of the system (digital, economic or regulatory frameworks) are difficult to aggregate in the analysis of physical flows and require qualitative assessment. They should nevertheless be considered as structuring variables of sectoral sovereignty. This choice does not ignore the complexity of the sector; it allows for prioritisation of levers.

Figure 1 (next page):

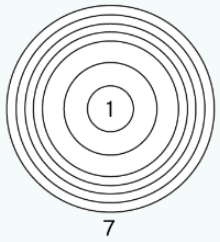
Energy sector sovereignty: complex interdependencies

Design and modelling: The Shift Project (2025). Production: Jeremy Masse (2025)

France's energy exposure (2022) in final energy

Data "Energy Exposure": IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

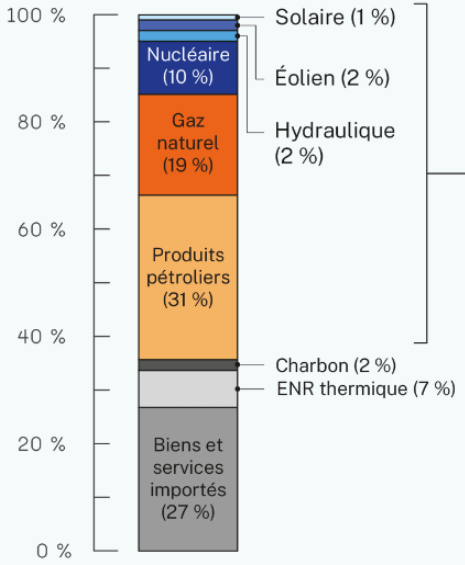
La souveraineté du secteur énergétique : des interdépendances complexes

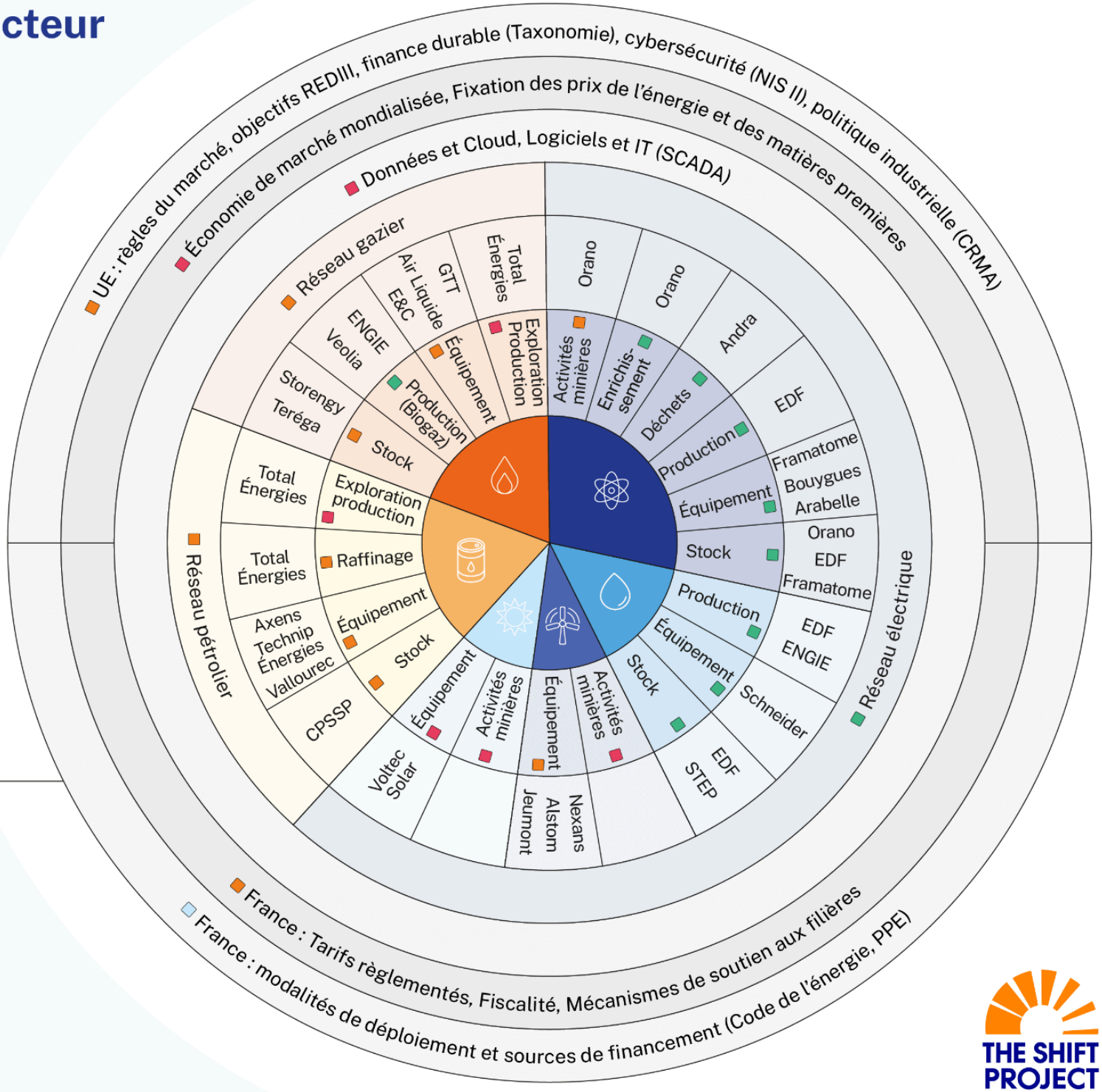


1/ Énergies primaires
2/ Industries
3/ Entreprises présentes en France
4/ Transport, Distribution
5/ Cadre numérique
6/ Cadre économique
7/ Cadre normatif

Souveraineté
- Nulle
- Partielle
- Majoritaire
- Entière

Exposition énergétique de la France (2022)





Réalisation : Jeremy Masse (2025)

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Tableau de traduction – Illustration “La souveraineté du secteur énergétique”

Texte source (inchangé)	**Traduction anglaise (institutionnelle, idiomatique)**
La souveraineté du secteur énergétique : des interdépendances complexes	Energy sector sovereignty: complex interdependencies
1/ Énergies primaires	1/ Primary energies
2/ Industries	2/ Industries
3/ Entreprises présentes en France	3/ Companies operating in France
4/ Transport, Distribution	4/ Transport, Distribution
5/ Cadre numérique	5/ Digital framework
6/ Cadre économique	6/ Economic framework
7/ Cadre normatif	7/ Regulatory framework
Souveraineté	Sovereignty
Nulle	None
Partielle	Partial
Majoritaire	Majority
Entière	Full
Exposition énergétique de la France (2022)	France’s energy exposure (2022)
Nucléaire	Nuclear
Gaz naturel	Natural gas
Produits pétroliers	Petroleum products
Biens et services importés	Imported goods and services
Charbon	Coal
ENR thermique	Renewable thermal
Solaire	Solar
Éolien	Wind
Hydraulique	Hydropower
UE : règles du marché, objectifs REDIII, finance durable (Taxonomie), cybersécurités (NIS II), politique industrielle (CRMA)	EU: market rules, REDIII objectives, sustainable finance (Taxonomy), cybersecurity (NIS II), industrial policy (CRMA)
Économie de marché mondialisée, Fixation des prix de l’énergie et des matières premières	Globalised market economy, Setting of energy and commodity prices
Données et Cloud, Logiciels et IT (SCADA)	Data and Cloud, Software and IT (SCADA)
Réseau gazier	Gas network
Total Énergies	Total Énergies
GRT Gaz	GRT Gaz
GRDF	GRDF
Exploration / production	Exploration / production
Stock	Storage
Équipement	Equipment
Raffinage	Refining
Activities / flows (selon secteurs du schéma)	Activities / flows *(according to sectors in diagram)*
Orano	Orano
Andra	Andra
Framatome	Framatome
Bouygues	Bouygues
Arabelle	Arabelle
EDF	EDF
Schneider	Schneider
STEP	STEP
Réseau électrique	Electricity network
Réseau pétrolier	Oil network
Axens	Axens
Technip Énergies	Technip Énergies
Valourex	Valourex
Storengy	Storengy
Teréga	Teréga
Voiléa Solar	Voiléa Solar
Activités amont	Upstream activities
Activités aval	Downstream activities
France : Tarifs réglementés, Fiscalité, Mécanismes de soutien aux filières	France: Regulated tariffs, Taxation, Support mechanisms for sectors

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
France : modalités de déploiement et sources de financement (Code de l'énergie, PPE)	France: deployment arrangements and sources of financing (Energy Code, PPE)
Réalisation : Jérémy Nassé (2023)	Design: Jérémy Nassé (2023)
THE SHIFT PROJECT	THE SHIFT PROJECT

B. Fossil fuels: the main cause of our energy dependence and climate change

Ending France's dependence on fossil fuels (coal, oil, gas), including those embedded in the €500 to €700 billion worth of products it imports annually[7], would deliver a double benefit.

On the one hand, **the combustion of these fossil fuels generates 67%[8] of global greenhouse gas emissions, which are responsible for climate disruption.** Continuing emissions at the current pace exposes France, like all countries, to growing and sometimes irreversible physical risks: heatwaves, floods and other natural disasters, loss of agricultural yields, geopolitical instability, etc.

To limit these risks, it was agreed to keep global warming below 2°C[9], a commitment made by 195 countries under the Paris Agreement. Although France has set medium- and long-term targets to gradually reduce the share of fossil fuels in its energy mix (-29% by 2030 according to SNBC3[10]), implementation remains a challenge. Moreover, the faster-than-expected deterioration of carbon sinks in France may require strengthening these commitments to maintain emission reduction paths[11].

On the other hand, **fossil fuels are also finite resources. Their availability depends on economic and technological factors, industrial and climate policies, geopolitical balances and, ultimately, geological scarcity.** Their physical characteristics, accessibility, abundance and consequently low relative price explain the large-scale diffusion of these energy sources across all sectors of the economy during the 20th century. They enabled electricity production, industrial activity, territorial development, increased agricultural yields and, more recently, digital technologies[12].

However, hydrocarbon supply is now increasingly constrained, both due to the state of available reserves — only partially offset by rising techno-economic extraction capacity — and geopolitical tensions (conflicts, intensified competition for supply). The peak of

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[7] In 2023, France's FOB imports amounted to €706.9 billion. Source: Customs and Indirect Duties – *Le Chiffre du commerce extérieur 2023* [*France's Foreign Trade Figures 2023*].

[8] In 2023, the use of fossil fuels caused emissions of 35.3 $GtCO_2$ of carbon dioxide, 2.9 $GtCO_2e$ of methane (2008–2017 data) and 0.3 $GtCO_2e$ of nitrous oxide (2007–2016 data), representing 67% of total greenhouse gas emissions, amounting to 57.1 $GtCO_2e$. Sources: Crippa et al. (2024), Foster et al. (2024), IPCC AR6 WG1 (2021).

[9] 2°C above pre-industrial levels

[10] SNBC 3 Draft, p.105: "réduire notre consommation d'énergie" [reducing our consumption of energy]

[11] Carbon storage in national carbon sinks has halved over ten years due to their degradation (HCC, IFN), mainly as a result of forest decline, posing a major challenge for the definition of the next French climate strategy (SNBC 3 Draft).

[12] The so-called "dematerialised" economy is also highly dependent on transformed resources, and is only possible in a world with very high energy consumption. For further reading, see The Shift Project, *Pour une sobriété numérique* [*Towards digital energy sufficiency*], 2018.

conventional oil production[13] was reached in 2008, according to the International Energy Agency (IEA), which notes that shale oil alone is unlikely to compensate for this decline over time.

Without sufficient reserves to offset the decline in current production from its suppliers, the EU could face oil supply risks within the next 20 years[14]. It is massively dependent on imports for its hydrocarbon consumption: 97% for oil[15] and 90% for gas[16]. This proportion has increased significantly since the start of the decline in North Sea hydrocarbon extraction, which began 20 years ago. Europe and France therefore face heightened geostrategic risks, and our lifestyles and production systems are vulnerable to geopolitical tensions, internal crises in exporting countries and energy market fluctuations[17].

Russia's military invasion of Ukraine in 2022 is one example: the interruption of Russian gas imports triggered a price surge[18], an inflationary spiral and a record trade deficit for France (€164 billion).

- Since then, our hydrocarbon imports have been disrupted: liquefied natural gas (LNG) has replaced part of Russian pipeline gas, and Europe's supplier countries have shifted, particularly in favour of Norway and the United States. In 2023, 45% of European LNG imports came from the United States and 11% from Russia[19].
- At the French level, Russian gas remains significant: one-third of our LNG imports, notably for re-export to other European countries, came from Russia in 2024[20].
- Imports of crude and refined oil from Russia to France have sharply decreased since 2022. Residual imports are embedded in refined oil from third countries (India, China, etc.). Meanwhile, imports of oil from the United States have risen significantly[21].

Escaping this "double carbon constraint"[22] is therefore a strategic and climate emergency for the security of France and the EU.

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[13] The peak of conventional oil is the point at which global production reaches its maximum and thereafter declines.
[14] The Shift Project, *The Future of Oil Supply in the European Union: State of Reserves and Production Prospects for Major Suppliers*, 2021. For further reading, see Box 10 and Annex 1.
[15] Data for 2022. Eurostat: *Oil and petroleum products – a statistical overview.*
[16] Data for 2023. Eurostat: *Natural gas supply statistics*
[17] For more information, see our reports *Natural gas: which risks for the European Union's supply?* [in French] and The Shift Project, *The Future of Oil Supply in the European Union: State of Reserves and Production Prospects for Major Suppliers*, 2021.
[18]This increase in energy and raw material prices began during the post-Covid rebound, as the rapid restart of economies strained supply chains that were still disrupted. The increase was then prolonged and worsened by Russia's invasion of Ukraine.
[19] *Energy Institute by BP, Statistical Review of World Energy*, 2024.
[20] *Connaissance des énergies avec AFP, France, the main entry point for Russian LNG in Europe* [in French], 2025.
[21] Imports of crude oil: SDES, *Key energy figures 2025* [in French]. Imports of refined oil: UN, Comtrade Database.
[22] On the double carbon constraint, see https://theshiftproject.org/la-double-contrainte-carbone/

Box 2: Energy dependence and economic issues

In addition to the two imperatives previously mentioned (geopolitical dependence and climate urgency), a third can be put forward: the economic cost of our dependence on fossil fuels.

In 2024, the European Union imported nearly €350 billion worth of fossil energy, according to Eurostat[23], mainly from authoritarian or proto-authoritarian States[24], some of which maintain conflicting trade relations with the EU and France (such as the United States) or political relations (such as Russia).

Ending the direct financing of competing powers on economic or geopolitical grounds is already a valid argument in itself. The argument of economic cost, however, must be handled with care. In addition to import-related expenses, there are costs incurred domestically, such as the construction and operation of energy infrastructures. However, these local expenditures can be seen positively from a macroeconomic perspective: they generate jobs, support national activity and stimulate economic cycles through distributed income.

Fossil fuels, although essential for powering machines in the economy (transport, agriculture, industry, etc.), contribute relatively little to local added value: less than 50% of their total costs[25] (national transport and distribution, boiler installation and maintenance) compared to 70% for solar panels (the panel itself accounts for only 30% of the total cost[26], the rest being mainly linked to installation and ancillary equipment), and 90% for nuclear (uranium represents only 10% of the total cost[27]).

Moreover, health costs associated with pollution from fossil fuel combustion represent both a social and economic burden. In France, 40,000 deaths per year are attributable to air pollution, a large share of which is directly linked to fossil fuel combustion[28].

While investment in low-carbon energy may seem costly in the short term (whether for building a nuclear plant or developing wind and solar capacity), these costs must be put into perspective: they are depreciable, unlike annual purchases of fossil energy, whose prices are volatile and subject to persistent geopolitical tensions.

C. Assessing France's Sovereignty Limits and Conditions Through Its Energy Exposure

[23] Eurostat, EU imports of energy products - latest developments,
[24] In the sense that the State displays early signs of authoritarianism, without yet being fully authoritarian.
[25] The cost of natural gas fuel represents at least 50% of the total production cost of one MWh of electricity, due to the sustained rise in gas prices since 2022. Source: Cour des comptes, *Analysis of the costs of the electricity production system in France* [in French], 2021.
[26] Assumption that, for the remaining 30% of cost, the rest of maintenance and construction is performed in the EU. Source: IRENA, *Renewable power generation costs in 2024*, 2025.
[27] Share rounded to 10%, based on the assumption that the remainder of maintenance and construction is carried out in France or the EU. Source: CEA, *Key facts on... The cost of nuclear power* [in French], 2014.
[28] Santé publique France, *Ambient air pollution: new estimates of its impact on the health of the French population* [in French], 2021.

France needs energy both to sustain French lifestyles and to support its economic activities. On the one hand, energy is required to meet almost all the needs of French citizens: powering a boiler for heating, producing foodstuffs for nourishment, fuelling private vehicle engines, etc. On the other hand, supporting France's economic activities and securing jobs for its population also requires energy — to heat buildings, operate factories, maintain networks, transport goods, power agricultural machinery, etc.

These two scopes describe different yet interconnected perspectives. Indeed, a large share of the energy consumed by the French economy serves to meet the needs of French citizens. However, this is not the whole picture. One-third of the goods and services consumed by the French population are imported from abroad, contributing to other countries' economies. Similarly, the French economy also exports goods and services, supporting the lifestyles of other countries' populations.

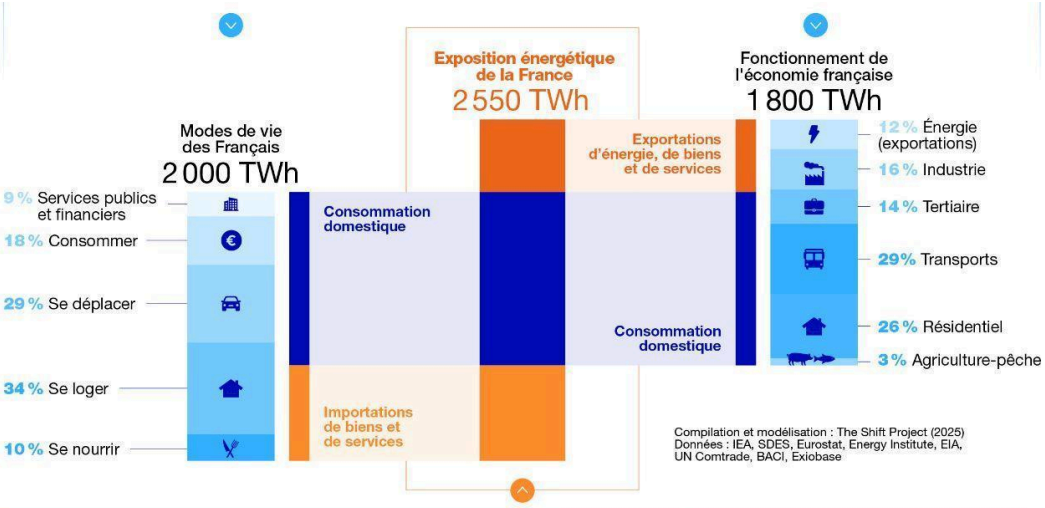


Figure 2: Definition of France's Energy Exposure (final energy, 2022)
Design and modelling: The Shift Project (2025)
Data: IEA, Eurostat, SDES, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Mesurer l'énergie nécessaire au fonctionnement de la France : l'exposition énergétique	Measuring the energy required for France's functioning: energy exposure
Pour comprendre la souveraineté de la France sur le plan énergétique, il faut mesurer l'ensemble de l'énergie nécessaire au fonctionnement du pays :	To understand France's sovereignty in energy terms, it is necessary to measure all the energy required for the functioning of the country:
Soutenir les modes de vie des Français	Supporting the ways of life of French citizens
L'ensemble des besoins d'une population repose sur de l'énergie : alimenter une chaudière pour se chauffer, produire des denrées alimentaires pour se nourrir, faire tourner le moteur des véhicules particuliers, etc.	All the needs of a population rely on energy: powering a boiler for heating, producing food to eat, running private-vehicle engines, etc.
Alimenter les activités économiques françaises	Powering French economic activities
Tous les secteurs d'activité ont besoin d'énergie pour faire fonctionner des usines, maintenir des réseaux, transporter des marchandises, alimenter des engins agricoles, chauffer des bâtiments, etc.	All sectors of activity require energy to operate factories, maintain networks, transport goods, power agricultural machinery, heat buildings, etc.
Modes de vie des Français	Ways of life of French citizens
Consommation domestique	Domestic consumption
Importations de biens et de services	Imports of goods and services
Exposition énergétique de la France	France's energy exposure
Fonctionnement de l'économie française	Operation of the French economy
Exportations d'énergie, de biens et de services	Exports of energy, goods and services
Services publics et financiers	Public and financial services
Consommer	Consumption
Se déplacer	Mobility
Se loger	Housing

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Se nourrir	Food
Énergie (exportations)	Energy (exports)
Industrie	Industry
Tertiaire	Tertiary sector
Transports	Transport
Résidentiel	Residential
Agriculture-pêche	Agriculture and fishing
Compilation et modélisation : The Shift Project (2025)	Compilation and modelling: The Shift Project (2025)
Données : IEA, SDES, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase	Data: IEA, SDES, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase
L'exposition énergétique intègre les modes de vie et les activités économiques	Energy exposure encompasses both ways of life and economic activities
Les activités des entreprises et les modes de vie en France nécessitent à la fois de l'énergie sur le territoire (dans nos bâtiments, nos véhicules, nos usines…) et en dehors du territoire (production de biens et services importés, transport de marchandises…).	The activities of businesses and the ways of life in France require energy both within the territory (in our buildings, vehicles, factories…) and outside the territory (production of imported goods and services, transport of goods…).
L'exposition énergétique de la France inclut :	France's energy exposure includes:
l'énergie consommée sur le territoire,	the energy consumed within the territory,
celle associée à nos importations de biens et de services	that associated with our imports of goods and services
celle contenue dans nos propres exportations.	that embedded in our own exports.
Synthèse	Summary

To integrate these two complementary perspectives into a single metric, The Shift Project proposes the concept of **France's energy exposure**. Energy exposure corresponds to the cumulative energy supporting the country's economy and the lifestyles of French citizens, while carefully avoiding any double counting. This metric makes it possible to assess a set of risks to which France's population and economy are exposed through energy: their sensitivity to trade and geopolitical conflicts, price fluctuations, policy changes and availability of energy sources. Today, these risks are mainly due to our dependence on fossil fuels.

To reflect France's energy needs, it is necessary to quantify the energy embedded in imported goods and services, which does not appear in national energy balances. Traditionally, debates focus on energy production or energy consumption. Too rarely do notions such as **grey energy** or **energy footprint** appear, even though they are key to understanding the energy dependence of French lifestyles. We propose to use and quantify these indirect dependencies for France through a risk-based approach with the most comprehensive scope possible: a vision of **energy exposure**. **Box 3** clarifies this new scope and compares it to domestic consumption and France's energy footprint.

The Shift Project presented an initial quantification of France's energy exposure in April 2025 and updates this figure in this final report using a new, more precise calculation model that traces each consumption back to its source and scrupulously avoids double counting across entire value chains. Note that this analysis is more relevant in units of **final energy**[29], which is why all measures in this report are expressed in **TWh/year of**

[29] Final energy corresponds to the energy used by consumers or businesses to provide an energy service, such as electricity to operate a microwave oven. Generally, final energy is seen as an invoice by consumers and corporations. It differs from primary energy, which is available in nature but cannot be used in its raw form. The Shift Project recommends reasoning in terms of final energy wherever possible when it comes to addressing energy needs, clarifying the debate and guiding more effectively choices and investments.

final energy (unless otherwise stated), with data most often covering the year **2022**[30], and some time-series analyses between 1995 and 2022.

Supporting French lifestyles requires **2,000 TWh**, while the functioning of the French economy relies on **1,800 TWh** — excluding upstream energy used in value chains. Taking both into account and subtracting double counting, France's energy exposure amounts to **2,550 TWh**. Thinking in terms of energy exposure makes visible the energy used outside the territory — abroad — to produce the goods and services we then import, without neglecting our exports of energy and goods and services (essential for many companies producing in France).

However, it is important to emphasise that not all dependencies are equal. Of the **2,550 TWh** of energy exposure, imported oil to fuel our vehicles does not pose the same challenges as an imported garment or electricity sold to our neighbours. The remainder of this report will detail each of these dependencies to understand the associated issues.

Box 3: Energy Exposure, Energy Footprint, Domestic Energy Consumption — What Are the Differences?

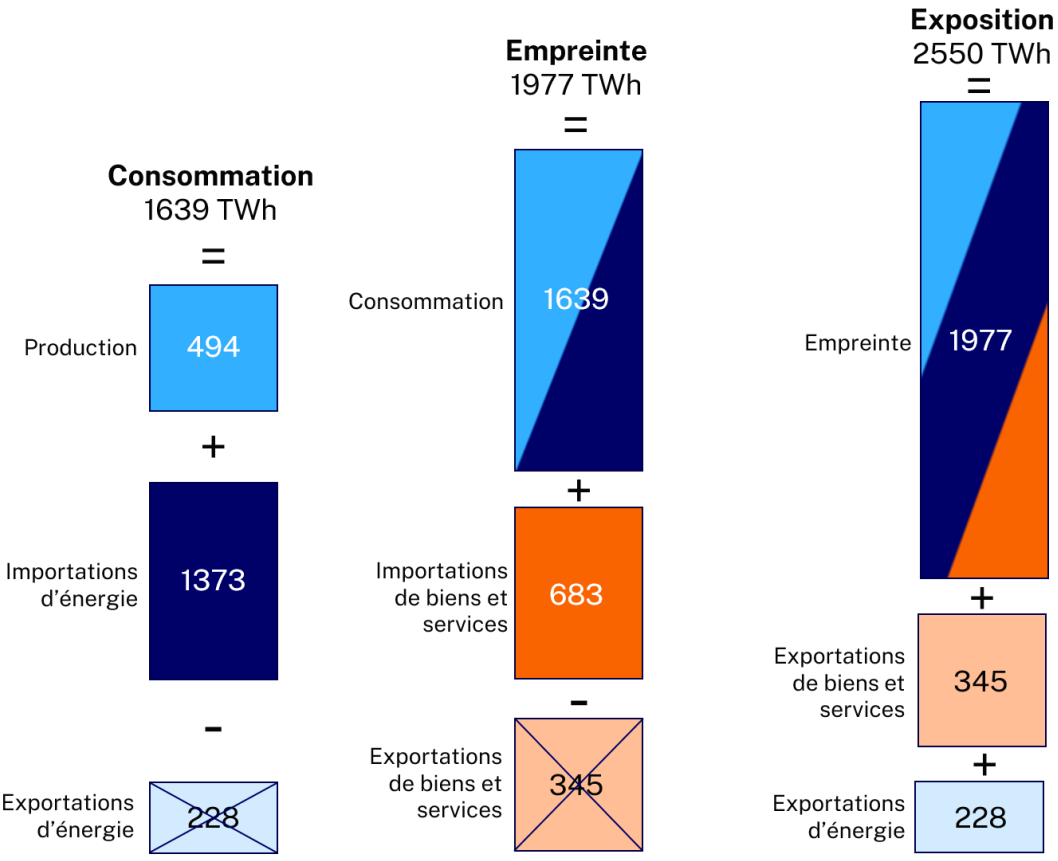


Figure 3: Comparison of Scopes — Domestic Consumption, Energy Footprint and France's Energy Exposure (final energy, 2022)

Design and modelling: The Shift Project (2025)
Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

[30] The year 2018 is the most recent year for which reliable global data on "grey energy" embedded in goods and services is available.

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Consommation	Consumption
Production	Production
Importations d'énergie	Energy imports
Exportations d'énergie	Energy exports
Empreinte	Footprint
Consommation	Consumption
Importations de biens et services	Imports of goods and services
Exportations de biens et services	Exports of goods and services
Exposition	Exposure
Empreinte	Footprint
Exportations de biens et services	Exports of goods and services
Exportations d'énergie	Energy exports

To account for France's energy needs, energy balances traditionally restrict their scope to **domestic energy consumption**. This parameter reflects all the energy required "on site" for lifestyles and the economy — at the socket, at the pump, at the meter, etc. However, this scope has two blind spots:

- **Exports of energy** produced (electricity) or transformed (oil refineries, LNG terminals) in France, which are essential for the activity of our energy companies and the jobs they support.
- **Imports of goods and services** into France, which are just as necessary for people's lifestyles — cars, food, technology, clothing, etc. — as for our economic activities — imports of raw materials, components, equipment… essential to keep production lines running and renew infrastructure. Including imported goods and services is therefore essential to truly measure our energy dependence.

A second, less-discussed metric, **energy footprint**, accounts for imports of goods and services but focuses solely on the energy needed for people's lifestyles. Its calculation subtracts all exports of goods, services and even energy from the total. This allows for correct attribution of goods and services to the final consumer but masks the role of all companies involved in producing them. Above all, this metric cannot reflect the energy dependence of all companies operating in France, some of which rely directly on exporting all or part of their production for viability.

By contrast, **energy exposure**, conceptualised by The Shift Project in April 2025, integrates energy exports and imports/exports of goods and services in addition to the previous scopes. This notion of energy exposure can describe both the energy needs of a population and those of an economy. Conceptually, it can be seen as the amount of energy consumed annually by the global economy to produce the goods and services consumed by French citizens and the clients of companies located in France.

In The Shift Project's calculation, a slight blind spot could not be quantified: the energy consumed outside France upstream of the production of goods and

services by companies operating in France for foreign markets. Estimating this would likely add between **0 and 200 TWh** to France's energy exposure.

France also benefits from its position in international trade: this is why thinking in terms of energy exposure allows us to refine our understanding of sovereignty from an energy perspective.

The energy exposure of the French economy corresponds to the amount of energy consumed annually by the global economy to produce the goods and services consumed by French citizens and the clients of companies located in France. It makes it possible to assess the constraining factors to which the French economy is exposed through energy: its sensitivity to trade and geopolitical conflicts, price fluctuations, policy changes and availability of energy sources. Today, these constraints are primarily driven by our dependence on fossil fuels.

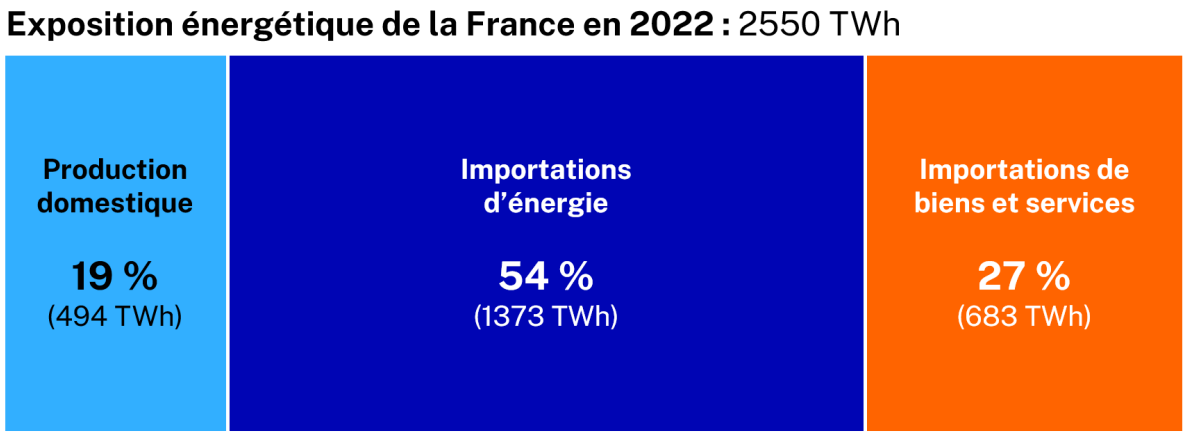


Figure 4: Breakdown of France's Energy Exposure in a Triptych
Domestic Production – Energy Imports – Imports of Goods and Services (final energy, 2022)

Design and modelling: The Shift Project (2025)
Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Exposition énergétique de la France en 2022	France's energy exposure in 2022
Production domestique	Domestic production
Importations d'énergie	Energy imports
Importations de biens et de services	Imports of goods and services

To analyse the risks to France's sovereignty using its energy exposure, we break down our reasoning into three steps:

1. France's domestic energy production, representing **19% of its exposure**
2. France's energy imports, representing **54% of its exposure**
3. France's imports of goods and services, representing **27% of its exposure**"

Box 4: Method and Model for Calculating Energy Exposure

To estimate France's energy exposure, **The Shift Project** relied on data of various types, combining them in a global energy flow mapping model developed in **Python**.

This model used several categories of data:

- **Energy balances** from the *World Energy Balances* dataset of the International Energy Agency (IEA).
- **Bilateral trade data for energy products** from:
  - Eurostat
  - EIA
  - Energy Institute
  - UN Comtrade
  - CEPII BACI
- **Input-output tables** from the academic database *Exiobase*, used to track goods and services exchanges along value chains.

This model is therefore a **hybrid** between physical data (energy balances, energy product trade) and monetary data (input-output tables).

All modelling outputs are expressed in **final energy**. The calculation method works "backwards": from consumption to production. Sectoral consumption data from the IEA (by energy carrier) were disaggregated across the 200 activity sectors of Exiobase's input-output classification, for the fifty countries included in Exiobase. Each consumption of energy carriers is broken down between domestic production and imports, tracing the energy production chain from one carrier to the previous, back to the primary source. Each step uses the energy balances of all countries and bilateral trade flows, until reaching the primary energy producer. Production is thus expressed here in **final energy**, derived from final consumption.

Every stage of the modelling involves a degree of uncertainty due to missing or non-concordant data across sources. This uncertainty has been quantified and is shown in many charts.

This model, developed in its first version for this publication, provides a calibrated view for France. A new version calibrated on a broader scale could be developed, potentially incorporating features for harmonising import-export and production-consumption data.

II. France's Current Energy Exposure

A. Domestic Energy Production in France

France's energy production corresponds to the total amount of energy produced on its territory from primary sources considered sufficiently sovereign. **Important note:** this excludes electricity produced in France from imported coal, gas or oil[31].

Box 5: Focus on the Notion of Energy Production
Let us look in more detail at what the concept of "energy production" covers and enables:

- **Most electricity:** all electricity produced from sufficiently sovereign primary sources on French territory (hydropower, nuclear, wind, solar, French biomass…) is counted in France's energy production (see Box "What risks affect the supply of energy materials and equipment […]?" below for more details).
- **Fuels extracted or produced on French territory**, such as biogas from digesters located in France, any biofuel sourced from French biomass, or the rare oil still extracted in France (less than 10 TWh), are included in France's energy production.
- **Renewable heat** (e.g., heat pumps) is also included, even if it does not yet appear satisfactorily in our data.

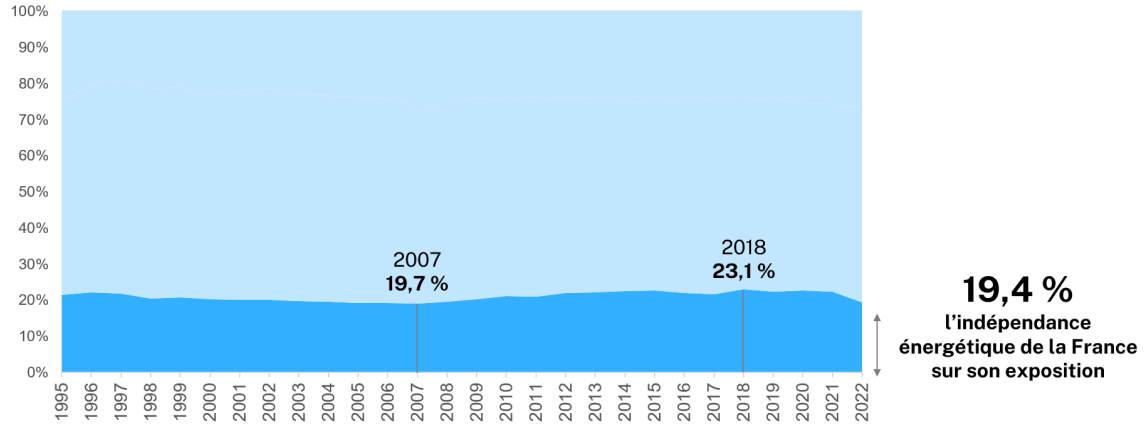


Figure 5: Evolution of the Share of France's Domestic Energy Production Compared to Its Energy Exposure (%, final energy)
Design and modelling: The Shift Project (2025)
Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Part de la production domestique d'énergie dans l'exposition	Share of domestic energy production in France's

[31] However, this is **not** included in France's energy production:
• Electricity produced domestically from gas, coal, domestic oil or other imported energy is not accounted for in the energy production of France.
• Imported crude oil which is processed on French territory is not accounted for either.
• Self-consumption of energy (for example solar panels for residential hot water production) is not accounted for as data is lacking. A more granular study might allow for it to be included.

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
énergétique de la France (%, énergie finale)	energy exposure (%, final energy)
indépendance énergétique de la France sur son exposition	France's energy independence relative to its exposure

Believing that France is protected from energy risks because it is self-sufficient in electricity is an outdated and reductive view that masks our dependence on imports. In 2022, France produced 494 TWh of final energy, excluding losses, mainly in the form of electricity, almost exclusively from decarbonised energy sources. This represents less than 20% of its energy exposure.

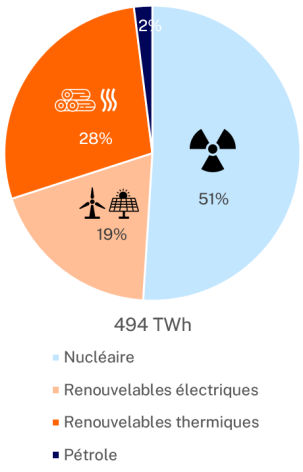
This view of domestic energy production nevertheless conveys a positive message: we currently know how to produce enough electricity to meet our present electricity needs, and this production is already decarbonised.

However, this does not account for our current non-electric energy needs. Imported and consumed energy in France (1,195 TWh), almost exclusively non-electric, is nearly twice the amount of energy produced nationally. In other words, France's energy production is far from sufficient to cover its energy needs.

France's current energy production would only cover the energy required to produce the goods and services it exports annually — about 350 TWh. This theoretical comparison highlights a significant limit to our sovereignty.

Figure 6 : Mix énergétique sur la production française (2022, énergie finale)

Figure 6: Energy mix of French production (2022, final energy)



Source : TSP sur données IEA

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Figure 6 : Mix énergétique sur la production française (2022, énergie finale)	Figure 6: Energy mix of French production (2022, final energy)
Nucléaire	Nuclear
Renouvelables électriques	Renewable electricity
Renouvelables thermiques	Thermal renewables
Pétrole	Oil
Source : TSP sur données IEA	Source: TSP based on IEA data

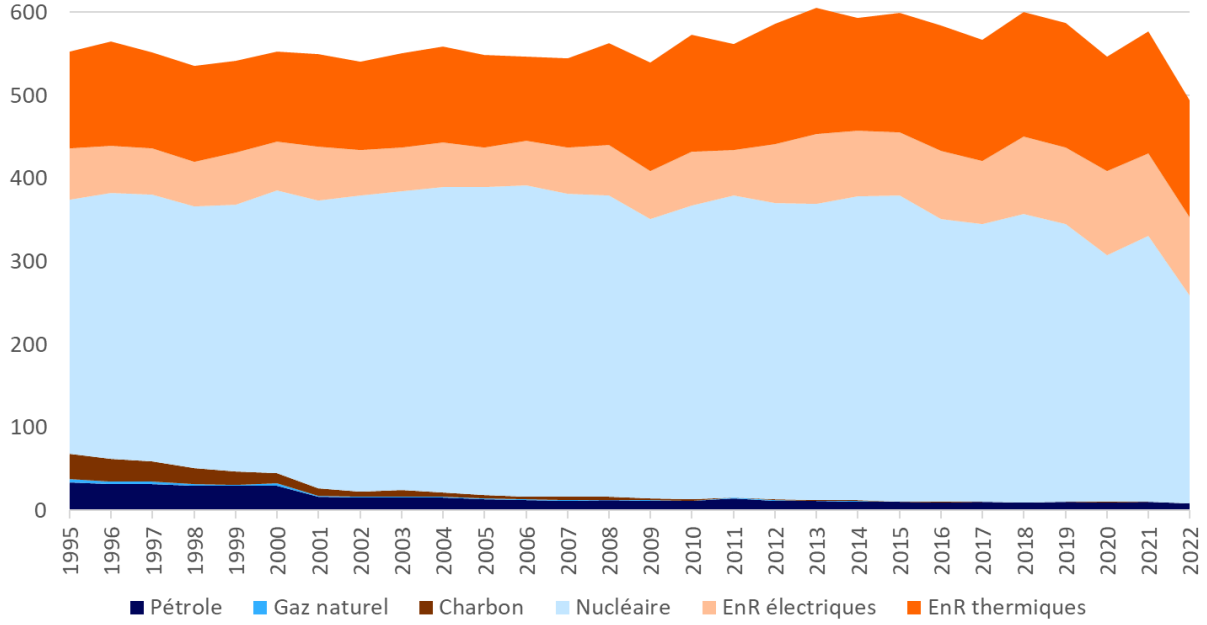


Figure 7: Evolution of France's Domestic Energy Production by Source (TWh, final energy)

Design and modelling: The Shift Project (2025)

Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Production énergétique de la France (TWh, énergie finale)	France's energy production (TWh, final energy)
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Nucléaire	Nuclear
EnR électriques	Renewable electricity
EnR thermiques	Thermal renewables

The graph above illustrates France's energy production expressed in final energy. Since the modelling method aligns with consumption data (after losses related to production, transport, distribution, statistical discrepancies…), the absolute production values shown here may be lower than figures reported by energy producers[32].

Until 2018, we observe stability in the historic nuclear base, which gradually replaced coal and oil-fired power plants. This shift was notably driven by the progressive implementation of carbon pricing, which made fossil-based electricity generation increasingly uncompetitive and less frequent on the European market. From 2019 onwards, the share of nuclear power declined due to major refurbishment works and the first ten-year inspections, which temporarily reduced output.

Renewable energy production, meanwhile, has shown a steady upward trend since the early 2010s, more than **1.5 times higher** from 2018 onwards. Growth peaked in 2020 (**+70% annual production**) and has slightly declined since. While this evolution is

[32] Further details on the calculation method can be found in the dedicated Box 1.

significant, it contrasts with the still relatively low share of renewable electricity in France's energy production (around **20%**) and the volumes involved, despite proactive policies supporting its development.

Thermal renewables have also recorded a marked increase in production since 2008–2009. These include energy recovery from waste, district heating networks and wood energy use.

Box 6: What Risks Affect the Supply of Energy Materials and Equipment Needed for Decarbonised Energy Production?

Renewables and nuclear do not fully shield us from dependency: we must import the uranium we consume, as well as the photovoltaic panels and wind turbines we install (or at least the materials required for their production). Likewise, maintaining these energy sources requires access to imported spare parts.

However, this vulnerability is far less critical than that induced today by our imports of oil and gas. Hydrocarbons are resource flows needed in very large quantities in the short term for the proper functioning of our equipment (vehicles, heating systems, machinery). In the event of a supply disruption and once the roughly 15 weeks of strategic oil stocks are exhausted, most of our economy would be unable to function.

Conversely, if we were to face a disruption in the supply of photovoltaic panels, the installed stock on our territory would continue to operate; only its expansion and renewal would become problematic over time — given that the typical lifespan of a panel is 30 years.

It would, of course, be possible to relocate solar panel production to our territory — several large-scale gigafactory projects exist for this purpose[33] and are supported by public authorities. Note also that for wind turbine manufacturing, dependency is much lower: European manufacturers such as Vestas (Denmark) and Siemens Gamesa (Germany-Spain) account for 30% of the global market and supply the French market extensively[34]. Part of the industrial base for the wind sector is even located directly in France, particularly for offshore wind.

As for uranium, our sources of supply are diversified: they include countries that may present political or security fragilities, with which our relations are unstable (Niger, Kazakhstan…), and stable, democratic partners or allies (Canada, Australia…). Furthermore, existing stocks in France would allow our nuclear fleet to operate for about 15 years[35], even in the (unlikely) event of a total disruption of uranium supplies. Finally, uranium represents only a small share of the cost of nuclear electricity: a sharp rise in global prices would therefore result in only a marginal increase in bills — something that cannot be said for oil and gas.

[33] Notably the Carbon and Holosolis projects. (…) PV Solaire Energie, *Gigafactories in France: Can the Solar and Battery Sector Really Be Relocated?* [in French], 2024; or Maritima, *CARBON authorised to build its photovoltaic gigafactory in Fos-sur-Mer* [in French], 2025.

[34] Wood Mackenzie, Global wind turbine market: state of play, 2021

[35] In addition to EDF's two-year uranium stock… (for the stocks, see ANDRA, *Inventaire national des matières et déchets radioactifs, Essentiels 2025* [*National Inventory of Radioactive Materials and Waste, Key Figures 2025*]).

B. France's Energy Imports

Energy imports account for the largest share of France's energy exposure: 1,370 TWh imported versus 490 TWh produced domestically. In other words, France consumes nearly four times more energy on its territory than it produces. The main explanation lies in our massive imports of fossil fuels, primarily oil and gas.

Box 7: Data Estimates for 2023 and 2024

The recent and rapid evolution of the geopolitical context has significantly altered France's energy imports, notably the share of each supplier and the energy carriers involved (LNG, refined oil…). In its energy flow mapping model, The Shift Project was limited by data ending in 2022, preventing complete modelling for 2023 and 2024. However, proxies can be used to approximate upward or downward trends in certain flows. Thus, some results provide estimates for 2023 and 2024, mainly based on data from SDES (Key Energy Figures 2025) and customs data (UN Comtrade), which include indirect imports (e.g., Russian crude oil refined in India then exported to France).

1. The Decline of Oil and the Rise of Natural Gas in Our Imports

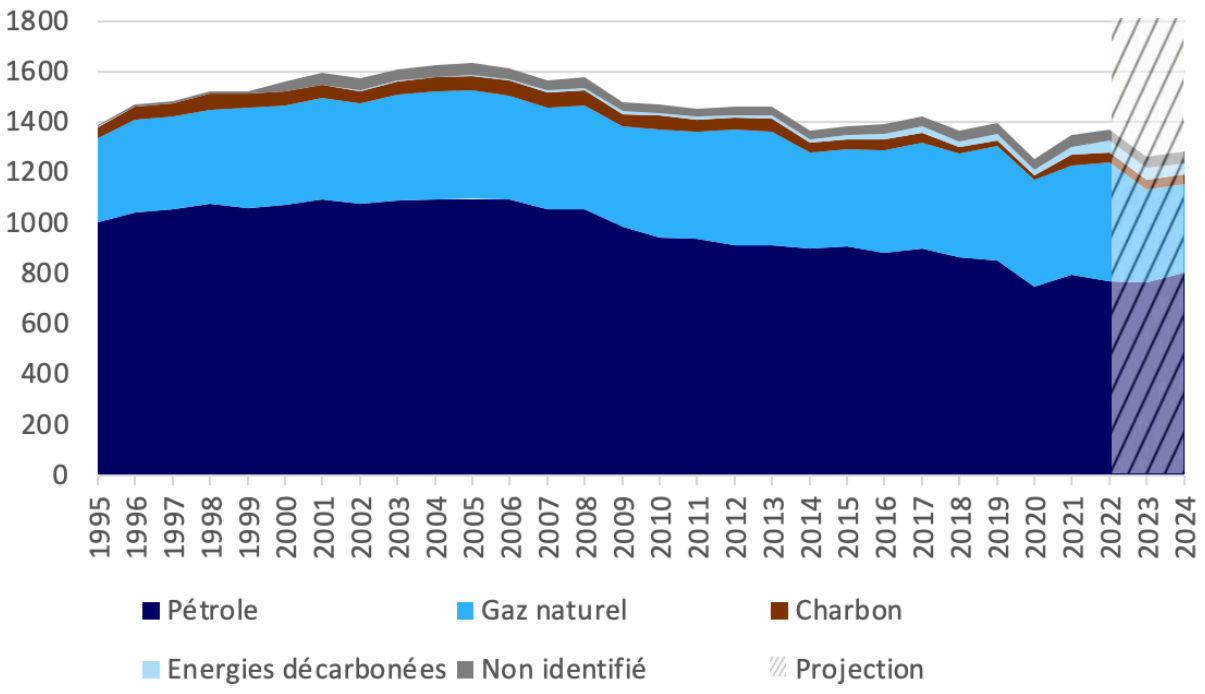
In France, oil and natural gas remain essential for the functioning of the country across all sectors. Oil still dominates the transportation sector (fuel for cars, planes and trucks), while gas is widely used for heat production (in buildings and industry) and as a flexible energy source for electricity generation. In industry, these energies also serve as raw materials (petrochemicals) or fuels for processes.

Historically abundant and inexpensive, these energies profoundly shaped our production systems and consumption patterns. But the situation has changed: since the oil shocks, and even more after the 2008 crisis, their prices have become volatile, supply flows have tightened with the depletion of certain deposits, and these resources are now used as geopolitical leverage by producing and transit countries.

In Europe, the share of imported oil and gas increased as domestic production declined[36]; the European oil peak was reached around the early 2000s[37], and the gas peak about a decade later[38].

In France, the graph below illustrates several trends:

- Fossil energy imports (led by oil and gas) rising until 2005, then declining.
- Imports almost entirely fossil-based (over 90% in 2022).
- A decline in oil in our imports, losing about ten percentage points in fifteen years[39].
- A rise in gas, which does not, however, offset the decline in oil[40].



[36] IEA, The Implications of Oil and Gas Field Decline Rates, 2025
[37] International Energy Agency, World Energy Outlook 2018
[38] The Shift Project, *Natural Gas: What Risks for the European Union's Supply?* [in French], 2022.
[39] For oil, however, a slight rebound (in relative terms) can be observed in 2023–2024…
[40] Ibid.

Figure 8: France's Energy Imports by Source (TWh, final energy)
Design and modelling: The Shift Project (2025)
Data: IEA, SDES, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Importations d'énergie de la France (en TWh)	France's energy imports (in TWh)
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Énergies décarbonées	Decarbonised energies
Non identifié	Unidentified
Projection	Projection

2. Role of Imports in Sectoral Energy Consumption

A sectoral analysis helps to better understand how the evolution of France's oil and gas imports have translated domestically.

As shown in Figure 8, oil consumption has declined in almost all sectors over the past twenty years, with the notable exception of agriculture and, above all, the transport sector, which remains by far the largest consumer (two-thirds of refined product consumption in 2024). Conversely, thermal renewables (including biofuels) are increasing in the transport sector, while slightly declining in residential use.

Coal, whose share in overall energy consumption is now marginal, remains mainly used in industry, notably for the iron sector (68%), electricity and heat production (13%), and manufacturing (11%), according to SDES data[41].

Gas is mainly consumed by three sectors: tertiary, industry and residential, which account for most of the demand. Total gas consumption is generally stable over time.

Finally, regarding electricity (although it is produced mainly in Europe), its share in the tertiary energy mix is increasing. Conversely, in industry, its consumption in volume is declining — a trend to analyse in light of the overall decrease in energy demand in this sector.

a. Sectoral Analysis: Residential and Tertiary

[41] SDES, *Key Energy Figures, 2025 Edition* [in French].

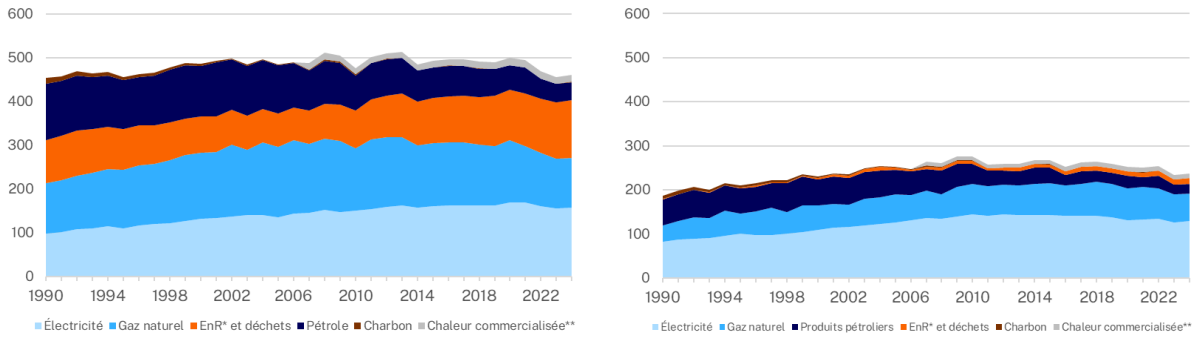


Figure 9: Energy Consumption in Residential (left) and Tertiary (right) (TWh, final energy)
Data: SDES, France Energy Balance / Footnotes[42]
Formatting: The Shift Project (2025)

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Électricité	**Electricity**
Gaz naturel	**Natural gas**
EnR* et déchets	**Renewables* and waste**
Pétrole	**Oil**
Charbon	**Coal**
Chaleur commercialisée**	**Commercial heat****

In the residential sector, the decline in consumption observed since 2018 can be explained by:

- Climate change (the data shown here are unadjusted for climate), which reduces heating needs with milder winters.
- Various energy-saving measures such as improved building envelopes (insulation, airtightness) encouraged by renovation incentives: *Energy Transition Tax Credit (CITE)*, then *MaPrimeRénov' (MPR)* and *Energy Savings Certificates (CEE)*.
- Efficiency gains in heating and domestic hot water technologies (e.g., condensing boilers improving yields, significant improvements in wood heating, better energy management), driven by technical innovation and public policies, notably renovation incentives (CITE then MPR, CEE).
- New buildings having become increasingly efficient under thermal regulations (from RT1974 to RE2020).
- More recently, the installation of heat pumps, particularly replacing fossil boilers, which tends to reduce overall energy consumption thanks to renewable heat drawn from the environment. This trend explains part of the reduction in fossil fuel consumption and the increase in electricity consumption.

Conversely, energy savings in the sector may have been hindered by:

[42] (p) = provisional. * EnR = non-electric renewable energies (mainly wood, solar thermal...). ** Data available only from 2007 onwards. Coverage: up to and including 2010, the geographical scope is metropolitan France. From 2011 onwards, it also includes the five overseas departments and regions (DROM).

- The increase in heated floor area per inhabitant, combined with population growth, resulting in a substantial rise in heated surfaces.
- Increasing electricity consumption (household appliances, audiovisual and digital equipment…), mitigated by improvements in appliance energy efficiency.
- More recently, the expansion of air conditioning.

In the tertiary sector, similar trends are observed in building systems and envelopes, as well as in the performance of new constructions. At the same time, there has been a significant increase in heated surfaces, a rise in electricity consumption, and an earlier and more systematic deployment of air conditioning, particularly in shops and offices.

b. Sectoral Analysis: Transport

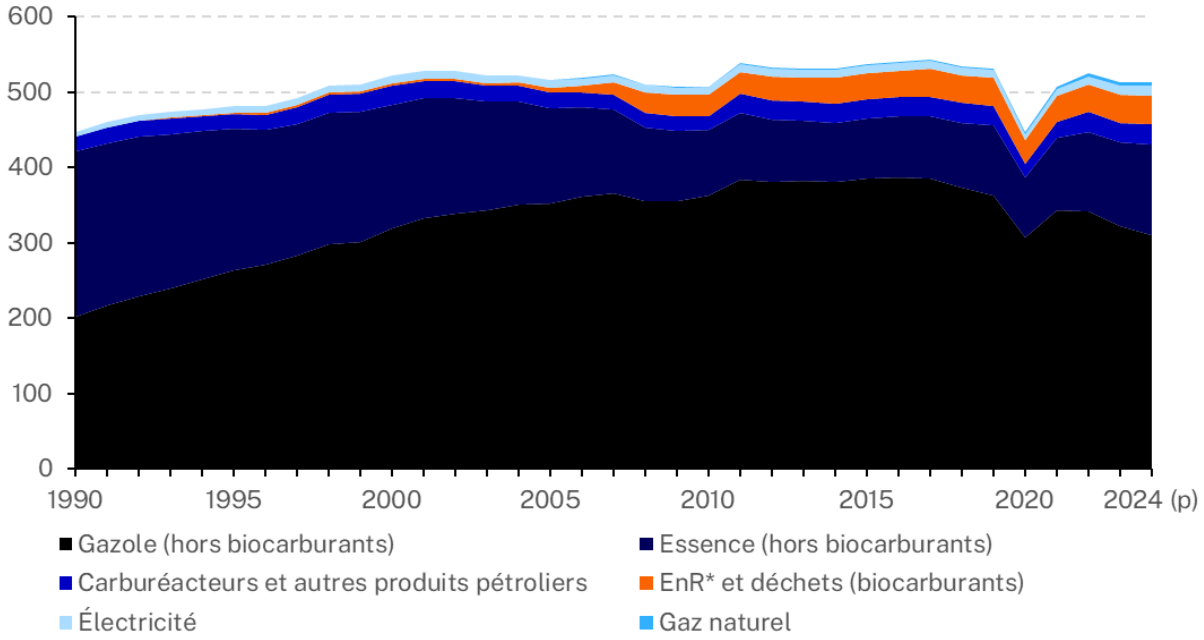


Figure 10: Energy Consumption in the Transport Sector (TWh, final energy)

Data: SDES, France Energy Balance / Footnotes[43]
Formatting: The Shift Project (2025)

Texte source (inchangé)	Traduction anglaise (institutionnelle, idiomatique)
Gazole (hors biocarburants)	Diesel (excluding biofuels)
Essence (hors biocarburants)	Petrol (excluding biofuels)
Carburéacteurs et autres produits pétroliers	Jet fuel and other petroleum products
EnR* et déchets (biocarburants)	Renewables* and waste (biofuels)
Gaz naturel	Natural gas
Électricité	Electricity

In transport, energy consumption is not decreasing. Several factors explain this:

[43] (p) = provisional. * EnR = renewable energies. Coverage: up to and including 2010, the geographical scope is metropolitan France. From 2011 onwards, it also includes the five DROM.

- Thermal renewables (biofuels) have seen a slight increase in share since the 2000s, driven by the introduction of regulations in 2000 and then 2009 allowing blending rates of up to 10% in petrol and diesel.
- The share of electric road vehicles in the fleet remains low (3% for cars and even lower for light commercial vehicles and heavy trucks in 2024). The effects of fleet electrification on reducing emissions will not be fully visible for several years.
- In aviation, domestic traffic is returning to pre-Covid levels and is on an upward trajectory.
- Meanwhile, kilometres travelled per person and tonne-kilometres transported remain broadly stable, with fleets still overwhelmingly thermal.
- Efficiency gains in thermal vehicles (excluding battery electrification) are insufficient to significantly reduce oil consumption.

c. Sectoral Analysis: Industry

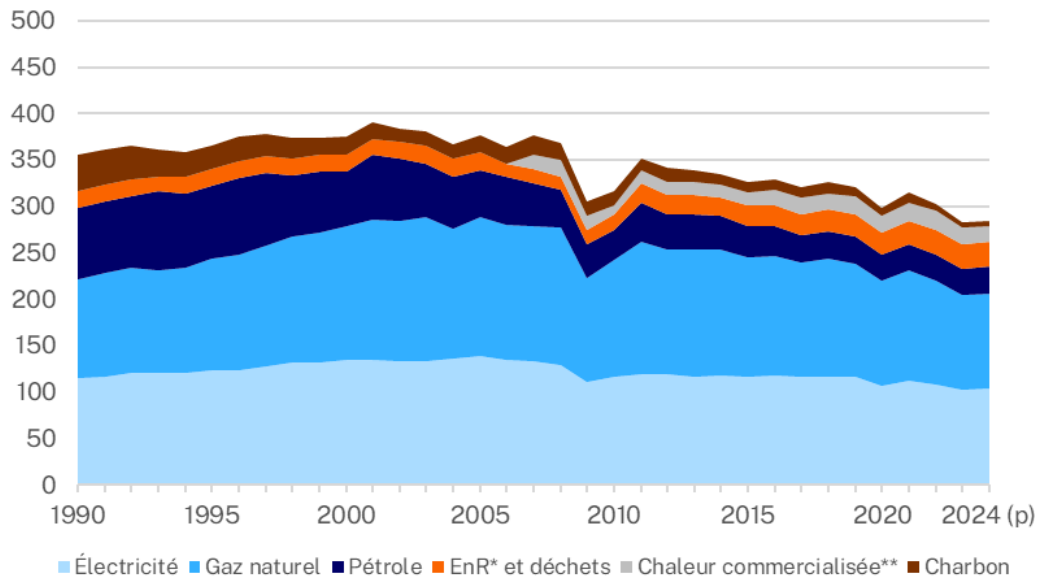


Figure 11: Energy Consumption in the Industry Sector (TWh, final energy)

Data: SDES, France Energy Balance / Footnotes[44]
Formatting: The Shift Project (2025)

Texte original (inchangé)	Traduction en anglais (UE, formelle)
Électricité	Electricity
Gaz naturel	Natural gas
Pétrole	Oil
EnR* et déchets	Renewable energy* and waste
Chaleur commercialisée**	Marketed heat**
Charbon	Coal

[44] (p) = provisional. * EnR = renewable energies. ** Data available only from 2007 onwards. Coverage: up to and including 2010, the geographical scope is metropolitan France. From 2011 onwards, it also includes the 5 DROM. Industry includes construction. Blast furnaces are excluded, as they are considered part of the energy sector in the energy balance.

Regarding industry, without ranking the factors involved, several elements explain the decline in energy consumption:

- Efficiency gains: improved industrial processes (better motor efficiency, heat recovery, automation, etc.), substitution of fossil fuels with electricity (often more efficient in final energy), and modernisation of industrial facilities, with the closure or replacement of the most energy-intensive sites.
- Offshoring part of production to lower-cost regions.
- The decline in industrial activity observed in recent years in France and Europe, driven by international competition, economic slowdown and loss of competitiveness in certain sectors[45].
- Changes in the structure of the economy, marked by the decline of heavy industries (steel, cement, basic chemicals) and the gradual shift towards higher value-added but less energy-intensive production.

Box 8: Focus on Imported Fossil Energies, Processed and Then Re-exported

In 2005, France imported **1,637 TWh** of final energy (mainly crude oil, natural gas in the form of LNG or via pipeline, refined petroleum products, as well as electricity produced in fossil-fuel power plants[46]). It is worth noting that not all oil and gas imported by France is intended for combustion on national territory: **11% was re-exported in 2005**, primarily refined oil processed in France and then re-exported.

[45] Some figures on the evolution of industrial production: between 2019 and 2024, –20% for chemicals (in MT), approximately –15% for concrete (in Mm^3) and cement (in MT), and –30% for steel (in MT). Sources: SDES, *Petrochemical Activity in France in 2024* [in French], 2025; France Ciment, *Cement in Figures 2024* [in French]; Eurofer, *European Steel in Figures*, 2025.

[46] In this case, the above chart shows a category "Other" in which various imports are aggregated, including imports of electricity produced in power plants running neither on oil nor on gas, and therefore on coal. The increase in 2021 and 2022 is due in particular to the rise in electricity imports, partly produced from coal, and to coal imported to generate electricity in France. This temporary setback is linked to stress-corrosion issues that led to the shutdown of numerous nuclear plants in France, resulting in increased imports and in greater use of gas and coal power plants in France and neighbouring countries, in a context where the price competitiveness of coal relative to gas was slightly improved due to pressure on the gas market.

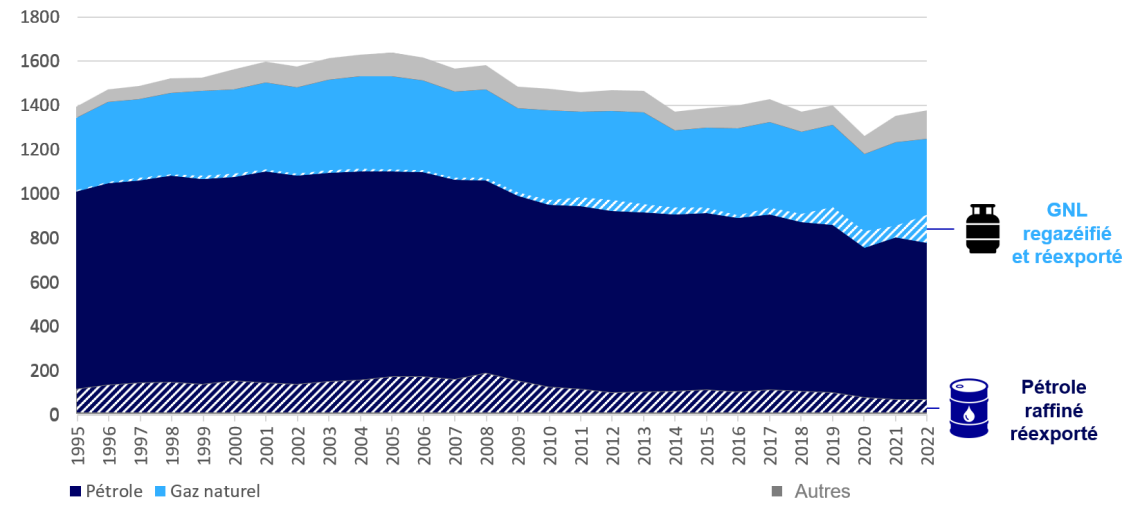


Figure 12: France's Energy Imports and Re-exports (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	Traduction en anglais (UE, formelle)
Importations énergétiques de la France (TWh, énergie finale)	France's energy imports (TWh, final energy)
Pétrole	Oil
Gaz naturel	Natural gas
Autres	Other sources
GNL regazéifié et réexporté	Regasified and re-exported LNG
Pétrole raffiné réexporté	Re-exported refined oil

Only 17 years later, in 2022, the country imported **1,373 TWh**, a decrease of **16%**. Nevertheless, price increases have driven up the national energy bill despite the decrease in imported volumes. France continues to re-export, and even slightly more: **16 TWh more than before**, now representing **14% of imports re-exported**. However, the structure of re-exports has changed, with a significant share now consisting of gas and **61% less oil**.

The decline in oil imports has been particularly marked thanks to reduced consumption and re-export: volumes fell from **1,096 TWh to 771 TWh**, a **30% decrease over 17 years**.

- Of this **30% reduction in imported oil**, **20% is due to lower consumption** and **10% to reduced re-exports**.
- Indeed, part of the crude oil is processed in refineries and then re-exported as refined products. The quantity of oil imported for re-export fell from **168 TWh to 65 TWh (-65%) over 17 years**. Several refinery closures (Flandres, Reichstett, Berre, Petit-Couronne) and changes in two others (La Mède converted to a biorefinery, Grandpuits scheduled to reopen in 2026 to produce synthetic fuels) have likely constrained refined product exports, against a backdrop of declining profitability following the 2008 financial crisis.

Driven by the commissioning of an LNG terminal and re-exports to neighbouring countries, gas imports have increased, rising from **429 TWh to 471 TWh in 17 years (+10%)**, mainly since 2017.

- Without this sharp increase in re-exported natural gas — from **9 TWh to 128 TWh** — gas imports would have fallen by **18%** over the same period, according to Shift Project modelling.

- In practice, this rapid surge in re-exported gas was enabled by the opening of France's largest LNG terminal in Dunkirk in 2017 and accelerated by the closure of pipelines in Eastern Europe. LNG terminals allow the import of LNG, its regasification, and injection into the French transmission network, which can then re-export the portion not consumed domestically. Since the closure of Russian pipelines supplying Europe from the East, France has become a gateway for LNG into Europe, and its re-exports have therefore increased significantly.

Thus, depending on whether they are intended for domestic consumption or for re-export, fossil energy imports reflect dependencies of different natures, which have different implications for French sovereignty. In 2022:

- **86% of our fossil energy imports supplied domestic consumption** (households, businesses, public authorities) on French territory, making these activities dependent on them. This is a source of vulnerability for our economy.

- **14% of these imports kept French refineries running and then supply consumption in other countries**, mainly European ones. France therefore controls on its soil a key link in the energy dimension of several neighbouring countries. This is why, albeit for limited volumes, in 2022 the sovereignty of our European neighbours and that of France were interconnected through gas and oil — and not solely through electrical interconnections between European countries.

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3. *France's Imports by Geographical Area*

Europe has entered a critical phase in its energy history, marked by the rapid depletion of its traditional sources of oil and gas supply. For several decades, the North Sea (through production in the United Kingdom and Norway) played a central role in the continent's fossil energy supply. Today, this historic resource is reaching the end of its geological life: British and Norwegian production has been declining since 2005, unable to return to the levels of the 2000s despite investments, technological innovations, and the exploitation of marginal fields[47].

This structural decline is gradually depriving Europe of its main domestic source of supply, which was relatively insulated from international tensions. The result is growing external dependence in a global context of geopolitical tensions, competition, and heightened economic instability.
This increasing reliance on energy imports makes Europe ever more vulnerable to the whims of producing countries, which use energy as a lever of power.

In the following section, we will analyse France's energy imports by geographical area, incorporating projections and forward-looking elements drawn mainly from oil and gas reports published by *The Shift Project* in 2021 and 2022.

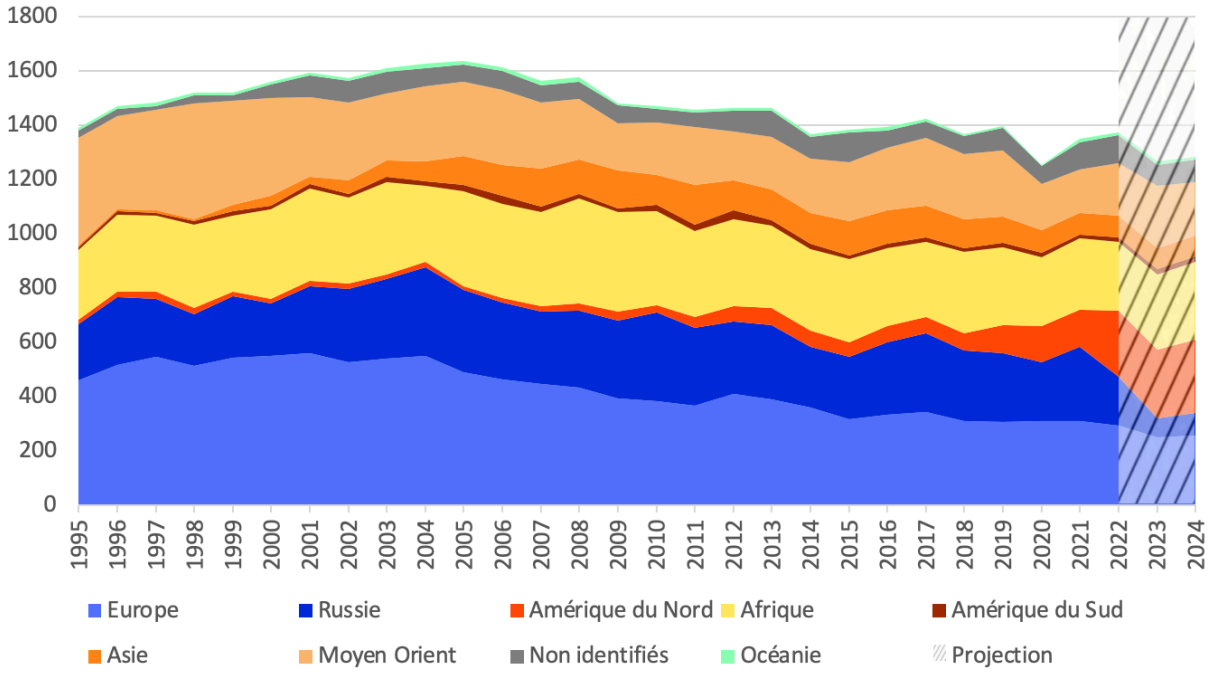

Figure 13: France's Energy Imports by Continent (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, SDES, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	Traduction en anglais (UE, formelle)
Importation françaises d'énergie selon les continents (en TWh)	French energy imports by continent (in TWh)
Europe	Europe
Russie	Russia
Amérique du Nord	North America
Afrique	Africa
Asie	Asia
Moyen Orient	Middle East
Non identifiés	Unidentified
Océanie	Oceania
Amérique du Sud	South America
Projection	Projection

[47] *The Future of Oil Supply in the European Union: State of Reserves and Production Prospects for Major Suppliers*, 2021.

a. Russia

→ Oil from Russia

Until 2022, Russia was by far the leading supplier of crude oil to the European Union, accounting for up to 40% of imports for some Member States. The invasion of Ukraine in February 2022 led to a sharp drop in Europe's direct imports of Russian oil in favour of oil imported from Asia. A share of these European imports from Russia, however, continues in the form of refined products, particularly via several refineries located in India[48].

Russia is an old and mature oil-producing country, whose reserves have been steadily declining since the 1990s. Output from currently producing fields is expected to fall by 35% by 2030 and by nearly 80% by 2050[49]. Unless there is rapid development of unconventional resources (notably Bazhenov shale oil and Achimov LTO in Western Siberia) or resources from geographically extreme zones (Vostok project), new developments are unlikely to offset the structural decline of many existing fields.

Moreover, international sanctions imposed since 2022 have weakened Russia's oil economy. The European embargo on crude oil and the G7 price cap have caused a significant drop in export revenues, estimated at around €34 billion in the first year (a decline of nearly 14%), according to the *Centre for Research on Energy and Clean Air (CREA)*[50]. While Russia still maintains high export volumes, each barrel now sells at a discount, limiting investment capacity in new oil infrastructure[51].

Ukrainian strikes targeting Russian refineries have further weakened the country's refining capacity. According to the *International Energy Agency (IEA)*[52], Russian oil revenues fell in September 2025 to their lowest level since the Covid crisis, at $13.35 billion, a drop of more than 20% over the first nine months of the year. The oil and gas sector, which provides nearly a quarter of state revenues, has seen its income more than halved compared to 2022[53].

Restricted access to Western technologies, spare parts, and specialised services—combined with Ukrainian attacks, natural field depletion, and falling oil revenues—risks accelerating the structural decline of Russia's oil production capacity.

→ Gas from Russia

Before 2022, Russia was the leading supplier of natural gas to the European Union, providing nearly 40% of its imports. The invasion of Ukraine disrupted this balance: According to the IEA, Russian pipeline deliveries to the EU fell from 140 billion m^3 in 2021 to around 60 billion in 2022, then dropped further to 38 billion in 2023, reducing Russia's share of European imports from 40% to less than 10%. This rupture accelerated with the shutdown of Nord Stream pipelines and the end of transit via Ukraine in early 2025. Remaining flows mainly transit through TurkStream, whose volumes also fell by about 20% in spring 2025.

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[48] See in particular: Center for the Study of Democracy, *Navigating Sanctions – Laundered Russian Oil Finds Its Way Back to Europe from India*, 2024.
[49] The Shift Project, *Future Oil Supply of the European Union: Status of Reserves and Outlook* [in French], 2021.
[50] CREA, *One year of sanctions: Russia's oil export revenues cut by EUR 34 bn*, 2023.
[51] IFRI, *2 Years of War in Ukraine: How Russia Manages to Maintain its Hydrocarbon Revenues* [in French], 2024.
[52] IEA, *Russia's War on Ukraine – Analysing the impacts on energy markets and energy security*, as of 11 November 2025.
[53] IEA, Oil Market Report, October 2025

International sanctions have also weakened Russia's gas sector through restrictions on financing, access to liquefaction technologies and specialised services, and withdrawal of Western partners. Major Arctic LNG projects, such as Arctic LNG-2, face delays and uncertainty regarding implementation. In this context, Moscow has sought to redirect part of its volumes to Asia (notably China via Power of Siberia), but these capacities remain limited and do not compensate for the loss of the European market.

Finally, according to *The Shift Project's 2022 report*[54], nearly half of Russian gas production is mature. So far, production decline has been offset, notably through the development of Arctic reserves. However, the ability to bring discovered but undeveloped reserves into production and export them in time appears uncertain, given the major role of Western expertise and capital in recent projects, and the consequences of war and international sanctions.

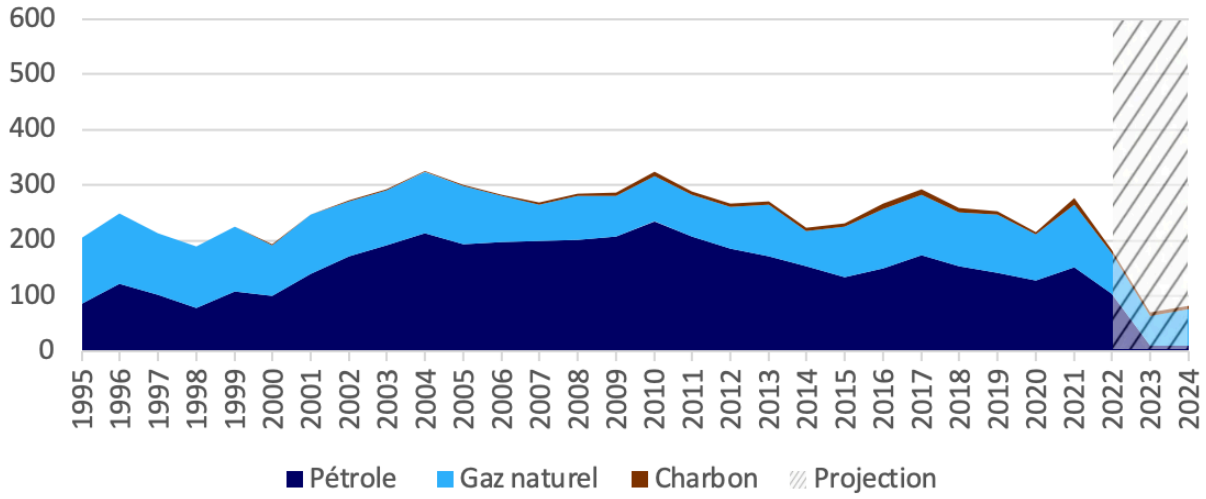


Figure 14: France's Energy Imports from Russia (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, SDES, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	*Traduction en anglais (UE, formelle)*
Importations d'énergie de la France depuis la Russie (en TWh)	*France's energy imports from Russia (in TWh)*
Pétrole	*Oil*
Gaz naturel	*Natural gas*
Charbon	*Coal*
Projection	*Projection*

b. North America

→ Oil from North America

With **214 TWh**, the United States accounted in 2022 for **91%** of France's hydrocarbon imports from North America, compared to **8% for Canada** and just **1% for Mexico**.

Since 1970, the U.S. has experienced a marked decline in conventional crude oil production, accompanied by a **72% drop in conventional reserves**. The base of conventional fields currently in production is expected to shrink by **63% by 2030** and by nearly **90% by 2050**[55]. Undeveloped reserves and the potential of yet-to-be-discovered fields, estimated at around **63 billion barrels**, are insufficient to halt the structural decline of currently exploited deposits.

[54] The Shift Project, *Natural Gas: What Risks for the European Union's Supply?* [in French], 2022.

[55] Ibid.

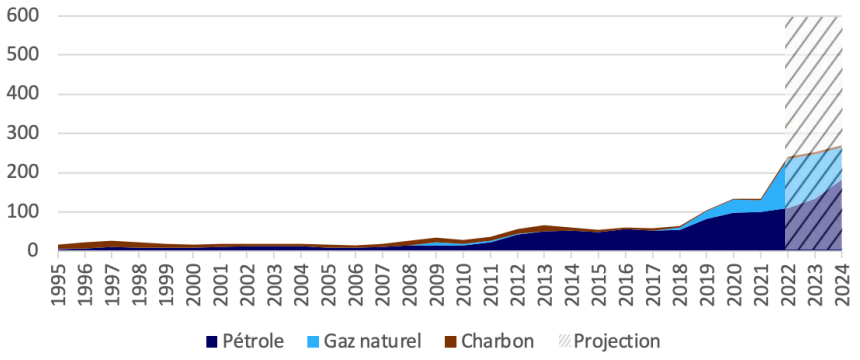
Since the 2000s, production of unconventional liquid hydrocarbons (*Light Tight Oil, LTO*) has grown strongly and has represented **more than half of total U.S. liquid hydrocarbon production since 2014**[56]. The rapid development of these capacities has enabled North America to regain its position as the world's leading oil exporter. Volumes exported to France have more than doubled over the past decade (**Figure 15**).

However, several analysts indicate that a historic peak in U.S. oil production could be reached soon[57]. Indeed, the pace of new investments is constrained by several factors: economic uncertainty; rising extraction costs linked to geology and the depletion of the most productive fields; and higher tariffs on equipment. In addition, the expected decline in demand due to the energy transition and oversupply induced by the gradual reduction of OPEC+ cuts exert additional pressure: the price of U.S. crude could fall from **$62 in September 2025 to below $50 on average in 2026**, according to the *EIA*[58], while extraction costs are expected to continue rising during the decade (currently around **$70 per barrel**). This is an unsustainable situation.

→ Gas from North America

Seeking to diversify its natural gas supplies, the Union found an opportunity in U.S. liquefied natural gas (LNG). This shift in European energy policy appears to combine two objectives: ensuring energy security and strengthening the transatlantic alliance.

In **2024**, the United States became the leading supplier of LNG to the European Union, accounting for about **45% of total imports**. This share has more than doubled compared to 2021. France remains Europe's largest LNG importer with **18 million tonnes in 2024**, of which about **6.7 million tonnes came from the United States**, making it the second-largest European customer for U.S. LNG after the Netherlands. Once regasified, LNG is injected into the national transmission network to be stored, distributed to industries and households, exported to other European countries, or used to fuel gas-fired power plants.



A recent study indicated that U.S. LNG may have the **highest carbon footprint of all gas supplies on the continent**[59]. In addition to increasing Europe's direct energy dependence on the United States, U.S. LNG imports weigh heavily on Europe's climate trajectory.

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[56] The oil and natural-gas production of all countries and continents can be consulted on the IEA's Energy Statistics Data Browser interface.

[57] See for example: *L'Usine Nouvelle, Oil: The United States' Hangover* [in French], 3 October 2025.

[58] US Energy Information Agency (EIA), Short-Term Energy Outlook (STEO), Release Date: October 7, 2025

[59] EERA for T&E, Well-to-Tank Carbon Intensity of European LNG Imports, 2024

Figure 15: France's Energy Imports from North America (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, SDES, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	Traduction en anglais (UE, formelle)
Importations d'énergie de la France depuis l'Amérique du Nord (en TWh)	France's energy imports from North America (in TWh)
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Projection	Projection

c. Africa

→ Oil from Africa

A historic supplier of crude oil to France, the African continent as a whole reached a peak in oil production at the end of the 2000s and has declined by nearly **30% since then**[60][61]. Its role remains significant in our supply: in **2024**, **30% of crude oil imported by France still came from Africa**, with the three main players being **Nigeria, Algeria, and Libya**[62].

Nigeria is one of the main African exporters of crude to France, accounting for about **12% of French imports in 2024**. However, Nigerian production peaked at the end of the 2000s and has fallen by nearly one-third since then[63]. The size of newly developed fields is decreasing, while the time between discovery and exploitation is increasing. Output from currently producing fields could fall by **65% by 2030** and by **95% by 2050**, largely due to the high proportion of deep offshore deposits.

Algeria supplies about **10% of France's crude oil**. Almost all of this production comes from fields discovered before 2000. Its crude output peaked in the mid-2000s and has declined by nearly one-third since then. Due to the high depletion rate of reserves and their low renewal, Algerian production is likely to continue falling in the coming decades[64].

Finally, Libya remains a significant supplier, accounting for about **7.5% of crude oil imported by France in 2024**. The size of fields being brought into production is shrinking, and Libyan output could decline by nearly **60% between 2019 and 2050**.

→ Gas from Africa

In **2021**, about **21% of the EU's natural gas imports came from Africa**, with **Algeria (19%)** as the main supplier. However, Algeria's gas production is in decline, with forecasts

[60] Energy Institute by BP, Statistical Review of World Energy, 2025
[61] The production of all countries and continents can be consulted on the IEA's Energy Statistics Data Browser interface.
[62] INSEE, Origin of Crude Oil Imported into France [in French] – Annual Data from 2011 to 2024, 2025
[63] Energy Institute by BP, *Statistical Review of World Energy*, 2025
[64] *The Future of Oil Supply in the European Union: State of Reserves and Production Prospects for Major Suppliers*, 2021. For further information, see Box 10 and Annex 1.

indicating a significant drop by **2030 and again by 2050**[65]. This decline is mainly due to the depletion of existing reserves and a lack of investment in new gas projects. Nevertheless, since **2022**, Algeria has significantly increased its LNG exports to Europe[66], which has sought to compensate for reduced Russian gas supplies.

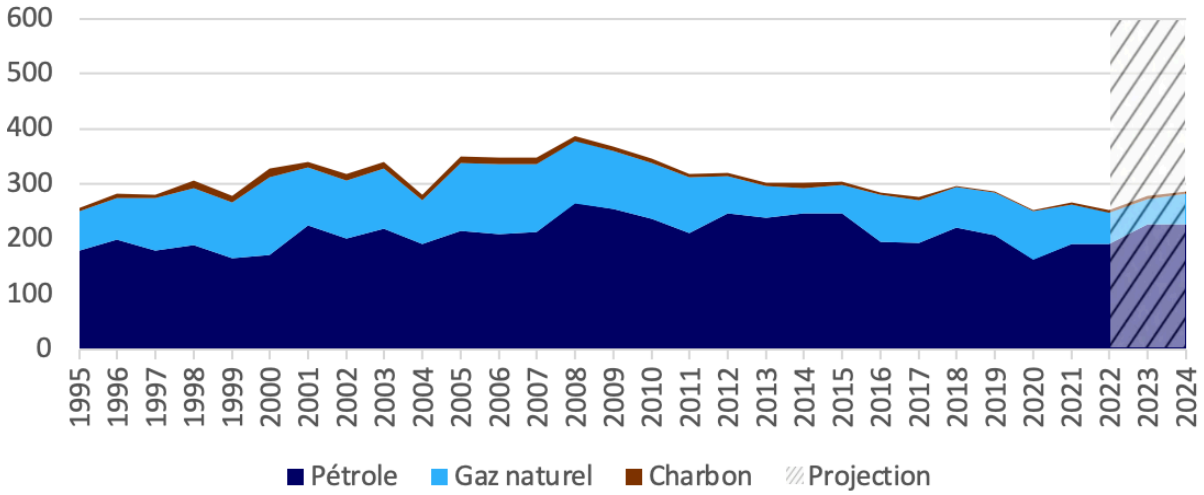

Figure 16: France's Energy Imports from Africa (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, SDES, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	Traduction en anglais (UE, formelle)
Importations d'énergie de la France depuis l'Afrique (en TWh)	France's energy imports from Africa (in TWh)
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Projection	Projection

d. Asia (excluding Russia) and the Middle East

→ Oil, Gas and Coal from Asia (excluding Russia) and the Middle East

The Middle East remains a strategic supplier of oil and gas to France, but trade flows to France have changed significantly in recent years. Since **2022**, France has increased its LNG imports from this region, notably from Qatar, to offset reduced supplies from Russia. Despite this rise in LNG, the share of oil and gas exports directed to France tends to decline, as several producing countries redirect their volumes to other markets.

This shift is part of a global context marked by strong growth in Asian demand. Asia — led by China — is becoming the dominant hub of global oil and gas consumption, attracting an increasing share of exports from producing countries.

Coal imports from Asia to Europe, and to France in particular, remain limited but significant for certain industrial sectors and thermal power plants. France mainly imports coal from Australia and Indonesia, while Europe as a whole also depends on Russian and

[65] The Shift Project, Natural Gas: What Risks for the Supply of the European Union? [in French], 2022
[66] Balance Point Research, Algeria: Steady underperformance, 2025

South African coal. Since **2022**, the reduction in Russian supplies has led to a slight increase in imports from Indonesia and Australia.

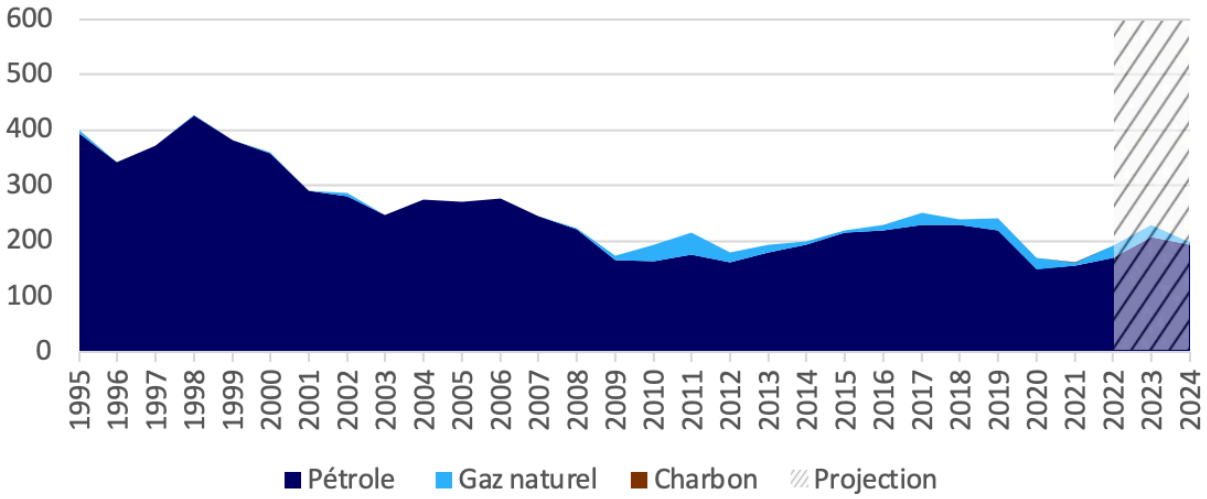

Figure 17: France's Energy Imports from the Middle East (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, SDES, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	*Traduction en anglais (UE, formelle)*
Importations d'énergie de la France depuis le Moyen-Orient (en TWh)	*France's energy imports from the Middle East (in TWh)*
Pétrole	*Oil*
Gaz naturel	*Natural gas*
Charbon	*Coal*
Projection	*Projection*

e. Europe

→ European Oil

In Europe, oil production capacity is slowing, particularly in the North Sea. Norway has reduced its output by nearly **50% since its peak in 2000**[67]. Fields currently in production could lose **40% of their output by 2030** and become negligible by 2050. Ongoing and upcoming developments could temporarily offset this decline. The country holds **10 billion barrels of reserves** and a significant number of undeveloped fields. With the exception of the giant Johan Sverdrup field (**3 billion barrels**), discovered in 2010, the small size of new fields creates uncertainty about the possibility of a sustainable rebound in production. Norwegian output could increase by **15% between 2020 and 2030**, with a possible secondary peak in 2025 at **790 million barrels**, thanks to Johan Sverdrup coming on stream. Beyond that, production is likely to enter terminal decline[68].

The United Kingdom is another highly mature oil-producing country. Its output has fallen by **60% since 1999**, and reserves have been continuously declining since 1978. Production is expected to continue its downward trend in the coming decades.

[67] The production of crude oil and natural gas of all countries and continents can be consulted on the IEA's Energy Statistics Data Browser interface.
[68] *The Future of Oil Supply in the European Union: State of Reserves and Production Prospects for Major Suppliers*, 2021.

→ European Gas

Natural gas production in Europe (excluding Russia) has been declining since the mid-2000s, despite growth recorded in Norway over the past thirty years. In **2022**, the EU's domestic production accounted for only **12% of its consumption**. This structural decline is due to the maturity of fields and the gradual depletion of reserves, with a key factor being the exhaustion of numerous North Sea fields. This also affects the United Kingdom, whose output has been falling since 2000. This situation makes Europe increasingly dependent on imports, just as the global gas market becomes more competitive and sensitive to geopolitical tensions.

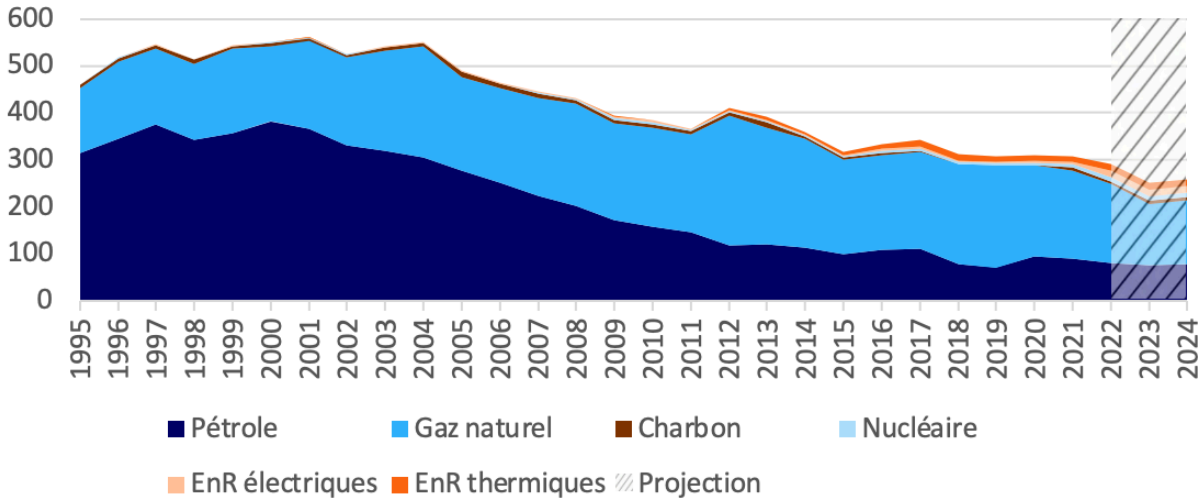

Figure 18: France's Energy Imports from the Rest of Europe (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, SDES, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	**Traduction en anglais (UE, formelle)**
Importations d'énergie de la France depuis l'Europe (en TWh)	France's energy imports from Europe (in TWh)
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Nucléaire	Nuclear
EnR électriques	Renewable electricity
EnR thermiques	Renewable heat
Projection	Projection

In short, Europe and France find themselves constrained on several fronts:

- **To the Northwest**, the gradual depletion of the North Sea severely limits the only domestic source on which Europe could reasonably rely for fossil fuel supplies.
- **To the East**, the growing disconnection from the Russian market, driven by political motives, simultaneously demonstrates our ability to largely dispense with a major supplier within a few years; alerts us to the high cost that increasing

independence from such a supplier will incur; and heightens our vulnerability to remaining suppliers[69].

- **Finally, to the West**, the United States, in a position to exploit our increased vulnerability, uses its dominance in energy markets as a lever of influence — as evidenced, for example, by the role of oil and gas in trade negotiations.

If we in Europe and France refuse to consider energy as a lever in power relations , this simply allows others to use it to our detriment. Whether for climate, economic, social, or security reasons, decarbonising the European economy remains a necessary condition for ensuring our sovereignty.

C. Imports of Goods and Services

1. Energy and Location of Production Activities Required for Goods and Services Imported by France in 2022

To sustain the French way of life and the country's economic activity, goods (finished products, semi-finished products, raw materials...) and services (digital, banking, air transport...) are "imported," generating energy consumption throughout their value chains. These imports expose us to the energy mixes of our suppliers, their fossil fuel supplies, and associated risks.

On the one hand, the production of imported goods consumes energy outside France at every stage of their manufacturing cycle — from raw material extraction and refining to final production and freight transport. On the other hand, the production of "imported" services also consumes energy — for heating buildings, powering data centres, employee travel and catering, etc. Across these complex value chains, a large amount of "invisible" energy used abroad must be considered: energy for the manufacture of factories, equipment, vehicles, food, and more. In other words, our analysis cannot stop at the energy consumption of first-tier suppliers; it must be traced back through every supplier along the value chain.

Figure 19 shows the volume of final energy consumed in each region of the world to produce goods and services subsequently imported by France. For a single product made from raw materials extracted in Africa, assembled in Asia, and transported across Europe, energy is used on each of these three continents. Studying each geographical import zone helps capture these energy transformations, revealing specific economic, industrial, and geopolitical dynamics.

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[69] It should be noted that Russia remains, regardless of the nature of commercial relations, a mature producer, and therefore it cannot sustainably increase its production without difficulties. Instead, it is heading towards decline, and would in any case have seen its supply stagnate and then become restricted over time.

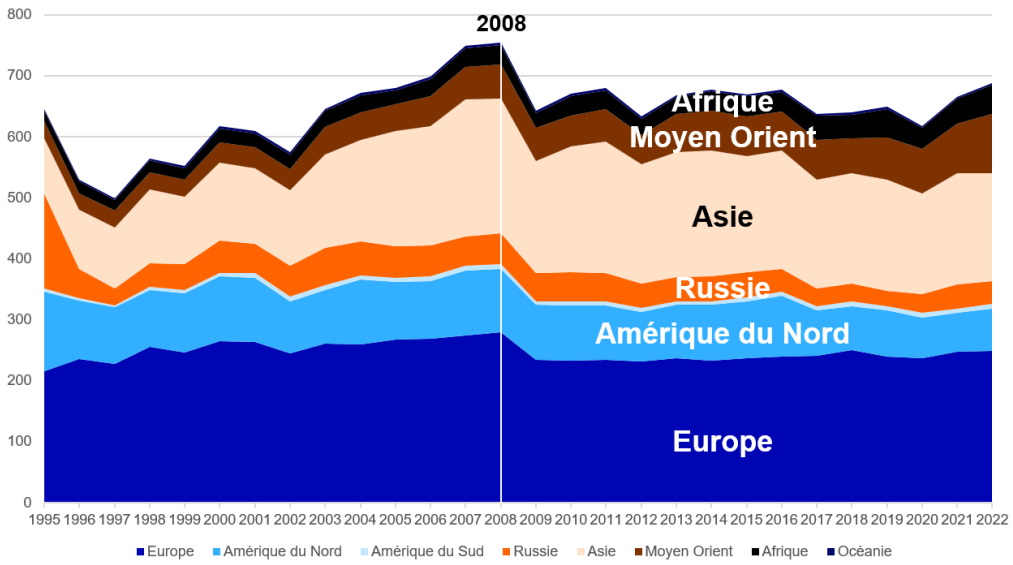

Figure 19: Energy Embedded in Goods and Services Imported by France, by Region of Energy Consumption (in TWh, final energy)

Design and modelling: The Shift Project (2025)
Energy consumption attributed to Russia before 1997 may be subject to geographical attribution errors linked to input-output tables used. These data should therefore be handled with caution.
Data sources: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte original (inchangé)	**Traduction en anglais (UE, formelle)**
Importations de biens et services de la France (énergie finale incorporée, TWh)	France's imports of goods and services (embedded final energy, TWh)
Afrique	Africa
Moyen Orient	Middle East
Asie	Asia
Russie	Russia
Amérique du Nord	North America
Europe	Europe
Amérique du Sud	South America
Océanie	Oceania

In **2022**, goods and services imported by France generated an indirect consumption of **683 TWh of final energy**. This volume exceeds France's entire annual energy production, estimated at **494 TWh**. Thus, even by doubling its energy infrastructure (nuclear plants, wind farms, hydroelectric dams…), France would not have enough energy to produce all the goods and services it consumes.

After a sharp increase to around **750 TWh in 2008**, energy consumption associated with these imports fell significantly and stabilised between **600 and 700 TWh from 2009 to 2022**, at a level equivalent to that of 2003–2006. These trends illustrate several concurrent dynamics: the gradual offshoring of certain French industrial sectors, the expansion of global industrial production, and France's growing integration into global value chains — developments that preceded the 2008 crisis.

With **one-third of the energy consumed for France's imported goods and services**, Europe is the main supplier from an energy perspective. This coincides with a monetary view, where more than **50% of France's imports by value come from other European countries**, and **8 of the top 10 supplier countries are European**[70]. While energy

[70] DSECE, Foreign Trade Figure [in French], 2025

consumption in Europe for goods and services imported by France was slowly increasing until 2008, followed by a drop in 2009, it has since remained remarkably stable. The predominance of European imports — from countries with which France maintains coordinated energy policies and long-term economic ties — contributes to the relative stability of its energy exposure.

Asia as France's Leading Non-European Supplier of Embedded Energy in Imported Goods and Services

Asia is France's largest non-European supplier in terms of embedded energy in imported goods and services, accounting for just under one-third of this total. Between the late 1990s and 2008, it was one of the main drivers of the increase in energy embedded in France's imports of goods and services. This period corresponds to China's accelerated industrialisation phase, marked by the relocation of value chains — particularly European ones — to more carbon-intensive economies.

Since then, Asia has declined in terms of embedded energy contained in its exports. This could be linked to an improvement in its energy efficiency[71] because its imports by value have continued to grow over the same period[72].

The remaining third of the energy embedded in France's imports of goods and services is shared among other regions — Africa, North America, South America, the Middle East, Oceania, and Russia. The Middle East and Africa account for a growing share of these imports, attributable to the expansion of their industrial production in certain sectors. North America's share has been falling since 2017, without any clear correlation to its partial deindustrialisation in some sectors[73]. Russia's share, meanwhile, follows a downward trend, which is expected to continue in 2023 and 2024 with the deterioration of bilateral relations.

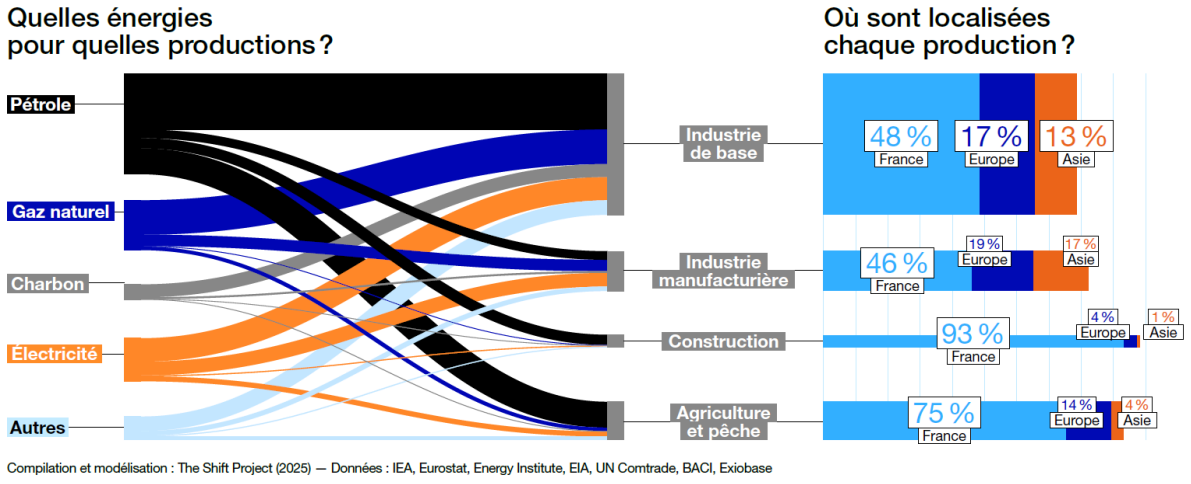

Figure 20: Energy and Location of Production Activities Required by France in 2022 (in TWh, final energy)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

[71] IEA, Understanding Energy End Uses – Efficiency & Demand, 2025
[72] OEC, *China–France*, 2023
[73] La Croix, In the United States, Ongoing Deindustrialisation [in French], 2017

Texte original (inchangé)	Traduction en anglais (UE, formelle)
Quelles énergies pour quelles productions ?	Which energies for which productions?
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Électricité	Electricity
Autres	Other sources
Industrie de base	Basic industry
Industrie manufacturière	Manufacturing industry
Construction	Construction
Agriculture et pêche	Agriculture and fisheries
Où sont localisées chaque production ?	Where is each type of production located?
France	France
Europe	Europe
Asie	Asia
Compilation et modélisation : The Shift Project (2025) — Données : IEA, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase	Compilation and modelling: The Shift Project (2025) — Data: IEA, Eurostat, Energy Institute, EIA, UN Comtrade, BACI, Exiobase

Figure 20 illustrates the geographical and sectoral distribution of energy consumed for production activities destined for consumption within France or for French exports. Therefore it includes production on national territory (for French consumption or for export) and imports. It highlights the strong European concentration of energy flows linked to this production activity: **71% of total embedded energy is used in Europe (with France accounting for more than half)**, while **29% comes from the rest of the world**.

This geographical dependence varies by sector:

- **Basic industry — raw materials and materials — accounts for more than half of the energy consumption for production activities required by France.** 65% of energy consumption for this sector is **located in Europe**, with nearly **50% in France**. Asia, France's main non-European supplier, represents **13% of this total**, demonstrating its strong presence in basic industry. This industry relies mainly on oil, particularly for non-energy uses (notably in petrochemicals).

- **The manufacturing industry shows a similar geographical profile to basic industry**, with **65% of energy consumed in Europe**, although France's share is proportionally smaller and that of neighbouring European countries higher. Asia, however, plays a much larger role here, accounting for **17% of the sector's energy consumption**. Overall, Europe and Asia represent **82% of the energy consumption of the manufacturing industry on which France depends**. This industry is far less oil-intensive and relies more on electricity and gas.

- **The construction industry appears overwhelmingly domestic or European (97%)**. The energy accounted for here corresponds to energy used in the building sector.

- **Finally, agriculture and fishing — highly local sectors — depend almost exclusively on energy consumed in Europe (89%)**, and predominantly in France (75%), although this consumption remains vulnerable to fluctuations in natural gas prices (fertilisers) and oil prices (fuels).

This overview confirms that France's energy vulnerability is primarily internal to Europe: while most of the energy embedded in goods is consumed in Europe, it remains more than **80% fossil-based**. Thus, this apparent geographical stability does not translate into real energy security: it still depends on the availability and price of hydrocarbons used in the European production system and across all value chains.

Decarbonising production chains and partially relocating certain sectors, in France and at the European level, would substantially reduce these risks by lowering the need for energy imports and strengthening the continent's industrial and energy sovereignty. Beyond usual mechanisms, this dynamic could be amplified by bilateral decarbonisation agreements with China, particularly in highly emitting basic industries (steel, chemicals, plastics).

Box 9: Energy Embedded in "Imported" Services — A Complex Dependency to Map

In the data modelled by *The Shift Project*, the energy to be attributed to "imported" services is complex to estimate. Most of their energy content is diluted within data from other so-called "real economy" sectors — industry for equipment production, agriculture for feeding employees, transport for staff mobility, and so forth.

Consequently, the analysis provided in this report does not offer detailed insights into imported services. Detailed, sector-by-sector analyses are necessary to achieve a more granular understanding. Among the work already carried out by *The Shift Project*, we note, for example, studies on the healthcare sector (notably the report *Décarbonons les industries de Santé [Decarbonising Healthcare Industries]*[74]) and on digital technologies (notably the report *Intelligence artificielle, données, calculs : quelles infrastructures dans un monde décarboné ? [Artificial Intelligence, Data, Computing: What Infrastructure is needed in a Decarbonised World?*[75]*]*), which aim to quantify France's extra-territorial dependencies in these sectors.

Such analyses provide a complementary perspective on the macroscopic view presented in this report. For instance, the report dedicated to artificial intelligence mentioned above highlighted France's and Europe's strong dependence on the United States for digital services — data hosting and management, software platforms, and AI services. In particular, energy consumption in U.S. data centres driven by French usage was estimated at **over 10 TWh of electricity**, revealing the limitations of the input-output macroscopic model used for this report, which is insufficient to account for such indirect consumption.

[74] The Shift Project, Decarbonising Health Industries: Medicines and Medical Devices [in French], 2025

[75] The Shift Project, Artificial Intelligence, Data, Computation: What Infrastructure in a Decarbonised World? [in French], 2025

2. Basic Industry — Highly Energy-Intensive and Oil-Dependent

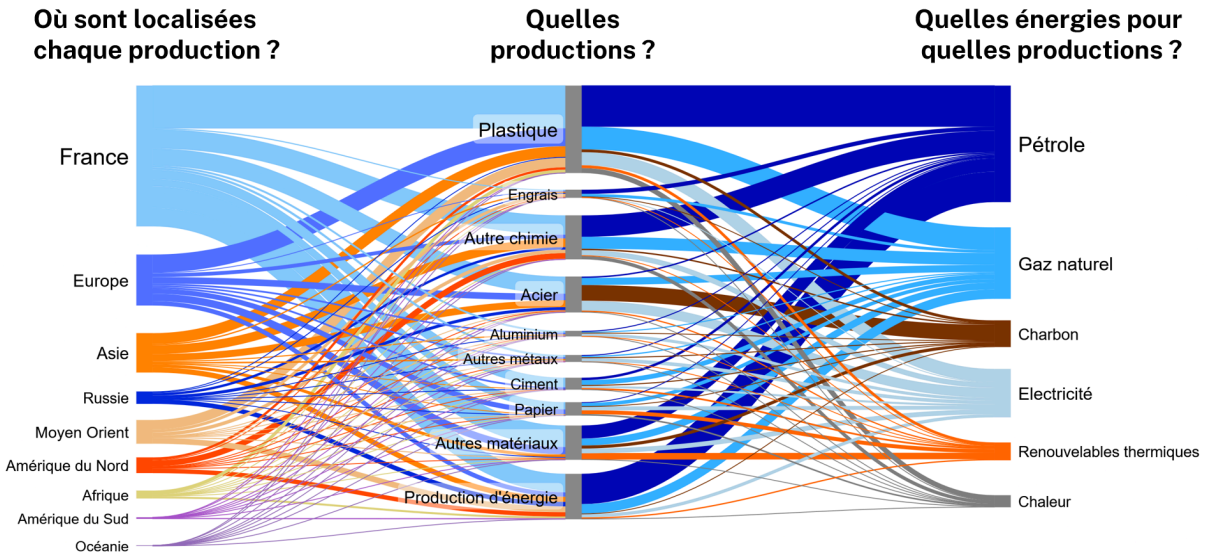

Figure 21: Location of Production Activities, Industrial Production and Energy in France in 2022 (in TWh, final energy)

Design and modelling: *The Shift Project (2025)*

Data sources: *IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	**Traduction en anglais (UE, formelle)**
Où sont localisées chaque production ?	Where are located the productions ?
France	France
Europe	Europe
Asie	Asia
Russie	Russia
Moyen Orient	Middle East
Amérique du Nord	North America
Afrique	Africa
Amérique du Sud	South America
Océanie	Oceania
Quelles productions ?	What productions ?
Plastique	Plastics
Engrais	Fertilisers
Autre chimie	Other chemicals
Acier	Steel
Aluminium	Aluminium
Autres métaux	Other metals
Ciment	Cement
Papier	Paper
Autres matériaux	Other materials
Production d'énergie	Energy production
Quelles énergies pour quelles productions ?	What energy for what production?
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Électricité	Electricity
Renouvelables thermiques	Thermal renewables
Chaleur	Heat

This diagram illustrates the dependencies of the basic industry underpinning the French economy, whether located in France or abroad.

The plastics industry, followed by the "other chemicals" sector, stands out as the heavyweight in terms of energy exposure. These sectors rely mainly on oil and, to a lesser extent, on natural gas, as both an energy source and for production inputs.

Any curtailment of oil supply — whether through price increases or restrictions on available volumes — would particularly weaken this sector.

This situation illustrates the convergence between the challenges of climate change and energy sovereignty: reducing plastic consumption would not only limit pollution linked to microplastics, but also decrease the structural dependence of the French economy on oil and natural gas. Transitioning to alternative materials and more frugal consumption practices thus constitutes a lever for increasing both economic and environmental resilience.

The rise in embedded energy within French imports from the Middle East could be explained by the region's persistent specialisation in highly energy-intensive sectors — hydrocarbons, petrochemicals, aluminium, steel — whose processes rely almost exclusively on fossil resources.

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3. Manufacturing Industry — Less Oil-Dependent, More Asia-Dependent

The manufacturing industry, France's second sector with exposure to energy risks, requires more detailed analysis. Examining physical energy flows highlights the strong sensitivity of the agri-food industry to variations in the price and availability of natural gas, on which it largely depends for thermal processes (cooking, drying, curing). Any supply pressure on the gas market would have a particularly damaging impact for this sector, far greater than the oil price fluctuation.

In the event of an energy crisis, government support for this industry would be particularly costly. From this perspective, accelerating the electrification of processes in France and Europe — especially in agri-food — appears a priority to reduce structural vulnerability and strengthen energy resilience.

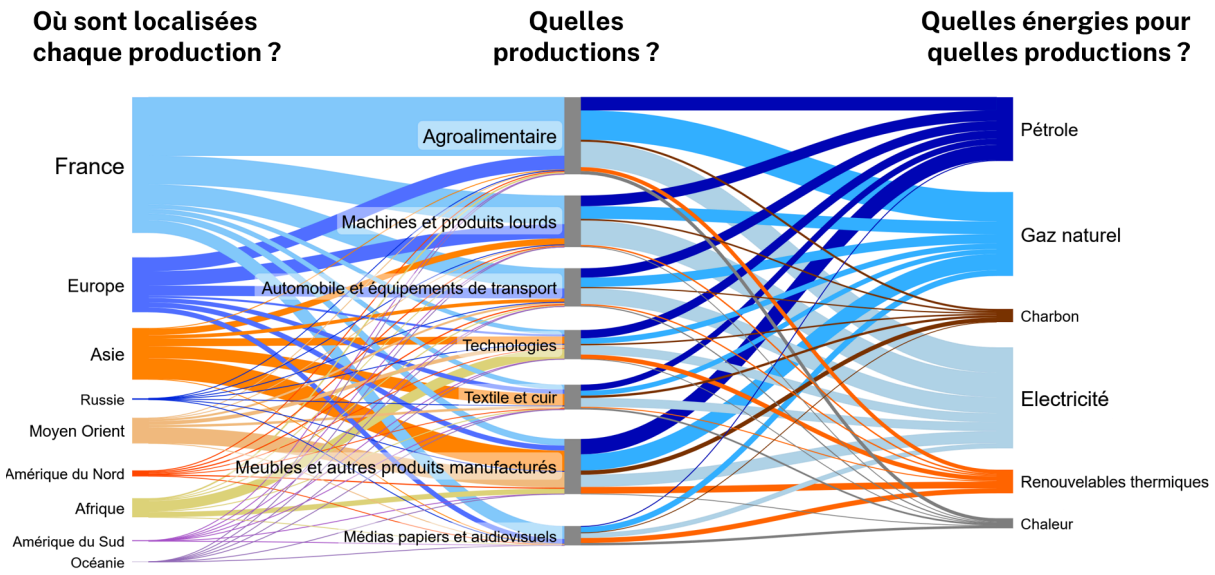

Figure 22: Location of Production Activities, Manufacturing Production and Energy in France in 2022 (in TWh, final energy)

Design and modelling: *The Shift Project (2025)*

Data sources: *IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	**Traduction en anglais (UE, formelle)**
Où sont localisées chaque production ?	Where are productions located?
France	France
Europe	Europe
Asie	Asia
Russie	Russia
Moyen Orient	Middle East
Amérique du Nord	North America
Afrique	Africa
Amérique du Sud	South America
Océanie	Oceania
Quelles productions ?	What productions?
Agroalimentaire	Agri-food
Machines et produits lourds	Machinery and heavy products
Automobile et équipements de transport	Automotive and transport equipment
Technologies	Technologies
Textile et cuir	Textiles and leather
Meubles et autres produits manufacturés	Furniture and other manufactured products
Médias papiers et audiovisuels	Paper and audiovisual media
Quelles énergies pour quelles productions ?	What energy for what production?
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Electricité	Electricity
Renouvelables thermiques	Thermal renewables
Chaleur	Heat

Franco-German trade is based on particularly dense industrial integration. Transport equipment accounts for about **a quarter of bilateral flows by value** — including **11% for automotive** and **9% for aerospace** — followed by chemicals (**12%**), machinery (**11%**), metallurgical products (**9%**) and agri-food (**8%**). Exchange of services — which are low in energy intensity — were estimated at **€68 billion in 2023** and further confirm Germany's position as France's second-largest trading partner, behind the United States.

It is also worth noting the near-total absence of North America in the energy exposure of this sector. Although the United States ranks among France's main trading partners, its exports to France have a low energy content — apart from direct purchases of oil and gas products accounted for in Section II.B of the report *France's Energy Imports*. This peculiarity is explained by the nature of the goods exchanged: U.S. exports to France are dominated by high value-added, low-material-intensity products such as aerospace equipment, technologies, or pharmaceuticals[76]. This profile contrasts with that of industrial imports from Asia, that are more concentrated on goods with higher energy intensity.

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4. *Imported Goods and Services Account for Half of France's Carbon Footprint*

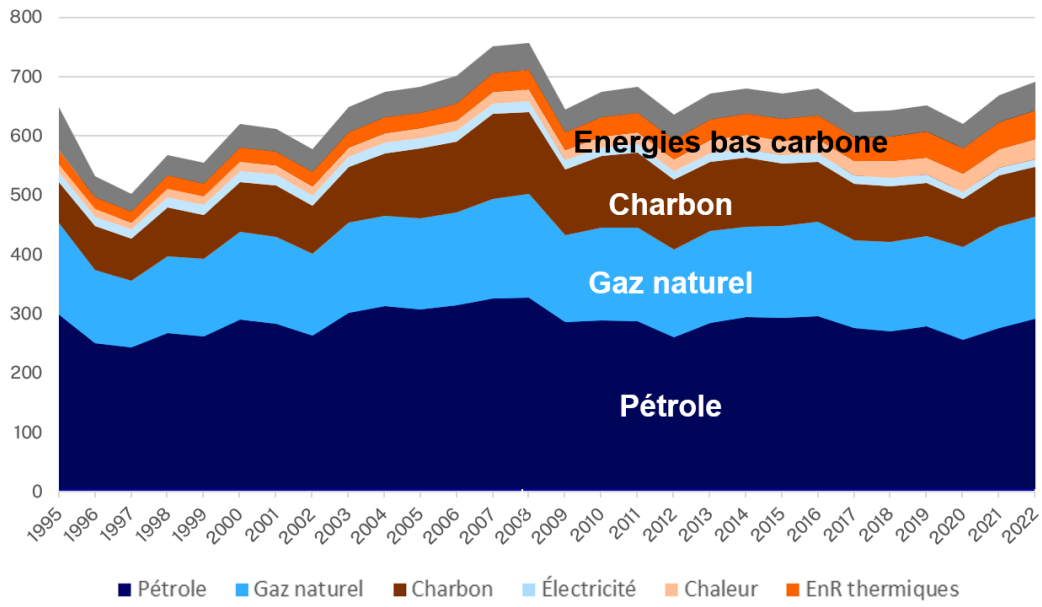


Figure 23: Energy Embedded in France's Imports of Goods and Services (TWh)
Design and modelling: *The Shift Project (2025)*
Data sources: *IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase*

Texte original (inchangé)	Traduction en anglais (UE, formelle)
Energie incorporée dans les importations de biens et services de la France (TWh)	Energy embedded in France's imports of goods and services (TWh)
Énergies bas carbone	Low-carbon energies
Charbon	Coal
Gaz naturel	Natural gas
Pétrole	Oil
Électricité	Electricity
Chaleur	Heat
EnR thermiques	Thermal renewables

[76] Douanes et droits indirects, No. 100, "Échanges commerciaux de la France avec les États-Unis" [France's Trade Exchanges with the United States], May 2025

Ultimately, nearly **80% of the energy embedded in imported goods and services is fossil-based**, revealing a persistent dependence on hydrocarbons that the apparent stability of trade cannot conceal.

This structural dependence weakens France, as a significant share of strategic goods and services comes from Chinese value chains powered by fossil energy. Any disruption or sharp increase in production costs in China would quickly impact the European economy.

For example, China remains heavily dependent on fossil fuels and lacks adequate domestic resources. As an importer of energy products, it is therefore exposed to energy risk, just like Europe. To address this vulnerability, China is pursuing an active policy of reducing its dependence on fossil fuels, based on electrification, the development of renewable energy, and the expansion of nuclear power.

Similar to the geographical distribution of energy exposure, the 2008 economic crisis also marked a turning point in the composition of energy resources embedded in French imports. Fossil fuels remain largely dominant in the energy embedded in imported goods and services, with oil by far the main vector of dependence, followed by natural gas and, to a lesser extent, coal — which occupies an intermediate position between fossil resources and decarbonised energy.

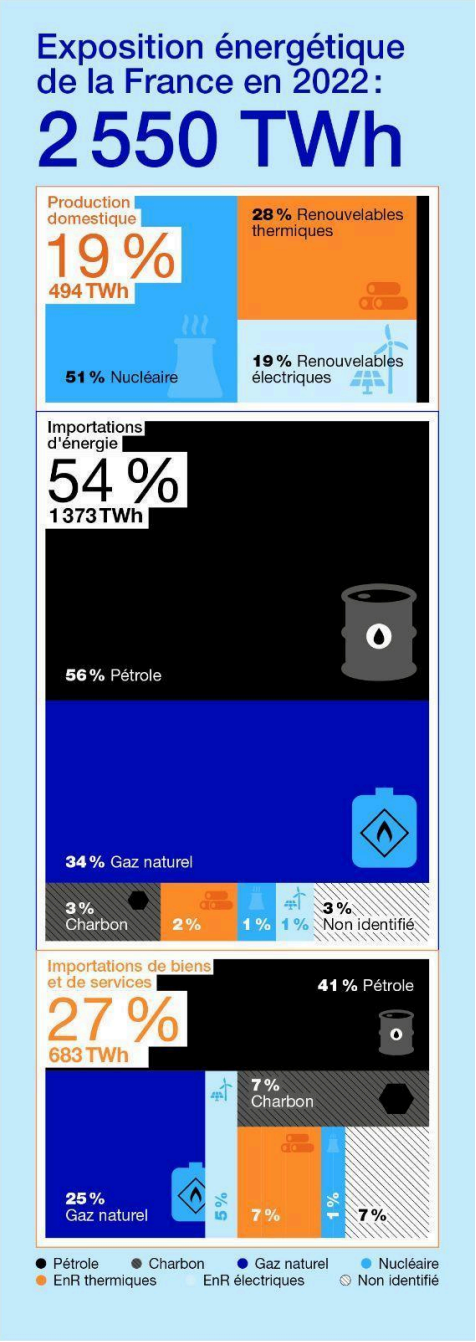
The downturn observed after 2008 affected all primary resources without any notable distinction. This trend suggests that no energy or trade policy has so far succeeded in specifically reducing dependence on a given resource or favouring imports from less carbon-intensive countries. Electric renewable energy, which began to appear gradually in trade from the 2000s, remains marginal in the energy structure of imports and does not alter France's overall vulnerability to supply tensions.

Oil thus remains the main risk factor for the French economy, both because of its weight in global trade and its structural volatility, as well as the risks affecting European and global supply at various time scales. Price fluctuations observed between 2014 and 2020 — a period of low prices followed by a marked rebound — did not lead to any significant variation in the energy content of French imports. This shows that an increase in oil prices does not translate into a reduction in imported volumes, but shows up at least partially into higher import costs, exacerbating the country's macroeconomic vulnerability and trade deficit.

Natural gas, whose main producers are largely the same as for oil, now occupies a firmly established second place in the energy content of French imports. Since the two markets are coupled, fluctuations in oil prices — particularly those linked to political decisions by major players such as OPEC+ — spill over into all energy carriers. These interdependencies contribute to increasing pressure on the entire French economy, affecting both domestic production — which is dependent on gas for industrial and thermal uses — and imports, whose costs automatically rise during periods of higher hydrocarbon prices.

III. Future Risks and Opportunities

A. The Fossil Constraint on France's Energy Exposure: Declining Dependence on Oil and Gas



1. The Omnipresence of Fossil Fuels in France's Energy Exposure

Through its imports of energy, goods and services, France is heavily exposed to fossil fuels. Although France's overall energy exposure has slightly decreased since 2008, the share of fossil fuels has not declined. While France's domestic energy production (494 TWh in 2022) is almost entirely decarbonised, our consumption of imported energy (1373 TWh in 2022) represents the bulk of our exposure to fossil fuels. It is composed of 56% oil (crude or refined), 34% natural gas (liquefied, gaseous, or, more marginally, embedded in the electricity produced by our neighbours), and 3% coal (used mainly as a fuel for melting steel).

Finally, the goods and services imported by France also entail indirect consumption of fossil fuels, primarily to power the industries that supply us with finished or raw products. Oil remains the main energy source consumed indirectly (41%), primarily for non-energy uses in the chemical sector. Natural gas accounts for 25% of our indirect consumption, used both as an input and as a fuel. Coal represents 12% of our indirect consumption, serving both as a fuel in blast furnaces and for electricity generation, notably in Asia.

Figure 24 : France's Energy Exposure in 2022
Design and modelling: The Shift Project (2025)

Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte original (inchangé)	Traduction en anglais (EU formal style)
Messages clés	Key messages
Exposition énergétique de la France en :	France's energy exposure in :
Production domestique	Domestic production
Renouvelables thermiques	Thermal renewables
Nucléaire	Nuclear
Renouvelables électriques	Renewable electricity
Importations d'énergie	Energy imports

Texte original (inchangé)	Traduction en anglais (EU formal style)
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Non identifié	Unidentified
Importations de biens et de services	Imports of goods and services
Pétrole	Oil
Charbon	Coal
Gaz naturel	Natural gas
Nucléaire	Nuclear
EnR thermiques	Thermal renewables
EnR électriques	Renewable electricity
Non identifié	Unidentified
sont nécessaires au fonctionnement de la France, pour soutenir les modes de vie des Français et l'économie nationale. Ce total représente l'exposition de la France à des risques énergétiques de différentes natures : approvisionnement en énergies fossiles, dépendance industrielle, tensions géopolitiques…	are required for France's functioning, in order to support the French population's lifestyles and the national economy. This total reflects France's exposure to various types of energy risks: fossil-fuel supply, industrial dependence, geopolitical tensions…
C'est :	This represents:
plus d'énergie que celle produite sur le territoire français	more energy than that produced within French territory
d'énergies fossiles (principalement du pétrole et du gaz naturel)	from fossil energies (mainly oil and natural gas)
Bien que la France produise globalement assez d'électricité pour couvrir sa consommation électrique actuelle, cela ne doit pas masquer la part d'énergies fossiles encore utilisée, en France comme à l'étranger, pour se déplacer et se chauffer, et pour produire les biens et services que nous consommons.	Although France produces enough electricity overall to meet its current electricity demand, this should not obscure the share of fossil energies still used, in France and abroad, for transport and heating, as well as for producing the goods and services we consume.
de l'énergie nécessaire au fonctionnement de la France est consommée en France ou en Europe. Décarboner à l'échelle européenne renforcerait significativement la souveraineté de la France.	of the energy required for France's functioning is consumed in France or in Europe. Decarbonising at the European scale would significantly strengthen France's sovereignty.
de notre exposition énergétique est liée à « l'énergie grise » incorporée dans les biens et services importés par la France : soit davantage que la totalité de l'énergie que le pays produit annuellement.	of France's energy exposure is linked to the "embedded energy" contained in imported goods and services: meaning more than the total amount of energy the country produces annually.
THE SHIFT PROJECT	THE SHIFT PROJECT

In total, France's energy exposure consisted of 72% fossil fuels in 2022, through a direct or indirect consumption of 1800 TWh of oil, natural gas and coal. This share is higher than for domestic energy consumption alone, which consists of 67% fossil fuels. In 2022, France's direct and indirect energy consumption was made up of: 42% exposure to oil, 25% exposure to natural gas, and 5% exposure to coal. Between 1995 and 2022, France never fell below the threshold of 70% exposure to fossil fuels on an annual basis. Exposure to fossil fuels was at its lowest in 2020 and 2021, two years marked by the Covid crisis, which led to a slowdown in the global economy and a decline in transport usage in France – and therefore in oil consumption – linked to the various lockdowns.

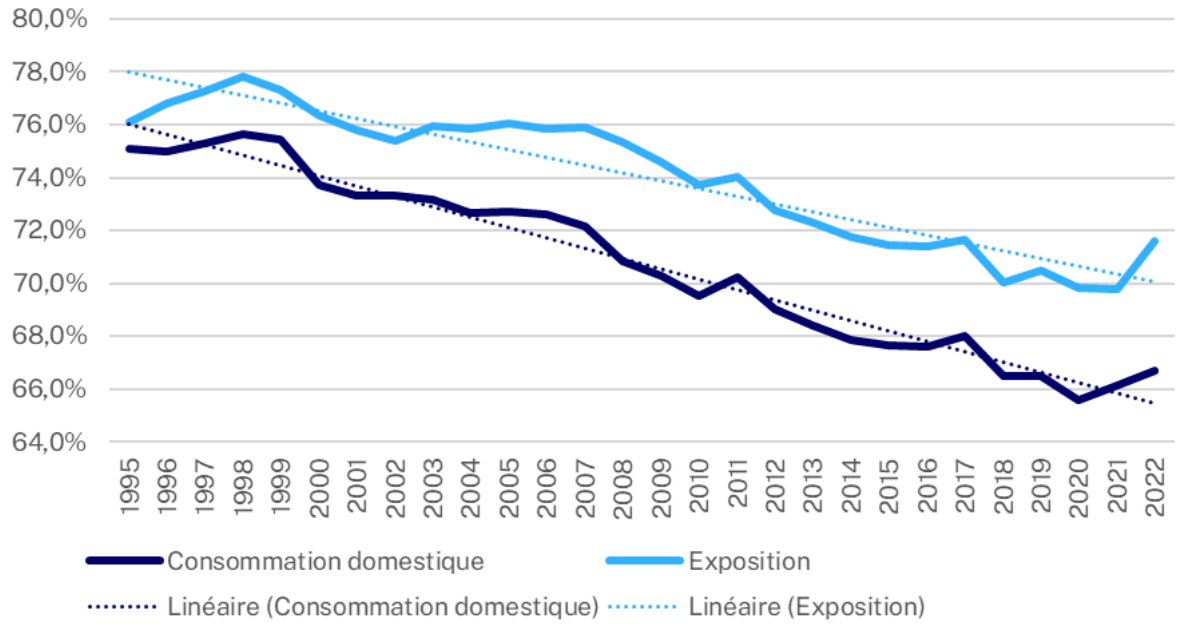


Figure 25 : Share of Fossil Fuels in Domestic Consumption and France's Overall Energy Exposure

Design and modelling: The Shift Project (2025)

Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase, SDES

Texte original (inchangé)	Traduction en anglais (EU, formal)
Part des énergies fossiles dans la consommation domestique et l'exposition énergétique de la France	Share of fossil energies in domestic consumption and in France's energy exposure
Consommation domestique	Domestic consumption
Exposition	Exposure
Linéaire (Consommation domestique)	Linear (Domestic consumption)
Linéaire (Exposition)	Linear (Exposure)

France's exposure to fossil fuels shows a very slow downward trend between 1995 and 2022. If this decline were to continue at its current pace after the post-Covid rebound, France's exposure to fossil fuels would reach 0% in just over 230 years. The decline in France's fossil fuel exposure follows a trend of –8% between 1995 and 2022, i.e. –0.3% per year. Since domestic energy consumption represents two-thirds of France's total energy exposure, the reduction in fossil fuels in French consumption is the main driver of this decline (although this reduction is itself far too slow to phase out fossil fuels by 2050). Energy consumed outside the territory is also decreasing in its fossil fuel content, but at a slightly slower pace than domestic consumption. In other words, France's decarbonisation is very slightly faster than that of its partners, in relative terms.

It should be noted that part of the rebound in energy and fossil exposure in 2021–2022 is due to the opening of the Dunkirk LNG terminal and the re-export of gas to some of our neighbours.

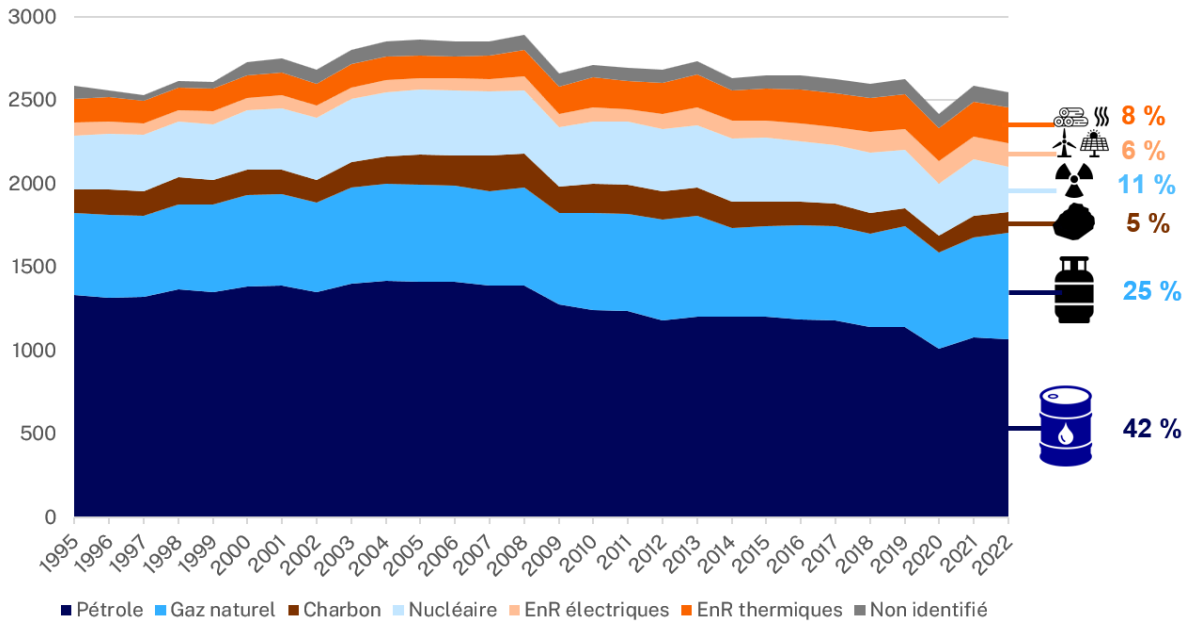


Figure 26 : France's Energy Exposure by Energy Source

Design and modelling: The Shift Project (2025)

Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte original (inchangé)	Traduction en anglais (EU, formal)
Exposition énergétique de la France par source d'énergie	France's energy exposure by energy source
TWh, énergie finale	TWh, final energy
Pétrole	Oil
Gaz naturel	Natural gas
Charbon	Coal
Nucléaire	Nuclear
EnR électriques	Renewable electricity
EnR thermiques	Thermal renewables
Non identifié	Unidentified

Since 2008, France's total energy exposure in absolute terms has followed a slow decline, entirely attributable to the reduction in its exposure to oil. France's exposure to oil was at its highest between 2003 and 2006, peaking at more than 1400 TWh of oil consumed directly or indirectly. Since 2020, it has fallen below the threshold of 1100 TWh, marking a total decrease of 350 TWh. In parallel, since the 2008 crisis, France's total energy exposure has also fallen by 340 TWh, from 2890 TWh to 2550 TWh. This decline may be associated with various factors, making precise attribution difficult: on the demand side, electrification of applications, energy efficiency gains, or sufficiency measures; on the supply side, a decline in conventional oil production (the historical maximum having been reached in 2008) or an increase in supply costs.

Over this same period, the entire decrease in coal exposure has been offset by an increase in exposure to natural gas. Coal exposure has fluctuated downward since its peak in 2007, halving by 2019–2020, a trend that has since slightly reversed. This downward trend is consistent with the progressive phase-out of coal in French and

European consumption. However, combined exposure to natural gas and coal has not decreased, due to the rise in natural gas exposure. Since natural gas emits fewer greenhouse gases, this remains good news from a climate perspective – although some studies[77] point to a potential carbon footprint of liquefied natural gas that is just as poor as that of coal. From a geopolitical and supply-risk perspective, natural gas presents other risks and cannot constitute a viable solution – the majority of gas consumed in France is imported from non-European countries. Moreover, the risks associated with its depletion are also concerning, given that reserves are more limited than those of coal.

The decline in France's total energy exposure has mainly affected the energy consumed for French lifestyles, and more marginally the energy required for exports of energy, goods and services. At their peak in 2008, French lifestyles relied on 2263 TWh of direct and indirect energy consumption. In 2022, this figure reached 1977 TWh, a decrease of nearly 300 TWh (14%). Over the same period, French exports of goods and services decreased by 34 TWh (–10%) in French consumption, and energy exports by 19 TWh (–8%).

The predominance of fossil fuels in France's energy exposure, and the excessively slow pace of its decline, weakens the country by exposing it to geopolitical risks and resource availability risks. As outlined in section II.B, France's fossil fuel suppliers are mostly non-European partners, with whom relations are nuanced. Moreover, the goods and services imported by France indirectly expose the country to fossil fuel consumption, raising geopolitical questions in turn. Both aspects increase France's vulnerability, given that reserves of these resources are limited. The cases of oil and natural gas – the two resources with by far the most limited reserves in the short and medium term – are discussed in the following sections.

2. Future Constraints on Oil and Gas Supply

Issues of availability and supply of oil and natural gas are still too often overlooked yet already pose, and will continue to pose, problems for Europe and France in the decades to come. As already discussed in section II.2, many oil- and gas-producing countries – mainly in Europe and Africa – have already reached their production peak, giving way to decline and an inability to satisfy all their clients and sometimes even their own consumption.

This fossil constraint is, however, still insufficiently integrated into sovereignty-related considerations. Yet its consequences are already tangible: with the depletion of the North Sea since the early 2000s, the European Union's energy sovereignty has steadily declined, forcing it to compensate by turning to suppliers outside the EU. In any forward-looking exercise involving energy, climate or industrial considerations over several decades, it is increasingly inconceivable not to integrate this constraint, which is nonetheless decisive.

[77] EERA for T&E, Well-to-Tank Carbon Intensity of European LNG Imports, 2024

The two maps below illustrate France's dependence on its direct and indirect suppliers of oil and gas. They provide an overview of a potential future constraint on France's oil and gas supply, comparing France's direct and indirect imports with the current (2024) and potential (2050) production of its suppliers, and with the future consumption of these suppliers as projected in the IEA's "Stated Policies" scenarios for 2050 provided in the World Energy Outlook 2024.

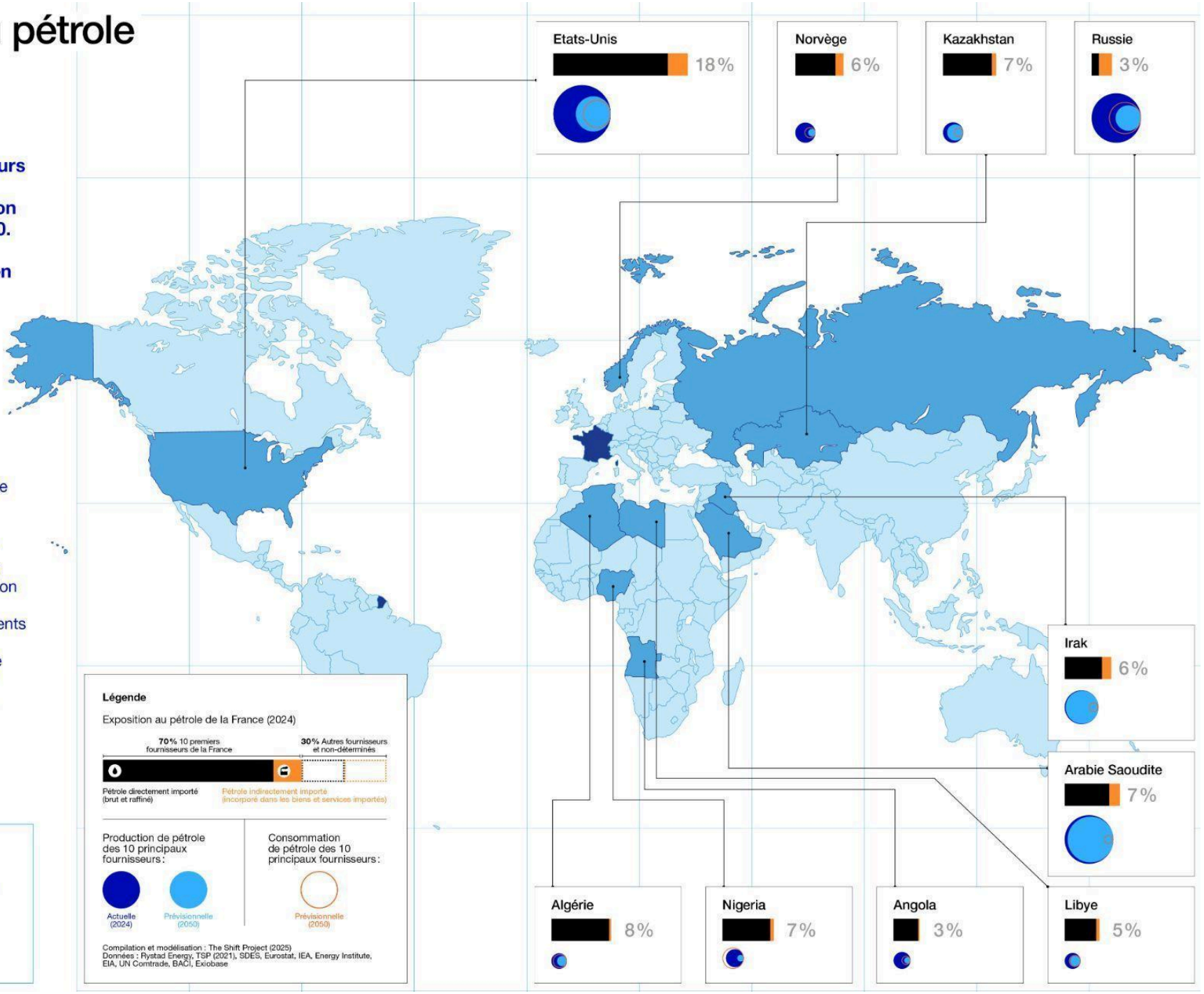
L'exposition au pétrole de la France

7 des 10 principaux fournisseurs de pétrole de la France risquent de voir leur production fortement décliner d'ici à 2050. Les producteurs les moins à risque sont localisés au Moyen Orient et en Asie centrale.

Le volume production de 6 d'entre eux (Algérie, Angola, Libye, Nigeria, Norvège, Russie) pourrait passer en dessous de leur propre volume de consommation, menaçant leurs capacités d'exportation et donc l'approvisionnement de la France. Par ailleurs, la consommation du Moyen Orient, de l'Afrique et de l'Asie pourraient continuer d'augmenter d'ici à 2050, posant des risques d'éviction au détriment de la France.

Dans ces scénarios, l'écart croissant entre la production et la consommation de pétrole pourrait exacerber les tensions autour des approvisionnements à l'échelle mondiale. Cela rappelle que la dépendance à cette ressource peut être utilisée comme levier dans les rapports de force internationaux.

Clé de lecture :
En 2024, les Etats-Unis produisaient 18 % du pétrole importé par la France, directement (sous forme de brut ou de produits raffinés) ou indirectement (lorsqu'il est incorporé dans les biens et services importés).



Texte original (inchangé)	Traduction en anglais (EU, formal)
L'exposition au pétrole de la France	France's exposure to oil
7 des 10 principaux fournisseurs de pétrole de la France risquent de voir leur production fortement décliner d'ici à 2050.	7 of France's 10 main oil suppliers may see their production decline sharply by 2050.
Les producteurs les moins à risque sont localisés au Moyen Orient et en Asie centrale.	The lowest-risk producers are located in the Middle East and Central Asia.
Le volume de production de 6 d'entre eux (Algérie, Angola, Libye, Nigeria, Norvège, Russie) pourrait passer en dessous de leur propre volume de consommation, menaçant leurs capacités d'exportation et donc l'approvisionnement de la France.	For six of them (Algeria, Angola, Libya, Nigeria, Norway, Russia), production volumes could fall below their own consumption, threatening their export capacity and therefore France's supply.
Par ailleurs, la consommation du Moyen Orient, de l'Afrique et de l'Asie pourrait continuer d'augmenter d'ici à 2050, posant des risques d'éviction au détriment de la France.	Moreover, consumption in the Middle East, Africa and Asia could continue to rise by 2050, creating potential crowding-out risks for France.
Dans ces scénarios, l'écart croissant entre la production et la consommation de pétrole pourrait exacerber les tensions autour des approvisionnements à l'échelle mondiale.	In these scenarios, the widening gap between oil production and consumption could exacerbate tensions over global supply.
Cela rappelle que la dépendance à cette ressource peut être utilisée comme levier dans les rapports de force internationaux.	This illustrates that dependence on this resource can be used as leverage in international power relations.
États-Unis	United States
Norvège	Norway
Kazakhstan	Kazakhstan
Russie	Russia
Irak	Iraq
Arabie Saoudite	Saudi Arabia
Algérie	Algeria
Nigeria	Nigeria
Angola	Angola
Libye	Libya
Légende	Legend
Exposition au pétrole de la France (2024)	France's oil exposure (2024)
70 % : importations directes	70%: direct imports
30 % : autres fournisseurs, production locale	30%: other suppliers, local production
Production de pétrole des 10 principaux fournisseurs :	Oil production of the 10 main suppliers:
Production	Production
Consommation	Consumption
Clé de lecture : En 2024, les États-Unis produisaient 18 % du pétrole importé par la France, directement (sous forme de brut ou de produits raffinés), ou indirectement via l'énergie incorporée dans les biens et services importés.	Reading note: In 2024, the United States produced 18% of the oil imported by France, directly (as crude or refined products) or indirectly through the embodied energy contained in imported goods and services.
La souveraineté par la décarbonation, voie nécessaire pour la France et l'Europe — Synthèse	Sovereignty through decarbonisation, a necessary path for France and Europe — Summary
P.8	p.8
P.9	p.9

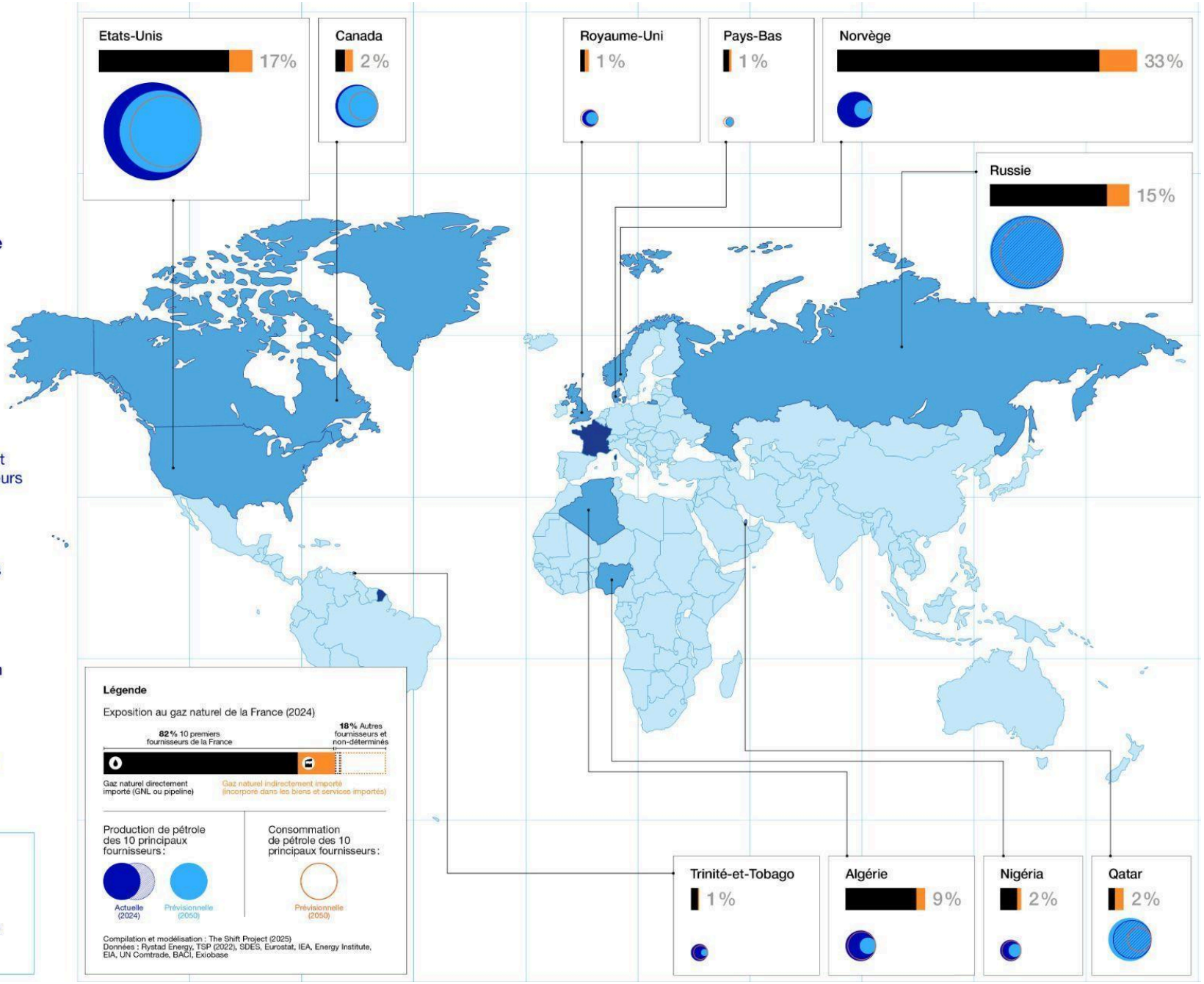
L'exposition de la France au gaz naturel

En 2024, plus de la moitié de la production mondiale de gaz naturel est concentrée aux Etats-Unis, en Russie et au Moyen-Orient. D'ici à 2050, ce monopole pourrait s'accentuer davantage, la production de la Norvège, de l'Afrique et de l'Amérique du Sud apparaissant en déclin à cet horizon.

Diversifier ses approvisionnements et rester libre du choix de ses fournisseurs de gaz naturel pourrait donc se complexifier. Même la Norvège, dernier grand producteur européen et principal fournisseur de la France, pourrait voir ses capacités d'exportation fortement décliner.

Dans une tendance de hausse mondiale de la demande en gaz, tout particulièrement des pays du Sud global, des risques d'éviction en défaveur de la France existent d'ici à 2050. A cela s'ajoutent des risques d'instrumentalisation de notre dépendance dans le cadre des rapports de force internationaux entre blocs de nations.

Clé de lecture :
En 2024, la Norvège produisait 33 % du gaz naturel importé par la France, directement ou indirectement lorsqu'il est incorporé dans les biens et services importés.



Texte original (inchangé)	**Traduction en anglais (EU, formal)**
L'exposition de la France au gaz naturel	France's exposure to natural gas
En 2024, plus de la moitié de la production mondiale de gaz naturel est concentrée aux États-Unis, en Russie et au Moyen-Orient.	In 2024, more than half of global natural gas production is concentrated in the United States, Russia and the Middle East.
D'ici à 2050, ce monopole pourrait s'accentuer davantage, la production de la Norvège, de l'Afrique et de l'Amérique du Sud apparaissant en déclin à cet horizon.	By 2050, this monopoly could become even more pronounced, with production in Norway, Africa and South America projected to decline by that time.
Diversifier ses approvisionnements et rester libre du choix de ses fournisseurs de gaz naturel pourrait donc se complexifier.	Diversifying supply sources and retaining freedom of choice among natural gas suppliers may therefore become increasingly difficult.
Même la Norvège, dernier grand producteur européen et principal fournisseur de la France, pourrait voir ses capacités d'exportation fortement décliner.	Even Norway, the last major European producer and France's main supplier, may see its export capacity decline significantly.
Dans une tendance de hausse mondiale de la demande en gaz, tout particulièrement dans les pays du Sud global, des risques d'éviction en défaveur de la France existent d'ici à 2050.	As global demand for natural gas increases — particularly in countries of the Global South — there is a risk that France could be crowded out by 2050.
À cela s'ajoutent des risques d'industrialisation liés à une dépendance accrue de pays importateurs concentrée entre blocs de nations.	Added to this are industrial risks linked to growing dependency among importing countries concentrated within geopolitical blocs.
Légende	Legend
Exposition au gaz naturel de la France (2024)	France's exposure to natural gas (2024)
82% : 10 premiers fournisseurs de la France 18% Autres fournisseurs et non-déterminés Gaz naturel directement importé (GNL ou pipeline) Gaz naturel (indirectement importé, incorporé dans les biens ou services importés) Production de pétrole des 10 principaux fournisseurs - Actuelle (2024) Prévisionnelle (2025) Consommation de pétrole des 10 principaux fournisseurs : Prévisionnels (2050) Compilation et modélisation : The Shift Project (2025) Données : Rystad Energy, TSP (2022), SDES, Eurostat, IEA, Energy Institute, EIA, UN Comtrade, BACI, Exiobase	82%: France's top 10 suppliers 18% Other suppliers and undetermined Directly imported natural gas (LNG or pipeline) Natural gas (indirectly imported, incorporated into imported goods or services) Oil production of the top 10 suppliers - Current (2024) Forecast (2025) Oil consumption of the top 10 suppliers: Forecast (2050) Compilation and modelling: The Shift Project (2025) Data: Rystad Energy, TSP (2022), SDES, Eurostat, IEA, Energy Institute, EIA, UN Comtrade, BACI, Exiobase
Clé de lecture : En 2024, Norvège produisait 33% du gaz naturel importé par la France, directement ou indirectement lorsqu'il est incorporé dans les biens ou services importés.	Key: In 2024, Norway produced 33% of the natural gas imported by France, either directly or indirectly when incorporated into imported goods or services.
Etats-Unis, Canada, Royaume-Uni, Pays-Bas, Norvège, Russie, Trinidad-et-Tobago, Algérie, Nigéria, Qatar	United States, Canada, United Kingdom, Netherlands, Norway, Russia, Trinidad and Tobago, Algeria, Nigeria, Qatar

Box 10: About The Shift Project Study: Future Oil Supply for the European Union: State of Reserves and Outlook (2021)

In 2021, under the auspices of the DGRIS and with recognised authors from the sector[78], The Shift Project published[79] a comprehensive analysis of the current situation and future crude oil production prospects of the sixteen main suppliers of the European Union, looking ahead to 2030 and 2050.

The report was based on a critical analysis of data from Rystad Energy, one of the few companies with detailed access to resources and to proven and probable reserves (known as P2). Public data, by contrast, are limited to proven reserves only (P1), which are declarative and offer far more limited visibility on the real evolution of global production. Access to these private — and usually costly — data enabled The Shift Project to produce an unprecedented overview of medium- and long-term oil supply dynamics, revealing a growing risk of imbalance between supply and demand.

Among these sixteen main suppliers, only two are located on the European continent (Norway, United Kingdom), while the others are located in North America (United States, Mexico), the Middle East (Iraq, Iran, Saudi Arabia), Eurasia (Russia, Azerbaijan, Kazakhstan) and Africa (Algeria, Angola, Egypt, Kuwait, Libya, Nigeria).

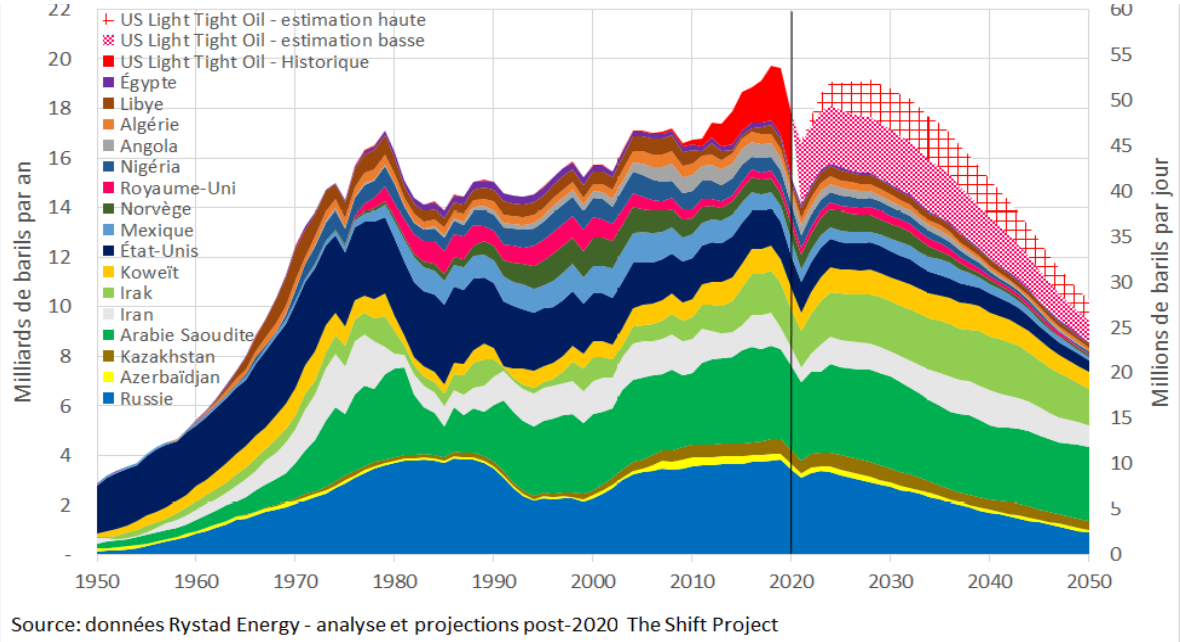


Figure 27: Crude Oil Production of the 16 Main Supplier Countries of the EU (Post-2020 Projections)

Analysis and projection: The Shift Project (2021) | Data: Rystad Energy

Texte original (inchangé)	Traduction en anglais (EU, formal)
Production de pétrole brut des 16 principaux pays fournisseurs	Crude oil production of the 16 main supplier countries
(projections post-2020)	(post-2020 projections)
US Light Tight Oil – estimation haute	US Light Tight Oil – high estimate
US Light Tight Oil – estimation basse	US Light Tight Oil – low estimate
US Light Tight Oil – Historique	US Light Tight Oil – historical
Égypte	Egypt

[78] Conducted under the auspices of the Direction générale des relations internationales et de la stratégie (DGRIS), this study was carried out by Olivier Rech (co-author of the International Energy Agency's World Energy Outlook 2007–2009), Marc Blaizot (former Director of Exploration at Total), and Alain Lehner (former Director of the Reservoir Development Division and Chair of the Reservoir Committee of the Total Group between 2004 and 2011).

[79] The Shift Project, Future Oil Supply of the European Union: State of Reserves and Outlook [in French], 2021

Libye	Libya
Algérie	Algeria
Angola	Angola
Nigéria	Nigeria
Royaume-Uni	United Kingdom
Norvège	Norway
Mexique	Mexico
États-Unis	United States
Koweït	Kuwait
Irak	Iraq
Iran	Iran
Arabie Saoudite	Saudi Arabia
Kazakhstan	Kazakhstan
Azerbaïdjan	Azerbaijan
Russie	Russia
Milliards de barils par an	Billions of barrels per year
Millions de barils par jour	Millions of barrels per day
Source : données Rystad Energy – analyse et projections post-2020 The Shift Project	Source: Rystad Energy data – analysis and post-2020 projections by The Shift Project

This study did not aim to predict the future, but rather to characterise a risk. In the medium term, the study highlighted the risk, over the coming decade, of crude oil production by the European Union's main suppliers falling to a level 10% to 20% below that of 2019, even when taking into account the expected evolution of US shale oil.
In the longer term, it underlined the risk of a prolonged decline in this production, potentially leading to a halving of total output from the sixteen suppliers by 2050. From the 2030s onwards, no development potential (fields discovered to date or exploration prospects) appeared, according to the study, capable of halting the decline in aggregated crude production, which is set to become irreversible, except for US shale oil.
The analysis of the main uncertainties surrounding US shale oil production led the authors to retain two trajectory estimates, high and low, each reflecting a growth potential lower than that observed during the 2010s, followed by an expected decline during the 2030s.
The study stressed that China, India and other high-growth-potential countries are competing for supplies with developed countries, whose demand remains massive. It recalled that rising consumption in many exporting countries also tends to gradually reduce their export capacity, thereby exacerbating the risk of constraints on net-importing countries.
Over the period 2021–2024, crude oil production from the sixteen main supplier countries of the European Union remained consistent with the projections published in 2021 by The Shift Project. In 2025, the risk remains fully relevant. Its origin lies in a structural phenomenon: the decline, underway for several decades, in discoveries — and therefore in remaining reserves — of conventional oil and gas. Annex 1 provides an updated assessment of the risk to France's and the European Union's future supplies since the publication of The Shift Project's 2021 study.
The scale of these dependencies, highlighted and reinforced by the energy exposure analysis, illustrates the structural vulnerability of the European system. The European Union and France remain largely dependent on so-called "mature" hydrocarbon supply regions, meaning those that have exhausted around half of their recoverable reserves. Among these regions are the North Sea and Africa, whose production has been declining for more than a decade. There are also mature producers close to decline. This is most notably the case of Russia.
This study, along with the 2022 study on gas[80], informed the maps presented above.

[80] The Shift Project, Natural gas : what supply risks for the European Union?, 2022

B. Decarbonisation: A European opportunity

France's energy exposure is largely polarised between Europe and the three major global players: Russia, the United States and China.

Energy relations between France and Russia have historically centred on significant imports of both fossil energy resources (oil and natural gas) as well as goods and services. Both factors have been declining over the long term, including fossil fuels, for which the downward trend began in 2004. The invasion of Ukraine in 2022 and the ensuing series of sanctions accelerated this trend, causing a real rupture in relations.

The United States is France's second major energy partner. At the end of the 20th century, exchanges between the two countries focused on goods and services. Between 2000 and 2010, France exported energy to the United States. At the turn of the 2010s, the boom in shale gas and unconventional oil changed the situation. The United States became, first and foremost, a direct exporter of energy (and particularly gas in the form of LNG) to France.

China, France's third major energy partner, remains at a more modest level than the other two historical partners (each above 200 TWh, whereas China's share in France's energy exposure barely exceeds 130 TWh). Exchanges between the two countries take place mainly through goods and services, and have remained relatively stable since 2007. An energy-based reading of Franco-Chinese exchanges up to 2022 shows a slight decline in imports from China, offset by a steady increase in French exports of goods and services to China. Thus, China occupies a significant place in France's energy exposure due to the energy content of its exports of goods and services, but is not at the level of Russia or the United States, as it does not export oil or gas directly to France. Nevertheless, China's importance for France in terms of energy is reinforced by the nature of certain Chinese productions: key equipment for the energy transition (batteries, electric vehicles, solar panels, etc.), and critical materials required for European production of energy technologies.

Beyond these major global partners, most of France's energy issues have been located within the European Union itself for several decades.

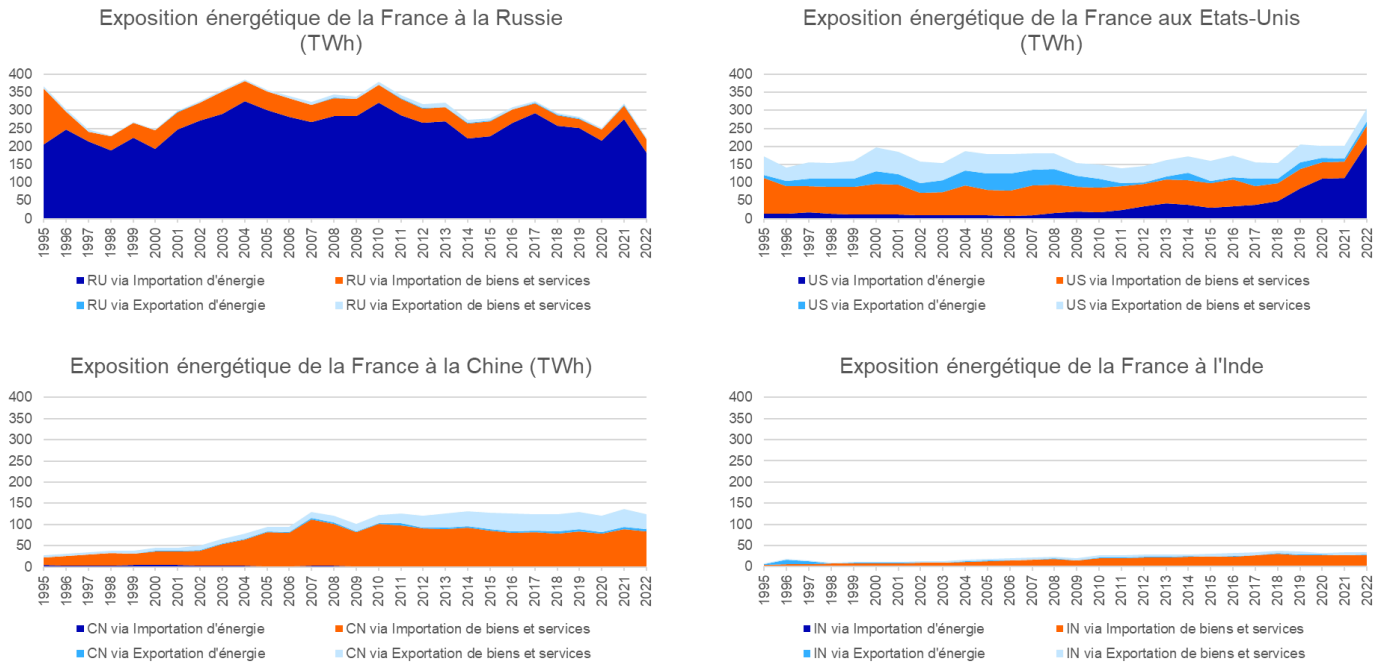
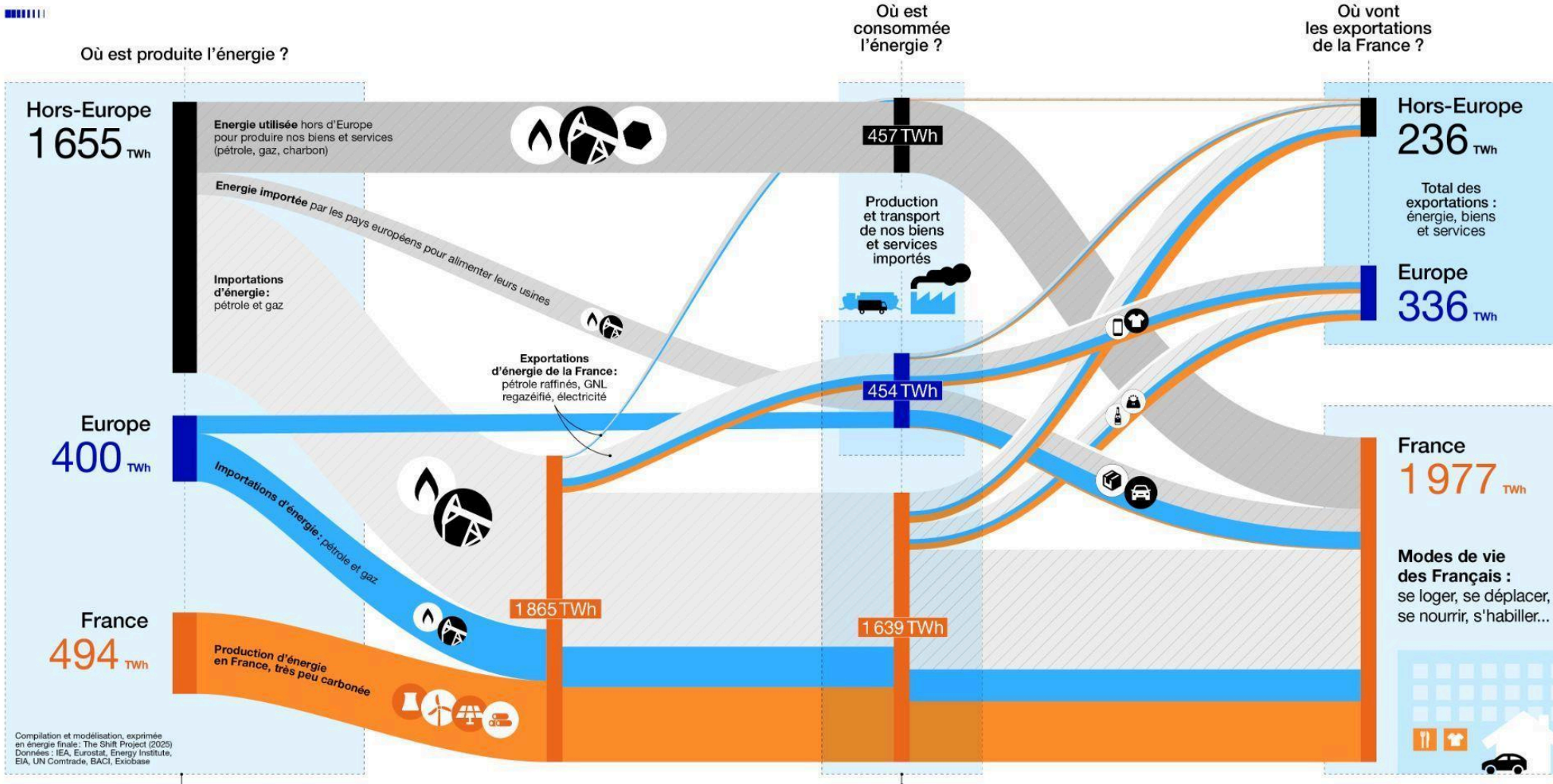


Figure 28 : France's Energy Exposure by Geographical Dependencies (in TWh, final energy, 2022)
Design and modelling: The Shift Project (2025)
Data: IEA, Eurostat, EIA, Energy Institute, UN Comtrade, BACI, Exiobase

Texte original (inchangé)	***Traduction en anglais (EU, formal)***
Exposition énergétique de la France à la Russie (TWh)	*France's energy exposure to Russia (TWh)*
RU via Importation d'énergie	*RU via energy imports*
RU via Importation de biens et services	*RU via imports of goods and services*
RU via Exportation d'énergie	*RU via energy exports*
RU via Exportation de biens et services	*RU via exports of goods and services*
Exposition énergétique de la France aux États-Unis (TWh)	*France's energy exposure to the United States (TWh)*
US via Importation d'énergie	*US via energy imports*
US via Importation de biens et services	*US via imports of goods and services*
US via Exportation d'énergie	*US via energy exports*
US via Exportation de biens et services	*US via exports of goods and services*
Exposition énergétique de la France à la Chine (TWh)	*France's energy exposure to China (TWh)*
CN via Importation d'énergie	*CN via energy imports*
CN via Importation de biens et services	*CN via imports of goods and services*
CN via Exportation d'énergie	*CN via energy exports*
CN via Exportation de biens et services	*CN via exports of goods and services*
Exposition énergétique de la France à l'Inde (TWh)	*France's energy exposure to India (TWh)*
IN via Importation d'énergie	*IN via energy imports*
IN via Importation de biens et services	*IN via imports of goods and services*

Exposition énergétique de la France :
Souveraineté et dépendances à l'Europe et au reste du monde



65 %
de l'énergie nécessaire au fonctionnement de la France est produite hors d'Europe.
Il s'agit presque exclusivement d'énergies fossiles.

80 %
de l'énergie nécessaire au fonctionnement de la France (entreprises et modes de vie) est consommée en France ou en Europe.

L'essentiel du risque énergétique de la France sera réduit par la décarbonation et la réindustrialisation du continent européen.

Texte original (inchangé)	Traduction en anglais (EU, formal)
Exposition énergétique de la France : Souveraineté et dépendances à l'Europe et au reste du monde	France's energy exposure: Sovereignty and dependencies on Europe and the rest of the world
Où est produite l'énergie ?	Where is energy produced?
Hors-Europe	Outside Europe
Europe	Europe
France	France
Énergie utilisée hors d'Europe pour produire nos biens et services (pétrole, gaz, charbon)	Energy used outside Europe to produce our goods and services (oil, gas, coal)
Importations d'énergie : pétrole et gaz	Energy imports: oil and gas
Importations de biens et services énergivores	Imports of energy-intensive goods and services
Exportations d'énergie de la France : pétrole raffiné, GNL regazéifié, électricité	France's energy exports: refined oil, regasified LNG, electricity
Production d'énergie en France, très peu carbonée	Energy production in France, very low-carbon
Où est consommée l'énergie ?	Where is energy consumed?
Production et transport de nos biens et services importés	Production and transport of our imported goods and services
Où vont les exportations de la France ?	Where do France's exports go?
Total des exportations : énergie, biens et services	Total exports: energy, goods and services
Modes de vie des Français : se loger, se déplacer, se nourrir, s'habiller…	The lifestyle of French residents: housing, transport, food, clothing…
Compilation et modélisation, selon différentes bases de données internationales (production et commerce) : Rystad Energy, OIES, Eurostat, IEA, Energy Institute, BACI, UN Comtrade, Exiobase.	Compilation and modelling based on various international databases (production and trade): Rystad Energy, OIES, Eurostat, IEA, Energy Institute, BACI, UN Comtrade, Exiobase.
65 % de l'énergie nécessaire au fonctionnement de la France est produite hors d'Europe.	65% of the energy required for France's functioning is produced outside Europe.
Il s'agit presque exclusivement d'énergies fossiles.	This is almost exclusively fossil energy.
80 % de l'énergie nécessaire au fonctionnement de la France (entreprises et modes de vie) est consommée en France ou en Europe.	80% of the energy required for France's functioning (businesses and lifestyles) is consumed in France or in Europe.
L'essentiel du risque énergétique de la France sera réduit par la décarbonation et la réindustrialisation du continent européen.	Most of France's energy risk will be reduced through decarbonisation and the reindustrialisation of the European continent.
La souveraineté par la décarbonation, voie nécessaire pour la France et l'Europe — Synthèse	Sovereignty through decarbonisation, a necessary pathway for France and Europe — Summary
P.12	p.12
P.13	p.13

Decarbonising and reindustrialising at the European scale would drastically reduce the French economy's exposure to energy risk.

Eighty-two percent of our energy exposure concerns energy consumed in France and Europe, i.e. 2093 TWh[81] out of 2550 TWh of total exposure. The grey energy incorporated in our extra-European imports of goods and services accounts for only 18% of our energy exposure. It is therefore possible to reduce most of the energy risk faced by the French economy through European-level action to decarbonise industry and freight across the continent.

[81] The energy on which the French economy depends that is consumed on the continent amounts to 2399 TWh, that is: the energy consumed on French territory (1795 TWh) + the energy exported by France to Europe (82 TWh) + the energy imported and then re-exported (refined oil in France, transit gas) by France to Europe (190 TWh) + the energy consumed in the rest of Europe for goods and services imported by France (332 TWh).

It is France's responsibility to persuade and mobilise its European partners to achieve decarbonisation, building on shared energy interests and the common governance maintained with most of these countries. Energy consumed by our European partners is currently only 33% decarbonised[82] and remains highly dependent on extra-European imports.

This task of risk reduction will be all the easier if our various neighbours realise, together with us, that sovereignty-related risks can be assessed — notably through the method presented here — and if they move beyond the narrow question of guaranteeing electricity supply[83], as we must do in France. The present analysis must be extended to the entire supply chain of each country and of the continent in goods and services.

Furthermore, Europe's reindustrialisation — essential in itself — thus presents a dual strategic interest: for our energy sovereignty and our industrial sovereignty. The objective of decarbonisation and that of reindustrialising the continent must advance together, as these two missions are interdependent for the sovereignty of France and Europe.

In 2022, goods and services imported from the rest of the world represented 18% of the French economy's energy exposure, i.e. just over 450 TWh. These imports rely mainly on fossil fuels consumed in the rest of the world. It is not realistically possible to rely on their rapid decarbonisation without an effort to relocate part of industrial production activities to the European continent — production of goods, semi-finished products, materials, extraction of raw materials, etc. Favouring sovereign production in Europe is therefore indispensable to achieving a phase-out of fossil fuels across entire value chains. The Carbon Border Adjustment Mechanism (CBAM) is, moreover, a powerful component of this effort.

This is why a decarbonised and ultimately reindustrialised Europe is a reliable path to enabling genuine emancipation of our country from fossil fuels and from their producing nations. In order to function, the French economy in 2022 was exposed to 2550 TWh of energy, of which 2000 TWh were directly necessary for the lifestyles of the French population.

However, only a small portion of this energy is actually produced on national soil (494 TWh). The remaining share (2056 TWh) comes from directly or indirectly imported energy, mainly composed of fossil fuels produced outside Europe, whose combustion — wherever it occurs — emits greenhouse gases.

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[82] For 2023 in the EU in final energy. Source: https://ec.europa.eu/eurostat/web/interactive-publications/energy-2025

[83] This necessary question remains insufficient and continues to be at the centre of debates on energy supply.

To break free from this, it is first essential to free our energy consumption in France from its dependence on these imported fossil fuels: through electrification and a robust energy mix, the development of renewable heat, efficiency and sufficiency.

It is then necessary to decarbonise the energy consumed in Europe, which supplies French consumption in electricity, goods and services.

Finally, a reindustrialisation of Europe would help complete the decarbonisation of our lifestyles by bringing the energy consumed outside Europe back within France's sphere of influence.

In a turbulent global context, our dependence on energy production from the United States, Russia and China can no longer be ignored: imports of LNG and oil from the United States and, still to some extent, from Russia; indirect imports of coal embedded in goods and services imported from China. All levers enabling the phase-out of fossil fuels therefore constitute levers of independence from these global powers.

The first part of this report recalled an essential finding: phasing out fossil fuels is a necessary condition for strengthening France's energy sovereignty and the resilience of its economy.

This is true for two mutually reinforcing and strategic reasons.

The first is climatic in nature – the combustion of fossil fuels remains the main cause of climate disruption, and therefore a direct threat to the stability of our societies.

The second is geological, physical: the fossil resources on which our economies largely rely are depleting, inexorably. At the European scale, this natural constraint is already visible in the evolution of our supplies. Since the North Sea production peak in 2005, Europe has lost the only domestic hydrocarbon source on which it could reasonably rely. It now imports almost all of its oil and gas – 97.3% and 90% respectively in 2022. Moreover, all of its historical suppliers are now mature or on the verge of becoming so, according to analyses by The Shift Project, placing the continent in a situation of structural instability and heightened geopolitical vulnerability.

The diagnosis is unequivocal: our lifestyles and the functioning of our businesses still depend on fossil fuels (oil, gas, coal) for more than 70% of their energy, a share that has not decreased since 1995. This vulnerability becomes even clearer when taking into account the "grey" energy embedded across entire value chains, invisible to traditional measurement tools but essential both to the lifestyles of French citizens (energy footprint) and to the functioning of the economy (energy exposure).

To these physical constraints are added geopolitical risks, whose reality recent history has repeatedly confirmed. Dependence on fossil fuels places us in the hands of major powers that now openly assert their ambitions, viewing energy as a central lever of their power strategy — and Europe's energy vulnerability as an asset in their sphere of influence.

In a context marked by the gradual depletion of oil and gas sources critical for Europe, and by the return of severe geopolitical tensions, dependence on supplier countries outside Europe places our economies at risk. Europe and France are thus caught in a double bind, both climatic and petro-gas related, which makes decarbonisation unavoidable for their sovereignty and competitiveness.

PART 2 : RECOMMENDATIONS

The energy exposure of France highlights avenues for action, including at the European level. Nearly 80% of the energy required for the functioning of the French economy is currently transformed within the European area, outlining possible pathways forward rooted in the converging interests of the nations of the Old Continent and reinforced by the European Union's capacity for action. Consequently, decarbonising and reindustrialising at the Community level is not only necessary but also represents a strategic opportunity for collective resilience and for safeguarding the medium- and long-term competitiveness of our economy.

For this reason, it is essential to uphold targeted industrial policies both in France and at the European level, based on coherent planning of needs and skills in order to ensure a successful transition. The robustness of the energy mix must be conceived as a cornerstone of this decarbonised sovereignty strategy. Developing all low-carbon energy sectors simultaneously (renewable and nuclear electricity, biomass, low-carbon heat, etc.) is indispensable in France to secure our supplies and strengthen the resilience of the entire system.

However, this opportunity should not divert us from a structural reality: although the energy required for our economic functioning is transformed on the European continent — whether in France or in neighbouring countries — it is not directly produced there. Even maximised to its full potential and supported by significant energy-efficiency gains, the French low-carbon mix will not, on its own, be capable of bridging the gap between domestic production and the energy needs of the French economy — a reality that the current French electricity export surplus cannot conceal in the long run.

As a consequence, France and the European Union will have to deploy ambitious energy sufficiency policies, based on the prioritisation of uses according to their social and strategic utility.

It is from this point that the second part of this report proceeds, outlining the levers intended to align France's energy trajectory with a dynamic that is fully consistent with its strategic interests. These levers are designed for France: although most of them are highly relevant for many other European countries. This will be the subject of further work.

Box 11: An energy sovereignty to be built at the scale of the continent

The European Union, as a supranational coordination and harmonisation entity, has equipped itself with common climate objectives—a 55% reduction in emissions by 2030 and carbon neutrality in 2050—as well as binding regulatory instruments to achieve them: reporting obligations on security of supply (National Energy and Climate Plans), a minimum share of renewables in final energy consumption (RED III), the Carbon Border Adjustment Mechanism (CBAM), the Emissions Trading System (ETS), energy-efficiency standards, and support schemes for low-carbon technologies…

Energy-exposure analysis shows that nearly 80% of the energy required for the functioning of the French economy is consumed on European territory. Thus, decarbonisation and reindustrialisation must also be considered at this level, in order to gain greater control over the material conditions of our strength and reinforce our sovereignty. Against the backdrop of geopolitical tensions that expose Europe and reveal its vulnerabilities, this paradigm has

begun to resonate, supported by the Clean Industrial Deal, discussions on the objective of a 90% emissions reduction by 2040, and the proposal of a "European preference" in several strategic sectors. The effort required, however, remains considerable if these ambitions are to be met. Moreover, the rise of new highly energy-intensive uses — foremost among them artificial intelligence, whose power demand is not yet integrated into planning trajectories — threatens both the continent's climate trajectory and its energy stability, while prolonging dependence on fossil gas, particularly U.S. LNG[84].

In addition to this European energy consumption serving France's needs, part of the energy is consumed outside European borders. Policy instruments, particularly the CBAM, nevertheless provide levers to act upon supply chains and encourage decarbonisation beyond European borders, thereby helping to mitigate the fossil risk weighing on the sovereignty of the continent. However, debates surrounding the objective of a 90% emissions reduction by 2040 — notably regarding the use of international carbon credits — should not lead to a dilution of the initial ambition: strengthening our sovereignty begins with the effective decarbonisation of the continent, as evidenced by the geographical distribution of our exposure[85].

Beyond these instruments, European decarbonisation trajectories remain marked by structural disparities between Member States, reflecting differing visions of energy sovereignty. Each country must contend with its resources, industrial heritage, and political priorities: Poland, still largely dependent on coal for its security of supply, perceives the transition as a social as much as an economic cohesion challenge; Norway, rich in gas resources, approaches decarbonisation through the lens of a gradual adaptation of its investment and export model; Germany, having turned the page on nuclear, now relies on gas and renewables to preserve the stability of its electricity system. Supported by its nuclear fleet, France aims to restore a balance between technological sovereignty and European cooperation.

These divergences illustrate the difficulty of reconciling national logics with the construction of energy sovereignty at the scale of the continent. For The Shift Project, the objective is not to erase these differences, but to organise them within a common framework so that the complementarity of national mixes becomes a security asset rather than a source of vulnerability. **Such an approach requires strengthening the European energy vision, in order to better assess and anticipate the weaknesses of energy systems — and therefore economic systems — as well as to harmonise and improve the quality of forward-looking tools, thereby increasing clarity and facilitating the pursuit of common objectives by national trajectories.**

In this regard, the energy-exposure metric and the analysis of the vulnerabilities of the European Union's oil and gas supply should be developed and integrated into the Governance of the Energy Union and Climate Action, particularly as reporting tools within the NECPs, so as to illuminate the physical foundations that condition the functioning of our economies and underpin our capacity for action across a multitude of crucial issues — combating and adapting to climate change, electrifying industrial processes and end uses, digitalisation and the "twin transition", among others. **In parallel, this work should be coordinated with the European Framework for Energy Security, in order to strengthen coherence between planning and the assessment of supply risks that threaten our sovereignty.**

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[84] See https://theshiftproject.org/en/publications/al-data-and-computing-shaping-infrastructures-for-a-decarbonised-world/

[85] This work, conducted essentially within the scope of France, will be extended by a Shift Project report to be published in 2026. Dedicated to European energy sovereignty, it will examine these issues in greater detail.

Ultimately, it is from the management of these divergences, as well as from the understanding of the extent of our dependencies — and, through them, of the central role of fossil energy, the machinery it drives, and its future constrained availability — that our collective ability to regain control over our destiny in the decades to come will emerge.

I. Accelerating the electrification of uses and the evolution of infrastructures: a necessary condition for phasing out fossil fuels

A. The limited availability of liquid and gaseous fuels requires a reduction in their consumption

Phasing fossil fuels out of our energy mix without profoundly degrading our ways of life requires a rigorous planning of this transition, as these energies remain essential today for many sectors: transport (cars, trucks, aircraft), industry (industrial processes, raw material extraction, gas-fired power plants), and buildings (gas and oil boilers).

Two main alternatives to fossil fuels currently exist, which do not require complete modification of our infrastructures: bioenergy (biofuels, biomethane, etc.) and **synthetic hydrocarbons** (e-diesel, e-ammonia, etc.).

However, none of these alternatives will be available in quantities comparable to fossil energies, nor will they be able to cover all current uses. In the PTEF[86], we estimate that **our consumption of liquid and gaseous energy must be reduced to a sixth of the quantity currently consumed.** A strategic approach is therefore required to allocate these resources to the sectors where they are most relevant.

On the one hand, the production of bioenergy is limited by the amount of available biomass and requires large land areas. On the other, the production of synthetic fuels requires a very large amount of electricity due to the low efficiency of their production. Fully substituting fossil hydrocarbons in the French economy would require dedicating to this purpose a quantity of (low carbon) electricity equivalent to five times today's total French electricity production — a volume far beyond reach, by a wide margin, by 2050[87].

[86] The Shift Project, L'évaluation énergie-climat du PTEF [Energy-climate assessment of the PTEF], 2022 (p. 41)
[87] Ibid

B. A massive electrification of equipment and infrastructures is necessary wherever it is realistic

Given the limited availability of low carbon liquid and gaseous fuels, the priority response is to turn towards **electricity, the only energy that France can produce abundantly and in a decarbonised way** — far ahead of renewable heat or biofuels. In order to rely mainly on electricity to power the economy, **all equipment and uses that can be electrified must be electrified.**

For transport, this involves both electrification and a massive modal shift. Electrifying the means of transport that are currently mostly internal-combustion-engine based: vehicle fleet and trucks become overwhelmingly electrified. **Liquid fuels must be primarily reserved for means of transport that are difficult to electrify**, mainly aviation and maritime transport. At the same time:

- For daily mobility: shifting from private cars to public transport (often electric) and active mobility (cycling, walking, and intermediate vehicles);
- For long-distance mobility (over 80 km): shifting from private cars and aircraft to trains;
- For freight transport: shifting from lorries to rail and, to a lesser extent, inland waterways.

For residential and tertiary buildings, the objective is to scale up comprehensive thermal renovations and then **electrify heating by promoting widespread use of heat pumps**, complemented at housing-stock scale by “classic” electric heating (so-called Joule-effect systems) and district heating networks. In this way, it becomes possible to largely shift away from oil- and fossil-gas boilers, which have high carbon intensity. Similarly, in the industrial segment, many industrial processes that currently consume fossil energy can be electrified or supplied with renewable heat, including high-temperature heat pumps.

C. It is essential to prioritise access to non-electric low-carbon energies, given their limited availability

For certain sectors, electrification may prove technologically complex or even impossible to implement. For instance, while small agricultural machinery is beginning to electrify, neither high-power electric tractors nor electric cargo ships are at present considered realistic deployment options in the medium term. The sectors concerned should therefore be given priority access to non-electric decarbonised energies, which are available in much smaller quantities.

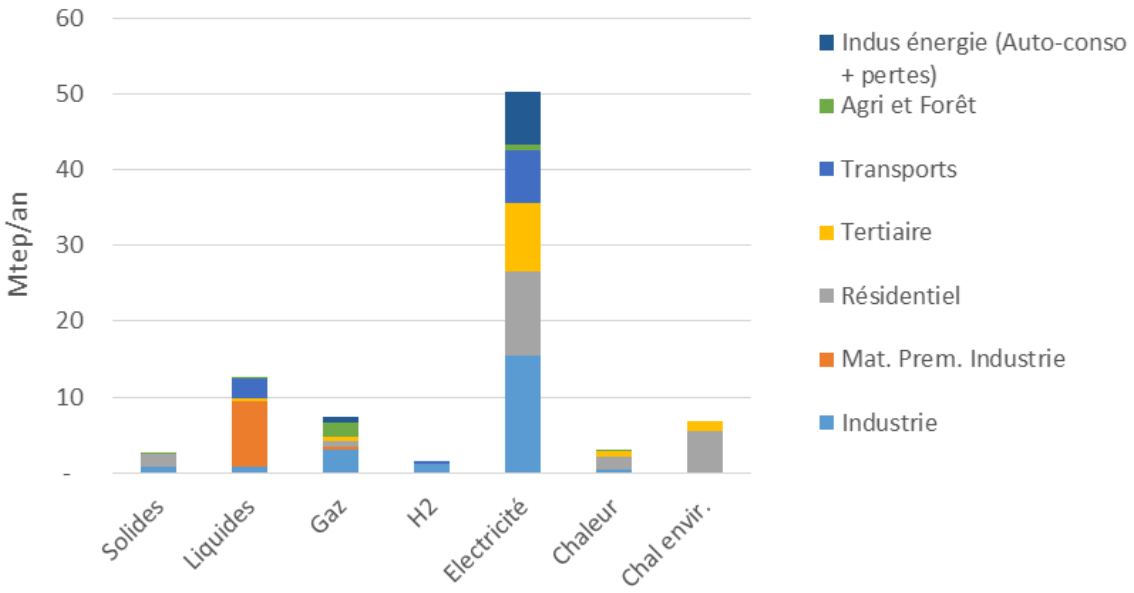

Figure 29 – Final energy demand by sector and by energy carrier in 2050,
From the PTEF scenario of The Shift Project (2022)

Texte original (inchangé)	**Traduction en anglais (EU, formal)**
Demande globale énergie finale en 2050, par vecteur	Total final energy demand in 2050, by vector
périmètre PTEF	PTEF scope
Mtep/an	Mtoe/year
Solides	Solids
Liquides	Liquids
Gaz	Gas
H_2	H_2
Électricité	Electricity
Chaleur	Heat
Chal. envir.	Environmental heat
Indus énergie (Auto-conso + pertes)	Energy industry (self-consumption + losses)
Agri et Forêt	Agriculture and Forestry
Transports	Transport
Tertiaire	Tertiary sector
Résidentiel	Residential
Mat. Prem. Industrie	Industrial raw materials
Industrie	Industry

In its 2050 outlook, The Shift Project considers that:

- The Nation's strategic reserves, emergency generators (hospitals, power plants, etc.), and the armed forces rely on liquid fuels.
- The remaining industrial sites for ammonia production and refining benefit from low-carbon hydrogen.
- The agricultural machinery that is most difficult to electrify is supplied with biogas and biofuel.

- In addition to the general rollout of heat pumps, the residential and tertiary sectors benefit from renewable heat for heating, and to a far more marginal extent, wood or biogas.
- Aviation relies on biofuels and synthetic fuels, , within the limits of availability.

Box 12: Examples illustrating the need to immediately prepare to downsize of fossil-fuel transport and distribution infrastructures on national territory

For the sovereignty of the country, it is absolutely essential to approach decarbonisation policy in an integrated manner with energy-network management policy.

Meeting our 2030 objectives means reducing the stock of gas boilers by at least 25%, particularly in the most energy-inefficient dwellings[88]. In the long term, this stock of boilers will have to virtually disappear, as will gas cookers and gas-powered domestic hot water systems.

At the same time, it is necessary to jointly plan — together with electricity and gas network operators[89], and involving local authorities, which own the gas distribution network — both the reduction of gas equipment in buildings (boilers and cookers) and the withdrawal of sections of the gas network (disconnections and dismantling of distribution branches)[90]. This planning, which can be conducted at local level, must at minimum be framed and encouraged by national incentive mechanisms. It will therefore be necessary to amend the Energy Code (notably Article L432-8) in order to halt the development of the gas distribution network.

Similarly, meeting our targets for new electric vehicles will lead to a widespread reduction in diesel and petrol consumption. The number of visits to fuel stations in large and medium-sized retail areas could thus fall by 30% to 50% by 2035[91]. The role of fuel stations must therefore be reinvented, shifting more towards the needs of electric mobility (optimal network coverage enabling long-distance travel, ultra-fast-charging electric stations, etc.). The reduction in fuel deliveries to service stations must also be planned in line with the objectives of phasing out new internal-combustion vehicles.

II. Relying in France on all low-carbon energy levers: renewable and nuclear electricity, biomass, low-carbon heat

A. Decarbonised electricity production must rely both on renewable energies and on nuclear energy

[88] The Shift Project, Response to the Public Consultation on the Decarbonisation of the Building Sector and Heating Systems [in French], 2023

[89] As an example, the gas network access tariff increased in 2024 by +5.9% due to the estimated decrease in consumption and in the number of gas consumers at the start of the ATRD7 tariff period. This decrease in consumption and in the number of GRDF customers will continue over the course of the tariff period with an impact of around +1.9%/year. (see CRE communication of February 2024)

[90] The Shift Project, Response to the Public Consultation on the Decarbonisation of the Building Sector and Heating Systems [in French], 2023

[91] Colombus Consulting, Electric Mobility: What Future for Service Stations? [in French], 2020

In the electrical sector, it is necessary to formulate objectives for both renewable energies and electro-nuclear power, in order to gain visibility and to plan the contribution of these energy sources**.** To support the progressive electrification of uses, renewable energies and electro-nuclear power will be complementary and will contribute to strengthening our strategic autonomy and meeting our decarbonisation objectives.

In 2023, the French electricity mix relied primarily on nuclear power, accounting for 63% of annual electricity production. This was followed by hydropower (12%), wind power (10%), fossil-fuel thermal generation (8%), photovoltaics (5%), and biomass-fired thermal generation (2%).

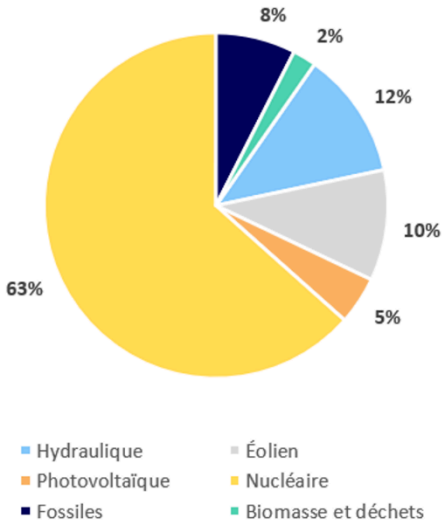

Figure 30 : France's electricity mix in 2023

Texte original (inchangé)	Traduction en anglais (EU, formal)
Hydraulique	Hydropower
Éolien	Wind power
Photovoltaïque	Photovoltaics
Nucléaire	Nuclear
Fossiles	Fossil fuels
Biomasse et déchets	Biomass and waste
Figure 6 - Mix électrique de la France (2023)	Figure 6 – France's electricity mix (2023)
Données : Chiffres clés de l'énergie 2024, SDES	Data: Key Energy Figures 2024, SDES

However, our electricity system is based on a fleet of nuclear reactors that were, for the most part, commissioned in the 1980s (47 out of 57 reactors will reach 60 years of age before 2050). It is essential to continue — and even extend — the use of historic nuclear plants for as long as they remain safe, but it is also urgent to launch the construction of new low-carbon electricity-generation capacities, both renewable and nuclear, so that they may be brought online as quickly as possible.

On the one hand, the extension of the historic nuclear fleet now appears feasible up to 60 years for a very large portion of the reactors and could extend beyond that[92]. On the other hand, new nuclear power currently depends mainly on EPR2-type plants — an evolution of the Flamanville EPR. As part of the nuclear revival decided in 2022, three

[92] ASN, ASN Takes Position on the Guidelines of the 5th Periodic Review of the 900 MWe Reactors [in French], 2024

pairs of EPR2 reactors were announced by the President of the Republic for 2035. However, at the time of publication of this study, this date is not guaranteed[93].

It should be noted that until this new nuclear capacity enters service — i.e. for 10 to 15 years or more — all additional electricity production required to enable the necessary electrification of uses will have to come solely from renewable electricity sources, which can be deployed much more rapidly. And even by 2050[94], nuclear power will find it difficult to supply more than half of our electricity, meaning that the remainder will have to come from renewable electricity sources[95].

To support the substantial electrification that must occur in the short and medium term, no-regret choices are required as far as possible.

On the one hand, efforts in the field of renewable energies must be continued and accelerated in order to achieve the widest and fastest possible deployment. Hydropower, which is renewable and dispatchable, must be maintained, but as most suitable sites are already in use, its production cannot increase significantly. The bulk of additional capacity must therefore come from photovoltaics (ground-mounted systems, rooftops, agrivoltaics) and wind power (onshore and offshore).

On the other hand, to remain coherent, a sovereignty policy must also include objectives for adapting the electricity grid — particularly through the development of flexibility resources to accommodate increasing shares of intermittent renewable energy (interconnections, demand-side flexibility, storage, vehicle-to-grid, etc.), as recommended in RTE's *Futurs énergétiques 2050*[96]. The expansion of non-dispatchable renewables (such as photovoltaics and wind power) must be coordinated with flexible and controllable consumption in order to maintain the major balances of the electricity system at a good level.

B. Sovereignty through energy is not limited to securing electricity production

Although electrification must be at the centre of the decarbonisation of the French economy, it is necessary to adopt measures covering all levers and energy sources,

[93] The target date for launching the first EPR2 is now 2038: Connaissance des Énergies with AFP, Nuclear: The Élysée Now Targets 2038 for the Commissioning of the First EPR2 [in French], 2025

[94] For 2100, other questions arise. The degradation of global geopolitical conditions and the current rise of nuclear power raise legitimate questions about the long-term need to diversify uranium sources, which until now had been considered sufficient. To secure the country's energy situation in the second half of the 21st century, France must initiate, within an appropriate timeframe, a reflection on nuclear sectors based on depleted uranium, notably fast neutron reactors (FNR). The sovereignty and abundance of these resources are incomparable to enriched uranium resources, which are used by PWR sectors (pressurised water reactors, currently the most widespread in the world).

[95] Thus, in the "Futurs énergétiques 2050" [Energy Futures 2050] scenario of RTE with the most nuclear power, the so-called N03 scenario, nuclear represents "only" 50% of the electricity mix in 2050. And this already assumes very ambitious hypotheses: extending all historical nuclear reactors to 60 years or beyond, commissioning 14 EPR2s, and deploying 4 GW of SMRs. Source: RTE, Energy Futures 2050 – Key Results [in French], 2021

[96] RTE, Energy Futures 2050: Production Mix Scenarios Under Study to Achieve Carbon Neutrality by 2050 [in French], 2021

including non-electric ones. This is a prerequisite for meeting the needs of sectors that are most difficult to electrify (heavy industry, aviation, agriculture, etc.). Based on its PTEF scenario (PTEF : Plan de Transformation de l'Economie Française, French Economy Transformation Plan), The Shift Project recommends setting 2050 final-energy production targets in the following areas:

- **renewable heating and cooling:** heat pumps (100 TWh), geothermal energy and solar thermal[97], the share of biomass in district heating networks, etc.
- **low-carbon recovered heating and cooling:** by scaling up the recovery of waste heat — in industry (20 TWh), in municipal-waste incineration (10 TWh), from refrigeration units, from data centres, etc. — and by supporting research for a possible development of nuclear cogeneration and the recovery of heat produced by nuclear reactors, which is usually dissipated into the environment.
- **biogas (100 TWh) and synthetic gases.**
- **liquid biofuels (45 TWh) and synthetic liquid fuels.**
- **solid biomass (60 TWh).**

Such targets are necessary to structure certain sectors, such as bioenergy production, which remains nascent today. This also requires finding the right trade-offs and balances between uses, and avoiding negative externalities (which, in the case of biomass-for-energy, means avoiding competition with agricultural production and ensuring the preservation of ecosystems).

C. The long-term sustainability of sovereignty depends on the robustness of the future French electricity mix

In a context of long-term national electricity-demand growth (between +20% and +70% by 2050 compared with 2024, depending on the scenario[98]), the sustainability of our sovereignty depends on our ability to meet our electricity-production targets. In the event of delays, we will remain heavily dependent on imported energy, the quantities, carbon content, and price of which will be uncertain and beyond our control.

Defining now the foundations of a robust 2050 electricity mix would maximise our chances of success by providing visibility to actors in the energy sector and in consuming sectors (mobility, housing, industry, etc.).

Total electricity consumption varies across scenarios — for example, in RTE's *Deep Reindustrialisation* scenario, 100 TWh of additional electricity must be produced compared with their reference trajectory, to support the reindustrialisation of key sectors.

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[97] Targets for geothermal and solar thermal energy have not yet been quantified by The Shift Project. Other estimates do exist, for example: Carbone 4, Renewable Heat: The Great Forgotten Element of French Energy Strategy? [in French], 2022

[98] According to foresight scenarios, electricity demand reaches very different levels in 2050: At RTE, the "Sobriété" [Sufficiency] scenario leads to consumption of 555 TWh in 2050 (+24% compared to 2024), while their "Réindustrialisation profonde" [Deep Reindustrialisation] scenario leads to consumption of 752 TWh (+67%). By comparison, the Shift Project's French Economy Transformation Plan (Plan de transformation de l'économie française - PTEF) scenario leads to consumption of 635 TWh in 2050 (+41%).

On the nuclear side, several uncertainties must be considered. First, there is relative uncertainty regarding the extension of the historic French nuclear fleet, which will depend on case-by-case decisions by the Autorité de Sûreté Nucléaire et Radioprotection (ASNR). While the extension of most reactors until their 60th year appears likely today, the exact number of eligible reactors is not yet known, and extension beyond 60 years is more uncertain.

Second, there is uncertainty related to the timelines and costs of new-build nuclear projects. The previously envisaged option of 14 new EPR2 reactors and several SMRs by 2050 now appears quite difficult to achieve. The exact number of reactors that can reasonably be considered remains to be determined. EDF has already initiated procedures for authorising 6 EPR2 reactors (at the Penly, Gravelines, and Bugey sites), representing around 10 GW of installed capacity in total — compared with roughly 60 GW for the current nuclear fleet.

In the field of renewable electricity, further uncertainties must be accounted for. Indeed, basing a vision of the electricity mix exclusively on renewables would require highly ambitious long-term deployment rates for wind and photovoltaics, as well as substantial flexibility resources to compensate for intermittency (interconnection, demand-side flexibility, storage, dispatchable generation)[99]. Yet these deployment rates are not guaranteed, given that several sectors may face difficulties due to numerous factors. The regulatory and economic environment is fluctuating, while the sector needs visibility and stability. There are several current or potential bottlenecks in administrative permitting, litigation processes, or grid connection. Local opposition is frequent, particularly for onshore wind power, despite generally favourable public acceptance, including among local residents[100]. There are also challenges relating to port infrastructure availability for offshore wind and land availability for ground-mounted photovoltaic plants[101], among others.

In general, betting exclusively on one sector — nuclear or renewables — is riskier than betting on both simultaneously: relying on diversification is less risky in the long term and therefore increases robustness. In other words, it is less likely that all sectors will face difficulties simultaneously.

The Shift Project adopts a risk-minimisation approach in its proposed 2050 electricity mix. It is based on the quantity of electricity that each production unit could reasonably be expected to produce, given today's known uncertainties, if deployment is pursued proactively between 2025 and 2050. The 2020 Shift Project scenario was based on an assessment of the risks inherent to each sector, provided by RTE following their consultations[102]. The Shift Project recommended reaching at least the installation rates of RTE's *2050 Energy Futures* scenario N1 (at least 4 GW/year for solar, 1.5 GW/year for onshore wind, 1.5 GW/year for offshore wind), continuing the planning of EPR2 reactors on French territory, and preparing the necessary adaptations of the electricity grid to

[99] All of these solutions must be tested and validated at scale, and are therefore also sources of uncertainty.
[100] IFOP-ENGIE, Exclusive IFOP x ENGIE Study: 84% of French People Have a Positive Image of Renewable Energy, 2025
[101] There is a scarcity of land eligible for PV given current regulations; there is no land issue in absolute terms, as 0.3% of the territory would be sufficient to install all the required PV. Source: RTE, Energy Futures – Key Results [in French], 2021 (p. 43)
[102] Ibid

meet the expected changes. Given the constant evolution of the national and global energy situation, the production potential envisaged for each sector has since evolved (upwards or downwards depending on the sector). **Updated estimates of the risk associated with each sector will be necessary to update the 2050 energy mix currently recommended by The Shift Project.**

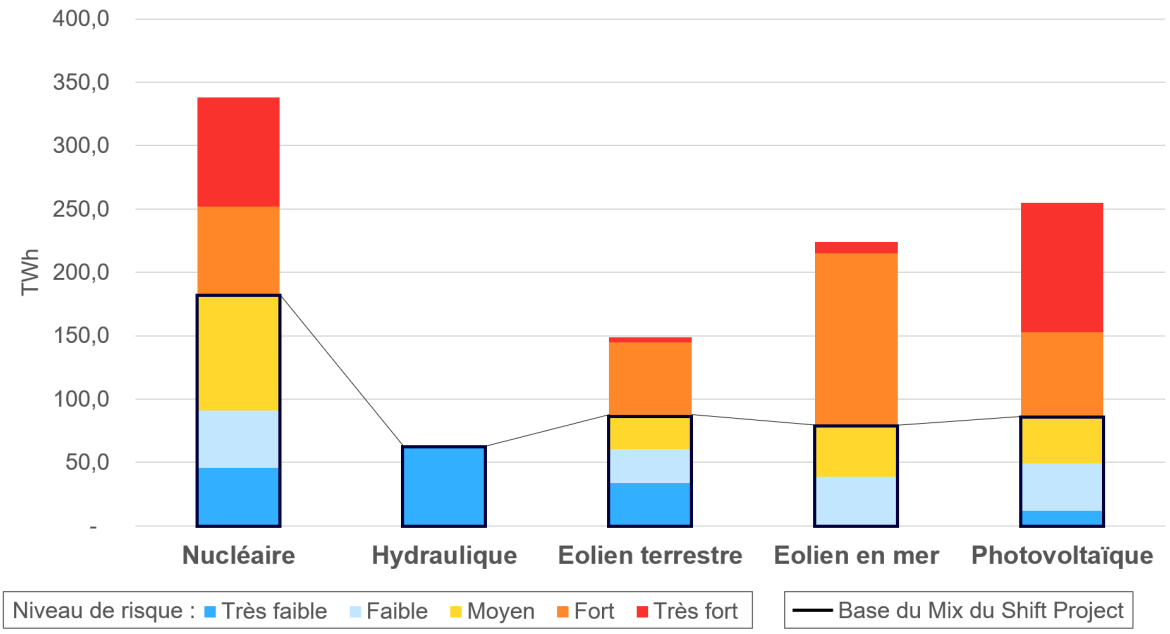


Figure 31 - 2050 electricity mix as planned in the French Economy Transformation Plan (2020)

Quantification by The Shift Project, based on RTE risk estimates

Texte original (inchangé)	Traduction en anglais (EU, formal)
TWh	TWh
Nucléaire	Nuclear
Hydraulique	Hydropower
Éolien terrestre	Onshore wind
Éolien en mer	Offshore wind
Photovoltaïque	Photovoltaics
Niveau de risque :	Risk level:
Très faible	Very low
Faible	Low
Moyen	Medium
Fort	High
Très fort	Very high
Base du Mix du Shift Project	Shift Project mix baseline

In its previous estimates, The Shift Project envisaged electricity demand of 635 TWh by 2050. To meet this demand, production options were prioritised according to risk: 496 TWh of electricity with low or medium risk can be produced under optimistic assumptions and constitute the basis of The Shift Project's electricity mix. The remaining 139 TWh to be produced in 2050 will depend on the evolution of each sector. At least some sectors will therefore have to mobilise additional production capacity and exceed their expected pace of production. To achieve this, it is necessary to support efforts across all sectors starting now, in order to meet the entirety of our electricity demand. Falling short of these objectives would mean relying on electricity imports or having to

increase the levers of efficiency and sufficiency even further — although these are already being heavily mobilised, as discussed in the next section.

Finally, to ensure a strong role for renewable energies, it is necessary in the short and medium term to strengthen flexibility resources — whether on the demand side or on the production side — to ensure the proper functioning of the grid. Failing to secure this network development may limit our ability to integrate intermittent generation sources.

Strategic planning must be strengthened not only to improve the country's energy security but also to preserve the quality of life of our fellow citizens. Government analysis must be based on a scenario-based approach drawing on recognised national expertise (for example, that of RTE) and applying it to the entire energy sector — not only electricity — as well as to consuming and importing sectors.

Box 13: The value of a scenario-based and risk-based approach

A scenario-based approach makes it possible to test the robustness of an energy strategy by placing it in different, more or less optimistic, possible futures. It facilitates long-term thinking, enabling the consideration of risks of various natures and the exploration of new and realistic energy options.

We reaffirm that forward-looking studies are essential tools for the debate on the energy transition, and we believe that more resources should be allocated to them. This includes bringing to the forefront — and placing at the heart of the public debate — the following:

- **Risky options:** for example, ruling out from the outset certain modes of low-carbon electricity production in order to rely exclusively on others; or relying solely on decarbonisation levers for energy without mobilising efficiency and sufficiency levers.
- **No-regret options:** having high-performing sectors across all modes of low-carbon energy production; making optimal use of the potential of renewable electricity; investing in the electricity grid; deploying flexibility resources to enable the electricity system to accommodate increasing shares of intermittent renewable energies (interconnections, vehicle-to-grid, demand-side flexibility, etc.), as recommended in RTE's *2050 Energy Futures*.

Forward-looking teams are therefore key interlocutors on whom government actors could rely in order to use their energy scenarios and better anticipate adaptation challenges and opportunities. We underscore the central role of RTE, whose work has greatly contributed to informing the debate on the transition of the electricity system, as well as that of other actors — institutional ones (ADEME), think tanks (NégaWatt, The Shift Project), among others. The government must also demonstrate political courage by asking these bodies to explore futures in which not all conditions for success are met, in order to better identify no-regret choices and risky options. The Shift Project encourages this discussion, as models — and more broadly energy-climate scenarios — remain essential tools for informing the strategic thinking of policymakers and for integrating the growing instability of the global economic and political system (geopolitical crises, risks to the supply of critical raw materials, economic crises, inflation, etc.).

III. Committing to efficiency and sufficiency

Constraints on low-carbon electricity and on decarbonised liquid and gaseous fuels will have an unavoidable consequence: French and European energy consumption cannot grow unreservedly. **The decarbonisation of our energy mix must go hand in hand with a reduction in final energy consumption — by around a half, in the case of France.**

This reduction can be achieved in two complementary ways: efficiency and lower-consumption pathways. Efficiency means reducing energy consumption for the same uses, while lower-consumption pathways involve reducing uses themselves.

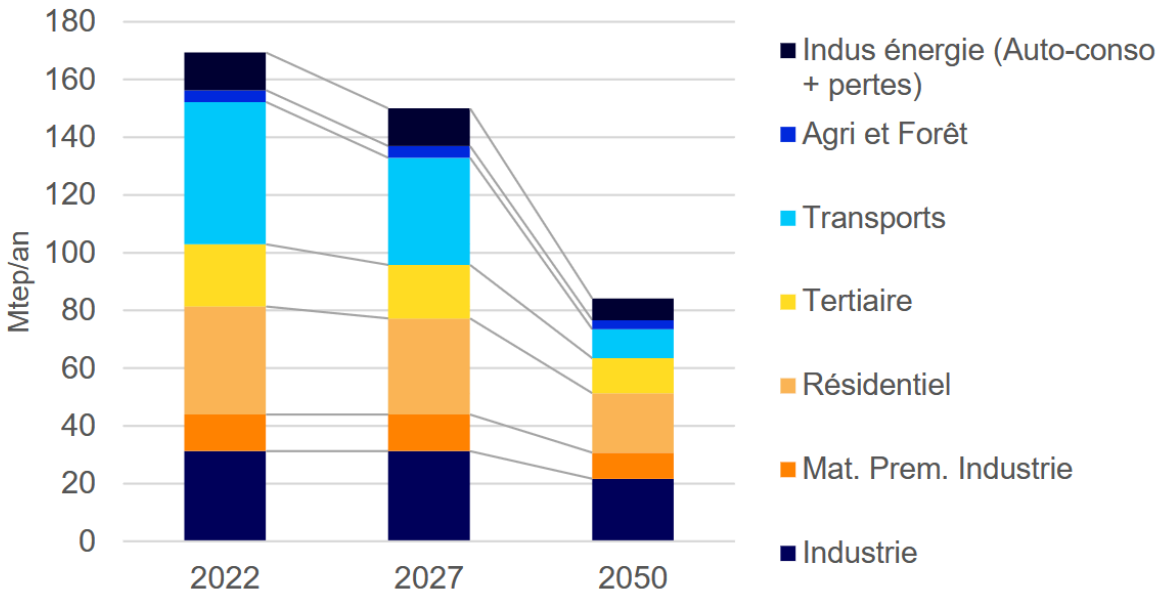


Figure 32 - Evolution of energy consumption between 2022 and 2050 in the PTEF scenario

PTEF scenario – The Shift Project (2022)

The electrification of certain uses is also an automatic source of energy efficiency, particularly by reducing energy losses as heat, especially in transport-related movements.

Texte original (inchangé)	***Traduction en anglais (EU, formal)***
Évolution de la consommation d'énergie finale, par secteur	*Evolution of final energy consumption, by sector*
par la mise en place du PTEF entre 2022 et 2050	*resulting from the implementation of the PTEF between 2022 and 2050*
Mtep/an	*Mtoe/year*
Indus énergie (Auto-conso + pertes)	*Energy industry (self-consumption + losses)*
Agri et Forêt	*Agriculture and forestry*
Transports	*Transport*
Tertiaire	*Tertiary sector*
Résidentiel	*Residential*
Mat. Prem. Industrie	*Industrial raw materials*
Industrie	*Industry*
2022	*2022*

Texte original (inchangé)	*Traduction en anglais (EU, formal)*
2027	*2027*
2050	*2050*

A. Activating all existing and realistic energy-efficiency levers

Efficiency refers to a reduction in energy consumption without reducing the quality or quantity of services delivered. It applies at all levels: in industrial processes; in transport, through reduced unit consumption of vehicles; or in buildings (residential and tertiary), through thermal renovation and the installation of more efficient heating systems (such as heat pumps).

Retrofitting is one of the cornerstones of transition: the renovation of both private and public buildings must be as swift and extensive as possible, targeting energy-inefficient dwellings as a priority and focusing on high-quality, comprehensive renovations.

Efficiency will also benefit from electrification, since electrical equipment and infrastructures generally perform much better than their fossil-fuel equivalents.

- An internal combustion engine has an efficiency of around 30–40% (i.e. 60–70% of the energy contained in the fuel is dissipated as heat rather than converted into motion), while an electric vehicle motor has an efficiency of over 90%.
- An electric vehicle therefore consumes far less final energy for the same service delivered.
- The same holds true for heating, as heat pumps are highly efficient.
- However, the development of hydrogen (necessary in particular to decarbonise certain industrial processes) and synthetic fuels leads to reduced energy efficiency for the uses concerned. Producing low-carbon hydrogen (via electrolysis) with current technologies results in an efficiency loss of around 30% of available energy (unless some of the waste heat is recovered).
- Likewise, producing synthetic methane from decarbonised electricity involves losses of around 50%.

In addition, the benefits of efficiency may be reduced or even cancelled out by the so-called “rebound effect”:

- lower unit consumption thanks to greater efficiency encourages a wider use of the good or service;
- total consumption may therefore be limited, or even remain unchanged.

In such cases, it is essential to simultaneously act to keep consumption volumes under control, which relies on lower-consumption pathways.

B. Commitment to structural, collective and individual sufficiency conditions the sovereignty of the country

Sufficiency refers to an intentionally organised reduction in usages, particularly in the volume of goods and services consumed. It has an essential role to play in sectors that are the most difficult to decarbonise.

In the field of aviation, for example, it is not reasonable to rely in the short or medium term on hydrogen aircraft; reductions in unit consumption per seat are slow; and the availability of sustainable fuels is limited. Therefore, it is essential to reduce traffic, at least temporarily — typically through modal shift to rail for European journeys, or by favouring less frequent but longer stays.

More broadly, in every sector — from food to housing and mobility — sufficiency plays a significant role in ensuring that each sector can access enough energy to meet its needs.

Committing to sovereignty means enabling the government to undertake measures that involve several levels of structural, collective and individual sufficiency, in order to address issues of resource availability and competing uses (of energy, materials, land, etc.) and to limit impacts on biodiversity:

- **Structural sufficiency**, through the development of "sufficiency infrastructures": large-scale deployment of rail and active-mobility infrastructure (cycling, walking, etc.), support for an industry producing small vehicles, territorial planning to reduce daily travel distances, democratically discussed measures limiting energy consumption, etc.
- **Collective or "organisational" sufficiency**, through public policies: limiting urban sprawl, taxing the most polluting vehicles, supporting the conversion of second homes into available housing, encouraging changes in habits, etc.
- **Individual sufficiency**, through voluntary behavioural changes and eco-friendly actions: buying locally, lowering heating temperatures of homes, choosing appropriately sized dwellings, limiting air travel, eating less meat, cycling, etc.

No single form of sufficiency is sufficient on its own; but together, they make decarbonisation possible and help guarantee our sovereignty.

CONCLUSION

In a world marked by growing geopolitical tensions, the energy-exposure approach sheds new light on the foundations of our sovereignty. As France makes decisive choices over the future of its energy mix, the debate often remains confined to a narrow perspective, limited to the electricity sector alone and framed by an outdated opposition between nuclear and renewable energies. For The Shift Project, this approach obscures the true challenges: the dual carbon constraint — structural dependence on fossil fuels and the impacts of climate change — as well as the preservation of our long-term competitiveness, to which decarbonisation provides a decisive response.

Addressing energy sovereignty at the right scale therefore requires a physical reading of an economic system in which materials, goods, services and knowledge cross national borders in both directions, incorporating the "embodied" energy mobilised throughout the value chains that support the functioning of our economy and the lifestyle of French citizens.

Through energy exposure, we can fully grasp the magnitude of the energy challenge ahead: the French economy is exposed to **2,550 TWh per year**. This is almost equivalent to the total electricity production of all nuclear power plants worldwide, or more than four times the energy that France can reasonably produce on its own territory by 2050 under conditions of relative control, including both nuclear and renewable sources. This reality illustrates the immense influence of fossil hydrocarbons — energy sources we do not control, and whose role we still fail to accurately measure. Yet they have a very real hold on our prosperity and our capacity to steer the material conditions of our national strength. In other words, thanks to this work, we can now better assess the energy risks associated with all these direct and indirect dependencies. In 2022, more than **70%** of the energy required for the functioning of the French economy still came from fossil resources — nearly **1,829 TWh** mobilised in France and abroad to produce the goods and services underpinning our prosperity.

This dependence — remarkably stable since 1995, despite a slight decrease since its peak in 2008 — exposes us to market volatility, resource scarcity, and the gradual erosion of our negotiating power vis-à-vis producer countries, in a context of shifting global power dynamics. Decarbonising in order to regain control over these 1,829 TWh of fossil energy is not only a climate imperative: it is a condition of power, a prerequisite for sovereignty, and a foundation of our long-term economic competitiveness.

If the functioning of the French economy required 2,550 TWh in 2022, the production of goods and services consumed by French citizens alone required around 2,000 TWh — already three times more than the country's annual production capacity. Under such circumstances, France could likely maintain its population's standard of living, but only by renouncing its exports, and thus an essential part of its financial resources. Such a situation, while sustainable for a time, is not a resilient or desirable long-term trajectory.

A decisive factor — and a source of hope — is that our emancipation from fossil fuels can largely be achieved at home, in Europe. Nearly **80%** of France's energy exposure stems from energy consumed on our territory or elsewhere in Europe, in countries with

which we share deep political, economic and historical ties. These nations, most of which lack significant fossil resources (aside from Norway and the United Kingdom), face the same physical constraints and operate under shared governance frameworks.

Thus, the decarbonisation of the European economy is not only a climate imperative: it is an act of collective sovereignty. To convince, mobilise and support our partners in this trajectory is to contribute to the preservation of a societal model forged on our continent for nearly eighty years — and to the building of a European power rooted in control over its material conditions.

For The Shift Project, a coordinated and clear-eyed approach, grounded in the decarbonisation of the industrial system and in the management of energy demand, is essential. Sovereignty will be built through our collective ability to anticipate physical constraints and to democratically organise the choices they require. This means deploying a fully-fledged French and European industrial policy — targeted and exclusive — whose robustness hinges on a diversified low-carbon energy mix relying on all mature levers available. These efforts must be accompanied by efficiency gains to reduce our energy needs and strengthen energy system resilience.

In parallel, a sovereignty strategy consistent with our medium- and long-term interests requires fully incorporating sufficiency — structural, organisational, and even individual — taking into account the social and strategic utility of uses. While sufficiency cannot be the primary determinant of our energy policy, it is one of the conditions for its resilience in a strained world. Already tested in other domains, sufficiency must be above all structural and collective in order to become accessible and genuinely meaningful for citizens.

Thus, thinking about sovereignty through the lens of energy requires moving beyond a purely territorial approach to energy production and consumption and examining energy issues along entire value chains. Public policies must integrate the full scope of our energy dependencies — both direct and indirect — and make energy exposure a genuine strategic indicator, at the heart of national and European forward-looking exercises (PPE, SNBC, NECPs, etc.). Such an approach would allow us to assess the robustness, resilience and sustainability of the energy system with clarity, while restoring the strategic depth that the debate requires.

In a country that produces only a limited fraction of the energy it consumes on its own territory, the challenge is no longer to trade low-carbon energy sectors off against one another, but to plan their complementarity so as to strengthen sovereignty and increase the resilience of our economy to shocks. The task is to identify and address the limits to our sovereignty through sustained, informed work — through clarity of diagnosis, coherence of planning, and consistency of collective action — at the scale of both France and Europe.

Annex: Oil and gas – current relevance of the risk of constraints on future supplies to France and the European Union

Below are five recent indicators suggesting that the risk of supply constraints for France and the European Union persists. This risk is both sufficiently significant and well-defined for public authorities to address it, examine it in depth, and integrate it as a major strategic indicator.

1 – Oil and gas. International Energy Agency, report on the implications of decline rates, September 2025

According to the IEA, *"nearly 90% of global upstream oil and gas investment since 2019 has served to offset the natural decline of existing fields, rather than to meet demand growth."*[103]

Current investment efforts are focused less on new projects and more on extending the lifespan of existing fields: *"Less than 40% of projects approved since 2020 relate to new discoveries,"* and *"more than 70% of new conventional discoveries approved in the 2020s are offshore resources — a far higher proportion than that observed in the 1990s to 2010s (40–50%)*[104]*."*

This shift towards resources that are more difficult to be accessed, capital-intensive, and subject to faster decline once brought into production increases the fragility of the global oil-production system. *"Average post-peak decline rates reach 5.6% per year for conventional oil,"* the IEAreports . Offshore fields experience an average decline rate of 10.3% per year, compared with 4.2% for onshore fields. Europe, rich in offshore fields, thus displays one of the highest rates in the world (9.7%).[105]

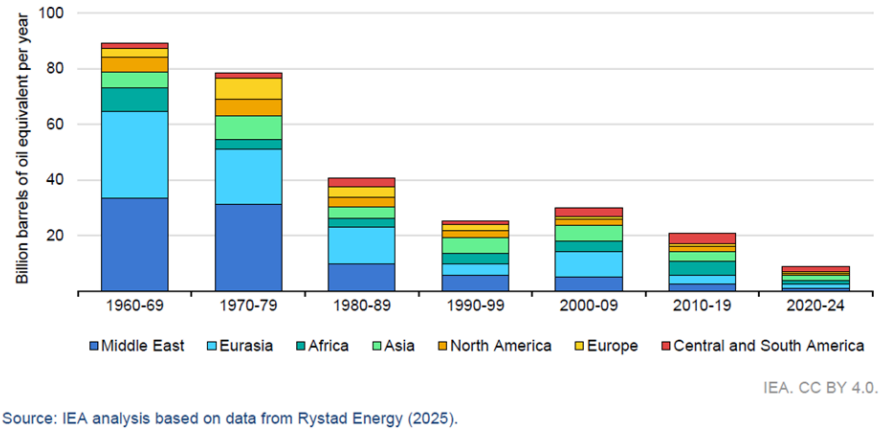


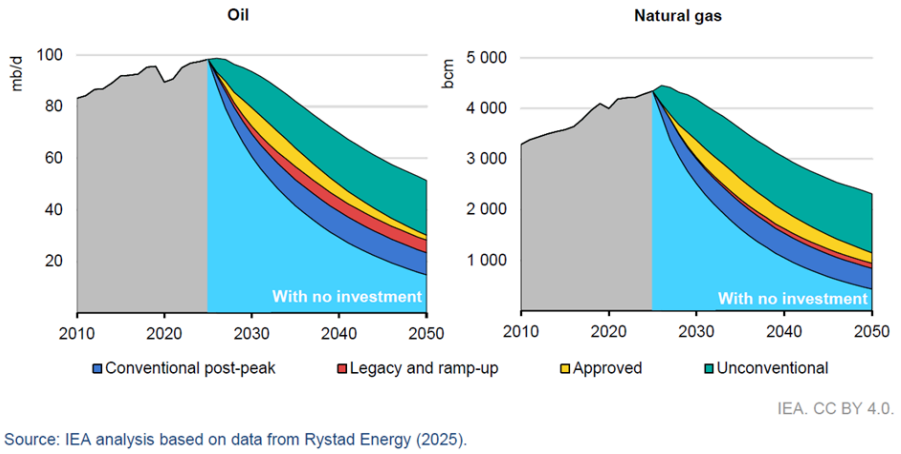
Figure 33 - Average annual oil and gas discoveries, 1960–2024
Source: IEA, The Implications of Oil and Gas Field Decline Rates, 2024 (p.17)

[103] IEA, The Implications of Oil and Gas Field Decline Rates, 2024
[104] Ibid
[105] Ibid

The IEA also highlights an increase in this rate of decline since 2010, *"linked to the growing share of unconventional resources and the widening of the global production base."*[106] This development makes global supply more unstable, as shown in the graph below. *"In the absence of new investment, shale oil and gas production would fall by more than 35% in one year, followed by an additional 15% the next year,"* states the IEA[107].

"In 2024, around 80% of global oil production and 90% of global natural gas production came from fields that had passed their production peak (including unconventional production)," the IEA notes.[108]

Finally, the IEA reports: *"Production losses due to natural decline are now far greater than fifteen years ago, on the order of +1.5 Mb/d for oil"*.[109]



Source: IEA analysis based on data from Rystad Energy (2025).

Figure 34 - Oil and gas production without initial or additional investment in existing and approved projects

Source: IEA, The Implications of Oil and Gas Field Decline Rates, 2024 (p.54)

To maintain current levels until 2050, 45 Mb/d would be required from new conventional fields (roughly half of today's production), even though new discoveries are dwindling and lead times to bring resources into production are close to 20 years, the IEA notes. Without new projects, global production would fall by 8% per year between 2025 and 2035 — that is, 5.5 million barrels per day, equivalent to the combined production of Brazil and Norway, according to the IEA.

The Middle East and Russian super-giant fields, characterised by slow decline rates, remain the pillars of global balance, the IEA further points out.

2. Oil – Persistent strain on reserve replacement, according to Rystad Energy

According to Rystad Energy[110], the replacement rate of oil reserves remains far below that of production. In 2024, 30 billion barrels were extracted worldwide, while identified and recoverable resources increased by only 5 billion barrels, mainly due to the

[106] Ibid
[107] Ibid, Executive Summary, p. 2; Chapter 3, p. 47
[108] Ibid, p. 32
[109] Ibid, Chapter 3, p. 51
[110] Rystad Energy, Discovered, recoverable oil resources increased by 5 billion barrels despite production growth in 2024, 2025

reassessment of the potential of already-known fields — Vaca Muerta in Argentina and the Permian Delaware in the United States.

Between 2025 and 2030, Rystad estimates that *"reserve replacement from new conventional oil projects will account for less than 30% of production, while exploration will compensate for only around 10%."* So-called "yet-to-find" resources have in fact been revised downward by 456 billion barrels in ten years, due to a sharp reduction in the prospects for new field exploration, the absence of shale outside North America, and the doubling of offshore exploration costs since 2019.

In 2025, *"proven global oil reserves represent only around fourteen years of production at the current rate,"* Rystad Energy stresses. To maintain supply, not only would sustained high prices be needed, but also massive investment in increasingly costly and risky projects — investment capital that *"will likely not be available,"* according to Rystad.

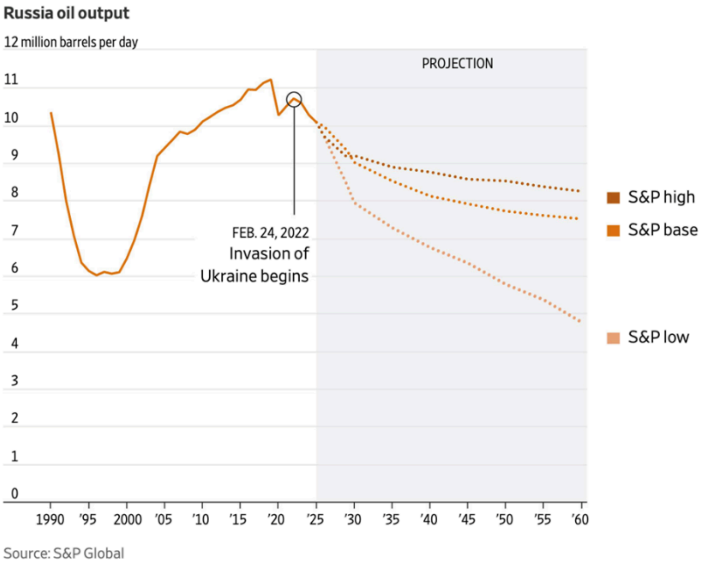
This dynamic reflects a lasting physical and economic constraint. According to Rystad Energy, *"if oil demand were to continue growing, global supply would be unable to meet it, leading to a strained economic environment (...)."*

3. Oil – Possible new peak in U.S. production

Among other recent statements by executives of competing companies, the Chief Executive Officer of Occidental Petroleum — one of the leading operators in U.S. shale-oil production — declared in May 2025: "We had estimated that total U.S. production would peak between 2027 and 2030. It appears it could happen earlier."[111]

4. Oil – Possible systematic decline of Russian extraction

Russian crude-oil production is expected to decline inexorably over the coming years, and in all scenarios, according to an S&P study reported by The Wall Street Journal.[112]



[111] Bloomberg,, US Oil Has Peaked, But Don't Expect a Rapid Decline, 2025
[112] *The Wall Street Journal*, The Slow Demise of Russian Oil - The toll from war and sanctions has hastened the decline in Russian oil output, 2025

Figure 35 -
Russian oil production
Source: S&P Global, reported by the Wall Street Journal, 2025

5. Gas – Global production peak anticipated by Rystad Energy in the early 2030s

In an analysis published in 2023, Rystad Energy predicted a peak in global natural-gas production during the next decade, taking into account all known fields likely to be developed by then.

As a result, such a production peak "would not be sufficient to meet global demand, (…) even in scenarios consistent with 1.9°C or 2.5°C warming, accounting for rapid growth in renewable-energy sources."[113]

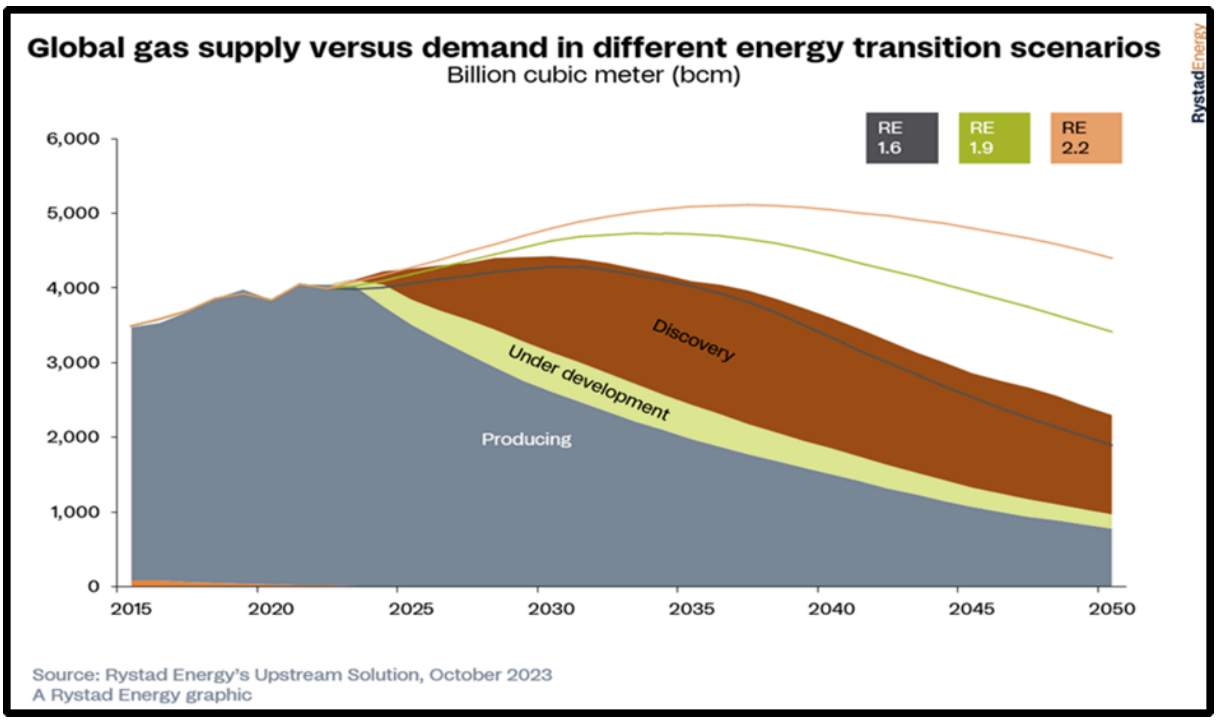


Figure 36 - Global natural-gas production and demand across different transition scenarios
Source: Rystad Energy, 2023

[113] Rystad Energy, New natural gas production is needed to meet demand; Middle East could hold the answer, 2023

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The Shift Project and The Shifters also thank the reviewers: Julien Armijo, Guillaume Allart, Damien Ambroise, Claire Bordenave, François B, Maxence Cordiez, Victor Court, Bastien Cuq, Jean-Pierre Daverio, Marc David, Olivier Descout, Alexandre Duforestel, Reuben Fisher, Tanguy Graffin, Rémi Grimaud, Emmanuel Hache, Joseph Hajjar, Jean-Marc Jancovici, Alexandre Joly, Pierre Lachaize, Annabelle Livet, Patrick Margaria, Phuc-Vinh Nguyen, François Picard, Nicolas Raillard, Pierre-Louis Vernhes, Laetitia Vialle, Guillaume Vidon, as well as the Europe Working Group of The Shifters Belgium and the Energy Thematic Circle of The Shifters.

We particularly thank Maxence Cordiez for his semantic suggestion that led to the term *“energy exposure”*.

The Shift Project est un groupe de réflexion qui vise à éclairer et influencer le débat sur les défis climat-énergie.

Nous sommes une association d'intérêt général. Nos membres financeurs sont pour la plupart des entreprises. Guidé par l'exigence de rigueur scientifique et technique, notre regard sur l'économie est avant tout physique et systémique.
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THE SHIFT PROJECT

Texte original (inchangé)	**Traduction en anglais (EU, formal)**
The Shift Project est un think tank qui œuvre en faveur d'une économie libérée de la contrainte carbone.	The Shift Project is a think tank working towards an economy freed from the carbon constraint.
Association loi reconnue d'intérêt général et guidée par l'exigence de la rigueur scientifique, notre mission est d'éclairer et d'influencer le débat sur la transition énergétique en Europe.	As a non-profit association recognised as serving the public interest and guided by scientific rigour, our mission is to inform and influence the debate on the energy transition in Europe.
Nos membres sont de grandes entreprises qui veulent faire de la transition énergétique leur priorité.	Our members are major companies that seek to make the energy transition their priority.
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