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The Age of Electrification

Teresa Ribera,
Executive Vice-President of the European Commission for Clean, Just and Competitive Transition

// Beyond Hormuz: Europe's Energy Future

Dominique Bussereau,
former French Minister, President of EdEn

// Electrification: a burning imperative

CONTRIBUTORS

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Teresa Ribera
Executive Vice-President of the European Commission for Clean, Just and Competitive Transition

Beyond Hormuz: Europe's Energy Future

The latest conflict in Iran and the Middle East is once again hitting European households and businesses where it hurts: energy prices and security of supply.

Russia's aggression on Ukraine just a few years ago. The oil shocks of the 1970s. The crisis over the Suez Canal in the 1950s. Different geography, different political reasons but the underlying vulnerability is always that we pay the price.

The numbers are quite telling. Half of all energy consumed in Europe is imported fossil fuels, one of the highest dependency ratios in the world. Europe imports €375 billion worth of fossil fuels annually. Instead, that same import bill could finance the electrification of our economy, supporting our industries, citizens and future. And there is a structural truth that can't be changed: Europe will always pay more for fossil fuels it does not produce. This is not bad luck. It is the price of dependency.

"Just as the Industrial Revolution and the Oil Era reshaped economies and rewrote the global order, the Age of Electricity is doing so right now.

But the world is changing in ways that offer Europe a genuine alternative.

Just as the Industrial Revolution and the Oil Era reshaped economies and rewrote the global order, the Age of Electricity is doing so right now. Renewables are already the cheapest source of new electricity generation in most parts of the world, with solar and wind below €40 per megawatt-hour. With current high oil prices, every kilometre driven in a petrol car can easily cost twice as much as an EV would. And at home, a heat pump delivers warmth at lower cost per degree than a gas boiler, as replacing gas and oil boilers with heat pumps would cut final energy costs in those buildings by up to 60%. Cleaner, cheaper, and made in Europe: the clean energy economy already employs 3.8 million Europeans and is growing. This is not sacrifice. This is not a distant promise. It is the smartest investment this continent can make.

This is why the Green Deal has never been just a climate agenda: it is a Freedom Deal. Freedom from volatile high energy prices dictated by distant conflicts. Freedom from weaponised supply chains. Freedom from the coercion and dependencies. The wind and the sun are not trapped in the Strait of Hormuz.

And Europe is better placed to lead the electrification revolution than most realise. We operate the largest interconnected electricity grid in the world with roughly twice the density of the United States or China. We are the most energy-efficient major economy in terms of energy per unit of GDP, second to the EU is Japan, 25% higher. We already export €80 billion annually in clean technology products. We are predictable and reliable. These are not aspirations. These are assets.

But we must move faster. Europe's electrification rate has been stagnating at around 23% for over a decade. We cannot afford to fall behind others in the technologies defining the next era. Europe needs to act.

That means concrete actions such as taxing electricity less than fossil fuels, phasing-out fossil fuel subsidies, putting the European Grids Package into motion to build the grids and interconnectors Europe needs, deploying the €100 billion Industrial Decarbonisation Bank to support industry electrification, setting a clear electrification target for Europe, expanding support for technologies such as EVs and heat pumps through financial instruments, social leasing schemes, tax relief and market based mechanisms as well as setting clear EU targets that give industry and investors the certainty they need to act. On 17 July, the European Commission presented its Electrification Action Plan to make this electrification revolution a reality in Europe.

The choice is ours. The window for action is now. Every year of delay will be another year of higher cost for society, another year of exposure to crises we do not choose, and another year of ground ceded to competitors who are not waiting for us. We can seize now the opportunity electrification offers.

"Europe's electrification rate has been stagnating at around 23% for over a decade. We cannot afford to fall behind others in the technologies defining the next era. Europe needs to act.



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Dominique Bussereau,
former French Minister,
President of EdEn

Electrification: a burning imperative

Electrification has become an imperative for France and Europe, as their domestic hydrocarbon resources fall short of meeting their energy needs, while continued reliance on oil and gas is ultimately incompatible with their commitment to decarbonisation.

This reality could have become clear to our governments and to the European Union as soon as the threat of climate change emerged and the global balance began to shift, driven by China's spectacular economic growth, rising geopolitical instability and slowing growth in Europe.

Yet this realisation did not occur. The underestimation of the consequences of our dependence on external powers – whose interests are increasingly diverging from ours – and the excessive hopes placed in certain technologies meant that France and Europe failed to recognise or exploit the major asset they possessed with an electricity system that had long been, for Europe and even more so for France, a major comparative advantage.

The devastating effects of global warming, the repercussions of the wars in Ukraine and the Middle East, and growing competition from Chinese industry have prompted France and Europe to rethink their energy strategies. In France, the electrification plan presented by the Government in April 2026 and the *Stratégie nationale bas-carbone* (national low-carbon strategy) adopted in July aim to increase the share of electricity in final energy consumption from 27% in 2025 to 52% in 2050. In Europe, the Electrification Action Plan presented by the European Commission on July, 17th sets an electrification target of 46% as early as 2040, compared with 23% in 2025.

Electrification is therefore an imperative. Yet the goal of doubling electricity's share in meeting our energy needs has become so commonplace in official discourse that it is easy to lose sight of the scale of the ambition – and of the challenge it represents.

From a technical, economic and societal standpoint, this is nothing short of a revolution. It will require strong political commitment and broad public support, underpinned by a clear understanding of why this transformation is necessary. The approach must be holistic: electricity generation, transmission, distribution, and end-use, as well as flexibility and storage must progress in a coordinated manner.

In terms of generation, the time has come to stop pitting the nuclear industry against renewables. They do not operate on the same timescale and their complementarity no longer needs to be demonstrated. In France, the government hopes to confirm, by the end of 2026, the launch of the New Nuclear France (NNF) programme, with, as a first step, the construction of six new EPR2 reactors representing 10 GW, which will replace existing power plants reaching the end of their service life. A subsequent phase of eight reactors could follow. The validation of this programme, including by the European Commission, given the public support it entails, will constitute a strong signal, both for the revival of the nuclear industry and, more broadly, for the new European electrification dynamic based on clean, sovereign and competitive electricity.

Electricity grids are subject to multiple demands, due to the need to connect hundreds of thousands of distributed energy sources and the desire to develop interconnections with neighbouring countries. Grids are structural assets that will be passed on to future generations. The priority must be to continue ensuring their quality and stability and that all consumers can connect quickly and access the capacity they need.

At the same time, we must consider ways of accelerating the electrification of uses: the growth in electricity generation only makes sense if it meets growing demand. It is in this spirit that EdEn is publishing this special issue of its *EdEnMag* magazine, bringing together analyses and testimonies from political figures, specialists, representatives of European institutions, companies and federations committed to electrification and decarbonisation.

This work clearly shows that electrification is possible: Norway provides an illustration of this. Solutions exist in most energy-consuming sectors, and they are beneficial from a strategic, economic and environmental perspective. They offer competitiveness for businesses and provide consumers with comfort and renewed purchasing power. Electric mobility and heat pumps are already gaining significant momentum. The challenge now is to create the conditions for electrification on a much larger scale.

The political signal must be strong: electrification, powered by decarbonised electricity, must now become the overriding priority of energy policy. This requires stable, long-term policies: we cannot expect to overcome in just a few years our dependence on hydrocarbons, that have ensured the prosperity of nations for the past 150 years.

“ Electricity is a solution that is ready to be deployed at scale today. Other solutions can complement it and should be further developed to reach maturity.

The main challenge is economic. Electrification offers a way to break free from the rents paid to hydrocarbon-producing countries, but it also requires substantial investment that must be financed. Public policies must help support this investment, notably through the European carbon pricing systems, the EU ETS and ETS2. Taxation must also be aligned with energy and climate objectives, while consumers must have access to pricing arrangements that provide a reasonable degree of stability and predictability.

Certain legislative or regulatory provisions that, until relatively recently, may have hindered the development of electricity must also be reconsidered. There is no inherently wrong use of electricity: what matters is that it enables us to move away from dependence on fossil fuels on economically viable terms.

We must avoid falling into a new form of dogmatism that would make electricity the only solution. Alongside electricity, there is significant potential to expand renewable heat sources, including geothermal energy, organic waste and solar thermal energy. Molecules will also remain necessary for certain uses, including non-energy applications in industry, very high-temperature processes, aviation and maritime fuels, and peak power generation. Electricity, however, is a solution that is ready to be deployed at scale today. Other solutions can complement it and should continue to be developed to bring them to technological and economic maturity.

The new direction emerging in France and across Europe, with greater recognition of the need for technological neutrality, should be welcomed. It signals a renewed sense of purpose in both France and the European Union. By making electrification the driving force of their energy transition, they can not only achieve their climate objectives but also restore the conditions needed to compete on a more equal footing with the world’s other major economic powers.

Electrification: the great challenge for energy policy

The need to accelerate electrification is now firmly embedded in French and European public policies. The contributions gathered in this edition of the EdEn+ show that electrification is possible across almost every sector of the economy. Yet, this new electrical revolution has barely begun. This overview explores the reasons behind this slow progress and sets out possible courses of action for French and European policymakers.



Jean-Pierre Hauet,
Chief Scientist, EdEn

Electricity is now at the heart of European energy policy. In its Communication of 17th July 2026, the European Commission sets an indicative target for electricity to account for 46% of final energy consumption by 2040. Reaching this target would make a major contribution to the EU's goal of cutting emissions by 90% compared with 1990 levels by 2040, while reducing Europe's fossil fuel import bill by €260 billion a year.

The International Energy Agency (IEA) also expects electricity to become the world's leading energy carrier. Its share of final energy consumption would rise from 21% in 2024 to around 40% by 2050 in a scenario where countries fully meet their climate commitments[1], and up to 50% under its Net Zero 2050 scenario published in May 2021.

France is moving in the same direction. Its National Low-Carbon Strategy (SNBC) aims to double the share of electricity in final energy consumption over the next 25 years, taking it above 50% by 2050. Alongside direct electricity use, additional demand would come from the production of hydrogen and e-fuels (Figure 1).

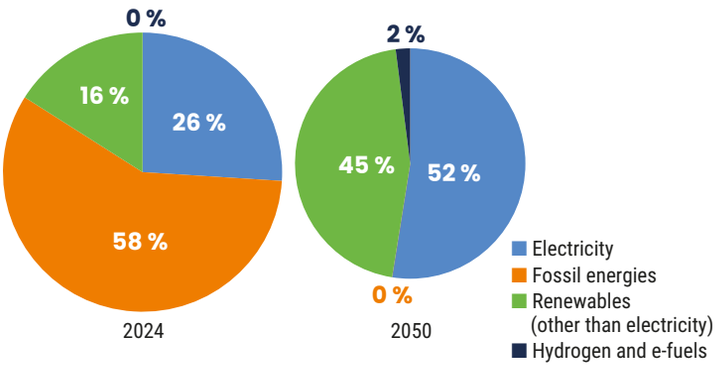


Figure 1: Final energy consumption mix in 2024 (weather-adjusted) and in 2050 under the central reference scenario of SNBC 3.
Source: SNBC 3 data (June 2026).

An energy carrier with multiple advantages

The growing focus on electrification in public policy reflects electricity's ability to meet four key requirements. Some Member States, including France, Finland and Sweden, already perform strongly against these criteria, while progress is being made across the European Union as a whole.

Low-carbon electricity

The carbon intensity of electricity generation has fallen sharply across Europe. According to the IEA, it stood at 172 gCO_2/kWh in 2025 and is expected to fall to 88 gCO_2/kWh by 2030 (Figure 2). In the first quarter of 2026, renewables accounted for 46% of electricity generation in Europe, up from 42.7% over the same period in 2025. The European Commission expects Europe's power generation to be almost fully decarbonised by 2040 at the latest.

France is already close to this position, thanks largely to the nuclear fleet developed between the 1970s and 1990s[2]. The average carbon intensity of French electricity generation was just 19.6 gCO_2eq/kWh in 2025[3], giving France the second-lowest-carbon electricity mix in the European Economic Area after Norway[4].

1. *Source: World Energy Outlook 2025.*
2. *With the exception of the Flamanville EPR, the last reactor connected to the French grid was Civaux, on 24 December 1999.*
3. *Source: RTE, Electricity Report 2025.*
4. *Source: ibid.*

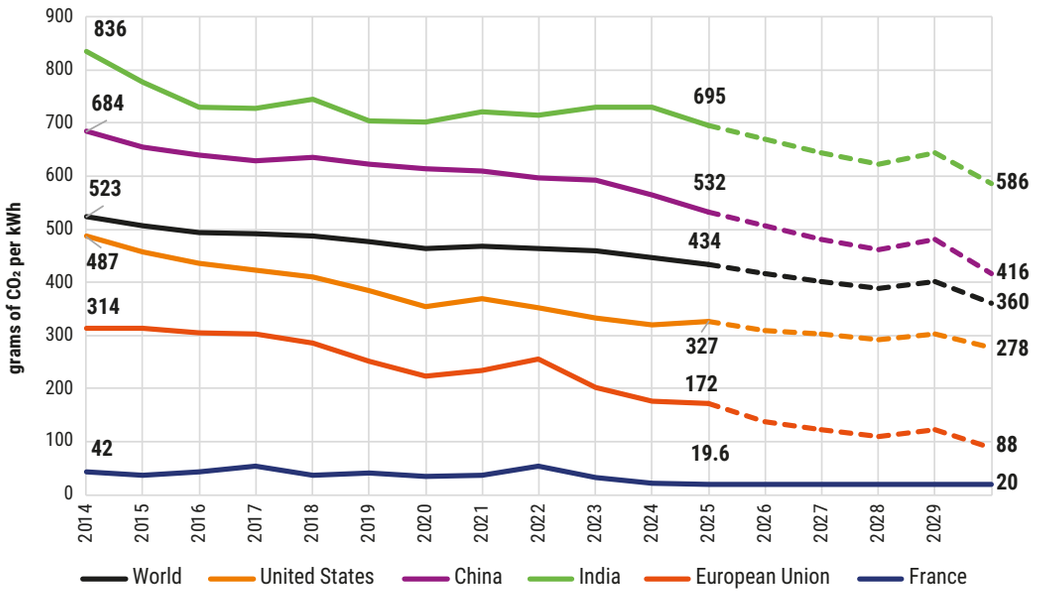


Figure 2: Carbon intensity of electricity generation worldwide, in gCO_2/kWh. For France, carbon intensity is assumed to remain stable at 20 gCO_2/kWh after 2025.

Source: IEA data (2026) and RTE electricity reports.

Electricity is available

Access to low-carbon electricity is a major competitive advantage for countries seeking to attract new economic activity. Not all European countries are currently in this position. The heatwaves of summer 2026 exposed vulnerabilities in several countries, pushing spot electricity prices to unusually high levels for the season and requiring some fossil-fuel generation capacity to be brought back online.

The European Union nevertheless benefits from an extensive transmission and distribution network, with around 11.3 million kilometres of power lines – roughly the same as the United States, despite its territory being more than twice the size – as well as a high level of interconnection between Member States.

France is particularly well placed. Its nuclear and renewable generation fleet enabled it to export 92 TWh of electricity in 2025 and 51 TWh in the first half of 2026, notably to Germany, Belgium, Italy and Great Britain. This generation capacity is backed by transmission and distribution networks that can generally accommodate new consumers within relatively short timeframes. Together, these assets provide favourable conditions for large-scale electrification.

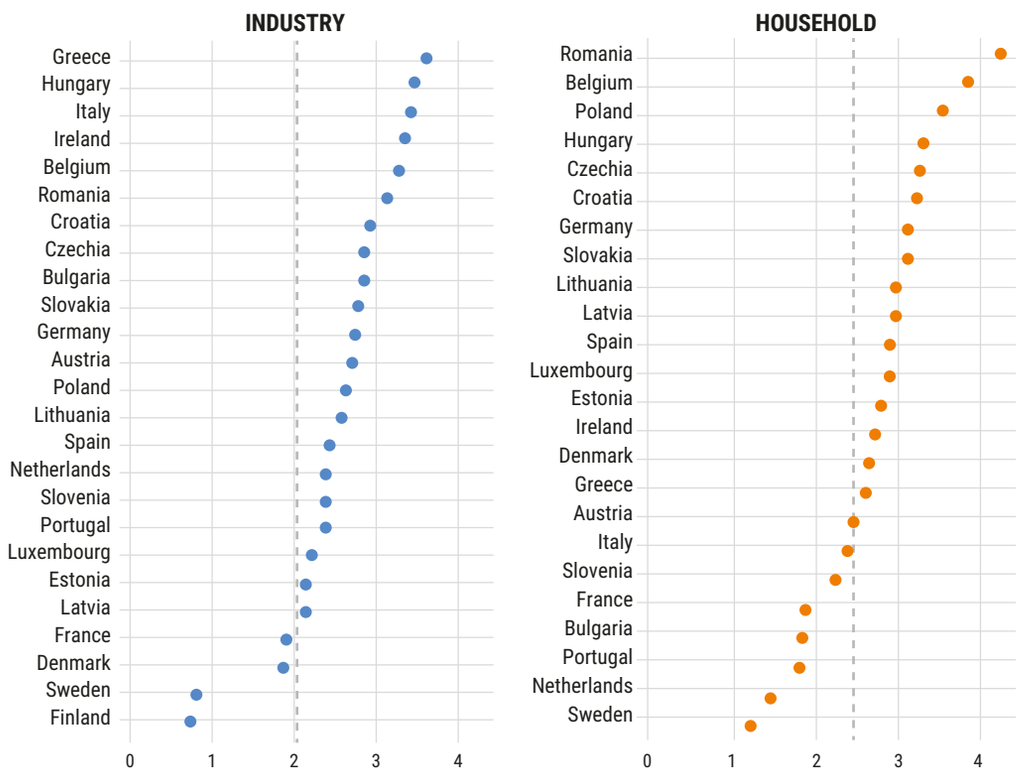


Figure 3: Electricity-to-gas price ratios in EU Member States for industry and households in 2025.

Source: COM(2026) 595, 17 July 2026.

Electricity is competitive

Electricity prices are a key issue for electrification in Europe. In its Communication of 17th July, the European Commission stresses the importance of narrowing the price gap between electricity and gas. It considers that electricity should cost no more than twice as much as gas for industry and 2.5 times as much for households. In most European countries, however, these ratios are currently higher (Figure 3).

Figure 4 compares electricity prices for non-household consumers across major European economies. Northern European countries and France are relatively well positioned thanks to their hydroelectric and nuclear resources. Competitive electricity prices give these countries an advantage in attracting data centres and new electricity-intensive industries.

According to Eurostat, average electricity prices for non-household consumers in France, excluding VAT and recoverable taxes, were 18% below the EU average in the second half of 2025, 27% below those in Germany and 36% below those in Italy.

Comparisons with the United States, India and China are more difficult because sufficiently consistent and reliable data are not available. According to the IEA, average electricity prices for non-household consumers in Europe are almost twice as high as in the United States, three times as high as in India and around one third higher than in Japan (Figure 5). French prices appear broadly comparable with those in Japan, but remain significantly above US levels and even further above those in India.

These figures should nevertheless be treated with caution, as the underlying definitions may not be fully comparable across countries. There are also considerable differences in electricity prices between individual US states.

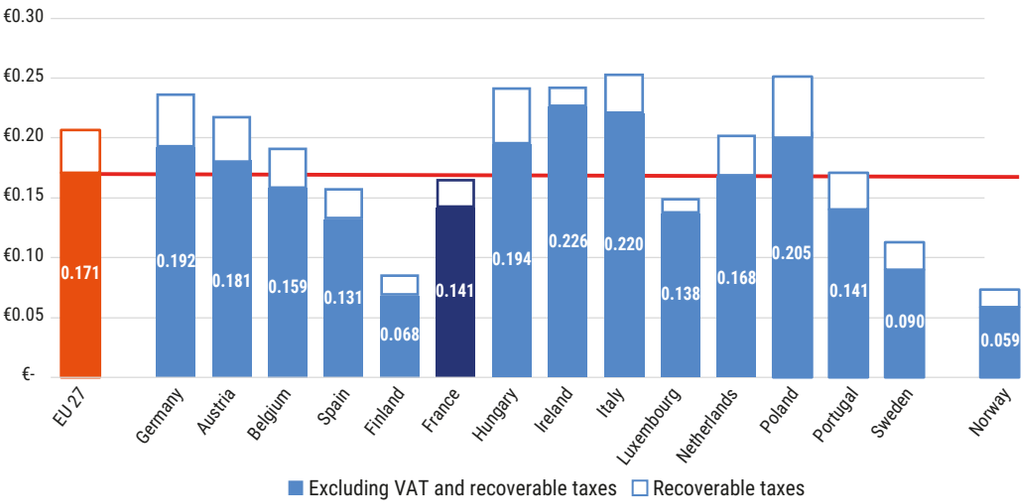


Figure 4: Electricity prices excluding recoverable taxes for non-household consumers in major European countries in the second half of 2025 (€/kWh). Source: Eurostat.

Security and sovereignty

Against the backdrop of the wars in Ukraine and Iran and the resulting global instability, security of energy supply has once again become a major concern. Industrial sovereignty – including control over key technologies and manufacturing capabilities – has also moved up the political agenda.

Thanks to its expertise and industrial capabilities in both nuclear and renewable energy, electricity offers Europe a powerful means of reducing its dependence on fossil fuels and strengthening its energy security.

Electricity has major advantages, but the electrification challenge is far from won

Electricity clearly sits at the intersection of three major priorities: **decarbonisation, competitiveness and sovereignty.** Yet, the second electrical revolution has barely begun. The electrification pathways envisaged in Europe represent a major break with both historical and recent trends. The challenge now is to turn these ambitions into reality.

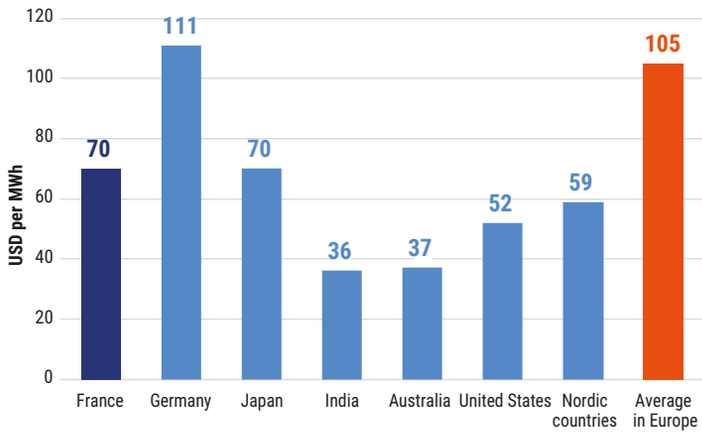


Figure 5: Electricity prices for non-household consumers in selected countries worldwide, according to the International Energy Agency (USD/kWh). Source: IEA, Electricity 2026.

For many years, particularly in developed economies, electrification has progressed much more slowly than would now be required.

Across Europe, electricity's share of final energy consumption has increased only slightly in recent years and remains at around 23-24% (Figure 6).

The situation is similar in France, where electricity's share of final energy consumption has remained broadly stable. Yet reaching the 2050 target would require it to increase by around one percentage point every year for the next 25 years – a pace never achieved in the past. Even between 1970 and 1990, when electricity use expanded rapidly in homes and the service sector alongside France's nuclear programme, its share of final energy consumption increased by only eight percentage points over 20 years.

This raises legitimate questions about the feasibility of current electrification targets and, above all, about the measures needed from policymakers and businesses to place the European economies on a trajectory where electricity meets more than half of consumers' energy needs within 25 years.

This special edition of the EdEn+ brings together the views of decision-makers from a range of economic sectors to assess whether such an electrification pathway is achievable and whether a common vision is emerging on how to deliver it. The contributions reveal a strong degree of convergence on both the need for electrification and its feasibility.

Turning this consensus into action will require a combination of long-term vision – essential in addressing climate change – and economic, political and social pragmatism, against a backdrop of constrained public finances, political uncertainty and acute public sensitivity to energy prices.

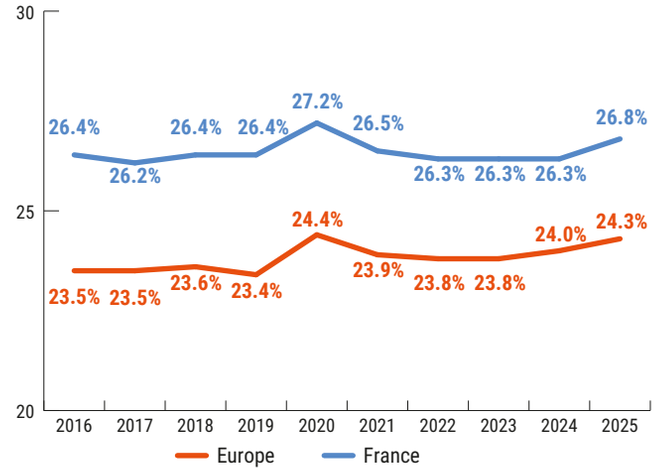


Figure 6: Electricity's share of final energy consumption in France and Europe. Sources: SDES for France; Eurostat, RTE and ENTSO-E for Europe.

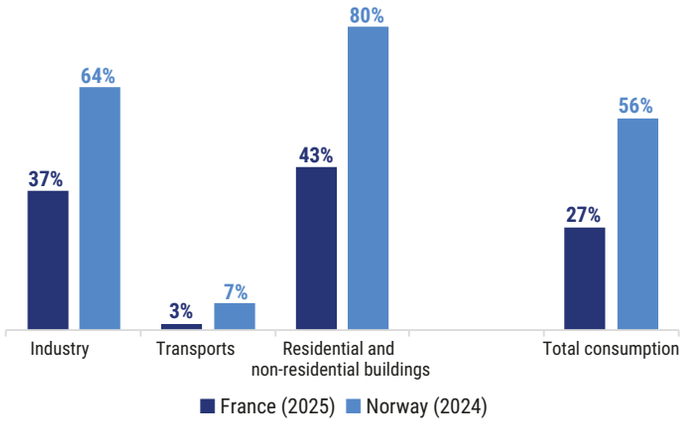


Figure 7: Comparison of electrification rates, measured in final energy consumption, in France and Norway. Sources: SDES, National energy balance (2025), for France; Statistisk sentralbyrå for Norway.

Electrification is achievable

Following the Chernobyl disaster of 26th April 1986, support for nuclear power weakened considerably across Europe. Renewable energy gained increasing public backing, while for many the Fukushima accident in 2011 appeared to bring the nuclear debate to a close.

In Germany, Chancellor Angela Merkel accelerated the nuclear phase-out and launched the Energiewende. The European Commission also showed a clear preference for renewable energy, while nuclear power was only reluctantly incorporated into the European green taxonomy.

In France, environmental movements, supported in this debate by parts of the gas industry, helped establish the idea that expanding electricity use would necessarily mean reviving nuclear power and should therefore be avoided.

Other European countries followed a different path, demonstrating the considerable scope that remains for electrification. Norway is a particularly striking example. Despite its vast hydrocarbon resources – producing more than twelve times its own annual energy needs – electricity already accounts for 55% of its final energy consumption (Figure 7), making it the only country to have crossed the 50% threshold.

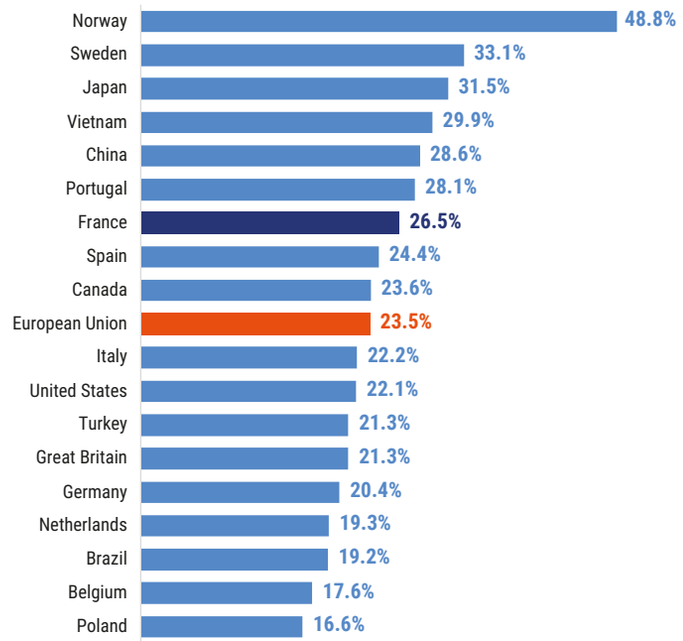


Figure 8: Share of electricity in total final energy consumption. Sources: Enerdata (2025) and Eurostat (EU-27, 2024).

This trend is set to continue as transport becomes increasingly electrified: battery-electric vehicles accounted for 95.9% of new vehicle registrations in Norway in 2025[5].

Norway therefore provides a useful benchmark for industrialised economies, where electrification rates generally range between 20% and 30% (Figure 8). More broadly, the Nordic countries perform particularly well, alongside China, Japan and Vietnam.

Greater electrification does not, of course, mean an all-electric energy system. Europe remains far from such a scenario. Even if electricity accounts for 52–55% of final energy consumption by 2050, a substantial share of demand will still need to be met by other low-carbon energy sources, which unfortunately remain limited and often face cost and availability constraints.

Sectoral analysis

While doubling electricity's share of final energy consumption appears achievable at the macroeconomic level, this ambition must also be tested against the specific constraints faced by each sector.

The analyses carried out for this edition of EdEn+ show that technical solutions exist across virtually all sectors, although their maturity and investment requirements vary considerably depending on the use case.

In sectors that already consume energy, electrification generally involves replacing another energy source. In some applications, electric solutions are already mature and widely proven. In others, they are only now reaching maturity, while some still require further technological development before they can be deployed at scale.

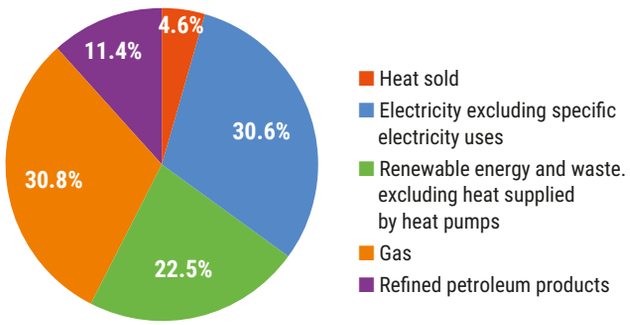


Figure 9: Breakdown of final energy consumption by energy carrier in the French residential sector in 2025, excluding specific electricity uses and external heat supplied by electric heat pumps. Source: SDES, provisional 2025 energy balance - France - Weather-adjusted.

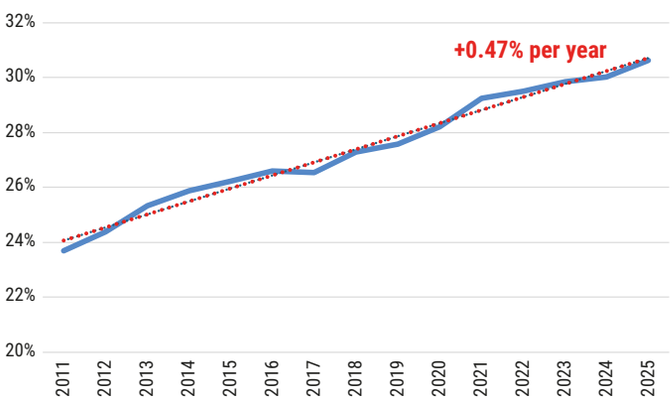


Figure 10: Electricity's share of final energy consumption in the residential sector in France since 2011, excluding specific electricity uses and external heat supplied by electric heat pumps. Source: SDES, provisional 2025 energy balance - France - Weather-adjusted.


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The situation is different for new sources of demand. Here, the question is not simply whether electricity should replace fossil fuels: countries are also competing to attract new investments. Electrification strategies must therefore reflect local circumstances, with economic considerations playing a decisive role.

Buildings

In the residential sector, fossil fuels continue to play an important role. Electricity accounts for only around 27%[6] of residential energy consumption in Europe, rising to 30.6% in France.

Gas and heating oil nevertheless still cover 42% of energy needs that could potentially be met by electricity or renewable heat (Figure 9).

Gas alone covers more than 30% of these needs and currently consists of 96% fossil gas and just 4% biogas.

Despite a regulatory environment that has often worked against electricity, its share has continued to increase in France over the past 15 years, albeit slowly. Figure 10 shows average growth of around 0.5 percentage points per year in electricity's share of residential final energy consumption.

5. *Source: European Commission, European Alternative Fuels Observatory.*
6. *Source: Eurostat, Energy in Europe – 2026 edition.*



© FRIMU EUGEN

This pace is far too slow. It would need to at least double for electricity to meet around 60% of residential energy needs in France by 2050. This is achievable: the technologies already exist and are mature. Four solutions in particular can drive this transition:

- air-to-air and air-to-water heat pumps;
- controllable electric radiators;
- heat-pump water heaters;
- air-conditioning systems, preferably reversible, which are becoming increasingly important as summers become hotter.

In new residential buildings, virtually all homes can be electrified, with the exception of those supplied by district heating. Some regulatory adjustments are nevertheless needed, particularly to improve resilience to increasingly frequent heatwaves.

In existing buildings, the challenge is greater. Some homes – perhaps around two million in France – will probably need to remain connected to the gas grid for technical and economic reasons, with the gas supplied eventually becoming fully renewable. Nevertheless, around 70% of today's existing housing stock could ultimately be heated with electricity by 2050, including circa 55% using heat pumps and 15% using electric radiators[7].

Reaching this objective will require a more consistent policy framework: regulations must be adapted, public support should prioritise switching to electricity. A progressive and long-term strategy for phasing down fossil gas must be developed and implemented.

In tertiary buildings, electrification is already well advanced across Europe. According to Eurostat, electricity accounts for around 52% of final energy consumption in the sector, a share that has remained broadly stable in recent years. There is scope for further progress, particularly through greater use of heat pumps in many subsectors. However, the sector's main priorities today are reducing overall energy consumption and deploying energy management systems.

Data centres follow a different logic. The sector is expanding rapidly and requires large amounts of electricity to power servers. One frequently proposed solution is to recover waste heat and supply it to neighbouring buildings. Public buildings, particularly schools and universities, could be a priority, as many still rely primarily on fossil fuels for heating. Boiler replacement could therefore be planned progressively over the period to 2050.

Transport

Road transport is undergoing a profound transformation, driven by the rapid growth of electric vehicles. After a period of uncertainty, the conditions are now in place for their widespread deployment in the light-duty vehicle market.

Member States must continue expanding charging infrastructure, particularly along highways, to provide drivers with an increasingly comprehensive service. However, beyond smoothing the decarbonisation trajectory and introducing some flexibilities, there is no reason to call into question the EU objective of ending sales of new internal-combustion-engine cars by 2035.

The conflicts in the Middle East have further strengthened the case for reducing road transport's dependence on oil through electrification. **Heavy-duty road freight represents another major opportunity for electrification and relatively rapid emissions reductions.** Developments in China demonstrate the maturity of electric truck technology. The main challenge is now economic, particularly in terms of Total Cost of

7. *Source: Equilibre des Energies « Une stratégie de rénovation efficace pour la décarbonation des logements » (mars 2026).*


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Ownership (TCO). Purchase incentives available in several Member States – including support provided through the French Energy Savings Certificates scheme – will therefore need to be maintained for at least the next few years[8].

The electrification of heavy-duty vehicles will follow a different timetable from that of passenger cars. This leaves room for transitional solutions, particularly biofuels, which could eventually be redirected towards aviation as road freight becomes increasingly electrified.

Public transport electrification is already well under way. Electric buses and trams are mature technologies. Rail electrification should also continue, both through further electrification of major lines and through battery-powered solutions replacing diesel locomotives on secondary routes.

Aviation and maritime transport are more difficult to electrify. E-fuels remain far from being cost-competitive, while international competitiveness is a major concern in both sectors. In the coming years, efforts should therefore focus on complementary measures: electrifying ports and airports and prioritising biofuels, with bio-kerosene for aviation and LNG blended with bio-LNG for maritime transport.

At the same time, pilot projects for e-kerosene and other e-fuels should continue. Although highly electricity-intensive, these projects are necessary to develop expertise and industrial capabilities in the relevant production processes.

Electrifying industry

European industry remains relatively weakly electrified. In 2025, the electrification rate of industry stood at 64% in Norway, compared with 37% in France. In France, this represented around 100 TWh of electricity consumption, including non-energy uses.

Yet, the potential for substitution is considerable, particularly for low- and medium-temperature heat. Technologies are already available, including heat pumps, mechanical vapour recompression, electric boilers and electric furnaces. France's National Low-Carbon Strategy (SNBC 3) estimates that electricity's share could reach 47% by 2030 and 57% by 2050.

The main barriers are economic rather than technical. Financing investment remains difficult, businesses lack sufficient visibility over future electricity prices and many industrial players continue to hope that competitive gas prices will return.

For new industrial facilities, grid connection times can also be a constraint, despite efforts to speed up procedures.

What needs to be done to deliver electrification?

The analysis above shows that there is significant potential for electrification across every sector of the economy. Yet despite electricity's many advantages, this potential remains underused. The status quo is no longer sustainable.

The European Commission recognised this challenge with the publication of its Electrification Action Plan on 17th July 2026. Member States are also taking action. France published its *Electrifying France: for cheaper, more sovereign and more sustainable energy* plan in April 2026. In the Netherlands, the new government's *Coalition Agreement 2026–2030* states that the country is "fully committed to electrification", identifying it as the main pathway for industrial decarbonisation. Finland's *Energy and Climate Strategy,* presented to Parliament on 4th December 2025, similarly calls for a significant increase in domestic electricity production and consumption.

These initiatives will only deliver results if a number of broader conditions are met alongside the sector-specific measures outlined above.

1. Electrification must become a central priority of energy policy.

For the past 50 years, energy policy in Europe and in France has focused primarily on energy savings and reducing consumption. Energy efficiency – which electrification itself can often improve – must of course remain a priority. But policy must now also actively promote the use of electricity. This should be reflected in dedicated electrification targets across key sectors of the economy, providing a clear direction for investment and policy action.

8. *Implementation of Decree No. 2019-771 of 23 July 2019, known as the 'Tertiary Sector Decree'.*

Electricity can decarbonise economic activity, strengthen energy independence and support both economic growth and citizens' well-being. Electricity consumption should not be discouraged where it enables fossil fuels to be replaced.

2. Electrification dashboards should be developed for each country and sector, aligned with the objectives set at European level.

3. Electrification must accelerate, while fossil-fuel use should be progressively phased down wherever viable. A multiannual European plan for reducing dependence on fossil fuels, particularly fossil gas, should be developed and translated into national strategies.

For gas networks, such planning is already provided for under Article 57 of Directive (EU) 2024/1788. Designing and implementing these strategies will nevertheless be complex.

Gas has an important role to play in reducing emissions in countries that still rely heavily on coal. Even in advanced economies, it remains necessary for some applications, including certain industrial processes, maritime transport and peak electricity generation.

A rapid transition would also require consumers to replace or adapt existing equipment, which they may be unwilling or unable to finance. Any strategy to phase down fossil gas must therefore extend over 20 to 25 years, be coordinated across Member States, reflect technical and economic realities, and provide a clear future for workers in fossil-fuel industries.

4. Europe must develop the generation capacity required to meet growing electricity demand, both in the coming years and over the longer term. Nuclear and renewable energy are not competing solutions: they are complementary.

France's new EPR2-based nuclear programme is a multi-generational investment whose benefits will extend beyond 2100. It could be complemented by projects in other Member States where interest in nuclear energy is growing. Together, these investments could provide Europe with a strong and resilient energy foundation and should receive appropriate support from the European Commission.

The development of Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs), particularly in Sweden, the Czech Republic, Poland and Romania, should also be supported.

5. Europe must preserve the competitive advantage provided by its electricity transmission and distribution grids.

Grid operators are facing rapidly growing demand, particularly from distributed generation, new consumers and expanding interconnections between neighbouring countries.

Two priorities stand out:

- maintaining grid quality and stability through greater flexibility and storage, particularly battery storage;
- ensuring that consumers can obtain timely connections with sufficient capacity to develop their activities.

One option would be for the European Union to encourage Member States to establish dedicated "electrification areas", where electricity networks and generation capacity are developed in anticipation of new demand.

6. Electricity prices will be critical to the success of electrification. Two issues deserve particular attention.

- **First, prices must be sufficiently stable over time.** Europe must avoid a repeat of 2022, when soaring gas prices drove wholesale electricity prices sharply upwards. Electricity markets have an important role to play and should be preserved, but market-based pricing should not be the only option. The ability to enter into bilateral contracts should be protected and further developed across Europe.
- **Second, energy taxation must support rather than undermine energy policy objectives.** The state of public finances in most Member States leaves little room for manoeuvre, but there is scope to rebalance excise duties in favour of electricity. The introduction of ETS2 could also help improve electricity's competitiveness relative to fossil fuels, provided careful attention is paid to the social impact and the risk of public backlash, as illustrated by the yellow vests movement in France.

7. Public authorities must continue to provide incentives to help overcome the investment barrier associated with decarbonisation and electrification.

European and national authorities should continue supporting investment within the limits of available public resources. Except for pilot projects, however, support should focus on investment rather than operating subsidies, which could place a lasting burden on public finances.

France's Energy Savings Certificates scheme is one example of a support mechanism that should be maintained and increasingly targeted towards electrification, particularly at a time of constrained public budgets.

Finally, regulatory inconsistencies that continue to hold back electrification must be addressed quickly. Primary-energy accounting, which has proved particularly disadvantageous to low-carbon electricity in France, should be removed as part of the revisions of the Energy Efficiency Directive and the Energy Performance of Buildings Directive.

Interview with Bernard Fontana,
Chairman and Chief Executive Officer of EDF

EDF: an action plan to deliver large-scale electrification



Aerial view of the Paluel nuclear power plant.
© Eliot Blondet / ABACAPRESS.COM

“To mark our 80th anniversary, we announced a €240 million investment to accelerate electrification.



© Laurence Godart

Bernard Fontana, you are the Chairman and Chief Executive Officer of EDF. Do you believe that the target of increasing electricity's share of final energy consumption to more than 50% by 2050 is achievable? What are the main challenges that need to be addressed to reach this target?

Bernard Fontana: The pathway to carbon neutrality by 2050 is clear: 60% of final energy consumption will need to be met by low-carbon electricity. This will require the widespread electrification of end uses that still rely on fossil fuels, particularly in transport, industry and buildings.

That is why EDF has launched a cross-cutting initiative dedicated to accelerating the electrification of end uses. A wide range of actions are currently being implemented to drive a genuine step change: working closely with manufacturers, transport operators and industry associations; developing tailored solutions; and taking the initiative to establish dedicated centres of expertise... Many of these actions are partnerships. Indeed, successful electrification must be a collective effort: the commitment of each sector, as well as the adaptation of the regulatory and legislative framework, will be necessary to make the electrification of end uses a reality, in a context where overall electricity consumption is stagnating.

To mark our 80th anniversary, we announced a €240 million investment to accelerate electrification across three key areas: €80 million to help low-income households install heat pumps, including a €1,000 grant; €80 million to support the electrification of heavy-duty road transport, including grants of around €15,000 for micro-enterprises and SMEs purchasing electric trucks, as well as the installation of 180 charging points for electric trucks; and €80 million to acquire and equip sites so they are ready to quickly accommodate industrial companies and digital businesses. In addition to these measures, we are allocating a further €30 million to accelerate the deployment of electric boilers in industry.

Our commercial policy is based on improving price visibility and stability for our customers, notably through medium-term four and five-year electricity supply contracts, and the development of Nuclear Production Allocation Contracts (CAPN). Through a risk-sharing arrangement, these solutions enable customers to secure their long-term competitiveness, helping to accelerate the investments required for electrification and improve their profitability.

To ensure that electrification is efficient, profitable and sustainable, EDF fully assumes its industrial responsibility. This means providing competitive, sovereign, low-carbon and dispatchable electricity generation; improving the performance of the existing fleet, particularly by extending its service life and increasing the capacity of certain reactors (+35 MW on 13 reactors equipped with new Arabelle Solutions turbines); accelerating the availability of new generation capacity, notably through the EPR2 programme; relaunching investment in France's hydropower fleet; modernising the networks by improving their resilience and grid connection capacity; and deploying the flexibility solutions (storage and synchronous condensers) that are essential to the future balance of a highly electrified system.

What are the latest developments in nuclear and hydropower to ensure that France can maintain a stable, decarbonised and competitive electricity supply?

B. F.: The electricity produced by EDF in France has a very low carbon intensity, at 3.6 gCO_2/kWh in 2025, making it a central lever for decarbonisation. Thanks to European interconnections, France has exported around 90 TWh of electricity per year over the past two years.

On nuclear energy, Europe has embarked on a clear change of direction, notably through the European Nuclear Alliance, of which France is a proactive member. EDF is involved across the entire value chain: the development of high-capacity reactors, SMR projects and the supply of key components through Framatome and Arabelle Solutions. In France, the Group is also modernising the existing fleet by extending its service life, increasing reactor capacity and reducing outage periods, in order to secure and optimise production.

For hydropower, the agreement reached with the European Commission enables EDF to relaunch major

structural investments: raising dams, modernising facilities and developing new pumped-storage hydropower facilities. These projects are essential for the management of the electricity system and will make it possible to secure up to an additional 150 TWh by 2035, while supporting French industrial sectors, sovereign expertise and tens of thousands of jobs.

How can electricity remain competitive for end users while preserving EDF's ability to finance the massive investments that lie ahead?

B. F.: The role of the EDF Group is clear: to contribute to the country's economic sovereignty and support reindustrialisation through electricity. In this respect, our responsibility is twofold: to produce and sell decarbonised electricity at a competitive price, while ensuring the sustainability of a historic investment programme in generation and networks.

Today, French electricity is the cheapest among our major European neighbours. It is at a level comparable to that of the most competitive US states, while offering significantly greater continuity of service and security of supply. In 2025, we exported more than the equivalent of Belgium's electricity consumption, which shows that our system is robust and capable of supporting a lasting increase in demand.

The next step is to successfully electrify our economy in order to achieve carbon neutrality by 2050. Electricity is available, let us use it! This is how we will respond to the challenges of competitiveness, energy sovereignty and climate. Alongside efforts in energy savings and efficiency, we must shift fossil-based energy uses – particularly oil, which accounts for more than one third of France's energy consumption – towards decarbonised electric uses. The example of the cost for charging an electric vehicle is surely the most telling: using home charging and driving 100 kilometres in an electric car is five times cheaper than the equivalent consumption of fossil fuel. Whether it is electrifying transport, industrial processes or heating solutions in residential, commercial and public-sector buildings, local authorities and decision-makers have an essential role to play.

We will also bring sectors together and support individual customers, businesses and local authorities, in order to convince them of the benefits of converting uses and accelerating the electrification pathway.



© Lucille PELLERIN/REA

What is your approach to supporting the electrification of industry?

B. F.: Since the end of 2023, we have been offering long-term contracts backed by the historic nuclear fleet: CAPN contracts.

We have decided to broaden this scheme to end consumers using more than 7 GWh per year and to authorised electricity suppliers and producers, by making available 1,800 MW – around 10.6 TWh per year – delivered in France from 2027, under a single contract based on cost and risk sharing. Interested players can already express their interest via our website, through an open and transparent window.

But access to competitive electricity is not enough. Many industrial processes were historically designed around fossil fuels, and the available skills – engineering firms and consultancies – remain largely structured around these technologies. Yet mature technological solutions already exist. These include heat pumps, geothermal energy, electric boilers and furnaces, as well as other promising innovations that our subsidiary Dalkia offers its customers to support their decarbonisation. More than 80% of processes could already be electrified using existing solutions, while improving both industrial performance and energy efficiency.

To make these technologies more visible and accelerate the transition to electricity, we have launched a centre of expertise dedicated to the electrification of industry: **electrifab.** Together with our partners, we want to create a place where equipment manufacturers, investors and design offices can work together to identify, secure and scale up electrification projects. Finally, some processes – particularly furnaces for steelmaking, glassmaking or cement production – still need first-of-a-kind installations in order to gain maturity. We are involved in a demonstration fund to "de-risk" these projects by making our R&D expertise available and co-financing these demonstrators alongside industrial companies. The objective is clear: to bring forward replicable solutions more quickly in the short term.

Through this combination – long-term contracts, accelerated sharing of expertise within the sector and support for emerging solutions – we want to provide concrete responses to accelerate electrification.

1. *https://www.statistiques.developpement-durable.gouv.fr/edition-numerique/chiffres-cles-energie/fr/donnees-cles#images-3*

In the residential sector, households are being encouraged to switch to heat pumps and electric vehicles. But these solutions require investment: what can EDF do to help, and what measures are needed to support investment in this equipment?

B. F.: In the residential sector, we have two major levers for decarbonisation: heat pumps and electric mobility. According to the Obs'COP25 study[2] (International Observatory on Climate and Public Opinion), two thirds of French people and Europeans see electrification as a response to decarbonisation needs.

Today, switching to electricity is not only possible but also economically relevant in most situations.

As I mentioned, the arguments in favour of electric vehicles are strong. They are cheaper to operate than internal combustion engine or hybrid vehicles: over five years, the saving ranges from €600 to €1,600 per year for a household[3]. More models are available for under €25,000, and the second-hand market will develop significantly thanks to the ongoing electrification of company fleets. This momentum confirms the strong interest in these solutions: 2025 ended with more than 2.5 million electrified vehicles on the road in France and a growth of more than 12.5% in registrations of fully electric models compared with 2024[4]. Infrastructure is also progressing: charging has become widespread at home, in workplaces and in public spaces, with more than 180,000 charging points[5]. Fast chargers now make it possible to meet the needs of long-distance journeys. The remaining barriers are mainly linked to misconceptions, and we are working to provide greater visibility and support on these issues.

Heat pumps are increasingly being considered by households: 67% of French people are very familiar with their benefits, according to the Obs'COP2025 study. They can reduce heating bills by up to 50% compared with gas or heating oil[6], while remaining effective regardless of geographical area or the building's level of insulation[7]. EDF offers a comprehensive approach: assessment, advice, sizing, installation and, above all, support in accessing public subsidies. This is essential to make the process simple and financially attractive. The past two years have been difficult for the market, due to the combined effect of instability in support mechanisms and declining purchasing power. This has prompted some households to adopt a wait-and-see approach.



© Franck Tremblay

At the European level, the Commission has published in July 2026 its Electrification Action Plan. What are your expectations regarding the initiatives that could result from it?

B. F.: Electrification is now a pillar of Europe's energy strategy, as it is in France with the PPE3, which has made the electrification of end uses the main lever for decarbonisation. The objective is clear: to replace gas and oil with electricity wherever possible.

The issue is strategic: reducing dependence on imported fossil fuels, strengthening industrial competitiveness and relying on electricity that is already largely decarbonised in order to reach carbon neutrality by 2050. EDF is actively contributing to this, notably through its investments in nuclear power, hydropower, networks and flexibility solutions.

We expect that this plan will remove the barriers to electrification in transport, industry and buildings in practical terms, by reducing taxes on electricity, accelerating connections, modernising grids and supporting flexibility solutions such as storage and demand response. By setting a clear direction and providing stable economic signals, the Electrification Action Plan can create the necessary investment conditions and become a decisive lever for the entire continent.

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2. Unprecedented large-scale opinion survey conducted for the 7th consecutive year by Ipsos BVA in 30 countries across five continents, representing two thirds of the world's population and including the largest CO_2 emitters. More information: https://www.edf.fr/groupe-edf/observatoire-international-climat-et-opinions-publiques.

3. BCG study for Charge France, September 2025.

4. French Automobile Manufacturers' Association (CCFA).

5. At the end of April 2026, France had 194,996 publicly accessible charging points, representing a 16% increase over one year. Source: Avere France.

6. Source: EDF R&D.

7. ADEME study on heat pump performance, October 2025.

Interview with Patrick Pouyanné

Chairman and Chief Executive Officer of TotalEnergies

TotalEnergies: the emergence of a major player in the electricity field



© Scott Dalton



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> **If oil was the major energy source of the last century, gas and electricity will lie at the heart of tomorrow's energy system.**

On 28 May 2021, Total became TotalEnergies, marking its ambition to become a multi-energy player in the energy transition. Nearly five years later, how would you assess this transition strategy, and what role does electricity now play within your overall strategy?

Patrick Pouyanné: In 2021, we renamed the company TotalEnergies to reflect our transition strategy, which combines oil and gas – particularly LNG – on the one hand, and electricity and renewable energies on the other. This strategy had already been underway for several years, driven by two strong convictions. The first is that electricity will be the energy of the 21st century, because it is the energy of decarbonisation. The second is that, until we have built tomorrow's global energy system – one that is decarbonised, available and affordable – we must continue investing in oil and gas, given the natural decline of existing fields, to provide our customers with the energy they need.

If oil was the major energy source of the last century, gas and electricity will lie at the heart of tomorrow's energy system. Electricity therefore plays a central role in our strategy. The proof is that, starting from almost zero in 2020, we have already built a renewable projects portfolio equivalent to the generating capacity of around fifteen nuclear reactors.

So, you consider electricity as a major growth area, yet at the same time you are targeting 3% annual growth in hydrocarbon production through to 2030. What is your position on natural gas, which many countries – including France – still rely on?

P. P.: We continue to invest in oil and gas to meet growing demand. As the International Energy Agency pointed out in its latest report published last September, oil and gas production would decline by 6% and 7% per year respectively in the absence of new investment. Continued investment therefore remains necessary. However, we are doing so while ensuring a sharp reduction in our direct emissions and lowering the carbon intensity of our oil and gas production. As for natural gas, it is a key energy source for the transition. When used to generate electricity, it emits around half the greenhouse gas emissions of coal. Its abundant availability makes it a valuable ally in helping coal-dependent countries reduce their greenhouse gas emissions – provided, of course, that methane emissions and leaks are kept to an absolute minimum.

Within gas markets, we are focusing on liquefied natural gas (LNG), which allows gas to be transported worldwide and therefore contributes to energy security, as is the case in Europe since 2022, following the sharp reduction in Russian pipeline gas deliveries. With diversified positions – including our status as the leading LNG exporter in the United States, with 19 million tonnes in 2025 – TotalEnergies is now the world's third-largest LNG player, with 44 million tonnes sold in 2025.

Ultimately, what matters for the planet is limiting greenhouse gas emissions. What are your emissions reduction targets, and what measures are you implementing to achieve them?

P. P.: We have already made significant progress in reducing emissions, and we remain fully committed to continuing these efforts. CO_2 emissions from our operated oil and gas assets have fallen by 38% compared with 2015 levels, and we reaffirm our target of reducing emissions from our operated assets by 40% by 2030 compared with 2015.

We are also implementing an ambitious methane emissions reduction plan. Methane is a greenhouse gas with a global warming potential around 30 times greater than CO_2. Thanks to the efforts undertaken, TotalEnergies has achieved a significant lead in methane emissions reduction, reaching a 60% reduction by 2025 compared with 2020 levels – exceeding its initial target of 50% by 2025. The company is now targeting a 70% reduction by 2026 and a 80% reduction by 2030, as part of its ambition to achieve near-zero methane emissions across its operations by 2030, with methane intensity below 0.1%.

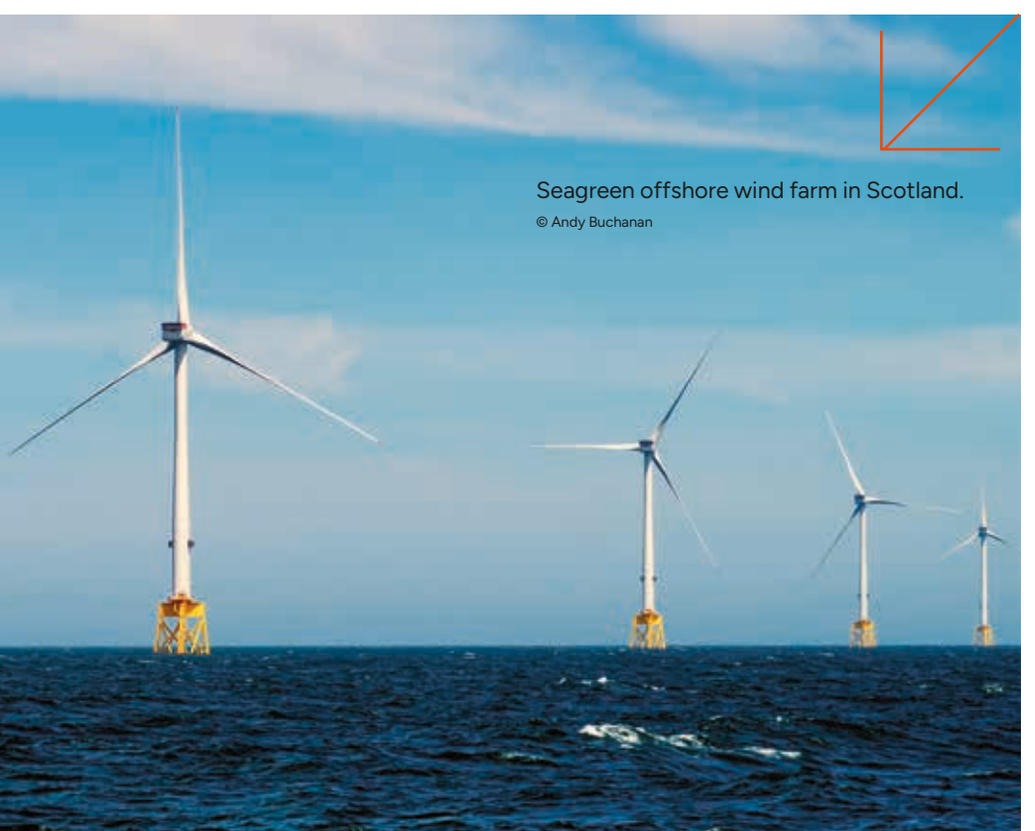
Patrick Pouyanné
Chairman and Chief Executive Officer of TotalEnergies

Europe's electrification agenda is currently facing stagnant electricity demand. Do you expect electricity consumption to accelerate in the short or medium term, and how could TotalEnergies contribute to this momentum?

P. P.: We believe electricity demand in Europe should continue to grow, driven by the electrification of transport, as electric vehicles progressively replace internal combustion engines. We are contributing to this shift by investing in charging infrastructure networks so that motorists can recharge their vehicles with confidence and without range anxiety. At the same time, the rapid expansion of data centres, fuelled by digitalisation and artificial intelligence, represents another major driver of growth in electricity demand. Finally, the gradual phase-out of coal-fired power plants across Europe will also require replacement generation capacities. To maintain its competitiveness and sovereignty, while integrating increasing volumes of renewable energy, Europe must invest massively in strengthening its grid infrastructure.

TotalEnergies is contributing concretely to this growth dynamic by accelerating its expansion in electricity, with a particular focus on renewables and flexible generation assets such as gas-fired plants and batteries. A recent and emblematic example is the acquisition of a 50% stake in flexible power plants (gas and biomass) from the Energetický a průmyslový holding (EPH). This transaction strengthens TotalEnergies' position in European power markets by developing complementarities between intermittent renewable electricity generation and flexible power generation. It will also enable us to expand our electricity trading activities in Europe and broaden our offering of low-carbon electricity available around the clock. This positions us particularly well to meet the growing electricity demand from data centres in Europe, for example. The transaction therefore marks an important milestone in the company's strategy to become a major player in the electricity field in Europe.

"The key challenge is to adapt the transition towards these energy sources to the reality of customer demand and the evolution of regulation.



Seagreen offshore wind farm in Scotland.
© Andy Buchanan

The transport sector lies at the heart of the electrification. TotalEnergies has invested heavily in rolling out charging stations across the highway network, but challenges remain. What is your strategy for addressing them?

P. P.: In the electric vehicle segment, we are taking a pragmatic approach, adjusting the pace of our deployment and investments in line with market developments. Our priorities are focused on expanding fast-charging infrastructure. Today, TotalEnergies is the leader in highway fast charging in France: at all our highway service stations, motorists can recharge up to 80% of their batteries in around 20 minutes. And of course, as new technologies emerge, we aim to reduce this to less than 10 minutes – or even 5 minutes.

For slower charging infrastructure, particularly for local authorities and urban areas, we rely on strategic partnerships. In France, we recently entered into a partnership with Banque des Territoires, enabling us to develop, operate and maintain a network of public charging infrastructure. This initiative helps expand territorial coverage and diversify charging locations.

As for heavy goods vehicles, TotalEnergies has launched a dedicated offering across Europe tailored to transport operators, covering both depot charging and en-route charging needs. We also plan to deploy a network of charging stations along the main European corridors in order to support the decarbonisation of road freight transport.

Hydrogen, biofuels and sustainable aviation fuels (SAF) are all central to decarbonisation strategies, particularly at the European level. Which sectors currently appear the most promising within your decarbonisation strategy?

P. P. : The key challenge is to adapt the transition towards these energy sources to the reality of customer demand and the evolution of regulation. For TotalEnergies, this means taking a pragmatic approach to investment in order to remain both flexible and competitive.



High-power charging stations, Limours Briis-sous-Forges service area.
© TotalEnergies

For biofuels, we already have strong industrial capacity. We chose to convert two of our existing refineries into biorefineries, at La Mède and soon at Grandpuits. However, to invest at the right pace in the production of these sustainable fuels, we need a stable European framework. For example, the target of increasing sustainable aviation fuel blending rates from 6% to 20% between 2030 and 2035 is ambitious and only makes sense if demand follows accordingly; otherwise, the risk of overcapacity increases.

We therefore need to adapt our production model, which is precisely what we are doing through co-processing – producing SAF within existing refineries by integrating bio-based feedstocks. This solution is competitive and responds to our customers' expectation for energy that is both lower-carbon and affordable.

As for hydrogen, we primarily see it as a way to decarbonise our European refineries. By replacing the natural gas currently used in our European refining operations with green or low-carbon hydrogen, we can significantly reduce their CO_2 emissions. TotalEnergies is currently the world's largest purchaser of green hydrogen. However, the fragmentation of national policies continues to hamper investment. What is needed is a reasonable European framework and clear incentives.

In terms of electricity generation, you are targeting more than 100 TWh of production by 2030. How do you intend to achieve this objective? Do renewables remain your priority? Are you considering exploring other technologies, such as small modular reactors, which are attracting considerable attention today?

P. P.: We are on track to achieve our target of producing more than 100 TWh of electricity by 2030. We reached 50 TWh in 2025, representing an annual growth of around 10 TWh over the past five years, starting from almost zero. We expect to exceed 60 TWh in 2026. So yes, we are progressing at the right pace to reach 100 TWh by 2030, based on a mix of renewable energy sources – solar and wind – together with flexible gas-fired power plants and battery storage. To support this ambition, TotalEnergies invests around €3 billion every year in its electricity business, focusing on key geographies such as Europe, the United States and Brazil, as well as high-potential renewable markets including India and South Africa, and regions where we are already present through our oil and gas activities, such as the Middle East. I can confirm that renewables remain firmly at the heart of our ambition to build a 21st century electricity company.

We do not intend to expand into nuclear power. We prefer to leave that sector to specialised players and focus instead on renewable energy, which remains central to our transition strategy.

Do you also have a role in electricity transmission and distribution?

P. P.: Electricity transmission and distribution are not part of TotalEnergies' core business. Transmission networks are generally owned and operated by state-owned or public companies. At the European level, the situation is similar: most transmission networks are managed by public or majority publicly owned operators, in line with European rules designed to ensure independence and security of supply. That said, TotalEnergies actively supports grid stability through its flexible generation assets, such as gas-fired power plants and battery storage systems. These assets help meet the needs of grid operators during peak demand periods and facilitate the integration of renewable energy sources.

Finally, which achievements in Europe best symbolise TotalEnergies' multi-energy transition strategy?

P. P. : The most recent symbolic example is the fact that TotalEnergies has been selected to deliver the largest renewable energy project ever undertaken in France, located off the Normandy coast. This offshore wind project will supply green electricity to more than one million households. It represents a total investment of around €4.5 billion – the largest project carried out by TotalEnergies in France in the past thirty years. We are very proud of it. We are equally proud of the momentum created by the new joint venture we are about to establish with EPH. This partnership between two European players will allow us to deliver our integrated electricity strategy in a practical and tangible way.



Christophe Grudler
Member of the European Parliament

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The electricity system: a comparative advantage for Europe

Europe is looking for comparative advantages in the current international context. Do you think the European electricity system is one of them, and what should be done to strengthen it?

Christophe Grudler: Yes, the European electricity system is a genuine comparative advantage, but one that remains underused. Europe imports nearly 60% of its energy, creating costly dependencies: more than €350 billion leaves our economy every year. By contrast, electricity is a sector where Europe has significant strengths: well-developed infrastructure, a highly interconnected grid, industrial know-how and a skilled workforce.

Accelerating the electrification of end uses would turn this weakness into a strength, by reducing our dependence on imported fossil fuels while making the most of increasingly decarbonised, homegrown electricity.

The Union also retains a comparative advantage in certain sectors, notably nuclear energy, where it holds a strong position across much of the value chain, provided that the sector continues to be supported.

To reinforce this advantage, we need to mobilise all regulatory and financial levers in support of European clean technologies, deepen grid integration, modernise infrastructure, and invest heavily in flexibility, storage and smart grids.

The European Commission now places electrification at the heart of its strategy. Do you think this marks a real strategic shift and a reorientation of priorities?

C. G.: Yes, there is a genuine shift, but it builds on existing foundations. Electrification has been at the heart of the Green Deal from the outset: the Renewable Energy Directive with sectoral targets, the end of sales of new internal combustion engine vehicles in 2035 and strengthened requirements for buildings and solar power. Therefore, the issue is not the purpose, but the lack of means to achieve it. At the same time, electrification has been stagnating in Europe for the past 10 to 15 years, while our industries pay two to three times more for their energy than their American or Chinese competitors. Under these conditions, it will not take off.

With the Draghi report, awareness is emerging: without strong incentives and coherent economic signals, European competitiveness will continue to fall behind. Electrifying does not only mean producing more; it also

means creating the conditions for consumption: grids, flexibility, prices and industrial uses. The shift is real; its success will depend on implementation.

What is your assessment of the Electrification Action Plan published by the European Commission on 17 July? Does it meet your expectations?

C. G. The Electrification Action Plan is a positive step forward, recognising electrification as a key driver of Europe's decarbonisation and competitiveness and setting an indicative target of 46% by 2040. This ambition must now be embedded in future EU and national policies to provide a clear and predictable signal to industry and investors.

The next step is to create the right economic conditions and support mechanisms to make electricity more competitive with fossil fuels across industry, transport and buildings.

The recognition of nuclear energy's role in supporting electrification and decarbonisation is also welcome. The priority now will be to ensure that this approach is fully reflected in the legislative proposals on renewable energy and energy efficiency expected later this year.

Is the creation of a legislative and financial framework designed to accelerate the electrification of end uses compatible with the priorities of the Fit for 55 package?

C. G.: Yes, fully. Accelerating the electrification of end uses is not only compatible with the Fit for 55 package, it is its logical extension, although it comes rather late. The package mainly structured low-carbon supply, without sufficiently preparing demand. The electrification of end uses is actually the missing link.

The Fit for 55 package provides a solid basis, but some rules need to evolve in order to better reflect the reality of emissions. In transport, for example, the climate benefits of electrification are assessed solely based on the share of renewable electricity in the national mix, without taking into account its actual level of decarbonisation. This creates distortions between Member States and penalises electricity mixes that are in fact very low-carbon. The plan will therefore need to restore coherence and pragmatism, drawing on all technologies that reduce emissions.

The electrification of the automotive sector is currently facing strong resistance. Should policymakers stay the course, revise the legislation, or introduce flexibilities?

C. G.: TThe context is challenging for the European automotive industry, but its future is clearly electric. Flexibilities may be useful in achieving our objectives, provided they are targeted and conditional. This is the spirit of the automotive package, particularly in supporting the development of small, affordable electric vehicles manufactured in Europe.

But any flexibility must come with concrete industrial commitments in terms of production, investment and jobs in Europe. The transition to electric mobility is a major industrial opportunity. By embracing a European preference and mobilising the right levers – financing, innovation and infrastructure – we can strengthen the competitiveness of our automotive industry and build a solid European ecosystem for electric mobility. The Industrial Accelerator Act will need to make this a reality.

"... flexibility must come with concrete industrial commitments in terms of production, investment and jobs in Europe..."

Electrification is a key issue for France. Why has it not taken off as hoped so far? What can France expect from European action, and what can it in turn bring to Europe?

C. G.: This highlights a paradox: our comparative advantage lies in low-carbon electricity, yet we still make too little use of it. The electrification of end uses is progressing slowly, due to economic signals that are not sufficiently attractive for consumers and a framework that remains too fragmented. European action can deliver a great deal, by accelerating interconnections, market integration, and investment in grids and flexibility. In return, France is already making a major contribution to the European system through largely dispatchable low-carbon generation – particularly nuclear – which is essential to balancing the grid at continental level.

Does France have the alliances it needs to defend its positions effectively in Brussels?

C. G.: This is a real question. Recent political instability has weakened France's ability to influence decisions in Brussels, particularly on energy files where consistency and clarity are essential. That said, France still has significant levers of influence, provided they are mobilised in a strategic and collective way.

The relationship between France and Germany remains an essential pillar. There are positive signals, notably on defence issues; the challenge will be to move beyond certain historical divides and extend this momentum to energy and industrial questions, whether on the recognition of nuclear energy or European preference. In addition, the alliance of Member States supportive of nuclear energy continues to broaden and represents an essential channel for France, particularly in view of forthcoming debates on the governance of the Energy Union and the post-2030 framework. French influence will depend on its ability to build coalitions beyond its national positions.

European electricity grids: an asset to maintain and develop



Bruno Tobback,
Member of the European Parliament

> **European-grown electricity is set to become the primary energy carrier of the European economy and a central driver of competitiveness.**

As a member of the ITRE Committee of the European Parliament and shadow rapporteur on the "Electricity grids: the backbone of the EU energy system" report, do you consider that European networks are currently at the level required to sustain the European Union's economic development and competitiveness?

Bruno Tobback: European electricity grids were largely developed in the twentieth century for an energy system that was centralised and based on a limited number of large generation assets. This legacy infrastructure no longer corresponds to the realities of today's energy system.

The European electricity system is becoming increasingly decentralised, both on the generation side, with the rapid deployment of renewable energy, and on the demand side, as electrification expands across industry, transport and buildings. At the same time, in the current geopolitical reality, Europe's competitiveness depends on its independence from petrostates willing to use energy as a weapon. Therefore, European-grown electricity is set to become the primary energy carrier of the European economy and a central driver of competitiveness.

In this context, European electricity networks are not yet at the level required to fully support the European Union's economic development and competitiveness. European households and industry are increasingly investing in electrification and reducing exposure to volatile fossil fuel prices. But across the EU, grids are facing growing congestion, limiting their ability to accommodate this new demand.

Significant reinforcement, modernisation and expansion of the grids, in particular at distribution level, are needed to integrate renewables efficiently, manage rising demand and prevent congestion that can lead to higher electricity prices.

Ensuring well-functioning, future-proof electricity grids is not merely a technical challenge, but a strategic economic priority for the European Union.

Many European industry players complain that permitting and connection delays are hampering the Union's competitiveness and industrial potential. How could the EU make it a smoother and faster process as part of the Clean Industrial Deal?

B. T. : Grid congestion drives up the energy cost and, when it leads to curtailment, eats into the profit margins of energy producers and hampers competitiveness. Speeding up the process to authorise and construct new connection capacity through more efficient permitting therefore needs to be a priority.

At the same time, we should not lose sight of the importance of public acceptance. No infrastructure project on this scale is possible without it, at least if we want to respect our democratic values.

Also, permitting is not the only bottleneck that slows down new investment. The EU can support better coordination and planning of cross-border infrastructure, but effective implementation ultimately depends on Member States acting to reinforce and modernise their electricity networks alongside electrification efforts.

Similarly, the European Commission recently proposed guidance on how countries can handle better the grid connection queues to reduce stress on the system. It will ultimately be up to the national governments to implement this guidance on the ground.

Expansion and modernisation of electricity grids – at both transmission and distribution levels – will require substantial investment. Which instruments can help mobilise and scale up these investments?

B. T. : Expanding and modernising Europe's electricity grids will require a combination of public leadership and private capital at scale. Public funding instruments, such as the Connecting Europe Facility, can play a catalytic role, not by covering all costs, but by de-risking projects and improving their bankability. This is particularly important for cross-border infrastructure, innovative technologies and projects with high upfront costs but strong system-wide benefits.

At the same time, regulatory frameworks must provide long-term visibility and stable returns for investors. Clear planning at European level, predictable remuneration regimes and incentives that reward efficiency, flexibility and digitalisation are essential to unlock private investment at both transmission and distribution levels.

Financial instruments such as guarantees, and risk-sharing mechanisms can further crowd in institutional investors and reduce the cost of capital. In parallel, Cohesion Policy funds can play an important role in supporting investments at distribution level, particularly in regions facing higher investment needs, helping to ensure an inclusive energy transition across Europe. Finally, improved cost-sharing frameworks for cross-border projects are needed to reflect asymmetric benefits and ensure that infrastructure delivering clear European value can move forward. Together, these instruments can help scale the investment required to deliver a modern, resilient and competitive European electricity system.

Interconnections are currently at the centre of intense debates among Member States. How far should we go in deploying them? And what criteria should be used to assess which interconnections are truly warranted?

B. T. : Interconnections are a cornerstone of a deeper Energy Union. They allow electricity to flow to where it is needed most, whether that is transporting renewable power from the North Sea to industrial centres in Southern Germany or enabling power exchanges between Italy and Romania. Without sufficient interconnection, the energy transition risks creating a Europe that electrifies at different speeds, with persistent price gaps between regions. Stronger interconnections are therefore essential to keep electricity affordable and to ensure a fair and cohesive transition across all Member States.

> **Europe is a global leader in many grid technologies, from high-voltage transformers to advanced cabling and smart grid solutions. We should champion this leadership, promoting innovation and scaling up production across the continent.**

> **interconnections must be deployed where they clearly add value. They should be developed when they deliver tangible economic benefits, strengthen energy security and support decarbonisation at European scale.**

That said, interconnections must be deployed where they clearly add value. They should be developed when they deliver tangible economic benefits, strengthen energy security and support decarbonisation at European scale. In this respect, the Commission's recent Grids Package is an important step forward, as it establishes common criteria for feasibility studies and cost–benefit analyses. This provides a shared and transparent framework to assess projects and underpin cross-border cost allocation.

Finally, the EU's 15% interconnection target remains a relevant benchmark. It represents the minimum level needed to safeguard security of supply and enable a truly integrated Energy Union.

Strengthening the EU's strategic autonomy is one of the European Commission's key objectives. Yet when it comes to manufacturing grid equipment, the EU remains far from achieving real autonomy. What kinds of measures could help stimulate and scale up European production in this sector?

B. T. : Manufacturing of grid equipment is actually one of the EU's existing strengths. Europe is already a global leader in many grid technologies, from high-voltage transformers to advanced cabling and smart grid solutions. We should champion this leadership, promoting innovation and scaling up production across the continent.

To do so, we need to support European manufacturing at scale, providing predictable demand, financing, and incentives for companies to expand capacity. Collaboration across the value chain, between transmission and distribution operators, equipment manufacturers, and research institutions, will accelerate development of high-quality, interoperable solutions.

Interoperability is also key. Too often, bespoke equipment creates bottlenecks. By promoting a minimum level of interoperability and even modularization, manufacturers can produce faster, cheaper, and at scale, while operators gain reliability and shorter lead times.

Electrification in practice: lower bills, cleaner air and stronger industry



Interview with Rosalinde van der Vlies

Director for Just Transition, Consumers, Energy Efficiency and Innovation at the European Commission's Directorate-General for Energy

The European Commission has announced several initiatives to accelerate electrification, including the Electrification Action Plan, the Heating & Cooling Strategy, and the Grids Package. Rosalinde van der Vlies answered our questions on the expected benefits of electrification for consumers and on the policy tools needed to support them throughout this transition.



In the current mandate, the Commission has established electrification as a priority for the EU. How do you see electrification as a lever for a just transition, industrial innovation, and improved consumer well-being?

Rosalinde van der Vlies: Electrification is a priority because it can indeed deliver a just transition, industrial innovation and benefits consumers. This is the main logic behind the upcoming Electrification Action Plan focused on making electrification work in practice across sectors, such as buildings, transport and industry.

From a just transition perspective, electrification reduces the EU's reliance on imported fossil fuels and exposure to volatile fuel prices. It can improve comfort and air quality, and, thanks to more efficiency, lower total energy costs over the lifetime of appliances and vehicles. To ensure these benefits reach everyone, we need the right conditions in place: a fair relationship between electricity and gas prices, better access to finance for households and SMEs, reinforced and smarter grids, well-functioning markets, and strong consumer protection, including support for the most vulnerable.

At the same time, electrification drives industrial efficiency and innovation. It helps industry to decarbonise and modernise in a more cost-effective way, especially for heat-based processes in the low- and mid-temperature range. As we electrify, we are modernising and digitalising our energy system faster; we are making our value chains more robust; we are making our industry more globally competitive; and, we are creating new quality jobs in the clean energy sector. In short, electrification not only reduces harmful emissions; it is also a valuable investment in resilience, innovation and our wellbeing.

In order to ensure the stability of the electrical system and, for consumers, to save on their electricity bills, it is essential to develop demand-side flexibility. Yet most consumers are unaware of this potential or lack the tools to use it effectively. How will upcoming EU legislative initiatives help unlock consumer-side flexibility?

R. v. der V.: Demand-side flexibility is essential to integrate more renewables, keep the power system stable, and reduce costs, which ultimately bring down consumers' bills. But for consumers to fully benefit, flexibility must be *simple, trusted and rewarding*. This means having the right devices and contracts, clear and reliable information, secure access to data, and transparent incentives, to adjust energy use in response to price or grid signals.

Recent and upcoming EU rules are designed to unlock exactly that:

- **Access to data and smart meters:** Smart meters are the entry point to flexibility and already available to around 60% of consumers across the EU. Completing the rollout and going even beyond the target of 80% of metering points, remains a priority. In parallel, EU rules are designed to offer secure and standardised access to metering and consumption data so that consumers, and trusted third parties acting on their behalf, can use that data to adjust their behaviour accordingly.

Rosalinde van der Vlies
Director for Just Transition, Consumers, Energy Efficiency and Innovation at the European Commission's Directorate-General for Energy

"We want to make it easier for consumers to participate in flexibility schemes, share data more safely, and turn flexibility into real energy cost savings.

- **More flexible retail offers and aggregation:** EU rules encourage dynamic and flexible electricity contracts and for consumers to benefit from adjusting their energy consumption, directly or automatically every day. The Commission will provide guidance to make these offers more transparent, comparable, and deliver tangible benefits such as lower bills.
- **Smart appliances and information for consumers:** The Commission is drawing up a voluntary code of conduct to make "plug-and-play" devices more flexible and interoperable. To instil consumer trust, we are exploring how energy labels can make demand-responsive features, such as the possibility to shift to low-price slots and automatically respond to grid signals, more visible at the point of purchase.

Taken together, these initiatives aim to make flexibility a mainstream consumer benefit, rather than a niche concept. We want to make it easier for consumers to participate in flexibility schemes, share data more safely, and turn flexibility into real energy cost savings.

The transition to electric solutions requires significant upfront investment from consumers, such as heat pumps, electric vehicles and electricity storage. To what extent can these costs decline in the coming years, thanks to technological progress, industrial scale-up and EU policies?

R. v. der V.: The transition to electric solutions does require higher upfront investment, particularly for heat pumps, electric vehicles and, in some cases, electricity storage. However, these technologies are already often cheaper to run over their lifetime thanks to much improved efficiency and lower maintenance needs. As a result, total costs can be lower, even if purchase prices are higher today. Looking ahead, high upfront costs are expected to decline further as technologies mature, production scales up, and competition increases across the value chain. For electric vehicles, falling battery costs and higher production are key drivers of lower vehicle purchase prices, while better charging coverage, interoperability and price transparency at charging points reduce the "hidden costs" of ownership and, in doing so, improve consumer confidence. For heat pumps, lower costs depend on the equipment itself, and on scaling installation capacity and standardising solutions, so that projects develop faster, are more predictable and cheaper to deliver.

EU policies can reinforce this downward cost trend in three concrete ways. First, industrial measures, such as support for European manufacturing capacity, innovation, and scale-up in batteries, heat pumps and other clean technologies, can strengthen European value chains, notably for batteries and clean tech. They help to scale up electrified end uses, and increase competition, bringing down unit costs. Second, market and infrastructure measures, such as transparent and comparable charging prices, interoperability of charging services and smart charging, give consumers the ability to make better use of electric solutions and avoid unnecessary costs. Third, financing and consumer support like effective public budget support able to crowd-in private capital, innovative financing solutions able to reduce high upfront capital costs, and measures to increase transparency that help consumers compare the total cost of ownership over the lifetime of technologies can make investments manageable for both households and SMEs. Together, these levers help ensure that electrification becomes not only technically feasible, but also affordable and attractive for consumers.

The Social Climate Fund is intended to support consumers in adjusting to the energy transition and the associated investments. How will this support be delivered in practice, to which categories of consumers and according to what timeline?

R. v. der V.: Member States are required to submit national Social Climate Plans, based on which the EU will provide support. Each Member State designs a package of measures, in consultation with stakeholders, and submits it to the Commission for assessment and approval. Once approved, funding is aligned with the plan to ensure support is targeted and measurable.

The fund is destined for those most exposed to the costs of the energy transition, such as vulnerable households in energy poverty, vulnerable transport users in transport poverty and vulnerable micro-enterprises affected by the extension of carbon pricing to buildings and road transport (the second emissions trading scheme - ETS2). In practice, the EU will primarily finance structural investments that reduce bills and improve living conditions. This means energy renovations, clean heating and cooling solutions, access to affordable and energy-efficient social housing and clean mobility such as public transport, alongside information and advisory services.

In terms of timing, the Social Climate Fund runs from 2026 to 2032. The objective is for support measures under the Social Climate Plans to start rolling out ahead of ETS2 applying from 2028.

Some actors are proposing to establish services that would pool consumer demand for electric appliances and negotiate with banks to secure more favourable loan conditions and interest rates for their purchase. Could it become a key lever to improve access to finance and accelerate electrification?

R. v. der V.: Yes—*it can help*, but it is best seen as a complementary lever, not a silver bullet.

Pooling consumer demand can reduce transaction costs and increase bargaining power vis-à-vis installers, manufacturers and banks. By standardising projects such as heat pump packages and aggregating many small loans into a larger, more predictable pipeline, such schemes can lower perceived credit risk and help secure private finance at lower interest rates. This especially helps households that are creditworthy but face financing constraints for technologies with high upfront costs.

At the same time, these schemes do not solve the affordability issue for vulnerable households where the constraint is a lack of income or the burden of high energy costs. In these cases, it is essential to provide targeted public support and strong safeguards for consumers.

Gas appliances undermine climate objectives and the development of electrification. What stance will the Commission take on the future role of gas in the building sector, notably in the upcoming Heating & Cooling strategy and related legislation?

R. v. der V.: The Commission's approach is guided by the recast Energy Performance of Buildings Directive (EPBD), which sets a clear direction towards a zero-emission building stock by 2050 and a gradual phase-out of fossil fuels in buildings. From 2030, all new buildings must be zero-emission, meaning they will no longer accommodate on-site fossil fuel combustion. For the existing building stock, Member States are required to implement measures to progressively reduce, and ultimately phase out, fossil fuel boilers.

A first key step is already underway. Since 2025, there are no longer financial incentives for standalone fossil fuel boilers. Looking ahead, National Building Renovation Plans, drawn up by Member States, should include measures to fully phase out fossil fuel boilers, by the indicative target of 2040. There is a certain degree of flexibility at national level, including the possibility, —though not an obligation, —of a national ban on these boilers.


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From 2030, all new buildings must be zero-emission, meaning they will no longer accommodate on-site fossil fuel combustion.

The Commission also considers the broader implications. With the declining demand for gas in buildings, the revised EU gas market framework aims for the orderly planning of networks, including decommissioning where demand structurally falls. In parallel, local heating and cooling planning helps coordinate renovation, heating choices and network development by linking building renovation strategies with local heat supply options and network investment planning.

We are preparing a Heating & Cooling Strategy which, among other things, examines this issue and points to more robust local planning processes and their relation to building decarbonisation and electrification.

Transforming industry, securing the future: Europe's opportunity to lead

Europe stands at a decisive moment. Its future depends on uniting growth, sustainability, and strategic autonomy. Innovation, competitiveness, energy independence—these are central to Europe's industrial evolution. The challenge is profound: transformation comes with costs, risks, and uncertainty. Yet maintaining the status quo is no longer an option.



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Kristian Ruby,
Secretary General, Eurelectric

At crossroads: regaining our energy independence

Our overreliance on Russian gas imports has taught us a hard lesson. Europe must regain control of its energy production and accelerate deployment of domestic clean capacities. The RePowerEU strategy has already driven remarkable progress: around 270 GW of solar and wind have come online since Russia invaded Ukraine. Impressive, but not yet enough to fully support our power system achieve a total transition away from fossil fuels. Between 2020 and 2030, installed capacity must more than double to replace fossil generation and expand the system.

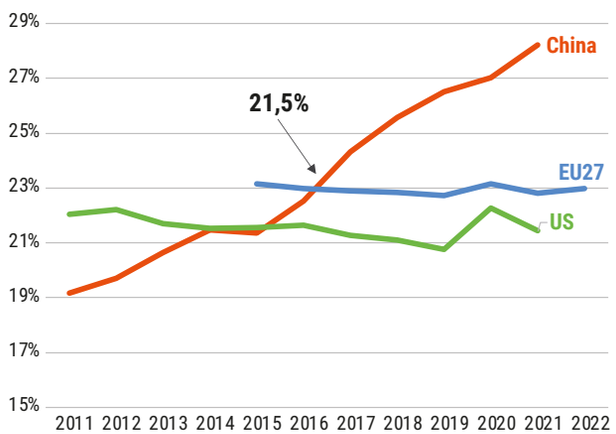
Demand uncertainty compromises investment

At the same time, electricity demand has stagnated and even declined, falling 7.5 % between 2021 and 2023. Industrial closures and consecutive crises removed over 100 TWh of consumption, weakening the commercial signals that investors rely on. Without demand, investment slows, delaying deployment of the technologies Europe needs to secure its energy independence. To break this cycle, Europe must provide clear, predictable frameworks that instil confidence in the long-term profitability of clean energy projects. Investment certainty is not a luxury—it is a prerequisite for financing generation, modernising grids, and ensuring industrial transformation proceeds at pace without compromising competitiveness or energy security.

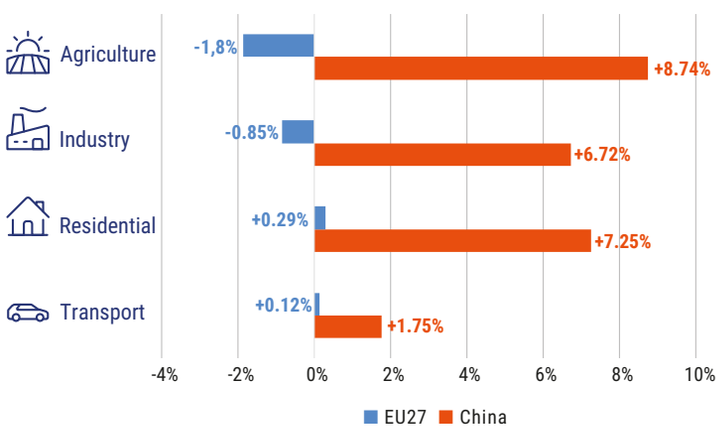
Electrification and clean power technologies offer a clear path forward. They enable industries to modernise, thrive, and anchor Europe's position as a global leader. The choices we make today will determine whether Europe merely adapts to change—or shapes it.

Today, electricity represents just 23 % of Europe's energy consumption. While the power sector is decarbonising, the wider economy remains locked into fossil fuels. This must change. Electrification is the most cost-effective route: it cuts emissions at scale while boosting efficiency. Heat pumps, electric vehicles, and other solutions can dramatically reduce energy demand, and modelling shows Europe must raise electricity's share to 50–70 % by 2050, with 35 % by 2030, to stay on track with RePowerEU.

Meanwhile, China's experience demonstrates what decisive policy can achieve. Strong incentives, central planning, and



Electrification rate by contry.
Source: IEA, Eurostat



Increase of electrification of China vs. EU27 between 2015 and 2021. Source: IEA, Eurostat

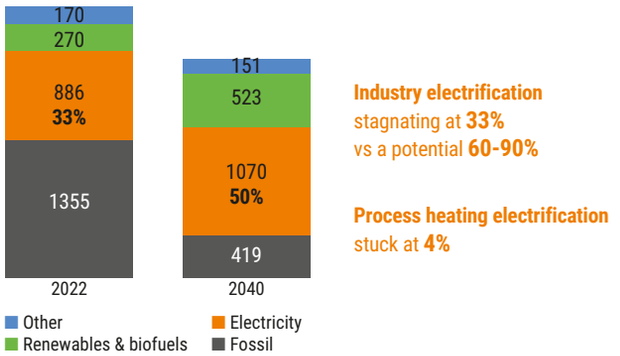
targeted support have transformed industrial electrification, particularly in low- and medium-heat processes, and have kept electricity prices comparatively low. Europe can learn from this, adapting policies to stimulate investment, reduce operating costs, and accelerate uptake.

Yet Europe faces stubborn de-industrialisation driven by competitiveness pressures. Many energy-intensive industries—steel, chemicals, cement—have relocated to markets with heavy subsidies and low-cost electricity. At the same time, many industries underestimate the potential and opportunities of electrification. While only a small share of industrial heat is currently electrified, the untapped potential is vast and well within reach. A large portion of industrial heat demand operates at temperatures that can be met by electric solutions using technologies that are already mature, competitive, and manufactured in Europe. From electric boilers and industrial heat pumps to arc furnaces and advanced heating solutions, European companies are at the forefront of these innovations. Scaling them up is a strategic industrial opportunity.

So what is holding us back? Uptake of electrified process heat is not limited by technology, but by economics. Electric solutions often carry higher upfront costs than fossil alternatives, while electricity itself is structurally disadvantaged on a per-megawatt-hour basis. These factors create a competitiveness gap—but it is neither permanent nor insurmountable. With decisive policy, investment frameworks, and industrial support, Europe can make electrification competitive by 2030.

Industrial electrification: from strategic wins to tackling the hardest cases

In some industrial activities, the case for electrification is already clear. Where electric technologies deliver high efficiency gains, electrification is not only environmentally sound but economically compelling. Sectors such as battery manufacturing, where industrial heat demand can be met efficiently through technologies like heat pumps, already benefit from significantly lower energy use compared to fossil-based processes. As electricity systems become cleaner and more cost-effective, these advantages will only grow, reinforcing electrification as a smart industrial choice as well as a climate one.



Final energy consumption in the EU (TWh).
Eurelectric Power Barometer 2024 (slide 62)

For other industrial activities, like the food and beverage industry and specifically milk powder production, the challenge is different. Their processes operate at relatively low temperatures, and can be achieved with heat pumps, but energy costs dominate their operating expenses. In these cases, competitiveness hinges less on technology availability and more on reducing overall energy consumption and ensuring access to affordable electricity. For them, electrification can deliver substantial efficiency gains, and its full value will only be unlocked as the share of clean, low-cost generation continues to grow. With the right conditions in place, electrification can become a viable and competitive solution across the board by the end of this decade.

The most energy-intensive industrial sectors face the steepest challenge. Activities that rely on very high-temperature processes—such as chemicals, cement, glass, and steel—will require deeper structural change before electrification can compete at scale. In these sectors, both upfront investment costs and operating expenses remain higher than those of fossil-based alternatives. Closing this gap will demand sustained innovation, economies of scale, and a policy framework that actively supports first movers. Electrifying these processes will not be quick or easy, but it is essential.

Through electrification and industrial innovation, Europe has the opportunity to lead globally. By modernising industry, embracing electrification, and fostering collaboration, we can build a sustainable, competitive and resilient economy – one that drives growth, attracts investment, strengthens trade, prepares for future risks.

		CHEMICALS		FOOD & BEVERAGE		BATTERIES	
	PRODUCT (UNIT)	Ethylene (EUR/tonne)		Milk powder (EUR/tonne)		Batteries (EUR/MWh)	
	ENERGY INTENSITY	c.30%		5-10%		c. 3-7% (in scope)	
	COUNTRY	Germany	Spain	France	Denmark	Hungary	Sweden
2024	FOSSIL FUEL	575	470	160	280	3560	4130
	ELECTRIFIED	1090	830	190	285	2490	1925
2030 Fossil Fuel	BASE	765	665	210	310	3735	4405
2030 Electrified	BAU	995	750	180	260	2250	1770
	BASE	835	680	170	225	2095	1640
	BEST	720	580	130	190	1860	1475

Competitiveness levers for 2030.
"The new industrial age" 2025, Eurelectric and Accenture (slide 30)

ADEME rallies behind electrification

France has a decisive competitive advantage: its electricity is already largely decarbonised, thanks to a balanced mix of renewable energy and nuclear power. Beyond the climate imperative, businesses face two strategic questions: how can they reduce their dependence on fossil fuels and the vulnerabilities that come with it? And how can they turn access to decarbonised electricity into a lasting competitive advantage? The time to act is now. Economic urgency has caught up with climate urgency, making electrification not only an environmental necessity but also a strategic business opportunity.


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Sylvain Waserman,
President of ADEME

Buildings, transport and industry account for 67% of France's greenhouse gas emissions and remain heavily dependent on fossil fuels, whose imports cost the country €67 billion in 2025. For an average household, this translates into around €2,000 a year spent on gas and transport fuels. We must face this reality with clarity and pragmatism. Every geopolitical crisis reminds us of our dependence on imported fossil fuels, and every international tension exposes the vulnerability of our economy. The current conflict in the Middle East is yet another illustration of this reality, following the 2022 energy crisis, when gas prices surged tenfold.

Against this backdrop, the latest French Multiannual Energy Plan (PPE) sets out a clear pathway to reduce greenhouse gas emissions, strengthen France's energy sovereignty and increase resilience in an increasingly uncertain world. Together with ADEME's forward-looking analyses, the PPE projects that electricity will account for around 50% of final energy consumption by 2050, nearly double its current share. This reflects both a physical and an economic reality: for equivalent services, electric technologies are substantially more energy-efficient than those powered by fossil fuels.

In this context, the electrification of end uses is emerging as a strategic lever not only to accelerate decarbonisation, but also to reinforce France's competitiveness, energy security and long-term sovereignty.

Electrification: a decisive lever for the energy transition.

The discussions I held during a *"Tour de France"* of the business community in 2025 confirmed a clear reality: the business ecosystem is neither in denial nor waiting to act. More than 1,350 companies – including SMEs and mid-sized firms form every regions – demonstrated a strong awareness of both the challenges and the opportunities of the energy transition. Business leaders are aware of our vulnerability to fossil fuels and the need to decarbonise by improving energy consumption, electrifying industrial processes, and deploying renewable heat solution. At the same time, they recognise the importance of building robust adaptation plans to protect their operations, supply chains and value chains. For many, this is not simply a strategic challenge, it is an existential one. As one business leader told me, *"this is about the future of our company"*. Supporting businesses throughout their decarbonisation journey is therefore essential. Our ACT© methodology, adopted by the Banque de France, provides a structured framework to help companies at every stage of the transition. It enables them to set measurable decarbonisation targets, develop credible and actionable transition plans, identify solutions tailored to their activities, align short-term investment decisions with long-term climate objectives, and demonstrate the robustness of their strategy to customers, investors, and other stakeholders.

> **"Business leaders are aware of our vulnerability to fossil fuels and the need to decarbonise...**

Every district heating network that supplies a territory by replacing fossil gas with renewable thermal energy, every electrified production process, every reduction in the share of fossil energy in our energy mix (which still accounts for nearly 60%, compared

© Freepik



The "One million heat pumps" plan aims to position France as a leading country both in the production and deployment of heat pumps.

with only 26% for electricity) represents a further step towards protecting not only the climate, but also our businesses, jobs and purchasing power from volatile fossil fuel prices. It is also an asset for our regions, which are at the heart of practical solutions for the ecological transition.

As a public agency, ADEME supports all those engaged in and leading ecological transition – whether elected officials or business leaders:

- Through major decarbonisation programmes implemented on behalf of the State: many of the approximately 500 industrial decarbonisation projects supported since 2020 include an electrification dimension;
- Through the rollout of social leasing schemes, which have enabled 50,000 low-income households to switch to electric vehicles;
- Through the *Fonds Chaleur* (Heat Fund), maintained at €800 million in 2026, which has already financed more than 10,000 renewable heat production installations in France (each year, this fund avoids €2.5 billion in fossil fuel imports);
- Through innovation calls for projects;
- And above all, through the expertise of 600 field engineers operating across France.

In addition, the "One million heat pumps" plan aims to position France as a leading country both in the production and deployment of heat pumps. A recent ADEME study[1] shows that heat pumps are delivering on their promises: their average real-world performance is very strong (with efficiency three times higher than gas boilers), despite the fact that nearly one-third could be further optimised in terms of installation or settings. The study highlights that combining heat pumps with good insulation maximises energy efficiency, energy savings and comfort, while also showing that heat pumps remain a relevant solution even before insulation works are undertaken.

This electrification dynamic also extends to transport, a key lever for decarbonisation. Electrification of mobility must be approached holistically, combining demand management, modal shift, logistics optimisation and improved vehicle occupancy rates. The collective innovation project "eXtrême Défi", led by ADEME, illustrates this approach. In three years, it has enabled the emergence of vehicles ten times less impactful, fully modular and repairable. It will lead to the market launch of several models in 2026, as well as a broader momentum now joined by major French manufacturers.

Finally, electrification must be accompanied by flexibility. Technological optimisation – particularly through artificial intelligence and storage developments – enables better real-time alignment between consumption and production. Shifting electricity consumption to periods where electricity is abundant and cheap, expanding demand response during peak demand, and improving interoperability between building energy management systems and energy suppliers illustrate the need for a more flexible approach to the electricity system. Together, these developments render the outdated debate that some continue to maintain between nuclear and renewable energy increasingly irrelevant. Electricity system operators are capable of managing the complexity of modern power systems. We need both nuclear and renewable energy to produce abundant decarbonised electricity – electricity that France exported to the tune of €5 billion last year (twice as much as Cognac exports).

Electrification of end uses is therefore a key lever for achieving carbon neutrality by 2050, alongside energy efficiency and the large-scale deployment of renewable district heating networks based on industrial waste heat recovery, geothermal energy and biomass. It is the best way to leverage France's almost fully decarbonised electricity mix and translate it into a competitive advantage for businesses.

Accelerating electrification – efficient and flexible – means strengthening our energy sovereignty, our competitiveness and our ability to meet our climate commitments.

1. *Assessment of the Real-World Performance of Heat Pumps – ADEME – October 2025:* https://librairie.ademe.fr/batiment/8634-avis-sur-les-performances-reelles-des-pompes-a-chaleur.html

Electrification of the automotive sector

Three key principles to be respected: flexibility, sovereignty, competitiveness



Christophe Aufrère,
CEO of the *Plateforme Filière Automobile* (PFA)

EdEn: What are the impacts of the European automotive crisis on the French sector?

Christophe Aufrère: France is not immune to what first appears as a crisis of volumes. Since 2020, the European market has dropped by 20%, and the French market has shrunk by more than a quarter. This corresponds to a loss of 500,000 vehicles sales in France each year!

Yet, we only produce what we sell: with 1.46 million light vehicles produced in 2025, over the past five years, since 2020, France has lost 1 million units of output – as much as it lost over the previous two decades since the early 2000s.

The impact on companies and employment is immediate. Over the same period, 40,000 jobs have been lost in the French sector. And, according to projections from the study we conducted with the XERFI consulting firm as part of the EDEC Auto, 75,000 jobs are at risk by 2035, if nothing changes.



Bumper production line. @ OPmobility

This is therefore a crisis that, far from being merely a low point in the cycle, raises questions about the sustainability of the automotive industry in France and Europe, especially given that this drop in volumes is accompanied by increasingly fierce competition from China.

Have the EU's countervailing duties on Chinese electric vehicle managed to halt Chinese penetration of the European market?

C. A.: For the first time in 2024, thanks to the implementation of these countervailing duties, Chinese imports of 100% electric vehicles (BEV) into Europe fell by 15%; but in parallel, imports of thermal and hybrid vehicles from China increased by 35%.

In 2025, imports of Chinese-made vehicles grew by 33%, exceeding one million units: fully electric vehicle volumes remained stable, while imports of internal combustion vehicles increased by a quarter, hybrid imports doubled, and plug-in hybrid imports quadrupled.

In 2000, the Chinese industry accounted for only 3.4% of global production; today, it represents 34%. The question is whether we allow China, now the world's leading producer, to become the automotive factory of the world.

As the European Commission has decided to bring forward the revision of the CO_2 regulation, what is the current state of the electrification trajectory?

C. A.: Two years after the decision to ban the sale of new thermal vehicles from 2035, the adoption of BEVs by the middle class remains far below the trajectory defined by European regulations.

At the end of 2025, the market share of BEV stands at around 20% in France and 17% within the European Union... short of the 25% needed to meet the 2025-2027 targets.

This situation risks compromising both the achievement of climate goals and the sustainability of the European automotive sector, which faces a triple challenge:

- having made massive investments in electrification;
- not reaching the volumes required for profitability;

- facing the risk of heavy fines precisely when manufacturers most need to invest.

In this critical context, the CO_2 regulation revision is an opportunity to realign climate ambition, industrial competitiveness, and market realities.

What position does the French automotive sector advocates for as part of the Strategic Dialogue on the Future of the Automotive Industry, launched by the Commission President Ursula von der Leyen?

C. A.: At the European level, the *Plateforme Automobile* (PFA) defends a position that unites the entire sector, manufacturers, suppliers, and equipment manufacturers. This position has also been expressed in a joint statement with the trade unions (CFE-CGC, FO, CFTC). It can be summarised in three key principles: flexibility, sovereignty, competitiveness. These are the three necessary conditions for the survival of the automotive industry, both in France and in Europe.

Consumers have failed to embrace the all-electric approach, and with only 17% market share for BEV today, one reality is unavoidable: Europe will not be on track for 2035. In this context, it is essential to give manufacturers the freedom to innovate and consumers the freedom of choice, by introducing flexibility and technological diversity into regulations. Ultimately, this reflects what consumers want.

> **The Draghi report must immediately become a roadmap for the European Union.**

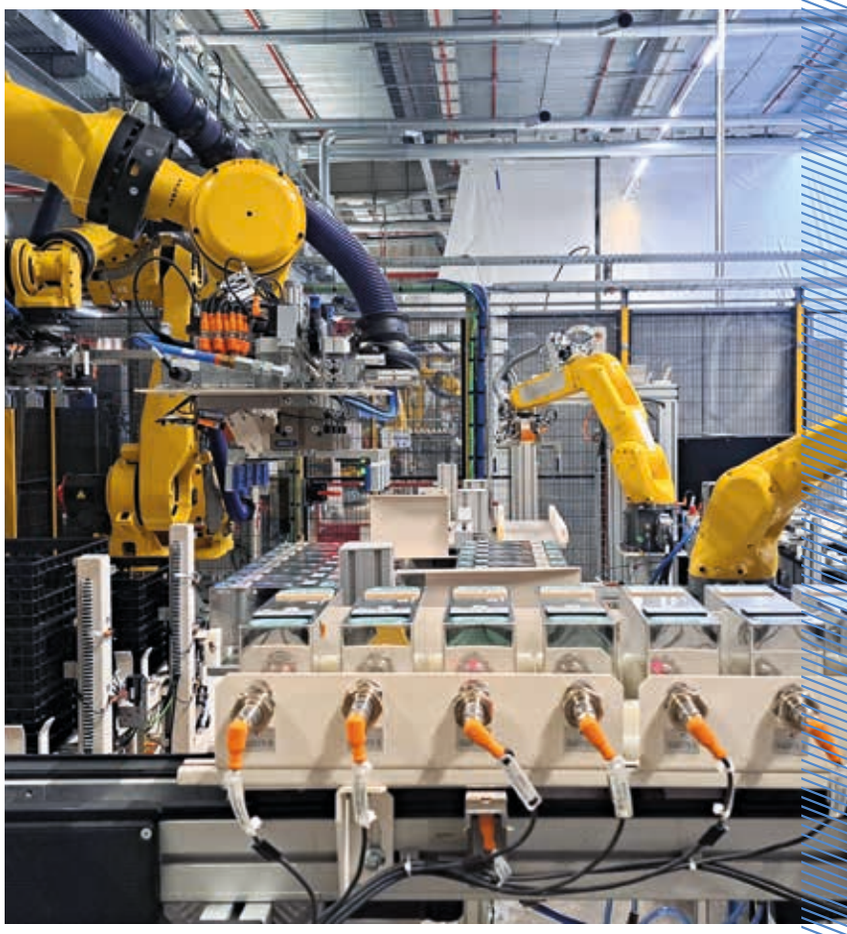
At the same time, the adoption by the European Union, after many other regions of the world, of local content measures appears both as a matter of sovereignty and an urgent requirement. Defining a minimum European content has become an essential condition for the survival of a industrial base in Europe.

Finally, the Draghi report has clearly emphasised the urgency of an European policy to strengthen competitiveness. The Draghi report must immediately become a roadmap for the European Union.

Given such expectations, what is your assessment of the proposals presented by the Commission at the end of 2025?

C. A.: These proposals reflect awareness of the sector's issues, but the devil is in the details…

The Commission is trying to introduce some degree of technological freedom for manufacturers. However, far from providing an adequate response to the volume crisis, the mechanisms proposed by the Commission are actually limited and, as they stand, appear insufficient to secure the trajectory through 2035.



Assembly line for battery modules at the ACC gigafactory in Billy-Berclau Douvrin. © ACC.

Moreover, the French automotive sector is particularly concerned by the absence of any mechanism to smooth targets for 2025–2029 for light commercial vehicles (LCVs). This is an urgent priority for the French sector: a quarter of European LCV production takes place in four factories in France.

Regarding local content, the Commission has taken a first step by introducing the concept of European preference. But its scope in the revision of the CO_2 regulation is far too limited – applying only to small EVs – to have an industrial impact commensurate with today's challenges in terms of sovereignty, competitiveness, and employment stakes. Finally, defining local content, as proposed in the Industrial Accelerator Act (IAA) presented on 4 March, across a geographic scope that includes all EU trading partners – far beyond the EU-27 – effectively undermines the very concept of European preference.

This underlines just how crucial the ongoing discussions, particularly the examination of these proposals within the European Council and Parliament, will be for the future of the sector.

Industrial electrification: a strategic imperative

Accounting for 18% of CO_2 emissions in France, industrial decarbonisation is slowing down: after a reduction of more than 10% of greenhouse gas emissions in 2023, the decrease was only of 1.4% in 2024, according to the French High Council on Climate. French industry now faces decisive choices...



Jean-Luc Laborde,
Director of Industrial Electrification, EDF

Some sectors, such as metallurgy, have even seen their emissions increase despite declining activity. Yet, a solution exists: massively replacing fossil fuels with electricity in industrial processes.

Today, electricity represents only 30% of the energy used in industry, but this share is expected to exceed 50% by 2050, according to the French National Low-Carbon Strategy (SNBC3). Replacing oil-based uses with electricity is both a way to drastically reduce the carbon footprint (given that 95% of France's electricity generation is low-carbon), to strengthen France's energy independence, and to reduce the country's substantial annual fossil fuel import bill, which stood at €64 billion in 2024.

Today, electricity prices remain low and electricity is available. France exported 89 TWh in 2024 and 92 TWh in 2025. From January 1st, 2026, the end of the "regulated access to historic nuclear electricity" scheme (ARENH) paves the way for medium and long-term offers for industrial companies, giving them visibility over 5 to 15 years, or even longer. This development is a lever for reducing exposure to market volatility and represents a precious competitive advantage at international level.

At the same time, public support for industry has reached an unprecedented level: initiated with the programme *"France Relance"* and strengthened by *"France 2030"*, it is supplemented in 2026 by the Industrial Decarbonisation Bank. The energy savings certificates scheme (CEE) is starting to include electrification solutions. In a context where part of France's ageing productive base will need to be renewed by 2030, this lever offers an opportunity to promote electricity.

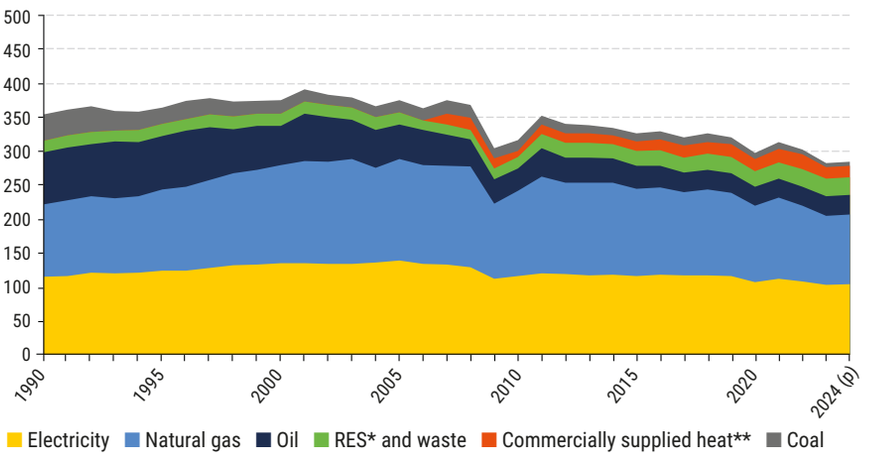
Diverse industrial pathways

Electrification pathways vary significantly from one sector to another. Some industries, such as materials, have already made substantial progress in their transition, while others, such as aerospace, are progressing more gradually[1]. These differences can be explained by the nature of the processes involved, their energy intensity and the associated infrastructure constraints. Some sectors have a history of using electricity; others must profoundly transform their thermal production chains in order to take a decisive step forward.

Despite these contrasts, a clear trend is emerging: electricity is gaining ground across the industry and is becoming, for sectors such as paper and cardboard, a genuine strategic lever for decarbonisation.

High-performance European technologies

Electrifying an industrial site often means adapting infrastructure originally designed for coal or gas and



(p) = provisional.
**RES: renewable energy sources.*
*** Data available from 2007 only.*

Scope: up to and including 2010, the geographical scope is mainland France. From 2011 onwards, it also includes the five French overseas departments and regions. Industry includes construction. Blast furnaces, however, are excluded, as they are considered part of the energy sector in the energy balance.

Figure 1: Industry: 285 TWh in 2024, climate-adjusted data.
Source: SDES, France's Energy Balance.

1. *Study conducted by L'Usine Nouvelle and EDF in spring 2025.*



Verallia's first electric furnace was inaugurated at the Cognac site in Charente in September 2024.
Source: verallia.com/communique-de-presse/inauguration-four-electrique-cognac/

redesigning the production chain. This is why industry is a more complex sector to decarbonise than buildings or transport, and requires tailor-made solutions.

Heat production processes, which still depend largely on fossil fuels, are responsible for two thirds of the sector's emissions. They represent the largest area for transformation, especially as the technologies needed to electrify these processes are already available. Three major families of equipment cover all heating, drying, cooking and melting needs: high-temperature heat pumps, with or without mechanical vapour recompression (MVR), electric boilers and electric furnaces. The supply chains for these solutions are largely established in Europe. In 2024, the European industrial electrification market was worth €3 to €4 billion, with more than 80% of its value originating in Europe, supporting 45,000 non-relocatable jobs. The large-scale deployment of these technologies could electrify up to 85% of industry's fossil-based thermal uses by 2035.

Overcoming economic barriers

Although technologies for electrifying industrial processes are widely available, their deployment is still held back by economic obstacles.

Industrial companies face a dual challenge: high capital expenditure to convert their facilities, and operating costs that depend on fluctuating electricity prices. However, new multi-year electricity contracts are changing the picture by offering price stability over five years, or even ten years and more with CAPN contracts (Nuclear Production Allocation Contracts) giving industrial companies unprecedented visibility over their energy costs.

From a technical standpoint, the operational benefits of electric solutions are tangible: energy efficiency, precise temperature control, lighter maintenance requirements, and more. These advantages help shorten payback periods. However, electrification opportunities vary by sector, with process temperature as the central criterion.

Below 150°C, solutions are mature and competitive, particularly when waste heat can be recovered. Heat pumps and mechanical vapour recompression are already widely deployed in the paper and cardboard, agri-food and light chemicals sectors.

Between 150°C and 500°C, most equipment – such as cooking furnaces and electric boilers – are available, but still require financial support to become profitable. Very high-temperature heat pumps capable of producing steam are beginning to prove their worth. Their growth will depend on the regulatory framework and targeted support, particularly as long as CO_2 prices are not sufficient to close the gap between gas and electricity.

Above 500 °C, the complexity increases: very high-temperature processes in steelmaking or glassmaking require induction or resistance electric furnaces which, to be deployed, need an incentive-based regulatory framework and financial support.

Technologies	Energy efficiency gains	Reduction in CO_2 emissions
Heat pumps*	Up to +300%	>90%
Electric boilers	+10	>75%
Resistance furnaces	+10 to 20%	80%
Induction furnaces	+20 to 40%	85%

** Very high temperature and steam*

Figure 2: Benefits of electric solutions compared with gas technologies.
Source: EDF R&D.

A challenge of knowledge and skills

Historically, industrial processes were designed around fossil fuels such as gas and fuel oil. The engineering firms supporting companies are still mostly trained in these technologies, slowing down the transition.

Many industrial companies therefore struggle to identify the electrification solutions suited to their processes and to understand how to integrate them into their facilities. This lack of knowledge is a major obstacle: some relevant technologies, sometimes available for a long time, remain underused because they are not sufficiently known or promoted. This is why greater efforts are needed to disseminate, explain and promote electric solutions, in order to make the existing options visible and help companies adopt them.

Industrial companies that commit to electrification understand that the issue goes far beyond energy efficiency. This transformation modernises processes, secures activity and sustainably reduces exposure to geopolitical and regulatory uncertainty. More than ever, it is a strategic choice to prepare industry for the demands of tomorrow.

The heat pump industry in Europe at the forefront of electrification

In Belgium, a factory turns sugar beets into sugar. In Denmark, a hospital keeps patients warm and medicines cool. In France, pulp is dried and turned into paper. From north to southern Europe, from east to west, citizens and workers stay cosy and comfortable in the middle of winter. Come summer, many of them will be able to keep cool. All of this, thanks to heat pumps...



Jozefien Vanbecelaere,
Policy Director, European Heat Pump Association

Heat pumps at the forefront of sustainable development and sovereignty

Across Europe heat pumps of many different types and sizes are being used in a vast range of settings to reach required or desired temperatures. Unlike stand-alone boilers, heat pumps do not burn fossil fuels. Instead, they use a small amount of electricity to transform natural heat from the air, ground or water – or waste heat from industrial processes – into higher temperatures, to warm buildings or power industrial processes. Large heat pumps can even use heat from sewage, or exhaust air from hospitals or swimming pools.

This use of natural thermal energy makes heat pumps extremely efficient – up to five times more so than a fossil fuel boiler. Indeed residential heat pumps in Europe – there are around 26 million installed today – are saving over 290 TWh of energy, compared to boilers.

As for industrial heat pumps, they can reach temperatures of up to 200 °C, which could cover 39% of process heat needs in Europe. When you consider that 60% of industrial energy needs go on heat, that is a huge amount of potential savings both in terms of carbon dioxide and greenhouse gases, and on companies' energy bills.

Electrifying the economy – including the heating, cooling and process heat sectors – is recognised by the EU and most European governments as the key to an energy efficient, sustainable and competitive future. Continuing to rely on imports of gas and oil into Europe from countries like Russia puts us into a very precarious and weak position, as well as harming our climate ambitions. Electricity can be produced locally through sustainable sources like wind and the sun. The EU has recently started initiatives to speed up permitting for such renewable energy projects and to beef up Europe's grid connections.

A market with huge potential

There are other advantages to investing in heat pumps: the heat pump sector in Europe is very strong globally. There are 300 manufacturing sites – mainly for domestic heat pumps – in Europe, and the industry provides around 433,000 direct and indirect jobs.

Despite the many benefits of heat pumps, Europe is set to be about 25% short of the EU target of 60 million heat pumps by 2030. There was a sales slump after the record year of 2022, when the Russian invasion of Ukraine prompted higher heat pump subsidies and greater uptake.

While this appeared to stabilise somewhat in 2025, with a 10% average increase across 16 countries, there is still huge growth potential. At the European Heat Pump Association, we calculated that around 14 times more heat pumps were installed in the biggest markets like Finland, compared to the smallest markets like the UK last year, relative to population.

Stable policy support and affordable electricity are key

The EU and national governments can help this potential be tapped through stable policies and support. National governments' reduction or tightening of support schemes for consumers in recent years has contributed to the slowdown of the market. The EU's climate and energy targets and rules must be implemented by governments, and one way to help this to happen is by supporting end users as they shift to clean and electrified heating solutions.

Another issue making it harder for households and businesses to switch from gas to heat pumps are high electricity prices. Too many countries tax gas many times less than electricity, and the correlation with slower or higher heat pump uptake.

European initiatives can boost heat pump rollout

In 2025 there was some EU movement on these areas, notably through the publication of the EU Clean Industrial Deal and Affordable Energy Action Plan. The year was book-ended in EU policy terms by the EU's Affordable Housing Plan in December. Significantly, this plan considers a home's 'affordability' also in terms of energy costs, says affordability should not come at the expense



Merode Castle in Belgium: aquathermal heat pump. © EXTRAQT



Calefa steam-pump. © Calefa



Heat pumps powering factory in Poland. © NIBE

of sustainability, and again repeats that energy bills & taxes must be addressed.

Other EU publications are being published in 2026 to support clean industrial competitiveness, electrification , and the decarbonisation of heating and cooling. These are the EU electrification action plan, the heating and cooling strategy and the industrial accelerator act.

Another way of making heat pumps competitive is by putting a price on carbon pollution. This is already the case for energy intensive industries and electricity under the EU Emissions Trading System (ETS). The ETS was due to be expanded to buildings and road transport, making heat pumps more competitive compared to fossil fuel heating. EU governments decided to delay the second ETS for a year to 2028, it is essential they stop kicking the can down the road and apply the agreed rules.

In terms of industrial heat pumps, the EU is pushing the take-up of industrial heat pumps through policies focused on encouraging industrial electrification, such as the recently published Industrial Accelerator Act and upcoming Electrification Action Plan. The Industrial Accelerator Act sets out guidelines to help European industries stay competitive, and boost products being 'Made in Europe'. It complements the Net Zero Industry Act, which already aims for 40% of clean technologies deployed in Europe to be produced in Europe.

The EU is also providing financing via a new 'Innovation Fund' auction for projects that decarbonise industrial process heat. This will be key to helping industry implement the switch from fossil fuel–based technologies to clean alternatives such as heat pumps.

Heat pumps can contribute to the stability of electrical grids

Another advantage of heat pumps concerns the power system. They can be turned on when electricity demand is lower, and off at peak times. This balances out electricity demand and reduces costs for the EU's energy system and for consumers.

But to ensure this happens, consumers need to have some sort of incentive, such as electricity tariffs that change according to overall demand.

What's more, grid operators need to be aware of the flexibility potential offered by heat pumps and take this into account in their grid planning.

It is also important that heat pumps can be switched off and on to enable grid stability and help the power system run smoothly.

In December 2025, the European Commission's published a Grids Package which aims to modernise Europe's electricity grids, and connect them up better. This will help integrate more renewable electricity and lower energy prices – both key to speeding up heat pump rollout.

Finally, investment in skills is key to meet the expected needs in terms of heat pump engineers and installers, with around 500,000 more full-time equivalent employees needing to be ready for action in the next seven years. Skills is one of the topics being researched by the European Commission's Heat Pump Accelerator Platform, of which EHPA is a co-organiser. This Platform brings together the heat pump sector to find ways to address the barriers to heat pump roll-out.

The conclusion? There are huge opportunities in the heat pump sector, and work to do to ensure they are tapped. Slowly but surely the EU is rolling out initiatives that will help this to happen, providing they contain the right elements and are correctly implemented in good time. It is the role of associations like EHPA, and its members, to do all we can to ensure this happens.



Chapelette Dam.
© Mathieu Semail.

Public Works: scaling up to meet the challenges of electrification and the energy transition

The large-scale electrification of end uses and the acceleration of the energy transition are profoundly reshaping the construction and public works sector. Companies must not only respond to growing demand – electrical infrastructure, telecommunications networks and smart monitoring and control systems – but, they must also integrate new requirements: expanding skills, mastering digital technologies, enhancing engineering expertise and stronger complying with increasingly demanding standards from contracting authorities.



Jean-Baptiste Gonnet,
Deputy Chief Executive Officer, NGE

This structural shift is deeply transforming the construction and public works sectors. Long focused on traditional activities – such as earthworks, civil engineering, water infrastructure, foundations – industry players must now master skills in electrical systems, connected technologies, energy management and renewable energy integration. The energy transition is creating an unprecedented need for infrastructure: connection of solar farms, electrical substations, electric vehicles charging infrastructure, smart grids, data centres and secure digital networks.
In this context, companies that can scale their operations and deliver integrated solutions combining civil engineering, energy, and digital expertise are particularly well positioned to meet the demands of this transformation. France's third Multiannual Energy Plan (*Programmation pluriannuelle de l'énergie* - PPE3) marks a major shift in France's energy strategy in response to the rising electricity demand and to the need to accelerate on decarbonisation. This new roadmap aims to speed up the electrification of the economy, reduce dependence on fossil fuels (by 40% by 2030) and reach carbon neutrality by 2050.

It also marks a clear return of nuclear power as a strategic pillar of sovereignty, with the construction of six EPR2 reactors, the consolidation and lifetime extension of existing reactors, and the construction of a first small modular reactor (SMR) in the early 2030s.
Here again, the contribution of construction companies is a decisive factor in the success of the electrification plan, both for nuclear infrastructure and for renewable energy infrastructure.

An opportunity for public works companies

As the electrification of end uses and the energy transition accelerate, construction players have a key role to play.

On the one hand, the revival of nuclear power, the development of renewable energies and the consolidation of existing grids place public works companies at the heart of this transformation, to build, renovate and maintain infrastructure.



Photovoltaic canopies in Rouen.
© DR

On the other hand, the electrification of end uses requires the deployment of complex infrastructure. This includes charging stations for light vehicles, heavy-duty vehicles and buses, building adaptations, electrification of industrial processes, and smart systems to manage this infrastructure. The construction sector must therefore be ready to deliver.

Developing skills and new professions

In this context, NGE created NGE Energies Solutions, a new subsidiary to bring together two activities: the deployment of very high-speed broadband networks and infrastructure connectivity. This strategic reorganisation enables the group to bring together 1,200 employees serving the energy and digital sector.

The objective: to build NGE's energy subsidiary, capable of addressing a rapidly transforming market and of providing greater clarity for customers.

This organisation also makes it possible to pool investments, processes and quality standards. This is decisive at a time when clients including local authorities, industrial companies and major operators increasingly require proof of certification, risk management and environmental compliance.

Another major challenge for the sector lies in recruiting qualified people. This is why an internal training programme has been created to support skills development and anticipate future needs.

For the EPR2 construction programme, the necessary skills will also need to be in place on time to ensure complete industrial control.

The decision was made to involve suppliers in the project as early as possible, through the early launch of calls for tenders, in particular to challenge the proposed design of the new reactor model.

The objective of creating a collective approach and developing a partnership-based and collaborative method around the project is new. It requires construction companies to mobilise all their expertise in order to deliver the best solutions.

The construction period will be closely analysed. Here again, companies will need to raise their skills levels to deliver flawless infrastructure.

THREE QUESTIONS FOR JEAN-BAPTISTE GONNET,

President of NGE Energies Solutions and Deputy Chief Executive Officer of the NGE Group

Why merging your energy and digital activities into a single entity?

Jean-Baptiste Gonnet: It is both a need for expertise and a need for efficiency. The energy market is growing very quickly and becoming increasingly demanding. Our customers want trained and certified teams capable of working at the intersection of power systems, low-current systems and digital technologies. With the creation of NGE Energies Solutions, we gain clarity, pool our resources and build skills more quickly. There is real strength in unity: in training, equipment, quality and safety.

How does this integration enable you to respond more effectively to the challenges of the energy transition?

J-B. G.: We have the ability to mobilise several of the group's areas of expertise – earthworks, civil engineering and foundations – in addition to our electrical and digital expertise. For a photovoltaic farm, a charging station or a storage facility, we can offer integrated solutions, from groundwork through to connection and supervision. The energy transition is creating multi-disciplinary projects: by structuring ourselves in this way, we are scaling up our activities and we can operate across business lines. This is also what clients are looking for.

What are your growth priorities for the coming years?

J-B. G.: We have two key priorities. First, the ramp-up of renewable energies:wherever electrical infrastructure is deployed, we are involved.. Second, the interconnection of equipment: controllable lighting, EV charging stations, video surveillance and more. Energy is becoming digital. And this convergence is opening up new opportunities. Finally, the decarbonisation of uses represents a tremendous growth opportunity. Our ambition is clear: to become a benchmark player in the electrification of communities and to support the large-scale deployment of renewable energies.

Electrification of the building sector: a major challenge for achieving carbon neutrality

In France, the building sector roadmap aims for full decarbonisation by 2050, with the objective of achieving the bulk of this transition by 2035. The challenge is to accelerate the electrification of energy uses while promoting more efficient and responsible energy use.



Nicolas Lecomte,
Regulation officer - Building sector, Strategy & Development department, Customers, Services and Territories division, EDF

As the leading consumer of final energy in France (nearly 650 TWh, representing more than 40% of total consumption), the building sector still relies on fossil fuels for more than one third of its energy needs, mainly for heating and domestic hot water production.

While the decline in emissions is slowing and electrification remains insufficient, carbon neutrality targets remain achievable provided that efforts are intensified. All available levers must be mobilised: energy efficiency, energy sobriety, the replacement of fossil fuels with electric and low-carbon solutions, particularly heat pumps, improved insulation, and the deployment of smart control systems and energy management systems.

Decarbonisation is underway in new construction

The 2020 French Environmental Regulation (RE2020) has established decarbonised heat production systems, and particularly electric solutions, as the reference option for new buildings. In 2025, this trend was clearly confirmed:

- in individual housing, 98% of building permits concern projects where electricity, wood or district heating networks are the primary source of heat;
- in collective housing, the share of gas has fallen from 75% in 2016 to 14% in 2025, driven by the strengthening of RE2020 requirements.

The electrification plan published on 23 April provides for a ban on the installation of gas boilers, including hybrid systems, in new constructions: from 2027 for residential buildings, 2028 for public buildings, and 2030 for all new buildings. This major step forward will need to be accompanied by robust regulation to prevent circumvention, particularly through the use of biogas guarantees of origin. Relying on a future supply of 100% biogas to justify maintaining gas boilers in new buildings would amount to postponing decarbonisation decisions.

More broadly, it is essential to make the carbon criterion the cornerstone of building policies and to integrate it into all legislation and regulations governing the sector, in order to fully recognise low-carbon electricity as the reference solution.

Decarbonising heat production by accelerating the deployment of heat pumps

Replacing a fossil fuel boiler with a heat pump (air-to-water, air-to-air, or water-to-water) makes it possible to decarbonise heating with zero on-site emissions.

Three to four times more efficient than a boiler, a heat pump emits up to 10 to 15 times less CO_2 and, on average, can halve heating bills. Relying on France's low-carbon electricity mix and renewable heat from the air, ground, or water, heat pumps represent an immediate lever for improving purchasing power and combating energy poverty, while remaining suitable for the vast majority of buildings.

Their deployment as a replacement for fossil fuel boilers must be prioritised. In renovation, air-to-water heat pumps play a central role and account for 30% of single-action *MaPrimeRénov'* grants awarded in 2025. In France, they represent the most effective renovation measure in terms of reducing energy consumption and CO_2 emissions per euro invested, well ahead of any other insulation measure[1] or heating energy replacement. The allocation of public funding must therefore be based on objective criteria and regular quantitative assessments.

Reforming the Energy Performance Certificate (DPE) to better target the phase-out of fossil fuels

Today, the DPE (Energy Performance Certificate) continues to disadvantage electricity by relying on primary energy rather than final energy consumption. This approach does not allow renovation policies to be effectively targeted towards homes heated with

1. https://www.statistiques.developpement-durable.gouv.fr/media/6700/download?inline

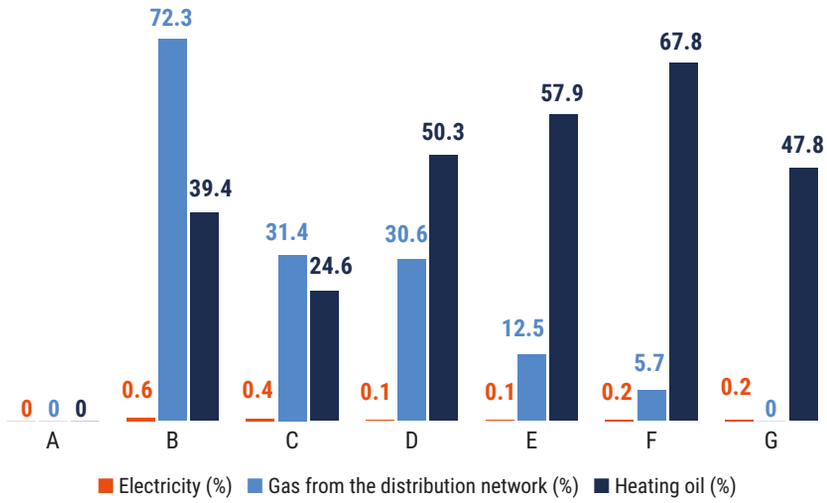


Figure 1: Percentage of dwellings constrained by the climate scale thresholds in each DPE class.
Source: EDF R&D study based on the ADEME DPE v2 database (October 2023 – March 2024 period).


© Marta NASCIMENTO/REA

fossil fuels, even though these should be prioritised: only 4% of gas-heated homes classified as energy-inefficient buildings receive this classification due to their emissions, thereby limiting incentives to replace fossil fuel-based heating systems.

Without waiting for a comprehensive overhaul of the DPE, including a shift to final energy consumption, several short-term changes should be implemented:

- make renovation subsidies conditional on the removal of fossil fuel boilers in multi-unit residential buildings with individual heating systems, following the approach adopted for the Energy Savings Certificates (CEE) schemes for comprehensive renovations of single-family homes, which no longer support projects that retain fossil fuel consumption for heating and domestic hot water after the works are completed;
- exclude methane-consuming equipment from individual heating subsidies (CEE schemes and *MaPrimeRénov'* support for hybrid heat pumps, etc.);
- strictly regulate the sizing and support mechanisms for hybrid heating systems in order to maximise the share of heating needs covered by heat pumps (with a "100% heat pump" target);
- finally, *MaPrimeRénov' Copropriété* should be reformed by replacing primary energy savings criteria with final energy savings criteria (with two levels of support corresponding to two levels of consumption reduction, of 30% and 50% respectively), in order to better recognise the value of decarbonised electric solutions.

These public policies aim to progressively phase out gas in buildings: an immediate ban on gas in new construction, a ban on the replacement of boilers in existing buildings by 2035, with the objective of achieving a building stock with "zero fossil fuel boilers" by 2050, or even by 2040 according to the European Commission. Beyond support for electrification, they require a binding legal and economic framework for gas and fossil fuel boilers, as well as strict regulation of energy uses. The electrification plan notably provides that, from 1 January 2027, gas network connection costs will be borne by the requesting buildings, thereby strengthening the competitiveness of electrification and district heating networks.

New measures to make electrification the key lever

After several years of strong growth, the air-to-water heat pump market has contracted as a result of the energy crisis, declining purchasing power, and instability in support schemes. This situation has created a wait-and-see environment, while the remaining cost burden continues to be a decisive factor for households, particularly the most vulnerable.

Yet, thanks to the combination of Energy Savings Certificates (CEE) and *MaPrimeRénov'* schemes, the return on investment of a heat pump replacing an end-of-life gas boiler can be less than one year for the lowest-income households.

To facilitate its restart, made essential by the consequences of the wars in Ukraine and with Iran on the oil and gas markets, several measures are needed:

- stabilise support schemes (*MaPrimeRénov'* and CEE) in order to avoid "stop-and-go" effects;
- ensure a clear regulatory framework while simplifying procedures and strengthening efforts to combat fraud;
- establish a "right to a heat pump" in collective housing through changes to voting rules for energy renovation works;
- progressively remove barriers to their architectural integration (restrictive urban planning rules, protected areas, opinions from the Architects of Buildings of France).

Heat Pumps: an effective and proven solution

The heat pump industry is staying on course to meet its 2030–2050 targets. To decarbonise the housing sector, electrification through heat pumps has emerged as one of the most effective and cost-efficient solutions. Following a doubling of sales between 2020 and 2022, the market has slowed down since late 2023, casting doubt on the pace of future deployment. Nevertheless, the sector's ambition remains unchanged: to reach 1.5 million heat pumps installed annually for heating by 2030. In a context of encouraging signals for 2026, the AFPAC is mobilising all stakeholders to achieve these targets.



François Deroche,
President of AFPAC
(French Heat Pump Association)

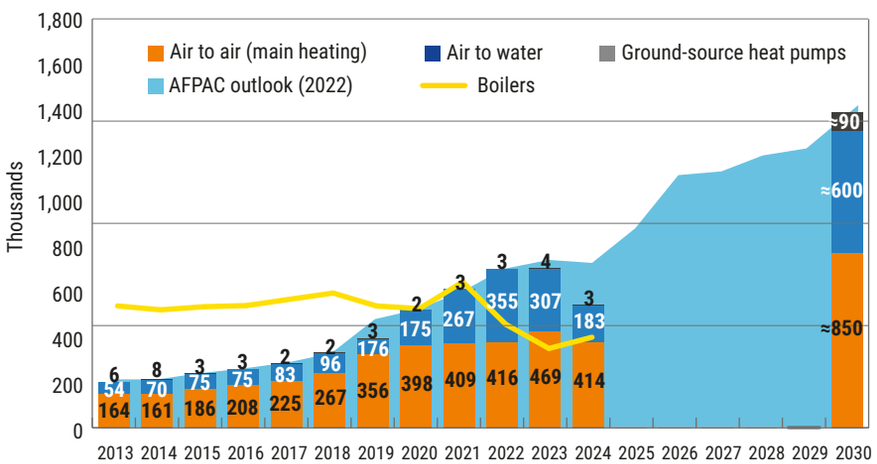
In France – A market adjusting after strong growth

The French heat pump market, which saw sales double between 2020 and 2022, has experienced a marked slowdown since autumn 2023. Several factors explain this evolution. The decline in purchasing power following the war in Ukraine has led some households to postpone energy renovation projects. The downturn in the construction sector and the drop in new buildings have reduced installation opportunities, especially as 90% of new single-family homes are already equipped with heat pumps following the introduction of the RE2020 regulation[1]. Regulatory instability and frequent "stop-and-go" changes in support schemes have also weighed heavily on market momentum, complicating processes for both installers and households and reducing the attractiveness of available incentives.

Lagging behind its intended trajectory, the heat pump sector has had to adapt: manufacturers have adjusted their investments, companies have limited recruitment of skilled technicians, and some had to announce temporary layoffs. After two challenging years, the market is now in a consolidation phase, with signs pointing to a more favourable outlook in 2026.

> **"... After two challenging years, the market is now in a consolidation phase...**

The first sign is the adjustment, in France, of the primary energy factor (PEF) to 1.9. This improves energy performance certificate ratings by two grades for 90% of air to water and water to water heat pumps installed as replacements for fossil-fuel systems (compared with 36% previously) and allows all such dwellings to move out of the lowest-performing energy efficiency category.. This measure also improves ratings by at least two classes for air-to-air heat pumps[2]. These gains translate into increased "green value" for properties, reflecting higher asset value thanks to improved energy and environmental performance[3].



Heatpump market dynamics.

1. *Source: Panorama RE 2020.*
2. *Source: AFPAC.*
3. *Source: Notaires de France.*

This is complemented by updated energy savings certificate (CEE in French) schemes for heat pump installations in both multi-family and single-family housing, significantly reducing the upfront cost borne by households.

These measures are steps in the right direction. To consolidate market recovery, AFPAC is calling for long-term regulatory stability, simplification of support schemes, and stronger communication on the proven performance and cost-effectiveness of heat pumps *(cf. ADEME study, October 2025).*

2030–2050 outlook: heat pumps as the main driver of heating electrification

Despite ongoing electrification, heating electrification currently covers only 46% of the residential stock[4]. Heat pumps have a major role to play in accelerating this energy transition, whose trajectory is now becoming clearer through 2030 and 2050 targets.

By 2030, the French National Low-Carbon Strategy (SNBC3) sets ambitious objectives to transform heating systems. The government aims for an average of 850,000 heat pump installations per year, bringing the total residential stock to 8.8 million units – effectively doubling the heating stock within five years.

In new buildings, momentum is already well established. According to RE2020 data, heat pumps account for over 90% of the market in single-family homes and more than 50% in multi-family housing, confirming the central role of electrification in construction standards. This dominance reflects not only the intrinsic performance of the technology, but also its alignment with regulatory and environmental requirements.

By 2050, the transformation of the residential stock is expected to continue, reaching 64% electrification. This trajectory is accompanied by a 24% reduction in final energy consumption in buildings (across all uses).

Air-to-water heat pump.



Heat pumps for all: scaling up deployment

AFPAC mobilised on key priorities

The large-scale deployment of heat pumps raises several challenges, which AFPAC is addressing with public support.

The first concerns integration into existing buildings, which will make up the majority of the stock by 2050. The challenge is to reconcile the preservation of architectural heritage with the installation of high-performance systems. To address this challenge, AFPAC, in partnership with ADEME, has developed a range of practical tools and resources. These include MÉMOPAC, a technical guide for multi-family residential buildings, and the forthcoming launch of CEPAC, the Centre of Expertise for Heat Pumps. These initiatives aim to support stakeholders and promote best practices for high-quality deployment.

The second challenge relates to skills, training and workforce renewal. Training and attracting new talent is essential to support sector growth.

Finally, the EU F-Gas regulation, which mandates the phase-out of high global warming potential refrigerants, significantly impacts certain technologies. The ongoing transition to alternative refrigerants requires substantial R&D efforts, technical adjustments, cost management and upskilling of installers. Constraints affecting air to air heat pumps from 2029 onwards could challenge their ability to meet building electrification needs.

An electrification plan to ramp up deployment

To address these challenges, AFPAC has proposed eight levers to French public authorities, aimed at ensuring access to heat pumps for all households and building types. These include pro-electricity taxation, simplified and stable support schemes, quality guarantees, and the development of dedicated electricity tariff offers.

This coordinated approach to scaling up heat pump deployment is supported by a French and European industry that ensures both performance and accessibility. On the ground, heat pumps have proven their effectiveness: 97% of equipped households report satisfaction and significant reductions in their energy bills[5]. These results confirm that heat pumps are one of the most effective energy renovation measures for reducing CO_2 emissions per euro invested, giving the sector strong momentum to accelerate building electrification and achieve 2030–2050 climate targets.

4. *Source: PPE – French Ministry of the Ecological Transition (public consultation)*
5. *Source: Study in Occitanie UFE-AFPAC*

Direct electric heating in the decarbonisation strategy of buildings



Eric Baudry,
Director of Public Affairs,
Intuis Group

The success of France's decarbonisation strategy depends on the rapid and widespread electrification of energy uses. Dispatchable electric heating is a readily deployable solution that can help move residential heating away from dependence on fossil fuels at a lower cost. Yet it remains one of the solutions least recognised by public policy.

Strengthening the electrification strategy in France and Europe

France and Europe have launched an ambitious strategy to decarbonise their energy mix, relying to a large extent on the widespread electrification of end uses in line with national and European climate trajectories. France's electricity supply has a particularly low carbon intensity, owing notably to the predominance of nuclear power and the continued expansion of renewable energy.

However, the electrification of energy use is not progressing at the expected pace. One reason for this delay is the scale of the investment required. Whether for electric vehicles or heat pumps, the cost borne by households exceeds their financing capacity. For many years to come, neither central government nor local authorities will be able to provide the level of support that would be required.

"The best is the enemy of the good", as the saying goes. This principle also applies to the energy transition. Despite the urgent need to end our dependence on fossil fuels, public authorities in both Paris and Brussels remain overly committed to the pursuit of technical excellence, particularly in terms of energy efficiency, when practical realities must now be taken into account in every country.

As a result, some solutions that are immediately available and fully aligned with climate objectives remain insufficiently recognised. This is particularly true of modern direct electric heating systems, which are efficient, connected and dispatchable.

A solution aligned with current challenges

Today, nearly one-third of French primary residences are equipped with direct electric heating systems. This represents more than 10.5 million homes, half of them in multi-unit housing, social housing and student residences, and the other half in single-family homes. This represents a considerable installed asset that cannot be ignored in a credible pathway for renovation, electrification and decarbonisation.

Next-generation electric heating has an important role to play in France's National Low-Carbon Strategy. It involves no on-site combustion, generates very low indirect emissions thanks to France's low-carbon electricity mix, and is fully aligned with efforts to decarbonise the building sector. It also offers a number of specific advantages that deserve to be highlighted.

Equipment that can be precisely adjusted to demand

The latest generation of electric resistance heating equipment, including radiators and electric boilers, benefits from highly accurate control systems, smart programming, sensors enabling dynamic management and connected interfaces that facilitate continuous optimisation.

These features can deliver significant reductions in energy consumption, particularly in existing homes where energy-efficiency improvements can be introduced gradually.

A contribution to flexibility and demand response

Connected electric appliances also provide significant flexibility benefits. In particular, they can participate to demand-response programmes, adjust electricity demand in real time according to grid constraints and dynamic tariffs, help manage peak demand and support the more effective integration of intermittent renewable energy sources.

Easy to install, even in challenging situations

Direct electric heating is straightforward to install. Provided that homes are adequately insulated, it can be deployed in almost all situations, in both new and existing buildings. In particular, electric heating provides a decarbonised solution where heat pumps face technical difficulties, especially in apartment buildings and smaller homes.

Compatibility with other heating solutions

The flexibility of direct electric heating allows it to be combined with other electric or non-electric technologies, such as air-to-air heat pumps, wood-fired boilers and heat-pump water heaters. These technologies can be incorporated into hybrid, decarbonised systems designed around the configuration of the building and the occupants' lifestyles. When combined with a reversible heat pump, electric heating can also form part of a system that addresses the increasingly urgent need for cooling during the heatwaves we now experience.

A solution that helps contain construction costs

Among decarbonised heating technologies, electric heating is undoubtedly the least costly in terms of initial investment. It is affordable for most households. Over the years, construction costs have been driven up by the accumulation of regulations and various requirements. The resulting slowdown in construction is clear. Electric heating can help bring construction costs back to more affordable levels. It is therefore one of the tools available to public authorities to revive new-build construction and renovation activity and meet the decarbonisation targets France has set itself.

Equipment manufactured largely in Europe

A significant proportion of the electric radiators sold in Europe is predominantly manufactured in France, although some production has been relocated to Eastern Europe and Asia, particularly for certain entry-level models and portable appliances.

According to estimates, the industry supports between 16,000 and 19,000[1] direct jobs and generates revenue of more than €4.7 billion. The market could grow by 3.5% per year over the 2025–2034 period[2].



@ Groupe Intuis

Conclusion

High-performance, connected direct electric resistance heating is not a marginal solution. It is a strategic tool for accelerating the widespread electrification of energy use in France and across Europe, in line with objectives relating to energy conservation, decarbonisation and grid flexibility.

It does not compete with heat pumps, a market in which the Intuis Group is one of the leaders in France. It is a complementary solution that has a legitimate role to play, provided that systems are properly designed, based on high-quality equipment and accompanied by the necessary insulation measures.

The primary-energy-saving criteria, applied to electric heating in French and even European building regulations, had the effect of steering choices towards fossil-fuel-based solutions. Today's priorities of decarbonisation and the phase-out of fossil fuels, translated into specific targets in the European energy performance of buildings directive dated 24 April 2014, should incentivise public authorities to make direct electric heating a structural component of residential electrification, alongside heat pumps and heat-pump water heaters.

1. *Study ASTERES by the GIFAM*
2. *Source: Global Market Insights (GMI), European Electric Radiators Market Size and Share, 2025–2034.*

Heat pumps: momentum at last?

The recent electrification plan announced by the French government reaffirms the role of buildings electrification in achieving national and European targets, as well as the role of heat pumps in decarbonising the sector and reducing our dependence on fossil fuels.



Benoît Lecornu,
Marketing manager,
Panasonic France

Long seen as a solution primarily suited to single-family homes, heat pumps were largely overlooked in collective housing and parts of the tertiary sector, where gas-based heating and hot water systems remained the dominant choice. If the French government has identified heat pumps as a cornerstone of its electrification plan, it is because the technology has demonstrated over the years its ability to address a broader market, more ambitious projects and, hopefully, exponential demand.

A question of sovereignty

Heat pumps are valued not only for their ability to reduce emissions, but also for the strategic advantages they offer in terms of sovereignty and technological readiness. Although the electrification plan is currently under the spotlight, it is above all part of a broader sequence of announcements and measures that have accelerated in recent months. These include, in France, the revision and diversification of Energy Savings Certificates programmes (CEE), as well as certification mechanisms aimed at promoting quality standards and industrial resilience. The sovereignty objective is twofold. On the one hand, it means moving away from fossil fuels, most of which come from countries outside the European Union. On the other, it means reclaiming technological know-how and the local production of thermodynamic systems. This would support the creation of new jobs, revitalise local areas and reduce overall economic pressure linked to energy, for both households and businesses.

The sector has been laying the groundwork for this momentum for many years. Because, yes, we are at a turning point: the moment when heat pumps will be recognized as the number-one solution and market leader for heating systems. Manufacturers are ready. Production capacity is in place, training is accelerating, and the range of products and services can now address all customer segments. Past investments have made it possible to build an offering based on quality and diversity. Although the market has yet to reach full maturity, the solutions themselves are already mature and continue to improve.

Technological maturity

From a technological standpoint, heat pumps have become highly versatile and can now meet the needs of the vast majority of projects. Initially developed for individual applications, they now offer a wide range of options, from heating-only systems to solutions with integrated domestic hot water. Simultaneously, the focus has shifted towards meeting a broader range of needs. As a result, heat pumps have expanded into high-potential markets such as collective housing and the tertiary sector.

With the development of high-capacity heat pumps, cascade systems and hybrid solutions that can be integrated into existing installations, heat pumps are emerging as serious alternatives to traditional boiler-based heating plants. In terms of innovation, capacity-maintenance technologies are also worth highlighting. These systems can achieve water flow temperatures of 75°C, even at low outdoor temperatures. This helps installers with system sizing and delivers even greater savings for occupants.

Systems without outdoor units, whether air-to-water or air-to-air, meet a genuine need that had previously been overlooked: the lack of available outdoor space, particularly in apartment buildings and city centres. On this point, manufacturers are making considerable efforts to offer compact, flexible and modular solutions, with reduced sound pressure levels that make it possible to comply with regulations in densely populated environments.

In the service sector, air-to-air heat pumps have gained ground through multisplit and VRF (Variable Refrigerant Flow) systems, which, in addition to heating, provide effective cooling capacity in summer. Air-to-water heat pumps are also expected to gain further traction in this segment, thanks to their ability to integrate into different configurations and provide a dual service: heating and domestic hot water. This development is reinforced by the properties of refrigerants such as R290 (propane) which enables larger available capacity. Heat pumps therefore respond both to the need to replace outdated, energy-intensive systems, running on fossil fuels, and to the needs of sites with significant domestic hot water requirements, such as hotels, sports centres and hospitals.

With this new electrification plan, the French government is confirming what the entire sector had been waiting for: a clear direction and strong commitments in favour of heat pumps. The framework provided by the various measures should help secure past and future investments and restore confidence to a sector that has been under pressure. Until now, it has seen many promises without being able to fully express its potential or demonstrate its ability to meet European challenges and the expectations of the French people.

EXAMPLES OF COMPLETED PROJECTS



Collective Aquarea Series M air-to-water heat pumps. © Panasonic.

A collective housing solution comprising two Panasonic Big Aquarea T-CAP Series M high-temperature air-to-water heat pumps using R290, installed in cascade to provide central heating for a seven-unit apartment building, replacing the existing oil-fired boiler.
Capitaine Ferber street, 75020 Paris

Replacement of a gas boiler with two Panasonic Big Aquarea T-CAP Series M heat pumps, each with an output of 20 kW, hybrid-ised with a 70 kW gas boiler for the school and town hall premises.
Grand-Parigny, Manche.



Grand-Parigny Town Hall. © Panasonic.



Big Aquarea Series M R290 cascade system. © Panasonic.

Decarbonisation of Safer Nouvelle-Aquitaine's regional headquarters (1,500 m² building) through the replacement of two oil-fired boilers with three Big Aquarea T-CAP Series M heat pumps, each with an output of 30 kW, for a total of 90 kW. This replacement improved the building's energy rating by two classes.
Niort, Deux-Sèvres.

Building electrification: mechanical ventilation as a key pillar of indoor air quality

Indoor air quality is a public health imperative. The electrification of tertiary buildings, combined with smart ventilation systems, makes it possible to reconcile energy performance with high standards of indoor air quality.



Edouard Vidoudez,
Head of Tertiary Market, France Air

A tertiary sector undergoing a major transformation

The tertiary building stock is undergoing a profound transformation, driven by decarbonisation and growing health concerns, particularly around indoor air quality (IAQ). These two priorities are often perceived as conflicting: the market still tends to assume that energy efficiency comes at the expense of IAQ.

The French BACS (Building Automation and Control System) regulation challenges this view. By requiring the progressive monitoring and automation of technical systems, it establishes the missing link between energy efficiency and air quality. Continuous monitoring reveals significant energy-saving potential in buildings – particularly existing stocks – where many malfunctions remain undetected due to a lack of measurement.

At the same time, this monitoring ensures that airflows are delivered when needed, based on actual usage, thereby guaranteeing controlled IAQ without unnecessary ventilation.

French regulatory frameworks – the RE2020 for new buildings, the "tertiary decree", IAQ requirements and the Building Automation and Control Systems regulation (BACS) – are converging towards an integrated approach to heating, ventilation and air treatment systems. The building sector has already reduced its energy consumption by 22% between 2019 and 2022[1]– representing almost half of the 2030 target – mainly by replacing fossil-based systems with heat pumps.

As buildings become increasingly electrified, the next step is to make these systems smart, monitored and controlled, enabling the simultaneous optimisation of energy performance and indoor air quality. In this context, France Air draws on its longstanding expertise in air management to support the shift of the tertiary sector towards solutions that combine energy efficiency, smart control and health requirements.

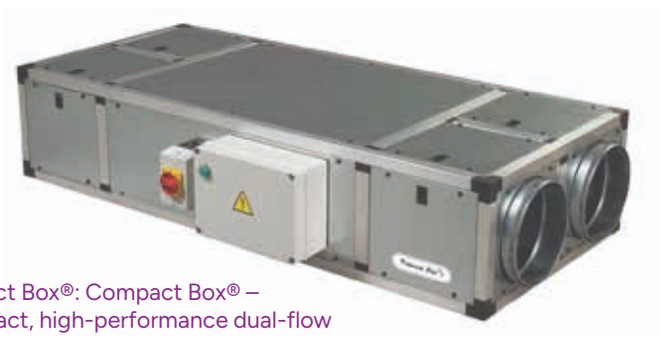
Indoor Air Quality: a strategic health issue

We spend around 80% of our time indoors, where air can be up to eight times more polluted than outdoor air. IAQ is influenced by many factors, including CO_2 levels, volatile organic compounds (VOCs), fine particles, relative humidity, insufficient air renewal, allergens and microbiological contamination.

Poor indoor air quality can have adverse effects on occupants, including headaches, reduced concentration, infectious diseases and viral infections, and respiratory conditions. All of this impacts comfort, wellbeing and productivity[2].

Monitoring Indoor Air Quality

Monitoring IAQ is therefore a major public health issue, governed by regulations requiring continuous monitoring to achieve and maintain reference



Compact Box®: Compact Box® – a compact, high-performance dual-flow ventilation solution designed to address the challenges of commercial building renovation. © France Air

1. *Source: https://operat.ademe.fr/public/home.*
2. *Source: ANSES study (France, 2019): Estimated socio-economic cost of indoor air pollution: €19 billion*



©zhu difeng - stock.adobe.com

> **Monitoring IAQ is a major public health issue.**

CO_2 concentration levels, as well as defining how such monitoring must be implemented in buildings.

To support compliance, France Air has developed *Réglement'Air,* a module integrated into France Air Connect that automates regulatory compliance.

With its connected CO_2 sensors and analysis platform, France Air Connect provides a turnkey solution to easily measure, monitor and control IAQ.

Electrification and IAQ: a necessary convergence

Mechanical ventilation plays a central role: without adequate air renewal and reliable air treatment, no IAQ strategy can be truly effective. This is where energy and health challenges converge: efficient ventilation requires coherent, responsive and properly controlled heating and cooling systems, which are enabled by electrification.

Air quality depends on controlled renewal: ventilation maintains acceptable CO_2 levels and dilutes pollutants such as VOCs. To combine health and energy performance, modern systems modulate airflow using CO_2 sensors, adjusting fresh air supply according to occupancy while maintaining a minimum continuous airflow to ensure adequate indoor hygiene without overconsumption.

The development of energy recovery solutions

Energy recovery helps reduce consumption while maintaining comfort and indoor air quality. In this respect, mechanical ventilation with Heat Recovery Ventilation (HRV) stands out as the most efficient solution: it ensures controlled air renewal while significantly limiting thermal losses. Thanks to heat exchangers capable of recovering up to 95% of the energy from extracted air, these systems combine filtered fresh air, efficient extraction and energy efficiency.

France Air has developed a wide range of high-performance ventilation systems with energy recovery, offering various options such as air handling units with hot water coils, electric heating, direct expansion or changeover systems, all equipped with control systems enabling time scheduling, free cooling and night time over-ventilation.

By adapting airflow rates to actual occupancy, a single unit can ventilate multiple spaces according to real needs, avoiding overconsumption. For example, a meeting room is ventilated only when occupied.

The role of the BACS regulation: efficiency through smart control

The energy performance of ventilation systems no longer depends solely on equipment, but also on their ability to be continuously monitored and maintained. This is precisely the aim of the French BACS regulation, which requires the installation of automation and control systems in commercial buildings to improve their energy performance.

France Air's solutions fully align with this approach: its air handling units, dampers and air treatment solutions are natively connectable (Modbus RTU, BACnet, KNX, etc.) and can easily integrate with supervision systems or connected monitoring tools. This compatibility enables real-time reporting of key data (filter status, CO_2 levels, fan faults, operational anomalies, etc.), ensuring controlled operation and long-term performance of ventilation systems.

The convergence of electrification, smart control and air quality marks a key step in the transformation of the commercial building stock. Mechanical ventilation remains a strategic pillar for low-energy, healthy and resilient buildings. Energy recovery, airflow modulation and advanced supervision position ventilation as a central component of overall performance. The BACS regulation reinforces this dynamic by making automation and continuous control essential for efficiency, compliance and system reliability.

Electrification of road transport: a major challenge for the energy transition



Arnaud Protat,
Head of Technical and Market Intelligence Department



Christophe Combre,
Business Development Engineer for Mobility TotalEnergies, New Mobilities – Truck Solutions

Road transport is a cornerstone of the global economy. In Europe, heavy-duty vehicles account for only 2% of the vehicle fleet, yet account for nearly 30% of road transport CO_2 emissions. As freight demand continues to grow and other sectors decarbonise at a faster pace, the sector is facing increasing pressure to reduce its carbon footprint.

For more than 70 years, TotalEnergies has been a trusted partner to transport operators, supporting the decarbonisation of road transport through a broad portfolio of multi-energy solutions that reduce emissions while addressing the operational and economic realities of its customers. In an increasingly demanding European regulatory environment, electricity is emerging as one of the most effective pathways to decarbonisation, particularly in France where the electricity mix is already largely low-carbon. Biofuels (HVO100, biomethane) are also levers for decarbonising transport in a transition phase, yet their availability is limited and demand for these fuels will face increasing competition from other sectors such as maritime and aviation.

The future of freight transport in France: insights from the TotalEnergies Energy Outlook

As a contribution to public debate on the energy transition, the 7th edition of the TotalEnergies Energy Outlook was published on 4 November 2025. It provides an overview of the energy system as well as scenarios for its evolution up to 2050.

The **Trends scenario** reflects the current trajectory of countries up to 2030 and assumes that existing public policies, particularly in China and Europe, as well as technological developments will continue along their path. It considers the recent acceleration in the deployment of mature low-carbon technologies (e.g., electric vehicles, heat pumps), and infrastructure constraints, especially electricity grids, geopolitical tensions and cost-related barriers. In this scenario, global primary energy demand for coal gradually declines,

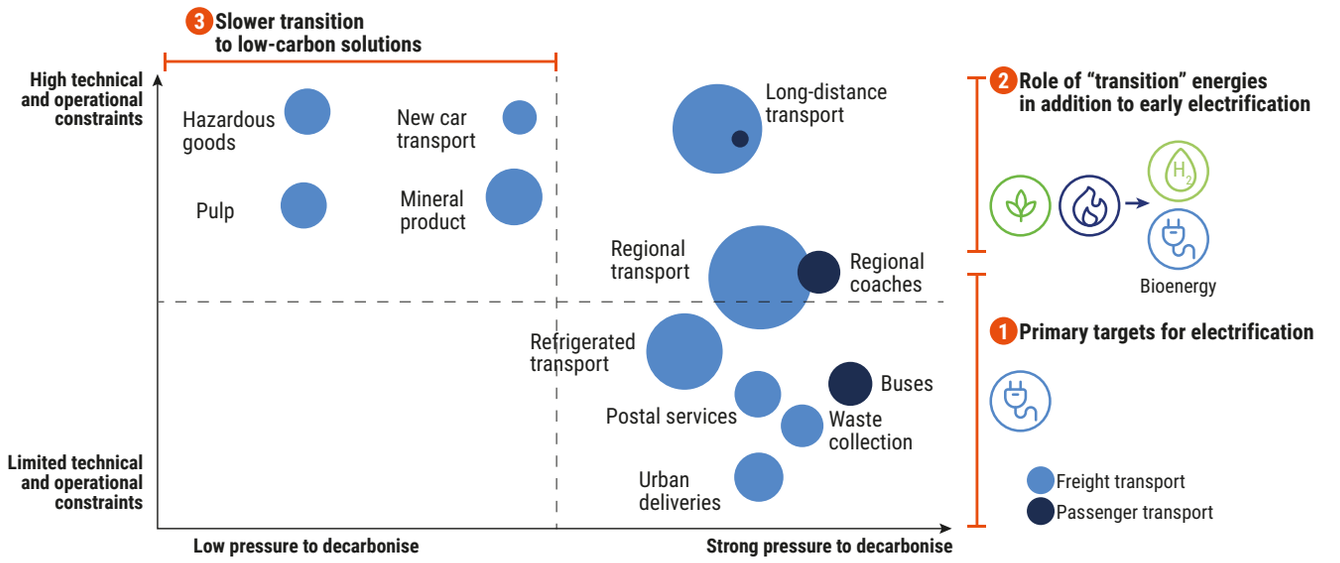


Figure 1: Three decarbonisation pathways based on the level of pressure applied and the operational constraints to be met.

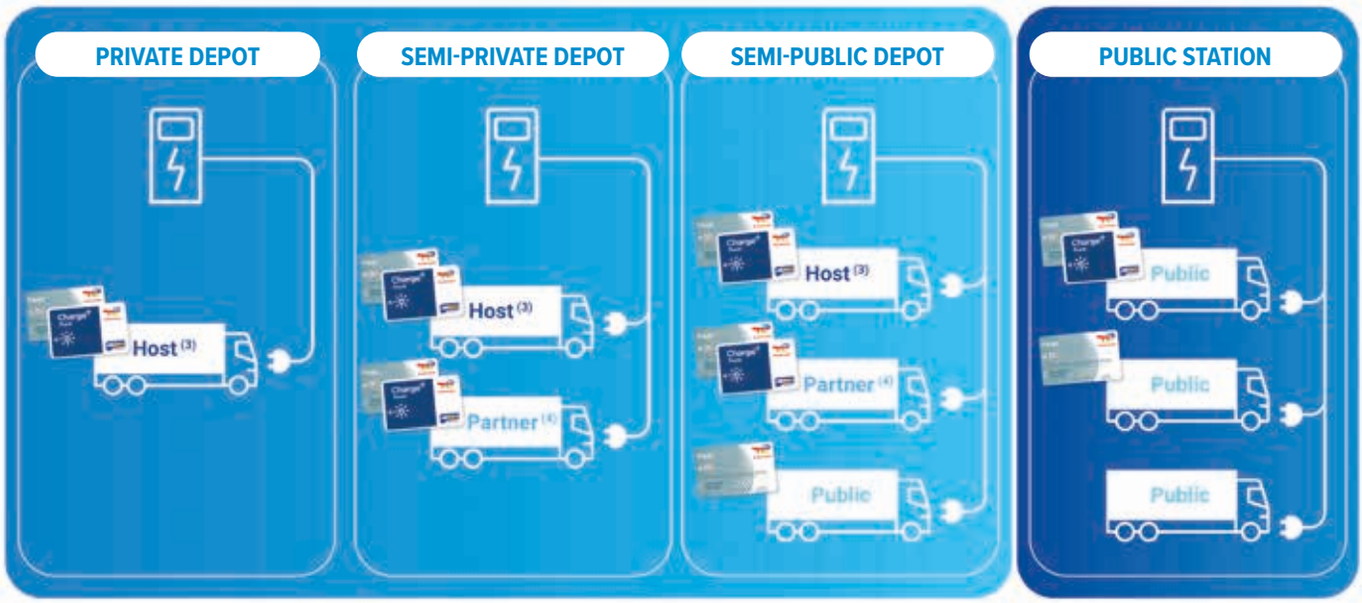


Figure 2: Four charging station models.

reaching levels close to those of 2000 by 2050. Global demand for oil products increases and stabilises until 2040 before slowly declining. Gas demand continues to grow until 2040 before stabilising. This scenario results in an estimated global temperature increase of between +2.6 °C and +2.8 °C by 2100.

The **Momentum scenario** represents a more ambitious outlook. It assumes that OECD countries reach near carbon neutrality by 2050 and China by 2060. It implies: (i) an increased electrification of final energy demand in OECD countries and China; (ii) the near phase-out of coal in OECD countries, a sharp reduction in China and a slight increase in India; (iii) the use of natural gas as a transition energy for electricity generation and industry worldwide; (iv) the deployment of new energy carriers in hard-to-electrify sectors (e.g. low-carbon hydrogen in industry, sustainable fuels in aviation and maritime transport) in OECD countries and in China. In this scenario, fossil fuels still account for half of the growth in energy demand in India and the rest of the world, due to insufficient low-carbon investment. This leads to a temperature increase of between +2.2 °C and +2 .4 °C by 2100.

Energy solutions tailored to each use case

Three decarbonisation pathways can be identified (Figure 1), depending on the segments considered, the level of pressure for decarbonisation (from shippers, regulation, urban policies), and operational constraints specific to each use case:

- rapid electrification for segments subject to strong decarbonisation pressure and limited operational constraints (e.g. urban logistics, buses, parcel delivery);
- gradual electrification, combined temporarily with biofuels, for regional and long-distance transport;
- slower and more complex transition for the most constrained use cases, requiring the full range of available alternative energy sources.

Managing Total Cost of Ownership (TCO): a profitability challenge

The higher upfront cost of electric vehicles remains a major barrier to transition. In an internal study published in early 2025, TotalEnergies found that TCO parity between electric and diesel trucks can already be achieved as early as 2025 for some use cases. However, this requires enabling conditions, such as optimising vehicle lifetime, mileage and charging.

It is also essential to leverage all available public support schemes. TotalEnergies supports the transport sector in accessing energy savings certificates (CEE) and assists operators in obtaining grants from the French programme *Advenir*. Competitive electricity pricing for charging is also critical.

TotalEnergies supports transport operators by:

- reducing investment costs through access to *Advenir* and Cerficates of Energy Savings (CEE) subsidies;
- providing more competitive energy solutions and optimised charging management (Smart Charging solutions).

Four charging models for heavy-duty vehicles

It is estimated that around 80% of heavy duty vehicles charging will take place at depots, and 20% on the road. TotalEnergies has identified four possible charging models allowing multiple uses to be combined at a single site (Figure 2).

These innovative models will help optimise transport operators' infrastructure and generate new revenue streams.

The first semi-public depot developed by TotalEnergies in partnership with Daimler Truck France illustrates how solutions are being adapted to market needs. This site combines several uses: private charging for Daimler Trucks workshops; public daytime charging for en-route use with 400 kW chargers; and public overnight charging through long-term parking spaces equipped with 22 kW and 100 kW chargers.

This initiative is part of a broader strategy aimed at accelerating the deployment of charging infrastructure across France.

Dynamic induction charging: smaller batteries for greater range

By testing dynamic induction charging on a pilot section of the A10 motorway, a world first, VINCI Autoroutes demonstrates the potential of this technology.



Pierre Delaigue,
Director of Connected, Automated and Electric Mobility, VINCI Autoroutes



Thomas Malagié,
Head of Electric Mobility Strategy, VINCI Autoroutes

Electrifying road transport is crucial to tackling climate change and reducing CO_2 emissions. However, high-capacity batteries for heavy-duty vehicles (HDVs) present several challenges: excessive weight that reduces payload, to match long downtimes for charging purposes, high cost and a significant environmental footprint.
As a complement to static charging points, Electric Road Systems (ERS) offer a strategic alternative: charging vehicles while they are on the move in order to reduce the size of onboard batteries. The charge as you drive project confirms the potential of this solution to decarbonise heavy-duty road mobility.

Road transport electrification at a forced pace

The European Union has set a strict decarbonisation pathway for HDVs, with targets to reduce CO_2 emissions from new vehicles on the market by 45% from 2030, 65% in 2035 and 90% in 2040, compared with 2019 levels. To support this transition, the AFIR Regulation requires the deployment of high-power charging stations every 60 to 100 km on Europe's main routes. In France, the benchmark study carried out by TotalEnergies, Enedis and VINCI Autoroutes in 2024 highlights the scale of the challenge: it estimates that around 12,000 charging points will be needed on the national road network for long-distance freight transport by 2035.

On the vehicle side, despite genuine technological progress, electric HDV uptake in France remains far too limited. Representing only around 2% of registrations in 2025, sales volumes are still insufficient to put the sector on track for its 2030 targets. Despite massive investment, manufacturers are caught between strict regulatory targets and a demand that is struggling to develop beyond a few pioneering markets.

Beyond static charging points: electric roads as a lever for more efficient and sovereign heavy mobility

For transport operators, rolling out an electric road network would radically transform the economic equation of fleet electrification. By enabling vehicles to recharge while driving, this solution would drastically reduce the size of onboard batteries, thereby lightening the vehicle, restoring payload capacity, improving energy efficiency and lowering purchase costs. ERS would act as a universal range extender, eliminating lengthy stops and optimising fleet operating time.

For manufacturers, interoperability between dynamic charging and static charging points would be strategic: it would avoid any technological lock-in to risky and incompatible industrial choices. ERS receivers would simply be "an additional plug" on an electric vehicle equipped with a smaller battery, while still allowing it to recharge at a charging point, particularly at the depot.

For electricity network operators, this approach would limit pressure on distribution grids by smoothing power demand beyond the mandatory rest breaks of HDV drivers, across the highway network as a whole rather than concentrating it at service areas.

The adoption of ERS would also address **major macroeconomic challenges** by enabling investment in national road infrastructure instead of large-scale battery imports (€27 billion worth of batteries were imported by Europe in 2023). Reducing battery size would lessen dependence on strategic materials and foreign-made cells, thereby strengthening European industrial sovereignty, creating non-relocatable jobs and supporting a cutting-edge local technology sector.

1. https://www.entreprises.gouv.fr/files/files/Publications/2024/themas/2024-themas-N23-batterie.pdf



Electric heavy-duty vehicle travelling on the experimental section of the A10 highway.
© Caroline Gasch pour VINCI Autoroutes

First pilot projects confirm the potential of dynamic induction charging

The charge as you drive project led by VINCI Autoroutes with support from the investment plan France 2030, in partnership with Electreon, Hutchinson, VINCI Construction and Université Gustave Eiffel, confirms the viability of dynamic induction charging under real motorway traffic conditions on a pilot section of the A10 motorway in the Île-de-France region.

The results show that it is possible to transfer energy wirelessly, at high power levels, to vehicles travelling at motorway speeds.

The trial also demonstrates the mechanical durability of the system under the stresses of heavy traffic, the absence of health risks linked to electromagnetic emissions, and the compatibility of this ERS infrastructure with standard road maintenance operations. By removing these critical barriers, the charge as you drive project confirms that electric roads are a safe solution, ready to be integrated into the national road network.

Overcoming technical, economic and regulatory challenges

Moving from a pilot project to the deployment of the first commercial sections presents major challenges.

- **Technical challenges:** the standardisation of induction systems to ensure interoperability between different onboard receiver technologies and ground-based charging infrastructure. The challenge is to define universal communication and energy transfer protocols, thereby avoiding technological fragmentation that would hinder large-scale deployment.
- **Economic challenges:** fully equipping the concession highway network requires massive investment, estimated at several tens of billions of euros. The business model has yet to be stabilised: energy and service access pricing must be defined in a way that is acceptable to transport operators while ensuring infrastructure profitability for infrastructure managers.
- **Governance challenges:** the deployment of electric road corridors or networks would create an unprecedented governance challenge, requiring close coordination between the State, grid operators, vehicle manufacturers, equipment suppliers, transport operators and highway concessionaires. Public leadership will be essential to trigger the first wave of major investment and ensure secure planning along key corridors. Without political harmonisation, including at the European level, the risk of technological fragmentation would slow uptake among transport operators.

Recommendations and actions for public authorities

To move beyond pilot projects such as the charge as you drive project and achieve large-scale deployment, concrete action is needed.

- **Funding for the first corridors:** introduce funding mechanisms to support projects aimed at deploying the first commercial sections.
- **Integrated planning:** incorporate ERS into national energy planning frameworks, such as France's Multiannual Energy Programme (PPE), and in regulatory frameworks, such as the AFIR Regulation at the European level, so that all stakeholders can plan the associated investments.
- **Strategic coordination:** ensure consistency between the deployment of ERS infrastructure and fleet equipment, by actively supporting the integration of ERS receivers into new vehicles as well as retrofit solutions to enable rapid uptake across the existing fleet.



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Electric mobility:

the Volkswagen Group puts forward concrete measures to accelerate the transition

The Volkswagen Group committed to electric mobility at a very early stage, developing a full range of vehicles and helping to expand charging infrastructure. However, a new momentum is now required, and Volkswagen Group France is putting forward proposals.



Laurent Bonavent,
Head of Strategic Projects
Electrification & Decarbonisation
Volkswagen Group France

The Volkswagen Group, like many car manufacturers in Europe, is heavily committed to electric mobility through its existing and upcoming models, as well as by deploying a support strategy for its customers and dealer networks.

Rapid and tangible results can be observed in this move towards electrification, but many challenges still lie ahead, whether technical, economic, or even resulting from pushback from lobby groups whose interest is to slow down our collective progress.

Fortunately, decisive action can be taken at both French and European levels, with some already underway and other currently under discussion.

Clear and measurable results

Despite the massive investments required and the complex technological choices involved, the Volkswagen Group continues to expand its range of electrified vehicles, both fully electric and plug-in hybrid models. More than 50 models are already available on the French market. By 2026, fully electric small city cars will be introduced under the Volkswagen, Škoda and Cupra brands. These models will further improve price accessibility, with entry-level versions announced at around €25,000.

The price of EV, long seen as a barrier compared to internal combustion models, is no longer the sole deciding factor, since 80% of private sales are now made through leasing contracts, and almost 100% in the business segment. Significant positioning efforts have made it possible to offer lease payments on par with equivalent combustion-engine models. On certain models, such as the Škoda Elroq, the proposed monthly lease is even €10 cheaper than the equivalent combustion model (Škoda Karoq), offered at €409 per month.

In the transport sector, event if charging and range challenges are greater, electric light commercial vehicles and heavy duty-vehicles are now arriving on the market in significant numbers. For example, trucks from Scania are equipped with batteries of up to 560 kWh net capacity (624 kWh gross), offering a stated range of up to 560 km depending on the version.

This brings us to the issue of charging infrastructure, as the fleet of electrified vehicles in France now exceeds two million. Here too, major efforts have been made, thanks to government support and investments by various electric mobility stakeholders. As a result, France has become a European

> **"... electric light commercial vehicles and heavy duty-vehicles are now arriving on the market in significant numbers.**

leader, with nearly 180,000 publicly accessible charging points and a target of 400,000 by 2030.

Volkswagen Group France is contributing to these efforts through the creation of ELECTRIFY France, bringing together its dealer network and currently operating 100 stations and 230 HPC charging points of 150 kW and above. The Group is also active at European level through the IONITY consortium, which operates 168 stations in France, open to all vehicles 24/7, with more than 1,000 350 kW fast charging points as of early 2025.

These charging stations are increasingly used and more reliable, with a 93% availability rate according to the French Gireve barometer. The growing number of fast charging points, including more than 20,000 HPC units, has made long motorway journeys possible without concern – except perhaps during peak holiday travel periods.

Significant challenges remain

However, significant challenges remain, both for private customers and for businesses. The future of state financial incentives remains uncertain, especially as support schemes have been steadily scaled back over the past two years. These incentives can change multiple times within a single year and are highly complex, leaving customers hesitant and often confused about their purchasing decisions. This wait-and-see attitude can be seen in the expected size of the French market, forecast at 1.6 million sales compared with 2 million before Covid.

At the same time, news regarding US customs tariffs and discussions between the European Union and car manufacturers on the 2035 regulations are creating a sense of confusion.

Economic challenges therefore remain considerable. Which technology should be prioritised? At what pace? And how should investments be managed at both European and global levels?

The Volkswagen Group invests tens of billions each year in new products, while also developing new platform technologies, batteries and digitalisation solutions. These investments must be carried out within a stable regulatory, fiscal and political environment to ensure a reliable return. The Group has confirmed its commitment to ending sales of combustion-engine vehicles by 2035, while continuing to explore alternative technologies such as synthetic fuels and maintaining constructive dialogue with Brussels.

Investments in this sector are long-term by nature, meaning that every euro invested must correspond to genuine market demand. Otherwise, financial difficulties may arise, as recently illustrated by the battery plant project developed by Northvolt.

Many challenges remain. Nevertheless, as a key player in electric mobility, it is our responsibility to do everything possible to ensure success, to communicate clearly and to counter misinformation about EV, which unfortunately continues to persist, even within some of the most established media outlets.



Battery repair centre.
© Volkswagen

STEP FORWARDS

First, we at Volkswagen Group France are aware that nothing is fully secured yet during this complex period of ecological transition. Our actions must be strong and sustainable.

Awareness and education efforts must continue – explaining why electric vehicles matter, how they connect with the home for charging, how to manage driving range, and how they help reduce carbon footprint. While many studies demonstrate these benefits, they are still sometimes questioned. This is what we do focus through our communications, on our websites, and across our distribution networks.

We also need to remove the remaining obstacles: access to charging in condominium remains complex, and ensuring interoperability in paid parking areas is still a challenge.

New building developments should better accommodate EV with dedicated conduits and electrical cabinets, not only incomplete cable pathways.

The current 20,000 fast charging points are sufficient for today's needs, but we need to plan for long-term growth in demand. An ongoing pilot project to install charging stations in motorway rest areas is a promising step in that direction.

Heavy duty-vehicles will require significant but essential investments to enable the Megawatt Charging System (MCS) charging and to adapt existing parking areas. Finally, however challenging it may be, we must continue to advocate for our case to the French and European authorities.

Electric vehicle charging infrastructure and its control

The development of electric mobility relies on the availability and service quality of charging infrastructure. As all charging points are connected to the electricity distribution network, Enedis plays a central role in their deployment. By the end of 2025, there were approximately 2.8 million charging points, representing more than 22 GW of installed capacity, located in homes, businesses, and public spaces.



Delphine Beauvir,
Head of Electric Mobility Department, Enedis

To achieve carbon neutrality by 2050, the electrification of the transport sector is an essential lever. It could represent an increase of 100 TWh in annual electricity consumption by 2050[1], with the majority of this energy transiting through the grid managed by Enedis. By the end of 2025, France already had 2.5 million electrified vehicles, with a monthly market share in new vehicle sales rising to more than 23% on average in 2025. By 2035, more than 13 million electric or plug-in hybrid vehicles could be on the road.

Achieving carbon neutrality by 2050 requires the electrification of the transport sector as a key enabling strategy. This transition could increase annual electricity consumption by approximately 100 TWh by 2050[1], with the vast majority of this energy being delivered through the distribution network operated by Enedis. By the end of 2025, France already had 2.5 million electrified vehicles, with electrified models accounting for an average monthly market share of more than 23% of new vehicle sales in 2025. By 2035, the number of electric and plug-in hybrid vehicles in circulation could exceed 13 million.

Charge management is a necessary condition for the large-scale integration of electric mobility. It is a major lever for optimising the cost of electric mobility for customers and for the electricity system, including the grid.

Charging times by charging type (approximate values)

Type of charging	Charging power	Where are the charging points located?	Charging time for 100 km	Charging time for 300 km
Slow charging P ≤ 3.7 kW	2.3 kW standard socket (10A)	Home	8 h	25 h
	3.7 kW reinforced socket (14A)		4 h	12 h
Normal charging P ≤ 7. 4 kW	7.4 kWsingle-phase charging station	Home or public roads / company car parks	2 h	6 h
Accelerated charging P ≤ 22 kW	22 kW three-phase charging station	Public roads / company car parks	40 min	2 h
Fast charging P < 150 kW	50 kW DC charging station	Service stations / retail car parks	20 min	1 h
	100 kW DC charging station		10 min	30 min
High-power charging P >= 150 kW	150 kW HPC charging station	Motorway service areas	6 min	20 min

Figure 1: Main types of charging infrastructure and associated approximate charging times.

1. *Compared with 2019. Source: Enedis – French Observatory for the Ecological Transition.*

By shifting energy consumption away from peak hours, it also helps reduce CO_2 emissions by limiting the use of gas- or oil-fired thermal power plants.
Charge management (Smart charging) is a prerequisite for the large-scale integration of electric mobility. It is a key lever for cost optimisation for both EV drivers and the power system, including the electricity distribution network. By shifting electricity consumption away from peak demand periods, smart charging also helps reduce CO_2 emissions by limiting the use of fossil fuel power plants.

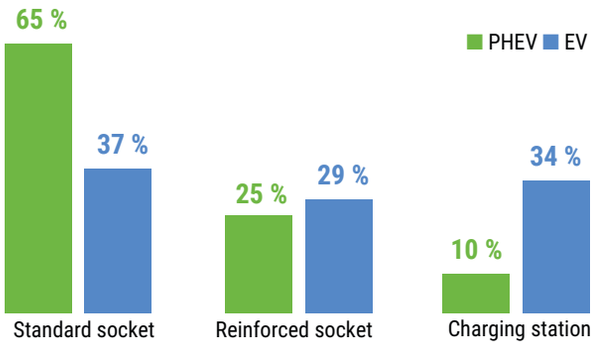


Figure 2: Distribution of home charging infrastructure.

The different types of charging infrastructure by customer category[2]

Home charging: 67% of homes have allocated (or private) parking lot

At home, drivers can charge their vehicle using a standard socket (with a maximum output of 2.3 kW), a reinforced socket (3.7 kW), or a dedicated charging station (7.4 kW or more), mostly of AC 1 phase installation. An Enedis survey shows that the standard socket is the most used charging mean among owners of plug-in hybrid vehicles (Figure 2)[3]. However, it does not allow remote control.
Moreover, while two-thirds of fully electric vehicle owners charge using a reinforced socket or a dedicated charging station, automated charge management requires a connection to the meter or to the internet.
To support French households in installing efficient charging equipment, several public support schemes have been introduced in France:

- the Advenir grant for residents of multi-unit residential buildings, which covers 50% of the cost of purchasing and installing an individual charging point, up to €600 (excluding VAT), regardless of income;
- the reduced VAT rate of 5.5%, instead of the standard 20%, for services including the supply and installation of an electric charging station;
- in addition to these financial support schemes available nationwide, some local authorities have introduced specific aid schemes for their residents, which can be combined with the schemes mentioned above.

Workplace charging for company fleets and employees

Companies play a driving role in the electrification of the vehicle fleet, under the influence of the French *Loi d'Orientation des Mobilités* (Mobility Orientation Law, LOM), and for economic and environmental reasons. In 2025, company vehicles accounted for 60% of new electric vehicle sales. In the coming years, they will be the main source of supply for the second-hand market.

In France, charging infrastructure in companies is distributed as follows[4]:

Standard sockets 28 %	Reinforced sockets 32 %	Charging stations 28 %

Among companies with charging infrastructure, 45% allow employees to charge their personal vehicles in the company car park. This has become the main charging location for 8% of electric vehicle drivers.

Public charging stations and fast-charging points

The number of public charging points passed a milestone in 2025, reaching 185,500 by the end of the year, an increase of 21% compared with 2024. This momentum is in line with the national target of 400,000 charging points by 2030. The aim is to complement home and workplace charging by serving drivers without access to dedicated parking facilities and supporting charging needs during long-distance travel.
Fast-charging points are experiencing particularly strong growth, making long-distance travel by electric vehicle easier. France currently ranks second in Europe for fast charging, behind the Netherlands.

Charge management: an essential lever for the power system

As millions of electric vehicles are gradually connected to the grid, charge management is becoming a strategic issue for the French power system. It involves steering electricity consumption towards periods when electricity is most available, and often cheapest, in order to reconcile economic benefits for customers with grid balance.
In this context, the deployment of charge management solutions must accelerate. It requires close coordination between transport and energy stakeholders, electricity suppliers, and manufacturers of charging stations and vehicles, to cover all use cases and offer suitable incentives to end users.

2. *Source: Electric Vehicle Charge Management – Enedis Report, April 2024.*
3. *Source: Enedis – 2025 behavioural survey of electric vehicle owners.*
4. *Source: Enedis – 2025 survey on the use and charging of vehicles in companies.*



© Enedis

Why manage electric vehicle charging?

For customers

Charge management helps reduce electricity bills by targeting charging during the cheapest hours, generating savings of around 15% on the part of the bill linked to vehicle charging. It also helps smooth electricity demand, avoiding the need for customers to increase their subscribed capacity – and the associated subscription costs – or to undertake costly grid connection upgrades.

For the electricity system

In an energy mix that includes an increasing share of renewable and intermittent energy sources, the system needs flexibility to maintain the balance between production and consumption. Charge management will play a key role from 2030 onwards, particularly to:

- avoid increasing consumption peaks around 7 p.m.;
- maximise charging during midday and summer periods, when solar production is at its peak[5].

For the public distribution grid

Smoothing consumption allows Enedis to spread grid reinforcement works over time. This approach contributes to more effective planning of the investments required for the progressive electrification of uses, by avoiding simultaneous consumption peaks that would require immediate and costly reinforcements.

However, not all electric mobility use cases are suited to charge management. Charging while travelling, or at public charging stations where immediate charging needs are involved, is difficult to manage. Charge management is particularly relevant for:

- home charging;
- workplace charging, for fleets and personal vehicles;
- heavy-duty mobility charging in depots during long breaks.

Static or dynamic charge management?

Static charge management is based on a fixed and predictable reference framework, such as recurring scheduled charging or power modulation to remain within the subscribed power level.

When customers align the charging of their electric vehicle with a peak/off-peak tariff structure, they can reduce the cost of their energy bill. This incentive is beneficial for the electricity system because it helps moderate power demand during periods of high consumption, both for the generation fleet and for grids. In the future, changes to off-peak hours will allow charging in early afternoon during the summer, when solar energy is abundant.

Dynamic charge management considers dynamic data from various external sources, such as the customer's mobility needs, dynamic pricing, or synchronisation with local photovoltaic production, in order to:

- optimise the energy bill by consuming electricity when it is cheaper, or even injecting electricity when it is more expensive;
- synchronise charging with nearby renewable energy production;
- respond to a flexibility need from the electricity system or from the grid.

Dynamic charge management is not as mature as static charge management, but solutions and market players are developing.

Generalising charge management at home

Enedis encourages the systematic use of static tariff-based charge management at home during off-peak hours.

Home charging practices remain varied:

- 35% of drivers say they systematically manage their charging;
- 10% manage it occasionally;
- 55% say they do not manage it at all.

Today, charge management is mainly carried out via interfaces provided by car manufacturers, at 59%, while charging stations, at 5%, or systems directly linked to the Linky meter remain little used (Figure 3). To be adopted on a large scale, charge management must be simple, accessible and inexpensive. To be effective for the electricity system, it must also be automated.

Promoting charge management in companies

Enedis encourages tariff-based charge management for collective charging infrastructure. In 2025,

- 36% of companies managed charging;
- among them, 41% used a global Building Energy Management System (BACS)[6].

5. Source: RTE, Energy Futures 2050 report.

6. Source: Enedis – 2025 behavioural survey of electric vehicle owners.

7. The BACS decree (Building Automation and Control Systems) , from 7 April 2023, requires all new or existing tertiary-sector buildings with a useful power rating above 70 kW, corresponding to buildings of more than 1,000 m², to be equipped by 1 January 2027 with a centralised and automated management system to control at least heating, ventilation and air-conditioning uses. This deadline has been postponed to 1 January 2030 for buildings with a power rating between 70 and 290 kW, in order to align France with European rules.

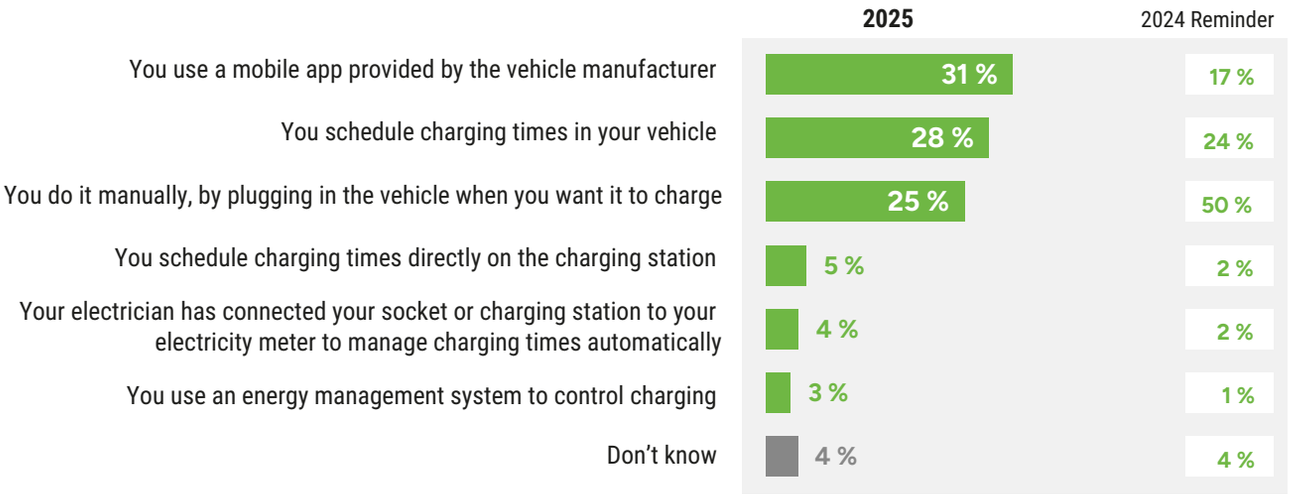


Figure 3: Methods used to schedule or shift home charging
Based on a sample of 394 users who reported managing their charging.

By 2030, 50% of tertiary buildings are expected to be equipped with BACS[7] (against 15% today) creating a strong opportunity to integrate the management of charging systems.

Overnight fleet charging during off-peak hours is often an achievable objective. In addition, with the growing use of workplace charging for personal vehicles, mid-day charge management is becoming a relevant lever for making use of solar production.

Making the most of charge management for heavy-duty mobility

Electric heavy-duty vehicles are gradually being deployed in the road freight sector. Enedis conducted a study simulating the effects of charge management during long depot breaks, mainly at night. This type of management offers significant economic benefits for road freight operators, whose profit margins are typically very slim. Any reduction in operating costs is therefore highly valuable. For the electricity system, the impact on peak consumption remains more limited than for light vehicles, due to the smaller volumes involved and the specific constraints of the logistics sector.

Four recommendations

In its report on electric vehicle smart charging, published in April 2024, Enedis issued four recommendations for stakeholders across the electric mobility ecosystem.

1. Make tariff-based smart charging the standard

Since 80% of residential charging takes place at home, the residential sector is a key area of focus. Installing controllable charging systems connected either to the distribution system operator's smart meter or to the Internet enables charging to be automatically scheduled during the most favourable tariff periods.

2. Encourage tariff-based smart charging for shared charging infrastructure

For charging facilities in workplaces, commercial buildings, and managed multi-unit residential buildings, regulatory and financial incentives should be strengthened to promote the widespread deployment of power and energy management systems.

3. Raise customer awareness of the benefits of smart charging

Only 35% of electric vehicle owners report actively managing their charging. Communication initiatives led by public authorities, vehicle manufacturers, electricity suppliers, and other stakeholders are therefore needed to inform users of the benefits of choosing an appropriate electricity tariff and charging equipment capable of smart charging.

4. Encourage customers to optimize their connection power capacity

Smart charging makes it possible to optimize the power required for vehicle charging alongside other household or building loads, thereby controlling the overall demand. Customers planning a new grid connection or an upgrade should therefore receive clear information encouraging them to size their contracted connection capacity while taking into account the benefits of smart charging.

As of early 2026, despite encouraging progress, the widespread adoption of smart charging remains an important objective. In the coming years, it should become a common practice, integrated into the daily habits of households, businesses, and transport professionals.



Decarbonising freight transport and the critical role of electrification

As freight transport is facing major challenges in reducing greenhouse gas emissions and cutting air pollutants, the electrification of fleets has become an obvious choice. It is not the only lever for decarbonisation, but it will be essential in meeting climate targets. La Poste, a pioneer and industry leader in this field, shares its experience.



Claire Baritaud,
Director of Sustainable Policies, Expertise, and Innovation, La Poste Group

Freight transport remains highly carbon-intensive

One of the major challenges of the twenty-first century is to fight global warming by achieving net zero emissions. France, which is warming faster than the global average, is bracing for a temperature rise of 2°C by 2030, 2.7°C by 2050 and 4°C by 2100 compared with the pre-industrial era, should current global climate policies remain unchanged. Ten times more heatwave days and tropical nights, heightened wildfire risks across the country, up to two additional months of dry soils, heavier rainfall and less snow in the mountains: this is what France could look like if the Paris Agreement is not upheld.

In France, the transport sector is the first source of greenhouse gas emissions. Freight transport expanded tenfold during the *Trente Glorieuses* to meet growing demand for consumer goods (a 3.4-fold increase in tonne-kilometres between 1960 and 1990). Road transport, which accounts for 94% of emissions from the transport sector, is the primary contributor due to its reliance on fossil fuels.

Five underlying factors behind emissions

The Kaya equation, which links anthropogenic carbon dioxide emissions to freight transport parameters, was adapted by Aurélien Bigo in his 2020 doctoral thesis, *Les transports face au défi de la transition énergétique*. It identifies five categories of decarbonisation levers, each with several actionable solutions (Figure 1):

- Transport demand (route optimisation, short supply chains, mixed-use development);
- Modal shift towards low-carbon modes (light mobility, rail freight, inland waterway freight, tram freight);
- Load factor (increasing density, better-organised bulk transport);
- Vehicle energy efficiency;
- Carbon intensity of energy (electricity, B100, HVO, bio-CNG, hydrogen).

Let's examine the feasibility of each parameter.

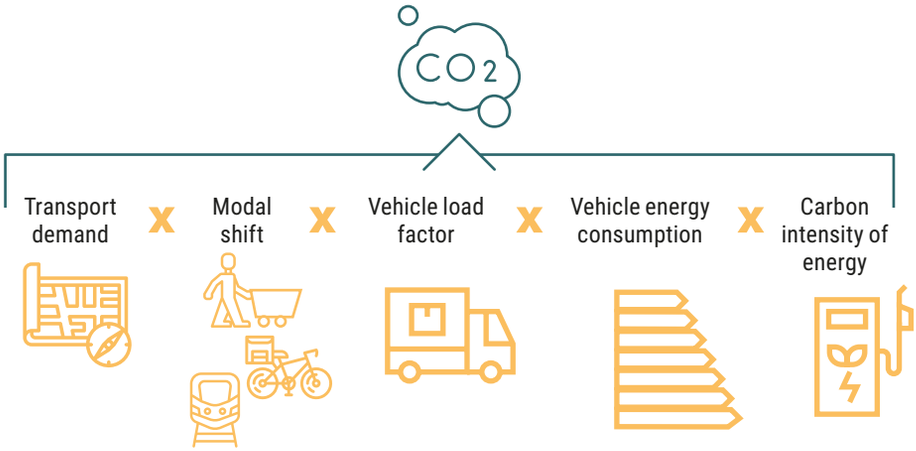


Figure 1: The five levers for decarbonising the freight transport sector.

Load Factor

Increasing the amount of goods carried per vehicle is, of course, a way to reduce carbon emissions. In passenger transport, this is illustrated by carpooling incentive policies. In freight transport, loading vehicles with bins or mobile crates that allow for optimised packing can increase the load factor by 10 to 30%.

Transport Demand

Road freight transport, like passenger transport, becomes efficient when it is grouped to minimise the number of kilometres travelled. By using an industrial system that manages collection, concentration, sorting, dispersion, and distribution, it is possible to reduce the average distance travelled per item and achieve an optimised freight transport system with a maximised load factor.

Modal Shift

Long-distance transport modes, ranked from least to most carbon-intensive, are as follows: rail, inland waterways/maritime, road, and air. This clearly points to prioritising a modal shift from air and road to rail. However, the reality of France's infrastructure must be taken into account. While the road network expanded by 11%[1], allowing for higher traffic capacity, both the rail and inland waterway networks contracted by 12% over 15 years between 2005 and 2020, with the main beneficiaries being passenger transport in the case of rail.

For first- and last-mile delivery, several freight tram pilots have been tested; however, their main limitation remains transfer operations, which are time- and resource-intensive due to the loading and unloading required for multimodal integration. Other transport modes are also well-suited to short distances, particularly cycle logistics, which has rapidly developed in urban centres thanks to proactive policies promoting new cycling infrastructure. Around 200 cycle logistics companies are now registered in metropolitan France across 74 cities.

Energy Efficiency

This last type of decarbonisation lever is in the hands of engine manufacturers, as well as in the research and technological development of engines with better energy performance. The internal combustion engine, limited by the Joule effect but equipped with improved combustion chambers, recovery systems, and post-injection techniques allowing complete fuel combustion, is in itself a technological marvel, the result of 40 years of advancements in the automotive industry, particularly following the oil shock crisis of the 1970s. The latest generations of internal combustion engines can achieve efficiencies of up to 50%. The electric motor, thanks to its energy conduction system, does not suffer from heat dissipation losses, allowing it to reach much higher efficiencies, around 80–90%.

Electric drivetrains are therefore, from the perspective of energy efficiency and carbon intensity, an essential solution for limiting global warming.

Carbon Intensity

From the 1950s onwards, oil became the world's primary energy source, meeting more than 30% of global energy needs. It is the main raw material for the fuels that power transport (cars, trucks, planes). In 2009, 98% of transport energy came from oil, with a very high carbon intensity per kilometre, not to mention the local air pollution generated by engine combustion.

In terms of carbon intensity, electric motors are an unmatched solution for decarbonising light goods transport. Through increased research and development efforts, particularly on battery technologies, electric motors have become highly efficient over the past decade for light vehicles.



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1. *Infrastructures de transport - Chiffres clés transports 2022:* https://www.statistiques.developpement-durable.gouv.fr/edition-numerique/chiffres-cles-transports/fr/

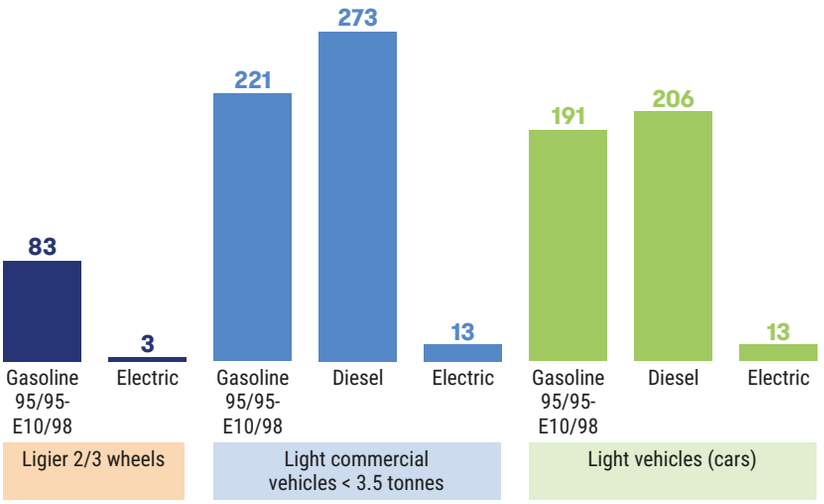


Figure 2: Well-to-wheel carbon intensity of common vehicles (in gCO_2-eq/km).

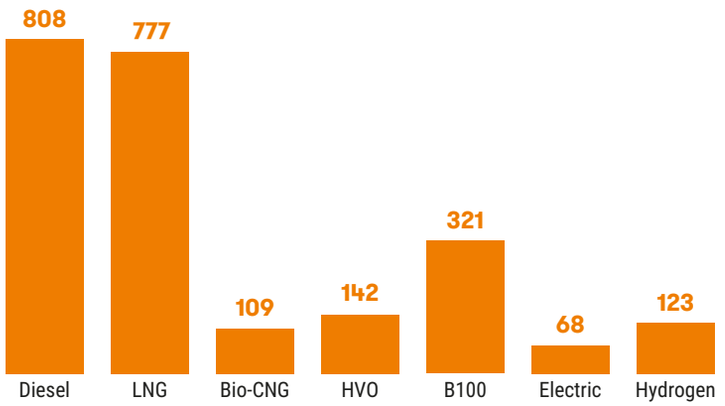


Figure 3: Well-to-wheel carbon intensity of heavy goods vehicles (tractors).

For heavy vehicles, since the carbon intensity of internal combustion engines is almost three times higher than that of light vehicles, other energy sources become attractive, such as hydrotreated vegetable oils (HVO) produced from waste, residual oils, and fats, or bio-CNG (compressed natural gas) and biomethane derived from the anaerobic digestion of organic waste, such as sewage sludge or grape marc residues, for example. In France, there are now more than 1,900 anaerobic digestion units providing 12 TWh of gas and electricity, compared with fewer than a hundred in 2010.

To meet the short-term 2030 commitments adopted by many companies, diversifying fuels in road transport is necessary and will allow for an effective reduction of CO_2 emissions. For net zero commitments by 2050, electric drivetrains are expected to take precedence, with battery technologies enabling long distances of over 400 km per charge.

However, many challenges remain. The main limiting factor for the development of electric heavy goods vehicles is cost, particularly the price of batteries. Currently, the total cost of ownership (TCO) of an electric heavy truck remains two times higher than that of a conventional diesel truck. It is also necessary to deploy charging infrastructure, which differs from that used for light vehicles. Finally, another limitation of an all-electric model for road freight is the required electrical power: each motorway service area would need a power station equivalent to 50–60 MW, and the overall demand would be around 5 GW, equivalent to four nuclear power plants.



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Postal Operations

La Poste has always been a freight carrier. Its history is closely tied to modes of transport, initially by horse with the *poste aux chevaux*, then by rail in the mid-XIXth century, followed by automotive and air transport (*Aéropostale*) in the XXth century.

In 2024, the La Poste Group transported nearly 5 billion items of mail and more than 2.5 billion parcels. It operates the leading parcel delivery network in Europe for packages under 30 kg, notably through its subsidiary Geopost (under the DPD brand) and its Colissimo brand in France. 95% of the vehicles it purchases are low-carbon, with the aim of reaching an 80% electric mail and parcel fleet by 2030.

La Poste Group covers 2.3 billion kilometres on first- and last-mile deliveries and 1.4 billion kilometres in linehaul operations, equivalent to circling the Earth 10 times... every hour!

Decarbonisation is therefore a major challenge for the La Poste Group, which



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Decarbonising freight transport is both part of the problem and part of the solution.

has been fully committed for over 15 years and has pledged to achieve net zero emissions before 2050. Its transition plan is now publicly published[2].

The History of Postal Electrification

For a company that collects parcels throughout the day and redistributes them under deadlines imposed by e-commerce merchants, operations must run like clockwork without risk of delays. Given these constraints and current infrastructure availability, road transport remains the only truly viable mode.

Archives consulted by our historian Sébastien Richez show La Poste's investment in the 2008 electric vehicle programme, launched under the *Grenelle de l'Environnement*. During the 2009 *États généraux de l'automobile*, the government spokesperson Luc Chatel revealed that La Poste had been tasked with placing orders for upcoming electric vehicles to reach the critical mass needed to build a new industry.

After 15 years of effort and collaboration with automotive manufacturers, several generations of electric vehicles, particularly light commercial vehicles, have emerged. By 2025, postal workers are operating with a fleet of nearly 26,000 light electric vehicles across cities and rural areas for mail and parcel delivery. The total cost of ownership (TCO) is now very competitive compared with internal combustion vehicles, and the Group continues the electrification of its *Vehipostes* fleet to reach over 80% electrification by 2030.

In the field of electric heavy vehicles, the story is only just beginning: the first two Volvo electric trucks have been operating in Auvergne since last October, and a few electric heavy trucks are being tested by our subsidiary DPD Switzerland. However, many questions remain, including the economic performance model. In this area, biogas, biofuels, and hydrogen drivetrains may have a role to play. According to the Global Decarbonization Summit held at La Poste headquarters on 18–19 March 2025, with leading heavy electric truck and battery manufacturers, the next ten years will be decisive.

Light Mobility

La Poste's sustainable urban logistics also incorporates light mobility modes. Cargo bikes and electric-assist bicycles make up a fleet of 15,000 vehicles. These vehicles are the result of co-development with Valeo motors, featuring automatic gearboxes, reverse gear, and traction capable of handling 30° slopes. In addition, La Poste is a leading beta tester for local authorities, as an intensive user of cycle paths. As a result, the company is frequently consulted when defining master plans for cycling infrastructure.

Multimodal Logistics Hubs

La Poste operates 3,100 logistics platforms, with the largest capable of handling 1 million parcels per day. To integrate new mobility modes, industrial logistics layouts have had to adapt, along with the configuration of logistics hubs, which have become multimodal.

For example, the 5,000 m² multi-flow platform opened in August 2024 at Saint-Pierre-lès-Nemours, certified *High Environmental Quality*, incorporates electric Kangoo vans, cargo bikes, and electric-assist bicycles.

Conclusion

I would like to conclude by reaffirming that it is time to act. Fight against climate change is humanity's main challenge of the XXI[st] century, and every fraction of a degree of global warming avoided is valuable. Decarbonising freight transport is both part of the problem and part of the solution. Through a detailed understanding of the transport system, including supply and demand dynamics, and through investment in research and innovation, we can make net zero emissions a reality.

2. *His transition plan is now publicly available: afCI8cBOoF08xXdY_Climate_Transition_Plan_La_Poste_Group_April_2026.pdf*



© Renault trucks

The electric truck hits the road

In response to the climate emergency, Renault Trucks has committed to fully decarbonising its product range by 2040. An analysis of the available options shows that biofuels, including biodiesel and biomethane, will remain scarce and expensive, while battery-electric technology offers the best balance between environmental and economic performance. The conditions needed to accelerate its ramp-up must now be strengthened.



Marc Lejeune
Director of Business Intelligence
Renault Trucks

Our pathway fully decarbonising our truck sales by 2040 is monitored by the independent Science Based Targets initiative. By 2030, the pathway requires trucks sold by Renault Trucks to emit 40% less CO_2, on a well-to-wheel basis, than in 2019. Achieving this target will require replacing fossil diesel with low-carbon energy sources: electricity, hydrogen and biofuels.
However, all these energy sources will not be available to the road freight sector on the same scale or within the same timeframe. To better understand the orders of magnitude involved, we have developed a simplified European energy model that accounts for demand across all sectors and balances energy supply and demand in Europe from 2025 to 2050.

Biodiesel will shift from road transport to aviation and shipping

Biodiesel and biokerosene currently account for 5% of the energy consumed by the European transport sector, with 90% of this amount used in road transport, mainly in the form of fatty acid methyl esters (B100 or FAME) blended with diesel. Producers aim to double their annual production volumes by 2050, mainly through hydrotreated oils such as HVO and HEFA, although questions remain regarding the actual availability of feedstocks in Europe.

The ReFuelEU Aviation Regulation provides for a gradual increase in the share of non-fossil aviation fuels, or sustainable aviation fuels, from 6% in 2030 to 70% in 2050. This increase will initially be driven by bio-SAF (SAF: Sustainable Aviation Fuel), which is less expensive than e-SAF. Similarly, international maritime regulations provide for decarbonisation measures that will require growing volumes of biodiesel.

As a result, we expect the price of biodiesel to rise and biodiesel to shift progressively away from road transport towards aviation and shipping. By 2035, we expect aviation to consume 38% of biodiesel-type fuels, with a further 20% being used by the maritime sector. By 2050, road transport is expected to consume only 5% of the biodiesel-type fuels produced.

Biogas is needed to replace some existing fossil gas uses

Biogas and its refined form, biomethane, currently account for 6% of the gas consumed in Europe, with 72% being used for electricity generation. Europe aims to triple its production by 2050. Here again, questions remain regarding the availability of feedstocks. This increase would enable biogas to cover 20% of current fossil gas uses.

For the remaining 80% of current fossil gas uses that will not be covered by biogas in 2050, electrification will need to be prioritised. Where this is not possible, the more energy-intensive and expensive hydrogen solution will have to be used.

Biofuels, including biodiesel and biomethane, which are already in limited supply, are therefore expected to become increasingly scarce for road transport. In the long term, they are estimated to meet the needs of no more than 5% of the truck fleet.

Battery-electric technology offers the best environmental compromise

When battery-electric technology, hydrogen and biofuels are compared against environmental criteria, battery-electric technology emerges as the best option (Figure 1).

There is, admittedly, some concern regarding the depletion of mineral

resources. Mineral reserves are sufficient to support the global economy's transition to electric technologies, but their availability on the market will depend on the pace of investment in mining. Fortunately, the recycling of all batteries, a legal obligation for manufacturers, will make it possible to operate increasingly within a closed loop by 2050, with a progressively lower requirement for newly mined materials.

Finally, it should also be remembered that electric vehicles contribute to economic sovereignty. Take the example of a 16-tonne rigid truck travelling 40,000 km per year over a 16-year period. The diesel version requires Europe to import €60,000 worth of oil, which is burnt and therefore lost, while the electric version requires just €7,200 worth of minerals for the truck, more than 80% of which can be recycled, together with €5,400 worth of coal, gas, uranium and copper for electricity generation and distribution. Overall, the electric truck reduces the value of Europe's raw-material imports fivefold.

Battery-electric trucks sometimes require changes to logistics operations

Turning now to operational considerations, electric trucks are highly valued by drivers for their quiet operation. Their payload capacity is very close to that of diesel trucks, thanks to the additional two tonnes permitted for electric vehicle combinations and, where necessary, the addition of an extra axle, as on our T 780 tractor unit.

In terms of cost per kilometre, battery-electric trucks are expected to become the most cost-effective decarbonisation solution before 2030, provided that sales volumes increase as planned.

To achieve this in France, further support is needed, in addition to the current energy-saving certificates (CEE), in particular the implementation of the European directive on road charges (the Eurovignette Directive), which allows for reduced road tolls for electric trucks, and the inclusion, in the calculation of the TIRUERT (Incentive Tax on the Use of Renewable Energy in Transport), of electricity charged at depots.

The remaining questions concern range and charging times. In most cases, our current urban and construction trucks have sufficient range to rely solely on slow overnight charging at the depot using their onboard chargers.

For long-distance operations, our new T 780 tractor unit, with a range of 660 km and the ability to recharge at up to 720 kW, during the driver's daily 45-minute break, using the Megawatt Charging System (MCS) can cover more than 90% of the daily operations currently performed by diesel tractor units.

Naturally, this requires public charging infrastructure to be rolled out quickly enough, at least at the rate required by the European Alternative Fuels Infrastructure Regulation (AFIR). We maintain an up-to-date map of existing and planned charging stations on our website.

A relay-based operating model, in which electric tractor recharge while exchanging trailers, can help accelerate this development. We have been using this model since autumn 2025 to transport goods by electric truck between our Caen and Lyon plants, over a distance of 700 km.

Hydrogen as a potential complementary solution in the next decade

Low-carbon hydrogen, whether blue or green, will not be available on a large scale until the next decade. Furthermore, switching to hydrogen is highly inefficient from an energy perspective: a green-hydrogen truck consumes approximately three times more electricity per kilometre than a battery-electric truck, resulting in a higher carbon footprint and higher operating costs.

Renault Trucks' strategy is therefore to wait until the next decade before bringing hydrogen trucks (powered either by combustion engines or fuel cells) to market, and to reserve them for regions and applications that are the most difficult to decarbonise using battery-electric trucks.

Finally, e-diesel produced from green hydrogen is unlikely to become available on the market in significant quantities before 2040, and its operating cost will be considerably higher than that of battery-electric trucks.

Battery-electric technology at the heart of the decarbonisation strategy

In conclusion, this multicriteria comparison explains why battery-electric technology lies at the heart of the road freight decarbonisation strategy. We already offer a complete range of electric trucks, all manufactured in France. They currently account for 3% of our sales, and their share will need to rise between 20 to 30% by 2030 in order to comply with European regulations.

For manufacturers to achieve this increase in production, companies will need to source a growing share of their transport services from electric fleets. However, there is currently no guarantee that demand will follow this trajectory.

	Diesel B7	Battery-electric	Low-carbon **hydrogen**			Biodiesel		Biogas
			Electric fuel cell	Combustion engine				
				H_2	E-diesel	B100	HVO	
Energy availability	🟢	🟢	🟠	🟠	🟠	🔴	🔴	🔴
Environmental criteria								
Global warming potential	🔴	🟢	🟢	🟢	🟢	🟡	🟢	🟢
Energy consumption	🟡	🟢	🟠	🟠	🔴	🟠	🟠	🟠
Water consumption	🟢	🟢	🟡	🟡	🟡	🟠	🟡	🟠
NOx emissions	🟠	🟢	🟢	🟠	🟠	🟠	🟠	🟡
Noise emissions	🟠	🟢	🟢	🟠	🟠	🟠	🟠	🟠
Mineral resource use	🟢	🟠	🟠	🟢	🟢	🟢	🟢	🟢
Operational criteria								
Cost per kilometre	🟢	🟢	🟠	🟠	🔴	🟡	🟡	🟠
Driver retention	🟠	🟢	🟢	🟡	🟡	🟡	🟡	🟡
Payload	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Range without refuelling	🟢	🟡	🟡	🟡	🟢	🟢	🟢	🟢
Refuelling infrastructure	🟢	🟡	🟠	🟠	🟢	🟡	🟡	🟡
Refuelling time	🟢	🟠	🟡	🟡	🟢	🟢	🟢	🟡

Figure 1: Comparison of energy sources for a long-haul tractor unit in 2030, from cradle to grave (800,000 km).



The electrification of road freight transport: challenges and prospects

Road freight transport remains a cornerstone of the economy. In Europe, the sector comprises nearly 570,000 companies, the majority of which are small businesses managing less than seven heavy-duty vehicles each, on average. The sector operates more than 4.1 million trucks, which consume over 60 billion litres of diesel every year to move 13 billion tonnes of freight. Road freight transport alone accounts for 12% of CO_2 emissions in Europe, a figure that has proven difficult to reduce despite the technical progress achieved since the 1990s.





Virginie Delcroix, Sustainable Development Director, GEODIS group

Jean-François Agenor, Director of Sustainable Fleet Transition, GEODIS group

Meeting the needs of road freight stakeholders with electric trucks

The sector faces a dual challenge: accommodating rising mobility demand while continuing its decarbonisation trajectory. For transporters, beyond contributing to Europe's and France's climate commitments, expectations are also being driven by customers. At GEODIS, 75% of major international accounts have made commitments aligned with the Paris Agreement, and French SMEs and small businesses are no exception. For transporters, climate inaction represents a commercial risk.

To meet this demand, GEODIS is working with its customers on all available levers: optimising routes and loads, deploying combined rail-road or inland waterway solutions, and implementing low-emission solutions.

Electric trucks are one such solution. Beyond decarbonisation, they offer multiple advantages: reduced noise and vibration, improved ergonomics, enhanced safety, greater attractiveness of the profession for new profiles, and increased acceptability in urban areas.

However, large-scale deployment is still held back by technical considerations (range, still-incomplete vehicle offerings, charging infrastructure), operational constraints (route organisation, downtime for charging, reduced payload), and economic factors (purchase costs more than twice as high as those of diesel trucks, infrastructure financing). Profitability, productivity and fair access to innovation are all challenges that must be addressed.

2045: road freight transport in a successful transition scenario

Let us assume that Europe has fully succeeded in its energy transition by 2045. Low-carbon electricity generation, thanks to the rise of renewables and the revival of nuclear power, enables the additional demand generated by mobility, particularly road freight transport, to be met. In France, the EPR2 programme and fourth-generation reactors will provide an annual capacity of

750 TWh, with a stable and competitive cost per MWh. Europe then benefits from unprecedented energy autonomy and security of supply.

Progress in battery technologies and the deployment of ultra-high-power charging stations, as well as dynamic charging on major highways, have removed the main technical barriers: range, charging time and battery weight. These innovations preserve the sector's productivity, reduce waiting times at charging stations and reduce land take. Driver comfort is significantly improved.

Road freight transport, once considered a "poor performer" in decarbonisation efforts, achieves carbon neutrality while continuing to fulfil its essential role in support of the economy and citizens, with increased efficiency. The relocation of the economic activity, driven by decarbonisation, stimulates transport demand, while the complementarity between electric solutions and biofuels supports the transition of the remaining combustion-engine fleets.

Key challenges for 2027: impacts on the industry, remaining barriers and required support

Looking ahead to 2045 may seem uncertain today, given the scale of the trade-offs facing both economic and political stakeholders. Consensus remains difficult to achieve, and we are still a long way from implementing solutions on a large scale. Across Europe, countries are taking various approaches based on their respective contexts, priorities, resources and challenges, particularly those related to their energy mixes and existing infrastructure. Yet, it is precisely in this uncertain environment that the road freight transport sector is expected to look ahead and commit to the large-scale transformation of its fleet by ordering approximately 40% new electric trucks as early as 2030 in order to meet the VECTO (Vehicle Energy Consumption calculation Tool) regulatory framework.

For the sector, this transition is deeply reshaping transport professions: new expertise in energy management, charging management, optimisation of transport plans and adaptation to evolving technologies.

For such a transformation to take place, several conditions still need to be created or maintained:

- **Technical:** extending electric vehicle offerings to cover all use cases, ensuring sufficient territorial coverage with depot and on-the-road charging infrastructure, and ensuring the grid's capacity to deliver electricity to transport companies' premises;
- **Regulatory:** adapting European weights and dimensions rules to ensure a payload equivalent to diesel vehicles, harmonising directives to guarantee fair international competition, and integrating charging times into social legislation;
- **Economic:** continuing to reduce vehicle purchase costs, maintaining incentive schemes over the long term (energy savings certificates (CEE), enhanced depreciation allowances and ADVENIR support for charging infrastructure) ensuring a fair distribution of costs across the value chain, and providing access to affordable electricity;
- **Support:** investment support for SMEs and small businesses, training for new professions, and coordinated management of changes in order to anticipate future needs;
- **Energy mix:** developing bio-refining sectors to support the decarbonisation of the combustion-engine road fleet, which will continue to coexist with electric vehicles in order to meet demand over the next twenty years. After an expected peak around 2030–2035, these production capacities could gradually be redirected towards the aviation and maritime sectors.

The electrification of road freight transport is no longer an option but a necessity. It requires coordinated governance, targeted investment, a stable regulatory framework and lasting support adapted to the diversity of stakeholders. Energy network operators, vehicle manufacturers, transporters, shippers and public authorities are at the heart of this transformation, helping to safeguard the competitiveness and attractiveness of the sector in the service of the economy and citizens. Thanks to its lead in low-carbon energy production, France can play a leading role in Europe.



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Electric vehicles and buildings: key synergies between consumers and the grid

In order to quantify the benefits that can be derived from managing the charging of electric vehicles and their integration into the building's energy system to which they are connected, EdEn has conducted a major study, the results of which are summarised in the present article.



Servan Lacire,
Scientific Adviser, EdEn

Electric vehicles (EV) are gaining ground in France as in Europe. Their deployment was further accelerated by the events in the Middle East in 2026, with electric vehicles accounting for close to 30% of new vehicle sales in France in the first half of the year.

Charging on public roads has developed, with infrastructure that are widely accessible in cities and on major roads. However, charging still primarily takes place at home or at the workplace, for economic and practical reasons.

Today, there are little interactions between charging infrastructure and buildings. Yet, their integration offers significant potential synergies, both for the consumer and for the electricity grid. Buildings are undergoing two major developments:

- the electrification of heating, mainly through heat pumps, accompanied by an effort to improve energy efficiency;
- the development of photovoltaic (PV) installations, which produce increasingly large quantities of surplus electricity in the middle of the day.

By 2050, electricity consumption from electric vehicles, at around 67 TWh, will exceed household electricity consumption for heating, ventilation and domestic hot water. This will make it possible to save some 21 Mt of petroleum products and reduce our trade deficit by more than €10 billion. However, without managed charging, the resulting power demand could reach between 15 and 30 GW by 2050 (Figure 1).

A major challenge is therefore to enable the growth of the EV fleet, through appropriate charging management, while limiting its impact on the grid and allowing users to benefit from the most favourable electricity tariffs.

Charging management

Managing EV charging consists of adapting its rate according to grid conditions, as reflected in electricity prices, while also taking into account electricity consumption from other building uses and any on-site solar generation. Several charging management modes are commonly identified.

Unidirectional charging

Static tariff-based management consists of charging the EV during periods when electricity is cheap (off-peak hours). This is very simple to implement, but only 32% of users reported doing so in France in 2024.

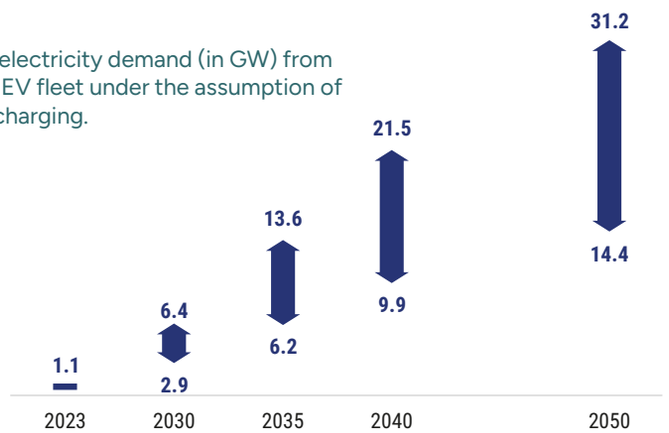
Dynamic management (V1G) consists of managing charging according to varying parameters such as real-time pricing, if dynamic pricing is offered to the consumer, or other consumption within the building. It is currently very uncommon.

Bidirectional charging

Bidirectional charging consists of using the energy stored in the vehicle's battery to feed it back, when necessary, into the building's local electricity system (V2B/V2H: Vehicle to Building or Vehicle to Home) or into the grid (V2G: Vehicle to Grid).

V2H and V2G offers are emerging on the market (Renault, Volkswagen), but remain confined to manufacturer-specific ecosystems.

Figure 1: Peak electricity demand (in GW) from the light-duty EV fleet under the assumption of 100% natural charging.
Source: RTE data.



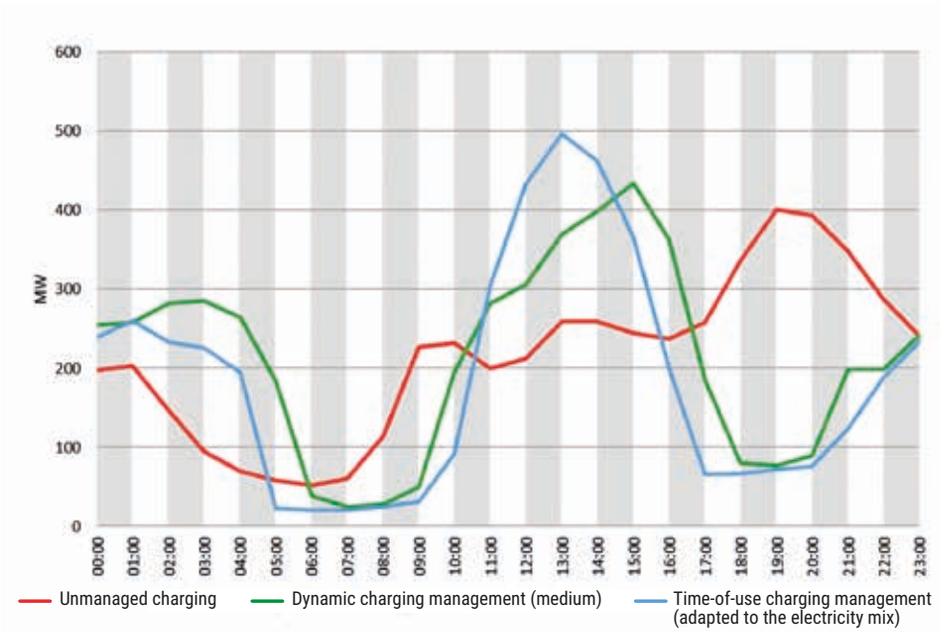


Figure 2: Load curves for one million EVs (in RTE's median Crescendo scenario) according to the type of charging management. Charging management makes it possible to shift the power demand to periods of the day when the electricity grid is less heavily loaded or when the contribution of solar energy is at its highest. Source: RTE data.

Benefits depending on use cases

To quantify the benefits provided by charging management, three scenarios for the evolution of electricity prices in France were considered:

- a 2024 reference scenario based on the prices observed under the regulated tariff set by the public authorities;
- a post-2026 scenario derived from 2024 prices but with time-of-use and seasonal pricing (modulation according to the season and time of day);
- a dynamic pricing scenario with hourly variation in the electricity tariff, as it already exists in Nordic countries.

Economic assessments were carried out for four use cases, assuming charging strategies adapted to each price scenario.

Single-family home

Static tariff-based management is sufficient to take advantage of off-peak hours as they exist in the 2024 scenario and thus reduce the bill by around €171 per year. Time-of-use and seasonal pricing for off-peak hours increases this saving to €206, or one third of the cost induced by the EV in the absence of charging management (€618 including an additional subscription cost).

Dynamic tariff-based management can, if offered, generate a saving of €319.

V2H can increase the benefit for the consumer even further (€542), as optimisation then covers the household's total consumption. Combined with management of photovoltaic generation, it can offset more than 100% of the expenditure induced by the EV.

Multi-unit residential buildings with parking

Whether the charging infrastructure constitutes an extension of the public grid or is operated by a private operator, with or without PV, simple static charging management makes it possible to significantly reduce the bill and, at best, delay the point at which the grid will need to be reinforced.

Multi-occupant commercial buildings

While the benefits are limited with basic pricing, static or, even better, dynamic charging makes it possible to take advantage of vehicles being present during daytime off-peak hours and reduce the cost of charging. However, the benefits for users depend on the pricing policy adopted by the charging operator, whose own objective is to minimise costs.

Single-occupant commercial buildings

This case covers a variety of situations: small commercial buildings in city centres, industrial facilities, with a mix of company vehicles, service vehicles or employees' vehicles. In all cases, the company is directly responsible for the charging infrastructure, its electricity supply contract and the management of its vehicle fleet.

This situation offers significant benefits:

- the charging of service vehicles at night costs only the price of energy because the charging stations and subscription are absorbed by daytime uses;
- PV generation can be fully absorbed by vehicle charging;
- charging management makes it possible to accommodate a large EV fleet without having to increase the subscribed power capacity.

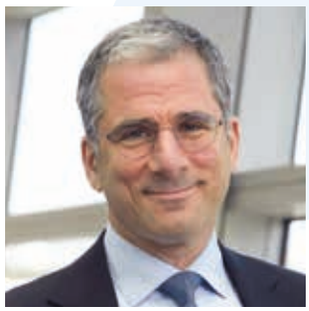
In conclusion

The synergies between electric vehicles and buildings offer significant benefits, helping to accommodate the growing EV fleet while delivering substantial savings for users – potentially enough to fully offset the additional electricity costs associated with charging their vehicles. To fully harness these synergies, several recommendations should be implemented:

- make static, tariff-based management the default approach to EV charging, as it alone can deliver most of the potential benefits;
- further develop time-of-use and seasonal pricing, particularly for off-peak periods;
- encourage the uptake of dynamic pricing, while ensuring that the resulting benefits are fairly shared between the electricity system and consumers;
- promote the development of V2H and V2G by establishing appropriate technical codes and removing restrictions on feeding stored electricity back into the grid;
- encourage workplace charging by renewing the exemption from social security contributions for the corresponding benefits in kind.

Maritime electrification: a strategic pillar of a multi-solution transition

The CMA CGM Group is often associated with low-carbon fuels for long-haul shipping – bioLNG and biomethanol – which are essential to decarbonising major maritime routes. Yet, electrification has emerged as a key component of the Group's decarbonisation roadmap and remains a strategic priority in support of CMA CGM's Net Zero 2050 commitment.



Farid Trad,
Vice President
Energy & Bunkering,
CMA CGM

This positioning reflects a clear conviction: the energy transition of maritime transport will be neither mono-technological nor ideological. It will be multi-solution, industrial and pragmatic.

Electrification is an essential building block in this transition. It is already mature in certain segments and is set to progressively broaden its scope of application.

CMA CGM's R&D work on batteries, hybrid propulsion architectures and the electrification of landside infrastructure is actively helping to accelerate this technological maturity.

The political and regulatory challenge is clear: to enable the deployment of the right solution for the right application, whilst avoiding dogmatic technological opposition and supporting the rapid evolution of European industrial capabilities.

For long-haul shipping, propulsion will rely on low-carbon fuels. But hybridisation could become a credible pathway: low-carbon fuel for main propulsion, and batteries for onboard electricity generation and port manoeuvres. CMA CGM's R&D is exploring these hybrid configurations in order to optimise the overall energy performance of long-haul vessels and anticipate tomorrow's industrial standards.

The energy transition of the maritime sector can not be 100% electric in deep-sea shipping; but it can be partially electrified, in an intelligent and complementary way.

A rapid expansion

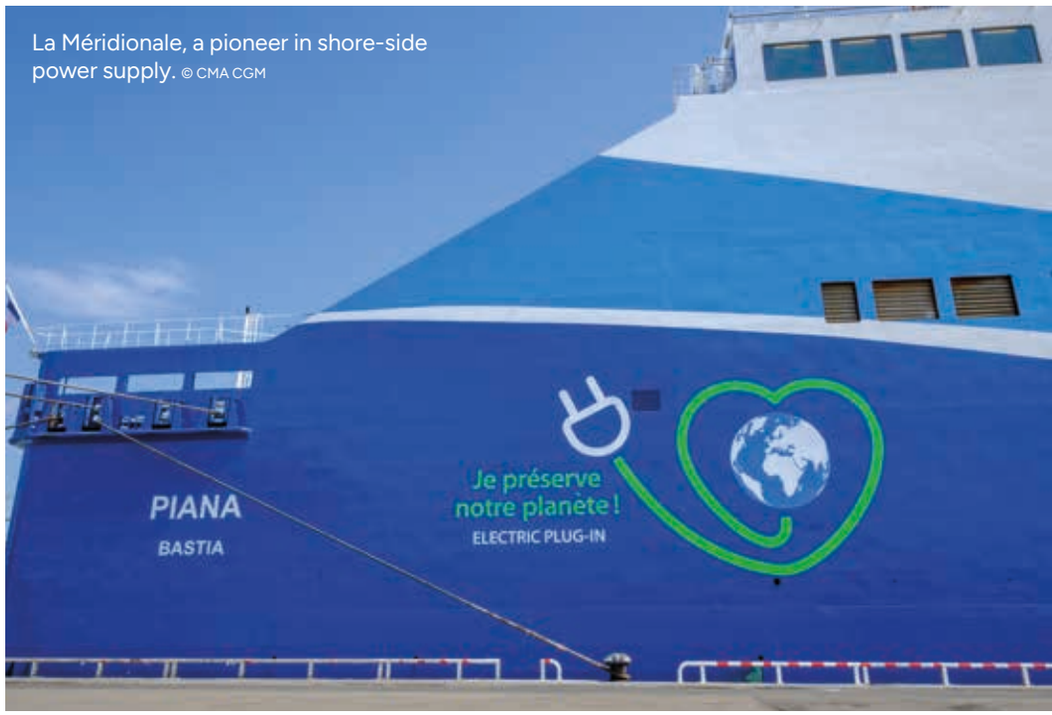
Electrification is particularly relevant today for:

- barges and inland waterway corridors;
- port operations and landside interface infrastructure, including terminals;
- regular lines over controlled distances.

Progress in battery technologies – increased energy density, longer lifespan, modularity, high-voltage charging and digital management – has significantly expanded what is possible. What was experimental yesterday is becoming industrially viable today.

The benefits are immediate: direct reductions in CO_2 emissions, elimination of local emissions in port areas, lower noise levels, improved energy efficiency and simplified maintenance.

As performance improves, new applications are becoming economically and technically relevant. Electrification is not a fixed technology: its scope is expanding.



La Méridionale, a pioneer in shore-side power supply. © CMA CGM



The first 100% electric barge: a zero-emission logistics solution adopted by NIKE in Vietnam. © CMA CGM

CMA CGM: already operational projects

Maritime electrification is no longer theoretical. It is being deployed:

- in Vietnam, CMA CGM will bring into service, in the second quarter of 2026, a 100% electric inland barge on a 180 km corridor between Binh Duong and Cai Mep. Powered by a dedicated solar farm producing 1 GWh per year, it will avoid 800 tonnes of CO_2 emissions annually while transporting 50,000 TEUs;
- in France, an electric barge, announced by the Chairman Rodolphe Saadé on 5 February, one year after the obtention of the sub-concession for the Port of Lyon to a consortium led by CMA CGM, will operate by 2028 between Fos-Marseille and Lyon. Measuring 185 metres in length and with a capacity of 156 TEUs, it will shift 156 lorries from the road on each rotation and reduce emissions by 80% compared with road transport;
- a pioneer in shore power connection, La Méridionale, is celebrating 10 years of connecting its vessels to the shore-side electricity grid in the Port of Marseille. This technological innovation eliminates particulate matter and nitrogen oxide emissions. It also improves working conditions for onboard crews and port staff, as well as quality of life for local residents.

These projects demonstrate that, with suitable corridors and coherent infrastructure, electrification is an efficient, scalable and competitive solution.

Port electrification: the decisive link

The energy transition in the maritime sector is not only taking place at sea. It is also taking place onshore. Onshore power for vessels, the electrification of cranes and handling equipment, and the decarbonisation of internal logistics fleets are major levers for immediately reducing local emissions in port areas.

The development of electric maritime solutions must be matched by the development of corresponding shore-side infrastructure (terminals). This requires:

- strengthening port electricity grids;
- investing in high-voltage substations;
- sizing infrastructure appropriately for future uses and the gradual intensification of demand.

Vessels and grids must evolve in parallel. Under-sizing infrastructure today would slow down the transition tomorrow.

Creating the conditions for scale-up

For the scaling-up of maritime and port electrification in Europe, two conditions are essential.

A coherent and predictable regulatory framework

European regulation must fully recognise the environmental benefits of electric solutions, guarantee their competitiveness against fossil fuels and harmonise port technical standards. Long-term visibility is a prerequisite for industrial investment.

Structured financial support

Electric infrastructure in ports represents a strategic investment. Targeted public support is needed to accelerate the deployment of onshore power solutions, modernise grids and ensure infrastructure is appropriately sized for future uses.

It is a climate issue, but also an industrial and energy sovereignty issue.

Maritime and port electrification is not a standalone solution. It is an accelerator of transformation. It can immediately reduce local emissions, strengthen the competitiveness of European ports and structure the industrial value chains of the future.

Electrification is already an operational component of the maritime transition and is set to play a growing role in the years ahead.

At CMA CGM, we support a multi-solution energy transition for maritime transport: electrification is neither exclusive nor symbolic, but strategic, deployed where it is relevant, combined where it optimises performance, and supported where it accelerates decarbonisation.

Electrification, a strategic priority for Dunkirk Port



View of the cross-Channel and Ireland ferry terminal.
©Yannick Delva/Dunkerque-Port.



Léopold Moeneclaey,
Deputy director for Planning and Environment, Dunkirk Port

Decarbonisation is a central pillar of Dunkirk Port's 2025–2029 strategic plan, spanning both industrial and logistics activities. Port infrastructure is not only a development area designed to accommodate industrial entities and logistics infrastructure, but also a key multimodal interface connecting maritime, rail, inland waterway and road transport.

A decarbonisation process driven by the electrification of uses

The report published by RTE on 9 December 2025, together with the *Stratégie nationale bas-carbone* (SNBC 3) published on 18 July 2026, underlines the priority given to electrification. In this context, Dunkirk Port acts as a facilitator between producers, industrial consumers, distribution and transmission system operators.

A few figures illustrate the scale of the challenges that the region is facing. The 7,000 hectares of port land already include France's largest industrial electricity consumer (Aluminium Dunkirk), as well as a nuclear power generation site which, following the construction of two new EPR reactors, will become the largest nuclear power generation site in the world, with nearly 9 GW of installed capacity. Steelmaking, a key sector for Dunkirk, is expected to significantly increase its electricity consumption as part of its decarbonisation efforts. In February 2026, ArcelorMittal confirms its investment of 1.3 billion EUR in its first electric furnace on the Dunkirk site.

For its part, RTE is planning 1.5 billion EUR of investment in the region by 2030. Although a large share of this investment is driven by industrial projects, freight transport has also begun its transition, particularly towards electrification, in line with national and European targets. The European Alternative Fuel Infrastructure Regulation (AFIR) aims to generalise shore-side electricity supply for certain categories of vessels, including container ships and ro-ro vessels. This regulation requires coordinated commitments from all stakeholders, including synchronised investments by both shipowners and port authorities.

Dunkirk Port, a pioneer in onshore power solutions

From 2020, Dunkirk Port has invested in shore-side electricity supply, or cold ironing, enabling container ships at berth to switch off their auxiliary engines while still meeting their electricity needs, especially to maintain temperature in refrigerated containers (*reefers*). This initiative serves two objectives: improving air quality and reducing greenhouse gas emissions. As such, the Flanders Terminal has seen a steady increase in the number of shore connections. Emissions avoided during a 24-hour port of call amount to several tens of tonnes of CO_2, directly contributing to the decarbonisation of maritime transport.

Dunkirk-Port is also studying the development of new connection points, particularly for ro-ro vessels. The connection with Ireland involves layover durations of up to 20 hours, a relevant timeframe for the implementation of cold ironing. From 2027 onwards, existing and future ro-ro berths will be progressively equipped, in line with the development of new North European routes.

"Emissions avoided during a 24-hour port of call amount to several tons of tonnes of CO_2.

Each connection point represents a capacity of around 3 MW, with one of them benefiting from 1.9 million EUR in European funding.

Dunkirk Port is also assessing the feasibility of onshore power infrastructure in the Eastern part of the port, close to urban areas, even though the vessels concerned – technically diverse – are not subject to mandatory connection requirements.

Green corridor: cross-Channel ambitions for 2030

For the ro-ro ships segment, the cross-Channel route to Dover presents specific constraints. With port layovers lasting only 45 minutes and crossings of around two hours, the relevance of cold ironing is limited. However, the concept of a *green corridor*, encouraging electric propulsion of vessels, is gaining momentum. The first hybrid ships have already been deployed by P&O in cooperation with the Port of Calais. Meanwhile, Danish shipping company DFDS is exploring fully electric propulsion by 2030. To support this transition, Dunkirk Port will deploy 40 MW of charging capacity close to cross-Channel ro-ro berths.

Anticipating electricity transmission and distribution infrastructure

To deliver sufficient power, the planning of robust electricity infrastructure is essential. In 2021, a new electrical substation – co-financed by RTE, Enedis, Dunkirk Port and the Urban Community of Dunkirk – was commissioned. It distributes electricity supplied by RTE's high-voltage transmission lines and was designed to anticipate future needs. This project illustrates the region's proactive approach to supporting industry and decarbonisation. This asset is now frequently highlighted as a key factor in industrial location decisions and serves as a model for other port areas.

Upstream, RTE is developing an ambitious grid reinforcement programme in the Dunkirk area, including the construction of the Flandre Maritime substation – one of the largest in France – and investments of around 1.5 billion EUR by 2030 to modernise and adapt the local electricity infrastructure to rising demand, electrification and new industrial projects. As part of this programme, two new 400 kV lines will be built across the region.

Building on the success of the first substation and anticipating future needs – particularly related to ship connection – studies have been launched for a second substation, with commissioning planned around 2030 and a capacity of approximately 100 MW. This facility will support the port's development strategy, including the future ZIA industrial zone and the connection of new container ships enabled by the CAP 2020 expansion project. This infrastructure, currently under development, anticipates future ship connection requirements.



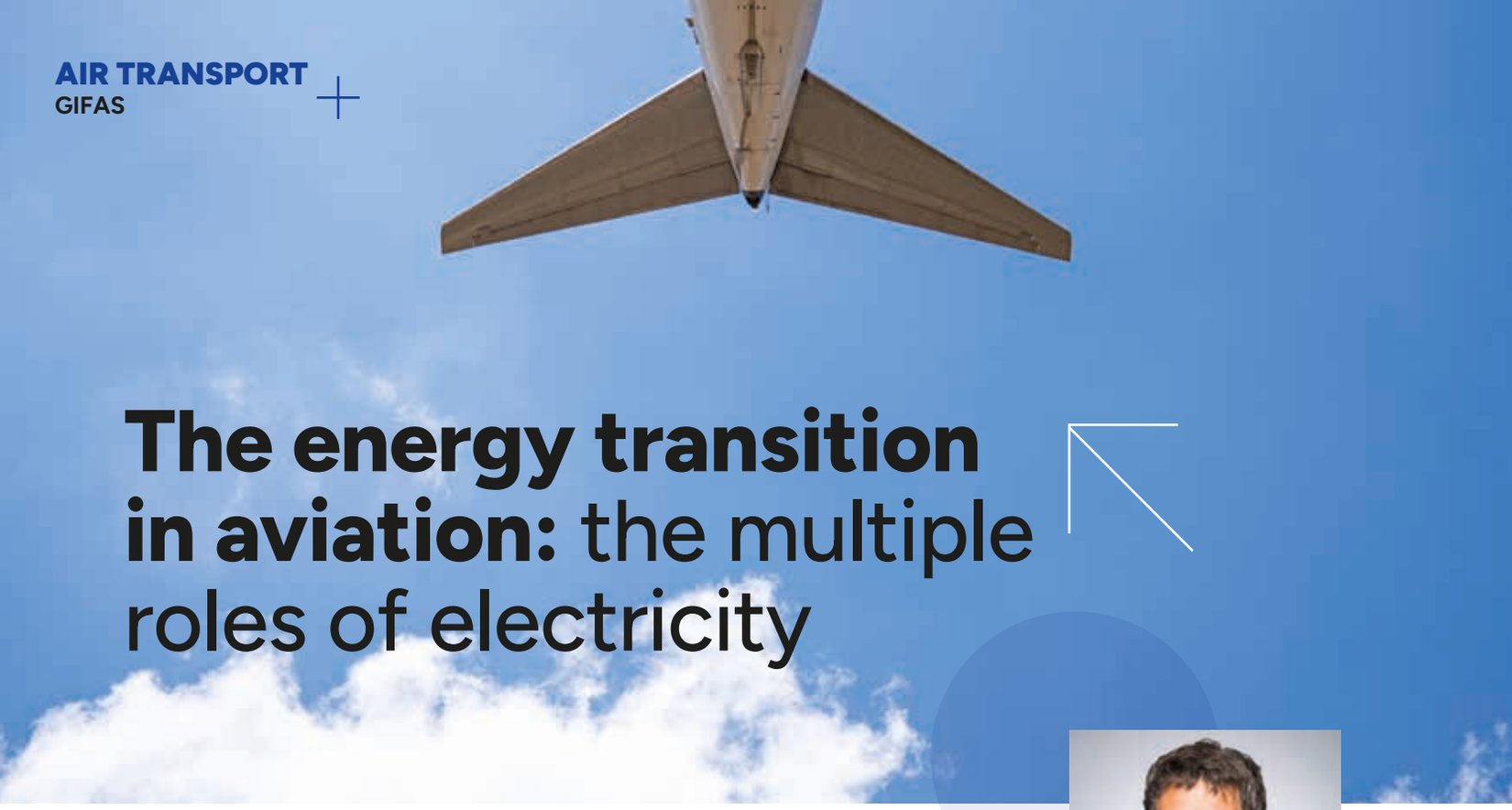
Shore power connections for ships.
© Yannick Delva/Dunkerque-Port

The need to electrify inland logistics

The available power primarily serves port users and clients. Several logistics operators have already begun installing charging stations for their truck fleets. Bogaert Group, located near the Flanders Terminal, aims to convert 60% of its heavy-duty vehicle fleet to electric by 2028.

As a land manager, Dunkirk Port hosts various truck parking and service areas. The future lies in the systematic deployment of photovoltaic canopies and electric charging stations dedicated to heavy-duty vehicles in these areas. Their expansion will help make the energy transition and fleet decarbonisation more attractive.

Finally, it is important to recall that the primary lever for decarbonising and electrifying freight lies in modal shift towards rail. The ongoing development of a rail motorway terminal at Dunkirk-Port is expected to enable the modal shift of 50,000 intermodal transport units (ITUs) per year and avoid 70,000 tonnes of CO_2 emissions.



The energy transition in aviation: the multiple roles of electricity



Baptiste Voillequin,
Director of R&D, Space and Environmental Affairs, GIFAS

The aviation sector is making significant efforts to meet its objective of reducing CO_2 emissions. Although we should not expect to see a fully electric, short-medium range commercial aircraft taking off in the immediate future, electrification is definitely a major pillar of the sector's decarbonisation strategy.

Aviation: a pioneer in the decarbonisation commitments

Aviation was an early mover in committing to decarbonisation, as demonstrated by two major initiatives:

- the global objective adopted within the United Nations framework through the International Civil Aviation Organization (ICAO), with the Long-Term Aspirational Goal (LTAG), endorsed by more than 190 countries in 2022 and aimed at achieving net-zero carbon emissions by 2050;
- in France, the aviation industry's response to Article 301 of the loi Climat et Résilience (Climate and Resilience Act). Aeronautics was the first industrial sector to submit its contribution, in February 2023, and to draw up a national roadmap for reducing the sector's emissions.

This roadmap was developed jointly with all the relevant stakeholders: the airline federations represented by FNAM, airports through UAF, energy companies through UFIP-EM, UFE and France Hydrogène, and, of course, the aircraft manufacturing industry through GIFAS.

There is now a broad consensus among all participants in the aviation ecosystem regarding the need to decarbonise air transport. The roadmap for the decarbonisation of French aviation, submitted to the Government in February 2023, is based on several levers.

These are similar to those adopted globally by ICAO:

1. fleet renewal, through the introduction of latest-generation aircraft and the development of a new generation of highly energy-efficient aircraft;
2. the optimisation of flight operations;
3. the deployment of sustainable aviation fuels (SAF);
4. market-based mechanisms to offset residual emissions.

In cross-sector planning initiatives, such as France's Multiannual Energy Programme (PPE) and National Low-Carbon Strategy (SNBC), the requirements of aviation are grouped with those of other forms of "heavy" transport that are difficult to decarbonise. Successfully delivering aviation's energy transition will therefore require the use of every available lever.

Electrification in aviation encompasses three main areas:

1. the electrification of aircraft;
2. the electrification of ground operations;
3. the installed electrical capacity required to produce new aviation fuels.

Innovation at the heart of aircraft electrification

Aircraft electrification involves electrifying energy systems as a whole. In the field of electric propulsion, 2025 saw Safran certify ENGINeUS, the world's first certified aircraft electric motor. This represents a key milestone in the development of regional aircraft, general aviation and urban air mobility. The flight-test campaign conducted using the CORAC EcoPulse demonstrator enabled Daher, Airbus and Safran to accumulate 100 hours of flight experience with distributed electric propulsion.

Although the current power-to-weight and energy-to-weight densities of batteries do not yet make a fully electric commercial aircraft feasible, electrical energy can favorably be used to support propulsion. Solutions are being developed that combine a turbine engine with an electric propulsion system powered by batteries. The objective is to develop hybrid propulsion systems, particularly for specific phases of flight – climb, cruise and descent – during which hybridisation can have the greatest impact in reducing fuel consumption and, consequently, carbon emissions. Hybrid propulsion systems are also being developed for helicopters.

The third area concerns the electrification of non-propulsive onboard systems. The next generations of commercial aircraft will undoubtedly be more electric. Numerous onboard systems could be electrically powered, including landing gear, air-conditioning systems, braking systems, flight-control actuators, de-icing systems, auxiliary power units and ground-taxiing systems. The benefit is considerable: designing an architecture that uses electrical energy wherever possible can improve the aircraft's overall energy efficiency.

Renewable electricity generation and electrification of ground operations: airports as electrification hubs

All airports have already introduced decarbonisation plans in which electrification plays a central role.

In addition to decarbonising buildings, infrastructure, and making use of available land by installing solar panels, airports have begun connecting aircraft parked at boarding gates or on the apron directly to the grid. This involves the use of electric ground power units, as well as electric vehicles for airport operations.

New aviation fuels as a major driver of electricity demand

The deployment of sustainable aviation fuels, which are expected to deliver more than half of the reduction in greenhouse gas emissions required by 2050, is now under way in Europe under the ReFuelEU Aviation regulation. The regulation provides long-term visibility by progressively increasing the mandatory proportion of SAF to be blended into aviation fuel. It also includes a specific sub-mandate for synthetic SAF (e-SAF), produced combining hydrogen and CO_2. While existing



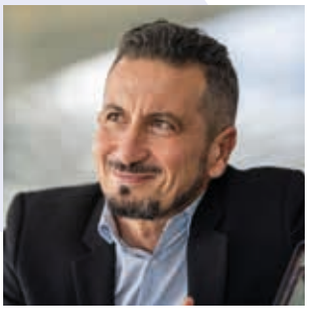
aircraft are certified to operate with blends containing up to 50% SAF alongside conventional Jet A-1 kerosene, future generations of aircraft will be certified to operate with up to 100% SAF.

Several SAF production pathways are currently being deployed, at different levels of technological maturity. Given the constraints affecting the availability of biomass and low-carbon electricity, as well as the volumes required to decarbonise aviation worldwide, all SAF production pathways will need to be developed. These pathways are complementary in terms of both their feedstocks and their technological maturity. They include co-processing, Hydroprocessed Esters and Fatty Acids (HEFA), Alcohol-to-Jet, as well as Power-to-Liquid (PtL), and Biomass-to-Liquid (BtL) fuels.

All these production pathways require substantial amounts of electricity at different stages of the manufacturing process. This includes the electrolysis of water to produce hydrogen and the capture of CO_2 in the case of synthetic sustainable aviation fuels. By 2035, the aviation sector estimates that its low-carbon electricity requirements in France will amount to 15 TWh. Depending on regulatory requirements and the industry's latest forecasts, demand is expected to reach between 60 and 90 TWh by 2050. The precise figure will depend on usage scenarios and on the proportion of sustainable aviation fuels produced in France. The aviation industry's forecasts with regards to future electricity demand have been taken into account by RTE, the French electricity transmission system operator, as part of its forward-looking studies. Against this backdrop, there is a major opportunity to incorporate the electricity requirements associated with e-SAF into today's electrification plans, recognising their production as a strategic use of electricity and pursuing an approach based primarily on domestic production.

The future of sustainable and decarbonised aviation will therefore also be shaped by the large-scale electrification of technologies, operations and fuel production.

The electrification and hybridisation of aircraft, a driver for carbon neutrality by 2050



Karim Mokaddem,
Head of Aircraft of Tomorrow R&T, Airbus

The decarbonisation of air transport, particularly for the next generation of single-aisle aircraft, is crucial. At Airbus, we are convinced that a combination of disruptive solutions is required, rather than a single technology. This approach includes a number of drivers: the use of sustainable aviation fuels (SAF), the development of new propulsion technologies, the integration of composite materials to reduce weight, and improved aerodynamic performance. At the heart of this strategy is electrification.

The large-scale electrification of the automotive market today offers an invaluable technological, industrial and human skills base to enable the aerospace industry to move towards a more electric transition, even if the challenges in terms of mass production and certification are significant.

From fossil fuel to electrons: our path to low-carbon aviation

We know that hybridisation, in other words the combination of fuel — conventional or SAF — and electricity, is a promising way of optimising energy efficiency and reducing fossil fuel consumption, by up to 5% for planes and 10% for helicopters. This technology is based on the frugal use of electricity during specific flight phases, providing support for the heat engine when its energy performance is low. It also reduces the amount of energy drawn from the engine to power systems such as pressurisation and air conditioning. However, it is important to stress that this is not a 100% electric aircraft.

Electrification represents a major challenge for our future single-aisle aircraft, given the speed of technological advances, particularly in the field of batteries. It is therefore essential to design a modular and scalable aircraft platform to capitalise on these developments throughout the operational life of our aircraft.

The Airbus roadmap: demonstrators, synergies and collaborations

Our hybridisation strategy is based on the exploration of several technological options tested on different test platforms. Its success is based on exploiting the synergies between our different entities (helicopters, defence and space and commercial aviation), around common components: a common voltage network, energy storage solutions and standardised electrical machines around a 300/500 kW building block for all our applications. This "technological brick" approach is essential to maximise synergies and accelerate development.

To move forward, we are developing several demonstrators:

- **Helicopters:** the FlightLab has tested an electric engine backup system (EBS) (100 kW for 30 seconds). The DisruptiveLab is testing a fully parallel

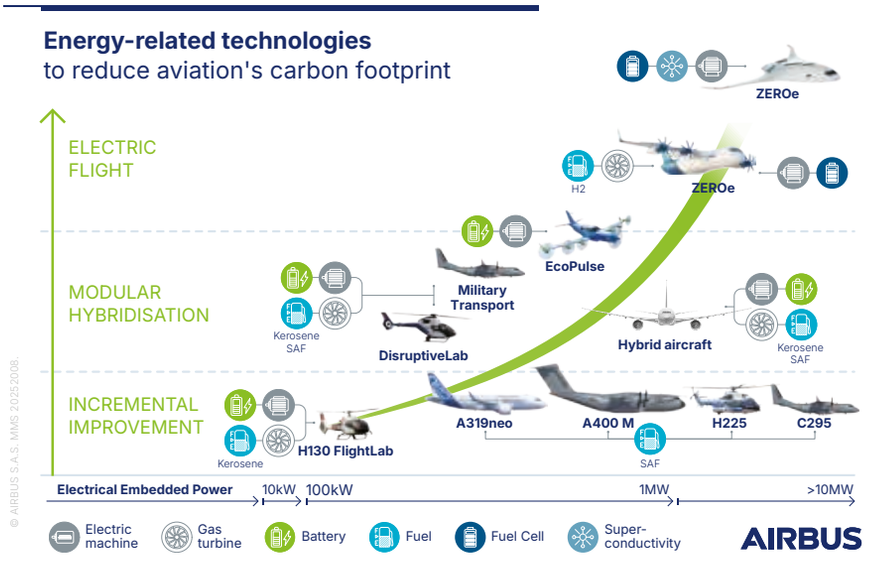


Figure 1: Airbus roadmap for energy transformation: a structured and modular approach, applicable to all its aerospace solutions



EcoPulse demonstrator.
© Jean-Marie Urlacher.

hybrid propulsion system that recharges the battery in-flight.

- **EcoPulse :** in collaboration with Daher and Safran, the first flight of this high-voltage hybrid-electric propulsion demonstrator took place in December 2023.
- **Hydrogen aircraft:** electrification and hydrogen are fully compatible, with electrons coming from a battery or a fuel cell combined with hydrogen. Our roadmap includes synergies with the ZEROe project.
- **SWITCH :** developed with Pratt Whitney, Collins and MTU, this hybrid electric demonstrator is designed to validate the performance of a hybrid architecture compatible with the requirements of future single-aisle aircraft.

We have also launched collaborations with other sectors. We have been working with Renault on common battery challenges and with STMicroelectronics on power electronics. We are also working closely with our engine manufacturers to develop a new class of more efficient engines that include a proportion of electric power.

Finally, the development of hybrid aircraft with fewer than 20 seats, particularly for the regional market with ATR, represents a crucial strategic step. It is a technological and regulatory incubator for maturing technologies, developing recharging ecosystems and setting up a certification framework.

Batteries, infrastructure and the race for innovation

While we have made significant progress, technical and strategic challenges remain.

Energy storage is a technological barrier. The battery is a chemical reactor with its own safety issues. Performance, sustainability, integration and certification are key elements on our roadmap. Although lithium-ion represents a step forward, the solid-state battery is our ultimate goal in terms of performance, energy density, recharging capacity and certification. All our modern devices already use batteries, and our aim is to increase their number, size and power safely, based on improved identification and containment of thermal runaway.

We also face infrastructure and supply challenges. The battery supply chain must be resilient. On this point, aviation has a comparative advantage: the volumes required (a few hundred MWh per year by 2035) are very low compared with the automotive industry (hundreds of GWh).

Finally, it is crucial for the recharging ecosystem to be powered by low-carbon energy. In France, the use of nuclear energy is a major asset for resilience, not only for batteries, but also for the production of synthetic sustainable aviation fuels (e-fuels) and low-carbon hydrogen.

The challenges we face together

Accelerating technological maturation: collaboration with players in the automotive sector such as Renault illustrates how aerospace can take advantage of mature markets to accelerate its development.

Pooling and synergies: the synergy-based approach is essential in order to mature technologies and ensure we are ready to pool our needs and volumes in energy storage systems and electrical components.

Tests and validation: the transition to a radically more electric aircraft involves a paradigm shift (on-board energy management, high-voltage safety and electromagnetic compatibility). This requires us to reinvent ourselves in terms of test resources, moving away from traditional physical testing towards more simulation and digital twins.

Stimulating innovation: public-private financing partnerships, both at national level (France, Germany, Spain, United-Kingdom) and at European level (Clean Aviation) are essential to validate technological breakthroughs, enabling the entire European supply chain to develop sovereign and competitive hybrid electric solutions for future commercial aircraft.

The decarbonisation marathon: a transition requiring preparation

The future of the aerospace industry will undoubtedly be more electrified. Hybridisation will redefine the traditional boundaries between propulsion and non-propulsion systems, and represents a crucial step towards high-power management and the emergence of a European source of supply for aeronautical electrical components. We must act now to avoid critical dependence on non-European electrical technologies. We need to think in terms of an evolving platform rather than limiting ourselves to a product-by-product approach. In this race to decarbonisation, let us be the pioneers and innovators leading all the players to the finish line!

ENGINeUS, Safran's step forward toward decarbonization in aviation

The aviation sector aims to achieve net-zero emissions from civil aviation by 2050. This major challenge is mobilising the entire industry around the objectives set by the Air Transport Action Group and the European roadmap. Within this framework, Safran is structuring its decarbonisation strategy around three main pillars: the development of ultra-efficient engines, advancing the electrification of propulsion systems and aircraft, and accelerating the use of sustainable fuels.

It is in this context that Safran Electrical & Power obtained certification from the EASA[1] for its ENGINeUS™ 100 electric motor in early 2025, a world first that opens a new chapter in aircraft propulsion.

"The certification of the ENGINeUS™ 100 marks a key milestone in the history of aeronautics and a global first. This certification reflects nine years of innovation and commitment," emphasizes Bruno Bellanger, President of Safran Electrical & Power. The program required more than 1,500 hours of certification testing and 300 flight hours to date, laying the groundwork for the emergence of international standards in electric and hybrid aviation.

A mature, certified technology ready for European industrialisation

Designed to combine performance with optimal integration, this electric motor incorporates a rotor-stator assembly, embedded power and control electronics, and an air-cooling system. Compact and lightweight, it delivers an unprecedented power-to-weight ratio.

ENGINeUS™ therefore represents a genuine alternative to combustion engines in general and regional aviation. Easier to integrate into small aircrafts, it simplifies access to certification while offering higher levels of reliability and safety than piston or gas turbine solutions.

Its serial production, scheduled to begin in 2026 across four automated industrial lines in Niort (France) and Pitstone (UK), is currently being deployed with the support of leading public partners such as the Aerospace Technology Institute (ATI) in the United Kingdom, and the French civil aviation authority (DGAC). The objective is also to build an integrated European supply chain covering the full range of technologies, from the production of primary components (permanent magnets, electronic components) to the manufacturing and assembly of critical elements such as the rotor and stator.

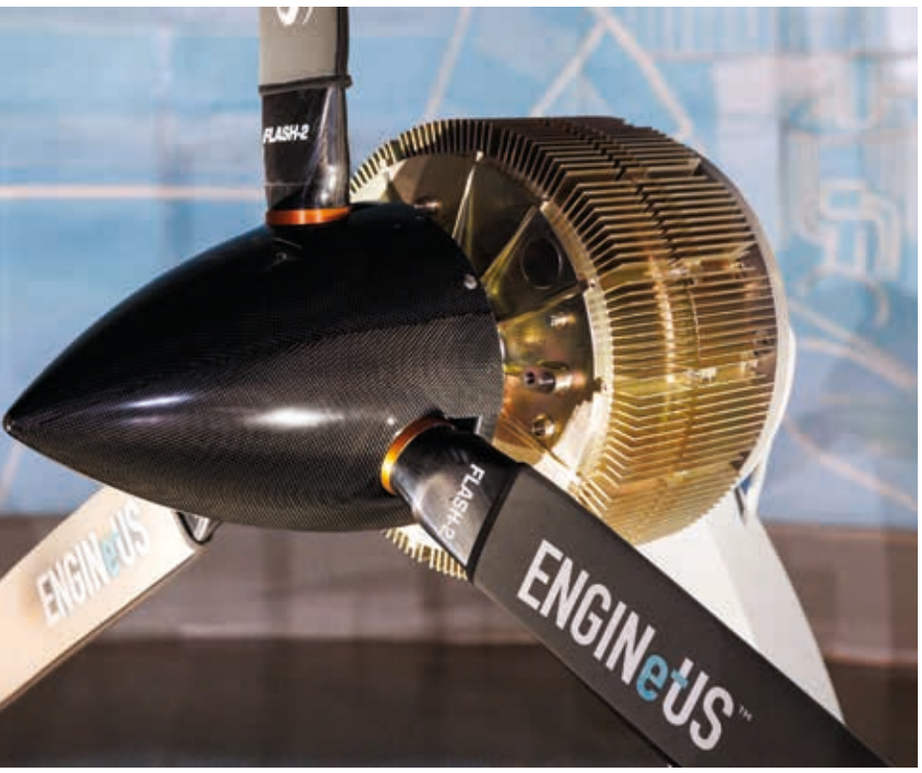


ENGINeUS electric engine. ©Adrien Daste-Safran

> **"Europe today has the expertise and rare earth potential required to build an autonomous and competitive electric aviation industry,"**
> says Jean-François Rideau, Strategy and Partnerships Director of the Power division at Safran Electrical & Power.

"Europe today has the expertise and rare earth potential required to build an autonomous and competitive electric aviation industry," affirms

1. *European Union Aviation Safety Agency*



ENGINeUS during the certification ceremony.
© Claire-Lise Havet - Safran

Jean-François Rideau, Strategy and Partnerships Director of the Power division at Safran Electrical & Power. This momentum is based both on Europe's direct capabilities and on the establishment of efficient recycling value chains. Aware of its vulnerabilities, Europe is organising itself: the adoption of landmark legislation such as the Critical Raw Materials Act and the creation of sovereignty funds, such as the European Competitiveness Fund, reflect a promising dynamic.

Committed to this ambition, Safran is positioning itself as a key partner of European institutions, with the aim of actively contributing to the establishment of a sovereign supply chain that will reduce dependence on China and the United States, while strengthening the continent's technological sovereignty.

From light aircraft to the regional hybrid aeroplane

ENGINeUS100™ is initially targeting the light aircraft segment, particularly training aircraft and private aviation, in its 130 kW version – equivalent to the Lycoming O-360 engine – already enabling fully electric flights. Its high level of performance and CS-E certification under CS-23 (Levels 1 and 2) have already convinced several manufacturers, including Diamond Aircraft (eDA40), AURA AERO (Integral E), Bye Aerospace (eFlyer) and TCab Tech (E20).

"Thanks to its modularity, ENGINeUS™ adapts to all architectures, from small aircraft to the next generation of regional transport, meeting the ambitions of each manufacturer," explains Agnès Pronost-Gilles, Director of the Power Division at Safran Electrical & Power.

> **"The solutions we are developing are paving the way for cleaner, safer aviation that meets tomorrow's challenges,"**
> says Bruno Bellanger, President of Safran Electrical & Power.

This modularity allows the ENGINeUS™ family to already offer a wide range of electric motors, from 100 to 750 kW, thus covering a broad market: from general aviation, including drones and cargo drones, to commuter aircraft (up to 19 passengers), and up to regional transport, as an alternative to current thermal solutions, namely piston engines and gas turbines.

Towards decarbonised aviation: prospects for 2050

Beyond the ENGINeUS engine, Safran is structuring its overall offering through its ePower range, which integrates all the equipment of an onboard electrical system compliant with the latest standards. Safran therefore provides a comprehensive portfolio: electric motors and generators, electrical network distribution and protection solutions, energy management, storage (in partnership with Saft, the only European manufacturer of aeronautical batteries), and wiring harnesses, meeting all the electrical needs of civil aviation.

This comprehensive and modular approach supports the evolution of aircraft architectures, whether light, regional or commercial aircraft, fully electric or hybrid, in order to provide each manufacturer with tailored solutions. It particularly targets the next generation of single-aisle commercial aircraft, whose ultra-efficiency will rely on engine hybridisation and increased onboard electrification.

These solutions, backed by a rapidly evolving European supply chain and deployed across a wide range of aircraft, will enable a gradual reduction in carbon emissions while meeting industrial integration and regulatory requirements. *"The solutions we are developing are paving the way for cleaner, safer aviation that rises to tomorrow's challenges,"* concludes Bruno Bellanger.

Interview conducted by Cecil Coulet

Industrial Green Heat: the hidden giant diversifies with electricity

With the Clean Industrial Deal, the focus of the EU legislation is shifting from decarbonisation of industrial processes to security of supply and competitiveness. In this context, the need to diversify the supply of industrial process heat in the EU has become so urgent that a shift towards new solutions, such as heat from renewable electricity, is now required.


© DR

Johannes Schrüfer,
Lead Storage and Solar Solutions,
Kraftanlagen München GmbH

Renewable electricity: an opportunity with some challenges

Generation of electricity from renewable sources is increasing significantly and this high electricity supply is met with lower demand at certain times. This lower demand leads to a sharp drop in electricity prices, particularly outside the heating period, as demand cannot be increased spontaneously, notably in the industrial sector, even if there are solutions.

Today there is no strategy yet to enable the coupling of the electricity sector with heat sector, even if the potential for sector-coupling is huge. As the expansion of electricity grids has not yet reached the required level for renewable energy sources (RES) expansion, electricity distribution grids are also becoming increasingly saturated, leading to curtailment and redispatch measures.

This challenge opens up a major opportunity: **the use of electricity as a "new fuel"**.

The emergence of thermal energy storage

The study "Net-zero heat" by McKinsey published online in 2022[1] compared decarbonisation options and concluded that heat pump systems achieve the lowest levelised cost of heat. But heat pumps are limited to temperatures of up to 150–200 °C today. For temperatures above 200 °C and up to 1,000 °C, electric heaters combined with thermal energy storage (TES) have generation costs similar or even lower to those of "clean gas" in gas boilers.

However, while power-to-heat boilers have found broad application among our customers, the market for power-to-heat with thermal energy storage (TES) is just now emerging, with the very first pilot plants distributed across the EU.

The Green Heat Module: a solution to tap into the potential of power-to-heat storage

The Green Heat Module (GHM) system takes advantages of these new opportunities and consists of electric air heaters combined with a heat storage unit made of ceramic honeycomb bricks. When electricity prices fall below clean gas prices (e.g. €50/MWh, see in figure 1 one of many

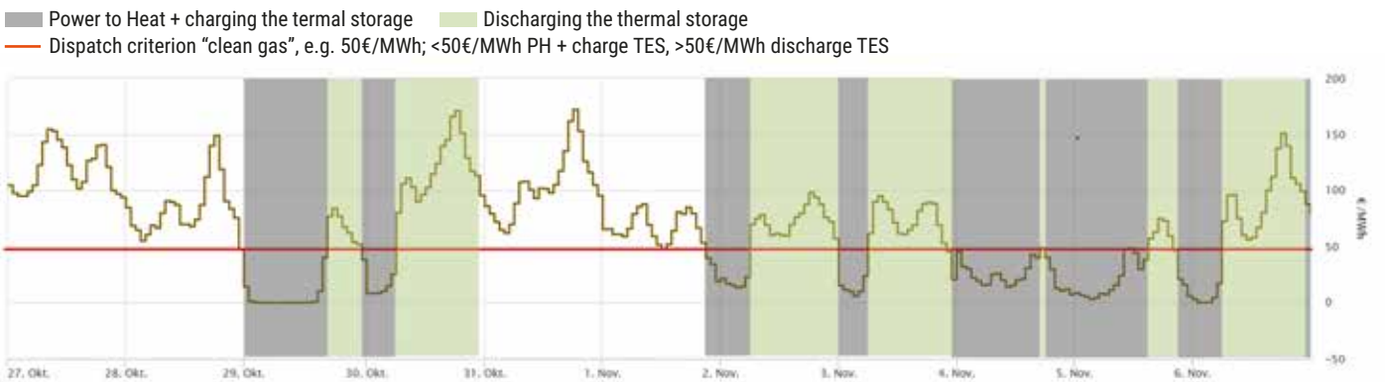


Figure 1: Dispatch of electric heaters and of the thermal storage (power-to-heat and storage in grey, discharging in green).

1. *McKinsey & Company 2022: "*Net-zero heat – Long Duration Energy Storage to accelerate energy system decarbonization*" (online).*
2. *Bundesnetzagentur, link: smard.de/home*

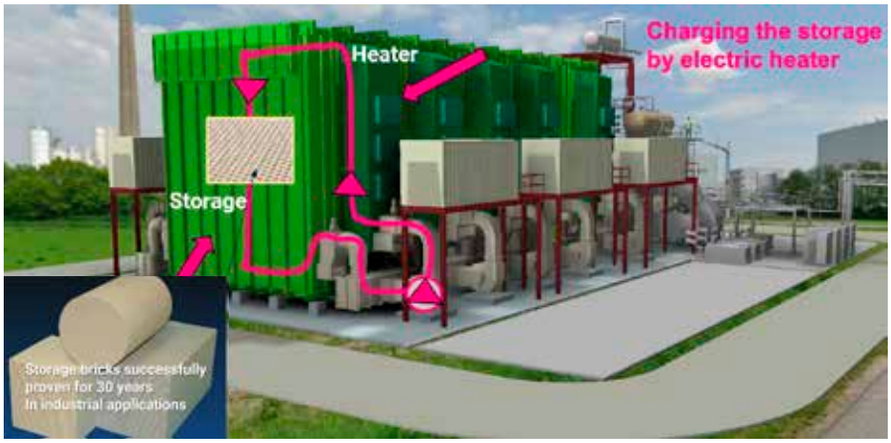


Figure 2: Green Heat Module, electric heater is on & storage is charged at favourable electricity prices. Source: Equans.

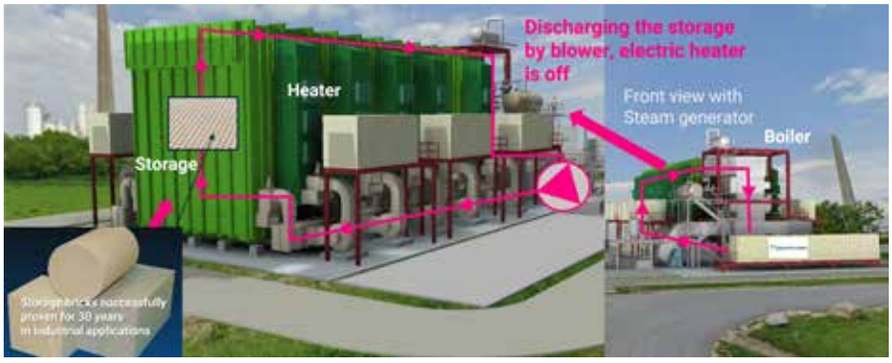


Figure 3: Green Heat Module, storage discharge to bridge high electricity prices – the electric heater is off. Source: Equans.

example weeks on the German electricity exchange in the autumn week from 28th October 28th 2023 to 6th Nov. 2023), the electric air heaters are switched on to generate process heat more cost-effectively than with natural gas and to fill the storage tank[2].

In this process, cold air is electrically heated to between 500 °C and 1,000 °C in a closed loop system in order to transfer thermal energy to the ceramic honeycomb material through its vast surfaces (figure 2).

If the price of electricity rises above that of clean gas again, the electric heater is switched off and the storage facility starts the discharge. The optimal storage size can be determined based on economic factors or security of supply requirements of the load.

Technically, another fan is switched on during discharging to direct a flow of cold air over the hot surfaces of the ceramic honeycomb bricks, heating the heated air to the unloading design temperature. This hot air flow, which can reach temperatures of up to 1,000 °C, can be used directly for drying processes or to operate a heat exchanger. This allows all heat transfer media, such as high-pressure steam or thermal oil, to be used by integrating them into existing heat generator systems in parallel.

This system brings significant environmental and financial benefits:

- High conversion efficiency up to 95%;
- Supply of industrial process heat around the clock with no direct CO_2 emissions;
- High (up to 1,000 °C) and constant discharge temperature; therefore no limit of e. g. steam production parameters (pressure and temperature);
- Environmental friendly storage system: no toxic, flammable or hazardous materials, no requirement for Seveso III permit process;
- Renewable energy-based process heat that has no fuel costs and is therefore permanently price-stable;
- Cost-neutral transformation of process heat.

The GHM works as an add-on solution for any thermal plant, which can be integrated without changing the production process itself. It fills a gap for technical challenging applications: process steam production, thermal oil systems, CHP plants with steam turbines or drying processes.

A policy framework to support Industrial Green Heat

New subsidy funds have been created at the EU, national and regional levels to subsidise these electrically based systems by 25% to 60% of the investment sum. For example, there is an new EU call (EU Industrial Decarbonisation Bank) for €1 billion mainly for the electrification of industrial processes. In contrast to previous technology agnostic funding calls this new sharp focus on electrification as the main decarbonisation route is appropriate. In the latest BIK call from the German Federal Ministry of Economics it has been shown, that projects involving electrically powered process heating were almost exclusively those which received funding commitments[3].

In addition, the EU Commission has recognised the problem of old-fashioned grid fees and charges in its Clean Industrial Deal action plan[4]. By reducing the gross savings achieved through the use of electric heat generators these fees are holding back the potential of sector coupling with green excess electricity as a new fuel. For this as an example, the German grid regulator Bundesnetzagentur is pushing towards flexible grid fees in its grid charge reform process being ongoing currently.

In order to prevent deindustrialisation and the emergence of new fossil fuel dependencies, a dynamic electricity grid logic is required, that will maximise the potential of renewable energy sources (RES), sector coupling and new technologies like the GHM for an independent, competitive and environmentally friendly EU economy.

3. *BIK-BMWE 2025, link online: https://www.klimaschutz-industrie.de/fileadmin/kei/Dateien/Bundesfoerderung_Industrie_Klimaschutz/uebersicht-bik-projekte-foerderwettbewerb-2025.pdf*
4. *EU COMMISSION 2025: "Delivering on the Clean Industrial Deal I", page 4, (online).*

Demand-side flexibility: the untapped engine of Europe's electrification

Electrifying end-uses is widely recognised as a cornerstone of Europe's energy-climate policy. Yet, despite ambitious targets and growing political consensus, electricity's share in final energy consumption is not rising quickly enough. The reasons are many, but one critical enabler remains underused: demand-side flexibility (DSF). At smartEn, we see unlocking the full potential of DSF not simply as a technical step, but as essential to make Europe's electrification affordable, resilient, and competitive.



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Michael Villa,
Executive Director of smartEn

The proven value of demand-side flexibility

Three priorities dominate today's EU energy debate: affordability, industrial competitiveness, and energy security. Policymakers in Brussels continue to search for new solutions, but the answer is already here. Demand-side flexibility is a proven market reality that delivers across all three priorities. The regulatory and enabling framework at EU level is largely in place, but flexible demand too often remains the intangible part of the energy transition.

DSF is supported by a growing number of commercial models, technologies, and service providers together forming the Flexible Demand Management Industry (FDMI). However, this clean-tech industry is developing unevenly across Europe. In some Member States, it is well established; in others, it remains limited or absent. Our recent publication, smartEn Map 2025 on the Flexible Demand Management Industry, shows where this vital industry to Europe's electrification stands today and highlights the direct link between enabling regulatory frameworks and market uptake. The International Energy Agency's recent report, The Value of Demand Flexibility – Benefits beyond balancing, reinforces this point and what we already know: daily system flexibility is set to more than double by 2030. The question is no longer whether DSF matters, but how to activate it at scale.

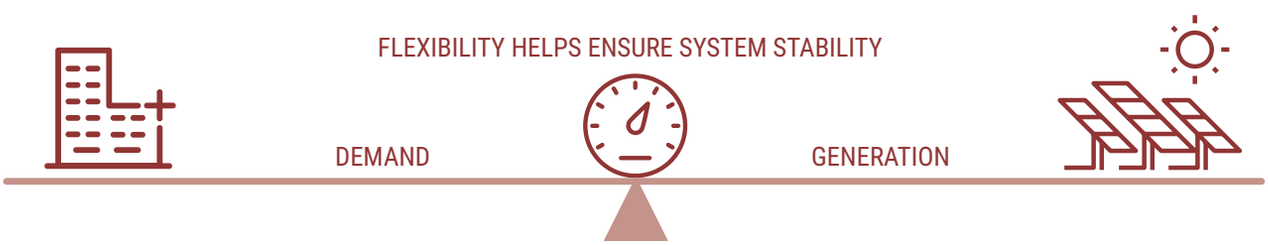
Market realities and regulatory gaps

Our 2025 Annual Market Monitor for Demand-Side Flexibility equally paints a mixed picture. While some countries have made significant progress in activating DSF, others lag behind due to regulatory barriers, lack of market incentives, or limited awareness. The Monitor shows that where enabling frameworks exist, innovative flexibility technologies Conversely, where barriers persist, the potential of DSF remains largely untapped, leaving cost-effective pathways to decarbonisation and electrification out of reach.

What is flexibility?
Flexibility is the ability of electrical generators and consumers to alter their output or consumption on demand. It can be provided by assets ranging from large front of meter generation to residential appliances.

What is Demand Side Flexibility?
DSF is the deviation from the planned consumption, generation and/or use of storage, in response to price signals or instruction, from residential, commercial or industrial customer sites, individually as well as through aggregation.

What is the Flexible Demand Management Industry?
The Flexible Demand Management Industry (FDMI) encompasses companies offering technologies and services designed to unlock the demand-side flexibility (DSF) potential of all connected end-users, including buildings, electric vehicles (EVs), and industrial consumers such as energy-intensive industries.



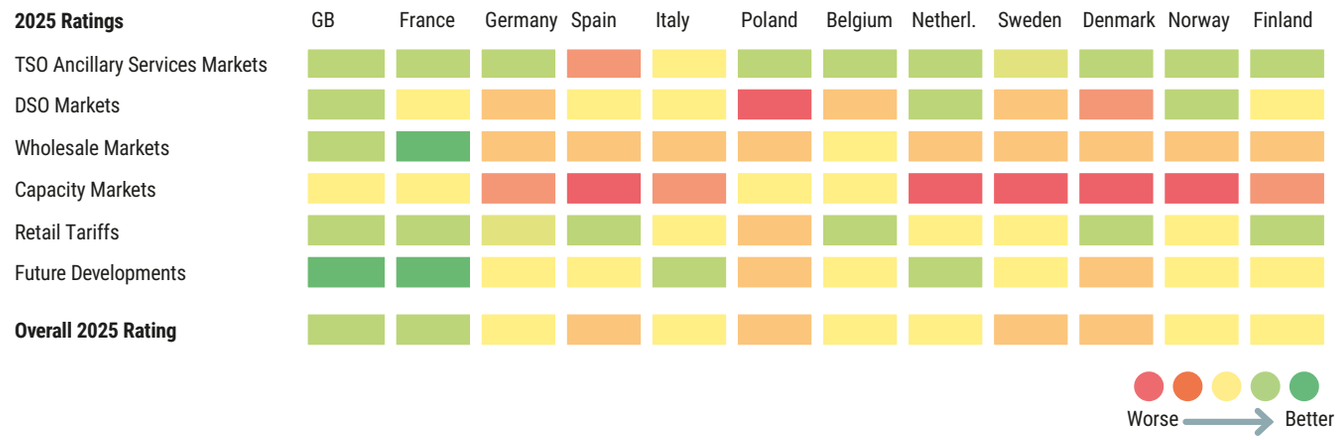


Figure 1: Overview of the demand-side flexibilities in Europe in 2025.
Source: 2025 Annual Market Monitor for Demand-Side Flexibility.

A clear understanding and quantification of systemic flexibility needs is essential. Without it, we risk missing the most cost-effective pathways to a decarbonised, electrified economy. The activation of flexible demand must become a priority—not as a dry institutional requirement, but as a rewarding, market-based opportunity that benefits both the energy system and consumers.

The slow progress is particularly notable given that the 2019 Clean Energy Package—through its Electricity Regulation and Electricity Directive—already included nearly all the reforms required for European countries to achieve full 'green' status and unlock the potential of the Flexible Demand Management sector. These measures were meant to be implemented years ago, but adoption has been inconsistent. However, there is a positive development: the forthcoming Network Code on Demand Response, though still under negotiation, is expected to provide much-needed clarity and stronger EU-wide harmonisation. This could finally enable the growth of demand-side flexibility and its monetisation through various commercial routes, bridging the gap between regulatory objectives and market reality.

The role of the EU's Electrification Action Plan

The EU Electrification Action Plan (EAP) offers a pivotal opportunity to embed demand-side flexibility at the core of Europe's electrification strategy. To reach the EU's 32% electrification target by 2030, the EAP must ensure that demand-side flexibility is not an add-on but a central enabler.

First, Member States should integrate explicit electrification and flexibility targets into their National Energy and Climate Plans, with clear milestones and demand forecasts. Second, market design must evolve to reward flexibility, removing barriers and ensuring fair access for all consumers—from vehicles and households to industry. Finally, EU funding should prioritise smart electrification projects that combine digitalisation, grid flexibility, and consumer empowerment.

By placing DSF at the heart of the EAP, the EU can unlock the full potential of electrification—making it more affordable, resilient, and aligned with the needs of a renewable-powered future.

A call to action: demand-side flexibility as a strategic asset

The era of pilot projects and small-scale demonstrations should now give way to mainstream deployment. Demand-side flexibility needs to be integrated into national energy planning and recognised by all stakeholders—from policymakers to consumers—as a core system resource. The FDMI is ready to deliver, but it needs a level playing field and a clear signal from Brussels and national capitals.

The year 2026 must mark the shift from proof to action. The Electrification Action Plan and the National Flexibility System Assessments, required from all Member States, will identify systemic flexibility needs and the most cost-effective solutions. This is a pivotal opportunity to embed DSF into national energy strategies and ensure that flexible demand plays a central role in meeting Europe's electrification goals.

Demand-side flexibility is not just a technical tool; it is a strategic asset for Europe's energy transition. By activating flexible demand at scale, electrification can become more affordable, resilient, and competitive. The building blocks are already in place. Now, we must act.

Electrification: RTE's perspective on key challenges


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Olivier Houvenagel,
Director of Electricity System Economics, RTE

Electricity is now everywhere, but not the dominant source of energy consumption in France. It accounts for less than half of building heating, a minority share of energy use in French industry, and remains marginal in the transport sector (excluding railway). The situation is similar across Europe, where electricity represents only around one quarter of final energy consumption.

A successful decarbonisation strategy based on rapid electrification would help fighting climate change, reduce dependence on imported fossil fuels and improve the trade balance. Supporting the electrification of end uses is therefore one of the main energy policy challenges facing France and Europe.

RTE's 2025 Annual Electricity review shows that the electricity's share of final energy consumption has stagnated in France at around 450 TWh per year, below the 475-480 TWh per year recorded throughout the 2010s. At the same time, France has returned to high levels of low-carbon electricity generation, based on nuclear power and renewable energy. This resulted in record electricity exports in 2024 and 2025.

Such levels of generation provide a strong foundation for the electrification of new end uses.

Stimulating the electrification of end uses: a prerequisite for meeting EU and French climate objectives and strengthening energy sovereignty

In its 2025 Annual Electricity review, RTE identifies the conditions required to decarbonise the French economy:

- rapid electrification of final energy uses, supplemented by a shift towards other low-carbon energy carriers;
- increase in low-carbon electricity generation consistent with rising consumption, thereby ensuring both decarbonisation and security of supply;
- development and reinforcement of electricity grids at both transmission and distribution levels, as a key enabler of electrification;
- continued efforts to improve energy efficiency and promote more responsible energy use.

On this basis, RTE considers two decarbonisation pathways (Figure 1):

- a rapid decarbonisation pathway involving a sharp acceleration in electrification (electricity accounting for 35% of final energy consumption in 2030 and 40-45% in 2035), in line with European climate objectives;
- a slower decarbonisation pathway, reflecting sustained but more gradual growth in electricity use across all sectors. Under this pathway, France would fail to meet the 2030 target of reducing greenhouse gas emissions by 55%.

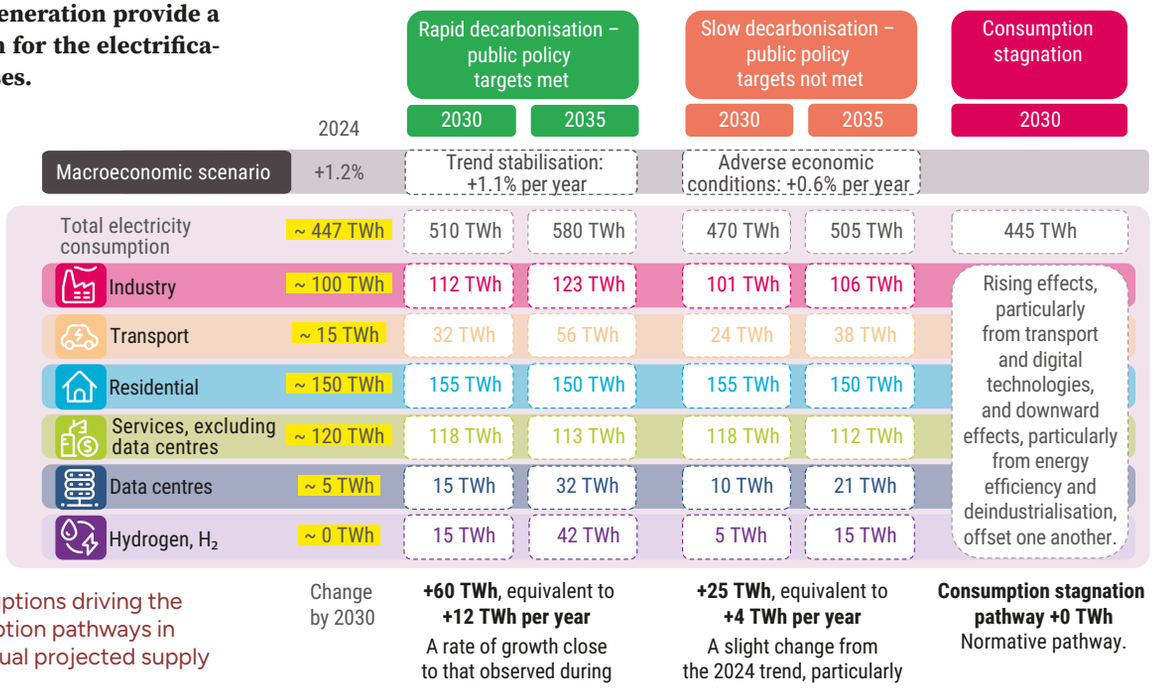


Figure 1: Key assumptions driving the electricity consumption pathways in the 2025 multi-annual projected supply forecast. Source: RTE


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Transport offers the greatest potential for growth in the short term. Under the rapid decarbonisation pathway, almost eight million electric vehicles would be on the road by 2030, resulting in a tenfold increase in the associated electricity demand by 2035. However, the slowdown in electric vehicle sales observed in France in 2024 (linked to the economic situation and reduced purchase incentives) highlights the importance of stable and predictable policies to support electrification in this sector.

Industry and hydrogen also offer significant potential for electrification. Numerous projects are under consideration, but many are struggling to materialise due to the deteriorating macroeconomic environment and competitiveness concerns.

More recently, data centres have been developing rapidly and are emerging as a new electricity-intensive segment. Their electricity demand is expected to increase by around 30 TWh by 2035, driven by efforts to strengthen digital sovereignty and meet the growing demands of artificial intelligence.

The current paradox is that, despite nearly 30 GW of signed grid connection agreements – covering around 200 projects across data centres, hydrogen and its derivatives, and industrial facilities – electricity consumption has remained stable. The challenge is therefore to ensure that these projects are effectively implemented so that France can achieve its decarbonisation objectives. Public policies must prioritise the acceleration of electrification in the sectors that are central to decarbonisation. These sectors represent the main levers for successfully implementing France's decarbonisation and energy sovereignty strategy.

Creating a favourable framework for the necessary development and reinforcement of electricity grids

The electricity grid is one of France's key assets in supporting electrification. It is not saturated, benefits from low-cost financing, and grid renewal has become RTE's largest area of investment following a sustained increase in investment over recent years.

The challenge in the coming years will be to ensure that the grid remains competitive at a time when France faces strong international competition to attract new industrial facilities. In February 2025, RTE proposed a grid development strategy focused on renewal, connections and reinforcement. It was designed to ensure that infrastructure investment remains sustainable from an industrial, environmental, human and financial perspective.

The plan amounts to approximately €100 billion over 15 years, representing a considerable investment. It was the subject of a public consultation in 2025 and was approved by the French Energy Regulatory Commission (CRE). The CRE supports RTE's proposed strategy and emphasises that the plan is the most highly optimised of its kind in Europe.

At the European level, the Commission now regards electricity grids as a fundamental component of the decarbonisation strategy. The question of how to finance them is becoming increasingly pressing.

The Commission has recently published a Grid Package concerning the development of interconnections. However, as highlighted in the Draghi report, this development cannot take place without the necessary adaptations to domestic electricity grids. Furthermore, given the scale of the investment required, funding, particularly European funding, must be directed exclusively towards the projects that are most strategically important for decarbonisation and sovereignty.

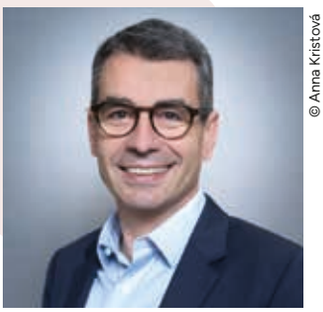
Maintaining the long-term balance of the electricity system

The development of demand-side flexibility and energy storage is essential for managing peak demand, integrating variable renewable generation, facilitating the operation of the electricity system and optimising grid reinforcement requirements. This flexibility may take various forms, including smart heating management, optimised scheduling of electric vehicle charging, flexible operation of electrolysers, and industrial demand-side response. Appropriate price signals are essential to encourage the development of flexibility. These could, for example, include changes to peak and off-peak time periods within market and tariff arrangements.

In its 2025 multi-annual projected supply forecast, RTE highlights the priorities that must be addressed to always maintain the electricity system's balance. These include voltage management, the participation of renewable energy installations in the balancing mechanism, and the controllability of renewable installations during periods of negative electricity prices.

Electricity grids: a strategic pillar for the electrification of Europe

As the electrification of end uses accelerates, electricity grids are becoming a strategic cornerstone of the energy transition. From modernising infrastructure and integrating renewable energy sources to advancing digitalisation, stakeholders across the sector are implementing concrete solutions to make electricity systems more flexible, resilient, and equipped to meet global energy challenges.



© Anna Kristová

Dominique Ferreira,
Brand Director,
Omexom, VINCI Energies



Construction of the 380 kV line in Salzburg, Austria.
© Standout Media

The electrification of end uses is now emerging as a central lever of the energy transition in France and across Europe. Mobility, industry, buildings: all sectors are concerned by this transformation, which relies on decarbonised, dispatchable and locally available energy. Electricity makes it possible to address a dual strategic challenge: strengthening energy sovereignty by reducing dependence on imported fossil fuels, while accelerating the reduction of greenhouse gas emissions through the development of renewable energy and nuclear power. As such, it is an essential driver of reindustrialisation and competitiveness for European economies.

However, this transformation also brings significant challenges. From a technical standpoint, grids must adapt to growing, scattered and less predictable demand, driven by the rise of electric vehicles, the electrification of industrial processes and the large-scale integration of intermittent energy sources such as solar and wind. At the same time, the rapid expansion of artificial intelligence is fuelling a sharp increase in data centre electricity consumption. These highly electro-intensive infrastructure could, on their own, account for nearly 10% of the increase in electricity demand by 2050.

From an economic perspective, the investment required is considerable and must be delivered within tight timeframes. Finally, regulatory frameworks must evolve to support these transformations, foster innovation and encourage new models such as self-consumption, energy communities and demand-side flexibility. In addition, strengthening grid resilience to extreme weather events is becoming an increasingly pressing priority.

Electricity grids: an investment as critical as power generation

Against this backdrop, one reality is becoming increasingly clear: for every euro invested in electricity generation, a corresponding euro must be invested in electricity grids. Long overlooked, grid infrastructure is now taking centre stage in the energy transition. It serves as the backbone of the energy system, maintaining the delicate balance between electricity supply and demand while ensuring a secure, reliable and high-quality power supply. This is precisely where the expertise of energy infrastructure specialists becomes critical, helping to modernise and optimise electricity grids through a range of complementary solutions. First, this expertise contributes to strengthening existing infrastructure by modernising high-, medium- and low-voltage grids in order to increase their capacity, reliability and lifespan. It also supports the development of European interconnections, which are essential to balance supply and demand across the continent, pool energy resources and secure supply.

In addition, companies in the sector support the integration of renewable energy sources by adapting grids to increasingly decentralised and intermittent generation, while developing storage solutions and flow management systems. They are also deploying smart grids capable of collecting and analysing data in real time in order to optimise the use of infrastructure and anticipate changes in consumption. Finally, they directly support the electrification of end uses, whether in electric mobility, buildings or urban infrastructure, with a comprehensive approach ranging from design to operation and maintenance.

Modernising and interconnecting to secure supply

These areas of expertise are being translated into concrete projects across Europe. In Bönnigheim, Germany, the modernisation of high-voltage grids has made it possible to better integrate renewable energy sources. This pilot project illustrates the need to adapt ageing infrastructure to more complex and fluctuating electricity flows, while improving its environmental performance through the use of more energy-efficient equipment.

On another scale, the electrification of the Port of Barcelona demonstrates the ability to deliver major cross-border projects. By allowing ships to connect to the electricity grid while at berth, this infrastructure significantly reduces local air pollution and strengthens the resilience of port energy systems. It is part of a broader logic of interconnection and grid convergence at the European level.

Integrating renewables and optimising electricity flows

Renewable energy integration is also being driven by the deployment of photovoltaic installations, particularly on public buildings, boosting local generation while reducing dependence on the centralised grid. These installations are supported by monitoring and maintenance solutions that optimise their long-term performance.

The WAVE project, developed in Lille, goes even further by experimenting with direct current power supply in buildings. This innovation significantly improves energy efficiency by limiting energy conversions and losses, while facilitating the integration of renewable sources and storage systems.

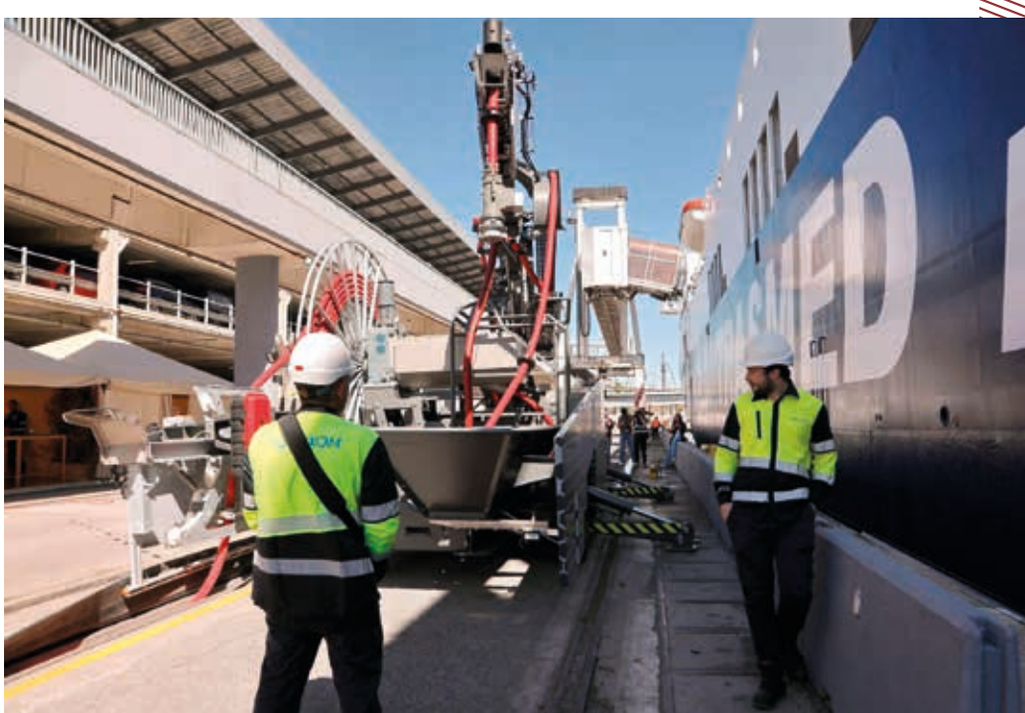
Grid digitalisation is another major area of focus. The SmartMagne project, in the Cher district (France), illustrates the potential of smart grids: through artificial intelligence, it makes it possible to optimise electricity generation and consumption in real time locally, supporting collective self-consumption and better management of demand peaks.

Enhancing infrastructure resilience in the face of climate hazards

Finally, in Portugal, an intelligent monitoring system for high-voltage transmission lines is helping to strengthen grid resilience to climate-related risks. It can detect anomalies that may signal fires or extreme events. By continuously analysing grid data, the system makes it possible to anticipate risks, alert operators and intervene upstream, or even proactively disconnect certain lines to avoid major outages.

This approach illustrates the shift from reactive infrastructure management, centred on repairing assets after an incident, to a preventive model based on anticipation and risk management. It is fully aligned with the challenges of adapting energy infrastructure to climate change.

These projects are actively contributing to the transformation of electricity grids into smarter, more flexible and more resilient systems. These infrastructure are essential to support the growing electrification of end uses and to build an energy model that is sustainable, sovereign and high-performing at the European level.



Electrification of the Port of Barcelona.
© Anna Kristová

Enedis supports the deployment of distributed flexibility solutions



Timothée Furois,
Flexibility Project Director, Enedis

Flexibility from installations connected to the public distribution grid is essential to the proper functioning of the electricity system. It helps meet the growing needs to balance supply and demand, and to resolve congestion issues on public transmission and distribution grids. To address these challenges, Enedis is structuring its action around three priority areas of development.

Facilitating the development of flexibilities to support supply-demand balance

These forms of flexibilities may be structural, dynamic or designed as safeguards, notably by giving flexibility providers access to the functionalities of the metering system and related services.

The growing penetration of renewable energy is making the production profile more variable, requiring greater use of flexibilities to ensure security of supply. It is also creating recurring periods of abundant low-carbon generation, particularly during the "solar bell", when residual demand – the consumption that must be met by dispatchable resources after accounting for non-dispatchable renewable generation – falls as solar generation increases. Wherever possible, consumption should therefore be shifted towards these periods (Figure 1).

Structural flexibilities refers to the flexibilities needed to respond to predictable changes in supply and demand. They are designed to adapt to the fact that consumption is structurally higher in winter than in summer, higher during the week than at weekends, and that solar generation is more abundant in the middle of the day, particularly in summer, etc.

Over shorter timeframes, the balance of the electricity system requires the use of **dynamic flexibilities** to address variations in consumption and generation that can be forecast from a few days to a few hours in advance.

These supply-demand balancing issues, linked to security of supply and the optimisation of the electricity system, are the main driver behind the need to develop flexibility. Flexibility will deliver its greatest value by addressing these challenges. Enedis is actively working to develop it:

- First, by adapting the peak/off-peak signal to encourage the development of structural flexibilities consistent with the evolution of the electricity system. This evolution means that the period between 11 a.m. and 5 p.m. is now more favourable than before for consuming electricity, particularly in summer.
  Enedis is therefore fully mobilised to adapt tariff signals through the seasonal adjustment of off-peak hours. This involves shifting off-peak periods more frequently to the middle of the day, particularly in summer, when low-carbon generation is more abundant and market prices

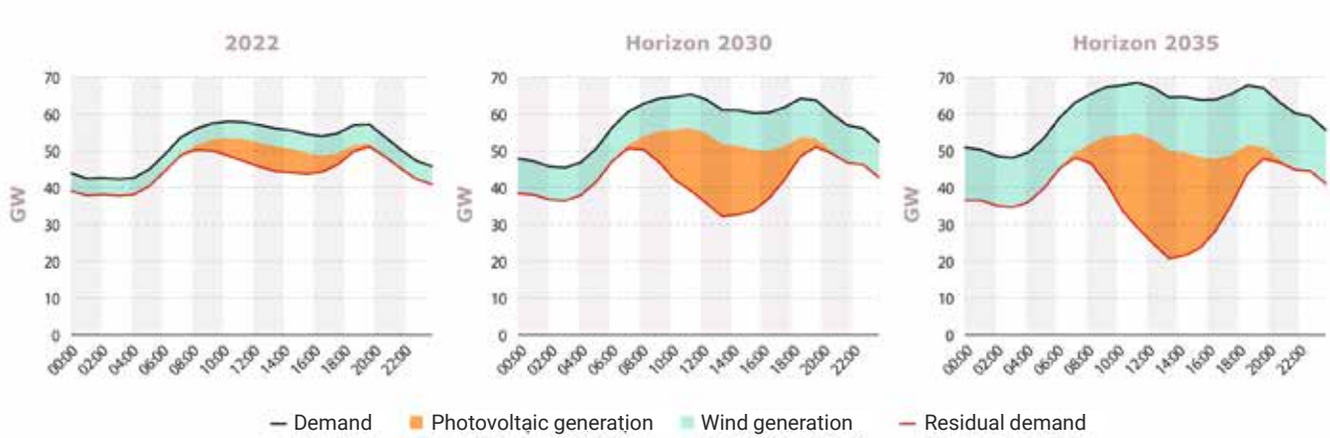


Figure 1: Evolution in the average hourly profile of residual consumption on working days, excluding uses under control, between 2022 and 2025.

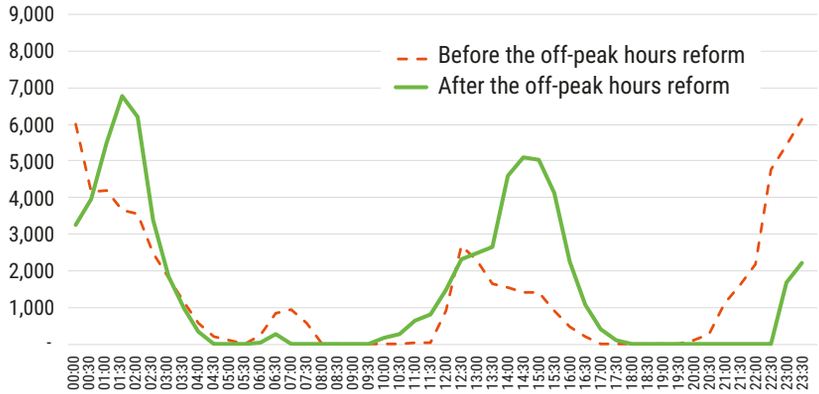


Figure 2: Daily consumption profile of hot water tanks controlled by the off-peak signal today and after the ongoing reform.

The time-of-use tariff scheme (peak/off peak) was introduced as early as the 1960s following the commissioning of the first nuclear power stations, and was extended in the 1970s and 1980s to residential and small business customers wishing to schedule certain uses.

It generates significant levels of flexibility (7 to 8 GW shifted away from the evening peak today), notably through the control of hot-water tanks, and has a major impact on the electricity system. This reform will enable up to 5 GW of power demand to be shifted to coincide with the peak of solar energy generation.

are structurally lower. This provides an incentive to shift consumption towards the most favourable periods.

- Second, Enedis is leveraging the capabilities of its metering system to enable the large-scale deployment of dynamic flexibility under industrial conditions, whether by suppliers or flexibility operators. This includes providing access to load curves through Linky, offering supplier calendars that support flexible tariffs, and making Enedis large-scale data-processing capabilities available to market players. One example is the introduction of a new method for verifying actual flexibility delivery, known as the panel method, which will help ensure the reliable measurement of distributed flexibility activations.

Mobilising flexibilities to facilitate the integration of renewables and optimise the distribution grid

The development of renewable energy requires significant grid investments. By 2035, the French distribution grid could host nearly 100 GW of generation capacity, compared with 56 GW at the end of 2025. The time required to carry out grid works does not necessarily coincide with the timelines of renewable energy projects. Until now, France has benefited from a well-sized electricity grid. However, in some very limited areas of the country, the grid can no longer accommodate new renewable energy projects without major works being carried out.

This is why Enedis is working to optimise grid use through flexibilities to facilitate the integration of renewable energy and efficiently manage investment. The aim is not to balance generation and consumption at every grid point, which would be sub-optimal, but to manage congestion issues by ensuring that flows on the grid do not exceed its capacity.

To achieve this, Enedis is developing a new grid operation tool to optimise flow management and identify the levers needed to relieve constraints. The REFLEX project makes it possible to offer faster and cheaper connections for renewable energy projects, with occasional power limitations. A new voltage plan, enabling an additional 2 to 3 GW to be accommodated without overinvestment, is currently being deployed. In coordination with RTE, experiments are being launched to control solar installations on the low-voltage grid in response to localised constraints on the transmission network. Flexible connection offers for storage are now being proposed to facilitate its integration into the grid and, where appropriate, reduce the number of production curtailments affecting renewable energy parks due to grid congestion.

Establishing, in coordination with RTE, a new framework for managing the electricity system

To address the challenges posed by the increasing decentralisation of the electricity system, such a framework will help optimise network congestion management and maximise the value of flexibilities across the electricity system. New sources of flexibility are mainly found in uses connected to the distribution grid, such as renewable energy installations, storage, but also electric vehicles, domestic hot water and heating. These uses offer significant flexibility potential: 38 GW of renewable generation connected to the medium-voltage distribution grid, and up to 10 GW of evening peak demand that could be avoided by 2035 through smart management of water heating and electric vehicle charging.

This “decentralisation” of flexibilities requires a revised framework for managing flexible assets across the electricity system, underpinned by closer coordination between grid operators. Maintaining system balance will require greater use of flexibilities at a time when grids are becoming increasingly constrained. It is therefore essential to ensure that flexibility activations do not create additional grid constraints, while enabling available flexibilities to be mobilised to address remaining constraints.

This requires new operational processes between grid operators to better anticipate such situations as well as closer coordination in real time to implement necessary measures. Enedis is working with RTE to develop these processes. New tools are also needed to enable flexibility services to be mobilised seamlessly in response to local grid needs. To this end, Enedis and RTE are preparing a pilot shared flexibility procurement portal, due to open in 2026. This will pave the way for the new arrangements for coordinating the use of flexibilities that will need to be implemented under the future Network Code on Demand Response.

Electricity storage and innovation:



Saft's strategy to reduce its CO_2 emissions and improve its competitiveness

Interview with
Cédric Duclos,
Chief Executive Officer of Saft

Few people know this, but Saft stands for *Société des Accumulateurs Fixes et de Traction* (Stationary and Traction Batteries Company). For more than 100 years, you have supplied high-performance batteries worldwide for a wide range of applications. Could you briefly explain how Saft contributes to the energy transition?

Cédric Duclos: Indeed, Saft has been supporting major industrial developments for more than 100 years. We design and manufacture batteries for a wide range of sectors: aviation, rail, space, Internet of Things (IoT), as well as Energy Storage Systems (ESS), thanks to our research centres and our 47 locations, including 16 industrial sites.

Today, we are at the heart of the energy transition. In practical terms, we develop complex energy storage systems that enable three major advances. First, they integrate renewable energies into electricity networks by ensuring flexibility and stability. Second, they electrify uses in mobility, industry and critical infrastructure, thereby reducing dependence on fossil fuels. Finally, they reduce the carbon footprint through storage solutions and innovative systems that optimise energy consumption.

Our ambition is simple: to provide reliable and sustainable solutions that help reduce CO_2 emissions, while guaranteeing European energy sovereignty.



Kyon Energy battery energy storage project in Dahlem, October 2025.
© Saft

What role do batteries play today in balancing the European electricity system?

C.D: Today, in Europe and around the world, our role in the energy transition is essential. Our solutions enable the storage of renewable energy, the stabilisation of networks and, consequently, the electrification of uses. From stationary systems for power grids to batteries for mobility, our technologies provide the flexibility needed to integrate more low-carbon energy and contribute to the reduction of CO_2 emissions.

Where does the market's priority lie today: supporting the development of renewable energies through grid-scale storage solutions, or developing behind-the-meter applications for industrial customers?

C.D: Saft is positioned in both segments, offering solutions that address the challenges of decarbonisation and competitiveness. The storage market is evolving rapidly and is being structured around two complementary areas.

On the one hand, grid-connected solutions are essential to support the development of renewable energies, particularly photovoltaics, by ensuring flexibility and stability in the electricity system. The technologies and markets for large-scale projects (several hundred MW) are already well established, and Saft is fully involved in them worldwide. The challenge now is to develop critical applications to integrate large volumes of variable renewable energy into the electricity mix, while ensuring security of supply, maintaining grid stability without conventional inertia, and limiting congestion and renewable energy curtailment.

> **"Grid-connected solutions are essential to support the development of renewable energies.**



Saft Bordeaux, from left to right: Cédric Duclos, CEO of Saft; Patrick Pouyanné, Chairman & CEO of TotalEnergies; Stéphane Lefevre, Director of Saft's Industry, Mobility and Infrastructure Division. @Alberto Bocos Gil

"As early as the beginning of the 2000s, the first Li-ion battery sent into space bore the Saft signature.

On the other hand, behind-the-meter applications, typically in the order of a few MW, are becoming increasingly important in buildings, industrial sites and, above all, data centres, which are major energy consumers. Beyond self-consumption and resilience, the challenge now is to make these sites flexible from the grid's perspective and to reduce their carbon footprint, while optimising energy costs through renewables and flexibility. We have done this, for example, in Bordeaux, with the Enershift installation inaugurated last September, which is a storage system designed for industrial sites.

Technology is a fundamental element of the battery industry. After the enthusiasm for the nickel, manganese, cobalt (NMC) technology, lithium iron phosphate (LFP) is now coming from China. Are you managing, both technologically and industrially, to remain among the world leaders?

C.D: We remain among the leaders thanks to an ambitious technology strategy and a constant capacity for innovation. We have expertise across all major lithium-ion chemistries (NMC, NCA, LFP and LTO) and were pioneers in the development of LFP with the invention of Super Lithium Iron Phosphate (SLFP). As early as the beginning of the 2000s, the first Li-ion battery sent into space bore the Saft signature. This lead is based on solid foundations, built over more than 100 years of history, combining development expertise and industrial excellence.

Today, we devote 10% of our turnover to R&D in order to innovate in battery chemistries and systems. We are investing in solid-state batteries, in which the liquid electrolyte is replaced by a solid electrolyte. This allows the use of metallic lithium, paving the way for significant gains in range, charging speed and, above all, major progress in safety, energy density and durability.

Since 2018, we have structured a strategic programme to industrialise this innovation, with key partnerships (CEA, ESA and European projects) and pilot lines in France.

To accelerate our innovation, we have built new lines at our R&D centre in Bordeaux, and last year we launched an innovation programme in partnership with start-ups. We are also innovating in systems, launching a new product for storing renewable energy every 18 months. In 2025, with our partner Safran Electrical Power, we presented a new high-voltage battery system to meet the growing demand for the electrification of aviation.

These efforts are accompanied by a circular economy and advanced recycling approach, meeting regulatory and environmental requirements.

The battery industry placed great hopes in Europe, through its successive plans and the IPCEI mechanism (Important Projects of Common European Interest). In the end, has European support been effective, and what do you expect from the second von der Leyen term?

C.D: European support has been real but limited. The institutions received a strong mandate on environmental policy and the reduction of CO_2 emissions, but a much more limited one on industrial policy.

Greater efforts and more funding are needed to support the deployment of these technologies, which are essential for the future and for European sovereignty.

Initiatives such as the IPCEI are moving in the right direction, but they have arrived late and remain insufficient to meet global competition.

For the second term, we expect a more ambitious policy, inspired by the proposals put forward by industry through the "A Battery Deal for Europe", which Saft supports. This plan is based on four major pillars:

- **strengthening** innovation through a dedicated and long-term R&D budget;
- **supporting** industrial ramp-up and production across the entire value chain;
- **encouraging** production in Europe through financial and industrial support mechanisms;
- **ensuring** competitiveness by tackling distortions linked to unfair subsidies and by diversifying sources of raw materials.

In summary, the aim is to move from a defensive approach to a proactive strategy, in order to guarantee European industrial sovereignty and support the energy transition.

About EdEn

Founded in 2010, EdEn makes recommendations to accelerate the decarbonisation of French and European economies while strengthening their competitiveness.

EdEn's members include stakeholders from the energy and grid sectors, infrastructure and buildings, as well as mobility and transport (including road, air, maritime and rail transport). Its membership reflects the diversity of the French and European economic landscape, from major industrial groups to SMEs, trade unions, professional associations, craftspeople and consumer organisations.

All share a commitment to innovation and industrial excellence as a means of reducing greenhouse gas emissions and progressively moving away from dependence on fossil fuels. Together, they draw on their expertise and experience to put forward concrete, feasible and economically viable solutions that reflect the realities of their respective sectors.

EdEn's recommendations to French and European policymakers are grounded in recognised economic and technical expertise, drawing on the work of its Scientific Committee.

EdEn's mission

EdEn contributes to shaping a net-zero world by 2050 and a more resilient society capable of adapting to the impacts of climate change.

To this end, EdEn puts forward recommendations to French and European policymakers on energy, buildings, mobility and transport policies, with the aim of moving away from fossil fuels and adapting our societies to the challenges posed by climate change.

This special issue of the EdEnmag is also available in digital format.

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EdEn members (as of 1 September 2026)





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Raoul Dufy,
detail from *The Spirit of Electricity*,
lithograph, 1952-1953