Barometer of french demand-side flexibility

Monitoring of the plan to scale up flexibility

16 October 2024

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Optimising our power consumption:
stakeholders in the French electricity system are taking action

Barometer of demand-side flexibility

1st edition - 2024

Editorial

1. Developing everyday demand-side flexibility: an air of déjà vu that conceals a real and fundamental change.

Managing an electricity system means balancing generation and consumption at all times. This can only be done by modifying either generation or consumption; this is what is known as flexibility in the electricity system. There always has been flexibility, but with the energy transition under way, both in terms of consumption trends and the generation mix, needs are changing.

Over the past fifteen years, the subject of demand-side flexibility has mainly focused on the development of so-called "explicit" demand response, to balance the electricity system in real time while reducing consumption peaks and ensuring security of electricity supply.

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From now on, the focus is on everyday flexibility, deferring and modulating consumption every day of the year, and not just demand response during annual peaks. This is one of the challenges to be met in order to optimise the use of low-carbon power generation, against a backdrop of the major transformation of the European electricity system resulting from the growth in wind and solar power.

2. This is a "win-win" approach, which means lower electricity bills for consumers and a better carbon footprint, while making it generally easier to switch from fossil fuels to electricity.

All consumers are concerned: manufacturers, but also companies and local authorities in the tertiary sector, as well as private individuals. In fact, more and more electrical uses can be deferred or modulated on a daily basis without any impact on comfort or the service provided.

This is a complementary approach to energy sobriety, with the aim of consuming less by consuming better, i.e. by consuming at the right times of day, when electricity is almost completely carbon-free: at night and in the afternoon. For decades, deferred consumption has been programmed to operate during off-peak hours at night, particularly for hot water tanks. The aim now is to take advantage of the benefits offered by photovoltaic solar generation to review the times of day when consuming electricity can be less expensive.

This approach can bring two benefits to consumers. First, there is the economic benefit of consuming more during the hours of the day when power generation is less expensive, thus saving money on the electricity bill. But there is also an environmental benefit, as these are the hours when electricity is almost completely carbon-free.

It also leads to a benefit in the public interest: adopting the habit of consuming at the right times helps speed up the energy transition in France. Shifting consumption to the right times puts less stress on the electricity system, and because it is under less stress, it can more quickly accommodate a wider range of uses transferred from fossil fuels: more electric vehicles, more heat pumps and more decarbonised industrial processes.

3. This approach involves no loss of comfort and no effort other than correctly programming part of your electricity consumption.

Fewer and fewer electrical uses are instantaneous. Of course, lighting, cooking equipment, motors and Internet and audiovisual equipment are all expected to start as soon as a switch is flicked. By definition, these uses cannot be shifted or modulated. They may be avoided in exceptional cases on days when the electricity system is under extreme strain – during an EcoWatt alert, for example, – but this does not constitute everyday flexibility.

However, an increasing number of appliances now run on or contain batteries, with the possibility of storing power to defer consumption. They can be charged at different times: this is particularly true of electric vehicles. At the same time, a very large proportion of power consumption is used for heating and cooling, to heat or cool a building or to heat water, for example. It is then the thermal inertia of the building or hot water tank that can naturally fulfil the energy storage role. These uses can be deferred or modulated over short periods of two or three hours to avoid peak times and optimise power consumption.

4. At the heart of the approach: programming equipment to simply manage power consumption.

Deferring and modulating usage can be programmed manually every day, but above all it can be automated using technologies and equipment that are now mature and accessible to everyone, companies and private individuals alike. These include our smartphones, Wi-Fi, connected objects and technologies for transmitting information, remote control and optimising power consumption, which have developed considerably over the past twenty years.

The essential prerequisite for demand-side flexibility is thus for buildings and industrial processes to be equipped with these devices for controlling and optimising electricity use, so that the *smart building* communicates with the *smart grid*. As such, this Barometer will closely monitor the deployment of Building Automation and Control Systems (BACS, or GTB in French) in large tertiary buildings, as well as home automation equipment in the residential sector.

This approach does not require consumers to react to real time signals from the electricity system. The best or worst times of day for consuming cheaper, less carbon-intensive electricity are known, so they can be planned and programmed several months or even years in advance, and optimised up until one day before in most cases.

5. Full scaling up of this approach will also require **that consumers have access to price offers enabling them to benefit from their shifted consumption.**

Spot prices on the wholesale electricity markets – where producers and suppliers exchange electricity utiliser l'expression "day-ahead" – now clearly show the differences in generation costs at different times of the day and at weekends. But this is not the same data that is used in the majority of consumer offers, whether industrial, tertiary or private.

For the reason, the French Energy Regulatory Commission (CRE) is working to ensure that the regulated components of electricity bills reflect these differences: network tariffs and regulated electricity sales tariffs. RTE is also working to align the signals it controls with this new situation: the capacity mechanism will be reviewed in 2026 to take account of these factors.

But it is also necessary that these price differences are reflected in market offers. A single electricity price throughout the year, with no difference between peak and off-peak periods during the day, removes any incentive to defer consumption and hinders the emergence of smart electricity management services. This is a major cultural change that needs to be brought about, and one in which suppliers and flexibility aggregators have a major role to play.

6. Conclusion

The electricity system is set to undergo profound change over the next few years, driven in particular by the electrification of energy uses and the transformation of the generation mix. To harmoniously combine these two dynamics and make the most of the advantages they bring (carbon-free energy at a controlled price and based in France), we need to manage to schedule a large proportion of power consumption to coincide with periods that are favourable for these forms of energy, without any loss of comfort and with a direct saving on bills.

This approach requires validation of certain prerequisites: collective awareness-raising, adjusting the programming of some appliances, deploying control equipment and ensuring the availability of appropriate supply offers. But it remains a low-cost measure that can be implemented very quickly, over the next two to three years.

The aim of this Barometer of demand-side flexibility is thus to track this pathway year after year. It monitors the effectiveness of demand-side flexibility in meeting the need to optimise the electricity system, as well as developments in the technical and economic prerequisites for the widespread use of everyday flexibility.

Aimed at a wide audience, it provides consumers and the public with a clearer understanding of the subject, tracks the pathway, and provides technical information for public decision-makers and all stakeholders in the electrical flexibility sector. This first edition is thus intended to be improved and enlarged over time to keep pace with developments in the public debate on the subject.

Enjoy the read!

Partners

Think Smartgrids is the association that unites and develops the smart grid sector in France and internationally, for the benefit of consumers, the appeal of the regions, and the energy transition.
Smart grid technology and infrastructure is an essential prerequisite for the development of flexibility, and so the ecosystem stakeholders are working within Think Smartgrids on drafting technical recommendations for the deployment of Flex Ready systems in tertiary buildings.

www.thinksmartgrids.fr

RTE, the French electricity Transmission System Operator, has a public service mission: to guarantee the supply of electricity at all times and with the same quality of service throughout France, through the efforts of its 9,500 employees. RTE manages electricity flows and the balance between generation and consumption in real time. RTE maintains and develops the high and very-high voltage network (63,000 V to 400,000 V), which comprises almost 100,000 km of overhead power lines, 7,000 km of underground lines, 2,900 substations in operation or joint operation and approximately fifty cross-border lines. The French grid, the most extensive in Europe, is interconnected with 33 countries. As a neutral and independent industrial operator of the energy transition, RTE optimises and transforms its grid to connect electricity generation facilities, whatever the future energy choices. Through its expertise and reports, RTE informs the choices made by the public authorities.

www.rte-france.com

Enedis is the electricity Distribution System Operator for 95% of mainland France. Here, it operates 2,200 source substations linking the distribution system to the RTE transmission system, 1.4 million km of power lines, and more than 700,000 public distribution substations linking the medium- and low-voltage grids. In this capacity, Enedis provides technical services to its 36 million customers (connection, troubleshooting, meter reading, etc.).

www.enedis.fr

GIMELEC is the trade association for the digital electronics industry. It brings together companies that design and deploy electrical and digital technologies for the electrification and optimised control of infrastructure, buildings, industry and mobility.
GIMELEC represents 210 companies employing 130,000 people.
These 210 committed companies work together to ensure that energy intelligence, automation and digitisation make it possible to achieve the national goals for energy transition and decarbonisation.

www.gimelec.fr

IGNES is an alliance of manufacturers offering electrical and digital solutions for the building industry. These solutions provide key answers to major climate and social challenges, enabling technical equipment to be controlled to consume less and better, improving summer comfort, adapting homes to ageing, ensuring electrical safety, securing access, providing effective ultra high-speed broadband, etc. The alliance is made up of 50 companies based in France, ranging from small enterprises to major international groups and representing more than 300 product families. All of its members share the values of innovation and entrepreneurship. IGNES works on a daily basis with the electrical, construction and security sectors.

www.ignes.fr

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1

Barometer of demand-side flexibility: a management tool for a pathway to scaling up

1.1

Developing demand-side flexibility, a winning pathway for consumers

Historically, demand-side flexibility has meant running hot water tanks so that they are switched on at night during off-peak hours, manual deferment by some consumers (for washing machines, etc.), and load reduction on peak days. Nowadays, it also means programming some daily uses, such as charging your car, washing your clothes or heating your home, to defer and modulate your consumption to the right time every day.
This makes it possible to take advantage of the times when electricity is cheapest and most carbon-free, while helping to balance the electricity system.

Developing flexibility: a priority for an electricity system in the midst of transformation

Ensuring a balance between electricity generation and consumption is a physical imperative to guarantee security of supply to consumers at all times. Added to this is the issue of economic and environmental optimisation: using the least expensive and least carbon-intensive power generation assets to meet demand.

The electricity system is set to undergo profound change over the next few years, driven in particular by the transformation of the generation mix and the electrification of energy uses. In this context, RTE has demonstrated the need to develop several GW of new flexibility to ensure security of supply and optimise the operation of the electricity system by 2030.

The RTE Generation Adequacy Report[3] details the various flexibility packages that can meet these needs. It concludes that demand-side flexibility plays an essential role, as it represents a lever that can be accessed quickly, at lower cost and with a better environmental balance than other flexibility levers such as batteries or thermal power generation assets.

This means rapidly and unapologetically pursuing the development of ways of eliminating or reducing consumption during peak periods, particularly in winter, and above all introducing everyday flexibility, so that consumption can be modulated and deferred on a daily basis wherever possible, giving preference to consumption at times when renewable and nuclear electricity is most abundant and prices are low: at night and increasingly during the day.


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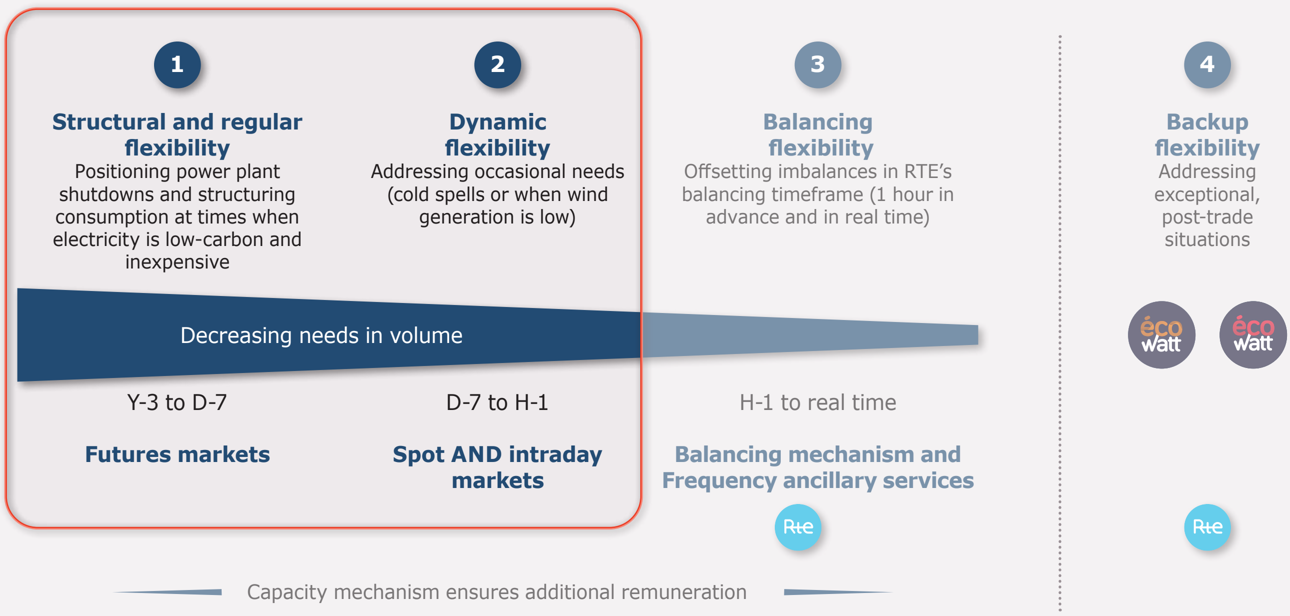
What is flexibility?

It is defined as the capacity of a power generation, consumption or storage asset to increase or decrease the power it injects to the grid or extracts from the grid.

Four types of flexibility can be described in terms of the needs they meet.

This barometer focuses on the first two types of flexibility need because they are the largest in volume and represent most of the need for new flexibility by 2030:

- structural and regular flexibility, linked to the structure of consumption and generation;
- dynamic flexibility, needed to offset the variability of renewable consumption and generation (particularly wind power) that can be predicted from a few days to a few hours in advance.



The threefold benefit of everyday demand-side flexibility

These new habits can be adopted without any loss of comfort for consumers. They involve, for example, deferring the charging of electric vehicles or modulating the consumption of a heat pump for a few hours, without affecting the use of the vehicle or the temperature in the home.

For consumers who are able to do so, shifting, modulating and cutting consumption provides a threefold benefit: it reduces their energy bills, reduces their carbon footprint and contributes to accelerating the energy transition by helping the electricity system to operate at optimum efficiency.

By 2030, if it develops in line with the "A - reference" scenario in the RTE 2023 Generation Adequacy Report[3], demand-side flexibility could provide almost half of the modulation needed during the day to optimise the system. By matching supply and demand for low-carbon electricity as closely as possible, it would allow for a fourfold reduction in the capping of renewable generation[4]. By avoiding the deployment of other, more costly flexibility levers, it could save the public purse up to €3 billion a year (when this type of flexibility is used instead of batteries).

3. To go further, see: RTE, 2023 Generation Adequacy Report, Chapter 6

4. Compared with a scenario in which demand-side flexibility does not develop beyond current levels, and in which the current off-peak/peak periods are not re-optimised.

1.2

A barometer to steer the pathway for scaling up demand-side flexibility

The entire French demand-side flexibility sector is taking action to ensure this pathway is followed.

To make this pathway a reality, all stakeholders in implementing demand-side flexibility must take coordinated action: public authorities, system operators, electricity and energy service suppliers, equipment manufacturers, building managers and consumers.

To ensure that this ambition does not remain a mere declaration of intent, there is a need for action:

- on the **economic framework,** to strengthen the incentive to consume at the right times and to ensure that service providers and operators make effective use of consumers' ability to defer, modulate and cut their consumption;
- on the **technical framework,** to define effective implementation methods and common principles for the design of control equipment and solutions;
- on the **operational framework,** to ensure the adoption of flexibility in normal operational practice in tertiary buildings and in the habits of residential consumers.

So, provided action is taken at all levels of the implementation of demand-side flexibility, **a new paradigm aimed at "consuming at the right time" every day could become widely adopted.**

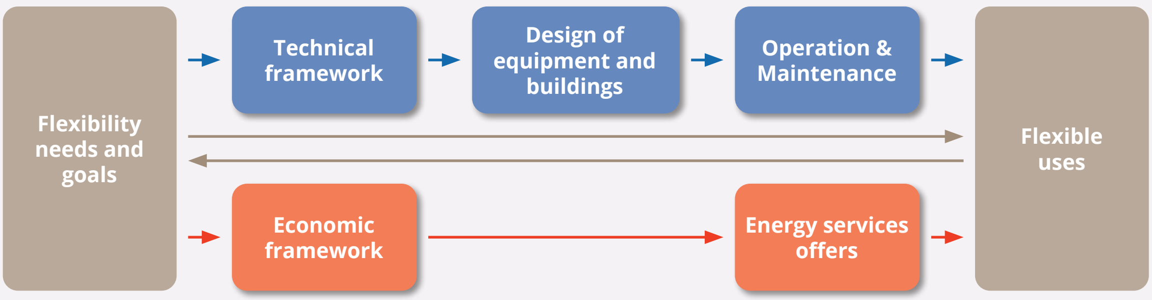
The barometer of demand-side flexibility will steer this development pathway, so that it does not remain a mere declaration of intent.

Unlike power generation assets, where the development indicators are known (nuclear generation potential, rate of installation of new renewable capacity, etc.) and where performance can be measured easily, the development of flexibility relies on dispersed actions, carried out by a multitude of different players, of which only some (certain types of demand response) are currently subject to public control.

The aim of this barometer of demand-side flexibility is thus to define new indicators to measure the aggregate impact of actions to defer and modulate consumption from the electricity system, and hence to monitor the need for demand-side flexibility and its growth, year after year.

It is thus proposed in this overview to monitor three families of indicators aimed on the one hand at measuring the change in the effectiveness of flexibility (through indicators relating to consumption, non-controllable generation and the resulting distortion of the residual load curve) and on the other hand at monitoring the deployment of its prerequisites (technical means and economic incentives), as explanatory variables of the effectiveness of demand-side flexibility.

Value chain of demand-side flexibility

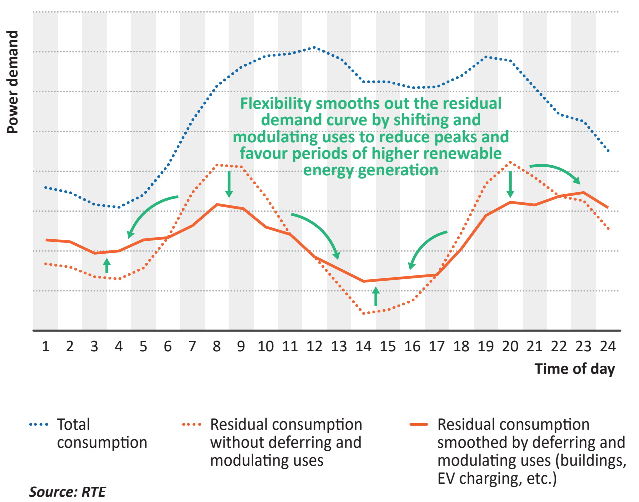


Monitoring the development of demand-side flexibility through three categories of indicator

Monitoring the need for flexibility and the contribution of aggregate consumer actions to meeting this need

The need for flexibility will be measured by analysing changes in the residual consumption curve, i.e. the difference between national consumption and non-deferrable renewable generation (photovoltaic, wind and run-of-river hydropower). It is this residual consumption curve that must be supplied by the controllable resources and it is thus this curve that dictates the regular and structural flexibility required, as well as the dynamic flexibility required by the electricity system.

The key indicator of this barometer will thus be assessment of the average need for modulation during the day (namely the average of the intraday differences between peak and trough residual consumption), in other words the need for "smoothing", which requires some power consumption to be shifted from the peaks of residual consumption to the troughs (see diagram below).



Source: RTE

At the same time, analysis of the distortion of the national consumption curve will make it possible to monitor how actions to defer and modulate usage are evolving to meet this need for flexibility.

This barometer will present additional indicators to specify flexibility needs and reveal their effects on the electricity system. These indicators will cover wholesale electricity market prices (dynamics of spot price trends, number of hours with negative spot prices), the amount of renewable energy capped in the event of negative spot prices, and trends in flexibility needs to cover residual consumption peaks.

Monitoring the prerequisites for developing demand-side flexibility

Lastly, the aim is also to monitor the prerequisites for the development of demand-side flexibility through indicators relating to:

- **monitoring deployment of the technical prerequisites for this flexibility, i.e. equipment that can be used to programme and control usage,** such as Building Automation and Control Systems (BACS) in the tertiary sector or connected thermostats and Home Energy Management Systems (HEMS) in the residential sector;
- **monitoring the development of the economic prerequisites for this flexibility, i.e. energy supply and service offers enabling consumers to benefit from their flexibility** by deferring, modulating or cutting their uses of power.

Methodological focus

The aim of this first edition of the barometer is to provide a current snapshot of the indicators that will make up the pathway for scaling up demand-side flexibility. They will be updated annually in future editions.

For indicators relating to the electricity system (consumption, generation, prices, etc.), most of the analysis will focus on the recent period from 2014 to 2023, and will present a "target" for 2030.

Thereafter, unless otherwise stated, the scenario used for this 2030 target corresponds to the "A - benchmark" scenario in the RTE Generation Adequacy Report, along with the reference flexibility mix.

To go further: *2023 GAR - Chapter 6*

1.3

The French demand-side flexibility sector is taking action and has a roadmap to 2030

This barometer of demand-side flexibility is part of a sector-wide approach. As such, it aims to describe the development and possible pathway of demand-side flexibility and to mobilise all French stakeholders: public authorities, the regulator, system operators, equipment manufacturers, building managers, electricity suppliers and energy service operators, and consumers.

The “plan to scale up demand-side flexibility” proposed by RTE in its 2023 Generation Adequacy Report has thus started to be organised around the stakeholders behind the report on the “Management of tertiary buildings” published by the French Energy Regulatory Commission (CRE) in 2023.

Today, this initiative is based on a core group from the sector led by RTE. It is gradually expanding to include all the major stakeholders in the French power demand-side flexibility sector.

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FNCCR territoire d'énergie

ifpeb

AICN Alliance Immobilière pour la Convergence Numérique

The plan to scale up flexibility in a few key figures

More than **40 stakeholders** **in the flexibility sector are involved in the process,** actively contributing to the creation of a technical, economic and operational framework conducive to the widespread use of demand-side flexibility.

To date, more than **30 collective actions** **and working groups have been set up to take action at all levels** of the demand-side flexibility value chain.

For example:

Technical framework

Defining common data principles and repositories to control usage

Economic framework

Adapting off-peak periods so that consumers benefit from “solar” off-peak hours during the day

Operational framework

Defining common guidelines for operators to integrate deferral and modulation of usage into tertiary building automation and control systems

1.4

Pathway for scaling up demand-side flexibility

	Indicator	2015	2019	2023	2030 projection *
Flexibility needs	Intraday amplitude of corrected residual consumption	~14 GW	~13 GW	~12 GW	~15 GW
	Demand-side flexibility index	3%	3%	3%	20%
	Volume of renewable energy capped	–	–	~0.5 TWh	~0.4 TWh
Tertiary	Consumption avoided at 7 p.m.	0	0	0	~2.5 GW
	Consumption shifted to 2 p.m.	0	0	0	
	Number of BACS installed	–	–	25,500	100,000
	% Flex Ready BACS	–	–	0	>50%
	Number of GOFlex buildings	–	–	70	10,000
Residential	ECS – Consumption avoided at 7 p.m.	3.3 GW	3.3 GW	3.3 GW	3.3 GW
	ECS – Consumption shifted to 2 p.m.	2 GW	2 GW	2 GW	7 GW
	Household ownership rate of active HEMS	0%	0.5%	3%	17%
	% of households applying more than two temperature setpoints per day **	–	–	13%	25%
	Consumers with offers that promote flexibility – *PH/OPH*	~14 million	~14 million	~14 million	–
	Consumers with offers that promote flexibility – *Mobile peak*	500,000	500,000	~1 million	–
	Consumers with offers that promote flexibility – *Aggregation*	A few thousand	A few thousand	250,000	–
Electric vehicle	Consumption avoided at 7 p.m.	0	0	1 GW	3.8 GW
	Consumption shifted to 2 p.m.	0	0	0	4.5 GW
	% EV charging controlled	–	–	32%	>70%

* Projection from the "A - reference" scenario of the 2023 Generation Adequacy Report and sectoral assumptions resulting from additional work with the partners behind this Barometer

** declaring that they control temperature based on tariff signals

2

Needs and expected effects of demand-side flexibility

2.1

Residual consumption is the determining factor for assessing the electricity system's need for flexibility

What is residual consumption?

Residual consumption is the consumption that still needs to be met by controllable power generation assets, once non-controllable renewable generation has been taken into account: run-of-river hydropower, solar and wind power. As renewable energies develop, it thus becomes increasingly different from total consumption. The Electricity System Review ("Flexibility" chapter) published regularly by RTE provides a detailed analysis of how it has changed in recent years.

Correcting for climate effects enables long-term trends to be analysed.

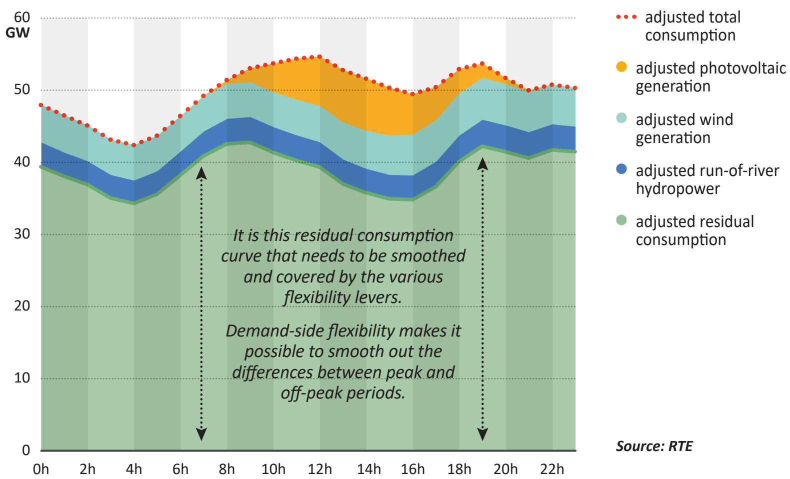
The analysis presented in this chapter is based on data corrected for climate effects. They smooth out variations in residual consumption, total consumption and wind, solar and hydropower generation due to weather conditions (temperature, sunshine, wind and water conditions).

While the data presented in this way does not reflect the actual consumption and generation values year by year, **this correction makes it easier to identify long-term trends, which depend mainly on the growth of installed capacity, the electrification of uses and the development of flexibility.**

Correcting for climate effects thus makes it easier to compare one year with another, by allowing for the difference between a particularly windy year and a less windy year, for example, or a very cold year and a warmer year. This also enables a comparison to be made between current values and those projected for 2030 at reference temperature and weather conditions.

Residual consumption curve corrected for climate hazards in 2023

Mean daily curve of total consumption and residual consumption at hourly intervals, corrected for climate effects and stacking of residual renewable generation making it possible to switch from one to the other.



Source: RTE

The key indicator for sizing and operating the electricity system is residual consumption (gross, i.e. not corrected for climate effects).

Previously, its shape was very similar to that of total (gross) consumption: a plateau in the morning, a peak in the evening and a trough at night. The growth in non-controllable renewable energies is significantly increasing residual consumption, which is becoming even more of a determining factor for the size of the electricity system.

As renewable energies grow, **the residual consumption curve adopts a characteristic shape with two short peaks in the morning and evening**

The development of photovoltaic generation creates opportune moments for flexibility every day: periods conducive to deferring power consumption to night-time, and to day-time between the two short peaks in the morning and evening.

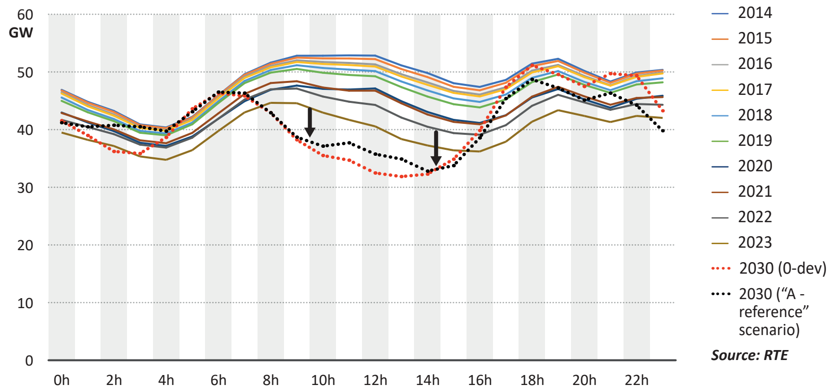
In the space of a few years, the average level of residual consumption has gradually fallen, under the combined effect of the increase in renewable generation (mainly solar and wind power) and more recently under the effect of the fall in consumption (energy sobriety and a drop in demand due to the price effect).

As well as decreasing in level, the daily residual consumption curve has become distorted, mainly as a result of increasingly high photovoltaic solar generation. The morning plateau has disappeared and there are now two short peaks lasting a few hours (in the morning and evening) and two troughs (at night and in the afternoon).

Changes to the residual consumption curve corrected for climatic variations

Mean daily curve of residual consumption at hourly intervals, corrected for climate effects, from 2014 to 2023 and projected for 2030 (2023 GAR, "A - reference" scenario and counterfactual with the "0-dev" scenario without development of flexibility).

In 2030, the distortion of the residual consumption curve reflects the assumptions presented in the "A - reference" scenario of the Generation Adequacy Report in terms of the development of solar and wind renewable energies, the increase in total consumption and the development of flexibility. The "0-dev" variant illustrates the residual consumption curve in 2030 if consumption flexibility is not developed.

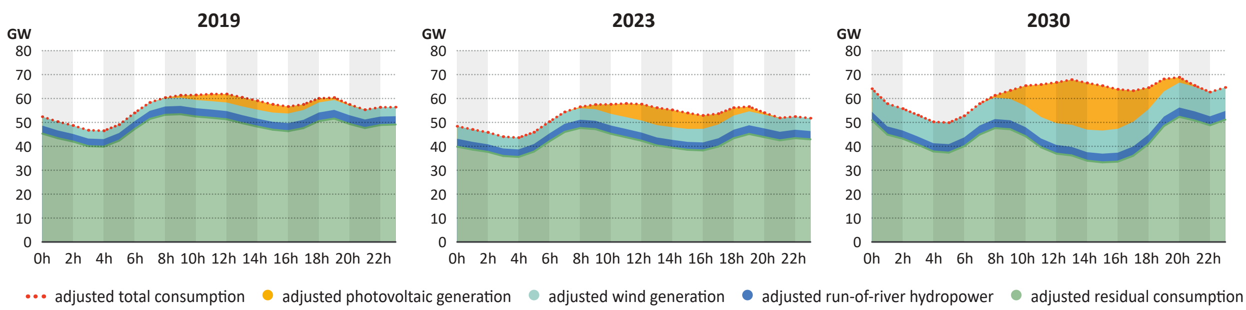


Source: RTE

Focus on

Change in the average hourly profile of the corrected residual consumption on working days in 2019, 2023 and 2030

Mean daily curves of residual consumption at hourly intervals, corrected for meteorological effects, for working days in 2019, 2023 and projected for 2030 ("0-devflex" scenario, no development of flexibility and no change in current peak/off-peak hours).



This distortion is growingly quickly: barely perceptible five years ago, it is now clearly visible and will continue to accelerate over the coming years.

Source: RTE

2.2

The best times for flexibility
vary according to the season and the type of day

The usual variations in consumption (higher in winter and on working days), combine with variations in non-controllable generation, particularly photovoltaic solar, to define the regular rhythms that structure the operation of the electricity system.

There are three seasons (winter, summer and shoulder season) and two types of day (working and non-working), with different levels of residual consumption and different peaks and troughs.

Methodological focus

Between 2025 and 2030, analysis of the projected variations in residual consumption, i.e. the combination of variations in total power consumption and renewable generation, reveals regular patterns corresponding to three types of season:

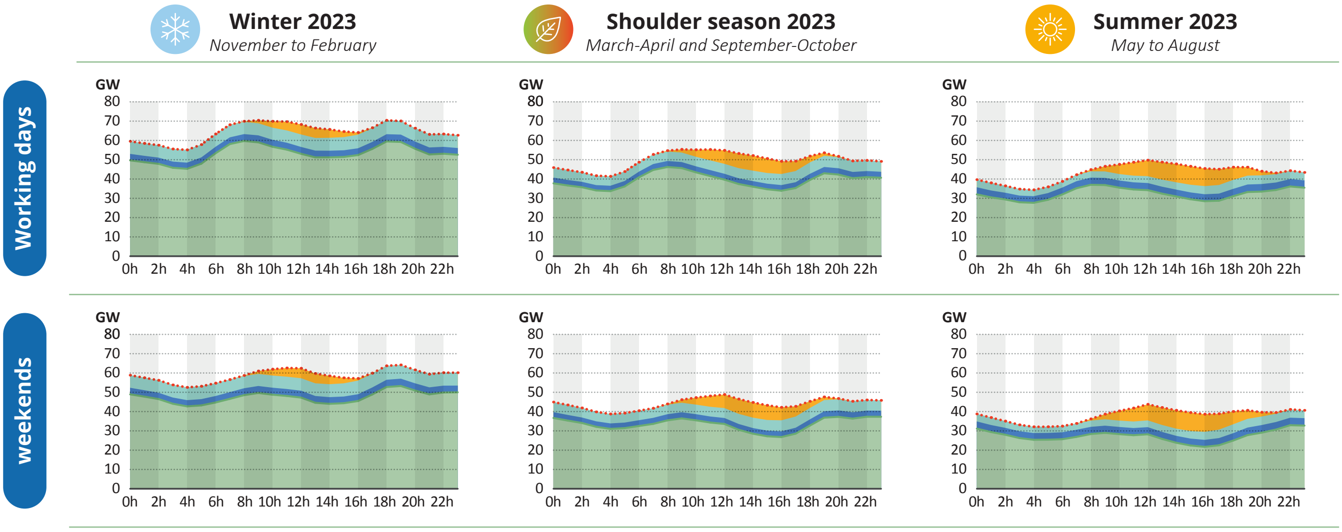
- winter, from November to February
- summer, from May to August
- a shoulder season, divided into two sub-periods: March-April and September-October

For the purposes of this barometer, this seasonal breakdown has thus been adopted.

These different patterns can already be seen today...

Corrected residual consumption curves, by season and by type of day in 2023

Mean daily curve of residual consumption at hourly intervals, corrected for climate effects, for 2023, distinguishing between seasons (winter, shoulder season) and summer) and type of day (working day or weekend)



Source: RTE

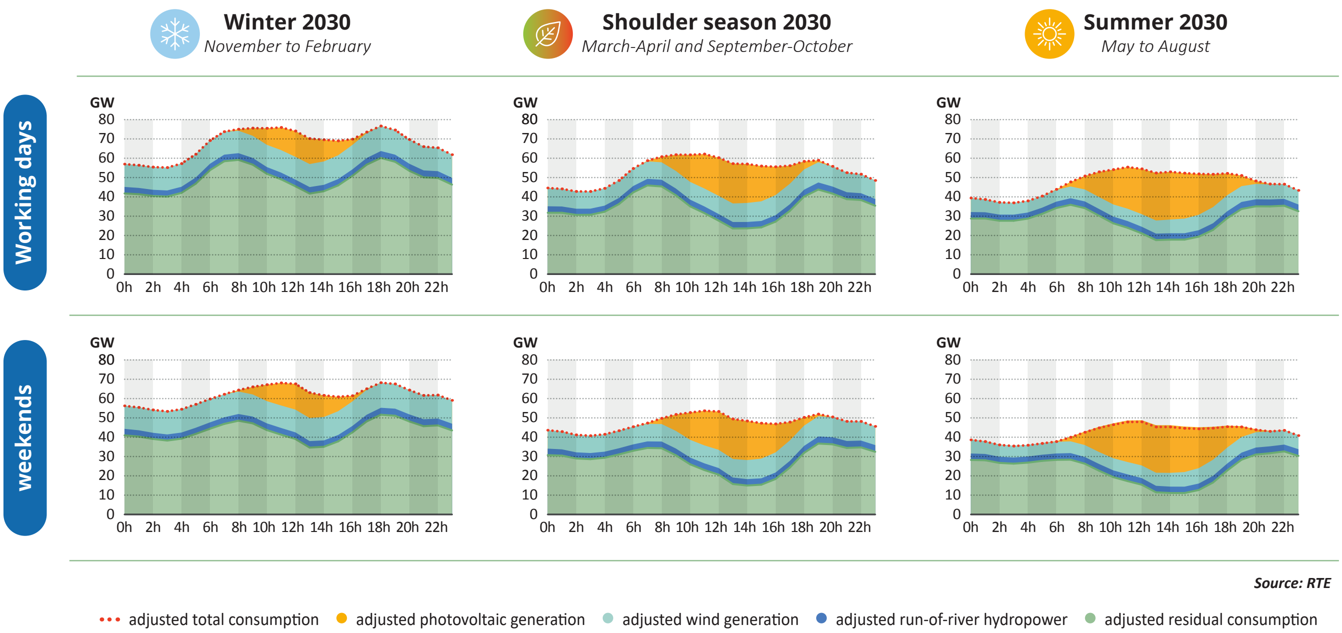
This breakdown by season and type of day highlights the differences in the average values of wind generation (higher in winter and the shoulder season than in summer) and solar generation (higher in summer and relatively higher in the shoulder season than in winter), as well as the differences in consumption levels (higher in winter and on working days than in summer and at weekends) and the shape of the consumption curve (very slight morning peak at weekends, very slight evening peak in summer).

Note: these curves include the effect of the measure taken by Enedis during the winter of 2022-2023 to prevent water heaters from being switched on at midday for the 4.5 million consumers with off-peak hours during this period.

... and their differences will increase by 2030

Corrected residual consumption curves, by season and by type of day in 2030 (“A - reference” scenario of the Generation Adequacy Report)

Mean daily curve of residual consumption at hourly intervals, corrected for climate effects, projected for 2030 by distinguishing the seasons (winter, shoulder season and summer) and the type of day (working day or weekend)



Source: RTE

By 2030, in the “A - reference” scenario of the 2023 Generation Adequacy Report, the development of wind and solar photovoltaic renewable energies leads to clearly marked differences between consumption and residual consumption. In winter, wind generation shifts the whole curve downwards, helping to reduce peak demand on average. In the shoulder season and in summer, the size of the solar generation “bell” leads to very clear distortion of the residual load curve.

The season and the type of day (working or non-working) influence the level and shape of the residual demand curve to be covered.

The time slots for deferring consumption are thus slightly different depending on whether it is summer, winter or shoulder season, and whether it is a working day or not.

In the short term, this changes raises the question of how consumption can be deferred so that all consumers can contribute to optimising the electricity system while benefiting from “solar” off-peak hours.

2.3

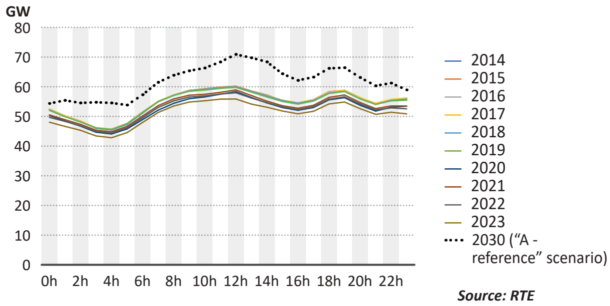
“Flexibility times” correspond mainly **to periods of high solar generation**

In recent years, the total power consumption curve has shifted slightly downwards, without changing shape. This is due in particular to the reduction in consumption since the end of 2022 as a result of energy sobriety measures and the constraints imposed by electricity prices.

Looking to 2030, projections for the electrification of uses will lead to an increase in consumption.

Change in the total consumption curve corrected for climate variations

Mean daily curve of corrected total consumption at hourly intervals, from 2014 to 2023 and projected for 2030 (“A - reference" scenario from the Generation Adequacy Report).

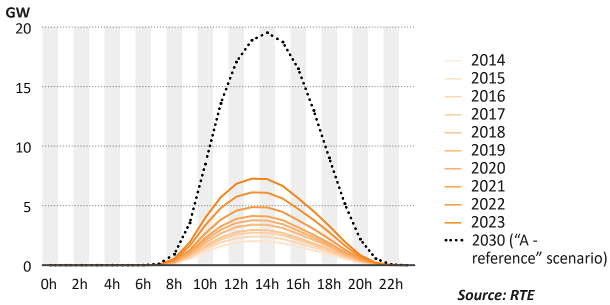


The mean daily curve for solar generation corrected for climate hazards is characterised by a “bell” shape centred on the early afternoon.

Its amplitude is directly linked to the development of the photovoltaic solar fleet in France.

Change in the photovoltaic solar generation curve, corrected for climate variations

Mean daily curve of corrected photovoltaic solar generation at hourly intervals, from 2014 to 2023 and projected for 2030 (“A - reference" scenario from the Generation Adequacy Report).

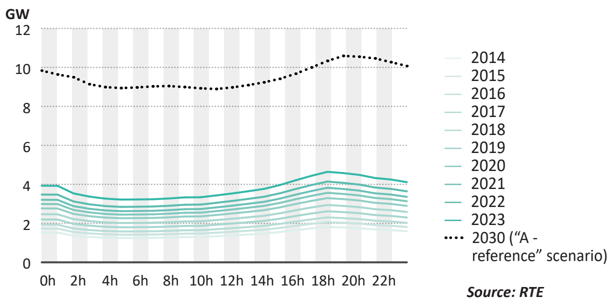


The mean daily curve for wind generation corrected for climate hazards is relatively flat in shape, even though this generation is marked by significant intraday and intraweek variability that masks the overall view of the average.

Its level is directly linked to the development of the wind power fleet in France.

Change in the wind generation curve, adjusted for climate variations

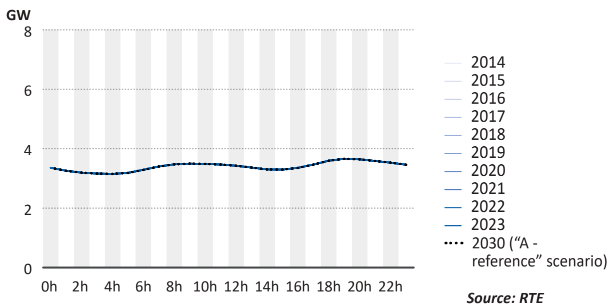
Mean daily curve of corrected wind generation at hourly intervals, from 2014 to 2023 and projected for 2030 (“A - reference" scenario from the Generation Adequacy Report).



The mean daily curve for run-of-river hydropower generation corrected for climate hazards shows a constant profile, as the installed capacity does not vary and the correction for climate effects eradicates the differences in water conditions from one year to the next.

Change in the run-of-river hydropower generation curve, corrected for climate variations

Mean daily curve of corrected run-of-river hydropower generation at hourly intervals, from 2014 to 2023 and projected for 2030 (“A - reference" scenario from the Generation Adequacy Report).



These regular generation and consumption patterns can be modified by more dynamic variations

The regular variations in residual consumption, which correspond to the need for structural and regular flexibility, are directly linked to the patterns of human and economic activity (more consumption in winter than in summer, during the week than at weekends, during the day than at night) and the predictable patterns of certain types of generation (more wind generation in winter, more photovoltaic generation in summer, no photovoltaic generation at night).

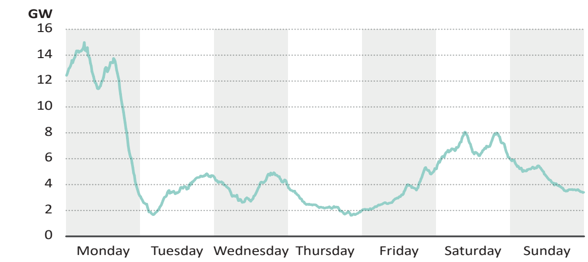
Beyond that, the electricity system also needs dynamic flexibility, predictable from a few days to a few hours in advance, to offset the short-term variability of heat-sensitive consumption and renewable generation – wind power in particular. This type of dynamic flexibility can be adopted in two different ways:

- **on a daily basis, by optimising usage within a given range of comfort and preferences, to adapt consumption more finely than with more traditional regular positioning;**
- **on peak days, by "cutting" usage, i.e. drastically reducing consumption for a few hours, in exchange for financial compensation. This is "peak-day demand response", which is useful on certain days but differs from everyday flexibility.**

These dynamic needs are particularly apparent when examining the wind generation and total consumption curves. There are significant variations in wind generation from one day to the next and within the same day. As far as consumption is concerned, in addition to the regular variations linked to human and economic activity, there are also variations in the consumption level from one day to the next.

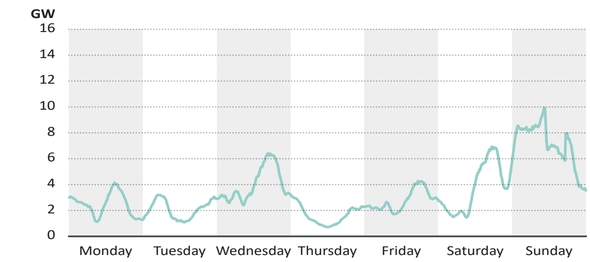
Gross wind generation (not corrected) during the week of 16 January 2023

Wind generation in 15-minute intervals for the week of 16 January 2023



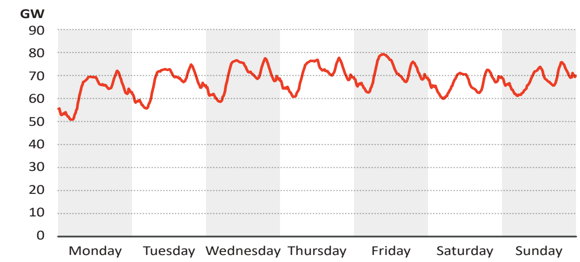
Gross wind generation (not corrected) during the week of 17 July 2023

Wind generation in 15-minute intervals for the week of 17 July 2023



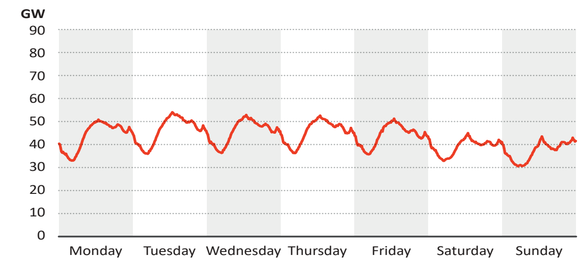
Total gross consumption (not corrected) during the week of 16 January 2023

Gross consumption in 15-minute intervals for the week of 16 January 2023



Total gross consumption (not corrected) during the week of 17 July 2023

Gross consumption in 15-minute intervals for the week of 17 July 2023



Source: RTE

2.5

The barometer offers two new indicators for monitoring demand-side flexibility

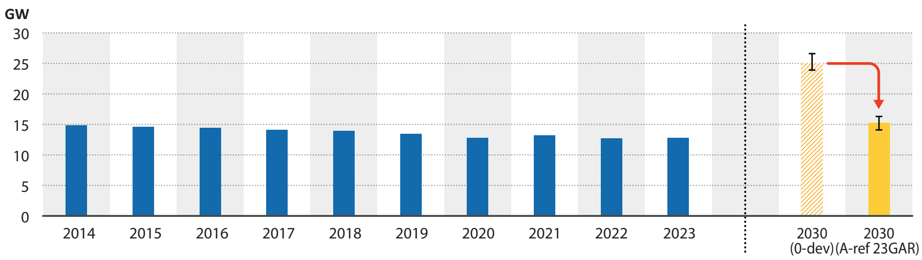
This barometer will monitor two new indicators to assess progress with demand-side flexibility and measure the tangible impact on the electricity system.

An indicator of the aggregate effect of demand-side and storage flexibility, measuring the mean intraday amplitude of corrected residual consumption.

The difference between the maximum and minimum values for residual consumption, adjusted for climate effects, is calculated for each day. The indicator corresponds to the average of these differences over all the days of the year.

It summarises the average need for modulation between the peaks and troughs of residual consumption, which remains to be satisfied once demand-side flexibility and storage flexibility have already taken effect. In other words, this indicator highlights the mean amplitude of the variations required from controllable generation (nuclear, hydropower and thermal).

The lower its value, the more easily generation will cover fluctuations over the day. Conversely, the higher this value, the greater the modulation effort required from generation.



Mean difference over all the days of the year between maximum and minimum residual consumption adjusted for climate variations, from 2014 to 2023 and projected for 2030 in the "0-devflex" scenario (no new flexibility and no change in off-peak periods) and in the "A - reference" scenario of the 2023 Generation Adequacy Report.

Over the period from 2014 to 2020, the distortion in residual consumption, due to photovoltaic solar generation in particular, has remained limited. Minimum residual consumption has thus remained defined by the night-time trough. As the daily consumption peak fell more rapidly than this night-time trough due to energy efficiency gains, the indicator has gradually fallen by 2 GW.

The recent period has seen a turning point in the electricity system, with an increasing number of situations where daily minimum residual consumption occurs in the afternoon, as a result of the growth of the photovoltaic solar fleet. This afternoon trough is now deepening faster than the peak is falling, leading to stagnation in the indicator to date and an increase in the medium term.

This means that, by 2030, the mean residual amplitude levels achieved in the past should remain within the same range, provided that new sources of demand-side flexibility (buildings, electric vehicle charging, electrolysers, etc.) and battery storage are developed, **and that the positioning of off-peak hours is modified.** Otherwise, the daily amplitude of residual consumption reaches high levels, posing challenges for the modulation of the controllable generation fleet.

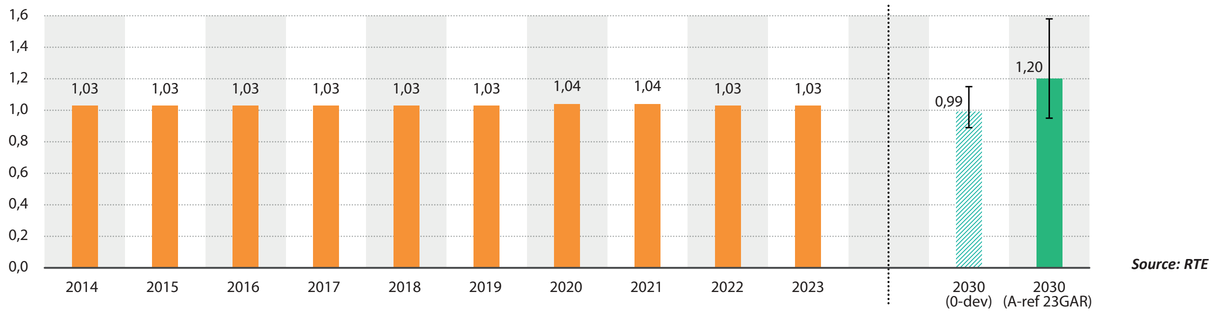
As renewable energies develop, particularly photovoltaic solar generation, the minimum residual consumption is increasingly defined by peak solar generation. In the medium term, this will lead to a controlled increase in the average intraday amplitude of adjusted residual consumption, due to new demand-side flexibility in particular. The more demand-side flexibility develops, the less modulation effort will be required from controllable generation.

Demand-side flexibility index: measurement of the shift in consumption from the evening peak to the mid-day trough.

The ratio between the maximum consumption during the mid-day period (11 a.m. to 5 p.m.) and the maximum consumption during the evening peak (6 p.m. to 8 p.m.) is calculated for each day. The demand-side flexibility index is defined as the average of these values over all days of the year.

This indicator summarises how deferring and modulating usage makes it possible to shift some power consumption from the evening peak to the mid-day period, thus helping to smooth out residual consumption.

A value close to 1 indicates that the mid-day and evening peaks are at equivalent levels, while a value greater than 1 means that power consumption is shifting towards the mid-day period, corresponding to the solar generation peak.



Mean daily ratio over all the days of the year between maximum mid-day consumption and maximum evening consumption, based on data corrected for climate hazards, from 2014 to 2023 and projected for 2030 in the reference scenario of the 2023 Generation Adequacy Report (“A-reference”).

Over the period 2014 to 2023, the value of the demand-side flexibility index remained stable. This reflects an equivalent level, on average over all the days of the year, between the evening peak and the maximum consumption during the mid-day period (corresponding to the peak demand at the end of the morning).

Over the next few years, consumers who are able to do so will benefit from choosing the afternoon to programme uses that can be deferred or modulated, such as domestic hot water production using hot water tanks, heating and cooling using heat pumps, recharging electric vehicles and washing. This represents a significant change from the usual practice of favouring night-time as much as possible when programming electrical uses that can be deferred (e.g. hot water tank, washing clothes and dishes).

If adopted by companies, local authorities and private individuals, these shifts in power consumption towards the mid-day period will help to optimise the operation of the electricity system.
This need for optimisation is reflected in the target demand-side flexibility index of 1.20 for 2030.

2.6

Electricity markets already reflect **the need for flexibility on the following day**

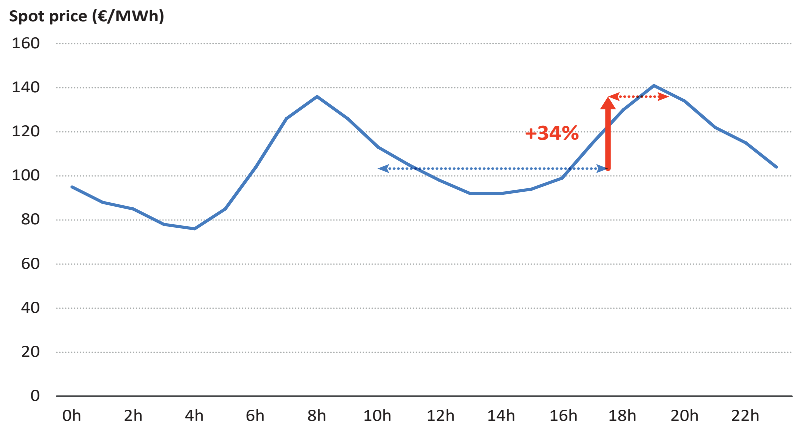
Spot prices now reflect the major role played by photovoltaic solar generation during the day: prices at the evening peak are much higher than during the whole of the mid-day period.

The spot price of electricity reflects the balance between supply and demand for each hour of the following day. As with residual consumption, changes in the shape and level of spot prices highlight the level of tension between electricity supply and demand, as well as the economic space for flexibility in the electricity system.

As photovoltaic solar develops in France and Europe, a clearly visible “trough” appears, corresponding to low price levels similar to night-time price levels. As a result, there are two short price peaks, in the morning and in the evening.

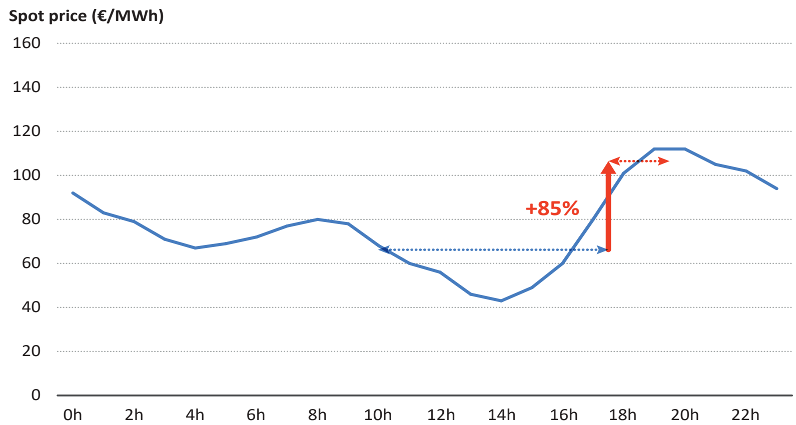
In 2023, on average, the price at the evening peak was 34% higher than during the mid-day period on working days and 85% higher than at the weekend.

Mean hourly spot price for electricity in France in 2023 (€/MWh), working days



Source: RTE

Mean hourly spot price for electricity in France in 2023 (€/MWh), weekends



Source: RTE

A price curve characteristic of electricity systems in transition to decarbonisation

This mid-day trough observed in 2023 has formed rapidly in recent years and could increase in the short term.

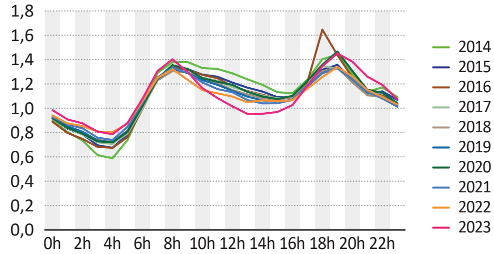
This phenomenon, known as the "duck curve" because the price curve resembles the shape of a duck, reflects a structural change in the energy mix in all countries where photovoltaic solar generation is developing. France is not an isolated case: the same price curve is found in many countries in Europe and around the world.

This characteristic shape could lead to reflections on the structure of products offered on futures markets, so that they better reflect the shape of the residual demand curve and the associated price signal.

To go further:
2023 GAR - Chapter 6. Supply and demand balance and flexibility

Normalised hourly spot prices from 2014 to 2023, working days

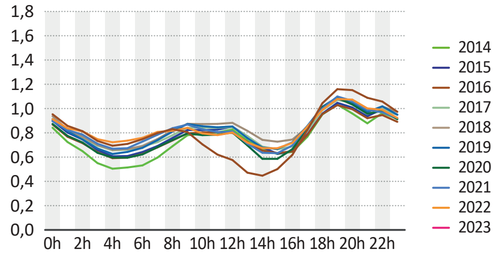
Mean daily curves of normalised hourly spot prices, from 2014 to 2023, working days. Normalised prices are obtained by dividing the average value of spot prices for each hour on working days by the mean spot price for the year in question.



Previously, the mean spot price curve showed a trough at the end of the afternoon, corresponding to the trough in total consumption on working days. Since 2021, this trough has shifted and grown to match the trough in residual consumption. At this stage it remains shallower than the night-time trough, on average over the year.

Normalised hourly spot prices from 2014 to 2023, weekends

Mean daily curves of normalised hourly spot prices, from 2014 to 2023, weekend days Normalised prices are obtained by dividing the average value of spot prices for each hour on weekend days by the mean spot price for the year in question.



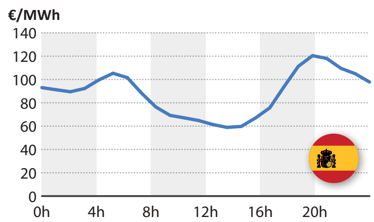
As with working days, the spot price curve for weekend days is gradually becoming distorted: the night-time trough, which was more pronounced at the start of the 2014-2023 period, has now been "caught up" by the afternoon price trough. In addition, the low-price period in the afternoon is rapidly expanding.

The duck curve

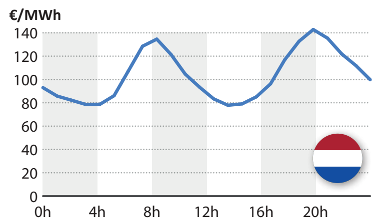
France is not an isolated case. The duck curve can be seen in all countries where photovoltaic solar generation is growing strongly.

Focus on some examples.

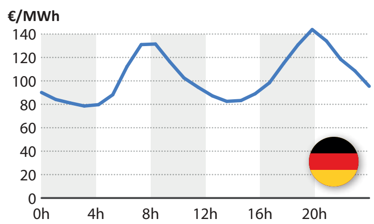
Mean hourly spot prices in Spain (working days, 2023)



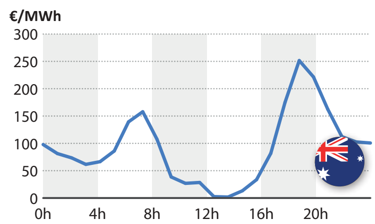
Mean hourly spot prices in the Netherlands (working days, 2023)



Mean hourly spot prices in Germany (working days, 2023)



Mean hourly spot prices in Australia (working days, 2023)



Source: RTE

2.7

Appearance of episodes of negative spot prices and renewable energy curtailment: an indicator of the need for flexibility

Change in the number of hours with negative spot prices, from 2014 to 2024, by year and by month

Number of occurrences of negative spot prices from 2014 to 2024, by month. The darker the shading of a box, the greater the number of hours at the corresponding negative spot price.

Source: RTE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**
2014	0	0	0	1	3	0	4	0	0	0	0	0	**8**
2015	0	0	0	0	0	0	0	0	0	0	0	0	**0**
2016	0	0	0	0	2	0	0	0	0	0	0	0	**2**
2017	0	0	0	2	0	0	0	2	0	0	0	0	**4**
2018	8	0	0	0	3	0	0	0	0	0	0	0	**11**
2019	0	0	9	2	5	10	0	0	0	0	0	1	**27**
2020	0	4	8	31	27	5	12	0	0	3	6	6	**102**
2021	0	2	3	2	18	8	5	23	0	3	0	0	**64**
2022	0	0	0	0	0	0	0	0	0	0	0	4	**4**
2023	8	0	4	2	25	14	47	0	15	3	0	29	**147**
2024	8	0	5	84	60	69	50	46					**322**

Cumulative number of hours with negative spot prices, from 2014 to 2024, by day of the week and by hour

Cumulative number of hours with negative spot prices, from 2014 to 2024, by day and by time of day The darker the shading of a box, the greater the number of hours at the corresponding negative spot price.

Source: RTE

Day / Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	**TOTAL**
Monday	0	0	2	4	4	1	0	0	0	0	0	0	2	3	3	2	4	1	0	0	0	0	0	**0**
Tuesday	0	2	3	5	6	3	0	0	0	0	3	3	2	4	7	5	4	2	0	0	0	0	0	**0**
Wednesday	0	0	1	3	4	1	0	0	0	0	0	0	0	2	4	2	1	0	0	0	0	0	0	**0**
Thursday	0	0	2	3	4	2	0	0	0	0	0	0	2	2	2	2	1	0	0	0	0	0	0	**0**
Friday	0	0	1	3	3	2	1	0	0	0	0	0	1	3	6	7	2	1	0	0	0	0	0	**0**
Saturday	0	0	0	2	4	2	2	0	0	1	6	10	13	17	22	20	14	6	1	0	0	0	0	**0**
Sunday	0	1	1	9	12	13	10	7	9	13	18	24	27	40	52	54	40	10	2	0	1	1	1	**1**
Public holiday	1	2	2	3	4	5	5	5	4	2	5	5	4	6	9	11	7	2	0	0	0	0	0	**0**

Negative spot price episodes mainly occur during the sunniest months (April to September). Most of them now take place during the day, when photovoltaic generation peaks (10 a.m. to 5 p.m.). While they mainly occur at the weekend and on public holidays, they are also starting to appear on working days.

Negative or zero prices occur in situations of high generation at low variable cost (renewable energies, nuclear) when consumption is not particularly high. They reflect the fact that some power generation assets have reached the limit of their flexibility, preferring to pay to continue generating rather than shut down (for technical-economic reasons).

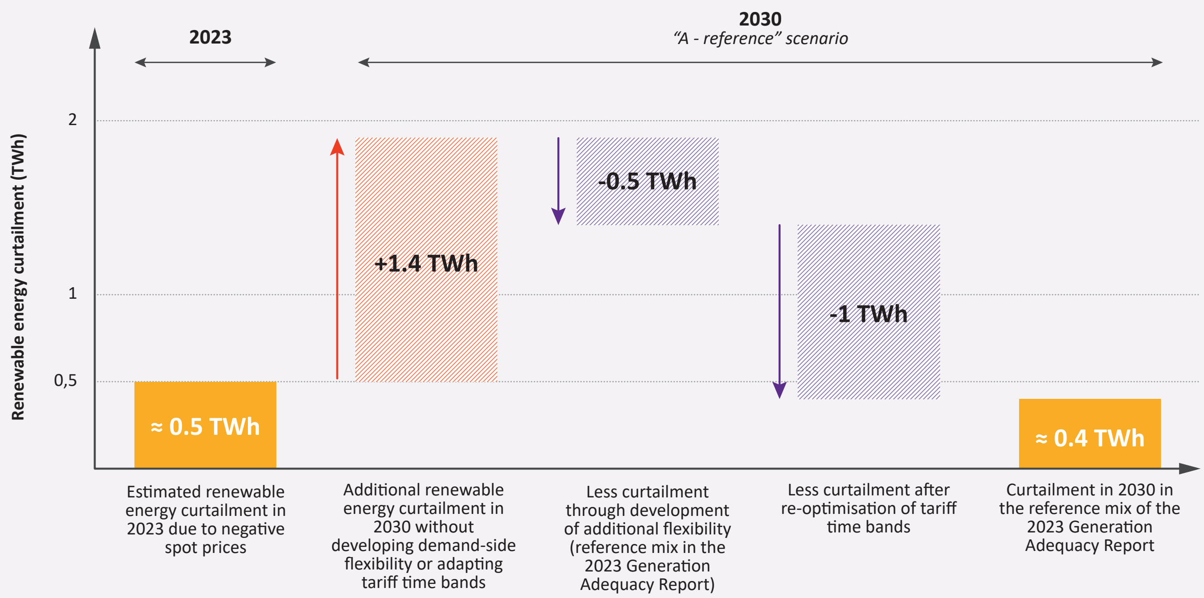
The number of hours of negative spot prices has risen sharply in France since 2023, as a result of the sharp fall in consumption in France and Europe, combined with increased renewable and nuclear generation and consumption that is still not very flexible.

Today, the response to these situations is essentially provided by the power generation assets. This is particularly true of the French nuclear fleet, which is manoeuvrable and thus capable of reducing its output during these episodes, but also of a growing proportion of renewable energy generation facilities (with the exception of those under a purchase obligation), which curtail their generation rather than continue to inject into the grid.

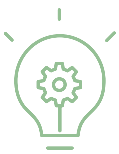
@ ***To go further:*** *Electricity System Review, first half 2024.*

Renewable energy curtailment in 2023 and 2030 projection

Estimate of curtailment of renewable energy in France in 2023 and projected to 2030 in the 2023 Generation Adequacy Report reference scenario ("A - reference"), in the reference flexibility mix configuration. The estimate of additional curtailment in 2030 if existing flexibility is not re-optimised and if new flexibility is not developed in France is also based on low growth of flexibility in Europe.



Source: RTE



Developing demand-side flexibility to avoid wasting renewable electricity:

Positioning off-peak hours in the low season (April to October), when photovoltaic generation peaks, would considerably reduce the number of hours at negative spot prices and, consequently, reduce the curtailment of renewable energy. In the very short term, consumption positioned in the evening can be shifted to the afternoon, so that all the decarbonised electricity available at that time can be used. In a few years' time, these volumes could be supplemented by new sources of flexibility, first and foremost the charging of electric vehicles.


SMART GRID
POWER GRID

3

Technical prerequisites
for demand-side flexibility

3.1

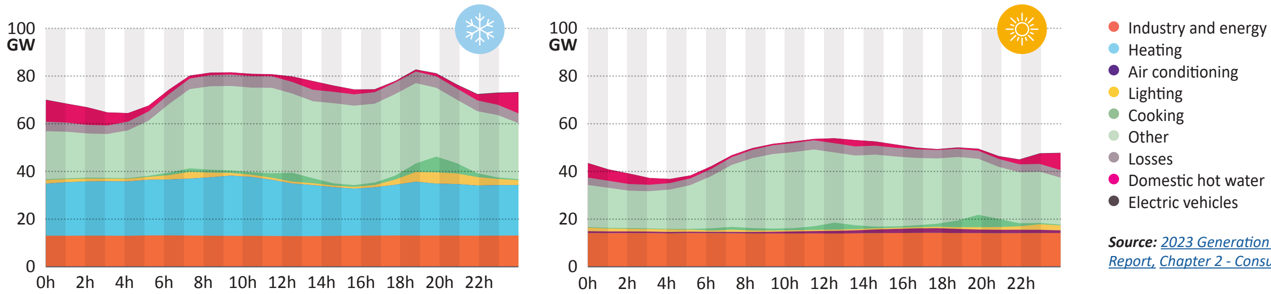
Global control systems exist to defer and modulate the power consumption of buildings

Why monitor the deployment of technical solutions to control usage?

- **The practical activation of flexibility in buildings is based on centralised control systems,** sensors, actuators and controllable energy equipment (boiler, ventilation, air conditioning, EV terminal, etc.) that enable overall optimisation of building energy consumption while taking account of occupants' needs and comfort preferences.
- While it may be difficult to establish a precise link between the penetration rate and the volume of flexible capacity (given the diversity of buildings, their uses and configurations), **the rate of deployment of these systems can be seen as an indicator of the ability to better programme power consumption as a function of economic signals.**

The systems to be targeted as a priority are those that enable consolidated control of the building's various uses that can be deferred or modulated

Daily profile of power consumed today, by use (at the reference temperature)



Source: *2023 Generation Adequacy Report, Chapter 2 - Consumption*

	Uses that can be deferred	Uses that can be modulated
Residential	Domestic hot water Electric vehicle charging Washing (washing machine, dishwasher)	Heating (winter) Air conditioning (summer) Electric vehicle charging
Tertiary	Heating - Ventilation - Air Conditioning (HVAC) Domestic hot water Cooling (in some cases) Electric vehicle charging	Heating - Ventilation - Air Conditioning (HVAC) Lighting Electric vehicle charging

We use the terms GTB* or BACS in the tertiary sector and Home Energy Management Systems (HEMS***) for residential. The spread of these systems in French buildings is a major driver for both energy sobriety and flexibility.**

GTB* Gestion technique du Bâtiment

BACS** Building Automation and Control System

HEMS*** Home Energy Management System

3.2

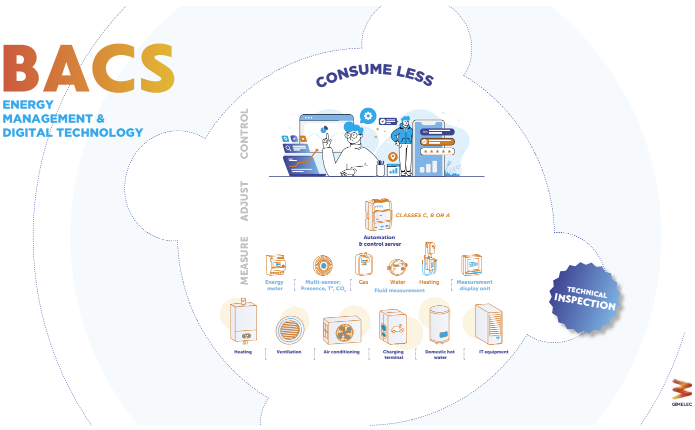
In the tertiary sector, controlling the energy of your building is an obligation

In line with French energy sobriety targets, **the BACS decree requires owners and managers of tertiary buildings to install a Building Automation and Control System (BACS) by 1 January 2027 at the latest.**

This decree gives buildings the means to achieve the ambitious targets for reducing energy consumption set out in the Dispositif ÉcoÉnergie Tertiaire (DEET) and to integrate new electrical uses in an optimised way (charging of electric vehicles, heat pumps, self-supply).

BACS is the technical lever of choice for reducing energy consumption in buildings. By using smart management in real time, consumption is limited to what is necessary for the comfort of occupants, avoiding any wastage.

BACS automatically regulates heating, ventilation, air conditioning, domestic hot water and electric vehicle recharging according to the occupant's instructions, making adjustments in line with actual activity (real-time occupancy of the building, weather, etc.).



Reducing energy consumption in a building is based on two main actions specified in the BACS decree:

- Measurement of consumption by functional area
- Centralised control of energy use

The decree covers all categories of tertiary building: offices, shops, schools, hospitals, nursing homes, cultural centres, etc., whether new or existing, as long as they have HVAC (heating, ventilation and air conditioning) systems with a thermal power of more than 70 kW.

The decree sets out the four mandatory functions of the BACS:

- **Continuous monitoring, recording and analysis of data** on the site's energy consumption and generation
- **Benchmarking the building's energy efficiency** against reference values to detect any drift and to inform the building operator of opportunities for improvement
- **Interoperability** with other technical systems in the building
- **Manual shutdown and autonomous management**

It also provides for **a regular technical inspection** to ensure the system's long-term efficiency.

From energy sobriety and flexibility to overall building performance

As well as saving energy, incorporating a high-performance BACS into a building opens the door to many other services for occupants and operators: improved occupant comfort and air quality, easier planning and performance of maintenance, secure access management, space optimisation, etc. BACS is thus a lever for enhancing the value of the building.

BACS decree timeline

8 April 2024
New buildings with equipment of cumulative nominal power **>70 kW**

1 January 2025
Existing buildings with equipment of cumulative nominal power **>290 kW**

1 January 2027
Existing buildings with equipment of cumulative nominal power **>70 kW**

3.3

To enable buildings to take advantage of their flexibility, **communication between BACS and the electricity system must be established**

Alongside equipment penetration, interoperability of flexibility activation channels is a major issue
The opening up of secure online interfaces between building managers, system operators and flexibility stakeholders is crucial, as is the standardisation of the data exchanged.

The control solutions to be deployed today must be able to receive and interpret the standardised flexibility signals sent by electricity suppliers (tariff incentives), aggregators (modulation requests) or during an EcoWatt alert, to optimise energy use at the scale of buildings and property portfolios, naturally taking account of occupants' needs.

Concerted efforts are now being made to define the technical and operational standards for this interoperability, which must now link the electricity system to buildings.

The sector has taken action and launched the flex ready collective brand

Flex Ready: the collective brand to identify control solutions capable of optimising energy consumption in tertiary buildings, in conjunction with the electricity system.

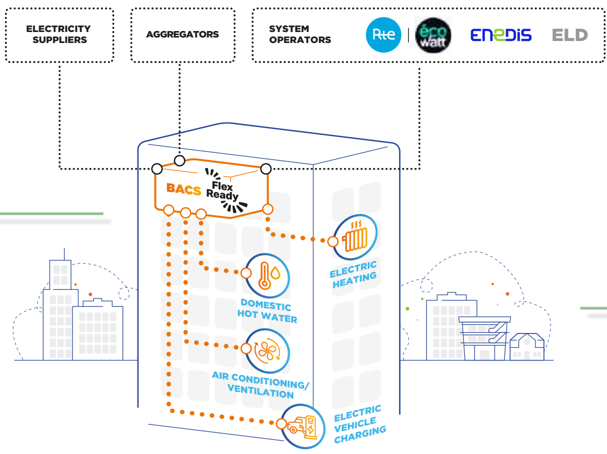
The "Flex Ready" BACS guidelines to standardised modes of communication between BACS and electricity system stakeholders.

These initial guidelines will soon be supplemented by others aimed at implementing associated good practice (Digital building framework, Missions and Responsibilities to guarantee the proper performance of BACS over time), thus forming the Flex Ready reference framework.

Standardised communication

Communication via standardised APIs, to enable BACS to receive and interpret flexibility signals from the system operators.

On receiving standardised signals, "Flex Ready" BACS is able to modulate or defer usage automatically, according to the scenarios programmed by the building manager.



Data to be exchanged

Data and formats relevant to the implementation of flexibility using BACS and correct adoption by the building manager:

1. **Clock:** to adapt setpoints according to standardised time intervals (minimum 15 minutes), two-way data exchange.
2. **Maximum instantaneous power (kW):** calculation of the instantaneous power.
3. **Price (in €/kWh):** reception and interpretation of electricity prices issued by the energy supplier according to the time of day.
4. **Subscribed power (kVA):** reception and interpretation of the subscribed power received from the energy supplier.
5. **Carbon footprint (tCO_2eq):** reception and interpretation of CO_2 emissions data according to the time of day.

Flex Ready BACS, the option to be systematically included in specifications!

At a time when the national goals of energy sobriety are being extended by a move towards decarbonisation of uses and energy sovereignty, **BACS has become Flex Ready** and now features an added benefit. **By being connected to a flexibility operator, it also enables building managers and occupants to consume energy "at the right time",** when electricity is abundant, less expensive and decarbonised.

The Flex Ready option enables the building manager, on receiving a signal, to automatically modulate or defer some electrical uses to take advantage of tariff incentives.

There are three modes:

- **regular mode:** this involves planning daily consumption according to the off-peak and peak hours defined in the electricity supply contract.
- **dynamic mode:** this means triggering an additional reduction in consumption for a few hours, on request and in return for remuneration. This request may come from the electricity supplier under a "Tempo" type contract, or from an aggregator under a demand response contract.
- **emergency mode:** means triggering a drastic reduction in consumption in the event of an EcoWatt red alert, according to a programmed emergency scenario.

From the point of view of the electricity system, the widespread use of Flex Ready BACS is the essential technical prerequisite for scaling up flexibility in tertiary buildings in France.

It ensures good communication between the system and the building manager.

The latter can thus be informed in near-real time of any need to moderate the consumption of electricity system stakeholders and decide, according to the building's own needs, whether to provide this service: **an invaluable interaction on a national scale, and a guarantor of resilience and energy sovereignty!**

For this reason, the sector has now created the Flex Ready collective brand.

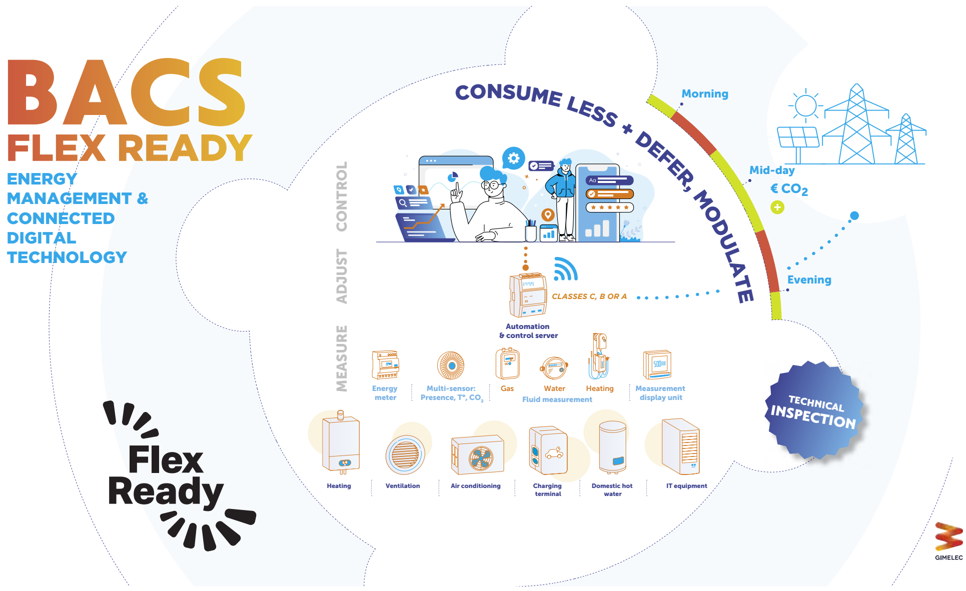
This work on standardising IT interfaces is being carried out jointly by manufacturers, suppliers, aggregators and system operators. It is described in the white paper on scaling up flexibility published by Think Smartgrids.

A reassuring brand that will enable building managers to make the right investment choices and equip themselves with BACS solutions that not only comply with the BACS decree, but also enable them to take advantage of economic incentives to consume when decarbonised electricity is abundant.

Did you know?

Flex Ready BACS is not mandatory under the BACS decree. For building managers, however, it is a "three-in-one winner" not to be missed, in order to:

1. consume less,
2. take advantage of attractive tariff offers,
3. and consume low-carbon electricity.



FLEX READY BACS, the option not to be missed!

3.4

Current status of BACS deployment
and pathway for scaling up by 2030

The rate of BACS deployment is not keeping pace with the national goals of energy sobriety and flexibility

While the number of BACS installations in France rose by 9% in 2023, **the deployment rate remains well below the targets set in the regulations.**
At this rate, all other things being equal, only 18% of eligible sites will be equipped with BACS by 2027.

The dynamic varies by business sector

1. Office, shop and educational buildings account for 70% of tertiary surface area and two-thirds of the BACS installed. They are thus major players in energy sobriety and flexibility on a national scale.
2. As early adopters in this field, healthcare buildings (particularly hospitals) and transport buildings (such as stations) have installed BACS without waiting for the regulations, driven by the need for continuity of service and comfort. They have the highest penetration rates at 37% and 26% respectively.
3. The hotel and sport, culture and leisure sectors are lagging behind for a variety of reasons: small buildings with few in-house technical skills, lower awareness, lack of incentives, etc.

BACS is already the obvious choice for large retail

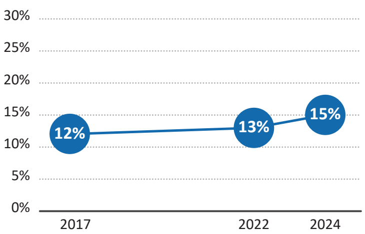
More than 84% of buildings over 20,000 m² are already equipped, and automation is becoming an essential part of energy and comfort management on a large scale.
The phenomenon is even more pronounced in the office sector (96% of buildings over 20,000 m² and 54% of those over 10,000 m²). On the other hand, for small and medium-sized buildings, there remains a lot of room for improvement.

The technology is there, but incentives and organisation are also needed!

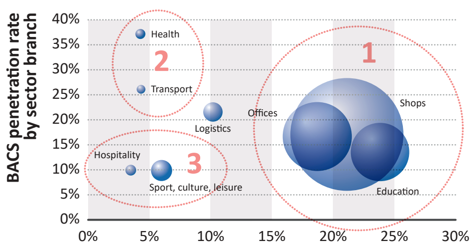
A survey of real-estate managers shows that barely 55% of installed BACS systems are actually in use. This is usually due to a lack of defined arrangements to monitor their correct operation over time: failure to commission the system, reconfiguration over time after refits or changes of business in the building, day-to-day maintenance in operational condition, including software updates, etc.

Main indicators of the national BACS deployment observatory

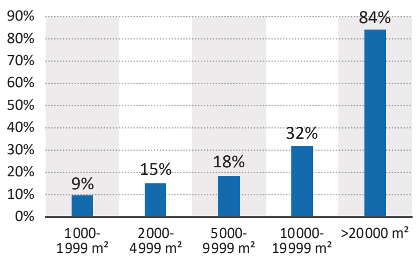
Deployment of BACS on tertiary sites in France
% sites >1,000 m²



BACS: Sectoral dynamic in 2024
Circle size proportional to total number of BACS installed



BACS by surface area in 2024
BACS penetration rate by surface area (% sites)



Source: CODA STRATEGIES / GIMELEC

The national BACS deployment observatory thus highlights the low take-up of BACS in relation to national targets. It shows that very few BACS have been connected to date, and also highlights the challenge of ensuring that the technical and organisational aspects of BACS are properly taken on board by real estate stakeholders.
The collective challenge now is to speed up the deployment of BACS, while promoting widespread adoption of the Flex Ready option and systematically including a chain of tasks and responsibilities to ensure that the systems are properly monitored over time.

A Plan for 100,000 BACS in 2030: the technical prerequisites for scaling up demand-side flexibility in tertiary buildings.

The acceleration scenario proposed by the sector is based on the deployment of 100,000 BACS by 2030. A proactive but achievable plan to equip half the buildings in France, generate 15% (up to 15 TWh) in energy savings and access:

- **2.5 GW of everyday flexibility on winter mornings**
- **4.5 GW peak days (cold or windless days)**
- **and up to 6.3 GW in the event of an EcoWatt red alert.**

This accelerated pathway should be achieved through targeted sectoral initiatives, including:

- specific, priority roadmaps for offices, shops and education, which account for two-thirds of the surface area to be equipped with BACS and are thus a key target
- reactivation and updating of systems already installed in large buildings in the short term
- provision of a simplified offer, suited to small and medium-sized surface areas

Such an ambitious plan will play its role effectively if it is based on the implementation of a breakthrough scenario, adopted collectively and supported by the public authorities.

A scenario that lies at the crossroads between the electricity system, industry and real estate, **starting in 2025 to implement the winning trio:**

1. Technological buy-in
2. Efficient organisation
3. Economic motivation

1. Buy-in to all the technological solutions offered by BACS through mass training and the widespread use of new benchmark practices such as:

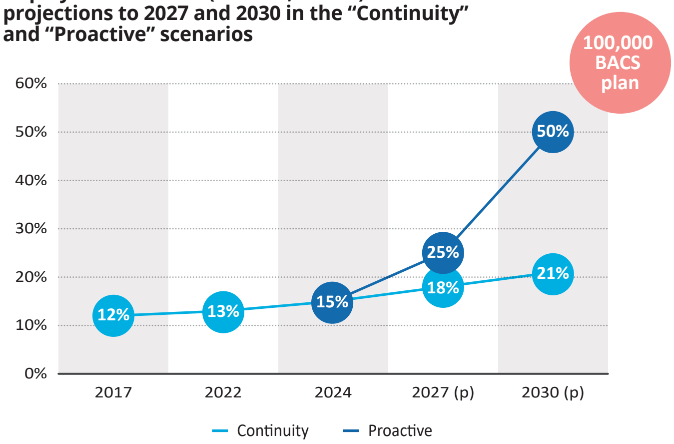
- calculating the GOFLEX label for buildings, as an educational lever enabling each building to take its first steps towards flexibility (see page 40)
- systematically specifying Flex Ready standards in calls for tender and contracts for renovation and demand response capacity, based on a reference framework for buildings.

2. Organising real estate players around new tasks and responsibilities to ensure the best performance from BACS over time

- systematically commissioning installation of the systems and regular recommissioning during their life

A proactive plan for scaling up by 2030!

Deployment of BACS (sites >1,000 m²) with projections to 2027 and 2030 in the "Continuity" and "Proactive" scenarios



By 2030, BACS could give rise to the potential for 2.5 GW of consumption modulation every day

	Annual energy savings	Everyday flexibility	"Peak day" flexibility (cold or windless)	"ÉcoWatt red" mode
Energy sobriety and Optimum Flexibility 100% BACS decree 2035	From 15 to 25 TWh	~3.8 GW	~6.3 GW	~7.9 GW
Proactive Scenario "100,000 BACS Plan" 2030	From 9 to 15 TWh	~2.5 GW	~4.5 GW	~6.3 GW
Continuity Scenario 25% BACS 2030	From 5 to 9 TWh	~1.6 GW	~2.6 GW	~4 GW

- implementation of a standard for buildings covering interoperability, cybersecurity and data governance issues
- transposing these new tasks and responsibilities into contracts currently in place between the various stakeholders for each building

3. Economic motivation, which remains the main trigger for taking action, for example:

- support for the acquisition of a Flex Ready BACS (by revising or upgrading the BAT-TH-116 form, for example)
- increasing the number of incentive-based electricity supply offers that include "solar" off-peak periods, enabling usage to resume at mid-day.
- sending out offers that encourage one-off dynamic flexibility on days of peak residual consumption (cold or windless days).

3.5

Findings from experimentation in the field

The CUBE Flex Competition

The flexibility testing ground for tertiary buildings

Launched in 2022 by RTE and organised by A4MT, this challenge is a vast testing ground for large-scale experimentation in demand-side flexibility.

Its aim is to test possibilities for deferring and modulating consumption in tertiary buildings.

In the first two seasons, buildings were able to test actions to be implemented in winter:

- **In an emergency:** in response to a EcoWatt red alert simulation
- **On an everyday basis:** to consume at the right times, avoiding peak hours (7-10 a.m. and 6-8 p.m.), without cutting back on user comfort

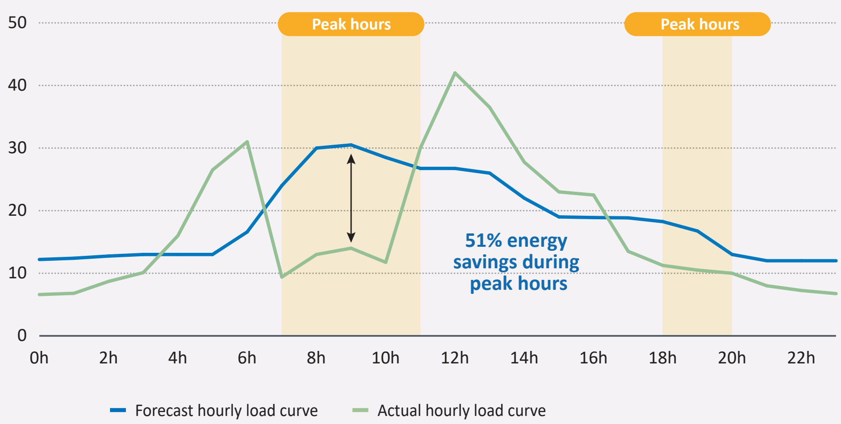
Findings from the CUBE Flex challenge

Feedback from the competition, involving almost 150 buildings, showed that tertiary buildings can:

- **defer and modulate an average of 7% of their consumption on an everyday basis, to avoid morning and evening peaks;**
- **reduce their consumption by an average of 20% during the peaks on EcoWatt red test days.**

Demand-side flexibility in tertiary buildings is thus a model that can be implemented rapidly, in less than three years, making it possible to release up to 2 to 3 GW every day in winter, and up to 6 GW during EcoWatt alerts.

CUBE FLEX FEEDBACK: ORANO – Prisme building



Actions implemented:

- Forward planning of heating
- Reduced heating and alternation with air handling units
- Move to “night-time reduction” mode for heating and ventilation

Mobilisation of the real estate sector by the AICN with its members

AICN
Alliance Immobilière pour la Convergence Numérique

Mobilisation of the private real estate sector to implement energy management in buildings involves a wide range of stakeholders bound by contracts: owners, asset managers, tenants, operators, systems and equipment suppliers and integrators, etc. They need to be coordinated, and their shared ambition to consume less and better energy on a daily basis must be reflected in a restructuring of the contractual chain, including the collective adoption of:

- standard terminology for tasks, roles and responsibilities,
- interoperability standards both within and between trades to automate exchanges,
- standard expressions of needs in terms of digital continuity, to ensure the durability of systems over the entire life cycle of assets.

That's why these stakeholders have joined forces within the AICN (Alliance Immobilière pour la Convergence Numérique - Real Estate Alliance for Digital Convergence) to produce the necessary standards and promote their adoption. For two years now, its members have been working towards convergence, in particular by experimenting with the allocation of roles in the context of EcoWatt alerts.

"Economic feasibility remains at the heart of our concerns in the particularly difficult circumstances faced by the real estate sector. But that in no way detracts from our shared ambition to pool our skills to consume less and better."

Csongor Csukas
AICN President

3.5

Findings from experimentation in the field

Pioneering local energy authorities, but they need to speed up

Eager to take advantage of their local renewable generation, encourage the development of collective self-supply operations and to provide new electrical uses (led by EVs) with a source of decarbonised electricity, local energy authorities are seeking to collect the data needed for the flexibility of tertiary buildings and to make it easier for their members to activate it.

Initially, initiatives are being developed to collect energy data (consumption data for buildings, public lighting, electric vehicle fleets) by installing sensors and, to a lesser extent, by collecting data available via BACS and aggregating it using hypervisor software at departmental level, as with Morbihan Energies and Sydev, for example.

In a second phase, the use of actuators to control usage in a flexible way is envisaged, via the installed BACS but also very often via direct communications such as SMS or email, given the difficulties for operators and managers in ensuring the connectivity of BACS installations. Some local energy authorities, such as USEDA, are developing their own management tools for use by elected representatives in regions of very low population density (in the case of USEDA, based in the Aisne department, the users are 550 town halls in villages of around 400 people). The USEDA ROC application uses interoperable standards to control certain uses directly or via connected BACS solutions, and can query the available APIs (such as EcoWatt). This strategy guarantees durability and scalability while keeping costs under control.

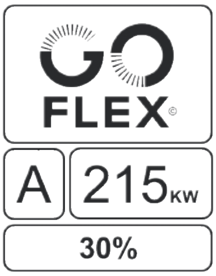
The local energy authorities agree on the lack of staff and lack of training for civil servants, and on the need for interoperability and updating of control solutions to ensure that data is received and processed correctly. Indeed, the contracts binding the parties (contracting authorities, project managers, equipment manufacturers, civil servants, etc.) have little to say on these points.

Eff'ACTEE: a flexibility support programme for local authorities

Since the end of 2022, the Eff'ACTEE sub-programme within the ACTEE programme run by the FNCCR has been helping local authorities, and in particular local energy authorities, to implement an electrical flexibility approach. This programme is designed to make up for the lack of time and engineering expertise that local authorities are currently able to devote to this issue. It subsidises human resources, tools for monitoring and measuring consumption, studies and project management services for public-sector contracting authorities to develop the electrical flexibility of their tertiary building stock.

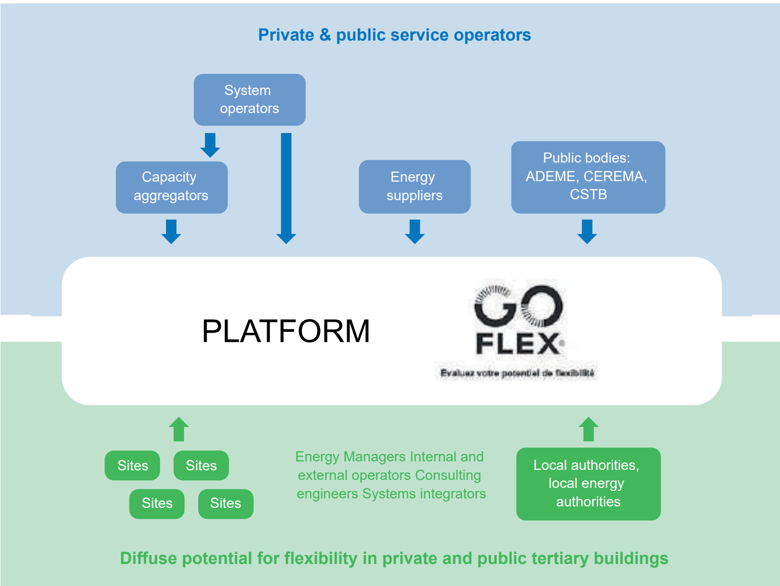
Eff'ACTEE has already supported around twenty regional authorities in this process, including a dozen local energy authorities, and has raised awareness among more than a hundred regional authorities through a dedicated programme of events. Coupled with the GoFlex platform, jointly developed within ACTEE (see box p. 45), it can help contracting authorities to benefit financially from their flexibility, via their supply contract or via contracts with aggregators.

GOFLEX is the label for building flexibility



A rating that allows buildings to calculate their flexibility potential using a benchmark method:

- a letter (from A to D) indicating the building's controllability
- an estimate of the site's potential for power modulation, in absolute terms (kW)
- an estimate of the site's capacity: power available for modulation as a percentage of subscribed power (%).



SIGN UP HERE

RTE, ACTEE, IFPEB and GIMELEC invite all public and private buildings in France to take their first steps towards flexibility by using the online platform to calculate their GOFLEX rating free of charge. The platform can also be used to communicate this label to demand-response operators, so that they can consider setting up a paid dynamic flexibility service.

"32 pioneering buildings have joined the platform to calculate their GOFLEX rating, revealing an average capacity for modulation of their power consumption of 24%"

Find out more: goflex.fr

SBA: 12 years serving responsible digital stakeholders in the building sector

Smart grids require smart buildings: achieving the goals of this new flexibility requires a high level of coordination between all the players involved and an approach based on total interoperability and de-compartmentalisation of controllable systems. To achieve this, **a benchmark digital building framework** is needed to set out the definitions, scope and requirements that can be verified by all stakeholders, inside and outside the building.

Interoperability, cybersecurity and data governance are the three pillars of this benchmark framework, which flexibility and real estate stakeholders will be able to use to define contracts and the terminology of tasks and responsibilities. This benchmark framework could include the necessary standards, for example the API specifications, the GOFLEX indicator, the minimum specifications for BACS and HEMS, as well as the maintenance and operating rules.

The SBA, which brings together more than 200 companies in the smart buildings sector, is proposing to define this benchmark framework for tertiary and residential buildings, **incorporating best practice and feedback from R2S and its variants** to smart grids, electric mobility and systems interoperability. Buildings certified to R2S and R2S4grid already have the technical foundations needed to play their part in providing this flexibility.

3.6

In the residential sector,
only partial uptake for the "I defer" scheme

Faced with the energy crisis, the French have demonstrated their ability to reduce their power consumption. This energy sobriety approach, embodied by the phrase "I turn it down, I turn it off", must now be accompanied on a massive scale by another action: "I defer".

The residential sector has historically employed everyday flexibility, through peak hours and off-peak hours in particular. The hot water tank, which switches on automatically during off-peak hours, is proof of this. The historic collaboration between the sector stakeholders (manufacturers, system operators, energy suppliers and electricity companies) has enabled flexibility to be adopted on a large scale. It now needs to be renewed and extended to other uses, such as deferring the charging of electric vehicles, modulating heating (electric radiators, heat pumps) and so on.

The deployment of technical control solutions is thus a prerequisite for optimised consumption, i.e. consumption at the right time and without fail, without the consumer having to think about it, and above all without loss of comfort.

Towards a regulatory obligation under the EPBD Directive

The energy sobriety and flexibility approach is anchored in the new definition of zero-emission buildings, introduced by the latest version of the Energy Performance of Buildings Directive (EPBD). This focuses on the **ability of buildings to react to external signals and adapt their power consumption, generation and storage,** thus encouraging smarter and more sustainable use of energy resources.

October 2022
1st Campaign "Every gesture counts"
Introduction of "I defer"

May 2026
Deadline for transposition of the EPBD flexibility component

1 January 2030
Deadline for application of the EPBD flexibility component for all new buildings

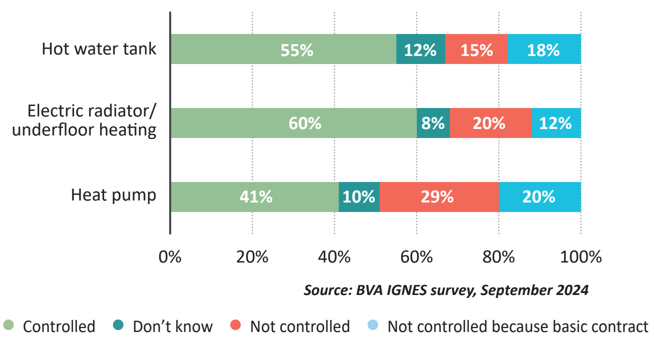
Change in the regulated sales tariffs for LV electricity <36 kVA

Electrical equipment still not sufficiently controlled

Whether it's hot water tanks, electric radiators or heat pumps, overall, **only one appliance out of two is controlled.** This is because many French people are still on "basic" tariffs, they do not see the value of control, or they are not aware of the subject.

The appliances where control is most frequently in place are electric hot water tanks and electric radiators/underfloor heating. For the hot water tank, this result is linked to the historical automatic activation during off-peak hours through the meter signal ("dry contact") or to programming by the user. In the case of electric radiators/underfloor heating, the energy sobriety policy promoted in recent years, with a recommended setpoint of 19°C and the promotion of connected thermostats, no doubt partly explains these figures.

% of French owners of these appliances who say they do or do not control them using tariff signals



Source: BVA IGNES survey, September 2024

To consume better, we need more control

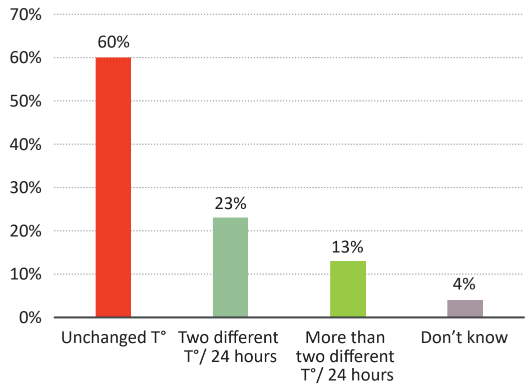
More frequent changes to temperature setpoints

Only 13% of French people with electric heating (heat pumps, electric radiators, underfloor heating) say they apply more than two temperature setpoints a day.

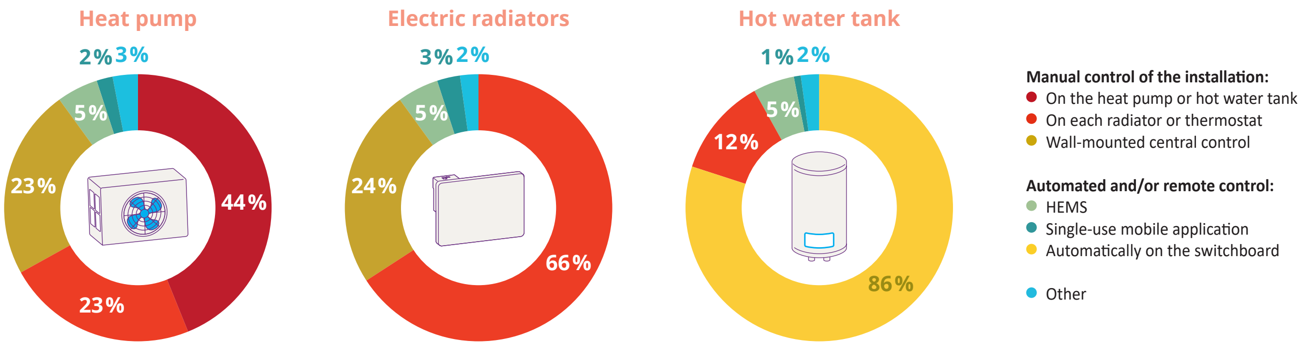
Significant gains in flexibility could be achieved by applying more daily setpoints to modulate the heating temperature in each room during consumption peaks (7-11 a.m. and 6-8 p.m.)

Number of temperature setpoints per day for users of electric radiators/ heat pumps

Source: BVA IGNES survey



Control modes used when equipment is controlled



Source: BVA IGNES survey September 2024

Focus on control modes

Manual control of the equipment	The occupant sets the required operating mode (e.g. Eco mode) on the equipment (or on an added system) and can possibly programme a timer and the settings for each room. **This is the most widespread control method (2/3 for electric heating control), but is limited** by poor ergonomics, the fact that tariff signals are not automatically updated, and the lack of overall optimisation, particularly with regard to power demand.
Single-use centralised manual control	With a wall-mounted central control or a mobile application connected to the equipment (integrated or an add-on), **control is easier.** The occupant can manually programme a type of equipment, for example electric heating, but within the limits of non-automated control. With a connected solution, it can be controlled when away from home.
Equipment control system	Triggered automatically by the meter signal, the hot water tank or charging terminal is activated during off-peak hours by contactors often found on the switchboard. The control system is typically compatible with equipment that supports ON-OFF control and for which consumption can be deferred (EVCI and hot water tank).
Automated global control	The Home Energy Management System (HEMS) automates **the programming of equipment according to the occupant's preferences and several parameters (tariffs, weather, presence/absence, etc.).** The occupant is thus assisted by a smart system that controls the whole home to optimise electricity bills (kWh and kVA) and comfort. The occupant can take back control at any time.

Although only recently introduced, connected solutions (including HEMS) have already been adopted by 6% to 8% of the French population to control their heating or hot water tank.

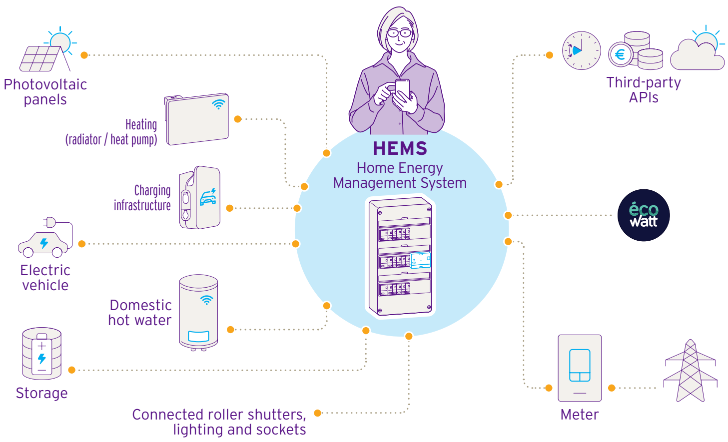
3.7

HEMS, the global, smart control solution

Photovoltaic panels and self-supply, catalysts for better consumption

As of 1 July 2024, of the 3% of French people equipped with photovoltaic panels, **61% were on self-supply** using the electricity they generated themselves *(Source: ENEDIS Open Data)*. To make the most of the energy produced, it is necessary to modulate or defer your daily loads. This explains why **French people with photovoltaic panels are three times more likely to be equipped with HEMS than the population as a whole** *(Source: BVA IGNES survey, September 2024).*

Putting the occupant in control



Still little known in France, HEMS is a new technology on the market that meets the challenge of consuming less and better.

The HEMS penetration rate in French occupied housing stock was 3% at the end of December 2023.

(Source: BVA IGNES survey, September 2024)

To consume better, we need to control better

HEMS is the smart system that enables occupants to manage the energy in their homes so that they consume less and better.

This Home Energy Management System (which can also be used in business premises), optimises energy bills by controlling the home's connected appliances (heating, hot water tank, electric vehicle charging, etc.).

It takes into account the various flexibility tariff signals, the occupant's preferences, available power, and local power generation where applicable.

Users have access to an application that enables them to monitor their consumption/generation data and the resulting savings, and to program their appliances.

Digital and scalable, HEMS can be regularly enhanced with new functions and third-party services.

Choose the right control solution from the first piece of equipment, to anticipate the electrification of uses

It is important to anticipate the electrification of uses and the subsequent addition of equipment to be integrated into the control system. This is why it is a good idea to choose HEMS from the outset, whether the goal is energy sobriety or flexibility.

A first component of the system can then be activated, e.g. heating control. It can then easily be extended to other uses, such as electric vehicle charging, hot water tanks, etc.

To be controllable, the equipment must be connected (by design or via an add-on) and compatible with HEMS.

By 2030, the residential sector will represent flexibility potential in the order of:

- **Domestic hot water:** 3 GW avoided at the 7 p.m. peak and 7 GW that can be shifted to the time of peak solar generation
- **Heating:** several GW can be modulated by automating the programming of different temperature setpoints for peak and off-peak periods.

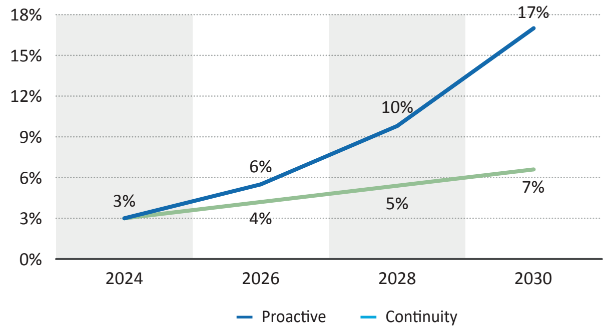
Pathway to 2030

The "continuity" scenarios, i.e. the deployment of solutions based on current trends, represent pathways that are insufficient in relation to flexibility requirements.

A proactive scenario would involve a **fivefold increase in the HEMS penetration rate,** with an acceleration from 2026 that should not be missed (by this time market conditions should provide more of an incentive).

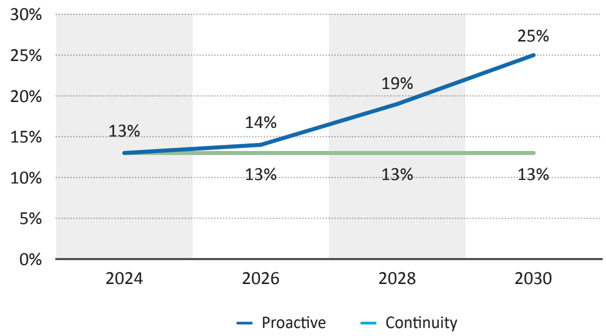
As heating is the largest consumer of power in the residential sector, it represents a particular challenge. The increase in the number of temperature setpoints per day is thus a key indicator for monitoring everyday flexibility. While momentum has been created through measures to reduce consumption, we need to go even further in ensuring that occupants systematically adopt the right habits.

HEMS penetration rate in France in 2024 and projection to 2030 in the "Continuity" and "Proactive" scenarios



Source: IGNES study, September 2024

% of homes with electrical heating applying more than two temperature setpoints per day



Source: IGNES study, September 2024

Levers for scaling up

Improving knowledge of available solutions and their benefits

- Commitment by the sector to promoting better consumption and related solutions to the general public.
- Skill-building in these new technologies for professional fitters.
- Raising awareness of existing support packages.

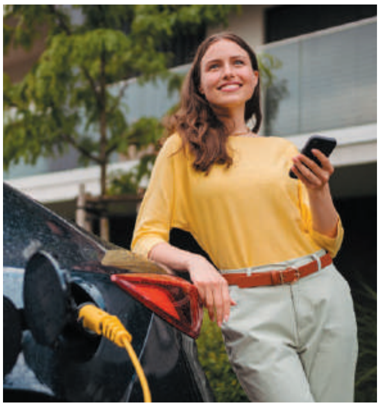
Facilitating the customer journey

- Simple, intuitive, "1-click" operation for HEMS users means that they can easily authorise access to the key energy management data in the home (tariffs, subscribed power, etc.) needed to set up automatic control.
- To achieve this, HEMS, like Flex Ready in the tertiary sector, must be able to receive and interpret standardised economic signals (APIs) from third parties, in particular electricity suppliers and system operators.
- A quality benchmark for HEMS to help identify high-performance, reliable and sovereign products.

3.8

Focus on the use of electric vehicles

In the residential sector

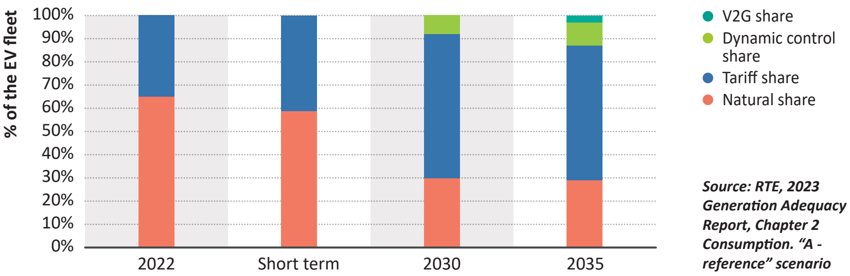


© Halfpoint - Adobe Stock

- At the end of June 2024, **1.8 million electric vehicles (EVs) or plug-in hybrids (PHVs)** were on the road in France.
- 85% of private owners live in individual houses, and **86% of them charge at home, mostly using a conventional socket (2 kW).**
- **61% of charging takes place between 9 p.m. and 7 a.m.** Only **32% of customers say they control the charging of their EV,** usually manually (50% of cases).
- More than two-thirds of electric vehicle owners say they charge their vehicle at home, according to an IPSOS survey carried out in 2024 for AVERE France.

Source: Enedis 2024 survey of private customers

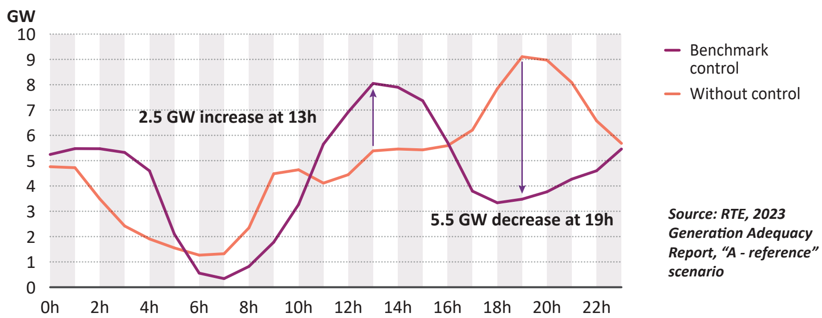
Change in the share of charging control methods for light electric vehicles



Source: RTE, 2023 Generation Adequacy Report, Chapter 2 Consumption. "A - reference" scenario

Tariff control is currently used to charge **around one-third of electric vehicles in France.**

Charging profiles for all electric vehicles, for an average working day in 2035, without charging control and making the benchmark control assumptions



Source: RTE, 2023 Generation Adequacy Report, "A - reference" scenario

In the residential sector, tariff control (PH/OPH signals, adapted supply offers, etc.) represents a major source of demand-side flexibility and should become more widespread.

For companies

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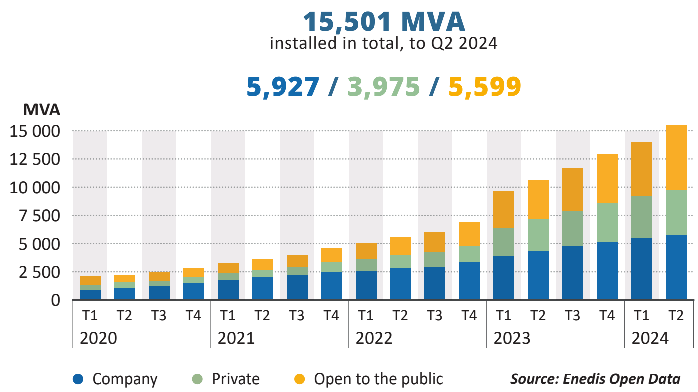
- In 2024, company vehicles represented 15% of the fleet on the road, but 42% of electric vehicles in France.
- More and more companies are buying EVs or PHVs, mainly for economic reasons: 55% of company fleets are electric.
- In 84% of cases, charging takes place in the company car park, mostly with one charging point per electric vehicle and plug-in hybrid.
- 1/3 of companies give their employees access to charging points at work.

Source: Enedis 2024 survey, Companies

At the end of June 2024:

More than 800,000 charging points installed in companies (employees' vehicles + company fleets)

Representing a total installed capacity of **5.9 GW**



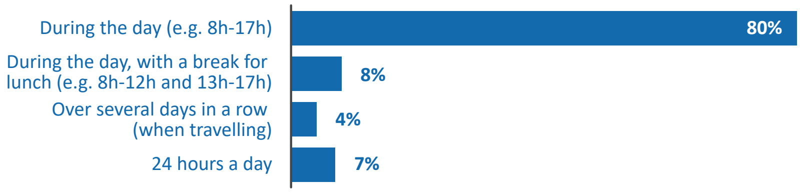
Source: Enedis Open Data

Given that only 21% of companies say they control charging, there is a real opportunity for these customers and the grid to control charging and defer consumption to off-peak hours using a centralised control system (BACS, EVCI manager, connection to the meter, etc.).

The use made of company vehicles is generally incompatible with daytime charging, so night-time charging is the preferred option.

What times of day are the electric vehicles in your fleet generally used (EVs and PHVs)?

Source: Enedis 2024 survey, Companies



4

Economic prerequisites for demand-side flexibility

4.1

Indicators for monitoring the economic prerequisites

Why monitor the deployment of offers that encourage flexibility?

To make demand-side flexibility a widespread practice, consumers must be able to derive economic benefit from deferring and modulating their day-to-day uses. Hence, they must have access to offers that differentiate prices according to the time of day or the day of the week.

The offers to be monitored are those that encourage residential and tertiary consumers to defer and modulate their uses, every day and on days of high demand or low renewable generation, on a regular and dynamic basis.

Structural and regular flexibility	Dynamic flexibility
Time-differentiated supply offers (PH/OPH, summer/winter, workdays/weekends, fixed peak)	Implicit offers of demand response inextricably linked with supply (EIF)
	Explicit flexibility offers via an aggregator

Focus on tariff signals Peak hours and off-peak hours (PH/OPH)

For all residential and tertiary consumers, **the network tariff (TURPE) includes off-peak periods, set locally by the public distribution system operator (DSO)** according to operating conditions and grid capacity.

Consumers benefit from 8 off-peak hours (OPH) and 16 peak hours (PH) per day, with more attractive tariffs during off-peak hours. Their current distribution is as follows:

- for around 60% of consumers, off-peak hours are concentrated during the night hours, between 8 p.m. and 8 a.m.;
- for around 40% of consumers, they are distributed between 12 noon and 5 p.m. and between 8 p.m. and 8 a.m.

The impact of TURPE off-peak hours differs depending on the type of supply offer:

- **For a Basic supply offer,** the OPH signal is irrelevant to the consumer, as the price is the same whatever the time of day, day of the week or month of the year.
- **For a profiled supply offer*** depending on the PH/OPH metering structure, the TURPE OPH signal is reflected in consumers bills, thus encouraging them to defer their consumption to OPH, which are cheaper than PH.
- **For a non-profiled supply offer*,** the supplier itself defines the metering time slots, independently of the TURPE time slots defined by the DSO. If this supply contract includes off-peak periods, these may or may not be identical to the off-peak periods defined by the DSO.

* Profiled in the sense of Reconstitution of Flows. The profile of a customer category is a set of half-hourly coefficients, constructed to reflect the way in which an “average” customer in this category consumes (or generates) electricity over time.

More than 35 million household and small business customers benefit from TURPE off-peak hours, but to date only 15 million are able to take advantage of them

- The positioning of off-peak hours by the DSO makes it possible to meet supply-demand balancing needs at national level, while ensuring compatibility with local constraints on the distribution systems. In this way, the variety and rules for allocating off-peak periods in a random and non-discriminatory way (regardless of the customer, supplier or type of supply offer) help to smooth out the effects of triggering uses controlled by the PH/OPH signal, such as hot water tanks today and electric vehicle charging in the future.
- Off-peak hours have historically been concentrated on night-time periods, when demand is low and there is excess generation. Over time, new mid-day off-peak periods (between 12 noon and 5 p.m.) have been introduced for new consumers. In the future, the off-peak periods are likely to evolve in response to the increase in solar generation, particularly in summer.
- To be fully effective, the PH/OPH signal must be sent directly to the consumer as part of the supply offer (whether at the regulated sales tariff or under a market offer). To date, this concerns 15 million residential and small business consumers (LV ≤36 kVA). The economic appeal of these supply offers structured around the PH/OPH signal is a prerequisite for their widespread use by all consumers.

2.4 GW: this was the load drop measured at 12.30 p.m. during the winters of 2022/23 and 2023/24, following the temporary operations carried out by Enedis, at the request of the public authorities, to inhibit switching on controlled uses for 4.3 million household customers with off-peak hours between 12 noon and 2 p.m.

Seasonal off-peak hours, an opportunity to respond to changes in the generation mix, in line with grid requirements

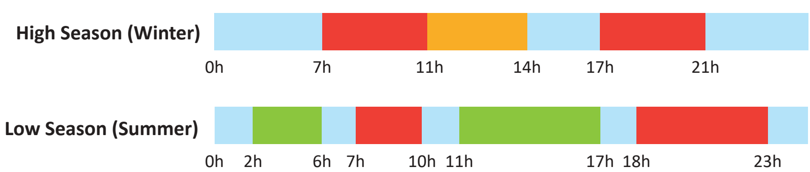
As part of the review of the TURPE 7 tariff exercise, guidelines for the positioning of off-peak hours are being studied with a view to:

- **introducing seasonal off-peak hours** for summer and winter;
- **excluding certain off-peak periods** that put a strain on the supply-demand balance in winter or summer in the short term;
- **promoting "solar" off-peak periods** in summer (between 11 a.m. and 5 p.m.) and during the night-time trough (2 a.m. to 6 a.m.).

If confirmed, these changes would require the reprogramming of a large majority of Linky and business market meters. (LV >36 kVA & MV) as from 2025.

Opposite, the new off-peak periods requested by the French Energy Regulatory Commission (CRE) for TURPE 7.

- Periods to be preferred
- Periods not to be developed
- Periods to be excluded



4.2

Seasonal consumption by household customers
according to their profile

At the end of Q1 2024, Enedis had 33.3 million household customers with an active supply contract, of which:

Type of supply contract	Number of consumers
Basic offer	18 million
Peak/off-peak offer	14 million
"Mobile Period" offers *(e.g. Tempo / EJP options under the regulated sales tariff, new EIF offer*)*	1 million

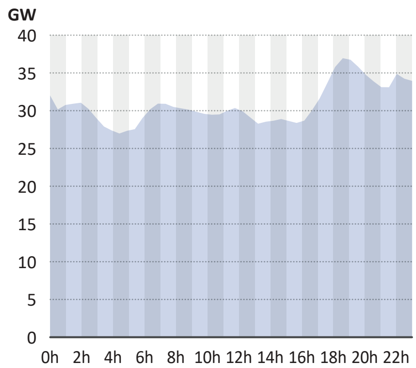
* EIF: Effacement Indissociable de la Fourniture (demand response inextricably linked with supply) within the meaning of Article L271-4 of the French Energy Code

Customers with a time-differentiated supply offer account for more than 60% of total residential consumption.

On a winter day, the ratio between the maximum and minimum consumption of residential consumers with subscribed power greater than or equal to 6 kVA varies from 1.7 for a consumer with the Basic offer, to 2 for a PH/OPH offer (and up to 3.2 for a mobile peak offer)**.

** 3 types of day (Blue, White, Red), 2 time periods per day (Peak, Off-peak)

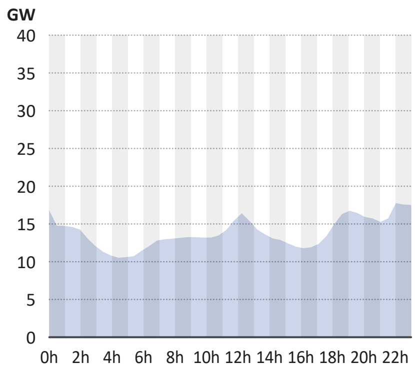
Total consumption for household customers on a cold winter day in 2023 at hourly intervals



Source: ENEDIS

In winter, peak consumption is concentrated in the evening around 7 p.m. E.g. 35.8 GW on 09/01/2024 at 7 p.m.

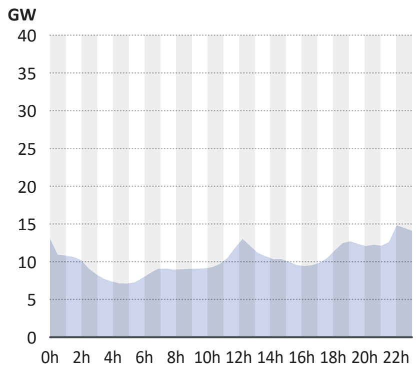
Total consumption for household customers on a typical shoulder season day in 2023 at hourly intervals



Source: ENEDIS

In the shoulder season, consumption is more evenly spread across the day, with two moderate peaks in the early morning and at mid-day, and an always pronounced peak in the early evening. There is also a peak between 10 and 11 p.m.

Total consumption for household customers on a hot summer day in 2023 at hourly intervals

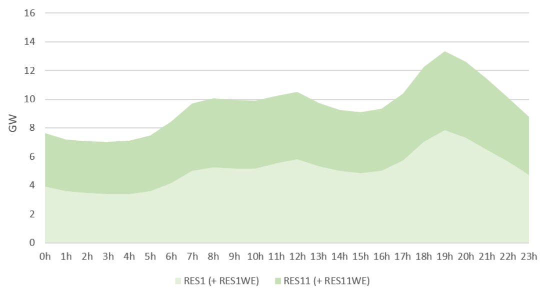


Source: ENEDIS

In summer, peak consumption occurs after 10 p.m., with more moderate consumption during the rest of the day.

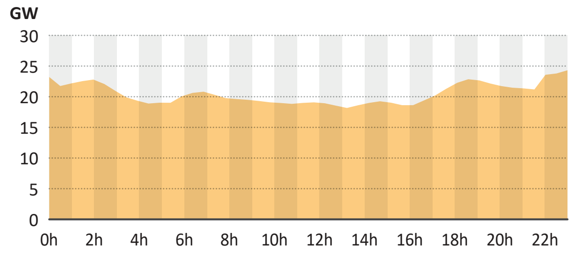
Deferring the most energy-intensive uses to off-peak periods is possible and should be encouraged

Consumption of household customers on the Basic offer for a cold working day in 2023 at hourly intervals



Consumption remains high during periods of high winter demand.

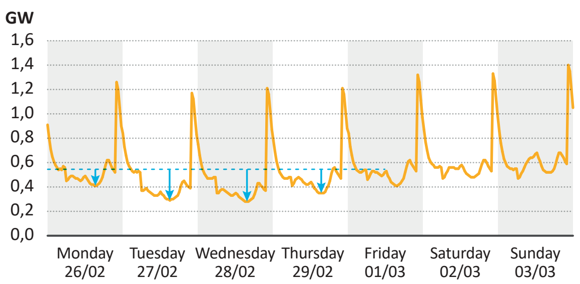
Consumption of household customers on the PH/OPH offer for a cold working day in 2023 at hourly intervals



Source: ENEDIS

Consumption is smoothed in winter, including on days of high stress on the supply-demand balance and the grids. All year round, part of the consumption is positioned during off-peak hours, at night or in the middle of the day.

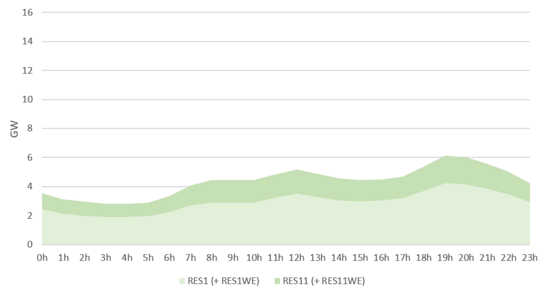
Consumption of household customers with a mobile period offer (6-dial meter) for a winter week in 2023 with high stress on the supply-demand balance



Source: ENEDIS

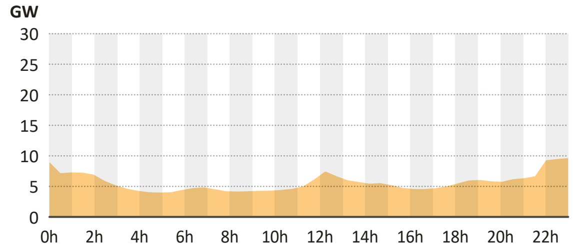
Example above for the week from 26/02 to 01/03/2024, with 2 Red days of high stress (27/02, 28/02), 2 White days of medium stress (26/02, 29/02) and 1 Blue day with no stress (01/03). On days of stress, consumption is lower during the day than on a normal day, and then partly shifts to the night or the weekend.

Consumption of household customers on the Basic offer for a hot working day in 2023 at hourly intervals



In summer, the morning and evening consumption peaks occur slightly later. The difference in consumption according to subscribed power level is reduced.

Consumption of household customers on the PH/OPH offer for a hot working day in 2023 at hourly intervals



Source: ENEDIS

To date, more than 1 million households have signed up to a mobile period supply offer, with an incentive to consume less during periods of stress on the electricity system.

On average, a household customer with a 6-dial meter reduces consumption by 20% to 30% during peak periods.

In the future, the price signals associated with these mobile period offers could encourage customers to defer their consumption to periods of surplus renewable energy generation.

4.3

Seasonal consumption by tertiary customers

Key figures for the sector

393,701
tertiary buildings
with a subscribed power greater than 36 kVA

2/3
are Offices, Shops, Educational establishments*

4.3
million buildings
with power consumption of **114 TWh/year**
(Enedis perimeter, 2023 data)

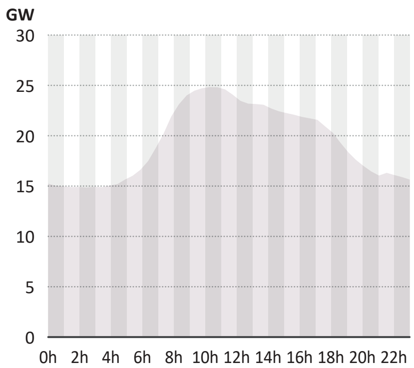
74%
of tertiary sector consumption
is represented by these buildings

1
billion m²
surface area with heating or air conditioning

91%
of tertiary sites are **"business customers"**
(with subscribed power less than or equal to 36 kVA)

*** Source: CEREN 2020**

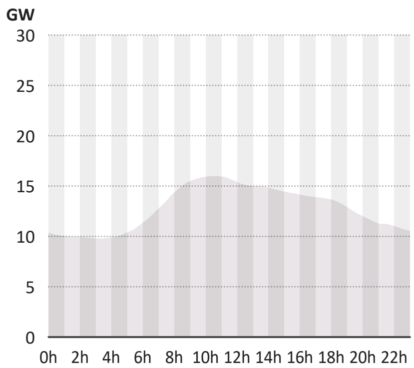
Total consumption for tertiary customers on a cold working day in winter 2023, at hourly intervals



Source: ENEDIS

In winter, consumption rises sharply in the morning (7 to 11 a.m.) and remains high during the day.

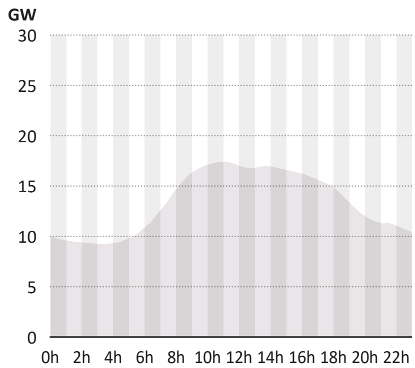
Total consumption for tertiary customers on a shoulder season day in 2024, at hourly intervals



Source: ENEDIS

In the shoulder season, the amplitude of consumption varies less within a given day.

Total consumption for tertiary customers on a hot working day in summer 2023, at hourly intervals

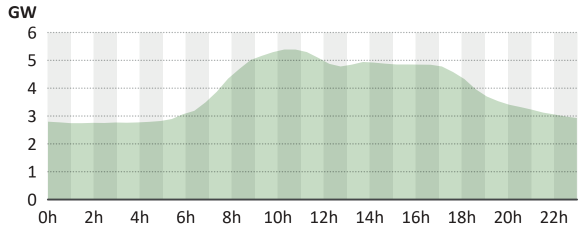


Source: ENEDIS

In summer, consumption is more spread out over the day (7 a.m. to 6 p.m.). During heat peaks, consumption is driven by air conditioning.

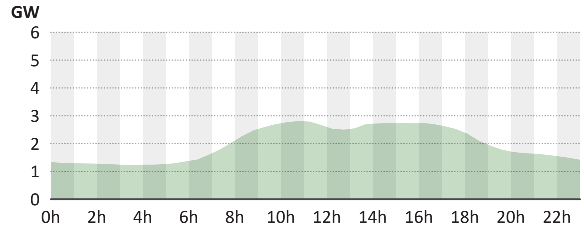
Focus on the consumption of business customers (LV ≤36 kVA)

Consumption of business customers on the Basic offer for a cold working day in winter 2023, at hourly intervals



Source: ENEDIS

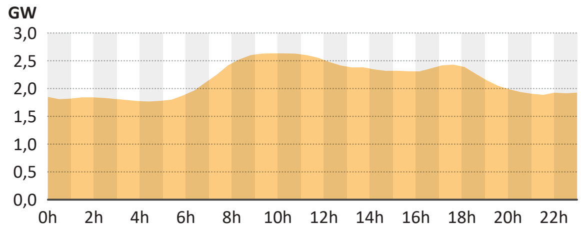
Consumption of business customers on the Basic offer for a hot working day in summer 2023, at hourly intervals



Source: ENEDIS

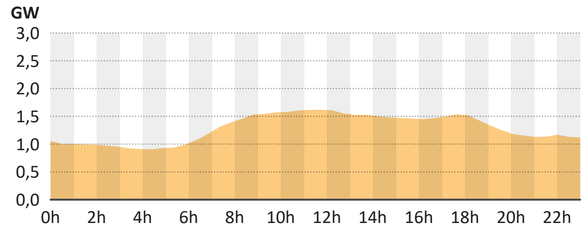
Around 3.1 million customers (70% of the "business customers" segment) have a Basic consumption profile, with no time differentiation. Consumption is highest during the day, with a peak at the end of the morning (10 to 11 a.m. time slot).

Consumption of business customers on the PH/OPH offer for a cold working day in winter 2023, at hourly intervals



Source: ENEDIS

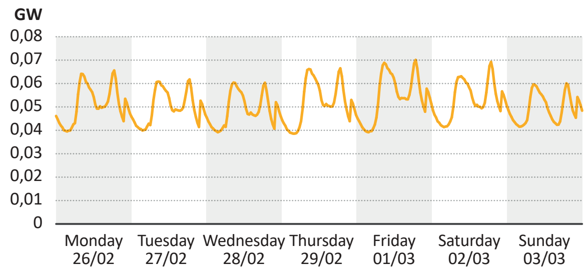
Consumption of business customers on the PH/OPH offer for a hot working day in summer 2023, at hourly intervals



Source: ENEDIS

Consumption is more evenly spread throughout the day. A slight increase in consumption can be seen at the start of off-peak hours around 10.30 p.m.

Consumption of business customers with a mobile period offer (6-dial meter) for a winter week with high stress on the supply-demand balance



Source: ENEDIS

Example above for the week from 26/02 to 01/03/2024, with 2 Red days of high stress (27/02, 28/02), 2 White days of medium stress (26/02, 29/02) and 1 Blue day with no stress (01/03).

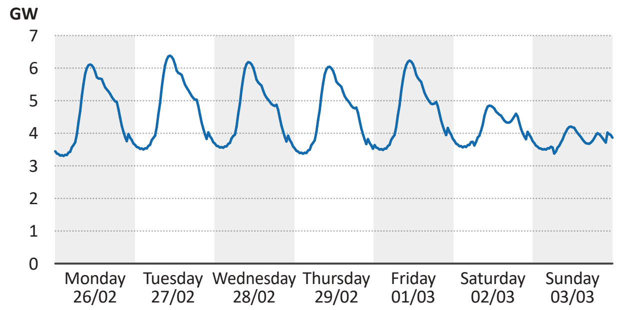
On the days of highest stress for the supply-demand balance, the consumption profile varies little compared with a normal working day. Consumption remains concentrated on the morning plateau (peak around 8.30 a.m.), and in the early evening (6 to 7 p.m.).

However, some consumption is deferred each day to off-peak hours as from 10 p.m.

Consumption in medium/large tertiary buildings (LV >36 kVA and MV)

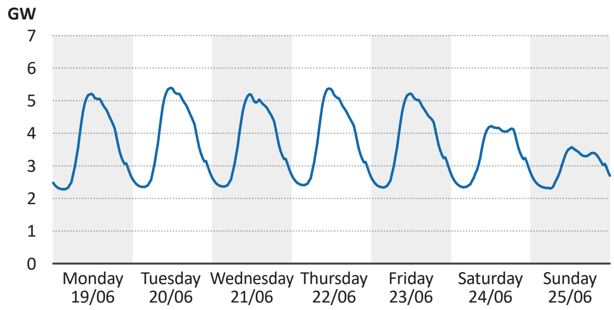
Focus on consumption in medium/large tertiary buildings (LV >36 kVA and MV)

Consumption of medium-power tertiary companies (>36 kVA and ≤250 kVA) for a cold week in winter



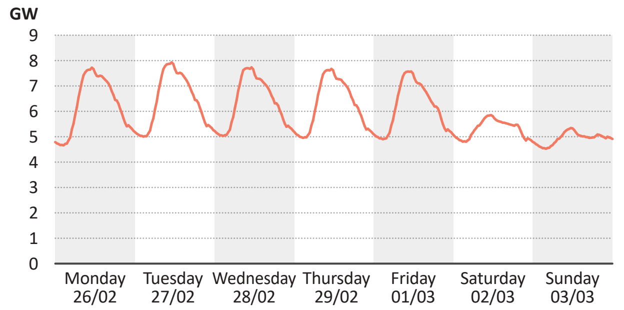
Source: ENEDIS

Consumption of medium-power tertiary companies (>36 kVA and ≤250 kVA) for a hot week in summer



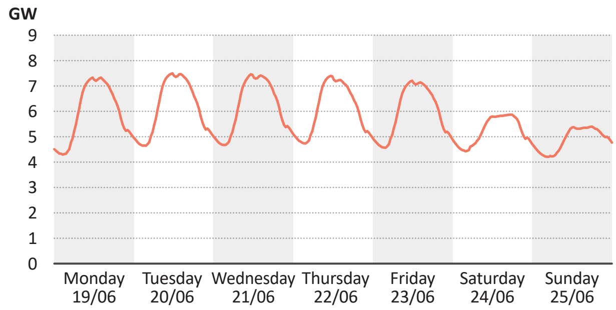
Source: ENEDIS

Consumption of high-power tertiary companies (>250 kVA) for a cold week in winter



Source: ENEDIS

Consumption of high-power tertiary companies (>250 kVA) for a hot week in summer



Source: ENEDIS

Within the Enedis perimeter at the end of March 2024, 393,701 tertiary buildings with a subscribed power >36 kVA were in service, all sectors combined.

Although they are associated with time-seasonal profiles (Peak/Off-peak + Summer/Winter), the load curve for these sites varies little according to the time of day or the season.

Consumption is concentrated during the day and on weekdays, with a peak at the end of the morning in winter (around 10.30 a.m.) and more spread out during the lunch break in summer (around 11 a.m. to 2 p.m.). At least 2/3 of consumption continues over the weekend.

Focus on tertiary sector consumption:
offices, shops and educational buildings

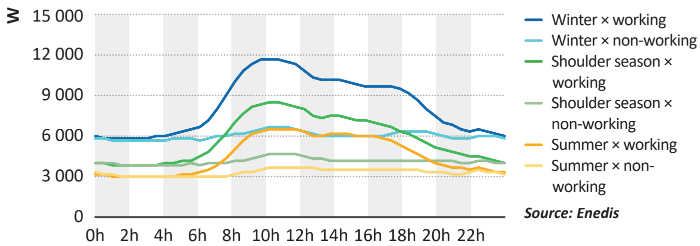
At the sub-sectoral level (offices, shops, educational buildings), average consumption is highly variable. The average values shown below can be used to assess the impact of buildings in terms of cumulative power demand during demand peaks and troughs. They are driven upwards by the 1% to 5% of customers with the highest consumption. The median values shown in the graphs represent the power drawn by a typical customer for a given sector of activity.*

In 2023, there were approximately 220,000 MV/LV SUP 36 customers in the Offices sector.

On average, office consumption on a working day varies between 14 kW and 22 kW from midnight to 5 a.m. and from 8 to 11.30 p.m., regardless of the season. Maximum power at 10 a.m. is 30 kW on a cold winter day and 23 kW in summer.

In the median, a typical office building consumes 12 kW at 10 a.m. on a working day in winter and 6.5 kW in summer.

Median load curve (in W) for offices by season and type of day in 2023, at hourly intervals



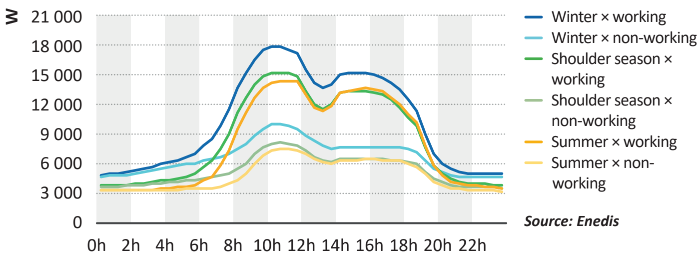
Source: Enedis

In 2023, there were approximately 110,000 MV/LV SUP 36 customers in the retail sector.

On average, shop consumption on a working day varies between 16 kW and 19 kW from midnight to 5 a.m. and from 8 to 11.30 p.m., regardless of the season. Maximum power at 10 a.m. is 37 kW on a cold winter day and 33 kW in summer.

In the median, a typical shop building consumes 18 kW at 10 a.m. on a working day in winter and 14 kW in summer.

Median load curve (in W) for shops by season and type of day in 2023, at hourly intervals



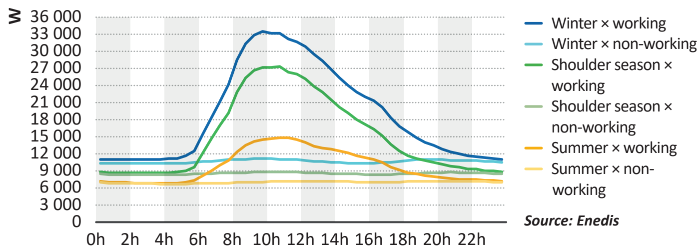
Source: Enedis

In 2023, there were approximately 16,000 MV/LV SUP 36 customers in the Education sector.

On average, consumption in an educational building on a working day varies between 24 kW and 31 kW from midnight to 5 a.m. and from 8 to 11.30 p.m., regardless of the season. Maximum power at 10 a.m. is 66 kW on a cold winter day and 43 kW in summer.

In the median, a typical educational building consumes 33 kW at 10 a.m. on a working day in winter and 15 kW in summer.

Median load curve (in W) for educational buildings by season and type of day in 2023, at hourly intervals



Source: Enedis

* classification of tertiary sites according to the CEREN nomenclature of NAF codes

4.6 Effectiveness of dynamic "insurance" flexibility (on peak days)

Implicit offers of "demand response inextricably linked with supply" (EIF)

By subscribing to a mobile period supply offer with their supplier, customers have a financial incentive to reduce their consumption during peak periods when prices are high. On the other hand, they can benefit from a lower price per kWh for the rest of the year. The metering structure reflects the supplier's tariff schedule, in particular the consumption allocated to mobile peak periods, which are triggered by the supplier the day before they take effect (minimum lead time of 8 hours for customers equipped with a Linky meter). The mobile periods correspond to days of stress signalled by RTE (schedule of Tempo days, EIF days) or to days entirely under the control of suppliers (market optimisation).

Until now, these offers have been developed exclusively to provide demand response capacity in the event of consumption peaks. In the future, these offers could evolve towards tariff schedules that include mobile periods favourable for consumption (zero or negative prices, surplus renewable energy generation), based in particular on the features of the DSO's smart meters.

Explicit flexibility offers via an aggregator

By contracting with a market aggregator, independently of their electricity supply contract, household or tertiary consumers can contribute to the dynamic flexibility requirements for supply-demand balance. To do this, they make a commitment to their aggregator to activate power modulation for all or some of their uses, the day before it takes effect, or even on an intraday basis.

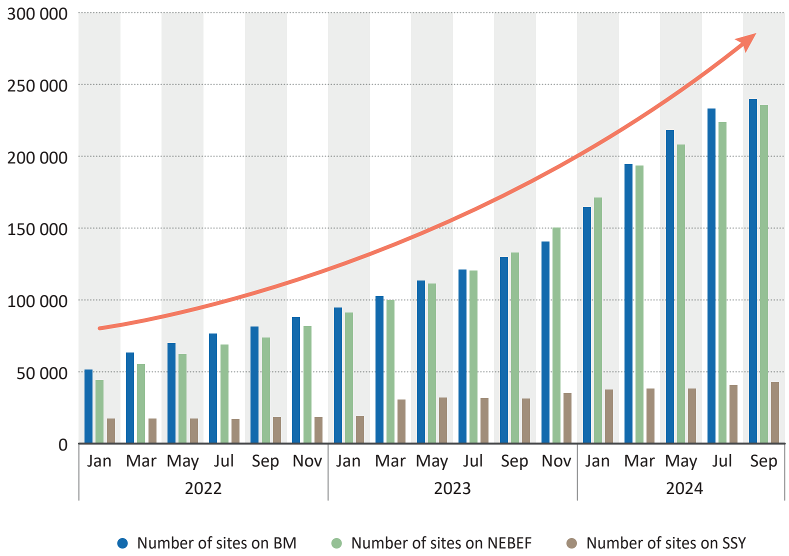
The economic benefits are manifold:

- **For the aggregator** which takes advantage of balancing offers with RTE (balancing mechanism, frequency ancillary services) or the load reduction on the wholesale electricity market (NEBEF).
- **For the final customer** who receives remuneration from the aggregator and/or provision of a technical service to control its energy consumption.
- **For the electricity system** which can limit the use of expensive and potentially carbon-intensive peak generation assets, and even avoid targeted power cuts as a last resort (load shedding).

Until now, market mechanisms have only paid for cuts in consumption, in response to periods of stress for the electricity system and the markets (high demand, high prices). In the future, with increasing renewable energy generation, photovoltaic in particular, combined with increasingly frequent negative price episodes, upward modulation of consumption will also have to be taken into account in flexibility schemes.

Until now, these offers have been developed exclusively to provide demand response capacity in the event of consumption peaks. In the future, these offers could evolve towards tariff schedules that include mobile periods favourable for consumption (zero or negative prices, surplus renewable energy generation), based in particular on the features of the DSO's smart meters.

Number of sites participating in market mechanisms for explicit flexibility, Enedis perimeter



~ ×4

is the growth factor since the beginning of 2022 in the number of sites connected to the Enedis grid and participating in at least one market mechanism.

~ 97%

is the percentage of low-voltage sites ≤36 kVA among those participating in these mechanisms, the vast majority being household customers.

Sector factsheets

Offices

Key figures for the sector

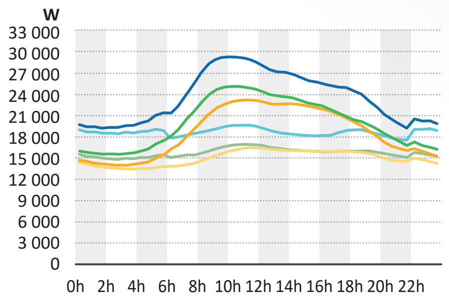
35,000 office buildings in France >1,000 m²

20% of public buildings

16% with a control system

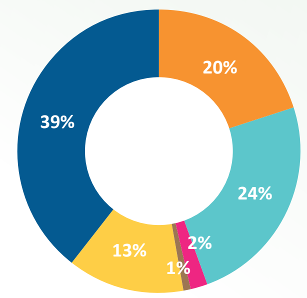
130

Load curve for an office building on a typical winter day in 2023



Source: ENEDIS

Breakdown of annual consumption by use



How can you optimise power consumption in your building?

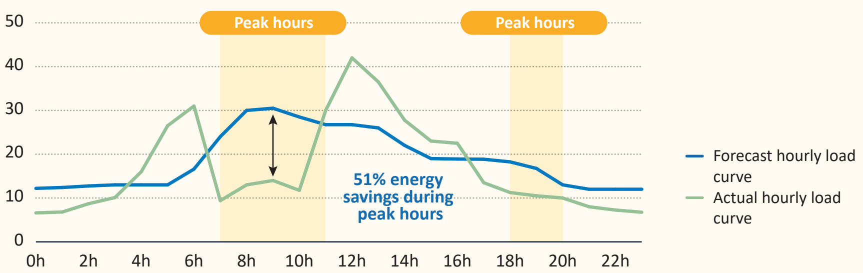
Uses in my building	Can be deferred	Can be modulated	**Systematically** *Depending on the tariffs set for different times of the day (peak/ off-peak tariffs, etc.)*	**Occasionally** *At the supplier's request for a few hours a day over one or more days*	**On request** *From a third party for short periods (e.g. demand response offers)*
Heating	✓	✓	✓	✓	✓
Air conditioning	✓		✓	✓	✓
Ventilation	✓	✓	✓	✓	✓
Domestic hot water	✓		✓	✓	✓
EVCI	✓	✓	✓	✓	✓
Lighting, Cooking	✓				✓

How does it work in practice?

Implemented actions:

1. Forward planning of heating
2. Reduced heating and alternation with air handling units
3. Move to "night-time reduction" mode for heating and ventilation

CUBE FLEX FEEDBACK: ORANO – Prisme building
Offices – 15,400 m² – 100% electric

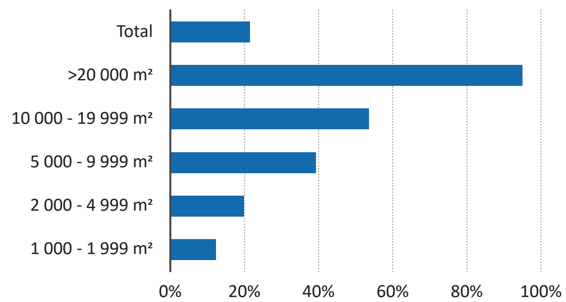


Penetration of BACS in 2024:
16% of sites and 37% of surface area

Operating mode

- The **BACS** are mainly operated by **facility managers (FMs)**, either directly or **subcontracted** by the BACS supplier at the initiative of the building manager in the case of multiple occupancy, or the occupant in the case of a single user.
- The systems are rarely subject to **commissioning**. Retro-commissioning has been or is being carried out by some major building stock managers, in parallel with energy audits.
- On small and medium-sized sites, **EVCI** is generally **managed directly by the occupant** using the electrical power available on site.
- On large sites and multiple occupancy sites, **third-party management** is common, usually with a power supply dedicated to EVCI.

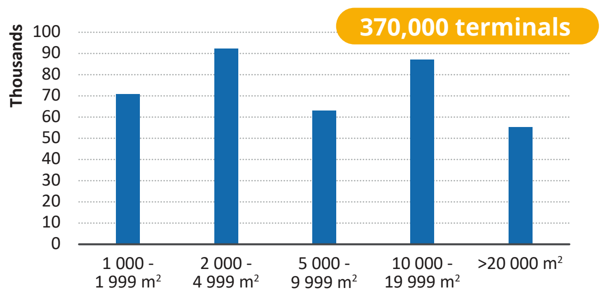
BACS penetration as % of sites



Current contribution to flexibility

- Some managers have planned **EcoWatt operations,** not often activated as the signal remains green.
- In the **absence of long-term financial incentives**, operations implementing demand response or deferred consumption policies are not practised.
- Pilot operations have been carried out or are planned for various electrical work packages such as lighting, lifts, etc. At this stage, BACS is seen as **a factor that can contribute to flexibility, but not exclusively.**
- Nevertheless, **EVCI** seems to be the area of consumption that can be most easily activated in the context of **flexibility** and the one that is already the most **widely used** in the context of balancing power demand on a given site.

Number of EVCI installations



Obstacles

- BACS without commissioning and regular inspection **does not deliver the expected performance,** according to some managers.
- Irrespective of the technical features, the lack of **skills** and resources, and the **lack of priority** given to BACS in the design of the site, do not help to promote solutions that are still perceived as **expensive** and **difficult** to manage.
- **Difficulties in interpreting** standard EN ISO 52120-1 and the consequences in terms of **Energy Savings Certificate subsidies** may lead to commitments being strictly limited to compliance with the BACS decree.
- The large number of **stakeholders** in office real estate explains the **divergent interests** when it comes to implementing BACS solutions.

Key success factors

- **Comfort for occupants** is seen as the first gain, followed by the contribution to controlling energy consumption.
- Systematic **commissioning** is widely perceived as the key to triggering beneficial investment in BACS.
- **Interoperability** should be better demonstrated to guarantee long-term investment.
- The lack of resources for managers could be overcome by **simplifying** technical management operations and by introducing **smart** automation.
- The BACS solutions proposed must demonstrate their ability to easily incorporate **flexibility functionalities** in the face of less integrated building management solutions.

Source: VERBATIM extract from interviews during the GIMELEC / CODA Strategies study, May-July 2024

Shops

Key figures for the sector

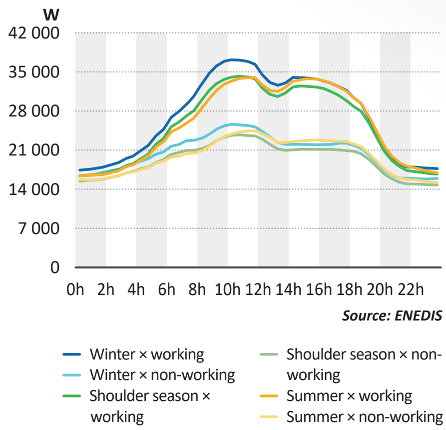
60,000 shop buildings in France >1,000 m²

23% food shops; **78%** specialist shops

17% with a control system

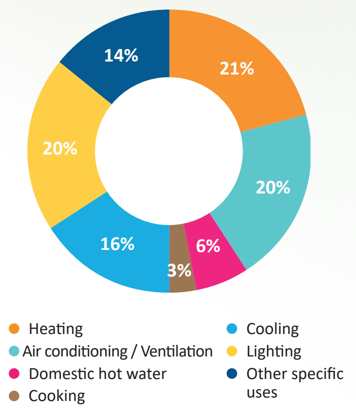
150 million m²

Median load curve for shops by season and type of day in 2023, at hourly intervals



Source: ENEDIS

Breakdown of annual consumption by use



How can you optimise power consumption in your building?

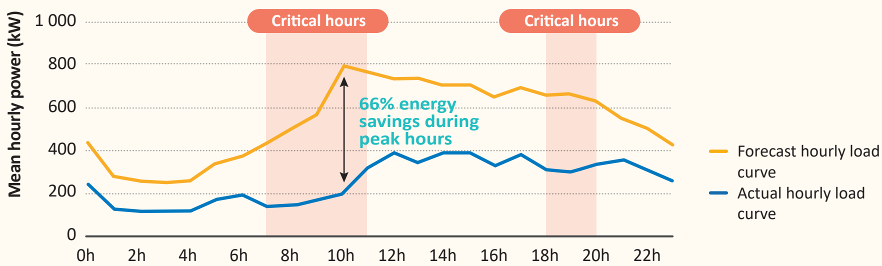
Uses in my building	Can be deferred	Can be modulated	Systematically *Depending on the tariffs set for different times of the day (peak/off-peak tariffs, etc.)*	Occasionally *At the supplier's request for a few hours a day over one or more days*	On request *From a third party for short periods (e.g. demand response offers)*
Heating	✓	✓	✓	✓	✓
Air conditioning, freezing	✓		✓	✓	✓
Ventilation	✓	✓	✓	✓	✓
Domestic hot water	✓		✓	✓	✓
EVCI	✓	✓	✓	✓	✓
Lighting, Catering	✓				✓

How does it work in practice?

Implemented actions:

1. Setpoint reduced to 19°C
2. Doors closed automatically in winter
3. Hot air curtain turned off
4. Lighting dimmed and switched off using BACS

CUBE FLEX FEEDBACK: Créteil Soleil shopping centre
96,000 m² - 220 shops

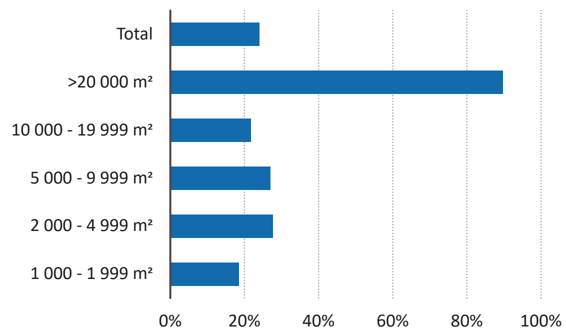


Penetration of BACS in 2024: 17% of sites and 30% of surface area

Operating mode

- Large retail chains have **staff** on site able to manage the main equipment, i.e. refrigeration systems and air handling units (AHUs).
- It is these same large retailers that will **implement hypervisor software solutions** to harmonise technical management and consolidate the demand response potential.
- For retail chains with smaller sites, the move towards **supervised BACS is becoming more widespread.**
- The business model for logistics sites encourages owners to invest in BACS, while their **occupants are responsible for operating them.**

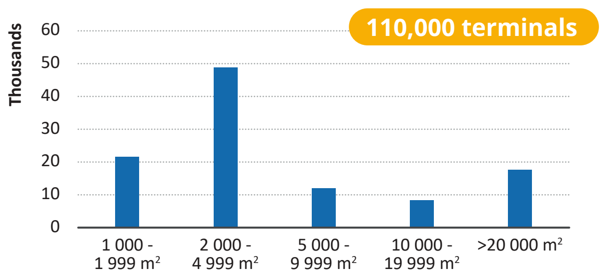
BACS penetration as % of sites



Current contribution to flexibility

- Operators of large retail chains and shopping centres signed **agreements with aggregators very early on.** Delaying the start of heating and fine-tuning the management of air handling units (AHUs) are already bringing **economic benefits** to operators, who can take advantage of consolidated improvement at national level.
- Flexibility is not necessarily associated with BACS management, as other solutions allow direct control of the targeted equipment.
- The **potential of refrigerated warehouses** has been identified as particularly promising, with this business process being a prime target.
- As EVCI is generally contracted out to third parties with the status of EVCI open to the public, **the flexibility lies with the third party** and not the site operator. The same should apply to renewable energies deployed on retail sites.

Number of EVCI installations



Obstacles

- Few obstacles are shared by the retail sector, which **is inclined to favour control.**
- However, smaller-sized retail chains have **difficulty convincing** site managers to adopt BACS solutions. Penetration is achieved by setting an example, which necessarily takes longer.
- For warehouses that have benefited from a windfall effect from BACS investments, optimal operation requires hypervisor software solutions that overcome the **absence of an on-site operator.** In addition, a significant proportion of the sites would likely be exempt from the BACS decree (no satisfactory rate of return on investment).

Key success factors

- The retail sector is promising, as it benefits from a **combination of needs** (CSR, customer comfort, consumption monitoring) that enable budgetary constraints to be rapidly overcome.
- The levels defined in the NF standard could be adapted to take account of the specific features of heterogeneous retail areas, with unified areas for the core business and ancillary technical areas. This would boost investment in **potentially class A systems.**
- The regulatory uncertainties surrounding the possibility of modulating the operation of air handling units (AHUs) in establishments open to the public could be resolved in order to secure any investments that may need to be made in the context of flexibility.

Source: VERBATIM extract from interviews during the GIMELEC / CODA Strategies study, May-July 2024

Educational buildings

Key figures for the sector

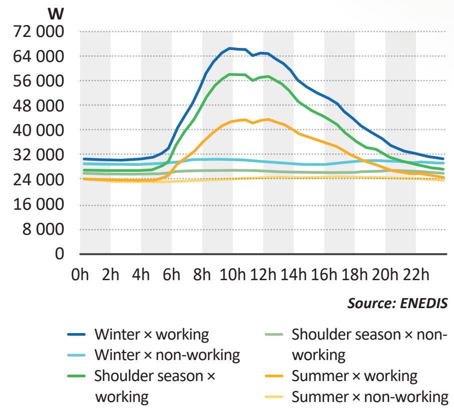
37,000 educational buildings in France >1,000 m²

55% of primary schools
29% of high schools (11-16)
15% of high schools (16-18)

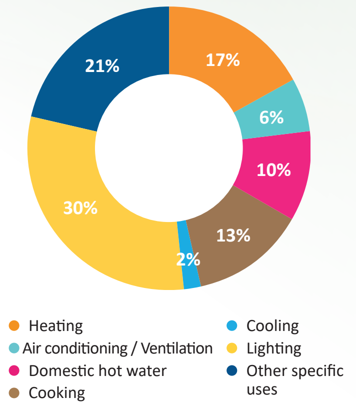
13% with a control system

166 million m²

Median load curve for educational buildings by season and type of day in 2023, at hourly intervals



Breakdown of annual consumption by use



How can you optimise power consumption in your building?

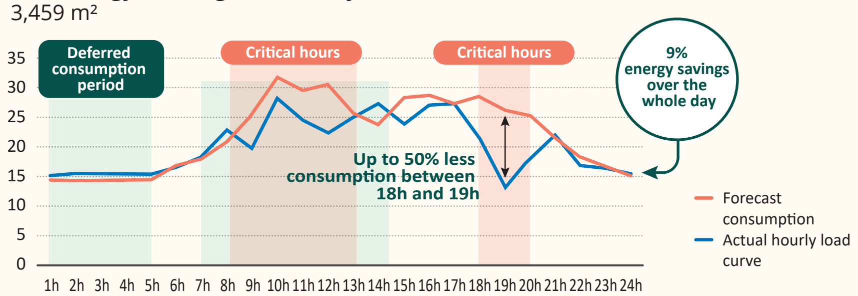
Uses in my building	Can be deferred	Can be modulated	**Systematically** *Depending on the tariffs set for different times of the day (peak/off-peak tariffs, etc.)*	**Occasionally** *At the supplier's request for a few hours a day over one or more days*	**On request** *From a third party for short periods (e.g. demand response offers)*
Heating	✓	✓	✓		
Air conditioning	✓		✓		✓
Ventilation	✓	✓	✓		✓
Domestic hot water	✓		✓	✓	✓
Lighting	✓	✓	✓	✓	✓
Catering	✓				✓

How does it work in practice?

Implemented actions:

1. Relaying of good practice by the building maintenance manager
2. Finer control and regulation of AHUs using building automation
3. Modification of the cooling setpoint temperature (including server rooms)

CUBE FLEX FEEDBACK:
Odontology building – University of Bordeaux
3,459 m²

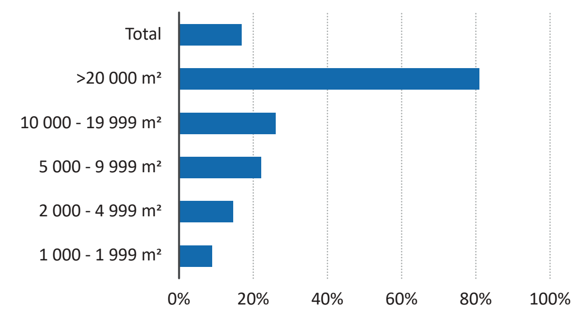


Penetration of BACS in 2024: 13% of sites and 28% of surface area

Operating mode

- Depending on the educational purpose, **the operating structures vary** (municipal technical departments, departmental energy units, dedicated regional departments, on-site teams).
- Use of a **multi-technical operator** is frequent, and it often takes charge of controlling the heating equipment, as part of a BACS approach, but for the time being is not much involved in controlling the other facilities.
- The pressure on financial resources, the limited appeal of jobs offered by the public sector, and the high level of staff turnover **are not conducive to setting up effective long-term control structures.**
- Public incentives (flow economisers, energy saving advisors, etc.) are **interesting levers** but remain underused. Some positions remain unfilled.

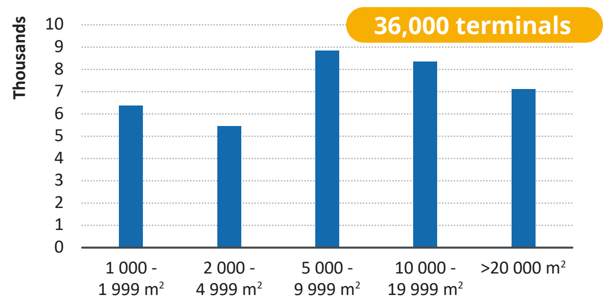
BACS penetration as % of sites



Current contribution to flexibility

- There is considerable potential for **contributing to regular flexibility** (managing intermittency, load reduction in unoccupied premises).
- The predominance of hot water central heating **reduces the potential** for demand-side flexibility.
- The introduction of flexibility measures must take account of **complex occupancy and scheduling arrangements** (making premises available to associations, leisure centres, etc.).
- **Knowledge of the real-time occupancy** of different rooms (in the higher education sector for example) would make it possible to implement flexibility measures that are transparent to users, but this is far from being achieved at this stage.

Number of EVCI installations



Obstacles

- For schools, the **lack of human resources** is an obstacle to the use of control systems, which can generate negative feedback.
- For **primary schools, the lack of a local technical team** limits the potential for control.
- In secondary and higher education, the situation **varies**, with some establishments, departments and regions acting as "pilots", while the majority prefer to wait and see, or are even reluctant to get involved.
- In the most advanced establishments and local authorities, dedicated human resources can be devoted to controlling the systems, but the majority of technical teams and local service providers are still imbued with a "boiler operator" culture, **still unfamiliar with handling BACS.**

Key success factors

- The solutions put in place by local authorities are based on **pooling resources.**
- The involvement of **departmental energy authorities** and the establishment of regional energy departments are thus levers for supporting establishments in their investments and spreading best practice in terms of control.
- **Consolidating consumption and control data** at departmental or regional level can provide facility managers with operational dashboards without any technical prerequisites.
- The **development of energy performance contracts** is another lever that can be applied to overcome the problems of scarcity of technical resources.

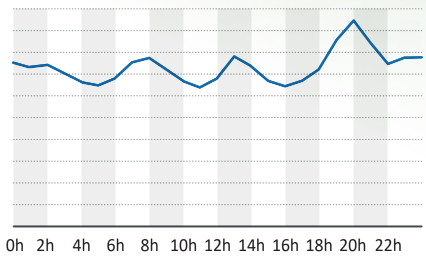
Source: VERBATIM extract from interviews during the GIMELEC / CODA Strategies study, May-July 2024

Residential sector

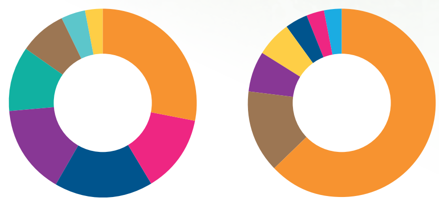
Key figures for the sector

- **37.8 million** homes
- **45%** apartment blocks
- **55%** individual houses

Median load curve (in W) for residential buildings by season and type of day in 2023, at hourly intervals



Breakdown of residential consumption by use



How can you optimise power consumption in your building?

In order to consume less and better, it is possible to adapt the use of certain electrical equipment either by deferring its operation to another time or by modulate its use for a given period, for example by reducing its operating intensity. This is what we call control.

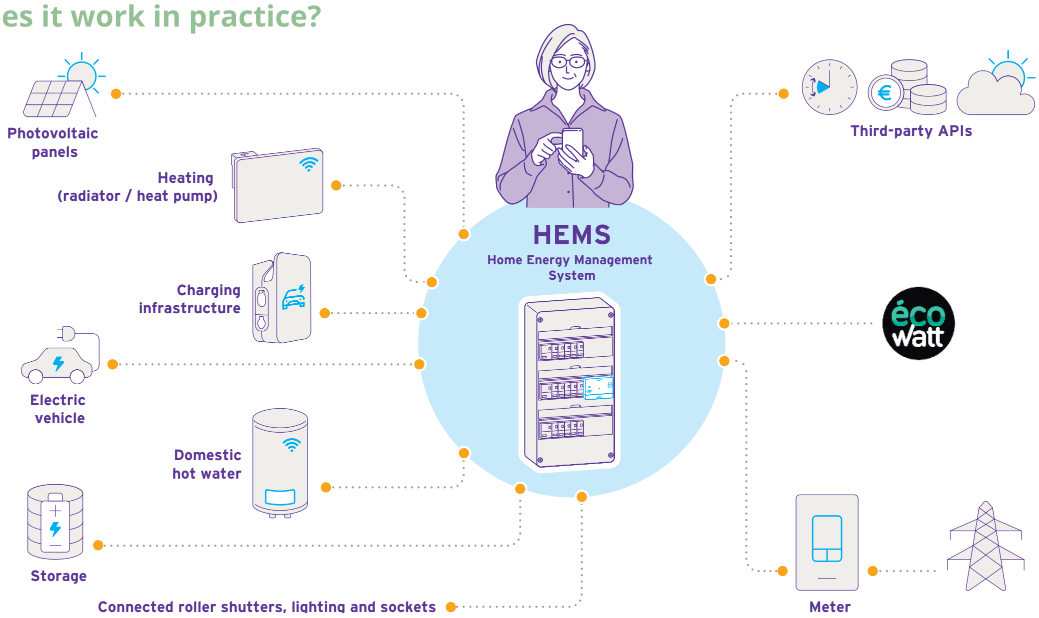
Uses in my building	Can be deferred	Can be modulated	**Systematically** *Depending on the tariffs set for different times of the day (peak/off-peak tariffs, etc.)*	**Occasionally** *At the supplier's request for a few hours a day over one or more days*	**On request** *From a third party for short periods (e.g. demand response offers)*
Control	Through their consumption control and monitoring interface, users give their instructions and enter the information needed for control when this is not automated.				
Heating*		✓	If the home is well insulated, heat a little more when electricity prices are lower and take advantage of this when prices rise. Good habits for energy sobriety: heat room by room and lower the temperature setpoint when away from home	Occasionally, lower/increase the setpoint temperature for a given period, and accept the reduced level of comfort	Automatically override the temperature setpoint for a few tens of minutes
Air conditioning*		✓	If the home is well insulated, cool a little more when electricity prices are lower and take advantage of this when prices rise.		
Household equipment: washing machine, oven	✓		Start your household appliance cycles at the cheapest times of day	Avoid using your equipment during sensitive time slots	
Domestic hot water	✓		Heat the water when electricity is at its cheapest – the water will keep hot in the tank for several hours	Turn the tank off at the most expensive times, even if this means having less hot water	Trigger the disinfection cycle (1 h) at a convenient time for an aggregator
EVCI	✓	✓	Charge your vehicle when electricity is less expensive	Charge in advance, or decide not to charge	

* for electrical equipment: radiators, heat pumps, electric water tanks, thermodynamic hot water tanks, etc.

What consumption control solutions are available to optimise my electricity bill?

	Manual control of the equipment	Single-use centralised manual control	Equipment control system	Automated global control
Energy (kWh)	The occupant sets the required operating mode on the equipment (or a remote system) and can possibly programme a timer and the settings for each room.	With a wall-mounted central control or a mobile application connected to the equipment (integrated or upgraded with a remote system), **control is easier.**	Triggered automatically by the meter signal, the hot water tank or EVCI is activated during off-peak hours, by contactors found on the switchboard in particular.	**The occupant is thus assisted by a smart system that controls the whole home to optimise electricity bills (kWh and kVA) and comfort. The occupant can take back control at any time.**
Subscribed power (3 kVA, 6 kVA, 9 kVA, etc.)	Be careful! There is a risk of exceeding the subscribed power and thus tripping the power supply to the home!		With a load-shedding device, the system can protect itself against the risk of tripping.	**The system optimises consumption so as not to exceed the subscribed power and avoid tripping**

How does it work in practice?



What are the key steps for taking action?

1. First take stock of the situation

I ask to collect my load curve measurements to understand my consumption cycles. I take stock of my equipment and their power consumption level: heating, hot water, electric vehicles. I identify how I can reduce or defer my consumption and whether I'm prepared to change some of my habits, or even my expectations in terms of comfort, over short periods.

2. Find out what contracts are available

I look into the different types of contracts offered by suppliers and aggregators (demand response), in particular those with tariffs that vary according to the time of day, the day of the week and the time of year. I identify opportunities for dynamic flexibility.

3. Get equipped

I get in touch with an electrical fitter to study and install automated global control solutions, to consume less and consume better without having to think about it.

Residential sector

INDIVIDUAL HOUSE

A typical example: how the Smith family can consume less and better

January 2024: Regretting not having taken up the option of connected programming to control their heat pump, the Smith family decide to purchase a connected control system comprising HEMS and connected thermostats for room-by-room temperature management.

January 2026: The Smith family receives their annual electricity bill: the new installation saved more than 15% energy over the year in 2025.

March 2026: Mr Smith has solar panels installed on the roof of his house by a qualified fitter. He activates the function on his HEMS that optimises self-supply. So when there's enough sunshine, HEMS makes sure that the heat pump and electric hot water tank are automatically powered by the solar panels.

June 2026: Mrs Smith is interested in new offers from suppliers with tariffs that according to the time of day. The family then takes out a contract of this type, which reduces the size of the electricity bill. HEMS programmes the operation of the equipment to meet comfort expectations at the best possible cost.

January 2027: The decree of 8 June 2023 stipulates that from 1 January 2027, all homes must be fitted with thermostats in every room. The Smith family doesn't need to do anything, as their home is already compliant.

September 2027: The family buys an electric vehicle and installs a charging terminal at home. HEMS optimises vehicle charging by programming it for off-peak hours, while ensuring that the power consumption of all connected equipment does not exceed the subscribed power.

November 2028: To make the most of the flexibility available to her, Mrs Smith signs a demand response contract with an aggregator. The operator sends commands which are checked and then executed by HEMS to reduce or defer power consumption for short periods. In return, the aggregator remunerates the Smiths.

APARTMENT

A typical example: how the Brown family can consume less and better

January 2025: The Brown family move into their new apartment. The building has just been renovated and benefits from good thermal insulation. The home is heated by electric radiators. They install HEMS and a connected thermostat in every room. HEMS automatically controls energy use (electric heating, water heater) to optimise energy bills. It takes into account the presence of the occupants, the weather and the level of comfort expected during the day and night. It automatically regulates the temperature in each room, reducing it at night and limiting heating depending on how long the occupants are away.

March 2026: The family subscribes to an electricity supplier's peak/off-peak offer, which, combined with efficient control, considerably reduces the electricity bill. HEMS programmes activation of the hot water tank, taking into account not only the hourly tariffs but also the Brown family's habits. As the home is well insulated, HEMS increases the temperature setpoint during the last off-peak hour, thus reducing the need for heating during peak hours.

January 2027: The decree of 8 June 2023 stipulates that from 1 January 2027, all homes must be fitted with thermostats in every room. The Brown family doesn't need to do anything, as their home is already compliant.

May 2028: The home already has electric roller shutters. The Browns have connected controls installed for their roller shutters, which can be controlled by HEMS. Through use of a sun sensor, the shutters open automatically in winter when the sun is shining, and close at night to keep the home warm.