

French Winter Adequacy Outlook 2016-2017



Analysis – November 2016

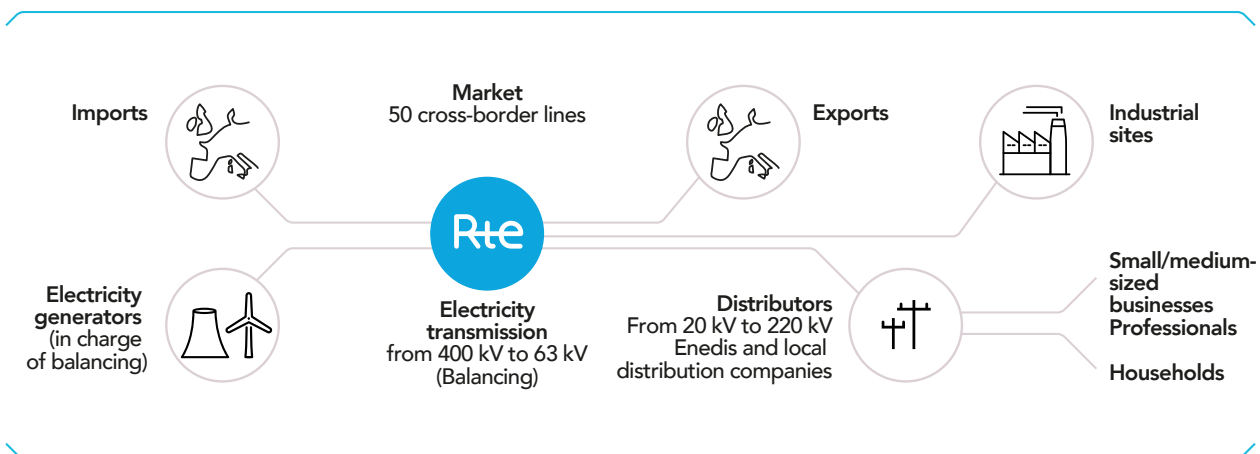


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A WINTER OF HEIGHTENED VIGILANCE

- ✓ More challenges to the electricity supply than in previous winters.
- ✓ Historically low availability across the nuclear fleet.
- ✓ Greater emphasis on renewable energy, consumption curtailment, energy savings and imports.
- ✓ Guaranteed electricity supplies in normal winter conditions.
- ✓ Challenges to the supply in the event of cold snaps.
- ✓ Exceptional solutions implemented by RTE to limit the risk of power cuts in the event of an intense and sustained cold spell or deterioration in generating capacity.



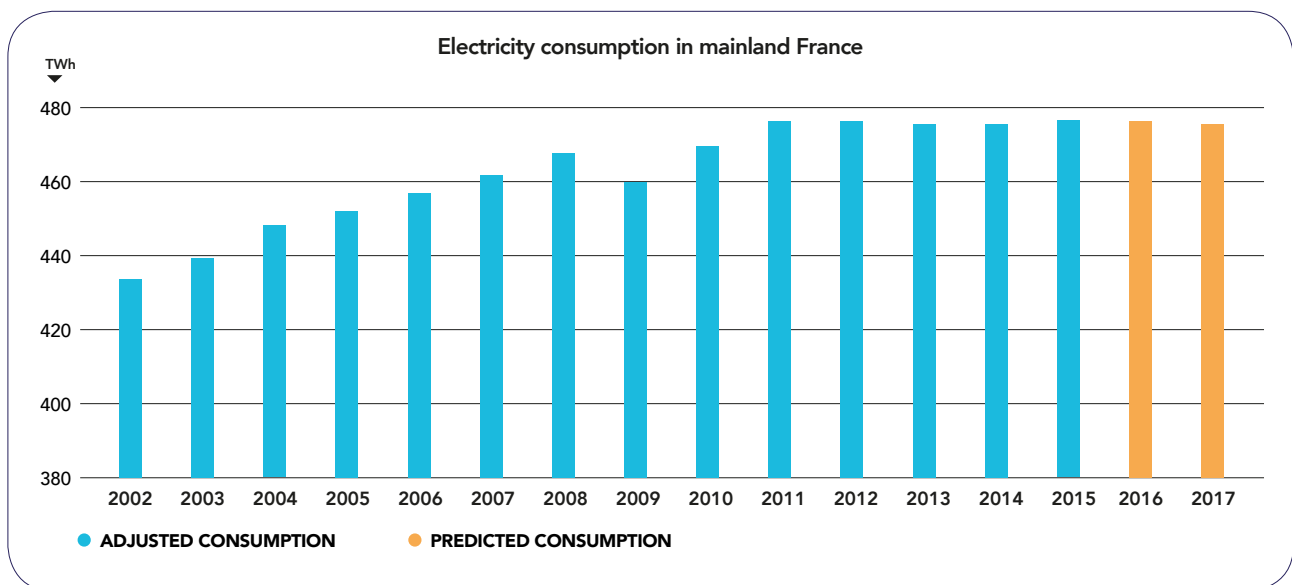
Regulated by
The Commission For Energy Regulation

1. Demand is stable but highly dependent on outdoor temperatures

The energy outlook for winter 2016-2017 has remained stable compared to recent years, with electricity consumption estimated at 221.5 TWh between mid-November and end March, given average temperatures.

However, wintertime demand for electricity is very much dependent on weather conditions.

a. Changes in electricity demand throughout winter



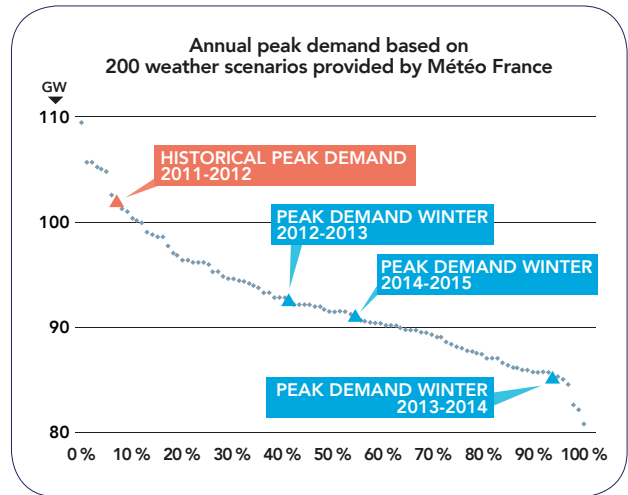
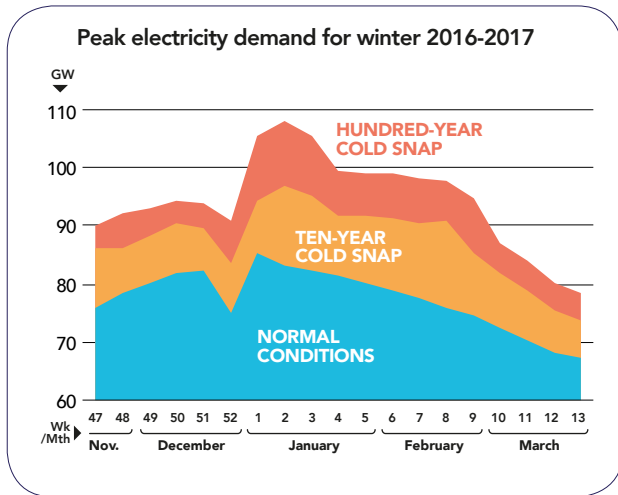
The pattern of French electricity consumption varies significantly throughout the season, some months being colder than others. If weather conditions remain normal for the season, peak demand will reach 85 GW in January, before dropping off gradually during the rest of the winter period and reaching 67 GW at the end of March. The 5 to 9 GW drop in demand during the last two weeks of December reflects the slowdown in economic activity linked to school and national holidays.

As the graph above shows, electricity consumption in mainland France has stabilised since 2011, after a decade of growth.

Therefore, as indicated in the analyses published in RTE's Generation Adequacy Report, the electricity demand forecast for 2017 was slightly downgraded to 478 TWh (-0.2%). Work continues to improve the energy efficiency of buildings and equipment, driven by the European energy policies that have been put in place, particularly the European directives on eco-design (setting out requirements for the energy efficiency of a wide range of products) and on energy labelling (providing consumers with information on the energy consumption ratings of products).

These energy efficiency measures have helped stabilise the growth in household consumption, despite an increase in housing stock. These energy performance measures will produce a 2 TWh saving every winter between now and 2020 (equivalent to the winter electricity consumption of 100,000 homes.)

b. Electricity demand impacted by outdoor temperatures



Aside from being subject to seasonal fluctuations, demand also varies considerably according to outdoor temperatures.

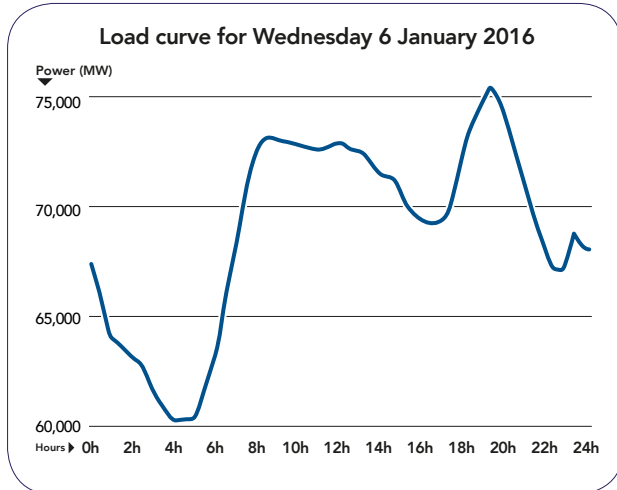
RTE estimates that every one degree centigrade drop nationwide causes demand to increase by up to 2,400 MW, equivalent to the amount of power consumed in central Paris.

This sensitivity to cold weather is very relevant in France due to the high use of electric domestic heating – despite a declining trend noted in recent years, as building energy performance regulations RT2012 have favoured the use of gas heating in new homes. France accounts for half of Europe’s demand-sensitivity to cold temperatures. Consequently, cold spells have a particularly significant impact on the French electricity system.

To arrive at the best possible estimate of winter-related risks, RTE uses different weather scenarios supplied by Météo-France, which reflect existing weather conditions and provide a representative picture of the contingencies. Based on these weather scenarios, winter peak demand could vary between 81 and 109 GW, as demonstrated in the graph above, depicting peak electricity demand for winter 2016-2017.

The historically high peak demand of 8 February 2012 - which reached 102,1 GW during an intense cold spell in France, despite the release of 2 GW through consumption curtailment – represents a level of demand that is only reached once every 20 years. In contrast, electricity demand during the winter of 2015-2016, which was very mild, reached a modest peak of 88,6 GW.

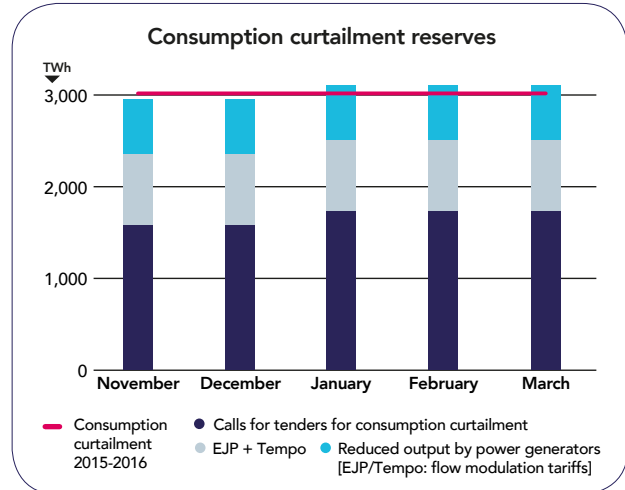
c. Two periods of high daily consumption



Daily consumption of electricity is characterised by two peaks in demand: a surge between 8am and 1pm, and an evening peak at 7pm.

Consumption during the morning period is lower than during the 7pm evening demand peak (2,000 MW less, on average, in wintertime) but stays high for close to five consecutive hours, whereas the evening peak only lasts a couple of hours. RTE therefore ensures that it has more available capacity during this interval (generation, consumption curtailment by customers, etc.) to deal with any contingencies.

d. A stable volume of consumption curtailment



In terms of the supply-offer balance, increasing generation is equivalent to reducing demand. Consumption levels can be lowered through voluntary curtailment, as part of the balancing mechanism.

Consumption curtailment involves industrial customers and individuals willingly and temporarily reducing their electricity consumption. In other words, consumers interrupt some electricity usage for a specified timeframe by modulating their planned consumption, thus contributing to the security of supply.

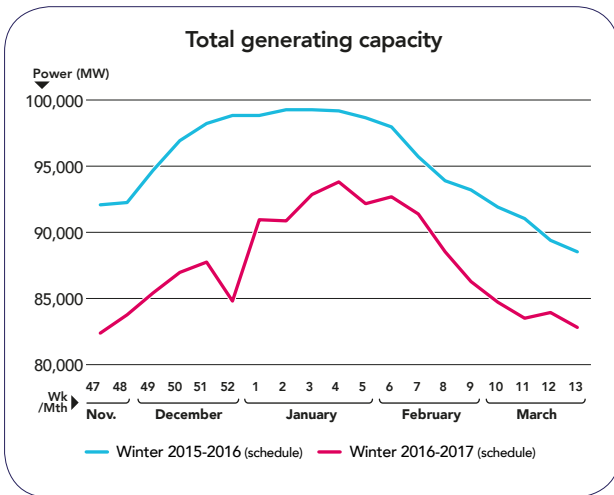
The different categories of consumption curtailment reserves have remained stable compared to the previous winter:

- ▶ Historical tariff-based reserves - stable after a marked drop on 1 January 2016;
- ▶ Invitations to tender for 2017 reserves - these have produced a stock of consumption curtailment offers that can be activated as from 1 January 2017 and is comparable to that of the previous winter;
- ▶ Consumption curtailment reserves excluding regulated tariffs and calls for load shedding tenders - these are based on bilateral contracts between consumers and suppliers.

2. An electricity supply in steep decline this winter

In light of the latest information from the different electricity generators, delivered on 7 November 2016, generating capacity will decline substantially this winter. Average capacity for the period will be 11,300 MW lower in December, compared to the previous winter.

This information is available to the public on the RTE website: <https://clients.rte-france.com/lang/fr/visiteurs/vie/prod/indisponibilites.jsp>

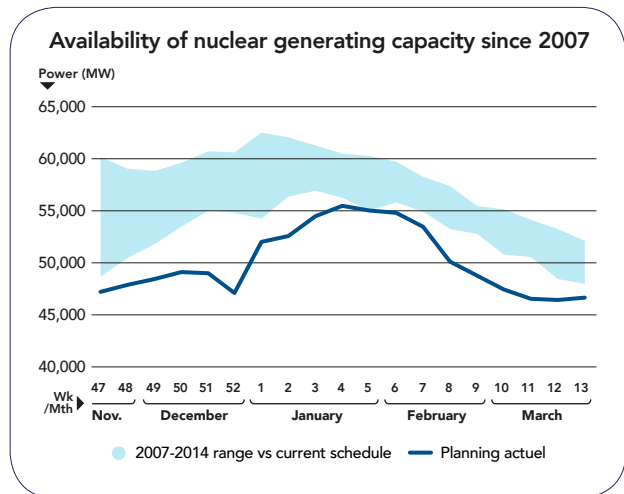


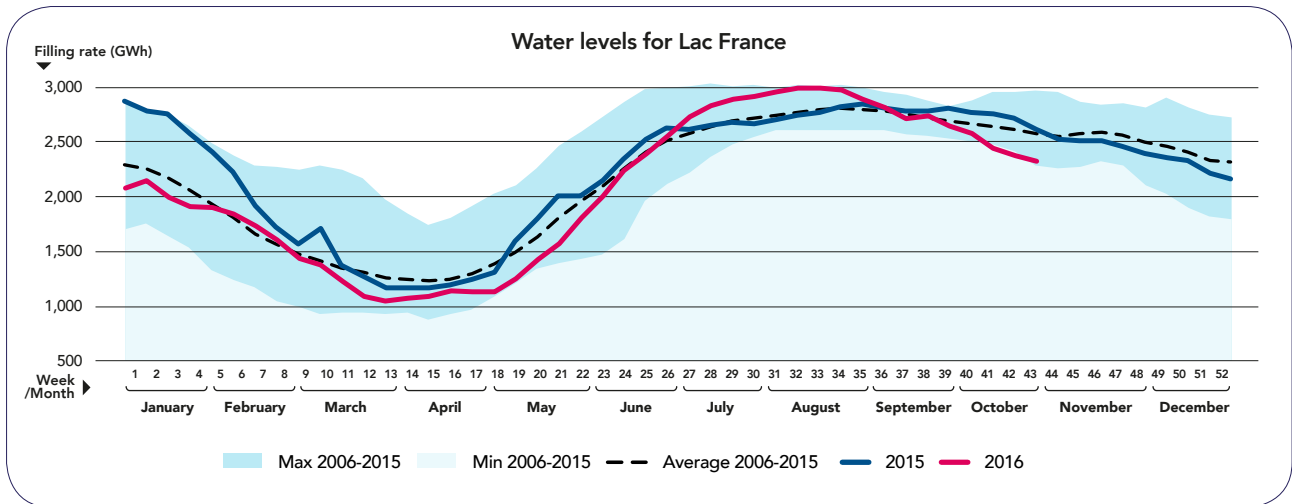
	Nuclear	-10,000 MW	↘
	Fossil-fuel (excl. fuel oil)	-1,200 MW	↘
	Fuel oil	=	→
	Hydropower	=	→
	Wind	+300 MW	↗
	Photovoltaic	+300 MW	↗
	Other energy sources	-700 MW	↘
	Consumption curtailment	=	→
TOTAL		-11,300 MW	↘

a. Nuclear power supply at a record low

The low availability of nuclear capacity is due to the closure of several reactors in the depth of winter. The forecasted availability of the generating nuclear fleet is therefore at a record low. With the equivalent of 9 nuclear reactors unavailable this winter, on average, this represents the lowest level of availability in the past 10 years.

Based on the information supplied by the operator on 7 November 2016, a total of between 4 and 13 nuclear reactors will be shut down during this winter - 13 in December 2016 and 9 at the beginning of January 2017. These shutdowns include maintenance outages that have been exceptionally extended by the operator, and further shutdowns scheduled by EDF in response to a request made by the regulator (Autorité de Sûreté du Nucléaire) on 18 October.





b. Shutdown of fossil-fired plants with a loss of 1,200 MW of capacity

The shutdown of thermal plants with a total power capacity of 1,200 MW, and the placement of two 600 MW plants in so-called ‘guaranteed long shutdown’ (also called mothballed), is partly compensated by the return to service of a 600 MW coal-fired plant and the commissioning of a 600 150 MW biomass plant.

c. Reservoir stocks at their lowest

‘Lac France’ represents water stocks in France as an aggregate average filling rate of all the country’s reservoirs, as though they were a single reservoir. Despite being at a 10-year high mid-August, by mid-October it had dropped to its lowest 10-year average for the season.

This reduces dispatchable capacity this winter, even if the forthcoming rainfall may influence the available electricity supply. In recognition of this, RTE uses historical scenarios of variations in reservoir stocks.

d. Growth in wind and solar power underpinning security of supply

With 1,900 MW of additional capacity compared to the winter of 2015/2016, the wind and photovoltaic fleets are contributing more heavily to meeting electricity needs. To take account of the intermittent generation from these generating fleets, RTE uses weather scenarios provided by Météo-France that simultaneously combine possible variations in temperatures, wind speeds and sunlight.

Average availability of wind-generated power depends significantly on weather conditions, causing the power supplied to vary widely. The average ratio between actual electricity output and maximum installed capacity is estimated to be 30% for the winter period.

In wintertime, photovoltaic generation is better able to contribute to the morning period than the evening demand peak, with an average contribution ratio of 40% at 1pm.

3. An analysis of the French market in a wider European context



a. A power system that optimises cross-border transmission networks

As the European electricity system is so highly interconnected, the supply-demand balance needs to be analysed not only at country level, but also at a European level. Indeed, the ability to pool power supplies thanks to interconnected electrical networks constitutes a key advantage in meeting demand on a larger-than-national scale, in so far as the French grid has not yet reached its maximum import capacity.

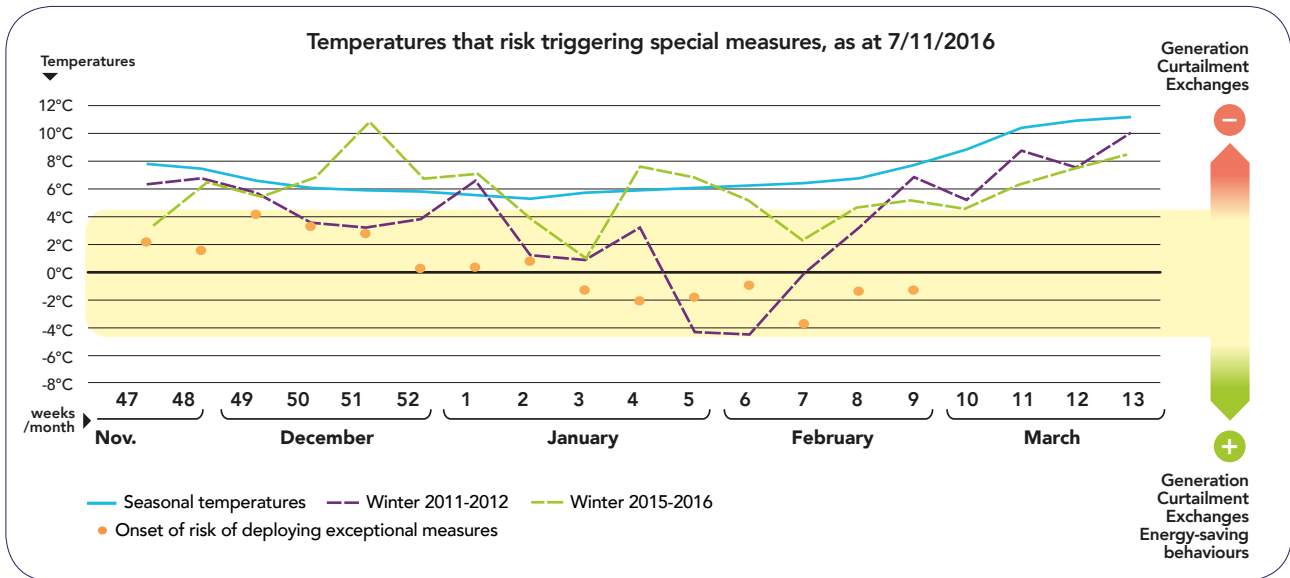
In addition to RTE's existing analyses encompassing 12 Western European countries, ENTSO-E will publish its Winter Outlook Report at the end of November, which will set out the conditions for available generation capacity in Europe and the balance between electricity supply and demand.

b. The highly positive contribution of interconnections to security of supply

For this winter, France's technical capability to import electricity has been established at 12,2 GW, that is, a 30% increase compared to winter 2015/2106. Such an import capability has never yet been seen, and should be enabled by the now fully available direct current line connection with Spain, and by the Flow Based mechanism for optimising cross-border electricity exchange capacities, now in its second year in operation. Furthermore, enhanced coordination of Italian Northern Borders capacity, which will come into effect on 1 January 2017, will also contribute to optimising import capability.

Simulations conducted by RTE incorporate a level of generation availability abroad that would allow an average level of imports of between 7,000 and 11,000 MW in the event of an extended cold spell.

4. Guaranteed supplies, barring outdoor temperatures 3°C below the seasonal norm in early December



To estimate the risk of failures in the supply of electricity, RTE examines the impact of a significant number of combinations of contingencies in generation and consumption, and computes probabilistic indicators.

Based on the information provided by electricity generators on 4 November 2016, RTE has worked closely with all relevant stakeholders (energy producers, market players) to predict and analyse possible scenarios and high-risk periods in order to implement all the available mechanisms needed to guarantee the security of the electricity system and safeguard communication with the French population.

Control of these high-risk periods is illustrated above by deviations from normal seasonal temperatures (mainland France). In the event of an intense and long-lasting cold spell, electricity consumption would increase, thereby reducing the forecasted safety margins needed to cover any technical contingencies that may be experienced by available generating facilities.

The graph above depicts, for every week of the winter period, the gap between the normal temperature (blue curve) and the trigger-temperature at which RTE may consider deployment of its so-called exceptional measures to maintain the supply-demand balance on the French electricity system (orange dots).

Consequently, according to the availability scenario supplied by electricity generators, weeks 49 to 51 appear the least resilient to a cold spell, thus highlighting that the risk of mobilising exceptional measures arises once temperatures drop 3°C below the seasonal norm for mainland France. During weeks 5 and 6, this tipping point appears at temperatures above those observed during the cold snap of February 2012 - such temperatures can be expected to occur on average once every 20 years in wintertime (purple dotted curve).

If the supply-demand balance comes under significant strain across continental France, and if energy suppliers have used all possible means at their disposal, RTE will, if necessary, deploy exceptional means and contingency measures. These measures include the balancing mechanism - whereby major industrial consumers voluntarily forgo their consumption; a 5% voltage reduction on the distribution networks; or, as a last resort, load-shedding to maintain an electricity supply to as many customers as possible.

Increased demand reduces the safety margins of the electricity system. As a result, the actions each of us take to control or reduce consumption, particularly during the morning hours and the evening peak period, contribute to reducing potential imbalances between supply and demand, and thus improve the security of supply to the country as a whole.



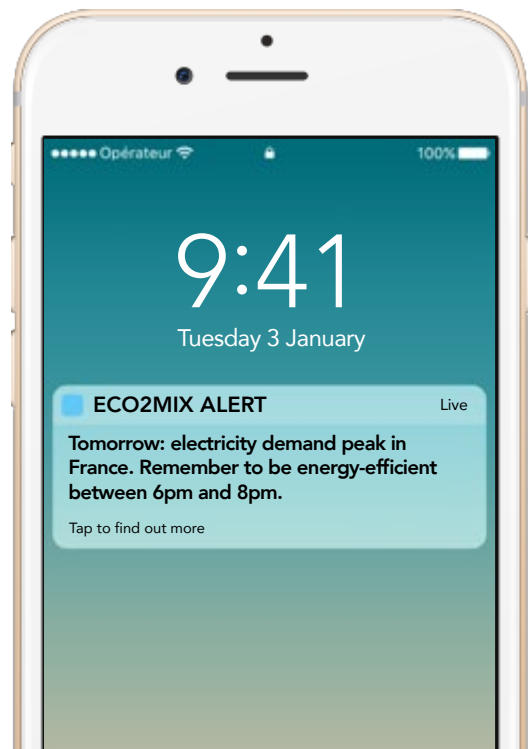
ECO2MIX ALERT:

COMMUNITIES WORKING TOGETHER TO KEEP THE COUNTRY'S ENERGY CONSUMPTION TO A MINIMUM

RTE lancera le 5 décembre le nouveau dispositif « Alerte Eco2mix » sur l'application Eco2mix (smartphones, tablettes, PC et MAC)

Orange and red alerts are issued a day ahead, depending on the pressures on the power network, encouraging consumers to cut their energy use by taking simple measures:

- ▶ Running appliances (washing machines, tumble dryers, dishwashers) during off-peak periods
- ▶ Lowering room temperature settings by 1 or 2 degrees centigrade
- ▶ Switching off computers (and screens) at the end of the day
- ▶ Limiting the number of lights that are switched on in rooms and switching off lights in unoccupied rooms
- ▶ Switching off all devices that are on standby
- ▶ ...



5. A real-time mechanism for balancing supply and demand

RTE calls on a balancing mechanism to manage any contingencies affecting either consumption or generation.

Through the mechanism, RTE can call for tenders so as to guarantee a supply-demand balance at all times, and restore the safety margins needed to operate the electricity system.

Since its launch in April 2003, the balancing mechanism – whose rules are approved by the Commission for Energy Regulation – has proved to be effective. In accordance with legal requirements, any available power that can be supplied by technically operational generating facilities, and that is not being used by these facilities to meet their own needs, must be made available to RTE via the balancing mechanism.

Additionally, since 2003, RTE has made it possible for consumers to use the balancing mechanism to volunteer offers for consumption curtailment on their sites. This approach has now been made permanent by the law on energy transition to green growth.

Lastly, the mechanism that is made available in France is open to balancing offers from bordering countries (Switzerland, Germany, the United Kingdom and Spain).

However, it is important to emphasise that these reserves are designed to address contingencies that occur in real time or close to real-time. So the balancing mechanism – providing a stock of offers to establish the operating reserves needed to deal with short-term generation or consumption contingencies – is not intended to address imbalances within the scope of responsibility of commercial players.

Aside from the mechanism used by RTE for real-time balancing of supply and demand, suppliers of electricity have portfolios of reserves for consumption curtailment, including tariff-based reserves.

6. Management of periods where the supply-demand balance is under strain

Periods where the supply-demand balance is under strain are characterised by a drop in safety margins to below the required minimum. Once suppliers have called in all offers available on the French and European markets, French suppliers can invoke additional consumption curtailment offers from their portfolios of customers. At this stage, only the consumption curtailment reserves disclosed by suppliers are taken into account by RTE, along with the reserves gathered from the call for tenders. Furthermore, generating facilities based in France can also adjust the maintenance schedules of their generating units to increase availability wherever possible.

Lastly, before deploying its exceptional measures, RTE draws on the following arrangements: it calls in the offers of curtailment made by consumers in France and abroad for load balancing purposes, and activates the emergency contracts established with other European grid operators.

Should these preventive measures prove inadequate, RTE will notify the public authorities of the risk of supply disruptions, and take action in real time by deploying the exceptional operating measures designed to limit the impact on the electricity system, which ultimately include load shedding.

7. Close monitoring of electricity supplies to the regions of Brittany and Provence-Alpes-Côte d'Azur

To overcome historical weaknesses in the electricity supply to the regions of Brittany and Provence-Alpes-Côte d'Azur (PACA), RTE has worked to set up 'safety nets' to sustainably upgrade the security of supply to these two regions.

The electricity network's safety net for the PACA region was inaugurated on 21 April 2015, while Brittany's network will be secured by 2017.

However, the specificities of the forecast for this winter – marked by a risk of reduced availability of the generating plants underpinning security of supply to these two regions – has led RTE to seek additional measures to secure these regions in the event of a lasting and intense cold spell.

RTE has therefore launched a campaign to identify further consumption curtailment opportunities in these 2 regions, which could be actioned in case of congestion on the transmission grids supplying the regions.

These consumption curtailment agreements could be formalised by RTE in contracts that would be valid from 1 January 2017 and in force throughout the winter.

These consumption curtailment reserves would be deployed first, before implementation of the exceptional measures established for the area, such as the 5% voltage drop on the distribution networks.

In the meantime, RTE continues its efforts to improve demand side management through the Ecowatt eco-citizen initiative aimed at encouraging consumers to moderate their electricity consumption during the winter months. This initiative relies on electricity system status forecasts, one for each of the two regions, drawn up a day ahead and comprising two alert levels (orange and red) reflecting current conditions.

ÉcoWatt Bretagne
Le bon geste énergie

58,200 EcoW'acteurs (participants)
+3,7% compared to the previous season

ÉcoWatt PACA
Le bon geste énergie

31 200 EcoW'acteurs (participants)
+7% compared to the previous season



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