Energy-saving behaviour in energy-intensive industries in 2022

The economic recovery following the health crisis, along with the war in Ukraine, have resulted in strong tensions in the European energy markets. Although not all French companies were immediately affected by this surge in energy prices, they were encouraged to reduce their energy consumption to protect themselves from possible shortages.

*With regard specifically to electricity, from monthly data on electricity withdrawal by almost 500 energy-intensive companies connected directly to the Electricity Transmission Network (*Réseau de Transport d'Électricité - *RTE), energy-saving behaviours could be identified in the course of H2 2022. Electricity consumption by these businesses would seem to have fallen back in December 2022 by about 22% year-on-year.*

By studying the sub-sample of around 200 companies which also appear in INSEE's business tendency survey, the electricity consumption of each company could be measured against change in its economic activity, as reported in the survey. This microeconometric analysis suggests that half of the decline in electricity consumption (i.e. about 11 points) would seem to represent energy-saving behaviour by the companies considered, i.e. a drop in electricity consumption independently of any change in their activity.[1] The other half of this downturn in electricity consumption can probably be explained by a drop in production by these companies. However, at a more aggregated level, production indices in the corresponding energy-intensive branches would appear to suggest a more moderate drop in activity, which may reflect a selection bias in the sample used for the microeconometric analysis: the activity of companies connected directly to the RTE network did indeed seem to have deteriorated more than activity in their sector over the period studied.

Due to the qualitative nature of the measurement of activity in the business tendency surveys, the estimate of energy-saving behaviours remains somewhat imprecise. These results also encourage us to look at the determinants of energy-saving by these energy-intensive industrial companies. Changes in energy-saving behaviour at the end of 2022 would seem to be more apparent in companies that, in previous years, had improved their energy efficiency only moderately or not at all. These companies would thus have potentially more useful room for manoeuvre than those companies that had already achieved a certain degree of energy efficiency.

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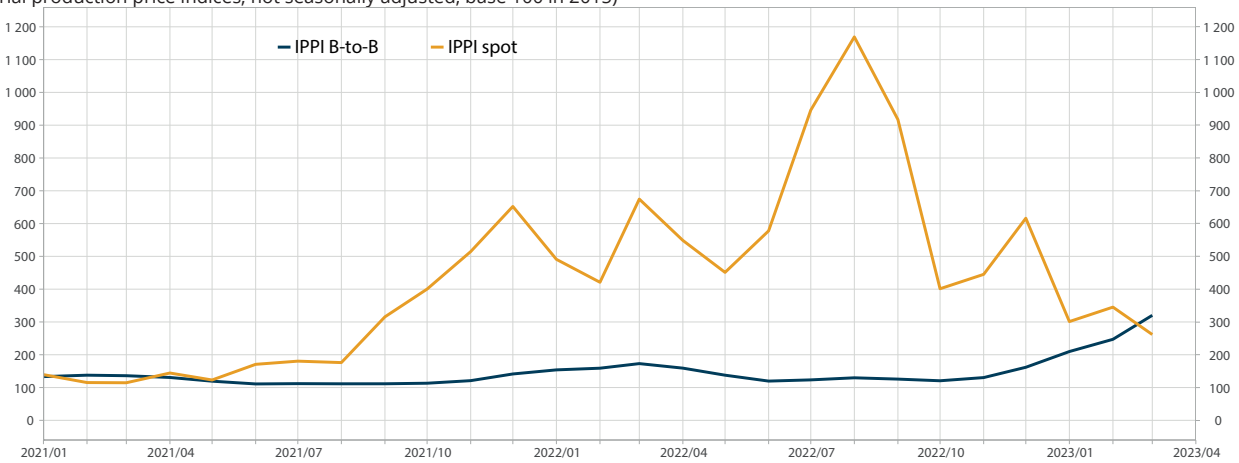
The increase in the market price of electricity is only passed on later to the price of electricity actually paid by companies

From summer 2021 and until mid-2022, the price of electricity on the European market increased sharply (►**Figure 1**): in addition to the vigorous upswing in demand once European health restrictions were lifted, the supply of natural gas from Russia was reduced. Thus the market price of electricity (EPEX) increased 8-fold between Q1 2021 and August 2022. However, the increase in the Producer Price Index in industry for electricity sold to companies was much lower.

1 In this study, we use the terms "energy-saving behaviour" and "energy efficiency" interchangeably, since the method used here is unable to differentiate between them. This is a slight inaccuracy, since energy-saving implies, unlike efficiency, a loss of "utility": for example, turning down the heating in offices reduces energy consumption with no impact on production, but it can affect employee comfort.

►1. Price of electricity exchanged on the markets and sold to companies in France

(industrial production price indices, not seasonally adjusted, base 100 in 2015)



Last point: March 2023.
Note: IPPI spot designates the industrial production price index for electricity sold wholesale at the spot price. The IPPI B-to-B for electricity designates the industrial production price index for electricity sold to companies that have signed a contract for power greater than or equal to 36 kVA.
How to read it: in March 2023, the production price index for electricity sold on the European market stood at 262 points, whereas the index corresponding to electricity sold to French companies was 320 points.
Source: INSEE, INSEE calculations.

In fact, only a minority of businesses, including industrial companies, pay the European market price for their electricity (►**Bjai and al., 2022**) ; the rest benefit from a price indexed to the regulated tariff, with price variations limited by the introduction of a tariff shield, or they are subject to fixed-price contracts which are reassessed at regular intervals. Almost 60% of industry is on a fixed-term electricity contract over a contractual period. While the inertia associated with his type of contract initially "protects" companies from a rise in the market price of electricity, this effect is gradually reversed: contracts renewed in 2022 remain indexed to a very high price, while at the same time, the market price of electricity has been relatively relaxed since autumn 2022. Thus in March 2023 the index price of electricity actually paid by French companies was higher than that of the European market.

This increase in electricity prices, combined with the supply chain difficulties that appeared at the start of 2021, hampered production in industrial companies. Thus, in energy-intensive branches such as metallurgy or the paper and cardboard industry, the industrial production index fell by more than 5% year-on-year in H2 2022.

Almost 85% of the reduction in electricity withdrawal is not accounted for by the decline in meso-economic production, suggesting the presence of both composition effects and energy-saving behaviour

In companies where production declined in H2 2022, this decrease was probably accompanied by a reduction in energy consumption associated with the production process, whether of gas or electricity. It is also possible that companies' energy consumption decreased more than would have been expected from their drop in production, suggesting energy-saving behaviours. The question therefore arises of how to identify, in companies' changing energy consumption, what is due solely to changes in their activity and what reflects energy-saving behaviour.

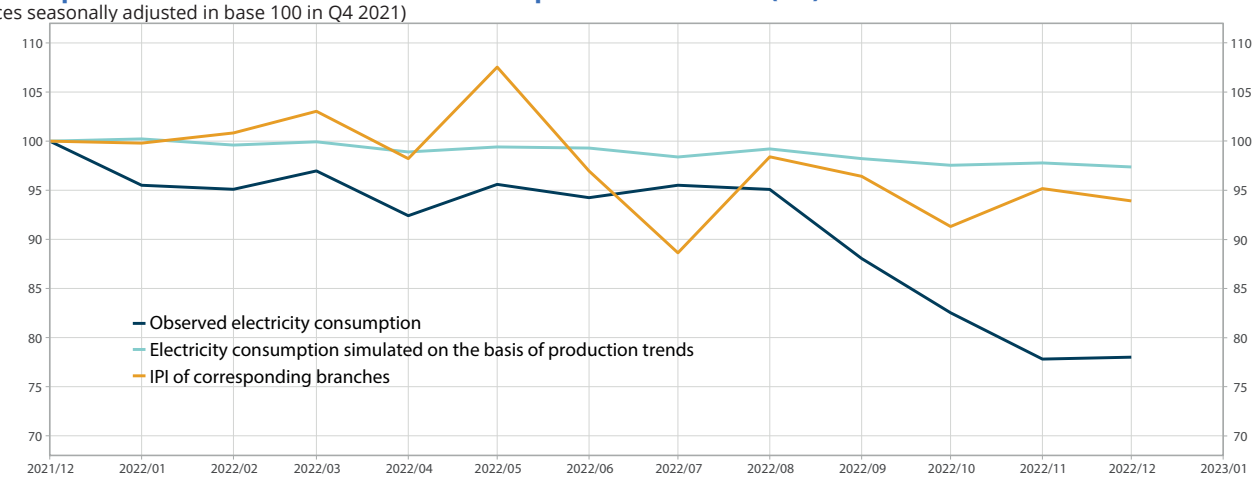
In this Focus, the aim is to provide an answer in the case of electricity consumption, by monitoring electricity withdrawal in about 475 industrial sites connected directly to the RTE (Electricity Transmission Network -*Réseau de Transport d'Électricité*). These withdrawal data have the triple advantage of being monthly, available quickly and concentrated on the most energy-intensive branches of activity. The rest of the analysis is limited to these branches, which are part of the manufacturing industry and represent a large proportion of "other industrial branches"[2]: metallurgy, the chemical industry, the wood, paper and cardboard industry, and the manufacture of non-metallic products, minerals or rubber[3]. For the rest of the economy, RTE withdrawal data do not cover enough companies to produce a satisfactory econometric analysis.

Electricity withdrawal by companies in the energy-intensive branches considered here and connected directly to RTE declined by around 22% between December 2021 and December 2022, i.e. 3.5 times more than production in the

2 Within the meaning of the classification of branches at level A17 of the national quarterly accounts.
3 These branches correspond to divisions 16, 17, 20 and 22 to 25 of NAF.

►2. Electricity consumption observed in energy-intensive companies connected to RTE and electricity consumption simulated with the industrial production index (IPI)

(indices seasonally adjusted in base 100 in Q4 2021)



Last point: December 2022.
Note: electricity consumption resulting from change in production is obtained using an econometric model which, for each branch of activity considered, accounts for variations in electricity consumption by companies in this branch connected to RTE (at division level) through variations in the IPI for this branch (►**Box Method**).
How to read it: in December 2022, the simulated electricity consumption index for companies in electricity-intensive industries and connected to RTE is 97 points, whereas the observed index is 78 points.
Scope: companies connected directly to RTE and belonging to the metallurgy, chemical industry, paper and cardboard industry branches, also the manufacture of non-metallic products, minerals, wood or rubber.
Source: RTE, INSEE, INSEE calculations.

corresponding branches (►Figure 2). This difference increases when electricity withdrawal resulting solely from change in production by the branches considered is simulated, branch by branch (►Box Method). Thus in the energy-intensive branches, about 85% of the decline in electricity withdrawal is not explained by the drop in macroeconomic production. This suggests that during 2022 and especially at the end of the year, electricity consumption declined much more than expected compared to production, thus reflecting possible energy-saving behaviours on the part of the companies considered.

In addition to energy-saving behaviours, this considerable difference between electricity consumption observed and that simulated from change in production in the branches being considered could also be due to the particularly mild weather at the start of winter 2022. This is not included in the model here, but could have been a reason for electricity consumption to be reduced without any particular drop in activity. In its report for winter 2022-2023, RTE (►RTE, 2023) stresses, however, that electricity consumption by industrial companies is not very sensitive to temperature variations.

An alternative explanation, unrelated to energy-saving behaviour, could be that of a substitution effect between electricity and other types of energy, with companies reducing their consumption of electricity and using another type of energy, and without reducing their activity. However, such a substitution effect seems negligible as the prices of the competing energies increased so much: the price of gas in particular increased 6 times more than that of electricity[4].

Finally, a sample selection bias could be a third possible explanation: companies connected to RTE could have experienced greater production losses than the branch as a whole during the period under study.

Microeconomic analysis suggests that in 2022, half of the reduction in electricity withdrawal by companies connected to RTE could be due to energy-saving behaviour

The previous meso-economic analysis highlights probable energy-saving behaviour, but also possible selection biases in the sharp drop in electricity withdrawal observed between the end of 2021 and the end of 2022, in companies in the energy-intensive branches and connected to RTE.

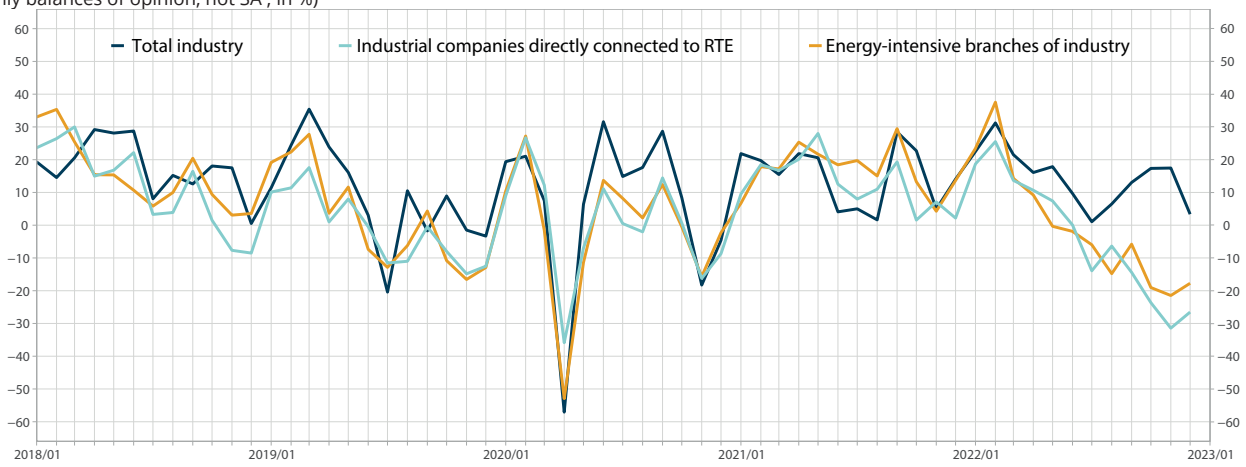
To dissociate energy-saving behaviour from selection biases, the analysis was completed at microeconomic level by matching data for electricity withdrawal by companies connected to RTE and the responses of these same companies in the monthly tendency survey in industry. This survey includes qualitative questions on past and expected change in activity, the idea being to compare, at company level, electricity consumption taken from RTE data, and production, measured qualitatively in the outlook survey. Of the 314 companies connected to RTE, about 183 are questioned in the outlook survey and thus constitute the microeconomic sample considered below.

Comparison of the balances of opinion on expected production in the next 3 months shows that during 2022, companies connected directly to RTE reported a declining production more often than companies in industry as a whole (►Figure 3). In addition, in Q4 2022, the balance of opinion of companies connected directly to RTE appeared to have deteriorated further than that of companies in the energy-intensive branches, which does indeed suggest the presence of composition

4 Calculation based on production prices of gas and electricity sold to French companies that are final consumers, as an annual variation 2022.

►3. Balances of opinion on expected activity, across all industry, in companies connected directly to RTE and in companies in energy-intensive branches

(monthly balances of opinion, not SA ; in %)



Last point: Decembre 2022.
How to read it: in December 2022, the balance of opinion on expected production in companies connected directly to RTE is -27 against +3 for all of industry and -18 for electricity-intensive industries. Here, the energy-intensive sectors include divisions 16 to 18, 20 and 22 to 25 of NAF. This balance is the difference, weighted by turnover of the companies questioned, between the number of companies in a given month reporting an increase in production for the next three months and those reporting a decline in production.
Source: RTE, INSEE business survey, INSEE calculations.

effects in the analysis in the previous section.

The answers to the qualitative questions on past and expected change in production were exploited in order to model, at the level of each company connected to RTE, monthly change in electricity consumption compared to production, in a company-specific effect and in various control variables (►**Box Method**). Thus, the part that remains unexplained at the end of this modelling could be likened to a measure of energy-saving behaviour.

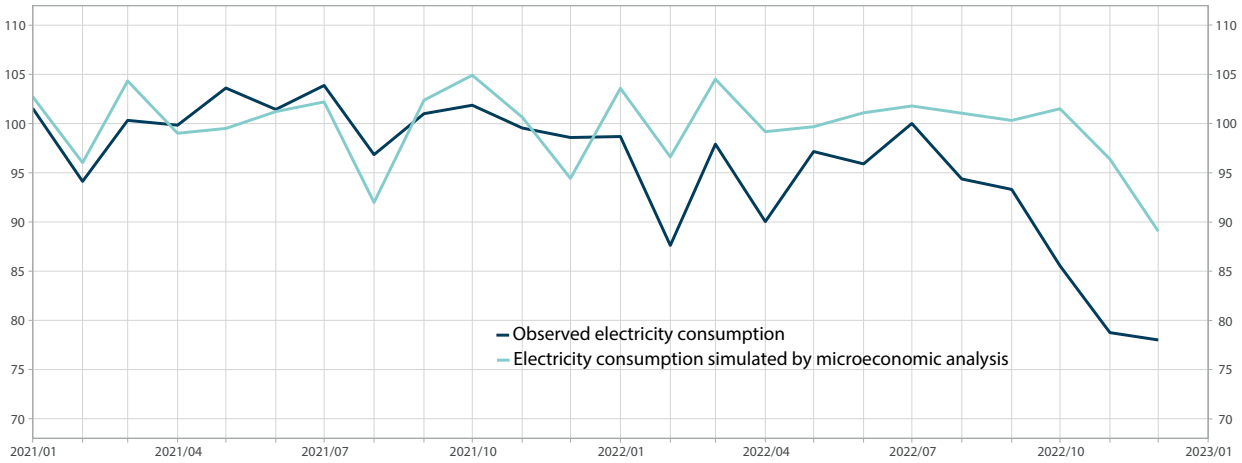
The electricity consumption of companies in the microeconomic sample fell by 22% at the end of Q4 2022 compared to Q4 2021, i.e. an identical decline to that measured at the meso-economic level. According to the microeconomic model, the decline in individual company production would appear to have led to a reduction in electricity consumption of approximately 11 points over this period, all other things being equal (►**Figure 4**). The scale of this drop in consumption is much greater than the estimate obtained *via* the meso-economic approach (around 3 points). The difference is attributable to biases in sample selection, notably the fact that companies connected directly to RTE would appear to have had a greater drop in activity than the drop in the branch as a whole over the entire period studied (►**Figure 3**).

The other half (about 11 points) of the drop in electricity consumption, which is not explained by the microeconomic model, could correspond to energy-saving behaviours and energy efficiency. This quantification has a certain number of limitations and probably represents an upper bound in energy-saving behaviours. However, the changes in activity reported in the outlook surveys are qualitative, which means it is more complicated to apply their predictive ability to a quantitative variable like electricity consumption. A conservative estimate *via* a quantitative measurement of activity but based on a fairly small sample of companies[5] thus suggests a drop in electricity consumption attributable to energy-saving behaviour of around 7 points (i.e. a quarter of the decline) –an effort estimated as less than that of the model presented here.
Variations in the weather are also not modelled; while they do not seem to have any significant impact in the macroeconomic analysis, this result is not necessarily valid at individual level. In addition, the size of the sample for analysis is limited due to the matching between companies connected directly to RTE, of which there are relatively few, and the non-exhaustive data from the tendency surveys in industry. Finally, as highlighted above, the scope of the analysis is very specific, focusing on electrical energy in the most energy-intensive branches, and cannot easily be generalised across the whole of the French economy.

5 For about fifty industrial sites, a match between the individual industrial production index and electricity withdrawals could be exploited using a model similar to the microeconomic assessment but with a quantitative rather than a qualitative activity variable.

►4. Electricity consumption observed in companies connected to RTE and electricity consumption simulated by microeconomic analysis, with production of these companies

(indices not seasonally adjusted, in base 100 in Q4 2021)



Last point: December 2022.
Note: the electricity consumption observed is obtained by aggregating individual data (SIREN level) on withdrawals by companies that are both connected to RTE and questioned in the tendency surveys of industry. The simulated electricity consumption is based on a microeconometric model (►**Box Method**) which simulates the electricity consumption resulting solely from changes in the company's production.
How to read it: in December 2022, the simulated electricity consumption index of industrial companies connected to RTE was 89 whereas the observed index was 78.
Source: RTE, INSEE business survey, INSEE calculations.

Energy-saving behaviours would seem to have been particularly pronounced for companies that had not yet improved their energy efficiency

The demonstration of a significant energy-saving effect at the end of 2022 suggests that, in the past, there was a disparity between the levels of energy efficiency actually achieved by industrial processes and those that are theoretically possible, without loss of production. The economic literature has investigated this disparity, called the "energy efficiency gap", both in its magnitude and its causes (►**Allcott and Greenstone, 2012**) –although these analyses focus more often on consumers than on companies. The main causes of this energy efficiency gap (►**Gerarden and al, 2017**) are assumed to relate to market imperfections, especially information problems concerning possible adaptations of the production process, also cognitive biases (e.g. inattention biases when confronted with low energy prices).

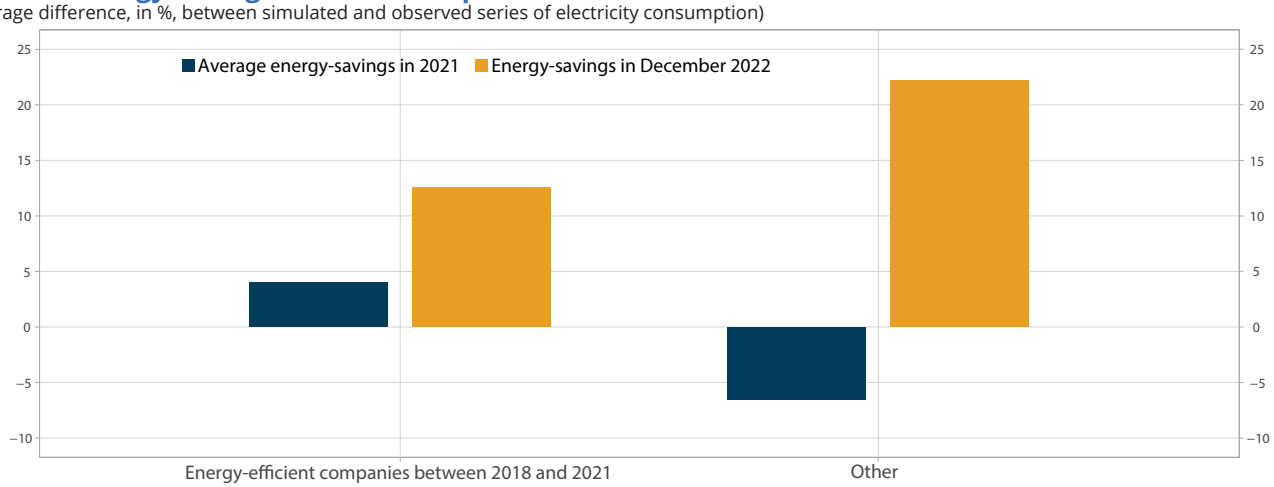
Although it does not provide the reasons for this electricity-saving behaviour observed at the end of 2022, the microeconomic analysis seems to suggest that the companies that have improved their energy efficiency most are the ones that, in recent years (2018-2021), demonstrated least energy-saving behaviour. This conclusion is consistent with the idea that the costs of closing the energy efficiency gap were low at first then increased rapidly (►**Abadie, 2012**).

By combining the microeconomic model presented above with the annual survey on industrial energy consumption (EACEI), an individual measurement of the "energy-saving trend" is constructed for each company over the period 2018-2021 (►**Box Method**). The energy-saving trend shows the companies' tendency to use less energy for its production, over the period 2018-2021. Companies are divided into two groups: those that have demonstrated a particularly strong energy-saving trend over the period 2018-2021, and the others. For each group, it is then possible to assess the extent of their energy-saving behaviour at the end of 2022, in the same way as was done in the previous section on the matched sample. Recent energy-saving behaviour appears to be greater in the group of companies that did not display a significant energy-saving trend between the years 2018-2021: at the end of 2022, their electricity consumption would seem to have dropped by more than 20% (excluding what would have resulted from change in their production) whereas this decline was a little over 10% on average for companies that have shown a marked energy-saving trend in recent years (►**Figure 5**). For the former this energy-saving behaviour at the end of 2022 contrasts with 2021 when their electricity consumption had, on the contrary, increased (by around 6%, excluding trends linked to change in production).

This analysis suggests that energy-saving behaviour at the end of 2022 would seem to have been more pronounced in companies that had not shown a marked trend towards energy-saving in recent years. One possible interpretation is that these companies may have more room for manoeuvre in this area, where additional efforts at energy-saving are more costly for companies that have already tended to improve their energy efficiency. ●

►5. Change in energy-saving behaviour between 2021 and the end of 2022, for companies trending towards energy-saving and other companies

(average difference, in %, between simulated and observed series of electricity consumption)



Note: the separation between the group of companies that improved their energy efficiency between 2018-2021 and other companies is defined in the ►**Box Method**.
How to read it: in 2021, companies that displayed most energy-saving between 2018 and 2021 consumed 4% less electricity than a simulation based on their economic activity; in December 2022, this difference between simulation and observation was 13%.
Source: RTE, INSEE (business survey, EACEI), INSEE calculations.

Methodology

Meso-econometric model of energy-saving behaviour

To monitor companies' electricity consumption, data on monthly electricity withdrawals by the 478 establishments (SIRET level) connected directly to the Electricity Transmission Network (RTE - *Réseau de Transport d'Électricité*) were mobilised for the period 2018-2022. The companies concerned were those connected directly to RTE for high voltages above fifty kilovolts. These energy-intensive companies cannot be said to be representative of companies across the whole of industry, and certainly not for the entire economy.

Consequently, in order to consider companies that were most representative of their branch of activity, the meso-economic analysis is limited to those branches for which the companies connected directly to RTE (SIREN level) represent a significant share of activity in the sector (in terms of turnover or total electricity consumption). To do this, a match is made between companies' annual electricity withdrawals in 2019 (RTE data at SIREN level), companies' tax returns for 2019 (FARE data) and the 2019 survey on energy consumptions in industry (EACEI survey by INSEE). ►**Figure 6** suggests that companies connected to RTE are particularly representative of certain energy-intensive sectors (paper and cardboard industry, chemical industry and metallurgy) and also in the manufacture of transport equipment and coke and refined petroleum (►**Cheptitski and Poulhès, 2021**). The meso-economic analysis is therefore limited to the following energy-intensive "other industrial branches": metallurgy, chemical industry, wood, paper and cardboard industry, and the manufacture of non-metallic mineral products or rubber.[6]

In the energy-intensive branches selected, monthly activity is measured by the industrial production index (IPI) of the branch. For each branch *b* selected, energy-savings in month *t* –written ϵ_{bt} – are estimated as the residual of the linear regression of the variation in electricity consumption *elec_bt* by the companies in branch *b* and connected to RTE on the variation in the IPI of the branch. More formally, the regression takes the following form:

$$\Delta log\left(elec_{bt}\right) = \underset{(0.001)}{0.002} + \beta_b \Delta log\left(IPI_{bt}\right) + \epsilon_{bt} \quad (1)$$

Estimation: 2018-01/2022-02, R^2=0.72

where β_b is a coefficient specific to each branch of activity and equal to 0.64 on average.[7] All model variables are seasonally adjusted. Equation (1) is estimated between January 2018 and February 2022 (before the start of the war in Ukraine).

►6. Sectoral representativeness of companies connected directly to RTE
(share of companies connected directly to RTE in turnover and total electricity consumption of the branch in 2019; in %)

Branch	Percentage of sales	Percentage of electricity consumption
Food products	10	13
Coke and refined petroleum	53	ns
Manufacture of capital goods	2	10
Manufacture of transport equipment	53	52
Other industrial products	18	58
energy-intensives	24	61
excluding energy-intensives	5	11

ns: not significant.
Note: the EACEI survey does not provide information on the coke and refined petroleum sector. Here, the energy-intensive sectors include divisions 16 to 18, 20 and 22 to 25 of NAF.
Source: RTE, INSEE (FARE, EACEI). INSEE calculations.

6 These branches correspond to divisions 16, 17, 20 and 22 to 25 of NAF.
7 This coefficient varies, depending on the branch, between 0.31 and 0.96, and is always significant at the confidence level of 1%.

The approach consists in using the model (1) to construct a "simulated electricity consumption" for the period from February 2022 to January 2023, by adding together the forecasts by branch and assuming ϵ_{bt} to be zero. This simulated consumption can be interpreted as the electricity consumption, for companies in the branch and connected to RTE, that should have occurred, given the change in activity in the branch. The difference between this simulated consumption and the electricity consumption actually observed can then be interpreted as reflecting cumulated energy-saving behaviours over 2022 in response to the energy crisis, with of course all the limitations described in the body of this Focus (weather effects, substitution effects, composition effects).

Microeconomic model of energy-saving behaviour

The meso-economic analysis can be combined with an estimate of energy-saving behaviour at company level. Such an estimate can be used to assess the robustness of the meso-economic results, to remove any selection bias and also to obtain an individual measurement of energy-saving behaviour, which is useful for analysing its determinants.

The aim is to match companies' individual electricity withdrawals (data have been aggregated by establishment at SIREN level) with individual data on company activity. For this, the tendency surveys in industry are used, and in particular the qualitative responses to the questions on past and expected production.

However, this matching poses several difficulties. First, attrition is significant as the tendency surveys in industry question only a sample of industrial companies. Thus for 2022, 58% of companies (or 57% of electricity withdrawals) connected to RTE are available in the surveys (or 183 SIREN out of 314 SIREN of companies connected to RTE).[8] As in the meso-economic analysis, companies represented in the matched sample are not representative of industry as a whole. As suggested in ►**Figure 7**, these are above all large companies, i.e. with large turnovers. In addition, the responses of these companies to questions on past and expected production suggest that their activity in 2022 had significantly deteriorated. As shown in a ►**Figure 3** in the body of the Focus, for companies in the matched sample, their balance of opinion on expected activity[9] was particularly in decline in 2022, compared to all industrial companies, but also slightly lower than that of energy-intensive industrial companies.

It should be noted that electricity withdrawals by companies connected to RTE were obtained at establishment level (SIRET level) while the data from the tendency surveys are at company level (SIREN level). The construction of the matched sample therefore involves adding together electricity withdrawal data per establishment in order to obtain withdrawals at company level. This therefore assumes that the variation in electricity withdrawals of establishments present in RTE is representative of total withdrawals of electricity by the associated company.

The tendency surveys in industry do not provide quantitative information on activity in month *t*. Information on company production is obtained from qualitative data on the variation in production in the past 3 months (stable, up, down) ad for the next 3 months. After comparing the performances of the different combinations of variables, the model finally adopted takes into account what the company declares in t+1 concerning its past activity:

$$\Delta log\left(elec_{i,t}\right) = \alpha_i + \underset{(0.01)}{0.02} \times \left(\ ActPass_{i,t+1} = Increase\ \right) - \underset{(0.02)}{0.04} \times \left(\ ActPass_{i,t+1} = Decrease\right) + g\left(X_t\right) + \epsilon_{i,t} \quad (2)$$

Estimation: 2018-01/2021-12, R^2=0.16, N×T=6355

where X_t is a series of control variables (month of the year to adjust results for seasonality, specific dummies for the months of lockdown during the health crisis, etc.), *ActPass* is the company's opinion on its past activity and α_i is a company-specific fixed effect. The fixed effect corresponds, for each company, to the average monthly change in electricity consumption at constant production (and adjusted for seasonal variations). With this fixed effect, it is possible to capture, at company level, both gradual improvement in its energy efficiency (its "energy-saving trend effort") and change in the electrification of its production process.

As in the macroeconometric model, the approach consists of using the model (2) to construct a "simulated electricity consumption" for 2022. The difference between consumptions can then be interpreted as cumulative energy-saving.

8 Microeconomic modelling is not limited to the energy-intensive branches of the meso-economic approach, even if these represent 75% of the final analysis sample.
9 This balance is the difference, weighted by turnover, between the number of companies declaring that in a given month their activity is up and the number declaring that their activity is down.

Accounting for energy-saving in 2022 through past energy-saving behaviour

In order to study whether energy-saving behaviour at the end of 2022 was driven by companies that had already made energy-efficient gains in the past or, on the contrary, by companies that had not done so, an "energy-saving trend" indicator was defined for the period 2018-2021 from the fixed effects α_i of equation (2): due to the specification of this equation, these effects reflect the average variation in electricity consumption, between 2018 and 2021, at constant production.

These fixed effects do not constitute a perfect measurement of companies' energy-saving from 2018-2021 as they may also capture company behaviour related to the electrification of production processes. Also, in order to remove these fixed effects of possible electrification behaviour, several years of the annual survey on industrial energy consumption (EACEI) were examined. These surveys provide information on the share of electricity in the energy mix for each company. For the companies in the sample matched above, these companies are compared between the 2014-2015 and the 2018-2019 EACEI surveys. For those that are in these years, the change in this share of electricity (written *ΔpartElec*) can be a proxy for the electrification of their production chains.

The "energy-saving trend" indicator for the period 2018-2021 –written $\hat{\alpha}_i$ – is the residual of the equation :

$$\alpha_i = \underset{(0.002)}{0.008} + \underset{(0.02)}{0.042}\ \Delta partElec_i + \hat{\alpha}_i$$

$R^2 = 0.03$, $N = 151$

Companies that improved their energy efficiency over the period 2018-2021 are defined as those where $\hat{\alpha}_i$ is less than the median.

According to this measurement, these companies are expected to be larger in size and more energy-intensive than the others. These results are consistent with the literature on business investment for industrial decarbonisation, which suggests that it tends to be the largest, the most productive and the most energy-intensive companies that have the highest investment rate in favour of decarbonisation (►**Faquet, 2021**). ●

►7. Distributions of turnover of companies in the tendency survey in industry sample and in the sub-sample matched with RTE data

(average –not weighted–, median, first and third quartiles of the distribution of company turnover –in thousands of euros– declared in the tendency surveys in 2022)

Data	Average	1st quartile	Median	3rd quartile
Final sample (RTE/ECJ)	629	104	231	646
Industry business survey	195	13	37	106

Note: the final sample (RTE/ECJ) corresponds to the matching (SIREN level) of data on electricity withdrawal from RTE and tendency surveys in industry. Turnover distribution corresponds to what was declared in the tendency surveys.
How to read it: on average (not weighted), companies in the tendency surveys in industry have a turnover of €195k against €629k in the final sample (RTE/ECJ).
Source: RTE, Insee business survey. Insee calculations.

Bibliography

Abadie L., Ortiz R., Galarrage I. (2012), "Determinants of energy efficiency investments in the US", Energy Policy, Vol. 45, 2012.

Allcott H. and Greenstone M. (2012), "Is there an Energy Efficiency Gap?", Journal of Economic Perspectives, n° 1 (26), 2012.

Bjai B., Chevalier C-M., Génin H., Lefebvre C., Roulleau G. (2022), "Companies coping with rising energy prices: contrasting situations and reactions", *Economic outlook* of 15 December 2022, INSEE.

Cheptitski A. and Poulhès M. (2021), "Can electricity consumption by businesses help improve forecasts of activity, especially in a period of crisis?", *Economic outlook* of March 2021, INSEE.

Faquet R. (2021) "Which Industrial Firms Make Decarbonization Investments?", working paper of Direction Générale du Trésor, 2021.

Gerarden T., Newell R., Stavins, R. (2017), "Assessing the Energy-Efficiency Gap", Journal of Economic Perspectives, n°4(55), 2017.

RTE (2023), "Bilan de l'hiver 2022-2023". ●