

Long-term developments of energy pricing and consumption in industry

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Researchers at the Paul Scherrer Institute PSI have collaborated with British economists to study how energy consumption by Swiss industry develops depending on energy pricing. To this end, they examined in particular the prices and consumption of both electricity and natural gas over the past decades. One result: For the most part, price increases have only long-term effects on energy consumption. Furthermore, the researchers worked out possible scenarios for future development up to the year 2050 in which they address, among other things, aspects of climate protection. Today the researchers are publishing their results in the report "Swiss Industry: Price Elasticities and Demand Developments for Electricity and Gas."

Rising energy prices can, among other things, trigger two effects in industry. On the one hand, <u>energy demand</u> should fall as companies try to offset higher prices by saving energy, for example through the use of more efficient technologies or production processes. On the other hand, higher energy prices can impair companies' global competitiveness, so that as a consequence production declines and therefore less energy is consumed. This correlation between price changes and changes in demand is also known as price elasticity.

In the present study, researchers from the Paul Scherrer Institute PSI, on behalf of a research project funded by the Swiss Federal Office of Energy (SFOE), together with economists from the British consultancy firm Cambridge Econometrics developed a method that can be used to understand this price elasticity retrospectively and to model it in future



scenarios. "As the basis for data on previous developments, we have used available scientific literature as well as data provided by SFOE and the International Energy Agency IEA," explains Tom Kober, head of the Energy Economics Group at PSI and one of the principal authors of the study. The data come from a period extending from 1970 to 2016. Prices and <u>consumption</u> of both <u>natural gas</u> and electricity were examined.

The reaction takes place after about five years

At present, natural gas and electricity account for two-thirds of the energy consumption of Swiss industry, with one-third coming from other energy sources and waste. The sectors with the highest consumption are the chemical industry, the food industry, machine building, non-metallic minerals including the cement industry, and the paper and pulp industry. One finding of the retrospective analysis showed that price increases rarely have an impact on consumption of gas and electricity in the short term. It was only in the longer term, after about five years, that the researchers were able to observe a reduction in energy consumption. According to the study, this can be attributed to the fact that, in most cases, it takes time after a price signal to adapt production processes and procedures or to invest in more energy-efficient equipment.

At the same time, individual sectors differ markedly from each other. Thus, the iron and steel industry, which is responsible for six percent of energy consumption of the Swiss industry, reacts the least to price increases. There a price increase of one percent led to a reduction in consumption of only around 0.14 percent. In contrast, industries such as non-metallic minerals and the pulp and paper industry cut their energy consumption more significantly as a result of <u>price increases</u>. Here, prices one percent higher led to around 0.7 percent lower consumption.

To be able to investigate long-term developments of industrial energy



consumption in the future, the researchers sketched out scenarios that they then calculated with computer models. The scenario designated E-POL is primarily oriented towards Switzerland's Energy Strategy 2050. This scenario itself does not provide any concrete values for the reduction of emissions of so-called greenhouse gases and is based mainly on the use of energy-efficient technologies and the build-up of renewable energy sources. So, for example, final energy consumption per capita in Switzerland should decrease to 57 percent of the 2000 level by 2035 and to 46 percent by 2050. The so-called CLI scenario, in contrast, is essentially based on the climate strategy of Switzerland, with the goal of achieving net-zero greenhouse gas emissions by the middle of the century.

Electricity applications as the key to greenhouse gas reduction

In both the E-POL and CLI scenarios, CO_2 emissions will decrease continuously until 2050, with all industrial sectors contributing to the reduction of emissions through increased reliance on electricity applications and the replacement or conservation of natural gas, mineral oils, and coal (which at present is burned mainly in the Swiss cement industry).

In the food and paper sectors, the proportion of electrical energy could increase through the use of appropriate technologies. For example, the energy efficiency targets imposed in the E-POL scenario support the use of heat pumps in combination with heat recovery. This could boost energy efficiency in this area by up to 40 percent. The energy savings in the industrial sector for non-metallic minerals such as stones, clay, and salt are estimated to be somewhat lower. In the long term, the switch from coal to natural gas will also contribute to increasing energy efficiency and reducing emissions in this sector. To what extent the separation of CO_2 can be used in the production of cement is yet to be determined.



Despite the efforts to reduce CO_2 , the industrial sector's share of Switzerland's total emissions will increase, as the reduction in other sectors will be even greater due to intensified climate protection efforts. Overall, the researchers anticipate a long-term increase in the cost of energy use and thus an increase in prices for selected energy sources. This has an impact on the economy and the total amount of energy in demand, as well as the composition of energy sources and technologies.

The researchers found, among other things, a special effect in the development of the end <u>energy consumption</u>. The demand for electricity remains largely stable or even grows. As a result, the share of electricity in total final consumption increases in all scenarios, from around 24 percent in 2015 to 28 to 35 percent in 2030, and 32 to 62 percent in 2050. In absolute terms, the demand for electricity remains roughly at the 2015 level in E-POL, while it rises nearly 40 percent by 2050 in the CLI scenario.

"In this context, it is extremely important how the electricity is produced," Kober stresses. "For an effective reduction of greenhouse gas emissions, the timely build-up of renewable energy is therefore necessary." The import of electricity from abroad must also be used, with renewable energy sources also gaining in importance there. Overall, this results in the recommendation to promote efficient use of electricity in industry and at the same time to maintain incentives to replace fossil fuels with electricity-based technologies. Gases also remain an important component of the energy mix for industrial heating applications, with synthetic and biogenic gases playing an ever greater role if greenhouse gases are to be reduced.

Short-term effects of COVID-19

The study did not consider short-term effects of the current COVID-19 pandemic. As a result of the shutdown of large shares of industry



worldwide, there was a massive price drop in the energy markets. "Our scenarios for the future are oriented towards a much longer-term perspective, since they model developments up to the year 2050," Kober says. It cannot be ruled out that the consequences of the pandemic could also have a longer-term influence. "How exactly that could turn out is uncertain. I assume, though, that the long-term dynamics in the <u>energy</u> system that our scenarios describe will basically be preserved."

More information: Swiss Industry: Price Elasticities and Demand Developments for Electricity and Gas: <u>www.aramis.admin.ch/Dokument.aspx?DocumentID=65688</u>

Provided by Paul Scherrer Institute

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