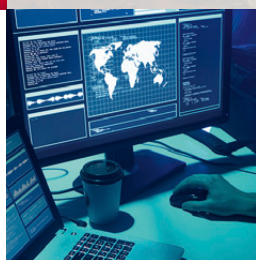

Report on Risks to National Economic Supply 2021

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Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER
Federal Office for National Economic Supply FONES

Foreword by Prof. Andreas Wenger

Supply risks rapidly changing all over the world

The COVID-19 pandemic has opened the public's eyes to Switzerland's reliance on global supply systems. Over the past two years, abstract process risks have suddenly become very real and tangible to all. There has been much talk about the fact that the manufacture of masks and certain therapeutic products is concentrated in Asian markets and the associated supply bottlenecks. And there has been no mistaking the interdependencies of value chains and supply chains. The measures introduced to tackle the pandemic caused the economy and society to come to a virtual standstill, which led to temporary gaps in supply for many everyday products. And the abrupt shift of large parts of the economy to working from home caused a surge in the use of information and communication systems. While digital data traffic was able to withstand the additional demands, the threats of cybercrime rose significantly. In light of cascade effects across borders, national and international crisis management was temporarily characterised by uncoordinated border closures and short-term export bans on personal protective equipment.

In a complex, interconnected and uncertain world, the supply risks for a country that is heavily globalised and dependent on foreign trade such as Switzerland are fundamentally changing. In the context of the Fourth Industrial Revolution, the socio-technical systems that shape our lives are becoming more complex. Digital technologies and automated processes are continuously integrating new aspects of the economy and society. This in turn increases the mutual dependency of supply processes. Owing to globalisation, the international networking of many supply systems has massively increased in the last 30 years, and the supply chains for essential goods and services extend well beyond national borders. This entails new challenges along the ever longer logistics chains on land, on water and in the air. Added to this come protectionist restrictions on free trade amid political rivalries between major powers. Unilateral economic dependencies are increasingly being manipulated for political ends. In the current international context, the risk of politically motivated disruption to supply processes is growing.

The interplay of state provision and individual responsibility

The economic, socio-technical and political context of Switzerland's national economic supply has thus become more challenging. Political decision makers must increasingly adjust to non-linear developments in a fragmented environment. Sustained power shortages and widespread outages of information and communication systems can present extensive challenges to whole regions and continents. The increasing number of natural disasters in the context of climate change can also have cross-border implications for logistics chains and capacity, and for crop yields, and thus for the supply of essential foodstuffs. It is not only for historical reasons that security of supply is a higher priority for Switzerland than it is for many other countries. As a resource-poor and import-dependent land-locked country, and as a liberal and federal small state that is not automatically integrated in the supply processes and crisis mechanisms of its EU neighbours, contingency planning and crisis management are a joint task of the government, the private sector and society – as exemplified by the COVID-19 pandemic.

In this sense, supply policy must take a holistic approach. This is about striking the right balance between state provision and individual responsibility of the affected sectors and of the public, and aligning risk-based prevention as effectively as possible with a resilience-based response to unforeseeable events. It is about recording the interdependencies of risks to national economic supply and identifying strategic and operational scope for action for crisis preparedness. This cross-departmental analysis of the risks to Switzerland's security of supply is an important instrument to define the future strategic orientation of national economic supply. It also deserves the attention of the broader economy and society and the necessary support of policymakers to ensure adequate supply.

Prof. Andreas Wenger, Head of the Center for
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Zurich, december 2021

Management summary

Serious incidents that are difficult to predict and that have a negative impact on Switzerland's security of supply must be anticipated at all times, even if they are very unlikely to occur. This was clearly shown by the COVID-19 pandemic, which also increased awareness among large parts of the population that hazard scenarios[1] that were previously considered abstract can inflict real damage to our society without warning. The COVID-19 pandemic illustrated the importance to society of ensuring a continuous supply of essential goods and services. This includes the instruments put in place for comprehensive crisis management.

Natural disasters, serious power shortages, technical breakdowns in communication and transport logistics systems or disruption to the global commodities market can present major – or in some cases existential – challenges to the governments of affected states that are responsible for security of supply and to the affected economic actors. As the world becomes more interconnected and as societies and economies become more dependent along the whole supply chain, the extent of damage of such incidents increases.

For example, the failure of a market-dominant raw materials supplier would quickly result in global supply bottlenecks, particularly in import-dependent economies such as Switzerland. Equally, a localised natural disaster in a densely populated area could have nationwide consequences. A sound energy supply and functioning logistics and ICT systems are essential to businesses, the government, but also private households.

It is therefore crucial for NES to have in-depth knowledge of risks and imminent challenges to security of supply in all of the areas it covers. This way, it can prepare for incidents that begin far beyond its sphere of influence, in order to guarantee Switzerland's supply of essential goods and services in the event of severe shortages.

On the basis of the risk analysis conducted by the Federal Office for Civil Protection (FOCP)[2] and the expert insights of the part-time NES executives from the private sector, the National Economic Supply (NES) organisation drew up its risk analysis with the aim of recording the consequences for and disruption to Switzerland's supply of essential goods and services. The analysis shows that most of the hazard scenarios in the FOCP's risk analysis could be relevant to national economic supply. The findings were summarised in 16 NES hazard scenarios.

The increasing complexity of society requires all risk scenarios from all divisions of national economic supply to be addressed and assessed individually in order to identify interdependencies. The results show that almost all risks that are relevant to national economic supply inevitably provoke cascade effects in other areas, with the exception of the supply of therapeutic products and foodstuffs. While they are dependent on supply processes, such as electricity, logistics and ICT, in the event of a shortage, they do not cause direct shortages in other areas of national economic supply. The other divisions would only be affected by extension in the longer term, as a shortage of foodstuffs or therapeutic products could hinder the population's ability to work. By contrast, a failure of logistics services would lead to shortages in the supply of therapeutic products and foodstuffs or in domestic industrial manufacturing.

[1] Hazard scenario is used to denote a specific hazard that exists for a specific subject of protection (in this case national economic supply). A hazard scenario therefore corresponds to a potential incident or a potential development with possible consequences for a subject of protection (Glossary of risk-related terms, FOCP, 2013).

[2] See: https://www.babs.admin.ch/en/aufgabenbabs/gefaehrdrisiken/natgefaehrdanalyse.html

A holistic assessment of all the areas of national economic supply makes it clear that a number of risks have intensified. As a result, the challenge of supplying the population with therapeutic products, foodstuffs, drinking water, energy, logistics services and ICT services has grown. The analysis of potential risks and dependencies in the various supply processes shows that supply chains are becoming more interdependent and thus measures to tackle supply disruption cannot be developed in isolation. These developments have an impact on the strategic orientation of NES. In addition, the report notes that while the areas of supply are protected against many individual risks, they face greater challenges as soon as several contingencies occur in combination.

In order to meet these new requirements, holistic approaches are important to make supply processes more resilient. The 2021–24 NES strategy and planning cycle again focuses on mutual dependencies and impacts if a hazard scenario arises.

A look at the current trends and developments influencing national economic supply clearly shows that greater emphasis on preventive approaches and cooperation with all relevant actors is set to become more important for effective contingency planning and crisis response.

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1 Introduction

Global, national and regional incidents can directly result in risks to security of national supply[3] of vital goods and services and as a result cause severe shortages. A severe shortage is a supply situation in which there is an extreme risk of immediate, major damage to the economy or considerable disruption to national economic supply (Art. 2 let. b NESA; SR 531). The monitoring and management of potential risks is therefore crucial for Switzerland.

The task of the national economic supply organisation is to guarantee Switzerland's supply of essential goods and services in collaboration with the private sector and the Federal Administration[4]. If a severe shortage occurs that the private sector cannot remedy on its own, the NES intervenes in a subsidiary capacity with targeted measures to guarantee the supply of foodstuffs, energy, therapeutic products, logistics and ICT. In its activities, the NES focuses on these supply processes, their interdependencies and on guaranteeing the resources necessary for supply (production factors such as raw materials and labour). Adequate supply can only be guaranteed if essential services, such as power supply, ICT and logistics are available. The NES is therefore organised in six divisions, which are highly interdependent and interconnected. If an essential supply process, an essential service or a resource is not available, this has an impact on other divisions and therefore results in a cascade effect.

Power supply in particular is a central component of national economic supply. Without power, things such as ICT systems and networks cannot function. As a result, the basis for production and distribution of all goods (logistics) – such as gas, oil, drinking water, therapeutic products and foodstuffs – is massively compromised or no longer available. The mutual dependence of supply processes is a risk that can only be addressed through collaborative approaches between the NES divisions and together with the private sector.

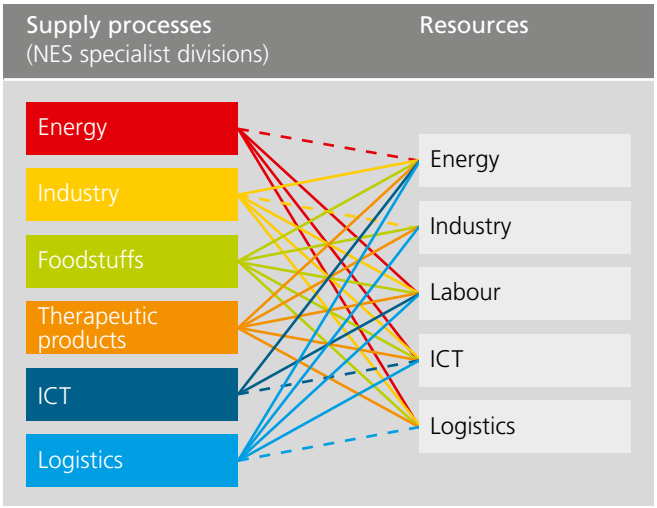


Figure 1: Dependencies of the NES specialist divisions

[3] Security of supply can be defined as a guaranteed supply of essential goods and services in cases of severe shortage. According to Switzerland's national economic supply, this concerns foodstuffs, therapeutic products, industry, energy, logistics and ICT.

[4] A comprehensive overview of the NES's mandate and its legal status can be found at: www.bwl.admin.ch

A cross-divisional analysis of the risks is therefore required to record and illuminate these mutual dependencies and consequences. The only way the risks can be identified, assessed and analysed is through a comprehensive, holistic and systemic view of the processes. The direct and indirect consequences of an incident on supply structures in the economy and the Federal Administration are thus identified as comprehensively as possible at the time of the analysis, and their dependencies and their vulnerabilities with regard to critical system elements and processes are assessed.

The aim of this risk analysis is to record the foreseeable risks to Switzerland's national economic supply. In order to ensure that the national supply of essential goods and services is as crisis-resistant as possible, knowledge of the relevant risks to supply processes is essential, bearing in mind that the details of the actual crisis will be different. This document identifies the critical resources along the supply processes and identifies potential disruption, failures and outages. This allows the private sector to increase the resilience of supply infrastructures, and allows appropriate measures to be put in place to restore the balance between supply and demand if there is a shortage.

On the one hand, the risk analysis is an internal instrument for the NES to adapt and update its strategic orientation and the resulting measures. On the other, it acts as a central source of information for businesses, specialist bodies and the public, demonstrates the relevance and scope of the NES, and encourages the various actors to prepare for potential shortages.

Before analysing the various risks (chapter 3), the report addresses the current supply situation in the individual divisions of national economic supply (chapter 2). This allows us to factor in a current overview of the supply situation and other factors that are relevant to a complete understanding of the impact of the risks. The analysis also considers potential developments and trends that could have an impact on security of supply and the NES in the coming years (chapter 4).

2 Switzerland's supply situation

Overall, Switzerland's supply situation is currently classified as good, although the COVID-19 pandemic has highlighted weaknesses. It should be noted that the number of incidents that have a critical impact on supply processes has increased in recent years. They have necessitated the regular use of NES measures, including in the areas of therapeutic products, energy and food supply (production inputs).

The current situation in the six NES divisions is described below.

2.1 Energy

2.1.1 Oil

Petroleum products (liquid fuels and combustibles) accounted for almost 51% of Switzerland's energy consumption in 2020, of which over 35% was fuels. Although oil has become less important in recent years (in 2010 oil accounted for around 54% of energy consumption) and this trend is set to continue, petroleum products will be essential to the functioning of society and the economy for many years to come. Secure supply is a prerequisite for Switzerland's prosperity.

Switzerland's supply of petroleum products continues to be very secure. The ease of transportation and storage of products, the large number of stakeholders involved (some 60 importers, around 60 refuelling facilities, many heating oil suppliers, and approximately 3,500 petrol stations), supply through various import channels using diversified means of transport (ship, rail, pipeline, road), and a refinery in Switzerland guarantee high reliability of supply and a resilient supply chain.

However, the vulnerability and resilience of Switzerland's supply of petroleum products has become clearly apparent in recent years. The closure of the Collombey refinery in 2015 reduced flexibility of supply and necessitated increased imports of finished products, in particular via the Rhine, by rail (North) and to a lesser extent via the SAPPRO pipeline. Most of the time, this did not lead to problems. The assessment of earlier analyses that supply problems would be caused less by incidents in major production countries and more along transport routes in Switzerland's neighbouring countries and in Switzerland itself, proved true. While the months of disruption to the Rhine Valley rail route near Rastatt in 2017 were successfully overcome thanks to major efforts by transport companies and importers, this was no longer the case in 2018 during the several months of low water levels in the Rhine. This was also because France and Germany were heavily affected (in Germany this coincided with failure of the Vohburg refinery following an explosion in September 2018). Alternative means of transport for the import of petroleum products were also in high demand in these countries and no longer available for Switzerland to the required extent. The temporary shortage of kerosene in the summer of 2019 was an unfortunate combination of known and unknown problems in railway logistics that built up over several weeks. Several cases have highlighted the fact that petroleum product supply is dependent on various factors, such as in 2021 when flooding led to a maintenance shutdown of the Leunen refinery.

In this sense, Switzerland's supply of petroleum products continues to depend on the same factors:

- Availability of crude oil and finished products abroad and open borders (availability has always been guaranteed in the last 40 years despite all the imponderables and geo-political and climate-induced uncertainty; so to date there has never been a global supply shortage).
- Availability of means of transport and capacity (including unloading of crude oil tankers in the port of Fos, France). Of particular importance are the crude oil pipeline to Cressier, the SAPPRO product pipeline to Geneva, the Rhine, the Rhine valley railway, and Switzerland's railways. Availability does not just mean that the means of transport is in a 'usable' state, but also that e.g. sufficient railway lines, operational locomotives and cistern wagons, train drivers and pipeline pumps are available without restriction, and that there are enough loading and unloading slots at the place of loading and destination.
- Smooth communication between the various parties involved is essential. In this sense, secure supply is not possible without electricity and communication (telephone, email, internet). This also applies to final stage distribution in Switzerland (delivery to petrol stations or heating oil customers).
- The COVID-19 pandemic reminded us that transport and infrastructures can only be operated and supply only works as long as staff are fit for work.

If problems with the influencing factors described above result in an imminent shortage (as was the case in 2018), Switzerland's supplies are initially guaranteed through the extensive compulsory stocks of petrol, diesel and heating oil (4.5 months' supply of each) and kerosene (3 months' supply). The compulsory stocks of petroleum products are stored with commercial stocks and are therefore integrated in the logistics chain and are very rapidly available.

2.1.2 Natural gas

The Swiss natural gas transport network is connected to the European network through 16 interconnection points. The most important import route is the Transitgas pipeline, which is part of the transit route from the Netherlands to Italy. This pipeline also flows through the southern part of Germany, which it also supplies with gas. In Switzerland it flows from Wallbach (AG) or Rodersdorf (SO) to Griespass (VS). Switzerland uses around 20 % of the gas that is transported between Germany and Italy. Around 70 % of Switzerland's domestic demand flows to Switzerland through this pipeline. Gas can also be fed in from France via a connector south west of Basel. The Transitgas pipeline was upgraded to allow gas to flow from south to north. This 'reverse flow' function increases the resilience of gas supply not only for Switzerland but for the whole of Central Europe.

For geological reasons, Switzerland does not have any large gas storage facilities, such as salt caverns and pore storage facilities. There are only smaller facilities for temporary storage and contractually agreed storage capacities in France (for the French-speaking part of Switzerland). In addition, around 20 % of domestic natural gas consumption is used for dual fuel systems, which can run on natural gas or heating oil. To be able to take advantage of the switching potential in the event of supply bottlenecks, the gas industry holds strategic stockpiles of heating oil in Switzerland. However, the proportion of dual fuel systems is not evenly spread across the country and has been in decline for some years. Furthermore, the definitions and interpretations of switchability sometimes vary.

The natural gas market in Switzerland and in Europe is set to change in the years ahead. In connection with the net zero target in particular, use of fossil fuels, which also include natural gas, is expected to decline. But there are various ways that the natural gas market can adapt its supply. These include biogas, synthetic gas and hydrogen. The transformation of the natural gas market will therefore also help secure Switzerland's energy resources, especially in conjunction with the strategy to resolve potential supply bottlenecks in the electricity sector.

In order to establish legal certainty regarding gas supply market regulations, the Swiss Federal Office of Energy is currently drafting a Federal Gas Supply Act, which is to be referred by the Federal Council to Parliament in 2022.

At European Union (EU) level, a new set of regulations is intended to safeguard the security of gas supply in the EU. This regulation enhances cooperation between member states in the event of crises and introduces the concept of solidarity between countries. EU member states are required to conclude bilateral agreements which stipulate that they will mutually support each other in the event of supply shortages, although this is deemed a last resort mechanism. Switzerland is not bound by the EU Regulation and is deemed a third country. However, it should be noted that Switzerland has an important role to play in Central Europe as gas trading between Italy and Germany is processed via the above-mentioned pipeline through northern Switzerland.

2.1.3 Electricity

On the demand side, Switzerland's supply situation between 2017 and 2020 was characterised by largely stagnant electricity consumption compared with the previous four-year period. Considering the economic and population growth, this is likely to be primarily down to the effectiveness of energy-saving measures, but also partly to milder winter temperatures. In 2020, electricity consumption was around 3.5% lower than before due to the COVID-19 pandemic.

On the production side, the Mühleberg nuclear power plant was shut down at the end of 2019. Since then, Switzerland's electrical output has been reduced by 355 MW (a few per cent compared with before). The production of nuclear energy in the 2017–20 reporting period was also reduced due to longer inspection times. Overall, it was around 1.5 % below the levels in the previous period (2013–16) and 9 % below the production levels in 2009–12. On the other hand, storage capacity was significantly increased through the commissioning of the Linth-Limmern pumped storage plant (1,000 MW). On the whole, Switzerland had significantly higher export surpluses than in previous years, particularly in 2019 and 2020 with some 6 TWh (1 TWh = 1 bn. kWh) (Ø 2013-16: 1 TWh).

The expansion of renewable energies has significantly influenced supply on wholesale markets in recent years. Installed photovoltaic capacity in Germany increased from 41 GW to 53 GW in the reporting period, while wind energy capacity increased from 48 GW to 62 GW. The fluctuation between rising feed-in values and periods of low production ('dark doldrums') has increased. The volatility of daily electricity prices and the price differences between countries have grown. According to an industry survey carried out in 2020, Switzerland's installed photovoltaic capacity is around 2.5 GW.

Switzerland continues to play a key role in the European Network of Transmission System Operators for Electricity. For example, in its role as Coordination Centre South, swissgrid was instrumental in rectifying an extensive grid separation incident in south-eastern Europe in January 2021. This involved a grid separation in the synchronous area of Continental Europe with a significant surplus and deficit of power in the two remaining east and west sub-regions, but did not have an impact on security of supply. This incident highlighted the fact that interconnected European markets can also result in critical situations that have to be rectified in a very short space of time.

2.1.4 Wood fuel

Switzerland's supply of wood fuel has been very good in recent years. This is one of the reasons why the country's annual wood fuel consumption increased from 5.18 million to 5.58 million cubic metres between 2017 and 2020. The total number of wood-fired heating systems declined from 573,635 to 539,166 in the same period. 2020 was characterised by long periods of drought and by damage caused by storms and bark beetle infestations, which led to a sharp rise in wood supply. The COVID-19 pandemic and new support programmes led to a sharp rise in demand in late 2020, which was met at all times, including in the cold spring of 2021. Switzerland still has a relatively high self-sufficiency rate for wood pellets[5]. A major demand group with no way of being self-sufficient is catering (pizza restaurants and bakeries with wood-fired bread ovens), which requires a very high combustion quality for hygiene reasons (air/particulate matter). Producers of wood fuel can therefore obtain good prices in this market. On the other hand, there are typical stove owners who only light their stoves occasionally and for whom price plays a minor role (e.g. buyers in petrol station shops). For wood pellets, the proportion of domestic production in 2019 was 77 %. Cheaper pellet suppliers from abroad are entering the Swiss market. Production capacity in Switzerland was massively increased in 2020 and increased use was made of forest wood pellets. Meanwhile, as of mid-2021 there has been an excess supply of wood chips due to the large amount of wood damaged by storms and bark beetle infestations. This more than offset the steady decline in trunk wood use and the – in theory – associated decrease in the supply of its by-product wood fuel. The supply of wood energy is primarily ensured by the market (forest owners, forestry enterprises and forestry and wood fuel companies) and particularly for wood chip furnaces, through wood chip supply agreements. Here, supply is dictated by demand. The price surges seen in timber ranges have not been seen in wood fuel.

2.1.5 Drinking water

A well-positioned drinking water supply depends on two key elements. On the one hand, the natural resource of water must be available in sufficient quantity and quality, while on the other, the infrastructure to extract and distribute the water must be well developed and managed.

Looking at the whole of Switzerland, the supply of drinking water over the next decades is secured, even in the context of climate change. This is due to the fact that many hydrologically independent water resources can be used and only a fraction of precipitation is used for drinking water purposes. Most water companies also manage without elaborate processing as over two thirds of drinking water in Switzerland can be extracted and distributed in a nearnatural state.

The degree of physical networking between water suppliers has further increased in recent years. Many larger drinking water suppliers currently have integrated networks with several pillars. However, in rural areas, drinking water supply is still in many places an isolated operation within the municipal boundaries. This decentralised supply structure is increasingly reaching its limits in terms of resilience and funding (need for renewal). The deficiencies were highlighted in the two years of drought (2015 and 2018) and by the recent issue of pesticide residues in groundwater. However, the envisaged increased physical networking of water supply areas means greater damage potential in the event of cyberattacks.

Qualitative aspects and conflicts of use have become much more important in recent years. In some places, water catchment areas have had to be abandoned because they no longer meet the regulatory standards regarding protected areas and water quality. While lost catchments can usually be offset, a lost catchment means an overall weakening of drinking water supply as the same production volumes must be guaranteed with fewer pillars.

[5] The self-sufficiency rate is defined as the ratio of domestic production of a given product to domestic consumption of that product.

2.2 Foodstuffs

According to the Food and Agriculture Organization of the United Nations (FAO), food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (four dimensions: availability, access, utilisation, stability).

Switzerland's useful agricultural land largely consists of natural meadows, with arable land accounting for just under 40 %. Switzerland, like the Netherlands, is among the European countries that has a small agricultural land per capita. The proportion of organically farmed land is double the European average. In organic farming, Austria takes the top spot. On a value basis, the United Kingdom (2019), Germany and Switzerland (2020) import more foodstuffs than they export. By contrast, the Netherlands and Spain in particular are net exporters of foodstuffs. Besides crop cultivation, livestock farming is an important supplier of calories. While cattle and pig populations have declined in Switzerland in the last decade, poultry farming has significantly increased.

Until around five years ago, overall domestic food production was steadily increasing, although crop farming in particular fluctuated from year to year due to a number of factors, including the weather. Besides the slight decrease in arable land as described above, the reasons behind the current decline are a lack of breeding progress in crop yields and animal performance, as well as increasing shares of extensive farming. At the same time, domestic calorie consumption is showing an upward trend due to population growth. This results in a slight decrease in Switzerland's self-sufficiency rate. The gross self-sufficiency rate, which comprises domestic production on the basis of imported feed, is currently just under 60 %. The net self-sufficiency rate – excluding imported agricultural inputs – has been just over 50 % in recent years. In this respect, the future legal frameworks for agriculture and the food industry (e.g. agricultural policy requirements) must be looked at in terms of incentives to encourage lower intensity production which could impact Switzerland's self-sufficiency rate. A potential way of increasing calorie production on limited arable land would be to cultivate more plant-based foodstuffs instead of animal feed.

It is not only imports of feedstuffs that play an important role in domestic production. For many other production inputs – particularly seeds and plant protection products – Switzerland is heavily reliant on imports with an increasing concentration on a small number of international suppliers.

In terms of yields, it must also be borne in mind that for a number of years now, extreme weather events, such as high temperatures and drought in the summer have influenced the production conditions of Swiss agriculture. Modelling by the IPCC shows a highly significant link between a rise in global temperatures and an increase in extreme weather events, crop yield fluctuations and potential disruptions to supply. On the basis of the CH2018 climate scenarios by the National Centre for Climate Services NCCS[6] we can assume that Switzerland will also be more impacted by these effects and that they will have significant implications for food supply.

Besides these long-term trends, it is clear that relevant risks such as a power shortage could lead to short-term disruptions to food supply, for which the resilience of the population (emergency supplies) is crucial. A study[7] conducted on behalf of the Federal Food Safety and Veterinary Office FSVO on food and dietary habits in the context of the COVID-19 pandemic confirmed once again that a significant proportion of younger and urban populations do not have sufficient supplies of foodstuffs and drinking water, and that they are not aware of the NES recommendations, nor do they intend to follow them in future.

In summary, we can say that security of supply has always been guaranteed over the last four years. But agriculture and the food industry is undergoing significant change, which is leading to greater complexity of supply structures, and increased dependencies and vulnerabilities.

[6] *https://www.nccs.admin.ch/nccs/en/home/climate-change-and-impacts/swiss-climate-change-scenarios.html*

[7] *Ritzel C. (2021), Agroscope: The Swiss population's emergency supplies before, during and after the COVID-19 pandemic, Agroscope Science No. 116/2021.*

2.3 Therapeutic products

Switzerland's chemicals and pharmaceutical industry is a sector with a strong international orientation and global supply chains. Switzerland is a key player in this industry, but the share of domestic production of therapeutic products in the area of primary care is small as there has been a shift in production towards highly specialised medicine. Therapeutic products for use in primary care are therefore mostly produced in Asia. And for cost reasons, only a small number of hospitals manufacture medicinal products themselves. Virtually all source materials for the chemicals and pharmaceutical industry are imported. Of the imported pharmaceutical products, some 71.4 % come from the EU. Germany is top of the list of importing countries in Europe with approx. 26.4 %, followed by Italy (8.9 %), Spain (8.0 %) and Ireland (7.8 %). Approximately 9.3 % comes from the United States[8].

Because the supply of therapeutic products for primary care increasingly depends on a small number of heavily centralised production sites abroad, the supply risk has increased. This is also reflected in reports of supply bottlenecks, which are becoming ever more frequent in Switzerland and in Europe. Using the NES reporting platform, bottlenecks in the supply of medicinal products for which there is a reporting obligation are recorded and analysed. This allows compulsory stocks to be released in good time if necessary, or other additional measures to be put in place. Compulsory stocks are held of individual key medical devices and medicinal products, such as antibiotics, strong analgesics, vaccines and various immunoglobulins. These strategic stockpiles cover demand for approximately three months.

In the event of supply bottlenecks for medical supplies (medicinal products, medical devices and hygiene products), the Therapeutic Products Division intervenes in the market with targeted measures, such as a reporting obligation, compulsory stockpiling or restrictions on consumption. On the other hand, preventive measures are taken, for example on the basis of risk assessments, so that supply bottlenecks do not occur in the first place. During the COVID-19 crisis, the market was not always able to guarantee the supply of COVID-19 therapeutic products throughout Switzerland, which is why quotas had to be introduced on some products.

2.4 ICT

The ICT Division is responsible for ensuring availability of critical ICT (information and communication technology) infrastructure as well as the associated services, and for improving the resilience of ICT as a resource for the other areas of supply.

ICT is an essential resource for Switzerland's security of supply. Due to the high level of automation, nowadays ICT is deployed centrally to control and monitor production, logistics and energy supply processes. At the same time, the physical ICT infrastructure (e.g. cables, data centres, mobile base stations) and the critical services (e.g. access to emergency numbers, information for the public) are also a critical infrastructure.

The supply of critical ICT services is currently guaranteed but is increasingly under pressure.

In the area of ICT, Switzerland is almost entirely dependent on other countries. The globally dominant manufacturers of hardware (e.g. semiconductors, chips and storage media) are geographically concentrated in Taiwan and China and to a lesser extent South Korea.

Meanwhile, the dominant providers of software solutions and cloud services are almost all US firms. A high degree of standardisation of individual components and a concentration on a small number of manufacturers means that loss of a single provider would lead to bottlenecks in the supply of hardware and replacement parts.

In the case of major incidents, which would necessitate the simultaneous replacement of large quantities of hardware, this could quickly become a problem. For example, during the COVID-19 pandemic, the delivery time for hardware (PCs, servers, accessories) rose dramatically. For individual, expensive network elements, such as EDGE routers, which are used by internet service providers, minimum delivery times are already several months, even when there is no crisis.

[8] *https://www.scienceindustries.ch/article/20089/chemie-pharma-life-sciences-sind-eine-stuetze-fuer-die-wirtschaft (21/04/2021)*

However, the ICT sector has proven to be very resilient to crises in recent years. While there have been repeated short interruptions to availability, this has never been to an extent that would have affected Switzerland's supply.

During the COVID-19 pandemic – when digital data traffic shot up due to the requirement to work from home – experience showed that supply-critical ICT services can also withstand very heavy loads.

However, the rapid technological development in the ICT sector brings diverse challenges. Cybersecurity remains a key concern and the threat in this area has greatly increased in recent years. All over the world, cyberattacks have already been registered that damage physical infrastructures (cyber physical attacks). And in Switzerland, too, critical infrastructures have been attacked (e.g. Ebikon drinking water supply, hospitals of the Hirslanden Group and Wetzikon Hospital). Other risks may occur as a result of theft of intellectual property, either for financial or political gain (e.g. attacks on the Swiss financial centre or espionage attack on RUAG).

The more processes are streamlined through the use of ICT, the more dependent they become. Many everyday processes are no longer even possible without ICT.

Nowadays, for example, smaller power plants are often operated without any staff on site. Possible manual intervention is therefore only available to a limited extent, if at all. At the same time, digitalisation also makes it possible to control processes over long distances. The determining factor in both cases is the availability of enough staff who have the necessary training to operate the systems professionally and effectively.

A particular challenge for ICT operators in Switzerland is the small geographical scale as more than 75% of the available space in Switzerland's data centres is concentrated in the Zurich, Bern and Geneva regions. A regional incident can therefore have consequences for the whole of Switzerland. In principle, critical data centres are geo-redundant (which means that data are always simultaneously available in two different data centres at two different locations). This makes them resilient to regional isolated incidents (e.g. natural hazards).

2.5 Industry

The NES Industry Division is responsible for the industrial tools, resources (means of production, staff) and services that are used across divisions and are classified as critical according to the situation and risk assessment conducted by the NES.

The whole chemical/pharma/life sciences sector and the packaging industry are almost 100 % reliant on imports of raw materials and semi-finished products from abroad. Open borders for goods, staff and financial flows are therefore vital to secure supply. Due to the mostly global supply chains, the availability of relevant means of transport (road, rail, air and water) and the corresponding transport capacities for the supply of raw materials and primary products and intermediate goods is essential.

Manufacturing requires process energy, as well as control and communication systems in order to manage processes reliably. Various critical infrastructures, such as data centres (protection against data loss), hospitals (protection of life and limb) and in some cases the pharma sector (protection of critical processes) invest in emergency power supply units to guard against power outages. The manufacturing industry often installs battery-operated UPS systems which can supply critical devices with uninterrupted power for 10 to 120 minutes. Because emergency power infrastructure is a longer-term preventive measure, it is crucial for the resilience of the emergency power infrastructure that there is functioning replenishment logistics in place under the scenario of a power outage and the associated tele-communications outage.

The supply of industrial foods has been ensured in recent years. The complexity of ensuring uninterrupted supply, particularly for procurement and logistics, is increasing considerably. Production stoppages abroad and disrupted supply chains can lead to bottlenecks.

2.6 Logistics

Besides the availability of goods, functioning logistics (in Switzerland and abroad) is fundamental to Switzerland's supply. Raw materials, semi-finished and finished goods find their way to the right place at the right time only thanks to sophisticated logistics systems. Many critical goods reach consumers via specific logistics chains tailored to the type of goods in question and involving a variety of modes of transport. In Switzerland, besides functioning transport for final-stage distribution, the transshipment terminals, Rhine ports, marshalling yards and warehouses for transshipment in particular are essential to a smooth flow of goods. Abroad, the crucial elements to Switzerland's logistics and supply include operational sea ports, shipping on the Rhine and key rail and road axes.

With the exception of a small number of incidents (primarily at the beginning of the first lockdown due to the COVID-19 pandemic), the supply of logistics has always been guaranteed in the last four years. But if logistics services were to fail, this could impact the supply situation.

3 Risks to national economic supply

A hazard scenario that is relevant to NES is a state or a situation in which it is possible that a significant shortage of an essential good or vital service could occur[9]. A hazard scenario is relevant to national economic supply if it concerns a nationwide shortage. A shortage is a considerable risk to the country's supply, with significant consequences for the population and major economic damage[10].

On the basis of the risk report conducted by the Federal Office for Civil Protection in 2020, the NES carried out a comprehensive analysis identifying 16 hazard scenarios (see Figure 2), which could have major implications for supply[11]. Below we set out these risks and their impact.

Risks to national economic supply	
3.1 Damage/destruction of supply infrastructure	3.9 Failure/disruption of food supply
3.2 Lack or shortage of labour	3.10 Failure/disruption of logistics
3.3 Failure/disruption of gas supply	3.11 Failure/disruption of mobile network
3.4 Failure/disruption of oil supply	3.12 Failure/disruption of data centre/cloud computing
3.5 Failure/disruption of therapeutic product supply	3.13 Disruptions to shipping
3.6 Failure/disruption of ICT	3.14 Power failure (blackout)
3.7 Failure/disruption of import	3.15 Electricity supply shortages
3.8 Failure/disruption of domestic industrial output	3.16 Failure/insufficiency of (drinking) water supply

Figure 2: Risks to national economic supply

[9] According to the National Economic Supply Act, essential goods include: energy sources together with all the means of processing and production they require; foodstuffs, feedstuffs, therapeutic products, seed and plants; other indispensable goods that meet day-to-day needs; raw materials and auxiliary agents for agriculture, trade and industry. Essential services are, in particular: transport and logistics; the provision of information and communications services; transmission and distribution of energy sources and energy; payment services; storage of goods and energy, and the operating facilities and resources required.

[10] For more information, see: Federal Act on National Economic Supply (National Economic Supply Act, NESA).

[11] Unlike the risk report by the FOCP, whose mandate is civil protection, the focus here was on the legal mandate of ensuring national economic supply. It focuses on measures to ensure that Switzerland is supplied with essential goods and services in the event of severe shortages if the economy is no longer able to independently fulfil its supply function.

The risk scenarios presented here particularly concern the impact on areas of the NES that are relevant to supply. The impact is also classified by NES experts as low, medium or high. Where possible, the example scenarios are derived from the 'extreme' category in the 2020 FOCP risk report in order to use comparable scenarios as a basis. The description of the relevant influencing factors sets out the factors that aggravate or mitigate the impact on NES.

«The national risk analysis 'Disasters and emergencies in Switzerland' (DES) is not only a key basis for preparedness planning, it is also increasingly used in other policy areas. It is not only relevant to NES because individual risks directly impact security of supply, from disruption of shipping traffic to power shortages. It is also relevant because other risks can also disrupt supply processes, such as earthquakes or a pandemic. In addition, many members of the NES organisation have been involved in the analysis since the first publication of the DES in 2013 and have contributed their valuable experience and knowledge. This report adds value as it builds on the results of the DES.»

Stefan Brem, Chief Risk Officer,
Federal Office for Civil Protection

3.1 Damage/destruction of supply infrastructure

Critical infrastructures such as the power grid, the transport network, water supply and information and communication systems are necessary to maintain vital functions in society. In every area of national economic supply, there are individual physical infrastructure elements that are crucially important to maintaining the supply process. Each individual area of supply is reliant on these specific critical infrastructures, but also on other infrastructures. The damage or destruction of critical infrastructures has a negative impact on Switzerland's national economic supply and the wellbeing of its citizens.

Example scenario

At least one critical infrastructure[12] is severely damaged. It is not operational for the time being. The hazard is considered from the perspective of a critical infrastructure in the relevant area of supply discussed here. The hazard scenario was not anticipated.

Potential causes are natural hazards, such as earthquakes, avalanches, mud flows, rock falls, meteorite impacts, storms or flooding. These hazards could cause destruction or make it difficult to access and operate key infrastructures due to damaged transport routes and building structures.

Cyberattacks can also have a disastrous impact on all types of critical infrastructure, on the one hand by paralysing the IT system and on the other through cyber-physical attacks and destruction. Criminal activities, attacks, unrest, acts of terror and armed conflicts nearly always result in critical infrastructure being damaged or falling into the hands of armed groups.

Influencing factors

The impact of damage to one or more critical infrastructures is heavily dependent on the level of redundancy in the relevant supply channel. If there is a lack of substitutability, e.g. as is the case of the port in Basel, the consequences are greater than for infrastructure with multiple available alternatives and redundancy, e.g. data centres.

[12] In this context, a critical infrastructure is an infrastructure that plays an important role in security of supply.

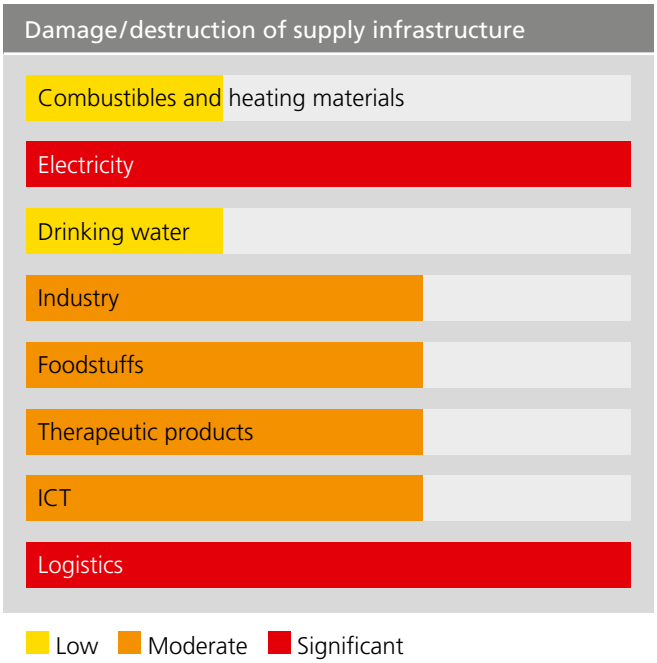
The question of whether supply is local or centralised also influences the impact. A distinction needs to be made between whether e.g. a natural hazard randomly affects a region or whether the incident involves a targeted attack on several critical infrastructures as the impact would vary greatly, particularly depending on whether or not there is insider knowledge.

Impact on critical supply processes

The destruction of one or more critical infrastructures would, from a certain level of intensity, lead to a severe shortage in the individual divisions. The specific impact would heavily depend on the precise nature of the incident. The chart on the right shows how heavily each division would be affected.

If the location has been specifically targeted, national shortages are possible even if the incident is localised.

In a number of supply processes, there are individual physical infrastructure elements that are critical to the maintenance of the supply process. In logistics, these are e.g. the Rhine ports in Basel, the Gotthard Tunnel (rail and road), and the central rail hubs (e.g. Olten, Limmattal marshalling yard) and various transshipment terminals (in Switzerland and abroad). These highlight the vulnerability of supply chains. The logistics division anticipates significant consequences even in the lowest intensity scenario. This is particularly because many other divisions – such as food supply and industrial manufacturing – are dependent on transport of their goods.



The supply of foodstuffs is otherwise not severely affected by individual incidents of this type as it is decentralised and can ensure supply through redundancy and substitution. Having said that, there are some geographically isolated concentrations in particular which could be critical in the event of an incident. Likewise, in the area of drinking water and gas supply, there are several, in some cases independent supply networks and therefore only minimal potential with regard to a national shortage. While the supply of petroleum is also organised in this way, key infrastructures such as Switzerland's only refinery in Cressier and the SAPPRO pipeline, via which the majority of the petroleum flows to Switzerland, has the potential to cause a shortage.

For electricity, there may be serious supply problems if e.g. the swissgrid control centre, via which all electricity import and export flows are controlled, and which in principle has a redundant design, were destroyed together with another key infrastructure.

Similarly, if high-voltage grids, dams or nuclear power plants are affected, there is a risk of a power shortage which could extend to nationwide blackouts that could last several weeks or months.

In the ICT supply process there are several independent networks run by different operators and these independent networks feature multiple redundancy. If communication channels are damaged, at most this would have isolated local consequences. An attack on an individual operator would have to be extreme to cause a Switzerland-wide shortage.

In terms of Switzerland's medical care, the most important critical infrastructures are hospitals. The loss of a larger hospital would mean a temporary deterioration in medical care for the affected patients. Critical infrastructures in the manufacture of therapeutic products and procurement are also usually local, also because many therapeutic products are largely imported. However, all the supply processes mentioned are reliant on a functioning distribution infrastructure (e.g. product pipeline or Basel Rhine port), which in this context makes them vulnerable.

Similar scenarios

The 'Disasters and Emergencies Switzerland' national risk analysis by the Federal Office for Civil Protection (FOCP) examines various causes that could have an impact on the availability of critical infrastructures. These include conventional attacks, chemical attacks, attacks involving biological or chemical weapons, attacks with toxins, attacks with dirty bombs, and accidents in a biological or chemical plant which would result in the relevant substances being released. From the perspective of national economic supply, such attacks become relevant if they cause downstream issues in Switzerland's supply processes.

3.2 Lack or shortage of labour

For the hazard scenario 'labour shortages' the situation is deemed relevant to supply if there are no longer enough staff to maintain critical supply processes.

Example scenario

The scenario presented here is based on the loss of a large section of the workforce or key workers for several weeks. It should be noted that every NES division is assumed to be affected.

The possible causes of a labour shortage that is relevant to supply in Switzerland are many and varied. A few examples:

- A pandemic or epidemic can lead to widespread staff absences due to sickness.
- Political unrest and strikes can make it difficult for people to get to work.
- Natural disasters such as earthquakes and flooding can make it impossible for a large number of people to get to work.
- An accident at a nuclear plant prevents people from getting to work due to the nuclear fallout and resulting evacuations.
- Political factors can hamper the availability of foreign workers in Switzerland.

Influencing factors

The most important influencing factors in labour shortages are the availability of suitable skilled workers (e.g. possibility of physically getting to work, no sectoral skills shortages), the timing of the shortage, the duration of the shortage (short-term issues can be reduced through overtime), and the possibility of working from home.

Impact on critical supply processes and expected shortages

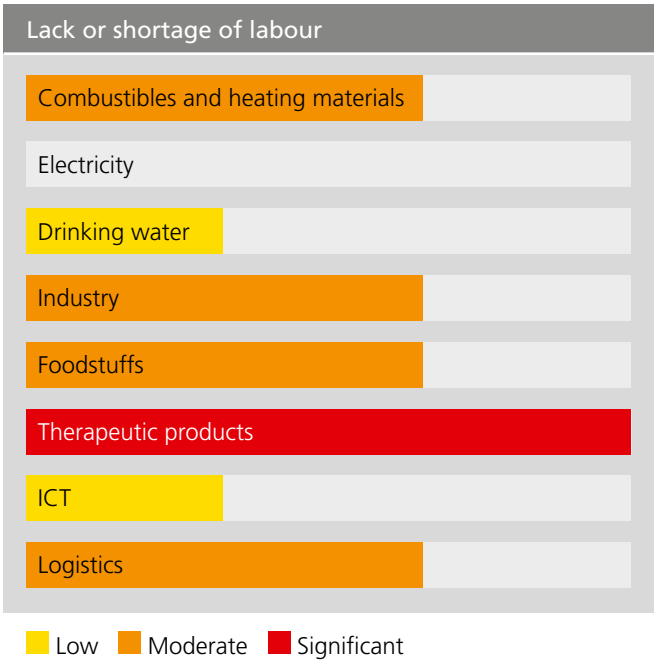
A labour shortage inevitably impacts society and the economy and can cause shortages in all critical supply processes. The chart on the right shows the intensity of the impact of the supply problems in the individual areas.

Critical supply processes in healthcare (e.g. hospitals), logistics and food supply (production, processing, distribution) are particularly labour-intensive. If not enough workers are available, this can result in critical infrastructures, such as medical care, production facilities, logistics centres and refuelling facilities no longer being fully operated. In a number of divisions, the impact of the risk is heavily dependent on which staff are affected by the shortage or disruption.

The Therapeutic Products Division is particularly affected by a shortage of workers as healthcare staff cannot be easily substituted. Severe negative effects would also be expected in logistics and thus in a critical input process that is vital to a number of other critical supply processes. Sufficient availability of truck drivers and staff in transshipment terminal facilities is necessary for the distribution of foodstuffs, therapeutic products, petroleum and industrial products to be maintained.

In ICT, the key functions can be maintained with a skeleton staff and working from home is often possible, which is why physical presence in the workplace is less significant.

In food production, the timing of the shortage is significant: considering seasonal fluctuations, staff are important resources, e.g. for picking and processing.



An interesting side note

In 2021, there were repeated shortages of essential goods in the UK. This was due to a shortage of truck drivers on the one hand, and a shortage of workers in key businesses on the other. The consequences were in some cases dramatic. For example, a number of rescue services, police forces and fire services issued warnings saying that they were affected by the fuel shortage and that it would affect rescue operations.

3.3 Failure/disruption of gas supply

Switzerland is fully reliant on imports for its gas supply. A shortage or disruption to gas supply can be caused by disruption to the distribution infrastructure (the gas can no longer be transported to end customers), or disruption to the available volumes of gas (reduced availability). A prolonged failure of the transport and distribution infrastructure for natural gas, or a lack of availability would mean a supply shortage.

Gas currently plays a crucial role in Switzerland's energy supply system. This applies to both industry and commerce, and building heating systems. Gas is also becoming more important in mobility and will in future be more important in power production, as is already the case in Germany[13].

Example scenario

This scenario corresponds to the 'major' category in the national risk analysis on 'Disasters and Emergencies in Switzerland' conducted by the FOCP from the gas supply disruption hazard file.

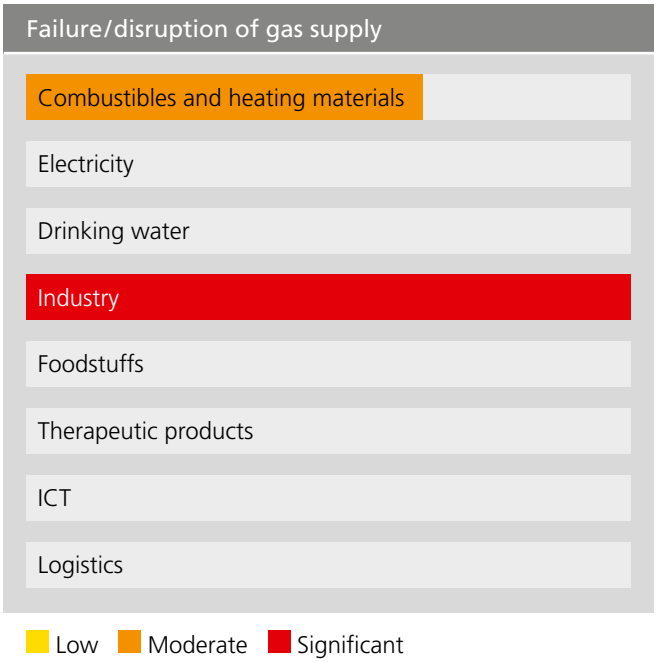
Supply disruption classified as having a 'major' impact equates to failure of a high-pressure gas pipeline or import difficulties lasting at least three weeks. The transport and distribution infrastructure for natural gas covers pipelines, gas storage facilities, distribution stations and control centres with their data centres (for dispatching). A failure of the infrastructure means that gas cannot be transported to end customers (households, industrial companies and businesses), which impacts them in various ways (e.g. no heating). The disruption occurs in the winter months. There is no redundancy for the high-pressure pipeline that is down.

As Switzerland does not have its own gas reserves, a reliance on imports is the most important cause of shortages. Political and trade risks in other countries should also be factored in. In physical terms, the principal danger to Switzerland's gas supply is damage to the pipeline network. Damage can occur as a result of natural hazards (e.g. earthquakes, mud flows, avalanches, rockfalls) but also accidents or terrorist attacks.

Influencing factors

The following factors influence the extent of the risk:

- Extent and in particular the duration of the disruption or halt to gas supply or to distribution.
- Properties of the affected pipeline (redundancy, diameter, pressure).
- Timing (season/holiday period/day of the week: gas demand from the public and businesses).
- Weather conditions during the supply disruption (particularly heat energy in the winter).
- Characteristics of the affected area (population and building density; businesses reliant on gas supply).



[13] *From the introduction 'Die Gasversorgung der Zukunft ist klimaneutral' ('The gas supply of the future is climate neutral') on the 2020 assumptions of the Swiss Association of Gas Industry*

Gas supply in Switzerland

The Transitgas pipeline is a particular risk in Switzerland's gas supply chain, but also an opportunity. In 2020, 70 % of Switzerland's gas requirement was imported via this pipeline. If the pipeline's transport capacity were reduced, importers would only have limited diversification options. However, in the event of a failure of the two interconnection points in the Transitgas pipeline (Wallbach and Oltingue/Rodersdorf), it would be possible – on the basis of current consumption – to temporarily import the required quantities of gas via the remaining cross-border feed-in points. In addition, the fact that the pipeline is very important to neighbouring countries is a guarantee that gas supply would remain financially attractive to foreign gas suppliers even in times of crisis, although in this context questions would be asked regarding the prioritisation of Italian and Swiss needs. The northern pipeline section, which is crucial to local supply (the import route to Wallbach) runs in both directions (reverse flow), which means that if there is disruption to one of the pipelines, gas supply can still be guaranteed. Since 2018, the Transitgas pipeline has been upgraded to allow natural gas to also flow from south to north (reverse flow); this additional redundancy further enhances Switzerland's gas supply.

Impact on critical supply processes and expected shortages

The gas consumed in Switzerland is mainly used for heating processes (drying, heating, cooking) and to a marginal extent as a fuel. For the gas industry, a failure of gas supply would mean increased workload (looking for alternative solutions, supporting gas customers, etc.)

In terms of gas supply, minor consequences would be expected, but not a shortage.

Industries that rely on natural gas expect a moderate impact. The possibility of shortages cannot be ruled out.

There could be production stoppages/delivery delays in industries and companies that are reliant on gas for production and for their buildings (e.g. paper mills and wood pellet factories for their heating and for drying of raw materials). Some 20 % of Switzerland's gas consumption goes to large consumers with dual-fuel systems. These systems can be switched over to heating oil if there are gas shortages. This allows supplies of gas to be stretched out.

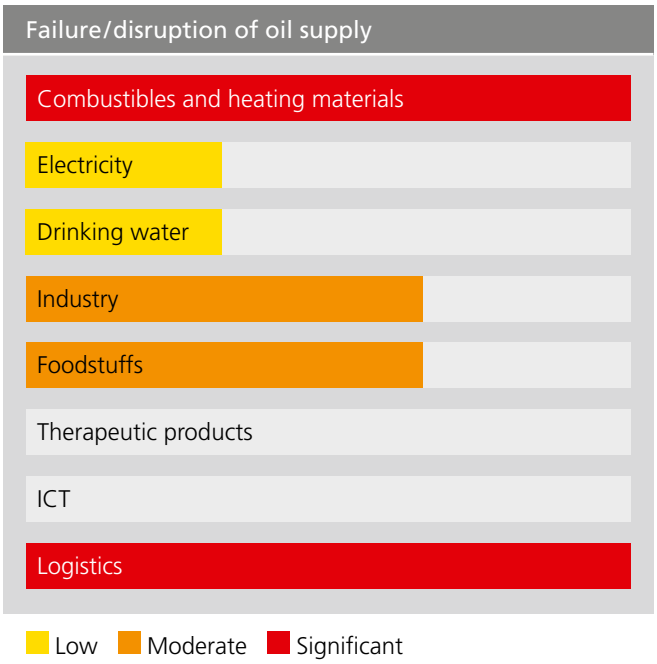
Meanwhile, there are other areas, such as agricultural production, which would barely be affected by a gas outage. No impact or shortages would be expected in electricity, ICT, logistics, drinking water, food, and therapeutic products.

3.4 Failure/disruption of oil supply

Just under 50 % of Switzerland's energy demand is covered by petroleum products. If the Swiss oil industry is no longer able to fully meet the demand for petroleum products in the whole or large parts of Switzerland for weeks or months, there would be a shortage. Depending on the severity and duration of the supply bottleneck, supply would be disrupted for most consumers without intervention by the NES. A shortage may only affect certain consumer groups, e.g. aviation.

Example scenario

This scenario corresponds to the 'extreme' category in the 'Disasters and Emergencies Switzerland' national risk analysis conducted by the FOCP from the petroleum supply shortage hazard file.



The extreme scenario assumes a global shortage of oil of 20 % on average over 1 to 2 years. There are shortages of fuel and heating oil. Consumption of fuels and heating oil would only be restricted after several months. Production processes are disrupted and petroleum products become more expensive.

By replacing oil-fired heating systems with heating pumps, using more efficient petrol and diesel vehicles and electrifying mobility, demand for petroleum products would steadily decrease. But as this would go hand in hand with a reduction in infrastructure (e.g. refineries, refuelling facilities) and market participants (e.g. importers, merchants, transport capacity), the supply chain would become less flexible and this would adversely affect security of supply. The decline in heating degree days (due to climate change) is also leading to a reduction in demand for heating oil.

The potential causes of a supply-relevant outage or disruption to gas supply in Switzerland are many and varied: import problems or distribution difficulties caused by logistics issues (high/low water levels in the Rhine, rail problems, pipeline failures, etc.) or due to conflicts in producing countries. Distribution can be affected by the destruction of critical infrastructure, attacks, technical defects or natural disasters.

Influencing factors

Switzerland is reliant on imports from abroad for all of its petroleum products. Heating oil is still the main heating energy used in Switzerland. Accordingly, demand is much higher during the cold winter months. However, there is a large amount of storage capacity along the entire supply chain. Importers as well as processors, merchants and households each have their own stockpiles.

Impact on critical supply processes and expected shortages

Everywhere that petroleum is used or is needed as an energy source for transport and to operate machinery, or for heating or as a raw material, a shortage quickly results in economic damage.

For the logistics division, a shortage of petroleum means that the transport of vital goods must be prioritised. Due to the rising oil prices, willingness to pay is another factor that has to be considered. In logistics, all areas are heavily reliant on the availability of fuels. This includes shunting locomotives, trucks, delivery vans, ships on the Rhine and aircraft. Consequences should be expected already in a scenario at a lower intensity.

Besides the ports on the Rhine, there are a number of other important infrastructures in the supply of petroleum products. If refuelling facilities in Vernier and/or the SAPPRO product pipeline broke down, this could lead to significant supply problems in the region in and around Geneva and Geneva airport. Significant disruption to the Cressier refinery and/or the crude oil pipeline to Cressier could lead to a longer-lasting refinery production downtime. A failure of the refuelling facility in the Greater Zurich area or the underground fuelling system for Zurich Airport would make it difficult or impossible to supply the airport.

For the area of natural gas, there are compulsory stocks of heating oil for the operation of dual-fuel systems (industrial system that can be switched from gas to heating oil) in the event of a shortage of gas. These compulsory stocks have to be regularly replaced (to maintain quality), which could be difficult if oil supply is disrupted. As compulsory stocks of heating oil would only be used if there was a simultaneous gas supply crisis, the risk to gas supply is classified as low.

The industrial sector would expect transport capacities to be restricted or lacking due to the non-availability of fuel, which could result in a shortage of raw materials, production stoppages and delayed deliveries. Likewise, the primary or secondary packaging of many goods is based on petroleum products, so their production would be affected.

All production and processing steps in the entire food supply chain substantially depend on petroleum supply. At the beginning of the chain, a bottleneck would particularly affect agricultural production. If there is a shortage of petroleum products, crops cannot be produced in the necessary quantities. This could particularly be the case if there is a protracted shortage.

A persistent shortage of petroleum would have a negative impact on the supply of therapeutic products. This can be attributed to lower production of therapeutic products, particularly medicinal products, as their primary and secondary packaging is based on petroleum products.

The areas of ICT, wood fuel and drinking water would only be marginally affected, particularly in relation to fuel for emergency power generators, commercial vehicles and heating oil for building heating systems.

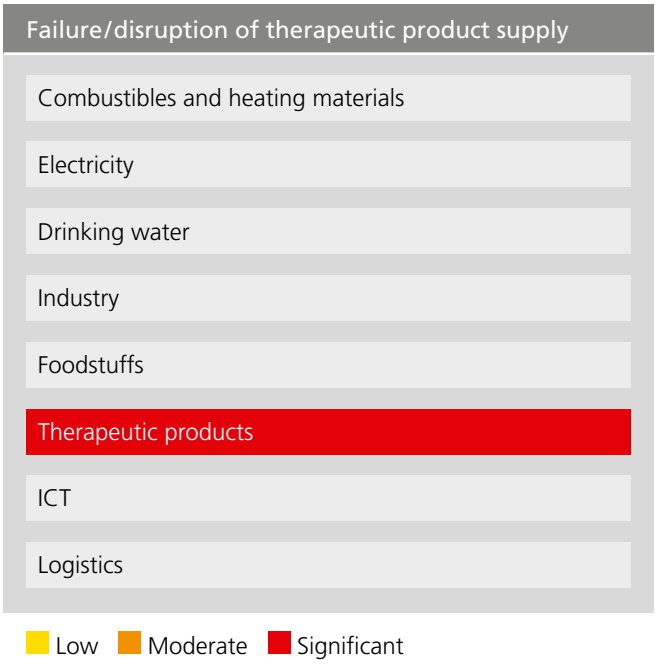
3.5 Failure/disruption of therapeutic product supply

If the supply of therapeutic products fails or is disrupted, a shortage exists if vital therapeutic products (medicinal products, medical devices and hygiene products) are no longer available in sufficient quantities in Switzerland.

Potential causes and influencing factors

Potential causes of a shortage or disruption to the supply of therapeutic products:

- The production of many active substances used in therapeutic products is concentrated on a small number of production locations, often in Asia. If one of these locations is unable to operate, this leads to a global shortage in the affected products. Although Switzerland is considered a traditional location for pharmaceuticals, the production of key products for primary care, such as vaccines and antibiotics, is often limited to a small number of manufacturers worldwide, and so it is also affected by a shortage.
- Fragmented supply chains and just-in-time production entail production risks and are frequently the cause of delayed delivery of therapeutic products.
- Pandemics, wars and natural disasters can cause a sharp rise in demand for specific groups of medicinal products, which cannot be covered by normal production.
- Cyberattacks pose a risk to supply chains for therapeutic products but also to the treatment of patients. For example, hackers can encrypt or manipulate patients' treatment information or authorise counterfeit medicines. This can lead to uncertainty and supply disruption, but can also put patients' lives at risk.
- The withdrawal of products from the market leads to a reduced product range and as a result more frequent supply bottlenecks because the barriers to market entry for substitute products are very high or the authorisation does not pay off.
- Another important influencing factor is the pricing of generic medicinal products. Particularly in the case of low-priced products with a small patient population (but high significance to primary care), even minimal fluctuations in profitability or demand, or additional regulatory requirements, can result in sale of the medicinal product no longer being profitable. Such medicines then disappear from the market. And due to the low potential profits, they are not replaced by the authorisation of a new medicinal product.



Example scenario

Shortage of a vital medicinal product: at present (in 2021), the heparin antidote Protamine is no longer available in sufficient quantities in Switzerland. This is due to the withdrawal of the manufacturing licence, which resulted in the bankruptcy of the active substance's manufacturer. Protamine stocks could be procured abroad in the short term. At present, however, there is no marketing authorisation holder for this vital medicine in Switzerland. Registering a new production facility for a Swiss marketing authorisation holder to supply the Swiss market would likely take four to five years. Until then, Switzerland can only procure goods licensed abroad.

Effects and expected shortages

A shortage of a vital medicinal product has far-reaching consequences for the affected patients and for Switzerland's health system. However, as medicines are very specific products for the patient groups in question, the consequences and the resulting shortages can vary widely.

COVID-19 pandemic

The COVID-19 pandemic has highlighted the consequences of a hazard scenario in a wide range of areas. Particularly for the Therapeutic Products division, it posed a huge challenge as demand for therapeutic products and protective equipment skyrocketed. The import and export of therapeutic products relevant to COVID-19 – including vaccines – was also severely limited due to the global nature of the crisis. Because of the long-term and tight production planning, the few central large-scale plants cannot usually respond to significant changes in demand at short notice, which is why a rise in demand quickly leads to a supply bottleneck.

Shortages of medicinal products had to be mitigated by the NES through releases of compulsory stocks, sale restrictions and quotas. Irrespective of the actual increased consumption of therapeutic products, there was also panic buying, which placed unnecessary demands on production planning and logistics for the relevant goods. To ensure that bottlenecks in the supply of therapeutic products could be recorded as rapidly as possible, a flexible monitoring system was developed. The NES is currently monitoring the supply situation with regard to COVID-19 medicinal products so that it can take swift action in the event of impending shortages.

The COVID-19 pandemic placed extra pressure on healthcare workers, many of whom were pushed to their physical and psychological limits. For these reasons, the staff who operate the hospitals should continue to be seen as a critical element in maintaining the healthcare system and controlling the pandemic. If no action is taken, labour shortages in the healthcare sector will continue to increase and could result in a situation in which patient care can no longer be guaranteed.

As the COVID-19 pandemic showed, a shortage of therapeutic products affects the availability of workforces (see labour shortages) and the operation of health infrastructures, which has a significant impact on all areas relevant to supply.

An interesting side note

There may be significant shortages of medical devices in Switzerland due to the failed framework agreement deal between Switzerland and the EU, as the applicable Mutual Recognition Agreement was not extended. This means that the mutual recognition of market authorisation no longer applies and Switzerland cannot access European safety data. Switzerland has also agreed to adopt the EU's new Medical Device Regulation (MDR), which means that manufacturers only receive market authorisation for their products after they have been re-assessed by notified bodies.

Owing to the large number of products to be assessed and the small number of notified bodies, we have to assume that not all medical devices will be assessed in time and that this may result in supply bottlenecks. As this also affects diagnostic products, such as reagents and laboratory tests, this area may also be supply-critical.

Quote

«If the supply of therapeutic products were to fail, it would be a scenario that would shake Switzerland to its core, provoke social and economic conflicts in society with implications for people's well-being, seriously challenge confidence in the government and its structures, and massively call into question medical progress. Measures to ensure resilience against such scenarios based on a private-public sector approach are therefore absolutely essential.»

Prof. em. Dr. pharm, Dr. h. c., hospital pharmacist FPH
Stefan Mühlebach, former head of the Therapeutic Products Division

3.6 Failure/disruption of ICT

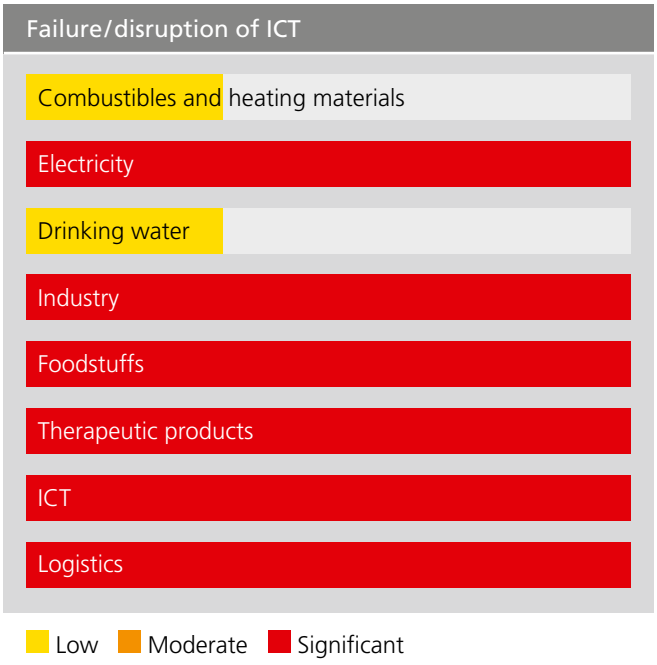
Information and (tele)communication technologies (ICT) affect every area of life today. Accordingly, access to these services is an essential resource for Switzerland. Access to four services is deemed relevant in supply terms:

- Emergency telephone numbers
- Means of informing and alerting the population
- Voice communication
- Data communication (internet)

When at least one of these services becomes completely unavailable or is severely disrupted, this is referred to as an 'ICT failure' or 'ICT system failure'. The term does not apply to system failures at a purely local level or temporary failures of short duration.

Example scenario

Following a cyberattack, a major Swiss telecoms provider is only able to provide a very limited service, if any. Cyberattacks can cripple the entire infrastructure Data used to control and monitor industrial processes is also transmitted via the provider's network. A large number of industrial processes (e.g. energy, logistics, foodstuffs) will therefore be affected by any system failure or disruption of data transmission.



Potential causes of an ICT failure with consequences for supply in Switzerland range from natural hazards to human error and from power outages to cyberattacks. Technical failure due to human error, e.g. faulty updates or configuration settings, can lead to services being disrupted.

Influencing factors

The ICT sector is almost completely reliant on foreign hardware and software. Geographically, the manufacturers that dominate the global hardware market (for semiconductors, chips, storage media, etc.) are mainly concentrated in Taiwan and China, and to a lesser extent also in South Korea. Given the highly standardised nature of the individual assemblies and the concentration in the hands of a few manufacturers, the loss of a single supplier can lead to shortages in the supply of hardware and associated spare parts. If large-scale incidents damage large quantities of hardware, making it necessary to replace everything simultaneously, the ICT failures will take much longer to rectify.

In addition, qualified ICT professionals are in very high demand globally. To guarantee supply in Switzerland, it is important to ensure that sufficient specialists can be trained and employed in the future.

Impact on critical supply processes and expected supply shortages

Any failure of critical ICT services will inevitably have an impact on every area of social and economic life. The chart on the right shows how severe the impact of the risk of an 'ICT failure' on the rest of the supply processes is likely to be.

ICT service failures typically occur without advance warning and come as a surprise. If they last for several days or more, this will have a major adverse effect on the National Economic Supply processes. ICT is basically an essential resource for all the specialist divisions. Thus, for example, it will no longer be possible to guarantee payment transactions if the relevant ICT systems fail.

The electricity sector relies on ICT to monitor and control the power supply. A failure here will not lead directly to a supply shortage as the relevant actors are prepared for such a situation; however, it will cause massive disruption. In terms of electricity supply, the loss of relevant ICT services will result in potentially significant shortages. In other words, electricity supply and the relevant ICT services are almost entirely interdependent.

Failures of specific systems or services can lead to major supply difficulties if systems that control critical infrastructures (power plants, transport systems, hospitals, etc.) are affected by them.

As far as the supply of therapeutic products is concerned, an ICT failure can lead to delays in customs clearance and the release, prescription, payment and manufacture of therapeutic products, resulting in availability becoming scarce.

When it comes to foodstuffs, ICT is a key component of the entire production and value chain. Failures in the ICT infrastructure will hamper food production and distribution.

In many logistics companies, resource management processes are now largely automated and digitalised. This means that ICT is used, for example, in rail transport production processes (e.g. for capacity management planning or traffic management). National and international distribution can therefore be severely affected or disrupted by the complete failure or restricted functioning of ICT systems. Major logistics supply problems can be expected even if the scenario is merely of 'major' intensity.

The only exceptions are the supply of drinking water and the supply of petroleum. Both are physical products that can still mostly be distributed without the aid of ICT. The drinking water supply can be managed via manually controlled physical valves and pumps, etc. And under normal circumstances, petroleum is usually delivered directly to the service stations or end customers by truck.

An interesting side note

One of the major threats currently facing ICT is that of ransomware attacks. 'Ransomware' is the name given to a type of software that enters an ICT system unnoticed then spreads and encrypts data, thus making that data impossible to use. The companies in question are then blackmailed by criminals who demand payment of a ransom to restore access to their data. In addition to causing extensive financial damage, ransomware attacks can also have implications for supply or pose a risk to life and limb. If, for example, a hospital is no longer able to access the patient database, its efficiency will be greatly reduced and there will be a risk of mix-ups leading to treatment errors. In the logistics sector, tour planning systems or warehouse management systems, for example, can be attacked. An attack of this kind has potentially serious consequences for the affected logistics company's ability to operate.

3.7 Failure/disruption of import

The 'import problems' risk category is understood to mean supply difficulties arising from challenges in importing goods. It refers to a situation in which it is no longer possible for Switzerland to import essential goods, either within the required timescale, or of the necessary quality, or in sufficient quantities.

Potential causes

Political factors are one cause of import problems. For instance, during COVID-19, various governments imposed export restrictions on medical goods to guarantee the supply of their own market. Political factors also include technical barriers to trade and the lack of mutual recognition of labels, test procedures and declaration regulations, etc.

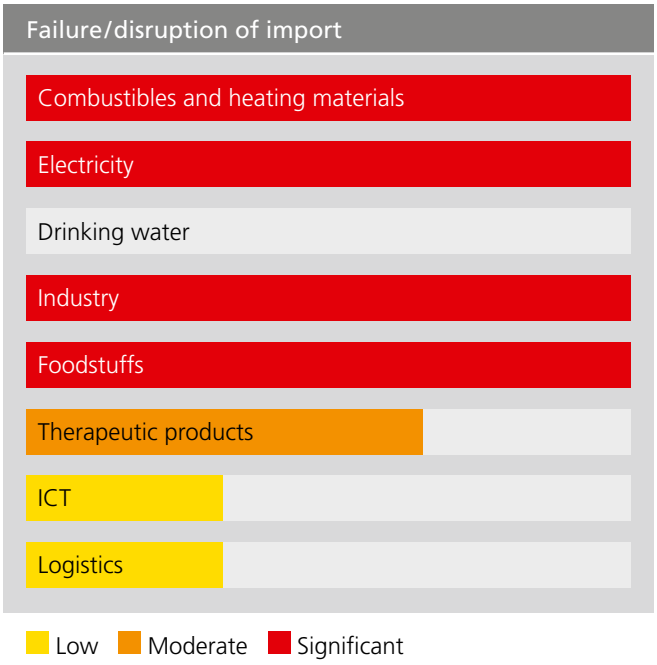
A sharp increase in demand, such as for COVID-19 vaccines or semiconductors, can lead to import restrictions. Import problems can also be caused by problems related to the production or availability of goods.

Crises in the countries of origin are the main influencing factor. Generally speaking, under normal circumstances, when the supply of essential goods is guaranteed, countries rarely introduce export restrictions. In situations where there is sudden shortage (e.g. because of the exponential increase in demand for protective equipment during the COVID-19 pandemic), export restrictions may be imposed. Import problems can be both a consequence of international trade conflicts and a means of exerting pressure.

Example scenario

Following the outbreak of COVID-19, a number of countries imposed export restrictions on medical supplies and protective equipment. This made it very difficult for Switzerland to import goods from these countries in the short term – and in some cases temporarily impossible.

The UK's exit from the European Union and thus from the customs union led to tailbacks of lorries on both sides of the English Channel, causing delays to the imports and exports of certain goods.



Impact on critical supply processes and expected supply shortages

Import problems have a notable impact on those sectors which are more or less always heavily dependent on imports, with foodstuffs, therapeutic products, industry, and energy produced from oil or natural gas being particularly hard hit. Severe supply shortages of essential goods can be expected in every area during a serious crisis.

Switzerland's gross self-sufficiency ratio for foodstuffs is just under 60%. This will leave it in a highly vulnerable position if imports fail, with consequences for the supply of the following goods in particular: durum wheat, vegetable fats/oils and animal feedstuffs. Major shortages of fruit and vegetables could likewise be expected, although their contribution to the calorie supply is relatively limited. In terms of inputs, this applies to certain seeds. Sugar beet seed, for example, is completely reliant on imports.

Strong cost pressure means that most basic medicines and many medical devices are produced centrally. The Therapeutic Products Division believes that this scenario could also have a considerable effect on supply as only one product is placed on the market for certain medicines, making rapid substitutions impossible. The entire chemical/pharma/life sciences industry, the packaging industry and the entire industrial manufacturing sector are almost completely reliant on imports of raw materials

and semi-finished products. The basic materials required to produce plastic packaging for the food and pharmaceutical industries are all imported from abroad and processed here. If imports of semi-finished products (granulates) fail or are delayed, packaging is also likely to be in short supply. That is why the free movement of goods, people and finance across borders is crucial to guaranteeing supply.

The Drinking Water and Petroleum sections of the Energy Division operate on the assumption that the time component is particularly relevant when it comes to estimating the effect on supply, given that the reserve capacity and operational stockpiles are both limited. In the same way, the time component plays a role in food production as, for example, fertiliser is needed at a specific time and may have negative consequences for the harvest if not available. This risk, and especially that of long-term disruption, is increasingly becoming a problem for ICT too given that the production of ICT parts is mainly concentrated in three countries: China, Taiwan and the United States. Critical situations can arise when, for example, a manufacturer of system boards (e.g. bays for a server) is affected. 'Operational technology' (e.g. vehicle technology) is another area in which critical situations can arise when the manufacture of spare parts (e.g. semiconductors) becomes impossible. The current shortage of chips for the automotive industry and its suppliers is one topical example.

Switzerland's supply of natural gas comes from diversified sources and many different regions (EU, Russia, Africa), the risk of a shortage that is relevant to the national economic supply is estimated to be very low. However, as Switzerland has no significant storage capacity, any loss of natural gas imports would be critical. The Logistics Division does not anticipate any great impact either so long as imports of spare parts, means of production, etc. can be guaranteed in the medium term.

3.8 Failure/disruption of domestic industrial output

A 'loss of domestic critical industrial output' means that Switzerland's ability to manufacture critical industrial goods is no longer guaranteed.

Depending on how long and serious a loss of this kind were to be, companies reliant on industrial goods that cannot be replaced by imports could no longer be guaranteed an unrestricted supply. In this case, their end customers could also expect to experience shortages.

Example scenario

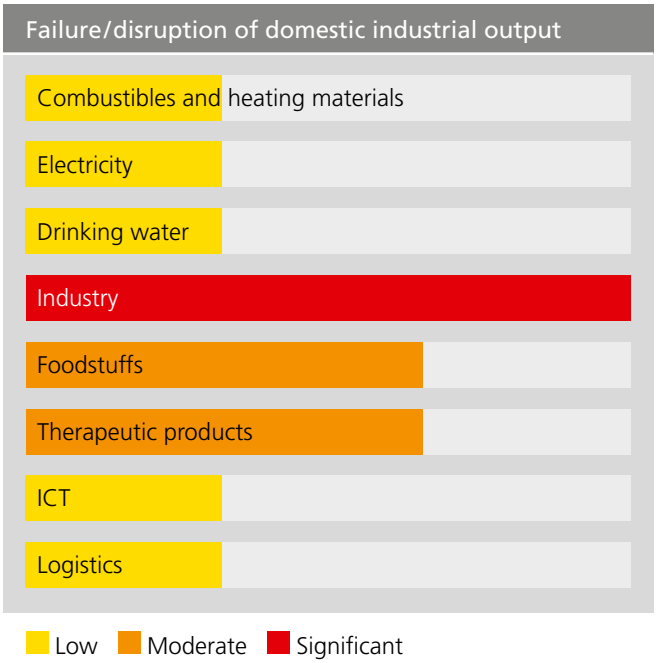
Due to the centralisation of production processes, the manufacture of raw materials and semi-finished products is concentrated in the hands of a few companies on which the others are highly dependent. Our example scenario assumes that it is no longer possible to procure certain raw materials and semi-finished products and that key companies requiring these goods for their manufacturing activities in Switzerland will therefore no longer be able to produce any output for weeks or even months.

Other potential causes of a loss of domestic industrial output with implications for supply are many and varied: import difficulties, electricity blackouts, restricted access to ICT, failure of logistics services, increasing barriers to trade and labour shortages.

Example: In the spring of 2021, more than 40 plants in Europe that produce plastic granules shut down production for a lengthy period, claiming 'force majeure' (a term used by companies to justify the impossibility of performing their contractual obligations). In addition, there was a sharp rise in global demand. The raw materials and, in some cases, plastic packaging could not be imported into Switzerland in sufficient quantities. This 'import problem' led to a deficit in Swiss manufacturing output. 50,000 processing companies across Europe were affected by shortages of plastic raw materials.

Influencing factors

As a manufacturing location, Switzerland is under pressure from increasing globalisation, monopolisation and the ensuing centralisation. In the course of globalisation, the production or production processes of certain goods have become concentrated in a handful of locations, some of which single-handedly supply entire continents or even the global market. If manufac-



turers with this kind of market power stop producing, cut back their output or withdraw from the Swiss market on regulatory grounds, or if logistics bottlenecks arise, Switzerland's industrial sector is no longer able to function adequately because of its dependence on raw materials and semi-finished products from foreign suppliers. Supply shortages arise.

The chemical and packaging industries will continue to focus on the manufacture of speciality products in order to remain competitive. The manufacture of products that are no longer profitable in terms of price will be relocated abroad. As a result, Switzerland's dependence on foreign suppliers will increase and its security of supply decrease. Free trade will therefore become increasingly important. The trend towards more protectionism and unilateral measures (export restrictions, 'Buy American' in the United States, the Industrial Strategy and Green Deal in the EU, China's aggressive foreign and trade policies) create obstacles to (barrier-)free trade.

The entire chemical/pharma/life sciences industry and the packaging industry are almost fully reliant on imports of raw materials and semi-finished products. That is why the free movement of goods, people and finance across borders is crucial to guaranteeing supply. Because most supply chains are global in nature, the availability of suitable means of transport (road, rail, air and water) and the corresponding transport capacities is essential for the supply of raw materials and commodities and intermediate products. Increasing regulations and new legal requirements further limit companies' scope of action, which could lead to them migrating abroad.

The Swiss packaging industry mainly consists of medium-sized SMEs, which are often too small to keep up with the global players when it comes to the allocation of scarce goods. Globalisation also means that professionals with specialist expertise in support functions no longer work in Switzerland.

Impact on critical supply processes and expected supply shortages

Any loss of domestic critical industrial output will inevitably have an impact on every area of social and economic life. The chart on the right shows how severe the impact of the supply problems on the individual areas is likely to be. Occurrence of the risk would impact every area.

Any loss of critical industrial output will have an impact on foodstuffs and therapeutic products in particular. In both cases, the supply processes rely on production machinery, packaging materials and semi-finished products, among other things. As far as the supply of therapeutic products is concerned, a loss of manufacturing output, e.g. in the chemical production of active pharmaceutical ingredients, will prevent the market being supplied with medicine.

This is particularly critical in cases where there is an acute need for products with a short shelf life or no stockpile of goods that could compensate for the loss.

In the case of grid-connected goods, such as electricity, ICT and water, any loss of domestic industrial output has potential consequences for grid and plant construction if, for example, construction materials, tools, spare parts, etc. are not available in sufficient quantities. For logistics services, any prolonged loss of domestic industrial output can impede the availability of spare parts and hamper maintenance work on vehicles or routes.

As these impacts can last for several months, the goods no longer being produced can only be substituted if another market participant makes additional investments and provided that it is possible to transfer knowledge and permits are available from the authorities.

3.9 Failure/disruption of food supply

According to the UN Food and Agriculture Organization (FAO), food security exists when all people, at all times, have access to sufficient, safe and nutritious food. There are four dimensions to food security: availability, access, utilisation and stability.

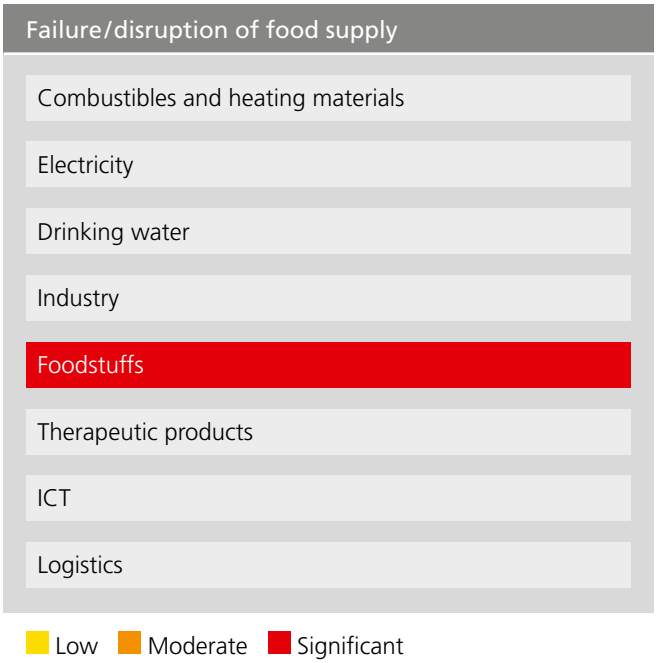
However, problems can invariably arise in just one of these dimensions. Availability can be jeopardised when global crop failures cause a shortfall in the procurable quantity and the exporting countries ensure that their own domestic market is supplied first. Stability is increasingly threatened by the impacts of climate change.

Example scenario and influencing factors

There are many situations in which food supply shortages can arise, the main difference between them being timing and location: regional/national events, such as strikes, blockages of logistics routes and natural hazards, can lead to shortages lasting from days to weeks. Continental events, such as the failure of an enterprise that is crucial to supply, the emergence of a pathogenic virus or political restrictions, can lead to food running out for up to 12 months. Global events, such as a pandemic, volcanic eruptions or climate events on different continents, can affect supply for at least 12 months. Value chains can also be interrupted if, for example, too little packaging material is available or logistics are disrupted.

The supply of food essentially depends on ensuring that sufficient foodstuffs and production inputs can be imported. The gross self-sufficiency ratio, in which domestic production is included on the basis of imported feedstuffs, is just under 60%. Domestic production of food energy has been falling for around five years. Goods from abroad are needed to produce many foodstuffs, especially in the case of seeds and plant protection products.

Important factors for Switzerland's future food security include: A) Maintaining the quality and quantity of agricultural soils. B) Reducing the dependence on non-renewable resources. C) Taking additional steps to achieve a mode of food production that is adapted to local conditions and uses resources efficiently, including ensuring that the required knowledge and processing capacities are available.



Dependencies

To ensure a sufficient supply of food in Switzerland, the following two conditions must be met:

- All ancillary resources must function: essential services such as the ICT infrastructure or power supply must function properly. Any failure of these ancillary resources, whether in full or in part, will make measures to guarantee food supply much more difficult or impossible.
- Networking: Switzerland relies on the good functioning of its international network, especially with neighbouring countries, for the supply of essential foodstuffs and production inputs.

Impact of risk

With a few exceptions (power failure or logistics problems), supply problems involve a time lag. Foodstuffs usually take a long time to grow between sowing and harvesting, and their production cannot be adjusted during this period. Accordingly, the timing of a crisis is crucial when it comes to assessing the situation. The impact will vary depending on the crop, growth phase, region (global or national) and quantity affected. However, the availability of raw products is not in itself enough.

If a supply shortage is severe, too few essential foodstuffs will reach the consumers. Accordingly, a deficit in this area affects many other areas of daily life (see chart).

The increasing complexity of the supply processes for foodstuffs and production inputs makes identifying the effects of numerous risks in good time challenging.

In general, when individual foodstuffs become unavailable, it is usually possible to replace them with other products. The same is not true of the means of production, which frequently have very specific uses and are therefore not substitutable.

A great many national and international trends and developments will shape the agriculture and food industry over the next four years. Some of these trends will have a significant and rapid influence on the environment, such as climate change, just-in-time production, increasing digitalisation and concentration, especially in the provision of inputs, the spread of invasive species, the battle for resources, population growth, etc. The general assumption is that these changes are likely to create greater vulnerability.

3.10 Failure/disruption of logistics

Risk

Logistics failure means a breakdown of or significant disruption to the logistics processes in Switzerland or abroad, including road, air and rail transport. Shipping is dealt with separately (see Risk 3.13 Shipping failure).

In addition to the availability of raw materials, semi-finished products and finished goods, a well-functioning logistics system is essential to supply in Switzerland. These goods find their way to the right place at the right time only thanks to sophisticated logistics systems, which are of fundamental importance to every single supply-related area.

Example scenario

The failure of an important logistics infrastructure will severely restrict the transshipment and/or transport of goods, or even make it impossible for several months.

In 2017, tunnel construction work at Rastatt in Germany resulted in the lowering of the Rhine Valley Railway track above the tunnel. The line was closed for almost two months. It forms part of the main rail corridor from the North Sea ports and Germany to Switzerland. It is of major importance both for imports and freight in transit. Detours had to be taken and/or goods transferred to other modes of transport.

Potential causes

The potential causes of logistics failures/disruptions with implications for supply are many and varied:

- Natural events such as avalanches, earthquakes and floods can damage the logistics infrastructure.
- Pandemics can cause major staff shortages and make the provision of logistics services difficult or even impossible.
- Restricted availability of ICT, electricity or fuel will disrupt the supply process as they all play a key role in the provision of logistics services.
- Blockages on major import routes (e.g. the Rhine) can lead to supply shortages for specific goods.

Influencing factors

The most important influencing factors are the extent and, above all, duration of the disruption to the logistics infrastructure.

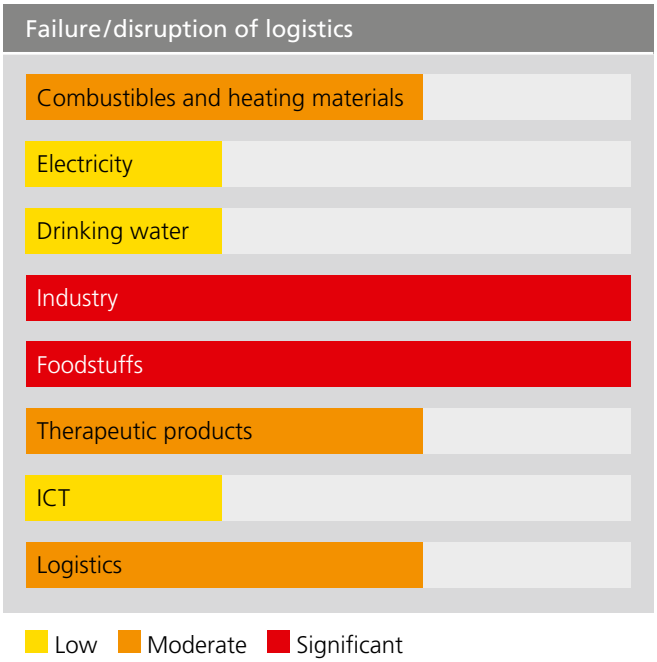
Other factors influence the impact of the risk:

- Possibility of using alternative transport routes and/or modes of transport.
- Possibility of 'increasing' existing transport capacities by granting exemptions.
- Prioritisation of modes of transport and goods.

Impact on critical supply processes and expected supply shortages

Any failure of logistics services will inevitably have an impact on every area of social and economic life. The chart below shows the severity of the impact of the supply problems on the individual areas.

Supply shortages are possible or likely to occur in a number of critical supply processes in the event of a logistics failure because of the highly important role it plays in them. The impact is expected to be significant in the case of foodstuffs and industry, and moderate in the case of therapeutic products and logistics. Foodstuffs are likely to be in short supply. The impact on energy will be either low or moderate, depending on the energy source. Supply shortages are anticipated for wood fuel and deemed possible for petroleum. The impact on the supply of digital services in the ICT field and on drinking water is thought likely to be low, and no supply shortage is expected.



If critical logistics services fail, many supply processes can expect to be affected. With the exception of foodstuffs, which would experience cascading effects, the duration of (any eventual) supply shortage is assumed to match the severity of the failure.

The supply of essential means of production and foodstuffs relies on all modes of transport. Once harvested, crops such as sugar beet are transported by rail for processing in sugar factories. The final stage of distributing means of production and foodstuffs is carried out by road. Consequently, the entire supply chain hinges on logistics, i.e. logistics is a key factor in the supply of foodstuffs. The time at which the risk-related damage occurs also plays a role here. The adverse effect on logistics services will vary depending on seasonal fluctuations – whether or not a production plant is at its busiest, e.g. due to seasonal processing.

Logistics is also crucial to industry. If the logistics system fails or fails to function properly for a lengthy period, this will lead to resupplying problems, thus disrupting production and supply in all areas. The current widespread practice of just-in-time supply will no longer be possible. In an extreme scenario, the capacity of alternative transport routes or means of transport may be limited to such an extent that raw material supplies will be severely disrupted for a considerable length of time. This would limit industrial manufacturing as a whole and make a supply shortage of relevant products for foodstuffs and therapeutic products conceivable.

In the case of therapeutic products, the reduced availability of emergency medication which is required by the affected patients immediately could lead to problems.

Certain key logistics routes are vital to supplying Switzerland with petroleum. Disruption to shipping at the Swiss Rhine ports, the port railways, the SAPPRO pipeline, the various tank facilities, the Cressier refinery and its loading terminal as well as the Gotthard railway line could have consequences leading to a reduction in supply. Temporary problems in replenishing the supply of hardware elements could occur in the ICT field.

3.11 Failure/disruption of mobile network

Information and (tele)communication technologies (ICT) shape every area of life today. Accordingly, access to these services is an essential resource for Switzerland. With the continuing decline in popularity of fixed-line telephones, mobile communications have become the most important form of technology for citizens to send alerts and contact the emergency services. The mobile network is increasingly being used to communicate information to the population both in normal times and in crisis situations (e.g. the AlertSwiss app allowed more than one million users to be reached directly by smartphone in 2021 and informed about relevant incidents). The number of industrial applications reliant on various mobile technologies for data transmission is also increasing. For example, sensor data is transmitted via mobile networks to monitor processes relating to the power supply, drinking water supply and public transport. Network outages make it difficult to control these industrial processes.

Example scenario

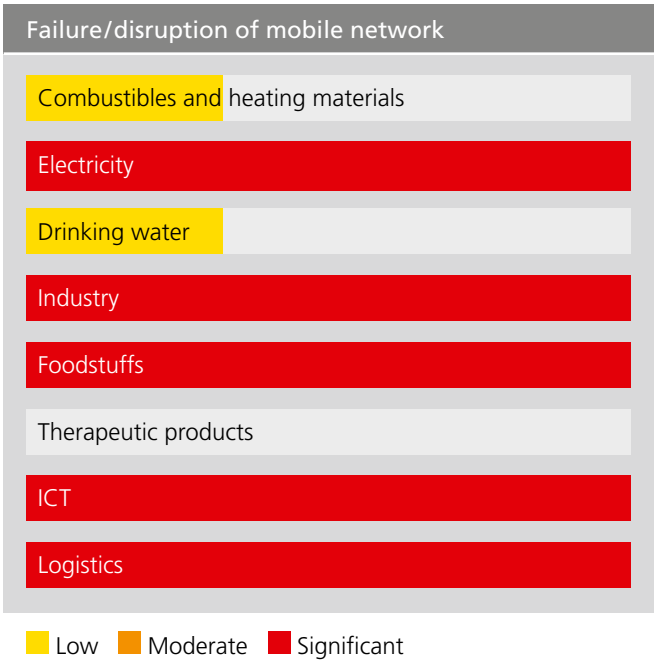
This scenario corresponds to the 'extreme' level of the National Risk Analysis of Disasters and Emergencies in Switzerland and the FOCP's 'Mobile network outage' hazard file.

A major Swiss telecoms provider's mobile network crashes completely. Emergency numbers are also affected. The service goes down at the start of the working week and stays down for six days. Data for monitoring and controlling industrial processes is also transmitted via this provider's network. The mobile network outage causes disruption to several other supply processes, e.g. public transport and the electricity supply.

Potential causes

The potential causes of one or more of Switzerland's mobile networks failing, with consequences for national supply, are many and varied:

- Physical destruction, such as severe natural hazards (floods, avalanches and storms can damage lines, data centres and transmission masts).
- Human error leading to technical malfunctions.
- Power failures making it impossible to operate the systems.
- A cyberattack against a major mobile provider leading to network outages.



Influencing factors

Switzerland is almost completely dependent on other countries when it comes to mobile hardware. Swiss telecoms providers rely on the availability of hardware and software produced abroad both to construct and operate their networks. Some countries have ruled out the use of mobile communications technology produced by certain manufacturers to reduce the risk of espionage or sabotage. The expansion of mobile networks is of particular importance. Their importance to the economy and society continues to rise in response to the steadily growing volume of data, making a rapid and widespread rollout of 5G technology necessary. There is a risk that the increase in capacity will not be able to keep up with the growing demands. Digitalisation and automation are giving rise to more and more industrial processes that rely on a functioning mobile infrastructure for control and monitoring purposes. The further this structural change advances, the greater that dependence will be in the future. (See also: Risk 3.6: ICT failure)

Impact on critical supply processes and expected supply shortages

A mobile network outage will have major consequences for society and the economy. The chart on the right shows the severity of the impact of the supply problems on the individual areas.

A mobile network outage is expected to have a particularly significant impact on the control and monitoring of industrial processes, which could lead to supply shortages. Food production, public transport and power supply processes, for example, can all be affected. For the general public, the lack of access to emergency telephone numbers in particular can have devastating consequences.

Digital service failures typically occur without prior warning and come as a surprise. A mobile network outage lasting several days will cause significant disruption to supply processes.

The electricity sector partly depends on functioning mobile networks to monitor and control the power supply. Reservoir water levels, for example, or electricity metre readings are transmitted over the mobile network. The same applies to public transport and other industrial processes. For instance, elements of railroad track production can be affected if GSM-R connections fail.

Service planning in general is likely to experience strong negative effects. Members of decentralised workforces, such as sales representatives, suppliers, service technicians, but also building maintenance and Spitex care employees, rely on properly functioning mobile connections as they increasingly use smartphones to organise their work. Mobile telephony is an important tool for service technicians who provide a maintenance and on-call service for critical infrastructures such as electricity, water and gas supply lines. If natural hazards affect parts of the supply lines as well as parts of the mobile communications infrastructure, for example, this will have a cumulative negative effect by making the repair work even more complicated.

Mobile communications, for their part, rely on the operators having properly functioning lines and data centres. They are also highly dependent on the power supply, and vice versa. Power failures have the potential to severely restrict the availability of mobile communications, while supplying power is increasingly reliant on mobile communications.

The supply of drinking water and petroleum is less affected. Both are physical products that can mostly be distributed without the aid of ICT. And under normal circumstances, petroleum (with the exception of kerosene) is usually delivered directly to the service stations or end customers by truck.

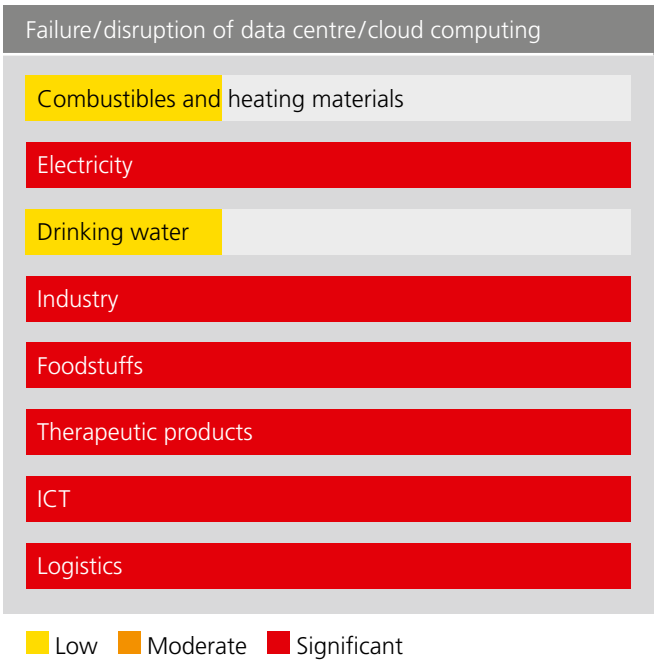
An interesting side note

Mobile data traffic is growing steadily. In 2017, approximately 56% of the data volume was generated by videos (image transmissions in areas such as entertainment, production, education, video conferencing, surveillance, medicine, and virtual and augmented reality). This figure is expected to rise to around 73 % in 2023. The current sharp rise in mobile data volume can really only be met by increasing the capacity of existing cell sites. Expanding capacity in this way on the basis of the existing 4G technology comes at a price. The current generation of mobile technology has almost reached its technical limits. This will mean congestion for everyone using these cellular networks.

It is interesting to note that the COVID-19 situation did not slow down data growth, but it did ease data congestion as users working from home were spread more evenly throughout Switzerland and using the network at different times. Both factors reduced the peak loads.

3.12 Failure/disruption of data centre/cloud computing

The risk of a data centre outage is defined as the failure of critical, cloud-based applications at a company that plays a key role in the supply chain. The operators of critical infrastructure are now also increasingly outsourcing their data and ICT processes to commercial data centres. An outage can affect office automation systems, ERP systems, communication systems, databases, and OT and SCADA systems. The failure of a cloud operator therefore has the potential to paralyse these processes. However, responsibility for purchasing an adequate level of protection (e.g. geo-redundant storage) lies with the customer. The consequences of a cloud computing failure, for example, are often the result of the customer misjudging the availability and resilience of the service. It is up to the customer to buy appropriately designed services from the ICT provider that meet the expected criteria.



Example scenario

Several critical infrastructure operators, or even an entire sector, are affected by the outage of a data centre to which they have outsourced their data. When communicating their requirements to the provider, the companies did not insist that the data be stored geo-redundantly or check whether this would be the case. As a result of the data loss, the companies are no longer able to provide their services, and their production or business processes come to a halt. No requirements for geo-redundant data storage and service delivery were contractually agreed, and implementation was not monitored. It is conceivable that a wide variety of critical infrastructures will be affected simultaneously by this same event and that they will all fail concurrently if the necessary requirements are not met.

Potential causes

Data centre outages and cloud computing failures have occurred several times in the past, affecting both national and international providers.

The causes are manifold and range from accidental human error to faulty updates and cyberattacks. Data centre services depend on properly functioning transmission lines. Their impairment leads to cascade effects.

Influencing factors

More and more, data, services and processes are being transferred to the cloud, mainly because of the advantages that a cloud-based services business model offers end customers. Flexibility, scalability and the option of purchasing services tailored to their own risk (data redundancy, backup processes, etc.) via service level agreements (SLAs) make this model attractive to customers and create many commercial opportunities. At the same time, dependence on the service provider gives rise to new risks. These may be of a data protection, technical or financial nature. US companies are the dominant global providers of cloud services. They are subject to national regulations (Patriot Act, Cloud Act, etc.) which may pose a risk to non-American customers with regard to the confidentiality of business secrets. See also: Risks to National Economic Supply 2021: 'Failure/disruption of ICT' and 'Failure/disruption of mobile network'

Impact on critical supply processes and expected supply shortages

Any failure of critical cloud-based ICT processes has the potential to severely disrupt or completely paralyse customers' business processes and thus lead to a shortage. Serious repercussions can be expected for the research, development and production of therapeutic products. Many pharmaceutical companies do not run their own data centres, but buy in this service. The logistics sector is also likely to experience significant disruption if critical ICT processes fail, e.g. with regard to tour planning or enterprise resource planning (ERP) software. This kind of resource planning software is also used by the emergency services and cantonal and national authorities, for example. If customers are no longer able to use their ERP software, this can also impede the ability of these governmental organisations or emergency services to function properly, or bring them to a standstill.

Digital service failures typically occur without prior warning and come as a surprise. Any outage lasting several days or more will cause significant disruption to supply processes. This is where cloud services are able to provide additional redundancy. At the same time, some global cloud service providers (for both infrastructure and software) have achieved such a dominant market position that any downtime on their part would inevitably hit many different companies and organisations equally hard, regardless of where they were located. Thus, the biggest risk from the point of view of national economic supply is risk accumulation or the development of a cluster risk. A major ERP solutions provider can have customers in the energy, healthcare and logistics sectors, all of whom will then be affected by a failure at the same time and to the same extent. The same applies to dominant global providers of office automation applications, especially as voice communication solutions are increasingly becoming an integral part of the office environment.

In terms of electricity supply, the scenario would only have to be of significant intensity for the failure of key data centre services to result in supply shortages. In other words, electricity supply and the relevant ICT services are almost entirely interdependent. Shortages in the supply of petroleum and therapeutic products can be expected in scenarios of a 'major' or 'extreme' intensity level, and in logistics in 'extreme' scenarios.

An attack on a US cloud service provider that was uncovered in 2020 impacted customers worldwide. The outsourcing of data, processes and services to global providers therefore has the potential to be affected by events that lie outside the outsourcer's control as well as outside the sphere of influence of national economic supply.

Driven by data privacy concerns, or to better protect themselves from industrial or political espionage, various governments have enacted regulations on the outsourcing of critical data to cloud service providers or have banned certain providers.

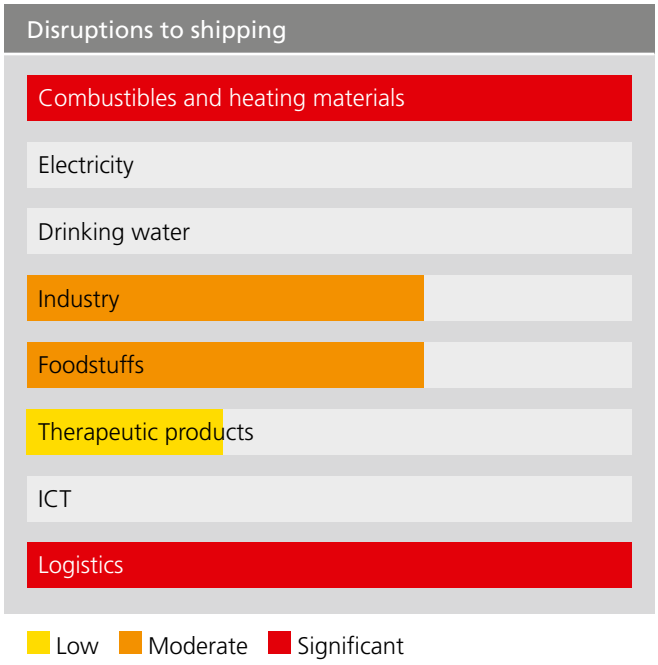
3.13 Disruptions to shipping

The use of navigable waters such as rivers and lakes for passenger or freight transport can be impeded by the occurrence of hydrometeorological and other natural hazards, leading to 'disruptions to shipping'. The Rhine especially, together with the Swiss Rhine ports, is hugely important for the import and export of goods.

Example scenario

This scenario corresponds to the 'extreme' level of the National Risk Analysis of Disasters and Emergencies in Switzerland and the FOCP's 'Disruptions to shipping' hazard file.

The Kembs lock is located on the Rhine, a few kilometres downstream from Basel. A total closure of the two lock chambers for six months leads to the Rhine being closed to shipping between the next port downstream from the lock and Basel for an equally long period of time. This obstructs the Swiss Rhine ports' direct corridor to the seaports. Other modes of transport must be used to convey the (import and export) goods between Switzerland and the next closest port or from and to the seaports.



Low water levels in the Rhine regularly have an adverse effect on logistics processes in Switzerland. A considerable share of Switzerland's petroleum needs is met by imports along the Rhine. If water levels are too low, cargo ships can no longer be fully loaded, thus significantly reducing their transport capacity.

Potential causes

Disruptions to shipping with implications for supply can be caused by various factors. For example, low or high water levels, accidents, technical problems at infrastructure facilities, deliberate destruction of infrastructure facilities, earthquakes and cyberattacks on infrastructure control systems can all lead to relevant disruptions to shipping.

Influencing factors

The key factors influencing the threat of a disruption to shipping are the extent and, above all, duration of the freight traffic restrictions on the Rhine but also the amount of prior warning.

- Possibility of unloading ships at the Rhine ports in Alsace or Baden-Württemberg and transporting the goods from there to Switzerland; plus, whether or not cross-border movement is hindered by (French, German) government measures.
- Possibility of switching to rail and/or road, provided there is sufficient time to prepare a risk plan in advance, especially for petroleum products, fertilisers, feedstuffs and vegetable fats/oils. However, doing so for all goods simultaneously is unrealistic.

Impact on critical supply processes and expected supply shortages

Any disruption to shipping will have an impact on every area of social and economic life. The chart on the right shows the severity of the impact of the supply problems on the individual areas.

If the Rhine remains closed to large-scale shipping for a lengthy period or there are prolonged low-water phases, this can be expected to have an impact on many supply processes. (Any) supply shortages in the affected areas are likely to last for several months.

Fertilisers, for example, are transferred onto inland vessels at the seaports and then brought to the Swiss Rhine ports via the Rhine.

A significant amount of petroleum products are imported via the Rhine. The low-water situation in 2018 showed that disruption to shipping on the Rhine cannot be completely offset by switching more imports to other modes of transport (mostly rail). However, the exact extent of the supply disruption is influenced by the season (in summer it is possible to prioritise diesel oil) and the rail capacity utilisation situation in Germany.

The problems facing industry are reflected by the fact that a longer-term closure of the Rhine to shipping, as in this extreme scenario, will interrupt the resupply of important raw materials and/or primary products, thus leading to production shutdowns and delivery delays for goods in the food and therapeutic products industry.

The situation is similar with regard to foodstuffs, where fertilisers, feedstuffs and certain vegetable fats/oils are important primary products in food manufacturing. Whether there is sufficient time for advance risk planning is paramount in this area.

Scenario intensity

Disruptions to shipping are of no relevance to drinking water, electricity, natural gas and ICT, regardless of the intensity of the scenario. Consequences are expected for wood fuel even if the scenario is merely of significant intensity, but only in the form of supply shortages, if any. Logistics can expect to be impacted if the scenario is classified as 'major' or higher. In the case of foodstuffs, petroleum, therapeutic products and industry, the scenario would have to be 'extreme' for effects to take the form of supply shortages. However, a supply shortage would not necessarily occur for therapeutic products.

Assessment

«*The Central Commission for the Navigation of the Rhine assumes there will be a further rise in freight volume on the Rhine. Because of climate change, prolonged droughts will affect the Rhine's water levels. We will increasingly be faced with low water levels and, consequently, with constraints on the transport of goods on the Rhine.*»

Bruno Egger, Logistics Secretariat

An interesting side note

The importance of unhindered shipping on the Rhine and thus its contribution to the security of supply is illustrated by import volumes: in 2020, for example, a total of 672,000 tonnes of fertiliser, agricultural products, foodstuffs and feedstuffs, as well as 2,253,000 tonnes of oil and petroleum products were imported via the Swiss Rhine ports. Together, these account for about 68% of the 4,280'000 tonnes of goods imported via the Swiss Rhine ports (source: Port of Switzerland, Monthly Bulletin, December 2020).

In July 2021, the Rhine had to be closed to shipping in many places due to high water levels. The geographical spread and duration of the closures were above average for flood situations Basel's Rhine ports were closed for over a week.

3.14 Power failure (blackout)

A power failure refers to the loss of the electricity supply. If this is large-scale and affects a large number of people, it is known as a 'blackout'. In general, a large-scale power failure can be caused directly by an upset in the balance between electricity consumption and generation. This can be due to a lack of generation (power plant outage/loss of generation capacity, insufficient generation) or a lack of transmission line capacity (overloading) as well as synchronisation problems (generation) and drops in frequency or voltage. Around 25% of Switzerland's demand for power is met by electricity (for heating, as fuel and as an energy source for various applications, such as electric motors, cooling systems, pumps and many more).

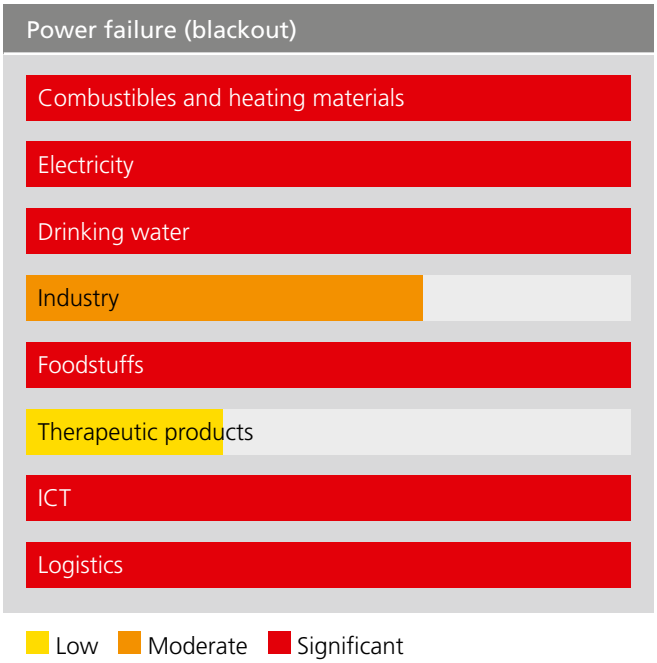
Example scenario

This scenario corresponds to the 'extreme' level of the National Risk Analysis of Disasters and Emergencies in Switzerland and the FOCP's 'Power failure' hazard file.

The example scenario envisages physical damage to the grid infrastructure throughout Switzerland. The extra-high voltage network is put completely out of action for five to seven days. This happens during the winter months. It takes three to four weeks to gradually restore the network.

Future trends/developments

- With the proliferation of decentralised energy systems (photovoltaics, wind turbines, etc.), controlling electricity generation and consumption is becoming increasingly complex.
- The use of increasingly complex smart control mechanisms is becoming a must at every level – in generation, in transmission and by end users (smart meters, smart grid).
- The growing networking of systems and the use of smart control mechanisms greatly increases the risk of cyberattacks and their effects.
- Establishing comprehensive cybersecurity measures is becoming an increasingly demanding task.



Potential causes

Technical factors are the main cause of a blackout. These include, in particular, accidents or incidents (short circuits due to severe weather conditions, negligence, malicious behaviour, attacks, etc.), meteorological disturbances (lightning, storm, floods, frost, etc.), the shutdown or loss of installations (lines, power plants, protective mechanisms, etc.), and even human failure (inadequate safety concepts, incorrect load fore-casts, faulty communication or coordination, lack of experience, incorrect action, etc.).

The growing complexity and interconnectivity of systems coupled with the impact of climate changes (increased occurrence of severe weather involving violent storms, lightning and floods) add to the risk of power failures.

Impact on critical supply processes and expected supply shortages

A power failure will inevitably have a huge impact on all the supply processes and seriously affect the way in which Switzerland functions. The availability of electricity is essential in all the areas covered by this report and can quickly lead to supply shortages.

Electricity is of central importance to both the population and the economy. Without it, much of what we take for granted in our lives no longer works.

An unforeseeable power outage would have devastating consequences for the supply of foodstuffs, at every level (from production to consumption).

In the case of drinking water, only spring water and plants with an emergency power supply would be available (estimated at 50 % of normal production throughout Switzerland). Decentralised supply would have to be ensured by means of provisional and emergency supply points.

Petroleum, natural gas, wood fuel: Supplying and using energy sources becomes a problem if there is no functioning power supply, as petrol stations and heating systems rely on electricity.

ICT is completely dependent on electricity. In the event of a blackout, all ICT services would also be lost shortly thereafter. A power failure only needs to be of 'significant' intensity (as defined in the 'National Risk Analysis of Disasters and Emergencies in Switzerland') for shortages to occur with an adverse effect on the supply of ICT processes and services.

In terms of logistics, a power failure would have a huge impact on freight transport. A power failure can lead to blockages and bring activities to a standstill on both the rail and road networks, as well as in logistics centres and at airports, during which time the infrastructure is no longer available. The cancellation of transport services can lead to supply shortages.

A blackout will result in the breakdown of production and infrastructure facilities in the field of industrial manufacturing. Payment services will no longer work. Supply chains will be interrupted, potentially leading to partial supply shortages of relevant products.

3.15 Electricity supply shortages

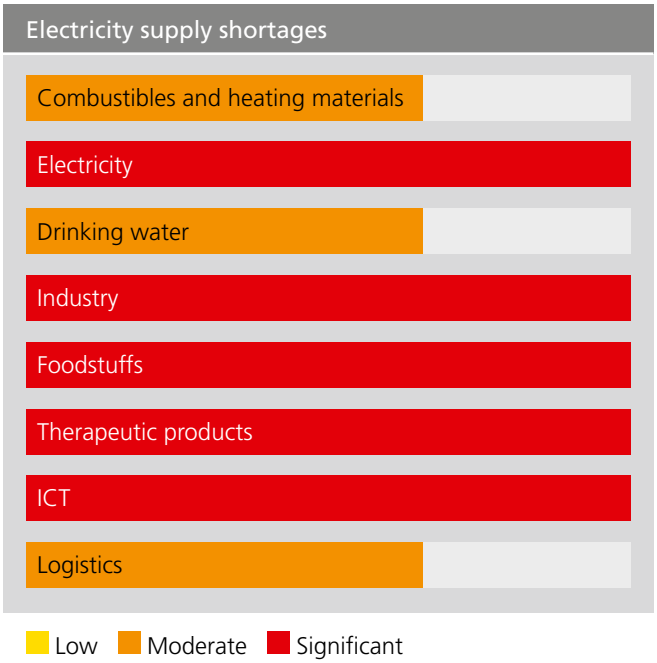
A power shortage means that the supply of electricity is unable to satisfy demand for several days, weeks or even months at a time due to limited generation, transmission and/or import capacity. This constitutes a supply shortage under Article 2 of the National Economic Supply Act (NESA), which cannot be overcome by the private sector on its own.

In the event of a power shortage, the majority of end consumers could no longer be guaranteed an unlimited and uninterrupted supply of electricity from the Swiss grids.

Example scenario

This scenario corresponds to the 'major' level of the 'National Risk Analysis of Disasters and Emergencies in Switzerland' and the FOCP's 'Electricity supply shortage' hazard file.

The example scenario assumes a power shortage of 30 % for 12 weeks. As a first step, direct appeals are made to the general public and businesses, calling on them to voluntarily use less electricity. When this proves insufficient, various management measures are put into effect to ensure electricity can be supplied at reduced levels. Thus, certain applications, activities and services that require electricity are henceforth restricted or no longer permitted. Quotas are imposed on major consumers, who must ensure that they do not exceed the quota they are entitled to. Power plants are no longer managed by the operators but are placed under central management, and cross-border energy trading is restricted in coordination with neighbouring countries. Despite these measures, additional grid closures are also necessary for two weeks to ensure network stability. Uncontrolled blackouts cannot be completely avoided.



Potential causes

An electricity shortage with supply implications is caused by a series of interconnected events and causes. These are many and varied, ranging from damage caused by natural forces to upheavals in economic and trade policy right through to technical errors and criminal or terrorist acts. These events then become critical to the security of electricity supply if they have a negative impact on either production capacity or transport capacity (including import/export capacity) over a prolonged period.

Examples:

- Long-term drought accompanied by low water levels in rivers and reservoirs can greatly affect electricity generation, both at hydroelectric power plants and, due to cooling water shortages, at certain thermal power plants (e.g. nuclear power plants).
- Technical malfunctions/defects at neuralgic points in the power grid infrastructure can restrict the supply of electricity to entire regions.
- No or limited import options due to low availability in neighbouring countries.

Influencing factors and developments

The occurrence and impact of an electricity supply shortage are strongly influenced by the political, social and technical landscape, and how this develops. For instance, the move towards decarbonisation, decentralisation, digitalisation and greater comfort (increase in electrical applications) in Switzerland and neighbouring countries plays an important role. Similarly, the decision to phase out nuclear power in Switzerland and Germany is one of the medium to long-term influencing factors.

Decarbonisation and Germany's exit from nuclear power have prompted a restructuring of the European energy system and, in particular, of electricity generation. This transformation brings its own challenges for electricity supply. The generation capacity of the power plants being closed must be replaced by renewable generation facilities, composed of large power plant fleets and many small decentralised production plants. This means that cross-border energy trading must function smoothly and be accompanied by the corresponding reserve and storage capacities, especially in winter, when Switzerland's dependence on electricity imports grows. At the same time, electrification in the transport (e-mobility) and building (e.g. heat pumps) sectors is causing more and more electricity to be consumed, which requires additional renewable electricity production facilities. Moreover, the changing load flows and their volatility place new demands on the transmission and distribution networks and their operation.

Impact on critical supply processes and expected supply shortages

An electricity supply shortage as outlined in the example scenario will inevitably have a huge impact on all the supply processes and seriously affect the way in which Switzerland functions. It will lead to a supply shortage in several essential areas of Swiss life. Supply problems can be expected in the majority of supply processes if the electricity supply shortage is of at least 'major' intensity. The most serious effects can be expected in the case of ICT, therapeutic products, industry and foodstuffs. However, a continuous power supply is of vital importance in all areas of life.

It is possible for the considerable impact on the entire food supply to drag on for months. The problems start with production (milking machines, cooling, harvesting, drying) and extend right through to industrial processing (no longer possible) and distribution (shops unable to open at all or regularly).

The supply of petroleum products relies on a functioning power supply and communication services with regard to imports, storage in tank facilities and delivery to consumers (petrol stations, households, etc.). Heating systems also cease to function without power.

With the exception of wood-burning stoves that have to be fed by hand, even modern wood heating systems (such as wood chip- and pellet-burning appliances) cannot function without a power supply.

A prolonged electricity supply shortage (lasting several weeks) can have serious consequences for therapeutic products and on the quality and quantity of treatment enjoyed by patients. The ability of hospital pharmacies in particular to prepare their own medicines would be severely limited and could lead to a shortage of those medicines that have to be made up specifically for individual patients (parenteral nutrition, cancer medication). The manufacture and distribution of therapeutic products would also be severely affected by a power shortage.

ICT is completely dependent on electricity. If grids have to be shut down, ICT services can no longer be guaranteed to function. Grid shutdowns and uncontrolled blackouts impact rail and road logistics, logistics centres, transshipment platforms, etc., as well as the Rhine ports and airports. The cancellation of transport services can lead to supply shortages.

In the industrial sector, the loss of electrical power and reduction in the number of people able to get to work would disrupt production and payments to such an extent and for such a length of time that material delivery delays could arise.

Most water companies can manage without a constant supply of electricity as reservoirs typically provide enough storage to meet demand for a single day, and only a few hours of pumping a day are required to fill them.

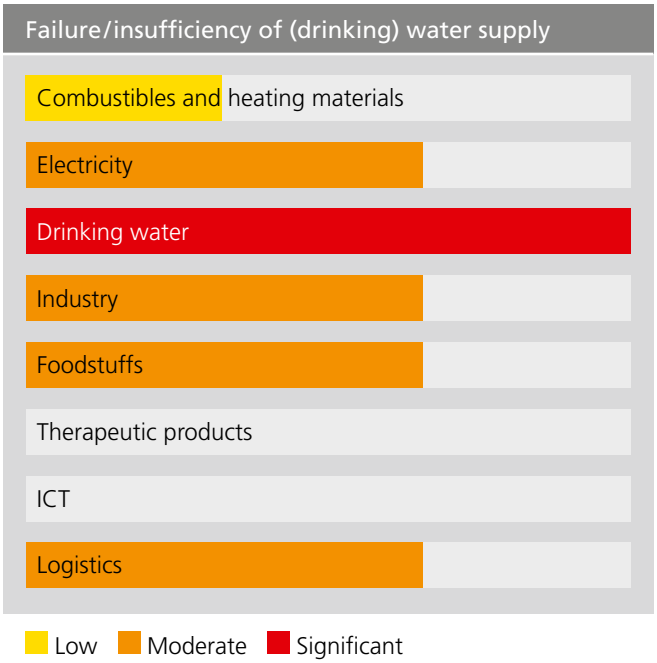
3.16 Failure/insufficiency of (drinking) water supply

A reliable supply of drinking water has two crucial elements: water must be available as a natural resource in sufficient quantity and quality, and the infrastructure for extracting and distributing that water must be well developed and managed. A failure or insufficiency of the water supply primarily means a shortage in the supply of drinking water to the general population, or a shortage of water available for agricultural use (animals, plants) and economic production (e.g. energy and foodstuffs, industrial manufacturing). Water scarcity also leads to low water levels for shipping and to low levels in reservoirs for electricity generation.

Example scenario

Under the 'extreme' scenario, water is not available as a natural resource in sufficient quantity and/or quality for more than a year.

Example of drought in 2018: appeals to conserve water had to be made to a number of communes or regions in 18 cantons in 2018 (reduced use of water by private households, voluntarily restricting certain uses, e.g. garden sprinklers, car washing). In 15 cantons the supply insufficiencies had to be relieved via distribution networks and by buying in water from elsewhere; five cantons enacted individual measures to secure an emergency supply (emergency wells, delivering water via tankers). After a prolonged period of drought, groundwater and spring water catchments in the public interest in 14 cantons either had no water or less than required for supply purposes.



Potential causes

- A prolonged dry period can cause the levels of groundwater reserves and surface waters to fall.
- The land areas that contribute water to the drinking water supply are competing with the expansion of the settlement area and agricultural activities, which can lead to water catchments having to be abandoned.
- Contamination tends to be mainly local or regional. However, in exceptional cases, very large areas may also be affected (e.g. following a chemical or nuclear accident).
- Long-term interruptions to the supply of electricity are a problem for the extraction, treatment and distribution of water.
- Cyberattacks on the system controlling the water supply can lead to a disruption or insufficiencies.

Influencing factors

Disruptions to the water supply can occur even in Switzerland, the reservoir of Europe, as the heat and drought events of the summers of 2003, 2015 and 2018 have shown. Globally, climate change is a serious problem for drinking water supply. Longer-lasting dry periods may also lead to local insufficiencies in Switzerland's supply. Small-scale catchments with vulnerable water resources, typically spring water in the karst area and (pre-)Alps, are particularly affected. Supply shortages in these areas exacerbate existing conflicts of use, such as for agricultural irrigation.

Switzerland's water supply is still highly decentralised and has more than 2,000 water suppliers. Many smaller suppliers face the challenge of having to renew their outdated infrastructure without, however, having set aside the necessary financial resources. In addition, the increased requirements placed on food and supply security call for appropriately trained personnel. It can be assumed that the trend towards larger supply areas (mergers between individual suppliers) will continue in the coming years. However, many communes are likely to be hesitant in their approach to this as they attach considerable importance to the concept of autonomy in managing their own water supply.

The shortage will be further exacerbated by conflicts of use and stricter quality requirements. To date, Switzerland's water supply has not experienced any major disruptions, apart from a few isolated difficulties.

Impact on critical supply processes and expected supply shortages

Any disruption to the water supply will inevitably have a major impact on every area of social and economic life. WHO guidelines recommend 4 litres of water a day per person for drinking and hygiene, and at least an additional 5 to 10 litres for other uses. The chart on the right shows the severity of the impact of the supply problems on the individual areas. A severe impact can lead to supply shortages. Water scarcity is generally expected to have serious consequences for supplying the general population with clean drinking water and in food production and processing. Water shortages caused by a prolonged drought will also limit the supply of electricity and disrupt logistics processes (low water levels in the Rhine).

Industry, logistics and drinking water could potentially experience supply shortages in a scenario of 'major' intensity. The same applies to foodstuffs, electricity and petroleum in an 'extreme' scenario.

Many small-scale water resources (spring water and groundwater) will be affected if this particular hazard scenario occurs. Today, many communes in rural and mountain areas operate small, isolated systems, i.e. they are not connected to other water suppliers. Sufficient drinking water is available throughout Switzerland (groundwater and surface water plants). However, this water has to be distributed. It is possible for many small-scale water resources, which are not (sufficiently) connected to other sources/water supply systems, to experience a supply shortage. This impact is deemed 'significant'. If a supply shortage is severe, the massive reduction in the amount of water available compared with normal circumstances can also cause drainage problems in the wastewater system.

A general shortage of water involving the depletion of sources and falling water levels due to climate change will have a serious impact on foodstuffs. As a result, soils and the crops that can be grown on them will change as groundwater levels fall.

In the case of industry, a shortage of cooling water or the unavailability of water as a raw material can be expected to prompt shutdowns of some production and infrastructure facilities. If cooling can no longer be guaranteed at a data centre, this can lead to outages.

Water shortages are likely to reduce the available capacities for electricity generation, which can lead to a supply shortage in the electricity sector.

A water shortage or low water levels in the Rhine will reduce the transport capacities of Rhine shipping. In 2021, ships were only able to carry 50% or less of their normal load for three months due to low water levels.

4 Outlook: Development and trends

To build a longer-term picture of the risks to national economic supply, it is essential to also keep track of developments and trends that will influence it in the future.

The risk analysis therefore includes a further component: an examination of social, economic, political and technological developments and trends expected to shape the future. These mark out long-term natural, technological and social change processes with far-reaching consequences.

To this end, the NES specialist divisions have identified key developments with implications for supply and evaluated them with regard to potential risks. The following six trends are explored here in greater detail:

- Globalisation: connectivity and competition
- Climate change
- Digitalisation
- Regulatory environment (Switzerland and abroad)
- Complexity and interdependence
- Demographics and changing values

4.1 Globalisation: connectivity and competition

On the supply policy side, four developments related to globalisation are of particular relevance to Switzerland:

Concentration of production sites; minimum inventory levels:
Therapeutic products provide a very good example of how the manufacture of established active ingredients traditionally used in medicinal products has become concentrated heavily or even exclusively in the Asian region over the last few years. Ultimately, this has led to these active ingredients, and low-price medical devices such as masks, swabs and incontinence articles, being produced centrally at only a few large-scale facilities. Due to their long-term planning and tight production schedules, such large-scale facilities are not usually able to react to short-term spikes in demand, which means that a rise in demand can quickly lead to a supply shortage. Since supply chains keep their inventory levels as low as possible due to the associated costs, it is generally difficult to cushion any manufacturing disruptions; these, therefore, have a direct impact in the form of supply shortages.

The concentration on a handful of large-scale manufacturers is the relevant aspect of this trend. Their location is of secondary importance. Supplies can just as easily be disrupted in Switzerland because of production stoppages at a Swiss company.

Increasing monopolisation:
The ICT sector provides an example of increasing monopolisation. Almost all the world's hardware is produced in Asia (mainly in China, Taiwan and South Korea). When it comes to software, there is great dependence on a few globally dominant producers, e.g. from the United States (Microsoft, Google, Apple, Oracle, etc.). Both the situation and developments in the United States and Asia thus have a direct influence on the availability of ICT systems.

Although not monopolisation in the economic sense, increasing technology convergence nevertheless represents a loss of redundancy. By this, we mean that a number of services, such as radio, TV, voice and data communication, are operated via the same platform or technology. If the (common) platform fails, this will lead to all the services failing concurrently.

Growing competition over resources:
The battle for resources such as soils, standard raw materials and rare earths is being exacerbated, inter alia, by global population growth and changing patterns of consumption. If economic and technical progress is no longer able to meet the sharply rising demand, especially in food production (including new breeding and cultivation methods), then shortages in the availability of goods that meet day-to-day needs will arise quickly.

Increased economic connectivity:
The concentration of production facilities and service offerings calls for closer relations across national borders. This impacts the energy sector in particular. The integration of Europe's electricity markets, for example, will be stepped up further over the next few years, thus enabling cross-border capacities to be optimised over the various time frames (day-ahead, intra-day and balancing) via market coupling. This will boost European welfare as a whole, as dynamic optimisation of cross-border capacities will allow more flows at borders, where the price differential is particularly high. On the other hand, the increasing efficiency measures, which are moving more and more towards real-time data, will make rectifying operations-critical situations more demanding. Switzerland is basically prevented from participating in the coupled electricity markets because it does not have a framework agreement with the European Union. However, due to its geographical situation, it must deal with the loop flows of its EU neighbours. The rules set out in the Clean Energy Package, the EU's fourth internal energy market package, present another challenge. They require, among other things, that 70 % of a grid's transmission capacity be made available for cross-border trade. This must be implemented by 2025 at the latest. Swissgrid is striving to reach technical agreements with the neighbouring capacity calculation regions, which take its grid security into account when calculating the available capacity and trading flows with Switzerland. This concerns in particular the CORE region with zone borders to France, Germany and Austria.

4.2 Climate change

Weather events:
Modelling by the Intergovernmental Panel on Climate Change (IPCC)[14] reveals a highly significant link between a global rise in temperatures and extreme weather events, crop yield fluctuations and potential disruptions to supply. According to a study by the World Meteorological Organization, the number of weather- and climate-related disasters has increased by a factor of five over the last 50 years[15]. An IPCC Working Group report published in August 2021 demonstrates that many of the changes are unprecedented in thousands of years and some, such as sea level rise, are irreversible over centuries. The report projects that climate changes will increase in all regions in the coming decades. The researchers state that with further global warming, every region is projected to increasingly experience concurrent and multiple changes in climatic impact-drivers. It can be assumed that Switzerland will also increasingly experience these effects and that this could have significant consequences for the supply of foodstuffs in particular.

In addition to rising temperatures, Switzerland's future climate will probably be marked by more frequent extreme events. There will be longer dry periods in summer and higher volumes of precipitation in winter. That precipitation will tend to fall in the form of rain rather than snow, thus additionally lowering river runoffs in summer and autumn. Climate change increases the overall risk that food shortages affecting the national economic supply will become more frequent in the future.

Droughts:
Longer-lasting dry periods may also lead to local insufficiencies in Switzerland's drinking water supply, with small-scale catchment areas with vulnerable water resources being particularly affected. Supply shortages there would exacerbate existing conflicts, such as those between the use of water for drinking, agricultural irrigation, nature conservation (e.g. compliance with residual flows) and industrial requirements. Moreover, water quality is becoming increasingly important. Information about

[14] *http://ipcc.ch*

[15] *http://worldweather.wmo.int/*

contamination, especially with pesticides, is creating public unease, although drinking water is of a much higher quality today than it was 20 to 30 years ago. Improved measuring technology means that many residues have only recently become visible. Water suppliers and authorities can expect to face the challenge of further problematic substances in the coming years.

More frequent dry periods in the summer months and a lack of precipitation can also pose a threat to the electricity supply, affecting the generation capacity of run-of-river hydropower plants as a result of lower runoff levels and that of nuclear power plants as a result of reduced river cooling. Given the importance of nuclear and hydropower as sources of energy, Switzerland is particularly exposed to this risk. Potential damage to the infrastructure for generating, transporting and distributing electricity (e.g. caused by natural hazards or human influence such as vandalism or terrorism) can make congestion even more intense. Dry phases of this kind also affect the water levels in the Rhine, and thus its navigability.

Greenhouse gas emissions:
Under the Paris Agreement, to which Switzerland has signed up, global man-made greenhouse gas emissions are to be reduced continually. This calls on every sector to make its business processes resource-efficient and carbon-neutral. In logistics, for example, this means promoting the use of regenerative fuels plus making route planning even more efficient and fleet management greener. All this entails transformation costs, which can affect the supply and demand of goods and thus the supply situation.

Energy Strategy 2050:
From 2050 onwards, natural gas is to be used in only a few industrial processes. According to this scenario, biogas would increasingly be used in its place to generate high-temperature process heat, in cogeneration plants and in district heat production (to cover peak loads). The extent to which natural gas should and can be replaced by renewable gases (hydrogen and synthetic methane) in this context has not yet been decided.

4.3 Digitalisation

There are a large number of supply-related developments in the field of digitalisation, from which the following can be singled out as key examples:

Smart metering and smart grids:
Under its Energy Strategy 2050, Switzerland has opted out of producing electricity from nuclear power. New, ecological sources of energy, such as photovoltaics and wind power, are to be used instead. These energy sources are more volatile and have decentralised distribution systems. At the same, energy needs are growing, among other things due to the sharp rise in electromobility. As a result, electricity network utilisation will increase in the future. Coupled with the move towards decentralised electricity production, this means that the electricity thus generated must be routed through the network by 'intelligent' measuring and control systems (smart meters and smart grids) to ensure efficient distribution. As this process generates considerable amounts of data, a high-performance ICT infrastructure is the only way to ensure proper control of the electricity system. This in itself increases the supply risk.

5G mobile network:
Like the electricity network, mobile communications are also expected to see an extremely sharp rise in data volumes over the next few years. Sensor-driven infrastructure data, e.g. from power grids, but also from cars and road or rail networks, will be especially reliant on efficient transmission via 5G mobile communications. The dependence on mobile communications will thus continue to grow and a lengthy mobile network outage could lead to serious problems in operating the infrastructure. In this respect, a rapid and widespread rollout of fail-safe 5G mobile networks is essential from a supply point of view; these must guarantee the greatest possible security against disruptions.

Cloud computing:
Outsourcing the operation of IT systems (infrastructure, hardware, software) to a specialised service provider has been an ongoing trend for years and shows no signs of slowing down. For Switzerland, this gives rise to an increasing number of questions about physical data retention. From a technical point of view, national borders have practically lost all meaning for ICT, but they remain important from a political, economic and data protection perspective. The issue of how Switzerland handles the opportunities and risks associated with outsourcing data and systems also has supply policy implications. In addition, the increasing market concentration among a handful of globally dominant providers leads to even more dependence and to data protection risks as well as economic cluster risks. In this respect, the availability of data must be weighed against data confidentiality.

Connectivity:
Today's ICT processes often involve a large number of participating companies and a wide spread of locations. As well as creating many advantages, this gives rise to specific supply risks. For example, the failure of an electronic payment service provider can lead to supply problems in the retail trade (food supply). That payment service provider may, in turn, be affected by the failure of its own ICT service provider. By extending the supply chain, increasing international connectivity creates additional opportunities for failures, which are often outside the control of the end customer.

4.4 Regulatory environment

In Switzerland

Balance in the regulatory framework
Three examples serve to illustrate the importance of finding a balance between various political concerns and maintaining security of supply:

- Manufacturers of generic medicines (pharmaceuticals whose patent protection has expired) face considerable cost pressure from efforts and requirements to reduce healthcare spending. This is reflected in the withdrawal of established medicinal products from the Swiss market.

- In recent years, the expansion of the settlement area and intensive agriculture have increased the pressure on riverine zones. In some places, this has led to the abandonment of water catchments and the impairment of bodies of water. Water resources must be protected to ensure they remain available as natural sources of drinking water in the future. These realisations are gaining more and more of a foothold in the public consciousness and steadily finding their way onto political agendas. There are signs of progress at the legislative level, but it remains to be seen whether this will reduce the existing enforcement gaps. Public expectations will continue to generate considerable pressure over the next few years, and drinking water-related issues will continue to feature strongly in the media.

- One of the factors influencing the development of the Swiss agricultural and food industry will be the deliberations on parliamentary initiative 19.475 'Das Risiko beim Einsatz von Pestiziden reduzieren' (Reducing the risk of using pesticides). The proposal aims to halve the risks arising from the use of plant protection products by 2027 and to reduce nutrient losses in agriculture to an appropriate level by 2030. This shows that Parliament is willing to give more consideration to environmental aspects when formulating its agricultural policy in the future, which will have a commensurate impact on the supply situation.

Structural challenges

Examples can also demonstrate the relevance of imminent structural changes to the national economic supply:

- Switzerland's water sector is decentralised and has more than 2,000 water suppliers. Many smaller suppliers face the challenge of having to renew their outdated infrastructure without, however, having set aside the necessary financial resources. In addition, the increased requirements placed on food and supply security call for well-trained personnel. It can be assumed that the trend towards larger supply areas (mergers between individual suppliers) will continue in the coming years. However, many communes are likely to be hesitant in their approach to this as they attach considerable importance to the concept of autonomy in managing their own water supply.

- Production costs (mainly labour costs) remain high in Switzerland, with the 'Swiss Finish' making products even more expensive. Increasing regulations and new legal requirements further limit companies' scope of action, which could lead to them migrating abroad, with a commensurate impact on the supply situation.

Abroad

- Growing protectionism worldwide
  'Buy American' in the United States, the Industrial Strategy and Green Deal in the EU, China's aggressive foreign and trade policies, and other export restrictions create obstacles to (barrier-)free trade. Despite its numerous trade agreements, these protectionist and unilateral measures can disrupt Switzerland's supply. The short- and longer-term export restrictions on medicinal products, hand sanitisers and personal protective equipment in managing the COVID-19 pandemic provide a specific example of this.

- No framework agreement with the EU
  Switzerland's decision to call off negotiations on an institutional framework agreement with the EU also has a bearing on the national economic supply. This can be illustrated using therapeutic products as an example: in the case of medical devices, the lack of a framework agreement could lead to supply shortages in Switzerland despite the latter's unilateral recognition of EU certification. Without a framework agreement, the current Mutual Recognition Agreement (MRA) will not be updated by the EU, thus bringing to an end mutual recognition of market approval and joint market surveillance. Regulations in both the EU and Switzerland (Medical Device Regulation, MDR) have been tightened up for reasons of patient safety, which means that manufacturers are now only granted market authorisation for products in higher risk classes once these have been re-investigated by 'notified bodies'. Because of the large number of products awaiting investigation, it is feared that it will not be possible to reassess all medical devices before the lengthy transitional period ends in 2025, thus leading to supply shortages.

4.5 Complexity and interdependence

All of the critical supply processes can also be adversely affected by disruptions in the other supply processes. This interdependence has grown in recent decades and will continue to do so. The reasons are to be found in digitalisation and globalisation. Value chains and supply chains are spread over several continents, with a large number of stakeholders involved. The planning, monitoring and management of supply chains typically follows the 'just-in-time' principle. This means that goods spend as little time as possible in warehouses along the value chain. In the case of those key goods for which Switzerland is largely or completely reliant on imports (e.g. therapeutic products, petroleum products), security of supply depends as much on the proper functioning of logistics chains, the power supply and ICT processes as it does on the physical availability of the goods in question. The supply chain as a whole is therefore only as resilient as its weakest link. This gives rise to new threats to Switzerland's supply security as most of the links in its supply chain are located outside its national borders.

The vulnerability of global supply processes was demonstrated in 2021 by a number of striking examples:

- After running aground in March 2021, the container ship Ever Given blocked the Suez Canal for six days, thus cutting off one of the main global trade routes between Asia and Europe. Hundreds of cargo ships were held up, disrupting global trade for weeks.

- From the summer of 2021, there was a shortage of cargo containers in various places around the world. That, plus the growing demand for goods, lack of labour and pandemic-related restrictions created huge obstacles to global trade. The container ports at Futian near the Chinese city of Shenzhen were affected, for example, but ports in the United States also experienced congestion. The port of Los Angeles was one of the worst affected, with ships having to wait several days before they could be unloaded.

- A labour shortage was basically the cause of supply problems in the UK in the autumn. Due to a shortage of truck drivers, there were considerable difficulties in ensuring the fuel supply for several weeks. Service stations could no longer be supplied with sufficient quantities of petrol and diesel. This in turn led to a certain amount of panic buying, which further aggravated the problem.

- In addition to a shortage of labour, disruptions to ICT-driven processes caused supply difficulties for critical infrastructures. The Colonial Pipeline case in the United States is a prominent example. A cyberattack targeting the operator impacted the computerised equipment managing the pipeline, which ultimately resulted in a large number of petrol stations on the east coast of the United States no longer receiving their usual supplies.

- The cyberattack on Kaseya, an IT service provider, left many of its customers unable to provide their supply-related services in full. As Kaseya's customers include many other IT service providers, a very large number of end customers were ultimately affected. In Sweden, the Coop supermarket chain (no relation to the Swiss company of the same name) had to close 500 branches temporarily because the checkout systems no longer worked.

As different as the causes were, all these cases had one thing in common: in the end, they led to shortages of important goods and services.

The chart below shows how the risks examined can, in turn, lead to supply problems in other supply processes. The individual risks are featured from top to bottom in ascending order of their criticality for other supply processes. A failure in the supply of therapeutic products has the least impact on other supply processes, whereas a blackout or electricity supply shortage has the greatest impact on the remaining supply processes. However, this should not detract from the fact that each of the areas reviewed in this report and the related goods and services remain highly relevant, regardless of the impact on the other specialist divisions.

Impact of selected risks on critical supply processes

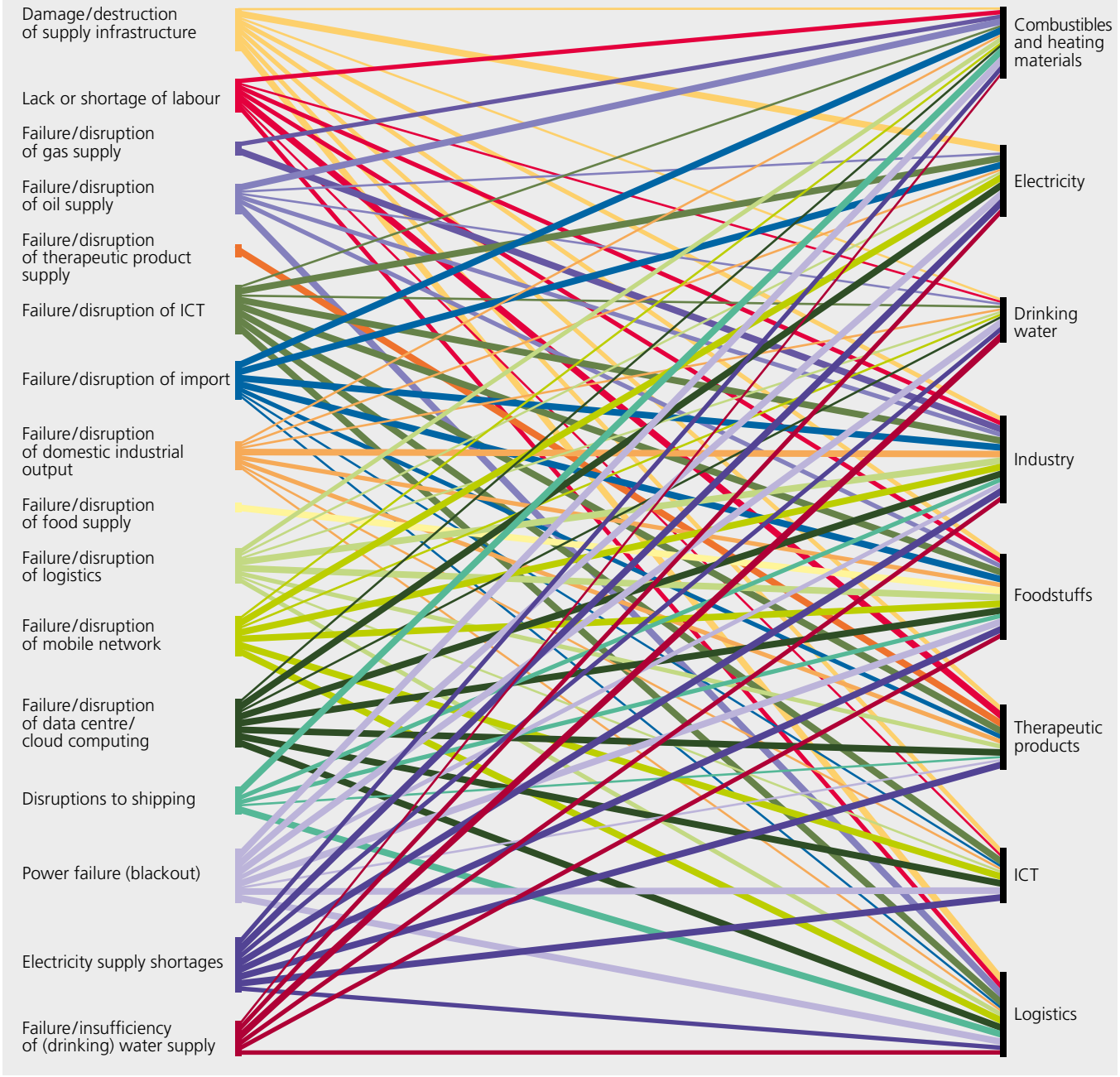


Figure 3: Impact of selected risks on critical supply processes

The width of the lines reflects the severity of the impact. The thicker the line, the greater the impact on the respective supply process.

The chart shows that supply is very complex and interconnected. This means that the NES must frame security of supply even more in terms of a complex, global process in the future. Strengthening international cooperation further will be of the utmost importance in ensuring effective security of supply. In future, to successfully fulfil its remit the NES will also have to step up its cooperation with economic stakeholders and other federal and cantonal specialist offices. This also applies at the interfaces between economic policy (free markets, avoidance of market distortions, etc.), foreign economic policy (international supply contracts, agreements on emergency aid, economic diplomacy, etc.) and security policy (e.g. national strategy for protecting Switzerland against cyber risks, protection of critical infrastructures).

4.6 Demographics and changing values

- Demographic developments
  Switzerland's population continues to grow, and the average age is rising. This is accompanied by the imminent wave of retirements among members of the baby boomer generation, all of which creates the risk that there will not be enough sufficiently qualified workers available. This shortage of skilled labour will intensify over the next few years. In addition, the need for therapeutic products (medicinal products and medical devices) rises with increasing age.

- Changing patterns of consumption
  Demand for seasonal, regional and sustainable products, as well as for meat-free alternatives and meat substitutes, is also becoming much more noticeable in Switzerland. This has an impact on agriculture and the availability of the foodstuffs in question.

- 'Work 4.0' and digital commerce
  The COVID-19 pandemic saw working from home become far more widespread in all sectors. Moreover, there has been a sharp rise in online retailing. This requires ICT infrastructures in particular to be available everywhere and all the time, and for the network quality to be high. Preventing network outages is becoming more important and the handling of network facilities more risky.

In conclusion, it is safe to say that despite the challenges outlined here, the NES assumes that essential goods and services will remain available or can be provided in Switzerland over the next four years on a sufficient scale. To this end, it is crucial that they are monitored and included in the strategic orientation plans for the national economic supply.

Conclusions

The globalisation of the economy and the associated structural changes have a fundamental impact on the supply situation in Switzerland. The reasons why the resupply of essential goods on the global markets can be held up or even temporarily prevented are numerous. In recent years, the tendency for supply chains to become longer and more complex has made the supply process even more vulnerable to disruption. As a result, the risk situation with regard to the worldwide exchange of goods and services is constantly changing. This requires particularly careful analysis in Switzerland, given its dearth of raw materials, if it wishes to be able to take preventive and reactive measures.

The evaluation of the potential risks and dependencies shows that the various supply processes are highly interdependent and that measures to cope with supply disruptions cannot therefore be developed in isolation. The generally high degree of complexity calls for a holistic approach to supply security. This development has consequences for the strategic orientation of national economic supply. More and more emphasis is being placed on approaches to strengthening supply process resilience in attempts to meet the requirements, both old and new.

In future, to successfully fulfil its remit the NES will have to step up its cooperation with economic stakeholders and other federal and cantonal specialist offices. This also applies at the interfaces between economic policy (free markets, avoidance of market distortions, etc.), foreign economic policy (international supply contracts, agreements on emergency aid, economic diplomacy, etc.) and security policy (e.g. national strategy for protecting Switzerland against cyber risks, protection of critical infrastructures).

Strengthening international cooperation further will be of the utmost importance in ensuring effective security of supply. The exclusive focus on national approaches is inadequate when dealing with global threats, especially now that economic processes are becoming ever more interconnected transnationally and critical supply components are increasingly to be found outside national borders.

The present risk analysis reflects the status of the assessments as of the end of 2021.

Glossary

FOCP	Federal Office for Civil Protection
FOEN	Federal Office for the Environment
FONES	Federal Office for National Economic Supply
FSVO	Federal Food Safety and Veterinary Office
ICT	Information and communication technologies
IPCC	Intergovernmental Panel on Climate Change
NESA	National Economic Supply Act
NES	National economic supply

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