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ON THE BRINK OF AN ENERGY CRISIS – WHAT CAN WE LEARN FROM THE PAST?

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Russia's war of aggression against Ukraine is causing immense human suffering and massive material damage. The war may also plunge Europe, including Finland, into a deeper energy crisis. Many organisations, including the European Commission and the International Energy Agency (IEA), have recently outlined the path out of dependence on Russia.

In this working paper, we have collected lessons from past energy crises and energy economic upheavals. First we look at the 1973 oil crisis, then Japan's recovery from the collapse of nuclear power generation in 2011. We also look at cases where the energy economy has changed significantly in the absence of crises.

Finland has traditionally been comparatively well prepared for exceptional situations. On the brink of an energy crisis, we should use all available tools: we can strengthen foresight and preparedness, seize the potential for energy savings and ensure the timely replacement of Russian energy. In the long term, we need to secure the transition towards a circular economy that is sustainable for the climate and nature.

Sitra working paper

On the Brink of an Energy Crisis – What Can We Learn from the Past?

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Summary

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The war of aggression launched by Russia against Ukraine is causing immense human suffering and massive material damage.

We could face a major energy crisis in Finland and Europe if energy prices rise to unprecedented levels or there are serious disruptions to energy supplies.

But this is not the first time that countries around the world have faced sudden energy price rises and shortages. Many Finns still remember the efforts to save energy during the oil crisis of the 1970s.

This working paper looks at what can be learnt from the past. We look at the 1973 oil crisis, Japan's recovery from the collapse of nuclear power generation in 2011, and cases where the energy economy has changed significantly without immediate crises.

Based on these examples, we provide proposals for discussion that could help Finland cope if the energy crisis becomes much more serious than it now is – not forgetting the underlying sustainability crisis.

This is not the first time that countries around the world have faced sudden energy price rises and shortages.

1. **Strengthening foresight.** We need foresight and an open debate on possible future developments – including unpleasant ones. The time and resources invested in preparedness will pay off at a time of crisis. On the positive side, Finland has a comparatively good level of preparedness.
2. **Investing in energy saving and efficiency as part of preparedness.** In a serious energy crisis, energy consumption must be adjusted quickly, but voluntary measures should be promoted even if we avoid a serious crisis.
3. **Ensuring energy production to replace Russian energy.** The use of Russian energy must be significantly reduced. Measures to replace energy that is lost this way must be launched immediately to minimise disruption. Key solutions include speeding up the construction of sustainable renewable energy capacity and moving more rapidly away from oil and gas heating.
4. **Supporting the long-term energy transition.** Exceptional measures are needed in an energy crisis. There is also an urgent need to address the loss of biodiversity and the climate crisis. Alongside crisis measures, overall ecological sustainability must also be safeguarded. For example, investments in offshore wind power, non-fuel-based district heating and synthetic fuels are also investments in the future.

1 Introduction

The war of aggression launched by Russia against Ukraine is causing immense human suffering, massive material damage and the largest influx of refugees in Europe since the Second World War. The war also threatens to plunge Europe, including Finland, into a deep energy crisis if energy prices rise to unprecedented levels and there are disruptions to energy supplies.

Finland and the rest of Europe have been very dependent on Russian energy. As recently as 2019, Russia accounted for 91 per cent of Finland's imported energy in crude oil and as much as 100 per cent in natural gas. Finland also imports wood fuels, coal, electricity and nuclear fuels from Russia. (Yle 2022a.)

The situation is nevertheless improving. Finland already has the supplementary Baltic-connector gas pipeline connection via Estonia. Since the outbreak of the war, for example, Neste has reduced its oil imports (Neste 2022) and Helen has stopped importing coal from Russia (Helen 2022). The Olkiluoto 3 nuclear reactor, which is about to start commercial production, and wind power projects under construction will also contribute to reducing energy imports.

Many organisations have recently outlined a pathway out of dependence on Russia. According to the International Energy Agency (IEA), Europe could reduce the use of Russian natural gas by a third as early as this year (IEA 2022). According to the European Commission, the use of Russian gas could be reduced this year by up to two-thirds (European Commission 2022). The independent think tank Bruegel has estimated that if Russian gas supplies stop completely, coping with the situation would require difficult decisions, such as cutting industrial production (Bruegel 2022).

In Finland, energy security in the new situation has been analysed by the Ministry of Economic Affairs and Employment (MEAE 2022), the National Emergency Supply Agency (NESA 2022) and Finnish Energy (FE 2022a). The BIOS research unit has analysed the links between disengaging from dependence on Russian energy and the green transition (BIOS 2022) and Aalto University has created a model of the potential impacts of the end of electricity imports (Aalto 2022).

In this working paper, we look at what we can learn from past crises and upheavals in the energy economy. First we look at the 1973 oil crisis, then Japan's recovery from the collapse of nuclear power production in 2011. We also look at examples where the energy economy has changed significantly under normal circumstances. Based on these cases, we outline proposals that could help Finland cope with the energy crisis that may lie ahead – not forgetting the underlying sustainability crisis.

The working paper focuses on centralised electricity and heat production, leaving aside issues such as building-specific heating and transport. Our aim is to apply the lessons from the past and from other countries, bearing in mind that the situation in Finland in 2022 is different in many respects. The estimates are based on the situation at the time of writing, and the conclusions may need to be revised if circumstances change.

Traditionally, Finland has been comparatively well prepared for various crises and has tried to maintain security of supply also when times are good. However, amid deep uncertainty and on the brink of a potentially unprecedented crisis, plans should be updated and strengthened.

We hope that this working paper will help stimulate debate on the ways to prepare for the energy crisis. Above all, we hope that the Finnish energy economy will prepare for the worst, even as we hope for the best.

Many organisations have recently outlined a pathway out of dependence on Russia.

2 1973 revealed the world's dependence on oil

The 1973 oil crisis was triggered by Egypt and Syria's war against Israel. Middle Eastern oil exporting countries restricted exports to the pro-Israeli West and raised the price of oil dramatically.

The impacts were severe, as the West was heavily dependent on OPEC oil. For example, the US had doubled its oil imports between 1970 and 1973 (EIA 2021a).

The effects of the crisis reached Europe, including Finland. How was the shock overcome?

2.1 The US woke up – momentarily

When the oil crisis hit, President Richard Nixon outlined six measures that could reduce oil dependence immediately (CVCE 2017).

1. Power plants were encouraged to use coal instead of oil
2. The amount of fuel reserved for aircraft was reduced
3. Measures were taken to reduce the consumption of heating oil in homes and offices by about 15 per cent, which meant a reduction of indoor temperatures by about 3°C
4. It was ordered that all vehicles owned by the Federal Government travel no faster than 50 miles per hour (about 80 kilometres per hour) except in emergencies
5. The construction of nuclear plants was sped up
6. States were encouraged to boost public transport, promote car pooling and introduce a speed limit of 50 miles per hour (about 80 kilometres per hour).

Nixon could see that the crisis called for crisis measures. He also highlighted the need for a greater change. "In the short run, […] we must use less energy – that means less heat, less electricity, less gasoline. In the long run, it means that we must develop new sources of energy which will give us the capacity to meet our needs without relying on any foreign nation." (CVCE 2017.)

Indeed, there was willingness to complement fast action with new legislation to support energy self-sufficiency (Office of the Historian). The legislative package included the following proposals:

1. A return to Daylight Saving Time on a year-round basis in 1974 and 1975
2. The relaxation of environmental regulations
3. The right to intervene in private companies' energy consumption, such as by imposing restrictions on the opening hours of shopping centres
4. Use of the Naval Petroleum Reserves
5. The Federal Government's authority to reduce highway speed limits throughout the country to 50 miles per hour (about 80 kilometres per hour) and adjust the schedules of planes, ships and other carriers to reduce their energy consumption.

The 1973 oil crisis and the second in 1979, following the Iranian revolution, shaped US energy policy. Congress quickly passed new legislation, industry sought energy savings and

invested in research and development and people learnt to make do with less energy. Voices calling for more sustainable energy and environmental policies grew stronger.

However, the key goal was to increase energy independence. The crisis proved to the US that it was possible to reduce dependence on imported oil quickly: between 1977 and 1985, oil imports fell by 50 per cent (EIA 2021b).

But this did not mean that the crisis had led to a move away from oil. On the contrary, after 1973, oil consumption continued to increase (EIA 2021c) – there was simply a shift from imports to domestic production. In 2020, the US was a net oil exporter for the first time (EIA 2021a).

While the oil boom continued, the crisis awakened the US to the potential of energy conservation, energy efficiency and renewable energy. The country took the initiative to create the International Energy Agency (IEA) (Scott 1994) and the US Department of Energy saw the light of day. Democrat and Republican US senators founded an organisation to promote energy saving, the Alliance to Save Energy (ASE 2022). Energy efficiency standards for cars were introduced, leading to a significant decrease in their energy consumption (U.S. Department of Transportation 2022). The National Aeronautics and Space Administration (NASA) led the active development of wind power technology starting from the mid-1970s onwards (NASA 2006). The turbines it developed laid the foundations for today's wind power generation. As a symbol of this change in thinking, President Jimmy Carter had solar panels installed on the roof of the White House in 1979.

However, the US idea of energy self-sufficiency still relied on fossil fuels and the sustainable energy revolution did not take off. In 1986, President Ronald Reagan removed the solar panels from the roof of the White House.

The severity of the oil crisis was equated with wartime, so the 1939 law allowing for oil rationing was introduced.

2.2 The energy crisis contributed to the rise of cycling in the Netherlands

In 1973, more than half of the Netherlands' energy needs were met with imported oil. About 70 per cent of this was imported from the Middle East (Venn 2016). The oil crisis caused deep concerns about job losses and inflation.

The government took quick action, even though there was no immediate certainty of a reduction in oil supply. The initial target was to reduce oil consumption by 10 per cent. The severity of the oil crisis was equated with wartime, so the 1939 law allowing for oil rationing was introduced. A driving ban was announced for Sundays and the speed limit was reduced to 100 kilometres per hour. Although the limit was voluntary, about 90 per cent of drivers complied with it. Home heating had to be reduced and curtains closed to prevent heat loss. Fuel distribution was restricted. The government established a separate co-ordination group and a ministerial working group to support the management of the oil crisis. Oil exports were restricted. (Hellema et al. 2004.)

Although times were difficult, the crisis was also a catalyst to inspiring developments. In post-war Europe, cycling was rife, but enthusiasm waned as the 1970s approached. The Netherlands managed to reverse this trend.

Protest movements against motorways and increased road deaths had become widespread in the Netherlands in the 1970s and, with the fuel price increases and restrictions on motoring due to the oil crisis, the ground was prepared (Bruno et al. 2021). On the first car-free Sunday, the number of train passengers increased by 30 per cent compared to a normal Sunday. Local youth held a picnic on a motorway. Even Queen Juliana cycled in public – and later the Netherlands became a cycling superpower. (Hellema et al. 2004.)

2.3 Finland turned to energy saving and new fuels

In Finland, the supply of Soviet oil mitigated the energy crisis somewhat. However, in December 1973, the government published a large-scale energy saving programme based on the Emergency Powers Act. The aim was to avoid unnecessary energy consumption (YLE 2022b) in a way that minimised disruption to industry and the critical functions of society. Finland was, and still is, dependent on oil imports, and before the crisis, oil accounted for nearly 60 per cent of the total energy consumption (Official Statistics of Finland (OSF) 2022).

In road transport, a speed limit of 80 kilometres per hour was set for cars and motorbikes, advertising lights had to be turned off at night and motorway lighting was banned. Sport and leisure activity was restricted by banning recreational aviation and motor sports competitions. Recommendations for homes included lowering the indoor temperature and reducing lighting and air conditioning, and restrictions were imposed on car heating. (YLE 2022b.)

The savings programme aimed to reduce energy consumption by about 10 per cent. This involved both large (lowering the indoor temperature) and small (banning recreational aviation) measures.

As the price of oil rose, attention turned to domestic sources of energy: the use of peat grew rapidly and peat production increase was subsidised with taxpayers' money (Saraste & Raivio 2021). Peat has remained a relatively important fuel, especially for heating, until the 2020s. Finland also expanded the range of imported fuels and started importing natural gas from the Soviet Union in 1974 (Official Statistics of Finland (OSF) 2022).

Before the crisis, oil consumption had been on the rise, and in 1973 consumption equalled about 515,000 terajoules (TJ). In 1974, consumption fell by 13 per cent to 446,000 TJ. The share of oil in total consumption dropped from 60 per cent to about 57 per cent, while total energy consumption decreased by about eight per cent. Thereafter, oil consumption started a gradual recovery, although consumption fluctuated from year to year until the end of the decade. (Official Statistics of Finland (OSF) 2022.)

Conclusions

- Exceptional measures have been taken in crises
- In the short term, countries can make significant cuts in energy consumption if necessary
- In the long term, major shifts are possible, so it pays to make wise policies from afar – quick wins are rarely attainable
- After an acute energy crisis, countries may revert to their old ways, in which case good progress in areas such as renewable energy or energy efficiency will not continue automatically.

3 The Fukushima nuclear disaster forced Japan to adjust its energy consumption

In March 2011, the largest earthquake ever recorded in Japan and the resulting tsunami caused not only massive human losses but also immediate, long-term challenges for energy production (Reconstruction Agency).

The natural disaster caused a nuclear disaster that shut down the Fukushima nuclear power plant, other production facilities and distribution networks. Eventually, all of Japan's nuclear power plants were shut down to ensure their safety, and only a few of the 54 power plants that were in operation before the disaster have subsequently been restarted (Kelly & Lies 2022).

In the weeks following the disaster, parts of the country suffered from temporary regional blackouts. The worst affected areas were the disaster's core areas – Tōhoku, Greater Tokyo and Kansai – where about half of the country's electricity was consumed. However, strong energy saving measures helped to overcome blackouts relatively quickly. (Kimura & Nishio 2016.)

In 2010, nuclear power accounted for roughly a quarter of Japan's electricity generation. Energy saving and energy efficiency measures were crucially important in the country's ability to cope with the post-disaster power shortage. It is estimated that about half of the nuclear electricity lost between 2010 and 2015 was successfully replaced by energy saving and efficiency. Just over a third was replaced through the increased use of fossil fuels and the remainder by renewable energy, which has since increased in importance. (REI 2017, REI 2021.)

Central and local governments, especially the Tokyo Metropolitan Government, were the key players in responding to the acute energy crisis. They took a number of significant measures.

- **Continuous nationwide communication on electricity adequacy:** Information on the electricity supply and consumption situation was provided in daily consumption forecasts. If case of imminent supply limits, a warning of the risk of a planned blackout was sent, for example by SMS. (METI 2013a.)
- **Energy saving obligations for large users:** A mandatory saving target based on law was imposed on commercial operators consuming more than 500 kW of electricity. In the summer of 2011, electricity use had to be cut by 15 per cent in the Greater Tokyo area and the Tōhoku areas between 9 a.m. and 8 p.m compared to the same period the previous year. Violators of the order could be fined of about USD 12,000. The order did not apply to operators considered critical, such as hospitals. (METI 2013a, Kimura & Nishio 2016.) In the Tokyo region, the savings measures identified in the regional emissions trading scheme and related energy audits launched in 2010 were widely implemented (Tokyo 2012, Tokyo 2013).

- **Voluntary targets and measures for small users:** Commercial consumers using less than 500 kW of electricity were asked to set themselves voluntary saving targets and action plans to achieve them. Both central government and the Tokyo Metropolitan Government provided targeted energy advice. (METI 2013a, Kimura & Nishio 2016, Tokyo 2012.)
- **Energy saving campaign for consumers:** A large-scale information campaign advised households on reducing consumption. The campaign included a savings manifesto, checklists, newspaper advertisements, seminars and workshops. (METI 2013a, Kimura & Nishio 2016.) In 2011, more than 330,000 energy-saving advice visits were made in Tokyo, a city of over 13 million inhabitants (Tokyo 2012). Scaled to the size of Helsinki, this would amount to about 16,500 visits a year.

Energy saving measures were continued in the years following the acute crisis. In medium-term (1–3 years) measures, three areas in particular stand out.

- **Indicative regional targets:** The government ordered indicative quantitative targets for regions to encourage them to reduce consumption especially in the summer and winter seasons when consumption is highest. The target level ranged from zero to 15 per cent. (METI 2013a.)
- **Update of the energy efficiency programme for products and materials:** The energy efficiency regulatory programme aimed at the use of best technologies, the so-called Top Runner programme, was complemented by the inclusion of building and insulation materials (METI 2013a, METI 2013b).
- **Preparedness for unlikely but high risks:** The central government, regional government and energy producers on Hokkaido island consulted in advance with major energy consumers about the potential of sudden power failures during the winter season. The companies that participated in the programme and responded to the saving requests received a price reduction on their electricity contracts in return. (METI 2013a.)

Overall, the energy saving measures exceeded the targets set and continued for several years. In industry, the most important measure was to reduce peak consumption by moving activities to nights and mornings. In addition, cooling was reduced, production processes were changed and purchased electricity was replaced by increasing in-house production. These actions, although successfully implemented, were later judged to be challenging. (Kimura & Nishio 2016.)

Large commercial operators cut consumption, especially by reducing air conditioning and lighting and by switching to more energy-efficient equipment. These measures were not considered unpleasant; in some cases, they were even seen as improving comfort. In the Greater Tokyo area, industrial and other commercial operators jointly achieved reductions of up to 27 per cent during the summer of 2011 and further reductions of about 12–16 per cent over the following summers and winters. (Kimura & Nishio 2016.)

In households, the most effective measures concerned reducing air conditioning and adjusting temperatures (wintertime heating to no higher than 20°C, summertime cooling no lower than 28°C), reducing lighting and purchasing more energy-efficient fridges and adjusting their temperatures. In the Tokyo and Kansai areas, electricity consumption decreases ranged from 4 per cent to 18 per cent, depending on the year. According to surveys, most people did not consider the measures particularly unpleasant. (Kimura & Nishio 2016.)

Some of the saving measures took root over the years as a matter of course; others were abandoned as the pressure eased. However, Japan's electricity consumption is still lower than in 2010 (IEA 2022b) and the move to more energy-efficient devices has contributed to limiting consumption in later years. (Kimura & Nishio 2016.)

Conclusions

- The electricity generation challenges that followed the 2011 disaster forced Japan to reduce consumption abruptly
- Energy saving and energy efficiency measures were key tools in overcoming the electricity shortfall; replacing about half of the nuclear electricity lost
- Existing regulation and administrative procedures helped the country react quickly
- The fast reduction of consumption was promoted by the readiness of people and businesses to work for the common good, urged on by government.

Overall, the energy saving measures exceeded the targets set and continued for several years.

4 Leaps without crises

Even rapid changes in the energy economy have not always required an immediate crisis, although they may have been spurred on by the concerns raised by crises. There are examples of this from past decades as well as from recent years.

Table 1. Largest reductions in fossil fuel power generation in Western European countries

Country	Period	Replaced fuel	Reduction	Primary replacement
Denmark	1972–1982	oil	–58%	coal
Belgium	1974–1984	oil	–30%	nuclear power
Ireland	1979–1989	oil	–49%	coal
Denmark	1995–2005	coal	–37%	renewable energy
United Kingdom	2007–2017	coal	–30%	renewable energy
Denmark	2007–2017	coal	–36%	renewable energy

Source: Vinichenko et al. 2021. The reduction is expressed as a percentage of total electricity production over 10-year periods.

The same country may have carried out several consecutive energy transitions. Denmark first switched its electricity generation from oil to coal in the 1970s, and then from coal to wind power and other forms of renewable energy in the 2000s (Vinichenko et al. 2021).

Our neighbour Sweden increased the share of nuclear power in electricity production from zero to more than a third in ten years – and up to a half in 15 years (Energimyndigheten). In France, the amount of energy produced by nuclear power grew fivefold in a decade (Our World in Data).

In the United Kingdom, the share of coal in energy production decreased from more than 40 per cent to less than 2 per cent in less than a decade. In 2020, the country managed to do without coal power for a whole month for the first time since 1882. The key reason has been the country's price floor on climate emissions. (Carbon Brief 2020.)

Sometimes quite big changes can take place in just a couple of years – or even in only one. In the Netherlands, the share of wind and solar power in electricity production jumped by more than 10 percentage points in 2019–2021. In our neighbour Estonia, the share of solar power in electricity consumption increased from less than one per cent to nearly four per cent in the same period. (Ember 2022.)

Last year alone, more than 2,100 megawatts (MW) of new wind power capacity was built in Sweden – more than three times as much as in Finland (Wind Europe 2022). This rapid development was driven by Sweden and Norway's common green certificate system, among other things (Swedish Wind Energy Association 2020). If the pace of construction had been as fast in Finland, wind power could have yielded an increase of about six percentage points to Finland's annual electricity production.

Transfers measured as percentage points may seem modest. By comparison, however, natural gas accounted for four per cent of Finland's electricity generation in 2021 (FE 2022b). An increase in electricity production in one area may not be able to compensate one to one for the use of natural gas for electricity generation elsewhere. Still, an increase of over two percentage points in clean electricity production would roughly equal the share of gas piped from Russia in Finland's electricity supply.

There have been a variety of drivers of energy transitions under normal circumstances. In Sweden and France, the increase of nuclear power was spurred by industrial policy, which supported domestic reactor manufacturers (IAEA 2020, IAEA 2021, Kaijser 1992). In recent years, the transformation has been accelerated by the sharp fall in the price of wind and solar power and the need to cut climate emissions.

Much depends on the policy chosen. The share of solar power in electricity consumption is higher in the Netherlands than in Greece, for example, and higher in Germany than in Italy (Ember 2022). The amount of sunshine does not determine how much solar power is used. The energy transition is proceeding fastest in countries that pursue it through determined policies.

Conclusions

- Major energy economy transitions have been possible even without crises
- In some cases, significant changes have been achieved in a short period of time
- The drivers of change vary but the policies in place are crucial.

5 Proposals for consideration

Strengthening foresight and preparedness

Foresight is a way of outlining likely and unlikely future developments, even in the face of deep uncertainty. Preparedness in Finland is relatively well developed, but the time and efforts dedicated to it well in advance will pay off in times of crisis.

- Identify potential developments – including the most worrying ones – and develop contingency measures to safeguard energy supply in all situations
- Favour, where possible, solutions that promote both energy self-sufficiency and overall sustainability
- Lay the groundwork for preparedness through a preparatory debate, both between parliamentary groups and, where possible, publicly, to ensure sufficient public acceptance of the measures.

Making full use of energy saving and efficiency measures

If we face a deep energy crisis, energy consumption must be adjusted quickly. There are a number of ways to prepare for this.

Voluntary measures should be taken even if we avoid a serious crisis. When Finns save energy, they also save money, which will bring relief in the face of rising costs. Energy saving also offers Finns the opportunity to support the transition away from Russian energy.

- Prepare a campaign to encourage the public and businesses to take energy saving initiatives
- Strengthen existing means to improve energy efficiency (such as subsidies for energy renovations and energy advice) so that they can be implemented immediately
- Prepare a package of crisis measures to cut energy consumption quickly, if the situation demands
- Update legislation, where necessary, so that the division of tasks between authorities is clear and all effective measures can be taken without delay.

Safeguarding energy production to replace Russian energy

Energy imports from Russia must now be reduced significantly. Measures to replace energy that is lost this way must begin immediately to minimise disruption.

- Temporarily accelerate the permit and planning processes for sustainable renewable energy projects
- Strengthen existing means of decoupling from oil and gas heating to achieve rapid results
- Remove bottlenecks to the rapid increase of energy solutions, for example by providing fast-track training for installers and organising bulk purchases of key equipment
- Support energy companies to switch to non-fuel based solutions for district heating to replace imported fuels.

Supporting long-term energy transition

Many crisis measures would be needed to respond to the energy crisis. However, exceptional short-term solutions must not detract from the transition to a climate and nature-positive circular economy, which is imperative in the medium and long term. Even in the turmoil of the energy economy, farsighted investments can be made, which will bear fruit in the future.

- Strongly support demonstration projects to promote the production of such things as offshore wind power, hydrogen and synthetic fuels as well as district heating without burning fuels.

Prepare a package of crisis measures to cut energy consumption quickly, if the situation demands

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