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Low power: how self-sufficient Sweden jeopardised its energy security

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In the late 1990s, Sweden had a uniquely well-functioning electricity system. It was virtually 100 per cent fossil-free, reliable, and cost-efficient. What went wrong?

Colourful paintings on dam, Stora Sjofallet hydroelectric power station, Lapland, Norrbotten, Sweden, June 2013. Credit: Nature Picture Library / Alamy Stock Photo

Europe has been plunged into an acute energy crisis. Although triggered by the war in Ukraine, a more fundamental reason for the predicament is an increased dependence on wind and solar energy. These intermittent electricity sources require backup from nuclear power, otherwise dependence on fossil electricity generation will increase. But after the Fukushima disaster, Germany, for example, stopped investing in new nuclear power, and accelerated the closure of existing nuclear plants, leading to dependence on natural gas and coal.

In the late 1990s, Sweden had a uniquely well-functioning electricity system. It was 100 per cent fossil-free, reliable, and cost-efficient. Large hydropower stations in the

north and twelve nuclear reactors in the south, where 89 per cent of the country's population live, meant that electricity was produced close to where it was consumed.

Since then, however, six of the twelve nuclear reactors have been closed prematurely, the gas-powered Öresund combined cycle power plant in Malmö has been sold to Vietnam, and the Swedish electricity market has been integrated with the grid on the Continent. The combined capacity of the two southernmost nuclear reactors at Barsebäck and the Öresund combined cycle power plant would have been sufficient to fill the electricity need for the 1.4 million inhabitants including the needs for all firms of Skåne in the south of Sweden.

Despite this, the Swedish government foresees a doubling of electricity demand by 2050. A substantial share of this projected increase pertains to 'mega-projects' for new industries in the far north of Sweden that are extremely energy intensive and where the socio-economic risks are enormous.

Reality is beginning to sink in. The electricity crisis is here and now. It not only entails sky-high electricity bills in Skåne, but also residential areas that cannot be developed and a halt on investments that would have generated thousands of jobs. There is an ongoing risk of power cuts and even of a system crash this winter.

And yet, based on the fact that annual electricity production exceeds annual consumption, the government has repeatedly asserted that Sweden has surplus electricity. This, however, is of little help, as electricity must be produced in an even flow, at exactly the volume being consumed. This means the price of electricity can be as high as six kronor per kilowatt-hour — around 48 British pence, or 57 US cents — on a hot August day in Skåne.

The lack of power that can be delivered and used on-demand in southern Sweden is now so great that surplus electricity in the north can no longer be transferred south to substitute for the decommissioned nuclear reactors. The issue is not a lack of cables; instead, to be able to receive electricity from a remote location, it is necessary to have adequate non-intermittent production of your own. The only remaining major source of such power in the south is an oil-fired power plant in Karlshamn which, if it is run at full capacity all year round — consuming more than 100,000 litres of oil per hour — can provide electricity equivalent to one of the scrapped nuclear reactors.

But if electricity cannot be transferred from north to south, perhaps it is a good thing that the 'surplus' is used to reduce total carbon emissions with the help of 'green' industries in northern Sweden? Impressive plans have been drawn up. The startup H2 Green Steel will make steel using electrically-produced hydrogen, while publicly-owned Luossavaara-Kiirunavaara Aktiebolag (LKAB), under the chairmanship of former prime minister Göran Persson, is planning to use hydrogen to transform ore into sponge iron, and state-controlled steel company SSAB will also produce hydrogen-based steel. Energy company Vattenfall, which is fully owned by the Swedish state and has lost hundreds of billions of Swedish kronor through poor business deals in the Netherlands and Germany, will provide a great deal of the power supply for these projects. The annual electricity needs are staggering: 80 TWh, the equivalent of Finland's total electricity consumption.

Is there really an electricity surplus? All electricity produced is used, and both businesses and the general population are used to accessing a good electricity supply at a reasonable price. There are also more and more energy-hungry projects taking shape in northern Sweden. The battery producer Northvolt, which partially has the same ownership as H2 Green Steel, calculates it will need more than 2 TWh per year, whilst H2 Green Steel itself is planning to use 12 TWh. Spain's Grupo Fertiberia, attracted by renewable manufacturing sources and Europe's lowest electricity prices, is building a fossil fuel-free artificial fertiliser plant outside the northern coastal city of Luleå that will require 4–5 TWh.

Combined with the data centre run by Meta (formerly Facebook) in Luleå, these investments will require the equivalent of 20 TWh annually. Is this a lot? Everything is relative, but just noting that Sweden's northernmost county, Norrbotten, with 22 per cent of the country's total land area has a total annual hydropower production of 14 TWh is enough to demonstrate that any 'surplus' would be completely wiped out by these investments. If the additional needs are to be covered by wind power, this will have to become the dominant power source, meaning that Norrbotten will end up with an unstable electricity system with occasional extremely high prices. Naturally, the biggest losers are the companies and households already living and working in the north. The effects are already noticeable in the small city of Skellefteå, home to Northvolt — its progress is forcing other companies to close as the local economy becomes overheated.

Once LKAB's and SSAB's projects have reached full capacity, there will be a need for a further 60 TWh or so per year, with wind power apparently the intended source. This is totally unrealistic. Offshore wind power requires an ice-free sea, so the turbines must be located on land — and the area required is equivalent to some 4,000 square kilometres, with heavy-duty access roads and dense cable networks for thousands of turbines in a mountainous landscape.

It does not stop there. To stabilise an electricity system that, in this case, is entirely dominated by wind power, there must be on-demand electrical power for when there is no wind. This will be from fossil fuels — gas, coal or oil — because all existing hydropower is already being used. Not including the impact on nature and the carbon emissions from this power, the costs for wind power and its grid, and for the back-up power only used when there is no wind, are far higher than the electricity price used by investors in their calculations. If production and distribution are to carry their own costs, it is hard to see that the electricity price can be less than one krona per KWh.

This brief overview is sufficient to demonstrate how unrealistic the largest of the aforementioned mega-projects are. On top of this, there is the difficulty of finding labour willing to move to the far north of Sweden. This is already apparent from Northvolt's struggle with recruitment at its new plant in Skellefteå. Yet, there are several reasons why these projects are likely to be continued. One is that they have sprung from the contemporary predilection for so-called mission-oriented innovation policy, in which states and public agencies do not simply indicate which problems must be solved, but also the technology that should be used to solve them. Another key reason is who receives funding for implementing the projects. The EU's Green Deal provides a sum of 4.3 billion euro, an amount close to Sweden's GDP in the form of funding and credit guarantees for hydrogen-based technologies, with the aim of achieving freedom from fossil fuels by 2050, while, in recent decades, Swedish

energy researchers have received billions of kronor for demonstrating the excellence of wind power.

Politicians flock around this. Both the former Social Democrat Persson and former minister of enterprise Anders Sundström have been given lucrative key roles to ensure that subsidies flow to their employers. The venture capitalists behind companies such as H2 Green Steel and Northvolt have become skilled subsidy entrepreneurs, able to transfer ownership to other actors — invited to invest in the 'green transition' — in good time, so they make an advantageous deal themselves. Meta has already led the way. The company received almost 140 million kronor for locating its data centre in Luleå and has received an additional 98 per cent tax discount on the electricity it uses. Attracting this gigantic data centre was motivated by a study that Business Sweden commissioned from Boston Consulting Group which promised 4,500 jobs. It turned out to be a little over 70.

The biggest project on the table is LKAB's plan to transform ore into sponge iron using electrically produced hydrogen. The company will invest more than 400 billion kronor over 20 years, which means that its entire predicted profit from mining ore will be invested in a high-risk project rather than being distributed to its owner, the state — it is clearly inappropriate to allow a fully state-owned company to make such a risky investment. The project requires electricity equivalent to four times the current need of the county of Skåne, and the number of production jobs is estimated to be a maximum of 200. If LKAB believe they can build a successful business for transforming ore into sponge iron, then placing it in Gällivare/Kiruna is hardly a rational choice; in addition to the difficulty of recruiting people it will make them dependent on a single supplier of ore. Rather, such an ambitious project should be undertaken by an independent company in a location with good access to cheap electricity and stable, long-term access to iron ore from several suppliers.

It is difficult to draw any conclusion other than that significantly expanding extremely electricity-intensive industry in the north of Sweden, under the management of major publicly-owned stakeholders, based on the enormous subsidies and profits from ore mining that could otherwise be distributed to the state, is in no way a wise policy. Not only is the business risk for these projects huge, the societal risks and the opportunity costs are enormous. These include the lack of labour, the risk of crowding out existing businesses, and high electricity prices in the future. Additionally, extensive complementary municipal investments will be required. These may turn out to be bad investments if the projects fail or provide negligible tax revenue for municipalities, because a very small part of their added value will be in the form of salaries for local jobs that generate municipal tax income.

- September 14, 2022

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