Research to reduce polarisation in the swedish energy policy debate

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Filip Johnsson, Professor at Chalmers University of Technology, argues that research can help to reduce polarisation in the Swedish energy policy debate

Sweden is an industrial country rich in natural resources such as iron ore, timber, and rivers for hydropower generation. These favourable conditions and the fact that Sweden remained neutral in WW2, resulted in strong post-war industrialisation, with many large companies expanding and becoming global players, including iron ore mining, steel companies, automotive industries, telecommunications, and the pulp and paper, shipbuilding and textile industries.

Post-war Sweden – the 'record years' of 1945 to 1973

The Swedish post-war industrialisation required large amounts of electricity, with the demand being met initially by building large hydropower plants on the large rivers in the north of Sweden. The era between the end of WW2 and the oil crises in the early 1970s is often referred to as the "record years" in Sweden. During this period, in addition to the strong expansion of industries, there was cheap energy from electricity and imported oil and strong economic growth.

Successful investments in nuclear power 1973-1985

Swedish industry suffered severely from the economic crisis that followed the oil crisis, especially the shipbuilding and textile and clothing industries, which were almost completely wiped out. Yet, nuclear power was strongly expanded between 1973 and the mid-1980s, with 12 reactors built with a total capacity of 11 GW. Thus, this expansion was based on decisions taken before the economic recession.

Nevertheless, when the new nuclear power plants entered operation, there was still sufficient demand for electricity, and the tariffs offered were, to a large extent, more competitive than those for oil used for heating.

Consequently, electricity-based heating became common in newly built houses, and the use of electricity-intensive processes in industry increased.

There was greater resistance to nuclear power after the Three Mile Island accident in 1979. In Sweden, this influenced the result of the 1980 referendum on nuclear power (which had the somewhat unclear outcome that nuclear power "shall be phased out, while taking consideration of the need for electric power for the maintenance of employment and welfare".) * Sweden today has six nuclear reactors in operation.

It is fair to say that the Swedish nuclear programme was impressive in terms of the 11 GW brought on-line between 1972 and 1985. During that period, there was strong optimism and belief in engineering, combined with a forward-looking attitude in society.

Constant electricity demand 1990-2023, but increased volatility in electricity prices

From 1990 until now, the electricity demand in Sweden has remained more or less constant at around 140 TWh/year (despite economic growth). Due to the internationalisation of the electricity market and favourable conditions for wind power generation at decreasing cost, the level of electricity generation has increased since Year 2010.

Today, it is around 160 TWh/year, i.e., there is a yearly net export of electricity from Sweden (SEA, 2023). An export surplus basically means that electricity prices in Sweden are, on average, lower than in the surrounding countries. Yet, there are also some hours during which Sweden needs to import electricity, with increased electricity prices as a result.

The robust expansion of the electricity generation system between the early 1970s and 1985 was conducted within a regulated electricity market for which the Government of Sweden most likely took on a large share of the financial risk for the investments in generation technologies. Until the mid-1990s, most electricity generation in Europe was from dispatchable power plants (coal, natural gas and nuclear) and hydropower in some regions, resulting in rather stable electricity prices.

Large increase in electricity demand is foreseen

Currently, Sweden finds itself once again in a situation where there is a need for a dramatic transition of the electricity system, primarily because electrification of the industry and transport sectors is essential to fulfil the carbon emissions targets.

In an industrialised country such as Sweden, it is estimated that the electricity demand will more than double up to Year 2045. Several large industrial projects, such as hydrogen-based steel, battery factories, and greening of the petrochemical industry, are underway – all requiring electricity at competitive prices.

The question is if the high spirit and ambition in engineering with a forward-looking attitude that characterised the period when decisions on nuclear power were taken can now be repeated for successful electrification of industries and transport.

The current energy policy debate in Sweden – the conflict raging between backward- and forward-looking perspectives

The current situation is different from that during the “record years.” The costs for renewable electricity in the form of wind and solar power have decreased dramatically, and the financial risk associated with investing in new power generation must mainly be

taken on by individual utilities and investors in the deregulated electricity market.

While a few nuclear power plants have been built in Europe over the last few decades, their construction has involved substantial budget overshoots and delays in the building process (Olkiluoto 3 in Finland, Flamanville 3 in France, Hinkley Point C in the UK). Nonetheless, new development projects involving Small Modular Reactors (SMRs) may create new possibilities for increasing flexibility (e.g., hydrogen production rather than electricity production) and reducing costs.

Even though the challenges and opportunities for wind, solar and nuclear power differ significantly, the energy policy debate in Sweden is highly polarised, with nuclear power positioned in opposition to wind power. The polarised debate persists even though wind and nuclear power technologies differ concerning expected construction and projected costs.

Wind power, mainly onshore wind power, can (assuming that siting permission is obtained) be built now and up to Year 2030 and beyond. There is also already substantial ongoing expansion of onshore wind power. However, it is meeting increasing resistance from municipalities, with local politicians often using their veto right to say no to wind power anywhere in the municipality.

On the other hand, nuclear power plants face long construction lead times (in addition to the permitting process), and the costs for new nuclear plants are likely to be high, making financing challenging. Accordingly, the new government has stated they want to establish loan guarantees from the state of some €40 billion for those building new nuclear power plants.

A common argument in the Swedish political debate on the future energy system is that nuclear power is required to attain stable electricity prices. Sweden's Minister for Energy, Business and Industry and Deputy Prime Minister, Ebba Busch, stated she wants to return to the 1990s when we had an electricity system "that all other countries wanted". ** This is most likely a reaction to the volatility of electricity prices seen in recent years, resulting from the increase in non-dispatchable electricity generation in northern Europe in the forms of onshore and offshore wind power, also enhanced by the effects mentioned above from Russia's war on Ukraine.

On the other hand, other politicians, some stakeholders and NGOs have adopted a more forward-looking perspective regarding the prospects of a future energy system with high shares of wind and solar power, perhaps sometimes underestimating the challenges associated with establishing such a system. These divergent views have resulted in a conflict raging between what can be described as backwards looking and forward-looking perspectives.

Flexibility in the future electricity system needed

One consequence of the variations in electricity generation from wind power (and solar power) is that there is a need for flexibility measures within the electricity system, both on the demand and the supply sides.

These flexibility measures, which are of a high technical maturity but yet to be implemented at scale, include hydrogen storage for industry, smart charging of batteries (both stationary and in vehicles), flexible gas turbines and smart control of heat pumps for home heating (there are some 1.5 million heat pumps in Sweden).

In our research group, we investigate how different forms of flexibility on both the supply and demand sides can work together for efficient integration of wind and solar power (see, for example, Göransson et al., 2018; Taljegard et al., 2019; Toktarova et al., 2022, Öberg et al., 2022).

Thus, such measures will reduce the need to curtail wind and solar generation; at the same time, various types of storage and import/export between regions will help meet the demand during lower wind and solar power production.

> “Currently, Sweden finds itself once again in a situation where there is a need for a dramatic transition of the electricity system, primarily because electrification of the industry and transport sectors is essential to fulfil the carbon emissions targets.”

Research to support energy policy debate to focus on future possibilities

In our recent publication (Göransson & Johnsson, 2023), which is based on the research that we have conducted over some 15 years, we apply our techno-economic modelling of Northern Europe (including the UK) to compare three scenarios for the future Swedish electricity system, with and without nuclear power in Sweden. This work concludes a strong need for flexibility measures in all three scenarios.

Swedish energy policy should focus on the factors that are crucial for the success of electrification in Sweden. These involve not pitting wind power against nuclear power but instead removing various barriers to expand new electricity production, regardless of the type of generation technology.

Thus, from our research at Chalmers University of Technology, we conclude that energy policy should focus on being forward-looking but in a way that considers all electricity generation technologies and available flexibility options, rather than looking backwards and longing for an electricity system that cannot be recreated.

References

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Footnotes

- * The original Swedish formulation is available at Wikipedia: [https://sv.wikipedia.org/wiki/Folkomr%C3%B6stningen_om_k%C3%A4rnkraften_i_Sverige_1980]
    - There is also an English version at Wikipedia: [https://en.wikipedia.org/wiki/1980_Swedish_nuclear_power_referendum]
    - Plus [https://findatwiki.com/1980_Swedish_nuclear_power_referendum]
- ** Translated quote from the Swedish National Climate Meeting 2023, available here (in Swedish) [https://www.youtube.com/watch?v=CGhouCt5wAc] around 5 minutes into the clip.

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