

Powering the Debate on **EU Energy Policy:** Towards Carbon Neutrality or Increasing Fragility?

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for European Studies



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Introduction: Energy in the Heart of Politics

It is not easy to write about energy. So much is happening in energy technology and politics, that writing something down on paper can feel pointless: much of the information may be outdated by the time a booklet like this comes off the press. However, the daily news of new innovations and of the latest ideas for new energy policies may create an illusion. In reality, energy is a rather conservative industry. On the larger scale, as we will see in this book, changes in energy production and use are slow and gradual. Many great innovations never become mass-produced. It is not economically feasible to scale up production for every good innovation there is. And many of the ideas in the news turn out to be not so great in the end.

“The energy systems we have inherited from the previous generations reflect the political situations, challenges and priorities that were being faced 20-40 years ago.”

A typical large-scale energy production facility is expected to function for perhaps 40 years. Investments are huge and have a long life span, so risks must be avoided – especially if you are a private investor. The energy systems we have inherited from the previous generations reflect the political situations, challenges and priorities that were being faced 20-40 years ago. At that time, climate change was not yet really one of them.

Instead, the oil crisis of the 1970s, for example, did affect the direction that energy politics took in many countries. Soviet-style planned economics directed the energy production, networks and use in Eastern Europe. Experiences of the Second World War and Cold War created a need for preparedness and self-sufficiency. European and American oil companies ventured into the Middle East in search of oil and impacted the geopolitics of the whole Middle East for more than a century. In Europe, we are still living in a manner that is based on the decisions made decades ago, both good and bad.

Times are a-Changin'

Yet, change is coming. The whole energy sector is going through many changes and restructuring such large systems can also be very good for the economy. The sources of energy are changing slowly but steadily, not only in Europe but globally. Major countries such as India and China are now investing heavily in renewable energy production. Still, the global CO₂ emissions are not yet decreasing.

Much hope is therefore being placed on technological development. However, even the best experts in energy technology and related fields seem to disagree on many things, such as the real potential of renewable energy sources and other future energy production technologies; whether decoupling of economic growth from the use of more and more (fossil fuel) energy is possible or not. And so forth.

Getting a clear picture has become extremely difficult and the daily news of innovations, new research and endless opinions does not always help. We therefore hope this small booklet will make some things more clear. Innovations and technological development are very important. In this short booklet, our main focus is on energy politics at the EU level. In any case, the challenge of decarbonization is enormous. Political scientist **Roger Pielke** has estimated in a popular article that net-zero CO₂

emissions by 2050 globally would require a new nuclear power plant every single day.¹

Energy is essential for life and our societies

Affordable energy – so far largely in the form of fossil fuels – has made modern society and its well-being possible. We need energy for virtually everything we do. Therefore, all issues related to energy are political, as well as social and psychological, too.

While much is being said and written about climate change and climate policy, there is not so much realistic discussion on the production and use of energy (electricity and heat), which accounts for nearly half of all CO₂ emissions. If we want to tackle climate change, the most important way to do so, is to change how we produce our energy in the future.

Energy unites and divides

Energy unites Europe. Euratom (est. 1957) was one of the first European institutions. In recent years, energy has become a major European issue again largely because of climate change and the common EU climate policy.

The **EU energy union** aims to create a single common market for energy. Electric networks are being standardized, which will help the flexible transfer of electricity from country to country.

Meanwhile, the European Council has affirmed that its aim is “ensur-

¹ Roger Pielke. Net-Zero Carbon Dioxide Emissions By 2050 Requires A New Nuclear Power Plant Every Day. Forbes, September 30, 2019.

ing the energy transition towards an affordable, safe, competitive, secure and sustainable energy system”.²

Yet energy also divides Europe and the EU. As an example, the German decision to install Nord Stream 2 and increase its energy (and political) dependency on Russia has been widely criticized. The German (and Belgian and Swedish) decision to give up nuclear energy is controversial as we will explain in this booklet. At the EU level, certain countries are not only phasing out nuclear energy, but also still actively lobbying against its use in the whole EU area – while installing new capacity for natural gas imported from Russia and, in some cases, also delaying the phasing out of coal.

On the other hand, nuclear energy is also making a comeback in some European countries. For example, Sweden and Finland, among many others, are researching small-scale nuclear reactor types for the generation of heat into district heating systems. This technology is relatively simple, but the progress of implementation is slow.

Energy in the heart of domestic politics

Energy systems and services, including power generation, transmission and distribution, transport and logistics of fuels as well as digital data systems, communications networks, payments and security transactions systems, are all part of the critical infrastructure in any country.

Governments and the EU direct energy production and use with legislation, research, taxes, subsidies and other means. The price of different forms of energy (especially petroleum products) is largely controlled by the state in many countries (taxes, subsidies, etc.). Every major power

² <https://www.consilium.europa.eu/en/policies/energy-union/#https://www.consilium.europa.eu/en/policies/energy-union/#>

plant construction is a political decision. Some of the recent demonstrations in countries such as Iran have started from a rise in the price of fuel. And in the global scale, the majority of the largest energy companies are state-owned.

Energy makes bad neighbours

Controversies over energy (geo)politics are, of course, not something new. Locations of nuclear power plants have generated tensions between countries on numerous countries. As an example, Danes strongly opposed the decision by Sweden to build the Barsebäck nuclear power plant as close to Copenhagen as possible (20 km). The Danish government pressed for its closure during the entirety of its operating lifetime. The last unit in Barsebäck was closed in 2005.

Another example is Belarus, who is completing its first, long-planned nuclear power plant in Astravyets, only 16 km from the Lithuanian border and not too far from Vilnius. Naturally, this has raised concerns in Lithuania.³

Moreover, within countries themselves, there can be immense tensions between cities and rural areas. A good example from Finland is the discussion over the use of peat in heat production for district heating systems. Today, peat is only used in smaller cities in the mid- and northern parts of the country. Peat is not a climate-smart source of energy, but on the other hand, Helsinki was heated by 79 % fossil fuel energy just in 2018. Therefore, new fossil-fuel free sources of heat energy are needed both in cities and in smaller towns. As such new investments are relatively more expensive to small, shrinking cities, the questions of “what

³ On 7 February 2019, the Meeting of the Parties to the UN Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) decided that Belarus had violated the Convention by choosing a construction site for its nuclear power plant.

is fair” is extremely relevant. Similar discussions are going on in many EU countries.

It is important that when we aim to achieve an ambitious energy transition, we need to keep the social and regional justice (fair transition) as well as safety and resilience in mind.

Geopolitics and power politics of energy

For centuries, energy has been an important geopolitical issue: a question that has to do with, for instance, balances of power between nations. Transitions in energy markets and new technologies can have a significant impact on the geopolitical balance and national security by affecting countries’ energy trade, economy and security of supply. The geopolitical questions in the future will not only be linked to oil, but also more and more to rare earth minerals and technology. For this reason, China and Russia will remain important players in the field.

As a major importer of hydrocarbons, China will be able to use energy diplomacy because of its high demand, and moreover China is also a net exporter of many of the materials required for manufacturing, such as renewable energy and battery technologies, and is an exporter of the technology itself.

In the past decades, the price of oil has been fluctuating significantly due to wars, economic crises, market regulations and changes in demand. And there have been many wars over oil resources.

In 2017, the EU imported 55 % of its primary energy and is very dependent on energy exporting countries, such as Russia. The dependency rate on energy imports has increased since 2000, when it was just 47 %.⁴

⁴ Source: EUROSTAT <https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2c.html>

Looking a bit further into the future, the possible decline in the global demand for fossil fuels would significantly affect this global balance of power. Technological development, climate change and conflicts in areas that are important for energy production and transport, impact global balances in ways that are difficult to predict. Decreasing demand can put pressure on countries with economies dependent on the exports of hydrocarbons (coal, oil and gas), and this may create political instabilities. At the same time, many petroleum-producing countries are also trying to diversify their economies.

Energy policy is history and emotions

The historical paths of European nations differ in energy politics. This is obvious even for geographical reasons. As an example, Sweden and Norway are often praised for their very high percentage use of renewable energy for electricity production (over 50 % and close to 100 %, respectively), but this is largely to do with the significant amount of hydroelectric power readily available.

History, how things are remembered and felt, does affect our thinking, and therefore also policy decisions – often much more than mere facts. Energy is not an exception. Politics is created by stories, images and headlines – much more than with facts and statistics. Why is nuclear energy today still not an option in Germany, for example, the home of **Albert Einstein, Otto Hahn, Fritz Strassmann** and Siemens – while it seems more or less an accepted option in other countries, like France? Many of the differences we are seeing today in energy policies may be due to historical and ideological differences – in people's minds.

Is necessity the mother of innovation?

Necessity (e.g. by tightening environmental legislation) may drive innovation and technological change. In times of war or other calamities, many technological innovations were made rapidly and even scaled up in production.

However, how much can we base our political decisions today on a technology that is not technologically ready or available at massive scale yet?

A recent example from Finland is the recent legislation that will ban the use of coal in heating and electricity production by 2029. Power companies are now intensively looking for – and investing into – alternatives, such as geothermal energy. Hopefully these will be commercially available by 2029 and the very best options will be chosen – because we need to live with the choices for the decades to come.

European Green Deal

At the time of writing, the new European Commission, under the leadership of **Ursula Von der Leyen**, has set ambitious climate targets for the European Union. The aim is to make Europe the world's first climate-neutral continent. However, as we see in this publication, the EU and member nations are still today making decisions in energy politics that make obtaining this goal more difficult, not less. The coming months and years will show more concretely what kind of Green Deal we will have and what will its implications be on energy systems. In any case, debates over energy politics will continue. For example, the European Parliament's recent resolution on green finance taxonomy still leaves the question of nuclear energy open.⁵

⁵ <https://www.euractiv.com/section/energy-environment/news/do-no-harm-nuclear-squeezed-out-of-eu-green-finance-scheme/>

Who should own energy production?

The age-old question of the best ownership model still is a relevant question in energy politics. We will discuss this further in the article by **Sami Karhu** and Tapio Luoma-aho.

We argue that the economic and ownership models in energy production should not be looked at ideologically, but rationally. In any case, all countries are mixed economies in one way or another; all ownership models have their pros and cons and all of them have worked under certain circumstances. The article also makes the case for cooperatives and cooperative principles in energy production.

Future of energy

What could the future of energy production look like in, for example, 20 years? It is very difficult to say. Investors (including national governments) still have financial incentives to run facilities that have been installed in the last 10 years for the decades to come. Nord Stream 2 is just getting ready during the writing this booklet. We will be inevitably be stuck with the project even though it is contradiction with the EU's ambitious climate goals.

In the big picture, of course, the EU is only a small player in emissions and the EU's share of CO₂ emissions is decreasing. Obviously, we (the EU) have to do our share in reducing our emissions and set a positive example for the world, while still trying to maintain our energy-intensive industry, such as steel production in Europe.

Electrification is a long and risky road

It is true that our societies are becoming more “electric” and we can solve climate change by electrifying everything? In our daily lives we are

in touch with electric equipment all the time, and this may create an illusion that “everything” is becoming electric. Our societies very much depend on electricity networks, yet the share of electricity of all energy produced/used has been rather stable for decades. As **Rauli Partanen** points out in his contribution, when we look at the real production and use of energy, electrification is moving very slowly.

The increasingly intelligent and complex energy systems also create new risks. Electricity and telecommunications networks are becoming increasingly interconnected. The purpose of our paper is to also look at some of the fragilities of future energy systems at a very general level. That is why we will also hear a very important message from **Timo Lehtimäki**, CEO of Suomen Erillisverkot (State Security Networks) that, as the global communication/electricity network may well be the most complex thing on Earth, its safety and resilience are a priority at all policy levels.

Ultimately, energy will remain at the heart of politics. In this small publication, we will certainly not present all the answers, but hopefully we will at least be able to ask some of the right questions...

Acknowledgements

We want to express our gratitude towards all the authors in this paper.

Dimitar Lilkov of WMCES provides a comprehensive overview of energy policy at the EU level and valuable insights regarding the Eastern European countries’ perspective on energy production.

Rauli Partanen, awarded science writer and leader of ThinkAtom writes about the technological developments with a realistic touch.

Timo Lehtimäki, CEO of Suomen Erillisverkot oy (State Security Networks) provides a sobering reminder of the importance of network security in the digital/electric society.

Sami Karhu, CEO of the Pellervo Coop centre provides perspectives on the important question of who should own energy production and networks.

Parts of the contents in this book are based on a seminar “*EU energy policy: Are We Heading towards Carbon Neutrality or Increasing Fragility?*” organized by WMCES and Kompassi in Helsinki, September 2019.

Tapio Luoma-aho is the executive director of thinktank Kompassi (Finland).

European Energy Policy Beyond 2020

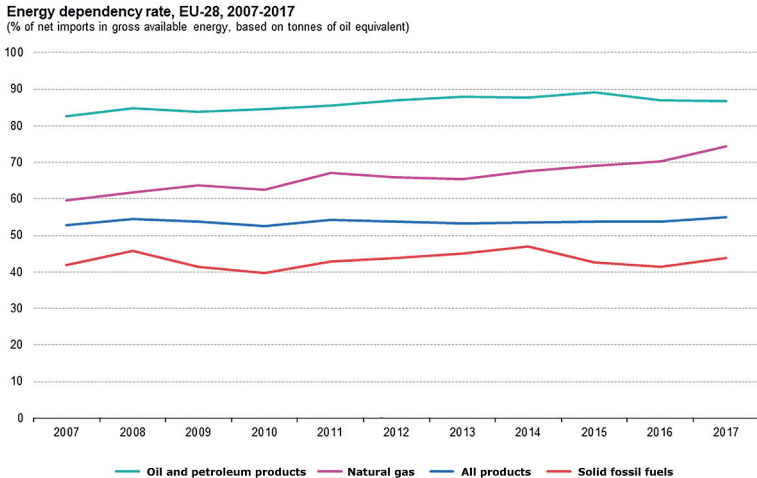
Is Carbon Neutrality Feasible?

The laudable goal of achieving carbon neutrality in the European Union by 2050 is becoming a priority for an increasing amount of political stakeholders in Europe. From today's perspective, however, is it truly feasible? This short analysis tries to outline some of the main trends in European energy policy and also makes an endeavour to provide commentary on the related political implications in the long run.

The European Union's energy mix is comprised of five main energy sources: petroleum products (including crude oil), natural gas, renewable energy, solid fossil fuels and nuclear energy.¹ The different shares of utilized sources vary dramatically among the European member states – nuclear energy is a main energy source in countries such as France or Sweden, while solid fossil fuels are a significant source in Poland, for example. This difference naturally stems from geographic, economic and historical reasons. Overall, more than half of the energy mix in the EU comes from petroleum products and natural gas. For both types of energy sources, European countries are extremely dependent on external imports from third countries. When it comes to oil and petroleum products (Fig. 1), the EU has relied on net imports for more than 80 % of its consumption throughout the last decade. Close to a third of these

¹ Eurostat, 'Share of energy products in total energy available', accessed at <https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2a.html>

deliveries are traditionally supplied by the Russian Federation (Fig. 2). A mélange of international partners supplies the rest of the quantities, but no country comes close to Russia. It should be noted that much of these imports come from northern Africa or the Middle East where political fragility or overall volatility remains a risk, which can influence potential oil deliveries to Europe. The drone attack on Saudi Arabian oil facilities in September 2019 is a prime example.



Source: Eurostat (online data codes: nrg_ind_id)



Figure 1: Energy dependency rate in the European Union, 2007-2017

Focusing on natural gas, the level of dependency of European member states on third countries also remains a notable concern, particularly since Europe has its own gas fields which it has historically exploited for domestic use. However, many of them have been steadily cutting their annual supply due to depletions or environmental concerns. Most notably, the UK, Dutch and German gas production is projected to fall throughout the 2020s,² which will further deepen the supply gap between European countries' gas demand and actual production. At the same time, the demand for natural gas is expected to go up as economic growth and the needs of European industry and households are increasing.

In parallel, the phasing out of hard fossil fuels due to environmental concerns is also making many countries reduce their usage of coal or peat and compensate with additional utilisation of natural gas. This is why around two thirds of the natural gas needs of the Union are covered by imports (Fig. 1). Again, the Russian Federation stands ahead, with Norway and Algeria trailing second and third, in the list of supplying countries. Close to 40 % of the all imported natural gas comes from Russian pipelines. This dependency has been steadily growing ever since the end of the Cold War and has reached peak numbers in recent years. This can be strongly felt particularly in Central and Eastern Europe (CEE). Countries like Bulgaria, Czechia, Finland, Hungary, Poland, Slovakia and the Baltic Republics remain almost entirely dependent on Russian gas, even though a series of steps were undertaken to ensure investment in gas interconnections between EU member states and improved storage capacities.

² F. Simon, 'Europe grapples with Dutch gas production 'collapse'', Euractiv (16 May 2018) accessed at <https://www.euractiv.com/section/energy/news/europe-grapples-with-dutch-gas-production-collapse/>

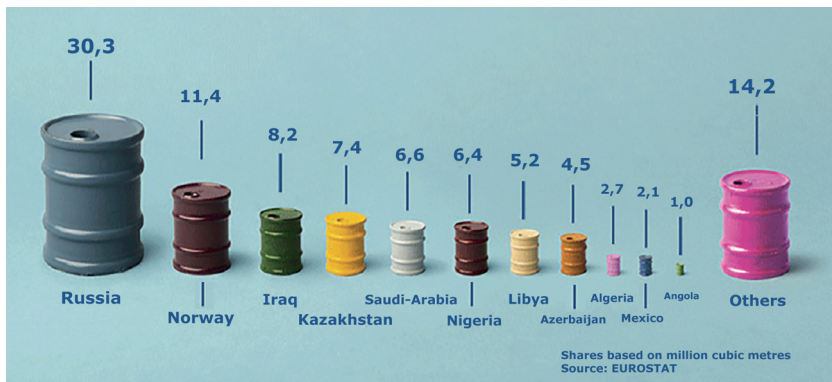


Figure 2: EU imports of crude oil by partners, 2017 (in %)

One of the priorities of the EU’s landmark Energy Union strategy was the diversification of supply countries and the reduced dependence on companies such as Gazprom in the long run. The EU is nowhere near this goal. On the contrary, the Nord Stream 2 project (still under construction) aims to double the capacity Russia currently possesses for delivering natural gas directly to Germany through the Baltic Sea (Fig. 3). Serious doubts remain about the so-called purely economic rationale that has been set forth for NS 2 and about Moscow’s overarching aim for the project. Nine heads of state and government from Central and Eastern Europe formally objected to the construction of the pipeline on account of its ‘destabilising geopolitical consequences’, which could jeopardise energy security in the region.³ And there is good reasons for the leaders’ suspicion. Russia has used its asymmetric energy dependency over CEE in the past to its strategic benefit, to advance its political and economic

³ A. Rettman, ‘Eastern EU Leaders to Warn Juncker on Nord Stream II’, EUObserver, (17 March 2016) accessed at <https://euobserver.com/foreign/132726>

interests region. In 2015, the European Commission started proceedings against Gazprom for abusing its dominant market position by unfair price setting and partitioning gas markets in CEE. By doubling down on its commitment to construct new pipelines to Europe, Russia aims to increase its energy influence on Europe and also makes sure that it has built a direct route which manages to circumvent Ukraine as a transit country. Also bearing in mind the potential extension of the Turkstream pipeline to European soil, the Russian natural gas dominance looks all but guaranteed.



Figure 3: Nord Stream 2 – Planned route

Source: Gazprom official website, 'Route map of Nord Stream and Nord Stream 2'

How about renewables? The European Union is one of the leaders when it comes to renewable energy investment and usage. After a consistent political and legislative push, renewables have become a viable alternative which will most likely reach the goal of representing 20 % of the energy consumption in the EU in 2020. Renewable energy has been instrumental in reducing the overall consumption of solid fossil fuels in the EU and its price has substantially fallen in the last decade – the cost of solar, for example, has dropped by 70 % since 2010.⁴ There is much optimism that renewables will remain economically competitive, even without subsidy support. However, a number of difficulties remain within the sector of renewable energy. Even though the 2020 goal will likely be reached at the EU level, the picture is far more nuanced on the national level (Fig. 4). As of 2018, many European Union member states were still far from achieving their own national renewable targets. The inconvenient truth is that there is no certainty that the majority of the member states will be able to successfully pursue more ambitious renewable targets, even though the EU is proposing an increased commitment by 2030. Disparities are observed also in specific economic sectors – even though renewables have heavily penetrated the power sector (e.g. electricity), renewable heating energy is showing very modest progress, while renewables in transport have penetrated only 3.4 % of the sector and are projected to stagnate.⁵ The unpredictability of solar and wind power is another headache, which will persist unless massive improvements are made in battery storage. Even though there is much hope for the role renewables can play in the overall move to a cleaner economy, certain doubts remain about the viability of this type of energy ensuring this ambitious transition.

⁴ Financial Times, ‘The key energy questions for 2018’ (31 December 2017) accessed at <https://www.ft.com/content/c9bdc750-ec85-11e7-8713-513b1d7ca85a>

⁵ European Political Strategy Centre, ‘10 Trends Reshaping Climate and Energy’, European Commission (2018) found at https://ec.europa.eu/epsc/sites/epsc/files/epsc_-_10_trends_transforming_climate_and_energy.pdf

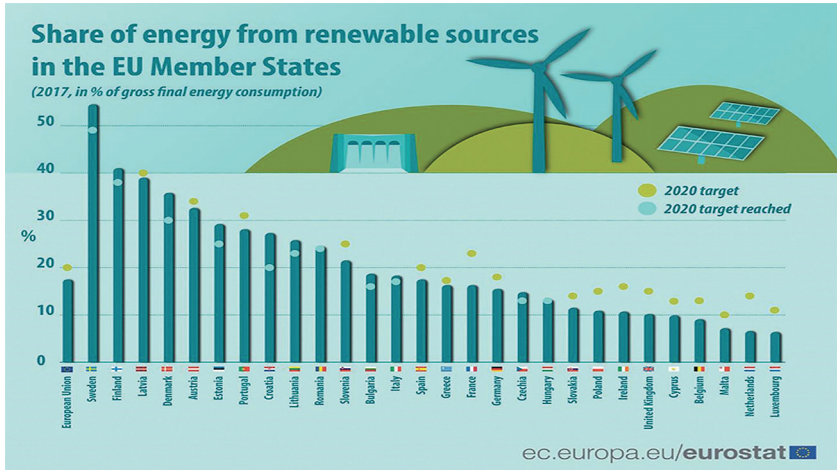


Figure 4: Share of renewable sources in EU member states

When it comes to nuclear energy, half of EU states have operational power plants which in total produce close to 25 % of the electricity generated on the entire continent. Even though there are societal concerns about safety and management of nuclear waste, it must be remembered that nuclear energy produces carbon-free electricity and has been a vital energy source for many member states. Over the next decade, several of the countries already utilising nuclear energy, like France and Finland, have planned to increase investment in nuclear plants. Others will be engaged in decommissioning some of their aging reactors, while Germany has pledged the complete phase out of nuclear energy all together. Deep divisions remain across the continent whether this type of energy should be considered as a source of clean energy in the upcoming decades. The high related costs and persistent pressure by activists make the political choice of investing in additional nuclear capabilities a thorny issue. All in all, the share of nuclear energy in the EU is

expected to remain close to similar levels in the upcoming years.

At the brink of a new decade, the European Union is faced with a complex challenge when it comes to its energy policy, and many troubling inconsistencies. The EU is committed to a landmark transition to a more sustainable economy by renouncing dirty energy resources, but the member states continue to massively subsidise fossil fuel production. Long-term European strategies pledge the diversification of energy imports, but ongoing energy infrastructure projects actually buttress and even increase the dependency on Russia. European institutions push for even more ambitious CO₂ reduction targets while a number of Southern/CEE member states wonder if this would be economically feasible for their troubled economies. The phasing out of hard fossil fuels should remain a firm priority for EU member states but this is inherently linked with the increased reliance on oil and natural gas for households and industry. This comes at its own political cost of dependence on third country suppliers and does not solve the over-reaching environmental goal, as natural gas is also pushing global CO₂ emissions up. This short analysis, indeed, hasn't properly considered the importance of landmark technology such as improved carbon capture and storage, smart technological solutions for energy-intensive industries or next-generation renewable sources. But for the time being, technology shows great promise but no absolute solution.

Which brings us to carbon neutrality, indeed the laudable long-term aim for Europe by 2050. European policymakers are convinced that even though Europe is responsible for less than 10 % of the global CO₂ emissions, achieving carbon neutrality will serve as a soft power instrument to convince many other global polluters to contribute in the fight against climate change. However, there shouldn't be that much surprise about the fact that carbon neutrality was not unanimously supported in the June 2019 European Council summit by all European countries. The concerns about sacrificing European competitiveness or the cost of the whole endeavour continue to trouble many political leaders. Additional

taxation measures or the restructuring of specific economic sectors might fuel citizen protests, as seen with the ‘Yellow vest’ movement in France. The EU has pledged to ensure a ‘Just Transition Fund’ to support transition measures in many member states. We are yet to see specifics on this at the time of writing, but perhaps something will emerge in the upcoming European Council meeting in December 2019.

There is at least one additional major concern going beyond money when we talk about aligning energy and environmental policies with carbon neutrality. This push shouldn’t cause an additional rift between newer and older member states in the EU. Environmental topics, fuelled by social media and even foreign disinformation propaganda, are causing visible societal polarisation which is damaging for the political discourse and for the very fight against climate change. European policymakers should be aware of this and try to accommodate all reasonable concerns when it comes to the energy transition. This is an important challenge also for centre-right parties in Europe and the European People’s Party, as well. The EPP has a strong foothold in many CEE countries and it should find a way to bridge potential divides between East and West on clean energy transition. The European centre-right must be committed to the long-term goal of carbon neutrality, but also bear the responsibility of making sure that this aim does not turn into a self-defeating strategy with damaging effects for European unity, society and the economy.

Dimitar Lilkov is a Research Officer for Digital Economy Affairs, Energy and Environment at the Wilfried Martens Centre for European Studies. Between 2014-2017 he acted as Head of the Bulgarian office of an EPP Group Member of the European Parliament. Dimitar has a Master’s Degree in Politics and Government in the EU from the London School of Economics and is currently pursuing a PhD at Sofia University.

Is Europe Becoming Fossil-fuel Free?

To put it bluntly: no, Europe is not becoming fossil-fuel free. Thorough decarbonization is not happening with current European policies, as replacing low-carbon nuclear with renewable energy will not bring emissions down and will only make the overall decarbonization of the electricity system more difficult and more expensive. Furthermore, electricity is only a small part of our energy use, as can be seen in Figure 1 below.

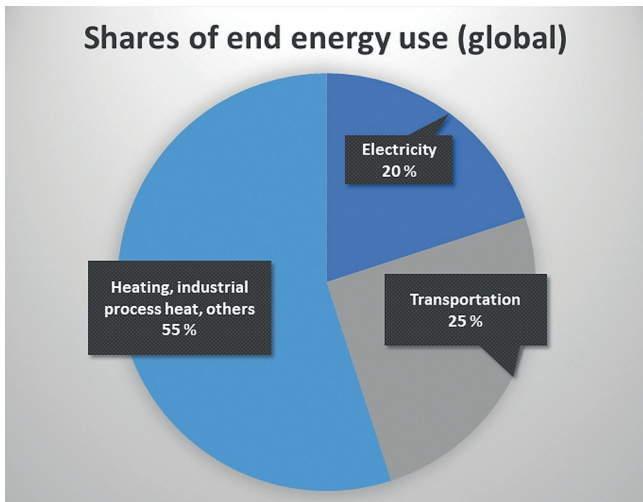
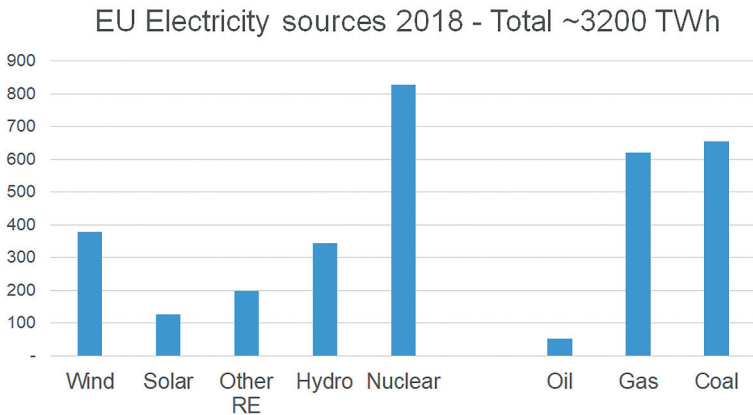


Figure 1: Global end energy uses by type.

Transportation fuels, heating, industrial processes all need to be decarbonized, and it is evident that we will need all the tools at our disposal to do that in an effective way. We need nuclear energy, both in terms of the current technology, as well as advanced and small reactors now being developed around the world. And to have those, we need policies that are enabling and supportive of nuclear energy.

Time to get evidence-based

Europe has been badly confused with what to do with climate change. On the one hand, it wants to be the front runner in climate mitigation. On the other hand, much of Europe's "climate action" has not been effective, and some have even been counterproductive. To simplify the case a bit, much of the resources have been spent on replacing one clean source (nuclear energy) with another (renewable energy).



Despite this, nuclear energy is still the biggest source of electricity in Europe. If this policy of closing down nuclear plants continues, it will take decades before renewable energy sources start to seriously replace fossil fuels.

And the fact is, we are not even doing that. The go-to policy seems to be to close down nuclear power plants prematurely and replace them with natural gas. Natural gas is, as the Brussels airport advertisements say, the “Perfect Partner for Renewables”, because it can load-follow the variable production from wind and solar.



Energy & Environment | New Nuclear | Regulation & Safety | **Nuclear Policies** |

Belgium maintains nuclear phase-out policy

04 April 2018

3 months later

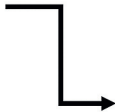


Figure 2: A "meme" showing how regressive nuclear policies often lead to more fossil fuels use.

As can be seen on the graph below, we can easily add 10 % more energy from wind and solar to the grid.

10% Variable Renewables

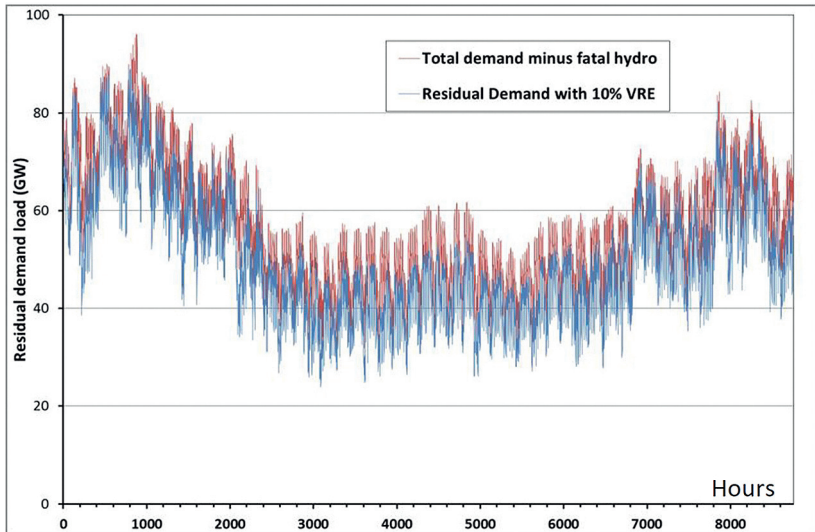


Figure 3: 10 % variable generation in a grid. Image: OECD-NEA 2019

But adding 75 % of variable production can seriously challenge system stability and increase costs.

75% Variable Renewables

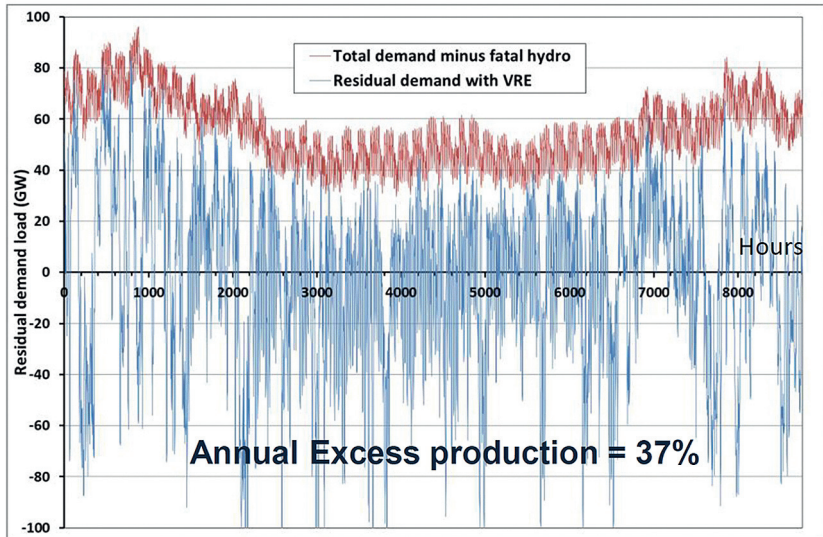


Figure 4: 75 % variable generation in a grid. Image: OECD-NEA 2019

While a share of 75 % variable renewables is still quite far away, it is clear that additional investments to advance technologies need to take place much sooner. Most of the countries are still below a share of 20 % in terms of variable renewable energy (VRE) in their grids, as can be seen on the figure below.

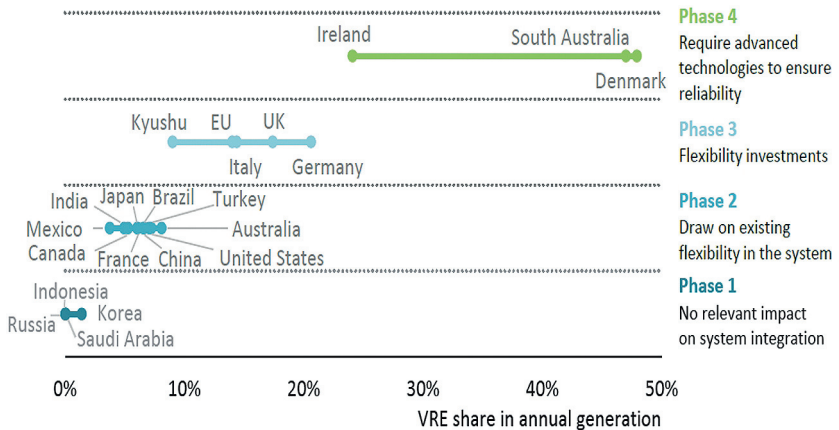


Figure 5: VRE shares in different countries and the needs for additional investments to increase system flexibility. Image: OECD-NEA 2019

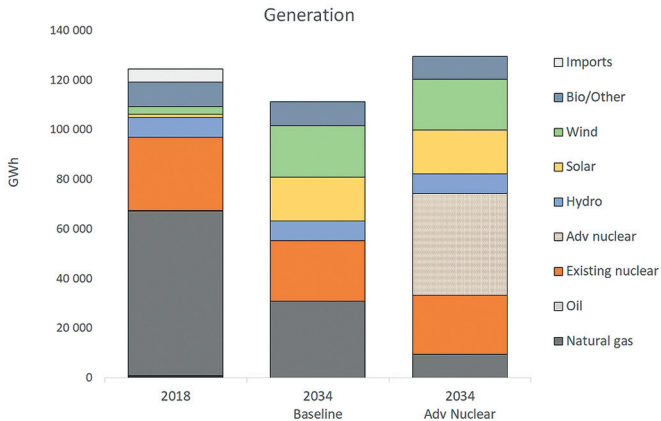
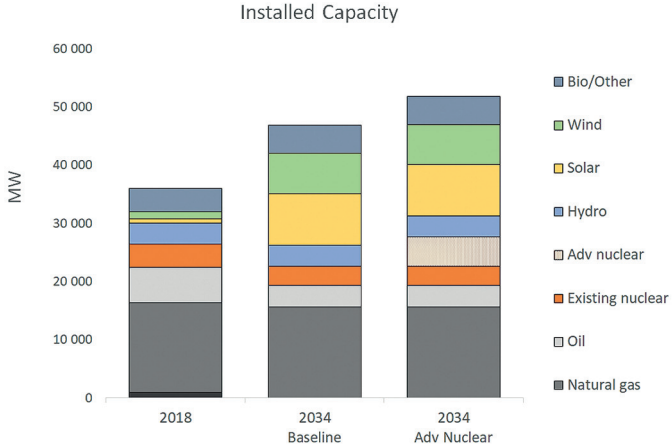
Somewhat ironically, the technology that is most discriminated could also provide us with the best means of supporting more VRE capacity in the power system. Advanced nuclear reactors are being developed to have substantial capabilities when it comes to ramping their production up and down to load-follow either demand or variable production from other energy sources – or both.

Combining nuclear reactors with high temperature thermal storage can make them as nimble as gas turbines, while allowing them to operate at full power all the time. Meanwhile, thanks to thermal storage, their output to the grid can vary between 0 and 200 percent, for example.

In the two graphs below¹, a relatively small amount (5 GW or about

¹ Initial modelling of New England with PLEXOS power system software. Based on NREL ReEDS Low Natural Gas Price and Low Renewable Energy Costs scenario. Image Credit: LucidCatalyst Ltd.

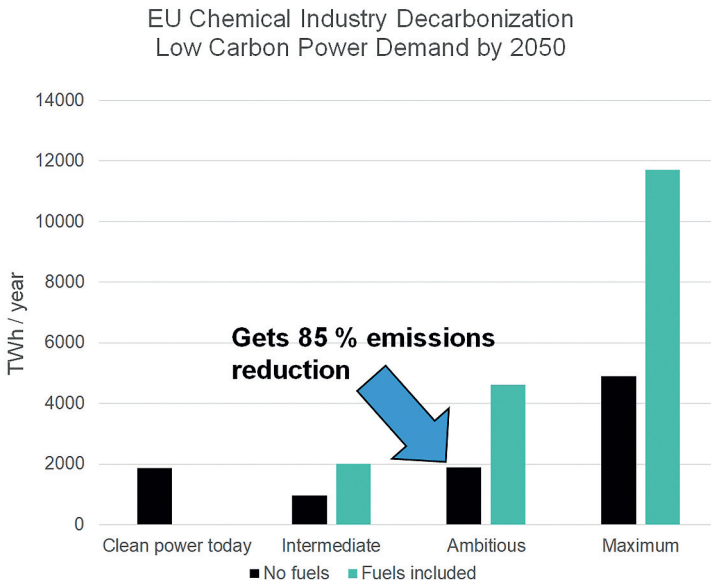
10 % of total capacity) of this kind of advanced nuclear capacity with thermal storage and extra turbines was added to a renewable-heavy scenario (Installed Capacity graph). As can be seen on the Generation graph, the advanced nuclear energy replaces most of the natural gas production in the modelled system, and a big chunk of the emissions.



This is, of course, somewhat bad news for the natural gas industry of the world. But the thing is, climate mitigation should be bad news for them. If we now lock-in to another generation of fossil fuels by closing nuclear plants and not building new ones, we are unlikely to give them up in the needed timeframe.

It's not just about electricity

To make the situation even more complicated, electricity is just a small part of our energy use, and it has been progressing at roughly two percentage points per decade. Even if we manage to increase the pace, it might still take us more than a century before we approach near total



electrification. Heating, industrial processes and transportation fuels are often hard to electrify, and hard to decarbonize. As an example, here is a graph of what would European electricity demand look like compared to current clean energy production (around 2000 TWhs, on the left in the graph), if the chemical industry would decarbonize its raw materials usage and processes.

As can be seen, an 85 % decarbonization of the chemical industry would require that we double our current clean electricity production (much of that would be used to produce clean hydrogen). The theoretical maximum, whereby the chemical industry would become carbon negative and we would utilize all the materials and by-products and make different liquid fuels from them, would require that we grow our clean electricity supply six-fold.

Another example of electrification is the production of steel. The Swedish company SSAB, among others, is studying the potential of using hydrogen in steel production. SSAB's steel production plants constitute 10% of Finland's and 7,5% of Sweden's CO₂ emissions.

To replace coke (pure carbon) with hydrogen for the reduction of iron in steel making, SSAB has estimated an electricity requirement of roughly 25 TWh per year just for the electrolysis to make the hydrogen. That is around 30 % of Finland's current electricity demand, and the equivalent of two Olkiluoto 3 type EPR reactors running at full capacity. A decarbonized world will need much, much more clean electricity than we can imagine, and that electricity often needs to be provided both reliably and cost-effectively.

Conclusions

Proposing to close down nuclear power plants in the face of an increasingly hard climate fight is both irresponsible and counterproductive. We have talked about climate change and the serious need to lower our emissions

for 30 years – yet the amount of fossil fuels we burn has continued to increase, year after year. What we have been doing is not working. But has anything worked?

The last time that the share of fossil fuels in our energy consumption decreased markedly was before we started to talk about the climate, in the 1970s to mid-1990s, when many countries built nuclear power plants. Indeed, the initiation of these programmes were mainly motivated by the oil and energy crises in the 1970s. This says something about the effectiveness of our current climate policies and projects: not one of them have even come close to what was done effectively by accident, without any specific consideration to climate, as nuclear energy has. Imagine what could be achieved with nuclear energy included as one of the supported climate mitigation tools.

Rauli Partanen is an award-winning writer, analyst and communications specialist. He has written several books on climate change, energy and its role in society. Today, he leads a non-profit think tank called Think Atom, which studies – and is popularizing the debate on – how we could use nuclear power to decarbonize our energy systems faster and more affordably.

Technological Risks and Fragilities of the Digital Society

New technologies in energy technology create immense possibilities but also increase the vulnerabilities of the networks that are critical for modern society. Technological improvements in energy production and networks have increased rapidly over the last few years and information has become an integral part of energy systems.

During that time, Finnish citizens have become increasingly familiar with the effects of power outages caused by power lines being damaged by storms and falling trees. The outages have been local, and in most cases, they have been repaired almost immediately. In the event of a major disruption, restoring the power grid is markedly difficult – it does not happen in hours or even days.

Our modern societies cannot do without electricity and communication networks. The necessity of electricity for modern life is well illustrated by the authorities dealing with power outages: a power outage is long if it lasts more than three minutes. What if the blackout lasts three hours, three days – or weeks?

Our societies are dependent on electricity and communications for virtually everything. So-called mission-critical services include, for example:

- Emergency services, rescue centres (112)
- Hospitals

- Police
- Army
- Water supply
- Heating
- Payment transactions
- Communication services (phone calls, messaging)

There can be many reasons for a major power outage. Typical widespread disturbances are caused by exceptional weather events and technical failures. The increase in extreme natural phenomena likewise increases the risk of interruptions throughout the electricity grid.

Cyber-attacks are also a constant threat: The risks of attacks by lone hackers and the influence of foreign powers exists in Finland and everywhere else in Europe.

Recognised threats to power and communication networks:

- Climate change increasing extreme weather conditions
- Accidental cable breaks
- Human errors, e.g. service breaks, software updates or bugs
- Cyber threats, vulnerabilities, cyber attacks
- Hybrid threats, e.g. governmental disruptions
- Terrorism

This year alone we have experienced, for example, cyber-attacks against the national health care systems in some Finnish cities and the terrorist attacks against oil production facilities in Saudi Arabia in September 2019. In June 2019, power outages in Argentina and Uruguay affected

50 million people and, in July, parts of Manhattan Island in New York were without electricity due to a transformer fire.

“The global communication/electricity network could be the most complex system on earth.”

One of the most important reasons for the increasing fragility is the symbiosis between electric and communication networks. Vulnerabilities are intertwined as the generation and distribution of electricity is completely dependent on telecommunications networks – and vice versa. This global communication/electricity network could be the most complex system on earth. Much of it is controlled by automation.

In a crisis, the functioning of communication networks becomes exceptionally important. Every now and then, there is a suggestion that critical systems should only use software and networks that are not connected to the Internet in any way. Personally, I do not believe in this approach, partly because all remote access systems that can be used to repair networks also function over the Internet.

One challenge for protecting electric systems is that energy production facilities and networks are physically large and easily located if, for example, someone is planning a terrorist attack.

Compared to the rest of Europe, significant parts of Finland are very sparsely populated. In Lapland, for instance, the average population density is only two persons per square kilometre, while the average population density in Finland is ca. 18 persons per km², compared to ca. 120 persons per km² in the entire EU-28 area. This poses special challenges to all networks. Local network companies Suomen Erillisverkot and Fingrid have created a new high-readiness network for recovery in the event of major electricity disturbances.

Nowadays, mobile network base stations can operate on backup

power only for a few hours, some for even shorter periods. Security and preparedness will be enhanced by strengthening the backup power supplies of base stations. Base stations and antenna masts are the building blocks of our society. If they don't work, no information or communication can pass through; not even emergency calls.

Situational awareness is a key to functioning in a crisis. Countries have their backup communication systems for emergency situations when normal networks are not working.

The European Union is also concerned with safeguarding the smooth functioning of the electricity grid. Recent EU legislation sets requirements for communication and automation systems for power grid management and disaster recovery.

According to the new EU legislation, by December 2022, EU countries must be able to maintain the critical telecommunications networks that are needed for power recovery for a minimum of 24 hours, even if the electricity supply fails. This requirement is in the interest of Finland as well as all EU countries as, over time, such actions being taken at the EU level will ensure Member States' grids are more resilient and generally less susceptible to interruptions and long-term outages. Ultimately, as the EU energy union is moving us towards a European-wide common market for electricity, the resilience of critical network infrastructure becomes all the more important.

Timo Lehtimäki is the CEO of Suomen Erillisverkot oy

Suomen Erillisverkot (State Security Networks) is a special-purpose company fully owned by the Republic of Finland. The Prime Minister's Office is responsible for the ownership steering of the company. Suomen Erillisverkot provides mission critical services, software services for situational awareness and services securing critical infra-structure and communication.

The Ownership Question

Cooperative Principles in Energy Sector Help Small Become Big

How should energy production and energy networks be organised and owned? States and state-owned companies are still key players in the energy sectors of many (most) countries. Out of the ten largest companies in the world, counted by revenue, seven do business mainly in the energy sector. Six of these seven are oil and gas companies and four of the top ten companies (Chinese Sinopec, China National Petroleum and State Grid as well as Saudi Aramco) are at least 50% government-owned. Politics influences companies and companies influence politics.

“Diversity in business models increases the economic performance as well as the resilience of the whole society.”

From a national security point of view, the risk of private enterprises is that in the course of time they tend to become sold to private investors, often foreign. In a vital sector such as energy production and networks, this is often perceived as being too risky. Generally, diversity in business models increases the economic performance as well as the resilience of the whole society.

As an example, in Finland, the experiences of the Second World War created the political will to create our own capacity in oil refining. As

the war started, the tankers of foreign oil companies quickly disappeared from the risky markets and Finland was left without access to petroleum products. The post-war political decision to establish a state-owned oil refinery led gradually to the birth of a whole cluster of petroleum and chemical industries.

However, state ownership and private ownership are not the only ownership models around. Cooperatives are a democratic bottom-up model of ownership. Cooperative enterprises and principles have had a significant role in the development of the energy sector in some countries, especially Finland.

Today, Finland is likely to be the country with the most cooperatives anywhere in the world. Cooperative groups are market leaders in many fields, such as finance and banking and consumer products.

From a national security perspective, cooperatives are a safe model of ownership as they cannot be easily sold abroad. The primary weakness of the cooperative model is that collecting large amounts of capital for investments may be slow.

Cooperatives help the EU reach its climate and social goals

Cooperative business models and principles in the energy sector can help EU countries reach their climate goals. For example, forming a cooperative can help small and geographically scattered producers of bioenergy enter the market with their products. Cooperative models can help businesses pool enough capital to invest in sustainable energy production that would otherwise be too large for individual companies.

In Finland, ca. 40% of our electricity produced today is by joint-venture companies, established on cooperative principles. Most of this is fossil-free energy (hydroelectric, nuclear, wind), of which the share is increasing.

In addition, cooperatives are an entity belonging to the “social economy”, with local ownership and democratic principles in decision making. Therefore, cooperatives can also support social cohesion, solidarity, resilience and other goals relating to the European Pillar of Social Rights, along with sustainable energy production and distribution. Many European countries would benefit from more inclusive and democratic business models.

The EU business and entrepreneurship policy must, therefore, take into account the diversity of business models, including the specifics of cooperatives. This includes not only legislation, but also financing and education.

Cooperatives in the energy sector

Consumer cooperatives

A consumer cooperative is formed by the customers/users of the product. In the case of energy, these can be individual consumers, companies, communes or even the state. As an example, in Finland, the largest gas station chain (ABC) is part of a large consumer cooperative, named S Group. Also, many of the largest producers of wind energy in Finland are at least partially owned by cooperatives or founded on cooperative principles.

Producer cooperatives

A producer cooperative is formed by the producers of such things like raw materials. The most common cooperative in the energy sector is a cooperative of several small producers of biofuels (e.g. wood chips). A cooperative makes it possible for small and geographically scattered producers (in this case forest owners) to enter the market.

Cooperative ownership could be used for organising other forms of energy, such as biogas production. For example, several farms and other companies can invest in a biogas production facility as a cooperative. Private enterprises can also form cooperatives. By forming a cooperative, small companies have more force in negotiating the price of their energy products. Or they can, for example, create a joint company for their logistics.

Cooperative principles in large energy projects – a Finnish example

Energy production is very capital intensive. In a small country, pooling large amounts of domestic capital for large investments can be very difficult. One power plant may need hundreds of millions, or even billions of euros in investments. Very few companies have such financial resources.

The so-called Mankala cost-price model is a post-war Finnish innovation that helped private companies invest in energy production and create economies of scale. In the model, several companies create together a jointly-owned limited liability company for a common purpose of producing energy (typically electricity). The shareholders pool together resources to finance the construction and maintenance of the plant and, in return, receive electricity from the plant at cost price, in proportion to each owner's share in the energy company.

The jointly established power company sells the produced electricity and heat to shareholders at no profit. The shareholders commit to paying the power company's costs in proportion to their holdings in the company and also share risk.

Mankala companies are typically owned by several private enterprises and sometimes communes. The model has helped build facilities that produce hydroelectric power, nuclear energy and, increasingly, wind power.

The most recent example of a major power plant to be completed

with the cost price model is the new Olkiluoto 3 nuclear reactor in Eurajoki, Finland. The total cost of the plant will be an estimated 10 billion euros, making it the second most expensive building ever built. While the project has been an economic disaster for the suppliers, Areva NP and Siemens AG, once completed, it will increase the supply of carbon-free electricity with a 1600 MW nameplate capacity.

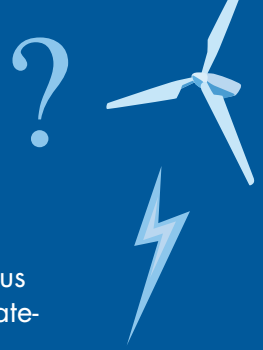
In summary, cooperative models and principles can help farmers, companies, communes and other interested investors, invest in fossil-free energy production while simultaneously fight climate change. National and EU legislators should take this into account.

All models of ownership have their pros and cons

To curb down climate emissions, we need rapid investment in fossil-free energy production. Whether energy production is owned and run by the state, private shareholders or by cooperatives is an important question. However, all ownership models have their pros and cons and, therefore, should not be dismissed by, for example purely ideological reasons. States, in particular, have a crucial role to play not only in research and development but also because state-owned companies are often the pioneers in new, technologically risky models of energy production. Nuclear energy plant suppliers, for example, have typically been state-owned companies.

Finally, it could be argued that, in the end, good governance and leadership is more important than the ownership model. State-owned companies have their own challenges. Private businesses seldomly are prepared to take major and costly risks in, for instance, pioneering a new type of technology in energy production. In Finland, cooperatives have had difficult times due to poor management decisions by the management and cooperative boards in the past. As **Hannes Gebhard**, the Finnish pioneer of cooperatives said: “Cooperatives are the most difficult model, therefore they need the best leaders.”

Sami Karhu is the CEO of Pellervo Coop Center, Finland. Pellervo is a service and a lobbying organisation for all Finnish cooperatives and a forum for cooperative activities. The goal of Pellervo is to make the cooperative business model more known to the public and offer the cooperative model as a competitive alternative for those thinking about starting a business.



The European Union has set the ambitious target of becoming the world's first climate-neutral continent by 2050. Carbon-free energy production is an integral part of the solution, but is the EU on the road towards carbon neutrality yet or not?

What kind of geopolitical and technological risks are involved in the energy systems of today and in the future?

This booklet provides some food for thought for decision-makers and anyone who is interested on what is arguably the most complex system on earth: energy networks.

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