100 percent renewable electricity by 2040
wind power: combating climate change and improving competitiveness
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1. Letter from the CEO

As CEO of the Swedish Wind Energy Association, I am proud to reflect on the amazing journey that wind power has made in the ten years since we formed our organisation. In the beginning it was single turbines raised by brave pioneers who dared to believe in the power of renewables. Today we can see large-scale wind farms backed by billions in investments. We are a mature and competitive industry standing on our own two feet. With the right conditions, the green transition can continue. Furthermore, we can pick up the pace and be a key part in facing the climate challenge!

The way of the future is unmistakeable. A new report ascertains that solar and wind power in combination with various forms of energy storage solutions will meet close to half of the energy demands of the entire world in the coming decades (BNEF, NEO 2019). According to an international expert group, solar and wind power can, if scaled properly, halve electricity production emissions by 2030 (Exponential Roadmap 2019). At the same time, coal-based power is plummeting across the EU, and in the first half of 2019, its usage was decreased by 19 percent, half of which was replaced by solar and wind power (Sandbag 2019).

Wind power is on the rise not only globally, in Sweden big strides are taken to reach a 100 percent renewable society. Wind power has passed the 20 TWh milestone and is developing at a record pace. The Energy Agency reports that a 100 percent renewable electricity system is fully possible if wind power and energy grids are expanded (Energy Agency 2019). It is not a question of if, but rather a question of how to best meet the challenges.

The Swedish Wind Energy Association’s forecast shows that the production from wind power will double in the next four years, thus constituting more than a quarter of all energy consumed in Sweden (SWEA 2019). By 2022, energy exports are predicted to reach a record high of 29 TWh, even while nuclear power generation is decreasing (Energy Agency 2019). Exports provide climate benefits by replacing coal-based power in our neighbouring countries and by creating sufficient margins for electrification here in Sweden. By the late 2020s, total wind power generation is estimated to overtake the production of nuclear power. By 2040 wind and hydro power are expected to make up almost 100 percent of the electricity consumption, and 75 percent of energy production. In this scenario, hydro power would maintain a similar level of output as today, while wind power would increase its output from the present level to 90 TWh. This is possible with larger and more efficient wind turbines on land and off our coastlines.

In the past 10 years, technological progress has halved the costs of new onshore wind power. Production costs are now below €30 per MWh for the most efficient projects. This makes wind power the cheapest power source.

The 2030-target for the Green Certificate System is on course to be reached 10 years ahead of time, and the continued expansion of wind power is now taking place completely without subsidies. This means that access to locations with suitable wind conditions and modern grid infrastructure will be critical in enabling further cost-effective expansion of renewables.

Much has happened since the Swedish Wind Energy Association published Roadmap 2040 last year. At the same time, a lot of work remains to reach the goal of an all renewable electricity system. In this year’s edition, we have focused particularly on how to overcome the challenges facing 100 percent renewable electricity on a system level, while maintaining supply and stability. We are also expanding the chapters on offshore wind power, whose benefits are becoming increasingly important.

What will it take for Sweden to reach the political goals of an all renewable electricity generation by 2040 and net-zero emissions by 2045, with wind and hydro power as the base? How can Sweden show leadership, both in the EU and globally, in the transition to a renewable world? These questions will be answered in the following pages.

Stockholm, October 2019
Charlotte Unger Larson
CEO, Swedish Wind Energy Association
2. Summary

The climate crisis is an urgent threat. Wind power can quickly reduce carbon emissions, both by electrification of transportation and our industry, and by replacing coal-based power in our neighbouring countries. The doubling of wind power output that we expect in the next four years can reduce emissions equivalent to almost one quarter of Sweden’s total emissions. However, despite these obvious benefits, the expansion of renewables still faces many obstacles.

The Energy Policy Agreement and the goal of 100 percent renewable electricity generation by 2040 has led to an influx of investments in wind power. Since the Energy Policy Agreement was struck in 2016, more than € 7.4 billion have been invested in wind power. When this new wind power is in operation, it will generate over € 740 million in energy and property tax revenue to the Swedish government, while creating more than 18 000 full time equivalent job opportunities (SWEA 2019).

Wind power creates immediate climate benefits and brings down electricity prices, which improves the competitiveness of Swedish industry and benefits all electricity consumers. The expansion is driven by the market and contributes to growth and investment, primarily in the countryside.

To reach the target of a 100 percent renewable electricity generation by 2040 and net zero emissions by 2045, wind power needs to increase to an annual output of at least 90 TWh. This implies that over €18.4 billion of further investments in wind power are necessary. This may seem like a large number, but studies show that every €1 invested in renewable energy returns €4 in socioeconomic benefits (BCG 2018).

The transition presents a new set of demands on the energy system. Sweden is in a uniquely good position to meet these demands due to the properties of hydro and wind power, which allow the power generation to interact and shift. Water can be stored when the wind is strong and be released to increase electricity output when the wind calms.
At the same time, technological advancements enable wind power to increase the delivery of both energy and capacity, even at lower wind speeds. When the expansion of offshore wind power is given the political prerequisites needed to be implemented, it will contribute with significant system benefits given its large scale and more level output.

In theory, wind and hydro in combination with maximized electricity import, cogeneration, and gas turbines could cover Sweden's peak power demand, even on a cold winter day. But there are however limitations in the grid, and sufficient margins are needed. This can be created through storage solutions or services that increase flexibility of consumption. It is also essential to increase the transmission capacity of the power grid, both in Sweden and to our neighbouring countries to better face variability in production and consumption.

There is wide political and popular support for the transition to renewables, and it is regarded as both necessary and desirable. Wind power, in combination with hydro power, can provide a solid basis for a fully renewable electricity system by 2040.

We bring six suggestions which should be implemented by the Swedish government within the current mandate period, to facilitate the transition to renewables.

The Energy Policy Agreement must be met in its entirety. The target of 100 percent renewable electricity generation by 2040 must remain, and the other parts of the agreement should be implemented. This includes closing the Renewable Electricity Certificate System in a responsible way and abolishing the connection fees for offshore wind power.

The Swedish Environmental Code should be supplemented so that climate benefits are more strongly prioritized when weighed against other interests. The instructions issued to authorities and agencies must be updated so that climate issues are considered in all decision making. This would make balancing interests easier in cases such as species protection, reindeer herding and the Swedish Armed Forces’ restricted areas.

The municipalities need to receive part of the economic gains. To provide the municipalities with a direct economic benefit from wind power, the property taxes on wind power should be awarded to the affected municipality instead of the state. At the same time, the so-called municipal veto against wind power should be removed.

The permit process for new wind farms and power grids must be shortened, simplified, and held in accordance with the revised Renewable Energy Directive (Art. 16 RED II). Drawn-out and uncertain permit processes are currently the greatest obstacle to the development of wind power. Moreover, the process must adapt to rapid technological developments so that wind resources can be utilized as efficiently as possible.

The power grids and electricity system must be modernized and adapted to a higher proportion of renewable electricity generation. Transmission capacities must quickly increase, and markets need to be developed for so-called ancillary services, so that wind power can contribute to increased security of supply when nuclear power is decommissioned.

"Technological advancements enable wind power to increase the delivery of both energy and capacity, even at lower wind speeds."
The Swedish Wind Energy Association projects that wind power generation will increase from today’s 20 TWh to at least 90 TWh in 2040. That is in line with the Swedish Energy Association’s scenario for an all renewable electricity system. Wind power can account for over half of the electricity consumption in Sweden.

The output from wind power is increasing, but the number of turbines is not increasing significantly – they may even become fewer. This is due to the rapid technology development, which increases the generation of each turbine.

Out of the total wind power output 2040, offshore wind power is expected to make up around 30 TWh annually. Given the right circumstances, unlocking the full potential of offshore wind power, the production could increase several times over.
The Swedish Energy Agency’s assessment that wind power could increase to 90 TWh in 2040 should be the premise for planning the future electricity system.

The actual potential from onshore and offshore wind power is, however, much larger. Technology development has in 10 years led to a 50 percent decrease in cost for onshore wind power and it can now be built without support. Production costs for offshore wind power are also falling quickly.

The expansion of wind power leads to large and immediate reductions of carbon emissions, both through Swedish electricity export replacing fossil-based power generation in neighbouring countries, and by paving the way for a climate efficient electrification of Swedish industry and transportation.

The potential of wind power

At sea, winds are steady and strong. Offshore turbine blades are generally longer in relation to the tower and the swept area is larger, hence more energy per turbine can be extracted.
3. Sweden’s large-scale green industry

Globally, within the EU and in Sweden, several initiatives are being taken to address the climate crisis and transition to a renewable world. Sweden’s conditions for wind power are among the best in Europe and can quickly reduce emissions, while increasing our industry’s competitiveness and building a new large-scale industry for Sweden.

3.1 Long-term framework promote investments

The UN Sustainable Development Goals, the Paris Agreement, the revised EU Renewable Energy Directive, Sweden’s National Energy and Climate Plan, the Swedish Climate Act, and the Swedish Energy Policy Agreement. The list of frameworks within areas of climate and energy is long. In the coming decade we will decide how to overcome the climate crisis, and a clear path forward is needed for the transition.

Increasing the share of renewables is a central part of addressing climate change. Fossil fuels still make up almost 80 percent of global energy input. There is a clear connection between ambitious and long-term climate and energy politics, with clear targets for shares of renewables, and rapid emission reductions. Through the joint targets of the EU, Europe has taken the helm and we now see declining emissions from electricity generation. As much as 95 percent of all investments in new capacity within the EU are now going to renewables (BNEF, NEO 2019).

In our neighbouring countries to which our electricity system is directly connected, coal, oil, and gas still represent 48 percent of the electricity generation (Sandbag 2019). Swedish electricity generation has historically been reliant on nuclear and hydro power and produces very little emissions. However, Swedish nuclear power is being phased out, and even if nuclear power owners state that the technical lifespan of a nuclear power plant is 60 years, it is uncertain how many reactors will be operational by 2040. The only single energy source which can replace nuclear power is wind power on- and offshore.

Sweden’s conditions for wind power are among the best in Europe. Politics and frameworks need to ensure that the advantages of good wind conditions and low production costs are harnessed. Wind power, Sweden’s new large-scale green industry, is ready to grow and contribute to the target of an all renewable electricity system.

**Sweden’s National Energy and Climate Plan**

EU member countries are to present National Energy and Climate Plans covering targets for 2030 before the end of this year. For Sweden, the level of ambition is important to secure the national targets of 100 percent renewable electricity by 2040. In the draft, however, Sweden sets targets that are lower than the expected expansion of renewables, which contradicts the national target. We believe that Sweden should aim for at least 80 percent renewable energy by 2030 to be in line with the political decisions taken in recent years (SWEA 2019).
The Green Certificate System has been vital for bringing renewable electricity at low costs to consumers. In the Energy Policy Agreement, it was decided to increase the system with an additional 18 TWh of renewable electricity by 2030.

Wind power has developed far faster than expected, and the certificate system is calculated to be full by 2021 at the latest. The system now needs to be closed in a responsible way.

The Swedish Energy Agency has suggested a "stop mechanism" in the Green Certificate System. This implies that new projects can be included within the system up until 2030, and is expected to, if followed through, to lead to a collapse of certificate prices due to oversupply of certificates. The principles for closing the system should be simple: new investments which neither need support nor contributes to fulfilling the target should be left out of the system. This way, the profitability of all previous investments is not destroyed as a result of the system crashing (SWEA 2019).

The Energy Policy Agreement furthermore promises abolishing connection cost for offshore wind power. This would give the important offshore wind power the same prerequisites as all other energy forms throughout the years, both renewable and non-renewable, through adapting the grid infrastructure. Offshore wind power will play a vital role for securing stability and delivery in the future 100 percent renewable electricity system, partly because of its large-scale, and partly because the increased production benefits the system (see chapter 4.6. on offshore wind power).

3.2 Electrification – electricity in new areas of use

It is likely that the electricity consumption will continue to rise in future. But it is unclear how much energy saving technologies will offset the increase.

A steady population growth in combination with electrifications of the transport sector and heavy industry means that the demand for electricity is expected to rise in the coming years. HYBRIT, the project for emission-free production of steel which LKAB, Vattenfall, and SSAB are backing, is expected to increase the electricity demands by 10 percent of Sweden’s current consumption.

Another clear trend is the increasing digitalization of society, and Sweden is at the cutting edge of this development. This also holds true for our electricity system, where exchange of information and analysis are increasing, leading to a more complex system which requires more electricity for its own processes.

It is difficult to estimate how much of the increased electrification will be offset by use of more efficient products, better building design, and smarter industrial processes. The Swedish Energy Agency has estimated that electricity demand will increase from today’s 140 TWh to 160 TWh in 2040, while other actors believe that the increase will be substantially larger than that (Swedish Energy Agency 2019).

The Swedish Wind Energy Association’s forecast shows that wind power production will increase from 20 TWh today, to around 40 TWh as soon as by 2022, thus constituting nearly 30 percent of all electricity demand (SWEA 2019). How much does wind power need to deliver after that to ensure the transition to 100 percent renewables? To reach the target of 100 percent renewable electricity generation by 2040, we estimate that at least 90 TWh of wind power is needed, which is in line with the scenarios for a renewable electricity system by the Swedish Energy Agency (Swedish Energy Agency 2019).
3.3 Environmental industry benefits

The wind power sector is attractive to long-term investors. The interest is expected to increase as the demand for renewable energy rises – if Sweden continues to offer low risks for investors.

Wind power and renewable energy are a rapidly expanding part of Swedish industry. Where wind power is built, primarily in rural areas, job opportunities and investments in the local community and infrastructure follow.

Sweden already has ample supply of cheap and clean electricity, and this has encouraged many IT and data centre companies to establish themselves here. Other companies are also likely to locate in Sweden attracted by the renewable energy mix and low electricity prices. Environmentally conscious companies that work towards climate neutrality and promote sustainability are on the rise, with new players focusing on charging infrastructure, energy efficiency and digital solutions for a sustainable future. It is essential that Sweden demonstrates a clear commitment to wind power for this trend to continue.

Swedish wind power developers are at the forefront in attracting investors – often foreign investment funds and insurance companies – through initiatives such as long-term power purchase agreements (PPA). Today, most new investments are realized through PPAs. Potential future buyers are government agencies and municipalities as well as heavy industry. To continue attracting capital, the market needs to be predictable and offer low risks for investors. The Energy Policy Agreement has created good conditions for future investments, and it is important it is upheld.

"Sweden is positively distinguishing itself in many ways, with one of the strongest wind resources in Europe."

Ingmar Helmke, Investment director of energy and infrastructure at the German asset management company Aquila Capital.
Sweden has a large and growing surplus of electricity. Even though nuclear power generation is reduced by 13 TWh, the Swedish Energy Agency is expecting electricity exports to reach a record-high 29 TWh by 2022. The benefits of a more integrated European electricity market with Sweden as a net exporter are obvious.

The EU imports over 50 percent of all energy used in the union. At the same time, the target of the EU Energy Union is to create a safe, competitive, and sustainable energy transition – at a reasonable price. According to a report to the European Commission, European businesses and consumers could save up to €40 billion with a more integrated electricity market and an additional €30 billion if renewables are deployed where it is the most cost efficient to do so (Booz & Company).

For Sweden, whose conditions for renewable electricity generation are uniquely good, a more integrated electricity market would mean increased profits through electricity exports. At the same time, Swedish consumers and Swedish industries would enjoy long-term lower electricity prices than the countries we export to. This strengthens competitiveness and attracts new business.

When Swedish emission-free electricity is exported it replaces fossil fuels in our neighbouring countries, which drastically reduce negative climate effects. Exporting 29 TWh can decrease emissions equal to one third of Sweden’s total current emissions.

A continued increase in electricity exports requires improved transmission capacity within Sweden as well as with other countries, but the expansion is slow. In addition to the opportunities for exports, an increased level of physical market integration also increases the security of supply when the phase-out of Swedish nuclear power continues. Regarding Sweden as an exporting nation could furthermore support the development of storage solutions, user flexibility, and other solutions which underpin the renewable society of the future.

The Swedish Wind Energy Association proposes that the government:

- Ensures that bottlenecks throughout the country are reduced, and that additional interconnectors are built to other countries.
- Implements a strategy for electricity exports and for Sweden to contribute towards the EU sustainability targets in a cost-efficient way.
- Urges to further develop cooperation in the EU Energy Union in line with the implementation of all parts of the Clean Energy package, by supporting that renewables are deployed in areas with the best conditions.
4. What is needed to enable green investments?
4.1 Update the Swedish Environmental Code and the agencies’ instructions

If Sweden’s climate and energy targets are to be met in the most cost-efficient way possible, efficient regulation and cooperation between our government agencies is needed. The government should update the agencies’ instructions and supplement the Environmental Code so that reduced climate is given higher priority when weighed against other interests.

Despite a broad agreement on the urgency to reduce emissions, the climate benefits of renewable energy sources are given low priority when compared to other interests. A simple first measure is to update the instructions to government agencies to include climate aspects in all decision making. Conflicts of interests could thereby be easier to handle, for instance with regards to species protection, reindeer herding, and the Armed Forces’ restricted areas. Furthermore, the Environmental Code needs to be supplemented so that climate benefits are given priority in permit processes and courts. Today, the application of the code leads to complex permits processes and delayed investments in new projects.

 Agencies can also become more efficient through increased cooperation. County Administrative Boards, the Environmental Protection Agency, the Energy Markets Inspectorate, the Swedish Agency for Marine and Water Management, and the Swedish Armed Forces, among others, are all involved in scrutinizing wind power. The Swedish government should encourage and demand cooperation between these authorities and agencies, so that Sweden’s ambitious targets are met in a cost-effective way.

The Swedish Wind Energy Association proposes that the government:

- Changes its instructions to all relevant agencies to ensure that focus on achieving the climate and energy targets approved by the Swedish Parliament.
- Supplements the Environmental Code so that climate benefits are given priority in permitting and courts.
- Clarifies the division of responsibilities among the authorities and agencies involved in energy and climate change issues.
- Acts to increase cooperation between agencies.
- Requires agencies to investigate and report how they can contribute towards climate and energy.

4.2 Simplify permitting processes for grid and environment

4.2.1. Drawn-out and complicated permitting processes

Today, several obstacles in the permitting process threaten to delay the deployment of renewable energy.

Every new wind power project is subject to two separate permitting processes: one for building the wind farm (environmental permit), and one for connecting it to the grid (concession). The relevant authorities examining the application are the environmental delegations of County Administrative Boards, the Swedish Energy Markets Inspectorate, and the Swedish Mapping, Cadastral and Land Registration Authority. In addition, several review bodies also scrutinise the project.

Few projects are as carefully reviewed as wind power. What makes it unique, however, is that the municipality explicitly need to approve all wind power projects. Legal firm Fröberg & Lundholm, appointed by the Swedish Wind Energy Association, compiled a list of all wind power projects between 2015 and 2018, and found that 76 percent out of roughly 2500 projects were rejected.

In total, the time taken from initial consultation to environmental permit can exceed 10 years. Meanwhile, technological progress is fast, and the terms of the permit seldom leave scope to use the best possible technology, as the Environmental Code instructs that it should.
Access to good wind conditions is crucial for building efficient wind farms. When wind power is relegated to non-ideal conditions more turbines are required, which leads both to greater impact on the landscape and increased costs to achieve the same output. Since winds strengthen with height, it is important that wind turbines can be as high as the technology allows.

If the average wind speed is reduced by an average of 0.5 metres per second, the output of a wind farm decreases by 20 percent. This implies that an increasing of the total wind power generation from 30 TWh by 2030, to 70 TWh by 2040, would requires 25 percent more wind turbines. This means that the effect on the local environment and the cost of production will increase by the same amount.

4.2.2. Grid connections – a limiting factor

At present, there are major challenges in connecting wind power to the grid. It is difficult for a developer to, within a reasonable timeframe, get information on availability of connections and the cost of connecting the wind farm.

There is uncertainty about which power lines require concession, and concessions tend to become more expensive and more drawn out. Requirements for technical details are high and often difficult to predict before the environmental permit has been passed. The speed of technological progress means that the technology approved in a permit rapidly becomes obsolete and it is difficult to have the conditions changed. The Concession Investigation presents some suggestions on how these challenges can be met, which should be implemented quickly (SOU 2019:30).

As wind farms become larger, connections are increasingly being made directly or indirectly to the national power grid. The connection process to the national grid is regarded as one of the major obstacles to connection. It can take over two years to be notified whether it is possible to establish a connection, either directly or indirectly, to the national grid. This process is inflexible and doesn’t follow neither the environmental permit process nor the process of investing in new wind power.

All things considered, connecting to the grid is one of the most problematic parts of a new wind power project. An additional complicating circumstance is that the grid in general has started to suffer from capacity limitations, which means that capacity raising measures have become the rule rather than the exception when connecting wind power to the grid, especially in northern Sweden.

The Swedish Wind Energy Association proposes that the government acts to simplify grid connections through:

- Freedom of concession in the entire area covered by the wind farm project plan and the possibility to make it easier to change existing concessions in accordance with the recommendations of the Concession Investigation.
- Letting the Swedish Energy Agency investigate how the amount of appeals and time for appeals can be reduced for concessions.
- Instructing TSO Svenska kraftnät to change their connection policy, so that the connection process is more rapid and better aligned with the permit process and the investment process for wind power developments.
4.2.3. How can the permit process become more efficient?

To reach the target of 100 percent renewable electricity generation and at least 90 TWh of wind power by 2040, many new permits for wind farms are needed. The drawn-out processing times for environmental permits and concessions need to be shortened to avoid cost increases.

Many of today’s problems and challenges are relevant for both kinds of permitting processes, environmental and grid. Examples are a lack of flexibility, drawn-out processes, and poor coordination between public authorities and agencies. Also, permissions in general are appealed with increased lead times as consequence.

The revised Renewable Energy Directive requires that permitting processes for renewable energy are simplified and shortened. The directive will be implemented in Swedish law by June 2021 at the latest. Among other things, it contains a requirement for a single contact point, which will enable the permitting processes for a wind farm and concession to run parallel. Today, two main factors make parallel permitting processes difficult: not knowing the levels of connected power for the concession until the environmental permit has been granted, and the large economic risks to apply for concession before acquiring the environmental permit.

The Swedish Wind Energy Association proposes that the government:

• Instructs the Swedish Energy Agency and the Environmental Protection Agency to investigate how permitting processes can be made more flexible in respect to technological advancement.
• Increases funding for review agencies and courts in order to shorten lead times in the permitting process.
• Investigates how the permitting process could develop within the framework of the revised EU Renewable Energy Directive (RED II), by, for example, creating better conditions for allowing the environmental and grid permitting processes to run in parallel.

4.2.4 Repowering with simplified permitting processes

By 2040, most of all wind power developed before 2015 will have reached its technical life spans. Through repowering, there is potential to massively increase today’s generation.

The oldest wind turbines in Sweden are in the south, in the counties of Skåne, Halland, Västergötland, and Gotland. Considering the power system, the best solution would be
Compared to other power sources, wind power has a low climate impact from a life cycle perspective, and progress forward is rapid. New studies from Vattenfall show that compared to older turbines, modern wind turbines have only half the climate impact from mining for raw materials to disassembly. This is partly because better production processes and lighter steel which reduces transport emissions. Turbines are also much bigger and more efficient, generating more electricity during the lifespan of the turbine.

Modern life cycle analyses show that carbon emissions from modern wind power are around 6 grams per kWh (Vattenfall 2019). For comparison, coal emits around 780–1000 grams per kWh (depending on the plant) and natural gas emits just over 500 grams per kWh (Vattenfall 2012).

The Swedish Wind Energy Association proposes that the government:
- Instructs the Energy Markets Inspectorate and the Environmental Protection Agency to create a special permitting process for repowering by 2021, in accordance with the revised Renewable Energy Directive.

An example is the modernizing of the wind farm Näsudden on Gotland. There, 58 old wind turbines were replaced with 27 new ones, the production increased four-fold, while the local intrusion was reduced.

To fully realise the potential of repowering, there is a need for a simplified permitting process that enables continued or increased generation in areas where wind power installations are already located.

Environmental impacts of wind power

Compared to other power sources, wind power has a low climate impact from a life cycle perspective, and progress forward is rapid. New studies from Vattenfall show that compared to older turbines, modern wind turbines have only half the climate impact from mining for raw materials to disassembly. This is partly because better production processes and lighter steel which reduces transport emissions. Turbines are also much bigger and more efficient, generating more electricity during the lifespan of the turbine.

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4.3 Revoke the provisions on the municipal veto

Since 2009, the municipalities have had a sole right of decision over new wind projects being adjudicated under the Swedish Environmental Code, i.e. the municipal veto.

The municipal veto was intended to simplify and shorten the permitting process and was implemented to promote the expansion of wind power in Sweden. The intended simplification did not happen. It has, in practice, complicated the permit process and prolonged the timespan—completely against its first intentions.

Municipalities should of course have a say in where wind power is being developed. But even without a veto, the municipalities can control the location of wind power through the spatial planning and as a central reviewing body during the permit application process.

The municipal veto completely goes against the demands for simplified and shortened permits processes, as per the revised Renewable Energy Directive. The use of the veto is not compatible with the principles of impartiality and objectivity which are central to decision making in the public sector.

The Swedish Energy Agency and the Environmental Protection Agency, who have been instructed by the government to review the permitting process for wind power, state that establishing wind power would be easier and more coherent with the law if the municipal veto is removed (Swedish Energy Agency 2017).

4.3.1. Property taxes to the municipality

Wind power is one of the most popular energy sources in Sweden, according to the SOM-institute’s yearly study of the public opinion on energy. 61 percent answer that Sweden should develop wind power even more, while an additional 20 percent answer that we should keep going at the same pace as today. By letting the property tax for wind power go directly to the municipalities, there will also be an economic benefit to those who live where wind power is built.

For a continued expansion of wind power, those most closely affected must also reap the benefits of wind power. This is achieved through information on how wind power benefits the local community through job opportunities, growth, and investments. In addition, we should revise the compensatory system to municipalities whose citizens are directly affected by developments.

A concrete suggestion is to let the property tax of the wind farm go to the municipalities instead of the state. This would ensure a meaningful addition to the municipalities’ economy. The property tax amounts to around €1000 per MW per year, which means that a project involving 20 modern wind turbines would result in €100,000 per year. This guarantees the local community part of the value of wind power, without compromising the financial conditions for wind power.

If the property tax goes to the municipality, the central government can still receive increased revenue from wind power. Both electricity production and consumption in Sweden is assumed to increase drastically in the coming
years, meaning that the state revenue from energy taxes and VAT will far outweigh the lost revenue from property taxes.

The Swedish Wind Energy Association proposes that:
- The parliament allocates the property tax from wind power to the municipalities.
- The government initiates an information campaign to make the expansion of wind power easier.

4.4 Promote co-existence with other interests

4.4.1 The Armed Forces’ restricted areas

The direction towards renewables is clear, and not only within energy policy. In December 2017, the Swedish Defence Commission stressed that the transition towards renewables is beneficial from a total defence perspective. Increased decentralized generation means more resilience compared to the centralized production of today.

Despite the insight on the pros of a decentralized electricity generation, the Armed Forces continues to oppose the expansion of wind power. Restrictions set up by The Armed Forces’ has long been one of the main obstacles to realising Sweden’s potential for wind power. Previously, half of the south of Sweden was affected by the Armed Forces’ restrictions. At the end of 2017, they decided to expand the restrictions even further. Further, in the suggestion to the Swedish Marine Spatial Planning, the restrictions are so extensive that offshore wind power is threatened to be completely excluded.

The Swedish Wind Energy Association proposes that the government:
- Changes the instructions to the Armed Forces and tasks them with contributing to creating the necessary conditions for developing wind power in line with 100 percent renewable electricity generation by 2040.

4.4.2 Strong species protection – but not on an individual level

It has become more difficult to obtain permits for wind farms under the Environmental Code in areas with significant bird life. This is even though the Swedish Environmental Protection Agency has stated that wind power poses no threat to the population of any bird species at a national level (EPA 2017).

Permitting processes have become more unpredictable and decisions have become stricter. Often, it is not the overall effect on the population of a species that is being evaluated, but rather whether any single individual of the species would be at risk of harm. Wind farms are even being denied permit to protect species of birds that are otherwise hunted.

Many other infrastructure projects, not only wind power, are being halted based on protecting individual birds, and not from an appropriate assessment of the impact on the population and its conservation status. The application of the Swedish Species Protection Act needs to be revised so that the protection of species is balanced against other environmental benefits, not the protection of individual animals.

The Swedish Wind Energy Association proposes that the government:
- Clarifies the application of the Swedish Species Protection Act to comply with the EU Birds Directive, so that § 4 of the Swedish Species Protection Act correctly adheres to the equivalent decision in the EU Directive (2009/147/EG) on the conservation of wild birds, and so that § 4 of the Swedish Species Protection Act can help ensure that the scrutiny process is reliable and predictable.
4.4.3 Wind power in reindeer pastures

The long and uncertain permitting processes have become even more difficult since authorities and courts increasingly are favouring reindeer herding when balancing the national interest of wind power against the national interest of reindeer herding.

It has become common that areas that are important for reindeer herding are exempted from wind power, even if the reindeer herding has not been deemed a national interest in the spatial planning. Combating climate change is vital to the future of reindeer herding, and the Swedish Wind Energy Association is convinced that reindeer herding and wind power can coexist. This assumes, however, that wind farm permit conditions are not formulated in a way which would seriously disadvantage the establishment of wind power in locations that are designated by the Swedish Energy Agency as a national interest for wind power.

The Swedish Wind Energy Association proposes that the government:

- Instructs the Swedish Energy Agency to suggest how the agencies involved in the permitting process can revise the conditions which, in practice, excludes the urgent interest of increasing the production of renewable electricity.

4.5 Enable job opportunities across the whole country

As a rule, wind power is built in rural areas, and gives people the opportunity to live close to nature and make a living off the new green technology. Big expansions in the north and along the coasts creates long-term job opportunities and bring tax revenue to rural towns. Over 37.5 million work hours, corresponding to 18 000 full-time jobs, will be created between 2017-2021 in building and operating wind power.

Glötesvålen wind farm is situated in the county of Jämtland, about 40 kilometres northwest of Sveg. The farm is owned by IKEA who thus achieved 100 percent renewable electricity use in the Nordic countries.

Glötesvålen has created 78 regional full-time jobs during construction and another 7 local full-time jobs for the operational period of 25 years. Additional jobs are also created for accommodation and service. For example, the construction of the wind farm resulted in nearly 12 000 guest nights in hotels. During 5 years of construction, salaries worth over €830 000 were paid and the local society saw reduced costs for unemployment by over € 2.5 million (given €32 000 per person per year).

The total addition to the local society from regional work during the building phase is estimated to just under € 3.4 million. Around 40 companies have provided services, products and working hours to the project. After an investment of over €92 million, 30 wind turbines are now in place that are calculated to produce 220 million kWh per year. That means electricity to 44 000 households per year.

"Around € 6 billion will be invested in Markbygden, which means a lot for the local businesses in our county. With the expansion of wind power, the access to renewable energy also increases. Over time, that is equally important as it attracts establishments of new industries"

Anders Lundkvist, Municipal Councillor in Piteå. (Svevind).
4.5.1 Wind power technicians

At least 170 new wind power technicians are needed every year to meet current demand.

In the coming four years wind power production will double, but there is already a shortage of wind power technicians. To ensure quality, safety and economic sustainability for future operation, well-trained personnel is needed in order not to become reliable on short term employees from other industries and countries. Currently, specific wind power technician education is only offered in Varberg and Strömsund but the total of 55 students per year is far from enough.

The Swedish Wind Energy Association proposes that the government:
- Instructs the Swedish National Agency for Higher Vocational Education to quickly act to make space for larger numbers of wind power technician students.
- Instructs the Ministry of Employment and the Swedish Energy Agency to spread information of the demand.

4.6 Set off offshore wind power

The future renewable electricity system shall be robust, provide security of supply, low environmental impact and deliver electricity at competitive prices. This requires sufficient margins in the system, which offshore wind power can provide. At sea, wind speeds are more even and turbines bigger than onshore, which results in more stable and larger generation and increased system benefits.

There are several permits for offshore wind farms in Sweden, which are yet to be realised. Thanks to clear policy ambitions in the countries around the North Sea (North Sea Declaration), the production costs for offshore wind power have decreased so fast that there are now several examples of offshore projects being built without subsidies. One example from September 2019 shows procurement contracts in Great Britain with costs below € 45 per MWh for the first time, which is comparable to the cost of combined heat and power (CHP) in Sweden.

In Sweden, offshore developers are hiring staff and investors show increasing interest. The TSO has granted connection to 9000 MW offshore wind projects in southern Sweden (prize areas 3 and 4), which is about as much as all wind power in generation today.

The Energy Policy Agreements promise of abolished connection fees for offshore wind power must be delivered with haste, to reap the benefits of this quick development. With its long coastlines and shallow waters, Sweden has good opportunity to develop offshore wind power as successfully as it has on land. Winds at sea are more even and deliver more hours of full capacity generation. The large scale of offshore wind power means that it can contribute with larger margins in the electricity system well before other large-scale production units are phased out. It is central that connections are planned from a grid perspective, where both producers, large electricity consumers, and local distributors are considered.

The electricity market is international. Increased interconnection between the Baltic countries would create

"The costs of offshore wind power have gone down dramatically in the last years, and at the same time, the amount of peak yield hours has increased alongside turbine size. Offshore wind power can therefore play a vital role in a stable and cost-efficient future Swedish energy system"

Magnus Hall, CEO på Vattenfall.
better conditions for a socioeconomically beneficial development of wind farms at sea, which is noted in the Energy Policy Agreement.

Sweden needs competitive conditions that are similar to those in the other countries around the Baltic Sea. Other countries have auction-systems and part of the development and connection costs are state funded. In Sweden, all costs and risks befall the developer. Therefore, it is important that connection fees are abolished, so that existing projects can be realised. Today, Sweden has 0.6 TWh of offshore wind power, but 10 TWh can be built by 2030, and by 2040, offshore wind power will be able to contribute with 30 TWh per year.

Swedish Marine Spatial Planning must allow offshore wind power in suitable locations. Coexisting with other interests is central for offshore wind power to be developed in Sweden. Today, the Armed Forces practically have a veto against wind power projects without needing to motivate the reasons, be transparent, or hold a dialogue. Other countries have shown that technological solutions can be used to bridge the gap between national interests.

Climate change is the greatest threat to life in the ocean. The sooner emission-reducing measures are introduced, the larger the effect. Swedish offshore wind power can increase the rate of replacing coal power in Europe and provide extensive climate benefits quickly. The increased electricity production that offshore wind power may provide also creates needed margins for when Swedish nuclear power eventually shuts down.

Increased access to renewable energy in the Baltic region would contribute to security of supply and reduced reliance on fossil fuels from the east. A joint planning between countries can result in quicker developments. Moreover, maritime industries in smaller coastal towns may develop as services such as pilots and captains will see a renewed demand.

The Swedish Wind Energy Association proposes that the government:

• Ensures that connection costs for offshore wind power are quickly abolished in accordance with the Energy Policy Agreement, to secure opportunities for industry, increase security of supply in the south of Sweden and to develop a large-scale energy production.

• Ensures that offshore wind power is enabled within the first version of the Marine Spatial Planning.

• Ensures that the climate benefits of increased generation and export of renewable energy from Sweden is accounted for, e.g. in the consideration of permits and planning.

• Signs and promotes the Baltic Sea Declaration for joint planning of wind power, and more efficient production around the Baltic Sea, which is in line with the Energy Policy Agreement’s part on transmissions.

• Instructs TSO Svenska kraftnät to continuously analyse planned offshore productions, local large electricity consumers around contact points, and develop a strategy for connections.

37 Mkr
regional yearly employments have been created to build Glötesvålen wind park

€ 3.7 million in total contributions to our society from regional work performed during the construction phase

40
companies have provided services or products to the project
Windpower in Sweden

By 2022, energy exports are predicted to reach a record-high of 29 TWh, even while nuclear power generation is decreasing. This is due to the increased production of wind power.

During the service period of a wind farm (25 years) one person per four wind turbines is required for operation and maintenance.

Swedish electricity consumption was 141 TWh in 2018. By 2040 it is expected to increase to 160 TWh.

A modern on-shore wind turbine reduces yearly emissions by an equivalent to 5000 cars each driving 120 000 km per year (calculated at 2 tonnes of co2 per car).

A modern offshore 8MW-turbine provides electricity to around 7000 households – three times more than a new onshore wind.

On-shore wind power can today be built completely without subsidies. The costs of offshore wind power are continuing to go down dramatically, and it is likely that offshore will also be able to expand without subsidies during the 2020s.

What are TWh, GWh, MWh, and kWh?

1 TWh = 1 000 000 GWh = 1 000 000 000 MWh = 1 000 000 000 000 kWh

5000 bilar

A modern offshore 8MW-turbine provides electricity to around 7000 households – three times more than a new onshore wind.

By 2022, energy exports are predicted to reach a record-high of 29 TWh, even while nuclear power generation is decreasing. This is due to the increased production of wind power.

Wind power contributes to a thriving countryside through increased employments as a result of wind farm establishments.
5. A modern electricity system
5.1 How wind power contributes to a stable electricity system

Swedish hydro power and trading with our neighbouring countries provides Sweden with an excellent foundation for a 100 percent renewable energy system. At the same time, the transition presents challenges in establishing a secure supply of electricity in all conceivable situations, since wind power is weather dependent by its nature.

Nuclear power generally produces electricity evenly, while wind and solar power generation varies depending on the weather. The transition to a renewable electricity system needs enough power to cover all conditions, and a built-in resilience against operational disturbances affecting both voltage and frequency.

Below, the main challenges to the system are described, along with the available solutions.

**Power adequacy:**
the ability of the electricity system to cover the demand for power and energy in any situation

**Frequency stability:**
the ability to handle larger deviations in the prognosis for production and consumption

**Voltage stability:**
the ability of the power system to uphold stable voltage levels and return to a new equilibrium after a disturbance

**Security of electricity supply**

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**Power adequacy: the challenges are not acute, but margins are needed.**

Power adequacy implies the ability of the electricity system to cover the demand for power and energy in any situation. As nuclear reactors are being shut down, we can expect more situations when it will be more difficult to cover the demand, especially on occasions when high electricity consumption coincides with low wind power output. In these situations, some other type of production must be added, or consumption decreased, for the demand to be covered.

To supplement the renewable electricity production, so-called flexible resources are needed. Today, flexible resources of around 28 GW are available in the forms of hydro power production, import, CHP, and gas turbines, which combined are equivalent to the power demand on a cold winter day. In theory, we can already manage such situations without nuclear power, given that hydro power and imports are maximized.

However, because of limitations in transmission capacity and in our neighbouring countries - generation, additional margins are needed. The highest expected instantaneous power demand is expected to increase to around 28-30 GW by 2040, as total electricity consumption increases (Swedish Energy Agency 2018). Additionally, margins are important if our nuclear power shuts down earlier than expected.

**There are many solutions for meeting these challenges.**

Increased transmission capacity within Sweden and to our neighbouring countries, as well as increased power outputs from hydro power, are easy technical solutions, even if the permitting processes are slow. Batteries and a more flexible demand for electricity can together supply over 35 GW. Power Circle and the Swedish Energy Markets Inspectorate estimates an additional 14 to 114 GW also can be added if the capacity in future electric cars are considered (NEPP 2019). Consequently, it is not a question of if, but rather how the challenge is best managed.

The most cost-efficient solutions are probably import, flexibility of demand, automated control of household appliances and heating systems, and electric car batteries supporting the system.

Moreover, the contribution of wind power increases as wind turbines with a higher capacity factor is being introduced to the system. This is because of technological advancements making wind turbines more efficient, and because of the expansion of offshore wind power with a more even gene-
The capacity factor for wind power has improved from 24 percent in 2014, to 37 percent today. In the long-run, the capacity factor is calculated to reach 50 percent, even for onshore wind power.

To create energy storage solutions, frameworks such as power companies’ revenue regulations need to be revised in order to create incentives to invest in alternatives to grid expansions. This also applies to user flexibility: for electricity use to be more flexible, incentives such as variable network tariffs and energy taxes need to be introduced.

Frequency stability: can be kept through synthetic inertia, batteries and inertia from other countries.

For the energy system to work, it is not only important that enough planned resources are available to balance the system, but it also needs to be able to handle larger deviations in the projections for production and consumption. If production exceeds consumption, the frequency rises and vice versa, and if frequency falls outside of the allowed interval, it may result in a power outage.

Today, nuclear power contributes with inertia to the system (synthetic inertia) which reduces the effect of a sudden drop in production since the generators keep rotating for a while thanks to the stored kinetic energy. Wind turbines often lack this ability, but with power inverters that connect the wind farms to the grid, the rotational energy in the wind turbine can be temporarily increased or decreased. This is usually called synthetic inertia.

So far, the incentive for wind power owners to contribute with synthetic inertia is lacking, since the ancillary services purchased by TSO Svenska kraftnät are not adapted to the conditions of wind power. In countries like Canada or Ireland, however, these services are used quite extensively. There are several other ancillary services that wind power can contribute with if the right conditions are given. Beyond synthetic inertia in wind turbines, there is potential to solve the challenges described above with batteries and by using system inertia in other countries through direct current links.

Voltage stability: wind power is already contributing today, but economic compensation should be given

Voltage stability concerns the ability of the power system to uphold stable voltage levels and return to a new equilibrium after a disturbance. For a system to have voltage stability, the need for reactive power needs to be met in each separate part of the grid. If this is not met, a voltage collapse can occur, which can result in a power outage for parts of, or the entire system.

Today, wind farms contribute with reactive effect through terms in the connection contract. Using reactive effect always means a decrease in generation, which needs compensation. Maximum use of the capacity for reactive effect can mean a 5 percent loss of total yearly production, which is a lot of money for the owner.

With additional equipment, wind power can deliver reactive effect even when the turbines are not active. This is of interest for the grid owners, since it can replace capacitors and reactors which otherwise need to be purchased for stabilising voltage. Thus, it can be socioeconomically beneficial to get help from wind power.

The Swedish Wind Energy Association proposes that:

• TSO Svenska kraftnät develops ancillary services in cooperation with the wind power industry, to make them better suited to the needs of wind power.
• The Energy Markets Inspectorate regulates network tariffs so that they steer toward increased user flexibility.
• The Energy Markets Inspectorate reviews the revenue regulations to incentivize the power companies to buy additional energy storages services.
• The Swedish Energy Agency evaluates the system margins which offshore wind power and developing wind power technology can help increase.

Resources available today:
• Import/export (around 10 GW)
• Hydro power (13 GW currently, potentially 15 GW in the future)
• Gas turbines (1–2 GW)
• Combined heat and power (CHP) (3–4 GW)

Future resources:
• Electric cars with vehicle-to-grid (V2G) technology (between 14–114 GW)
• Batteries (up to 30 GW)
• Flexible demand (5–7 GW)
• Energy effectivization (around 3 GW)
• Energy storage (yet unknown potential)
5.2 Reinforce the grid’s capacity

The shortage of capacity in the power grid, particularly the main grid, is one of the main obstacles to achieving the target of 100 percent renewable electricity generation by 2040.

Since electricity generation is greater in the north of Sweden, and consumption greater in the south, electricity must be transmitted over long distances. The Swedish transmission system operator (Svenska kraftnät, TSO) has stated that parts of the northern grid are already limited in the amount of electricity that can be received. Accordingly, there is a need to increase capacity over all, from smaller power stations to new power lines in order to facilitate the planned expansion of wind power.

The Swedish Wind Energy Association estimates that until 2022, 90 percent of all new wind power will be built in the north. The grid infrastructure also faces a great challenge as massive reinvestment is needed for steadily replacing old power lines with new ones.

According to TSO Svenska kraftnät, the permitting processes for building new overhead lines is probably the largest bottleneck limiting the speed of expansion of wind power (Svenska kraftnät 2015). Lead times of 10 years from decision to operational start are not uncommon. In 2013 plans

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Frequently asked questions on a 100 percent renewable electricity system:

Where will the electricity come from when the wind is not blowing? Sweden is well suited for a completely renewable energy system, not least thanks to hydro power and our possibilities for importing when the wind is not blowing. There is also an enormous potential in flexible electricity usage and energy storage, which together with today’s solutions will be able to meet the challenges. Moreover, wind power production becomes more stable in line with technological development.

Will disturbances become more common in a renewable electricity system? Wind power does not contribute with natural inertia like nuclear power does. However, it can support the system with so called synthetic inertia, down-regulation, and voltage regulation. For wind power to contribute with these actions, the incentives need to become more clear and ancillary services become more adapted to the conditions of wind power.

Will Sweden become dependent on importing fossil energy when the electricity system is 100 percent renewable? Sweden already has continuous trade with our neighbouring countries, where we sometimes import energy primarily from Norway, and sometimes export. Over a year, Sweden has a large net export, and this is expected to increase in the coming years. In the future, we will sometimes have to import electricity, but by expanding our renewable electricity production, Sweden can keep its large surplus and keep exporting more than what we import.
to reinforce the north-to-south corridor were announced. Instead of proceeding with the announced measures, Svenska kraftnät chose a different approach. Now, capacity is planned for upgrades alongside reinvestments – over a 20-year period. It is however uncertain if the increased transmission capacity will cover the demands in either the short nor long term.

Without action, it will be increasingly difficult to connect wind power to the grid. Bottlenecks between the north and south also pose an increased risk of locked in power which decreases profitability for power plants and wind farms in the north, while increasing costs for consumers in the south. Since the potential for onshore wind power is mainly in the north, these bottlenecks can make it noticeably harder to reach the target of 100 percent renewable electricity generation.

"The current grid plans create a catch-22 situation: no new grid without wind power, but no new wind power without the grid."
Mattias Wondollek, head of grid and markets, SWEA

TSO Svenska kraftnät does not want to expand the grid based on speculation. Thus, many challenges appear when wind power develops faster than any predictions: calculations for future investments are underestimated leading to undervaluing the need for future grid expansion, and long lead times for grid expansion result in solutions not arriving until it’s too late and wind power investments have already been inhibited.

The Swedish Wind Energy Association proposes that the government:
- Instructs the TSO Svenska kraftnät to develop an action plan which enables a wind power expansion of at least 60 TWh by 2030, and at least 90 TWh by 2040.
- Instructs the Swedish Energy Agency in consultation with the Energy Markets Inspectorate and Svenska kraftnät, to investigate how the lead times for the expansion of the main grid can be significantly sped up. Within the instruction, questions of increased local acceptance and centralised reviews should be investigated.

Alternatives to grid expansion

Enabling increased capacity in the existing grid is an important success factor for achieving the transition to renewables in a cost-effective way. The transmission capacity of the grid is often limited due to overheating in the cables or...
a drop-in voltage. Through better measurement and control based on actual weather conditions, transmission capacity can be increased without having to building new power lines.

In what is often called the North-south project, TO Svenska kraftnät are currently installing features in main grid stations to regulate the reactive effect thus enabling a higher transmission capacity, which is something grid-connected wind farms also can do. This is a fast and cost-effective approach to somewhat increase the transmission capacity without building new power lines.

Another way of enabling more wind power in existing grids is to connect an energy storage facility between the wind farm and the power grid. This may become feasible if the costs of storage solutions continue to fall at a rapid rate.

The energy storage unit can be charged during high winds and transmit electricity to the grid when the wind farm is not producing. Through a hybrid system which combines wind, hydro, solar, and storage, the peak load can be reduced, which enables the grid to be optimized and dimensioned more efficiently. This also enables wind power to be connected to power lines which would otherwise be considered “full”.

The need for grid reinforcements can also be limited through placement of new large electricity consumers, such as the Northvolt factory outside of Skellefteå, new data centers or the Hybrit-project in the north. Therefore, it is important to hold a dialogue and cooperate between producers, power companies, and consumers around the plans for the grid.
Today, wind power is the cheapest power source that is also capable of large-scale expansion in Sweden. Our favourable wind conditions give us a big competitive advantage. Wind power is a growing green industry, and through electricity exports it can replace electricity generated from coal in Europe. Wind power enables the electrification of industry and transportation, increases security of supply, and creates jobs in rural areas.

Technological progress is fast, and we now see a huge amount of ways to face the challenges of a renewable electricity system. Wind turbines are developing and can now deliver energy and power even during weaker winds, new solutions are developed for energy storage and flexible consumption, and new features in the power grid all contribute to securing the supply of electricity in the future.

To reach the target of 100 percent renewable electricity generation by 2040, we estimate that wind power needs to expand to at least 90 TWh, and this must be done without the support of the Electricity Certificate System. Therefore, access to good wind conditions, efficient permitting processes, and modern grid infrastructures are critical in ensuring that the expansion takes place in a sustainable and cost-efficient manner. We have come a long way, but much work remains. The political will is clear but it needs to be put into action within the current governments’ term of office.

A good start would be to update all climate related instructions to government agencies and authorities to make it easier to balance different interests. The remaining parts of the Energy Policy Agreement must be implemented to protect the investment climate. An additional key measure is to create incentives for municipalities to contribute to the transition to renewables, for example by allocating the property tax from wind power installations to the municipalities.

When these obstacles are overcome, the full potential of wind power can be realised. It creates climate benefits and competitiveness. It provides job opportunities and growth. It promotes Swedish industry and builds a modern and sustainable society.

“Let us realise the potential of wind power, both onshore and offshore. It is economically profitable. It benefits Swedish industry and technology. It creates a modern and sustainable society”.

Charlotte Unger Larson, vd Svensk Vindenergi