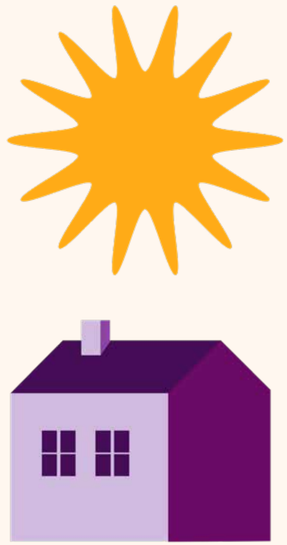
Finland – Persistent Performer or European Champion of the Energy Transition?

Vision of a prosperous energy future

Finnish Energy

Contents



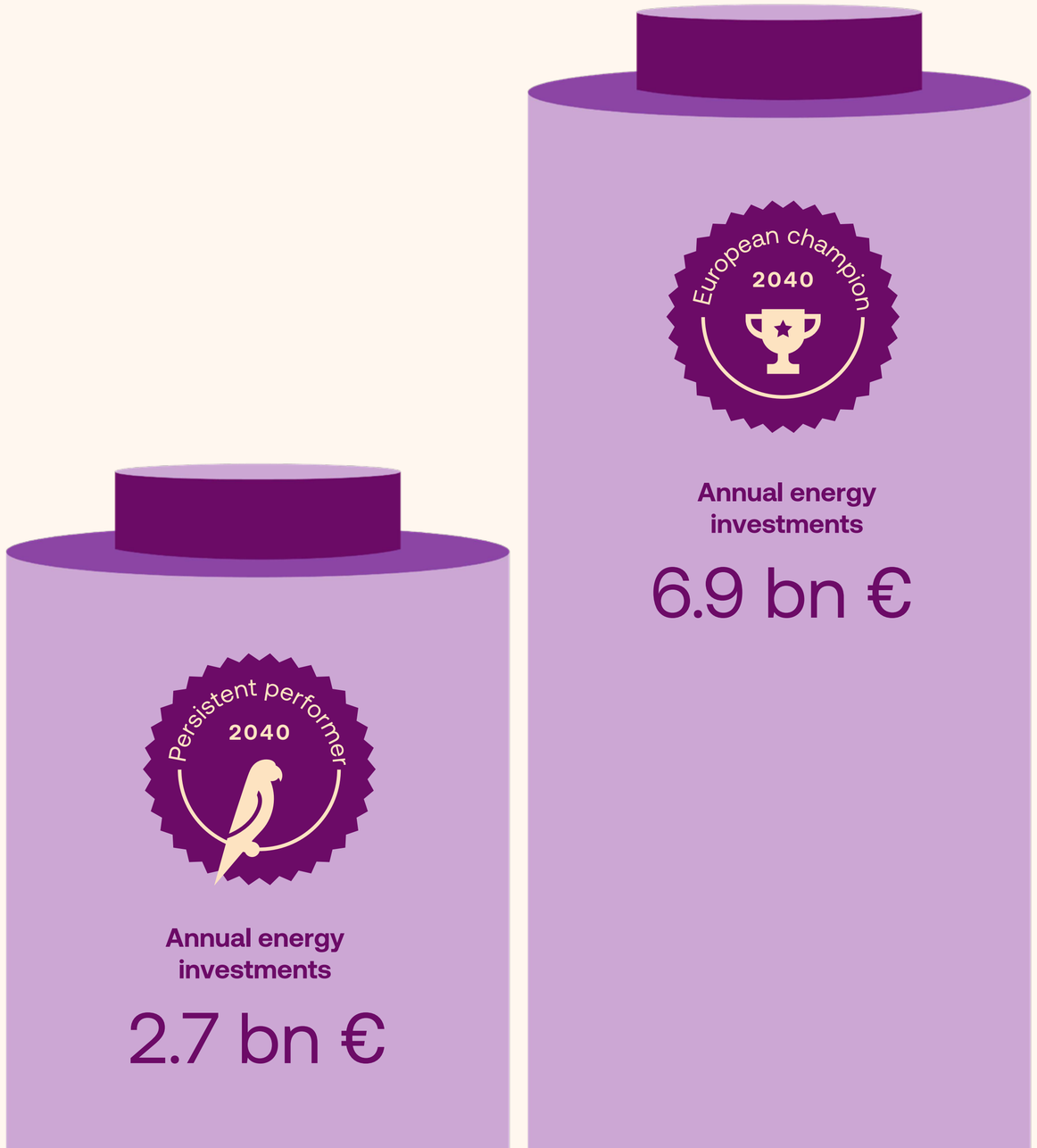
Energy boost for the Finnish economy

The Finnish economy has been stagnant for some time and this has caused a funding crisis for the welfare state. The energy sector offers solutions to Finland’s problems. We do this by investing in the future and inviting everyone to join in making a change.

Finland has a good chance of being a European champion of the energy transition by 2040. Finnish society, energy users and the environment will greatly benefit from this. There will be enough energy to meet the needs of an electrified society and industry while also taking care of our natural capital. An advanced and clean energy system will be based on flexible co-operation between production and consumption through strong networks.

In 2040, the challenges of the 2020s have been tackled with significant investments in energy production and networks, creating favorable conditions for a new era of industry and services. A new chapter has been written in Finland's success story, securing the funding of the welfare state.

Even in a less bold vision of the future, Finland has made a demanding and persistent performance. We have fulfilled our obligations, but we end up reading about the success stories of others.



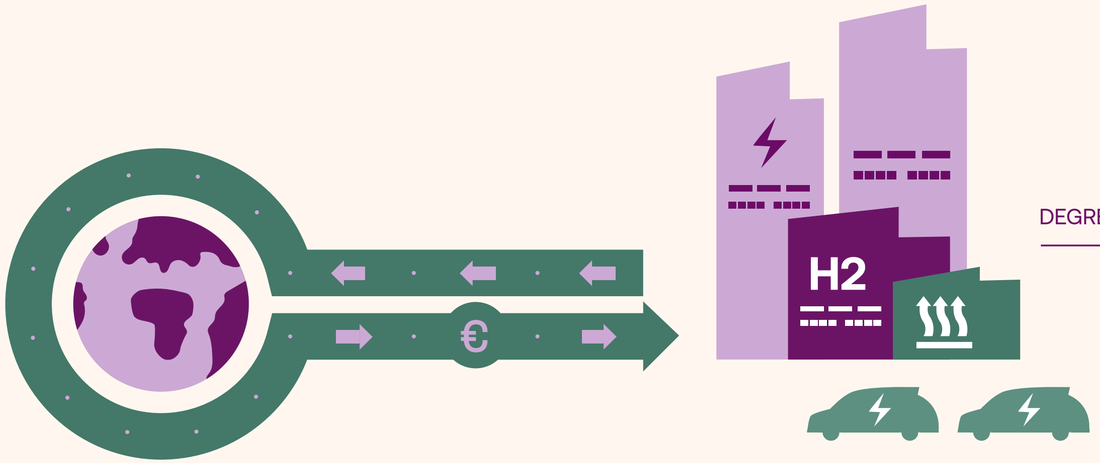
Clean energy as an enabler of green growth

Energy determines Finland’s direction

Growing industrial exports

By 2040, Finland's economy will be driven by industries and services based on clean electricity, hydrogen, and captured carbon dioxide. Their development is based on reliable and competitive energy.

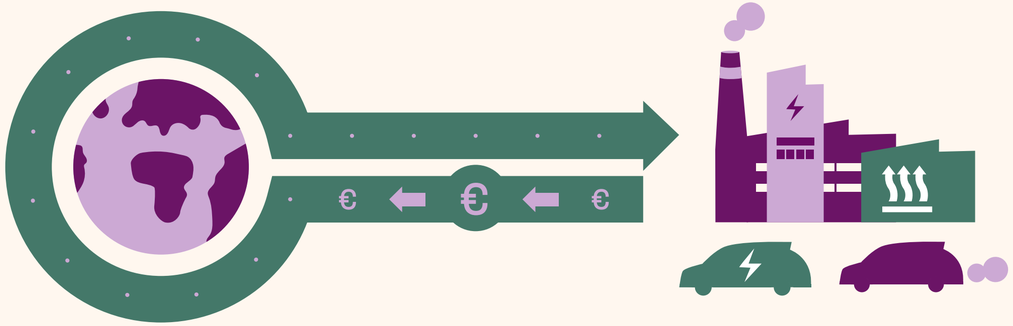
Hydrogen produced with clean electricity will be used to clean up industry and as a raw material for synthetic fuels. The data economy with its data centres uses a lot of clean electricity. The electrified economy will be in full swing, and the heat generated as a by-product of industry and services keeps our homes warm without emissions.



European champion 2040

DEGREE OF ELECTRIFICATION 66 %

2.7 times higher
compared to 2023



Persistent performer 2040

DEGREE OF ELECTRIFICATION 50 %

2 times higher
compared to 2023

In 2040, the European champion of the energy transition is generating prosperity

Finland is the best country in Europe for energy-intensive industries and produces high-value-added products for the European and global markets.

Hydrogen produced with clean electricity is used in the export industry, which has grown in Finland. The main use of hydrogen is as a raw material in the chemical and metal industries. Hydrogen is also used to produce clean fuels for transportation and industrial needs.

The energy sector can directly and indirectly employ 100,000 people, with the energy-utilising industries employing significantly more. The energy trade balance has turned positive.

Finland is heated using byproduct heat, heat pumps, small nuclear power, and affordable electricity. Over two million electric cars cover more than 80 percent of the driven kilometers. Household energy bills are reasonable in relation to the well-developed purchasing power.

40 bn €

Potential contribution of the energy economy to the national economy

In 2040, the persistent performer has met its obligations

Finland has managed to retain part of its energy-intensive industry by electrifying its processes and improving energy efficiency. Fossil hydrogen has been replaced with hydrogen produced using clean electricity in its traditional applications, such as the production of liquid fuels and nitrogen fertilisers.

Products of the new, clean economy are imported from Sweden, Central Europe, the United States, and China. The energy sector can directly and indirectly employ 60,000 people.

Finland is heated not only with heat pumps and electricity with variable pricing but also with wood fuels. Over one million electric cars cover more than 50 percent of the driven kilometers. Some households mitigate energy costs by actively managing their energy use. Households have adapted their energy consumption to rising and fluctuating fuel prices.

10 bn €

Potential contribution of the energy economy to the national economy

The energy future needs its makers

What makes up the European championship team of the energy transition?

At least installers, product developers, digital experts, technical salespeople, customer service representatives, nuclear physicists, and interdisciplinary specialists.

They continuously develop and implement solutions that benefit society, energy users, and the environment. Particularly valuable skills for building a bright energy future include:

- Learning skills, interaction and problem solving
- Cybersecurity
- Project management
- Science and mathematics
- Customer service and sales
- Environmental responsibility and sustainable development
- Digitalisation and data analytics

100 000 people

Potential employment impact of energy economy

60 000 people

Potential employment impact of energy economy

Hydrogen economy requires more electricity

Hydrogen is used to produce fuels for applications where switching directly to electricity is not viable. Climate-neutral fuels are obtained by combining hydrogen with captured biogenic carbon.

The flexibility of hydrogen production and storage smooths out electricity price fluctuations. Hydrogen is also used in international energy trade.

In the scenario of a persistent performer, the conditions for strong growth in the hydrogen economy have not been realised in Europe, and the majority of Europe's hydrogen needs are met through imports. Even here, hydrogen produced with clean electricity replaces some of the industry's hydrogen demand, and new production of synthetic fuels has emerged to a limited extent.

Finland's share of green hydrogen production in Europe

10 %

it requires

100 TWh

of emission-free electricity

Finland's share of green hydrogen production in Europe

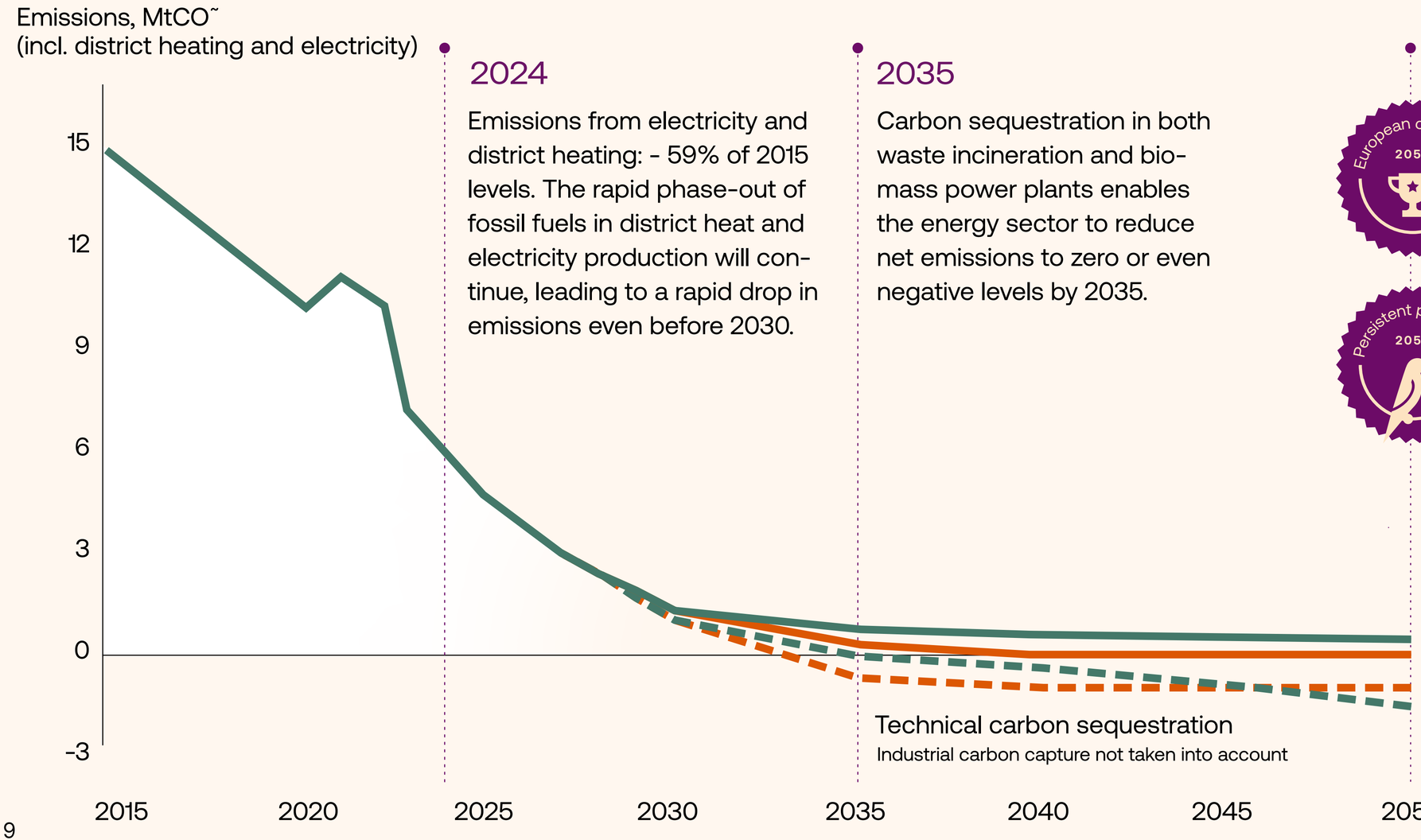
1 %

it requires

10 TWh

of emission-free electricity

Emissions fall below zero



2024

Emissions from electricity and district heating: - 59% of 2015 levels. The rapid phase-out of fossil fuels in district heat and electricity production will continue, leading to a rapid drop in emissions even before 2030.

2035

Carbon sequestration in both waste incineration and bio-mass power plants enables the energy sector to reduce net emissions to zero or even negative levels by 2035.

Technical carbon sequestration
Industrial carbon capture not taken into account

2050

European champion 2050

1 million tonnes of negative emissions and 0 gross emissions.

Gross emissions
Net emissions

Persistent performer 2050

2 million tonnes of negative emissions and gross emissions of 0.4 tonnes*

Gross emissions
Net emissions

*In this scenario, biomass is needed for combined heat and power production allowing slightly higher carbon capture in 2050.

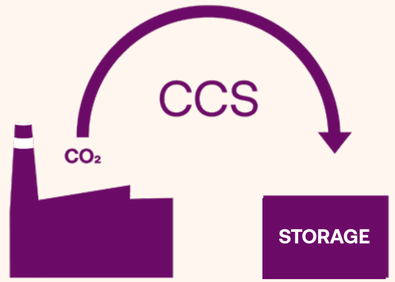
Storing carbon or recycling it into new products

Carbon capture offers an additional means of achieving carbon neutrality and removing carbon dioxide from the atmosphere.

Currently, 28 Mt of biogenic carbon dioxide is generated in Finland, particularly in the forest industry, as well as in waste incineration and other energy production. This carbon dioxide can be captured and either permanently stored or used in various products as a substitute for fossil raw materials.

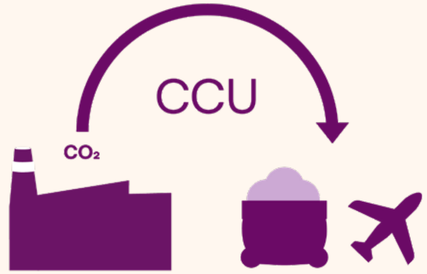
At present, storage is not economically viable. According to a study commissioned by the Finnish Climate Change Panel, the estimated total costs for capturing and storing a ton of carbon dioxide from industrial emission sources in Finland around 2030 range from approximately 120 to 240 euros, depending on the capture site.

In Finland, plans emphasise the utilisation of captured carbon dioxide in the production of synthetic methane and methanol, which can be used as fuels and as raw materials for chemicals.



Carbon Capture and Storage (CCS)

There are no geological formations suitable for permanent storage in Finland. Storage requires transport, for example to storage sites in the North Sea.



Carbon Capture and Utilisation (CCU)

In Finland, several projects are underway to produce new products, such as fuels and chemicals, from captured carbon dioxide and hydrogen.

Unprecedented growth of clean electricity

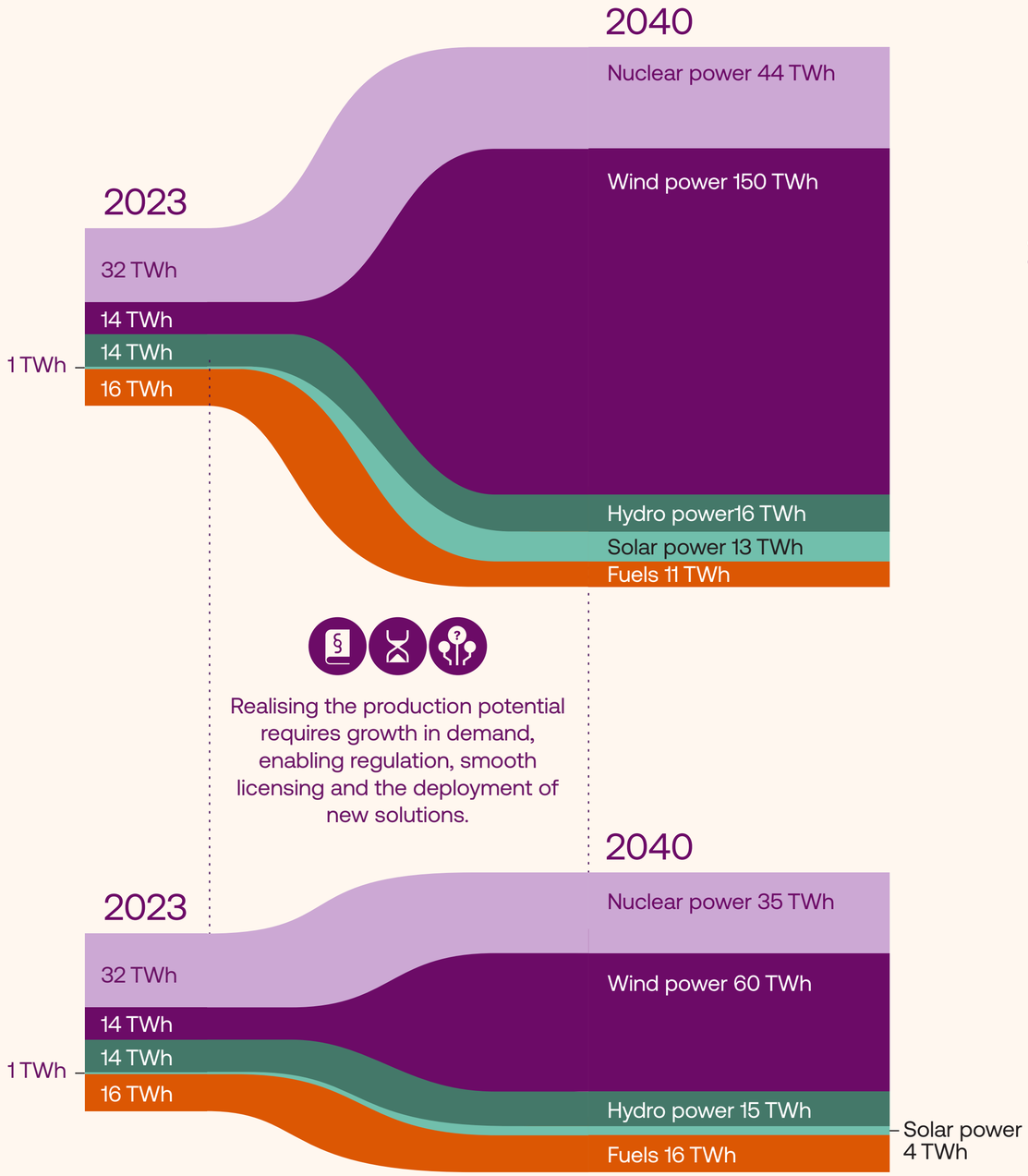
Production will be multiplied

Clean energy growth empowers Finland

Finland is a winner in clean electricity production.

In the European Champion scenario, onshore wind power production has increased eightfold. The champion also requires a substantial amount of offshore wind power, solar power, and small nuclear power. Maintained and developed hydropower, traditional nuclear power, and sustainable fuels balance the production. If we can't achieve this, then who can?

Even in the Persistent Performer scenario, Finland meets its climate and energy obligations, but economic growth remains modest. Additional clean electricity is obtained through significant investments in wind and solar power.



European champion 2040

2.8 times higher
compared to 2023

Persistent performer 2040

1.6 times higher
compared to 2023

There is potential for growth in current technologies...

Onshore wind power

+ Very competitive in terms of price, good investment prospects throughout the country, once the obstacles in Eastern Finland have been overcome

– Production varies considerably

Combined heat and power from biofuels

+ Important for security of supply, especially in winter, new business opportunities from carbon capture

– Price outlook for sustainable biofuel and electricity

Conventional hydropower

+ Important for security of supply and the balance of the electricity system

– Limited scope for adding new plants

Electric boilers

+ Highly cost-effective heat generation when electricity is cheap, brings balance to the electricity system, volumes growing strongly

– Requires a lot of transmission capacity

Extending the lifetime of existing nuclear power plants

+ Low operating costs, facilities and infrastructure exist

New large nuclear power plants

+ Well-known technology

– High construction costs, long permit processes

Waste to energy

+ Energy from the incineration of non-recyclable waste is used in the production of electricity and heat; in the future, carbon dioxide capture will make it possible to replace fossil raw materials in the manufacture of products (CCU technologies).

...but new solutions are also needed

Technologies are already in commercial or large-scale use, but growth in Finland is only just beginning:

Offshore wind power

+ Technology is developing rapidly, great investment potential, more consistent production than onshore wind power
– Technical challenges related to winter, the cost level is high so far

Pumped-storage hydroelectricity

+ Would balance the electricity system and smooth out price peaks

Industrial-scale solar power plants

+ Competitively priced, rapidly evolving technology, great investment potential, volume growing
– Production is highest in summer and low in winter, the opposite for demand

Industrial heat pumps

+ Technological advancements are promising, allow the use of new byproduct heat as the district heating system evolves

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Technologies in the pilot phase:

Small modular nuclear reactors (SMR)

+ Technological developments are promising, especially in reactors designed for heat production, offering a potential production method in areas where byproduct heat is not available
– Currently high investment costs, but mass production could reduce prices

In 2040, Finland as the European champion has succeeded in the growth of electricity production

Thanks to a competitive operating environment, smooth permitting processes, and increased demand, Finland has built a significant amount of new electricity production. By far the largest production method is onshore wind power. Offshore wind power, solar power, and nuclear power have also increased substantially. The flexibility of power generation has improved due to upgrades in hydropower capacity, the establishment of a few new facilities, and pumped hydroelectric power.

Combined heat and power generation still utilises some wood fuels alongside waste fuels. Annual production investments have been in the billion-dollar range throughout the 2030s.

In 2040, Finland as the persistent performer has seen missed growth opportunities

Production investments have been directed towards replacing fossil fuels in industry, transportation, and heating. Finland's uncertain operating environment, slow permitting processes, and industrial investments in other countries have resulted in the country losing electricity production investments to competitors. Small-scale nuclear power has not been implemented in Finland. Increased rainfall due to climate change has slightly boosted hydropower production without new investments.

Industry still maintains a significant amount of combined heat and power generation, primarily using wood fuels. Waste fuels are utilised in combined heat and power generation for electricity and district heating.

Finland is a leader in small-scale nuclear power. A few medium-sized modular nuclear power plants produce about 9 terawatt-hours of stable but adjustable electricity per year. In addition, several small nuclear boilers are the main source of un-burned heat in large cities, alongside industrial-scale heat pumps.

Small-scale nuclear power has not reached techno-economic viability in Finland. Legislation, which only partially allows modularity and series production, increases costs. Zoning has not found viable sites for nuclear thermal plants.

Wind powers the welfare state

In 2040, Finland has 7,500 wind turbines. They are strategically placed on land and at sea in locations beneficial for society, nature, and the energy system. Finland's electrical grids are robust, and challenges related to the radar operations in Eastern Finland have been resolved. Thus, the local benefits of wind power are distributed across the entire sparsely populated country.

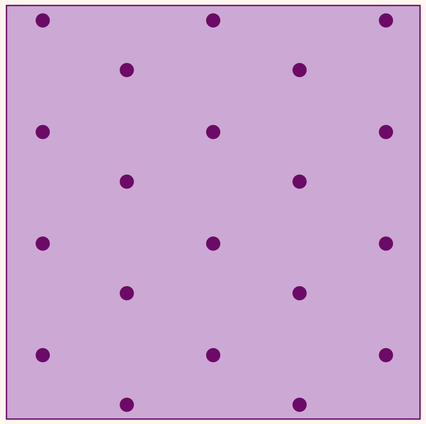
Due to its cost-effectiveness, wind power generates two-thirds of Finland's electricity. Environmental and landscape impacts are managed through flexible placement and responsible project planning.

In the second scenario, there are only 3,500 wind turbines, and their placement is concentrated. Finland does not gain the desired new engine for its welfare state from wind power.

Will wind power fit in Finland?

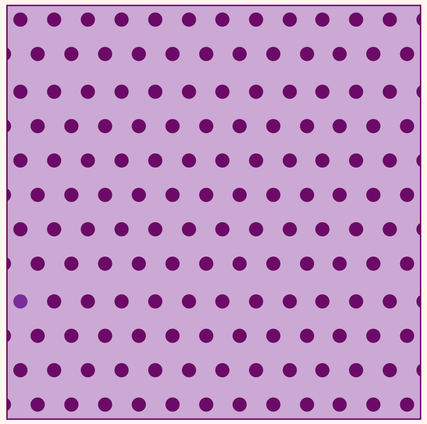
In the European champion scenario, the wind power density in Finland in 2040 is only one seventh of that in Denmark in 2023.

FINLAND 2040



20 wind power plants / 1000 km2

DENMARK 2023



138 wind power plants / 1000 km2

Strong networks and resilient system

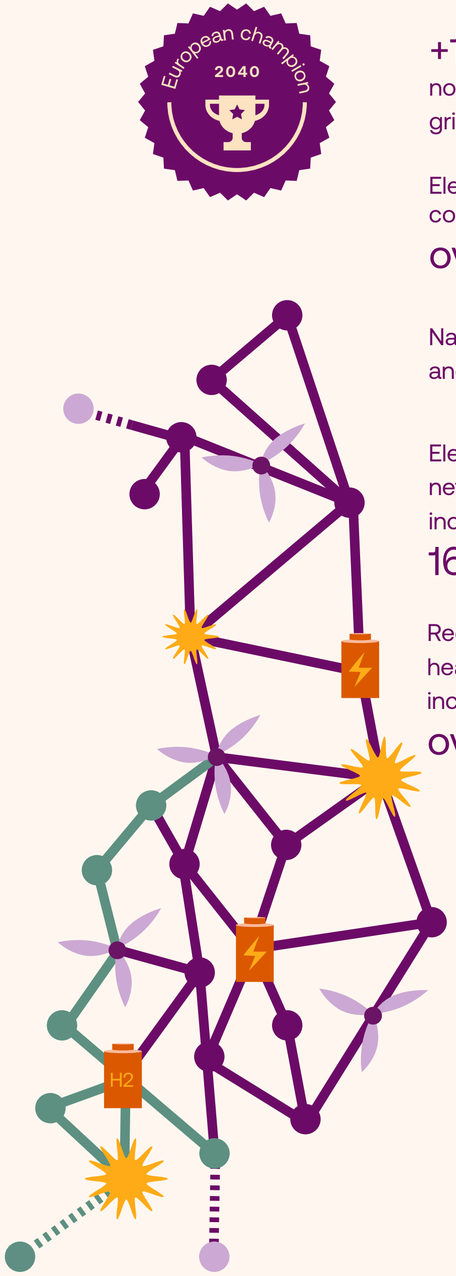
Finding a new balance through cooperation

Networks enable the transition

The new energy system is based on robust grids. Finland's success in grid construction is based on expertise and an excellent starting point, along with smart incentives.

With a much stronger electricity distribution network, new production and consumption can be aligned. Hydrogen covers as much as half of Finland's north-south energy transmission.

Heat networks enable the utilization of heat generated by industry and data centers in cities. Heat storage allows the storing of heat produced in summer for use during winter.



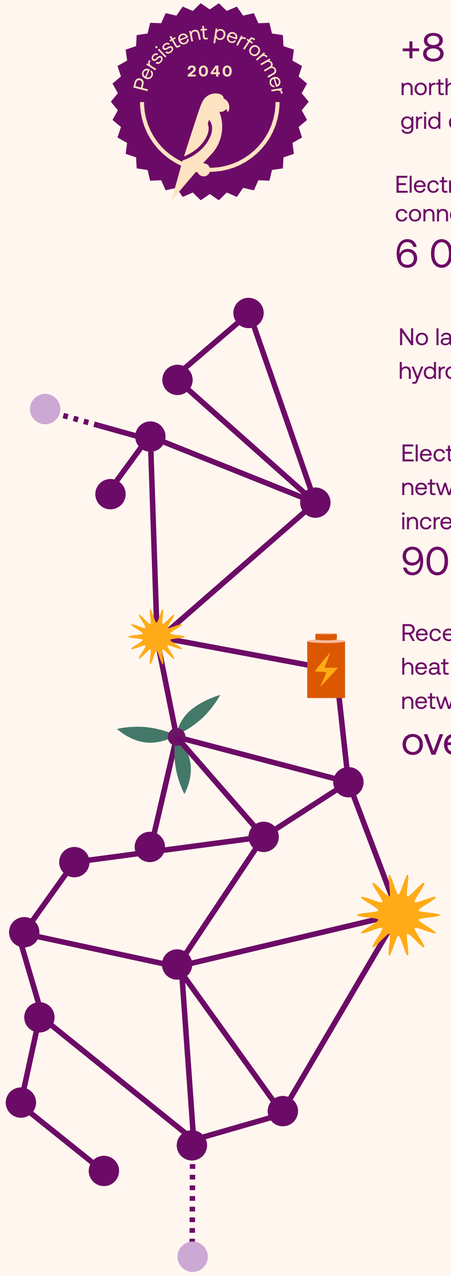
+10
north-south
grid connections

Electricity inter-
connection capacity
over 8 000 MW

National hydrogen network
and interconnections

Electricity distribution
network capacity
increased by
160 %

Reception of waste
heat in heating networks
increased by
over 100 %



+8
north-south
grid connections

Electricity inter-
connection capacity
6 000 MW

No large-scale
hydrogen network

Electricity distribution
network capacity
increased by
90 %

Reception of waste
heat in heating
networks increased by
over 50 %

European championship will be achieved with strong and smart networks in 2040

The electricity and hydrogen transmission networks have been built in synchronisation, ensuring that users – both industrial and consumers – receive energy reliably to meet their growing needs. The placement of networks and production facilities is planned in collaboration with energy-intensive industries. Hydrogen and heat networks, along with large energy storage facilities, smooth out fluctuations in production and consumption.

Customers, served by a strong electricity distribution network, are active participants in the energy system. They have incentives to increase or decrease consumption as needed. Thanks to artificial intelligence and robust networks, flexibility occurs automatically, ensuring good reliability and reasonable costs.

Energy is also exported to neighboring countries as electricity, hydrogen, and refined fuel products, but above all as value-added industrial and service products.

In 2040, the persistent performer fails to utilise the full potential of renewable energy

The utilisation rate of the grids is high. Occasionally, the energy networks are unable to direct or store all renewable energy for beneficial use, thereby necessitating production limitations. Industries and services have limited opportunities to invest in Finland due to insufficient transmission and distribution connections.

The sufficiency of electricity is occasionally dependent on imports. During electricity surplus situations, heat networks act as storage.

Hydrogen networks are local and serve industrial production processes. Synthetic fuels are produced to cover part of the domestic consumption in heavy transport. Properties regulate their own energy consumption based on price signals.

District heating significantly balances the electricity system: a total of three gigawatts of capacity from electric boilers and hundreds of gigawatt-hours of heat storage help manage supply and demand. District heating networks enable the utilisation of waste heat generated by industry and services, thereby improving viability of investments.

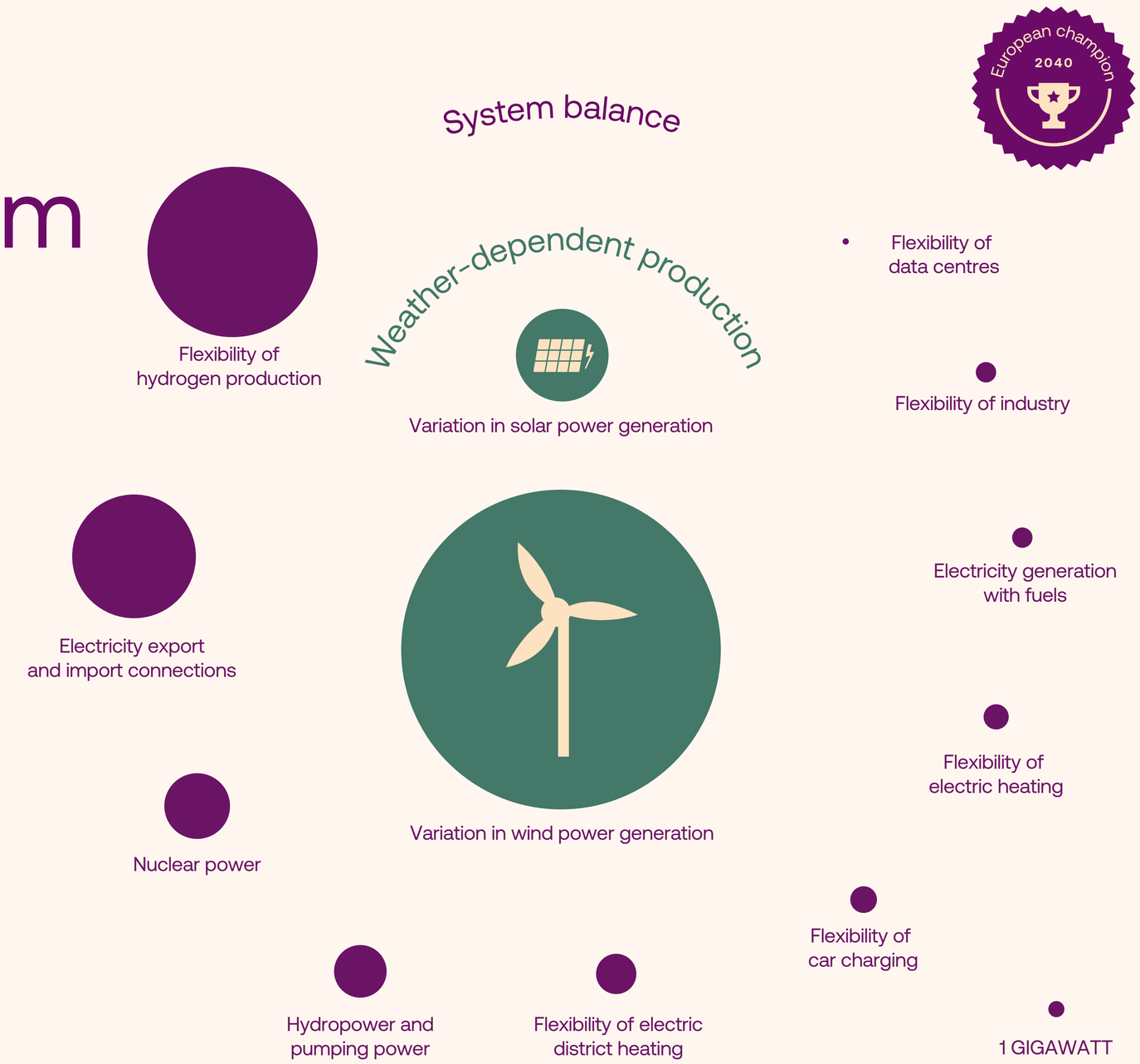
The development of electric boilers and heat storage in district heating has slowed down due to taxation, zoning, and network constraints. Industrial-scale heat pumps mainly utilise environmental heat, as byproduct heat from new industry is scarce due to new investments being sidelined.

The balance of the electricity system is built on versatile flexibilities

Competitively priced, variable energy production has increased tenfold in Finland. The balance of the energy system is ensured through all available means.

Hydropower and nuclear power, along with fuel-based capacity, balance the fluctuations of onshore and offshore wind power and solar power. The electricity consumption of industries, households, and transportation adjusts with active and automatic control. Heat networks store large amounts of energy.

Hydrogen production flexes with the help of hydrogen networks and storages. In Champion Finland, electricity transmission connections to neighboring countries are needed more than twice the amount in 2023. The predictability of weather-dependent production and curtailment facilitate balancing when necessary.



Solutions to sustainability challenges

Nature sets the boundaries for energy transition

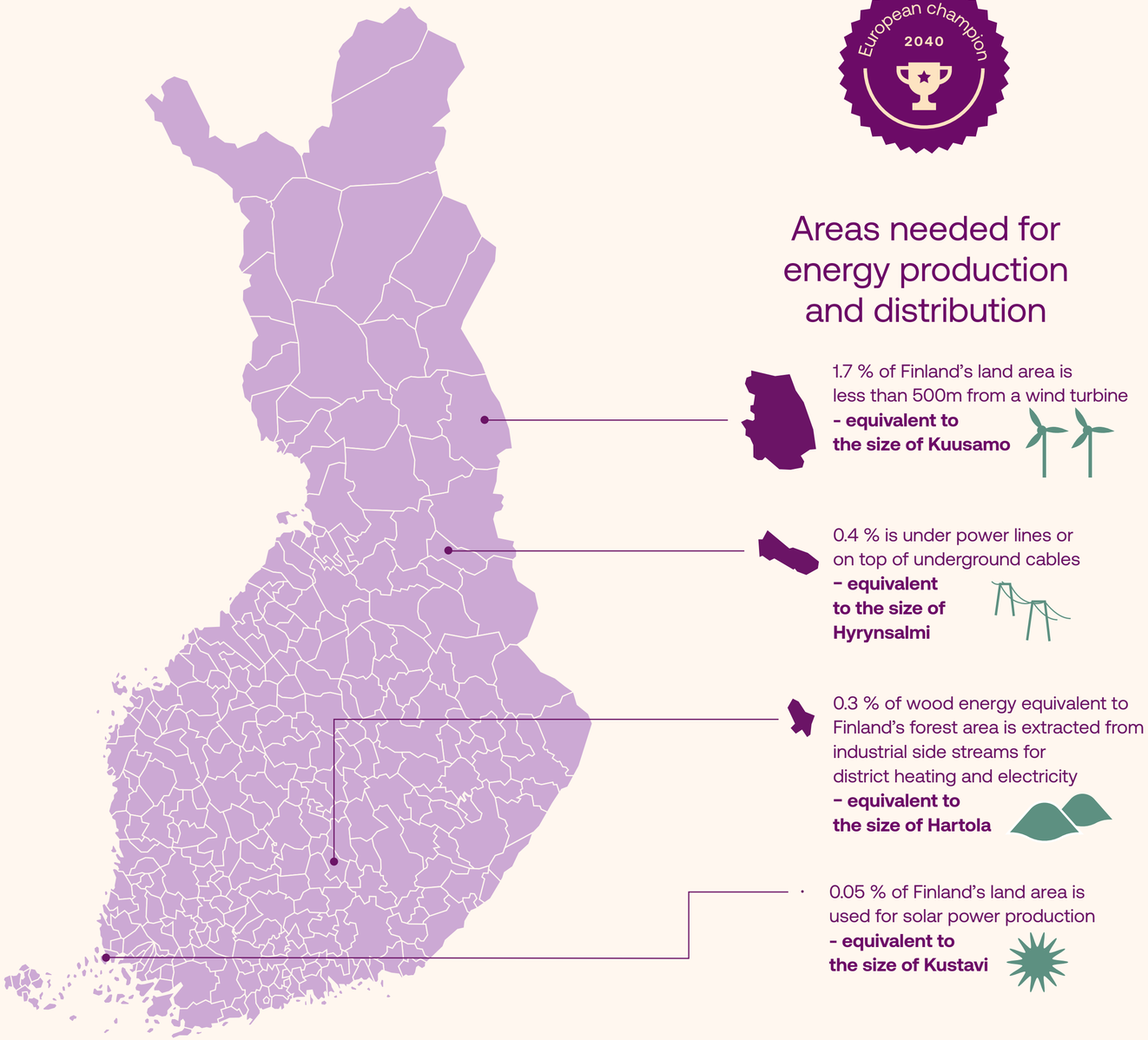
Nature-positive energy by 2040

Detaching from fossil fuels and their production chains is the greatest environmental action in the energy sector. Effectively combating climate change also helps prevent biodiversity loss.

Conserving nature values remains crucial, whether aiming to become the European champion or settling for the less ambitious scenario. The scale of the challenge and the approaches vary in part. In Finland with strong economic growth, the energy system is larger, but so are also our means to mitigate and compensate for environmental impacts.

Land use plays a pivotal role in determining environmental impacts. Larger wind turbines now require less total land area in nature, allowing avoidance of areas with the highest conservation value. The modest land footprint of increased nuclear power has reduced the land use impact of energy.

Diverse nature can thrive alongside energy networks and production by harmonising operations with local conditions and valuing environmental considerations.



The energy system of the European champion is sustainable and resilient

Finland is a self-sufficient participant in the European energy market, safeguarded by its diverse energy system. A competitive cost level is provided by wind power as the main source of electricity added with means to balance out its fluctuation. Economically strong Finland ensures security and maintains social cohesion.

Considerable efforts have been made to account for the environmental impacts of energy in planning and permitting. After minimizing the impacts, the remaining effects have been compensated. Migratory fish populations can thrive in most hydro-power water bodies thanks to various bypass solutions. Dams that have lost their purpose have been dismantled.

Electric grids have been constructed strategically to minimize land use needs and avoid habitat fragmentation. Diverse meadows, traditional biotopes, and wetlands flourish in the power line areas.

Due to the responsibility and benefits of energy production methods and networks, they have strong public support. This has been reflected in consistent regulation.

Even the persistent performer takes care of nature

In collaboration with the Nordic and Baltic countries, Finland is largely energy self-sufficient, and energy security has been ensured. Finland has not succeeded in competing for new electricity production and consumption investments, and customers are somewhat unequal in the energy market.

Environmental impacts of energy have been mitigated through voluntary and mandatory measures, partially limiting investments.

The minimum European targets for environmental conditions have been met. Companies have good examples of local sustainability projects. There is a lively debate about the acceptability of energy production and networks.

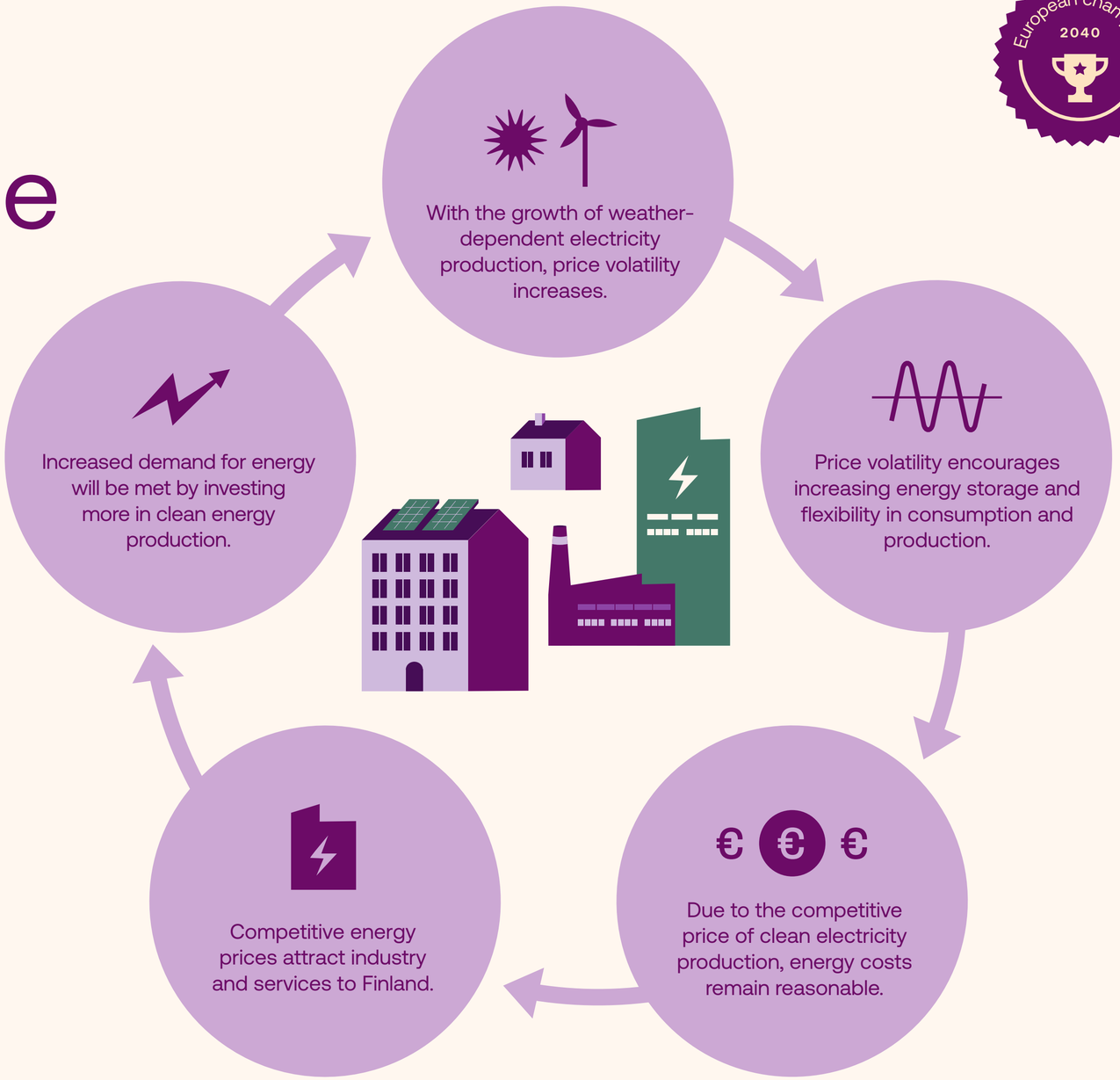
Forest biofuels for district heating and electricity production are sourced from industrial by-products, and their use has decreased. The industry follows forest management practices that consider biodiversity to protect valuable areas. Drainage has been reduced, the amount of deadwood has increased, the age structure of forests is more diverse, and the impact of logging operations is less significant than before.

Customer benefits from a virtuous circle

The energy transition is not free, but failing to make it would be immeasurably costly. Successful Finland has attracted entirely new energy users, who are bearing their share of the costs of generation and grid investments. A strong economy enables the welfare state to provide services for the less privileged.

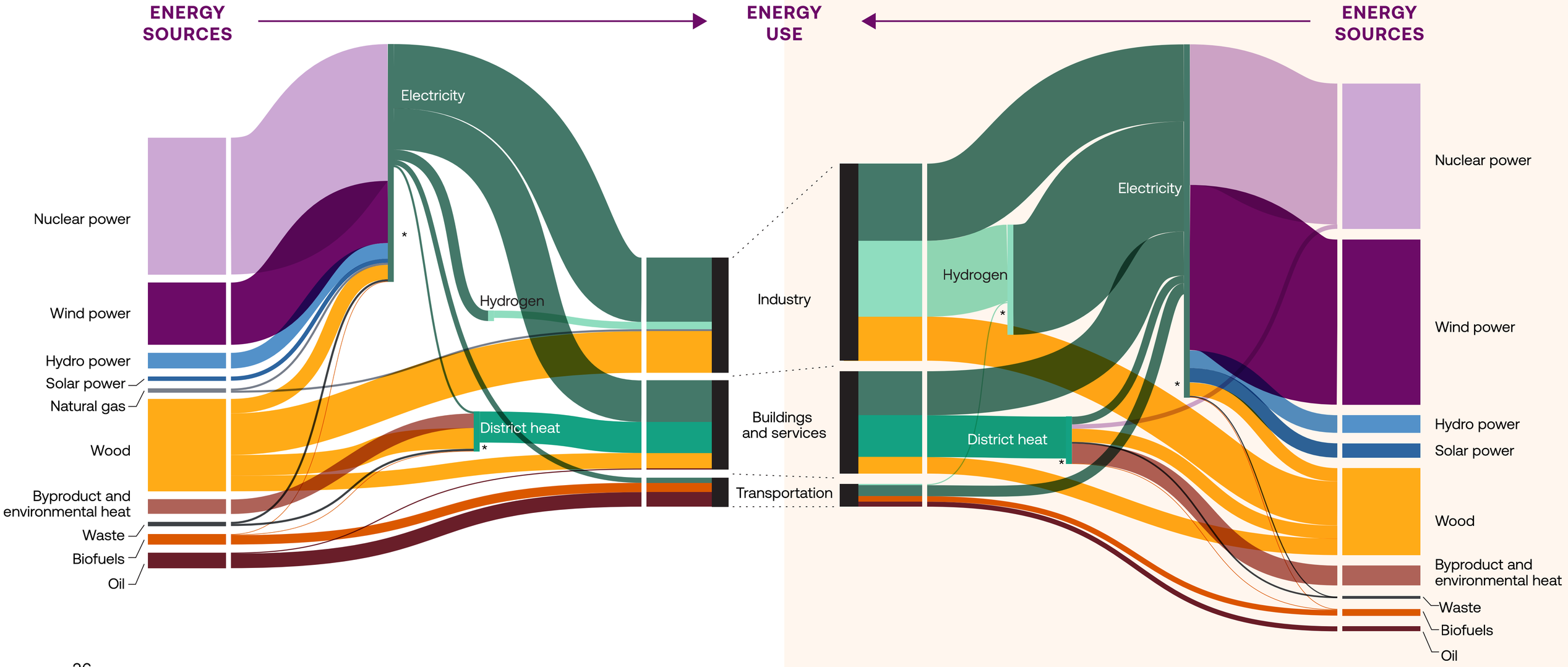
The industries actively participate in balancing supply and demand. Customers can take advantage of price fluctuations through different types of contracts, their own energy production, storage, and automated consumption control. Additionally, households and businesses can choose suitable ways to protect themselves from price fluctuation risks. Energy companies act as partners for customers in these efforts.

In the persistent performer's Finland, new investments in energy-intensive industries have not been attracted, resulting in less need for electricity production, flexibility, and storage.



Summary:
Energy system 2040

Energy production and consumption in Finland 2040



*=production losses

Summary: a bright energy future ahead

The energy sector calls on everyone to make Finland the European champion in energy transition. The task is not Mission: Impossible. The opportunities are much greater than the obstacles on the path to a bright future vision.

Finland must aim for more than just meeting its climate obligations in the energy transition. Clean energy can become a strong growth factor. Growth comes from investing even more significantly than in past years. The growth of clean energy-related industries and business activities has significant employment effects, especially in export industries, and helps finance the welfare state expenditures. While most of the significant growth in electricity production comes from wind power, other forms of production are also needed.

Electrification, the hydrogen economy, and the flexibility brought by district heating networks form a competitive and reliable whole.

Building electricity transmission and distribution grids, as well as hydrogen networks, is essential for growth, as they help balance new production and consumption. It is crucial to implement all factors that balance weather-dependent production and adapt to new operational methods.

With strong growth, there is also greater responsibility and capability to find new ways to care for biodiversity. A new, more environmentally friendly energy system can fit well in Finland. It is important that the prosperity it brings is distributed throughout the country.

Energy markets guide the development of the energy system to meet customer needs. Customers, with their new alternatives and services, are in a good position in the future energy world.

A bright energy future is achievable.

Steps for decision-making

How Finland becomes the European champion of energy transition

Five steps to European championship

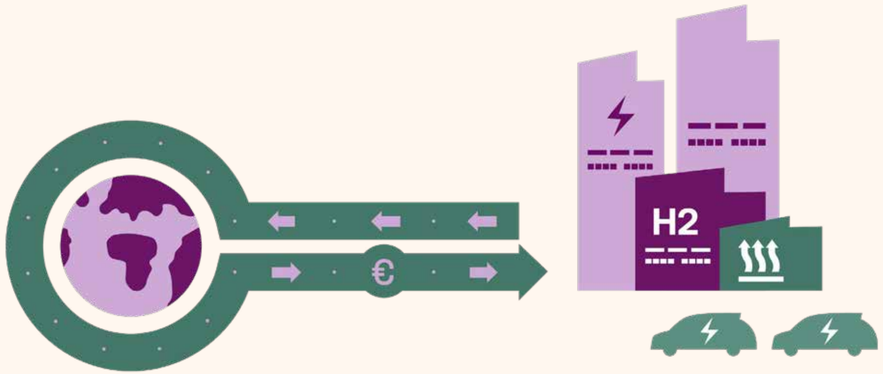
Finland constantly faces challenges in its economy, security, and environment, and the world of competition isn't always fair. We need to excel in creating a favorable investment environment and leveraging our strengths. We do not succeed in a competition of state aid schemes.

We have many strengths, such as favorable wind conditions, vast land area, high expertise, reliable networks, digitalization, stable ground, and a cool climate. We cannot succeed in the energy transition alone, so we invite all parties to join forces and capitalise on our strengths.

Let's create the policy conditions for achieving excellence.

Finland – the best location for energy-intensive industry

How can energy investments be made to generate sustainable growth and jobs in Finland?



CHALLENGE

Large quantities of substantial long-term investments are needed, but their profitability depends on the future direction of climate and energy policies and the choice of regulatory measures. Competitors attract investments with substantial state aid as well. Uncertainty slows down the energy transition and complicates investment financing.

SOLUTION

Strengthening the market demand for climate solutions by setting targets and main guidelines for climate governance for the period 2030–2050 in the EU and nationally.

- Continue to expand and strengthen emissions trading, thereby avoiding regulatory measures such as national taxes or subsidies that increase investment uncertainty.
- Develop energy taxation towards a fossil-free energy era in a long-term manner. The energy transition should not be slowed down by taxing fossil-free energy.
- Adhere to the long-term course of energy policy and assess the impacts of changes over the long term.
- Accelerate investments by setting a total timeframe for permits and developing a comprehensive cross-administrative electronic service system.

Diverse production ensures global competitiveness

How does Finland ensure competitiveness and energy security?

CHALLENGE

The energy system must be rapidly transformed to meet climate targets and remain competitive in a tough global market. Throughout this transformation, the system needs to remain reliable and affordable.

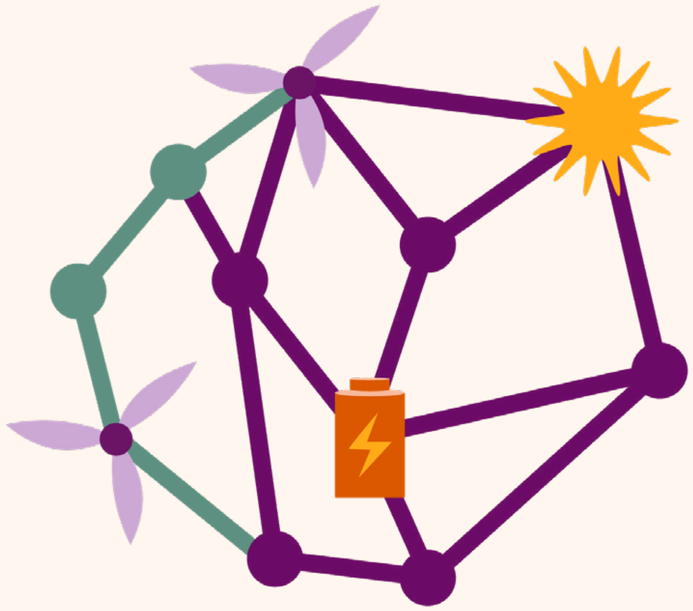
SOLUTION

Ensuring that Finland maintains a diverse energy portfolio by safeguarding the operating conditions for all production methods that provide us with competitive advantages and energy security. Guide the selection of production methods by limiting their negative impacts, such as emissions and environmental effects.

- Treat nuclear power on par with renewable energy and enable the construction of small modular reactors in urban areas.
- Recognise the importance of hydropower under the Water Framework Directive and maintain the Water Act as the governing legislation for water use.
- Secure the utilisation of forestry and industrial by-products for electricity and heat production.
- Accelerate the construction of onshore and offshore wind power across Finland by streamlining zoning procedures and addressing constraints related to radar systems.
- Create value for captured carbon dioxide in the European market. Accept carbon dioxide derived from sustainable bioenergy and waste as raw materials for the production of synthetic fuels.

Integrated energy networks enable the energy transition and growth in well-being

How Finland achieves its carbon neutrality goals and growth cost-effectively?



CHALLENGE

The energy system is diversifying, requiring integration of new production, consumption, flexibility, and storage solutions. Significant opportunities arise from the growth in variable electricity production, hydrogen production, and waste heat utilisation, all of which require substantial energy transmission.

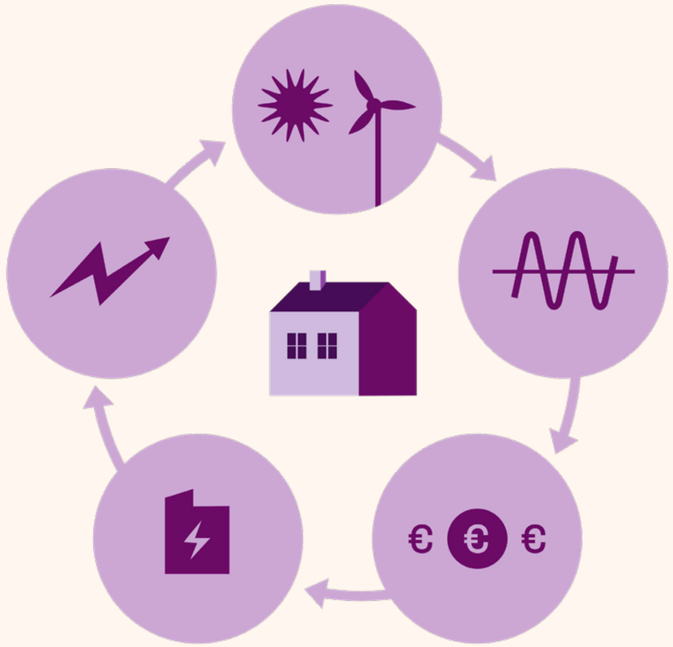
SOLUTION

Provide an enabling environment for the energy grids, that promotes sustainability, innovation, and market flexibility. Strengthen and proactively build new electricity, gas and heat networks through a long-term regulatory framework to anticipate customer needs and take into account the decades ahead.

- Streamline procedures for grid siting and permitting.
- Ensure efficient and equitable construction of energy grids from the perspective of customers and operators.
- Develop a national strategy for clean gases (biogas, synthetic methane, and hydrogen) to strengthen gas grids as part of the future energy market and sector integration.
- Provide energy grids with the capabilities to serve as platforms for various energy forms, technologies, services, and sector integration.

Customer benefits are secured with fair market regulations

How do consumers and business customers benefit from a new energy system?



CHALLENGE

Customer needs and opportunities vary. Customers should be able to participate in energy markets and protect themselves from risks. Responsible development of the energy system requires consideration of social and economic impacts. Bringing customer-generated flexibility to the market benefits everyone.

SOLUTION

Legislation is created to facilitate the supply of advanced energy products and services. Energy market rules are further developed towards openness, efficiency, flexibility, fairness, and clarity. Differences in electricity, heat, and gas markets are acknowledged.

- Ensure the cost-effective integration of flexibility across energy system components (electricity, heat, gas).
- Create a level playing field for district heating and on-site heating solutions. Use company-specific district heating emission scenarios in calculating emission factors for buildings. Streamline the use of waste heat through planning and permitting.
- Enable the offering of various pricing models to customers without unnecessarily increasing regulatory risks.
- Remove barriers to electrification and the adoption of other clean energy technologies, and support research and development of new energy technologies.

The energy sector needs its changemakers

How can the job opportunities of the energy transition and the supply of skilled labor be matched?

CHALLENGE

The energy transition requires top experts and continuous renewal of skills. Both experienced professionals and new talent are needed to develop and create new solutions. Energy companies employ significant number of people, but the value chains in the sector can employ three times as many. Securing future top talent is essential for companies to succeed and enable this extensive employment.

SOLUTION

Ensure financial investments in skills development. Seize job market potential of new tasks in solving the climate crisis. Ensure the renewal of skills at all levels of education.

- Improve proficiency in natural sciences and mathematics starting from primary school. This is the foundation for future top expertise.
- Create and enable multidisciplinary skills and interdisciplinary approaches at all levels and fields of education.
- Secure that there are enough education and training positions available, and that they are regionally comprehensive, to have enough skilled technicians, product developers, digital experts, or nuclear physicists to meet the needs of the energy transition.

Background of the vision

The energy system vision 2040 was created through the collaboration of Finnish Energy (Energiateollisuus ry), its members, and stakeholders. The concept and communication consultancy was provided by the sustainable development agency Kaskas.

Finnish Energy gathered a current perspective on the development needs, direction, and challenges of the energy system. This utilised a wide range of domestic and European studies.

The perspective was divided into two scenarios, which were questioned, supplemented, and modified in stakeholder workshops held in November 2023. The first workshop focused on the overall picture, functionality, and development requirements of the energy system. The second workshop focused on defining the key sustainability challenges related to energy's climate, nature, security, and price issues, and finding solutions to these challenges.

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