

NERS 2019

Fortum's Approach to Low CO₂ Energy in Finland

Role of Nuclear, Renewables and New Solutions

Toni Salminen / Head of Simulation business / 6.11.2019

Agenda

1 Finnish Energy and Climate Strategy

2 Fortum Introduction and Strategy Overview

3 Fortum and Decarbonization

- Electricity and Heat
- New Innovations and solutions (Spring, Charge&Drive)
- NPP's (Loviisa, TVO, Fennovoima, SMR's)

4 Fortum Offering Abroad for Decarbonization

Finnish Energy and Climate Strategy

- National energy and climate strategy defined in 2016 with targets set to year 2030 and 2050
 - Reduction of greenhouse emissions by 39% by 2030 (compared to year 2005)
 - Reduction of greenhouse emissions by 80-95% by 2050
- Long term goal: carbon neutral society
 - The current Finnish government updated these goals to include **carbon neutrality by 2035**
- Finnish government is also currently working on an update to the nuclear legislation
 - **Renewing licensing** to better take into account **SMRs** in future



Finnish Energy and Climate Strategy

Some targeted actions

- With minor exceptions, Finland will phase out the use of coal for energy
 - This will primarily have an effect on heating sector
- The share of transport biofuels will be increased to 30 per cent
- The minimum aim is to have 250 000 electric and 50 000 gas-powered vehicles on the roads
- The flexibility of electricity demand and supply and, in general, system-level energy efficiency will be improved
- The domestic use of imported oil will be halved as planned.
- Technology neutral tendering processes will be organised in 2018–2020, on the basis of which aid will be granted to cost-effective new electricity production from renewable energy.

Fortum in Brief


Our core
Hydro and nuclear
Combined heat and
power production
Circular economy
Energy-related
products and expert
services

8,300
professionals
in the Nordics,
the Baltics,
Russia, Poland
and India

2/3 of our
power
production is
**hydro and
nuclear**

We are the largest
electricity retailer in
the Nordics and one of
the leading heat
producers globally.
We have
2.5 million
customers.

96% of our
electricity
production is CO₂
free in Europe,
57% in all
operations

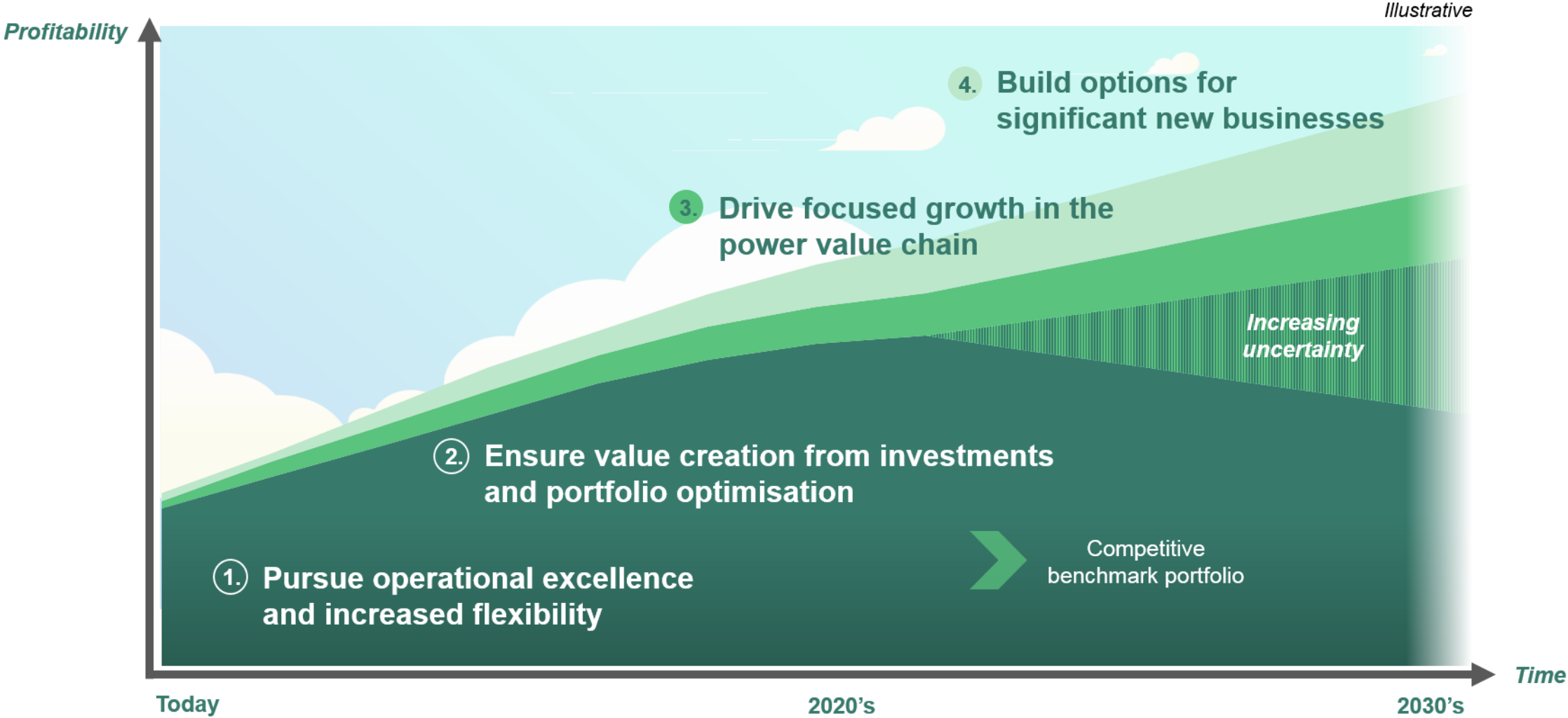


“The urgent need to respond to climate change will impact the whole society. Decarbonisation is needed in all sectors and clean electricity can be a significant enabler. Hence, we see the 2020’s becoming the decade of electricity.”

CEO Pekka Lundmark

Fortum's vision is even more valid today

– For a cleaner world





Fortum and Decarbonisation

The decades of electricity will affect several sectors – and Fortum is well positioned for decarbonisation

Global climate challenge (indicative)	Electricity demand (2018-2050)	Sector	Future solutions, examples	Fortum's current offering, examples
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		Transport	Electric vehicles, hydrogen/biofuels for heavy transport	E-mobility, pyrolysis
		Heating & cooling	Low-CO ₂ DH/CHP, heat pumps, hydrogen	Biofuel, waste-to-energy DH/CHP
		Industry	Electrified processes, hydrogen, resource efficiency, CCS	B2B solutions
		Other	Recycling, biomaterials (e.g. fractioning)	Plastic recycling

DH/CHP = District heating/combined heat and power
 CCS = Carbon capture and storage

Fortum and Decarbonization

Electricity

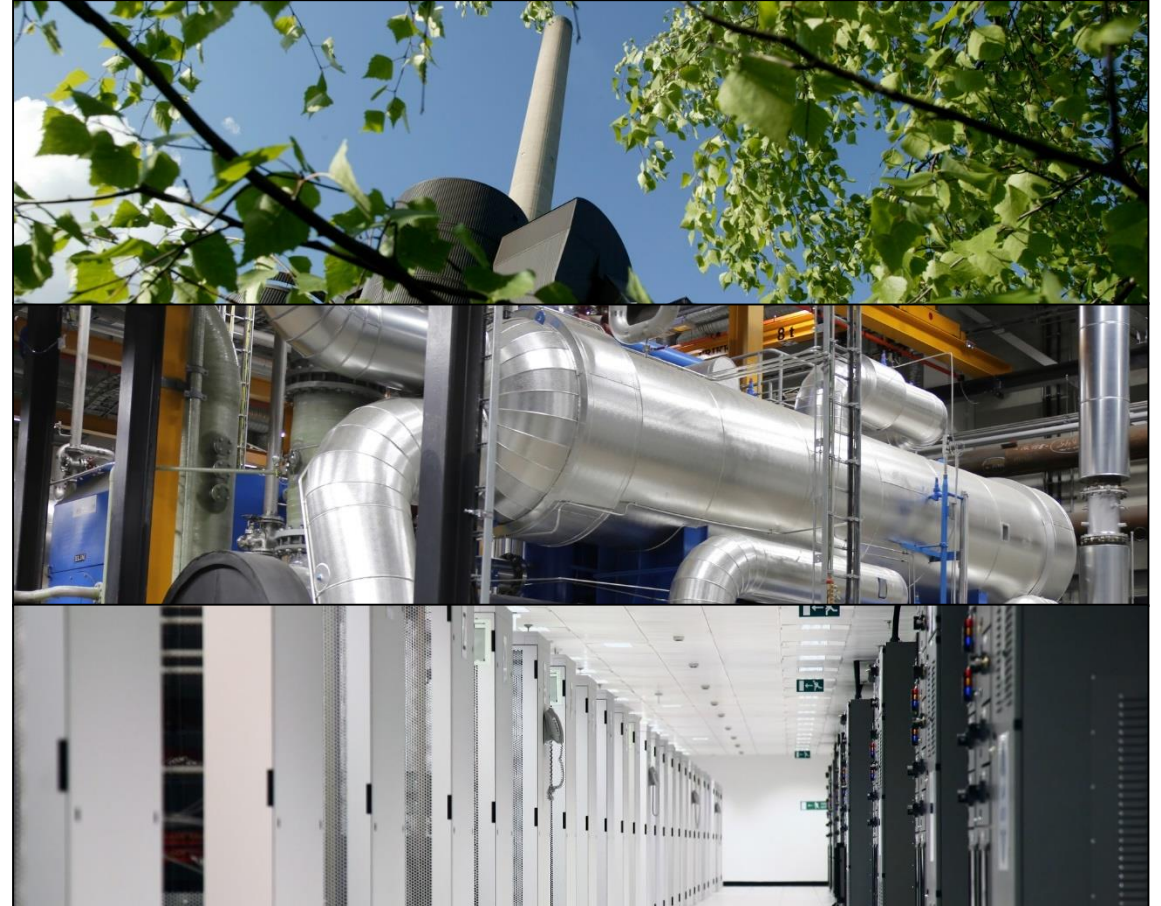
- Our electricity production in the Nordics is already primarily decarbonized through hydro and nuclear
- Technology neutral tendering processes will be organised in 2018–2020 for cost-effective new electricity production from renewable energy
 - Fortum’s 90-MW wind power project in Närpes, Finland approved for renewables scheme
 - Fortum’s target is to build a multi-gigawatt portfolio in solar and wind worldwide



Fortum and Decarbonization

Heating

- With minor exceptions, Finland will phase out the use of coal for energy by 2029
 - New biomass boilers, datacentre heat utilization, geothermal heat utilization to replace coal use
 - Long term vision is to build **a carbon neutral system focusing on non-combustion heating solutions**
 - In 2017 the City of Espoo and Fortum signed an agreement to make Espoo's district heating carbon-neutral in the 2020s



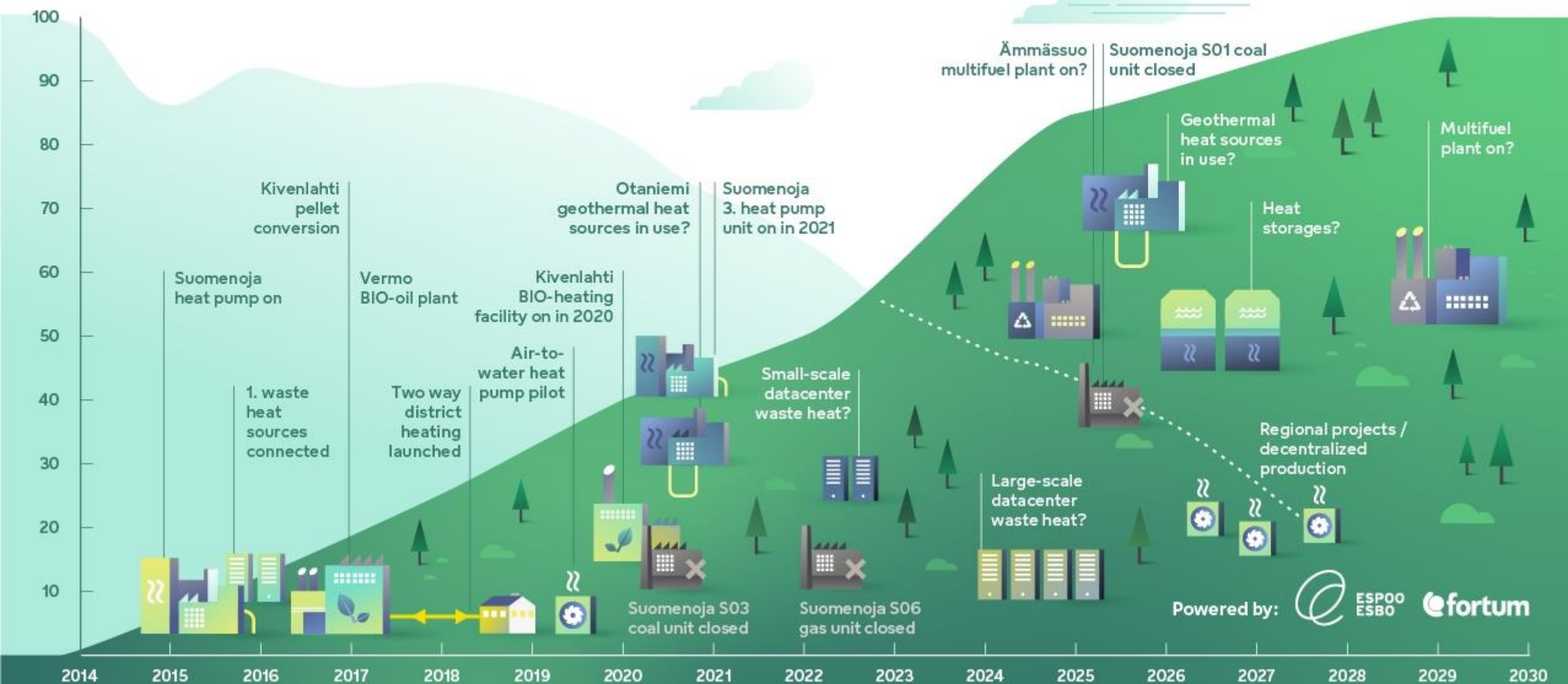
Espoo district heating transformation journey 2014–2029

Illustrative

■ % CO₂ emissions in relation to 2014 level

■ % share of carbon neutral production

Espoo
Clean
Heat



Fortum and Decarbonization

Smart Solutions

- The flexibility of electricity demand and supply and, in general, system-level energy efficiency will be improved
 - Virtual power plants – Spring
 - Smart living solutions – SmartLiving
- The domestic use of imported oil will be halved as planned.
 - Bio-oil production plant in Joensuu, Finland

Transportation

- Transport biofuels will be increased to 30 per cent
 - At the moment no transport fuel production in Finland, but Fortum's biorefinery project in India aims to convert bamboo into biofuel (BIO2EX)
- The minimum aim is to have 250 000 electric and 50 000 gas-powered vehicles on the roads
 - EV charging: Fortum Charge & Drive (Nordic countries)

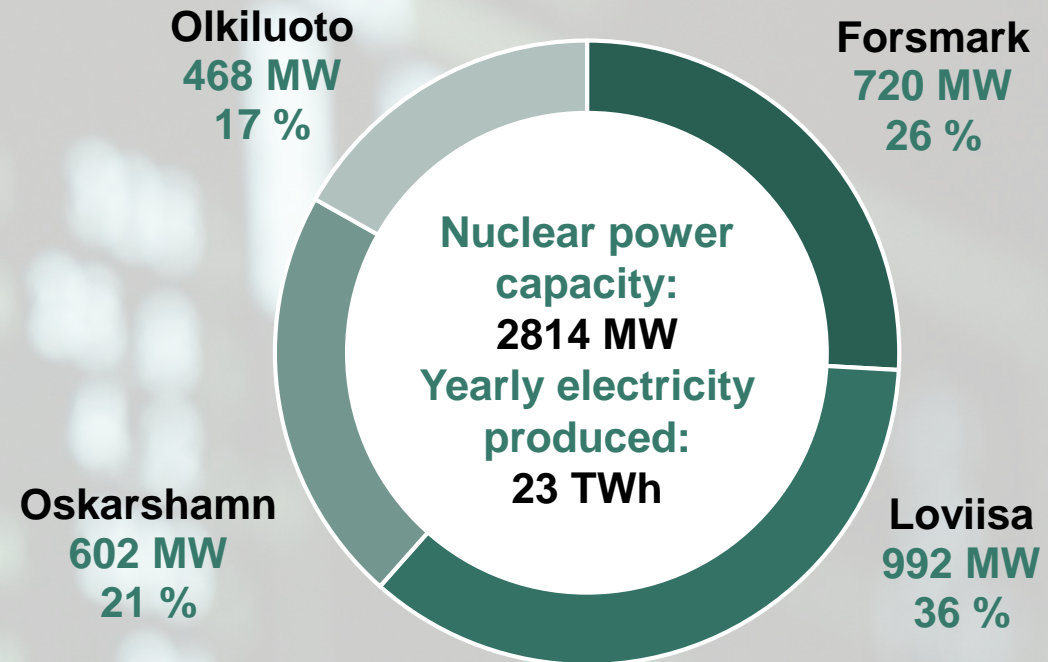
Nuclear Power Plays an Important Role in Our Energy Production

Nuclear power plays an important role in Fortum's energy production. As a **CO2-free and reliable base-load source**, nuclear power is needed to secure the supply of energy and to mitigate climate change.

Our nuclear power plant in Loviisa, Finland, is unique and exemplary. It has provided clean and reliable base production of energy for the last **40 years**.

Fortum is a Strong Nordic Nuclear Power Plant Owner and Operator

- Nuclear license holder of Loviisa NPP
- Shares in both of the Finnish newbuilds Olkiluoto 3 and Hanhikivi-1
- Nuclear power plant & waste management operator
- Nuclear service & technology provider
- Strong in-house nuclear know-how and expertise
 - Experience from several NPP technologies
 - The full lifecycle of a nuclear power plant



Loviisa NPP automation renewal successfully completed

Biggest, single project since the construction of Loviisa NPP

Improves safety and ensures the reliable operations of the NPP

Commissioned during outages in 2016 - 2018

Fortum:
Safety automation architecture ADLAS™

Fortum:
Validation of safety functions APROS™

Automation renewal completed on time and on budget

Main partner **RollsRoyce** (agreement in 2014)

R&R: design, licensing, installation and commissioning of safety systems

Fortum and NPP's in Finland

Support for New Builds

- Olkiluoto 3
 - Support in commissioning, development of spare part strategy, severe accident management and core calculations
 - Review of core testing program and writing of test instructions
 - Validation and verification of normal and emergency operating procedures
 - Engineering simulator (Apros®)
- Hanhikivi 1
 - Engineering support in safety engineering (ADLAS®), I&C design and safety analysis review
 - Design of Spent Fuel Interim Storage
 - Preliminary safety analyses with Apros®

SMR

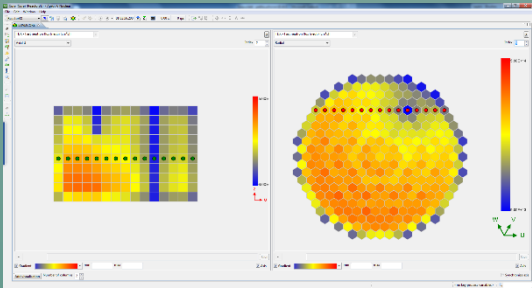
- Long-running R&D project on SMRs currently focusing especially on district heating and CHP possibilities
 - Work done on evaluating the licensing, safety and market potential of SMRs as well as simulating the new plant types.
- Working on a suite of business options for Fortum in SMRs
- Leveraging our existing nuclear expertise to better understand SMR ourselves and help others move forward with projects through consulting



Fortum offering for decarbonisation abroad

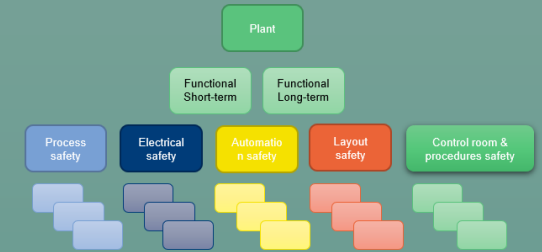
We offer a wide range of nuclear services

Our expertise is based on nuclear experience since the 1960's

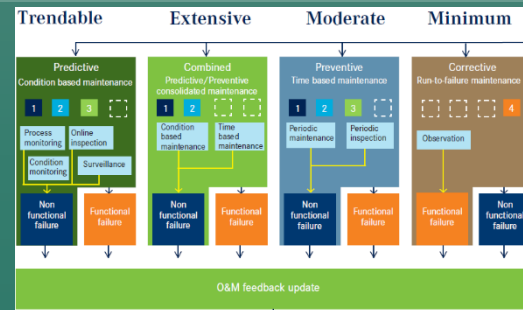
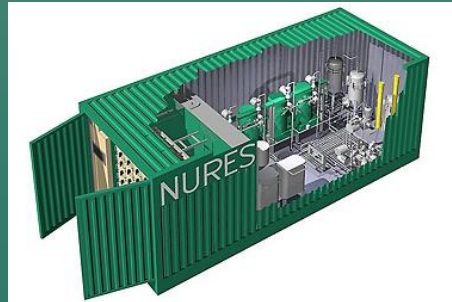


Highly efficient software Apros® for simulating all processes of a power plant and testing I&C; different simulators.

Method of system engineering ADLAS® for licensing and safety systems design. Consulting for safety upgrade, power upgrade, lifetime extensions, new-build projects.



One of the World's most effective solutions for purification of radioactive liquids NURES®



Methods ReMaint® for optimization of maintenance activities and execution of annual outages to increase nuclear plants availability and safety.



Solutions for interim storage and final disposal of nuclear waste. Decommissioning services.

Applications of virtual reality, augmented reality, 360 video for training and more efficient maintenance and projects execution.



Get ready for tomorrow's energy production

Fortum eNext helps traditional power plants improve their operations and reduce emissions. Through that, energy companies can meet the tightening environmental regulations and maintain shareholder value.

Fortum eNext's solutions revise plant processes and make them fit for the coming years.

Fortum
eNext

Fortum
eNext
Smart Operations

- Comprehensive O&M services, appropriate digital tools and plant consultancy.
- Our task is to help you run your plant with the industry's best knowledge and technology

Fortum
eNext
Environmental Performance

- Solutions to make your plant more efficient.
- We help you to reduce emissions to meet new regulations. Our expertise allows you to increase profitability without compromising your environmental commitments.

Fortum
eNext
Turbine and Generator Services

- Turbine and Generator Services with decades of experience in plant perfection.
- We look forward to helping with your rotating main equipment management from planning to optimized maintenance, modernizations, and repairs.

Charge & Drive

Full Service Electric Vehicle Charging Operator

Build on extensive experience in Norway, Sweden and Finland. R&D since the 80s. Commercialized as Charge & Drive in 2011.

Services applicable for any charging network and service provider. Runs business with any IP-connected EV-chargers.

- **Charge & Drive – the cloud-based business system**
Customer experience, infrastructure and business management
- **Nordic Public Charging Network**
Leading charging operator in the Nordics
- **Turn-key charging solutions for B2B and B2G**
From planning and hardware to services and a mobile web apps.



Trusted and used by brands such as





Thank You

Further information on our complete offering for decarbonisation at [fortum.com](https://www.fortum.com)

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@FortumNuclear

