

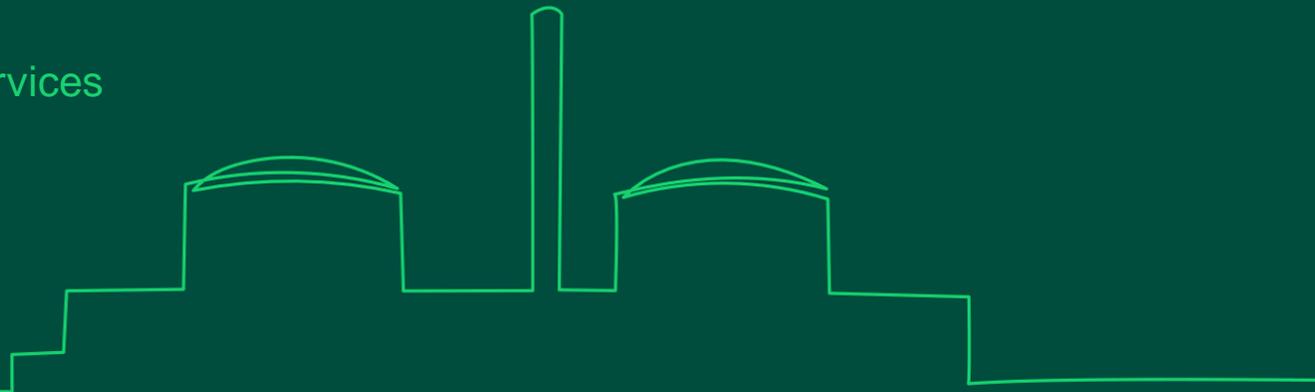
Fortum's competences gained through experience in recent nuclear newbuild projects

15th NE•RS 2023 Annual Conference on Nuclear Power

Presented by Timo Vuorinen, Senior Project Manager

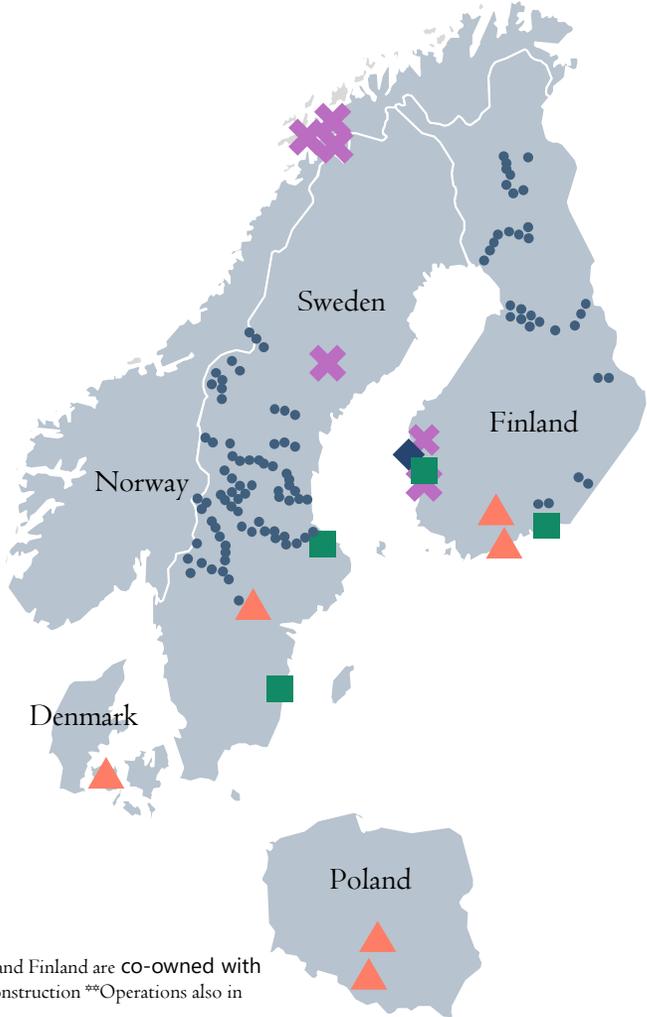
Author Jani Ikonen, Director, Newbuild and Operating Services

Prague, October 19th, 2023



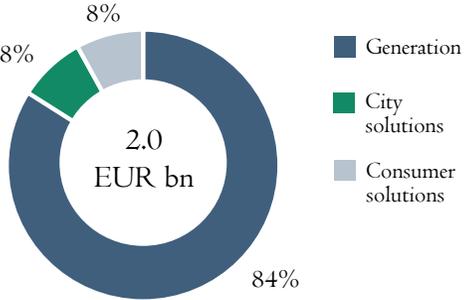
We are one of the cleanest power generators in Europe – with strong Nordic focus

- Hydro
- Nuclear
- ▲ CHP
- ◆ Coal condensing
- ✕ Wind*
- Solar**

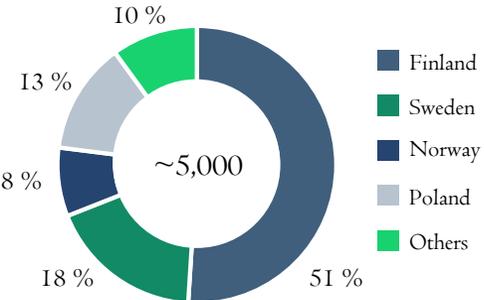


*The wind farms in Norway, Sweden and Finland are co-owned with a partner, Pjelax wind farm under construction **Operations also in India

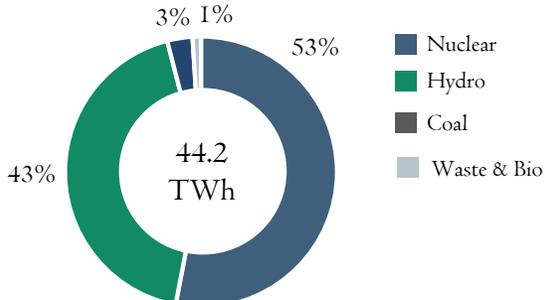
Comparable EBITDA*



Personnel*



Power generation*



Specific emissions*



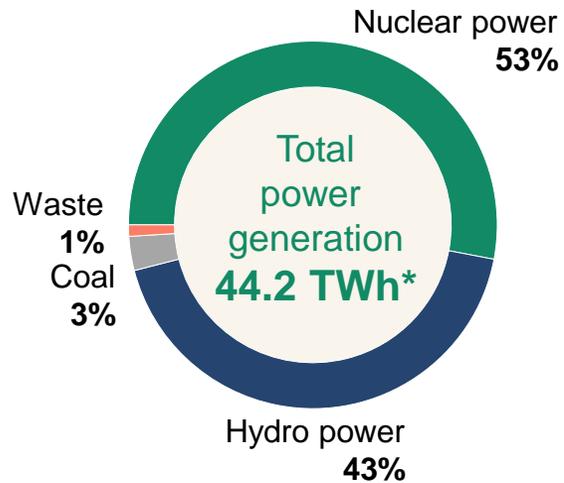
*All 2022 figures for continuing operations excluding Russia
Fortum's specific CO₂ emissions from total energy production including Russia 184 gCO₂/kWh

Fortum is a strong Nordic nuclear operator

Key figures 2022

Nuclear generation **23.4 TWh**
 Total nuclear capacity **3.2 GW**
 Share of Fortum's total power generation **53%**
 Nuclear professionals **~750**

Fortum's power generation in 2022



We have 40+ years' track record of safe nuclear operations and we are forerunners in responsible waste management

Fully-owned nuclear power plant in Loviisa, Finland

Co-owned nuclear power plants in Finland and Sweden

Spent fuel and waste mgmt (Posiva (FIN) and SKB (SWE))

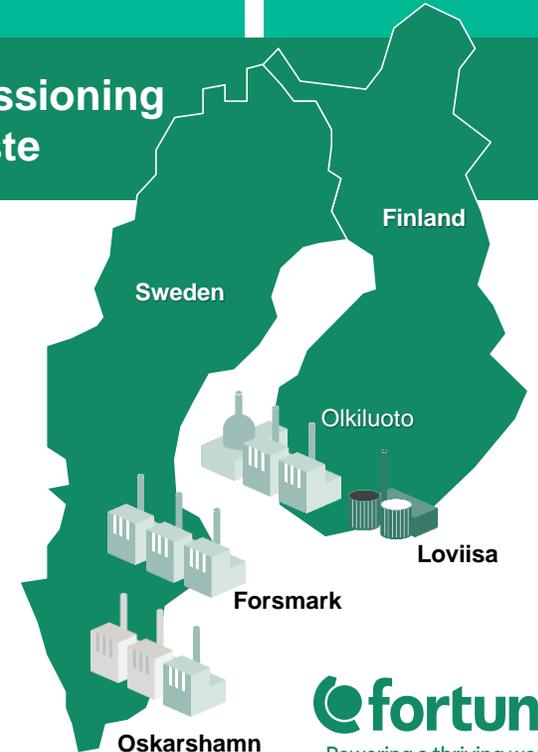
We develop new, innovative products and services

Nuclear newbuild feasibility study Finland and Sweden

Expertise from new builds to decommissioning and final disposal of nuclear waste

Unit	Mwe (net)	Fortum Share %
Loviisa 1 Loviisa 2	507 507	100 100
Olkiluoto 1 Olkiluoto 2 Olkiluoto 3	890 890 1600	26.6 26.6 25
Forsmark 1 Forsmark 2 Forsmark 3	988 1120 1172	23.4 23.4 20.1
Oskarshamn 3 Oskarshamn 1 Oskarshamn 2	1400 decom decom	43.4 43.4 43.4

- Units fully owned by Fortum
- Co-owned units
- Units under decommissioning



We support our customers throughout the entire nuclear power plant lifecycle

Strong in-house nuclear engineering department



Nuclear operator experience based proven solutions



Projects delivered to global customer base



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Proactive influencing and co-operation on international nuclear forums



Newbuild, licensing, commissioning

- Licensing and safety design capabilities, eg. ADLAS® concept
- Owner's engineering services for newbuild
- Plant design
- Small modular reactor consulting

Operating and maintenance

- Operational support, e.g. trainings
- Maintenance and outage optimization
- Procedures
- Owner's engineering for upgrade and plant modernization projects, e.g. automation renewal and human factors engineering design

Plant safety and process simulations

- Deterministic Safety Analysis with Apros®
- Severe Accident Management guidelines and analysis
- Probabilistic Risk Assessment
- Radiation safety analyses

Plant modernisation, lifetime management

- Apros® dynamic simulation to define technical requirements for new equipment
- Process and I&C design verification and testing
- Virtual commissioning

Waste management, decommissioning

- NURES® radioactive liquid purification
- Nuclear waste treatment, storage and disposal
- Expertise in final disposal of radioactive waste
- Extensive nuclear decommissioning services

Fortum's Offering for Nuclear Newbuilds



Fortum's Offering for Nuclear Newbuilds

Site Selection / Characterization

- Environmental studies (desktop and field)
- Environmental Impact Assessment
- Cooling water modeling
- Radiation dispersion analyses and modeling
- Radiation dose calculations
- Analysing the effects of site and environmental conditions on plant design
- Specification of site-related design basis, including seismic hazard evaluation
- Emergency planning

Fortum's Offering for Nuclear Newbuilds

Program planning & Feasibility studies

- Overall program plan development
- Organizational development
- Building up processes for licensing, construction and commissioning as well as operation
- Plant vendor independent feasibility studies and technology assessments
 - Both SMRs and large NPP units
- Close collaboration with the customer and owner-operator knowledge transfer

Fortum's Offering for Nuclear Newbuilds

Prepare Bid / Contract specifications

- Compiling RFQ and contract specifications for newbuild projects internationally
- Deep understanding of EPC contract specifications taking into account the lifetime costs of the plant, including operation and maintenance
- Experience in conducting dialogue with plant vendors, minimising the risks related to technical requirements
- Familiar with most of the large reactor and SMR technology alternatives, but neutral towards the alternatives

Fortum's Offering for Nuclear Newbuilds

Contract negotiation

- Experience in contract negotiations with several plant vendors in various contexts
- Ability to utilize lessons learned from previous contract negotiations
- Thorough understanding of newbuild projects, including first-of-a-kind technologies
- Ability to support with decade long owner-operator experience in situations requiring understanding of nuclear technology and licensing
- Understanding of technical, commercial and legal requirements over the plant life-cycle



Fortum's Offering for Nuclear Newbuilds

Design Phase / Apply for Construction License

- Supporting the customer in setting up a separate design project prior to final investment decision
- Identification of risks related to licensing and design changes
 - Specific understanding of first-of-a-kind and first-in-a-country related risks
- Support in licensing planning and evaluation of technical and licensing documentation
- Planning and implementation of risk mitigating actions

Fortum's Offering for Nuclear Newbuilds

Preparation for operation

- Developing maintenance strategy and programs
- Fuel procurement support
- Safeguards support
- Outage optimisation
- Developing and implementing operating procedures
- Supplier, spare part and storage management
- Training
- Commissioning planning
- Decommissioning planning

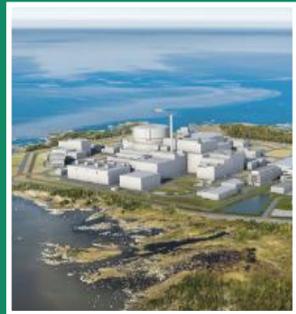
Fortum's Offering for Nuclear Newbuilds

Construction oversight / Commissioning

- Review of design and as-built documentation
- Quality assurance and quality control during construction
- Radiation protection on site
- Review and compilation of commissioning plans and test programs
- Support in commissioning activities and test runs
- Guarantee tests
- Validation of operation procedures



Selected Examples of experience in Newbuild Nuclear



Hanhikivi 1*

- Technical advisor for I&C design
- Safety engineering documentation (ADLAS®)
- Engineering simulator with APROS®
- Review of various design documentation
- Design of Spent Fuel Interim Storage
- Development of Preliminary Safety analysis Report (PSAR) in construction license application phase



Olkiluoto 3

- Review of core testing program and test instructions
- Validation and verification of normal and emergency operating procedures
- Engineering simulator (Apros®)
- Development of spare part strategy
- Severe Accident Management
- Core calculations
- Support in commissioning



Olkiluoto 4*

- Feasibility studies
- Development of technical requirements
- Development of bid invitation documents
- Bid evaluation
- Contract negotiations



Loviisa 3*

- Environmental impact assessment
- Application for decision-in-principle
- Development of design project agreement
- Preparation for purchasing and implementation model
- Cooling water studies and planning
- Conceptual evaluations of nuclear district heat alternatives
- Development of information and data management systems

Finland



* Hanhikivi 1 terminated 2022

* Olkiluoto 4 cancelled 2014

* Loviisa 3 cancelled 2010

Thank you!



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More information:

<https://www.fortum.com/services/nuclear/newbuild/nuclear-newbuild-projects>