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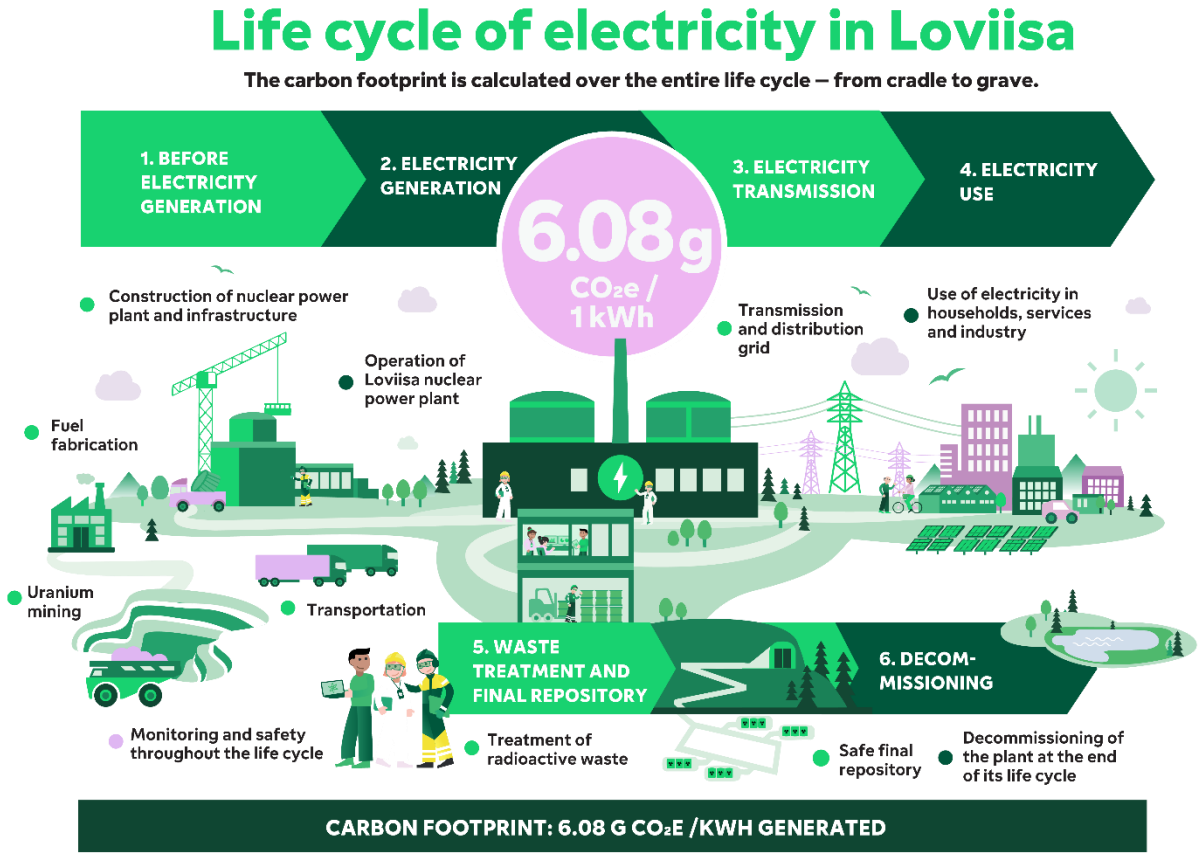
LOVIISA NUCLEAR POWER PLANT LIFECYCLE ASSESSMENT (LCA): SUMMARY OF FINDINGS

In this life cycle assessment (LCA) study the environmental impacts of nuclear power produced in 2024 at Loviisa nuclear power plant are assessed. The nuclear power plant operates two units. Both units are pressurised water reactors of 507 MW net electrical output, which were connected to the grid in 1977 and 1980, respectively. Loviisa nuclear power plant has been granted a lifetime extension until the end of 2050.

The carbon footprint (i.e. climate change impact) and other environmental impacts are calculated per 1 kWh net of electricity delivered to the customer. Thus, the whole life cycle from cradle-to-customer (i.e. cradle-to-grave for energy products) is considered. **The system boundary of nuclear energy produced considers all relevant upstream, core and downstream operations**, including raw material extraction and processing, transportation to the nuclear power plant, energy generation and supporting operations at the nuclear power plant, waste treatment, including Posiva nuclear fuel waste repository, and transmission of electricity to end user. The life cycle of infrastructure is also considered in each stage.

The cradle-to-grave carbon footprint of 1 kWh delivered to the customer, produced at Loviisa power plant, is 6.08 g CO_2e.



The most important life cycle stages for the climate change impact of nuclear power from Loviisa are

1) nuclear fuel supply (45.1 % contribution),
2) construction and decommissioning of Loviisa power plant (21.2 %),
3) purchased energy, chemicals and fuels (15.0 %), and
4) downstream infrastructure for electricity transmission; construction and decommissioning of the power grid (7.4 %), which contains large uncertainties.

These four stages together contribute 88.7 % to the carbon footprint result.

In summary, **across all studied environmental impact categories, the most significant life cycle stages** by relative contribution for 1 kWh of electricity from Loviisa are, on average,

1) nuclear fuel supply chain (54.5 %),
2) purchased energy, chemicals, and fuels to Loviisa (11.4 %),
3) downstream infrastructure for electricity transmission; construction and decommissioning of the power grid (10.0 %),
4) radioactive waste treatment and radioactive emissions from Loviisa (7.3 %), and
5) construction and decommissioning of Loviisa power plant (6.6 %).

These five stages together contribute, on average, 89.9 % to the studied impacts.

The cut-off rule of 1 % of environmental impacts is applied to each separate life cycle stage in the studied product system. For upstream operations, several insignificant input chemicals in the fuel supply chain and to Loviisa are excluded, and in core operations the emissions of few radioactive species from Loviisa and few small waste flows from and chemical inputs to Posiva are excluded. Infrastructure related to any other input than nuclear fuel to Loviisa is excluded, unless included in the used datasets. For core infrastructure, insignificant flows of construction materials without readily available modelling data were excluded. Additionally, already in the data collection stage, only the main machines and equipment with noticeable masses at the Loviisa plant are included. Based on the estimated threshold of impacts, cut-offs do not exceed 1 % by overall environmental impacts.

The study has been conducted in line with the following standards and applying relevant parts of the applied product category rules (PCR): LCA standards ISO 14040:2006 and 14044:2006, Carbon footprint standard ISO 14067:2018, and PCR 2007:08 Electricity, steam and hot/cold water generation and distribution (version 5.0.1) of EPD International AB (2024) (referred to as the “PCR”).

The Commissioner of the study is Fortum Oyj and the Practitioner is Etteplan Finland Oy. A critical review was performed at the end of the study by an independent third party: Aarni Ojanperä and Tiina Pajula from AFRY Management Consulting Oy, and Laura Sariola from AFRY Finland Oy.