



**Statkraft**  
PURE ENERGY



# FLOKKE

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# Welcome to TOKKE

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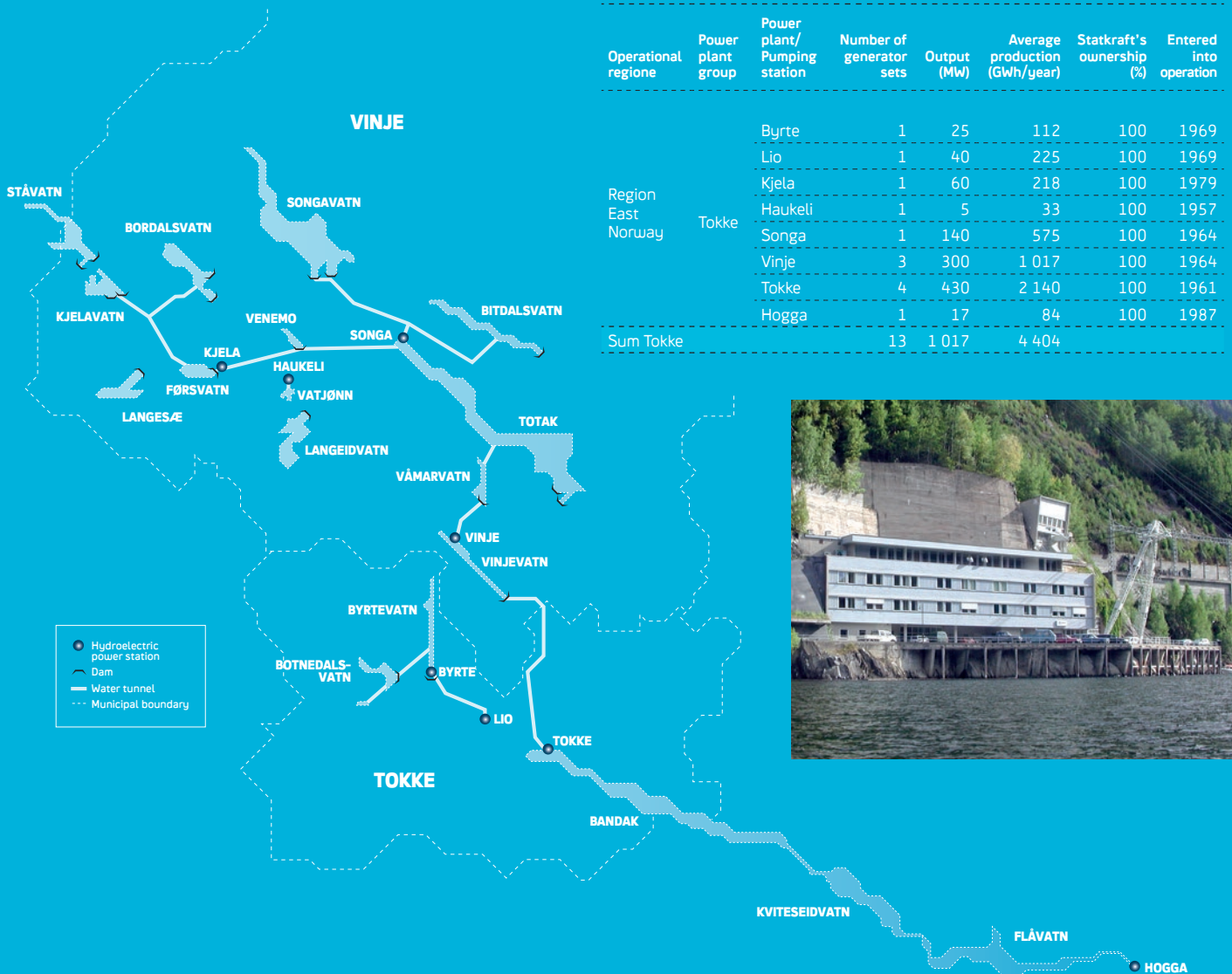
Tokke power plant is part of the Tokke municipality, at the top of Bandak canal. With the Hardangervidda and Tokke/Vinje river systems as its sources, this hydroelectric plant is ideally situated for energy production. The nominal annual production for the entire Tokke regulation area is 4.4 TWh, corresponding to the annual consumption of some 200 000 households.

Songa and Totak are the main reservoirs for Tokke power plant, with a combined volume of 897 million m<sup>3</sup> of water. The power station itself is located 250 metres within the mountain, where penstocks and pressure shafts carry the water from the reservoirs down to the plant's four turbines. Gross head is 400 metres.

Hydropower is clean and renewable – a real perpetual motion machine. The sun evaporates water, which falls as rain that new energy can be produced from. Hydroelectric plants with reservoirs, as in Tokke, can regulate their output. This means that we can produce power when it is needed and when other renewable sources, such as wind, sun and tidal power, are not available.

Regulation of the Tokke-Vinje water system, was at one time, Norway's largest hydropower project, and now has resulted in eight power stations between Songa in Vinje municipality and Hogga in Nome municipality.

Tokke power plant was opened in 1961, and since then has supplied Norway and Europe with clean, renewable energy.



### TOKKE POWER PLANT

- Built into the rock (rock cavern)
- Four generators
- Average annual production: 2.1 TWh
- Total length of waterways into Tokke power plant (tunnels): approximately 17 km
- Total reservoir volume in the whole of the Tokke regulation area: approx. 1 909 million m<sup>3</sup> of water.

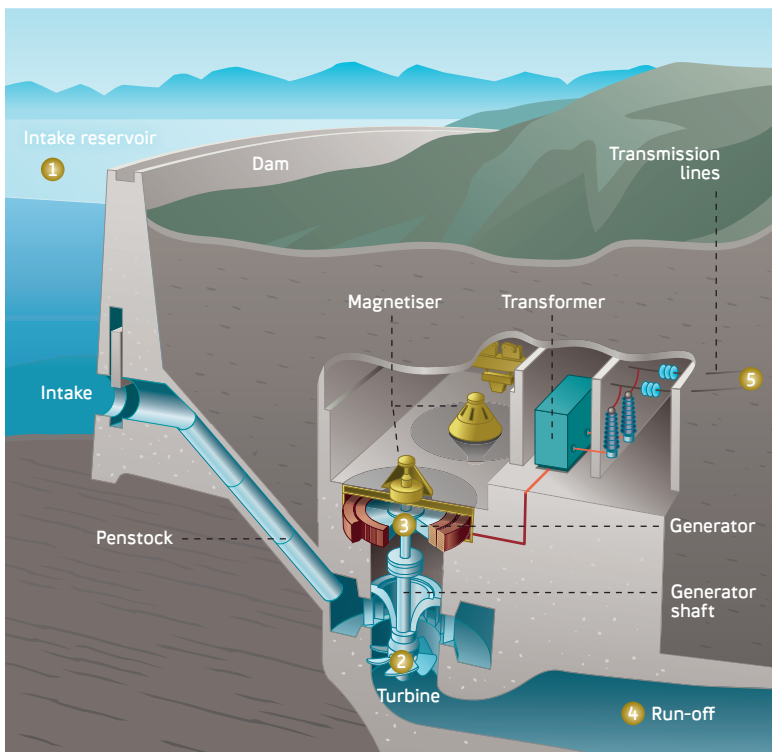
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# FROM WATER TO ELECTRICITY

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Water from melting snow and rain collects in the reservoirs up in the mountains. The water is released from the reservoirs into tunnels and shafts to the power station and the turbines. The water rotates the turbine runner and pulls with it the generator mounted on the same driveshaft. The kinetic energy is transformed into electric energy in the generator. The generators have a voltage 17 kV (kilo volts). To minimise possible losses during transmission from the power plant to the consumer centres, the voltage is converted to 300 kV. The electricity is then carried over the national grid to wherever it is needed.



1. The kinetic energy from the water level is the raw material of the energy production.
2. In the power station, the water is routed into a turbine runner under high pressure.
3. A generator transforms the kinetic energy to electricity.
4. The water is lead through an outlet tunnel down to a reservoir or into the river.
5. Transmission lines transport the energy to where it is needed.

## HISTORY

The power plants in the Tokke river systems use the flow of watercourses primarily in Tokke and Vinje municipalities. Including Hogga power station, the plants have a total catchment area of 3 104 km<sup>2</sup> and an average annual inflow of about 3.3 billion m<sup>3</sup>.

The Tokke regulation area includes the reservoirs at Songa, Totak, Ståvatn, Kjelavatn, Førsvatn, Langesæ, Bordalsvatn, Byrtevatn, Langeidvatn, Våmarvatn, Bitdalsvatn, Venemovatn, Vinjevatn, Hyljelihyl, Vatjern and Bandak. Together, they can hold up to 1 909 million m<sup>3</sup> of water. This volume of water yields a total annual production of 4 404 GWh (million kilowatt hours) from the eight power stations along the watercourses.

The reservoirs and power stations are connected by around 108 km of tunnels and 32 dams. At one time, one of the stone-filled dams at the Songa reservoir was the largest in Norway, at 40 metres in height and around a kilometre in length.

For the construction and maintenance of the installations in the catchment area, about 140 kilometres of access road were built, and these provide both local residents and tourists with good access to the countryside. The power plants contributed to the laying and reinforcement of 70 kilometres of public highways.

The Tokke regulation includes lakes of varying size and importance. Each year, many thousands of hatchlings are released to improve fish production for local and visiting anglers. These releases are regulated by the County Governor, on a needs-basis.

Due to their large falls and regulation potential, the Tokke and Vinje river systems are considered one of the best sources of energy in South Norway. Through the Norwegian Water Resources and Energy Directorate, the Government owns the fall rights to the river systems. The development decision was made by Parliament on 23 April 1956, and the final stage of the construction was Hogga power station, which came onstream in 1987, a total of 31 years of development.

Water flow and operation of all eight power stations are controlled remotely from the Dalen operations centre.



## LOCAL HISTORY

### 1918 -1957

**1918:** Parliament provides the initial funding for the purchase of fall rights in the lower section of the Tokke river system.

**1956:** On 23 April, Parliament authorises development to exploit the fall rights. Financing is arranged through two loans from the World Bank of NOK 350 million and the sale of letters of credit totalling NOK 240 million to the county and municipalities, which then acquire the rights to power from the stations.

**1957:** Following completion of the preparatory works, including the building of Haukeli power station, construction gets fully underway in 1957. From late 1957 to 1963, between 800 and 1000 people work at the plant.

**1957:** Haukeli power station (4MW) with its two generator sets comes onstream. The power station uses the fall from lake Vatjern down to the lowermost part of the Flothylåi River. The station is originally built in order to provide the construction works with power.

### 1961-1964

**1961:** The first generator set in Tokke power station is operational. Water is run through a 17 km long tunnel from Vinjevatn Lake to the Tokke plant above Bandak.

**1962:** The three other generator sets at Tokke (430 MW) are brought onstream. Power from Tokke is distributed over the South Norway grid.

**1964:** Songa power station (120 MW) at the top of Totak, comes onstream. Its main intake is from the Songa reservoir, but it also draws water from Bitdal and some smaller streams that run into the reservoir.

**1964:** The first two generator sets in Vinje power station are put into operation. Vinje power station gets water from Totak through the Våmarvatn Lake. The water is run through a 3 km long tunnel from Våmarvatn to the Vinje power station at the top of Vinje Lake.



### 1965-1969

**1965:** The third generator set in Vinje power station comes onstream, raising the total output to 300 MW.

**1969:** Lio power station (40MW) comes into operation. The station's main intake is in Byrtevatn Lake and the water is regulated by a 20 metre long stone-filled dam. The power station is close to Rukke bridge, 5 km from the centre of Dalen. The water is discharged into the Tokkeåi River.

**1969:** Byrte power station (20MW) comes into operation. Its intake is in Botnedalsvatn Lake, where a dam with a regulation height of more than 40 metres is built. The power station is located due north of Byrte dam.

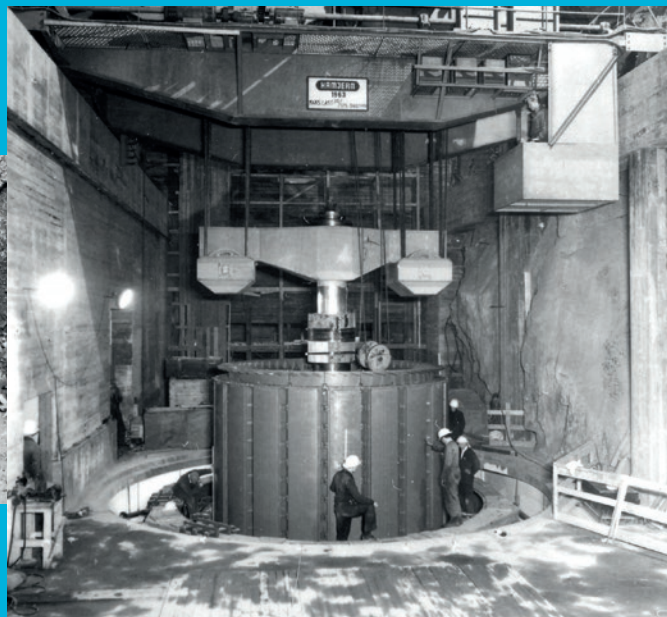
### 1979-2007

**1979:** Kjela power station (60MW) comes onstream. It takes water from Førsvatn Lake, and discharges at Hyljelihyl, into the Kjelaåi River.

**1987:** Hogga power station (17MW), the last of the Tokke development, is put into operation. The station is located in Lunde and runs on the fall between Bandak and Nomevatn Lake.

**2007:** Statkraft takes over operating responsibility of power plants on the Eidselva River, downstream from Hogga. The three stations Statkraft runs are:

- Vrangfoss power station – owned by Cappelen DA
- Eidsfoss power station – owned by Midt Telemark Kraft AS
- Ulefoss power station – owned by Cappelen Holding



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# HYDROPOWER AND THE ENVIRONMENT

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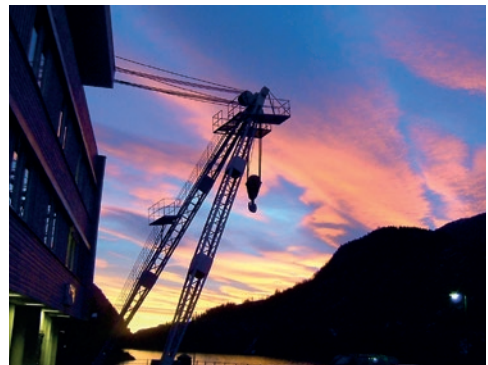
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Hydropower is a renewable, clean, reliable and flexible energy source. It is a mature energy technology which will supply electricity for generations, and hydropower plays a strategic role in reducing and handling climate change. Expertise in developing hydropower plants has developed together with knowledge of the environmental impact.

Hydropower plants with reservoirs are a bit like rechargeable batteries, meaning that they store water as an energy resource. Hydropower plays an important role in renewable energy generation as hydropower is able to supply the electricity grid when there is no wind or sun. Hydropower contributes to security of supply and energy flexibility without the emission of greenhouse gases.

Statkraft spends vast resources on specific conservational and environmental measures, and carries out research at the highest levels for the benefit of tomorrow's environment and power supply needs.

Hydropower can cause changes in the water flow and levels of rivers and lakes, which makes it difficult for salmon and trout to spawn. To mitigate such impact, Statkraft is obligated by law to ensure that fish are replaced. Over the years, this has turned into a major commitment. Statkraft has therefore built several hatching facilities for restocking fish, and is also partner in a few joint hatcheries. Statkraft is constantly seeking to improve the natural environment for fish in the rivers and lakes and undertakes biotope improvement.



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