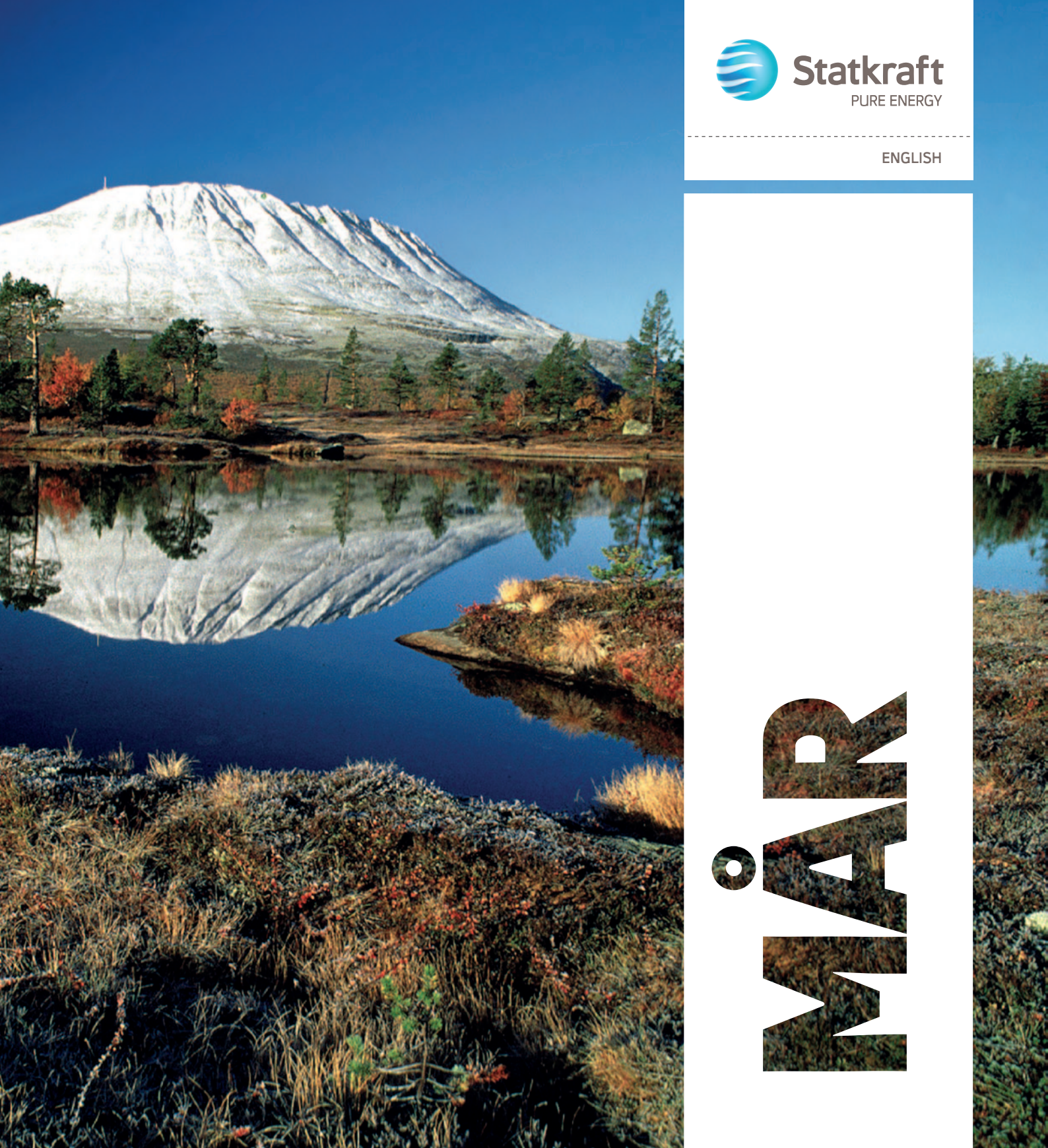


Statkraft
PURE ENERGY

ENGLISH

MÅR

Operational regione	Power plant group	Power plant/ Pumping station	Number of generator sets	Output (MW)	Average production (GWh/year)	Statkraft's ownership (%)	Entered into operation
Mår/Hakavik	Mår	Mår	5	180	995	100	1948
		Stegaros	1	3	12	50	2002
		Hakavik	1	5	21	100	1922
Total Mår			7	187.6	1 028		

MÅR POWER PLANT

- → Built into the rock (rock cavern)
- → Five generators
- → Average annual production: 1.1 TWh
- → Total length of waterways into Mår power plant (tunnels): approximately 17 km
- → Total reservoir volume in the whole of the Mår regulation area: approx. 595 million m^3 of water.

- Hydroelectric power station
- Dam
- Water tunnel
- Municipal boundary

Welcome to

Mår kraftverk

Mår power plant is in the Tinn municipality. Its regulation area includes five reservoirs, Mårvann, Kallhovd, Gøyst, Strengen and Grotte, which have a combined capacity of 595 million m^3 of water. Nominal annual output of the power station is approx. 1 TWh, equivalent to the consumption of some 40 000 households.

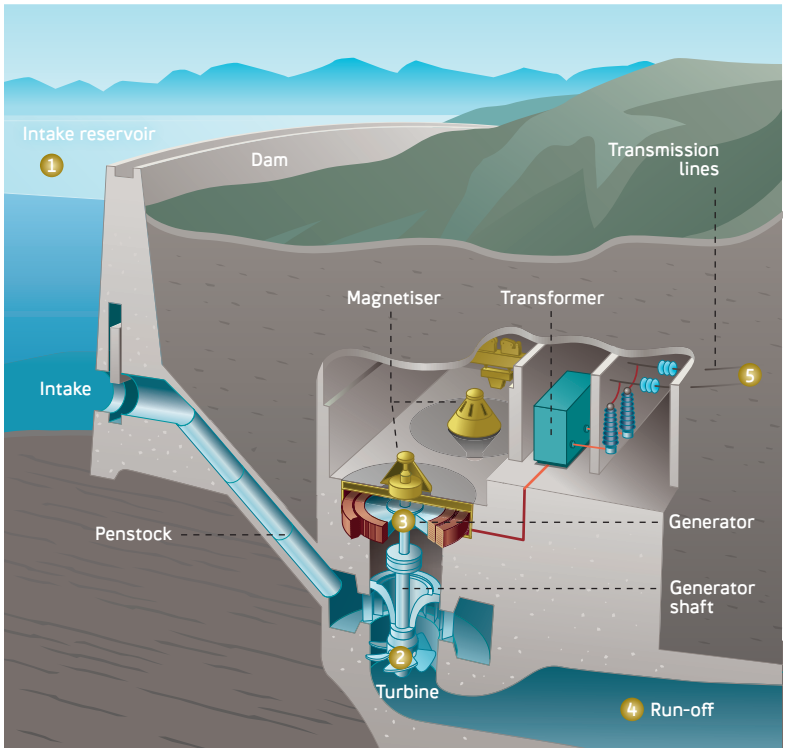
The reservoirs and power plants are interconnected by 17.3 km of transfer tunnels, and the head from the intake to the outlet is a full 820 m. The water is run from the main reservoirs into a distribution reservoir. From here it is piped down through two penstocks to the power station. These pipes are 1 250 m long and have an incline of 42 degrees. In the shaft between them is the world's longest wooden stairway, consisting of 3 875 steps.

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 power plants with reservoirs, as here at Mår, 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, are not available.

Mår power station came on stream in 1948, since when it has supplied Norway and Europe with clean, renewable energy.

From water to electricity

Water from melting snow and rain collects in the reservoirs up in the mountains. From there, it runs down through tunnels and shafts to the power station's turbines. The water turns the turbine, rotating the generator fitted on the same shaft. In the generator, this mechanical energy is converted into energy – i.e. electrical current. The voltage in the generators, in the case of Mår power station, is 6,2 kV (kilovolt). In order to minimise transmission losses between the power station and the consumers, the voltage is transformed, up to 132 and 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.

MÅR POWER STATION

Mår power station utilises water from watercourses in the municipality of Tinn and has a catchment basin covering 770 km², with an average annual inflow of 560 million m³.

Mår's regulation area includes the reservoirs of Mårvann, Kallhovd, Gøyst, Strengen and Grotte. These have a combined capacity of 595 million m³ of water, which is enough to produce approx. 1 TWh. The head from the intake down to the outlet is a full 820 m.

The reservoirs and power station are interconnected by 17.3 km of transfer tunnels. The water is run from the main reservoirs into a distribution reservoir. From here it is piped down through two penstocks to the power station. These pipes are 1 250 metres long and have an incline of 42 degrees. In the shaft between them is the world's longest wooden stairway, with 3 875 steps.

The Mår Dam is one of Norway's few stone dams.

Stegaros power station came on stream in the autumn of 2002. It uses the fall between Mårvatn lake and Kalhovd-fjorden. It has an output of 2.6 MW and potential average annual production of some 12 GWh, and it uses the penstock from Mårvatn.

Hakavik power station in Buskerud has a catchment of 38.5 km² and average annual inflow of 29.7 m³. The Øksne and Hajeren catchments are utilised jointly, with Hajeren's inflow being transferred by tunnel to Øksnevannet lake. The two have the same upper regulation limit. The dam on the Øksnevannet lake is a concrete gravity dam. The largest gross head of water is 389 metres. The power station contains four turbines, but only one is in daily operation.

The road up to Øksnevannet is open to ordinary traffic.

Power production at Mår, Stegaros and Hakavik is remotely controlled from the control centre at Dalen.

The Mår Dam

The world's longest wooden stairway, at Mår power station - 3 875 steps

The control room at Mår power station

LOCAL HISTORY

1918–1920

1918: The Mår Dam was completed and, along with the old dam at Kalhovd, was used for flood control and timber rafting.

1920: The fall rights for the Mår watercourse were acquired by the government for NOK 960 000. A power station at Mår was planned before the Second World War.

1922–1936

Hakavik power station put into commission. Four Pelton turbines have an annual output of 25 GWh. This power station produces electricity for the railways (16 2/3 Hz single-phase). It supplies current over three "railway power lines" to Asker, Skollenborg and Sande. There were plans for a further two turbines and a third pipe, but these were never put into action, because the "railway electricity" system was phased out.

1941–1948

1941: Construction of Mår power station began. The initial work was done by the occupying Germans, but it was soon halted due to combat operations at Rjukan. When it resumed immediately after the war, the machinery, turbines and generators which had been ordered in Germany had to be tracked down. Engineer Jens Hjort travelled to Germany and found the turbines in Heidenheim in the Allied Zone, while the generators turned up in the Russian Zone.

1948: The first two generators at Mår came on stream. The next two followed suit in 1949 and the fifth in 1954 (180 MW).

2002

Stegaros power station came into operation. This plant utilises the fall between Mårvatn and Kalhovdfjorden (2.6 MW). Statkraft and Tinn Energi have equal joint ownership.

Horse and wagons at Dale

Dam building

Hydropower and the environment

Hydropower is renewable, clean, reliable and flexible. This is a mature energy technology that has worked from generation to generation and plays a strategic role in climate change reduction and mitigation. Our expertise in building hydroelectric plant has evolved in step with our awareness of our environmental impacts.

Hydroelectric power stations with reservoirs work like rechargeable batteries that store the energy resource, that is, water. Hydropower has a key role to play in the family of renewable energy sources, since it can supply the power grid even when there is a lack of wind or sun. It contributes to energy security and energy flexibility, without emitting greenhouse gases.

Statkraft devotes a lot of resources to specific nature and environment protection measures, and conducts high-level research focused on tomorrow's environmental and power supply requirements.

Building power plants can change water-flow patterns and water-courses, making it difficult for salmon and trout to reproduce. Statkraft is under an obligation to release fish in the watercourses to counteract such adverse effects. Over the years, this has turned into a major commitment. Statkraft has therefore built a number of fish hatcheries around Norway and is also involved in some joint ventures. Statkraft is constantly seeking to improve the natural environment for fish in the rivers and lakes and under-takes biotope improvement activities in many watercourses.

Hakavik power station

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COVER PHOTO: TINN KOMMUNE