The Walchensee Power Plant

A Technological Jewel in the Alps

e·on | Wasserkraft

Electricity obtained from hydropower is a technology that has fascinated man since its conception. And one of the best examples of power generation using renewable resources is the Walchensee storage power plant in Upper Bavaria. Old and young can visit the facility to learn how power finds its way to the sockets in our homes. In its modern information centre, E.ON Wasserkraft showcases a host of information about hydroelectric power. Every year thousands flock to the centre – located opposite the historical powerhouse – to learn more about the energy of the future.

A Milestone of Hydroelectric Power

Oskar von Miller´s Vision

He wanted to supply the entire state of Bavaria with electricity with the aims to drive the economy and to spread prosperity. Prompted by industrial expositions in major European and North American cities the 27 year old von Miller organised in 1882 a similar exhibition in the Munich "Glaspalast" (Glass Palace), which he hoped would jump-start electricity generation in Bavaria. For the first time electricity was transmitted over a considerable distance – a great sensation! Power of between 150 and 200 volts flowed from Miesbach, where it was generated, to the "Glaspalast " in Munich, a distance of 57 kilometres, thus proving that power could be transmitted over large distances.

The Kingdom of Bavaria had only limited coal reserves. Therefore, as early as 1911, von Miller urged the state to consider hydropower as the best option for the production of electricity. He envisioned individual power plants supplying the whole of Bavaria—including the railway system—with electricity generated by hydropower and distributed via an extensive high-voltage Grid.

On June 21, 1918, the Bavarian state parliament decided to construct the Walchensee power plant in line with von Miller's plans and proposals. The scheme involved using the 200-meter drop from the lake, Walchensee, to a lower one–Kochelsee.

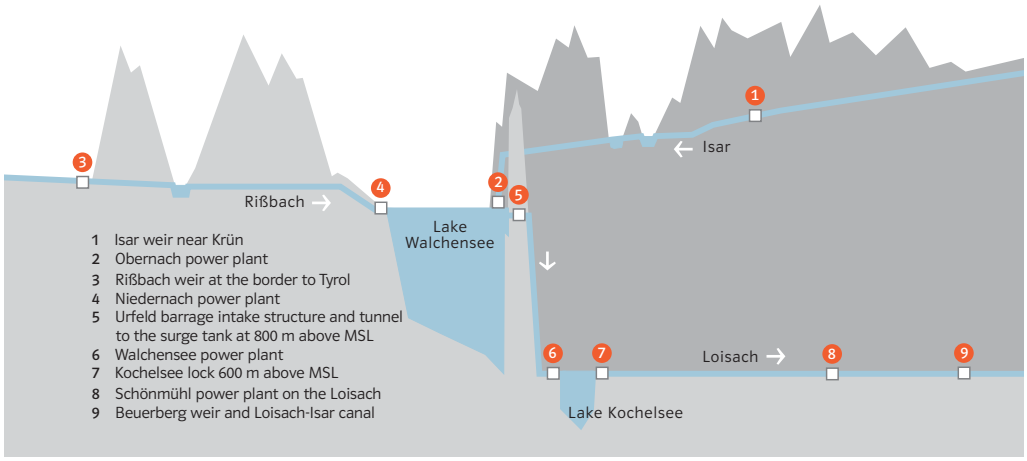
Construction lasted from 1918 to 1924: The storage power plant at Walchensee is one of E.ON Wasserkrafts oldest facilities – and boasts on of the biggest outputs to boot.

It all began at Walchensee

Building the Walchensee power plant just after the end of the First World War was a command performance. More than 2,000 labourers and engineers were given food and jobs around Kochelsee. Initially the extreme sparsely populated area had next to no roads or enough ccommodation for the workforce. The construction crews had to put in an unimaginable effort to transport heavy material and machinery, including pipes, turbines and generators to the site. In winter sometimes the only way to move the construction material was by sled!

The mission was accomplished on January 24th, 1924: Walchensee´s water spun the turbines for the first time. Channelled through six pipes the water surged down onto the power plant's turbines who's spinning, in turn, brought the generators to life and the first volt flowed from the plant into the power lines. At that time, with a capacity of 124,000 kilowatts (124 megawatts) the Walchensee power plant was one of the world largest hydroelectric power stations. Even today with its generation of about 300 million kilowatt hours (300 gigawatt hours) per year it ranks as one of the largest water storage power stations in Gemany.

Generating Energy – Systematically



The Storage Power Plant Principle

The Walchensee complex is a wonderful example of a storage power station. It uses the difference in altitude between the higher lying reservoir, Walchensee, and the lower hydropower station at lake Kochelsee.

Making Sensible Use of Water

To use Walchensee as a permanent energy storage basin water have to feed into it. Therefore, during the 1920s, the planers, incorporated connecting channels and tunnels with the rivers Isar and Rißbach. The necessary water is channelled into the lake through the Isar channel, commissioned in 1924, and the Rißbach tunnel, added in 1950. The 1950´s saw the creation of an extensive power generation system that today reaches from the Tyrolean border to Wolfratshausen. Before the water flows into the Walchensee, it passes through the Obernach and Niedernach power stations generating regenerative electricity.

The Walchensee System

First, water is guided along the Isar weir near Krün (1). And flows through a canal and gallery system into Walchensee. Since 1955, the Obernach power plant (3) has been harnessing energy created by the Isar´s waters by channelling it through a 3,900-meter long headrace tunnel with a drop of 70 meters.

The 3,600-meter long Grasberg tunnel and the 3,300-meter Hochkopf tunnel were built in order to divert the Rißbach (3) into the Walchensee. A siphon tunnel running beneath the Isar connects the two tunnels. Before the water from the Rißbach drops the 20 meters into the Walchensee it generates electricity in the Niedernach power station (4).

At the centre of the power generating system are the intake structure at Urfeld (5), the tunnel which lead to the surge chamber, the plainly visible pipelines at Kesselberg and finally the Walchensee Power Station with its eight turbines.

The natural discharge of water from the Kochelsee (7) into the river Loisach can be additionally regulated by a lock. Farther on the Loisach feeds water into the Schönmühl power station near Penzberg. The water is then channelled through the Beuerberg weir and the Loisach-Isar canal (9) before reaching the Isar.

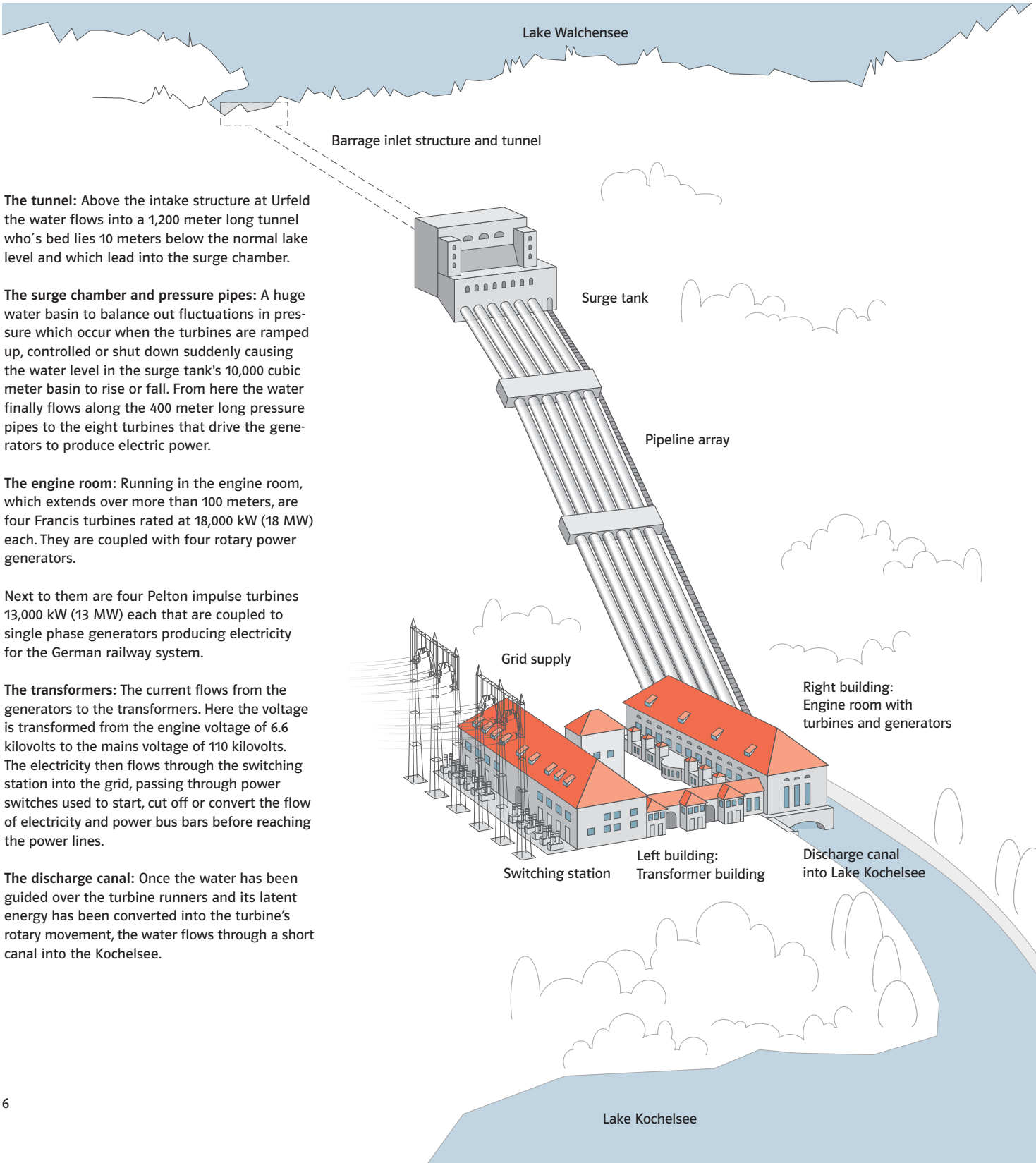
Isar weir near Krün (1)

Rißbach weir (3)

Niedernach power plant (4)

Walchensee power plant (6) and surge tank (5)

Water from Lake Walchensee Generates Electricity



The tunnel: Above the intake structure at Urfeld the water flows into a 1,200 meter long tunnel who´s bed lies 10 meters below the normal lake level and which lead into the surge chamber.

The surge chamber and pressure pipes: A huge water basin to balance out fluctuations in pressure which occur when the turbines are ramped up, controlled or shut down suddenly causing the water level in the surge tank's 10,000 cubic meter basin to rise or fall. From here the water finally flows along the 400 meter long pressure pipes to the eight turbines that drive the generators to produce electric power.

The engine room: Running in the engine room, which extends over more than 100 meters, are four Francis turbines rated at 18,000 kW (18 MW) each. They are coupled with four rotary power generators.

Next to them are four Pelton impulse turbines 13,000 kW (13 MW) each that are coupled to single phase generators producing electricity for the German railway system.

The transformers: The current flows from the generators to the transformers. Here the voltage is transformed from the engine voltage of 6.6 kilovolts to the mains voltage of 110 kilovolts. The electricity then flows through the switching station into the grid, passing through power switches used to start, cut off or convert the flow of electricity and power bus bars before reaching the power lines.

The discharge canal: Once the water has been guided over the turbine runners and its latent energy has been converted into the turbine's rotary movement, the water flows through a short canal into the Kochelsee.

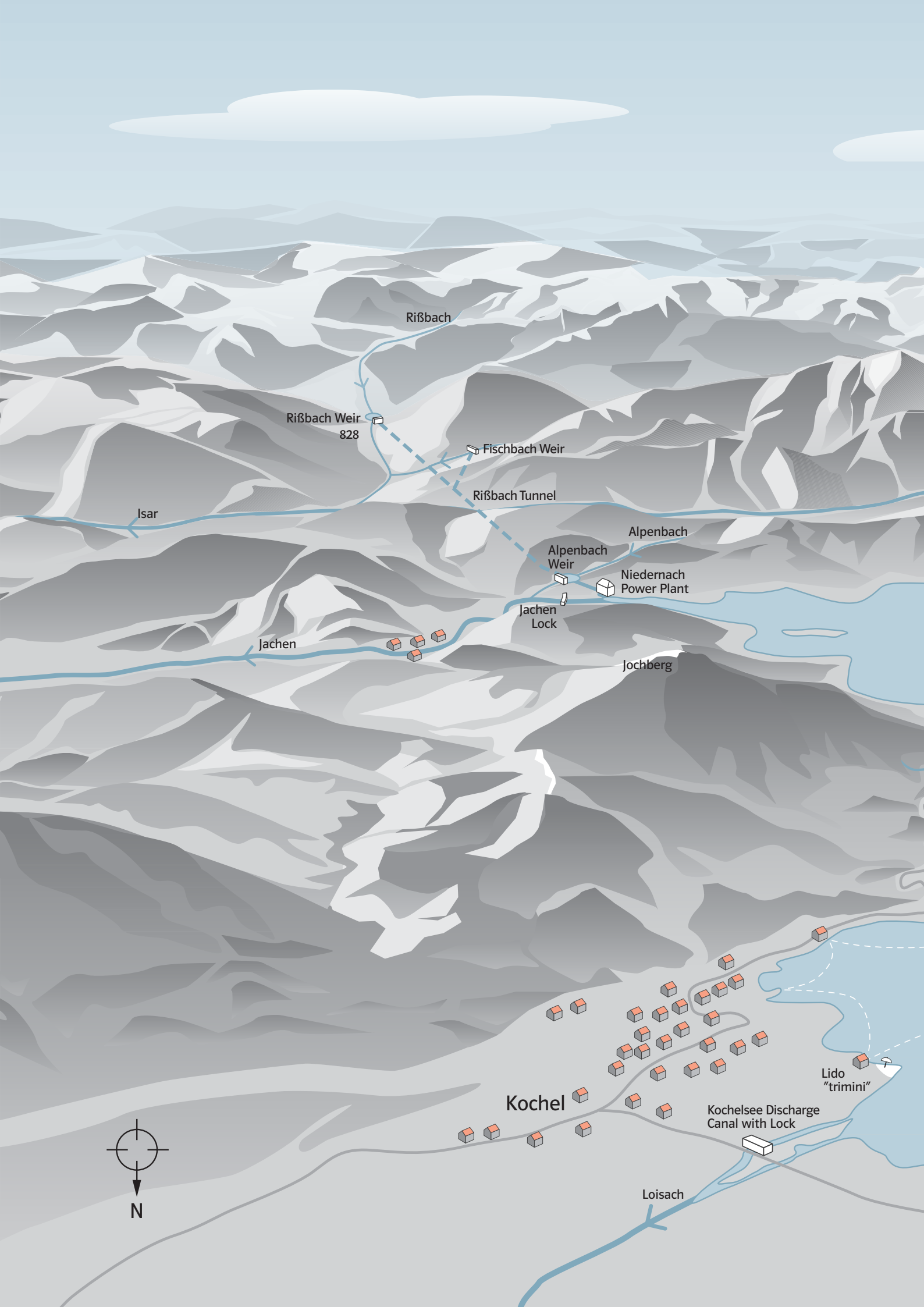
The Water Slide into the Valley

Six Distinctive Conduits: The Water Pipes
Visible from afar, the high-pressure pipes are the Walchensee power plant's hallmark. Water rushes from the surge tank's buffer basin to the powerhouse through six massive pipes.

The pipes are built to withstand a pressure of 28 bar. This roughly corresponds to ten times the pressure in a car tire. From top to bottom, their diameters run from 2.25 meters to 1.85 meters. The pipes' wall thickness amounts to ten millimeters at the surge tank and 27 millimeters at the power plant inlet structure.

A very high grade of steel was used in the manufacture of the pipes, this is impressive given the difficulties faced by the German economy in the 1920s. The pipes still meet the strict technical requirements to this very day, bearing witness to the builder's engineering ingenuity.

The surge chamber with its six huge power pipes high up on the mountain is the visible hallmark of the Walchensee Power Station. Together they have a weight of around 3,600 tons.


Rißbach
Rißbach Weir
828
Fischbach Weir
Rißbach Tunnel
Isar
Alpenbach
Alpenbach
Weir
Niedernach
Power Plant
Jachen
Lock
Jachen
Jochberg
Kochel
Lido
"trimini"
Kochelsee Discharge
Canal with Lock
Loisach
N


KARWENDEL MOUNTAINS
Mittenwald
Isar Weir with
Power Plant
870
Isar
Krün
Kranzbach
Altfinz
Jungfinz
Wallgau
Lake Sachensee
868
Obernach
Attempt Institution
Obernach
Power Plant
Walchensee
Herzogstand
Heimgarten
Lake Walchensee
802
Urfeld Barrage
Intake Structure
Surge Tank
Pipeline Array
Walchensee
Power Plant
Kesselbach
Power Plant
Discharge Canal
Lake Kochelsee
599
Schlehdorf
Loisach

Electrifying Energy in the Power Plant

Technical Data

Walchensee Storage Power Plant	
Installed capacity	124,000 kW (124 MW)
Annual output at normal load	300 million kWh (approx.)
Turbine variants	4 Francis, 4 Pelton
Installed capacity	4 x 18,000 kW (18 MW) 4 x 13,000 kW (13 MW)
Engine speed	500 rpm (Francis) 250 rpm (Pelton)
Turbine throughput	84 m^3/sec. max.
Drop	200 m
Water data	
Lake Walchensee 800 m ASL (approx.)	16 km^2 (surface area)
Lake Kochelsee 600 m ASL (approx.)	6 km^2 (surface area)
Lake Walchensee's maximum drawdown:	6.60 m
Storage space	110 million m^3
Isar diversion flow rate	25 m^3/sec. max.
Rißbach diversion flow rate	12 m^3/sec. max.
Other lake feeders	3 m^3/sec.
Run-off-river Power Plants	
Obernach Power Plant	
Installed capacity	12,800 kW (12.8 MW)
Annual output at normal load	50 million kWh (approx.)
Niedernach Power Plant	
Installed capacity	2,400 kW (2.4 MW)
Annual output at normal load	10 million kWh (approx.)
Schönmühl Power Plant	
Installed capacity	5,000 kW (5.0 MW)
Annual output at normal load	30 million kWh (approx.)
Small Power Plants	
Krün Power Plant	
Installed capacity	200 kW (0.2 MW)
Annual output at normal load	1.6 million kWh (approx.)
Kesselbach Power Plant	
Installed capacity	200 kW (0.2 MW)
Annual output at normal load	1.5 million kWh (approx.)

Cathedral of Technology: The Powerhouse

Flowing through high-pressure pipelines the water reaches the turbines located in the more than 100-meter long machine room. This is where four Francis turbines operate. They are in turn coupled to four three-phase generators each rated at 18,000 kW (18 MW) and four Pelton turbines connected to four single-phase generators, each of which has a capacity of 13,000 kW (13 MW). After the latent power of the water has been converted into the energy to drive the turbines it flows into the Kochelsee via the discharge channel.

How Power gets on the Right Track

The Walchensee power plant is one of the major suppliers of energy to the Deutsche Bahn, the German railway operator. Single-phase generators, which when built were the largest worldwide; generate the electricity needed by the German railway system. Of the roughly 300 million kilowatt hours generated annually by the power station, 2/3 is fed as three-phase current into the 100 kilovolt power grid and 1/3 to the German railway system.

Peak Performance for Peak Loads

Electricity must be generated when it is needed and the demand for power can fluctuate considerably over the course of a day. It is above all during times of peak consumption such as noon or eight o'clock in the evening when storage power plants, like the Walchensee facility come into play. Their generators can produce peak output as soon as the need for additional electricity for the grid arises. When other power sources reduce their performance or even fail the Walchensee Power Plant compensates for the short fall. This "Regulating Energy" ensures round the clock power supply.


AEG

The Walchensee Power Plant Experience

In the Information Centre there's a lot to discover for both large and small.

Hydropower up Close and Personal: The Information Centre

Its spectacular location in Bavaria just north of the Alps, the beautiful surroundings and the fascinating building attract several thousand visitors every year.

The Walchensee power plant was declared an industrial monument in 1983. The architecturally interesting information centre has been built into the face of the mountain directly opposite the power plant and works as a delightful contrast to the power station building. Modern information technology including model turbines, interactive touch screens and information panels convey a host of information about hydroelectric power.

Visitors who feel hungry or thirsty after walking through the exhibition can let themselves be spoiled in either the restaurant or beer garden (open daily from spring to early autumn) right next to the massive high-pressure pipes.

Come and Visit our Information Centre!

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F +49-88 51-77-2 98
info.wasserkraft@eon-energie.com
Open daily from 9:00 am to 5:00 pm
Guided group tours by arrangement

Oskar von Miller restaurant in the information centre.

The Isar – an Alpine River Running Wild

Excursions and rafting – for example the longest raft slide in Europe at Mühltal near Munich – draw many visitors to the Isar every year.

The Finsing power plant has a unique offering in store for its guests: Germany's only drift matter museum. On display amongst other exhibits are discoveries—some of which curious—fished out of the Isar by power plant staff over the years. Guided tours are available by arrangement: Seestrasse 3, 85464 Finsing, Germany, T +49-81 21-70 92 11

Conserving Nature's Resources

For more than 100 years man has made huge investments in order to gain control of mountain rivers. In particular substantial efforts have been undertaken in providing protection from flooding and erosion.

Water coming from the Walchensee runs through the power plant, the river Loisach and the Loisach-Isar canal into the Isar. Before the Isar flows into the Danube, E.ON Wasserkraft operates in addition to the Walchensee power plant above all 25 run-of-river power plants. They have a combined installed system size of 240 megawatts. Every year they generate 1.3 billion kilowatt hours of electricity. This is enough to supply nearly 400,000 Bavarian homes with environmentally friendly electricity generated from hydropower.

A Boon for the Environment

Hydropower – Naturally

Much can be said in favour of hydropower when it comes to generating electricity. Hydroelectric technology generates electricity without combustion residue, noise or emissions. Because the process is devoid of CO_2 emissions this renewable energy helps combat the danger of global climate change.

E.ON Wasserkaft GmbH is one of the leading hydropower generating companies in Germany. The concern, with its headquarters in Landshut, also occupies a top position amongst European renewable energy producers. Throughout Germany many private and commercial operators are producing environmentally friendly energy using run of river, reservoir and pump storage hydropower plants.

The knowledge of experienced personnel and the substantial investments in proactive flood protection, renaturation projects, drift material disposal and the maintenance of the generation infrastructure not only benefits the environment but also the people living near the waters and power stations.

Hydroelectric Power: An Ecological Niche

The Building of hydropower plants also creates new environments for plants and animals. They are of significant ecological importance as safe havens for rare plant and animal species. At the locations of E.ON Wasserkraft are about 100 nature, landscape and bird protection sites as well as flora and fauna habitat regions. The company works with nature protection authorities to maintain and expand these areas, making a contribution to securing a natural environment.

In Good Company

E.ON Wasserkraft is a subsidiary of E.ON Energie AG, Europe's leading private energy service provider. E.ON Energie assumes corporate social responsibility for ensuring that power supplies continue to be reliable, conserve resources, and remain oriented to the consumer.

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