Electricity from Hydro Power.

Austrian Hydro Power

Verbund
Austrian Hydro Power

Philosophy

Water is our Energy

- VERBUND-Austrian Hydro Power AG (AHP) is by far the largest Austrian electricity producer and a significant European producer of electricity from renewable sources of energy.
- AHP is the competence centre for hydropower in the Verbund Group.
- The management of the company is based on efficiency, market conformity, social responsibility, environmental compatibility and sustainability.
- The continuous extension of our capacities ensures the success of the company.
- AHP responds actively to the challenges posed by the market.
- The commitment and specialist skills of our staff play a decisive role in our corporate success.
- Water is our life and our energy.

Water

The Source of Life

Hydro Power is Solar Power

Water formed the face of the earth. Water is the source of all life. Water is the most versatile of all elements and indispensable for humanity and nature. Water is inexhaustible.

The water cycle runs continually, driven by the power of the sun: The heat of the sun evaporates water and the water vapor condenses into clouds and falls back to earth as rain or snow. This rainfall feeds the springs, lakes and rivers that flow back to the sea, thus completing this cycle of renewable hydro power.

Austria: the Land of Hydro Power

The mechanical utilization of hydro power has long been known. In Medieval times, water power was already being used to drive mills and shop machinery. In the nineteenth century the first hydro-electric plants were constructed.

Thanks to its topography, Austria is a prime candidate for the use of hydro power. It therefore has a clear environmental advantage when compared to most European countries, where nuclear or conventional thermal generating plants dominate.

Austrian Hydro Power

Electricity from Hydro Power

Austria's Hydro-Electric Center

VERBUND-Austrian Hydro Power AG (AHP) is a subsidiary of Verbund, its headquarters are located in Vienna. Today, it has hydropower plants in seven provinces. AHP has approximately 1,050 employees; it sets up, operates and maintains power plants. With its 90 hydropower plants, AHP has a turbine output of around 6,150 MW (1 MW = 1,000 kilowatts) and produces about 22,800 million kWh of electrical energy a year (1 GWh = 1 million kWh). Thus, AHP is the largest Austrian producer, by far, of environmentally friendly electricity from hydropower.

"Austrian Hydro Power" 100% Hydro-Electric Power – "TUeV" Certified

With its power plants, AHP ensures that the eco-product "Austrian Hydropower" is fully available to Verbund and thus to electricity consumers. "Austrian Hydropower" is defined as "clean" energy from 100% hydropower; it also carries the seal of approval of TUeV.

The Freudenau Power Plant on the Danube

The Kölnbrein Reservoir of the Malta storage power plants

Verbund

Austria's Driving Force

Power Plants with Tradition

Verbund, Austria's leading electrical utility, was founded in 1947. It provides about 50 % of Austrian power requirements by means of its 116 hydro-electric and thermal power plants. Approximately 90 % of Verbund's electricity comes from hydro power, which makes it one of the most environmentally-friendly generators of electricity in the European Union. Additionally, Verbund is Austria's largest electricity transporter and a company group of international dimensions with participation in approximately 45 enterprises.

Verbund is Ready For Europe

The liberalization of the electricity markets in Europe was a particular challenge for Verbund. In order to encourage competition, the 1996 EU internal market directive on electricity requires that electrical utilities separate the divisions Generation, Transmission and Sales/Trading - at least for accounting purposes. Verbund has made great strides toward this goal by completing the legal unbundling process as required by company law. Verbund already started to establish its own companies for Generation, Transmission and Sales/Trading in 1998.

The legal separation of hydro-electric and thermal generating facilities has distinct advantages for our market presence. The electrical generating facilities of Verbund are today divided as follows:

- Hydro-electric generation: VERBUND-Austrian Hydro Power AG
- Thermal generation: VERBUND-Austrian Thermal Power GmbH & Co KG

Hydro Power

Practical Environmental Protection

The Use of Hydro Power is Environmentally-Friendly

Verbund's electricity is generated with the greatest possible consideration for the environment. The hydro process has no affect whatever on the quality or quantity of the water used for generation. Hydro-electric plants emit neither dangerous radiation nor air pollutants. The unavoidable alterations to the environment at some sites in order to best utilize the water power were, and will continue to be, planned together with ecologists and executed, so that the landscape is not affected more than is absolutely necessary.

Wetlands of International Importance

Verbund has invested almost 1.5 billion euros in environmental measures in the last 15 years. Numerous new wetland areas have been created around our hydro-electric plants. The design of reservoir areas and blind river branches creates new and varied habitats for flora and fauna. The so-called "Gießgänge" (irrigation channels with floodgates, fed from groundwater and spillways from the reservoirs, and designed to provide water and regular natural flooding to wetlands) as well as numerous fish ladders are further tangible proof of Verbund's construction policies and commitment to the environment. Due to all these measures, Austria has become an international model for the ecological utilization of water power.

The feeding water course near the Greifenstein Power Plant

The Fish Ladder near the Melk Power Plant

Hydro-Electric Plants

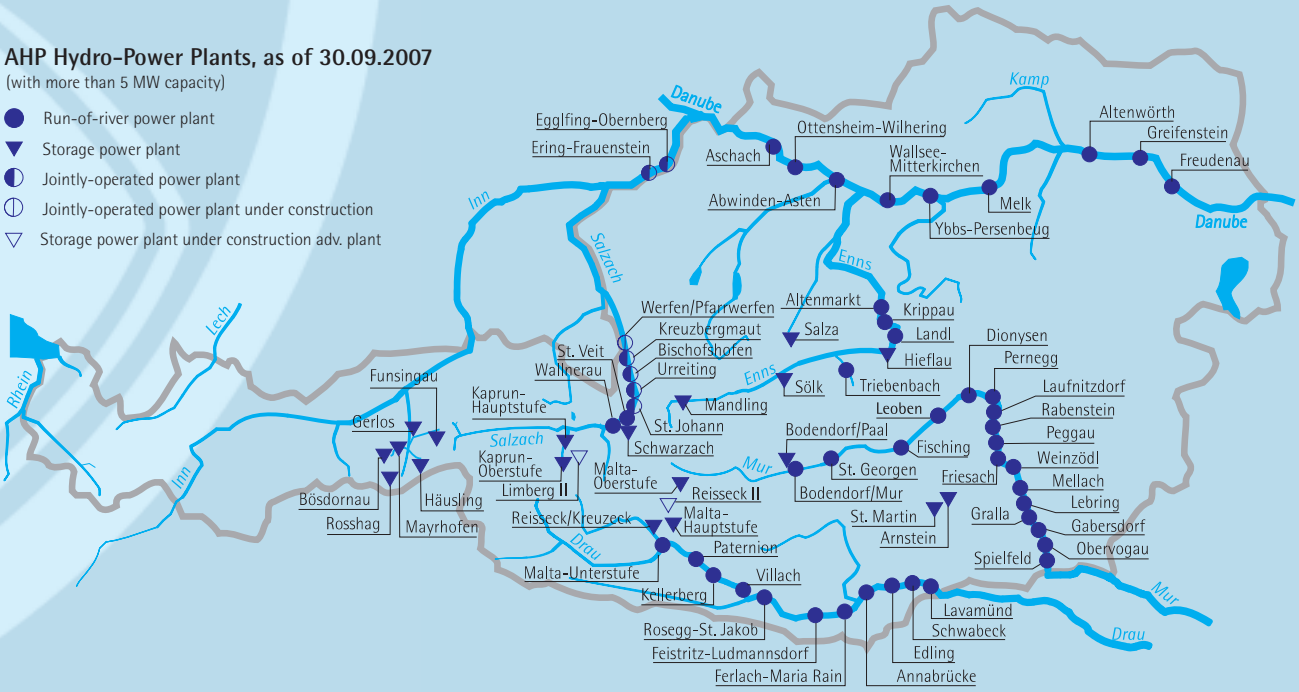
The Foundation of our Power Generation

Power Plants in Seven Provinces

AHP's 90 hydro-electric plants, 69 run-of-river power plants and 21 storage power plants in the provinces Carinthia, Upper Austria, Lower Austria, Salzburg, Styria, Tyrol and Vienna, make it by far the largest producer of environmentally-friendly hydro power in Austria.

AHP Hydro-Power Plants, as of 30.09.2007
(with more than 5 MW capacity)

- Run-of-river power plant
- Storage power plant
- Jointly-operated power plant
- Jointly-operated power plant under construction
- Storage power plant under construction adv. plant



AHP's Hydro-Electric Power

Facility	Type	River area	BC MW	SC GWh
Aschach	L	Donau	287.4	1,617.4
Ottensheim-Wilhering	L	Donau	179.0	1,134.9
Abwinden-Asten	L	Donau	168.0	995.7
Wallsee-Mitterkirchen	L	Donau	210.0	1,318.8
Ybbs-Persenbeug	L	Donau	236.5	1,335.9
Melk	L	Donau	187.0	1,221.6
Altenwörth	L	Donau	328.0	1,967.6
Greifenstein	L	Donau	293.0	1,717.3
Freudenau	L	Donau	172.0	1,052.0
Kaprun-upper stage [1]	PS	Salzach	112.8	166.1
Kaprun-main stage	S	Salzach	240.0	505.0
Schwarzach	S	Salzach	120.0	482.3
Wallnerau-Salzach	L	Salzach	10.0	38.3
Wallnerau-downstream	L	Salzach	5.1	20.7
St. Veit	L	Salzach	16.5	67.0
St. Johann [1]	L	Salzach	16.5	71.2
Urreiting [1]	L	Salzach	16.5	76.2
Bischofshofen [1]	L	Salzach	16.0	70.2
Kreuzbergmaut [1]	L	Salzach	17.7	80.0

Facility	Type	River area	BC MW	SC GWh
Häusling	PS	Ziller	360.0	179.4
Roßhag [2]	PS	Ziller	231.0	313.2
Mayrhofen	S	Ziller	345.0	671.2
Bösdornau	S	Ziller	25.3	68.9
Funsingau	S	Ziller	25.0	27.0
Gerlos [2]	S	Ziller	200.2	320.3
Paternion	L/S	Drau	23.5	95.0
Kellerberg	L/S	Drau	24.6	96.0
Villach	L/S	Drau	24.6	100.0
Rosegg-St. Jakob [3]	L/S	Drau	80.0	338.0
Feistritz-Ludmannsdorf	L/S	Drau	88.0	354.0
Ferlach-Maria Rain	L/S	Drau	75.0	318.0
Annabrücke	L/S	Drau	90.0	390.0
Edling	L/S	Drau	87.0	407.0
Schwabeck	L/S	Drau	79.0	378.0
Lavamünd	L/S	Drau	28.0	156.0
Malta-upper stage	PS	Drau	120.0	76.0
Malta-main stage	PS	Drau	730.0	715.0
Malta-lower stage [3]	L/S	Drau	41.0	120.0

L Run-of-river power plant
L/S Run-of-river (Pondage power plant)
S Storage power plant
PS Annual reservoirs with storage pumps
BC Bottleneck capacity
SC Standard capacity (average annual output from natural inflows)
MW Megawatt (= 1,000 kilowatts)
GWh Gigawatt-hour (= 1 million kilowatt-hours)

1) Joint power plants 50% owned by AHP
2) Values include the house service unit
3) incl. weir turbine
4) incl. cooling-water turbine
5) 11 reservoirs thereof with a total output of 640 MW.
6) 6 pumped-storage power plants thereof with a total pumping capacity of 1.182 MW.
7) including 36 eco-certified facilities up to 10 MW.

Plants

As of 01.01.2006

Facility	Type	River area	BC MW	SC GWh
Reißeck annual reservoir	PS	Drau	67.5	73.0
Reißeck daily reservoir	S	Drau	23.2	62.0
Kreuzeck daily reservoir	S	Drau	45.0	163.0
Ering-Frauenstein [1]	L	Inn	72.9	437.7
Obernberg-Egglfing [1]	L	Inn	80.7	485.0
Mandling	S	Enns	6.1	23.5
Sölk	S	Enns	61.0	206.0
Salza	S	Enns	8.5	28.5
Hieflau	S	Enns	63.0	284.0
Landl [3]	L	Enns	25.0	135.5
Krippau [3]	L	Enns	30.0	173.5
Altenmarkt [3]	L	Enns	25.7	165.9
Triebenbach	L	Enns	9.9	41.7
Bodendorf-Paal	S	Mur	27.0	86.0
Bodendorf-Mur	L	Mur	7.0	34.0
St. Georgen	L	Mur	6.0	32.0
Fisching [3]	L	Mur	21.9	74.0
Leoben	L	Mur	9.9	50.0
Dionysen [3]	L	Mur	16.2	85.9
Pernegg [3]	L	Mur	19.2	109.1
Laufnitzdorf	L	Mur	18.0	121.0
Friesach	L	Mur	12.0	60.0

Facility	Type	River area	BC MW	SC GWh
Rabenstein	L	Mur	13.9	64.5
Peggau	L	Mur	13.2	84.2
Weinzödl [3]	L	Mur	15.6	63.0
Mellach [4]	L	Mur	15.6	74.0
Lebring	L	Mur	20.2	83.9
Gralla	L	Mur	14.5	71.0
Gabersdorf	L	Mur	14.5	68.0
Obervogau	L	Mur	13.0	60.0
Spielfeld	L	Mur	13.0	67.0
St. Martin	S	Mur	9.8	15.5
Arnstein	S	Mur	30.0	50.0
19 run-of-river power plants less than 5 MW			20.1	90.8

	Total	BC MW	SC GWh
Run-of-river power plants [5]	69	3,308	18,269
Storage power plants [6]	21	2,850	4,516
Hydropower plants [7]	**90**	**6,158**	**22,785**

Projects under construction:

Limberg II (PS), plant commissioning 2011/2012
Aschach, unit modification (L), plant commissioning 2010
Werfen/Pfarrwerfen (L), plant commissioning 2009
Hieflau, exansion project (S), plant commissioning 2009

Projects: Reisseck II, plant commissioning 2014

Run-of-River Power Plants

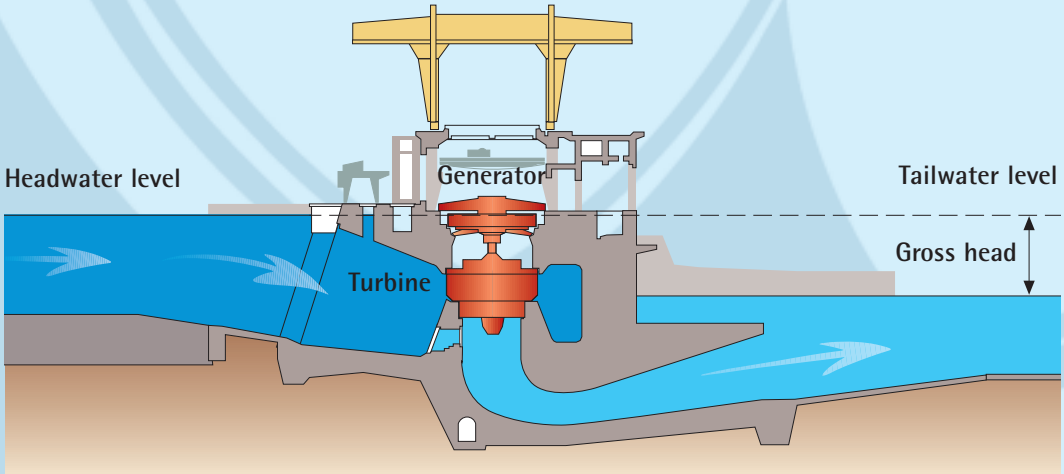
Current from the Current

Run-of-River Power Plants for the Primary Demand

Run-of-river power plants convert the energy of flowing water in rivers and streams into electricity. The elevation difference between upstream and downstream water is small when compared to storage power plants, but the quantities of water available are normally larger. Run-of-river power plants operate continually. They cover the primary demand for electricity and are, therefore, the base-load plants. However, their electricity production depends on the water level of the river. They normally produce more electricity in summer than in winter.

The Backbone of Power Generation

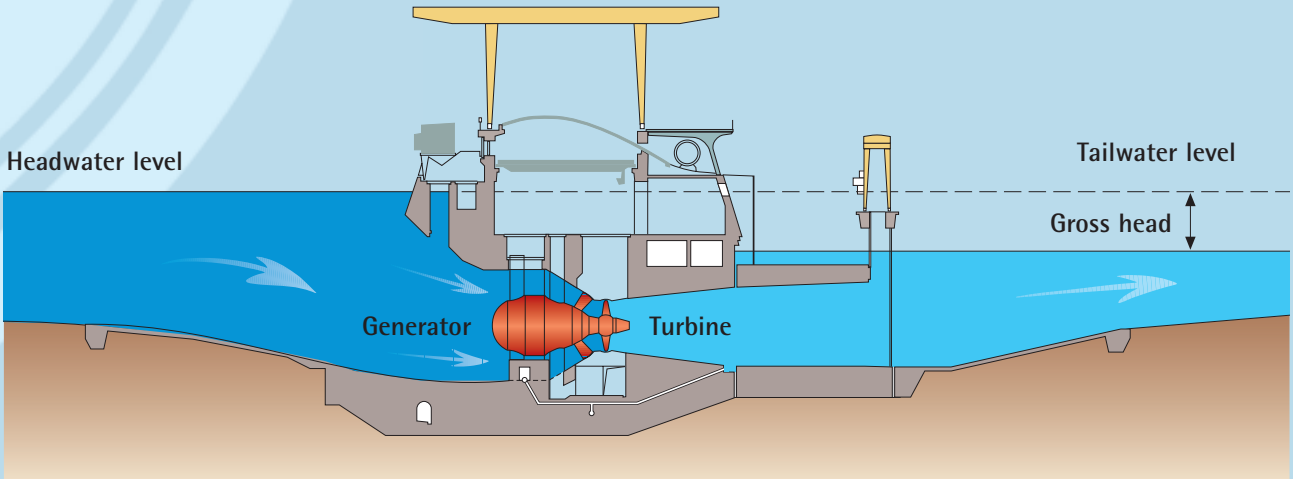
AHP's run-of-river power plants utilize the energy potentials of the Danube, Drau, Enns, Mur, Inn and Salzach rivers. With an annual electricity production of around 18,300 GWh and an installed capacity of around 3,300 MW, they form the backbone of AHP's electricity generation. The flow of the rivers are influenced by the large storage power plants. This results in a significant increase in electrical generation in the run-of-river power plants especially in winter.



Kaplan turbine with vertical shaft

Electrical Generating Facilities with Multiple Uses

The run-of-river power plants have multiple other uses in addition to their primary purpose of generating electricity, as do all power plants planned and constructed by AHP. Flood control for certain stretches of river has been increased as a consequence of plant construction. The higher water levels on the Danube due to the dams have significant advantages for ship traffic, which would otherwise be hindered by currents and seasonal low water levels. Responsible construction methods have assisted decisively in the preservation of endangered natural habitats. A substantial contribution to the preservation of nearby wetlands and riparian areas has been achieved by means of an innovative groundwater conservation and management program. Additionally, many recreation areas have been created, which have received a favorable reception from nearby residents and visitors.



Kaplan turbine with horizontal shaft

Storage Power Plants

Power from Austria's Mountains

Storage Power Plants for the Peak Demand

Electricity cannot be stored in large amounts. However, it is possible to store water in reservoirs and to transform its potential energy into electricity at the precise time when it is required. Storage power plants use the water stored in reservoirs to drive their turbines. Characteristic of this type of plant is a large head (the vertical distance through which the water falls) and greater pressure, but a smaller flow rate. Storage power plants are also used to regulate the grid, as they can react very quickly to load changes in the grid. Depending on requirements they can be put into operation or switched off again within minutes. These plants, because of their immediate availability, also provide an important safety back-up for the main power plants in case of breakdown or failure.

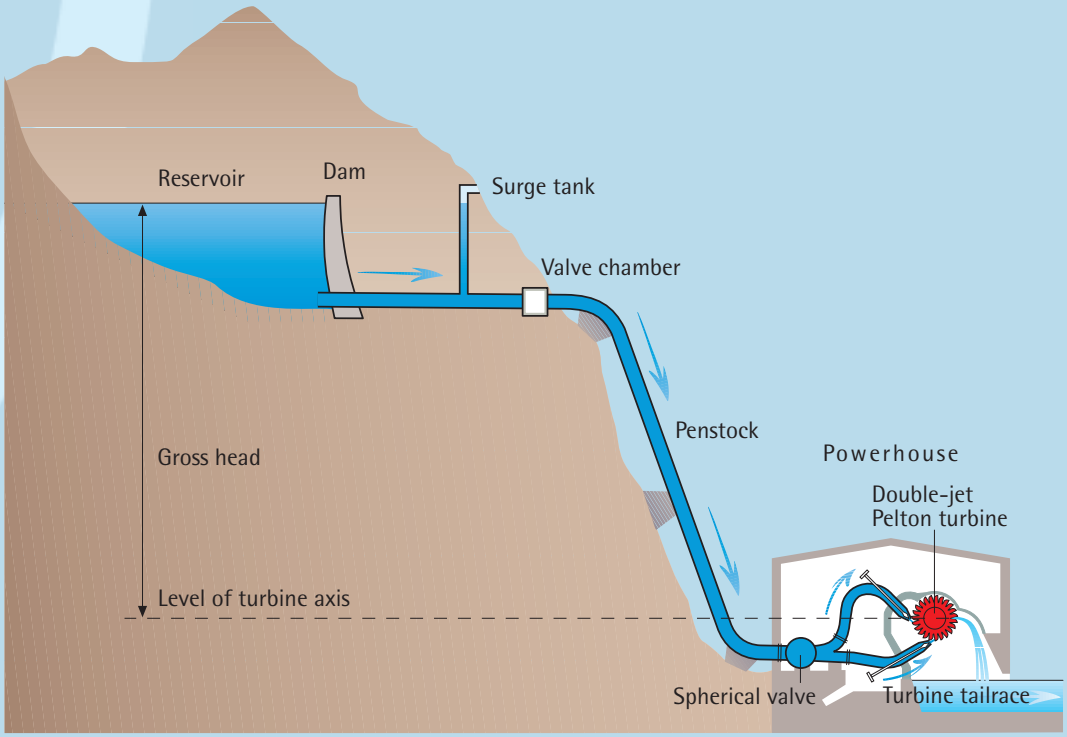
Most of AHP's storage power plants are in the provinces of Salzburg, Tyrol and Carinthia. With an installed capacity of 2,850 MW they can produce around 4,500 GWh per year. The construction of the power plant in Kaprun was a symbol for the rebuilding of Austria after World War II, and also the first milestone on the road to a reliable power supply.

Fine-Tuning Power with Pumped Storage Power Plants

A special type of storage power plant is the pumped storage power plant. Pumped storage power plants have an upper and lower reservoir. When the demand for electricity is low (e.g. at night) or when the run-of-river plants are generating more electricity than is required at that moment, the water can be pumped up to the reservoir located higher up the mountain. Later on, when demand is high, it is quickly available for electricity generation. Thus, the same water from the Austrian Alps can be used many times to generate electricity.

Alpine Wonderland: Reservoir Lakes

Hydro-electric power plants contribute greatly to flood control in the alpine valleys. In addition, access to alpine recreational areas has been opened up through their construction. More than half a million visitors every year enjoy the unique experience of the breath-taking alpine landscape during a visit to one of our facilities.



Storage power plant with Double-jet Pelton turbine

Operation and Deployment

Power at the Touch of a Button

Your Reliable Energy Partner

Electricity cannot be stored. It must be generated when it is needed, around the clock, day after day. To ensure that electricity is available at the touch of a button, extensive technical facilities and the employment of qualified specialists are required.

Your On-Demand Energy Supplier

Due to the many complexities involved, the operation of power plants requires a coordinated and computer-supported operating plan, which is optimized for both energy production and management. Programs for predicting water levels as well as daily, weekly and yearly supply models form the basis for the operation of the power plants.

The liberalization of the electricity markets has resulted in even greater importance for AHP's storage power plants, for they are the most suitable power plants to provide the system services necessary for the secure and reliable operation of the European transmission grid. This includes providing controlling power range for power frequency control and maintaining the quality of supply.

Outlook

Future-Oriented Business Practices

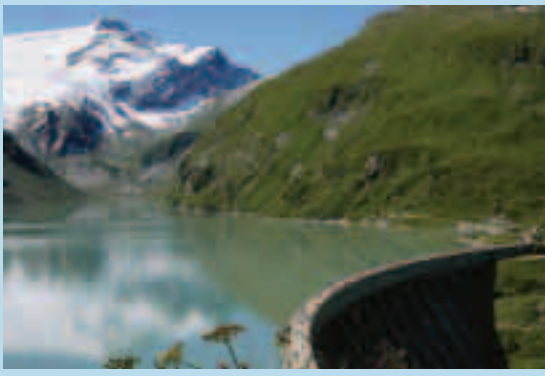
Responsible management

AHP is exclusively orientated towards the generation of electricity from renewable hydropower. We react to increasing demand by extending the capacities of our power plants and by raising the efficiency levels of our existing plants.

Innovative Technologies

AHP's policy is that research is a crucial ingredient of good business practice. Results from our research are continually being applied in practice and further developed. Main points of emphasis are: the ecological aspects of utilizing hydro power, maintaining high technological standards and plant safety as well as further optimizing efficiency.

The Edling Power Plant on the Drau



The Mooserboden Reservoir

VERBUND-Austrian Hydro Power AG
Am Hof 6a, A-1010 Vienna
Telefon: +43 (0) 50313-0
Telefax: +43 (0) 50313-51099
e-mail: ahp@verbund.at

Contact

Publisher:
VERBUND-Austrian Hydro Power AG
Layout and Production:
emobrain - Gesellschaft für Kommunikation, Marketing & Werbung GmbH
Photos: Verbund
Printing: Huttegger
Edition: September 2007

www.verbund.at