



HYDROCONNECT



Austrian  
State Prize 2015  
Environment & Climate

# HYDROCONNECT The electricity- producing fish lift

Double rotating hydropower screw with integrated fish lift for upstream and downstream migration of fish and microorganisms in flowing water



# (Why) HYDROCONNECT's hydropower screw

In light of the currently existing EU Water Framework Directive, operators of small hydroelectric power plants are struggling as much as large energy providers with its implementation.

The HYDROCONNECT combination system consisting of a hydropower screw AND a fish lift makes it possible for the first time to have easy and economical revitalisation as well as efficient new construction. With it, HYDROCONNECT has the solution for owners of water rights to fulfil the fish passage of power plants called for in the EU Water Framework Directive and at the same time, it makes electricity production possible.

The EU has stipulated improvements in Europe's waters since 2000. This includes the requirement to achieve fish passage in both directions of the respective flowing water by 2027 at the latest. The legal requirement to build fish ladders has existed for a long time. However, most existing ones cannot be described as bidirectional fish passage systems.

The electricity producing HYDROCONNECT hydropower screw with integrated fish lift now makes it possible for fishes to migrate upstream as well as downstream, and it does so completely without injury and in a resource-saving and energy-efficient way.

**„Nature and technology must not be a contradiction. The original principle of the Archimedean screw conveyor has found two applications in the HYDROCONNECT hydropower screw: energy generation with simultaneous injury-free transportation of fishes and micro-organisms.“**

# Benefits for the environment and economy



**Injury-free upstream and downstream migration** of fish and other river life confirmed in various studies



**Energetic utilisation** of the residual water



**Optimised guiding current** makes it possible for fish to find their way into the fish ascent screw (EU patent)



**High energy efficiency (65–70%)** thanks to the gap-free drum design, even at low water



**Green system**  
Even microorganisms can pass through without harm



**Amortisation**  
possible from electricity production



**Low space requirements**  
Low amount of construction work and sleek construction even for gorges and small water-courses



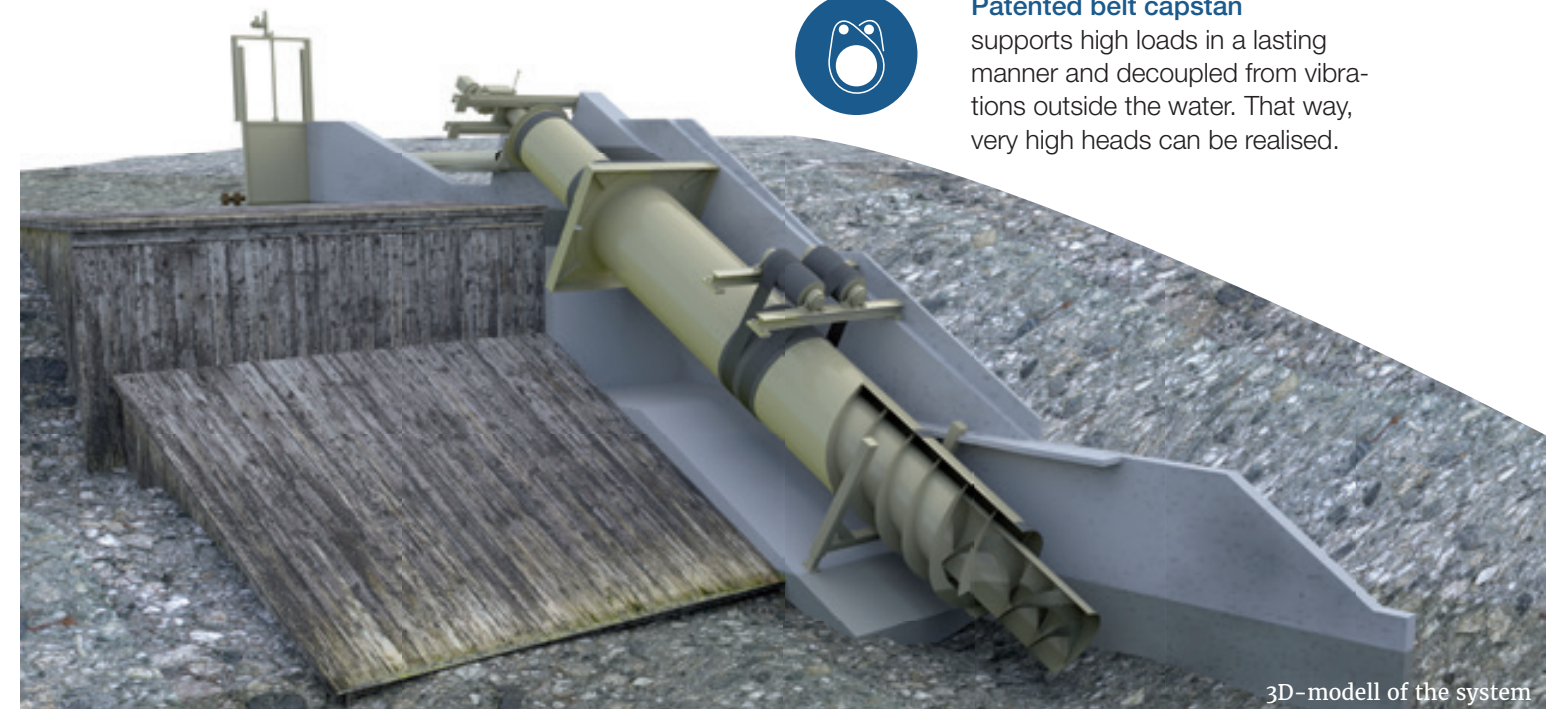
**Low noise**  
therefore optimally suited for use in populated regions



**Patented belt capstan**  
supports high loads in a lasting manner and decoupled from vibrations outside the water. That way, very high heads can be realised.



Walter Albrecht, inventor of the HYDROCONNECT hydropower screw with the Albrecht fishLift inside



3D-modell of the system

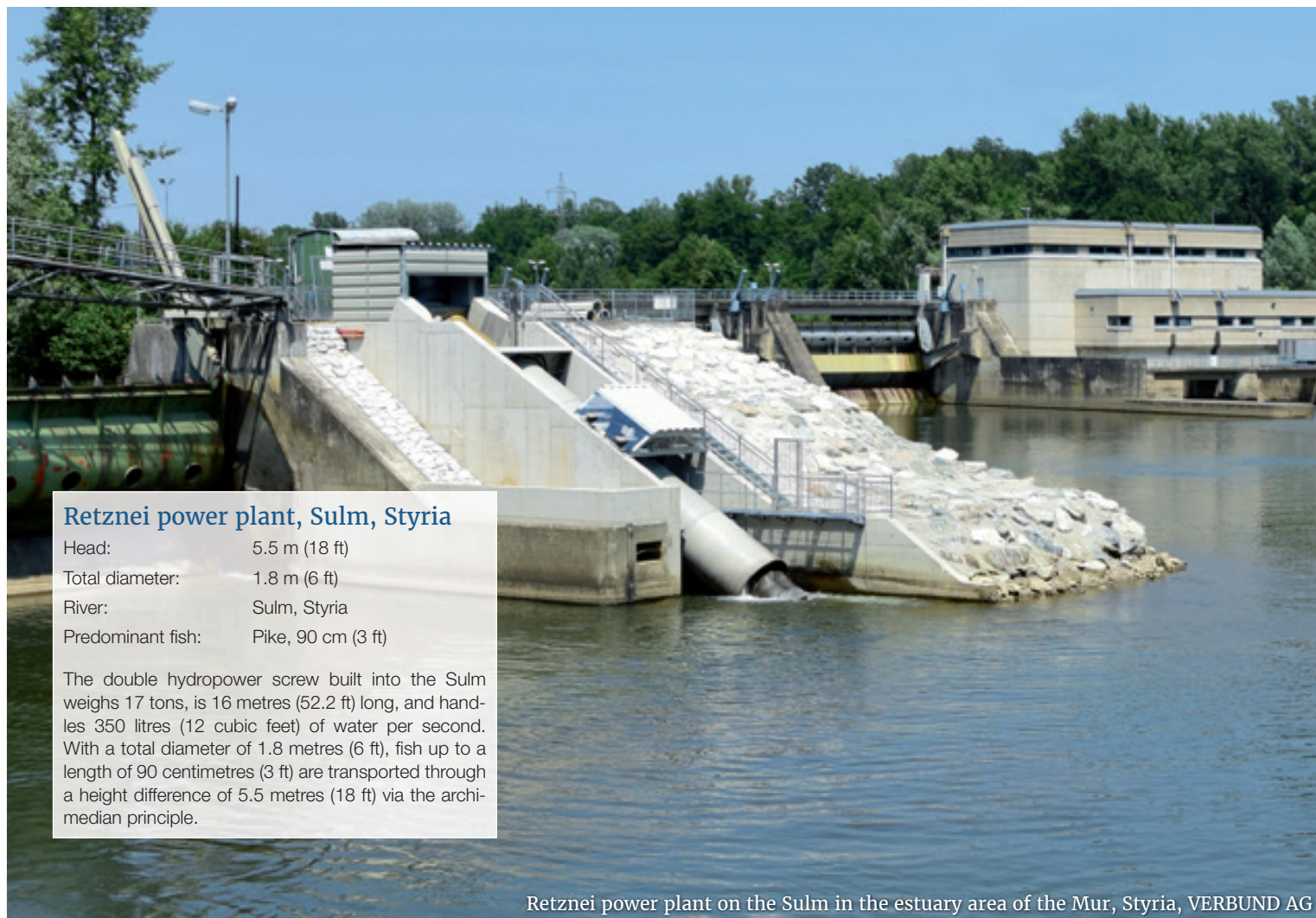


# A variety of application areas

Due to its dual use as a fish lift and electricity generator, the hydropower screw is the most efficient solution at many locations and in many situations. Besides the EU required fish passage, the HYDROCONNECT

hydropower screw pays for itself due to the efficient electricity production depending on the location and flow rate.

- Existing (run of river) power plants for fish ascent and descent incl. energy production
- Small hydropower plants as independent power plants
- Diversion power plants as a residual water machine
- Supplement to turbines as a fish lift
- Replacement for conventional fish ascent aids on existing dam stages and migration obstacles
- Water pumping station for irrigation and/or storage power plants



## Retznei power plant, Sulm, Styria

Head: 5.5 m (18 ft)  
 Total diameter: 1.8 m (6 ft)  
 River: Sulm, Styria  
 Predominant fish: Pike, 90 cm (3 ft)

The double hydropower screw built into the Sulm weighs 17 tons, is 16 metres (52.2 ft) long, and handles 350 litres (12 cubic feet) of water per second. With a total diameter of 1.8 metres (6 ft), fish up to a length of 90 centimetres (3 ft) are transported through a height difference of 5.5 metres (18 ft) via the archimedian principle.

Retznei power plant on the Sulm in the estuary area of the Mur, Styria, VERBUND AG



## Jeßnitz power plant, Neubruck, Lower Austria

Head: 3.32 m (11 ft)  
 Total diameter: 2 m (6.5 ft)  
 River: Jeßnitz, Lower Austria  
 Predominant fish: Brook trout (30 cm) (1 ft), bullhead (accompanying fish species)  
 Biggest possible fish: 90 cm (3 ft)

With prior registration, details of the hydropower screw such as the belt capstan or housing can be viewed at the demo power plant in Neubruck. The HYDROCONNECT hydropower screw has an empty weight of 14.5 tons and maximum water flow rate of 1000 l/sec (35 cfs). On the Jeßnitz, the substrate-bound bullhead profits in particular from the connection to the bottom, which makes effortless fish migration possible.

Power plant Neubruck, Lower Austria, open for visitors



# Electricity + fish migration: How it works

The HYDROCONNECT hydropower screw with double rotating cylinders is based on the Archimedean principle, the operating principle of a hydropower screw. There is an outer sheath with a headrace screw that contains an inner, counter-rotating, spiral fish transport screw, which pumps water into the headwater. Power generation is made possible by a drum (rotating cylinder) with a casing pipe that is seamlessly welded to the screw blades. The system is mounted on the outer shell by means of a patented belt capstan, through which high heads are possible.

The flow of water from the exiting headrace and the central luring current are used to guide fish wanting to reach the upper level to the inner fish lift. As soon as they swim into the entrance, which reaches down as far as the river bed, they are transported gently upwards in the screw chamber in the constantly filling water. Afterwards, the fish end up in the headwater via a fish discharge chute. The water transported to this upper level is ready once again for reuse by the plant or alternatively for the fish to make their way down.

## Steel construction

- welded steel construction
- screw blades welded throughout
- high stability
- long service life
- gap-free
- large-scale corrosion protection

## Intake gate

- steel protection for blocking the inlet or alternatively to regulate the water quantity
- self-closing in the event of a power outage

## Fish discharge chute

- chute to transport the individually ascended fish into the calm headwater
- minimum slope
- can be disassembled

## Generator works

- Generator
- Gearbox
- Brake

By varying the operating speed, the supply can be adjusted to the water flow. This variation possibility is realised through the implemented frequency converter technology.

With a planned shutdown, the hydropower screw can be actively driven in order to empty it (protection against icing).

Spring-loaded brakes are used for braking, which are triggered by electromagnets. The brake is applied automatically in the event of a power outage.

## Cover/housing

Built to be waterproof on request including design variations (wood, glass, stone, concrete, etc.)

## Belt capstan

- patented mounting by means of flat belts
- no underwater mounting needed for the first time
- high heads possible

## Walk-on maintenance gangway

for maintenance and cleaning of the system

## Seals

- rubber seal in the headwater (underwater) area
- long service life
- easy to replace
- adjustable

## Substructure

possible as a concrete structure or steel frame

## Control system

- speed and displacement controllable by means of a level sensor or manual input
- can be configured as an independent system

## Fish ascent & descent (patented double screw)

The fish transport is based on Archimedes' principle: Fish are raised effortlessly upstream or alternatively downstream in the standing water of the inner or alternatively outer screw chamber.

- special shape of the screw blades to create an optimised guiding current
- bottom connection for fish that are weak swimmers such as the bullhead, for example

## Hydraulic lifting frame

makes it possible to offload the rotating cylinder during maintenance and to replace the belts or ball bearings.

You can find function videos at [www.hydroconnect.at/en/videos](http://www.hydroconnect.at/en/videos)





# Future solution, *fish descent*

**„Fish need a humane solution to overcome unnatural obstacles.“**

Through the generation of a real luring or guiding current, HYDROCONNECT makes it possible for the fish to enter in the intended direction. This is ensured through patented technologies: the double screw as well as the special belt capstan. By connecting to the bed, ascent is also made possible to fishes that are weak swimmers or substrate-bound such as the bullhead, for example.

That way it is possible for fish and microorganisms to pass transverse structures upstream and downstream safely, effortlessly and quickly, which is a requirement of the EU Water Framework Directive that operators of small power plants and hydropower plants have to meet by 2027 at the latest.

From this fish ecology approach, the topic of fish ascent was researched together with the Institute for Hydrobiology and Water Management (IHG) of the University of Natural Resources in Vienna (BOKU).



View of fish descent in the outer pipe, still picture of the fish ecology accompanying research at the Jeßnitz river in Lower Austria, 2014

Look into the outer pipe with the elliptical shape of the screw blade

# Safe fish transport proven

Fish ecology studies in the form of accompanying research on the HYDROCONNECT hydropower screw with integrated fish lift were carried out by BOKU, the University of Natural Resources in Vienna, Institute for Hydrobiology and Water Management from 2012 - 2014. Starting with the first trials between December 2011 and March 2012, juvenile and adult trout and bullheads ascended without injury.

In studies conducted in March 2012, 151 of 372 individuals of the main fish species, i.e. brook trout, rainbow trout, bullhead and grayling (fish lengths between 3 cm (1.2 in) and 48 cm (19 in) = juvenile and adult individuals of all four species) ascended via the inner pipe screw.

In another ascent trial in December 2013 with the expanded fish species aitel, barbel, sneep, roach, pike and Danube salmon, 75% of the fish ascended.

In the descent study in March 2014 with 140 fish (bullhead, brook and rainbow trout), at total of 56% descended (Fig. 1) and numerous individuals ascended again (total use Fig. 2). This secures an ecological balance and the fish population.

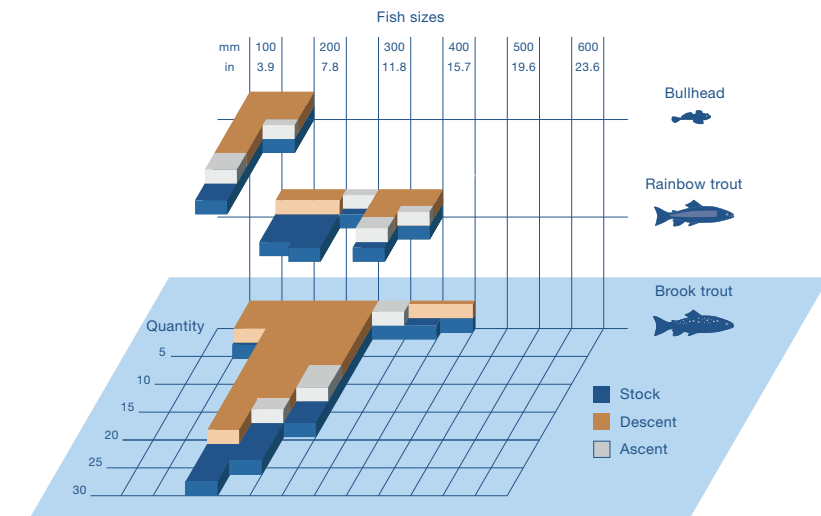


Fig. 1 Ascent and descent of domestic fish of various sizes and stages of life, March 2014

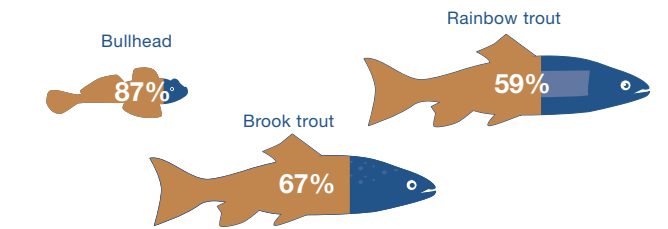


Fig. 2: Total use of the bidirectional transport (ascent and descent) of bullhead, rainbow trout and brook trout, March 2014.

### Conclusion of the Institute for Hydrobiology and Water Management (IHG/BOKU):

- ➔ **No injuries** for fish ascent and descent with the HYDROCONNECT hydropower screw
- ➔ **Functionality** of the fish ascent screw confirmed for the fish ecology coenosis model of the River Jeßnitz.
- ➔ **The hydropower screw** from Hydroconnect is very well suited for fish descent

Data origin: Fish ecology studies of the „HYDROCONNECT“ hydropower screw with the „Albrecht fishLift inside“ at the Jeßnitz power plant location; Bernhard Zeiringer, Maxim Grigull and Stefan Auer

# Frequent questions & answers

## How high is the efficiency of the HYDROCONNECT hydropower screw?

The mechanical efficiency is up to 90%. This results in electrical efficiency, minus all the mechanical losses, of 65% even for small systems - even at low water. In larger systems, the electrical efficiency increases to 70% and more.

## Is the HYDROCONNECT hydropower screw with integrated fish lift suitable for all fishes, or more precisely will the fishes in my waters fit through the screw tube?

The screw diameter is oriented in any case around the predominant fish in the waters in order to comply with the EU Water Framework Directive. Each location is planned separately, and the machine size is defined according to financial and ecological criteria. Drum diameters of up to four metres are possible. Hence, this system provides up to 170 cm (5 ft 7 in) of space (in both directions) for the predominant fish species.

## For what designated uses and heads is the HYDROCONNECT hydropower screw suitable?

Installation sites and possible uses of the Hydroconnect hydropower screw with integrated fish lift are:

- ➔ existing reservoirs and migration obstacles
- ➔ existing (run of river) power plants for fish ascent and descent incl. energy production
- ➔ small hydropower plants as independent power plants
- ➔ diversion power plants as a residual water machine
- ➔ water pumping station for irrigation and/or storage power plants

In the process, the hydropower screw handles water volumes of 0.2 m<sup>3</sup>/s (7 cfs) to 5.0 m<sup>3</sup>/s (177 cfs) and heads of 2 (6.5 ft) to a maximum of 20 m (65 ft) (possibly also higher). The belt capstan makes it practically independent of the supply and head.

## What benefits are offered by the HYDROCONNECT hydropower screw with double rotating cylinders?

Besides efficient, fish-friendly electricity production, the hydropower screw with double rotating cylinders makes it possible for fish to ascend and descend. Through the compact design with an integrated fish lift, an economical and self-amortising installation can also be realised at existing power plants and other transverse structures.

## Is the HYDROCONNECT system only for the passage of specific fish species?

No, the hydropower screw with double rotating cylinders with integrated fish lift is for the passage of the strongest and weakest swimming species of fish at all stages of life. You can find out more on this on page 9 of this brochure.

## What is the advantage of a belt capstan over conventional underwater mounting?

Thanks to the belt capstan, high heads in steep terrain are possible without any risk of the screw sagging. In contrast to underwater mounting, the belt capstan makes it possible for fish to enter the fish ascent without obstruction and without injury. No lubricant hazard as well as the low amount of maintenance are also arguments for the belt capstan.

## Are fish wary of the transport?

No. Many years of studies as well as numerous underwater videos show the calm, almost playful way of using the fish lift. Also, the results of the ascent and descent studies and in particular the multiple use of the lift prove that fish are neither wary nor afraid of it. This is due to the fish-friendly transport of the energy-saving technology (the fish ascends in the calm water of the auger flight) and the extremely short transport path for the fish.

## Are the fish sucked into the hydropower screw?

No. The lower screw area is designed and patented so that it creates an optimised guide current for fish and water life. That way the fish find the way via the fish ladder without being forced to do so. There is a current leading to the screw in the bottom area of the entry, which is very well suited for fish and microorganisms that are weak swimmers.

## Can logs, branches and various floating debris become trapped in the screw?

No. Trapping of branches or floating debris is extremely unlikely, because there are no constrictions or bottlenecks in the screw. A coarse screen in front of the intake grate keeps logs and large floating debris away.

## Data & Facts on HYDROCONNECT

- 2011** • Inventor Walter Albrecht develops an electricity-producing fish lift. The first prototype is created.
- Ecological accompanying research** • Ongoing trials and monitoring by the University of Natural Resources in Vienna (BOKU) show the injury-free passage of fish and microorganisms with the HYDROCONNECT hydropower screw.
- 2013** • Hydro-Connect GmbH is founded.
- 2014** • At the „Forum of the Fish Migration and Hydropower Initiative“ in April 2014, experts gave top marks to the fish friendly and efficient hydropower screw.
- VERBUND AG as first customer** • HYDROCONNECT receives an order from VERBUND AG to construct a fish lift at the Retznei power plant, which went into operation in spring 2015
- Numerous awards** • 3rd place in the Green Business Award, winner of the special environmental prize, 3rd place in NEPTUN Water Prize as well as **winner of the Austrian State Prize for the Environment and Climate 2015**.
- Demo power plant** • The Jeßnitz demo power plant was built and opened in autumn 2015.
- International interest** • HYDROCONNECT is planning continuous projects across the EU with sales and production partners, which are to be equipped with electricity producing fish lifts from HYDROCONNECT.





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