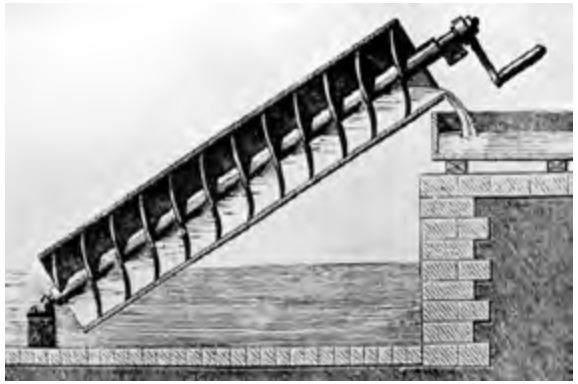
Hydrodynamic Screws

An idea from Greek antiquity was the source of inspiration for this technology.

Archimedean screws are an old idea (*attributed to Archimedes of Syracuse in the 3rd Century BC*), but until recently – within the past 10 years, they have always been used to pump water *uphill*.



The hydrodynamic screw turns that principle around and uses the position and natural energy flow of falling water to generate power.

The hydrodynamic screw turbine consists of three or more helix shaped blades mounted on a central shaft. This shaft and blade assembly is put into a trough and set at a specific angle.

Water enters the top of the screw, filling it to about half the diameter of the screw. As the water flows down it creates torque on the screw and causes it to turn. The screw is connected to a gearbox, to step up the rotational speed, which is in turn connected to a generator which maximizes the torque of the screw to produce power.

Hydrodynamic screw turbines are especially suited to low head sites such as 1 to 10 metres and work economically with flows from 100 litres per second to 10,000 litres per second.

Compared to other low head turbines, such as the Kaplan, the hydrodynamic screw is technically very simple with significantly lower installation and operational costs.

Fish Passage Studies

A number of studies have been carried out in Europe and by Mann Power Consulting in the UK on the impact of Archimedes hydrodynamic power systems on fish. Study results are available.

Thousands of fish passages have been monitored using cameras at the intake, within the screw and at the outflow of screw systems. Trials have included salmonids (smolts and kelts), trout and eels, and have been carried out over a range of fish sizes and turbine speeds.

No adverse effects were noted for fully grown fish or kelts, while 'at most' 1.4% of the smolts observed suffered limited and recoverable scale loss. This is '*at most*' since the wild fish that were observed were likely to have had some minor scale damage before their passage. Of 160 eel passages, 0.64% suffered "minor and recoverable" pinching to the tail.

The Archimedes screw is commonly used to safely move fish out of tanks for processing (*The Pescalator is an example of the Archimedes screw being used for this purpose*).

Species	Max length	Numbers studied	Numbers affected	Damage sustained
Bitterling	5cm	5	0	
Bullhead	14cm	5	0	
Brown trout	44cm	708	0	
Bream	7cm	239	0	
Carp	19cm	2	0	
Chub	43cm	63	5	limited scale loss/ haematoma
Dace	21cm	1	0	
Eel	58cm	22	0	
Grayling	36cm	3	0	
Perch	18cm	18	0	
Rainbow trout	63cm	4	0	
Roach	21cm	17	2	limited scale loss
Salmon, smolt	18cm	249	4	limited scale loss
3 Spined Stickleback	5cm	5	0	
Stone Loach	11cm	3	0	

Fishtek Consulting: Combining results from all 3 investigations. The River Dart, German (Spah, 2001) and Dutch (Vis Advies, 2007) studies.

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Gerrard McCarthy
Mobile: +64 21 839 153
micropicosystems@gmail.com

MICROPICO SYSTEMS LIMITED
EWRB Registered Electrician Licence # E17842

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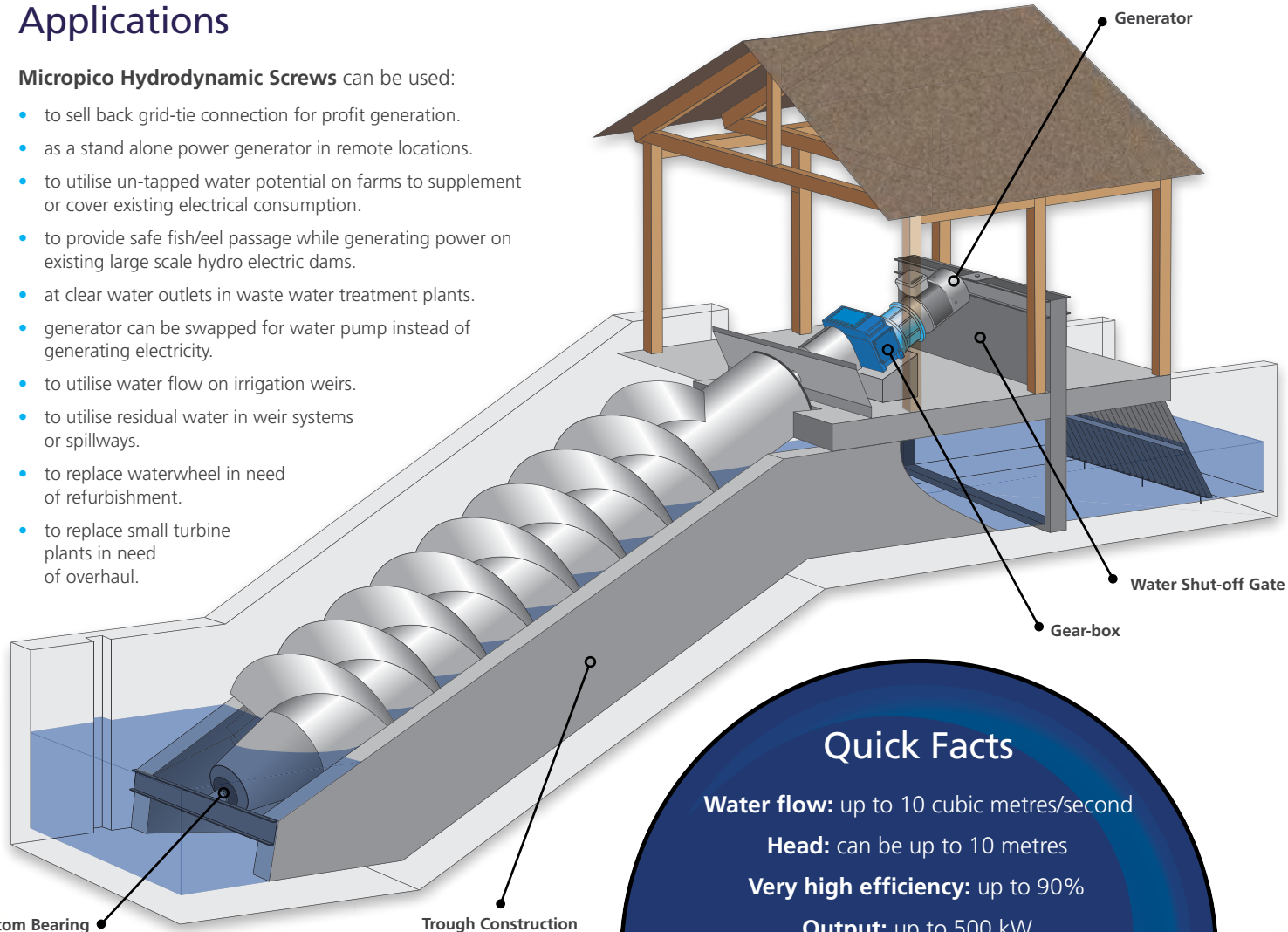
Hydrodynamic Screws Factsheet

Applications

Micropico Hydrodynamic Screws can be used:

- to sell back grid-tie connection for profit generation.
- as a stand alone power generator in remote locations.
- to utilise un-tapped water potential on farms to supplement or cover existing electrical consumption.
- to provide safe fish/eel passage while generating power on existing large scale hydro electric dams.
- at clear water outlets in waste water treatment plants.
- generator can be swapped for water pump instead of generating electricity.
- to utilise water flow on irrigation weirs.
- to utilise residual water in weir systems or spillways.
- to replace waterwheel in need of refurbishment.
- to replace small turbine plants in need of overhaul.



Quick Facts

Water flow: up to 10 cubic metres/second

Head: can be up to 10 metres

Very high efficiency: up to 90%

Output: up to 500 kW

Fish, eels and other creatures pass through the hydrodynamic screw unharmed

No need for fine screening as large debris / flotsam can pass down through the screw without hindering performance

Produces electricity 24 hours per day

Advantages

- **Rapid amortization** thanks to small investment and low operating costs
- **High efficiency**, even with fluctuating water levels and volumes
- **Continues to generate with low water flow**, down to 20% of normal
- **Cost effective output** – even with low hydropower potential – as low as 1 kW
- **Rugged, wear-resistant, trouble-free, durable** technology
- **Self-regulating system** that adapts automatically to the water volume and mains voltage frequency
- **Low maintenance plant** that requires no cleaning at all
- **Operates with coarse screen only** (no fine screens needed)
- **Transports fish and floating particles unharmed.** Several tests have shown fish friendliness in the Netherlands, Canada, the USA and other countries
- **Improves water quality** in deeper water through oxygenation
- Can operate with **variable and fixed speeds**
- **Low civil costs.** Simple foundation with two concrete supports can be sufficient. Units can be specifically designed to suit existing civil layouts
- Bottom bearing **requires no lubrication** and is **environmentally safe**
- Gearbox is **lubricated with food grade oil** for minimal environmental impact
- **High efficiency** compared to water wheels and other small turbines
- **Long product lifetime** – up to 30 years is not unusual as long as maintenance is carried out when required. This is due to low rotational frequency (25 – 80 rpm) and wear resistant parts.