The demand for sustainable and economically competitive sources of energy has risen dramatically in recent years – and will do so in the years to come.

Hydrokinetic energy, harvested from tidal currents and river flows, is of major importance for the future energy mix. It is an inexhaustible and renewable source of energy and more predictable in comparison to wind, solar and wave energy.

It is the aim of SCHOTTEL HYDRO to make this ever-reliable energy resource commercially viable and its generation easy and cost-efficient.

Harvesting tidal and current energy means being exposed to harsh conditions. SCHOTTEL HYDRO can draw on 60 years of SCHOTTEL experience in the field of marine engineering and knows what’s required: robustness, high availability and experienced engineers are the basis of SCHOTTEL HYDRO products and services.

SCHOTTEL HYDRO offers its services in three segments: instream turbines, platform systems as well as engineering and manufacturing of power train components. SCHOTTEL HYDRO is specialized in developing hydrokinetic energy solutions for customer-specific applications.
SIT – SCHOTTEL INSTREAM TURBINE

DESIGN FEATURES

- Horizontal axis free flow turbine
- Passive-adaptive composite blades
- No active pitch mechanism
- Safe and reliable sealing system
- Robust drive train with two-stage planetary gearbox
- Optional multi-disc brake
- Induction generator
- Passive cooling by ambient water
- Innovative control strategy

ADVANTAGES

- Robust, simple and lightweight
- Low investment cost
- Low maintenance cost
- Scalable in terms of quantity
- Compatible with various support structures
- High efficiency and low thrust
- Easy transportation
The SCHOTTEL INSTREAM TURBINE (SIT) harvests hydro-kinetic energy for commercial projects. Using standardized drive trains allows the turbine to be a cost-effective component of customized projects.

**MINIMUM CAPEX**

In contrast to other instream energy converters with nacelle weights of 130 t to more than 200 t, a single SIT weighs about 1 t. This results in 1 MW of installed power using about twenty SIT turbines at a weight of only 20 t or less leading to an optimum ratio of power and material use. The turbine structure is kept simple, avoiding complex subsystems.

**MINIMUM OPEX**

The robust turbine layout ensures a long device lifetime, and the SCHOTTEL HYDRO design philosophy guarantees easy access to the turbines for regular maintenance.

**MAXIMUM REVENUE**

Besides low investment and operational costs, high availability of the power plant is required to increase each project’s revenue. The multi-turbine principle of SCHOTTEL HYDRO installations includes redundancy. Together with easy and cost-effective maintenance this ensures high availability. The smart design of platforms additionally increases the energy yield by locating the turbines into an optimum position.

**STANDARDIZATION**

SCHOTTEL HYDRO has summarized the distribution of tidal flow velocities into three flow speed standard classes. These cover a range of reasonable sites, reflected in three turbine ratings sharing the same standard drive train. The customer can choose the best suited device for the proposed project with a reasonable cost. Common parts are an integral part of the SCHOTTEL HYDRO system.

**FLOW SPEED STANDARD CLASSES**

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<th>I</th>
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<tr>
<td>Rotor diameter [m]</td>
<td>3.0</td>
<td>4.0</td>
<td>5.0</td>
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<tr>
<td>Rated power (el.) [kW]</td>
<td>70</td>
<td>62</td>
<td>54</td>
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<tr>
<td>Rated water velocity [m/s]</td>
<td>3.8</td>
<td>3.0</td>
<td>2.6</td>
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<tr>
<td>Cut-in speed [m/s]</td>
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<td>0.7</td>
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<td>Cut-out speed [m/s]</td>
<td>6.75</td>
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<td>4.6</td>
</tr>
<tr>
<td>Nacelle weight [t]</td>
<td>approx. 1</td>
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SIT turbines can be combined with practically any kind of support structure: Fixed land-based, floating, semi-submerged or fully submerged platforms can be used. Even sluice gate type installations are possible. The turbine features straightforward mechanical and electrical interfaces that can be connected and disconnected within a short time using simple, standard tools.

FOR ALL SITES AND NEEDS

Both the type of support structure and the number of SIT units can be selected according to the specific site conditions and the customer’s needs. Installations at sites with restricted water depth use just one row of turbines. Whereas deeper sites are equipped with multi-row platforms to capture maximum energy from a tidal flow or current by positioning the turbines in the “sweet spot” in the middle of the water column.

CONSIDERING ENVIRONMENTAL FACTORS

At locations with a rough wave climate semi-submerged or fully submerged platforms may be preferred, whereas more sheltered sites may favour floating or jetty installations. Other considerations may include whether flow is unidirectional or bidirectional, if access will be from sea or shore, local availability of equipment, local regulations and permitting requirements. Whatever the environmental conditions are, SCHOTTEL HYDRO will help select the best suiting platform type.

SCHOTTEL HYDRO has established relationships with platform design partners worldwide. Based on these partnerships, platform options can be tailored to the local environment.
The SIT turbines are equipped with an induction generator converting the variable rotation into electric power. Each of the turbines is connected to a frequency converter feeding into a DC bus installed on a tidal platform. Finally, a common frequency converter and a large transformer produce electricity which can be fed directly into the grid. Hence, no further reconditioning is required onshore.

This principle applies to the full range of applications, from small jetty-type installations to multi-MW offshore platforms. Near-shore community-scale type installations may use power conversion onshore. The modular approach of SIT turbines allows for an optimum installation tailored to the specific site and customer needs, covering the entire range from community scale to utility scale.
OFFSHORE APPLICATIONS

The TRITON S platform has been developed by TidalStream Ltd., a subsidiary of SCHOTTEL HYDRO. It is especially suited to deepwater offshore and carries a variable number of turbines. TRITON S offers a maximum power capacity on a single installation.

The system consists of a tether arm, two spar buoys and a variable number of cross arms. The entire structure is linked to a foundation (e.g. gravity-based or drilled pile) by a universal joint, allowing for pitching, rolling and self-alignment to the flow direction.

TRITON S is especially maintenance friendly: emptying or filling the ballast tanks in the lower part of the spar buoys causes the platform to transition from operating mode to maintenance mode and vice versa.
REFERENCES

INSTREAM TURBINES FOR CANADA

A TRITON S will be built and delivered by the SCHOTTEL HYDRO subsidiary Black Rock Tidal Power in the Bay of Fundy, Canada. The platform will provide a capacity of 2.5 MW. The electricity supply generated will be fed into the North American power supply system. The device will be profitable over the course of the fifteen-year project.

SUBMERGED PLATFORM SYSTEM

A fully submerged platform with two SIT turbines is being operated by Sustainable Marine Energy (SME) off the Isle of Wight. The device is positioned subsea using a taut mooring system. It can thus be deployed in a wide range of water depths and seabed types without the need for heavy lift vessels for installation or maintenance. The platform simply floats on the water surface for maintenance access when the mooring lines are released. This system is especially suitable for small-scale projects.
UNDERWATER COMPONENTS

SCHOTTEL HYDRO can draw on 60 years of SCHOTTEL experience with underwater machinery. SCHOTTEL HYDRO uses this extensive knowledge for its component supply service in the market segment of instream energy. SCHOTTEL HYDRO offers the entire range, from single components such as pitch mechanisms through to complete drive trains including gear box, generator and power conditioning.

REFERENCE

A three-bladed turbine was developed by the Norwegian company Hammerfeststrøm. SCHOTTEL HYDRO provided the turbine shaft, hub and pitch mechanism including hydraulics and controls for this 1 MW tidal turbine HS 1000. The HS 1000 is designed for installation on the seabed at a depth of 40 to 100 metres in tidal streams. The pitching system allows optimal harnessing of tidal currents in both ebb and flood directions.
RESEARCH AND DEVELOPMENT

SCHOTTEL HYDRO has vast experience in the emerging hydrokinetic energy market - and knows about its challenges. To guarantee the quality of its products the company invests in research and development of robust, efficient and cost-effective devices for harvesting energy from tidal and river currents.

SUCCESSFUL UNDERWATER

Extensive laboratory and field tests have proven the functionality and efficiency of the SIT. Pushing tests were performed using a harbour tug. By varying the speed of the tug, diverse flow conditions were simulated, measured and monitored from aboard the tug.

260 OPERATING HOURS

Full-scale tests in a highly turbulent environment were performed in Strangford Narrows, Northern Ireland. The tests included 260 operating hours and were carried out in accordance with the latest standards of the International Electrotechnical Commission (IEC).
A local presence, expert advice on the spot and prompt service are all major principles of the corporate SCHOTTEL strategy. A SCHOTTEL subsidiary, service centre or sales office is never far away. SCHOTTEL HYDRO is represented by subsidiaries and partners in all major shipping centres all along the worldwide coasts.

This large network of service and sales locations ensures customer proximity and fast response time: Experienced engineers on site and the rapid provision of spare parts from the extensive SCHOTTEL stock guarantee vitally reduced machine downtimes.
NEW IDEAS
BASED ON
EXPERIENCE

SCHOTTEL HYDRO is specialized in developing hydrokinetic energy solutions for customer-specific applications. The company offers its services in three segments: hydrokinetic turbines, platform systems, and turbine components.

SCHOTTEL HYDRO can draw on 60 years of SCHOTTEL experience in marine engineering. It supplies submerged rotating electro-mechanical systems which operate under sea conditions. A large network of sales and service locations ensures customer proximity worldwide.