



Hydropower Industry Guide 2022/23

Innovative Products and Services

3rd Issue

Individual success through exchange of experience
vgbe energy e.V. | Essen, September 2023

HYDROPOWER INDUSTRY GUIDE 2022/23

Innovative Products and Services

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The “Hydropower Industry Guide” is an annual guide that gives a comprehensive and up-to-date overview of the newest products and services offered by the Hydropower sector. It provides an easy-to-use directory of companies providing key products and services to the worldwide hydropower market. These products and services can assist you in your business and provide support and advice.

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Essen (Germany), September 2023

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The Hydropower Industry Guide provides some information on current research activities and projects in the hydropower sector in Europe.



Company Profiles 21

Leading suppliers present their state-of-the-art and innovative products and services. Read their offers and get a quick overview and well-founded, structured information on the offers for your business.



Media Partner Profiles 116

Prominent "Media Partners" promote comprehensive knowledge on technical, economic, environmental and legal events in the hydropower sector.



vgbe energy – Range of Services 125

vgbe energy offers services for cooperation, networking and professional exchange at expert level, and in particular provides information on the operation and maintenance of hydropower plants.

Foreword



Karl-Heinz Gruber



Mario Bachhiesl

The EU Green Deal sets the guidelines for Europe's path to a secure, environmentally compatible and economically successful future. In this process, Europe's energy supply will be sustainably transitioned towards renewable energies.

Electricity generation from hydropower offers considerable potential for meeting the ambitious set targets. The multiple advantages of run-of-river, storage and pumped storage power plants make an important contribution to security of supply and guarantee a controllable supply in an increasingly decentralised and volatile generation fleet.

The stable and largely plannable availability of hydropower, the high degree of efficiency, the flexibility within seconds, the storage capacity and the long service life are indisputable advantages for the increased use of hydropower in the future energy mix, which will be dominated by volatile renewable energy sources.

However, most existing hydropower plants have been in operation for several decades. Reliable and safe operation over such a long period of time can only be guaranteed by regular maintenance and

repair measures. The associated costs can be stabilised or, in some cases, even reduced through innovative technological measures. This is a decisive factor for the future competitiveness of hydropower.

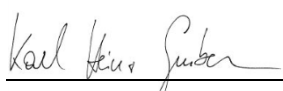
In particular, given the additional legal requirements, there is a pressing need to make significant efforts in order to ensure the stability and efficiency of hydropower while managing costs. It is important to note that the growing expectations for nature conservation and environmental protection, while simultaneously striving to expand renewable hydropower production, serve as just one example of the challenges we face in this regard.

To maintain hydropower's competitiveness over the coming decades, innovative strategies are being jointly developed through the framework of international exchange of experience.

vgbe energy, the international technical association for the generation and storage of electricity and heat offers an excellent platform for expert-level exchange, especially on operation and maintenance.

With the third edition of our "Hydropower Industry Guide", vgbe energy is pleased to provide a comprehensive and up-to-date overview of the latest innovative products and services in the hydropower industry.

We hope you enjoy reading the articles about innovative products and services in the field of hydropower and derive the greatest possible benefit for your future activities.


Dr. Karl-Heinz Gruber

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Managing Director


Dr. Mario Bachhiesl

vgbe energy e.V.
Head of Department
Renewables

Research Information



The Hydropower Industry Guide provides some information on current research activities and projects in the hydropower sector in Europe.

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Importance of hydropower in Europe to mitigate the energy crisis and to serve as a catalyst and enabler for the Green Deal

Global warming is the biggest known threat for the 21st century. The European Union (EU) is pioneering the fight against global warming through the announcement of the European Green Deal, bravely setting an example for other countries and continents to follow. The EU aims to make Europe the first carbon-neutral continent by 2050. To fulfil this objective, solar and wind power will replace oil, gas and coal for electricity generation. However, solar and wind are volatile and not dispatchable energies. For integrating this huge amount of variable renewable electricity into the grid, Europe must also lead the development and integration of the high storage and flexibility capacity of hydropower into the new energy system, efficiently and cost-effectively. To provide an effective contribution to this unprecedented new European Green Deal in a sustainable, efficient, and cost-effective manner, the hydropower sector needs to develop strongly through technical and environmental innovations.

The current energy crisis reveals the importance of an independent electricity supply with high availability. Here the existing hydropower reservoirs already played an important role in helping to overcome the critical situation in the last, as well as upcoming, winters without the risk of blackout. New multi-purpose storage schemes and pumped-storage powerplants will be vital in future for a safe, independent and renewable electricity supply besides other services such as flood and drought protection to mitigate climate change effects. Nevertheless, to tackle environmental, societal, technological and market challenges, the hydropower sector needs to find novel approaches to future development in accordance with environmental and social demand.

1 Status of hydropower development in Europe

Today within Europe, including Turkey, almost 650 TWh are generated in an average hydrological year, which equates to about 65% of the economically feasible hydropower potential (see Figure 1). In recent years, the yearly production of hydropower has stabilized near 650 TWh and the total installed capacity close to 230 GW.

It should be noted, however, that the yearly hydropower production is also influenced by the hydrological situation each year.

Figure 2 shows the situation for hydropower use and untapped potential in different countries within the Europe region. It can be noticed that in many countries there is still considerable potential for development.

In Figure 2, the highlighted countries have developed less than 50% of the economically feasible potential, assuming that the market conditions would allow for it. For 14 countries the share of hydro in the overall electricity generation is between 25% and 50%, for three countries between 50% and 90% and for another two countries higher than 90%.

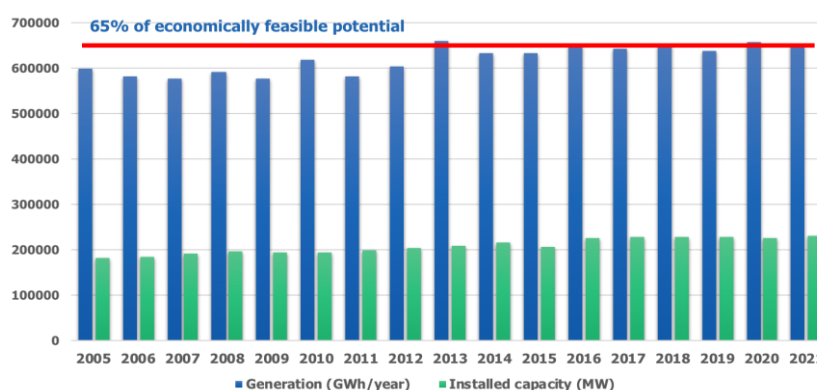


Figure 1. Evolution of yearly production and installed capacity of hydropower in Europe since 2005 (according to Hydropower & Dams World Atlas 2022).

This demonstrates that in more than half of the countries in Europe (as shown in Figure 2) hydropower represents an important share in the electricity generation, which is important for the success of a safe energy transition.

Nevertheless, relatively little investment has been undertaken over the last 15 years, as can be seen in Figure 3 which shows the installed capacity under construction. In 2012, a quite significant increase in the construction of new power plants reaching almost 10,000 MW can be seen. This may be attributed to the Fukushima catastrophe leading many countries to redefine their energy strategy towards renewable sources such as hydropower alongside the planned phasing out of nuclear energy. Since 2015, however, construction activity has been decreasing to some 3,000 MW with an activity above 5,000 MW in 2019.

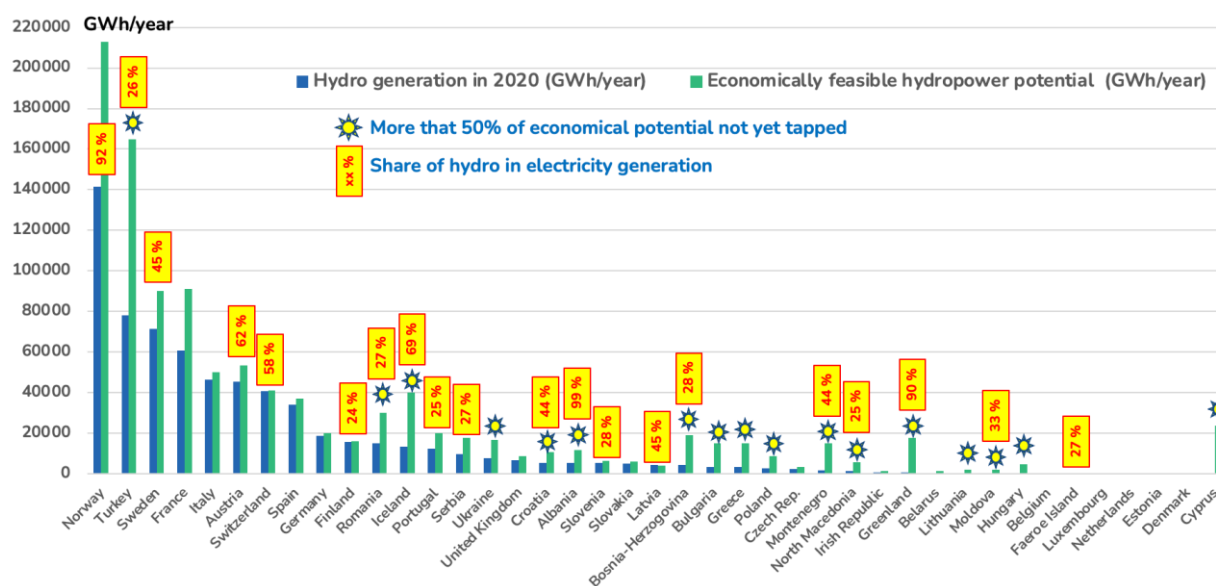


Figure 2. Generation and extension potential of hydropower in countries within the European region (according to Hydropower & Dams World Atlas 2021). The countries having developed less than 50% of their economically feasible potential (assuming market conditions have a demand for it) are highlighted. The share of hydropower in electricity generation is indicated for the countries with a share of more than 25%.

The low investment level around 2021 can be attributed to the fact that electricity prices on the European spot market since a decade were very low due to the following reasons:

- Production capacity in Europe was too high (especially via conventional thermal generators using coal)
- The cost of CO₂ certificates was very low
- The market was distorted due to the high subsidies provided for renewable energy sources such as solar and wind

Thus, under such market conditions hydropower generation was strongly penalized. However, the current energy crisis reveals the important and vital role of hydropower – storage and pumped-storage - to help ensure a safe supply of electricity in the coming winters in Europe. Due to the energy crisis, the attractiveness of the extension and upgrading of existing hydropower plants, with the purpose of making them more flexible through the refurbishment of equipment and increasing storage where possible, together with the construction of new pumped-storage power plants, has increased again strongly in countries with high storage potential.

Furthermore, in many countries, a significant amount of untapped hydropower potential still exists.

However, in view of environmental and socio-economical constraints, the partial use of this remaining potential is extremely challenging and can be reached only through innovative and sustainable solutions for new hydropower plants.

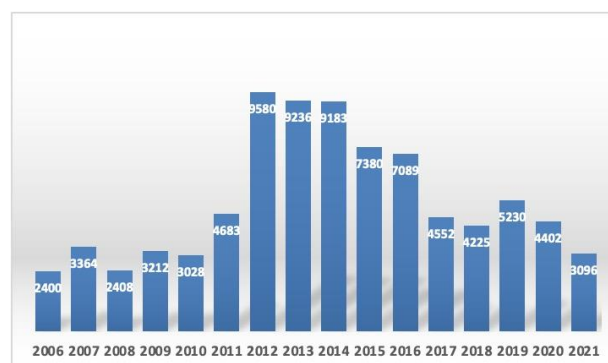


Figure 3. Installed capacity in MW under construction since 2006 (according to Hydropower & Dams World Atlas 2022 without Turkey).

2 Outcomes of the HYDROPOWER EUROPE Forum

The HYDROPOWER EUROPE Forum (<https://hydropower-europe.eu>) was supported by the EC under the Horizon 2020 programme innovative environmental strategies (LC-SC3-CC-4-2018).

The initiative aimed to establish a Forum for conducting an extensive consultation program to support the formulation of a Research and Innovation Agenda, as well as a Strategic Industry Roadmap.

These guides were designed to facilitate the introduction of various innovations within the hydropower sector, with the ultimate goal of transitioning towards an energy system characterized by high flexibility and a significant share of renewable energy sources.

The outcomes of the HYDROPOWER EUROPE Forum show the pathway to the vision for hydropower in Europe defined through wide consultation following four directions:

- Increasing hydropower production through the implementation of new environmentally friendly, multipurpose hydropower schemes and by using hidden potential in existing infrastructures.
- Increasing the flexibility of generation from existing hydropower plants by adaptation and optimization of infrastructure and equipment combined with innovative solutions for the mitigation of environmental impacts.
- Increasing storage by the heightening of existing dams and the construction of new reservoirs, which have to ensure not only flexible energy supply but also support food and water supply and thus contribute to the WEF NEXUS and achievement of the SDGs of the United Nations.
- Strengthening the contribution of flexibility from pumped-storage power plants by developing and building innovative arrangements in combination with existing water infrastructure.

This vision was underlined by the Research and Innovation Agenda (RIA) and the Strategic Industry Roadmap (SIR), which also provide an example for hydropower development worldwide. Eighteen research themes comprising some 80 topics were identified in the RIA (see Figure 4) as well as 11 strategic directions including some 40 detailed actions in the SIR, ranging from regulation framework to social acceptance.

In addition, the work done through the HYDROPOWER EUROPE Forum laid the groundwork for the creation of a European Technology and Innovation Platform for hydropower.

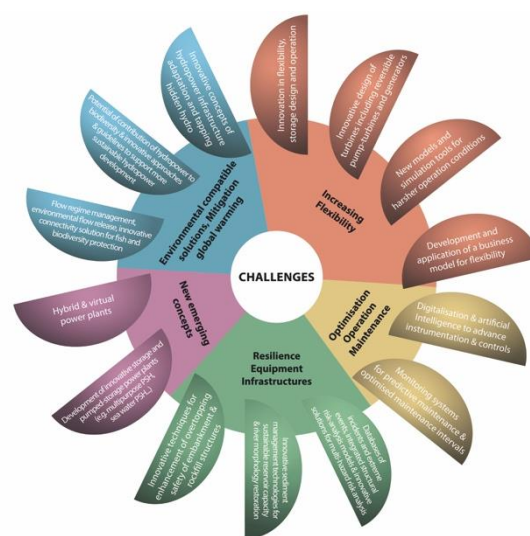


Figure 4. Suggested research themes by HYDROPOWER EUROPE with high to very high priority grouped according to the challenges which hydropower must address.

3 ETIP HYDROPOWER - Unifying the voices of hydropower

A European Technology and Innovation Platform (ETIP) is a community whose primary purpose is to define R&I priorities for its sector. The secondary purpose is to overcome barriers to the deployment of R&I outcomes: e.g., industrial strategy, market opportunities, exploitation of research results, international cooperation, education, environmental and social impacts. There is a need for a unified industry to be represented and recognized at a European level. The HYDROPOWER EUROPE Forum provided a first opportunity to gather some 650 stakeholders representing all the sectors of the value chain. Under the ETIP HYDROPOWER project (<https://etip-hydropower.eu>), the hydropower forum will continue to grow and offers an ideal opportunity to help unify the voices of hydropower in Europe.

ETIP HYDROPOWER will further detail the already developed industrial strategies as well as analysis of market opportunities and research and development funding needs, by deepening the understanding of innovation barriers and exploitation of research results, which are in line with the Recovery Plan for Europe and the latest EU climate and energy related policies.

The ETIP HYDROPOWER has the mission to:

- represent a consolidated and strong network of representatives from industry, academia, research centers, civil society and sectorial associations of the hydropower sector,
- enhance and disseminate the RIA and the SIR taking into consideration the future needs of the sector and R&I targets and emerging policy priorities,
- align and coordinate the industry RIA and SIR strategies to provide consensus-based strategic advice to the European Commission and the SET Plan (European Strategic Energy Technology Plan) covering analysis of market opportunities and research and development funding needs, biodiversity protection and ecological continuity,
- and deepen the understanding of innovation barriers and the exploitation of research results in line with the latest EU climate and energy related policies.

Figure 5 provides a generic representation of the mission and activities of ETIP HYDROPOWER at a strategic level within the hydropower sector. As illustrated by the anchor symbol the ETIP HYDROPOWER can unify and magnify the voice of hydropower to key stakeholders such as the European Commission and other EU institutions. It does not replace existing initiatives; rather it links them, allowing for the presentation of key issues with one voice when appropriate. The job of the ETIP HYDROPOWER is to manage the linking and unified messaging process (arrows in brown in Figure 5). Existing initiatives continue with their own programmes and communications as before as shown in Figure 5 (blue dotted arrows).

ETIP HYDROPOWER has received funding from the European Union's Horizon Europe research and innovation programme under grant no 101075620. Project partners are: International Commission on Large Dams (ICOLD), European Association for Storage of Energy (EASE), European Renewable Energies Federation (EREF), Association of European Renewable Energy Research Centres (EUREC), International Hydropower Association (IHA), Samui France SARL (SAMUI), vgbe energy (vgbe) and ZABALA Brussels SPRL (ZABALA).

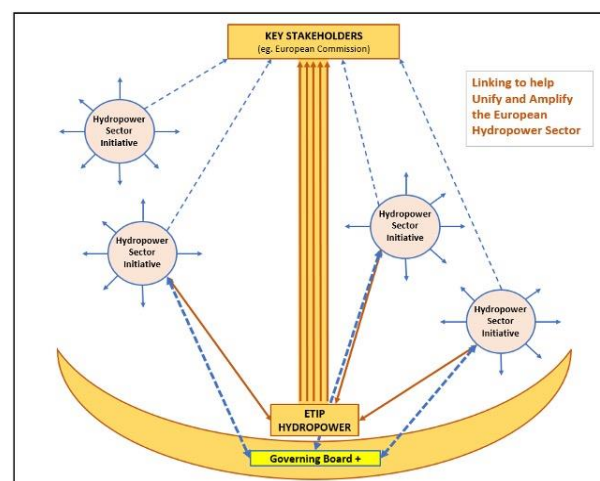


Figure 5. Generic representation of the mission and activities of ETIP HYDROPOWER at a strategic level within the hydropower sector.

The ETIP Hydropower project runs for three years from September 2022 to August 2025 and aims to be a facilitator for unifying the voices of the hydropower sector and to be a recognized interlocutor for the European Commission, Member States and Associated Countries regarding the hydropower sector specific deployment and R&I needs. The purpose of the ETIP HYDROPOWER project is also to prepare for a transition into a sustainable, self-funded organization i.e. association which lasts after the duration of the project.

4 Conclusions

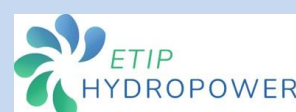
ETIP HYDROPOWER will help to unify the voices of hydropower in Europe and worldwide, to increase public awareness of its catalyst and enabler abilities as well as motivate innovative collaborative research towards environmentally compatible solutions. Besides electricity supply, hydropower can offer other services which are important to help mitigate climate change effects, like water supply, contribution to flood and drought protection with potential for recreational and tourism activities and facilitating navigation on the large rivers.

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Sustainable hydropower opportunities in the European Union (EU) and lead position of EU companies and institutions

Hydropower is a complex system within the Water-Energy-Food-Ecosystem (WEFE) nexus. Hydropower is characterised by several advantages with respect to other renewable energy technologies (e.g., multiple purposes of reservoirs, storage capacity, flexibility), but new hydropower plants may also generate some adverse impacts on the environment. This situation has generated several conflictual views and policy debates, especially in the European Union (EU). In this article, the complexity of hydropower is discussed. Some sustainable deployment strategies of hydropower are presented for the European context, and the global lead position of EU companies and institutions is presented.

1 Introduction

Hydropower is a complex and challenging sector within the WEFE (Water-Energy-Food-Ecosystem) nexus, especially in the European Union (EU). New barriers and dams in freshwater systems (not only for hydropower generation) are perceived as a source of impact in the Water Framework Directive (Directive 2000/60/EC), which is aimed at the preservation or recovery of the “good ecological status” of the aquatic environment. The impacts associated to new barriers can be of different types, e.g., hydrological and morphological alterations, interruption of river continuity and impoundments, amongst others. On the other hand, hydropower is a renewable and clean energy source; its flexible operation and storage capacity allow to integrate the volatile energy production of wind and solar power plants, ensuring flexibility, grid stability and ancillary services. Therefore, hydropower plays a key role in the long-term decarbonisation scenarios and in the renewable energy targets set in the Renewable Energy Directive (Directive 2009/28/EC, REPowerEU).

In the EU, hydropower and wind energy are the renewable energy technologies with the highest share of electricity generation (70%): hydropower contributes for about 33.5% of electricity generation from renewable sources (360 TWh/y, on average, including energy generated by turbines in pumped hydropower storage systems), corresponding to about 12% of the EU’s net electricity generation. This is placed just below wind energy (36.5%) (Eurostat, 2021). Hydropower installed capacity was 151 GW in 2021, a +6 GW increase compared to 2011. The European pumped hydropower storage fleet (PHS) (the 45 GW of turbine capacity in EU PHS are more than a quarter of the global installed one) represents nearly all the EU’s electricity storage

capacity and ensures flexibility to the electric grid.

The hydropower complexity, the policy controversies and the debate between impacts and benefits require a more comprehensive dialog among stakeholders (e.g., industry, academy, institutions, citizenry, associations), especially the large projects. These issues pose the light on the fact that sustainable development is a major challenge for hydropower, because sustainable hydropower requires attention to a wide range of economic, social and environmental objectives. Sustainable hydropower needs to achieve a good balance between electricity generation, social benefits and impacts on the ecosystem and biodiversity.

Within this context, the International Hydropower Association (IHA) has developed the Hydropower Sustainability Standard. The Hydropower Sustainability Standard is a global certification scheme, outlining sustainability expectations for hydropower projects around the world. Continuous R&D activities are also ongoing to develop novel technologies, innovative mitigation measures and more sustainable solutions (Kougias et al., 2019). Furthermore, the JRC of the European Commission conducted the Exploratory activity SustHydro, aimed at estimating the potential of some sustainable hydropower strategies in the EU (see the publications of Quaranta et al., and the EU hydropower report Quaranta et al., 2022). Fry et al (2022) showed the research themes, topics and strategic actions to promote hydropower as a catalyst for the energy transition in Europe.

In this article, some opportunities of sustainable development for the European hydropower sector are discussed and the global position of EU companies and institutions is described.

2 Sustainable hydropower strategies in the EU

Global cumulative hydropower capacity is expected to expand from about 1,397 GW in 2022 to 1,555 GW by 2030 and can reach 2,500 GW in 2050 according to IEA and IRENA. Hydropower is the key technology for an optimal integration of volatile energy technologies (e.g., wind energy and photovoltaics) into the electric grid. Hydropower (together with water & energy storage) capacity needs to increase in the near future, but it has to face several environmental constraints. For the European Union (EU), the energy scenarios estimate an increase of hydropower generation up to about 390-420 TWh/y (Tarvydas, 2022) in 2050, thus an increase of about 30-60 TWh/y with respect to the annual average generation of the last 10 years. This projection means that hydropower will increase slightly. Figure 1 shows the hydropower projects in the pipeline in Europe.

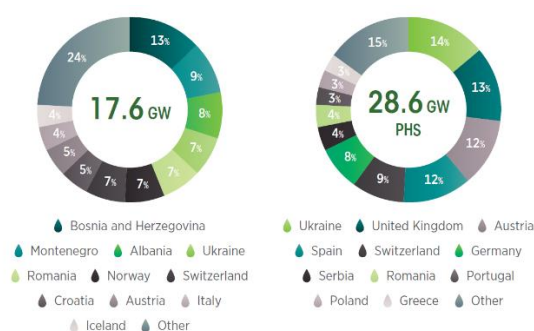


Figure 1. Hydropower project pipeline in Europe, 2022-2037 (IRENA, 2023).

Within this context, Quaranta et al. carried out several assessments to identify the available sustainable hydropower potential in the EU, with a minimal impact on the environment. Table 1 summarizes these hydropower potentials, including also other assessments published in existing scientific studies, focusing on:

- 1) low-impacting technologies and strategies for traditional hydropower generation, i.e., strategies aimed at increasing energy generation with minimal impact on the environment and that do not require additional barriers;
- 2) additional storage capacity that does not involve new reservoirs in freshwater systems;
- 3) additional pumped hydropower storage (PHS) systems.

The modernization of the existing hydropower fleet is an attractive opportunity to increase efficiency, flexibility, sustainability and resilience to climate changes (the average age of the EU fleet is almost 45 years, Figure 2). Quaranta et al., (2021), and later updates (e.g., Dorati and Quaranta, 2023), estimated that the annual electricity generation from the existing hydropower fleet could be increased by more than 10% (~40-50 TWh/y), implementing hydropower digitalisation (including better reservoir management), modern electro-mechanical equipment and new waterways. Dam heightening (useful especially to increase storage capacity), new waterways to increase the peak installed capacity, and a better reservoir management to reduce spills, are additional strategies to increase efficiency, generation and flexibility.

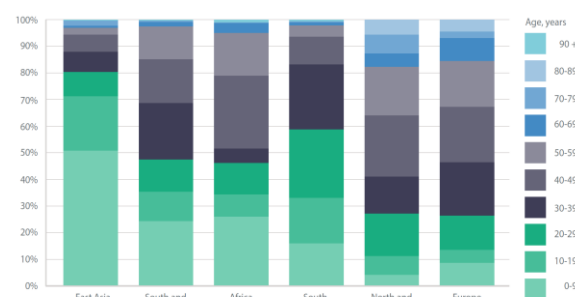


Figure 2. Age of hydropower plants in different geographic contexts (IHA, 2023).

The potential of new hydropower developments in existing infrastructures, e.g., in water distribution networks (aqueducts), in existing low head barriers (e.g., water wheels in water mills) and in wastewater treatment plants is environmentally sustainable, as it does not generate impacts in the environment (Punys et al., 2019; Quaranta et al., 2022b). Benefits of hidden hydropower integrated in existing facilities are several, e.g., they can provide decentralized energy when the electric grid is not available, difficult to be connected or to avoid further expansion of the grid. The technical potential associated to these technologies is estimated at approximately 12 TWh/y in the EU, which is, anyway, non-negligible. Also hydraulic infrastructures in the private water intensive industry, such as mining or energy production (using cooling waters) host hidden hydropower potentials. Hydrokinetic turbines exhibit a low potential, but could represent an interesting strategy when installed at the hydropower plant tailrace (Quaranta and Muntean, 2023).

Stocks et al., (2021) estimated that the additional potential associated to closed loop pumped hydropower storage (PHS) in Europe is 260 TWh, among which 19 TWh are the cheapest sites and 67 TWh refer to the most expensive sites. Indeed, one of the most limiting factors in the potential use of large-scale PHS is that not many locations could offer economically viable deployment, thus new PHS capacity addition in the EU will be hard to be increased, due to environmental and geographic constraints. The assessments of Stocks et al. did not consider restrictions on population, land use, biodiversity, transmission, etc., thus it assesses the existing potential and not its viability.

Therefore, a real technical opportunity for PHS expansion is expanding the operating range. By introducing smart sensors, variable speed turbines with increased efficiency and system optimization to new or existing PHS, the overall PHS utilization can increase. Countries with redundant energy generation could sell their services to neighbouring countries. Opening up cross-border markets for balancing capacities could also serve as an important incentive to increase the use of the existing PHS capacity. Reservoir interconnection, virtual energy storage gains resulting from the spatio-temporal coordination of hydropower over Europe and the upgrading of existing PHS are other sustainable and viable opportunities for pumped hydropower and to balance generation variability. Looking at these less impacting solutions, the potential achievable by interconnecting reservoirs within 20 km is +4 TWh in the EU (+20 TWh/y of energy generation potential, estimated) and +29 TWh in Europe (Gimeno-Gutiérrez and Lacal-Aránz, 2017). However, if a maximum distance of 5 km is considered, the energy storage potential reduces to 140 GWh. Spatial coordination can virtually increase energy storage by 140 TWh in Europe (Wörman et al., 2020). Underwater PHS, low-head energy storage (Hoffstaedt et al., 2022) and underground PHS using abandoned mines are under investigation. Energy could be stored using existing lakes, small depressions or retention basins on a terrain in sustainable urban drainage systems. In France, the potential of PHS from small lakes and reservoirs was estimated to be about 33 GWh, which is almost a third of the current national energy storage capacity (Rogean et al., 2017).

Additional strategies to increase generation include hybridization of hydropower with other energy technologies. For example, run-of-river plants can produce hydrogen when energy prices fall to zero. Batteries can ensure energy storage for several hours, whilst hydropower can store and release energy for days and weeks, including seasonal transfer, and can be integrated together. Reservoirs can host floating PV, or PV could be installed on dam surfaces. Methane capture processes are under investigation, but R&D is further needed to improve cost-effectiveness (methane emission is relevant especially for tropical reservoirs).

Hydropower technology/strategy	Potential (TWh/y)
Hydropower plant modernization	40-50
Existing historic barriers not mill-related	5.2
Hydropower in pressurized water and wastewater systems	3.1
Water wheels in existing mills	1.6 (3.5*)
Rainfall on building roofs	0.5
Hydrokinetic turbines in rivers	<1.2
Hydrokinetic turbines in hydropower tailrace	1.4
Pressurized conduits for irrigation and industrial flows	<0.1
Floating PV (evaporation reduction)	<0.1
Closed loop hydropower	19 TWh
Spatio-temporal coordination of reservoirs	140 TWh
Reservoir interconnection	0.14 TWh
Sea water PHS	t.b.d.
PHS in mines	t.b.d.
Heat recovery from generators	2.9
Floating PV on hydropower reservoirs	139

Table 1. Sustainable hydropower potentials in the EU. See Quaranta et al. (2022) for further details. * if using also other turbine types.

Hydropower offers room for digitalization, real-time and remote control, that are emerging strategies to support the EU digital and green transition. Digital solutions can be implemented both for monitoring and enhancing quality of the surrounding environment (e.g., water discharge, water temperature and quality, fish habitat, water levels, Quaranta et al. (2023)), for improving the overall efficiency and supporting Operation and Maintenance activities.

3 Lead position of EU companies in the global hydropower sector

EU companies and institutions are global leader in the hydropower sector, both due to their scientific achievements and thanks to the high quality of their products, that are exported all over the world.

In terms of scientific publications, the hydropower knowledge production in the EU is the highest, globally, after China. A bibliometric analysis using the Scopus dataset shows that the number of records (research articles) concerning the word "hydropower" (within the Title, Abstract, Keywords) has been increasing in the past five years (from 1,648 in 2017 to 2,412 in 2021). Between 2017 and 2021, EU institutions participated in the publication of 2,123 articles (out of the total 10,392), led by Germany (405), Italy (268), Spain (255), Sweden (192) and Austria (187), and China is the world leader with 3,879 records (1,187 for the U.S.). Norway (378 publications), Switzerland (304) and the U.K. (506) are also lead scientific contributors. EU-based institutions participated in the publication of 70% of the highly cited papers. This is an indication of the important role of the EU in supporting R&D activities (Quaranta et al., 2022).

The EU hosts about 28% of the innovative companies (analogously to the U.S.). Although China is the main patent leader (partially also due to the different patenting procedure in the country), the EU, Japan and South Korea perform almost similarly, and slightly better than the U.S. During the period 2010-2019, the patent activity in EU has registered 471 entities from companies, 18 from non-profit organization or government institutions, 48 from Universities, while 56 are from individuals. The EU holds 33% of all high-value inventions globally (2017-2019), with Germany, France and Finland the main contributors (Quaranta et al., 2022).

Novel technologies are under investigation and implementation in European hydropower plants, often supported by projects funded by the European Commission (EC) (e.g., Horizon, Interreg projects, among others). Some of these are dedicated to mitigation strategies and less impacting technologies (e.g., FITHYDRO), while others are trying to make hydropower more resilient to climate changes and more flexible (X-FLEX), or aimed at tapping hidden opportunities (e.g., in water distribution networks, REDAWN).

Novel technologies are under investigation to integrate hydropower generation with other technologies and energy sources.

The large European operators continue to invest in many hydropower projects outside of Europe, while manufacturer companies have a great export potential. There are several large construction companies which have a worldwide activity in hydropower and dam projects. Many European engineering and consultancy companies offer knowledge, expertise, or consulting to hydropower projects outside of Europe. The global hydropower equipment exports within the period 2019-2021 accounted for EUR 2 billion, with EU countries holding almost 50% of this (China accounted for EUR 376 million of exports in the period 2019-2021) (Quaranta et al., 2022). Based on R&D investments and high-value inventions, innovative companies can be identified, and Figures 3, 4, 5 show this data (Quaranta et al., 2022).

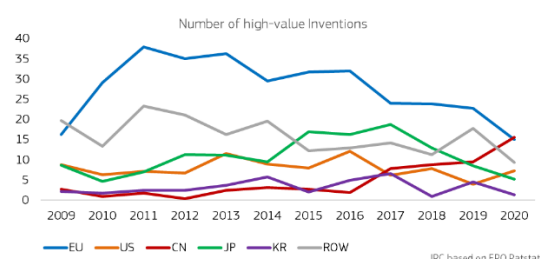


Figure 3. Number of high-values inventions for different countries.

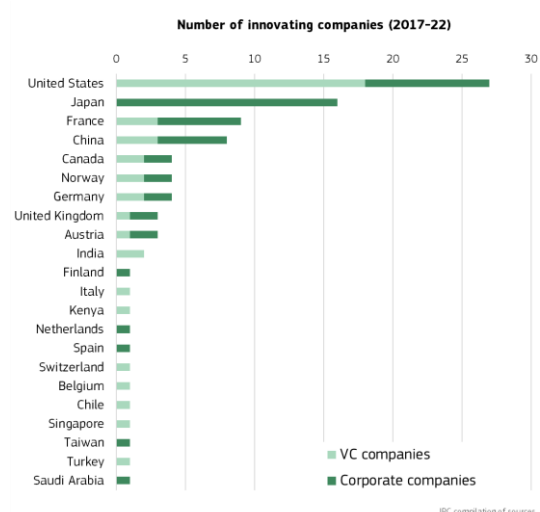


Figure 4. Countries hosting the most innovative companies in the world.

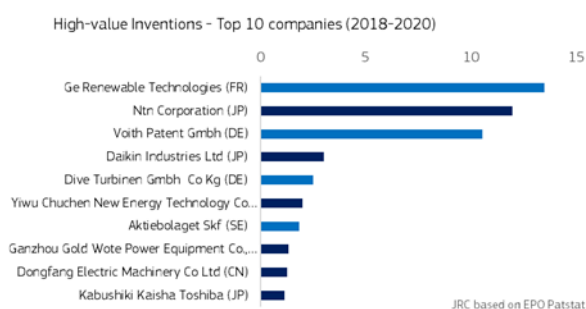


Figure 5. High-values inventions Top 10 companies in the world.

4 Conclusion

Hydropower is the largest renewable energy source to date, with a global installed power capacity of 1,397 GW and an annual generation of 4,408 TWh in 2022. Hydropower provides, on average, 360 TWh/y in the EU, and a quarter of the global pumped hydropower storage (PHS) turbine power capacity is in the EU.

The hydropower sector is characterized by several strengths and advantages with respect to the other renewable technologies. Hydropower is the most flexible technology, providing flexibility and stability services to the grid. As the penetration of volatile energy sources (mainly wind and solar power) increases, the flexibility provided by hydropower operation is essential. PHS is a mature technology and, as a result, its technological and manufacturing/market position is considerably more advanced than that of other energy storage technologies (e.g., battery storage, flywheel, thermal and chemical storage). PHS can store water-energy (with daily, monthly and seasonal storage depending on the installed capacity) more cost-effectively than any other option, and can put and adsorb energy available in seconds or few minutes.

In the EU there is still room for new hydropower developments, and the main potentials that were identified consisted in the modernisation of the existing fleet and in the retrofitting and repowering of hydraulic infrastructures. By tapping this potential, it is possible to substantially contribute to the hydropower energy projections. New PHS developments are also possible, although the remaining available sites are the least economical, and hence new technologies and strategies have to be

developed (e.g., interconnecting reservoirs, spatio-temporal virtual interconnection, upgrading).

Companies within the EU are very competitive, and are of strategic relevance especially in light of the current geopolitical situation. European companies own a great export capacity of their products and knowledge in the fields of sustainable and mitigation solutions, new turbine technologies and in the O&M, exerting their consulting services worldwide. 47% of the high-value inventions of the top-10 companies is shared by two EU companies. Furthermore, the EU is well positioned in terms of scientific publications, with the main concurrence of China. The global exports in 2019-2021 accounted for EUR 2 billion with EU countries holding approx. 50% of this. Outside China, the three EU-based companies delivered 73.5% of the total orders in terms of capacity (2013-2017).

Therefore, to keep a competitive EU hydropower sector in an increasingly challenging world (including for energy crises ahead and the competitiveness of China), the strong competence (scientific and industrial) of EU companies and institutions is key. Dialog and cooperation with some non-EU European countries, which highly rely on hydropower, are strongly encouraged, such as Norway and Switzerland. It is essential to increase public awareness about the benefits of hydropower, as a required catalyst for a safe and independent energy transition, that is key to securing the European Green Deal.

A better communication between stakeholders (e.g., institutions, academy, industry and citizenry) and experts (e.g., engineers, environmental experts, ecologists, ichthyologists, hydrologists, economists and geologists) and a transparent process to find a balance between different policy targets, impacts and benefits, and conflicting interests of multi-purpose reservoirs, are essential.

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Digitalising the European water and hydropower sectors

Digital technologies delivered about EUR 300 billion in capital and operating expenditure savings in the global water industry in 2016–2020, targeting water segments such as the treatment of wastewater, distribution, customer management and metering of drinking water. The most widely used digital tools include real-time monitoring, modelling approaches to support decision making and optimization measures, for example in energy consumption and data-based decisions. The three main water sectors, which are significantly affected by digital tools, that are discussed in this article are Water Distribution Networks (WDNs), Wastewater Systems (WWs) and Hydropower. The benefits of digitalisation that were here assessed were quantified in EUR 5.0, 0.14 and 1.7 billion per year, respectively, excluding environmental and social benefits, which may play a non-negligible role.

1 Introduction

Digital technologies are shaping our world and are at the centre of policy and technological developments worldwide. Digital technologies generate technical, economic, environmental and social benefits. In the social sphere, digital infrastructure and rapid connectivity bring new opportunities. Digitalisation can connect people together independently of where they are physically located. Digitalisation can allow people to reach out beyond specific territories, explore and fulfil ambitions, interact with public administrations, manage their finance and payments, make use of health care systems, automate transport systems, participate in democratic life, be entertained or meet and discuss with connected people anywhere in the world. Digital solutions will create new opportunities for businesses, encourage trustworthy technology, foster an open and democratic society, enable a vibrant and sustainable economy, and help fight climate change effects. Digital solutions are bringing significant benefits especially in the water industry, which is the topic of this article.

The digital transformation is of high relevance, especially in the EU water sector, which is currently facing several challenges. In the past 50 years, water demand has continuously increased on the back of a steadily growing population and economic growth. The amount of water resources per capita has already dropped by 24% and water scarcity affects almost 20% of the EU territory. About 40–60% of water is lost globally in terms of non-revenue water, an indicator for water that has been produced and lost before it reaches the customer. In the EU, the average water losses in water distribution networks (WDNs) are 23% of the total water introduced in WDNs.

Therefore, there is now an established awareness on the importance of water conservation

strategies, for example, by closing water loops, reducing water import and export, converting storm water and other potential hydric sources into a reliable and sustainable water supply, reducing water losses (e.g., in water distribution networks), enhancing water recycling and better managing multi-purpose reservoirs.

In this context, digital technologies delivered about EUR 300 billion in capital and operating expenditure savings in the global water industry in 2016 – 2020, targeting water segments such as the treatment of wastewater, distribution, customer management and metering of drinking water, for example through real-time monitoring, modelling approaches to support decision making, or optimization measures in energy consumption. Closely related to the digital revolution is the emergence of new applications for Big Data technologies. Rapid advances in affordable sensors, high-resolution remote sensing, communication technologies, and social media are opening new opportunities for data collection, including real-time monitoring. Big data analytics combined with artificial intelligence (AI) and machine learning can better support data-based decisions with high accuracy and less computational cost.

The exploratory study Quaranta et al. (2023) explored the market opportunities of digitalisation in the European Union (EU)'s water sector and sought to quantify some economic benefits at the Member State level. The aim of this large-scale analysis (country and EU scale) was to carry out a screening-level assessment of the possible economic benefits of digitalisation to support the policy-making process. The investigated three water sectors are water distribution networks (WDN), combined sewer systems and hydropower plants.

2 Water distribution networks

A water distribution network (WDN) is a net composed of nodes, where water is injected or collected, and pipes where water flows. Water losses (leakages) are the main problem in WDNs, mainly due to poor maintenance/management and due to leaks and pipe breaks. Through digital technologies, it is possible to monitor and detect these losses in real time, acting quickly to correct the problem. In addition, digitalisation allows the implementation of real-time water flow measurement systems, which allow supply system managers to monitor demand and water consumption in real time. Digitalisation also allows to identify patterns of water consumption by different categories of users, which can be used to predict and avoid failures in the distribution system. The lost water from distribution systems over the world can meet the demand of 200 million people, and the energy consumption for treating 1 m³ of water is 0.6–12 kWh and varies depending on the source of water. On average in the EU, a 5% decrease in water distribution system leakage would save 313 million kWh of electricity annually. This is equal to the electricity usage of over 31,000 homes. It would also avoid the emission of approximately 225,000 metric tons of CO₂.

3 Wastewater systems

Combined wastewater sewers are designed to collect the dry weather flow, consisting of sewage from households, industrial discharges and seepage of groundwater, into the sewers, together with urban runoff, and convey a certain amount of the combined flow to a wastewater treatment plant (WWTP). A WWTP generally receives a discharge of 4–6 times the average DWF in order to ensure the design pollution removal efficiency of the treatment process, although in some cases, it can be >6. When the sewer network discharge exceeds the conveyance capacity of the network, the overflow is released into the environment. Combined sewers are a widespread reality in the world and in the European Union. Pollution from combined sewer overflows (CSOs) exerts a significant pressure on the receiving water bodies and raises concern as a water management challenge (Quaranta et al., 2022).

Real-time control (RTC), by means of digital solutions (digital twins), is emerging as a water management strategy for the reduction of CSOs, as it allows for the better operation of hydraulic structures, such as gates and storage tanks within the sewer network.

In Denmark, the entire water cycle of Aarhus's wastewater treatment plant became energy neutral thanks to big digitalisation investments. Carbon footprint was also cut down by 35% through the installation of sensors, new variable speed drives and advanced process controls.

4 Hydropower

The hydropower sector is highly interconnected with the environment and with our society, especially the hydro schemes equipped with large water reservoirs. Thanks to its flexibility, hydropower allows for the integration of volatile energy sources (wind and solar energy) and can also be hybridized with other energy technologies (e.g., floating photovoltaics and batteries). Hydropower is a clear example of the so called water–energy–food–ecosystem (WEFE) nexus.

Digital solutions can be implemented both for monitoring and enhancing the quality of the surrounding environment (e.g., water inflow and discharge, water temperature and quality, fish habitat, water levels), for improving the overall efficiency (Table 1) and supporting the operation and maintenance sector, predicting and detecting possible damages and failures (Table 1). Digitalisation can reduce costs and increase resilience against physical and cyber threats.

The energy-associated benefits typically correspond to an increased efficiency (e.g., due to a better load distribution among the turbine units), less shutdown periods and less water spills thanks to a better inflow forecast and reservoir operation (Kougias et al., 2019; Quaranta et al., 2023b). Table 1 shows that the efficiency increase entailed by the implementation of digital solutions typically ranges between 0.5% and 2%, while the increased generation from reservoir management improvement can reach +10%.

Benefit Type	Benefit Value
Efficiency	+0.5% +0.8% (better loading of turbine units)
Efficiency, water availability	+1% of efficiency and -11% spill reduction
Efficiency	+2%, Kaplan-Bulb, by machine learning
Cost reduction	cost savings over 8 months due to the prevention of unplanned shutdowns were estimated in the range of 25 kEUR to 100 kEUR for a 1000 MW plant (Francis turbine)
Energy, cost saving	Globally, +42 TWh (+1%) +annual operational savings of USD 5 billion
Efficiency, water availability, revenue	+1% efficiency, -11% spills, +10% revenue

Table 1. Some benefits of digitalisation. For details see Quaranta et al. 2021.

5 European estimate of benefits brought by digital technologies and challenges

Quaranta et al. (2023) carried out a preliminary/tentative estimation of some benefits entailed by digital technologies implementation in the European Union (+UK), including leakage reduction in WDNs, reduction of CSOs and improved hydropower (and reservoir) operation. The quantified benefits are EUR 5.0, 0.14 and 1.7 billion per year, respectively, excluding environmental and social benefits, which may play a non-negligible role, but which are very hard to estimate in a large-scale study. The benefit to population ratio ranges from 1.1 EUR/person/year (Belgium) to 59.1 EUR/person/year (Sweden), with an overall average EU aggregated value of 13.2 EUR/person/year (including the UK). The MS with the highest monetary benefits are Italy and France (and the UK).

However, digitalisation also comes with costs and challenges (Quaranta et al., 2023; Stein et al, 2022). To foster the digital transition, a 2020 estimate shows that additional investment of around EUR 125 billion are needed per year in the European Union, that corresponds to 280 EUR per year per EU citizen. Data usage and consumption also come with an environmental cost, which is associated with water and energy consumption in data centres, and to the rare earth material needed to produce the electronics. In 2021, the average European citizen used around 187 GB of data, which increased by 32.4% from 2020.

Future projections to 2030 foresee that the use of digital technologies would increase water consumption to 0.8 m³ per person per year and energy consumption to 171 kWh per person per year in Europe, which correspond to EUR 19.7 per person per year. At present, digital technologies account for between 8-10% of our energy consumption, and 2-4% of our greenhouse gas emissions. Digital technologies are subject to security attacks (physical attacks on sensors, cloning, data theft, high dependence to centralized servers). Other challenges are related to the integration of up-to-date advancements in the IT sector on existing and operating stations that currently use obsolete systems. However, data acquisition is not an easy task: for example, in the EU, the number of monitoring points found today in drinking water networks ranges from zero to about five per 100,000 inhabitants, which is still extremely low.

6 Conclusion

The green and digital transitions are two interconnected issues that are at the centre of policy and strategic debates in the European Union. Digital technologies entail several economic, environmental and social benefits. In this contribution, a preliminary and screening-level assessment was carried out to quantify some economic benefits entailed by the application of digitalisation in the water sector, with a focus on water distribution networks, combined sewer systems and hydropower.

The benefits are calculated for each EU Member State (MS), and then aggregated at the EU scale. The UK was also included. Benefits were quantified in EUR 5.0, 0.14 and 1.7 billion per year, respectively, excluding environmental and social benefits, which may play a non-negligible role, but which are very hard to estimate in a large-scale study. The MS with the highest monetary benefits are Italy and France (and the UK). The benefit to population ratio ranges from 1.1 EUR/person/year (Belgium) to 59.1 EUR/person/year (Sweden), with an overall average EU aggregated value of 13.2 EUR/person/year (including the UK). The benefits included leakage reduction in WDN, reduction of CSOs and improved hydropower (and reservoir) operation. The associated social and environmental benefits were not quantified by this study; nonetheless, we show that the quantified benefits can cover a large portion of the costs associated with data use.

However, digital solutions also present some challenges. These challenges should foster additional research on this topic, both to support policy-making strategies and technology implementation. Further research should be carried out to estimate the transversal benefits of digitalisation and to highlight how costs and benefits could be affected by a changing world, in particular by climate change, geo-political conflicts, energy crisis and water scarcity.

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- Local Energy Communities
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The AIT Center for Energy positions itself as a competent partner in questions of digitalization of electrical energy supply. Digital innovations are investigated within the scope of cooperative research together with manufacturers, network operators and energy suppliers. Our strength is the precise knowledge of specific system requirements in the energy domain, and at the same time scientific competence in the field of the digital methods used, such as virtualization, digital twins, data analysis, Internet-of-Things technologies, ICT architectures, cyber security and co-simulation of ICT and power networks. We work on the further development of scientific methods and tools for automated development processes with a focus on validation methods for digital system solutions and new functionalities. This empowers operation and maintenance personnel to keep initiative to optimize costs and minimize unplanned downtime.

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ANDRITZ has a leading position in the growing modernization, refurbishment, and upgrade market for existing hydropower plants.

Pumps (for water transport, irrigation of agricultural land, and applications in various industries) and turbogenerators for thermal power plants are also assigned to this business area.



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ANDRITZ HYDRO GmbH

Let's connect

Synchronous condensers for EnergyConnect, Australia and some more ...

The synchronous condensers provided by ANDRITZ will be part of EnergyConnect, the new interconnector between South Australia and New South Wales. EnergyConnect is a new 700 km transmission line and will significantly increase the power transmission capacity between the two regions. In addition, it will make the electricity supply more reliable and support Australia in its transition towards renewable energies. Completion is expected by 2024.

The new interconnector will be equipped with the two synchronous condenser plants Buronga and Dinawan to provide system strength services including synchronous inertia. These services are needed to provide grid stability and will allow to connect additional largescale renewables, such as wind and solar, into the National Energy Network.

Each plant will be equipped with two salient pole synchronous condensers, each with a rated capacity of 120 MVA. The features of the synchronous condensers allow the operator to manage the reactive power of the network (+100/- 50 MVar) at 330 kV, in addition to services such as short circuit contribution, fault level support and large amounts of synchronous natural inertia.

In September 2022, the first condensers have successfully undergone the factory acceptance test in our facilities in Weiz, Austria.

In November 2022, further contracts for a 300 MVar condenser in Australia and another with 150 MVar in Brazil were signed.

[Read more](#)



ANDRITZ' synchronous condensers are a cost-effective and reliable solution for new grid requirements. They help balancing the increasing volumes of variable renewable energy and a corresponding loss of system inertia, hence providing important grid stability and a secure electricity supply.

For more information, please contact

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ANDRITZ HYDRO GmbH

Strong partners for decarbonization

Solar PV, Wind ... and Pumped Storage

Hydro Power from the Desert - Dubai, Hatta

Dubai has the clear goal to diversify the emirate's energy mix and increase the share of renewable energy from the current level of 7 to 75% by 2050. To achieve this ambitious target, DEWA decided not only to increase the share of power generation from renewable sources, but also to build the necessary hydro-pumped storage capacity required to balance the volatility of these renewable energy sources.

Hatta is the first project of its kind on the Arabian Peninsula. The concept is based on a shaft-type powerhouse close to the existing reservoir, built by STRABAG. It hosts two pump turbine and motor-generator units with a capacity of 125 MW each. Capable of producing a total net power of 250 MW over a six-hour generation cycle in turbine mode and a 7.4-hour storage cycle in pumping mode, the project provides an overall storage capacity of some 1,500 MWh. Due to the relatively limited reservoir capacities, the available head varies significantly, changing between 175 and 125 m during the charge-discharge cycle. To overcome this large head variation while keeping the units running at a high efficiency over the complete cycle, both pump turbine units are equipped with double-fed asynchronous motor-generators. They allow the units to operate at variable speed.

Startup is expected for the first quarter of 2024.



Transport of first MIV from our factory in Ravensburg in August 2022.

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Wises and Eldridge Pits act as the upper and lower reservoirs
Copy right: Genex Power

Kidston pumped storage plant, Australia.

Featuring an innovative approach to integrating of solar power, wind and low-cost energy storage, Kidston is set to be the world's first co-located solar pumped storage hydropower plant. Located in an abandoned gold mine in Queensland, Australia, once complete it will deliver 'Renewable Energy on Tap'. ANDRITZ is supplying all electro-mechanical and two 125-MW reversible pump turbine units as well as full operation and maintenance services of more than 10 years. The plant will be fully managed by ANDRITZ and remotely connected to the ANDRITZ control center in Schio, Italy.

After completion in 2024, the Kidston project will generate enough electrical energy to supply approximately 280,000 households with clean and sustainable energy, the equivalent of taking 33,000 cars off the road.

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Pinnapuram pumped storage plant, India.

Another large-scale hybrid pumped storage hydropower and renewables development is underway in India.

The world's first gigawatt-scale integrated renewable energy storage project, the Pinnapuram Pumped Storage Plant in the state of Andhra Pradesh consists of a 1.2 GW pumped hydro storage plant, a 3 GW solar plant, and 0.5 GW wind park all in close proximity.

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Hand in Hand, Agile and Predictive

A Milestone in Innovative O&M Approaches

Cerro del Águila (500 MW), Peru

Cerro del Águila HPP was equipped by ANDRITZ and commissioned in 2016.

Now, under a new long-term O&M contract, ANDRITZ is providing a Metris DiOMera platform and all related services. The ANDRITZ "Smart Spares" concept has been specified by the customer. This forecasts the delivery of a selected volume of spares which is kept available at the Cerro del Águila site and is available to be used on demand by means of an innovative "Use and Stock" mechanism.

The most relevant aspect of this O&M agreement is the implementation of an "Integrated Maintenance" concept. It helps to forecast rehabilitation works for major components such as all the plant units, valves and so on. For the first time in the hydropower business, this new model provides a guarantee for KPIs in the period between major service intervals.

ANDRITZ guarantees core client KPIs like annual water availability under well-defined and measured constraints such as limits on operations, sediment contents and so on. Digitalization is the key enabler for this new concept.

In Sept 2022 our team closed with full success the major maintenance of Unit 1, having completed the works in 16 days versus the contractually foreseen 33 days.

All information collected in Cerro del Águila, is sent via secure online communication to the ANDRITZ Hydro Global Control Center (GCC) in Schio, Italy, and analyzed there based on sophisticated mathematical models and algorithms by ANDRITZ experts with decades of experience.

Metris DiOMera becomes an important tool to make well-founded predictions of future output and expected wear on basic components, such as bearings, runners or generators:



With the Global Control Center (GCC) ANDRITZ Hydro has established an advanced remote monitoring and control center for worldwide operations and maintenance

For more information, please contact
mario.arquilla@andritz.com

ATLANTIUM Technologies Ltd.

**The leader in non-chemical, environmentally friendly
biofouling control of invasive mussels.**



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info@atlantium.com

Member of vgbe energy | Hydro Power

For more than a decade Atlantium Technologies has been working to apply our environmentally sustainable Hydro-Optic™ (HOD) ultraviolet (UV) disinfection technology to help hydroelectric facilities prevent biofouling from invasive mussel species and their profound operational effects.

In large numbers, mussels (zebra, quagga, golden etc.) can devastate aquatic biodiversity and water quality. And because they can attach to and quickly clog up water intake and delivery pipes and foul dam intake and pipes, and the decay of dead mussels can corrode steel and cast-iron pipelines, they pose substantial economic headaches. Particularly at risk are hydropower facilities, whose power production can be severely hampered by mussels that can latch onto intake structures and trash racks, penstocks, gates and valves,

cooling water systems, raw water fire protection systems, service and domestic water systems and even instrumentation.

Long-term and full-scale commercial evaluation of Atlantium's HOD UV technology has been completed with facilities across Australia, Canada and the United States.

The HOD UV technology has achieved extraordinary efficacy in settlement control and mussel mortality not seen with traditional UV. The HOD UV solution is proven to control aquatic invasive species, such as invasive mussels, with the ability to achieve 100% inactivation even under conditions with less than 50% UV transmittance (%UVT). Before the introduction of the HOD UV technology to provide mussel prevention, hydroelectric facilities were predominantly reliant on chemically-based prevention or manual cleaning technologies.



Atlantium's Hydro-Optic™ (HOD) UV achieves 100% inactivation of invasive mussels even under conditions with less than 50% UVT.

Atlantium Technologies Ltd.

Reclamation Showcase

Most notable has been the extensive review undertaken by the U.S. Bureau of Reclamation (Reclamation) Lower Colorado Region who began a series of feasibility studies in 2007 to assess risk from mussel fouling, outline best low-ecological- impact management practices for coping with invasion, and identify control options for raw water systems to prevent invasion and infestation.

Following their review of various chemical and non-chemical treatment methodologies, in 2013.

RECLAMATION

Managing Water in the West



Reclamation selected the HOD UV technology as their preferred treatment option. The HOD UV technology was installed at Davis Dam in 2013, Parker Dam in 2015 and Hoover Dam in 2018.

In April 2019, the Bureau of Reclamation's Science and Technology Program selected the research project, "Control of biofouling in hydropower cooling systems using hydro-optic ultraviolet light," as Project of the Year.

And continuing with the recognition, in July 2019 Reclamation's Parker Dam was awarded the 2019 Top Water Plant award by POWER Magazine.

In addition to Reclamation, leading environmentally-oriented companies such as Ontario Power Generation, the US Army Corps of Engineers, the Salt River Project and more have selected the HOD UV treatment solution to help prevent mussel infestation given its safety and proven performance.

Ontario Power Generation Profile

The Ontario Power Generation (OPG) DeCew II Generating Station, a hydroelectric generating station with a nameplate capacity of 144 MW, undertook an evaluation of innovative environmentally friendly and cost-effective methods to control invasive mussels without the use of hazardous chemicals.

As a result, OPG installed and commissioned a HOD UV system in 2017 to undertake a six-month pilot study of a full-scale demonstration of this non-chemical and sustainable disinfection method to control invasive mussels at DeCew II.

Atlantium Technologies Ltd.

During the six months of operation, no viable individual mussels settled in the test biobox while settlement was recorded in the control biobox. The results demonstrated that the HOD UV system is providing settlement control within DeCew II generating station and that the system met and exceeded the treatment objective of achieving 95% control of settlement. This result was achieved under varying UVT conditions ranging as low as 49.79% UVT and as high as 98.99% UVT.



Atlantium's Hydro-Optic™ (HOD) UV demonstration unit installed at OPG DeCew II Generating Station.

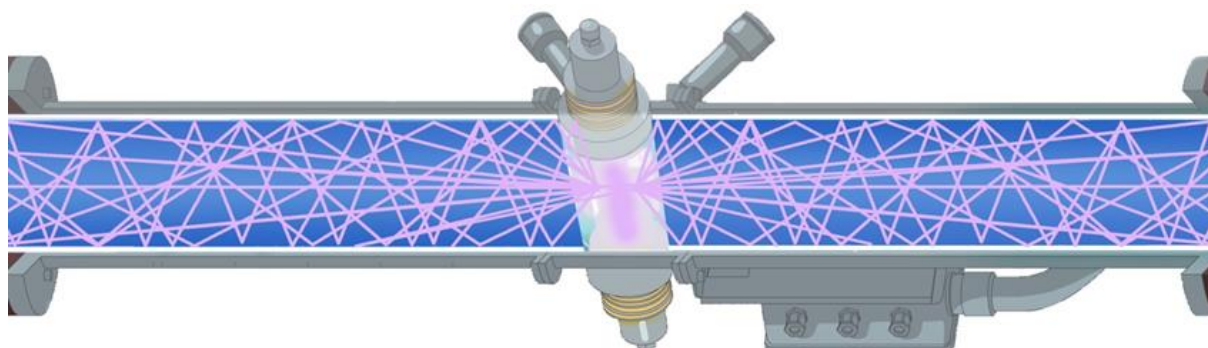
Why HOD UV?

Unlike chemical treatment approaches, UV systems employ a physical process for disinfection. When bacteria, viruses and protozoa are exposed to the germicidal wavelengths of UV light, they are rendered incapable of reproducing.

HOD UV systems feature the unique Total Internal Reflection (TIR) technology that recycles UV light energy, ensures homogenous UV dose distribution and provides superior power (kW) efficiency compared to traditional UV. The system's patented TIR technology, which is similar to fiber optic science, recycles UV light energy within the HOD UV chamber. The core of the technology is its water

disinfection chamber made of high-quality quartz surrounded by an air block instead of traditional stainless steel.

This is especially important given that in traditional UV systems metal adsorbs or "detracts" the UV dose the closer it gets to metal, whereas the TIR enhances the UV dose. This configuration uses fiber optic principles to trap the UV light photons and recycle their light energy. The photons repeatedly bounce through the quartz surface back into the chamber, effectively increasing their paths and their opportunities to inactivate microbes.



Atlantium's medium pressure Hydro-Optic™ (HOD) UV lamp and chamber. The system's patented Total Internal Reflection (TIR) technology recycled UV light energy within the HOD UV chamber.

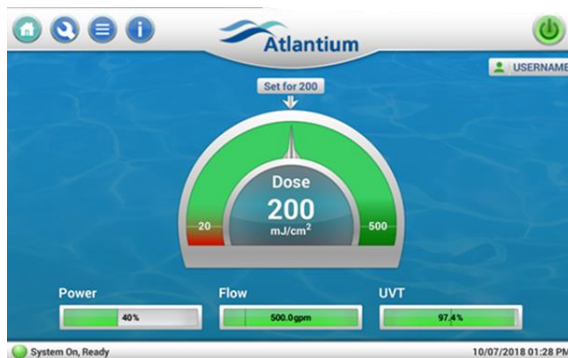
Atlantium Technologies Ltd.

Real-time Monitoring and Control

HOD UV features a comprehensive control and monitoring system. Atlantium's proprietary UV system includes a dedicated UV sensor per lamp, integrated UVT sensor and feed from a flow meter to maintain the required UV dose to meet application specific needs. This is a feature unique to the HOD UV technology.

The novel control of the HOD UV technology promotes stability, assures water safety, provides operator flexibility and guarantees quality.

HOD UV systems also come equipped with an intuitive, user-friendly and comprehensive control interface to track system operation in real-time. This provides operators with live data on the operation of their system.



Atlantium's Hydro-Optic™ UV systems feature the All-in-One (AiO) controller that sets a new standard in precision, monitoring and operation.

Global Service & Support

HOD UV systems are globally supported and spare parts, such as UV lamps, are readily available 24/7.



Not all UV is equal— Hydro-Optic™ (HOD) UV is designed to achieve unmatched inactivation levels.

Advanced Control Systems

- Continuously displays UVT, flow, power and UV dose
- Provides real-time data on operation and efficiency
- Features built-in data logging, up to six months
- Integrates with the control SCADA system
- Easy integration with the control SCADA system
- Customized with user settings for alarm signals

Contact

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Augmensys GmbH

Make industrial data usable for everyone, to increase the value of existing data – any time, any place!

augmensys

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Augmensys was founded to turn an ambitious idea into reality: the establishment of Augmented Reality (AR) in industrial processes.

The company's many years of experience, both in industry and in the field of industrial software, is the key to closing the gap between aspiration and reality. With the mobile and AR solution UBIK, Augmensys provides a powerful tool for the entire industry, branch independent and application oriented and offers the chance to significantly simplify everyday work. The focus here is clearly on productively applicable tools and solutions.

- Years of experience
- Innovative technologies
- Customized solutions

The Augmented Reality Software UBIK is a mobile data management software for mobile devices (smartphones, tablets, wearables) which is mainly used in industrial environments.

It enables the user to access data and documents from various source systems. Due to the advancing digitalization under the term Industry 4.0, a constantly growing amount of data is generated. The challenge is not only to extract valuable data for the user, but also to represent it intuitively on the mobile device.



UBIK on a mobile device.



Augmented Reality makes us unique.

UBIK accompanies an industrial plant already throughout the paperless commissioning process, directly at the construction site.

A big amount of different data sources is not a problem anymore, since they are seamlessly consolidated for efficient use.

Through the whole life cycle of a plant (construction, commissioning, operation and maintenance, shutdown management) UBIK offers an intuitive, mobile and channelled access to all the digital systems in the background of a plant, for inspectors, maintenance workers, engineers and operators.

The possibility to work mobile with the entire data asset of a company, edit information right on site and sent back photos and voice memos that automatically end up in the right systems, creates a highly effective work environment for anyone who has work to do in the plant.

But UBIK doesn't only identify what the user sees, it also helps people in finding what they are looking for. Using Augmented Reality Tags and its unique navigation functionality, UBIK directs external staff and subcontractors through the plant on efficient and safe routes.

Augmensys GmbH

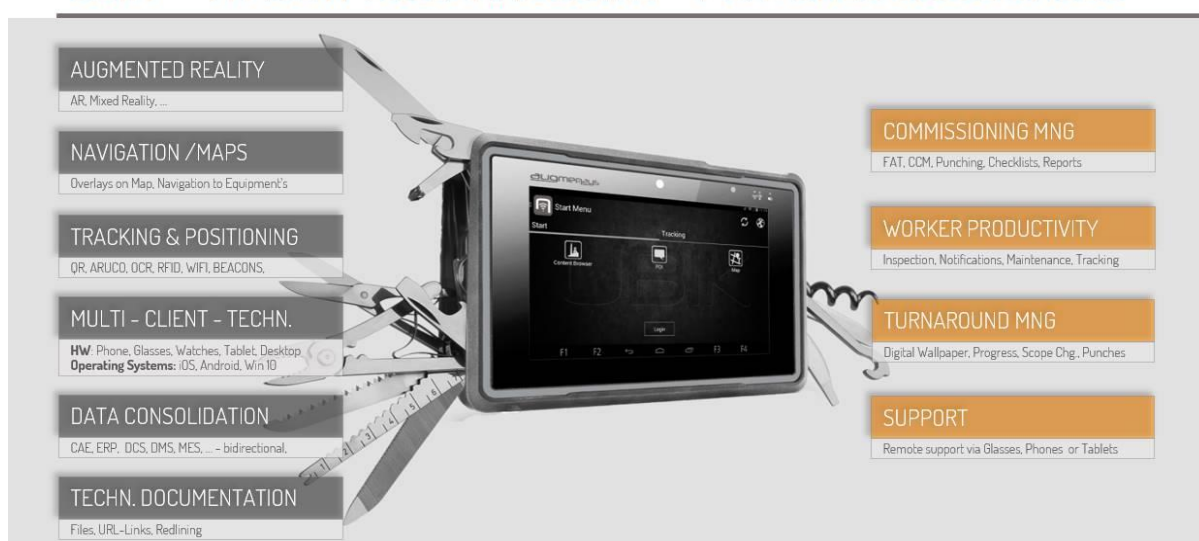
Augmensys provides companies in the energy supply market with new technologies to support switching operations in medium-voltage networks. AR overlays make switching operations simpler, error-free and, above all, safer.

The employee is guided through the entire switching process. The required information is defined in the network control system as a switching letter with the switching point information and the switching sequence and automatically transferred to UBIK.



Switching operations in a medium-voltage network.

UBIK® – A MULTI TOOL 4 INDUSTRY – FEATURES & USE CASES



UBIK, our Augmented Reality Software, is a powerful tool with cross-industry usability through its application-oriented configuration.

UBIK completely digitizes the customer's workflows, which were previously mostly carried out manually. All data at the right time, in the right place for the right user. Due to the fact that UBIK is individually adapted to the customer's needs, there are many different profitable application possibilities on the customer's side (inspection tour, maintenance, commissioning of new plants, etc.).

User acceptance is high due to user-friendly and customizable user interfaces. The quality of the data is increased due to direct, digital and thus immediate feedback from the on-site employees to the source systems.

In addition, the safety of the employees is increased with UBIK, which improves the quality of the entire work process.

Thanks to UBIK, robust mobility and AR is entering the industry and enables to connect reality with any available data. The client-part of UBIK runs on mobile-devices.

UBIK is already used at a significant number of well-known industry companies. It has therefore proven its value and robustness through various projects and use-cases, where each of them in return contributed to the constant improvement of the product. It also passed several scalability, quality and security audits from major corporate IT's.

Contact

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AvailabilityPlus GmbH

LexaTexer – next generation predictive analytics.



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LexaTexer is the analytics platform for the digital power plant. Power producers globally need to constantly improve operations, reduce unplanned outages, identify optimal operations parameters and manage variations in market conditions, fuel costs and weather patterns. LexaTexer provides a comprehensive answer, based on physics, machine learning and artificial intelligence, that gives power companies the means to transform operations with actionable insights that drive improved business decisions.

LexaTexer analytics provides these benefits:

Transform data into actionable intelligence by combining robust analytics with domain expertise. Create a single source of data for all power generation or renewables assets across a fleet, utilizing predictive analytics to identify issues before they occur, reducing downtime and extending asset life while still balancing maintenance costs with operational risk. Operations optimization: Deliver enterprise data visibility across power plant and fleet-wide footprints, providing a holistic understanding of the operational decisions that can expand capabilities and lower production costs. Predict remaining-useful (RUL)-live of turbines and adjacent equipment like pumps and deliver optimal operational parameters to optimize KPIs like RUL, downtime or costs per MW/h.

Predictive Maintenance

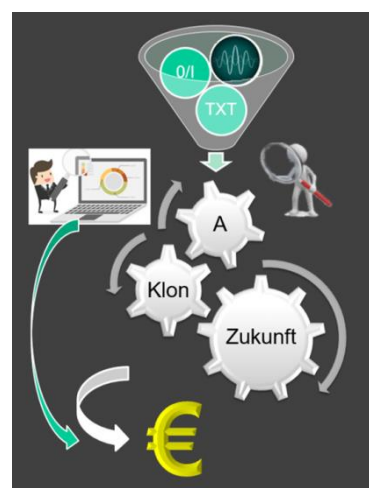
Predictive maintenance anticipates equipment failures to allow for advance scheduling of corrective maintenance, thereby preventing unexpected equipment downtime and improving service quality. LexaTexer introduces a new level of quality.

Predictive Maintenance at Hydropower Plants

Many hydropower facilities do show prototype characteristics, bespoke architectures, adapted to geographic and business needs with highly individual technical parameters and are integrated into a fleet of interacting assets.

These individual settings make it difficult to apply off the shelf analytics. However, using historic data and advanced analytics it is possible to predict the remaining useful life for major assets and to identify anomalies, which common SCADA-systems are not able to identify.

We use data from a number of sources (SCADA, maintenance reports, weather, ...) and create digital models, using data analytics and machine learning, to predict the current and future states of assets, providing the results in an interactive way, to enable the technical personal to not only see the results, but also to modify operational parameters to identify optimization opportunities.



Predictive analysis with artificial intelligence.

This empowers operation and maintenance personal to keep initiative to optimize costs and minimize unplanned downtime.

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Brno University of Technology, V. Kaplan Department of Fluid Engineering



Brno University of Technology is the second largest technical university in the Czech Republic, Faculty of Mechanical Engineering is the largest of its kind in the Czech Republic.

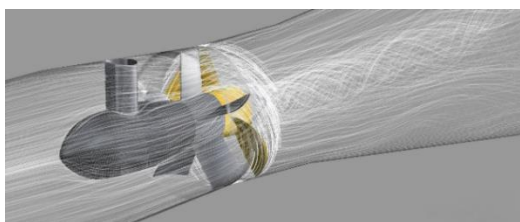
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V. Kaplan Department of Fluid Engineering

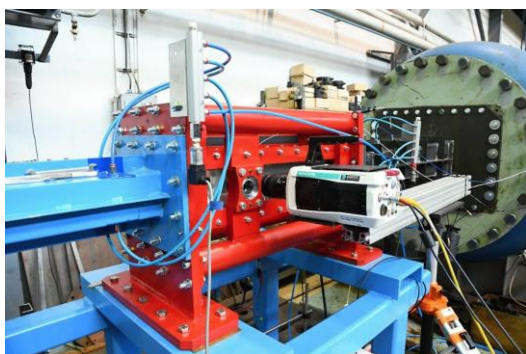
V. Kaplan Department of Fluid Engineering has more than 120 years history in design, analysis and testing of hydraulic machines and systems. The department focuses on research and education in the field of hydraulic machines, fluid systems and applied fluid mechanics.

Group of experienced researchers is capable of design of small hydraulic turbines, pumps, analysis of water hammer, flow pulsations, rotor-dynamics, machine vibrations, fluid-structure interaction problems, cavitation.

Heavy hydraulic laboratory is suitable for testing hydraulic turbine models and pumps up to max parameters: 300 kW, 180 meters head, discharge 800 l/s, offers measurement of energy curves, cavitation characteristics, vibrations, noise, flow visualization using high-speed camera.



Low head turbine design and flow simulation.



Fluid-structure interaction analysis of hydraulic profile in cavitation tunnel.

Department is equipped with commercial CFD codes ANSYS Fluent, CFX and open source software OpenFOAM and large cluster for massive parallel computations.

Department is active in research projects funded by grant agencies and industrial companies.

Department members are involved in EERA (JP Hydropower, JP Energy Storage), IAHR, Euromech.



Pump turbine testing.



Installation of siphon low head turbine.

Brno University of Technology, V. Kaplan Department of Fluid Engineering

Research activities and topics for collaboration

- Design of hydraulic machines (hydraulic turbines and pumps)
- Testing of pumps and hydraulic turbine models (energy and cavitation performance)
- Measurements of fluid systems on site
- Computational fluid dynamics
- Analysis of pressure pulsations and vibrations
- Cavitation erosion testing
- Design of experimental fluid circuits
- FSI analysis
- Multiphase flow simulations and experiments
- Complete education in fluid engineering branch (applied fluid mechanics, CFD, hydraulic machines design, experimental methods in hydraulic machinery and systems, specialized courses for companies)

Contact

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Head of Department

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DAGOPT Optimization Technologies

Experts in mathematical modelling and process optimization, revolutionizing your energy production plans.



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DAGOPT uses mathematical modelling to digitalize industrial processes, which helps our clients simplify their day-to-day business.

Our clients come from the energy industry, financial sector and industrial sectors. For a wide range of business challenges, we create a digital twin, digitalizing their individual processes and workflows.

Together with the client our team of experts analyses the existing processes and creates an individualized concept for their needs. In the end we implement a tool that respects all conditions and constraints discussed. The User Interface (UI) suits our customers' necessities from a simple front end to a polished interactive software.

We are passionate about mathematics and love to solve complex industrial problems!

With a multitude of mathematical tools beyond state of the art at our disposal, we set ourselves apart from the competition and solve problems where other modelling software fails.



@dagopt.

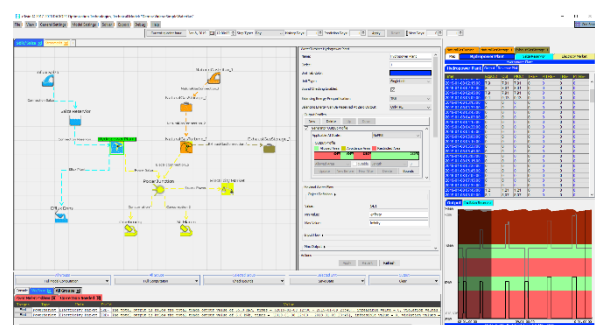
The eTwin Framework and Modelbuilder

The eTwin framework is our award-winning technology to create a digital twin of technical systems, especially in the energy industry.

Some of the advantages eTwin can offer our clients are:

- Modelling of energy markets (spot, futures and intraday market)
- Optimal operation of power plants and grids
- Short, medium and long term price and consumption forecasts
- Optimal energy price hedging
- Smart grid and smart metering solutions
- Long term investment prediction for power plants

A key component of eTwin is the Modelbuilder. It creates an exact mathematical model of the technical system, capturing all its requirements and constraints.



The eTwin user interface.

Depending on the goals of our clients, their individualized eTwin solution leads to significant technical and economic benefits for our clients.

Automated updates ensure adaptations to changing circumstances, while maintaining a powerful, yet easy-to-use UI.

DAGOPT Optimization Technologies

"eTwin enables us to automatically adjust the optimized energy schedules of our hydropower plants as little as possible, that even those constraints and restrictions that cannot be mapped in our optimization system are satisfied. This means that we are ideally equipped for the short-term intraday and balancing energy markets."

Gotthardt Bernhard, Salzburg AG



@Salzburg AG, Kraftwerk Sohlstufe Lehen.

Applications in Hydropower

Hydropower operations face constant changing conditions, which they have to take into consideration when creating production plans.

eTwin digitalizes existing manually created production plans. With this system our client simulates the plans, checks for errors and optimizes the projects.

Our industry partners in the Hydropower sector have been using eTwin with great success for over two years.

Based on its mathematical model, eTwin performs production planning of hydropower plant networks, containing dozens of individual power plants.

The system considers all constraints necessary for operation, like for example:

- Dependencies between individual plants (e.g., surge constraints)
- Environmental influences
- Storage capacities
- Physical restrictions of the turbines
- Financial constraints

Including these and more constraints, the system re-creates real life operation conditions and offers faster and easier solutions.

eTwin employs advanced mathematical methods to compute extremely precise forecasts. It automatically detects errors in the data points, even during real-time operation.

Possible predictions include load, demand, peaks, balancing energy, or grid losses.

Furthermore, eTwin incorporates a dynamic model of the power market. This allows our clients to optimize their operations, maximizing profits while complying with all market rules and restrictions.

We support our partners right from the start of the modelling process to the development of individualized optimization algorithms, as well as deployment and live maintenance of the system.

Are you interested in simplifying your processes with mathematical accuracy? Get in touch with us now to find your perfect solution.

Contact

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DIVE Turbinen GmbH & Co. KG



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www.dive-turbine.com
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Hydropower turbine 2 m – 120 m head, 100 kW to 4 MW

Turbines for hydropower plants up to 4 MW

DIVE Turbinen GmbH & Co. KG is designing and manufacturing hydropower turbines up to 4 MW per turbine. They are installed in municipal power plants or industry power plants starting at 100 kW at a head range from 2.00 m up to 120.00 m.

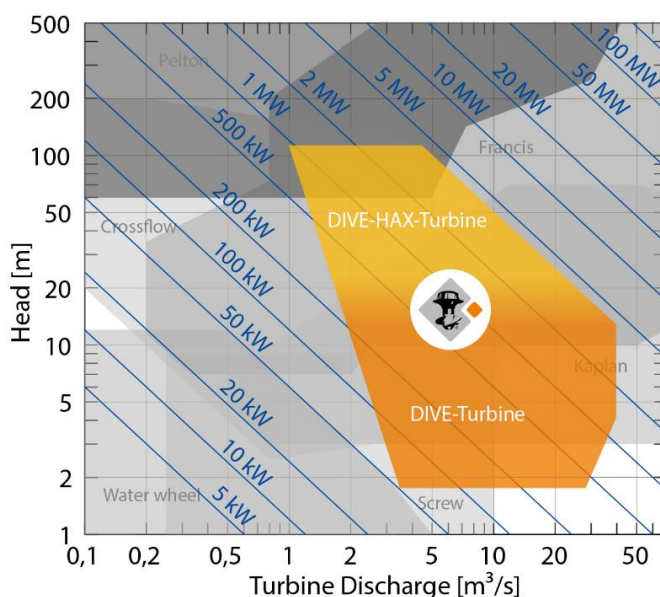
Applications

- Medium head (double regulated)
- Low head
- Fish friendly power plants
- Ecological flow
- Residual head (out flow of power plants)
- Irrigation canals
- Unexploited hydro power potential at dams (flood control/irrigation)
- IN-PIPE applications (e.g. process water)
- Saline water (e.g. fish farms)
- Submersible power plants

More than 45 DIVE-Turbines have been connected to the grid since 2006.



Medium head DIVE-Turbine in France.
Installed capacity 600 kW.



Range of Application

The range of application for DIVE-Turbines is:

- Head: 2 m – 120 m
- Discharge:
0.5 m³/s – 40 m³/s
- Capacity per turbine:
100 kW – 4,000 kW

DIVE Turbinen GmbH & Co. KG

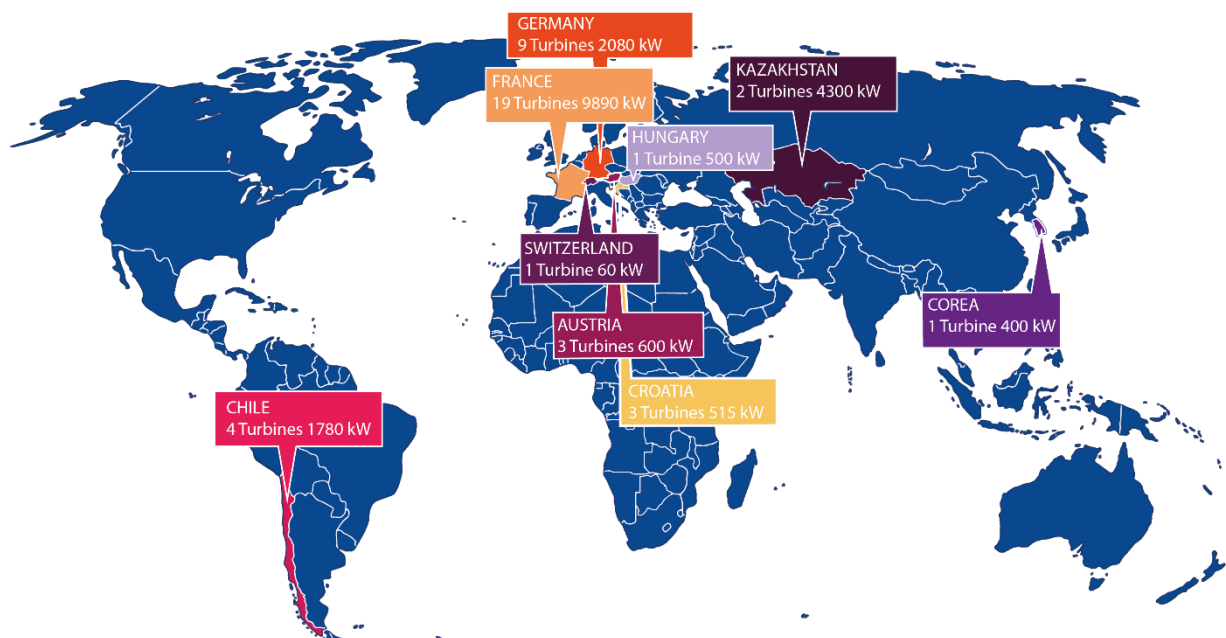
Fully assembled turbine for easy installation

The DIVE-Turbine is fully assembled and pretested in factory.

Therefore, the installation on site is simple and has very low restriction on civil works tolerances. The service and maintenance works are minimal due to the patented and wear and tear free sealing system of the DIVE-Turbines.



DIVE-Turbines in Chile: the turbines are fully assembled in factory. The tolerances to the civil works on site are very big.

DIVE-Turbines worldwide

We have local partners and regional offices all over the world. Don't hesitate to contact us for further details.

Contact

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Sales Manager

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ELIN Motoren GmbH



Customized electro-mechanical drive solutions for energy conversion.

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Technology for a sustainable future

The importance of decarbonization and CO₂-neutral energy applications require long-term and sustainable technologies. ELIN Motoren is the preferred partner for developing highly efficient and compact electric machines. Active flexibility is a part of our performance philosophy and enables us to develop perfectly tailored solutions for customer requirements. From electric motors, up to 35 MW, to generators in the power range up to 65 MVA: our technology is proven for a lifetime.

Quality as a boundless mindset

The unique quality advantage of our solutions is based on integrated quality management, which includes all development and manufacturing stages. Our products are tested in-house and comply with all relevant international standards. To ensure the high-quality standard for the future, we continually train our employees and keep our production facilities on the cutting edge of technology. The development and manufacturing center of ELIN Motoren is among the most modern worldwide and possesses one of the most advanced testing laboratories.

Next generation power plants

As a planning partner for high-quality low- and medium voltage generators, motors, and controlled system solutions we implement innovative drive concepts for the next generation of power plants.

You will benefit from our decades of experience in the requirements of the power industry and our know-how as one of the leading drive technology specialists.

Through active investigation of interfaces, the assembly of tailored packages and dedicated, flexible project management, we bring your project forward safely and efficiently.

As a full-range supplier, we support all the companies in the supply chain of power stations (owners / planners / general contractors / OEMs) with generator and motor solutions for all kind of power plant applications. The synchronous generators are used worldwide for steam turbines, hydro turbines, gas turbines, as well as for gas and diesel engines. The 4-pole range extends from 1 to 65 MVA and the higher pole ranges from 500 kVA to 35 MVA for voltages from 3 to 15 kV.

We develop synchronous and asynchronous generators specially designed for hydro turbines and tailor-made to the needs of each specific customer and project. This, whether for Pelton, Francis- or Kaplan-turbines, as well as for small matrix or submersible turbine applications.



We manufacture generators for various hydro turbines.

Global partnership and beyond

We have evolved as a high-tech company, with a long industrial tradition in the heart of Europe. Our global network of certified partners enables us to be close to our customers from America to Asia through to Australia. As a specialist, we are right at home in demanding market segments; we meet the highest technical and application-specific requirements with innovative technology. Quality, efficiency, and reliability throughout the entire product life cycle: therefore, leading companies worldwide are among our long-standing customers.

ELIN Motoren GmbH

Lifecycle partner for rotating electrical machines

Whenever you need technical support: we are standing by 24/7. Our mobile and specially trained team of experts ensures help throughout the entire life cycle of your plant fast, reliable, worldwide. A global network of certified partners supports our mission to offer service with the decisive quality advantage. A variety of services can be carried out on-site (e.g., maintenance and refurbishment for all makes and models). Repairs are also carried out on our premises at the highest quality level by using advanced technology. As your life cycle partner, we ensure the most efficient, sustainable solution. In addition to mechanical work, our scope of services also includes winding analysis such as Tan Delta measurements and partial discharge measurements as well as vibration analyses.



ELIN Motoren generators and motors.



ELIN Motoren generator for a hydro turbine.



ELIN
Motoren
A Voith Company

We keep the world in motion.

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EPLAN GmbH & Co. KG



EPLAN supports building a sustainable energy system with its engineering solutions.

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Member of vgbe energy | Hydro Power

EPLAN is a global player for engineering solutions in renewable energies. The solution provider supports operators of hydro power plants since decades. Also OEMs and system integrators for hydro power solutions use the integrated EPLAN Platform. The company optimizes processes with standardization, integration and automation. Here are some of the EPLAN applications for efficient engineering in hydro power:

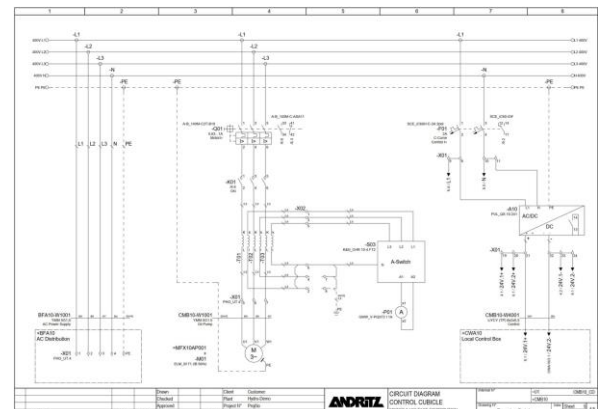
- Basic engineering of hydropower plants with P&IDs
- Planning and documenting of electrical systems
- 3D build-up of power distribution and control cabinets
- Collaboration platform for digitalized operations and maintenance processes



EPLAN serves the complete hydro power eco system with its software platform.

EPLAN GmbH & Co. KG

Terminal	Cable name / Cond. cross sect.	Cond. / Name	Identification	Pin	Strip	Identification	Pin	Cable name / Cond. cross sect.	Cond. / Name	Function line
1	1.0000	1.0000	1.0000	1	1	1.0000	1	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	2	2	1.0000	2	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	3	3	1.0000	3	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	4	4	1.0000	4	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	5	5	1.0000	5	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	6	6	1.0000	6	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	7	7	1.0000	7	1.0000	1.0000	1.0000
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12	1.0000	1.0000	1.0000	12	12	1.0000	12	1.0000	1.0000	1.0000
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23	1.0000	1.0000	1.0000	23	23	1.0000	23	1.0000	1.0000	1.0000
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27	1.0000	1.0000	1.0000	27	27	1.0000	27	1.0000	1.0000	1.0000
28	1.0000	1.0000	1.0000	28	28	1.0000	28	1.0000	1.0000	1.0000
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100	1.0000	1.0000	1.0000	100	100	1.0000	100	1.0000	1.0000	1.0000



Typical schematics and terminal diagrams of a hydropower application

EPLAN provides software and service solutions in the fields of electrical, automation and mechatronic engineering. The company develops one of the world's leading design software solutions, not only for machine and panel builders, but also for industry-specific applications in energy, process industries, maritime, building technology etc. EPLAN is also the ideal partner to streamline challenging engineering processes.

Both standardised as well as customised interfaces to ERP and PLM/PDM systems ensure data consistency along the whole value chain. Working with EPLAN means boundless communication across all engineering disciplines. No matter whether small or large enterprises: Customers can apply their expertise more efficiently. Worldwide, EPLAN supports more than 65,000 customers.

EPLAN wants to grow further with customers and partners and pushes integration and automation in engineering forward. Within the EPLAN Partner Network, open interfaces and seamless integrations are realised together with partners. „Efficient engineering“ is the focus.

EPLAN was founded in 1984 and is part of the owner-operated Friedhelm Loh Group. The Friedhelm Loh Group operates worldwide with more than 12 production sites and over 90 international subsidiaries. The entire group employs more than 11.600 people and generated revenues of €2,5 billion in 2021. For the 14th time in succession, the family business has won the accolade “Top German Employer” in 2022. In addition, Friedhelm Loh Group was recognized as “Top vocational trainer” according to a study of Deutschland Test and Focus Money.

For more information visit:

www.eplan-software.com,
[Energy \(eplan-software.com\)](http://Energy.eplan-software.com) and
www.friedhelm-loh-group.com.

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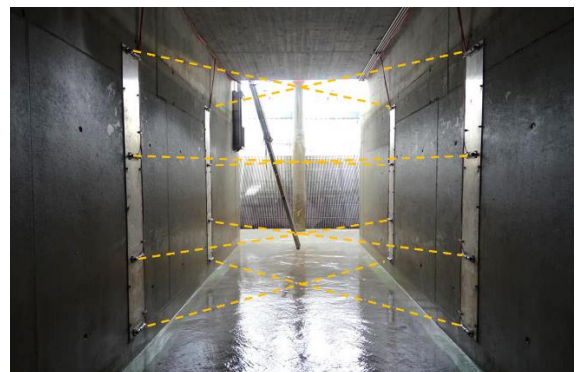
etaeval is an engineering company offering its services mainly in the field of hydroelectric power plants and water supplies. We measure efficiency of turbines, pumps, or plants using state of the art instruments and techniques. We are experts of thermodynamic efficiency measurements, acoustic (ultrasonic) discharge measurements, and measurements with propeller type current-meters in low head power plants.

We have access to numerical flow simulations (CFD) and system simulation tools for optimization our flow measurements and to round up our consultancy services. Based on scientific inquiries we provide added value for our customers regarding plant operation and optimization. We offer IEC- and ASME PTC-standard compliant measurements and advisory services.

Utilities benefit from our independent services, when measuring and simulating their tasks. Our independency is valued by power plant owners and operators, by consulting companies, as well as by turbine manufacturers.



Studying hydro-abrasive erosion, AXPO, Switzerland.



Acoustic discharge measurement at HPP Pradella, EKW, Switzerland.

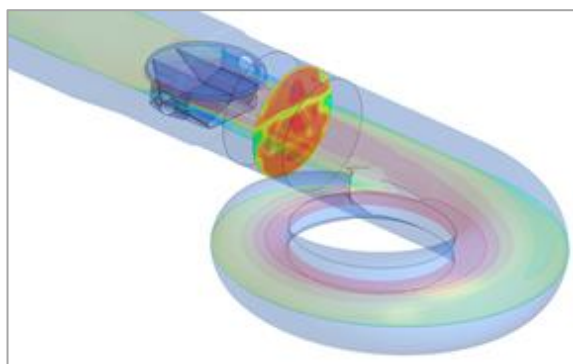


Pelton jet visualization at HPP Lünensee, VORARLBERGER ILLWERKE, Austria.



Low pressure measuring section at HPP Tannuwald, ALPIQ, Switzerland.

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CFD study for an acoustic discharge measurement at HPP Ralco, ENEL, Chile.



Death weight manometer at HPP Silz, TIWAG, Austria.



Current-meter measurements at HPP La Rance, EDF, France.



Current-meter measurements at HPP Erlabrunn, UNIPER, Germany.

Our services

- Efficiency measurements with primary methods
- Efficiency monitoring implemented in the control system
- Comprehensive hydro power plant monitoring and analysis
- Pump storage energy cycles (hydro certificates)
- Transient simulations and water hammer analysis
- Transient measurements, vibration measurements and analysis
- Expert activities accompanying acceptance tests conducted by turbine manufacturers
- Pelton jet visualization
- Numerical flow simulations (CFD)

Our mission is to satisfy customer requirements efficiently. Our services are completed by comprehensive, professional documentations.

Contact

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Prof. Dr. Thomas Staubli
 Executives

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GEISSELER LAW



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Legal advice in respect of contracts (e.g. for the supply of machines or the erection of power plants and other large infrastructure projects worldwide).

GEISSELER LAW offers a wide range of legal services regarding the drafting and negotiating of contracts for - among others - the supply / procurement of machines or the erection, rehabilitation, maintenance ("O&M") and acquisition of power plants and other infrastructure projects such as dams, tunnels or bridges - worldwide.

GEISSELER LAW advises regarding

- Conventional power plants
- "Renewables" (wind, hydro and others)

The law firm advises different industry sectors, mainly the civil, mechanical and electrical engineering industry.



Barrage Ouljet Es Soltane, Maroc, 2017 (under construction at that time); © Bettina Geisseler.



Centrale hydroélectrique de Romanche-Gavet, France; © Bettina Geisseler.

Bettina Geisseler, Lawyer, has a long-time experience as legal counsel and later on as Head of Legal in the civil, mechanical and electrical industry (ABB Switzerland; Babcock Borsig Service GmbH, Germany; Losinger AG, Switzerland, a company of the Bouygues group, France).

Legal Services

- Supply resp. Procurement Contracts
- EPC and Turnkey Contracts
- Contracts with IPPs or state utilities
- Contracts under BOT/ BOOT schemes
- Power Purchase Agreements
- Consortium or Cooperation Agreements
- Operation and Maintenance Agreements
- Engineering Contracts
- Claim Management
- Dispute Resolution



Nuclear Power Plant, Containment Liner (at that time under construction); © Babcock Noell GmbH (nowadays Bilfinger Noell).

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Converter Station offshore windfarm Meerwind Süd/Ost;
© Alstom Grid (nowadays: GE Grid Solutions).

Working languages

- German
- French
- English

GEISSELER LAW advises

- Suppliers or Buyers
- Owners/ Operators



Storebælt Bridge, Denmark; © Sund & Bælt Holding A/S.



Oxyfuel Pilot Plant; © Babcock Noell GmbH
(nowadays Bilfinger Noell).

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GEOS3D, Geodetic and Industrial Surveying GmbH

Industrial Laser Scanning and CAD Data for Digital Twins, BIM and As-Built Data



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Building Information Modelling (BIM)

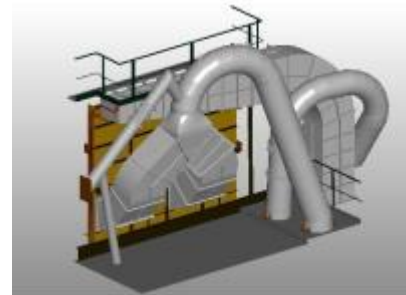
Building Information Modelling (BIM) enables architects, designers, engineers, manufacturers, CGI experts, developers, and contractors to work together to create a 3D building information model.

The effect: Projects can be designed, constructed and managed more efficiently and accurately. Terrestrial laser scanning enables you to create a factually accurate foundation that captures and expands the dimensions of complex environments and geometries required for your BIM.

As-built documentation

Whether plant parts, lines or buildings – we scan complete factories and plants for your documentation.

With 3D laser scanning, we generate high density and accurate point clouds. From these a CAD model is created. You then receive the data for example in DXF, DWG, STEP, JT.

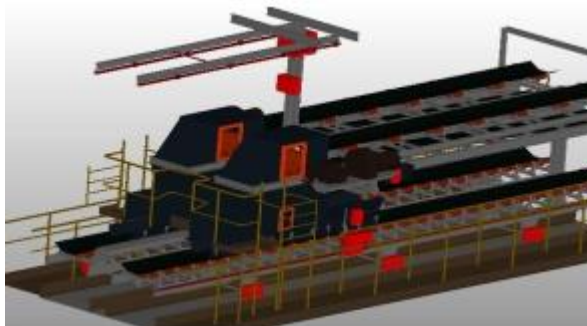


Filter Scan and remodelling Spare Parts are Produced from the Data. of 12x5x6 meter.



Thermal Spa.

Detailed Remodelling of a complete Thermal Spa Inside and outside including the Piping and acquisition of 3D building data with the laser scanner, then we create a CAD model for you, e.g. in AUTO CAD REVIT format – this then serves the architect or planner as a basis for further planning and modelling.



(Scan and CAD remodelling Industrial Conveyor belt) approx. 20 meter length.

Industrial Conveyor belt Scan and remodelling Spare Parts are Produced from the Data.

Contact

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Global Hydro Energy GmbH

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GLOBAL Hydro is the world's first contact for small hydropower technologies and ensures a livable environment for future generations through innovative solutions. We are specialized in Kaplan, Pelton and Francis turbines in the range from 100 kW to 30 MW. With HEROS, the fully automated turbine and plant control system, and smart, GLOBAL Hydro's PLUG-IN turnkey power plant, we can offer our customers sustainable complete solutions.

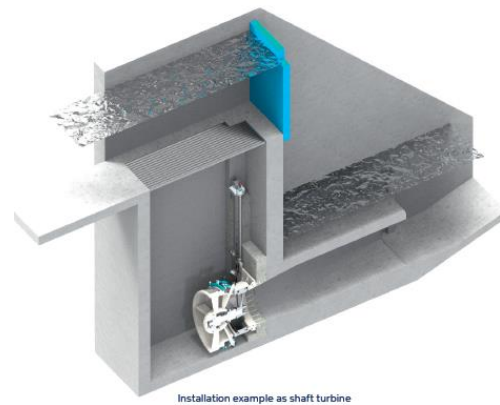
GLOBAL Hydro Energy GmbH introducing the EVO product line for extraordinary ranges of operation in most economic ways

Hydropower is an exciting discipline with many challenges, to achieve ideal performances with parameters given by the nature. Continuous development and an innovative mindset are major keys to be steps ahead to bridge certain gaps of the biggest known challenges.

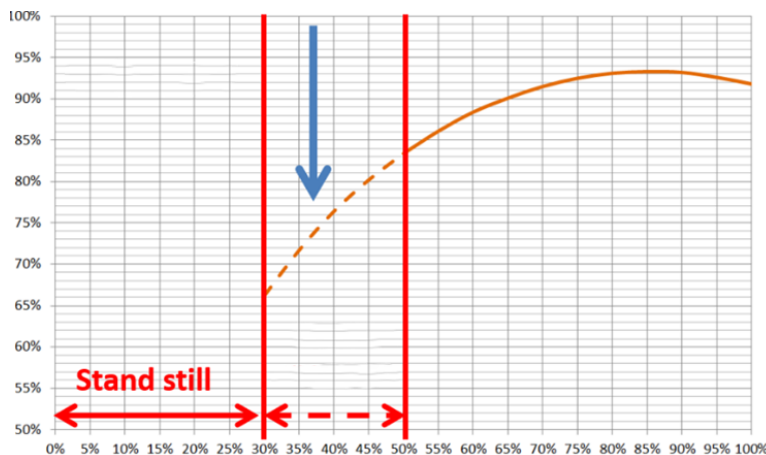
We at GLOBAL Hydro are therefore proud to present our newest innovations, to cover more operational range than anyone else, with our newest development, the EVO product line.

Starting at low head, the EVO Kaplan turbine can be used for a head of up to 12 m.

The fully pre-assembled turbine-generator unit can be double regulated by speed and flow regulation and can be integrated into existing systems, which means that old or inactive power plants can be reactivated at low costs and existing dams (e.g. for irrigation) can be used to produce power. This allows a high efficiency for an optimized invest and many more advantages:



Installation Layout of a Kaplan EVO turbine application.



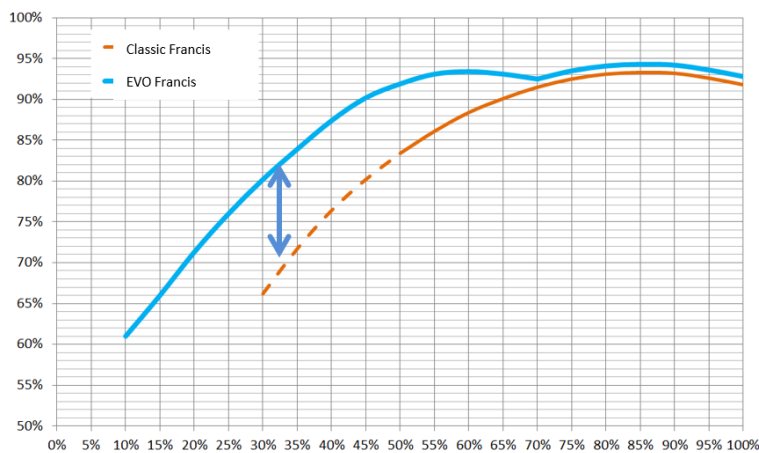
Efficiency curve of a classic Francis turbine.

In addition, the housing is completely flooded, which means, no noise emissions and no auxiliary and lubricants are necessary! This fact automatically leads to the next advantage: reduced maintenance and as the equipment is flooded and all components are in contact with water, no sealing system is needed. The maintenance intervals will be significantly longer. Mounted in a frame, the whole turbine can be lifted via rails for maintenance, which means, no diver or pumping equipment is required!

Global Hydro Energy GmbH

In addition to the advantages in regards of maintenance and fast return of investment, our Kaplan EVO turbine concept is fish-friendly and does not use any hydraulic oil, lubricants or grease and therefore not only economically but also environmentally the ideal solution for low head hydropower plants in the mini and small hydro sector.

Don't think our innovative way of thinking ends at heads of 14 m: Francis turbines usually face the problem of low efficiencies at lower operational points and therefore a restricted area of operation.



Efficiency curve of a Francis EVO turbine.

If you're looking for a revolutionary and economical high end Francis turbine to bridge this gap, we have a solution.

Our unique design of the GLOBAL Hydro EVO Francis turbine enables operation in a much wider range, even at down to 5% of nominal power, and available for total power outputs of up to 5 MW. It has significantly higher efficiencies in part load than conventionally known designs and therefore consequently allows to react to unsteady and variable flow conditions.

Due to a mostly in house pre-assembled equipment, we are able to considerably reduce civil works, time for installation and commissioning and hand over an innovative and durable solution with high flexibility and a larger operation range to our valued customers.

What has always made GLOBAL Hydro outstanding is our innovative mindset and ability to see difficulties from our customers' perspective. With our equipment we ensure our customers highly economically, innovative and viable products.

Contact

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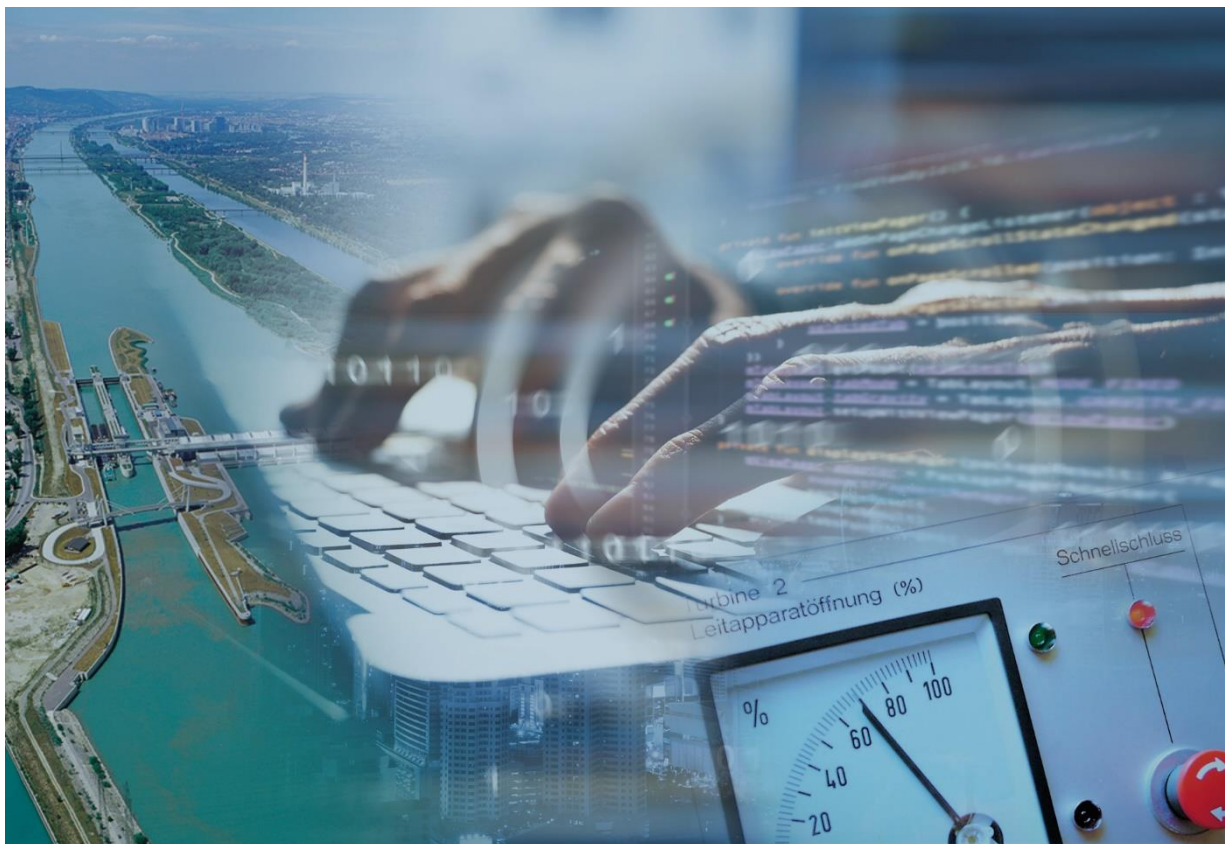
Luise Hummel Weg 3a
AT I 4040 Linz
office@gr-consult.at

In cooperation with various universities, software engineers and experts in the field of civil engineering, we have developed large software packages for flood forecast, damage estimation, inflow prediction, and optimization.

Modelling rivers and lakes, which are influenced by hydropower plants and hydraulic structures, is one of our core competences. Thus, we have implemented models and simulation systems for many large mid-European rivers, like Danube, Main, Lech, Inn, Aare, Rhine, etc.

Besides, GR-Consult has broad experience in providing technical opinions and expert assessment focusing on the hydraulic aspects of hydropower plant (HPP) operation and the influence of HPP chains.

Thus, we have significantly contributed to the reconstruction of flood events and to elaborate the impact of HPP during flood events. Thereby we provide services for operation companies, administration, and courts.



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VIRTUAL RIVER 4.0 – reliable testing and sustainable training

Overview

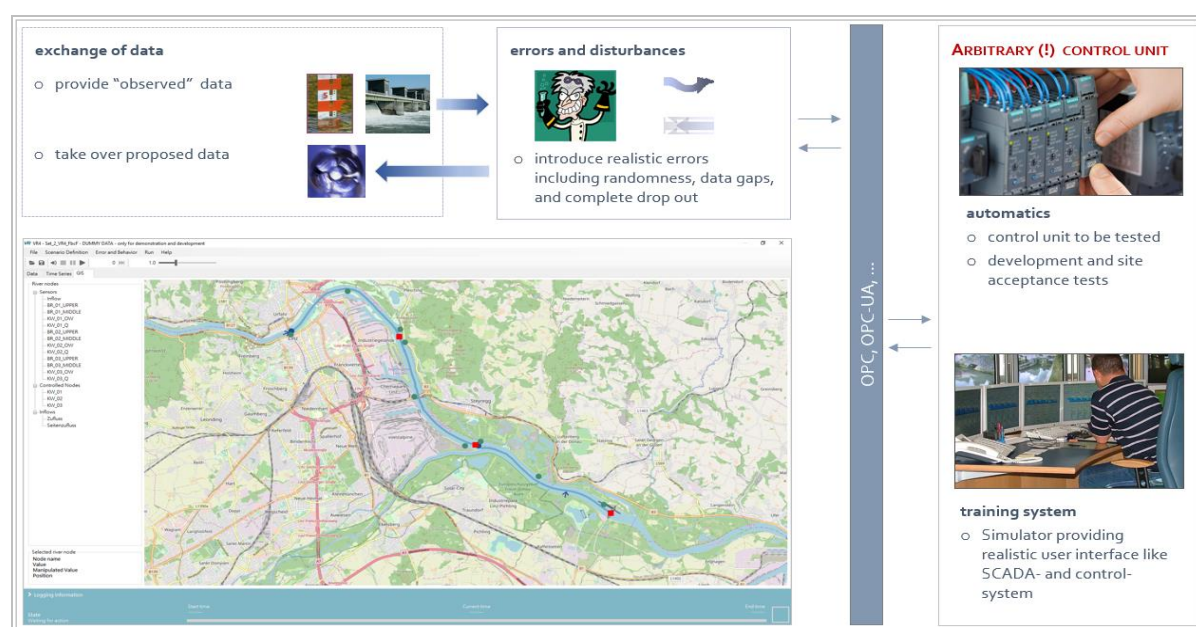
Virtual River 4.0 is a simulation system, which can substitute the river for various purposes: It is utilized for testing control systems, as a core system in training facilities and as a virtual twin.

We provide VR-systems as made-to-measure and ready-to-use systems. All systems are designed specifically based on our customers' needs.

VR systems combine a hydrodynamic model with a standard interface, typically OPC or OPC-UA. Thus, any arbitrary control unit or control system can be linked to VIRTUAL RIVER.

For providing a realistic environment, we emulate various types of errors and failures. They affect both, the data provided by VIRTUAL RIVER and the data provided by the systems being linked to VIRTUAL RIVER.

VIRTUAL RIVER 4.0 and VR-based systems are being implemented in close cooperation with DHI and Hydrotec.



Three tasks – one solution

Being a model-based digital image of real rivers, VIRTUAL RIVER 4.0 is designed for three major applications:



Development and acceptance tests of control units and strategies

Being a model based digital image of the real river, VIRTUAL RIVER 4.0 serves as the perfect environment for developing and testing control strategies, parameterising automation facilities (e.g. "water supply automatics").



Training of technical personnel – even for extreme situations

Applying VIRTUAL RIVER, you can prepare and train yourself and your team for every specific situation – no matter when and as often as you want.



VIRTUAL RIVER as an additional source of information to manage the real process

Use Virtual River as a digital twin running in parallel to the real river and supplying you with data to widen the information about the real world.

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Based on hydrodynamic simulation

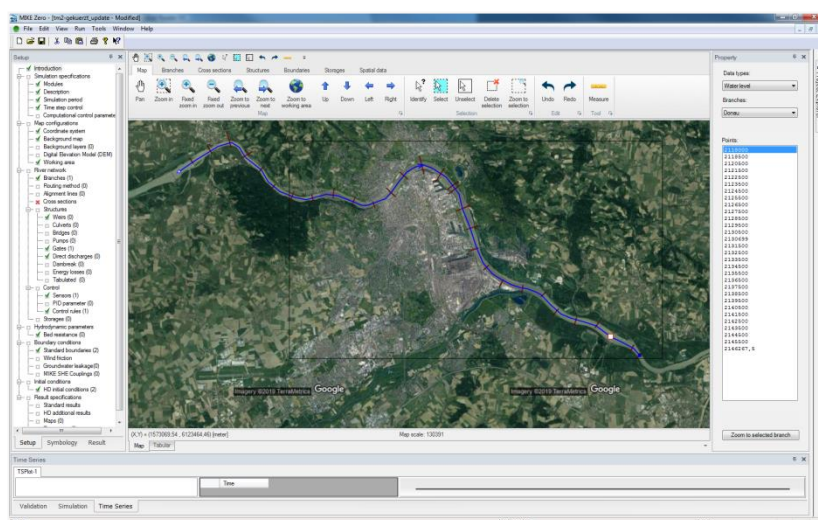
VIRTUAL RIVER 4.0 uses FLORIS and MIKE1D as numerical engines. MIKE1D is DHI's completely revised numerical core of MIKE11 that is also being used in MIKE HYDRO RIVER and MIKE URBAN+.

This type of 1D-simulation fits perfect for describing the relevant hydrodynamic processes that we use to face in our river system.

Virtual River 4.0 as a core system for training and education

When being used in a training system, Virtual River is typically linked to a copy of the original SCADA system. Thus, the trainee faces the same user interface as it is used for the real operation.

For communication between SCADA and VIRTUAL RIVER, OPC and OPC-UA are supplied by default. Other protocols can be implemented project-related on short notice.



In the first step, the base model is designed applying standard tools. Thus, we use Mike Hydro River when building a model for Mike1D, Flux^{DSS}/Designer when building FLORIS-models or SMS for building HYDRO_AS-2D-models.

In a second step, specific adaption is made for setting virtual gauges, parameterising communication, defining inflows and – if wanted - for specifying error emulation.

However, when 2D simulation is required, we have available interfaces to integrate HYDRO_AS-2D or we can build interfaces for using MIKE21. Furthermore, we can build systems combining the modelling of surface runoff and urban water systems.

From an IT's perspective, services on the internet and especially "Software as a Service" (SAAS) can be implemented.



In VHP's central control room at the HPP Freudenuau close to Vienna, the 10 HPP located along the Austrian section of river Danube are managed. VHP's training system utilizes VIRTUAL RIVER as a substitute for the real river.

www.futurezone.at

GR-Consult e.U.**Stress test for water resources management**

We use Virtual River when we prepare ourselves for conditions we hope will never or at least rarely occur. Thus, we aim to provide an environment that is as realistic as possible.

Measurement errors, malfunctions, and breakdowns are part of reality – above all in extreme cases. As another taste of reality, Virtual



When using Virtual River, you shall be free to focus on your specific business and your core tasks. Like preparing yourself and your team for any situation – including extreme ones like flood, malfunction, and breakdowns.

Thus, we take responsibility to provide ready to use systems including the hydro-dynamic model and all settings to ensure communication with your systems.

River can introduce errors to both, measured/ displayed data and the processing of input data:

We emulate random and systematic errors, data failure and transmission errors. Those malfunctions can be parameterised easily and combined in any desired setting.

Providing “ready to use” System

For the application of Virtual River, we focus on made-to-measure and ready-to-use systems:

A team of highly specialized modelers identifies and implements all the relevant aspects and parameterises models and interfaces for you. Our teamwork is based on cooperation agreements with DHI and/or Hydrotec. As a result, you get a model-based “digital image” of your river which covers all your needs.

However, before developing the models, all the details that are to be considered, are discussed with you and defined based on your requests.

The entire development of model systems is being done by hydraulic experts under the supervision of the Virtual River team. We thus offer you a reliable foundation for your work – no matter if you are testing, developing or training personnel.

GR-Consult – your team for acceptance and quality assurance

In many projects VIRTUAL RIVER is used as a formal basis for acceptance tests and quality management systems for hydropower plants’ automatization system.

We are pleased to support the formal acceptance and we execute all the necessary preparations and evaluations regarding water control management.

Contact**Günther Reichel**

Managing Director

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E g.reichel@gr-consult.at

HEICO Befestigungstechnik GmbH



HEICO Group - Quality. Innovation. Service.

Oesterweg 21
DE | 59469 Ense-Höingen
www.HEICO-GROUP.com
sales@heico-group.com

Fastening Solutions - Made in Germany

For more than 120 years, HEICO has been designing, producing and selling high-quality fastening products and solutions. Today, the company is an expert in its field and is a leading manufacturer of bolt locking devices and pre-tensioning technologies.



HEICO Headquarter

Around the world, "Made in Germany" signifies high quality and performance, two elements critical to HEICO's global outlook. All HEICO products are manufactured in Germany and supplied in more than 68 countries worldwide by 14 company owned subsidiaries, each with their own distribution warehouse that serves numerous well-known dealers and authorized business partners.

In early 2022 after a multi-year construction effort, HEICO's two manufacturing divisions were consolidated into the same location in Ense-Höingen. The extensive renovation and expansion of the existing facilities included a state-of-the-art high-bay warehouse, modern administrative offices and a cutting-edge technical test laboratory. HEICO Group's new headquarters provides a new level of synergy and efficiency between the two company divisions and also illustrates their commitment to Germany's Sauerland region.

HEICO-LOCK® Wedge Locking Systems

HEICO-LOCK® assures reliable and effective prevention of bolted joint self-loosening. Dynamic loads and vibrations that occur in running machines and systems, can lead to unsecured bolted joints becoming loose. Oftentimes bolts become loose gradually and stay undetected for a longer time. Technical malfunctions and machine failures are often the result of unsecured bolt connections.

The HEICO-LOCK® wedge locking system's extensive product range all effectively prevent bolted joint self-loosening. The HEICO-LOCK® function is based on the wedge locking principle and is characterized by a pair of interlocking washers that engage with each other. In addition to the classic wedge lock washers, HEICO offers numerous product variants that can offer both production solutions and performance advantages according to the application.



HEICO-LOCK® Wedge Locking Systems.

HEICO Befestigungstechnik GmbH

HEICO-TEC® Tensioning Systems

Accurately tightening bolted joints larger than M24 is difficult, if not impossible. Expensive hydraulic, electric or pneumatic tools are commonly used to achieve the required preload. HEICO-TEC® tensioning systems represent an effective and convenient alternative.

The special design of both the HEICO-TEC® Tension Nut and the HEICO-TEC® Tension Bolt equally distributes the bolted connection's required preload force to many smaller pressure bolts. Instead of tightening a large bolt with great effort, the HEICO-TEC® system with multiple pressure bolts allows even the largest bolted joint to be easily and accurately pre-tensioned using only a conventional torque wrench.



HEICO-TEC® Tensioning Systems.

Hydropower Application Fields

Components in hydropower plants and machines are often exposed to vibration and dynamic loads. Therefore, it is not surprising that many safety-relevant bolted joints are secured by HEICO-LOCK® products. Large diameter bolts are also common in this industrial sector where HEICO-TEC® tensioning elements are successfully used. Typical applications are: turbine runner main shaft couplings, large scale ball or butterfly valve main frame connections, high-pressure pump assemblies and generator components.



HEICO-TEC® Tension Nuts installed in main connection of turbine runner with main shaft.

Contact

MBA & Eng. Sven Heggemann

Certified Fastener Engineer (DSV)

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HES-SO

University of Applied Sciences

Western Switzerland Valais/Wallis



The HES-SO is one of the largest universities in Switzerland, spread over the entire French-speaking cantons of Switzerland. One of the strategic research areas of the HES-SO Valais/Wallis is energy research which has become one of the most active places for energy research in Switzerland.

Route du Rawil 47
CH | 1950 Sion
www.hevs.ch/ieet

Institute of sustainable Energy

Research in energy-related areas has been done inside HES-SO Valais/Wallis for several years. Since 2019 all these activities have been brought together in one institute. As such, the institute brings together researchers from different schools of the HES-SO Valais/Wallis, thus merging technical, digital, economic and social skills.

The activities of the Institute of sustainable Energy include the production, management and storage of renewable energies, the management of multi-energy grids and electric mobility. All addressed issues and developed solutions include a strong assessment of their environmental impact.



Topics (Excerpt)

- Energy Market operations
- Energy Management & Optimization
- Data Management & Analytics
- Modelling and simulating of fluids
- Design & optimization of turbines and hydraulic systems
- Mini & Micro hydro power installation

Research Field: Hydropower

In the research field of hydropower different expert worked in different aspects of hydropower are grouped together. The research field hydropower starts with traditional areas in modelling and simulating fluids to investigate potential threads of cavitation, but also covering field like the design of novel turbines, enabling more flexible use cases.

The aspect of the digitalization of hydropower there is on the one the options that can be realized by addressing new ways of sensing and sensor-data analysis, which can lead to approaches of predictive maintenance. On the other hand, the digitalization of hydropower installations allows for better synchronized operations of various installations, and therefore a more flexible operation management of complex cascades to valorise market opportunities, in flexibility markets.

Furthermore, is it necessary in countries like Switzerland, where hydropower provides nearly 60% of domestic energy production, to consider the importance of the change in the energy mix, its future modes of operations where its flexibility can be valorised on different grid-levels, and its potential consequences for hydropower operations, and long-term technical developments and investments.

Contact

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Smart Infrastructure Laboratory
Institute for Sustainable Energy
HES-SO Valais/Wallis

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HollyFrontier LSP Europe B.V.

**Providing lubricants solutions
beyond today's standards.**



Mainhavenweg 6
1043 AL Amsterdam
Netherlands
www.hollyfrontier.com/hfls
www.lubricants.petro-canada.com

Member of vgbe energy | Hydro Power

HollyFrontier LSP Europe B.V.

For over 30 years, HollyFrontier Lubricants & Specialties has researched, developed, and produced more than 350 world-class advanced lubricants, specialty fluids and greases under the Petro-Canada Lubricants brand. Our products continue to perform beyond expectations in virtually every industry around the globe.

BEYOND TODAY'S STANDARDS

We are always looking ahead with purpose and creativity, identifying tomorrow's needs and answering them today.

IMPROVING BUSINESS

By going beyond specifications in ways that matter, our lubricants help customers realize benefits beyond equipment performance through operational efficiencies that reward their bottom line.



Commitment to quality

Our products set the bar for quality and performance well above standards. Our long-standing commitment to quality is demonstrated by our extensive registrations:



Contact

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M +49 172 409 5540
E Stephan.Conradt@Hollyfrontier.com

HollyFrontier LSP Europe B.V.

A pure advantage

Petro-Canada Lubricants specialty fluids, lubricants and greases have a pure advantage in quality and performance. We create 99.9% crystal-clear base oils – some of the purest in the world.

Most finished lubricants formulations are composed of over 70% base oils, so base oil selection is critical. The purer the base oil, the better it works with specialty additives, resulting in advanced performance and longer lasting lubricants.

Our goal is to save you time and money by making sure you have the right lubricant for the job. By identifying your needs, we can help you extend maintenance intervals; prolong the life of your equipment; simplify your lubricant requirements. Because more uptime means more profitability for you.

High viscosity index

PURITY™ base oils have a naturally high viscosity index, which allows for performance across a wider temperature range.

WHY BASE OIL MATTERS

Petro-Canada Lubricants are available in a wide range of package sizes and are stocked at many strategic locations around the world by either HollyFrontier Lubricants & Specialties or one of our many global distributors.

To help our customers select the right lubricant for the job, request a copy of our Lube Source Product Catalogue. It is an informative guide, which narrows your lubricant choices to a primary recommendation.

Low temperature properties

The low temperature properties of our base oils keep them fluid at extreme low temperatures, which protects equipment and allows for easier cold weather start-ups.

Oxidation & thermal resistance

PURITY™ base oils exhibit excellent thermal stability for high temperature performance and excellent resistance to oxidation, contributing to long lubricant life in finished products.

NOT ALL BASE OILS ARE
CREATED EQUAL

OURS ARE 99.9% PURE

At HollyFrontier Lubricants & Specialties, we do not just produce lubricants; we deliver lubricant solutions – tangible savings solutions – to increase productivity for your manufacturing operation.

Low volatility

Next-generation engine oils have very stringent NOACK volatility requirements, which is largely dependent on the base oil volatility.

HollyFrontier LSP Europe B.V.

Hydro power and related industries lubricants for power generation

When your job is to manage, protect and optimize some of the largest, most complex and expensive equipment in the industry, every operational decision you make is critical, especially when it comes to the lubricant.

LUMINOL™ TRi inhibited insulating oils are suitable for use in large power and distribution transformers operating at peak capacity. This product offers the added safety provided by negative gassing technology as well as improved low temperature performance.



The lubricant plays a key role in overall productivity: it is critical to meeting operational goals; it protects and prolongs the life of the machine and it is the lifeblood of the equipment. We want operators to get the most out of their equipment and that includes choosing the best lubricants for the job.

TURBOFLO™ – extends intervals between oil top-up or change-outs. TURBOFLO turbine fluids handle the extreme conditions facing your gas, steam and hydro turbines. In fact, TURBOFLO turbine fluids out-perform many leading competitive lubricants in various tests.

Unlike competitive products formulated with naphthenic mineral oils, LUMINOL TRi uses Petro-Canada Lubricants ultra-pure isoparaffinic base oils to deliver worry-free, corrosive sulphur-free performance in your transformer.



Gas, steam and hydro turbines operate at high temperature and pressure extremes. TURBOFLO turbine fluids reduce overall maintenance costs by extending intervals between oil top-up and complete change-outs.

HollyFrontier LSP Europe B.V.

Petro-Canada Lubricants premium product lines of HYDREX™ and ENVIRON™ hydraulic fluids are engineered to resist thermal and oxidative break-down, provide extended drain intervals, and protect against equipment wear. They minimize sludge and varnish deposits for smoother equipment performance and reduced maintenance.

Our hydraulic fluids perform year-round in wide temperature ranges, and the ENVIRON line has been specially formulated for operations working in environmentally-sensitive areas.



Our no-nonsense lubricants warranty

"HollyFrontier Lubricants & Specialties will repair damaged equipment, or replace damaged equipment parts resulting from a failure due to defects of the Petro-Canada Lubricants product, as long as the lubricant is used in accordance with your equipment manufacturer's and our recommendations."

It's more than just a warranty.

It's a commitment.



A HOLLYFRONTIER BRAND

Hovering Solutions Ltd.



Calle de María Tubau 4
ES | 28050 Madrid
www.hoveringsolutions.com

Changing the condition monitoring process from a manual, subjective to an automatised, data-driven approach.

The problem

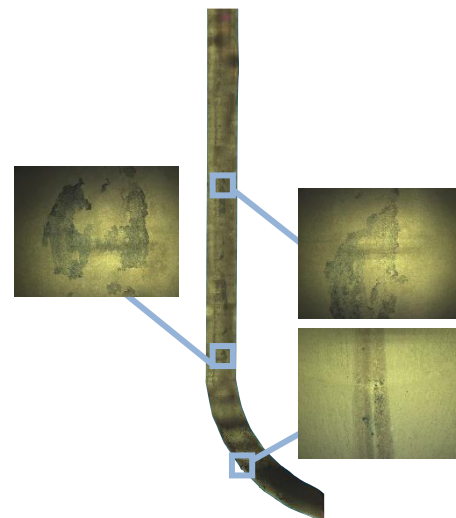
Infrastructure operators such as utilities and hydro companies need to inspect and monitor their assets on a regular base. This process is time consuming and expensive, yet unable to provide high quality information and in several cases entails a considerable risk for human operators.

Our approach

Hovering Solutions has developed aerial robots (a kind of drones) capable of flying autonomously, with no pilot, in absence of light, Global Navigation Satellite System (GNSS) or any other kind of wireless radio communication system. Those robots are capable to fly indoor and can be used for inspection and 3D mapping purposes. Following this approach, the inspection time can be reduced increasing the quality of the retrieved information significantly, whilst reducing the human risk to an absolute minimum. In contrary to current inspection approaches, we are recording a complete data stream not being limited to certain areas, which are supposed to be relevant based on the subjective assessment of the operator.

Our service

Hovering Solutions is not selling its in-house developed robots but providing the acquired data to the customer. Post-processing of those data enables the customer to gain unprecedented insights about the infrastructure condition. This allows to improve and re-think the entire maintenance processes and to reduce unplanned downtimes to a minimum thanks to the findings resulting from the analysis of the available datasets.



Penstock corrosion maps with geolocational information

Contact

T +34 912328318
E contact@hoveringsolutions.com

HYDAC International GmbH

HYDAC – Your Professional Partner for the Hydropower Industry.



Industriegebiet
DE | 66280 Sulzbach
www.hydac.com
hydro-power@hydac.com

Member of vgbe energy | Hydro Power

HYDAC has decades of experience in oil hydraulics and process water treatment. With individual components constantly being added to the product range, such as filters, accumulators, valves, pumps, coolers and sensors, HYDAC has built up an extensive and complete product portfolio over the years that leaves nothing to be desired when it comes to designing systems for the hydropower industry. In addition to supplying individual components, HYDAC also provides complete systems for almost all hydropower applications. These are comprehensive systems which are specially tailored to suit the customer's needs.

HYDAC was founded in 1963 as a company for hydraulic accessories and is today an international, family-run company group with over 9000

employees, 50 subsidiaries and 500 sales and service partners worldwide. Our motto is: global yes local. HYDAC components and systems can be found in all sectors of industrial and mobile hydraulics. In the hydropower industry, HYDAC is represented in the following applications for both large and small hydropower stations:

- Hydraulic steel structures and trash rack cleaners
- Shut-off devices
- Turbines
- Process and cooling water treatment
- Generators



Components & Systems for Hydro-Electric Power Stations



Advantages

- Many years of experience in all aspects of fluid power applications in hydro power
- Worldwide service from initial start-up to proper maintenance
- Continuous development of our products and systems
- Internationally active, family-run company group

HYDAC International GmbH, Industriegebiet, 66280 Sulzbach
T +49 (0)2234 96766-5449, hydro-power@hydac.com





Contact

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Industry Manager Hydropower

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HYDAC International GmbH

Hydraulic steel structures and trash rack cleaners: hydraulic units and cylinders for gates, sluice, weirs and trash rack cleaners.

Shut-off devices: hydraulic systems for main inlet valves, shut-off valves and needle valves, piston and bladder accumulator stations for storing closing power and water-powered servo motors with corresponding protective filters.

Turbines: bearing lubrication systems, hydraulic turbine controllers, piston and bladder accumulator stations for **the emergency shut-down function**, control valves.



HYDROBox

Process and cooling water treatment: for the filtration of seal water, cooling water and extinguishing water, the required components – e.g. the automatic back-flushing filter RF3 (are mounted on compact frame = skid), TwistFlow Strainer (ATF) and pump-stations for closed cooling circuits.



RF3



ATF



WGK

Generators: lifting and brake cylinders, oil lubrication cooling systems and cooling water systems, high-pressure discharge systems (HP systems), brake lifting systems, oil mist separators.



Breaking Cylinder



STENO

HYDAC also supplies products for **Condition Monitoring**, such as sensors for monitoring water content (Aqua sensor), metallic contamination (MCS sensor) and the automatic monitoring oil cleanliness (CS sensor) along with service instruments for maintenance such as dewatering units (FAM), offline filtration units (OLF), nitrogen charging units for accumulators (N2 server) and mobile units for measurements and data acquisition (HMG).



CSM-E

HYDAC also provides **worldwide services** from commissioning to proper maintenance and inspection.

The HYDAC portfolio is rounded off with extensive fluid engineering services which help to optimize your key components and fluid power systems. We are very happy to support you in areas such as energy efficiency, process and system reliability, conservation of resources and system availability.

HydroPower Engineering



Your hydro manufacturing partner. It is not just machining, it is engineering.

Saray Mah. 1076.Sokak No:1/L
TR | Kahraman Kazan – Ankara
www.hydropower.com.tr
info@hydropower.com.tr

A leading manufacturing company in the Hydro-Electric sector.

Bullet points:

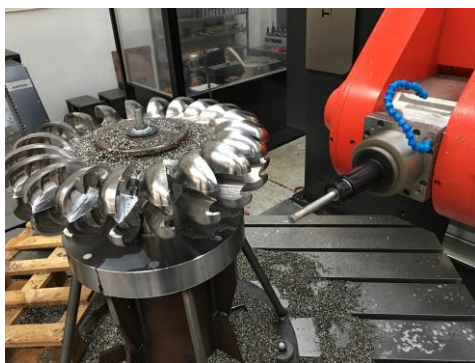
- Experience and quality
- End to end projects
- Complete project documentation

HydroPower Engineering is a Turkish firm, experienced in building and manufacturing the hydro-electric turbines whether it is Pelton turbine, Francis turbine, or Kaplan turbines.

Ever since its establishment it has been ISO9001 certified. It offers high precision machining which makes it suitable for the highly accurate machining applications and fields. With the help of our 6-axes machines, it is pioneer in manufacturing and machining the turbine runners. It offers all the required and necessary non-destructive tests -NDT-, the balancing that the runners require. The machines' capabilities make it able to provide Francis runners whether it is a mono-block runner, or welded bi-blocks with the help of its certified and experienced welders and welding shop.

Also with the help of its coordinate measuring machine -CMM-, its able to accurately and precisely inspect its products' dimensions up to the satisfaction of its customers.

Although it has been established for 5 years now, its turbines and turbine equipment are located all over Europe, Asia and even Australia.



Pelton runner being machined on a 6-axes machine.



2 finished Francis runners before dispatch.

Get benefit of our free quotations for your projects and inquiries now. NDA can be signed upon request.

Always at your service!

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Hydrotec

Water and Environment Consulting Engineers GmbH



Experts for Operational Flow Prediction and River System Modelling

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Delft-FEWS

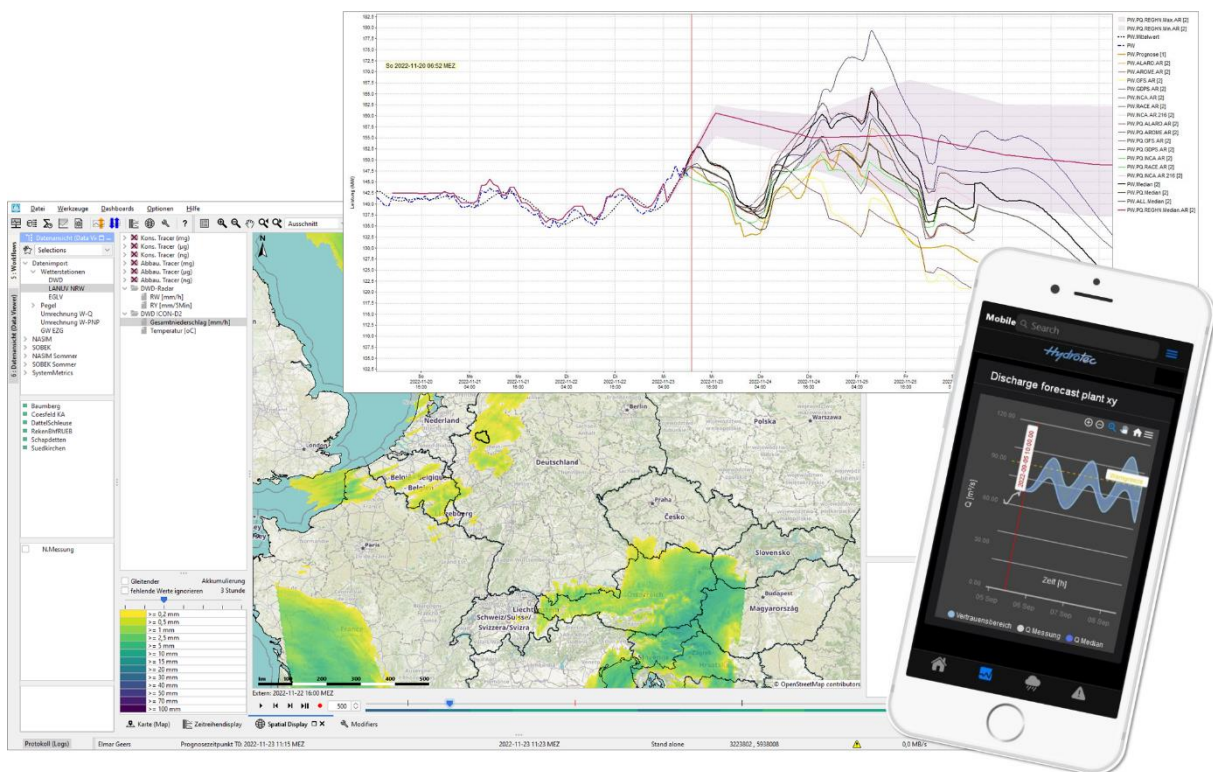
The Delft-FEWS forecasting system can be used to optimize the operation of run-of-river as well as storage power plants. It provides important information for energy planning and secures decision-making in the event of flooding. Energy suppliers can react flexibly to fluctuations in prices and supply, while at the same time safely complying with legal requirements.

Delft-FEWS discharge forecasting system

- Rapidly available, operational forecasts
- Forecast data with high reliability
- Flexibility to meet customer requirements
- Ease of use
- Generation and dispatch of reports

Delft-FEWS serves as a data integration and simulation shell that automatically maps all operational processes of a model. Statistics and reports from the system are freely configurable.

Integrated rainfall-runoff models, continuously driven by the output of numerical weather prediction models, rainfall radar data or rain gauges, calculate forecast inflows to power plants.



The Delft-FEWS dashboard offers spatial data and time series views to the user. Additionally, data can be processed to be visualized in mobile devices.

Hydrotec

Delft-FEWS for Run-of-River Power Plants

Delft-FEWS continuously imports recorded water levels, discharges and operating conditions in the barrages, at the weirs and turbines and evaluates this information with the calculated forecast data.

With the help of RTC Tools 2 the discharge from the reservoirs can be optimized using the weir height as control. Specified target values regarding energy generation, flood protection and water ecology are thus met.

When a flood wave is expected, the operator can provide retention space in good time by lowering the reservoir water level in advance.

The restorage can be initiated as quickly as possible to minimize the impact of the flood on the safety of the hydropower supply.



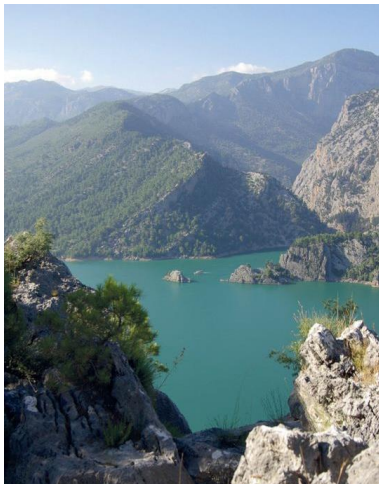
Delft-FEWS supports the operation of Run-of-River Power Plants.

Forecasting discharges

- Power plant scheduling
- Scheduling by the load dispatcher
- Storage and pump deployment planning
- Short-term revision planning
- Support of medium-term planning

Inflow prediction for operation support

- Use of model predictive control for optimal operation of structures and valves
- Fulfilment of regulatory requirements
- Anticipatory action in case of flooding



Storage Power Plants can be run more efficiently by the forecasting system Delft-FEWS.

Delft-FEWS for Storage Power Plants

Delft-FEWS is scalable from simple to highly complex systems representing complex topologies with several hydropower plants and interconnected reservoirs.

The forecasting system provides concrete inflow forecasts based on hydrological calculations and thus supports the management of the reservoirs. RTC Tools 2 can be used to optimize control processes.

Based on measured reservoir levels, power generation schedules and forecast data, a predicted balance of levels is determined. Thus, trends can be identified at an early stage, especially for storage facilities managed during the year.

With the integrated decision support module, users can simulate and visualize processes and control them in the forecast both rule-based and interactively.

Development and support

Delft-FEWS is developed by Deltares, The Netherlands, used worldwide and free of licence fees. Hydrotec configures forecasting systems based on Delft-FEWS according to customer specifications and provides support and maintenance.

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IFTA GmbH



Efficiency and Safety with Digital Vibration Monitoring & Machine Protection Solutions

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www.ifta.com
sales@ifta.com

Since 1996 we at IFTA have been supporting our customers to solve complex vibration problems. We provide profound engineering expertise as well as turnkey monitoring and protection solutions that make machines more reliable and efficient.

Our well-established IFTA ArgusOMDS system has accumulated millions of operating hours with gas and hydro turbines around the world. Its modular design provides seamless scalability from test bed to field applications.

Outstanding 24/7 data acquisition and analysis capabilities combined with reliable real-time protection make it a unique product for plant digitalization.

Your Benefits

- Early detection of harmful vibrations & anomalies
- Data analysis for production efficiency
- Protection for plant availability and safety
- Know-How through engineering expertise



Gain deep insight into your machinery with IFTA's 24/7 monitoring solution ArgusOMDS.

IFTA GmbH

Monitor and Protect your Turbine Shafts

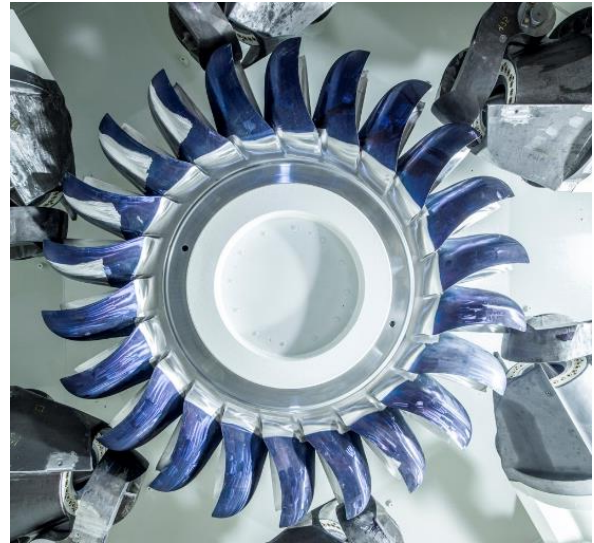
Real-time signal processing of shaft oscillations, configured to address your requirements:

- Order tracking
- S-max
- Whirl/whip detection
- Torsional vibration monitoring

Visualize your Data with our Plot Library

Application-specific plots give an intuitive and quick overview of multidimensional data streams. For rotor-dynamics, our visualization options include:

- Spectrograms
- Bode plots
- Orbit plots
- Shaft-centerline plots



IFTA ArgusOMDS systems can flexibly be adapted to the monitoring requirements of all turbine types.

IFTA Solutions and Services

IFTA delivers all from one hand with inhouse hardware and software development in Germany:

- Modular flexible turnkey solutions for hydro and gas power plants
- 24/7 monitoring and data recording
- Fleet monitoring
- Reliable protection of machines
- Real-time data analysis
- AI-based anomaly detection and optimization
- Consulting expertise



The visualization and analysis software IFTA TrendViewer enables efficient online monitoring, root cause analyses or AI-based optimization.

IFTA – More than 25 Years of Expertise

- Expertise in the field of complex vibration diagnostics and rotor dynamics
- Focus on quality and longevity
- Remote service and support
- Training capabilities inhouse/online

Contact

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Technical Sales

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KELAG-Kärntner Elektrizitäts-Aktiengesellschaft



Your energy, our nature.

Arnulfplatz 2
AT | 9020 Klagenfurt am Wörthersee
www.kelag.at

Member of vgbe energy | Hydro Power

Kelag is one of the leading energy service providers in Austria that is active in generation, distribution and district heating. The company head quarter is located in Klagenfurt, Carinthia.

The international activities in renewable energy generation from hydro, wind and photovoltaic as well as energy trading are bundled in Kelag daughter company KI-KELAG International GmbH.

Kelag with almost 100 years of experience in developing, designing, construction and operation of hydro power plants provides the full range of competence and knowhow from the project idea to the successful project realization.

After the completion of a power plant, our experts guarantee reliable operation, specified maintenance service and performance orientated refurbishment.

From the acquisition, developing, designing and operation of our wind and photovoltaic power plants in and outside of Austria we could intensify our competences within these technologies.

Based on our wide experience, Kelag provides to our partners excellent support from the development to the realization of a power plant project. Furthermore, we support our partners with operation and maintenance and energy trading services in international markets.



Contact

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Head of Power Generation
and Technical Services

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M + 43 676 8780 5237

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KELAG-Kärntner Elektrizitäts-Aktiengesellschaft

Project development and design

We identify a first project idea followed by concept studies and bring the project to an optimized design. Our evaluations are based on technical and commercial feasibility studies considering the project risks and the current market situations. Our experts provide the required competences and licenses in the field of civil, electrical and mechanical engineering and design works.



Intake with fish pass, hpp Kremsbrücke, Austria.

Design, permit procedures and procurement

We provide the relevant documentation including design drawings, studies and calculations in the permitting procedure and support the entire administrative process.

Within the design process, we are preparing the tender documentation and specifications tailored the project requirements either in single lots or for EPC tenders.

We support through the entire procurement process to ensure the purchase order in the required quality, time and cost objective.

Beside the entire project management, we also cover the contract and claim management.



Renewal of 80 years old weirs structure and steel mechanical equipment, hpp Schütt, Austria.



Machine room in Zapeče, Bosnia.

Project realization and commissioning

We support the entire project execution phase with documentation review and approvals, factory and site acceptance tests, installation coordination and site supervision and coordination as well as quality control and management.

Designing, manufacturing, installation and commissioning of steel mechanical equipment is also in our scope of services.

After completion of construction and equipment installation, we are leading and managing the commissioning process through the trial run period to the successful takeover of the power plant.

KELAG-Kärntner Elektrizitäts-Aktiengesellschaft

Operation and maintenance

After successful project execution, we support our customers with operation and maintenance excellence and optimized power plant operation scheduling. Beside revision and overhaul work, we also offer qualified training of our customer's staff.

Complete power plant refurbishment or rehabilitation of single power plant equipment is part of our services.



Generator maintenance.

Energy management and trading

Through qualified production forecasts and market analyses, we provided optimized sales of the produced energy.

We offer energy trading services, PPAs operational generation scheduling and balance group management and guide through the relevant market rules.



Restoration of the inlet guiding cone at Wurtenspeicher, Austria.



Pump Oschenik, hpp Innerfragant, Austria.

Your advantages

- Turn-key solution for power plants
- Production optimization of your power plant
- Full support in all technical and energy management issues
- Independent and competed consulting services in the field of electrical, mechanical and civil engineering
- We are your reliable partner with almost 100 years of experience in the energy business.

KISTERS

We provide professional software solutions for observation, forecasts and optimization of water and energy resources.



Pascalstr. 8+10
DE | 52076 Aachen
www.water.kisters.de/en
water@kisters.de

In addition to retrofitting existing dams, power companies are maximizing value by increasing hydraulic efficiency at hydropower plants. Even when water flows and levels are tightly regulated, the same amount of water can produce more energy if the head is optimized. Generators also have the option to better time energy production to coincide with higher demand or price as much as possible.

A few centimetres of flexibility have been demonstrated to generate as much as 10% more revenue.

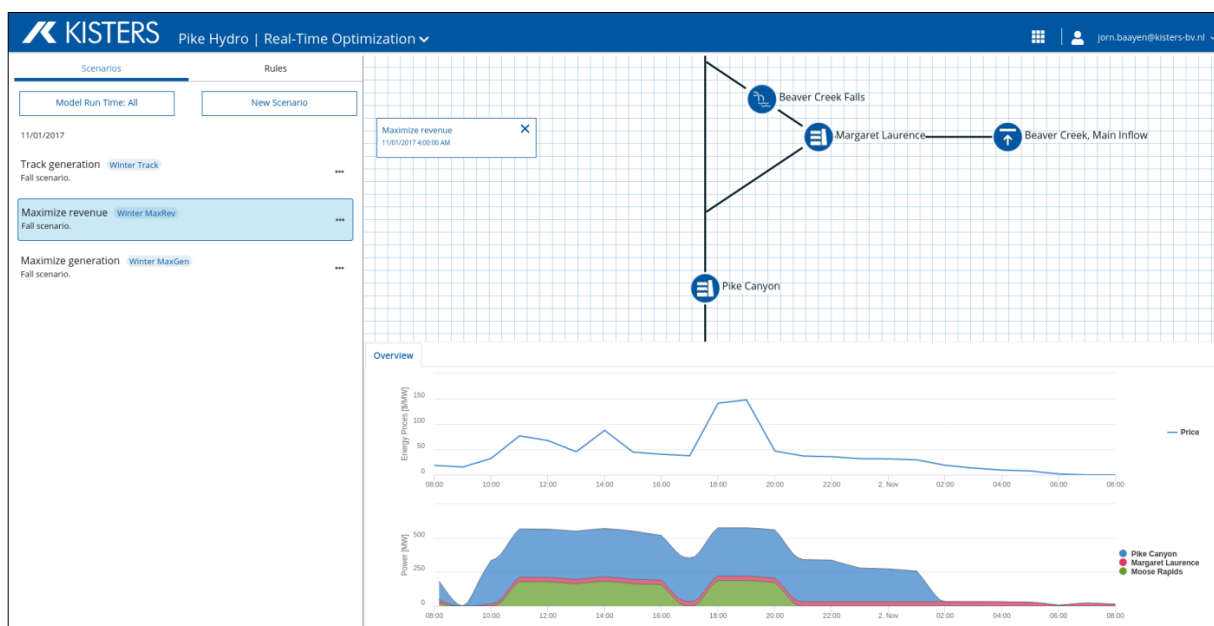
Hydroelectric companies can bolster cost-efficient innovations that integrate with energy storage technologies and align with community values of generating energy sustainably and achieving ecological benefits.

KISTERS Real Time Optimization works on the basis of your existing river models. It takes into account non-linear effects such as wave propagation and head-dependent power generation.

Built upon patent-pending technology, it solves a fully customizable prioritized list of optimization objectives, which allow you to:

- Schedule generation during price peaks and maximize revenue.
- Maximize hydraulic efficiency and maximize total generation.
- Reduce water level fluctuations and dampen flood waves.
- Improve compliance with environmental flow requirements.

Solution optimality guarantees are provided at each stage.



Intuitive Web application for configuration and operation control.

KISTERS**Maximize revenue**

Contribute to the green economy by operating your hydroelectric plants when the clouds are out and the wind lies down – and prices are high.

All the while, stay within regulatory commitments and leverage synergies between efficient operation and ecology.

Maximize e-flow compliance

Minimize your exposure to legal action by maximizing environmental flow compliance, prior to maximizing generation and/or revenue in a subsequent optimization stage.

**Increase effective flood retention capacity**

Prepare for extreme events by dynamically creating retention capacity when storm events are predicted. Is it going to rain? Our software suggests how much to draw down your reservoirs and river reaches to make space, without compromising other operational requirements.

We are ready for your challenge.

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Head of Sales, Business Unit Water,
KISTERS Group

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KWS Energy Knowledge eG



Knowledge – Workmanship – Safety

KWS Energy Knowledge eG (KWS is an educational institution and service provider for the German and international energy sector and has been offering modern and customer-specific training and consulting for more than 60 years. Beginning more than 18 years ago, KWS has also been conducting training measures for hydropower plant operating personnel. The two-week course "Basic Training Control Room Operator" was developed with the assistance of the vgbe expert committee on hydropower installations.

408 participants from 19 businesses were trained in 24 courses and received their graduation certificate following their successfully concluded final examination. This certified degree provides responsible personnel in their respective companies with greater legal security regarding their organizational functions.

Complementing basic training is a one-week consolidation seminar offered by KWS since 2010. This seminar focuses in depth on operational demands. Other topics are flood control, occupational safety and efficient operations under changing market conditions.

Beside these standardized German-language training courses in our training center in Essen, Germany, we also offer customized on-site training measures tailored to the needs of international clients. We are happy to assist our customers, plant operators and component manufacturers in the selection and training of operating personnel for new hydropower installations.

With its training offerings, KWS keeps pace continually with new developments in energy technology and assures high personnel qualification standards in energy sector businesses. It thereby makes a significant contribution to a company's success in the marketplace – a valuable investment in the future!

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KWS Training Center.

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LocLab Consulting GmbH



The Digital Twin Company

Wherever our 3D digital twins come into action: they form the modern basis for sound decisions.

Groß-Gerauer Weg 1

64295 Darmstadt, Germany

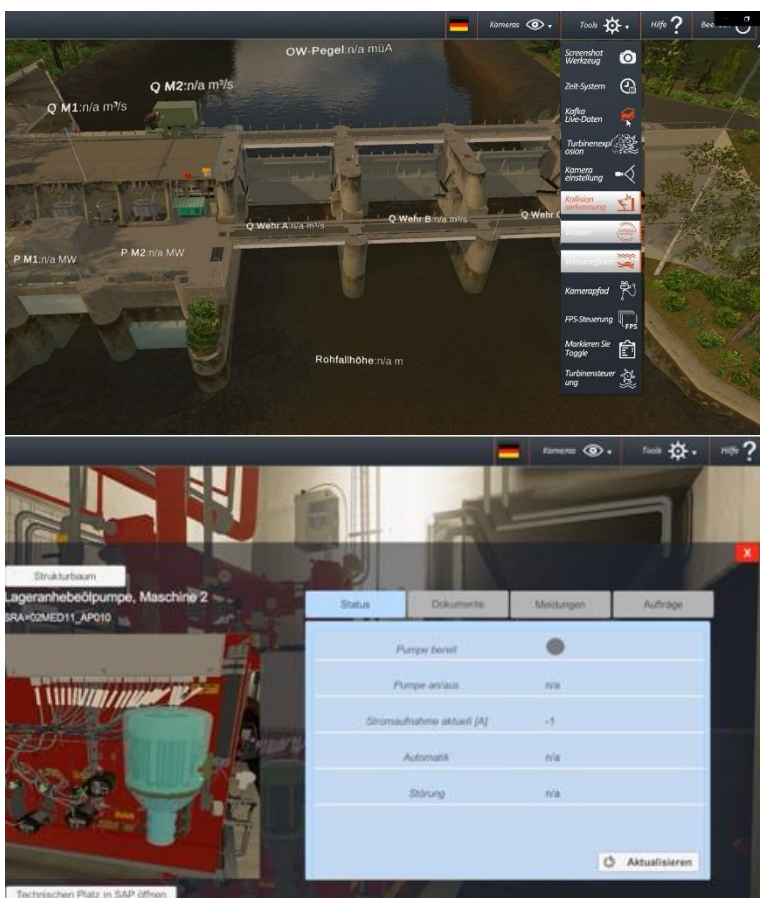
www.loclab-consulting.com

info@loclab-consulting.de

Our digital twins will revolutionise your business processes. As object-based virtual images of existing or planned buildings, technical facilities or other built assets, they provide a completely new intuitive access to your asset data. In addition to semantics as a prerequisite for systems integration, data analyses and simulations, our models are characterised by extremely high performance, the smallest data volumes and a remarkably realistic appearance.



The Wedtlenstedt lock was built in 1939 and needs to be modernized and expanded. Our 3D model of the existing lock and the environment, generated from terrestrial photographs and videos, was used for early stakeholder engagement and communications.



Real-time semantic 3D model connected to SAP and Apache Kafka.

Case Study: Rabenstein Hydropower Plant

The aim of the pilot project of VERBUND, Austria's leading electricity company and one of the largest producers of electricity from hydropower in Europe, is to create an interactive VR model of Rabenstein hydropower plant, including the immediate environment, based on 3D survey data and photos. New possibilities are expected from VR models in the following areas, among others: safety instructions, training / education environments e.g. simulation of floods or of incidents, intuitive access to relevant information.

Technical documents, IoT and live sensor data from process control technology have been successfully integrated into the 3D digital twin Rabenstein.

LocLab Consulting GmbH

Output	Real-time semantic 3D model connected to SAP and Apache Kafka
Functionality	Existing layout, mini map, time system (shadow analysis), water effects, fault reporting tool, turbine simulation, real-time data connection to SAP and Apache Kafka
Production time	<ul style="list-style-type: none"> Data acquisition 1 day Modelling 6 weeks Application development 10 days
Advantages	<ul style="list-style-type: none"> Improved troubleshooting and reporting Improved simulation of scenarios Shortening of asset management processes through better understanding of the context Model is used for other use cases (Web-GIS, training)

Case Study breakdown.

GIS and 3D Digital twin connection

With the WebGIS "GeoWeb", created and operated by the company rmDATA from Vienna, an application is available in Austria and Germany for obtaining information from diverse 2D geodata. Designed as a self-service portal, users obtain the desired information via an interactive map.

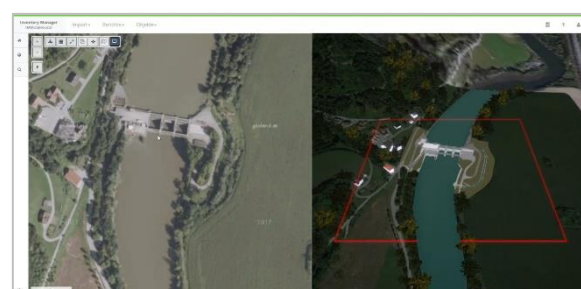
The goal is to provide a network of employees with a central system for geo-related information and to integrate all relevant data directly or indirectly into it.

The distinctive aspect of this project is that direct access and interaction with a complex 3D digital twin is enabled within the GIS application.

In a first integration step, the existing WebGIS of VERBUND has been extended to include a link to the virtual power plant model Rabenstein.

The WebGIS serves the user as a navigation/entry point to a VR model or to the interaction between the power plant exterior (2D) and the power plant interior (3D).

The user is offered the possibility to "dive" directly into the interior of the power plant via defined entry points and to move around in it.



WebGIS GeoWeb application – GIS & 3D outside view.



WebGIS GeoWeb application – GIS & 3D inside view.

LocLab Consulting GmbH

The Verbund 3D-Rocket Player for bathymetry data to visualize water survey data in a real-time 3D environment

Bathymetry is the survey of underwater depth to map ocean, lake, or river floors.

The underlying approach of the project is the linking of the 3D-Rocket Player of LocLab Consulting GmbH with the HIS'3D database of Verbund. The manufacturer of the database as well as the add-on programs is Simutech GmbH.

Simutech provides the software for handling the bathymetry data. The bathymetry data are stored in the form of triangle meshes (3D OBJ data) with textures in the HIS'3D database by Simutech. LocLab focuses on the visualization of the data.

From the database, the triangle meshes provided by Simutech can be loaded into the 3D Rocket

Player. The user of the player is then able to view the bathymetry data in real time. The data is automatically inserted into a Digital Terrain Model, with existing Digital Twins of power plants. The user can move freely around the scene and view the 3D riverbed in detail.

Via the loading of triangle meshes, which originate from data collections of different years, geo-metric comparisons over the years can be created. In this way, for example, outwash or accumulations of soil material can be made visible directly in the 3D model. In addition, the user can load existing differencing calculations to historicized data and analyse them.

The basis for the display of the triangle meshes of the bathymetry data is a geographic survey (georeferencing) inside the 3D software.



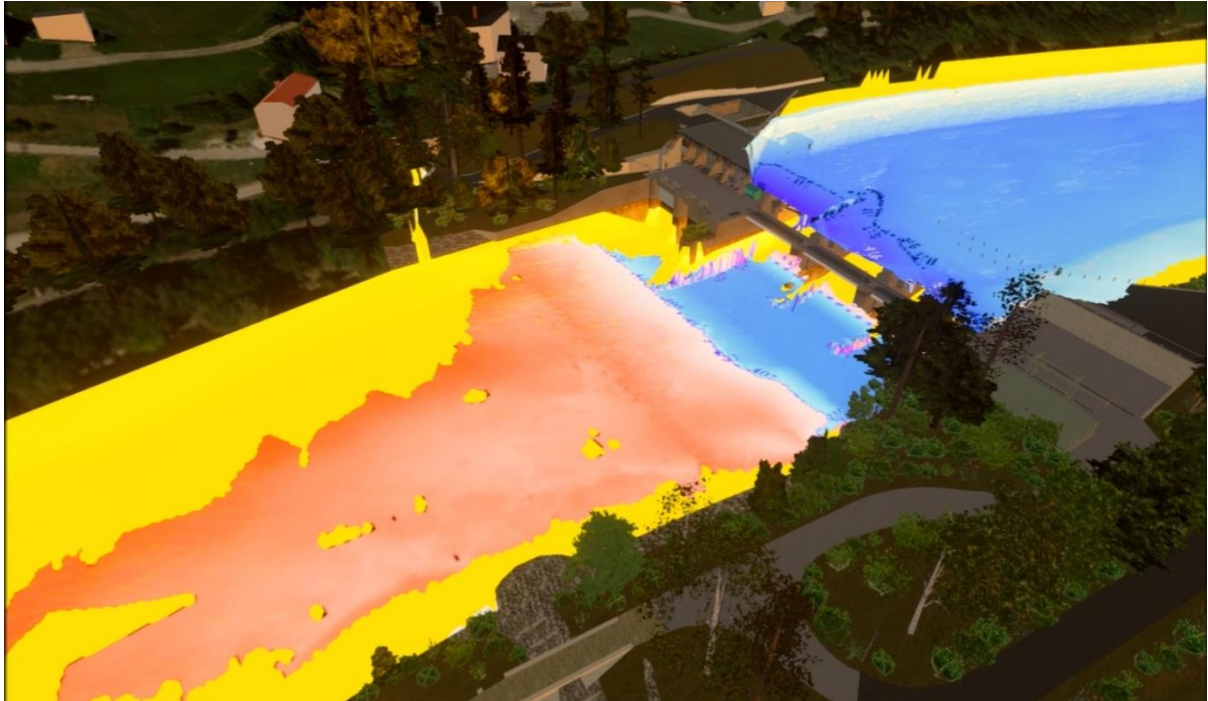
Visualization of 3D Bathymetry data at Powerplant Rabenstein.

The 3D-Rocket Player for Verbund already contains a low level of detail 3D model of Austria, which is displayed when the player is started.

Georeferencing is the basic requirement for loading the triangle meshes of the bathymetry data in a combinable way. The correct location also ensures that the data can be combined with other data sources. As the user approaches with the camera, the coarse LoD of the terrain models in the area being viewed is replaced by a higher resolution one, as can be seen in Google Earth, for example.

In the future, live values measured by sensors on site could also be used to display the water level. The interface of the 3D-Rocket Player to Verbund's Apache Kafka Server already exists. The values are currently displayed in the digital twin of the Rabenstein power plant. However, it is also possible to process the values directly and include them in the visualization. This would mean that the displayed water level corresponds exactly to the currently prevailing water level on site.

Loclab Consulting GmbH



Visualization of 3D Bathymetry data at Powerplant Rabenstein.

Find more Information here:

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MJ2 TECHNOLOGIES S.A.S.

MJ2 Technologies S.A.S. is the designer and manufacturer of the Very Low Head turbine called VLH.



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Zone d'activités Millau-Larzac
FR | 12230 La Cavalerie
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vlh-turbine@vlh-turbine.com

This revolutionary new concept integrates the most advanced technologies available in the power generating sector such as directly driven variable speed PMG, and frequency converter.

MJ2 is also designer and manufacturer of direct driven low speed Permanent Magnet Generators (PMG) for low head hydro application in replacement of speed increasers and asynchronous generators.

Very Low Head VLH Turbines

The VLH offers an unmatched opportunity to harness existing hydraulic infrastructure, with a reasonable profitability thanks to the savings in civil work infrastructure costs.

It addresses the most demanding environmental integration conditions in terms of noise, vibration, fish migration through the running turbine, or visual impact.

The approach is to have an Integrated Generating Set (IGS) built around a large Kaplan runner directly coupled to the generator, the trash rack and trash rack cleaner all integrated in one block installed in sluice passage of existing dams.

The large runner diameter running slowly, (30 to 50 rpm) the water velocity at both end of the turbine is reduced and the needs for complex civil structures are eliminated.

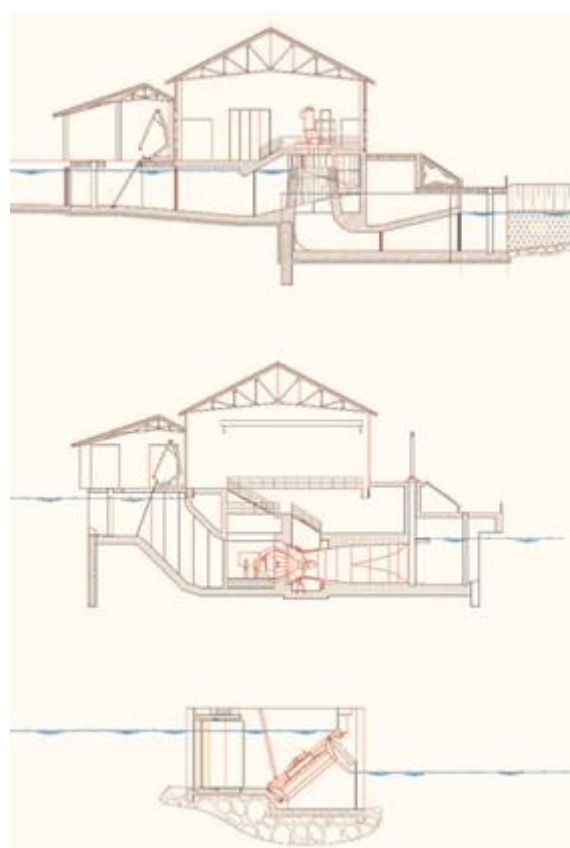
The VLH is a standardised line of turbines including five different size of runners. It addresses the following range of heads and flow:

- Heads: from 1.5 m up to 3.4 m in standard design and up to 4,5 m in customised reinforced design
- Flows: from 8.8 up to 35 m³/s per unit
- Outputs: from 100 kW up to 700 kW per machine at frequency converter terminal box

MJ2 Technologies has installed more than 120 VLH in 7 different countries.



A VLH in lifted maintenance position.



Required Civil Work infrastructure for the same head and Flow with different technologies: Upper figure shows a Vertical Kaplan.

Intermediate Figure Shows an Axial Kaplan in Pit configuration: The lower figure shows a VLH.

MJ2 TECHNOLOGIES S.A.S.

Permanent Magnet Generators (PMG)

- Our goal: provide to the hydropower market low speed & high efficiency generators
- PMG can integrate Thrust bearings, Hollow shaft for Kaplan blade mechanism control
- Output: from 100 kW to 3,000 kW
- Speed: from 60 rpm to 250 rpm

MJ2 has delivered more than 150 PMG in the last 15 years. Each unit is custom designed to the specification of each site.



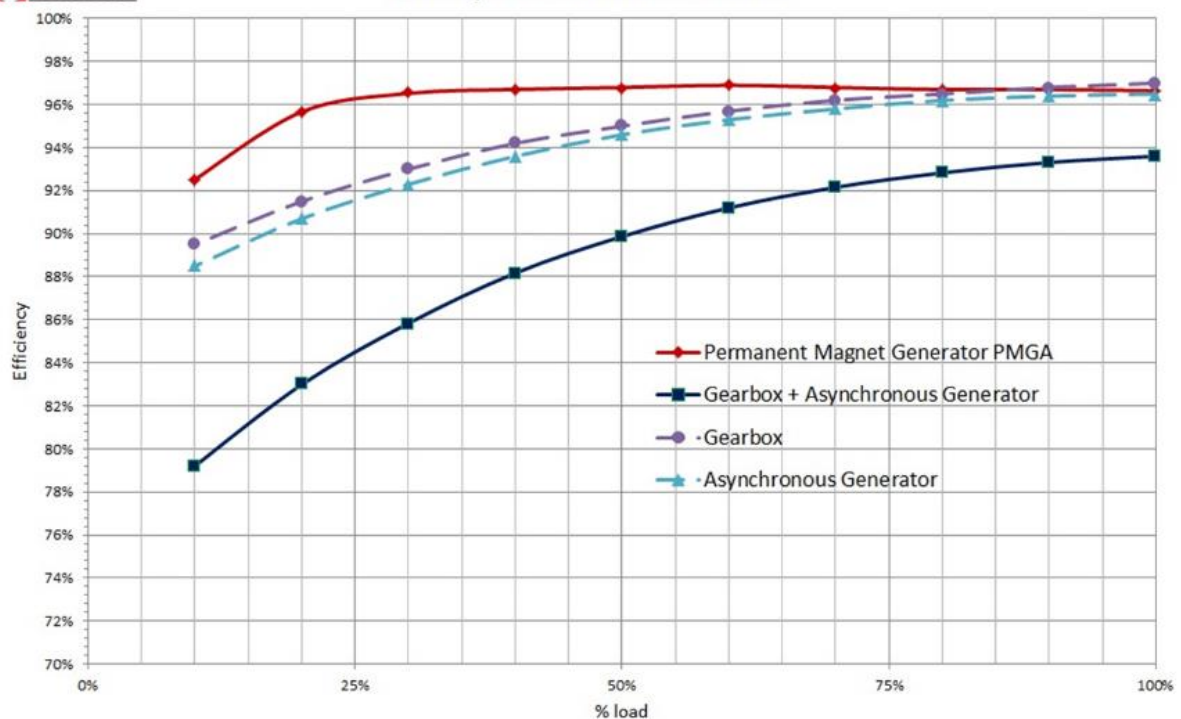
St. Gery HPP 3 Vertical PMG 650 kW.



Las Rives HPP 3 Horizontal PMG 800 kW.



Efficiency benchmark of various solutions



Efficiency gain compared to a conventional application with speed increasers from 5 to 10%.

MJ2 TECHNOLOGIES S.A.S.

Kaplan Turbines

Kaplan Turbines

A range of modern turbines for very small heads

- Gross heads: from 2 to 6 m
- Nominal Flows: 6 to 55 m³/s
- Outputs from 200 kW à 2,000 kW
- Verticals, horizontals o inclined Kaplans
- Double regulation or simple regulation
- Hydraulic profiles moderns and customised
- Exclusive use of PMG Generators



Axial Horizontal Kaplan Runner Ø 2,800 mm 2,000 kW.



Vertical Kaplan Runner Ø 3,150 mm.



Wicket Gate mechanism for the same Turbine Runner Ø 2,800 mm 2,000 kW.

Contact

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Prof. Dr. Jaberg und Partner GmbH



We are among the leading experts for fluid technology issues in application-oriented mechanical engineering for turbines, pumps and systems. Based on our extensive modular methodology, we support our customers' success and reliably keep our promises.

Kerscheckstrasse 41
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www.jabergundpartner.com
info@jabergundpartner.com

FIELDS OF ACTIVITIES

We offer high performance numerical simulation for multidimensional calculations and – as of our tight interlocking with research and educational institutions – extraordinary experimental and metrological competence, especially test rigs in accordance with the IEC/ISO standard and also highly performant and exact measurement technology for plant measurements.

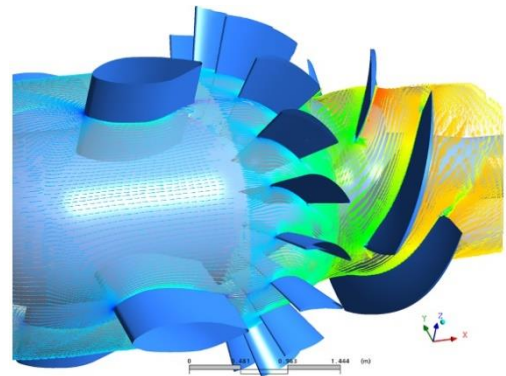
We are independent and work as a team with our partners and customers from industry, research and science. With our expertise, we cover the entire value-added process – from market requirements to implementation.

RESEARCH & ENGINEERING

Numerical Simulation

One of the ways to solve problems regarding fluid mechanics is numerical simulation, which we successfully apply for decades now. Numerical fluid mechanics / CFD often represent a rather cost-efficient and fast method compared to experimental research.

- Analysis, design and optimisation of hydraulic fluid machinery, components and systems
- Water hammer and pressure surge as well as transient conditions of water and gas flows
- Fluid-structure interaction



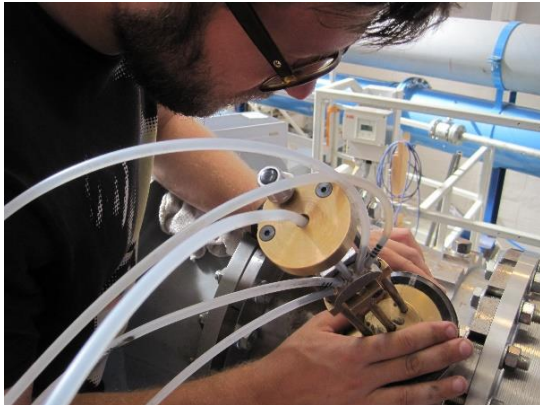
Assessment & Consulting

Our profound know-how, experience and well-established numerical as well as experimental methodology ensures the quality of our work on innovations and independent expertise.

- | | |
|---|---|
| ▪ Feasibility studies | ▪ Support with regard to Environmental Impact Assessments |
| ▪ Modernisation of power plants and systems | ▪ Damage events |
| ▪ Product development | |

Prof. Dr. Jaberg und Partner GmbH

Test Rig



Our modern laboratory - interlocking with research and educational institutions - equipped with numerous state-of-the-art test rigs and reliable measurement technology allows for industry-oriented as well as application-oriented research and development work.

- Acceptance tests and model tests according to IEC 60193, ISO 9906, IEC 60534, IEC 62006
- Plant, operation and life cycle tests
- Endurance test
- Comparison of experimental data with numerical simulation (3D-CFD)

On-Site Measurements

A competent team of engineers provides independent measurements and consulting for the optimisation of industrial plants / power plants according to IEC 60041 and IEC 62006.

- Thermodynamic eff. measurements
- Acoustic flow measurements
- Pressure loss measurements
- Vibration and voltage measurements
- Winter Kennedy



POST GRADUATE TRAINING & TEACHING



In our tailor-made trainings in all fields of hydraulic fluid machinery, we provide user-oriented and profound knowledge. These programmes are founded on our well-established know-how and our expertise.

- 8th Practitioners' Conference
Hydropower / Turbines / Systems
September, 2023 | Graz, Austria

www.wasserkraft-graz.at

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RITTAL GmbH & Co. KG



Rittal – The System for hydropower

Auf dem Stützelberg
35745 Herborn
www.rittal.com
energy@rittal.de
info@rittal.de

Rittal is a leading global supplier for renewable energies, e. g. in the wind energy, photovoltaics and hydro power sector.

Low-maintenance and compact solutions for control and low-voltage systems ensure the long-term operational reliability of small and large power plants. Systems can be set up in a short time with standardized, modular components. The international availability of our solutions ensures that your platforms can be delivered with a uniform basis all over the world.

- Digital integration and data consistency throughout the whole value chain with the help of Eplan and Rittal configurators
- Laboratory tested according to international standards
- Tested arc fault safety according to IEC 61 641
- International service network for minimising downtime and increasing efficiency



We streamline and speed up your processes at every phase: from engineering, to procurement and manufacturing, through to operation.

The company Rittal

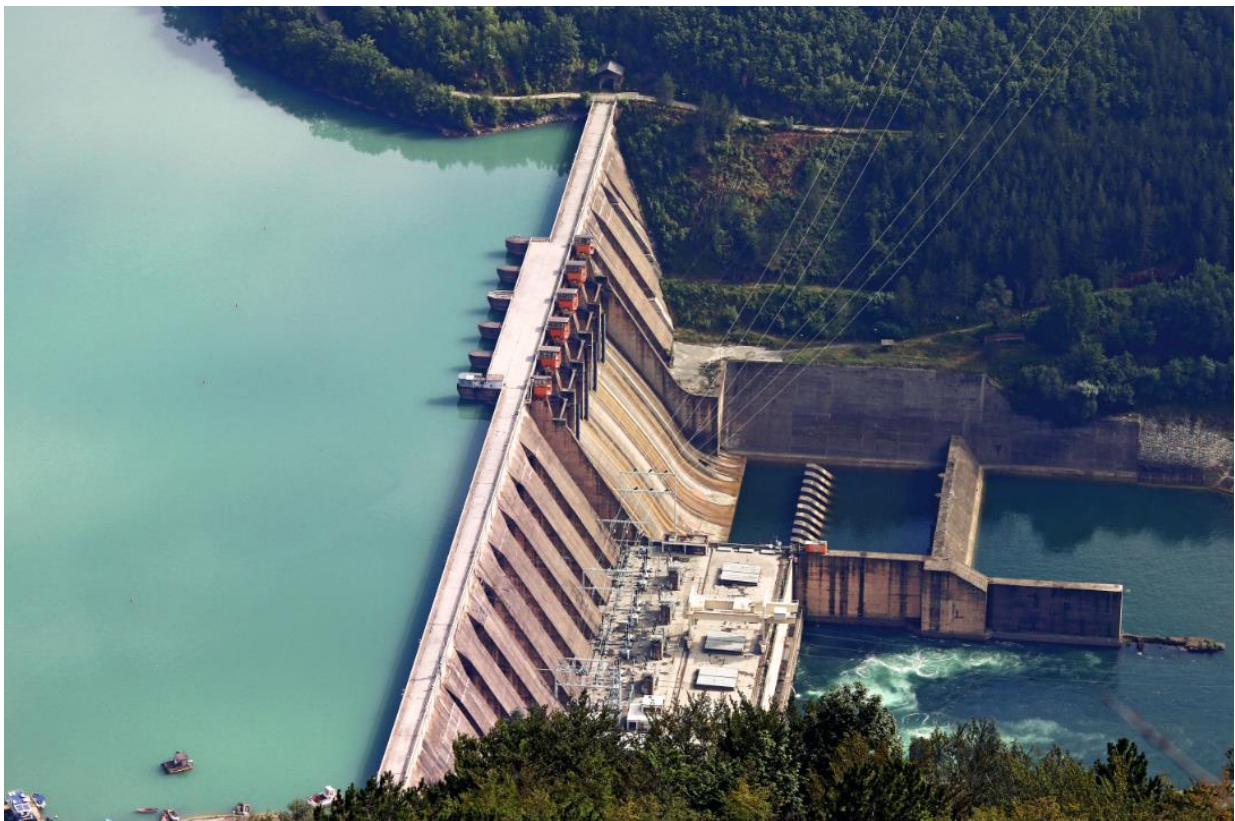
Rittal, headquartered in Herborn, Hesse, Germany, is a leading global provider of solutions for industrial enclosures, power distribution, climate control and IT infrastructure, as well as software and services. Rittal solutions can be found in more than 90 percent of all industrial sectors worldwide. Systems made by Rittal are deployed across a variety of industrial and IT applications, including vertical sectors such as the transport industry, power generation, mechanical and plant engineering, IT and telecommunications.

RITTAL GmbH & Co. KG

Rittal is active worldwide with more than 9,000 employees and over 64 subsidiaries. Its broad product range includes infrastructure solutions for modular and energy-efficient data centres with innovative concepts for the security of physical data and systems. Leading software providers Eplan and Cideon complement the value chain, providing interdisciplinary engineering solutions, while Rittal Automation Systems offers automation systems for switchgear construction.

Founded in Herborn in 1961 and still run by its owner, Rittal is the largest company in the Friedhelm Loh Group.

The Friedhelm Loh Group operates worldwide with more than 12 production sites and over 90 international subsidiaries. The entire group employs more than 11,600 people and generated revenues of €2.5 billion in 2021. For the fourteenth time in succession, the family business has won the accolade "Top German Employer" in 2022. In addition, Friedhelm Loh Group was recognized as "Top vocational trainer" according to a study of Deutschland Test and Focus Money for the fifth year running in 2021. In 2022, Rittal was awarded the Top 100 accolade as one of Germany's most innovative mid-size businesses.



From Automation and Protection to Low Voltage Auxiliaries and IT Infrastructure - Rittal delivers modular solutions to enable our customers.

Further information can be found at
www.rittal.com and
www.friedhelm-loh-group.com.

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RWTH Aachen University

Institute for High Voltage Equipment and Grids, Digitalization and Energy Economics (IAEW).



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Our Joint Vision

From the materials and components to the digitalized system.

IAEW researches solutions for the energy transition.

Technically. Economically. Regulatorily.

IAEW comprises a team of more than 120 employees including around 90 research associates at the professorial chairs for

- High Voltage Equipment and Technology
- Transmission Grids and Energy Economics
- Active Energy Distribution Grids

Transmission Grids and Power Economics: High Expertise in Energy System Analysis

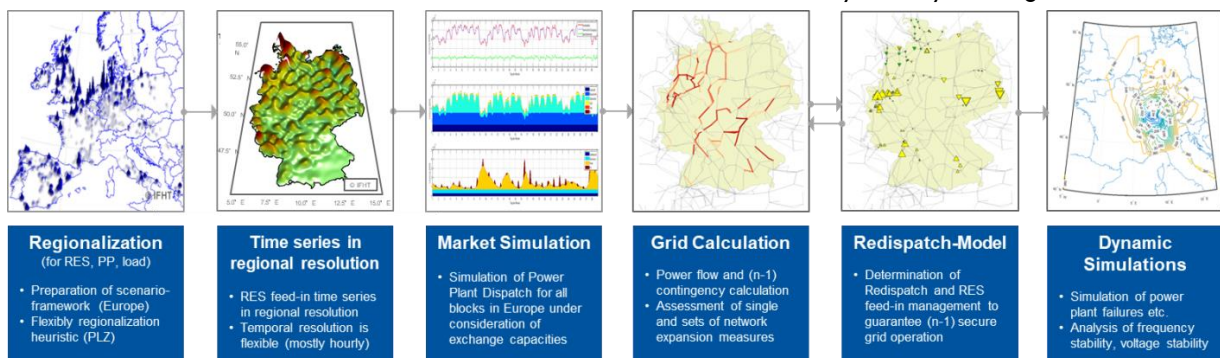
Exemplary research questions:

- Is the operation of a particular hydropower plant economically efficient?
- To what extent can hydropower plants and their ancillary services contribute to the integration of renewable energies by using storage capacities?
- How do individual plants contribute to the stability of the grid and what voltage support can be provided?

Our Solution: IAEW-Toolchain

Modelling environment for the whole process of energy system analysis

- Regionalization / Feed-in of renewable energies
- Energy market simulation
- Stationary and dynamic grid calculations



IAEW-Toolchain for Energy System Analysis.

Related Research Topics

- Operation and planning of future energy systems under consideration of energy sector coupling
- Design and simulation of energy markets
- Investigations of security of supply and system stability

References: Application and validation of IAEW-Toolchain in a broad variety of public projects and in collaboration with industry partners.

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Salzburg AG für Energie, Verkehr und Telekommunikation



Full digitalisation of a power plant with a Digital Twin.

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kundenservice@salzburg-ag.at

Member of vgbe energy | Hydro Power

Salzburg AG is a local energy and telecommunication provider and utility operator in Austria, with decades of experience in operation and maintenance of hydro power plants.

Ocean Maps offers a wide range of services and solutions, based on state-of-the-art measurement equipment and world's leading 3D software engine.

Ocean Maps as well as Salzburg AG are combining their strength and experiences and are continuously looking for innovative solutions.

DIGITAL TWIN FULL DIGITALIZATION OF A POWER PLANT

With the Digital Twin solution, we offer a complete power plant digitalization, which includes the visualization of the underwater area, the dam, the power plant building as well as the internal machinery and operating data.

The Digital Twin allows for any kind of interaction, in particular free location selection, data integration, data analytics, first-person simulation and much more. With our product we set new standards in terms of appearance and intuitive usability. Whether Windows 10, MacOS, Android or iOS – Ocean Maps supports all common platforms!

Our team has the expertise needed to professionally survey large-scale underwater terrain using Multibeam Sonar, as well as surveying terrains and structures over water using drones and photogrammetry.

The correct generation, processing, visualization and analyzation of data and results are the key factors for future success in digitalization projects. In a world of increasing complexity, we need to find ways to decrease complexity for our personal by implementing the best fitting tools for each job.

For example, the visualisation in 3D can be a very practicable way to provide land or field survey data or site data in a useful and future orientated way.

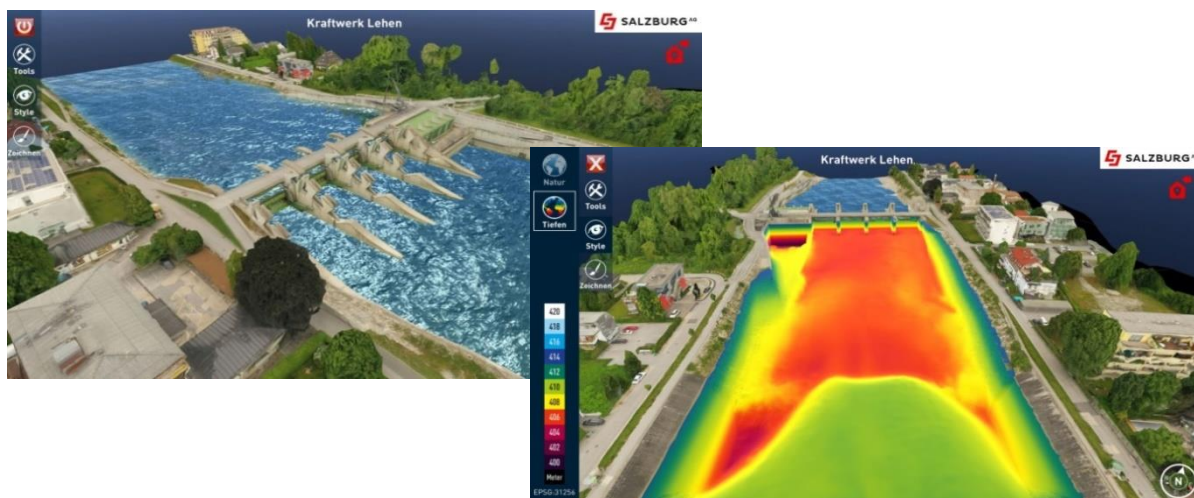


Examples of visualization and analyses of sedimentation at a hydro power dam.

This opens the opportunity to

- analyse data in a better way,
- store data in a new structure which supports human cognition,
- present data and information,
- improving communication with 3rd parties,
- train personal virtual (Knowledge Management, Safety Management, ...),
- and so on.

Salzburg AG für Energie, Verkehr und Telekommunikation



Examples for visualization of the river bed situation (HPP Sohlstufe-Lehen, Salzburg AG).



Visualization tool used to find documentation in an easy way.

Salzburg AG is successfully using such tools, provided by OCEAN MAPS, to analyse the underwater situation in river beds for flood prevention or to provide underwater measurement data for maintenance purposes, within interactive 3D applications based on sonar-, laser- and other surveying data.

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SEAMTEC GmbH



**SEAMTEC GmbH is an international company
based in Upper Austria in the field
of cloud automated solutions.**

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office@seamtec.at

Master digitization with SEAMTEC

SEAMTEC has set itself the goal of using the energy sources water and biomass efficiently and sustainably in harmony with nature. Since the company was founded in 2009, SEAMTEC has completed projects in more than 15 countries and implemented more than 130 power plants.

The aim of our solutions is to optimize processes, network systems, save resources and increase efficiency. We pursue a holistic approach, think networked and combine the best of the worlds of mechatronics and IT.

Award-winning SEAMTEC cloud

SEAMTEC develops the SEAMTEC cloud, a web application that is used in a wide variety of industries since 2011. 2016 the system was awarded the 1st prize of the Constantinus Awards in the Industry 4.0/IoT category as the best project.

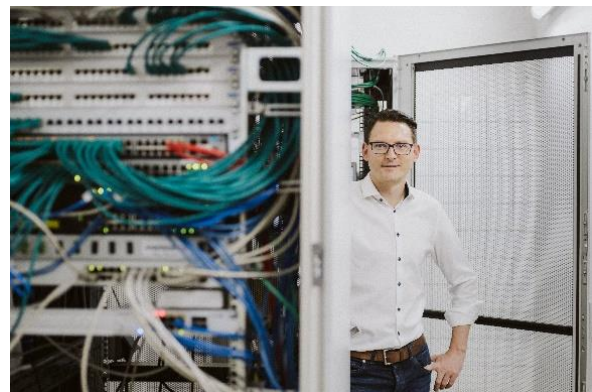
The advantage of this solution is that real-time values can not only be visualized, but systems can also be actively controlled remotely.

The best of two worlds

SEAMTEC GmbH has the necessary know-how and the corresponding expertise in the areas of mechatronics, electrical engineering, automation technology, control technology as well as software and web development inhouse. SEAMTEC not only reads data and displays it online, but also understands the entire platform of its customers.

Advantages of the SEAMTEC cloud:

- State-of-the-art/safest cloud
- Technology in our own data center in Austria (ISO 27001 certified)
- Real browser-based solution without plugins (HTML5, SVG, Javascript)
- Modular structure: quickly adaptable
- No additional software required
- Networking several systems: quick & easy
- User administration with different roles
- Multilingual



Peter Reiter founded SEAMTEC in 2009.

SEAMTEC GmbH

Digital Power plant of the future

The SEAMTEC portfolio includes the following products and services in the field of hydropower:

1) Automation and control technology for hydropower plants

Our service includes:

- Turbine controllers for all types of turbines
- Hydraulic steel engineering control
- Planning and implementation of the entire electrotechnical system
- Plant optimization
- Innovative visualization in the SEAMTEC cloud

2) SEAMTEC cloud - way to the digital power plant

Our specially developed SEAMTEC cloud makes it possible to control these power plants remotely, so that users are always up to date, no matter where they are.

Optimization on all levels

With SEAMTEC you have a strong partner for your requirements in the hydro sector: We implement digitalized documentation for your power plant. In addition, you can visualize data in the cloud and thus summarize the control systems; all relevant data is displayed automatically.

Better predictability and intelligent operational management of the individual systems are just a few of the advantages.



HPP Dagbasi (Turkey): Control for hydropower plant and cloud integration



HPP Vardenik (Armenia): Control for hydropower plant and cloud integration



WKW Pollinger (Styria): Control for hydropower plant and cloud integration

SEAMTEC GmbH

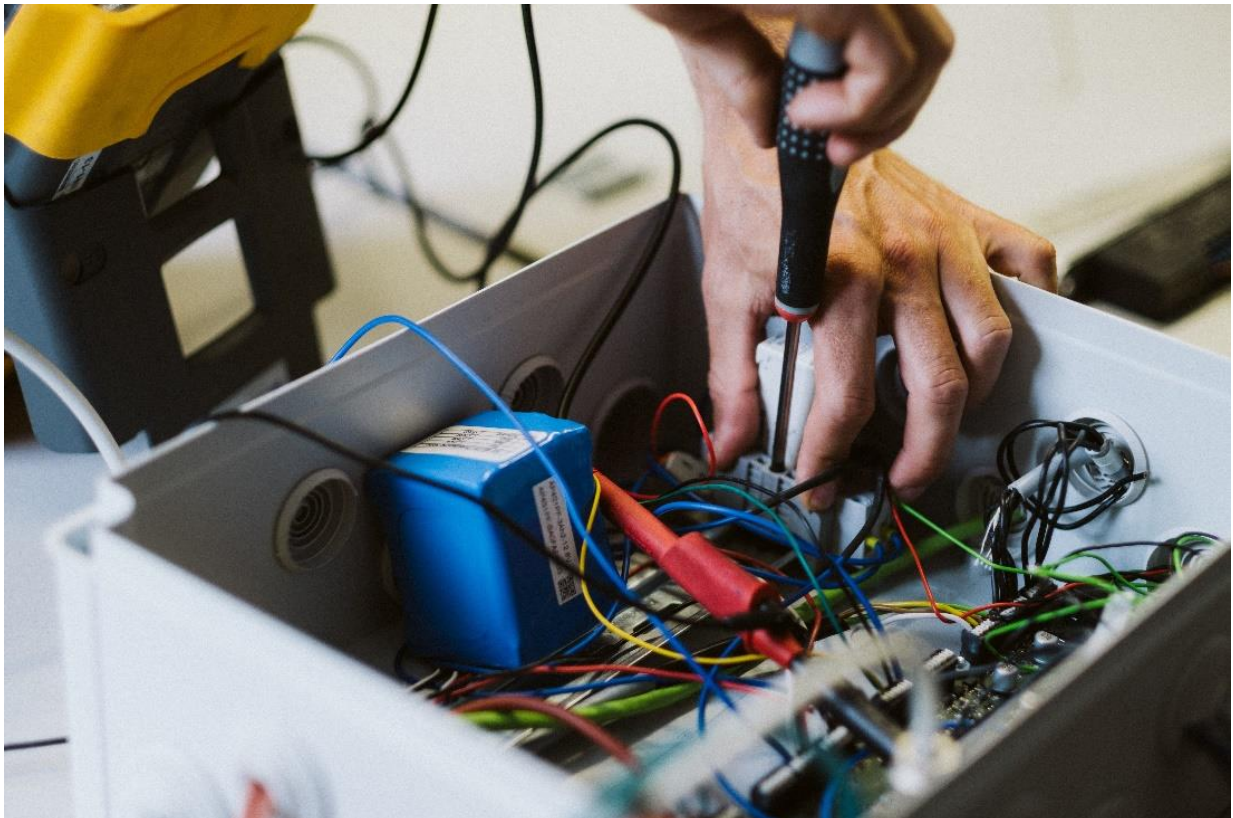
With the SEAMTEC solution, power plant control technology and energy technology merge, allowing you therefore to optimize production. With the SEAMTEC solution your power plant thinks for itself - predictive maintenance is made possible by processing the existing measurement data and corresponding evaluations.

As a complete supplier of electrical and control solutions for hydropower plants, SEAMTEC supplies everything from electrotechnical planning to installation and commissioning that guarantees carefree and optimized operation of hydropower plants. With this, SEAMTEC intends to support and modernize the use of further power plants in Austria in the future and thus optimize and simplify it for operators.

"We are cloud experts, pioneers and solution providers when it comes to automation technology and control processes", says Peter Reiter, who founded the company in 2009. He and his team are always trying to develop the optimal solution for its customers.



The right solution for every customer - that's what Peter Reiter and his team are working on.



SEAMTEC relies on research and development in order to stay up to date with your requirements.

Free digitization check

Do you have questions about our services or are you not sure whether you have come to the right place? We definitely find the right solution together with our customers – just **contact** us!

Contact

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Founder & CEO

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M +43 676 814 282 36

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Software AG



Experts for Operational Flow Prediction and River System Modelling

Tech Gate Vienna, Donau-City-Straße 1
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www.softwareag.com
daniel.ebner@softwareag.com

Cumulocity IoT

The IoT platform Cumulocity makes it easy to integrate existing and new sensors to monitor or analyze data.

Operational benefits:

- Fastest integration of non-digitized equipment into a comprehensive Industry 4.0 platform
- Graphical components that can be orchestrated into dashboards by the experienced end user

Technical capabilities:

- Ease of device integration with the ability to expand the solution
- Preconfigured device management with the possibility of enhancement
- Set of graphical components that can be re-usable extended by developers
- Self Service, fast and easy integration into your existing IT Landscape

TrendMiner

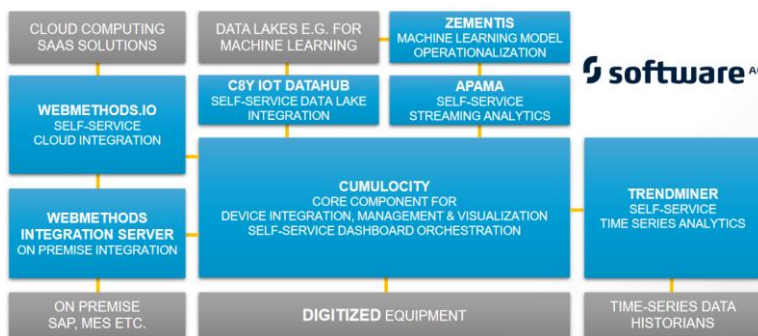
TrendMiner helps to Improve plant availability, production quality and overall asset effectiveness through self-service search, diagnostic, and predictive analytics using pattern recognition and seamless machine learning technology.

Operational benefits:

- Increases the throughput of analysis per time unit and thus the added value of analysis in general
- Ease of use – no need for data scientists
- Can replace or accelerate quality assurance

Technical capabilities:

- Easy deploy on premises or consume from the cloud
- Plug-and-play connections to a wide range of historian systems
- Establish golden batch monitoring



In the graphic you see Software AG's Industrial IoT platform architecture with a self-service focus to leverage Industry 4.0.

With our solutions you can upgrade your existing plants to Industry 4.0 standard and enable your on-site employees to easily analyse and understand the status of the plant.

We would also be pleased to arrange an individual meeting to assess the potentials in your hydropower plant.

For questions or further information do not hesitate to contact us.

Contact

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Country Manager Austria

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E gerald.friedberger@softwareag.com

Technical University of Graz Institute of Electrical Power Systems



Power-Hardware-In-The-Loop laboratory for variable speed hydro power plants

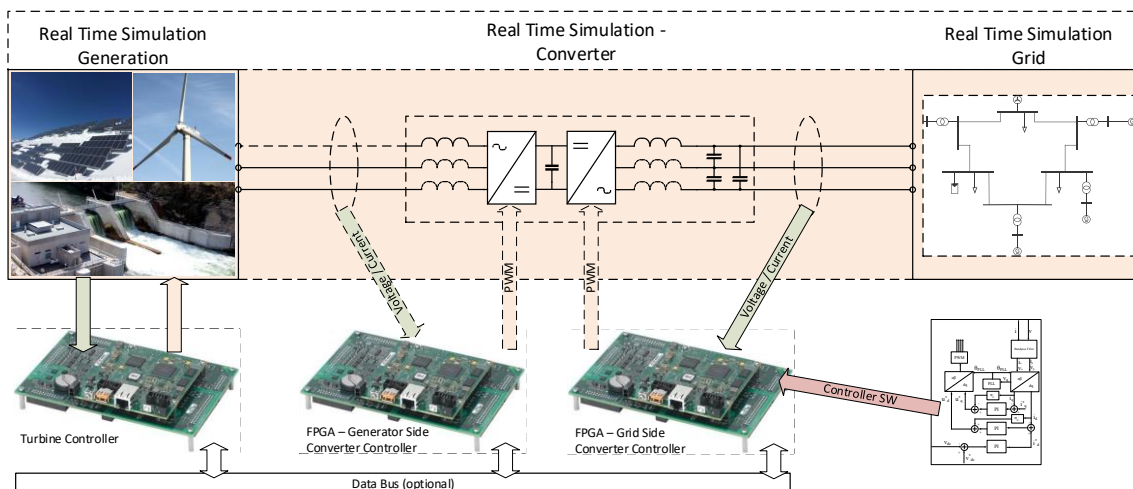
Inffeldgasse 18/1
AT I Graz I 8010
www.iean.tugraz.at
office.iean@tugraz.at

Hardware-in-the-Loop-Laboratory

The PHILlab (Power-Hardware-In-The-Loop Laboratory) at the Institute of Electrical Power Systems offers the possibility to evaluate the converter and its control, which are key components of a variable speed hydro power plant. Based on advanced Power/Controller Hardware in the Loop technology, PHILlab offers an environment that provides an accurate approximation of real-world events for the device under test, where its actual control system can be evaluated and investigated.

Equipment

- Real-time simulator up to 2 MHz
- Programmable FPGA Controller
- 2×30 kVA power amplifier



Structure of Controller Hardware in the Loop system.

Evaluation Methods

State of the art methods for evaluation of variable speed hydro power plants are:

- Controller Hardware in the Loop (CHIL)
 - Evaluating actual controller
 - Test special control conditions
- Power Hardware in the Loop (PHIL)
 - Evaluating real equipment behaviour
 - Test grid-critical situations

Applications examples

Test of grid code compliance, test of unit protection, interaction of different controllers, behaviour in case of grid disturbances and unbalances.

Contact

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Head of Institute

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Technical University of Graz Institute of Hydraulic Fluid Machinery



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We are one of the leading academic research institutions for hydraulic fluid machinery and systems.
Due to our comprehensive expertise on all issues related to hydraulic machinery and plants we are recognised as problem solver.

Main focus of the Institute

The Institute of Hydraulic Fluid Machinery engages in basic research, analysis and optimisation of hydraulic systems and complete plants consisting of

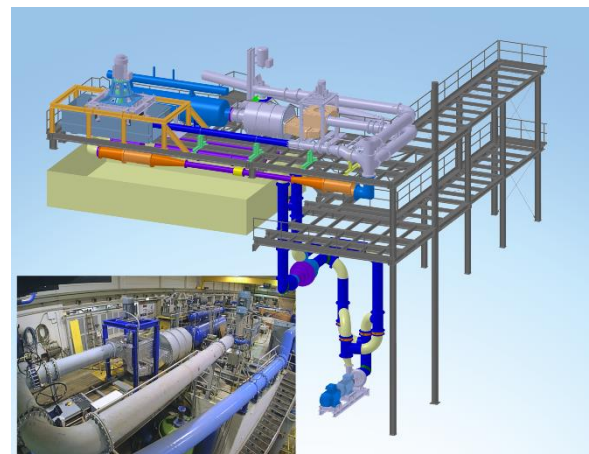
- Hydraulic machinery
- Shut-off devices
- Piping and related components

Research

Our institute is independent and disposes of a laboratory in which we research on fluid mechanical problems. For this purpose, a powerful test bench as well as numerical tools and methods are available.

In addition, the practical suitability of the scientific measurement methods can be tested and proven through plant measurements.

Thus, we provide solutions for industrial and hydro power plants



4-quadrant model test bench



Experimental setup and measurements at the test rig

Model tests

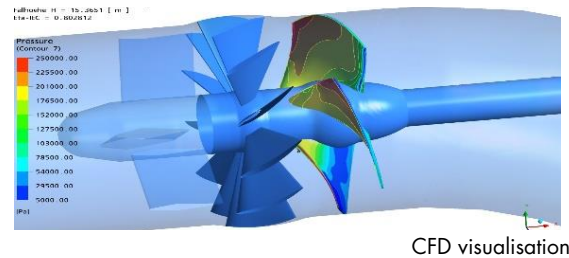
Our modern laboratory equipped with state-of-the-art test rigs and reliable measurement technology allows for industry- and application-oriented research.

- Model tests acc. to IEC 60193
- Acceptance tests of centrifugal pumps acc. to ISO 9906
- Valve acceptance tests acc. to IEC 60534
- Long-term tests for mechanical seals and shaft seals
- Comparison of experimental data with numerical simulation results (CFD)

Technical University of Graz – Institute of Hydraulic Fluid Machinery

Numerical Simulation

- Analysis, design and optimisation of hydraulic fluid machinery, components and systems
- Transient numerical simulation (1D) of plants with liquid and gaseous fluids
- Fluid structure-interaction



Power Plant measurement

On-Site Measurement Technology

Measurements of industrial plants and power plants according to IEC 60041 and IEC 62006.

- Thermodynamic efficiency measurement
- Current meter method and ultrasonic flow measurement
- Dynamic pressure method
- Vibration measurement

Expertise

Our profound know-how, experience and well-established numerical as well as experimental methodology ensure the quality of our work on innovations and independent expertise. Expert opinions and damage analyses, as well as troubleshooting, round off our portfolio. This way, the knowledge developed from research can be applied in a target oriented and practical manner.

- Expert opinions
- Damage analysis
- Plant modernisation and optimisation



Education

In addition to traditional on site teaching at the university we also offer Master degree distance learning courses on waterpower engineering with following main topics:

- Hydraulic machinery
- Pumps and compressors
- Numerical methods and CFD
- Plant hydraulics and calculation
- Hydraulic measurement technology
- Project development and operational management



- **8th Practitioners' Conference**
Hydropower / Turbines / Systems
September, 2023 | Graz, Austria
www.wasserkraft-graz.at

Contact

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Head of the Institute

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TEMAT – company for technical testing, services and trade d.o.o.



Experienced examiners, modern technology, international presence in the field of NON-DESTRUCTIVE TESTING OF METALLIC MATERIALS –

SUCCESS IS OUR DUTY ALREADY SINCE 1999

Industrijska ulica 2
SI 1 2310 Slovenska Bistrica
www.temat.si
info@temat.si

About our company

We work in the field of non-destructive testing of metallic materials. With our services we provide quality to clients in the field of water, heat and nuclear energy production, petrochemical industry, construction, renovation and maintenance of steel structures, tanks, pipelines, rotary furnaces etc.

The guideline of the company is fast reaction to changes and adaptability to clients' wishes. Services are provided on domestic and foreign markets.

The key orientation of all employees is the acquisition of new skills. With continuous training, knowledge and our work, we ensure the implementation of testing and quality control in the most demanding projects.

We strive for constant improvement of our knowledge and innovations in the field of non-destructive testing and constant updating of standards, equipment and thus for constant improvement of the quality of our services, with which we try to meet and exceed the needs of our clients in the best possible way. Gaining trust of our clients is our guideline in carrying out our services.

Our aim is to maintain the accreditation as a test laboratory according to SIST EN ISO/IEC 17025:2017 and as a control body according to SIST EN ISO/IEC 17020:2012 type A and introducing constant improvements.

[Check our ACCREDITED METHODS online.](#)



MT unacceptable indication in weld.

The company employs four Level III and six Level II examiners. With these we cover the following methods:

UT (TOFD and PA), PT, MT, VT, RT, LT.

Three of our employees also gained the Certificate for Frosio Inspectors.

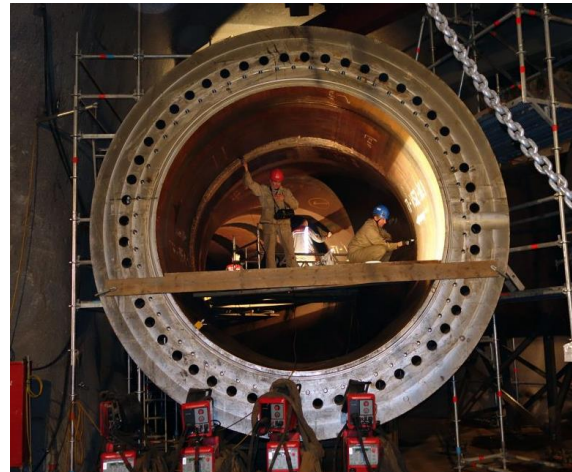
TEMAT

THE BUSINESS ACTIVITY INCLUDES THE FOLLOWING NON-DESTRUCTIVE TESTING AND OTHER SERVICES:

- ultrasonic testing (UT) of welds, forgings, castings and sheet metal, as well as UT-PA and UT-TOFD methods,
- ultrasonic measurement of wall thickness (UT),
- x-ray testing of welds and base materials with x-ray and radioactive isotopes (RT),
- leakage testing (LT),
- visual testing (VT) of welds, sheet metal, castings,
- testing of ferromagnetic materials (welds, forgings, castings) with magnetic particles (MT),
- testing of welds, forgings, castings with penetrants (PT),
- hardness measurement,
- Metal analysis with XRF analyzer,
- measurement of coating thickness and other services in the field of anti-corrosion protection (Frosio inspectors).



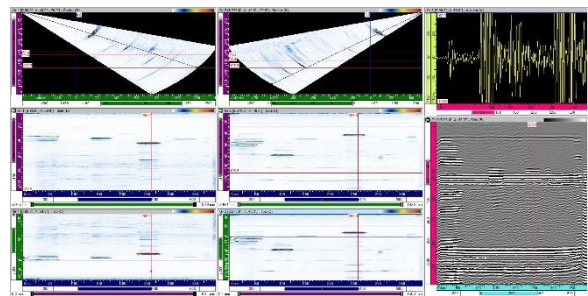
Scanning of welds – TOFD/PA testing.



Ultrasonic testing – welds of bifurcator – hydro energy.

Another great advantage is our advanced equipment, which includes **five x-ray machines** and **five OLYMPUS OMNISCAN ultrasonic devices** for TOFD / PA testing. Among other things, we also have: several **ultrasonic devices**, thickness gauges, white and UV light gauges, UV lamps, magnetic yokes, T8 / 5 timing equipment, various VT tools, a **Videoscope Mentor Flex**, hardness and roughness gauges and **XRF analyzer (elemental analysis)** ...

With the help of subcontractors, we also offer services in the field of destructive tests.



TOFD/PA scan.

Contact

Katarina Jelen

General Manager

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Tractebel Engineering GmbH

We are a global community of imaginative experts engineering a carbon-neutral future.



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www.tractebel-engie.com/en
info-de@tractebel-engie.com

Member of vgbe energy | Hydro Power

Specialised Engineering Services in Dams & Hydropower

Our international project teams for construction design are organised in three categories:

- Expertise centers: responsible for project management, definition of design orientations and provision of customised expertise.
- Design centers: dedicated to the mass production of high quality construction drawings.
- Site design offices: assisting the technical interface and coordination with clients on site.

Dam and hydropower projects are site specific, complex infrastructures with unique challenges. Tractebel provides high level engineering solutions worldwide to public and private organisations for the design, implementation and operation of dams and hydropower infrastructures, respecting project timelines while maintaining the highest quality standards.



Global capabilities enabling cost-advantageous services.

At Tractebel, we anticipate and innovate as we adapt to markets' needs.

- Our teams work smarter in a connected environment.
- Latest technologies to enable greater project visibility, control and reduced risk.

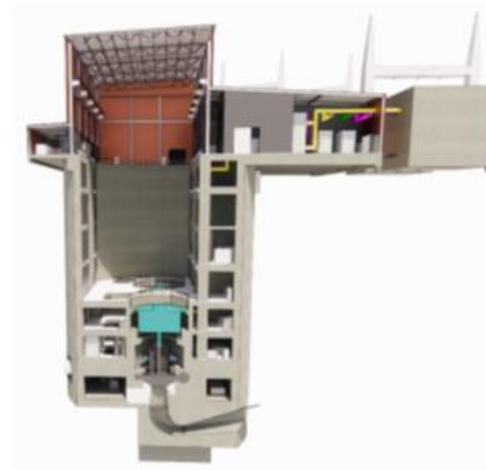
Design optimisation all the way

We offer end-to-end design optimisation for cost effective outcomes guaranteeing the safety of the facilities.



BIM 3D modelling.

BIM is at the heart of our construction design activities for dams and hydropower plants. It allows a collaborative approach that turns complex projects into collective success.



Virtual design and construction simulation.

Contact

Nicolas Lefèvre

Head of Sales Hydropower and Water Resources Division

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TÜBİTAK Marmara Research Center



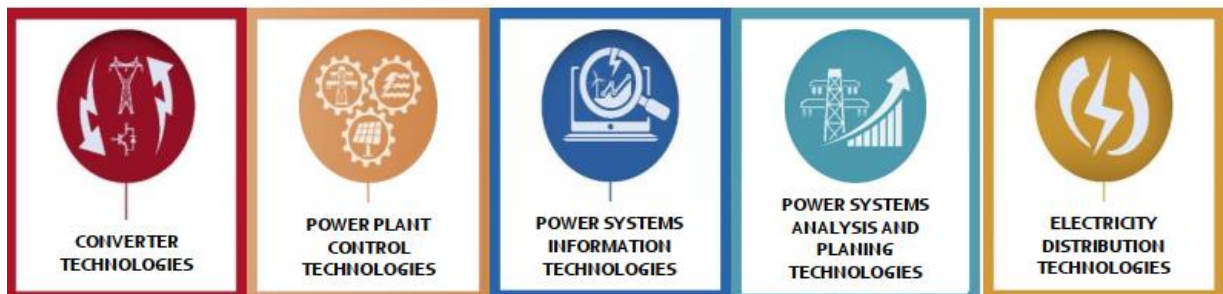
METU Campus
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www.mam.tubitak.gov.tr/en

TÜBİTAK MRC is one of the oldest and largest research centers of TÜBİTAK and conducts applied research and development activities.

TUBITAK Marmara Research Centre (MRC)

Energy Institute performs its research and development activities in Gebze and Ankara. The groups in Ankara focus on generation and transmission of electricity: The power plant control technologies group mainly conducts refurbishment projects for hydroelectric power plants. The power system analysis and planning group, coordinated with Turkish TSO, conducts technical analysis on the Turkish transmission network including ENTSO-E regulations.

The power systems information technologies group focuses on forecast of renewable energy resources, operation optimization of hydroelectric power plants, and monitoring of power quality across the transmission network. The converter technologies group performs projects in power electronics domain mainly in the areas of renewable energy power electronics interfaces, flexible alternating current transmission systems and generator excitation systems.



TÜBİTAK Marmara Research Center**Products & Qualifications**

- SCADA, Protection and Synchronization System
- Unit Controller
- Switchyard and Joint Controller
- Power Plant Control Level
- Protection and Synchronization System
- Auxiliary AC&DC System
- Cyber Security System
- Speed Governor System
- Excitation System
- Vibration, Cavitation Performance and Efficiency Analysis for Water Turbines

Analysis, design, manufacturing, testing, implementation, commissioning of the refurbishment projects. Approximately 3 Gigawatts design, implementation and commissioning experience of aged hydropower plants in Turkey.



Keban HEPP – 1.4 GW.



Some visuals of recent projects.



First national HEPP turbine and generator design, increasing the power output from 8.8 MW to 9.5 MW.

Contact

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Group Leader

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Umwelt-Pollution Messtechnik GmbH



Hausbergstraße 13
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www.upm-gmbh.de
verkauf@upm-gmbh.de

Oil alarm device for continuous and reliable monitoring of the water on floating oils, hydrocarbons and other floating materials.

Oil on water surface

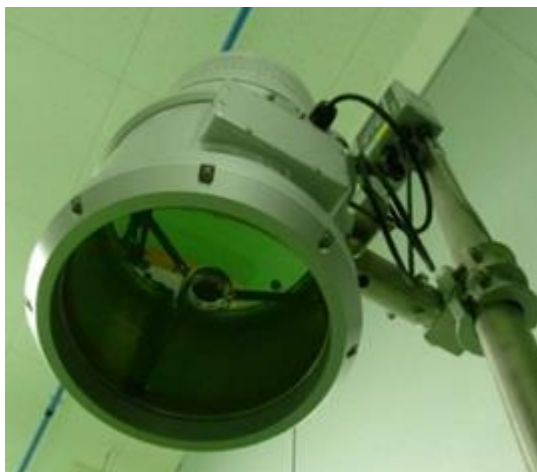
Our Oil on water monitors are detecting the presence of a very thin oil-film floating on the surface.

A scanning laser beam system provides enhanced detection even under rough surface conditions, such as the presence of floating debris, bubbles or curved oil surface.

The measuring method is without contacting the water-surface, nor taking samples. A laser beam is scanning the water-surface.

The enhanced optical design allows the detector to be installed at heights of 0.3 up to 10.0 m above the surface of the water.

This extensive range enables you to install the detector in locations where the water level fluctuates greatly or where it is difficult to come close to the surface of the water.



View inside the detector with heated sight glass to prevent condensation

For further information, please be so kind and contact us.



Model OD1-1610A (DKK/TOA Product)

Benefits

- Special version for greater distances above water
- Based on standard model (same laser scanning etc.)
- Enhanced optical design
- Can be mounted up to 10 m above water surface - Can cope with greater water level variations
- Better protection from abnormal conditions such as flooding, high tidal conditions
- Suitable for "difficult" installation conditions

Contact

Friedrich Kümmerer

Position

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Université Catholique de Louvain (UCLouvain) / BERA



The group for the Security and Performance of Networked Systems at UCLouvain works on intrusion and anomaly detection systems to protect Industrial Control Systems and IoT from cyber-attacks.

Place Sainte Barbe 2 bte L5.02.01
BE | 1348 Louvain

www.secperf-uclouvain.bitbucket.io

About the group

Founded in 1425, UCLouvain is the largest French-speaking University in Belgium. UCLouvain currently has more than 28,000 students (including 4000 foreign students from more than 100 different countries), 3,000 teaching and research personnel, and 1,800 technical and administrative personnel. UCLouvain hosts more than 1,000 external research contracts and is the nucleus of an industrial park containing almost 100 companies.

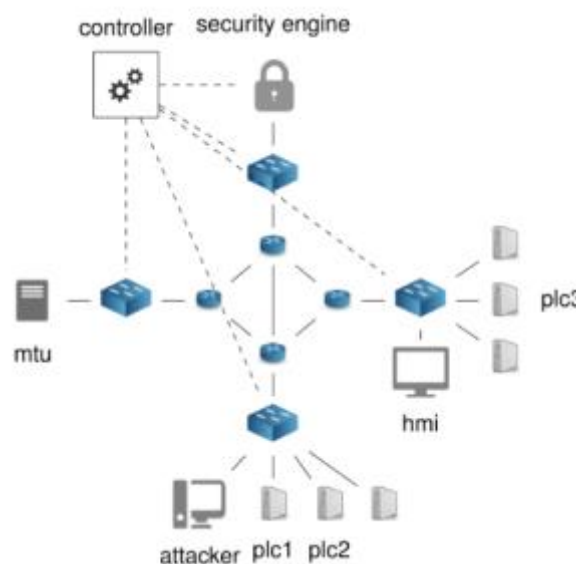
The group for the Security and Performance of Networked Systems is part of the Institute for Information and Communication Technologies, Electronics and Applied Mathematics (ICTEAM) at UCLouvain. The group is led by Ramin Sadre. Our research fields are the security and the modelling and analysis of networked systems, with a focus on Industrial Control Systems (ICS) and on the Internet of Things (IoT).

Our research interests and activities

We work on techniques to monitor and secure networked systems and to detect and mitigate cyber-attacks. Application fields are the Industrial Control Systems and the Internet of Things. We are particularly interested in scalable techniques, such as Software Defined Networking, that allow to distribute the monitoring and detection overhead over the network instead of relying on single hosts. We use Machine Learning methods to build self-learning and adaptive attack/anomaly detection systems.

In the past decade, experts interested in the security of the energy sector have mostly focused on the protection of the electricity distribution grid against cyber-attacks. This was a development triggered by new trends, such as the Smart Grid. We believe that similar trends will take place in the Hydropower sector.

We are interested in understanding the specific risks and vulnerabilities present in Hydropower and how new developments, for example the introduction and interconnection of small Hydropower plants, impact the cybersecurity.



Contact

Prof. Dr. Ramin Sadre

Security and Performance of
Networked Systems group

T +32 10 47 25 29

E ramin.sadre@uclouvain.be

VERBUND Hydro Power GmbH

VERBUND Hydro Consulting – Our experience. Your benefit.

VERBUND is one of the largest producers of hydropower in Europe and a pioneer in innovation, secure operations and cost leadership. This has given us a great insight into the needs and interests of our customers.

As an investor in and operator of hydropower plants, you face many challenges such as creating profitable investments, ensuring sustained operations, complying with strict environmental standards and fulfilling regulatory requirements. With VERBUND, you have a competent partner at your side to offer you the customised solutions you need.

In the field of Hydro Consulting we offer our experience in the planning, construction, operation and maintenance of hydropower plants. Our portfolio includes asset management, asset support, asset services as well as environmental services.

Consulting Services for Global Costumers

- Asset Management
- Asset Support
- Asset Services
- Green Assets

Verbund

Power for the Future

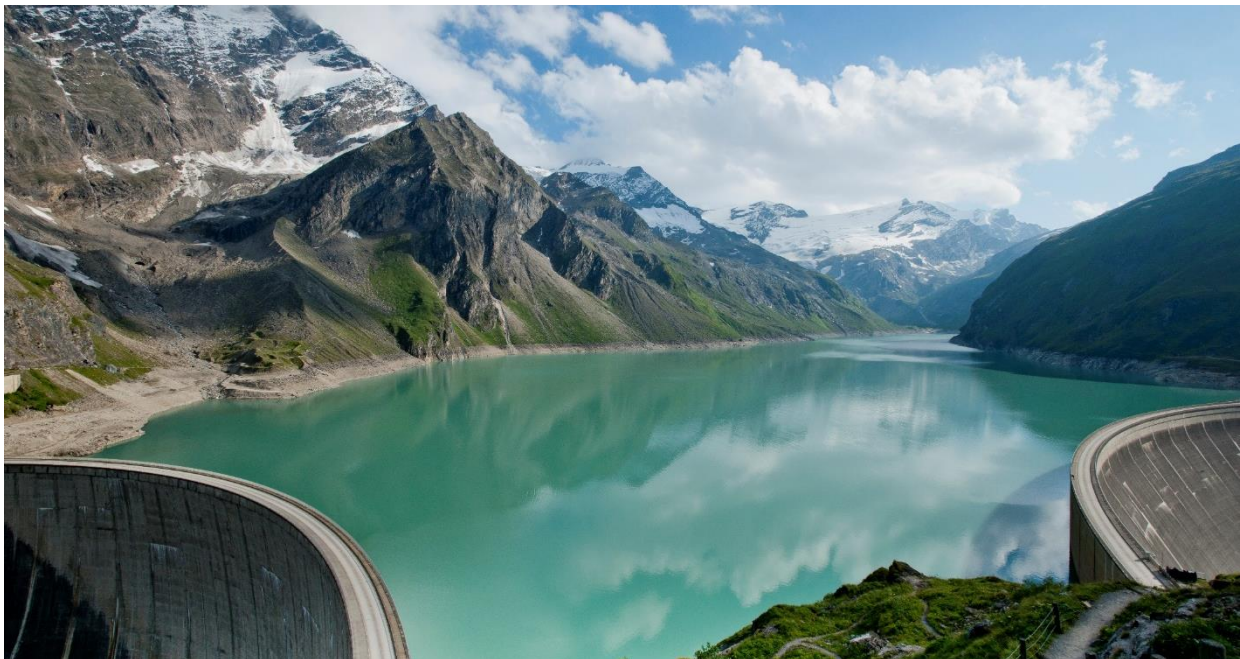
Europaplatz 2

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www.verbund.com

hydropower@verbund.com

Member of vgbe energy | Hydro Power



VERBUND Hydro Power GmbH

Asset management: Assessment, optimisation, operation

Hydropower plants should be used in a way, which ensures electricity generation in the most efficient way. For this reason, we develop strategies to optimize power plant portfolios and assist during the technical and organisational implementation process.

Our services

- Assessment of the plant condition
- Development of strategies and implementation concepts to optimise your power plant portfolio considering the market climate, the technical possibilities and economic options
- Development of implementation concepts for operation and maintenance
- Organisational analysis and development as well as human resources development, technical training and continuing education
- Execution of the hydropower plant operations



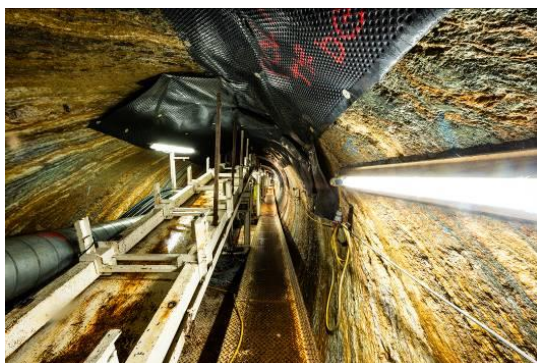
Freudenau hydropower plant on the Danube River (Vienna).



Birecik hydropower plant on the Euphrat River (Turkey).



Generator diagnosis.



Cavern construction site of the project Unterer Tuxbach.

Asset support: General services

Professional diagnosis and monitoring of all hydropower plant types are necessary to secure cost-optimised maintenance, which is based on the plant conditions. To supplement our routine servicing activities, we have developed an extensive package of services which is used on our own plants. These services consist of inspections and objective assessments of conditions as well as planning, selecting and implementing the necessary repair and renovation projects.

Our services

- Electrical engineering: generator diagnosis, protection technology and measurement technology
- Mechanical engineering: materials inspections, calculation and construction of steel hydraulic installations, efficiency measurements
- Civil engineering: dam construction supervision

VERBUND Hydro Power GmbH

Asset services: Project planning and implementation

You plan to build a greenfield plant? You want to renovate or expand your existing plants? We implement and manage your power plant projects. Take advantage of our many years of experience with plants of varying sizes and in the management of the entire plant lifecycle.

Our services

- Preparation of feasibility studies for new construction and expansion projects, efficiency increases, refurbishment and concession renewals
- Energy efficiency evaluations and profitability analyses
- Project management (assisting the asset owner or owner's engineer)
- Support and execution of the approval management process
- Organisation of the design planning and approval process inclusive supervision of all planning, assembly and commissioning activities
- Support in the stakeholder management as well as in the tendering and contract management
- Development of the operational structure and training of the operating personnel

Green assets: Environmental services

The consideration of environmental aspects due to the EU Water Framework Directive is significant when building and operating hydropower plants. Here as well, we want you to benefit from our experience in economic implementation of efficient environmental measures.

Our services

- Development of strategies and concepts for cost-effective implementation of projects that are in legal compliance with the applicable environmental requirements
- Planning and implementation of measures and projects in environmentally sensitive regions in harmony with nature
- Support the implementation of fish bypasses and other structural environmental measures



Fish bypass at the hydropower plant Greifenstein.



Project LIFE+ to restore the estuary stretch of the Traisen River in Lower Austria.

Contact

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Voith Hydro Holding GmbH & Co. KG

Voith Group – a global technology company.

VOITH

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Member of vgbe energy | Hydro Power

With its broad portfolio of systems, products, services and digital applications, Voith sets standards in the markets of energy, oil & gas, paper, raw materials and transport & automotive. Founded in 1867, the company today has around 21,000 employees, sales of € 4.9 billion and locations in over 60 countries worldwide and is thus one of the larger family-owned companies in Europe. The Group Division Voith Hydro is part of the Voith Group and a leading full-line supplier as well as trusted partner for equipping hydropower stations. Voith develops customized, long-term solutions and services for large and small hydropower plants all over the world. Its portfolio of products and services covers the entire life cycle and all major components for large and small hydro plants, from generators, turbines, pumps and automation systems to spare parts, maintenance and training services, and digital solutions for intelligent hydropower.

Intelligent hydropower

The increasing demand for energy and the use of different energy sources worldwide require greater flexibility and more precise data from hydropower providers. Plants are therefore networked with the power supply grid, centrally managed, and software algorithms control many processes on their own. Hydropower is already highly automated; now Voith is making it intelligent.

Intelligent data analysis for hydropower stations with Voith

Thanks to the intelligent hydropower plant, we are making our customers' plants ready for the requirements of tomorrow. We know the data that is important for hydropower plant operators to achieve greater efficiency, flexibility and security – today and in the future.

This is why we focus on collecting and structuring data, detecting anomalies, deciding on proper actions and smart workforce and asset management. Digital hydropower solutions by Voith enable customers to tread the path toward the digital hydroelectric power station. Whether it is about taking the very first step in digitizing selected systems in the power plant or seeking support in increasing the plant's efficiency and availability with intelligent solutions or keeping data security on a high level – our experts will assist in making your equipment, assets, and workforce ready. As the increasing demand for energy, the use of different energy sources, and advancing digitalization require greater flexibility as well as precise and real-time data from hydropower providers Voith is providing the OnPerformance.Lab.

Benefit with OnPerformance.Lab

Voith experts in the OnPerformance.Lab help hydropower operators to reduce maintenance costs and standstill times by remote support and the provision of digital health assessments. Our expert team combines domain know-how with state-of-the-art data analytics to enhance the maintenance and operation of the power station. The outcome are concrete recommendations for action. This service is provided within OnCare.Diagnostic.

Reliable information about the health status of your machines

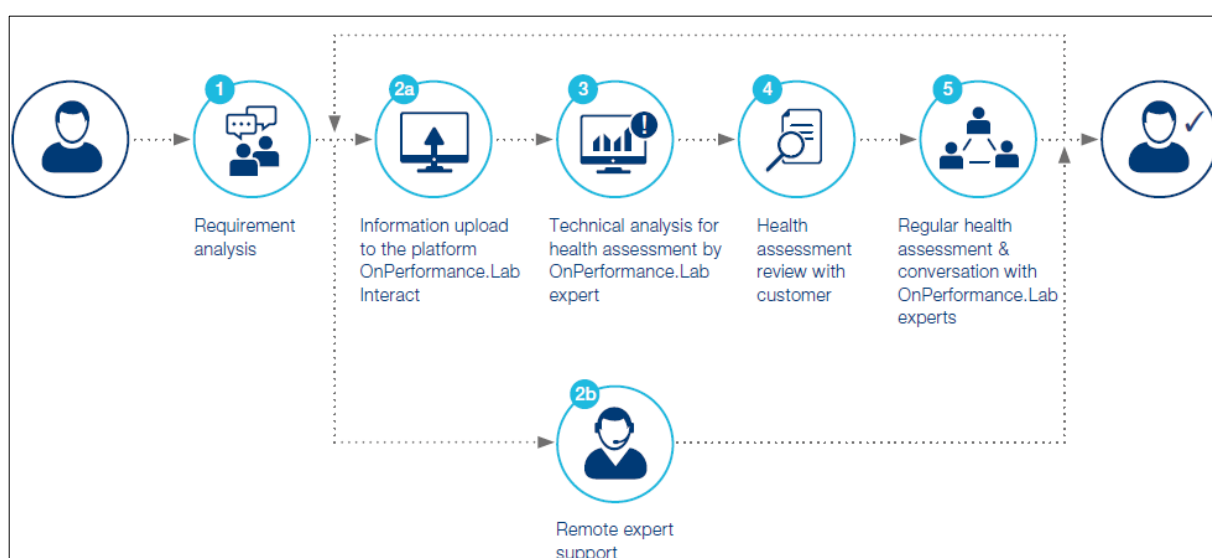
With OnCare.Diagnostic our customers are able to schedule maintenance activities precisely and prevent unplanned shutdowns. The interactive applications enable the integration in the customer asset management structure and the direct communication to Voith Hydro experts from the OnPerformance.Lab.

Voith Group

Benefits

- Increase plant availability
- Effective budget allocation
- Shortened maintenance planning
- Automated calculation of malfunction values
- Trend and event-based analysis of malfunctions
- Root cause analysis as well as warnings and alarms of malfunctions
- Access everywhere, thanks to the web browser application
- More than 66 malfunction diagnostic values
- Regular Digital Health Assessment reports
- Dedicated maintenance recommendations
- Risk indications on the assets and Remote expert support
- Easy access to OnPerformance.Lab Interact via MyVoith
- Interactive communication and report structure

Health assessment and remote expert support procedure with OnCare.Diagnostic



Our expert team combines domain know-how with state-of-the-art data analytics to enhance maintenance and operation of the power station.

Hydro Pocket

While it has been possible to control other technical installations from a smartphone, this has not previously been an option in hydropower. Voith, in conjunction with digital specialist Ray Sono, has now developed a solution to achieve this. The use of real-time data and intelligent analysis permits faster and better decisions. Hydro Pocket is a smart, all-in-one solution for small and medium-sized hydropower plants, which offers operators greater efficiency, flexibility and security. The cloud-based solution will now enable them to manage the system data on a "smart" basis. Thanks to the transparent view of assets, assistance in the form of intelligent analysis methods, view of assets, assistance in the form of intelligent analysis

methods, maintenance and repair planning can be optimized, and faults or unplanned downtime can be reduced. As a result, management of the system is simplified, and communication requirements are reduced.

Easy installation

Hydro Pocket can be adapted to individual needs and user requirements but is also quick to install and easy to configure. The user receives a starter kit to assist in this process, and attaches the hardware contained in the kit to the power plant. The task of configuring the system is subsequently performed by Voith, with the entire process taking less than four weeks to complete.

Voith Group

Three pillars

The three pillars covered by the product are the monitoring, analysis and management of the system. This offers operators various advantages, which span the need to increase efficiency and flexibility and make optimum use of manpower, to the transfer of knowledge, and the security and modernization of the aging infrastructure. Hydro Pocket is a holistic and contemporary solution, which guarantees optimal operation of small or medium-sized hydropower stations.



Intuitive dashboards permit the monitoring, analysis and optimized performance of individual machine units, complete systems, or entire fleets in a single application.

Small Hydro

Small hydropower stations are an important component of the energy mix. Today 64% of all existing dams and weirs around the world remain unused for hydropower generation. With their enormous energy potential, taking advantage of them could make a key contribution to an ecological supply of electricity. Voith offers solutions that exploit this potential, generating sustainable energy while remaining in harmony with nature.

StreamDiver – Innovative, reliable, and eco-friendly turbine

The StreamDiver was designed to keep constructional effort and peripheral equipment to an absolute minimum. This allows power generation at locations where conventional power stations are not viable for economical or ecological reasons.

Benefits

- Submersed, modular power unit with low visual and noise impact
- Reduced civil costs through innovative plant layouts Flexible and easy integration
- Water lubricated drive-train
- Long and simplified service intervals, minimized maintenance
- Environmentally friendly thanks to an oil-free operation



Voith has developed an innovative, reliable, and eco-friendly turbine – the StreamDiver.

Voith Group



Voith HydroSchool provides global and individual courses, such as condition assessment, rehabilitation, and modernization of turbines or generators, regardless of manufacturer, with the goal of improving on-the-job performance.

HydroSchool

HydroSchool is paving the way for a new, knowledge-based future for customers and partners. HydroSchool delivers training solutions – that are globally available – for all hydropower-related topics, thus, bridging the gap between technology and industry experience.

Voith HydroSchool offers three training types: public courses, which cover topics of all hydropower station types, dedicated trainings for customers and partners as well as comprising

training programs tailored to specific needs. The latest know-how is thereby conveyed by Voith subject matter experts.

By accommodating a range of professionals, from engineers to maintenance and repair specialists, technical personnel, and members of management, HydroSchool offers customers and partners the opportunity to identify, expand and fully utilize their team's resources.

Contact

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VSB Technical University of Ostrava

Long tradition university in high-quality engineering education and research.

VSB TECHNICAL
UNIVERSITY
OF OSTRAVA

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www.fei.vsb.cz

Department

The university has seven faculties. The Faculty of Electrical Engineering and Computer Science is one of the largest faculties of the VSB - Technical University of Ostrava. Department of Electronics is a part of it which deals with modern technics which is also applied in the field of renewable and sustainable energy.

We have a team of qualified staff for education and science and research activities involving post-graduates.

The department concern knowledge and experience in renewable energy at all or individual parts, where it can be used. We deal mainly with electric parts of the solution to provide better results, new visions and ideas with special impact on the environment, efficiency and sustainability. Our laboratory and equipment provide possibility of practical verification of theoretical assumptions and ideas.

Possible cooperation topics

- Simulation in Matlab (Simulink) and OrCAD
- Microcontrollers, embedded systems, control systems, communication, RT control
- SW development
- Power semiconductor system
- HIL testing
- Measurement and diagnostic
- Electric drives
- Power electronics
- Automotive electronics
- Electrical drives



Small hydro power plant laboratory model.

Prototype design of electronics devices, microprocessor control systems and converters.

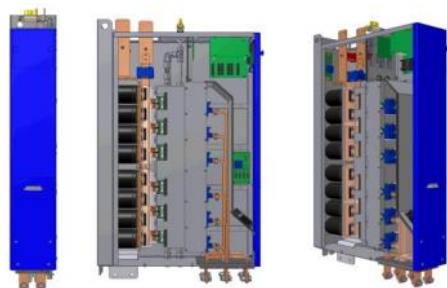


Control system with DSP TMS320F28335 + data acquisition extension.

VSB Technical University of Ostrava

Research Activities

- Research of power converters for renewable energy sources include energy storage.
- Research of power semiconductor systems with soft switching.
- Research of accumulation systems.
- Research and application of active power filters.
- Hardware-In-the-Loop simulation and testing.
- Development of MATLAB/Simulink models.
- Measuring and Testing of systems.
- Electronic systems for autonomous mobility.
- New control methods for sensorless AC drives using non-linear observers and soft computing methods, sensor fault tolerant control.
- Improving efficiency and reliability of electric devices.
- Development of microcomputer control systems with modern DSP.
- Design, modernization and realization of electrical drives for the industry and renewable energy.
- Development of electronic systems for industry. Electrical Drives, Analog and Microcomputer Control Technique.



Reversible voltage inverter for an accumulation unit.

In the field of hydropower research, we are focused on conversion of hydraulic energy into electrical energy, accumulation process monitoring and control. There are different electric topologies to fulfil grid conditions for varying condition. Interesting task is also increasing energy efficiency under variable operating conditions and increasing reliability in case of sensor failure. Testing and verification of control algorithms.

Further projects

- Technology Agency of the Czech Republic – Centre for Intelligent Drives and Advanced Machines Control (CIDAM), Centre of Competence, 2014-2019
- IT4Innovations Centre of Excellence, Research Programme VP5, (R&D for Innovations Operational Programme), 2011-2014
- ENET – Energy Units for Utilization of Non-Traditional Energy Sources, (R&D for Innovations Operational Programme), 2010-2014
- Ministry of Industry and Trade: External Fixation, 2011-2013
- Škoda Electric a.s.: Research of Algorithms for Regulating Drives with the Asynchronous Motor without the Sensor Speed, 2010
- GA CR - Research of Applications of Artificial Intelligence in the Control of Electrical Drives, 2005-2007
- GA CR - New Structures and Algorithms of Mobile Hybrid Systems, 2008-2010

Cooperation with practice

Department of Electronics cooperates with many important companies and technical universities in the areas of the applied electronics, industrial electronics, automotive electronics, microcomputer control systems, power semiconductor systems and electrical drives.

- Škoda Auto a.s.
- ABB s.r.o
- Siemens s.r.o.
- ELCOM, a.s.
- Škoda Electric, a.s.
- LEM SA (Switzerland)

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VUM Verfahren Umwelt Management GmbH



Visual inspection, documentation and surveying using UAV's (Unmanned Aerial vehicles)

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umwelttechnik@vum.co.at

VUM Verfahren Umwelt Management GmbH (VUM) has been dealing with energy infrastructure (feasibility, approval, implementation, maintenance and aftercare) for many years. In particular VUM is increasingly pursuing the goal of incorporating innovation into its activities and deals with the use of remote sensing in the energy industry, particularly in the hydropower sector.

VUM offers a wide range of drone-supported services. The experienced team has the specific expertise for status documentation visual inspections of technical infrastructure and aerial surveying as well as for the collection of environmental data. The information generated supports constructors, operators and maintenance staff of infrastructure in a variety of ways as decision support and forms an important basis for planning and documentation.

VUM also deals with R&D-projects concerning aerial surveying. One focus is for example the development of a method for an extensive snow

depth detection to improve snowmelt forecasts in alpine terrain.

Our drone-experience especially in the hydro-power sector is:

- **Inspection of technical infrastructure**
 - Condition Monitoring at Power Plants and Power Lines
- **Environmental & Construction Progress Monitoring (surveying)**
 - Digital Elevation Models, Volume and length measurement e.g. of excavation
 - Change Detection of terrain or surface e.g. Snow height measurement in alpine regions to improve forecast models
 - Orthofotos for visual documentation, comparison and surveying
- **Video- & photo- documentation**
 - Image brochures, Illustrations, panoramic views



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VUM Verfahren Umwelt Management GmbH

Insulation liquid analysis of high voltage equipment – Monitoring in the 21st Century

Physico-chemical laboratory

VUM Verfahren Umwelt Management (VUM) runs a physico-chemical laboratory specialized in the analysis of oil-immersed high voltage equipment (e.g. transformers). With more than 250 customers and manufacturer all over Europe and more than 25,000 analysed specimen of high voltage equipment, VUM has built a strong and decade-long expertise on this field. VUM is a reliable partner for standard routine-analyses, state-evaluations, oil-regeneration and post-mortem analyses, equipped with all necessary analytical tools according to the newest normative standards, highly-trained personnel and cutting-edge database-assisted evaluation technology.

The analysis tool helps the customer to easily gain an overview about the status of their high voltage assets and compare them to historical data. This helps to formulate precise recommendations for future revision-measures wherever needed.

The analysis tool also opens new possibilities for innovation, as the experts are now able to extract more information out of historical data. Taking analytical data from the database and combining it with environmental data, such as weather, temperature or geographical region can help to identify unknown risks and brings new possibilities and chances to improve existing routine methods and asset monitoring.



Diagram - An exemplary Duval triangle generated with the data available from historical routine analyses, summarized and evaluated via the innovative VUM analysis tool for insulation liquids. This simplified and quick visualization enables the customer to evaluate the high voltage assets at a glance, indicating the evolution of a thermal fault. In this case, the customer had sufficient time to react upon the possible thread. The efficiency of the repair measures taken is easily visible respectively can be tracked in the analysis tool.

Analysis tool for insulating liquids

The 2018 newly launched innovative insulating liquid database improved customer-service even further. The software-assisted evaluation system combines the expertise of our chemists and engineers with an automated recognition system for electrical and thermal faults, alongside their exact categorization according to standardized criteria. The system utilizes acknowledged international methods and standards to display analytical data, graphical representations (e.g. Duval-triangle) and color-coded indications for the overall state of the analysed assets.

VUM strives to broaden the field of expertise and to face new challenges in the analysis of insulating liquids. VUM is also always open to engage in innovative research-projects and industry-cooperation.

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Media Partner Profiles



Leading media partners promote comprehensive knowledge exchange on technical, economic, environmental and legal events in the hydropower sector via its various channels.

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Energetski portal IN000200

Energy portal is business portal on clean energy with daily news, mainly in the sectors of renewable energy sources and energy efficiency in the Balkan region and Europe.

Energy portal (EP) is a specialized news portal, in Serbian and English, on sustainable energetics. We offer daily updates and information necessary for investors and other parties in renewable energy sources (RES), improvement of energy efficiency in industry, transportation and buildings (EE) in Serbia and the Western Balkans, as well as for broader audience interested in "clean" energy, energy efficiency improvement and sustainable development.

EP has also a role of a mediator for implementation of sustainable projects and cost-effective "green" investments.

The portal serves as up-to-date guide through regulations, procedures, materials, design, technologies, research, sources of funding.

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EASY ENGINEERING MAGAZINE

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Easy Engineering addresses passionately the world of professional technology, reporting about the most innovative products available today. With world-class graphics, it enchants and raises readers' curiosity beyond the limits of imagination and providing value through quality topics.

Easy Engineering readers see the world different. Where some see chaos, they see opportunity. They are leaders with global vision, innovators, professionals, they are decision makers and influencers. They are intelligent and become more intelligent. They are constantly searching for new ideas and solutions.

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energate

energate stands for up-to-date and independent information on energy topics as well as for tailor-made content for B2B communication.

energate is the leading B2B media brand in the energy market. Since the liberalization of the energy market about 20 years ago, the information and communication services have provided customers with a decisive know-how advantage. A team of around 15 energy journalists in Essen, Berlin, Brussels and Switzerland researches the relevant events on the German and European energy market every day and prepare them for information services, industry reports and magazines.

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messenger⁺**

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Energy 4.0 – Energy. Technology. Industry.

Digitization, decentralization and decarbonization - three megatrends are driving the rapid change in the energy industry.

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- Editorial focus
- Digitization & Networking
- Power Generation
- Energy Networks
- Energy Storage
- Green Production

Energy 4.0-Kompodium

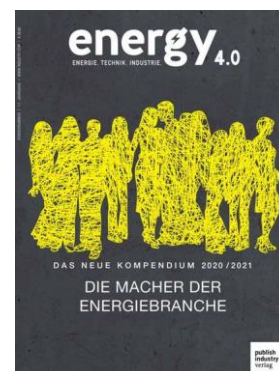
Once a year the Energy 4.0 Kompodium asks the 50 outstanding minds in the energy industry the question "How are you changing the future" and presents in an exclusive compilation ideas & developments, assessments and outlooks that shape the future.

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Global Goals Yearbook

17 Goals / 1 Yearbook

The Global Goals Yearbook is a publication in support of the SDGs and the advancement of corporate sustainability globally.



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DE | 48153 Münster
www.globalgoals-yearbook.org

Dr. Elmer Lenzen

Chair of macondo foundation

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W www.macondo-foundation.org

About the Goals Yearbook

The Global Goals Yearbook offers proactive and in-depth information on key sustainability issues and promotes unique and comprehensive knowledge-exchange and learning in the spirit of the SDGs and the Ten Principles of the UN Global Compact.

Copies are distributed to UN organizations, many sustainable companies, relevant NGOs, stakeholders, journalists, and analysts as well as to international book fairs and related conferences.

The Global Goals Yearbook helps to advance corporate transparency, promotes the sharing of good business practices, and, perhaps most significantly, gives a strong voice to the regional and global stakeholders that are at the heart of the sustainability agenda.

The Global Goals Yearbook is published under the patronage of the macondo foundation. It is a non-commercial publication and emerges from the renown "Global Compact International Yearbook" (2009-2017).

GoingPublic Magazin

(E-)MAGAZINE – ONLINE – EVENT - NETWORK

GoingPublic
— Magazin

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About GoingPublic Magazine

The monthly magazine gives issuers an insight into being public trends and investor relations issues, as well as covering any relevant capital market innovations. Leading law firms contribute their expertise in the form of specialist articles on tax and legal issues, whilst the M&A section charts developments from the spectrum of public takeovers to companies going private.

In addition, the magazine sees itself as being the leading public platform and as a channel for communications between issuers, institutional investors, service providers and the financial community. The crossmedial approach of the platform is completed by

- the GoingPublic Magazine
- the HV Magazine
- the newsletter KapitalmarktUpdate
- the website www.goingpublic.de and
- a series of networking events.

gwf Wasser | Abwasser

The technical-scientific journal gwf Wasser|Abwasser informs experts in all important questions of the water field. Technical updates, latest scientific findings and industry news from politics and business provide a wide range of knowledge for the demanding tasks in the water and wastewater management.

The thematic spectrum ranges from hydrogeology and water treatment to hygiene and microbiology, analytical, metrological and regulatory developments, wastewater treatment and sludge treatment, as well as legal issues and economic concerns.

The main part consists of peer-reviewed papers. The practical part consists of interviews, topics and discussion papers, news from the industry, as well as research and development.

About 2,200 copies of gwf Wasser|Abwasser are circulated, mainly in German speaking countries. The journal is read by experts of the water and wastewater treatment sector, construction industry and scientific institutes. gwf Wasser|Abwasser is the official journal of Bundesverband der Energie- und Wasserwirtschaft e.V. (BDEW), Bundesverband der Firmen im Gas- und Wasserfach e.V. (figawa), Österreichische Vereinigung für das Gas- und Wasserfach (ÖVGW), Fachverband der Gas- und Wärmeversorgungsunternehmen, Österreich, Arbeitsgemeinschaft Wasserwerke Bodensee-Rhein (AWBR), Arbeitsgemeinschaft Rhein-Wasserwerke e.V. (ARW), Arbeitsgemeinschaft der Wasserwerke an der Ruhr (AWWR), Arbeitsgemeinschaft Trinkwassertalsperren e.V. (ATT).



Visit us on www.gwf-wasser.de to take a look at the current issue and our other media.

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JOBVERDE.de is the green career portal for sustainable employers and their jobs.

JOBVERDE.de - Germany's career platform for JOBS with a sense of purpose and sustainable employers. We bring together what belongs together: People with the right skills and the right mindset for a sustainable economy and society. As a digital, regional and analogue interface, JOBVERDE creates encounters between candidates who want to give their careers meaning and sustainable employers. A career platform with a course for the future!

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Lorenz Kommunikation

Lorenz Kommunikation is a German business and communication consulting agency. The objective of Lorenz Kommunikation is the strategic consulting and support of companies or institutions. Lorenz Kommunikation is also an organizer of own or customer congresses /conferences/trade fairs in the field of new technologies and renewable energies – also virtual.

Lorenz Kommunikation offers a comprehensive package of measures tailored to the target group in order to support customers in all aspects of press and public relations work or in the implementation of events. In addition to the classic press and public relations work such as press releases, press reports or press meetings, online communication and online events are also an important aspect to reach the specific target group in this case.



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Lorenz Kommunikation - range of services:

- Strategy consulting
- Communication consulting
- Change management
- Public Relations
- Event management (analog & online)
- Business Coaching

Moritz Schäfer GmbH & Co. KG

Wasserkraft & Energie

International quarterly magazine for renewable and clean energy

4 issues per year, average circulation 1,300 copies, distribution: Germany 88%, abroad 12% with a focus on Austria and, Switzerland and Italy.

It provides detailed editorial contributions on technical issues of environmental friendly energy production as well as expert papers on energetic turbine optimization, dam raising techniques, and automation enhancement. With up-to-date information on technical and economic events, legal comments, and expert literature.

More information:

www.wasserkraft-und-energie.de



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NaturEnergy

The Alternative Energy portal

Since 2013 NaturEnergy give information and news for all alternative industry are open for cooperation with specialists from the field and with companies involved in green energy.

The most important sections of the portal are:

- News & events
- Solar thermal energy
- Photovoltaic energy
- Wind energy
- Geothermal energy
- Hydro energy
- Tidal energy
- Biofuels
- Fairs and exhibitions
- Comments and opinions
- Other renewable news



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NaturEnergy with his two versions (Romanian and English) are one of the oldest alternative news portal in Romania.



Editor of NaturEnergy.ro is CYCLON TECH SRL.

Newspaper Energie & Management

Energie & Management - Information for better decisions

Objective - Independent - Up to date

With a circulation of around 5,500 copies and its current reports, features, interviews and analyses, the bi-weekly newspaper Energie & Management has been one of the leading specialist media in Europe since 1994.

Around 20 journalists and correspondents throughout Europe work daily to ensure that Energie & Management, as an independent medium, sets the standard for well-founded and neutral specialist information on the energy industry in Germany. Around 2,000 subscribers rely on the information for better decisions by Energie & Management. The language of the newspaper is german.

Energy & Management - Information for better decisions

- Energy industry and politics
- Power generation and distribution
- Energy technology and management
- Energy services and support
- Decentralized energies
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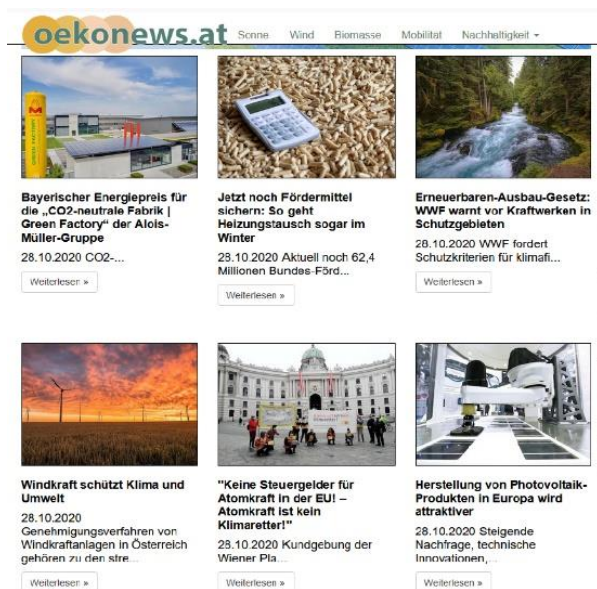
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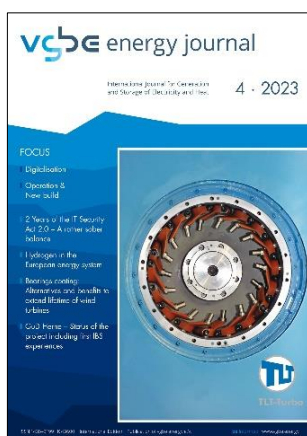
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vgbe energy service GmbH

vgbe energy journal – International Journal for Generation and Storage of Electricity and Heat

The “vgbe energy journal” is among the leading international technical journals for power plant operation and engineering. 11 bilingual German/English issues per year reflect on all important and current topics of power and heat generation and storage with qualified technical papers and latest news on operational, plant safety, environmental compatibility, economic efficiency, research and development and relevant legislation.



About 3,500 printed copies of the vgbe energy journal are circulated (increased number for vgbe events and other events of the industry) in 42 countries worldwide. The journal is read by experts, decision makers and opinion leaders of the energy industry. Make advantage of this renowned medium and advertise in vgbe energy journal as well as additional event publications – a unique option to address customers and markets.

vgbe members have access to the digital edition of the vgbe energy journal via the member's network “eNet”.

Contact for a free specimen copy, subscription, advertising and Media Data: ads@vgbe.energy

<https://www.vgbe.energy/vgbe-energy-journal/>



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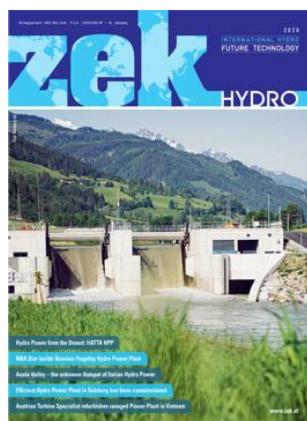
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zek-Hydro

zek is a leading trade magazine specialising in international hydropower and future technologies with six German and one English edition a year.



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Circulation

zek has a total circulation of 10,000 throughout Austria, Switzerland and the German federal states of Bavaria and Baden-Württemberg.

zek provides full coverage of many major international hydropower events to its broad readership of governmental authorities, industry-specific businesses and power plant operators.

vgbe energy – Range of Services



vgbe energy offers an array of specialized services, fostering cooperation, networking, and professional exchanges among experts. A primary focus lies in providing valuable insights pertaining to the efficient operation and maintenance of hydropower plants.

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vgbe Expert Events

Benefit from our two Expert Events per year with selected lectures and on-site visits!

The international Expert Events provide a unique platform for professional discussions following the presentations and an ideal opportunity for the transfer of knowledge and exchange of experiences as well as establishing contacts with operators, project developers, investors, energy providers, scientists, research institutes and industry.

vgbe Expert Events, offer participants the chance to expand and refresh existing contacts as well as to establish new relationships on the sidelines of the event as well as at the get-together in the evening.

We typically offer two Expert Events related to hydropower each year. Save the dates for the upcoming events now. All event times and contents can be found on our [vgbe event platform](#).

vgbe Expert Event “River Management and Ecology” (Annually in spring!)



This vgbe Expert Event brings together experts from policy organizations, authorities, leading operators, manufacturers and suppliers, scientists, NGOs as well as further relevant stakeholders to discuss crucial issues in the fields of river management, restoration and ecology.

Rivers are biodiversity hotspots and provide water for domestic supply, irrigation, power generation, navigation and industry as well as a range of other ecosystem services. Managing rivers to provide multiple benefits is therefore essential to water security and multiple other policy priorities. Specifically, environmental protection and nature preservation, as well as restoration, are key challenges not only for hydropower operators and industries but also for society as a whole. Being among the most environmentally and climate-friendly forms of energy generation, hydropower plays a crucial role in the energy system of today and the future. Operation and maintenance of existing plants, as well as new projects, can only be realized by pursuing a holistic approach, i.e., by balancing ecological, social and economic aspects and promoting sustainable use of water.

Topics of the lecturers could be:

- European R&I on Hydropower
- Ecological hydraulic engineering
- European framework and regulation
- Sediment management strategies
- Legislative and political frameworks
- Approaches for operating with hydropeaking
- Experiences with the implementation of the WFD
- Fish migration and monitoring systems

All event times and contents can be found on our [vgbe event platform](#).

vgbe Expert Event “Digitalisation in Hydropower” (Annually in autumn!)



Digital transformation is an ongoing process in nearly all areas of modern life. With regard to the generation of electricity from hydropower established business models and processes are substantially changed through new concepts, methods and models such as “Hydropower 4.0”, machine learning, cyber-physical systems, the Internet of Things, data mining and the Internet of Services. Digitalization will also affect the maintenance and operation of hydropower plants with an unexploited potential for reducing costs as well as for increasing the effectiveness of workforce management.

The international vgbe Expert Event “Digitalisation in Hydropower” provides a comprehensive overview of important topics regarding digitalisation in hydropower dealing mainly with the results and practical experiences of newly developed and implemented innovative digital measures, tested products and tools from the view of the operators.

Topics of the Expert Event could be:

- Asset Management
- Workforce Management
- Advanced Data Analytics
- Platform Solutions
- Digital Twins
- 3D Printing
- Inspection & Measurement
- Visualization (VR, AR, 3D GIS ...)

Based on practical examples, you will gain insights into how to implement and apply digital solutions successfully. This may contribute to improving and optimizing digital solutions in your own company.

In general, speakers from operators and manufacturers will present practically tested measures on the first day. In addition, current results of research projects on digital measures in hydropower will also be presented.

On the second day of the expert event, a pilot hydropower plant in which several digital measures have already been implemented will be visited. Stations will be set up at the power plant site where experts from the operator and their project partners will explain and demonstrate the practical application of measures that have been implemented. In the afternoon, participants can visit the stations independently (open day). Experts will be on hand to answer questions and hold intensive technical discussions.



Visit to 12 digital implemented digital measures in hydropower plant Rabenstein, VERBUND 2019



Visit to 14 digital implemented digital measures in hydropower plant Mapragg, AXPO 2023

All event times and contents can be found on our [vgbe event platform](https://www.vgbe.energy/event).

vgbe Expert Workshops

vgbe energy organises topic-specific expert workshops for vgbe members only to foster exchange and problem-solving between experts with extensive practical experience.



Networking opportunity



Topic-specific workshops

The Expert Workshops are planned by vgbe energy in cooperation with its members and cover a broad variety of applications that include established and emerging technologies for energy generation and storage. They can be organised on short notice and can therefore not only address pressing issues in the industry but also be used proactively to find solutions for upcoming challenges.

The Expert Workshops are targeted at operators that are vgbe members and require active participation according to the policy **"give and take"**. Therefore, it is mandatory to give a presentation in order to join the active discussion and benefit from the experience of the other participants.

The following vgbe Expert Workshops have been held in 2022/2023:

Title	Category	Date
Sensors and diagnosis systems for generators	Operation	08.09.2022
Digital documentation management system	Management	23.02.2023
Underwater inspection	Operation	16.03.2023
Surveillance and maintenance concepts for dams and refurbishment of the water side of concrete dams	Maintenance	02.05.2023
Lessons learned from the application of Fault Tree Analyses in EGP's hydropower fleet	Operation	09.05.2023
Practical experiences in operation of battery systems	Operation	16.06.2023

In total, more than 105 experts from 20 different vgbe members have participated in the 6 vgbe expert workshops held so far.

The experts of the vgbe members from the hydropower sector have selected the following topics for upcoming vgbe Expert Workshops.

Title	Category
Fish monitoring systems	Ecology
Climate change and its consequences	Ecology
Maintenance work in the I&C area	Maintenance
Workforce management	Management
Dealing with a lack of qualified specialists	Management
IT/OT experiences with the implementation of ISO 27001 and NIS 2	Operation
Sensors and diagnosis systems for turbines	Operation
Condition Monitoring System (CMS) for auxiliary systems	Operation
Dealing with the requirements of grid operators	Operation
Experiences in operation of spillways	Operation
Flexibilization of hydro turbines operation	Operation
Monitoring and classification of energy losses coming from water spillage	Operation
Plant production optimization based on inflow forecast and price forecast	Operation
Availability for run-of-river power plants	Operation

Task

- Intensify the exchange of operational experiences according to the motto "give and take"
- Very in-depth analyses and documentation

Benefits

- Proactive approach: Overcome emerging challenges before they become an issue at your company.
- Expert talks: Discuss with experienced and specialized experts.
- Train young professionals: Take the opportunity to train your young professionals on specific topics through exchanges with experienced industry experts.
- Documentation: Presentations available to all vgbe members.

Technical Programmes

vgbe energy with its leading role in understanding good and best practices in hydropower operation and development jointly launches with its members different Technical Programmes. These programmes are part of the comprehensive activities of vgbe energy for the hydropower sector to support daily operation routines, maintenance and plant optimisation as well as techno-economic, environmental and strategic challenges. Therefore, the programmes are open for vgbe members as well as non-vgbe members.

To learn more about the approach, expected types of analyses provided, participation, etc. please follow this [Link](#) and download the Technical Programmes.

Technical Programme: Occupational Health & Safety in hydropower

To meet the high expectations of the latest health and safety standards in hydropower plants, the existing processes in the companies must be continuously reviewed and adapted to new findings.

In this context, vgbe energy started a new exchange-oriented platform that will become a driving factor to improve occupational Health & Safety in hydropower. The platform is aimed at operators, manufacturers and suppliers alike and will provide valuable insights into current developments in the industry. As a user-driven platform, it will expand the Health & Safety culture. In this way, experience and know-how can be shared to prevent safety risks and achieve the overarching goal of zero occupational accidents and work-related diseases.



- [Download Programme](#)
- Feb 2022 – ongoing

Technical Programme: Cost comparison for run-of-river power plants

Cost comparison can help operators of power plants (such as hydropower operators) to maintain their competitiveness by not just relying on growth options, but through permanent improvement of their efficiency, which can be achieved primarily through optimisation.

Cost comparison for run-of-river power plants is based on a proven and unique methodology which assures an objective and best-in-class benchmarking of all O&M cost components taking into account the vast variety of such plants and their specifications. The objective of this cost-comparison method is solely to establish a comparable basis for O&M cost performance and is designed to systematically analyse the complex relation of O&M cost types, cost drivers and resulting cost performance. The profitability of individual run-of-river plants is explicitly not taken into account in the analyses.



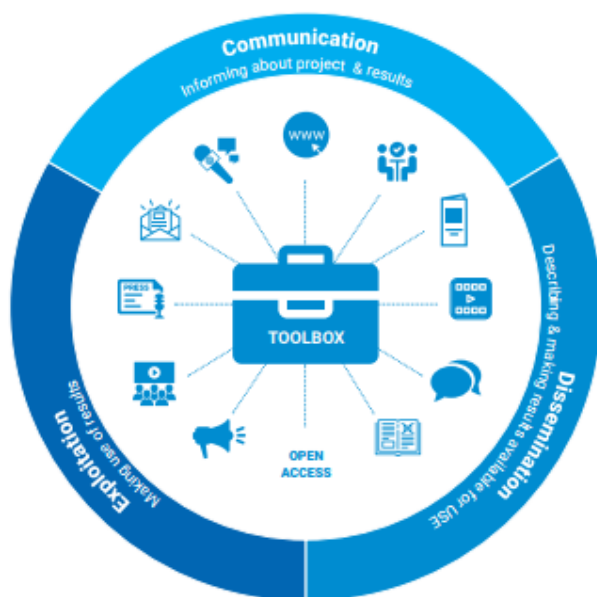
- [Download Programme](#)
- Feb 2022 – ongoing

Research

Research cooperation is a process, not an event. It is not just about having a good idea, but also about sharing that idea with others and getting feedback to improve the idea's implementation. Collaborative research leads to higher quality research than when done by individuals, as each problem can be looked at from multiple angles.

vgbe energy is an important player within the European research community through active participation in research projects. Successful cooperation due to the extensive European network with operators, manufacturers, universities, research institutes and the public sector increases the likelihood of implementing a research project. In addition, we can draw on the experience and experts of our member companies.

A wide range of activities can be carried out by vgbe energy for dissemination, exploitation, and communication. The key here is to stay in line with the strategic plan of the project and select the activities that are best suited to achieve its objectives.



There are many tools that can be used for dissemination, exploitation, and communication purposes. However, some are specific to the dissemination of results such as scientific publications, and sharing results in an online repository; and there are other tools, such as IP Rights, that may be used to specifically support commercial exploitation: i.e., patents, design rights, utility models, database rights, copyright, trademarks, and others.

Benefit from international collaboration to improve access to public funds as well as from cost-savings, build-up and sharing of know-how.

Benefits

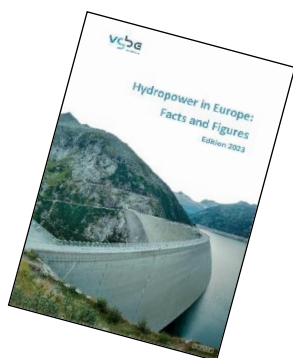
- **Improved funding opportunities**
Higher likelihood of being awarded a contract due to our network with various stakeholders and institutions.
- **Expertise in the submission phase**
Benefit from vgbe energy's expertise in developing a dissemination, exploitation and communication plan for submission.
- **Dissemination network**
Events and conferences across Europe, partner organizations and editors of journals.
- **Topic-specific expert network**
Pooling of expertise and resources to answer larger and more complex scientific questions or to conduct surveys.

vgbe energy's contribution

- Recruiting project partners and/or self-participation
- Co-coordinating the submission proposal
- Responsible for different Working Packages (e.g., dissemination, exploitation and communication)

Publications

Our hydropower network produces a range of publications on hydropower's role, new trends and developments in the sector. The following latest publications are also available for download in the publication section of our [website](#).



Hydropower in Europe Facts and Figures

Hydropower provides significant amounts of balancing power, enabling the efficient integration of the constantly increasing shares of variable renewables such as wind and solar power. Due to the projected increase in variable renewables, the importance of hydropower will even rise in the future.

➤ [Download Publication](#)



vgbe-Interpretation Note | EU Taxonomy & Hydropower: Criteria on Climate Change Mitigation and Adaptation

The vgbe-Interpretation Note | Hydro Power on Hydropower & the EU Taxonomy Climate Delegated Act provides guidance for the application of the EU Taxonomy for the hydropower sector.

➤ [Download Publication](#)



vgbe Position Paper | Position regarding EU Taxonomy Regulation

Position of vgbe energy | Hydro Power regarding EU Taxonomy & Hydropower in the context of the EU Sustainable Finance ambitions and their impact on hydropower generation and storage.

➤ [Download Publication](#)

vgbe-Standards in hydropower

vgbe-Standards represent the current best practice for the generation and storage of power and heat and are developed in close cooperation with operators and manufacturers.

Areas of application are:

- Engineering and Design (E&D)
- Procurement and Manufacturing (P&M)
- Construction and Commissioning (C&C)
- Operation and Maintenance (O&M)
- Dismantling and Recycling (D&R)

Ordinary members of vgbe energy have access to vgbe-Standards in electronic format (eBook) free of charge. Special conditions are offered to Affiliated and Sponsoring vgbe members.



Ordering Number	Areas of application	Title Media are available in the languages according to the country codes in the ordering number.	ISBN Print ISBN eBook
VGB-S-002-02-2014-06-EN	E&D	Hydro Power - Definitions and Indicators	eBook only 978-3-86875-811-5
VGB-S-025-00-2012-11-EN	E&D	Electrical Generating Unit Protection	978-3-86875-410-0 978-3-86875-674-6
VGB-S-175-00-2014-04-EN	E&D O&M	IT-Security for Generating Plants	978-3-86875-744-3 978-3-86875-775-0
VGB-S-034-00-2014-10-EN	O&M	Assessment of fatigue loaded components in hydro power plants	978-3-86875-837-5 978-3-86875-838-2
VGB-S-823-01-2015-09-EN-DE VGB-S-823-31-2014-12-EN-DE	E&D O&M	Reference Designation System for Power Plants (RDS-PP®) - Application Guideline Part 01: Power Plants, General RDS-PP® – Application Guideline, Part 31: Hydro Power Plants	978-3-86875-845-0 978-3-86875-846-7 978-3-86875-388-2 978-3-86875-389-9
...

Furthermore, vgbe energy provides the two designation systems KKS (Power Plant Identification System) and Reference Designation System for Power Plants (RDS-PP®). Both are two essential internationally known basics for the designation of systems and components of energy plants, especially with regard to digitalisation, cost-efficient planning, construction, operation, maintenance and dismantling.

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Ask for the vgbe-Standard catalogue with all available vgbe-Standards.

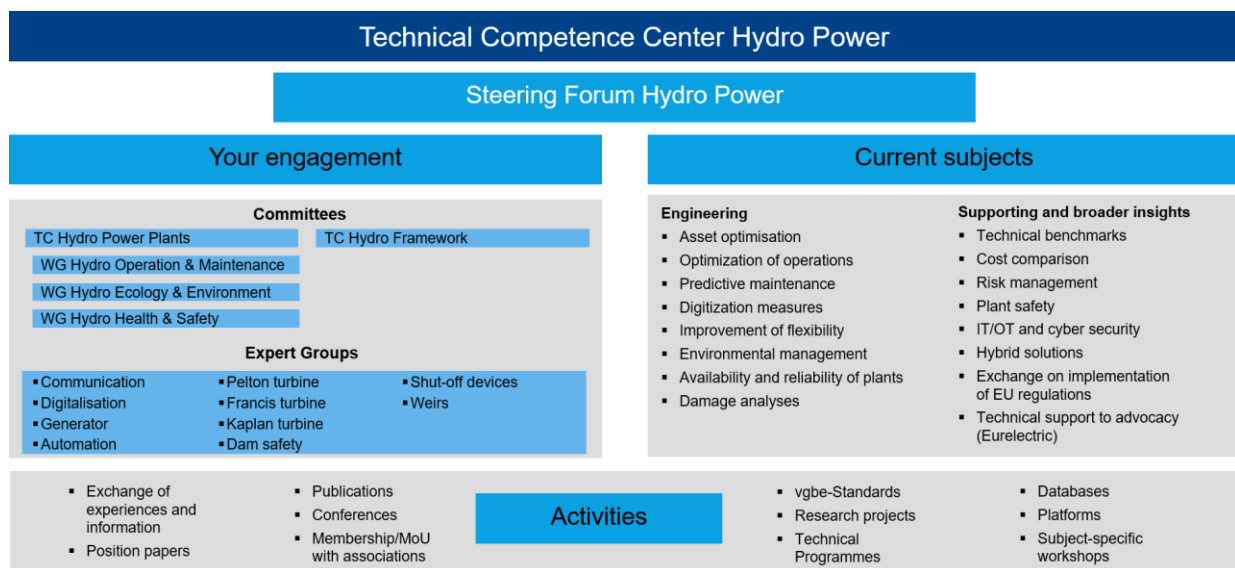


About vgbe energy

vgbe energy is the technical association of energy plant operators. Our members are companies that operate power, heat and cooling, energy storage and sector coupling plants worldwide. Currently, vgbe has 411 members, comprising operators, manufacturers, and institutions connected with energy engineering. The members come from 29 countries and represent an installed power generation capacity of 292,000 MW.

vgbe energy | Hydro Power as part of vgbe is the first address for interested parties in techno-economic, ecological and strategic issues concerning hydropower and performs as the collective European platform and key representative for operators, manufacturers and suppliers of the hydropower community.

In this context, our hydropower community has been sharing experiences and knowledge on a high level of expertise since the year 2000. Currently, more than 250 experts from 68 operating companies and 24 suppliers are actively participating in vgbe's Technical Competence Center "Hydro Power" and benefit from our offers as a member of the successful hydropower network.



TC ... Technical Committee WG ... Working Group

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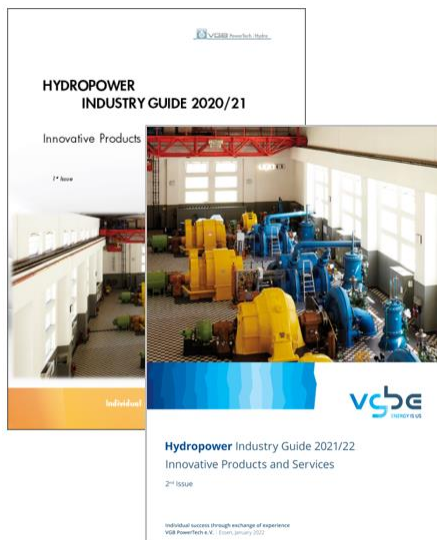


Take the opportunity to present your innovative products and solutions or provide us with a contribution for the next edition

1. Background

At vgbe energy | Hydro Power, we are constantly striving to expand our services and tools to respond to important questions or issues on upcoming topics in the hydropower sector. The hydropower industry has become a successful sector worldwide in recent decades due to its innovative strength, cost efficiency and flexibility. However, technical innovations are crucial to maintain its competitiveness.

2. Publication



The guide will be released every two years and distributed to the hydropower community in Europe through our media partners and social media channels. You can freely download it from the vgbe homepage, providing an excellent and effortless opportunity to showcase your latest products or services to a vast audience within the hydropower industry.

Our second edition "Hydropower Industry Guide 2021/22" had more than 4,000 downloads from our website.

3. Interested in submitting a contribution for the next edition

For the upcoming "Hydropower Industry Guide" we offer you once more the opportunity to participate with an article or a company presentation including the presentation of your innovative products and solutions. Participation is free of charge. Please contact us and request the template.

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