



HIGHLIGHTS 2023

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be informed



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Dear members, dear readers,

Another exciting year has come to an end for our association and we are delighted to present our vgbe Highlights 2023 to give you an insight into the diverse activities of your vgbe energy and our community.

The challenges the energy sector is facing have not diminished significantly over the past year, even though the year was characterised by a substantial easing on the energy markets. The question of whether the path to climate-neutral energy supply is possible while maintaining security of supply was the key question of the vgbe Congress 2023 in Berlin. The answer was basically positive; the main technologies are available, even if research and development are still much needed. However, when it comes to implementation, our member companies face numerous challenges, e.g. in the necessary creation of economically viable framework conditions by politics, in overcoming various bottlenecks along the supply chains or in public acceptance.

In addition to the rapid expansion of renewables, energy storage and grids as well as the market ramp-up of hydrogen and other green gases, the importance of secure generation capacity has finally been recognised by politicians and the public. As an association, we are equally committed to all energy sources, even if the national energy mixes are very different. In Germany alone, at least 20 GW of additional dispatchable capacity will be required by 2031, initially fuelled by natural gas and later by hydrogen and other green gases.

Now to some highlights from vgbe's work, on which you will find more details below:

- ▶ In the first reporting year after the corona crisis, which had shaped and changed the way we work for almost three years, we have found a good mix of online and face-to-face work resulting in a trusting dialogue between all members.
- ▶ As a further result of the "VGB2025" project, we established our new Competence Centre "Future Energy System". Here, in our "Home of New Technologies", we follow with an open-minded view on all technologies, innovations and developments in the industry. In an interview, Professor Nikolaus Elze, Chairman of the Steering Forum "Future Energy System", and Doreen Kückelmann, vgbe expert of the Technical Committee "Future Technologies", explain our motivation for establishing the Competence Centre and its goals and activities.

- Technical Services were once again an important part of our work. Numerous orders for our materials laboratory, water chemistry, oil laboratory, engineering consultancy and supervision of construction and assembly at home and abroad are evidence of the trust our customers place in our expertise.
- Internationally, vgbe's expertise once again contributed to a wide range of initiatives and collaborations, from Europe to India and Japan.

Concerning the promotion of young talent, we were able to celebrate the 50th anniversary of the "Holiday Course – Introduction to Power Plant Engineering", now known as the "Summer School", financed by the vgbe RESEARCH FOUNDATION. The close cooperation between universities, vgbe and its member companies has existed since 1973 and since then, more than 1,500 participants from 25 countries have been introduced to power and heat generation through interesting lectures and excursions. In many cases, their professional path has later led them back to vgbe, whether through the working committees or our events.

A further increase in the number of member companies and a pleasing business result again demonstrated the attractiveness of our association. We would like to thank all our members and customers for their trust and commitment.

We hope you enjoy reading this issue and that we arouse your interest in "more vgbe".

be connected

be informed

be inspired



With energetic regards

Dr Georg Stamatelopoulos
Chairman of the Board
of vgbe energy e.V.

Dr Oliver Then
Executive Managing Director
of vgbe energy e.V.

Future Energy System



Future Energy System (FES) – The association and its members are pushing the energy transition

vgbe and its member companies are important partners in implementing the ambitious climate protection targets of the EU and national governments. Topics such as the EU's "Green Deal", the German government's climate policy and compliance with the Paris Climate Agreement are at the centre of these policies. For years, operators have been pursuing the overarching goals of climate protection, security of supply and affordability of energy with their expansion and corporate strategies in order to secure the industrial location and social prosperity.

The key for mitigating climate change is the expansion of renewables and the associated rapid market ramp-up of the hydrogen economy. Green hydrogen, produced from renewable energies in a climate-neutral way, is on top of the agenda.

However, the International Energy Agency (IEA) believes that the pace of expansion of renewable energies to date is not sufficient to achieve the targets set at the World Climate Conference. Despite the unprecedented growth in the reporting period, countries would have to do even more to increase the capacity of renewable energy by 2030 as planned.

Particularly energy-intensive industries, such as the steel and chemical industries, have to reduce emissions to achieve the global climate targets. Hydrogen plays a decisive role, especially in high-temperature processes. In addition, hydrogen can also be used universally in the field of heat and power generation as well as in other power-to-X applications.

For years, the vgbe community has been a driver of the energy transition and is advancing the issues with its national and international partners through its joint work. These activities were also manifested as part of the vgbe restructuring with the establishment of the vgbe Technical Competence Centre "Future Energy System" (FES). The highest authority of the vgbe Competence Centres are the Steering Forums. The constituent meeting of the Steering Forum "FES", which is chaired by Professor Nikolaus Elze, took place in March 2023.

The following Technical Committees are affiliated with the vgbe Competence Centre FES:

- Technical Committee "Future Technologies" (TC FT)**
- Technical Committee "Hydrogen" (TC H₂)**
- Technical Committee "Photovoltaics" (TC PV)**
- Technical Committee "Biomethane" (TC BM)**

As anchored in the association's statutes, the Technical Committees are primarily dedicated to the exchange of experience, the development of vgbe Standards and position papers, joint research projects, the organisation of specialist events and workshops on the relevant topics of the TCs, the initiation of vgbe Technical Programmes, participation in committees of other organisations, such as the Hydrogen Standardisation Roadmap, the Energy Research Network or the World Energy Council Germany, as well as other tasks.



From left: Lee Estrellado, expert "Photovoltaics", Doreen Kückelmann, expert "Future Technologies", Sebastian Zimmerling, head "FES", expert "Hydrogen" and "Biomethane"

Technical Committee "Future Technologies"

The TC "Future Technologies", which was established in 2019, serves as a technical think tank for vgbe members and, in addition to technology scouting, deals with topics such as flexibility in the energy system, hybrid concepts for power plant locations, electricity and heat storage as well as energy efficiency and energy saving. The different perspectives of the participating companies lead to creative approaches to jointly develop viable solutions for the challenges of the transformation in the energy sector.

The committee, which currently comprises 34 operators and four research institutions, held its 13th meeting during the reporting period. The focus was on technical opportunities for new business activities to supporting the European decarbonisation pathway through the integration of wind and solar parks, biomass, hydropower, hydrogen technology, heat pumps and energy storage technologies as well as combined cycle power plants designed for CHP operation to maintain the security of energy supply in the future. Account was taken of the delegated act defining criteria for the purchase of electricity for the production of renewable hydrogen, which was adopted by the European Commission on February 10, 2023 to supplement the Directive (EU) 2018/2001 of the European Parliament and of the Council ("RED II Directive") and which is considered a blueprint for the energy sector.

In addition, an expert workshop was held in June 2023 on the topic "Experiences with batteries in operation". A second event took place in November 2023 entitled "Maximising efficiency: The potential of storage technologies in power-to-heat-to-power-systems".

Technical Committee “Hydrogen”

The Technical Committee “Hydrogen”, in which 22 operators and three research institutions are currently represented, deals with all technical and regulatory issues relating to the production of green hydrogen through water electrolysis. In addition, topics such as material qualification or thermal utilisation of hydrogen are covered by horizontal networking with vgbe Committees of other vgbe Technical Competence Centres and the vgbe energy service GmbH. In this context, the internal vgbe Working Group “Hydrogen@vgbe”, whose synergies have already been reported on in the previous vgbe Highlights, should be mentioned in particular. In addition to the Technical Committee “Hydrogen”, the materials laboratory of vgbe energy service GmbH and the Technical Committees (TC) “Gas Turbines”, “Industrial and Co-generation Stations”, “Materials and Quality Assurance” and “Chemistry and Emission Control” are involved in this working group via their respective speakers.

The H₂ Workshop is to be emphasised here, which was held on several dates by the Technical Committee “Gas Turbines” in addition to the vgbe Position Paper “H₂-Ready” and the vgbe Factsheet: “H₂-readiness for gas turbine plants” (see also the article “H₂ Workshop of the TC “Gas Turbines”, page 35 in these Highlights).

Technical Programme “Materials safety in the hydrogen economy” initiated

The choice of materials is an important aspect for hydrogen applications, as hydrogen can lead to the embrittlement of steels under unfavourable conditions. When retrofitting existing systems or new plants, the materials used should therefore be thoroughly assessed regarding their type and condition. This also applies to sealing materials.

As part of the Technical Programme, which is coordinated by the TC “Materials and Quality Assurance”, topics and project ideas are collected so that open questions in materials technology in connection with hydrogen can be answered successfully, in a solution-oriented and practical manner. The Steering Committee “Materials and Hydrogen” is involved in this process, prioritising these topics and projects and drawing up a roadmap in order to achieve synergies and avoid parallel developments. The activities of the Steering Committee are intended to contribute to an accelerated market ramp-up of hydrogen and the use of H₂ as a substitute fuel in gas turbines. In line with its tasks, vgbe assumes the role of a networker and contact partner who examines public funding, obtains offers for technical projects, takes on the organisation, networks potential partners and monitors and identifies the latest technical developments and trends.

As with all other Technical Programmes, both association and non-association members can participate in the programme on an equal footing.



During the reporting period, the TC “Hydrogen” continued to drive forward the vgbe Technical Programme “XSTAND-H₂ – Development of Key Performance Indicators (KPI) for the specification of water electrolysis plants”. This Technical Programme aims to evaluate and compare plant concepts using a database.

Three programme phases are planned:

1st phase: implementation of a KPI meta-study to analyse existing KPI concepts and uniform KPI definition

2nd phase: verification of the vgbe KPI concept together with manufacturers and operators, detailed mapping in the vgbe RDS-PP® indicator system and comparison with ECLASS

3rd phase: benchmark and analysis of operating data, design and programming of the database and evaluation of real operating data

The overarching objectives of this programme include the comparability of systems on the market using standardised performance parameters, membership of an expert network with timely access to current technical developments and the development of a database-based benchmark for optimised future H₂ generation.

Cooperation with VAIS

VAIS and vgbe energy develop a guideline for acceptance tests on water electrolysis plants

In February 2023, VAIS (Association for Plant Engineering and Industry Service e.V.) and vgbe set up a joint project group to develop a guideline for acceptance tests on water electrolysis plants to determine performance data and efficiency.

Acceptance rules form the basis for specifying and verifying the warranted properties of a technical system. Such rules have long been established in energy engineering. Generally, their application is contractually agreed between client and contractor. Experience from numerous projects shows that early and reliable agreements between supplier and subsequent plant operator are essential to ensure smooth running of the acceptance tests and thus the success of the entire project.

A first draft of the guideline is expected to be presented to the public at the end of the first quarter or the beginning of the second quarter of 2024.

In addition to these activities, vgbe regularly organises expert events to provide stakeholders in the industry with an adequate platform for exchange and networking.

In the field of hydrogen, the “Hydrogen Industry Day” and the “Essen Hydrogen Regulars´ Table” are organised at regular intervals with our partners. During the reporting period, these events took place for the fourth and fifth time, respectively.

Technical Committee “Photovoltaics”

According to the International Energy Agency (IEA), the expansion of renewables increased by 50 % worldwide in 2023 compared to the previous year. Photovoltaics will account for around 75 % of this growth. With its TC “Photovoltaics”, vgbe brings together experts from this fast-growing sector to create the necessary framework for the exchange of experience.

The TC “Photovoltaics”, which currently comprises ten operators and one research institution, identifies, discusses and works together on topics relating to the provision, installation and operation of PV generation systems.

Guide for the maintenance of PV components

In addition to these general committee activities, the TC “Photovoltaics” is developing a “Guide for the maintenance of photovoltaic system components” by tracking and describing faults and carrying out risk assessments.

Photovoltaics is also increasingly moving towards predictive maintenance to avoid system failures by replacing components early and in good time. The aim of the guide is to develop a maintenance concept based on the minimum approach: “good enough to ensure safe operation with regard to people and the environment”. Past cases of damage and years of practical experience in maintenance and repair serve as the basis for this new guide, which is intended to be used as a decision-making aid for maintenance measures to be taken and, above all, to show which risk scenarios can occur with individual system components.





Technical Committee “Biomethane”

The TC “Biomethane” is currently made up of experts from eight member companies and two research institutes to discuss various topics relating to biogas production and the upgrading process to biomethane as well as to foster an intensive exchange of experience.

The committee has been in existence since 2007, but the focus of the group has been sharpened during the establishment of the TCC “FES” and in view of the role that hydrogen is to play in a future energy system. For example, the TC “Biomethane” has set itself the task of compiling the state of the art in biogas upgrading based on many years of operating experience. It also aims to take a closer look at the special role that biomethane will play in the future and to further optimise plant operation, e.g. by using CO₂ captured during upgrading. Biomethane can, e.g. be used directly as a fuel in natural gas vehicles. Anaerobic digestion of agricultural residues for

biomethane production cannot only generate renewable energy, but can also reduce environmentally harmful methane emissions from agriculture and the excessive introduction of nitrogen into the soil, e.g. by using the digestate as a substitute for direct application of liquid manure.

Furthermore, biomethane can also play an important role as a carbon source in basic chemistry and close a carbon cycle here.

Biomethane therefore has the potential to reduce the harmful environmental impact of agriculture and contributes to the development of a bio-economy based on renewable resources and reducing dependence on fossil raw materials

Promoting young talents

As already reported in the previous vgbe Highlights, the training and further education of young academics is a high priority at vgbe. In addition to offers such as free participation in vgbe events or the vgbe Summer School, the association highly appreciates to supervise bachelor's and master's theses, as this always results in a win-win situation for the association and the prospective engineers.

In the reporting period, the TCC "FES" supervised a student thesis on "Carbon Capture Use and Storage – CCUS", which was supplemented by a subsequent bachelor's thesis on "Investigation of a plant concept for CO₂ capture and the production of synthetic fuels", supervised by the Technical Competence Centre "Thermal Plants".

Another master's thesis within the project "StHyle – Standardisation of steel in hydrogen-based energy applications" is co-supervised by vgbe energy service GmbH.

The thesis consists of a research section in which among other things existing material standards are reviewed and compared with each other to answer questions about suitable materials, material characteristics, etc.

The second, practical part of the master's thesis focuses on the design and construction of an autoclave that can be used to test materials in a pressurised hydrogen atmosphere



In August 2023, the vgbe Summer School took place for the 50th time with international students. An attractive programme of lectures and visits gave the next generation of engineers an insight into the energy sector.



with Dipl-Ing Doreen Kückelmann and Prof Nikolaus Elze
on the vgbe Competence Centre “Future Energy System”

vgbe Competence Centre “Future Energy System” – Home of New Technologies

Hydrogen, sector coupling, large heat pumps and energy storage – these are examples of innovative technology concepts that will play an important role in the energy system of the future. With the Competence Centre “Future Energy System” (FES) established in February 2023, “FES” offers vgbe member companies the opportunity to jointly promote the use of promising innovations. This includes e.g. joint research and development projects, activities relating to standardisation, the exchange of experience and the development of recommendations for suitable framework conditions. The new Competence Centre also sees itself as a think tank in which promising new topics are identified and developed further. In this way, “FES” forms an overarching addition to vgbe’s thematically more vertically orientated focal points of hydro-power, wind energy, thermal plants and nuclear energy.

In the following interview, Doreen Kückelmann and Nikolaus Elze discuss why this interdisciplinary approach is expedient, which specific projects are currently on the agenda and how interested companies can get involved.

Dipl-Ing Doreen Kückelmann

is a consultant at vgbe. The mechanical engineering graduate oversees the Technical Committee “Future Technologies” and played a key role in setting up the new vgbe Competence Centre.



Prof Nikolaus Elze works as Head of Technology – Business Unit Generation Portfolio Development at EnBW Energie Baden-Württemberg AG. He heads the Steering Forum of the Competence Centre “FES” – another honorary position he has held over his many years at vgbe.



” Why has vgbe expanded its Competence Centres to include “Future Energy System” and what can vgbe members expect from it?

Nikolaus Elze: vgbe and its members are clearly committed to the goal of developing a climate-neutral economy and society and implementing the European Green Deal – climate neutrality in Europe by 2050. Our joint contribution is to ensure sustainable, environmentally friendly, secure and economical energy supply. In addition to the expansion of renewable energies, flexibility in the energy system and sector coupling play an important role. There is still a huge need for development in the areas of flexibility and sector coupling.

And this is precisely where the new Competence Centre “Future Energy System” comes in. The new structure offers the opportunity to identify, discuss and further develop new, promising technologies and concepts in a systematic and targeted manner. And that is exactly what our members expect from their association, namely that we lead the way on new topics and help shape the development of technology and the framework conditions for its use.

Doreen Kückelmann: The Technical Committee “Future Technologies” (TC “FT”), which I have overseen for many years, can be described as the nucleus for the new Competence Centre. This committee was set up back in 2019 under the name “Future Energy System” as a cross-thematic group for an open dialogue. Experts from operators, research institutions and other associations work together on this committee, which in principle represents the entire energy value chain. Experience shows that the need for dialogue is particularly high when it comes to innovative technologies. Over the course of time, we have identified many topics which require fixed structures and

processes within the association for their further development. This situation gave rise to the Competence Centre “FES”, which now helps us to work on topics much more intensively and in greater depth.

” What topics and projects does the Competence Centre “FES” deal with?

Doreen Kückelmann: We have already developed numerous topics to such an extent that they are being worked on in independent committees. In addition to “Future Technologies”, there are now the Technical Committees “Hydrogen”, “Photovoltaics” and “Biomethane”, as outlined on the previous pages of these Highlights. Other topics we are currently working on are storage technologies, large heat pumps and geothermal energy. Project, bachelor’s and master’s theses by students are an important tool for this, providing our committees with important impetus and guidance.

Particularly in the field of hydrogen a lot of specific projects are underway: In 2023, for example, we published the Factsheet “H₂-readiness for gas turbine plants” in German and English, a “H₂ Process Guide for the transformation of electricity and heat generation to operation with renewable and CO₂-free gases” together with the German Association of Energy and Water Management (BDEW) and started to develop a guideline for acceptance tests on electrolysers together with the Association for Plant Engineering and Industry Service e.V. (VAIS).



Nikolaus Elze: The Steering Forum “Future Energy System” only started its work a few months ago. We are currently in the process of analysing the activities of the individual committees and developing a work programme for our Competence Centre. As already mentioned by Doreen, the topic of hydrogen plays a particularly important role for us. Many members operate plants to produce green hydrogen or are planning to do so. There are still many challenges, which we are working on together with the help of standardisation and research projects, for example.

Another new aspect is that we are working across departments within vgbe. A lot of our topics require interdisciplinary work – with the Competence Centre “FES”, we have now also created the structural bracket to coordinate complex topics across disciplines.

” How can interested parties get involved and who can join?

Nikolaus Elze: In principle, anyone can join – members and non-members alike. Our aim is to bring the “community” together and maximise professional exchange. Our specific activities range from the exchange of experience, research projects and Technical Programmes – i.e. various activities within a subject area – to the creation of position papers and the development of vgbe Standards. We also organise specialist events in the areas that are part of the “Future Energy System”.

Doreen Kückelmann: All committees are international, so communication is in English. We rely on innovative approaches not only for the content, but also for the committee work itself. For example, external contributions from start-ups and research institutions are part of our programme, as this allows





us to broaden our horizons and learn to think “out of the box”. We also involve students in our work. We offer them the opportunity to work on current topics, present their work at meetings and get to know our member companies.

” **What is your personal assessment of the first year of “FES”?**

Doreen Kückelmann: The fact that we have managed to establish the Competence Centre “Future Energy System” fills me with pride. The basis for this success is the trusting cooperation and the great commitment of our members. I am delighted that we have been able to inspire not only our member companies, but also the next generation for the new technology through our dynamic, cordial and inspiring cooperation. Together with the Chairman of the TC “Future Technologies”, Carsten Hendriksen from Ørsted, I really enjoy working with this committee and I look forward to the energy supply of tomorrow with confidence.

Nikolaus Elze: The formation of the new Competence Centre is an important milestone for the further development of vgbe. We can now also implement the successful concept of “added value through networking” in future technologies. The Steering Forum, which I chair, will do everything it can to ensure that this succeeds. I am delighted that we have already been able to attract a broad spectrum of stakeholders to our committee. There are experienced representatives from member companies who have been active partners in vgbe for many years, but the fact that start-ups and students have become part of our community is particularly noteworthy. Many different perspectives bring new impetus, which we need at vgbe.



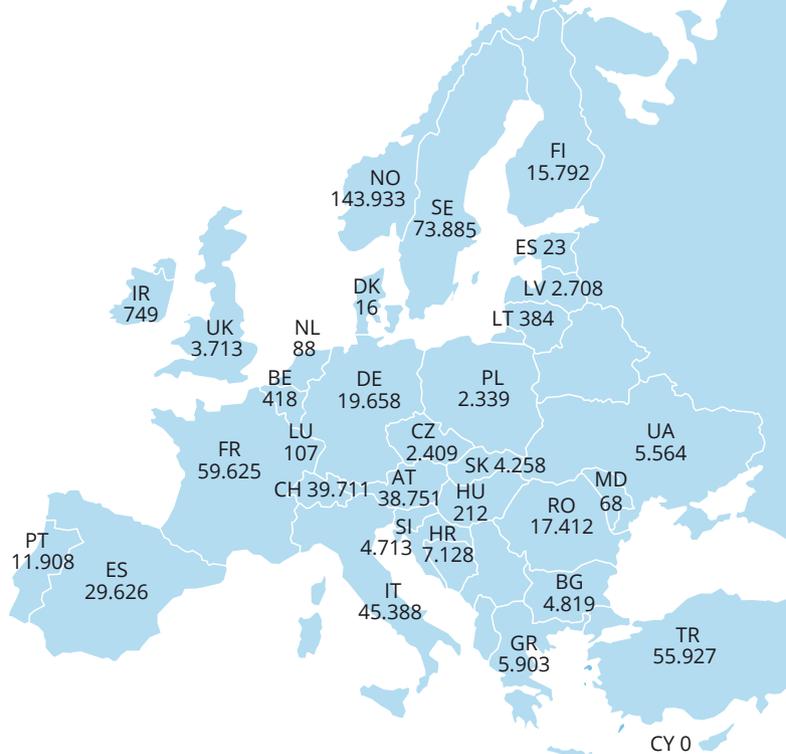
HYDROPOWER



Hydropower in Europe

In European comparison, Russia is the most important country in terms of the installed capacity of hydropower plants. It is followed by Norway and Türkiye.

Overall, the amount of electricity generated in EU hydropower plants has fluctuated between 291 and 372 terawatt hours (TWh) in recent years.



Gross electricity generation from run-of-river and reservoir power plants in Europe in 2021 in billion (10⁹) kWh.¹

¹ Source: (1) eurostat; (2) CH Bundesamt für Energie BFE; (3) UK Department for Business, Energy & Industrial Strategy

Hydropower – Digitalisation increases

Hydropower is not only a reliable renewable energy source, but also one of the leading renewable energy sources, which is utilised in almost all European countries. Particularly the Nordic and the Alpine countries rely on this proven form of energy conversion.

In addition to the highly predictable and constant generation in run-of-river power plants to cover base load, hydropower is becoming increasingly important in the provision of reserve capacity and peak load to ensure security of supply and, in particular, the provision of balancing energy to maintain grid stability against the backdrop of an increasingly flexible energy market. In the EU, these requirements are predominantly met by highly efficient pumped storage and storage power plants with a total installed capacity of almost 46,000 MW. Hydropower is an extremely efficient, reliable and storable form of energy and an indispensable source of energy that must be preserved and further promoted as part of the energy transition.

Within Europe, Norway, Sweden and France are the countries with the highest energy production from hydropower. Overall, the amount of electricity generated by hydropower in the EU has fluctuated between 291 and 372 TWh in recent years.¹

Despite the importance of hydropower in the European energy mix, both today and in the future, this sector faces numerous challenges and hurdles. From the need for a clear legal framework and a level playing field at European level to technical challenges.

The vgbe hydro community has been active for years to expand and stabilise the important contribution of hydropower to the share of renewables and to optimise plant operation.

Compared to other renewables, the expansion potential of hydropower can be categorised as rather low. Electricity generation from hydropower is primarily achieved through the modernisation and expansion of existing sites, e.g. through modern turbines that make more efficient use of the seasonally varying water volumes, which means that higher annual yields can be generated.

Even less cost-intensive measures, such as overhauling turbines, replacing gearboxes or generators and renewing screens and screen cleaners, can significantly increase yields. There may also be potential for expansion through the new construction or reactivation of plants. Existing transverse structures that have not yet been used to generate electricity

¹ <https://de.statista.com/statistik/daten/studie/233230/umfrage/anteil-der-wasserkraft-an-der-stromerzeugung-in-deutschland/#statisticContainer>

may be suitable for this purpose. The requirements of the Water Resources Act for improving water ecology and the continuity of the watercourse must be observed.²

Expert Event “Digitalisation in Hydropower”

Digitalisation is another key aspect for increasing the performance and optimising the operation of hydropower plants. Experts are certain that digitalisation will change the way in which hydropower plants are operated and maintained in the future. Possible applications include energy forecasting, better control of ancillary services, cyber security, optimisation of plants and fleets, maintenance work and production forecasts.

Improved digital controls can help to increase efficiency, minimise downtime, optimise asset management and reduce operating costs. During the reporting period, the vgbe TCC “Hydro

Power” held the sixth international Expert Event “Digitalisation in Hydropower” in September 2023 in Switzerland. The event was jointly carried out with Axpo.

This Expert Event focused on experiences with various digitalisation measures already implemented:

- Plant management
- Staff scheduling
- Advanced data analysis
- Platform solutions
- Digital twin
- Inspection and measurement
- Visualisation (VR, AR, 3D GIS)



² https://redaktion.hessen-agentur.de/publication/2020/Faktenpapier_Wasserkraft.pdf.

The expert event was rounded off on the second day with a tour of the digital systems at Axpo's Mapragg hydropower plant. The state of digitalisation in the areas of plant identification, personnel management, indoor drone inspections, etc. was presented at various stations.

Since 2018, 755 participants from 209 companies/institutions and 27 nations have taken part in this series of events. The next Expert Event "Digitalisation in Hydropower" with the focus topic "Innovative data-driven measures for performance optimisation and resilience" will be held together with Uniper in September 2024 near Munich.

Demonstration stations and the presenters		Demonstration stations and the presenters	
	Station 1 (Axpo, Voith) Access Asset Documentation with eDoc Live Demo and User Story (operational)		Station 8 (Axpo) Drone Indoor Inspection Live Demo at HPP Mapragg (PoC System)
	Station 2 (Axpo, Sogema) Digital Workforce Management in HPP Live Demo and User Story (operational)		Station 9 (Axpo) Hydrone - Drone Outdoor Inspection Live Demo at HPP Mapragg (operational)
	Station 3 (Axpo, Partners) Useful Frontline Apps Demo of various digital tools (operational)		Station 10 (Axpo) State of the art Dam Monitoring SmartMeasure, DATAL, WATAL (operational)
	Station 4 (Axpo) Asset Identification with PowerOwl Live Demo and User Story (PoC system)		Station 11 (Axpo) Automated Real Time Fish Detection Presentation of test case HPP Stroppel (PoC)
	Station 5 (Axpo) Hydro Insights - Analyze Operational Data Live Demo and User Story (operational)		Station 12 (Axpo) Hydropeaking Modelling Methods to verify hydropeaking impacts
	Station 6 (Axpo, etaeval) etahydro - Online Efficiency Monitoring Presentation of optimization in HPP Filisur		Station 13 (Axpo, WZ Systems) Digital Transformation & Projects Data coverage, mobile devices, consulting
	Station 7 (Axpo, Schuck, Verbund) Underwater Inspection Live Demo at HPP Mapragg (PoC system)		Station 14 (Axpo) Asset Optimization with RevOpt Live Demo and User Story

Expert Workshops "Hydro"

Apart from the exchange of experience in the vgbe committees and panels, vgbe organises topic-specific expert workshops exclusively for vgbe members to promote problem-solving between experts with extensive practical experience. Expert Workshops are planned by vgbe in co-operation with its members and cover a wide range of applications, including established and new technologies for energy generation and storage. They can be organised at short notice and can therefore not only address pressing issues of the industry, but can also be used proactively to find solutions to upcoming challenges.

The Expert Workshops are aimed at operators and require active participation according to the "give and take principle". In line with this principle, it is mandatory to deliver a presentation to actively participate in the discussion and benefit from the experiences of the other participants.

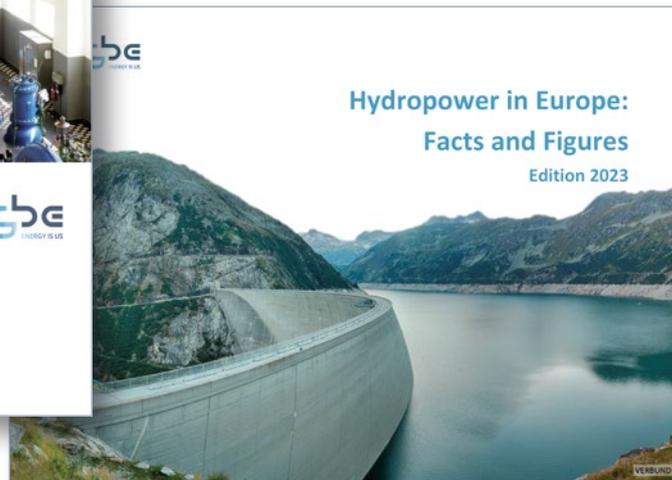
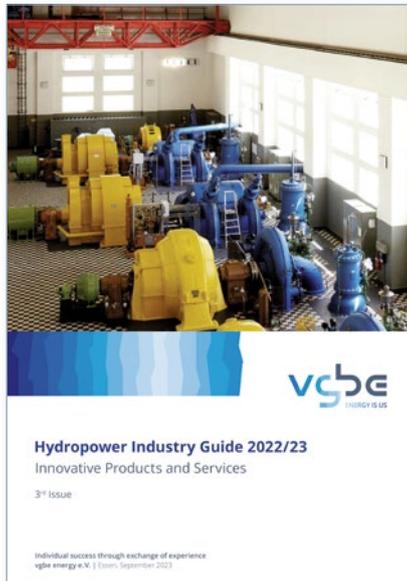
The following Expert Workshops were held in the TCC "Hydro Power" during the reporting period:

- ▮ Sensors and diagnostic systems for generators
- ▮ Digital document management system
- ▮ Underwater inspection
- ▮ Monitoring and maintenance concepts for dams and rehabilitation of the water side of concrete dams
- ▮ Experience with fault tree analysis at Enel Green Power (EGP)
- ▮ Practical experience with the operation of battery storage systems

New publications

Last year, the vgbe TCC “Hydro Power” published the third edition of the “Hydropower Industry Guide”. The Industry Guide contains an up-to-date and varied overview of products and services in the hydropower sector with extensive information on research, company and media partner profiles and vgbe services in the field of hydropower.

In addition, the publication “Hydropower in Europe: Facts and Figures 2023” was published. Due to the predicted increase in variable renewable energies, the importance of hydropower will increase in the future, particularly with regard to the provision of balancing energy for grid stabilisation.





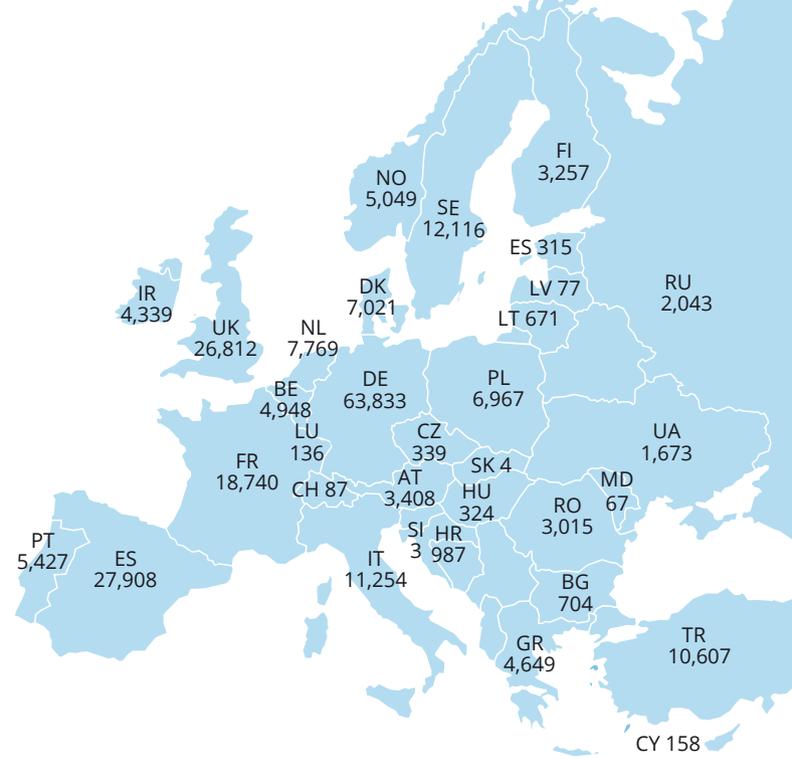
WIND POWER



Expansion of wind power in Europe

Around 31 GW of wind power capacity was under construction in Europe in May 2023. With 17.1 GW, most of this capacity was erected in the Northern European countries. In addition, there were 310 GW of wind power plants in the pre-construction phase and a further 268 GW had been announced¹.

This means that the onshore and offshore wind capacity of 188 GW currently installed in the 27 EU member states will increase further. However, future expansion also has to consider the loss of capacity due to the end of service life of existing plants, as this has been compensated for.



Installed capacity for onshore and offshore wind energy in Europe. In the 27 EU member states, 188,371 MW (EU-27 + UK 215,183 MW) of capacity was installed².

¹ Source: statista 2024

² Source: eurostat 2023

Wind power – Still on the rise

Wind power in Europe

According to preliminary figures from WindEurope, more wind turbines – around 17 GW – were built in 2023 in the EU than ever before. Most of the new generation plants were built on land with 14 GW, while three GW were added at sea. Germany is in the lead here, followed by the Netherlands and Sweden.

Despite the positive signal, the expansion must continue to be focussed and driven forward. In purely mathematical terms, 30 GW per year are required to achieve the EU's climate targets and significantly increase the share of renewable energies in total energy consumption by 2030. According to the EU Commission, capacities must therefore be more than doubled. The aim will be to achieve more than 500 GW of installed capacity by 2030 – at the end of 2023, this figure amounted to around 220 GW.¹

vgbe presence at recognised trade fairs and specialist conferences

vgbe presented itself at several trade fairs and conferences during the reporting period. In particular, vgbe was once again represented with its own stand at the 31st Wind Energy Days in Potsdam and at Husum Wind.

At Husum Wind 2023, vgbe organised a joint vgbe stand with six other co-exhibitors, which is planned again for 2025 due to the very positive feedback. The vgbe oil laboratory was also on site as a co-exhibitor. Here, too, intensive discussions were held on oil analyses and oil inhibition.

These trade fairs offer a unique opportunity for our association to network with leading players in the wind industry, present the latest developments and contribute to important discussions in the sector.

The association's own stand served as central point of contact for interested parties, members and business associates. Here we were not only able to demonstrate our commitment

¹ <https://windeurope.org/newsroom/press-releases/the-eu-built-a-record-17-gw-of-new-wind-energy-in-2023-wind-now-19-percent-of-electricity-production/>

to innovation and sustainability, but also to promote an active dialogue on pioneering technologies and industry-specific challenges. The leading trade fairs were therefore an excellent platform to strengthen the visibility of the association, intensify relationships and promote the common interests of the wind industry.

vgbe committee meetings

The committee meetings are essential for the exchange of experience and information between vgbe members. It is regularly determined which topics are current and of particular importance to address them with suitable formats. Relevant topics were identified in 2023 and will be further explored in 2024.

Examples include the following:

- Continued operation and repowering of wind turbines
- Secondary market for wind turbines
- Selective operation and maintenance strategies for various markets
- Data-based optimisation as part of digitalisation measures
- Cyber security measures to secure critical infrastructure

vgbe has been working intensively on the topic of wind power for more than 20 years. The association constantly adapts its activities to the needs of its members and the requirements of the market. In view of the dynamic developments and ambitious expansion targets in the wind sector, the vgbe wind community will continue to focus on innovative topics that promote the expansion and optimised operation of wind turbines in the future.



Design of the joint vgbe stand.



The vgbe oil experts were popular contacts at the vgbe stand.



Update on the “SOPWICO” research project

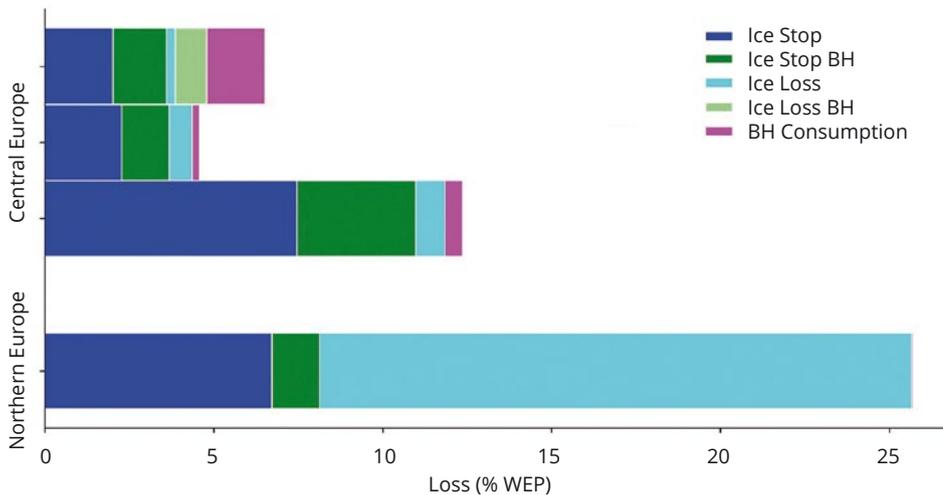
As part of the “Smart Operation of Wind Power Plants in Cold Climate (SOPWICO)” project, data from four wind farms in Central Europe and Scandinavia were analysed in detail.

The results show that icing losses between April and October lead to a reduction in production of approx. 5 to 25 % (also known as “winter energy production” [WEP]). Even when active rotor blade heating systems are in use, there is a considerable WEP loss due to icing (“ice loss”). It is difficult to quantify

the amount of ice loss avoided by rotor blade heating systems as no reference turbine, i.e. a turbine without active rotor blade heating, is available for comparison. However, the analysis shows that not all rotor blade heating cycles are successful and that the losses can possibly be reduced by adjusting the time at which the heating cycles are triggered.

As can be seen from the figure, the total amount of ice loss as well as the periods during which ice loss occurs, depend very much on the operating strategy during icing (automatic stops and restarts or not, blade heating during operation or not, criteria for triggering blade heating, etc.).

Production loss of three wind power plants in Central Europe and one wind power plant in Scandinavia



Ice Stop:

Loss due to icing stops

Ice Stop BH:

Loss due to icing stops with active blade heating

Ice Loss:

Loss due to icing during operation

Ice Loss BH:

Loss due to icing during operation with active blade heating

BH Consumption:

Loss due to energy consumption of rotor blade heating

Interpretation of the figure

In wind turbine 1 (top bar in the diagram), the blade heating is activated during operation. The early triggered and long-lasting heating events help to prevent a large accumulation of rotor blade ice and thus reduce the total duration of ice-related downtimes (ice stops, in blue and dark green). This turbine therefore has a comparatively low loss during ice stops. However, a major disadvantage of early and long-lasting heating is the high expenditure of heating energy (pink).

Turbines 2 and 3 are only heated at standstill. These are two different turbine types from the same manufacturer and the same wind farm. The large difference between the losses of the two turbines shows the great variability and high sensitivity of the icing losses.

Turbines 1 to 3 show relatively high losses during forced ice stops (blue). Such stops are prescribed by the authorities to minimise the risk of ice throw in a populated area.

Turbine 4 is in Scandinavia and is exposed to longer periods of icing than the other three. For this turbine, the rotor blade heating is only used when the turbine is at standstill. Rotor blade heating is rarely activated in view of the long icing periods. Therefore, almost no losses occur during the active rotor blade heating periods. Most of the losses occur when the turbine produces as usual despite iced rotor blades and loses some of its power due to the disturbed aerodynamics of the rotor blades (light blue). In turbine 4, large amounts of icing repeatedly lead to abnormal vibrations, triggering safety stops of the turbine.

Algorithm for optimised rotor blade heating

During the project, an algorithm was developed that optimises the timing of the triggering of rotor blade heating events based on current and future atmospheric conditions.

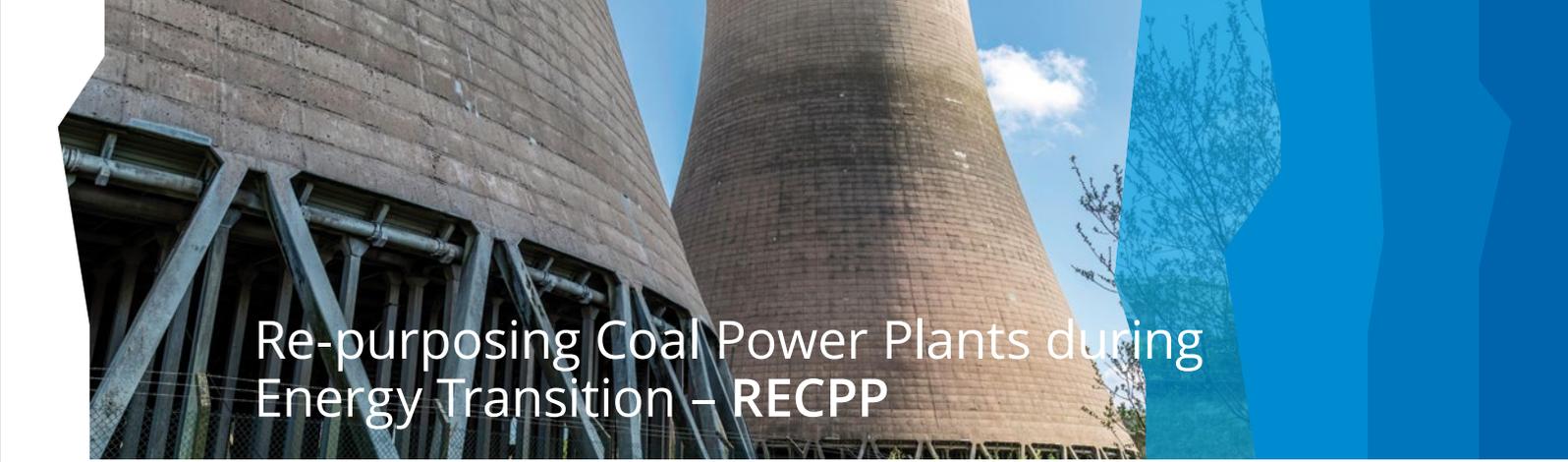
An initial version of the algorithm was developed as part of the partner project “Smart Operation of Wind Turbines in Icing Conditions (SOWINDIC)”. This first version predicts the optimum heating time based on weather forecasts and current icing conditions. This algorithm will soon be tested for the wind farms of the SOPWICO partners and further adapted and optimised to the individual needs of each wind farm.



A large, white, cylindrical cooling tower stands against a blue sky with scattered white clouds. The tower has a textured, ribbed surface and is supported by several thick, white, tapered legs at its base. The image is partially overlaid by a large blue geometric shape that contains the title text.

THERMAL POWER





Re-purposing Coal Power Plants during Energy Transition – RECPP

vgbe coordinated project on the subsequent utilisation of power plant sites

vgbe coordinated the RECPP project (Re-purposing Coal Power Plants during Energy Transition) which was carried out by European operators and research institutions from July 1, 2020 to June 30, 2022.

This accompanying measure, funded by the EU through the Research Fund for Coal and Steel, focused on the repurposing potential and subsequent use of coal-fired power plants to open prospects for European coal regions during the transition and after the coal phase-out. The conversion and subsequent use of decommissioned coal-fired power plants supports the gradual phase-out of fossil fuels and contributes to the economic, social and environmental development of coal regions in transition. It provides European and local communities with viable re-use options and development opportunities, supports industry innovation and triggers investment in environmentally friendly technologies.

Site-specific solutions utilising existing infrastructure have also been assessed in terms of re-use savings. In line with the objectives of the European Green Deal, a particular focus was placed on innovative and emerging technologies that support the transition of coal regions to eventually identify the most optimal solutions for different former coal power plant sites.

At the end of the project, the specified and clustered sites were matched with the available technologies for site re-use. The RECPP project started with mapping and screening the coal regions in transition, categorised by country, type, age, etc. A total of around 350 sites were identified for re-utilisation. In total, around 350 sites were found for subsequent utilisation, which corresponds to around 70 % of the coal-fired power plant capacities installed in Europe. The aim of this study was to collect and systematise data that can be used to assess the conditions for the sustainable use of coal-fired power plant assets and infrastructure in the phase-out process. Finally, a strategic and significant number of typical power plants were selected to analyse the best sustainable approach to further utilise this infrastructure.

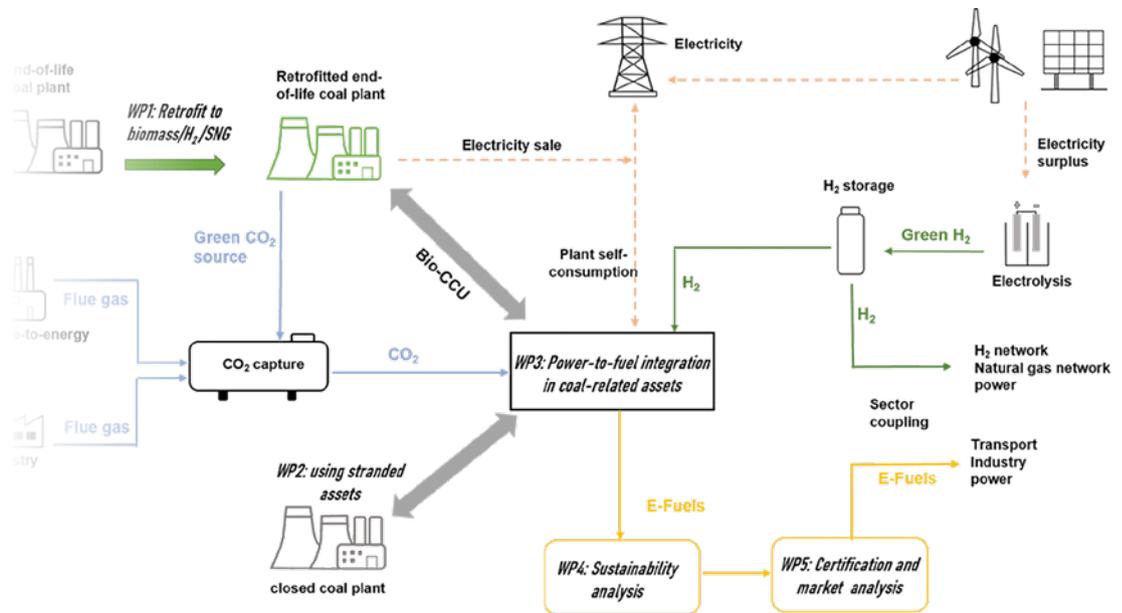
At the same time, more than 20 sustainable technical solutions for the subsequent utilisation of infrastructure were developed and systematically described, considering the boundary conditions for the circular economy and sector coupling. Essentially, these are technically proven processes that can be implemented quickly, from fuel switching to battery storage, e-fuel production or tertiary utilisation options such as server locations, office buildings, etc.

These technologies may be suitable for a specific site or for a range of sites, depending on various criteria such as legal and technical issues and market prospects.

In addition to the RECPP project, other projects, also involving vgb, are being carried out with the aim of re-utilising existing power plant sites and their infrastructure. One example is the GreenDEALCO₂ project, which is being coordinated by the Institute of Combustion and Power Plant Technology at Stuttgart University (Institut für Feuerungs- und Kraftwerkstechnik (IFK)).

GreenDEALCO₂ – Green Deployment of E-fuels And Liquids based on CO₂ for closed and end-of-life coal-related assets

E-Fuels – Production of alternative fuels at power plant sites



© <https://www.greendealco2.com/project>

The planned rapid coal phase-out is putting pressure on European coal-fired power plants. This does not only lead to stranded assets, but also requires alternatives for energy supply.

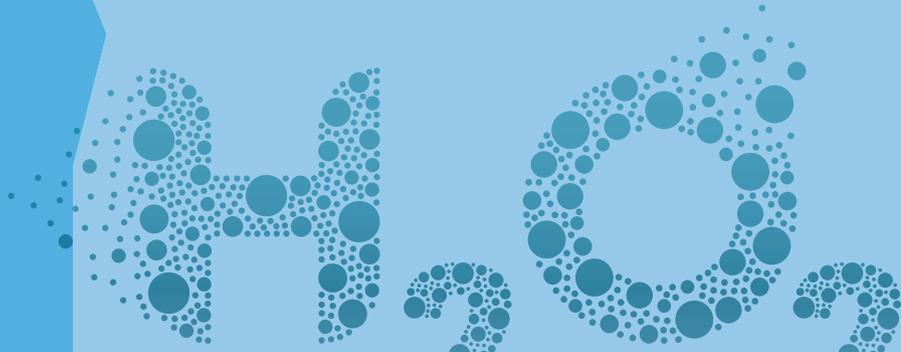
As part of the GreenDEALCO₂ project, dis-used and decommissioned coal-fired power plants are to be put to an innovative subsequent use, as already envisaged in the RECPP project. The assets of the decommissioned plants that are no longer required are to be used efficiently through synergies with neighbouring industries or waste incineration plants. Sustainability assessments and certification systems are to accelerate the cost-effective use of power-to-fuel technology on the European market.

The focus is on the following objectives:

- Optimising the design and operation of power-to-fuel technologies in retrofitted and decommissioned coal-fired power plants

- Improving the economic feasibility of power-to-fuel technologies by utilising existing infrastructure, assets and process configuration
- Investigating retrofit scenarios for selected former coal-fired power plants using biomass and waste-based fuels to promote bio-CCU (carbon capture and utilisation) technology
- Experimental combustion tests and theoretical studies on NH₃, Si and H₂/SNG as alternative energy sources for pulverised combustion plants to bring the technology to TRL 5
- Study on the feasibility of retrofitting dis-used coal-fired power plants with hydrogen as an energy source of the future
- Market analysis and promotion of e-fuels in the European energy and fuel market
- Consideration of the socio-political aspects and public acceptance of power-to-fuel integration at former coal sites





Utilisation of hydrogen peroxide in power plants

Further use of environmentally friendly biocide through vgbe activities

As part of the implementation of the Biocides Regulation, notifications for active substances have to be submitted to the European Chemicals Agency (ECHA). The evaluation of “old” products, i.e. products already on the market at the time of publication of the regulation, is ongoing. In November 2022, the ECHA requested that interest in taking over the notification of hydrogen peroxide (H₂O₂) for the product types PT 11 and PT 12 had to be notified within 12 months.

vgbe was informed that the manufacturers of hydrogen peroxide, which is used as a biocide for water treatment in the product type PT 11 “Preservatives for liquid-cooling and processing systems” and PT 12 “Slimicides”, reject this notification due to new, cost-intensive evidence of genotoxicity. However, without the corresponding notification, H₂O₂ can no longer be used for water treatment.

In October 2023, the association analysed the current situation, identified a manufacturer interested in taking over the product and supported a market analysis. In addition, technical discussions were held with experts from different areas (users, manufacturers/distributors and authorities).

The experts agreed that H₂O₂ was an important (biologically neutral) soft biocide of product type PT 11 and that alternatives (especially chlorine-based) had a much higher environmental impact. A fundamental problem was identified with H₂O₂ as a biocide in all product types, as the genotoxicity study now required for PT 11 will also be necessary for product types 1 to 6 (including food and sanitary products).

According to one manufacturer, the application for notification was submitted on time. Official information from the manufacturer or the ECHA is not yet available for procedural reasons.

Thanks to vgbe’s activities, discontinued use of hydrogen peroxide as a biocide for water treatment in product type PT 11 was avoided. This means that power plant operators do not have to use any new biocides, which would possibly lead to violations of limit values, new authorisations, etc.

The effects of the amended notification on sales will be reported once official information is available.



Gas turbines – H₂ readiness in the focus of activities

The expansion of renewables and the market ramp-up of green hydrogen are the core elements of the future decarbonised energy supply. Fuel-efficient gas turbine plants (GTP) are partners of renewables to reliably balance out the volatile feed-in of renewables and ensure security of supply as well as grid stability. In addition, gas-fired power plants with their controllable capacities have to compensate for the planned phase-out of fossil-fuelled coal-fired power plants.

In view of these developments and the increasing demand for electricity, e.g. due to electro-mobility, innovative production processes, electricity-based heating systems, etc., the German government is aiming to increase the capacity of gas-fired power plants by 25 GW, which will mainly be split between hydrogen power plants and hydrogen-capable gas-fired power plants.¹ To this end, existing gas-fired power plants and new plants to be built have to be upgraded for the use of hydrogen, and innovative concepts have to be developed to realise the targeted CO₂-neutral power generation and the transformation to an H₂-based energy system.

Activities of the vgbe gas turbine community

The vgbe Technical Committee “Gas Turbines” is part of the internal vgbe Working Group “Hydrogen@vgbe” (see page 9 of these vgbe Highlights). vgbe and its member companies have set themselves the task of promoting the environmentally friendly use of hydrogen and blends of hydrogen and other gaseous fuels, such as natural gas, in line with the requirements of the energy transition. In addition to manufacturers and research institutions, operators of gas turbines are also increasingly focussing on hydrogen and hydrogen co-combustion in gas turbines. The topicality and relevance of these issues prompted the Technical Committee “Gas Turbines” to hold an interactive third workshop in November 2023 prepared by the Gas Turbines’ Committee and the Dresden Technical University on the topic of “Considerations on H₂ (co)-combustion in gas turbines and realisation of 100 % H₂ readiness in new and existing plants”.

¹ https://www.ewi.uni-koeln.de/cms/wp-content/uploads/2023/07/EWI_Policy_Brief_Die-Kraftwerksstrategie-2026.pdf

The following subjects were covered by the extended portfolio of this third H₂ workshop

- Summary of the important fundamentals of H₂ combustion and examples of the state of the art in H₂ combustion in gas turbines
- Definition of stages on the way to H₂ readiness and estimation of the associated costs
- Simplified consideration of a virtual 64 MW GTP for 100 % CH₄ (natural gas) and 100 % H₂ combustion and conclusions
- Overview of the technical requirements for H₂ readiness for the sub-systems of the gas turbine plant in accordance with the vgbe Factsheet “H₂ readiness for gas turbine plants”

Relevant questions were identified and communicated in preparation for the workshop. The approximately 30 participants discussed the questions in a lively manner, further concretised the topics and received relevant input for the implementation of specific GT projects.

Successful cooperation between BDEW and vgbe continued

“Process guideline for electricity and heat generation based on renewable and decarbonised gases for the transformation of gas-based generation plants”

In its “Position Paper H₂-Ready” published in September 2022, vgbe explained the technical, economic and regulatory challenges for the use of hydrogen in the energy sector. In this paper, the association defined the term “H₂-ready” and outlined the steps towards 100 % utilisation of hydrogen in gas turbine plants.

With its supplementary vgbe Factsheet: “H₂ readiness for gas turbine plants”, it was additionally shown which challenges are involved in the energetic use of hydrogen from the perspective of gas turbine operators.

Furthermore, in preparation of the effects of the delegated act on existing power plants and the tendering of H₂-ready power plants within the power plant strategy, it became clear that there is a need for the definition of precisely this technical, regulatory and (authorisation) legal framework for the transformation process towards hydrogen-capable power plants. To this end, the joint vgbe–BDEW process guideline was created which, in addition to the technical focus of the “vgbe Position Paper H₂-Ready”, pursues a cross-sectoral approach that combines politics, regulation, environmental protection, security of supply, economic efficiency and technical feasibility.

With the process guideline, both associations have succeeded in describing the various challenges in relation to the design of H₂ readiness in electricity and heat generation and outlining the transformation process towards the increasing use of hydrogen against the background of necessary planning, approval and construction times.

As a result, it was confirmed that the political, technical, regulatory/emission law and external factor levels have been considered jointly.

Summarised

H₂ readiness and the use of other fully or partially green-house gas-neutral fuels dominated the activities of the vgbe gas turbine community in the reporting period.

The adjustment of NO_x values is also an important issue in connection with the (co)-combustion of hydrogen and other green gases. Due to the higher H₂ combustion temperature, the European and national NO_x limits have to be adjusted accordingly.

These topics were also focussed at the gas turbine conference held in June 2023, where around 160 participants discussed the latest developments in gas turbine technology and operation at expert level.



NUCLEAR POWER



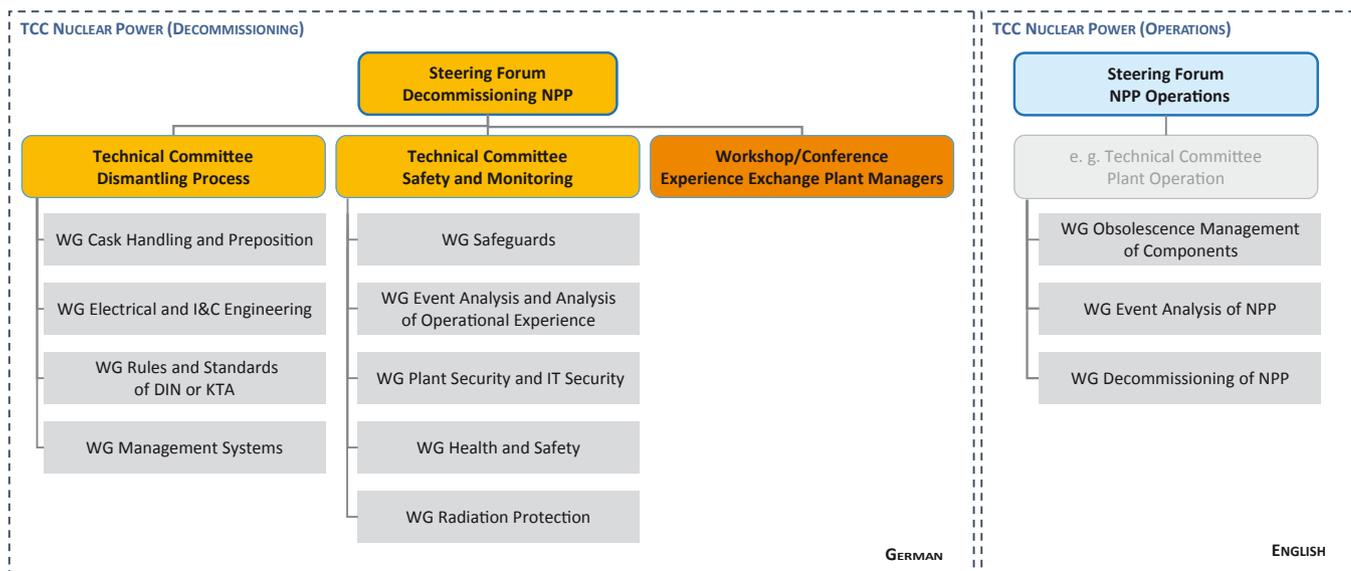
Still great need for the exchange of experience: Nationally on decommissioning, internationally on operations

Now that the last three nuclear power plants in Germany have ceased operation on April 15, 2023 in accordance with the phase-out decision of June 2011, German operators are finally focusing on the decommissioning and dismantling of their nuclear facilities.

In contrast, efficient nuclear power plants continue to be operated worldwide and new nuclear power plants are being planned and built for CO₂-free generation. In France alone, 14 new nuclear plants are to be installed and other European countries, such as the UK and the Netherlands, will continue to rely on nuclear energy in the future.

vgbe energy has responded to these different needs and divided the vgbe Technical Competence Centre “Nuclear Power” into the areas of “Decommissioning” and “Operations” to meet the respective requirements.

Technical Competence Centre “Nuclear Power” – Structure of nuclear committees at vgbe



TCC: Technical Competence Centre
WG: Working Group

DIN: German Institute of Standardisation
KTA: Nuclear Safety Standards Commission

Topics relating to decommissioning are dealt with in the tried and tested manner in the German-language Steering Forum “Decommissioning”. In order to continue the exchange of experience on operational topics, a new international committee structure has been set up, which is open to all vgbe members and offers a platform for exchanging information on technical aspects of plant operation.

In addition to an international Steering Forum, initial working groups have been set up on topics that vgbe members believe can make a significant contribution to the safe continued operation of nuclear power plants. Further topics are currently being discussed to be able to offer foreign vgbe members existing services in the field of nuclear technology as well as possible solutions.

The reorganisation of the committees in the field of nuclear technology also required a new financing model apart from the changes in the committee structure. Now Technical Programmes are offered in addition to the services covered by membership fees. These programmes include vgbe services that are not covered by the membership fees and are offered

as solidarity programmes that are open to both German and international members and non-members.

In the reporting period, the following services were offered in the form of Technical Programmes:

- ▮ Support for the “Central Reporting and Evaluation Centre” (ZMA) database, including support for the Working Group “Event Analysis”
- ▮ Technical support for the Working Group “Radiation Protection”
- ▮ Technical support for the Working Group “Fissile Material Monitoring”
- ▮ Support for the “External Personnel Database” (FPDB)
- ▮ Support for the “Quality and Product Database” (QPDB)
- ▮ Project management for joint projects in electrical engineering and instrumentation and control technology
- ▮ Supervision of the “Research and Development Database System” (FESY)
- ▮ Coordination and support of standardisation work in the DIN specialist area of nuclear technology and radiation protection

“Decommissioning timeline”



Decommissioning timeline for nuclear facilities

Following last year's successful kick-off event, the 2nd event of the vgbe Steering Forum "Decommissioning" took place for plant managers from October 19 to 20, 2023 at the Jülicher Entsorgungsgesellschaft für Nuklearanlagen (JEN) with a total of 24 participants.

The aim of this year's event was once again an intensive exchange of experiences. JEN also presented its dismantling projects and its plant. This year, the focus was on the workshop to identify common interests and challenges. To this end, a "decommissioning timeline" with current site issues was developed.

Radioactive residues play an important role in the dismantling of nuclear power plants. In accordance with legal requirements, such residual materials have to be recycled without causing harm, i.e. returned to the materials cycle or disposed of in an organised manner. While handling of these materials is theoretically regulated by a series of principles and requirements, in practice the conditions for these radioactive residues and waste materials are repeatedly more difficult, which leads to considerable cost increases.

For example, despite existing acceptance obligations for the disposal of conventional residual materials in landfills, there are major acceptance problems and in many federal states, the approval process is repeatedly hampered by delayed or halted process steps under the responsibility of the authorities and experts.

The increasing sensitivity to conventional pollutants such as asbestos or PCBs also has an aggravating effect on dismantling work.



Another problem is the loss of expertise in the industry. The German phase-out of nuclear energy has made it more difficult to recruit employees. Whilst experienced personnel with know-how are gradually retiring, positions often cannot be filled with qualified successors. This loss of quality is often associated with delays in planning and difficulties in execution.

The plant managers also discussed further topics in depth. The need to share experiences is very high and the plants are in very different phases of decommissioning and dismantling, so an exciting workshop for plant managers will be held again next year.

Common challenges were quickly identified.

New nuclear regulations

With the end of nuclear power plant operation in Germany, the requirements for nuclear regulations are also changing.

Against this backdrop, the responsible Nuclear Safety Standards Committee (KTA) decided in November 2019 to review all required KTA regulations in 2022 for the need for alteration and, if necessary, to revise them until all decommissioned nuclear power plants are expected to be fuel-free in 2027.

The responsible State Committee for Nuclear Energy (LAA) has presented a concept for the transfer of the KTA regulations, which will still be required after 2027, into a new set of regulations, which essentially regulates the responsibilities and decision-making procedures. In addition, the involvement of operators in the development of the regulations, which are to be developed within individual specialised working groups, is already planned. The final draft resolution will be prepared by a federal-state working group. A coordinating body at the Federal Office for the Safety of Nuclear Waste Management (BASE) also exists.

German operators have already agreed to participate in the drafting of new regulations, as experience has shown that the benefits of a practicable set of regulations outweigh the use of human resources during the drafting process.

A first step in this direction was the preparation of a concept paper "Proposals for the development of the new nuclear rules and regulations for decommissioning", in which operators advocate utilising their nuclear expertise in the same way as for the regulatory work in the preparation of KTA rules to create a practical set of rules.

With a kick-off event on the KTA successor regulations on November 3, 2023, the authorities have shown themselves to be open to the industry's proposals and will announce further details shortly. It is expected that two technical working groups will be convened soon to begin drafting the nuclear rule(s) based on the KTA rule(s) in the form of two pilot projects.

Probably there will be another working group to deal with overarching issues, such as possible cut-off criteria for the transition to the conventional regulatory framework. It will therefore soon become clear to what extent operators will actually be involved in the process.

More than 20,000 reports in around 40 years – “Central Reporting and Evaluation Centre” (ZMA)

The ZMA was set up in 1984 at the request of German nuclear power plant operators as a hub for information flows at vgbe.

Since then, all incidents that are relevant to safety, essential for availability or of public interest have been reported to the ZMA by vgbe member companies.

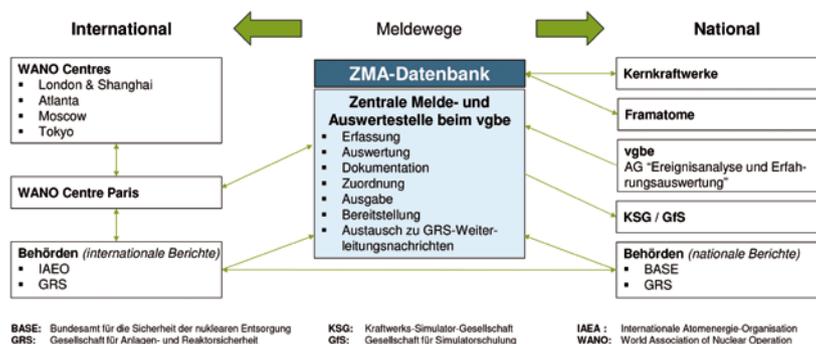
The incidents are evaluated, analysed and assessed by the vgbe Working Group “Incident Analysis” and suggestions for improvement are developed to ensure and improve plant safety. In addition, the incident reports are analysed in detail by Framatome (formerly Areva or Siemens/KWU) as plant manufacturer within the scope of an evaluation contract.

In addition to the operator reports, the ZMA regularly checks the information and incident reports provided nationally and internationally for their relevance to those nuclear power plants connected to the ZMA. For example, the ZMA is the central liaison office for German nuclear power plant operators with the World Association of Nuclear Operators (WANO) and the German authorities.

All incidents and analyses of experience are included in the ZMA database along with a wide range of additional information.

In around 40 years and with over 20,000 reports, the ZMA database has contributed to the continuous improvement of plant safety and availability. With the shutdown of the last German nuclear power plants in 2023, the requirements for the ZMA have also changed. In addition to the cancellation of the WANO membership of the German nuclear power plant operators, the evaluation contract with Framatome, which has been in place for over 30 years, also expired at the end of 2023. From 2024, the ZMA will then be adapted to the requirements of decommissioned plants that are being dismantled.

ZMA – Central Reporting and Evaluation Centre (ZMA) of NPP



A photograph of a laboratory setting. A hand in a white glove holds a glass flask containing a yellow liquid. In the background, another flask is visible. The image is overlaid with a blue grid pattern.

vgbe TECHNICAL SERVICES

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and power plant expertise – 1,291 times on duty

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- / Inhibition

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- / Technical consulting with a long tradition and a large network of experts

Seminars

- / Recognising damage mechanisms use strategies – avoid damage

vgbe engineering consultancy

Support on repair and root cause analysis of a steam turbine rotor

A 500 MW CCGT plant, which was commissioned in 2021, experienced increasing vibrations on the turbine ND rotor over the course of the operating period when passing through the critical speed. Around nine months after commercial commissioning, the turbine could no longer be started up due to excessive vibrations. vgbe was commissioned to assist with repair and supported the necessary root cause analysis.

Measures at the manufacturing plant

A previous vibration measurement carried out by the manufacturer indicated out-of-roundness of the rotor as the cause of the vibrations. In the first quarter of 2023, the turbine rotor was dismantled and sent to the manufacturer's factory for investigation and repair.

The visual inspection revealed defective labyrinths at stages 1 to 9 of the rotor and the stator blade carrier as well as severe rubbing marks at the blades' labyrinths. The integrity of the rotor material was confirmed by hardness and replica testing. A crack in the welded joint of the rotor parts was ruled out by ultrasonic testing.

To rule out cracks in the blade feet or the grooves as cause of the vibrations, stages 1 to 9 were dismantled and the grooves were checked for cracks. Roundness testing confirmed rotor bending. The maximum out-of-roundness of the rotor was approx. 9 times above the permitted set value.

Elimination of the out-of-roundness

The out-of-roundness was to be relieved by thermal treatment in order to reduce possible residual stresses. The subsequent roundness test did not show noteworthy changes of the measured values.

The roundness was initially improved by deliberate heating of the rotor. However, further heating cycles did not result in any further improvement; the rotor was still not in the tolerable roundness range.

Mathematical tests confirmed that the rotor could be balanced despite the existing bend. It was decided to recommission the bent rotor for the heating period 2023/24 and to install a newly manufactured rotor in spring 2024.

vgbe expert supports root cause analysis

The fundamental improvement of plant operation is among vgbe's core topics. "Lessons learned" and the resulting optimisations are an essential part of the synergies between vgbe Technical Services and the association.

This failure was also subjected to root cause analysis. It was established that the maximum rotor bend was precisely around an extraction line. Analysis of the operating data showed that there were various problems with the drainage of this pipe.

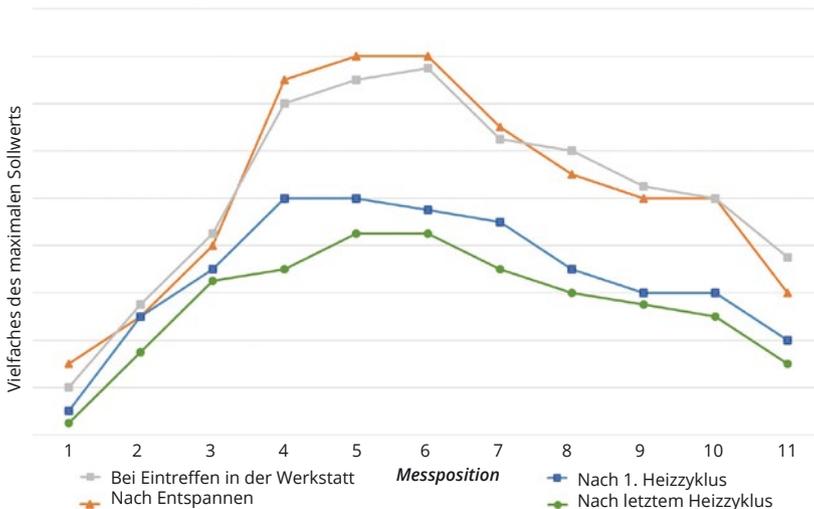
It had to be assumed that the damage had already occurred during first start-up of the turbine due to the design of the drainage system, the length of the pipe up to the non-return valves and problems upon commissioning of dewatering.

During turbine shutdown, negative pressure was created in the steam chamber of the turbine, which drew any condensate from the extraction line back into the turbine.

Temperature sensors were positioned in the guide vane carriers and it was confirmed that repeated serious temperature drops, caused by the wetting of the hot component with cold condensate, had occurred. These "water hammers" resulted in increased rotor bending. The extraction line and drainage were modified before the turbine was recommissioned. Further measures were taken (e.g. adaptation of the start-up ramp, additional mobile vibration monitoring) to enable operation of the bent rotor.

By the time these Highlights were finalised, the rotor was successfully in operation.

Runout measurements



Runout measurements of the dismantled rotor at the manufacturer's site revealed out-of-roundness, which was approx. 9 times above the permitted set value.





vgbe pulse – Digital energy know-how from experts for experts

“pulse” – 5 letters stand for an extensive document database that pools vgbe’s knowledge for the industry and makes it digitally available.

“vgbe pulse” – behind this inconspicuous abbreviation lies a document database that currently contains around 750 publications with the complete set of vgbe energy rules and regulations and the “vgbe energy journal”.

Document databases provide a central platform for organising, storing and searching for important documents. By categorising and indexing documents, they enable fast and efficient access to all relevant information. This optimises access to a wide range of publications, data and even technical drawings, which increases productivity and efficiency and reduces or avoids errors.

► pulse.vgbe.energy

Since 2017, the **vgbe pulse – publication library service document** database has offered ordinary members, plant operators or plant owners, online access to vgbe rules. Around 450 publications, i.e. standards, guidelines, information sheets and technical-scientific reports, can be accessed and provide 46,000 pages of expert knowledge.

The addition of the “vgbe energy journal” in 2023 supplies further expertise and up-to-date information. At present, all issues of the renowned trade journal are included going back to the year 2000. In the long term, further expansion of this database section is planned to include digitised issues from 1950 onwards.

vgbe pulse offers all the usual tools of a modern online document database, including:

- Search function for all documents including their content
- Online view of the documents in the browser
- “Memory function” of documents and pages for later retrieval
- “Bookmark” function and sharing as link
- Download documents as PDF files

► pulse.vgbe.energy/public/

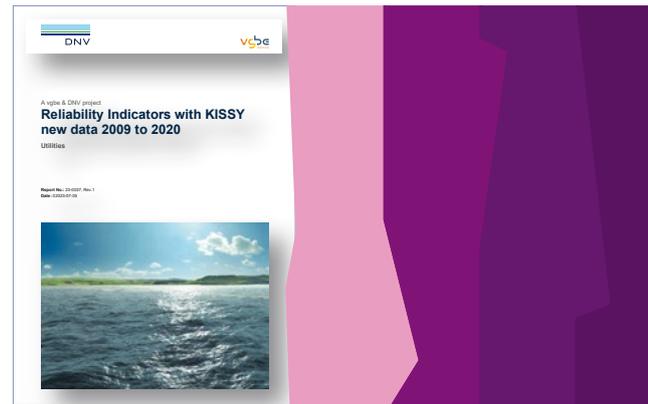
In 2023, **vgbe pulse** was expanded to include a public download area. Here, vgbe offers freely available publications, such as the free vgbe Standards of the “002” series, which also includes important explanations, definitions and notes on terms, key figures and data in the energy industry and technology for daily practice with reference to the “KISSY” power plant availability database. It also contains information, positions, data and statistics from the association’s work.

vgbe pulse – the online data base of vgbe

Screenshot



A DNV and vgbe project: Reliability Indicators with KISSY new data 2009 to 2020



1,167 pages for plant optimisation

vgbe pulse also contains the technical publication “Reliability indicators with KISSY new data 2009 to 2020” by Henk Cornelis Wels, published in 2023. With 1,167 pages, this is certainly one of the association’s largest publications ever. Using availability data, reliability indicators and unavailability events, the work provides information and results to optimise plant reliability and availability, the planning of capacity expansions, optimal redundancies, maintenance, spare parts management, etc.

**A DNV and vgbe project:
Reliability Indicators with KISSY new data 2009 to 2020**
Hendrik Cornelis Wels[†] (lead author), 1,167 pages, approx. 1,000 figures, 750 tables, English, e-book (PDF), Arnhem, The Netherlands/Essen, Germany, vgbe energy service GmbH, Essen, 2023, ISBN: 978-3-96284-331-1

Figures

vgbe 2023 in figures: In addition to the highlights presented, a multitude of activities, offers and campaigns were arranged in 2023 for our member companies and for the industry.

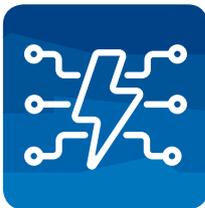


418 members in 33 countries

311 members from Germany
107 members from another 32 countries

State: December 31, 2023

246 ordinary members (operators)
144 sponsoring members
28 affiliated members
 (universities, authorities, associations)



Installed capacity

296 Gigawatt electrical
50 Gigawatt thermal



140 committees

300 meetings
more than 2,500 experts
 online and in presence



The association's trade journal is one of the leading international trade journals providing information on the generation and storage of electricity, heat, hydrogen and energy carriers based on it, as well as sector coupling.



36 publications

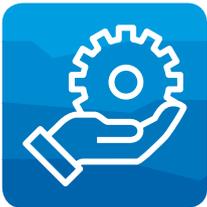
20 vgbe/VGB-Standards
5 Reports

11 issues of the trade journal
vgbe energy journal



21 vgbe events

1,722 participants from 32 countries
2 events online
8 technical exhibitions
108 exhibitors



1,291 orders, analyses and reviews

1,080 oil analyses¹
157 in materials laboratory and water chemical examinations
22 in the field of supervision of construction and assembly

21 engineering consultancy
11 inhibitions of turbine oils, i.e. preparation of oils through additives which avoided oil changes and saved 230,000 litres of turbine oil.

¹ lubrication oil: 625 · engine oil: 50 · fuels/fuel oil: 70 · insulation oil: 335

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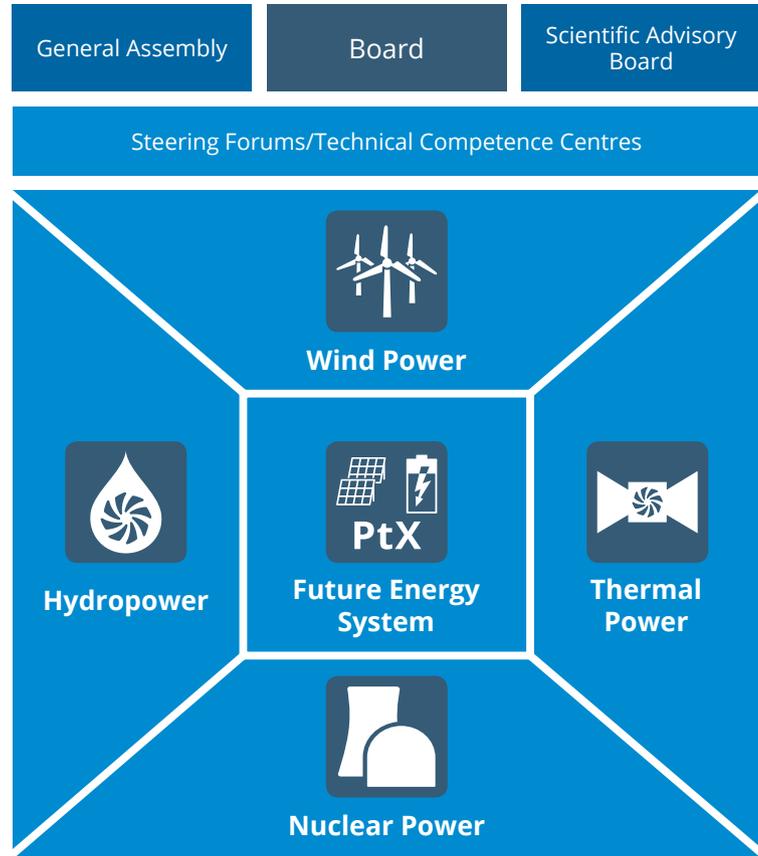
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The Steering Forums (SF) are the highest authority of the five Technical Competence Centres. They advise the vgbe Board on all issues relating to electricity and heat generation as well as energy storage and sector coupling and provide strategic orientation and additional suggestions for vgbe's range of activities.





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- Metroscope SAS,
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- SKL Engineering GmbH,
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vgbe energy welcomes its
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association in 2023.

vgbe members

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- EDP Gestao da Producao de Energia
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- EEW Energy from Waste GmbH,
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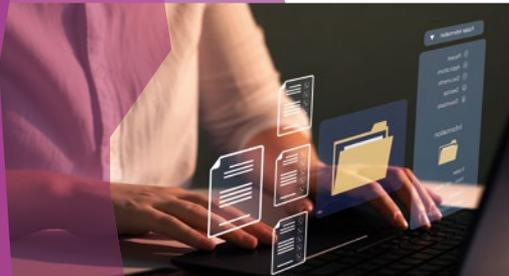
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