

Environment and Energy in Bavaria

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Editorial

For a sustainable and liveable environment

This topic has been in society's focus like no other.

Undeniably, climate change is the biggest global challenge and it is continuously increasing in importance.

Reconciling ecology and economy requires new ideas and technologies to ensure a climate-proof future.

We provide a thorough briefing on the ambitions and reality as well as climate policy goals:

- Who offers environmental expertise at the highest level?
- What role does the world's leading trade fair IFAT play in global climate protection?
- How can climate-friendly hydrogen be stored and transported?
- To what extent is global sustainable water management possible?
- Which mitigation and adaptation strategies can be used for society, land use, ecosystem services and biodiversity?
- How can the condition of forests be visualized?
- What danger does unchecked global warming pose for peace and prosperity?

- Who supports research and innovation processes in the field of environment and energy?

„Environmental technology and energy in Bavaria“ focuses on sustainable quality of life.

Walter Fürst, Managing Director

This publication can also be found on the internet at www.media-mind.info

Masthead:

Publisher:	media mind GmbH & Co. KG Hans-Bunte-Str. 5 80992 Munich/Germany Phone: +49 (0) 89 23 55 57-3 Telefax: +49 (0) 89 23 55 57-47 E-mail: mail@media-mind.info www.media-mind.info
Managing director:	Walter Fürst, Jürgen Bauernschmitt
Design + DTP:	Jürgen Bauernschmitt
Prepress:	media mind, München
Responsible editor:	Ilse Schallwegg
Printed by:	No print, www.media-mind.info
Published annually:	1 x annually

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Greetings



One accomplishment achieved by the “Fridays-for-Future” movement is that climate protection and energy transition now rank at the top of the political agenda. There is indeed a great need to act, not only in the light of the negative impact greenhouse gases have on planet Earth, but also with regard to the global consumption of natural resources – two topics that are inseparably linked with each other. At present, we are using up nature 1.75 times faster than eco-systems are able to regenerate. This cannot go on. The fact remains that the world’s resources are finite and the demand for raw materials continues unabated. Over the past forty years alone, the global use of resources has more than tripled, from 22 billion tons to an annual consumption of some 70 billion tons. The efficient use of resources is therefore crucial for the future and, for companies, it is far more than just an end in itself: on the one hand more and more customers are looking for manufacturing pro-

cesses with a low consumption of natural resources. On the other hand, resource-efficient production methods are increasingly seen as a switch to a future without bottlenecks and one that also pays off financially. For manufacturing companies, material costs now represent on average approximately 43 per cent of the total expenditure. Personnel costs account for about half as much, and energy costs represent a share that is even significantly lower. Companies operating with resource-efficient processes therefore have a decisive competitive edge. Bavaria benefits particularly from an efficient use of resources. When it comes to metals and industrial minerals we are almost exclusively dependent on imports, and for this reason we need to push ahead with decoupling resource consumption from economic growth. In the past 25 years we have managed to boost raw materials productivity – this being the ratio of gross domestic product to the use of raw materials – to

almost 71 per cent. In comparison, the German nationwide average over the same period was just 55 per cent. A significant contribution to this success comes from the Bavarian environmental industry. Accounting for approximately 4.7 per cent of the working population in Bavaria and with sales of over 51 billion Euros, this is one of Bavaria’s key industries. We want to live up to Bavaria’s pioneering role in this sector and press ahead with the smart handling of raw materials in a proactive partnership between the public sector and industry. IFAT, as the world’s leading trade fair for water, sewage, waste and raw materials management, is an important partner in pursuing this goal. We are delighted that Bavaria is the fixed venue for the IFAT. This is Germany’s number one location for the environmental sector. My sincere thanks go to Messe München GmbH and to all organisers and supporters!

Thorsten Glauber, MdL
Bavarian State Minister of the
Environment and Consumer Protection



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**Sharing our passion for
energy and service**

MVV Industriepark Gersthofen GmbH manages Industriepark Gersthofen (Gersthofen Industrial Park), which is currently occupied by ten companies with a total workforce of around 1,200 people. The core competencies of MVV include the supply of energy and utilities, services connected with the site infrastructure and security/environmental management.



Economic and ecological factors go hand in hand in Gersthofen: by using refuse-derived fuels (RDFs) as a source of energy for a high-efficiency power plant, MVV reduces CO₂ emissions and therefore makes a significant contribution to environmental protection and, consequently, to sustainable waste management in Bavaria.

MVV Industriepark Gersthofen GmbH is a subsidiary of the MVV Group, which is a listed company headquartered in Mannheim.

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The Landkreis Augsburg bets on Solar Power

The future of the industrial sector in Swabia looks bright – literally! The total number of hours of sunshine in the region is much higher than the national average, making it the perfect place for solar energy. Rising energy prices from external providers interfere with effective cost planning and cost management, which can weaken a company's ability to stay strong in a competitive market. A solar energy system can help by providing cost stability for the next 25 years with prices averaging between 6 to 9 cents per kilowatt-hour (depending on size and situation).

The key to the profitability of solar power no longer lies in feeding the produced energy into a larger grid but in the internal use right on site. Due to the high usage of energy during daytime hours in the industrial sector, 90 percent of all industrial buildings in Germany are suitable or very suitable for the installation of individual solar power systems.

The investment can start paying off in well under ten years. The Landratsamt Augsburg recognized this opportunity and installed solar panels on the roof of the administrative building. 92 percent of the energy produced is used directly on site, which is good for the environment as well as the finances.

You are interested and motivated but still have some questions about solar energy and solar panels? Take advantage of the consultation services offered by the Landratsamt Augsburg. Independent experts provide guidance, tips and tricks to get you started on your own solar powered journey.



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For years, the district of Dillingen an der Donau has been working towards consistently implementing the energy transition. It is regarded as a pioneer throughout Bavaria and plays a lead role in many sectors. The motivation for this was and is based on the objective of making a sustainable contribution to climate and environmental protection, securing natural resources and creating value for the region, in the region. Based on a future-oriented cooperation of regional actors geared towards the challenges of climate change, a secure, environmentally friendly and affordable energy supply should be guaranteed for residents in the district of Dillingen. For example, the district of Dillingen an der Donau's participation in the European Energy Award in the past years has triggered numerous projects and gave impetus to the regional energy transition. In particular, the district's solar campaign on „Photovoltaics and electricity storage“, which was conducted in close cooperation between the district, the municipalities and the regional energy suppliers last year, was a complete success. With more than 600 visitors attending a total of five lecture events that were offered, the solar campaign attracted a lot of attention far beyond the district boundaries.

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How smartly can we live nowadays?

Affordable living for all – erdgas schwaben's concept model!

Where can families still find affordable accommodation in an environment worth living in nowadays?

Equivalent living and working conditions are the challenges for which we now need to find solutions. In pursuit of efficient concepts for attractive living spaces which are climate and environmentally friendly, erdgas schwaben can support different proposals independently. This starts during planning and continues through to the infrastructure's completion. The following examples represent a small selection and clearly illustrate the scope within which proposals can profit from this collaboration. ■

Langweid Village – an entire housing estate heated using a fuel cell

In Langweid near Augsburg, erdgas schwaben, together with M. Dumberger and Viessmann, fully equipped Germany's first housing estate with fuel cells – a total of 30 semi-detached and terraced houses. The fuel cell creates quite an impression with its low heating costs and minimal CO₂ emissions due to its low energy consumption and exceptionally efficient technology. For Langweid's second mayor, Christian Herfert, the project proves that "everyone can do their bit for the energy revolution." ■



Standing up for continuously affordable housing:

Dr. Hans Reichhart, Bavarian Minister of the Interior, for Building and Transport and Helmut Kaumeier, erdgas schwaben Regional Customer Services (from left to right). ■

Hülläcker Park, Oberhausen – a tailor-made accommodation concept

erdgas schwaben has fully developed a housing estate and developed a sustainable energy strategy for its accommodation. In Hülläcker Park, a local heat network with a highly efficient, combined heat and power plant powered by natural gas supplies just under 60 residential units located in blocks of flats and terraced houses with climate and environmentally friendly energy. Anything can be achieved in the single family houses using natural gas: from a house which complies with the Energy Conservation Directive (EnEV

standard) to a KfW Efficiency House 40+ with a fuel cell. Photovoltaic units with storage batteries are offered and electromobility is integrated from the start. The electric vehicle charging station in the new housing estate supplies 100 percent hydroelectric energy. Mayor, Fridolin Gößl: "I am very pleased that I, as mayor, have been able to offer my community something so great. The high level of demand has shown me that we have managed to fulfil young families' needs." ■

More autonomy due to self-sustaining estates – erdgas schwaben can help with creating this.

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"Birth certificates" for hydrogen

Hydrogen can be used for storing and transporting energy. It can be produced not only in the conventional manner, but also by using green power and renewable raw materials. TÜV SÜD informs about guarantees of origin which can be used for identifying climate-friendly hydrogen in the market.

This year an EU-wide system was established for tracking "sustainable" hydrogen in a registry. The system refers to hydrogen (H₂) produced with the help of energy from renewable sources. This characteristic cannot be taken for granted; fossil resources are sometimes used in hydrogen production by steam reforming or partial oxidation, for example. Hydrogen produced in electrolyzers operated with conventional electricity likewise has a unfavorable carbon footprint.

By contrast, the use of green power supports climate-friendly and resource-saving hydrogen production. The same can be said for some types of hydrogen production based on biomethane reforming. Clients, purchasers and consumers who opt for green hydrogen make an active contribution to the mitigation of climate change because green hydrogen replaces an equivalent amount of conventionally produced hydrogen in the market. ■

Greater transparency in the market

In the past it was impossible to distinguish between green hydrogen and conventional hydrogen sold on the market. There was no standard recognised throughout the EU that enabled independent third parties to assess and certify carbon-neutral hydrogen production and the volume produced. The CertifHy consortium now ensures greater transparency.

Environmental know-how adds value

Sustainable management must be worthwhile for people, the environment and companies. TÜV SÜD's third-party experts offer support in all issues related to environmental law and engineering – from planning, implementation and operation to decommissioning and disposal. Their services include assessment of environmental impacts, safety in use and technical feasibility of technical plants, construction projects and infrastructure, but also measurement of pollutants and certification of climate-change actions.

More information about the services provided by TÜV SÜD can be found at www.tuev-sued.de/is/en

Consortium members include the experts from TÜV SÜD Industrie Service and stakeholders from the hydrogen industry. Over recent years CertifHy has both developed and successfully tested guarantees of origin, which now bring transparency and traceability throughout the hydrogen trade from the producer to the trader and consumer.

Companies producing hydrogen can now opt to be audited by TÜV SÜD. The technical services organisation has provided green hydrogen certification according to its in-house GreenHydrogen standard since 2011, and now also offers certification according to the CertifHy standard. Following a successful audit including verified measurements, TÜV SÜD certifies that greenhouse gas emissions have been

reduced by a defined percentage compared to the conventional production of hydrogen.

The CertifHy scheme enters the volume of renewable or climate-friendly hydrogen in a central registry. If, for example, a refuelling station buys one tonne of green hydrogen, an equivalent amount of guarantees of origin will be cancelled in the registry. Similarly to green power, the disclosure and trade of green hydrogen is based on an accounting system. ■

Outlook

At present, the consortium is working on further improvement of the CertifHy standard to harmonise it at EU level and throughout all EU Member States, thus setting the course for cross-border trading of green hydrogen. ■

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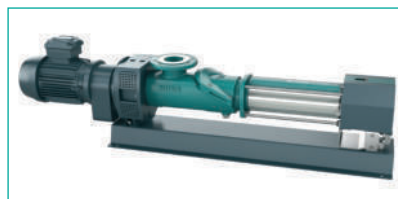
High customer benefit through modular full-service-in-place design from NETZSCH:

Stator adjustment system xLC® permits step-by-step adaptation and extends service life of PCP pumps by three times

With the xLC® system of the NEMO® progressing cavity pump, NETZSCH successfully takes account to further increase customer benefit. The result is a tripling of the original service life, especially when pumping difficult and abrasive media. When wear occurs in the rotor-stator system, the xLC® module allows the performance of the pump to be re-established by adjusting the preload in the rotor-stator system. ■

Adjustment rather than replacement

It is important for the xLC® stator adjustment system that the elastomer can move axially in the rigid metal sleeve of the stator, which was made possible with the development of the proven iFD stator® 2.0. The xLC® adjustment system uses its characteristic that the elastomer is not vulcanised into a tube but rather fixed in its housing



The xLC® unit presses an axially mounted sleeve in the direction of the elastomer core, compressing it in the housing. This increases the preload and re-establishes the sealing line. ■



A scale with seven defined stop points facilitates gradual adjustment of the stator with only two setting screws. ■

through axial pressing. To regulate the preload in the rotor-stator system, the elastomer is extended by pulling or shortened by pressing, which changes the preload between the pumping elements. In case of wear, compressing the elastomer increases the preload and re-establishes the reduced sealing line. How it works: If the stator has to be adjusted due to declining performance of the pump, the setting nuts of the system are adjusted, compressing the elastomer insert in the metal housing once again. A scale with seven defined stop points facilitates gradual adjustment of the stator with only two setting screws while also showing the remaining potential until stator change. ■

Environmentally friendly and easy to operate

The iFD stator® 2.0 is also very efficient when it comes to re-sources. The stator housing can be used throughout the service life of

the pump with a new elastomer insert, which can be replaced in a matter of minutes. After opening the stator housing, the elastomer insert can simply be pulled off the rotor. This makes maintenance even easier and allows separate, environmentally friendly disposal of the elastomer, which is not possible with conventional stators. ■

What's behind the FSIP® design?

Thanks to the FSIP® concept, all wetted, rotating parts of the pump are immediately accessible without disassembling of pipes or drives. The central inspection opening provides quick and easy access into the pump chamber from the gasket to the flange. Step by step, the traditional NEMO® pump can be converted into the maintenance-friendly and resource-saving FSIP® concept and the xLC® module also fits into the existing footprint.

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Munich: the cradle of environmental technologies



Munich is considered Germany's leading technological base. Every two years, when IFAT—the world's largest trade fair for environmental technologies—takes place at the exhibition center, the Bavarian state capital turns into the hot spot for technologies that could provide the answers to today's major environmental challenges.

It began in 1966 as a modest conference with an accompanying exhibition exclusively for the sewage industry and attracted 147 exhibitors and 10,000 visitors. Today, IFAT is the world's leading trade fair for the entire environmental sector: in 2018, a good 3,300 exhibitors from almost 60 countries and more than 140,000 visitors took part.

The goal: a world without waste

Today, in addition to all areas of modern water management, IFAT covers the segments of waste and raw materials management. The big goal behind it: a world without waste, in which used resources are recycled and remain in the cycle. This does not only apply to solid waste, but also to production water and sewage, for example. And thanks to modern treatment technology these can already be turned into water of drinking water quality.



Technologies for the entire water industry at IFAT in Munich. ■



Messe München has one of the world's largest photovoltaic roof systems. ■

From Munich into the world

Drinking treated sewage? This can save lives in countries with acute water shortages, such as South Africa or India. This is precisely why Messe München exported a total of seven subsidiary shows following the IFAT example—to China, India, Turkey and South Africa. While the subsidiary fairs are dedicated to the country-specific environmental challenges, IFAT Munich remains the global innovation hub.

Sustainability through environmental technologies

When, for example, microplastics became a subject of public debate two years ago, exhibitors at IFAT 2018 already had the first technological solutions ready, such as special filters or membranes. And the environmental technology companies also offer advance-

ments in the field of „Sustainable cities and communities“ which contribute to the reduction of emissions.

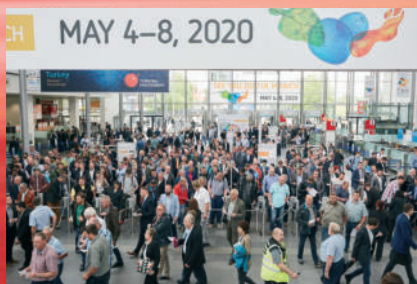
One of the great environmental challenges of our time is the increasing number of extreme weather events, such as heavy rainfall, heat waves or droughts. Here, the IFAT exhibitors are also developing suitable techniques such as the intelligent control of sewer systems – for infiltration or retention of rainwater – as well as technologies for the entire water industry.

Hence, one thing is clear with all the challenges that climate change poses: the right solutions, whether for municipalities or industries, are readily available in Munich—on an area of 270,000 square meters. Next time from May 4 to 8, 2020.

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“Environmental technology is the answer to the great challenges of our time”

IFAT, the World's Leading Trade Fair for Water, Sewage, Waste and Raw Materials Management, takes place in Munich every two years. In the interview, Managing Director Stefan Rummel talks about how the Munich trade fair company implements sustainability practices and what role IFAT technologies play in global climate protection.

Mr. Rummel, the exhibition center in Munich is regarded as a „green“ pioneer in the trade fair industry. In what way?

When the new exhibition center was constructed 20 years ago, we already had sustainability in mind. We installed one of the world's largest photovoltaic roof systems that helps us avoid emitting around 1,600 tons of carbon dioxide per year. Our newly built exhibition halls are heat-ed exclusively by district heating from geothermal energy. And we have a sophisticated rainwater infiltration system that relieves the load on the sewer system in the event of rain-to name but a few technical examples. Yet we are still a long way from reaching our goal.

Your portfolio also includes IFAT, the leading trade fair for environmental technologies. Who is IFAT aimed at?

IFAT is aimed at those who are looking for solutions for the sustainable management of raw materials and who want to find out more about the possibilities of recycling. In addition to representatives from a wide range of industries such as the construction, chemicals pharmaceutical and plastics industries, these



Stefan Rummel, Managing Director of Messe München: „Those who want to remain competitive in the long term, have to rely on environmental technologies.” ■

include above all local authorities that need sustainable solutions for their towns and villages.

How many exhibitors do you expect?

We cannot give an exact number yet, but we expect around 3,300 exhibitors.

More and more cities declare a climate emergency. What role do technologies play in climate protection?

If we are to meet the massive challenges facing our planet without permanently slowing down

economic development, one thing is absolutely essential: technology. Just think of the many possibilities for industrial exhaust gas cleaning and air pollution control. In the future, we will see even greater technological leaps, which will not only contribute to progress in climate protection, but also to economic power and jobs.

How many IFAT fairs are there around the globe?

Eight. In addition to IFAT in Munich, there are three trade fairs in China, two in India, one in Turkey and one in South Africa.

The next IFAT in Munich will take place from May 4 to 8, 2020.

Thank you very much for the interview, Mr. Rummel!

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From the lab to the midst of society – EU funding for research and innovation in the area of environment and energy



The image of scientists sitting in dusty libraries or labs and pondering on questions hardly tangible for the general public is outdated and no longer representative of the reality of knowledge production. Globalisation and transformation processes require solution-oriented collaboration between diverse societal actors. Given these global challenges, research and innovation processes no longer take place in a disciplinary and nationally-isolated vacuum.

While climate change is increasingly perceived as the main challenge of our future throughout various social groups, the importance of environmental and energy research with a focus on climate change mitigation and adaptation is equally on the rise. These research areas pursue targeted, cross-border cooperation between countries, disciplines and sectors. They aim to deliver substantial solutions to existing challenges and, at the same time, contribute towards the sustainable and livable development of the future.

The European Union demands and fosters this very approach through its research and innovation programmes. One of these programmes is Horizon 2020, the worldwide largest funding programme for research and innovation. In Horizon 2020, scientists along with numerous

other societal stakeholders are encouraged to cooperate across borders to produce innovative, creative, and future-oriented solutions. Scientists from universities and research institutions work together in interdisciplinary and application-oriented EU projects with colleagues from industry, local communities, and public authorities. Due to cross-border cooperation, the participants benefit from the knowledge and the research culture of partnering countries and increase their international visibility by competing for the best solutions. The European Commission embeds a large part of its Horizon 2020-funding topics in multi-annual work programmes that enable a clear orientation towards research policy. In top-down calls for proposals, Brussels defines which specific EU research projects are eligible for funding. Applicants have to submit an exactly fitting proposal that ideally meets the expectations of the European Commission. However, Brussels also offers funding for bottom up research proposals, where applicants can introduce in pre-defined funding instruments, their own ideas e.g. for individual or mobility grants, or for doctorate networks.

Cooperation in European research projects is by no means limited to Europe. According to the EU Commission's „Open to the

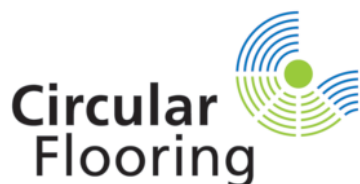
World“ strategy, the integration of non-European partners in EU projects is explicitly desired to expand the global perspective of the European Research Area. In doing so Europe benefits both in research policy and economic terms, through positioning its researchers in joint projects, joint international publications, the transfer of knowledge, and the long-term supply of European products within global markets.

In the third pillar of Horizon 2020, seven societal challenges are defined, of which two specifically focus on environmental and energy research. In the area of environmental research there are frequent calls for proposals on the following topics: Water, climate, natural resources, raw materials, circular economy, eco-innovations, marine research, cultural heritage, and environmental information. In energy research Horizon 2020 emphasises the following objectives and research areas: reduction of energy consumption and carbon footprint, low-cost, low-carbon electricity supply, alternative fuels and mobile energy sources, renewable energies, energy efficiency, market uptake of energy and ICT innovation, robust decision making and public engagement, and a single, smart European power grid. Through research and development of new technologies, EU-financed research and



Post-consumer PVC Floor coverings are shredded before entering the CreaSolv® recycling process. Copyright: Arbeitsgemeinschaft PVC Bodenbelag Recycling ■

innovation projects make an important contribution towards a carbon-free and climate-resistant future, and thus to the implementation of the Paris Climate Agreement and an economy in accordance to the Sustainable Development Goals (SDGs) of the United Nations.



In transition towards a circular economy with an efficient use of resources, the results of EU research and innovation projects are integrated in sustainable business models and innovative products. One example is the EU-project Circular Flooring, which is being funded by Horizon 2020 as part of the societal challenge “Climate action, environment, resource efficiency and raw materials”.

Although the recycling rates for plastics have increased, at present only 12% of plastics return to the European economy. This illustrates the great potential for innovative and sustainable recycling technologies. In the Circular Flooring project, research institutions, universities, industry and trade associations from Germany, France, Austria, Belgium and

Greece make up the eleven European partners who are working on an innovative recycling process for PVC floor coverings. Such floor coverings often contain legacy plasticisers that may no longer be used. As a result, they cannot be included in conventional recycling programmes. The possible solution for reuse of this waste material is the solvent-based CreaSolv® recycling process. Under the coordination of the Fraunhofer Institute for Process Engineering and Packaging (IVV), the project consortium will further develop this recycling process that allows the removal and safe destruction of legacy substances. At the same time, a high-grade PVC recyclate is obtained that meets EU legislation standards and satisfies manufacturers of floor coverings. The physical and chemical properties of the recycled PVC are comparable to that of virgin material, therefore it is possible to retain valuable resources in the business cycle. Circular Flooring will thus contribute to the European package of measures for a circular economy and sustainable economic growth in the long term.

Horizon 2020 also funds research and innovation projects that work towards the “realisation of a secure, clean and efficient energy system”.



EASY-RES

EASY-RES is a Horizon 2020 research project funded by the EU. Eleven partners from Germany, Spain, Great Britain, Greece, Slovenia and the Netherlands are working together to facilitate grid services for renewable energy sources. The aim of the project is the safe operation of the European grid powered by a high percentage (of up to 100%) of renewable energy sources. Because of the discontinuation of conventional generators which produce electricity through synchronous alternators, fluctuations in voltage and frequency are increasingly experienced. This largely affects the quality of electricity and can result in system malfunctions. EASY-RES is developing new system services that are generated by renewable energy sources in combination with inverters and batteries, and lead to a stabilisation of the network. One focus is the creation of a digital infrastructure that facilitates the coordination and monitoring of the increasing number of diverse systems, and that makes their data accessible to network operators. The EASY-RES vision is “100% renewable. 100% secure”.

The Aristotle University of Thessaloniki is coordinating the project in which six universities and five partners from the industry are developing novel solutions to make the use of 100% of renewable energy possible in Europe within a time frame of just 3.5 years. Bavarian participants in this project are Hassfurt Utility Company, Landau Utility Company, Fenecon, the University of Passau and Zentrum Digitalisierung.Bayern (ZD.B).



EASY-RES project meeting at the Universidad de Sevilla. Copyright: © EASY-RES ■

Another EU funding instrument are so-called Innovative Training Networks (ITNs).



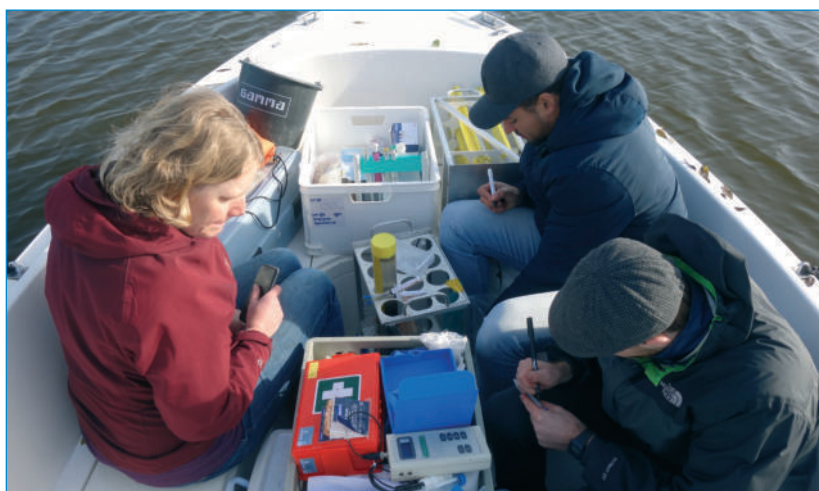
In P-TRAP, a Horizon 2020-ITN project under Marie Skłodowska-Curie (MSCA), methods are being developed to prevent phosphates in intensively-farmed lands from flowing into watercourses and lakes, and to reclaim the phosphates. Currently, the washout of phosphates from agricultural lands into drainage canals constitutes a waste of important soil resources. At the same time, the increasing phosphorous load in water bodies is one of the primary causes of their nutrient oversaturation (eutrophication), resulting in a significant increase in plant growth in the waters and by this a reduction in oxygen content due to increased degradation processes. The aim of P-TRAP is to contain the uncontrolled loss of phosphorous from intensively-farmed lands and thus reduce the nutrient contamination of water

bodies. In this manner, the project will make an important contribution towards the implementation of the EU's Water Framework Directive to improve water quality.

The P-TRAP consortium consists of 17 European universities, research institutions and industry partners, for whom EU funds finance a total of eleven doctoral candidates. With the aid of an ITN, a new generation of creative, entrepreneurially thinking and innovative researchers is being trained. This is achieved through cooperation between industry and academia, in which the doctoral students in the P-TRAP network become acquaint-

ted with diverse research and work cultures, both at home and abroad. In addition, interdisciplinary training in the areas of intercultural communication, funding procurement, raising of awareness for gender-specific and social aspects etc., prepares them for the job market of the future.

When applying for European funds, applicants generally have some challenges to address. First, they must sort out whether they wish to work alone, in small consortia, or in larger internationally-oriented networks. In other words, applicants must match their own strengths with institutional requirements to select the right funding instrument. In addition, they must verify whether their research networks (universities, research institutions, industry, local communities, public authorities etc.) in their home country as well as abroad are suitable to write a competitive proposal that convinces the evaluator. Further, they must familiarise themselves with the administrative challenges of managing an EU project, and thus prepare their own institution to sign a grant agreement with the funding agency. To support applicants during this challenging process, numerous information centres and service points are at their disposal, e.g. National Contact Points (NCPs) at a



Water sampling in the Reeuwijk lakes, Netherlands. Copyright: T. Behrends 2019 ■

national level, as well as research and EU officers or innovation managers at an institutional level.

BayFOR – Your full-service provider for RDI funding by the EU

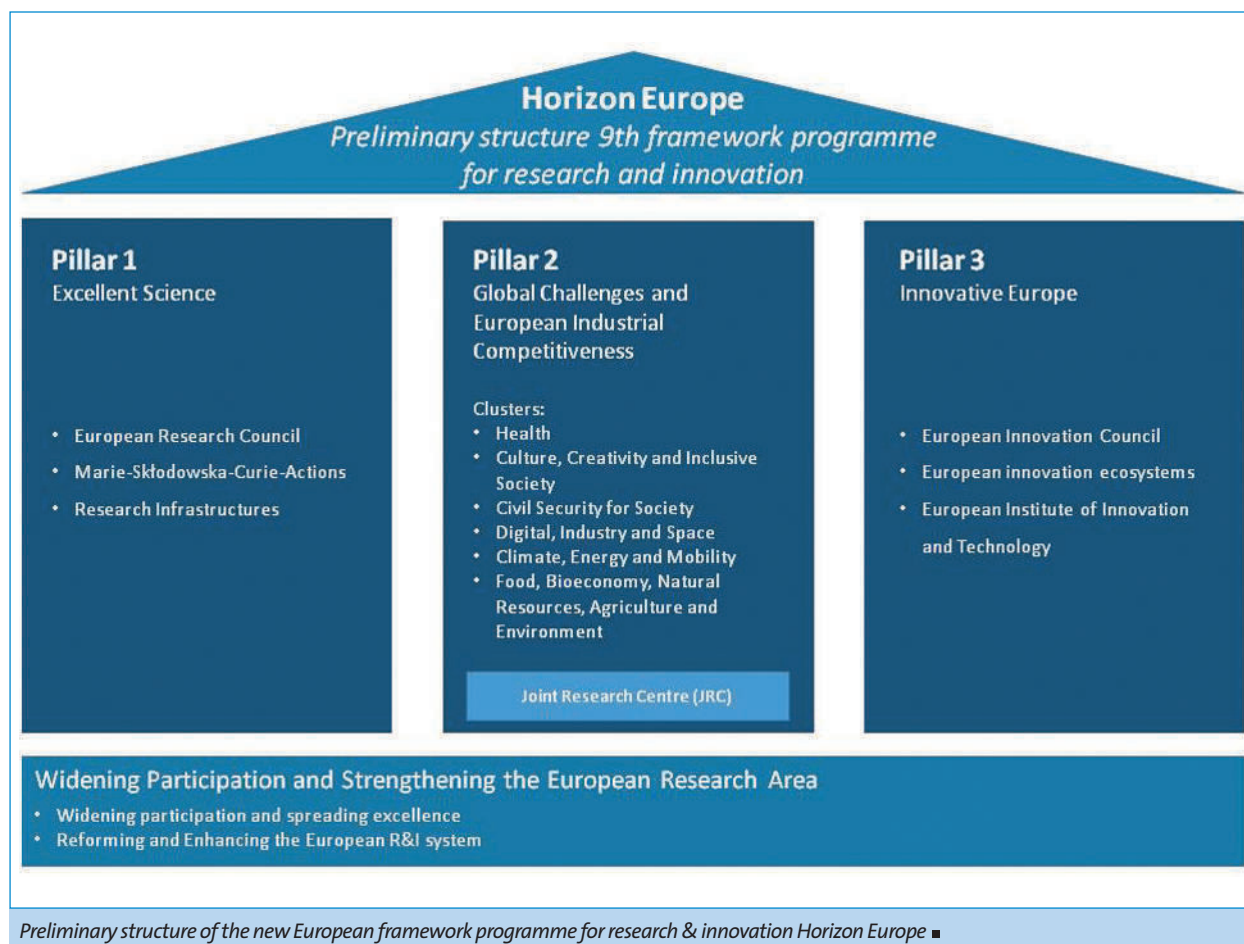
At a regional level in Bavaria, the Bavarian Research Alliance (BayFOR) is the main service point for EU funding. Together with its four partners in the Bavarian Research and Innovation Agency (BayFIA), the Bavarian Research Foundation, the Bayerischen Patentallianz GmbH (Bavarian Patent Alliance), Bayern Innovativ GmbH, and Projektträger Bayern, BayFOR supports universities as well as small and medium-sized companies in the acquisition of funds from the Free State of Bavaria, the federal level, and the EU, as well as with all questions regarding the transfer of knowledge and technology, and patent utilisation. BayFOR offers consultancy services to applicants regarding

European funding instruments, and actively supports all phases of the project cycle (application, contract preparation, project implementation). Thanks to its locations in Munich, Nuremberg and Brussels, BayFOR is well-connected both regionally and Europe-wide.

The precondition for receiving support from BayFOR is the participation of at least one Bavarian project beneficiary in a consortium. The scientific officers at BayFOR offer potential applicants specific advice on the European funding landscape and specific calls, help with the search for partners both nationally and abroad, and actively support the proposal writing process as well as during contract preparations with the funding agency. As the entire range of services is mainly financed by the Free State of Bavaria, BayFOR's support for the application process does not generate additional costs for the consortia.

Horizon Europe – A future outlook of the EU research-funding programme

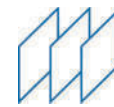
While the EU has published numerous calls for the year 2020 in the area of environment and energy, and many research projects funded by Horizon 2020 are well underway, the EU focuses already on its ninth research framework programme named Horizon Europe, which will be implemented between 2021 and 2027. In contrast to earlier radical changes between European framework programmes, the currently planned modifications for Horizon Europe are rather moderate in terms of content, structure and administration. For future applicants, this means a higher level of planning reliability regarding the proposal preparation and project implementation. Thus, calls within Horizon Europe will remain divided in three pillars and will be published in multi-annual work programmes (see fig. page 35).



The currently outlined global challenges foresee again extensive European funds for research and innovation projects within the area of environment and energy research, e.g. climate, energy, mobility and food, bioeconomy, natural resources, agriculture and the environment (see fig. page 35). Starting 2021, Horizon Europe will also work with an innovative, mission-oriented approach that envisages five research and innovation focal points: Adaptation to climate change including societal transformation, cancer research, healthy oceans, coastal and inland waters, climate-neutral and smart cities, as well as healthy soil and food. Consequently, environmental and energy research will continue to be key priorities.

Horizon Europe will offer a variety of funding possibilities for application-oriented environmental and energy projects, which are to be realised as part of interdisciplinary,

inter-sectoral and international collaborations. In addition to the numerous thematic funding opportunities in the environmental and energy sector, the possibility of international participation will also increase considerably for potential project partners: More than 20 non-EU partner countries will be able to participate in Horizon Europe projects. With a total budget of approximately 90 to 120 billion of Euros, Horizon Europe will surpass the currently largest research funding programme in the world, Horizon 2020. With BayFOR the consortia of applicants continue to have a reliable partner that competently advises and supports them in all matters involving the European proposal application and project cycle. In the environmental and energy sector, BayFOR is committed to supporting new European research and innovation projects, which will have a positive impact on a sustainable society of the future.



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Climate change and forests in Bavaria: students make trees talk about themselves



In order to assess the impacts of climate change on forest ecosystems and initiate appropriate countermeasures, in-depth knowledge of climate research and ecology is required. At the same time, student understanding of complex scientific interrelationships is often limited. To counteract this, the BayTreeNet project at the Friedrich-Alexander-University Erlangen-Nuremberg (FAU) uses “Talking Trees” and combines climate modelling and dendroecology with social science educational research in a novel interdisciplinary approach.

With the aim of making the Bavarian forests resilient to the consequences of climate change, it is necessary to adapt the forest composition and structure. However, basic knowledge about the regionally different effects of climate change and the tree species-specific reactions to extreme weather events is still lacking. Due to its topography, with low mountain ranges in the north and east of the country, the Alps in the south, and basins in between, climate changes in Bavaria have a very different regional impact. In particular, precipitation varies spatially and depends on the prevailing wind direction determined by large-scale weather patterns. These patterns, ultimately, have a more comprehensible impact on the growth behaviour and survival rate of tree species than a general temperature increase alone.

The ecophysiological and growth reactions of trees to climatic fluctuations can also be seen years later by researchers from the width of annual rings. Quantitative analyses of the wood anatomi-



Fig. 1: Presentation of a “Talking Tree” during the BayTreeNet opening kick-off workshop on May 23, 2019 at the forest education center Erlangen-Tennenlohe. ■

cal structures and the proportions of stable oxygen and carbon isotopes in wood provide an archive for the reconstruction of past weather extremes and for the derivation of important climate trends. By creating a growth model that is calibrated to the current growth patterns, dendroecologists can simulate the growth patterns under changed temperature and precipitation distributions. The future frequency

and probability of occurrence of climate-determining large-scale weather patterns will be calculated with comprehensive climate models for the middle of the 21st century on high-performance computers. The responsible subproject “climate dynamics” thus provides the physical, meteorological basis for understanding the effects of large-scale weather patterns on Bavaria’s forest locations.



Fig. 2: Development of an internet-enabled "Talking Tree" at high school Wunsiedel. Visible (from left to right) are sensors for measuring water transport (grey), a data logger with transmission unit (green), a dendrometer for measuring tree growth (green, on the trunk top right) and the transmitting antenna (top). ■

The educational part of the project focuses on the development of a teaching concept for students in Bavaria that concentrates on the regionally varying effects of macro weather situations on forest ecosystems. Therefore, a network of more than ten "Talking Trees", which are located in climatically differing areas of Bavaria and are equipped with an Internet-capable transmission unit, has been established. Thus, every reaction of the tree to the local weather conditions can be called up in real time via the Internet. These Talking Trees are managed by a network of partner schools. The students learn to understand the reactions of "their" tree to local weather conditions and translate the ecological and meteorological measurement data of the tree into human language messages in class and share them with the general public on a website and by using Twitter. As a result, the general public will understand what the talking trees have to "say" to us. In addition, the cooperation in

the tree network promotes the understanding of spatial differences in tree growth, because the regional impact of specific general weather conditions on different growing regions in Bavaria (e.g. in the Allgäu and in Lower Franconia) becomes immediately clear by comparing the tree reactions at different locations. The tree and climate data, as well as the comments of the students entered via the communication platform "twitter", will be available on the project's own website www.baytreenet.de.

The effects on climate knowledge and student's attitudes are investigated using methods from empirical social research. These results in turn flow back into a revision of the concept, so that an empirically based teaching concept tested in school practice can be developed under the guiding principle of education for sustainable development. As an overall objective, this makes it possible to transfer knowledge to civil society via school as an institution which is particularly relevant in this context.

In sum, the project combines plant sciences, climate research and educational research – hence it strengthens the link between universities and schools in the field of MINT subjects. The project is funded by the Bavarian state ministry of science and arts as part of the Bavarian climate research programme bayklif (www.bayklif.de). Close international links exist with the Laboratory of Plant Ecology of the University of Gent (Belgium) and numerous other European partners who collaborated in the EU COST-Action FP 1106 STReSS from 2012 – 2016 (Studying Tree Responses to extreme Events: a Synthesis; [https://www.cost.eu/actions/FP1106/#tabs\[Name:overview\]](https://www.cost.eu/actions/FP1106/#tabs[Name:overview])).



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Transferring know-how and technology from Bavaria

Bavaria's contribution to globally sustainable water management

For more than 20 years, the Technology Transfer Water (TTW) initiative has been active and can look back on a track record of success. Set up by the Bavarian State Ministry of the Environment and Consumer Protection and located at the Bavarian Environment Agency's Hof site, TTW shall underpin international cooperation in water management issues. Work focus is the impartial consultancy assistance of colleagues from Central and Eastern European countries to whom partnership agreements exist.



Visiting the wastewater treatment plant Monheim as part of an expert seminar with participants from Slovakia ■

As a state-run non-commercial entity, TTW is used to channel the comprehensive experience of the Bavarian water resource management administration, as well as to provide support in building up functioning eco-management systems and setting appropriate environmental standards. TTW sees itself as a cornerstone of Germany's efforts to transfer technology in the water resources



Visualization of water social function with participants from TTW summer academy ■

sector and to achieve implementation of the goals set out in the Agenda 21.

The difficulties inherent in implementing environmental and infrastructural programmes are complex and tend to have their roots in the overall institutional field, with legal frameworks, administrative organisations, and management structures as the specific causes of most issues.

It is in this area that TTW measures are applied. In order to pass on the principles of integrated water resource management (IWRM) and good governance, TTW organises a broad range of activities to promote exchanges and educational measures to accompany projects being implemented. Within the framework of our IWRM seminars, for example, we try to offer insights

into how different players in various parts of the water management sector work, removing mutual prejudices, showing the advantages of a modern services administration, and encouraging the growth of interdisciplinary networks abroad.

TTW is currently in contact with water management professionals in many countries in Southern and Eastern Europe, Asia, and Latin America. ■

Further information is available at:
<http://www.lfu.bayern.de/wasser/ttw/index.htm>

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Renewable fuels for aviation

Renewable fuels

In contrast to road transportation where different fuels such as gasoline, diesel or natural gas, as well as electric cars and first fuel cell vehicles are used in parallel, civil aviation relies almost exclusively on jet fuel. Jet fuel is a mixture of kerosene range hydrocarbons that is mostly derived from crude oils. In the course of the energy transition, renewable jet fuels are seen as a plausible option to achieve climate goals also in the aviation sector. The blending of conventional jet fuel with renewable kerosene is already approved, but the production volumes of renewable jet fuels are still small compared to biodiesel and bioethanol production for road transport. The small volumes of renewable jet fuel, which are currently used are mainly hydrogenated biooils (HEFA fuels). HEFA fuels can be produced in limited volumes from waste streams like used cooking oils or greases. Scaling the production of HEFA fuels to the level of conventional jet fuel demand would require a significant expansion of the global vegetable oil cultivation.

The research focus area on alternative fuels at the Bauhaus Luftfahrt explores further options to supply renewable fuels with less pressure on agricultural land. Bauhaus Luftfahrt performs research on alternative fuels in collaborative projects with different partners from industries and academia.

One example of this is the collaboration with TU Munich to



Fig. 1: Research plant for solar-thermochemical jet fuel synthesis (SUN-to-LIQUID research facility, Photo Credit: Christophe Ramage, © ARTTIC 2019) ■

explore the cultivation of microalgae in photobioreactors at the Algentechnikum on the Ludwig Bölkow Campus in Taufkirchen/Ottobrunn. Microalgae show rapid biomass growth rates and promise a comparatively efficient production of algal oils, which can be further processed to bio-kerosene. This rapid growth is offset by a relatively high technical effort for the cultivation of algal biomass and the extraction of oils. The system analyzes of Bauhaus Luftfahrt show that at the technological state of art algae fuels are still too expensive for a competitive productions. One way around the elaborate drying and oil extraction is the hydrothermal liquefaction of wet algal biomass. Hydrothermal liquefaction can convert a broad range of biomass feedstocks at temperatures around 350°C and

pressures around 200 bar into a viscous black biocrude. Roughly simplified, the formation of fossil crude oil is replicated in just a few minutes. This biocrude can be further upgraded to various transportation fuels. Bauhaus Luftfahrt is the coordinator of a joint European research project, which develops all major process steps of the hydrothermal liquefaction process. The project name „HyFlexFuel“ (www.hyflexfuel.eu) indicates the feedstock flexibility of the process. The project succeeded in the conversion of algae, sewage sludge, and lignocellulosic biomass (*Miscanthus giganteus*). The HyFlex-Fuel process can be embedded in waste management systems and is suitable for the conversion of abundant biogenic feedstocks, which are available in much greater volumes than vegetable oils. Beyond biofuels, there are sever-

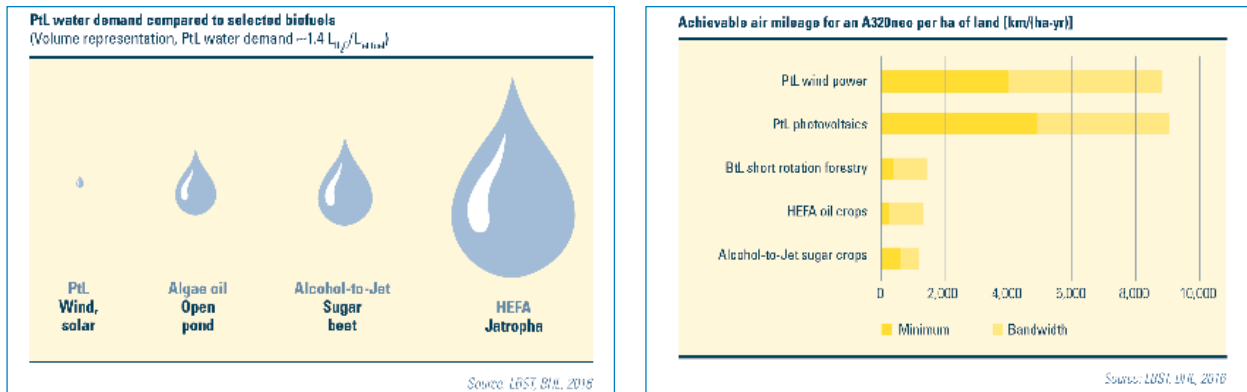


Fig. 2: The production of synthetic fuels from water and CO₂ can be much more resource efficient in terms of water demand (left) and area requirement (right) than biofuel production from energy crops. ■

al technological possibilities to synthesize jet fuels from water and CO₂, thereby the combustion process is reversed under significant expense of energy. Such synthetic fuels are expected to be more expensive than conventional kerosene for the foreseeable future. Nevertheless, they offer the long-term perspective to produce very large volumes of sustainable aviation fuel, if the energy is provided by solar or wind and the CO₂ feed is sourced from the atmosphere. First demonstration plants that capture CO₂ from ambient air already exist. As coordinator of the European research project SOLAR-JET (www.solar-jet.aero) Bauhaus Luftfahrt was involved in the first synthesis of solar kerosene from water and CO₂. The first sample of solar-thermochemical kerosene was produced in April 2014 using a high-flux solar simulator at ETH Zurich. Bauhaus Luftfahrt is also the coordinator of the follow-up project SUN-to-LIQUID (www.sun-to-liquid.eu) which has meanwhile produced the first solar fuel samples in the field. Figure 1 shows the research plant at the Spanish Institute IMDEA Energy. 169 focusing mirrors concentrate sunlight by a factor of more than 2500 into the reactor opening on the experimental level of the solar tower, where hydrogen (H₂) and carbon monoxide (CO) are produced in a solar-thermochemical reaction.

This energy rich synthesis gas (H₂ and CO) can be converted to liquid hydrocarbon fuels via the established Fischer-Tropsch process. The so-called power-to-liquid process (PtL) is based on a similar approach, but uses renewable electricity as primary energy source for electrolysis pathways that convert water and CO₂ into jet fuel (Figure 2). More details about different PtL process routes are described in a joint background paper by Ludwig-Bölkow-Systemtechnik and Bauhaus Luftfahrt on PtL fuels which was commissioned by the German Environment Agency (UBA, <http://bit.ly/2cowOyf>). Bauhaus Luftfahrt is also a partner in the PowerFuel project, which is funded by the Federal Ministry for Economic Affairs and Energy (BMWi). PowerFuel is sited at KIT in Karlsruhe and investigates the full PtL production chain from direct air capture of CO₂ to finished jet fuel components that fulfill the specifications for civil aviation.

In addition to drop-in capable renewable jet fuels, that require only minor adaptations within the aviation sector, Bauhaus Luftfahrt investigates also radically new solutions: battery-electric flight may evolve into a serious option for regional aviation, while mid-to long-range aircraft are expected to remain dependent on liquid fuels. From a technical perspective, liquid hydrogen is also a

suitable aviation fuel, however, a transition to hydrogen fuel would require fundamental changes along the supply chain and novel aircraft concepts that accommodate the voluminous tanks for liquid hydrogen at cryogenic temperatures. Further interesting research questions relate to the climate impact of aviation beyond CO₂ emissions, which can be fundamentally different for different jet fuels. In summary, we currently see very promising solutions, but also plenty of research needs to guide the transition to a climate-neutral future of air traffic. ■

Funding Statement:

The research leading to these results has received funding from the European Union Seventh Framework Program (FP7/2007-2013) under grant agreement no. 285098 - Project SOLAR-JET. HyFlexFuel and SUN-to-LIQUID have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 764734 (HyFlexFuel) and under grant agreement No 654408 (SUN-to-LIQUID). ■

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