ENERTRAG

Green hydrogen and wind-based thermal energy

Keys to the green transition

December 2022

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Energy is more
than just electricity

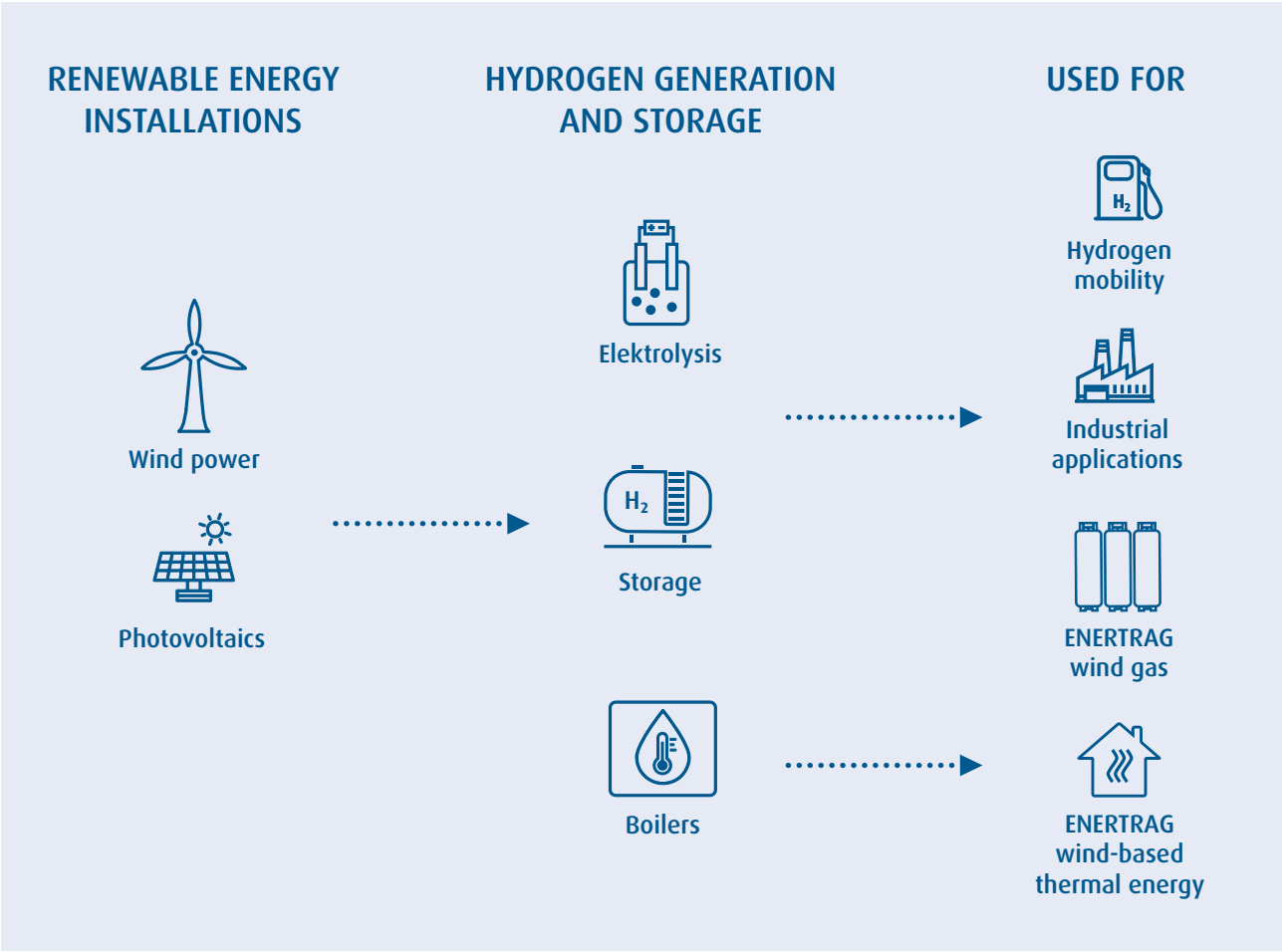
New energy solutions

When we got our first wind turbine up and running over 25 years ago, our goal was to provide a secure, low-risk supply of energy. From the outset, we realised that we had enough of the two key renewable energy sources, wind power and solar power, to replace fossil fuels cost efficiently. Lots of people believe that the switch to renewables is only about transitioning to electricity, although electricity only accounts for a sixth of our final energy requirements. Therefore, the switch of electricity generation to renewables is only the first phase in the green transition.

As the energy supply needs to be reliable, not just for the electricity sector, but also for industry, transport, and heating requirements, even when there's not enough wind or sun to meet demand, we need power buffers. Which is why we grappled with this issue early on and started generating green hydrogen over 10 years ago. By storing electricity that's not immediately required, we can also remove fluctuating quantities of renewable energy generation from the grid.

In the second phase of the transition to renewables, we're now looking at connecting electricity, heat, industry, and transport intelligently and providing consistently clean and cost-efficient energy. The answer lies in sector coupling directly at or near the power generating installations – in other words, converting renewable energy into energy that can be stored. The power buffers store the fluctuating energy to use it for other sectors. The first step in this process is the integrated power plant ENERTRAG built and operates, which generates electricity, hydrogen and heat. As a result, we can provide a predictable supply of energy, tailored to demands, just like conventional power plants do.

At ENERTRAG, we've developed energy solutions for all sectors over the past few years. As a result, we can heat buildings with surplus wind power, use hydrogen from renewables to decarbonise road and rail transport, or supply industry with clean chemical products and green hydrogen.



Why choose ENERTRAG?

We reconcile ecological and commercial factors and operate green hydrogen projects, from planning renewable energy generating installations all the way to the finished hydrogen filling station. We don't just support you in implementing your projects, but also see ourselves as a long-term partner when it comes to operating your installations.

Our goal is to create a sustainable hydrogen economy at a high degree of local value creation to achieve the climate and environmental protection objectives.

Hydrogen is part of our brand DNA. We've been generating green hydrogen for over 10 years and delivering it to all sectors. We develop sector coupling projects with our partners from industry. Consequently, we create opportunities to decarbonise carbon-intensive industries and to produce and market high-quality products. We're also convinced that hydrogen is the way forward in tomorrow's world. Are you seeking a partner for your project? Why not get in touch and we can embark on that journey together?

Green hydrogen with ENERTRAG - an end-to-end solution

Planning

- Developing concepts
- Developing business cases
- Selecting and acquiring sites
- Planning urban land use
- Engineering
- Planning for permits

Carrying out projects

- Financing
- Acquiring subsidies
- Managing projects
- Managing construction
- Commissioning
- Planning grids

Operating

- Managing technical operations
- Managing commercial operations
- Service

Put our expertise to the test and contact us about further projects on:

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Hydrogen mobility

ENERTRAG wind power in a tank

As of 2021, almost 50% of the German rail network didn't have electric overhead lines. Almost all vehicles in the public sector and the associated service providers, such as refuse collectors, are operated with diesel or natural gas.

On 2 August 2021, the German Procurement of Clean Vehicles Act came into force. This piece of legislation means that local authorities and state-owned companies are facing enormous challenges. For the first time, compulsory minimum targets have been set for procurement of low-emission and emission-free cars, as well as light and heavy-duty commercial vehicles, particularly for public transport buses.

Other ways of powering the vehicles are required. Hydrogen will play a role in supplying public transport vehicles, regional rail transport and regional delivery and disposal transport vehicles.

We operate our own hydrogen filling station and will convert our entire vehicle fleet to run on electricity and hydrogen by 2025. We've been operating a fuel cell vehicle since 2017 and saw firsthand just how well it copes under different conditions every day.

In 2021, to ensure two converted public buses can run, we supplied a local transport company with green hydrogen and discussed projects to convert waste disposal vehicles in the Uckermark region.

In conjunction with a utility and a regional railway company, we're currently planning and designing a joint project sponsored by the Federal Ministry of Transport and Digital Infrastructure (BMVI). From 2024, we'll be supplying the hydrogen for six trains powered by fuel cells to provide a green link between the region to the north of Berlin and the German capital itself.

All the challenges we tackle are aimed at local energy generation and ensuring regional value creation. Each project is scalable and can be customised to suit requirements. We can turn any scenario into reality, whether you want to set up your own filling station, or have energy supplied by trailer to existing infrastructure.

Get in touch with us and we'll turn your project into reality. Over 25 years' project experience and over ten years in producing and supplying hydrogen guarantee your project will be a successful one.

Hydrogen for mobility

RENEWABLE ENERGY INSTALLATIONS

Wind power

Photovoltaics

ELECTROLYSIS AND STORAGE

Elektrolysis

Storage

TRANSPORT AND FILLING STATIONS

Hydrogen filling stations

Supplied by trailers

Gas network feed-in

USED FOR

Cars

Public transport

Medium- and heavy-duty transport

Hydrogen for industrial applications

ENERTRAG wind power in the power plant

Green hydrogen plays a key role in decarbonising industrial processes. ENERTRAG offers tailormade solutions for hard-to-abate sectors. We develop projects that allow green hydrogen to be used in all sectors of industry.

ENERTRAG can be your green hydrogen partner for many industrial processes. In direct process applications, climate-neutral steel can be produced in direct reduction furnaces in steel mills where the fossil blast furnace has been replaced by direct reduction with hydrogen. Green hydrogen can be used in refineries as well. We also offer customised project solutions for processes where hydrogen is treated in innovative processes to produce high-quality, climate-neutral derivatives (e.g. aviation fuel, ammonia, methanol).

We offer solutions for processes where high-quality synthetic hydrocarbons can be produced from a carbon source and green hydrogen via CCU. Processed in this way, green hydrogen really comes to the fore as a sustainable aviation fuel or basic chemical in the transport, industry, and chemical sectors. In our innovative sector coupling projects, it provides primary energy from wind and solar power for the other sectors.

ENERTRAG develops projects for producing, processing, and distributing green hydrogen as well as hydrogen derivatives, which can be turned into reality and applied in a wide range of industrial processes.

An overview of the benefits:

- Customised solutions to meet your challenges
- Financing with the best-possible use of subsidies
- Open technology approach to making green hydrogen

Hydrogen for industrial applications

RENEWABLE ENERGY INSTALLATIONS

Wind power

Photovoltaics

ELEKTROLYSIS & TRANSPORT

Elektrolysis onsite/decentral

H_2 pipeline

H_2

Storage

PROCESSING

without = H_2

NH_3

Ammonia synthesis = NH_3

Methanol synthesis = CH_3OH

USED FOR

Refineries

Steel

Fertilisers

Shipping

Aviation

Hydrogen delivery

ENERTRAG wind gas

We don't just support you in implementing your projects, but also see ourselves as a long-term partner when it comes to operating your installations. Our goal is to create a sustainable hydrogen economy at a high degree of local value creation to achieve the climate and environmental protection objectives.
Hydrogen is part of our brand DNA. We've been generating green hydrogen for over 10 years and delivering it to all sectors. We operate our own hydrogen filling station and help you to select the right logistics option and means of transporting the fuel. It can be shipped in cylinders, bundles, via a gas pipeline or by trailer. We can supply green hydrogen from 25 to 500 bar. We deliver the right transport solution for any application.

An overview of the benefits:

- Refuelling or customised usage
- In a trailer or directly to you
- Lorry or car refuelling at 300 or 500 bar
- Possible from a 300 kg shipment
- If you purchase 40 tonnes annually, we can plan a filling station for you

We're always „one energy ahead".

Since December 2014, we've been feeding 1.0 GWh of green hydrogen annually into Ontras's natural gas network for gas customers, such as those of Greenpeace Energy. As a result, use of the existing infrastructure is maximised and the share of natural gas in the gas network can be decreased ever more. Therefore, we can reduce dependence on imports and hedge against rising fossil fuel prices.

Cylinders have been filled and supplied since 2017. Customers primarily use these to replace diesel-powered emergency generators with fuel cells. Consequently, they have a secure solution for critical infrastructure, regardless of the temperature, and it's carbon neutral.

Since the summer of 2021, we've also been operating a tank and transport trailer to deliver large quantities of green hydrogen to customers as well.

Hydrogen for customised solutions

RENEWABLE ENERGY INSTALLATIONS

Wind power

Photovoltaics

PRODUCTION AND STORAGE

Elektrolysis

Storage

TRANSPORT AND FILLING STATIONS

Gas cylinders

Supplied by trailers

Gas network feed-in

Wind power for supplying heat

ENERTRAG wind power storage

Are you looking for ways to supply your community or a business park with sustainable and carbon-free heat? Are regional value creation and locally generated energy and heat important to you? Are you nervous about high investment costs for new central heating and is your oil heating system quite old? Then ENERTRAG's wind-based thermal energy is the right choice for you.

The concept uses peak loads of wind power to make practical use of surplus production and therefore avoid having to shut down wind turbines. Depending on the configuration, wind-based thermal energy can be stored for several weeks and supply the installations concerned. Whether you wish to connect to a local heating grid to cut costs, or completely replan your requirements, we can do all that for you. We identify the best configuration based on the project concerned.

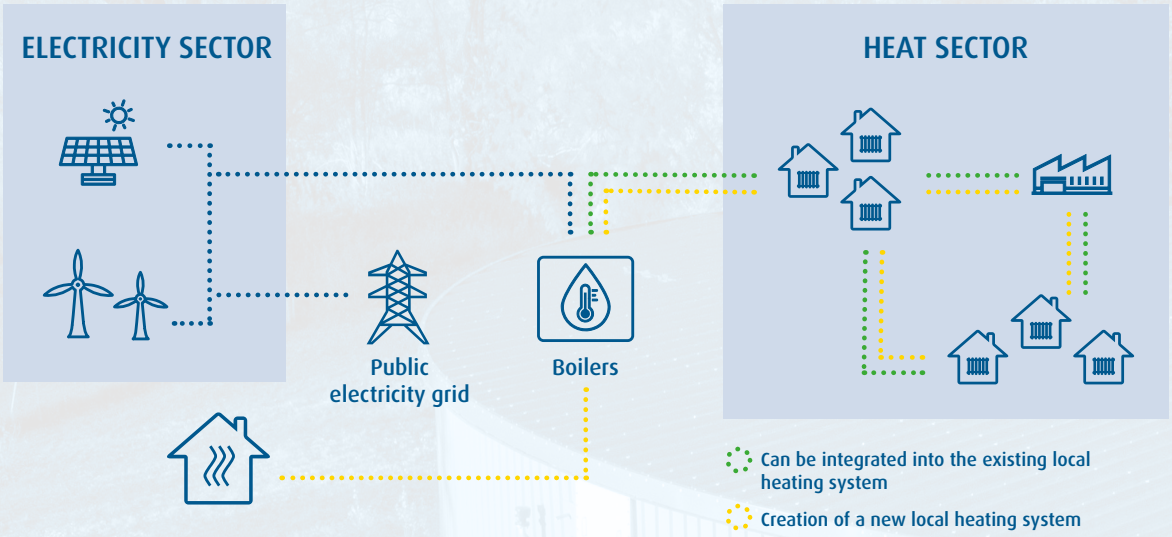
Since spring 2020, we've been operating a wind-based theral energy storage facility in Nechlin because we believed that using surplus wind was better than switching it off. Getting the project up and running was simple. The nearby Nechlin wind field's turbines generate about 70 million kilowatt hours of electricity annually. On particularly windy days, when the electricity generated by the wind turbine can't be fed into the grid (causing a bottleneck), we use it instead of shutting it down, which means low prices for customers. In the flow heater, water is heated to over 90°C and fed into the storage tank.

The wind-based thermal energy storage facility in Nechlin can hold up to one million litres of water and releases its energy as needed to the local heating network, which supplies 35 homes. Once heated and charged, Nechlin can be supplied for up to two weeks. As it's windy very often, the wind-based thermal energy storage facility can provide green heat for the village.

An overview of the benefits:

- Heating costs are lower than with oil heating
- 100 percent climate-neutral renewable heat
- Reliable and uncomplicated technology
- Online data heat supply for every household

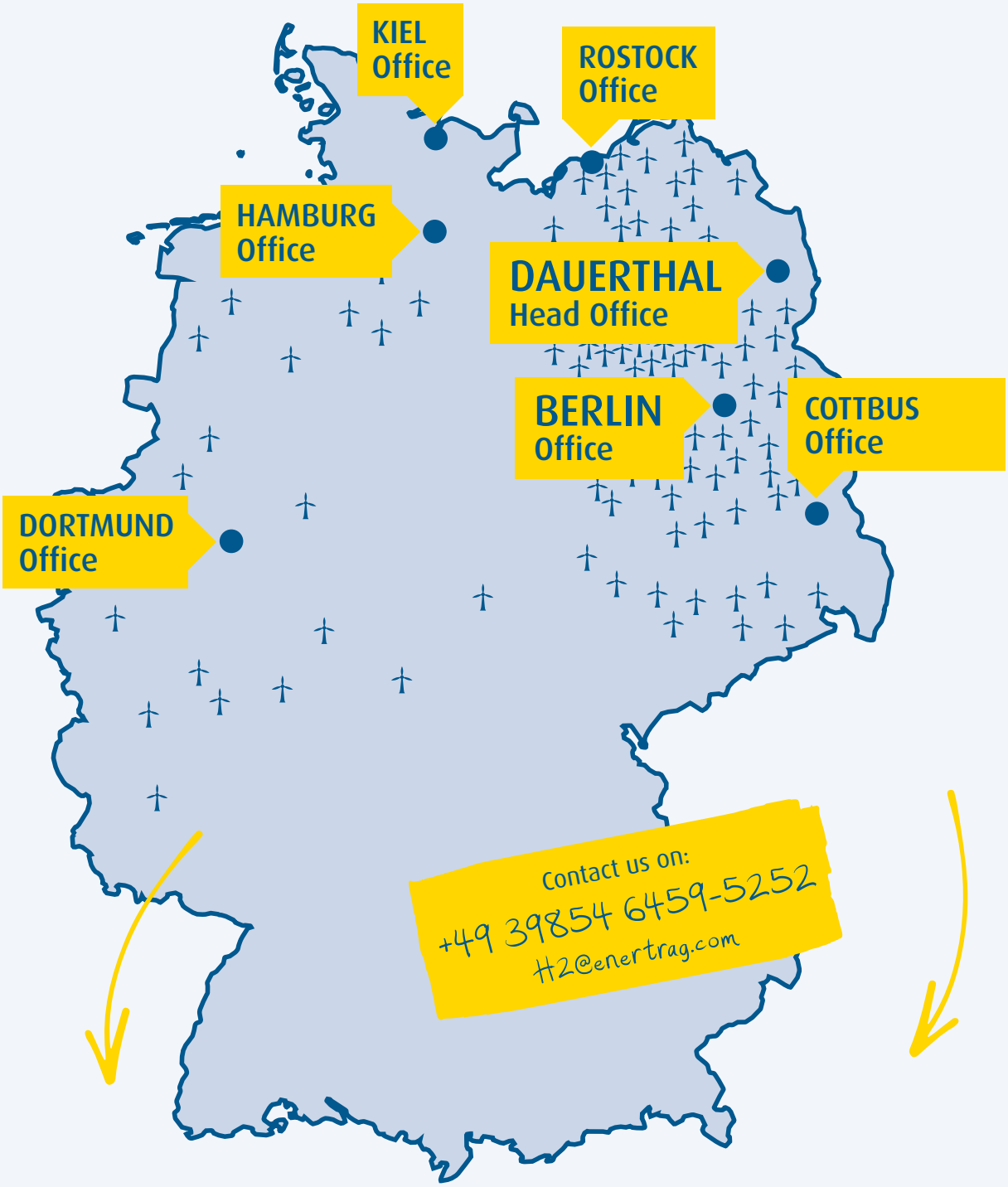
Heat through wind



A summary of the services and advantages

- Many years' experience and long-term partner for operation of installations
- Locally generated energy and regional value creation
- We offer customised projects for processes where hydrogen is turned into climate-neutral derivatives
- We put surplus energy to good use
- Many years of generating green hydrogen

New energy-solution sites



Ruhr region coastal sites

Dortmund | 44263 | Phoenixseestraße 17
Rostock | 18146 | Stangenland 2a
Hamburg | 21073 | Buxtehuder Straße 1
Kiel | 24114 | Kaistraße 90

Sites in central Germany

Dauerthal | 17291 | Gut Dauerthal
Berlin | 10117 | Friedrichstraße 152
Cottbus | 03046 | Wilhelm-Külz-Straße 17

ENERTRAG

www.enertrag.com

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