MS Wissenschaft 2025

Energy of the Future

List of exhibits & exhibit texts

No.	Exhibit	Research facility
1	**Heat from the Earth**	Fraunhofer Research Institution for Energy Infrastructures and Geotechnologies IEG, Bochum and Cottbus
2	**Offshore Wind Energy**	Federal Maritime and Hydrographic Agency (BSH), Hamburg and Rostock
3	**Fusion Energy**	Max Planck Institute for Plasma Physics (IPP), Greifswald
4	**Green Energy for Everyone**	Institute of Energy and Process Technology (IEP), Münster University of Applied Sciences, Münster
5	**The Artificial Leaf**	Helmholtz Hereon Centre, Geesthacht
6	**Heating with geothermal energy**	Helmholtz Centre for Geosciences (GFZ), Potsdam
7	**Powerful Batteries**	POLiS Excellence Cluster, Karlsruhe
8	**Hydrogen: A Fascinating Resource**	Fraunhofer Gesellschaft for Promoting Applied Research e.V., Munich
9	**Marine Hydrogen Technology**	The H_2Mare hydrogen flagship project, Fraunhofer Institute for Wind Energy Systems (Fraunhofer IWES), Bremerhaven
10	**Hydrogen Research**	Hydrogen flagship projects H_2Giga, H_2Mare and TransHyDE, Max Planck Institute for Chemical Energy Conversion, Mülheim an der Ruhr
11	**Focus on Raw Materials**	Leibniz Institute for New Materials (INM), Saarbrücken
12	**Hydrogen and Sustainability**	Hydrogen flagship project H_2Mare, EUCC – the Coastal Union Germany e. V., Rostock-Warnemünde
13	**Smart Networks**	ENSURE – a Copernicus project, RWTH Aachen University, Aachen
14	**Variable Hydrogen**	Hydrogen flagship project H_2Giga, Schaeffler Tech. AG & Co. KG, Herzogenaurach | Thyssenkrupp Nucera, Dortmund
15	**Spherical Energy Storage**	Fraunhofer Institute for Energy Economics and Energy System Technology, Kassel
16	**Driving Sustainably**	Schwerdtfeger & Vogt, Münster Wissenschaft im Dialog gGmbH, Berlin

wissenschaft : im dialog

Eine Initiative des Bundesministeriums für Bildung und Forschung
2025 Wissenschaftsjahr ZUKUNFTS ENERGIE

17	**In the Web and on the Move**	The 6G Platform project, Fraunhofer Institute for Integrated Circuits IIS, Erlangen
18	**Refrigerant Compressors for Sustainable Heating**	Energy & Life Sciences Faculty, Flensburg University of Applied Sciences, Flensburg
19	**Sustainable Shipping**	Institute of Thermodynamics and Sustainable Propulsion Systems, Graz University of Technology, Graz
20	**Energy Efficient Buildings**	Institute for Construction and Materials Science, University of Innsbruck, Innsbruck
21	**Industry's Raw Materials Transition**	Max Planck Institute for Chemical Energy Conversion (MPI CEC), Mülheim an der Ruhr
22	**Clever Waste Recycling**	Helmholtz Centre for Environmental Research (UFZ), Leipzig, Halle, and Magdeburg
23	**Climate-Friendly Construction**	Faculty of Materials Engineering/ Energie Campus Nürnberg, Nuremberg University of Technology – Georg Simon Ohm, Nuremberg
24	**Green Fuels**	Max-Planck-Institut für Kohlenforschung, Mülheim an der Ruhr Max Planck Institute for Chemical Energy Conversion (MPI CEC), Mülheim an der Ruhr
25	**Science Meets Society**	Ariadne – a Copernicus project
26	**Transformation Tracker**	Ariadne – a Copernicus project
27	**Green Energy for Cities**	Faculty of Electrical Engineering and Computer Science, Gottfried Wilhelm Leibniz University Hannover, Hannover

1 Heat from the Earth

Endless energy from inside the Earth

Heat that comes from inside the Earth is called geothermal energy. We can use it to heat our homes and to supply industry with fossil-free energy.

To find out where there is the most geothermal energy, press the button on the sign, touch the place on the globe and feel the temperature. Now compare different places – the warmest one is where there is the most energy under the Earth's crust.

Currently, we mainly use coal, oil and gas to heat our homes and run our factories, but this emits a lot of CO_2, which is harmful to the climate. Geothermal energy is a sustainable, regional and cost-effective alternative. The heat from deep in the Earth could supply as much as a quarter of the energy needs of households and industry in Germany.

Fraunhofer Research Institution for Energy Infrastructures and Geotechnologies IEG (Fraunhofer IEG)

We design the climate-neutral energy systems of the future. Together with our partners from industry and the public sector we are engaged in application-oriented research into sector-coupled electricity, gas and heating grids, drilling technology, process engineering, energy economies and hydrogen infrastructure.

2 Offshore Wind Energy

What role do the North Sea and the Baltic play in the energy transition?

How many offshore windfarms does Germany have? Find out how much electricity they generate and what potential an environmentally friendly expansion of this sector would offer in the future.

Look at the North Sea and the Baltic Sea on the map. Test your knowledge of offshore wind energy in the quiz.

Many interests coincide in the North Sea and the Baltic – marine conservation, shipping and fisheries, to name a few. To rapidly expand offshore windfarms, all these interests need to be taken into account at the planning stage. Windfarms in the North Sea and the Baltic, including in deeper and more distant waters, are a key component of the energy transition and will help to bring Germany closer to achieving its climate protection goals.

Federal Maritime and Hydrographic Agency (BSH)

We have oversight over German offshore waters and regulate which areas can be used for what purpose. We are working on making offshore wind energy less harmful to the environment. This will protect the seas and promote their sustainable use.

3 Fusion Energy

Researching the energy supply of tomorrow

Hotter than the sun: The large-scale experiment Wendelstein 7-X is exploring the foundations for a future fusion power plant.

Tap the camera controller on the touchscreen to tour the experimentation hall at Wendelstein 7-X. Learn about the components that make up the fusion device.

The sun creates energy by fusing light atomic nuclei. Our aim is to imitate this extremely efficient process on Earth and harness the results. In the nuclear fusion device, this involves enclosing a gas heated to millions of degrees in a very powerful magnetic field. Providing the gas does not touch the walls of the device, the atoms' nuclei will fuse and release energy. Together with renewables, nuclear fusion could help to meet our increasing energy demands without harming the climate.

Max Planck Institute for Plasma Physics (IPP)

We are using the ASDEW Upgrade and Wendelstein 7-X device to research the development of a fusion power plant.

4 Green Energy for Everyone

Saerbeck takes the energy transition into its own hands

How can a community cover its energy needs sustainably? Find out how a small community is taking the initiative to cover its future energy needs.

Here you can explore Saerbeck's bioenergy park interactively. Use the touchscreen to find out about different energy technologies – from wind power to hydrogen storage systems – and test your knowledge. Play with the LEDs on the model and see how everything is connected.

This bioenergy park is quite unusual, because it's owned by Saerbeck's citizens. The park generates four times the village's electricity needs from solar, wind and biowaste and also produces heat for buildings and businesses. The bioenergy park not only makes the community independent and climate-friendly – it also boosts the local economy. This all makes Saerbeck a model for other towns and villages.

Münster University of Applied Sciences – Institute of Energy and Process Technology (IEP)

We develop practice-oriented solutions for the energy transition and conduct research into energy storage systems, renewable energy, hydrogen systems and building technologies. We are testing these technologies in practice at bioenergy park Saerbeck.

5 The Artificial Leaf

Green hydrogen production: inspired by nature

Plants harness sunlight to produce energy from CO_2 and water. In the future an artificial leaf will use the same method to create climate-friendly hydrogen.

Explore the artificial leaf. Click through its various layers on the touchscreen. How is the solar-powered electrolysis cell structured? What can it do?

When sunlight hits the artificial leaf, light energy is transformed into electrical energy. This energy splits water into oxygen and hydrogen in a process known as water electrolysis. The surface of the artificial leaf has a special structure. It absorbs a great deal of light and ensures an efficient process. The combination of photovoltaics and electrolysis in a single cell might enable us to produce large amounts of green hydrogen in the future.

Helmholtz Hereon Centre

Climate and coastal research, materials development and technology all come together at the Helmholtz Centre Hereon. We not only want to understand climate change but also to develop effective solutions that can help us deal with it.

6 Heating with geothermal energy

How does geothermal energy work?

How can we use warm water from deep in the Earth to supply our houses and apartments with climate-friendly heating? Find out what's needed for all this to happen.

Not every kind of ground is suitable for extracting warm water. Use the drip experiment to get a feel for the porousness of various types of rock. On the screen you can find out whether geothermal energy is a good option in the place you live

Geothermal energy is renewable, climate-friendly and also available in Germany. It harnesses the warmth below the Earth's crust to heat houses or entire neighbourhoods. To exploit this energy resource, suppliers drill into various rock strata and pump water up to the surface. If geothermal energy is to be used efficiently, the rock must be sufficiently porous. The water is stored in the rock's pores, which act like a sponge. Preliminary geological exploration can help find the optimal areas for drilling.

Helmholtz Centre for Geosciences (GFZ)

The GFZ in Potsdam is one of the world's leading centres for geosciences. We address global challenges, such as natural hazards, climate change and sustainable use of resources. Our geothermal research group is the largest of its kind in Europe.

7 Powerful Batteries

All-rounders in the energy transition

Where can we get our electricity when the sun isn't shining and there's no wind? Look at all the different ways batteries can be used to store electricity.

Activate the screen and follow the path of the electricity. On the way you'll find out how the generation and storage of electricity are connected.

Batteries are a key component of the energy transition. They help us to use renewable energy such as solar and wind efficiently. After all, solar energy systems and wind turbines don't always supply electricity when we need it. That's where batteries come in. They store excess electricity so that it's available according to requirements. In the future, batteries will be used in households, industry and our electrical infrastructure. In cars they can replace engines that harm the climate.

POLiS Excellence Cluster

We are conducting research into the batteries of the future. These will no longer require lithium, and they will be powerful, sustainable and environmentally friendly.

8 Hydrogen: A Fascinating Resource

Experience hydrogen's journey from generation to use

There are a lot of myths surrounding hydrogen. But what do you really know about the opportunities and challenges it presents?

Solve the tasks in the game and move your hydrogen molecule forward on its journey. You'll encounter several exciting facts and innovations along the way.

Hydrogen offers us the best opportunity to promote climate protection, the energy transition and economic progress.

Its greatest strength is its ability to store surplus energy, which can later be transformed into electricity almost emission-free.

However, the use of hydrogen will only be truly effective when it is combined with renewable energy, more efficient transition and transportation technologies and adequate infrastructure.

Fraunhofer Gesellschaft for Promoting Applied Research e.V. (Fraunhofer)

Hydrogen technology is one of Fraunhofer's important areas of research. Thirty-eight institutes have joined together in a hydrogen network with the goal of developing market-ready solutions.

9 Marine Hydrogen Technology

What are the benefits of on-site hydrogen production?

In the H_2Mare Game you can build your own offshore wind farm and learn about the world of hydrogen technology.

Produce climate-neutral hydrogen and trade it with others. Test what you know about hydrogen and collect bonus points for your climate-friendly behaviour.

The ocean offers good conditions for producing renewable energy. Here the wind is strong and dependable. Offshore facilities can produce green hydrogen from wind energy on-site, which can be significantly cheaper than generating it on land. For a start, access to the electrical grid isn't necessary. We are also researching secondary products such as green fuels.

The H_2Mare hydrogen flagship project, Fraunhofer Institute for Wind Energy Systems (Fraunhofer IWES)

H_2Mare is one of the three hydrogen flagship projects of the German Federal Ministry of Education and Research (BMBF). Around thirty partners from the fields of science and industry are working together to develop the technology to produce green offshore hydrogen and its secondary products – for a successful energy transition.

10 Hydrogen Research

Pioneering technologies for environmentally friendly energy

A tiny molecule with a big impact. Discover how researchers and industry are coming together to make a hydrogen energy system a reality.

Touch the different markers on the map on the screen. Learn more about the technologies and the findings of the flagship projects.

The hydrogen economy of the future requires efficient technologies for its production, storage, transport and use, which are the topics our researchers are now focusing on in the flagship projects. The results are impressive. To take just one example, efficient fuel cells and H2 technologies were created on an ocean test field.

Hydrogen flagship projects H_2Giga, H_2Mare and TransHyDE

The three hydrogen flagship projects are the largest funding initiatives of the German Federal Ministry of Education and Research designed to promote the energy transition. The projects are researching the serial production of electrolysers, the offshore production of green hydrogen, and hydrogen transport and storage infrastructures.

11 Focus on Raw Materials
Sustainable lithium extraction

Currently, the lithium we need for our batteries is extracted using methods that harm both the environment and human health. What are the alternatives?

Look at the maps to find out where lithium is extracted. Zoom into the cell on the screen and watch lithium ions being isolated from water.

Lithium-ion batteries are currently essential for electromobility. But lithium extracted using environmentally harmful methods which has to be transported long distances is problematic. This is why scientists are looking for alternatives. In an electro-chemical cell, lithium ions can be extracted from mine or thermal water—both of which contain lithium— without using chemicals and with little energy input. Lithium can also be recycled directly out of old batteries using the same method.

Leibniz Institute for New Materials (INM)

The INM develops innovative, sustainable and efficient materials. Researchers in the Energy Materials Department focus on electro-chemical energy storage materials, innovative hydro-technologies and environmentally friendly recycling methods.

12 Hydrogen and Sustainability

What does green hydrogen have to offer?

Green hydrogen protects the climate. Discover how it can help us achieve all 17 global sustainability goals.

Pull out the panels and learn exciting facts about the effects of green hydrogen. Have a closer look at the pie chart. Which goals would be positively impacted by a hydrogen energy system?

The “17 Sustainable Development Goals” are political targets set by the United Nations. Their aim is to promote sustainable economic, social and environmental development worldwide. Experts have evaluated how green hydrogen might affect the realisation of global sustainability goals and thus many important aspects of our lives as well.

Hydrogen flagship project H_2Mare, EUCC – the Coastal Union Germany e. V.

H2Mare is one of the three hydrogen flagship projects of the German Federal Ministry of Education and Research (BMBF). Around thirty partners from the fields of science and industry are working together to develop the technology to produce green offshore hydrogen and its secondary products — for a successful energy transition.

13 Smart Networks
Intelligent energy management

How can we best use renewable energies? Build the energy grid of the future or adjust industrial operations to synch with electricity production.

Start the game with the relevant tokens.

EnergyFlow: Use the virtual tokens to build and optimise an energy grid. Keep an eye on the resources.
EnergyTetris: Direct industrial processes. How can you prevent a grid overload? Try your hand at distributing energy consumption over time.

Our energy system is undergoing a transformation. Increasing numbers of small producers are feeding solar energy into the grid. At the same time, demand is rising thanks to electric cars and heat pumps, for example. A new smart energy grid will ensure greater flexibility and help balance supply and consumption. If households and businesses take a smart approach to electricity, they can save money while helping to keep the grid stable.

ENSURE – a Copernicus project

Over thirty partners from industry, the sciences and society are developing modular approaches to sustainable grid structures for the energy grid of the future. You can learn about these at the ENSURE ZukunftsraumEnergie showroom.

14 Variable Hydrogen

Discover the secret of electrolysis

What is hydrogen? Where can we get it? Find out how green hydrogen is obtained using a process known as “water electrolysis”.

You’ll find Electra waiting for you on the screen. She will show you how electricity from renewables splits water into hydrogen and oxygen. Have a look at the stack of electrolysis cells.

Germany aims to become climate neutral by 2045. If we produce hydrogen using green electricity, it can significantly reduce greenhouse gas emissions – in industry for example. Electrolysers are an indispensable part of hydrogen production, but at present they are made mainly by hand. Future goals are mass production and further advances in electrolysis technology.

Hydrogen flagship project H_2Giga

H_2Giga is one of three hydrogen flagship projects of the German Federal Ministry of Education and Research (BMBF). Around thirty partners from the fields of science and industry are working together to develop the foundation for the mass production of large-scale electrolysers. The stack was produced by Schaeffler and the AR-QR code by Nucera – two of H_2 Giga’s partners.

15 Spherical Energy Storage

Storing energy on the seafloor

StEnSEA is an underwater energy storage system which transfers the principle of pumped storage hydropower to the seafloor.

How does a spherical energy storage unit work with green energy? Look at the model and discover on the screen how this innovative solution can store huge amounts of energy.

On windy and sunny days, wind turbines and solar panels generate more electricity than is needed. The spherical energy storage units on the seafloor store the surplus energy. A pump turbine in the hollow cement sphere pumps out the water. If we later allow the water to flow back in under great pressure, we can use it to produce electricity. Storage capacity depends on the size of the sphere and the depth of the water.

Fraunhofer Institute for Energy Economics and Energy System Technology

We are developing solutions for the safe and efficient operation of sustainable energy grids based on renewables.

16 Driving Sustainably

A car running on electricity, hydrogen or e-fuels – which of these will win the race?

What kind of car engine is most efficient? Discover which is the best kind of fuel for future mobility.

Choose how you want to power your car. Each of the two cars starts out with the same volume of energy. Which one will go furthest? Start the car race.

Electric, hydrogen and e-fuelled cars all use renewable energy and are therefore climate-neutral. However, more energy is needed to produce green hydrogen and e-fuels. In addition, the three different kinds of engine use the energy with varying degrees of efficiency. An electric car goes five times as far with the same volume of energy as one using e-fuels does, and twice as far as a hydrogen car. Although manufacturing batteries for electric cars does more harm to the environment, their long-term use compensates for this and makes them an environmentally friendly alternative.

Schwerdtfeger & Vogt, Wissenschaft im Dialog gGmbH

17 In the Web and on the Move

How much energy does the mobile internet use?

If the internet were a country, it would be the world's sixth-largest producer of CO_2 emissions. Discover how the internet can be made more climate-friendly.

Start the quiz and test your knowledge of how much energy you consume when surfing the internet.

Smartphones, tablets and smartwatches – we are using ever more devices to access the mobile internet when on the move. But surfing the internet consumes a lot of energy. Green electricity, optimised grid infrastructures and more efficient communication and data processing can help make the mobile internet more climate-friendly in the future.

The 6G Platform project

The 6G Platform project coordinates scientific contributions and cooperation with business and society to develop future mobile communications standards in Germany. Together with the Fraunhofer Institute for Integrated Circuits (Fraunhofer IIS) and the Barkhausen Institute, we are highlighting the challenges posed by energy consumption.

18 Refrigerant Compressors for Sustainable Heating

How heat pumps work

Heat pumps can provide heat at levels many times higher than the amount of electricity they consume. This might sound unbelievable, but it's all thanks to the clever use of a single component: the refrigerant compressor.

Take a close look at the compressor and turn the crankshaft. What happens when you press the switch? On the screen learn about the role refrigerant compressors play in heat pumps.

A heat pump draws heat from the ground, from the groundwater or from outside air. A heat exchanger transfers this heat to a refrigerant, which then evaporates. The refrigerant compressor then compresses the resulting gas, which causes it to heat up. The gas transfers heat to the building's heating circuit. Its ability to harness green and environmental energy makes the heat pump the key to a successful energy transition.

Flensburg University of Applied Sciences

At the Flensburg University of Applied Sciences, around 3,000 students in more than twenty degree courses are finding answers to the questions of the future – for example, in the areas of renewable energies, environmental technology, digitalisation and artificial intelligence.

19 Sustainable Shipping

Climate-friendly maritime global trade

Combustion engines that emit large amounts of CO_2 are still in use in the cargo shipping industry. Discover how green fuels can make shipping more environmentally friendly.

Look at the model. How is CO_2 used as a raw material? You can learn more about this future technology on the screen.

Cargo shipping requires solutions that can reduce greenhouse gas emissions. The use of batteries is not an option, as these do not store enough energy for the ships' long journeys. This is why we are researching a new propulsion method: an onboard reformer splits methanol into hydrogen and CO_2. The hydrogen is fed into the large motor, where it combusts and propels the ship. The CO_2 is stored on board and later used on land to produce methanol.

LEC GmbH – Large Engines

Competence Centre in collaboration with the Institute of Thermodynamics and Sustainable Propulsion Systems at Graz University of Technology (TU Graz)

20 Energy Efficient Buildings

Keeping cosy in winter while saving energy?

Most of the energy consumed by households is still used for heating rooms. Find out how to keep your home pleasantly warm using very little energy.

Turn the cranks to raise the water level on each of the scales to above 20°C. Compare how much effort you need to turn each crank.

Keeping a building at room temperature can be like adding water to a leaky bucket. In a poorly insulated old building, around ten times as much energy is lost as in a new building. But refurbish an old building and you'll save up to 80 per cent of the energy needed to heat it. Modern heating systems, such as heat pumps, are particularly efficient.

University of Innsbruck

In Energy Efficient Building unit we conduct research into the energy efficiency of buildings' shells and of building services. Our aim is to find resource-saving solutions that can help decarbonise buildings. We are thus making an important contribution to the energy transition and to climate protection.

21 Industry's Raw Materials Transition

How climate-damaging waste gases are transformed into raw materials

The CO_2 that is a part of unavoidable industrial waste gases can be reintroduced into the production cycle as a raw material.

Follow the process from waste gas to methanol production. What are the end products? Tap the various stations on the screen to find out more.

Steel production, power plants, cement factories and refuse incinerators are all particularly energy-intensive operations emitting a great deal of CO_2. This climate-damaging gas is filtered out of the waste gases in a complicated process, mixed with hydrogen and transformed into methanol. This allows it to be used as a raw material in the chemicals industry.

Max Planck Institute for Chemical Energy Conversion (MPI CEC)

Since 2016 numerous industrial firms have been working together with the Max Planck Institute, the Fraunhofer Gesellschaft and universities in the Carbon2Chem® project to develop a global solution to the industrial raw materials transition.

22 Clever Waste Recycling

A banquet for microorganisms

What new products can be made out of biowaste or CO_2? Explore how microorganisms and biotechnology can enable a climate-friendly circular economy

Choose a token and feed the bioreactor. Watch which micro-organisms become active. What happens to the waste material?

Microorganisms are tiny metabolic professionals. They can turn biowaste into useful chemicals or sources of energy such as hydrogen. Some of these valuable little helpers can recycle greenhouse gases and also help us replace fossil fuels in various branches of industry. In this way a bio-based circular economy can evolve, paving the way to a climate-friendly future.

Helmholtz Centre for Environmental Research (UFZ)

The UFZ is a leading centre for terrestrial environmental research. One of its research fields is how biotechnological processes can help to create a circular economy.

German Biomass Research Centre (DBFZ)

The DBFZ studies how biomass can be used efficiently to produce renewable energy and sustainable materials.

23 Climate-Friendly Construction

What difference can the building materials industry make?

Around 30 per cent of greenhouse gases emitted in Germany come from the construction and operation of buildings. Innovative building materials can help reduce these emissions.

Look at the building materials. They show us two different ways in which the construction sector can be transformed to make it more energy efficient and climate-friendly.

The production of cement and building materials containing cement leads to huge CO_2 emissions. Geopolymers made of ground-down building rubble offer a good alternative. The large share of recycled matter in this innovative material reduces greenhouse gas emissions.

Energy efficiency is extremely important when refurbishing old buildings. Highly thermally insulating bricks can lower future energy consumption.

Nuremberg University of Technology

The Faculty of Materials Engineering at Nuremberg University of Technology has teamed up with Energie Campus Nuremberg to develop innovative energy-efficient materials.

24 Green Fuels

New applications for an old process

The Fischer-Tropsch Process can be used to make sustainable fuels and chemicals out of CO_2 and hydrogen.

Use the levers to activate each step of the process. Watch how liquid fuel gradually emerges.

It isn't possible to replace liquid fuels with green electricity to power airplanes and ships, so we need to come up with sustainable alternatives. That's where the climate-friendly Fischer-Tropsch Process comes in. This chemical reaction was actually discovered 100 years ago in Mülheim an der Ruhr – and today it's more relevant than ever!

Max-Planck Institut für Kohlenforschung
Max Planck Institute for Chemical Energy Conversion (MPI CEC)

These two Max Planck institutes are studying the effect of catalysers on the chemical processes used to produce the fuels and chemical products for our sustainable future.

25 Science Meets Society

Learning from each other for the energy transition

What concerns do people have when embarking on the road to climate-neutral mobility and green electricity? Energy transition dialogues are designed to get people talking to one another about these issues.

Find two future worlds for green electricity and four future paths for climate-friendly mobility on the touchscreens. Explore the different impacts they can have.

Social acceptance and active support are needed if the energy transition is to be successful . In the Ariadne project, scientists talk with citizens about their views on energy and transport policy measures. In various forums they discuss how transport and electricity generation can be made climate-neutral. The discussion focuses on the challenges as well as viable solutions.

Ariadne – a Copernicus project

Twenty-seven research institutions are engaging in a joint learning process with policymakers, stakeholders and citizens in a project funded by the Federal Ministry for Education and Research. The project is looking for ways to shape the energy transition and providing orientation for decision-makers.

26 Transformation Tracker

Are we still on track for the energy transition?

Should we be building more wind turbines in Germany? Are people installing heat pumps and buying electric cars? You can find out using the tracker.

Check the forty-five indicators to find out whether we're on course for climate neutrality. Compare the different sectors. Where is there still work to be done? Tap the different speedometers to explore the topic in more detail.

Germany's goal is to be climate neutral by 2045. To achieve this goal, various measures are being implemented to transform its energy system. To find out how successful they are you can compare the various indicators with the target paths. Discrepancies offer indications of where adjustments need to be made. Instruments like the Transformation Tracker show our current status and indicate what still needs to be done to achieve the energy and climate transition.

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27 Green Energy for Cities

How will cities of the future be supplied with energy?

The energy transition is changing the way we live. How will renewable energy be generated in cities, and how will it be stored and used?

Explore the miniature city and see if you can find some examples of the future of urban energy use. You'll find more information on the screens.

The United Nations' sustainable development goals stipulate that every human being should have access to affordable and clean energy. That also applies to cities, where many people live together in a small space. A variety of technologies combined with smart grids will make it possible to supply cities with climate-friendly energy. Wind and solar power will supply electricity for households, transport and industry. Green hydrogen can be used to store energy, while heat pumps can heat our homes and other buildings.

Leibniz University Hannover, Faculty of Electrical Engineering and Computer Science

Energy is a research focus of the university, where around thirty institutes are engaged in coordinated research. The topics range from the transformation of the energy system to a sustainable energy supply for the future.