

# VERBUND Climate Report.

## Climate action requires decarbonisation.







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# Report of the Executive Board: For a future worth living!

Initially a public health emergency, the coronavirus pandemic has unleashed an economic crisis that is overshadowing the biggest challenge of our time – the climate crisis. And yet climate action can help stimulate the economy. Let's use this opportunity to decarbonise!

The Paris Agreement and the European Green Deal provide the road map for decarbonisation. In Austria, the Federal Government plans to reduce greenhouse gas emissions to a zero balance by 2040, making it a frontrunner in European climate policy. All actors, from policy-makers to the energy market to industry sectors, are encouraged to play their part in achieving this goal.

## **Towards cleaner energy**

Climate change is a key issue for VERBUND. We have set the course for a green energy future with our 2030 strategy. As Austria's leading utility and one of the largest producers of hydroelectricity in Europe, we are big believers in the potential of renewable energy. We will keep our 130+ hydropower plants in good working order, work on steadily increasing efficiency and exploit the potential to expand renewables in Austria in an ecological manner. Over and above this, we will push ahead with the profitable expansion of wind and solar power.

The transmission grid is also crucial to achieving our ambitious climate targets. Our wholly owned subsidiary Austrian Power Grid (APG) is Austria's independent transmission system operator and controls and is responsible for Austria's national transmission grid.

Applied research helps us to take advantage of market opportunities and develop innovative business models and services for our customers. Promising technologies such as green hydrogen, battery storage

units and electric transport are the focus of our attention. Concentrating on these will enable us to tap additional forward-looking lines of business and safeguard a secure supply of electrical energy for consumers and business with our products and services.

## **Responsibility for the future**

In our quest to become a carbon-free utility we have set ourselves clear objectives, one of which is reducing greenhouse gas emissions by 90% measured beginning from the basis year 2011 until 2021. However, this will require diverse efforts, and decarbonisation can only work if all sectors of the economy play their part. Together with partners from science and research, industrial companies and start-ups, we work on sustainable solutions to reduce the existing level of resource consumption and emissions as quickly as possible.

What is more, we continuously evaluate the risks of climate change for electricity generation and take advantage of any opportunities that arise. This, VERBUND's first published climate report, gives insight into how VERBUND is handling the new challenges.

Working towards a climate-neutral world also necessitates striking out in new directions and developing sustainable solutions in the process. As a pace-setter for our industry we will continue to lead the way in a focused manner – for a future worth living!

## **VERBUND's Executive Board**

Wolfgang Anzengruber, Chairman of the Executive Board  
Michael Strugl, Vice-Chairman of the Executive Board  
Peter F. Kollmann, Member of the Executive Board  
Achim Kaspar, Member of the Executive Board

# At a glance: climate action requires decarbonisation

The effects of climate change are already apparent, which is why rapid decarbonisation of our economic system is so essential. This need also gives rise to opportunities to develop renewable sources of energy and innovative green technologies.



New habitats: Austria's longest fish pass at the Ottensheim-Wilhering power plant on the Danube (Upper Austria)

## Starting position and challenges

Historical measurements and climate models show that rising temperatures are a consequence of climate change. We are likely to see extreme weather events increase in intensity and frequency. Now is therefore the time to act!

**Challenges.** Decarbonisation of the energy system is one of the biggest challenges.

Yet it also creates opportunities for Austria as a business location. Once the coronavirus pandemic is over, we need to combine the economic rebound with climate action. This requires a level playing field as well as incentives to invest in renewables.

**Energy future.** New approaches are needed to tackle the climate crisis. As Austria's leading utility and one of the largest producers of hydroelectricity in Europe, we are taking an active part in shaping the future of energy: we invest in research, innovation and the expansion of renewable energy and safeguard a secure supply of electrical energy for consumers and business.

**Transmission grid.** The transmission grid is crucial to achieving the climate targets. Our subsidiary APG will invest several billion euros in the renovation and expansion of the grid over the coming years. This will form the basis for a successful transformation of the energy system, allowing electricity to be transported from regions with large volumes of wind and solar power to the regions where it is needed.



## A selection of VERBUND projects

### Hydropower amid climate change

What effect does a reduction in precipitation or a 1°C temperature rise have on a river's water supply? In the POWERCLIM\_HOT project VERBUND collaborated with scientists from the University of Natural Resources and Life Sciences in Vienna to analyse potential effects of climate change on the generation of hydroelectricity. Here, regional climate models were linked to a hydrological model and different emissions scenarios were incorporated, allowing possible scenarios up until the end of the 21st century to be mapped out.



### Evaluating Alpine snow cover

Modelling melt water inflows to Alpine reservoirs requires exceedingly precise recording of snow cover. This is because the annual snow run-off plays an important part in filling the reservoirs. Climate change is expected to cause even greater variability in the future. In the SNOWPOWER project, scheduled to run until 2022, we will develop an innovative method for evaluating snow cover in high Alpine regions with the use of drones and for determining the potential for run-off. This will allow for better estimates of the flow rate.



### Drones for a safer grid

Events such as storms can cause disruption in the high-voltage grid, leading to automatic shut-offs. Before lines are switched on again, steps must be taken to ensure that they have not been damaged. Drones allow for faster inspections of disruptions. As soon as an error message is received, the drone starts up and flies to the fault location to take photographs. In 2019, APG became the first company in Europe to successfully complete an approved automatic flight out of sight.

→ Other projects: [pages 18/19](#)



## Future scenarios and solutions

Scenarios in the energy market assume rising carbon prices, growing demand for electricity and significant growth in renewables. These will give rise to strategic opportunities for new renewable sources of energy such as wind and solar power, climate-friendly technologies and innovative business models:

**Advancing cleaner technologies:** As a leading hydropower company, we also embrace new renewable sources of energy, becoming involved in markets of tomorrow such as e-mobility and battery storage.

**Exploiting hydrogen for future growth:** Green hydrogen is a promising resource. We are collaborating with industry and mobility partners to achieve a breakthrough in this clean source of energy.

**Promoting research and development:** Innovation is the bedrock for the future of energy. Together with universities, leading enterprises and start-ups, we are designing new solutions for mitigating climate change.

# Climate action framework: energy and climate policy objectives

Climate action is necessary to protect the environment and essential for an advanced economy and society. The Paris Agreement and the United Nations' Sustainable Development Goals (SDGs) provide a road map for the climate and energy targets. The Austrian Government Programme 2020–2024 aims to make Austria climate neutral by 2040.

The new Renewable Energy Development Act (Erneuerbaren-Ausbau-Gesetz, EAG) is intended to be an key cornerstone for achieving the climate targets. This also requires a clear regulatory framework with incentives for companies to invest. VERBUND advocates ambitious climate action at all levels. We support effective instruments for reducing greenhouse gas emissions and call for a strong carbon price for all sectors.







# The energy and climate policy framework for VERBUND

As an energy supplier, VERBUND is subject to a wide range of energy and climate policy actions at global, European and national level. We strive to build these developments into our business models as effectively as possible so that we can support climate initiatives and take an active part in shaping the future of energy.

## Climate action at all levels

Policy guidelines provide a framework for our activities. Which obligations need to be met and which opportunities arise from them depends on these. VERBUND supports the climate targets at all levels and champions effective instruments for reducing greenhouse gas emissions.

In implementing measures to mitigate climate change we are a reliable partner – for policy-makers, business and our customers.

## Taking advantage of new opportunities

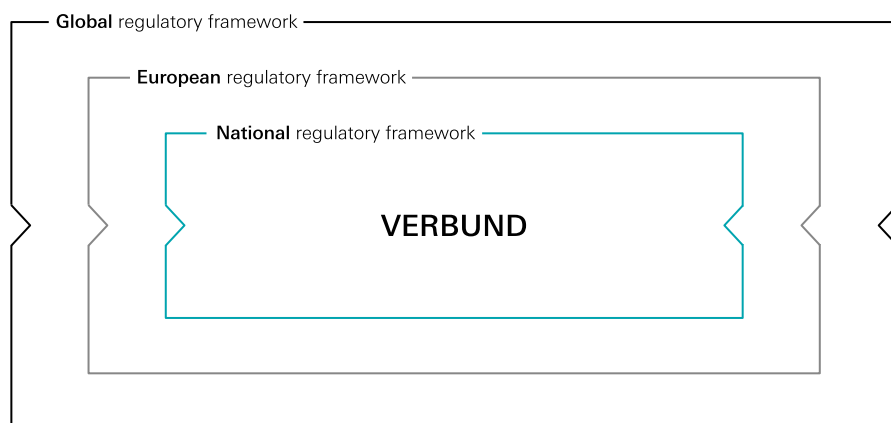
Decarbonising the energy system is one of the biggest challenges of our time. However, it also provides opportunities for Austria as a business location. If all stakeholders are committed and make an appropriate contribution, Austrian companies can retain their standing among the international leaders, enabling prosperity and a high quality of living to be safeguarded in the long term.



### Our position: Now is the time to act!

As a leading Austrian utility, VERBUND is committed to ambitious climate action. We support the national and international climate targets. If these are to be achieved, there is no time to lose: in addition to clear regulations for renewable energy expansion, we need swift and effective instruments for reducing greenhouse gas emissions that are designed to cover all sectors of the economy.

## National and international frameworks for VERBUND





# The international framework

The global framework provides a road map for climate action. Two key elements are the United Nations' Sustainable Development Goals (SDGs) and the Paris Agreement.

## The Sustainable Development Goals

The UN's Sustainable Development Goals consist of 17 goals with the vision of creating a better future. With these the international community hopes to tackle poverty and hunger, eliminate inequalities, promote the expansion of renewable energy and mitigate climate change by the end of 2030. More than 190 countries have made a commitment to implementing long-term measures at a national, regional and international level.

## The Paris Agreement

The members of the United Nations Framework Convention on Climate Change (UNFCCC) set a clear course with the Paris Agreement that entered into force in 2020: to limit global warming to such an extent that it remains possible to live and work in safety and good health. The Paris Agreement has the following specific aims:

### Limit global warming

Hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C. This means that industrialised nations must reduce their greenhouse gas emissions to net zero by 2050.

### Adapt to the adverse impacts of climate change

Increase countries' climate resilience, i.e. their ability to adapt to the adverse impacts of climate change.

## Financing

Make finance flows consistent with a pathway towards decarbonisation. In addition, industrialised countries shall provide \$100 billion per year for measures to mitigate climate change and adapt to the adverse impacts of climate change in developing countries.

## Climate-related losses and damage

If climate damage can no longer be prevented, the countries affected to the greatest extent shall receive financial aid. The provisions of this Agreement are the subject of further climate summits.



### Our position: Implement the SDGs

We intend to play our part in the achievement of all SDGs, which is why we have anchored these in VERBUND's sustainability mission statement. SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action) have particular relevance for us. We are committed to maintaining the value of our plants, continuously increasing their efficiency and pushing renewable energy expansion.

## The UN's Sustainable Development Goals





### The EU's 2030 climate and energy targets

The main targets of European climate and energy policy up to 2030 are as follows:

- A reduction of at least 40% in greenhouse gas emissions (compared to 1990 levels) (To bring the targets into line with the Paris Agreement, a raising of the target to a cut in emissions of at least 55% compared to 1990 is currently being discussed.)
- Increasing renewables to at least 32% of final energy consumption (with an upward revision clause by 2023)
- Increasing energy efficiency by at least 32.5% (with an upward revision clause by 2023)

### The European Green Deal

At a European level the European Green Deal implements, among other things, the global climate targets and the Sustainable Development Goals. It aims to make Europe the world's first climate-neutral continent by 2050. Other priorities are cleaner, affordable and safer energy, decarbonisation and a circular economy, protection of ecosystems, biodiversity and a zero-pollutant action plan.

Further areas of focus are green finance and research and innovation. VERBUND is a frontrunner in innovative green finance with its issuance of a green bond and an ESG-linked syndicated loan.

As part of the European Green Deal, there are plans to raise the EU climate target with a view to lowering greenhouse gases by 2030. We support the new targets and the implementation of the deal, also as an economic stimulus programme. Frameworks for the future in the EU and in Austria must be based on the new European targets as set out in the Paris Agreement and the SDGs.

### The Sustainable Finance package

To be able to achieve the EU energy and climate targets by 2030, Europe needs to raise an additional €260 billion per year. The Sustainable Finance package was drawn up for channelling cash flows into sustainable investments.

### The EU Emissions Trading System

Since 2005, the EU Emissions Trading System (EU ETS) has been the cornerstone of the EU's policy to combat climate change. It covers industry and the power sector, which is why it is also crucial for VERBUND. Companies need to acquire an emission allowance for each tonne of CO<sub>2</sub> emitted. While some allowances are allocated for free, auctioning is the default method. Due to the oversupply of emission allowances, the carbon price was so low for such a long time that the Emissions Trading System had very little effect. When the market stability reserve (MSR) introduced in 2019 is revised, it will be easier to prevent an oversupply on the market. CO<sub>2</sub> duties, known as border tax adjustments, are also being considered.



#### Our position: Yes to a carbon-neutral Europe

Efforts must be stepped up if Europe is to become climate neutral by 2050. In the "Decarbonisation Alliance" VERBUND, together with other European energy companies, is calling for the EU climate target to be raised up to 2030, with a binding interim target for 2040. We also support an effective emissions trading system with a rising minimum carbon price, as well as a carbon price for all sectors (including transport and buildings).



# The Austrian framework



Diverse natural landscape: meadow in front of the Wallsee-Mitterkirchen power plant on the Danube (Upper Austria)

Climate and energy topics carry a lot of weight in the Austrian Government Programme 2020–2024. The following topics are important from VERBUND's perspective:

## **Austria's climate neutrality after 2040**

The Federal Government intends to implement the Paris Agreement. It supports the planned increasing of the EU's climate and energy targets as well as the European Green Deal. Austria has set itself the goal of slashing greenhouse gas emissions to net zero by as early as 2040. A CO<sub>2</sub> budget with a specific reduction pathway will be drawn up for this.

## **100% electricity from renewable energy**

One area of focus in the power sector is the use and coupling of renewable resources in all areas of application. Here the aim is to generate 100% of electricity (national balance) from renewable sources of energy by 2030. This will be implemented in particular through the Renewable Energy Development Act (Erneuerbaren-Ausbau-Gesetz, EAG). A heating strategy will be developed

for the complete decarbonisation of the heating market. Another goal is grid safety and security of supply, which is to be achieved by developing an integrated grid infrastructure plan and other measures.

## **Ecosocial tax reform and carbon pricing**

In response to the climate crisis, the government is banking on cost transparency for CO<sub>2</sub> emissions and a greening of the tax system. Ecosocial tax reform is planned from 2022. This is intended to improve conditions for people in Austria and create ecological cost transparency in the tax system through carbon pricing, for instance. At EU level, the government will make the case for an effective emissions trading system and a minimum carbon price, among other things.

The goals of the Government Programme 2020–2024 underpin VERBUND's 2030 strategy. We also facilitate achievement of these goals with our company's strategic thrust. In addition, the provisions of the Renewable Energy Development Act (Erneuerbaren-Ausbau-Gesetz, EAG) and the Austrian hydrogen strategy are particularly important for the implementation of our strategy.



### **Our position: Rapidly become climate neutral**

VERBUND welcomes the climate and energy policy course being taken by the Federal Government. We support the efforts to become climate neutral by 2040 and the goal of generating 100% of electricity from renewable sources of energy (national balance) by 2030.



A full-page background image showing a majestic mountain range. In the foreground, a calm lake reflects the sky. The middle ground features steep, rocky slopes with patches of snow and sparse vegetation. A small, isolated wooden cabin sits on a flat patch of land near the water's edge. The background is dominated by high, rugged mountain peaks, some of which are partially obscured by low-hanging clouds and mist, creating a sense of depth and scale.

# Challenges arising from the climate crisis: managing the effects of climate change

Historical measurements and climate models show that one effect of climate change is a significant rise in temperatures in Austria compared to pre-industrial levels. Clear trends cannot be observed for precipitation and wind speed. We are likely to see extreme weather events increase in intensity and frequency.

VERBUND is rising to these challenges: we factor in climate-induced natural hazards when planning, constructing and operating power plants. We implement a wide range of technical and organisational measures to protect our run-of-river and storage power plants.







# Meteorological parameters

This Climate Report is based on various climate models and historical measurement series.<sup>1</sup> To assess the effects of climate change on the water supply, regional climate models were combined with a hydrological model in VERBUND’s POWERCLIM\_HOT<sup>2</sup> project. Integrating different emissions scenarios allowed potential scenarios up to the end of the 21st century to be mapped out.

### Rising temperatures

All combinations of climate models and emissions scenarios show that in recent decades temperatures in Austria have risen much faster than the global average. This is due to Earth’s land-water distribution (land heats up faster than water) as well as to the northward shift in the subtropical high-pressure belt. The latter is leading – with measures to improve air quality since the 1980s – to longer periods of sunshine. There has also been a marked increase in the number of very hot days (daily highs in excess of 30°C).

2018, which saw an increase of 1.8°C compared to the reference period 1981 to 2010, was the warmest year in the 251 years that have passed since Austrian record-keeping began. A total of 14 of the 20 warmest years in Austria have occurred during the 2000s.<sup>3</sup> This puts Austria far above the global average: a temperature increase of 0.4°C was measured worldwide in 2018.<sup>4</sup>

### Fluctuating water supply

No dominant trends have emerged for precipitation and wind speed over the decades. Combined with the retreat of

a glacier, precipitation can nevertheless have serious consequences for the water supply. In some years, for instance, the average annual flow may decrease by up to 35%. Changes are even more important when viewed seasonally. Depending on the climate model and emissions scenario, the water supply may plummet in the summer months and climb again in winter.<sup>5</sup>

### The challenge of extreme weather

Extreme weather events are also connected to climate change. Here, the mechanisms are very complex. Preliminary findings of a recent study carried out by the Central Institution for Meteorology and Geodynamics (ZAMG) on storms and bad weather over the past 30 years show a marked increase in such events since the 2000s. The potential for storms has risen by 30–50% mainly in Southern and Eastern Europe, and by 20% in Austria. It is important to note that this does not equate to an increase in the actual number of storms, since not all meteorological conditions that tend to cause storms ultimately lead to their occurrence.

At the same time, and especially in regions frequently affected by thunderstorms, the probability of flooding and mudslides may also rise. Increasing sealing of surfaces and compaction of soil on agricultural land may exacerbate the effects of storms and hence the potential for damage. Further research is required for more detailed statements about future trends.<sup>6</sup>



Powerful: the Kölnbrein dam at the Malta power plant group in Carinthia is resistant to climatic challenges.

### Rising temperatures in Austria and globally

Year	Globally	Austria
2018	+0.4°C	+1.8°C
2015	+0.5°C	+1.4°C
2014	+0.3°C	+1.7°C
1994	-0.1°C	+1.2°C

Source: Climate Status Report Austria 2018 (2019)

1 See sources (extract) on page 30.  
2 POWERCLIM\_HOT – Impact of hot climate scenarios on hydropower production. Project involving VERBUND and the University of Natural Resources and Life Sciences in Vienna (2019).  
3 Source: Climate Status Report Austria 2018 (2019).  
4 Source: [Information portal on climate change](#) of the Central Institution for Meteorology and Geodynamics (retrieved in January 2020).  
5 Source: Climate Status Report Austria 2018 (2019).  
6 Source: [Weather systems with storm potential have increased](#). Information provided by ZAMG on zamg.ac.at (retrieved on 20 July 2020).



# Management of extreme weather events

VERBUND's hydropower plants and APG's transmission grid are exposed to a multitude of possible climate-related natural hazards ranging from prolonged droughts to torrential rain. The related events, such as flooding, mudslides and avalanches, can impact on the water supply and electricity generation as well as on electricity transmission.

## Legal requirements

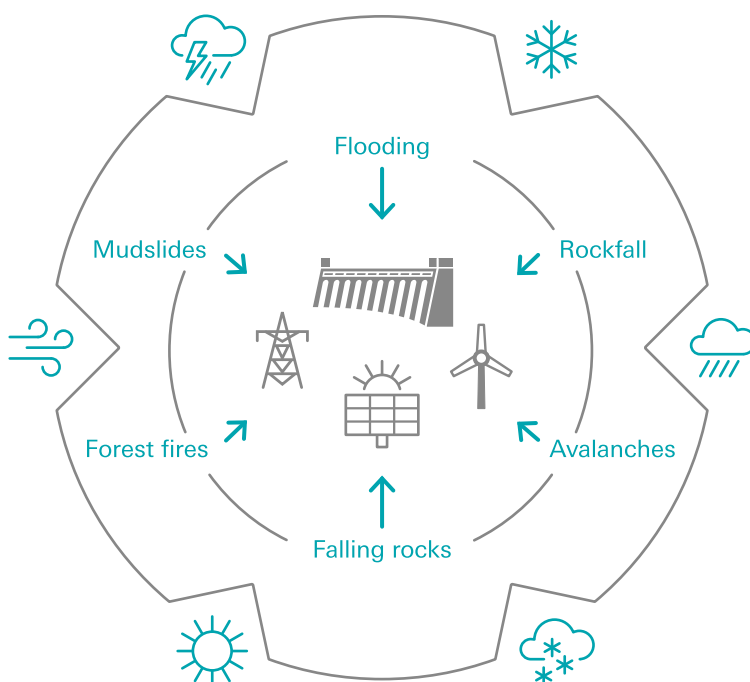
Extreme weather events pose some of the most serious threats to electricity generation and transmission. We have always taken these factors into account when planning, building and operating

our plants, complying with the provisions of European and national law. These are, specifically, the European Flood Directive (Directive 2007/60/EC on the assessment and management of flood risks) and its transposition into the Austrian Water Rights Act (Wasserrechtsgesetz, WRG) of 1959.

Further requirements for the consideration of natural hazards such as flooding are regulated in the approval notice and in the operating and monitoring regulations for each power plant. The latter provide instructions for conducting continuous monitoring and on how to act in an emergency situation.

## VERBUND plants and natural hazards

Source: VERBUND



Flooding of the Drau River in 2018 at the Rosegg-St. Jakob power plant (Carinthia): destroyed embankment (top), debris (centre)

Effects of a mudslide on a pylon (bottom)



Schleieis reservoir (Zillertal Valley/ Tyrol): the dam installation at Schleieis keeps back flood waves, thus permitting controlled discharge (top).

Typical elements of a run-of-river power plant; here the Abwinden-Asten power plant on the Danube (Upper Austria)



### Flood management plans

We take numerous technical precautions to ensure safe power plant operation. Here, a distinction is made between run-of-river power plants and storage power plants. With a run-of-river power plant, active intervention in the case of flooding is not possible. However, it is possible to control the rate of flow.

During normal operation, the weir of the run-of-river power plant is closed and the entire flow of water passes through the powerhouse. If flooding occurs, the weir is gradually opened. In the case of extreme flood events, the turbines must be switched off. Pondage power plants constitute an exception because at such plants the headwater areas can be drained prior to a discharge wave in order to mitigate the flooding.

With a storage power plant, part of the incoming flood wave can be held back, relieving some of the pressure below the dam. Effective spillway mechanisms are essential, however.

In addition to flood management measures, action is taken to avert further natural disasters, for example installation of check dams and avalanche barriers. The measures differ depending on the power plant and local requirements.



### Our commitment: Flood protection and ecology

Whenever a state-of-the-art hydropower plant is being built, flood protection is combined with ecological measures. One such example is the Vienna-Freudenau power plant constructed in the 1990s. Together with the New Danube Channel it guarantees flood protection for the Austrian capital.

Other ecological measures are the water supply to the New and Old Danube. In addition, biotopes, bays, islands and a semi-natural bypass channel with a fish ladder were created on the Danube island. A riverside promenade was built on the southern bank, and a footpath and cycle path leads the way across the power plant.



### Monitoring and maintenance

The 29 dams at VERBUND's storage power plants and the around 100 run-of-river power plants are continuously monitored in accordance with the provisions of water laws and operating and monitoring regulations. Our dam managers and their deputies are responsible for monitoring dam safety. The dam wardens are in charge of the continuous monitoring on site. Meteorological controls such as measurements or hydrographic assessments ensure the safety of the run-of-river power plants and headwater areas of rivers.

Continuous maintenance of the safety installations extends to both the structures and the headwater areas. Sediments such as sand and gravel must be moved for flood protection. This is done by lowering water levels or dredging sediment in the headwater areas (sediment management).

### Emergency and crisis management

To be prepared for extreme weather events, VERBUND relies on well-trained personnel who are available in case of emergency. Our emergency and crisis management system is based on the national crisis and disaster management system, which facilitates a coordinated approach together with the emergency services and enables us to respond quickly. It is founded on scenario-based contingency plans as well as general and advanced training of crisis units and the officers in charge. Drills in preparation for extreme weather scenarios are carried out regularly, with the lessons learned being used to refine the crisis management system.

APG cooperates closely with the Austrian Armed Forces to rectify the damage to high-voltage lines caused by storms, among other things. With this unit's assistance, an emergency restoration structure with a replacement line to bridge a damaged mast can be installed within days. APG also maintains ongoing dialogue with meteorologists and avalanche warning services to ensure the best possible preparations are made for extreme weather events.



Gries run-of-river power plant (Salzburg): the check dam helps to reduce the risk of flooding and hazards for local residents. (top)

Power lines with bent pylon after a storm (bottom)

# Applied research at VERBUND

VERBUND is involved in applied research and also commissions studies itself. This allows changes in the climate and their effects on the water supply to be identified at an early stage. Here you can find a selection of projects:

## Permafrost in the Hohe Tauern region

The Hohe Tauern region spans an area of nearly 2,500 km<sup>2</sup>. Almost one-third of this is permafrost – ground that is frozen solid the whole year round. An increase in the temperature can lead to melting of the permafrost and destabilise slopes and steep rock faces, potentially causing rockfalls, landslides or mudslides. The Permalp<sup>7</sup> project involved drawing up the first detailed permafrost distribution map for the Hohe Tauern region. Completed in 2012, the project thus laid the foundations for planning future infrastructure measures in the mountains.

## Climate change and water balance

The POWERCLIM project commissioned by VERBUND investigated possible effects of climate change on the water balance and hydroelectricity generation, focusing on ten catchment areas in Austria and Bavaria. The COMET-funded study was conducted by the Meteorological Institute and by the Institute for Hydrology and Water Management of the University of Natural Resources and Life Sciences, as well as by alpS GmbH in Innsbruck. It was updated and supplemented in 2019 with POWERCLIM\_HOT<sup>8</sup>.

## Snow cover and potential for run-off

Snow cover in spring plays an important part in filling Alpine reservoirs. Due to climate change, snow conditions are likely to differ considerably from one winter to



In the SNOWPOWER project drones are used to evaluate snow cover in high Alpine reservoirs.

the next. Modelling melt water inflows necessitates a precise, extensive evaluation of the snow cover. VERBUND is taking advantage of rapid advances in drones and digital cameras. In the SNOWPOWER<sup>9</sup> project, which will run until 2022, we will develop a cost-effective method for evaluating snow cover in high Alpine regions and for determining the potential for run-off.

## Natural hazard management

Due to Austria's Alpine location, VERBUND's energy infrastructure is subject to many natural hazards with the potential to cause damage at different points in the system. In the RIMES<sup>10</sup> project that was completed in 2016, uncertainty factors in the different research objects (climate change, natural hazards, economic losses) were investigated and interdependencies interpreted. The study was funded by the Climate and Energy Fund of the Austrian Climate Research Programme (ACRP).

## ABS for the power grid (ABS4TSO)

In response to climate change, renewable generation is being expanded all across Europe. This is transforming the electricity system and helps to compensate for frequency variations. APG is able to manage

<sup>7</sup> Permalp – Modelling Alpine permafrost distribution in the Hohe Tauern region, Austria. Project partners: Hohe Tauern National Park, ÖBB-Infrastruktur, Gletscherbahnen Kaprun AG, VERBUND and others (2009–2012).

<sup>8</sup> POWERCLIM\_HOT (2019).

<sup>9</sup> SNOWPOWER – Evaluating snow cover in high Alpine locations. Project partners: VERBUND, Verfahren und Umwelt Management GmbH (2019–2022).

<sup>10</sup> RIMES – Climate Change and Natural Hazards Risk Management in Energy Systems. Project partners: VERBUND, Climate and Energy Fund (2010–2016).





such variation using effective balancing services. In the ABS4TSO<sup>11</sup> project this countermeasure is being researched by APG together with VERBUND, Vienna University of Technology and the Austrian Institute for Technology (AIT). The core element of the project is a battery storage system with a capacity of 1 MW/500 kWh.

#### **Solar wind early warning system**

Solar storms passing Earth may cause turbulence, which can have a negative impact on components of the transmission grid. By measuring the Earth's magnetic flows in APG's grid<sup>12</sup>, the Central Institution for Meteorology and Geodynamics (ZAMG) obtains new data and findings that will be used to refine the solar wind evaluation system designed by ZAMG. This early warning system will allow APG to respond to critical developments in a timely manner.

#### **Protection of the red kite**

The LIFE Nature project EUROKITE<sup>13</sup> is analysing human influence on the mortality of the red kite and three other species of birds of prey with the objective of developing measures to reverse this. The project is based on robust data on habitat use and covers a relevant geographical area.

APG expects the project to deliver information for protective measures on relevant sections of lines, among other things.

#### **Flood forecasting in Salzburg**

In the HYDRIS II<sup>14</sup> project the flood forecasting system in the federal state of Salzburg was developed further. The discharge trend in the next 72 hours can be forecast using the water balance model, thus simplifying flood management for the Mittlere Salzach power plant group and allowing the emergency services and local residents to be alerted in good time. VERBUND, Salzburg AG and the Hydrographic Service of Salzburg participated in this project, which was brought to a close in 2015.

#### **Movement of sediment in rivers**

Erosion, transport and deposits of sediment all impact on bodies of water. A project by the Christian Doppler Laboratory for Sediment Research and Management<sup>15</sup> that is scheduled to run until 2024 is analysing the options for optimising sedimentation in Austria's rivers.

The LIFE Nature project EUROKITE creates a basis for protecting the red kite around high-voltage lines. (left)

HYDRIS II helps to forecast flooding in Salzburg over the following three days. (right)



#### **Our commitment: Research into climate change**

VERBUND operates over 130 hydropower plants and the Austrian transmission grid. Scientific discussion of climate change and the resulting natural hazards is important for their safe operation, which is why we continuously become involved in applied research projects. These focus primarily on climate change, effects on the water supply and temperature extremes as well as the resulting generation and marketing potential.

11 ABS4TSO – Advanced Balancing Services for Transmission System Operators. Project partners: APG, Austrian Institute for Technology (AIT), Vienna University of Technology and VERBUND (2018–2021).

12 Solar winds and their effects on the Austrian high-voltage grid. Project partners (among others): APG, Graz University of Technology, ZAMG (2014–2017).

13 LIFE EUOKITE – LIFE Nature project. Project partners: APG, European Union's LIFE programme (2020–2024).

14 HYDRIS II – Hydrological Information System for flood forecasting. Project partners: VERBUND, Salzburg AG and the state of Salzburg (2010–2015).

15 See: [Christian Doppler Laboratory for Sediment Research and Management](#).







# Scenarios in the energy market: prospects for VERBUND

We attach importance to interacting with the environment in a responsible manner. This involves continuing to reduce greenhouse gas emissions at VERBUND. We are resolutely charting our own course, prioritising climate-neutral electricity generation from hydro, wind and solar power.

Scenarios in the energy market assume rising carbon prices, growing demand for electricity and a significant expansion of renewable energy. The objective is to decarbonise the entire electricity market. How quickly this happens depends on the future climate and energy policy and on the technical and economic possibilities.

VERBUND is ideally positioned to take advantage of any opportunities that arise: as a producer of hydroelectricity and a driver of innovation, we are the partner of choice for the green energy future. Through our 2030 strategy we have addressed key topics and created effective levers for their implementation.

# Managing greenhouse gas emissions

VERBUND is committed to interacting with the environment in a responsible manner. This includes continuously reducing its greenhouse gas emissions. We are therefore resolutely charting our own course, prioritising electricity generation from renewable hydro, wind and solar power.

## Emissions in Austria<sup>16</sup>

According to Environment Agency Austria, around 79 million tonnes of greenhouse gases were emitted in Austria in 2018. The lion's share as reported in emissions trading, at 34.3 million tonnes CO<sub>2</sub> equivalent (36%), is emitted by industry and the power sector. Of this figure, emissions traders in the power sector generated 9.1 million tonnes, while industry generated 19.3 million tonnes. This was followed by the transport sector, which was responsible for 23.9 million tonnes (30%).

In 2018, industry and the power sector generated 2,2 million fewer tonnes of CO<sub>2</sub> than in 1990. Transport, on the other hand, saw emissions climb by 10.2 million tonnes (+73.7% since 1990). The national climate target (excluding emissions trading) was therefore not reached. A comparison of

Austrian greenhouse gas emissions and the targets set out in the Paris Agreement shows that there is still work to be done!

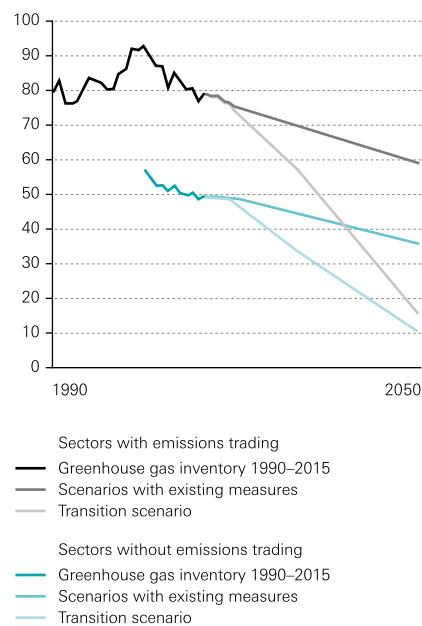
## Emissions at VERBUND

VERBUND emphasises emission-free generation of hydroelectricity, supplemented by wind and solar power. Most of our greenhouse gas emissions stem from thermal power plants, which are used for grid support across Austria and to supply district heating to the city of Graz. The discontinuation of coal-fired generation of electricity and district heating from the end of March 2020 is an important step in further reducing these emissions.

## Scope 1, direct emissions

VERBUND's direct greenhouse gas emissions amounted to 1.07 million tonnes in 2019. Over 99% of this figure was attributable to CO<sub>2</sub> emissions arising from the combustion of fuels in thermal power plants. Less than 1% was attributable to CO<sub>2</sub> emissions from fuels used by VERBUND's vehicle fleet and to SF<sub>6</sub> emissions. SF<sub>6</sub> is used as an insulating gas in high-voltage facilities.

## Greenhouse gas emissions up to 2050 in Austria



Source: Environment Agency Austria (2017)  
Emissions in million tonnes CO<sub>2</sub> equivalent

## How greenhouse gases are recorded at VERBUND

VERBUND's carbon footprint is measured based on the "Corporate Accounting and Reporting" reporting standard of the Greenhouse Gas Protocol (GHG Protocol).

This divides greenhouse gas emissions into the following scopes:

**Scope 1** emissions are direct emissions – for example arising from combustion in thermal power plants or from the vehicle fleet.

**Scope 2** emissions are indirect emissions from the generation of purchased energy (district heating, electricity).

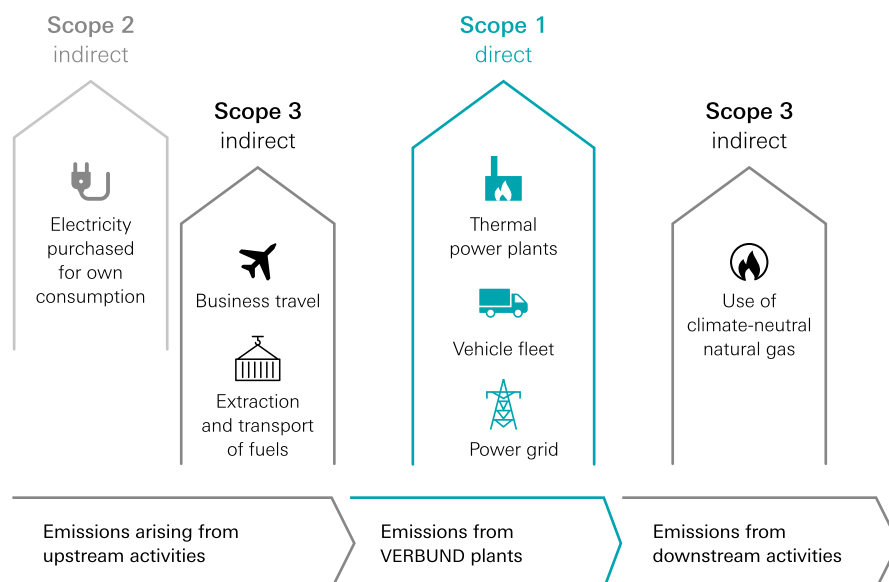
**Scope 3** emissions (optional) are other indirect emissions arising in the value chain outside the organisation, for example through business travel or transport.



## VERBUND's carbon footprint

Source: chart based on the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard

Greenhouse gas emissions in CO<sub>2</sub> equivalent



Direct emissions from thermal power plants fall within the scope of EU emissions trading. In other words, a valid emission allowance must be acquired for every tonne of CO<sub>2</sub> emitted. Some of the required allowances were purchased because the free allocation for VERBUND's combined cycle power plants covered only 5% in 2019.

In the carbon footprint, emissions are converted into CO<sub>2</sub> equivalent. VERBUND factors all CO<sub>2</sub> and SF<sub>6</sub> volumes into this calculation. Direct biogenic emissions are reported separately. In 2019, approximately 1,000 tonnes CO<sub>2</sub> equivalent per kilowatt hour (CO<sub>2</sub>e/kWh) were generated from the co-incineration of sewage sludge. The N<sub>2</sub>O and CH<sub>4</sub> emissions generated from burning fossil fuels at the thermal power plants and the emissions arising from coal storage are not counted. This is because a study showed that these factors together make up less than 1% of the power plant's Scope 1 emissions.

### Scope 2, indirect emissions

The Scope 2, indirect emissions arising from electricity purchased are provided with their location-based and market-based figures. Location-based Scope 2 emissions are calculated using the CO<sub>2</sub> emission factor of the local power grid. This figure therefore only changes if there are changes in the absolute volume of electricity purchased and/or general changes in the European generation landscape.

Market-based Scope 2 emissions can be reduced by purchasing electricity generated from energy sources with lower emissions per kilowatt hour. For several years now, VERBUND has exclusively used electricity with guarantees of origin from 100% renewable energy to operate pumped storage power plants, which has helped us to substantially reduce our market-based emissions. The figure is determined by adding the losses in the power grid and has

remained consistently low in past years. In 2019 it came to 0.3 million tonnes CO<sub>2</sub> equivalent.

### Scope 3, indirect emissions

Scope 3, indirect emissions currently comprise the following emissions in the value and supply chain:

Upstream emissions arise from the production and transport of the fuels and from business travel by plane, train or private car.

Downstream emissions arise from the combustion of natural gas at customers. VERBUND compensates for these emissions through certified climate action projects (expansion of renewable energy, for example at the Ashta hydropower plant in Albania) and reports them as part of its carbon footprint.



### Our position: Climate action requires decarbonisation

Increased decarbonisation is required if we are to combat climate change. The aim is to reduce CO<sub>2</sub> emissions to the greatest extent possible by using electricity from renewable energy sources, while increasing energy efficiency at the same time. This calls for an integrated approach: the energy, heating, transport and industrial segments will be connected through sector coupling.

### Our reduction targets

VERBUND is on course to become a 100% carbon-free utility. As a reliable grid operator and a provider of customer-centric solutions we also support climate action, one of the main goals of which is decarbonisation.

### Target: “well below 2 degrees”

The Paris Agreement aims to reduce world-wide emissions of greenhouse gases to a level intended to limit a rise in global temperatures to below 2°C or, better still, to below 1.5°C. VERBUND has set itself an ambitious climate target of a 90% reduction in our greenhouse gas emissions by 2021 compared with 2011.<sup>17</sup> This target was validated in 2016 by the international Science Based Targets Initiative as being consistent with the reductions needed to limit global warming to well below 2°C.

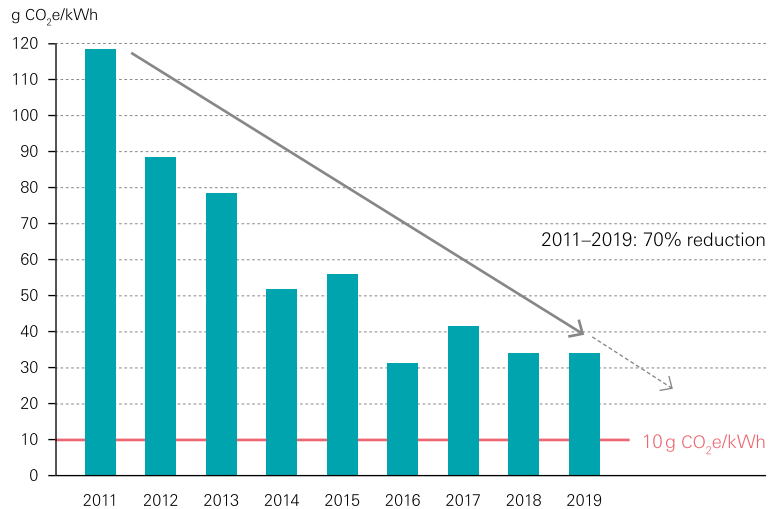
We continuously implement measures to achieve this target. In addition to scaling back thermal generation, we are switching the electricity for pumped storage operations over to 100% renewable energy, reducing fuel consumption and increasing energy efficiency. Together with other European utilities, the CEO of VERBUND signed the Declaration by European Electricity Sector Chief Executives – Carbon Neutrality 2050 back in March 2009.

### Reducing specific emissions

VERBUND's specific Scope 1 emissions are expected to fall to below 10 g CO<sub>2</sub>e/kWh of total electricity generation by 2021. In 2019 they amounted to 32 g CO<sub>2</sub>e/kWh. This has already put us well below the specific figure for direct emissions in the Austrian production mix (2018: 142 g CO<sub>2</sub>/kWh) and even further below the figure for Germany (2018: 469 g CO<sub>2</sub>/kWh). Between 2011 and 2019 the specific emissions had already fallen by 70%. VERBUND also provides

### Reduction of specific greenhouse gas emissions at VERBUND

Source: VERBUND (greenhouse gas emissions Scope 1/total electricity generated incl. purchase rights excluding electricity generated for district heating)



regular updates on target achievement in ratings such as the Carbon Disclosure Project (CDP).

### Reduction versus 1990

A comparison of direct CO<sub>2</sub> emissions from VERBUND's thermal power plants in 2019 with those in 1990 shows a reduction in the absolute figure by almost 3 million tonnes CO<sub>2</sub>e/kWh. The Dürnröhr, Korneuburg, St. Andrä, Voitsberg, Pernegg and Zeltweg thermal power plants that were still in operation at this time have since been shut down.

The average specific value in 1990 was 860 g CO<sub>2</sub>e/kWh, but in 2019 it was only 680 g CO<sub>2</sub>e/kWh of the electricity generated in thermal power plants. Discontinuation of coal-fired generation at the Mellach district heating power plant near Graz in March 2020 will further reduce this figure.

### Further reduction of emissions

Discontinuing our coal-fired operation of thermal power plants enables us to press ahead with cutting our greenhouse gas emissions. We will also reduce other emissions into the air, such as CO, SO<sub>2</sub>, NO<sub>x</sub> and dust. We plan to lower the volume of emissions generated by VERBUND's vehicle fleet by implementing measures from the fleet strategy.



### Our commitment: Phase out hard coal

Discontinuation of coal-fired generation at the Mellach district heating power plant near Graz in March 2020 put an end to coal-fired electricity generation in Austria. Austria's last coal-fired power plant had used hard coal to generate power and heat. By switching over to gas firing, the plant serves as a “grid fire department” to support the power grid as needed. The nearby Mellach combined cycle gas turbine power plant is also regularly used for this purpose. In addition, the site in Mellach will be developed into a VERBUND innovation and research centre.

<sup>17</sup> These include Scope 1, Scope 2 market-based and parts of Scope 3 emissions for fuel and air travel.



# Scenarios in the energy market



Mooserboden reservoir near Kaprun: Austrian pumped storage power plants will continue to play a key part in stabilising the power grid going forward.

This Climate Report is based on different scenarios in the energy market ranging from VERBUND's calculations and the forecasts of the international consulting firms IHS Markit and PÖYRY to the World Energy Outlook published each year by the International Energy Agency (IEA).

All of the scenarios assume that carbon prices will rise, demand for electricity will increase and generation of electricity from renewables will be expanded, with a view to achieving complete decarbonisation of the electricity sector. The speed of decarbonisation is estimated differently based on the parameters assumed. This depends to a large extent on the future climate and energy policy outlined in the framework at the beginning, as well as on our technical and economic opportunities.

The scenarios, which are ambitious from a climate policy perspective, assume that electricity generation in Europe will be carbon free from as soon as 2045. Less ambitious scenarios put this at 10 to 20 years later. At a global level, the IEA does not expect a carbon-free energy sector before 2070 at the earliest. An investment programme is required for this. The IEA estimates the annual capital expenditure required in the power sector alone at US\$ 1.2 trillion, an increase of around 60%.<sup>18</sup>

<sup>18</sup> Source: IEA – World Energy Outlook 2018 (2019).

# The climate crisis – an opportunity for VERBUND

The high share of hydropower in VERBUND's generation portfolio makes us one of Europe's most climate-friendly utilities. The current scenarios in the energy market give rise to strategic opportunities for new renewable energy sources, climate-friendly technologies and innovative business models.

## Growing demand for green electricity

The IEA's Sustainable Development Scenario forecasts that global demand for electricity will increase by as much as 60% until 2040.<sup>19</sup> At the same time, the share of renewable energy will rise from around one-quarter to up to two-thirds. Along with ambitious emission targets, such as those set out in the Paris Agreement of 2015, two factors in particular are contributing to this megatrend: the falling costs of generating electricity from solar and wind power and the expansion of electricity storage.

Austria's Government Programme 2020–2024 sets a target of generating 100% of electricity from renewable sources (national balance) as early as 2030. This requires a nationwide expansion of renewable energy by 27 terawatt hours. So that this target can be reached, VERBUND is continually increasing the efficiency of its existing power plants and exploiting potential to expand its hydropower operations. We are also pushing ahead with wind and solar power projects.

## Sector coupling requires expertise

The future of energy rests on the decarbonisation of the entire economy. A critical factor for success in this regard is sector coupling and sector integration, i.e. the use of green electricity in transport, the heating supply and industry with the aim of successively replacing fossil fuels with renewables. Using electricity in these sectors will reduce CO<sub>2</sub> emissions

and increase energy efficiency. Domestic hydropower, which is reliable and flexible, is a key pillar of this strategy.

Having over 70 years of experience with major projects and a firm foothold in the capital markets, VERBUND is the partner of choice when it comes to advancing sector integration. Strategic partnerships with Austrian industry leaders such as voestalpine and OMV underline our policy of harnessing our strengths to develop Austria as a business location.

## Climate change is a key issue for VERBUND

We have set the course for the future of energy with VERBUND's 2030 strategy. It is built on five pillars: maintaining the value of hydropower generation while exploiting the potential to increase efficiency and grow this form of energy; expansion of wind and solar power from new renewable sources of energy; safe grid operation; security of supply; and customer-centric solutions in the energy sector.

## Hydroelectricity

Generation of electricity from hydropower forms the basis for the renewable power supply as well as security of supply in Austria both now and in the future. VERBUND is one of the largest producers of hydroelectricity in Europe. Over 90% of our energy comes from climate-neutral hydropower. We are continuing along this path by ensuring smooth operation of our power plants, implementing measures to increase efficiency and exploiting the potential to expand in Austria.

## Expansion of wind and solar power

We are pressing ahead with expanding our onshore wind power and solar power operations. By 2030 as much as one-quarter of VERBUND's electricity generation will be

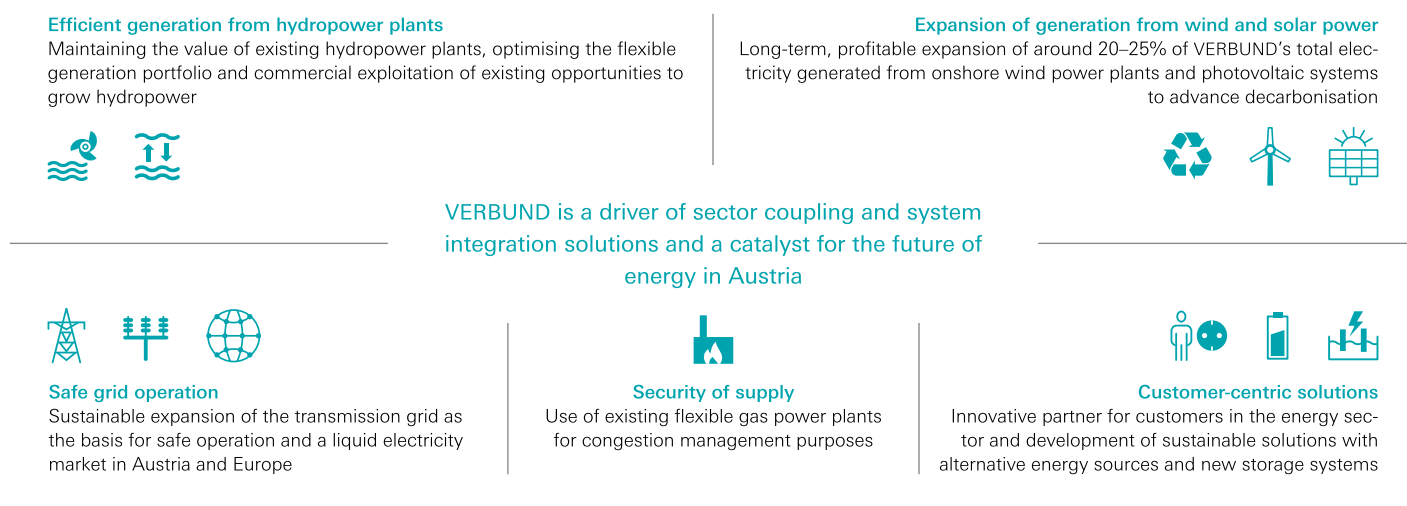


Wind power – as here in the Bruck an der Leitha wind farm (Lower Austria) – has good prospects, as does solar power.

<sup>19</sup> Source: IEA – World Energy Outlook 2018 (2019).



## VERBUND's 2030 strategy



from new renewable sources of energy. Besides our core markets of Austria and Germany, we have other attractive regions in our sights. Here the focus will be on implementing the Group's own projects as well as acquisitions.

### Reliable grid operation

The transmission grid is the backbone for the future of energy, which is why extensive investments will be made in the expansion of the power grid that will ensure an uninterrupted supply of power in Austria in the long term.

### Security of supply

The expansion of new renewable energy sources poses challenges for the power grid. To safeguard supply, we rely on flexible congestion management. The existing gas power plants in Mellach near Graz are a key element of this strategy.

### Customer-centric solutions

VERBUND is a valued partner for its customers on the road to the future of energy thanks to its sustainable products and services. At their core are innovative technology and business models – from energy storage systems to e-mobility to demand response solutions.







# Looking forward

As Austria's largest utility, VERBUND is a pace-setter for the future of energy. To ensure security of supply, we will also continue to observe closely the risks arising from the climate crisis.

## Advancing the use of clean technologies

We are taking advantage of the new opportunities arising from the climate crisis for renewable energy expansion, development of climate-friendly technologies and establishment of new business models. One such example is VERBUND's long-standing commitment to e-mobility. Through the SMATRICS joint venture founded in 2013 we offer a nationwide network of charging stations for electric vehicles in Austria. Further projects are being evaluated.

We use local battery storage units to meet the challenge of providing high-powered grid connections for the latest charging solutions. The first ten locations with a high-performance charging infrastructure will be implemented in Austria and Germany by 2021 as part of the EU-funded innovation project SYNERG-E. Lithium-ion batteries for use in industry and electric vehicles are tested at our innovation hub in Mellach, near Graz.

## Hydrogen – an opportunity for future growth

One promising resource for the future is green hydrogen. As a supplier of hydroelectricity we have the capacity to produce hydrogen from green electricity. This has huge potential as a substitute for hydrogen produced from natural gas, for reducing CO<sub>2</sub> emissions in industry and traffic and as a storage medium for wind and solar power. VERBUND and a number of partners from industry are collaborating on the breakthrough of this clean source of energy in Austria.

## Cutting-edge research and development

Research, development and innovation are the bedrock for the future of energy. We develop new solutions for mitigating climate change along up with partners from science and research, innovative companies and start-ups. We are building an innovation and research centre in Mellach near Graz that will focus on hydrogen, new storage and battery solutions, and digital applications.

The climate crisis is the great challenge of our time. Tackling it requires striking out in new directions and developing sustainable solutions. At VERBUND we are rising to this challenge. Using our powers of innovation we are refining our energy system so that it is in shape for what lies ahead. We will ensure that people and business in Austria have a consistent supply of energy, thus laying the foundations for a future worth living.



## Our commitment: Push green hydrogen

In collaboration with partners from research and industry we are developing green hydrogen as the key to the future of energy. In the H<sub>2</sub>FUTURE project we have teamed up with leading Austrian companies to produce hydrogen for industrial processes. Green hydrogen will be produced at VERBUND's Mayrhofen power plant in Tyrol that after 2023 will be used to power the Zillertal Railway. At the Mellach site near Graz we are testing hydrogen technology with high-temperature fuel cells.



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VERBUND is Austria's leading utility and one of the largest producers of hydroelectricity in Europe. Almost 100% of our electricity is generated from renewable sources of energy. We are also active in the fields of transport, sales, trading and energy services.

VERBUND has been listed on the Vienna Stock Exchange since 1988, with 51% of the share capital held by the Republic of Austria. Our around 2,800 employees do sterling work every day, making us one of Europe's most profitable electricity companies.

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