GREENING THE GAS

RESEARCH REPORT 2021

AUSTRIAN ASSOCIATION
FOR GAS AND WATER

ÖVGW
ÖSTERREICHISCHE VEREINIGUNG
FÜR DAS GAS- UND WASSERFACH

Legal notice

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PREFACE

Photo: G. Koch

Michael Mock
CEO, ÖVGW

When the *Greening the Gas* strategy was developed three years ago, and the ÖVGW research initiatives 'Green Gas 4 Grids' and 'Green Gas 4 Mobility' were launched, they came as a response to the political provisions for moving away from fossil energy sources. The driving force behind research into the technical feasibility of increasing the use of renewable gases was the knowledge that even in a decarbonised energy system, gas cannot be dispensed with as an energy source, and the belief that the decommissioning of a well-developed infrastructure is irresponsible from an economic point of view.

At the beginning of this year, the discussion surrounding transforming the energy system took on an additional aspect. The war in Ukraine and the West's response, linked to scenarios such as a potential freeze or embargo on Russian gas supplies, suddenly made energy supply security a public issue. Green gas now stands out not only in terms of sustainability and climate neutrality, but also as an energy source that can be produced domestically and is largely independent of imports – with corresponding local added value and positive effects on the domestic labour market.

Green gas as an energy source that is as climate-neutral as it is secure in supply and reduces dependency on imports – in light of this, the ÖVGW feels all the more validated in its research mandate and will continue to fulfil it with great commitment. In the past three years, the association has already awarded around 30 projects to its research partners and thus made a significant contribution to creating the technical prerequisites for the increased use of biomethane and hydrogen. The research work is accompanied by an image and information campaign carried out jointly with the Gas Heat Association to raise public awareness of the topic of green gas.

The annual research report offers an overview of currently commissioned reports and provides information on research progress.

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ÖVGW RESEARCH INITIATIVES AS PART OF THE 'GREENING THE GAS' STRATEGY

Background

As a result of the Paris climate conference, the Austrian federal governments have also set themselves ambitious goals – initially with #mission2030 and then in the Government Programme 2020–2024: From the year 2030, Austria's electricity, at least in terms of balance, should come 100 percent from renewable sources, and by 2040 the entire energy system should be largely decarbonised. In the long term, the planned energy transition and move away from fossil energy sources also spells the end of natural gas, which remains a major pillar of energy security in today's landscape.

Meanwhile, the switch to renewables such as wind energy, photovoltaics and hydropower poses its own significant problem: as their extraction is heavily dependent on weather and other natural factors, secure, reliable and affordable energy supply cannot be built on these alternative sources alone. Production cannot cover demand, particularly during periods of high energy demand (in the winter months), which energy surpluses achieved (in the summer months) cannot be stored for technical reasons.

Variety and role of gas as an energy source

Use of existing gas infrastructure offers a realistic and economically viable solution to the problem that is quick to implement. Excess power from volatile renewable sources can be converted into hydrogen via electrolysis and supplied to the gas network – or, in an additional step, turned into methane. As a result of this pairing of sectors, the widespread distribution and enormous storage capacities of gas infrastructure are available to energy obtained from renewable resources.

That means gas isn't just gas. Although consumption is still largely covered by natural gas imports, renewable gas generated in Austria is increasingly important. This 'green gas' consists partly of biogas from residues, which is supplied in refined form to make biomethane, and partly of synthetic gas or hydrogen obtained in power-to-gas plants.

Electricity production in Austria has already largely moved from coal and oil to natural gas, which has made major savings in CO_2 and pollutant emissions.

Gas Roadmap 2040

The aim is now to gradually replace fossil fuel natural gas with climate-neutral gases in all sectors of use. The Austrian gas industry is pursuing this goal with its *Greening the Gas* strategy.

The role of the ÖVGW

For the implementation of the *Greening the Gas* strategy, in addition to the design of suitable economic and legal framework conditions, clarification of a large number of technical and safety issues in connection with the use of biomethane, synthetic gas and hydrogen is required. This is part of the ÖVGW's remit. As the technical arm of the Austrian gas industry, it must create the conditions in this area for gas as an energy source to take on the decisive role necessary for the energy transition to succeed. Comprehensive measures are required to perform these duties. From an organisational perspective, a working group dealing with this topic – 'Greening the Gas' working group – was set up, the coordinating Gas Research Council was created and the financial and human resources were expanded.

ÖVGW research initiatives

This material requires an incredible amount of research. Accordingly, the ÖVGW has launched two initiatives, each initially set up for five years. Their purpose is to clarify fundamental questions and set the timetable for natural gas to be replaced by renewable gases. It will then be time to examine the details.

With the launch of the research plans in 2019, the ÖVGW awarded seven projects. A further nine followed in 2020. In the reporting year 2021, 12 projects were on the agenda. Projects were continued in some research areas, while new subject areas were also addressed.

The organisation of ÖVGW research initiatives

Gas Research Council

Chair: DI(FH) Manfred Pachernegg
Members: Board members and CEOs from gas sector member companies
Function: Strategically orienting research initiatives
Set up by decision of the board of directors

Temporary working group – 'Greening the Gas'

Chair: DI(FH) Manfred Pachernegg (as chair of the Gas Research Council)
Deputy: DI Wolfgang Kral (as chair of the Gas Coordination Committee)
Members: Representatives of member companies in the gas sector
Function: Project operations, coordination within member organisations
Set up by decision of the board of directors

ÖVGW office, gas division

Coordination and management of research agendas and relevant committees by advisor DI Sascha Grimm

Duration and financing

The research initiative is set up for a minimum of five years. The research funds are raised by an increase in membership contributions.

ÖVGW research initiatives – remits and responsibilities

Green Gas 4 Grids

The aim of the ÖVGW research initiative *Green Gas 4 Grids* is to clarify outstanding questions regarding the production and network supply of renewable gases. This ranges from the efficient generation and processing of gas to a possible redefinition of the gas quality and the creation of a corresponding technical regulatory framework in the ÖVGW regulations and ÖVGW certification.

Green Gas 4 Mobility

The *Green Gas 4 Mobility* initiative should allow research projects to help lay the foundations for the use of renewable gases in the transport and mobility sectors. Fundamentally, the aim is to determine the extent to which renewable gases can be used and which options and limitations are in play.

The research partners

A wide variety of aspects must be taken into account as part of the *Greening the Gas* strategy: technical (such as material issues, combustion technology, P2G technology, gas processing or CO_2 separation), infrastructural, safety-related, economic, socio-economic, business and environmental. Projects designed to clarify the issues faced must therefore be conducted in collaboration with renowned universities, research institutions and experts from a variety of disciplines.

For the research projects in 2021, contracts were awarded to the following partners:

- *BESTresearch – Bioenergy and Sustainable Technologies GmbH*
- *DBI Gas- und Umwelttechnik GmbH*
- *Forschung Burgenland / FH Pinkafeld* (Department of Energy & the Environment)

ÖVGW cooperation partners in Greening the Gas research initiatives 2021

- *Hydrogen Center Austria*
- *Johannes Kepler University of Linz*
- *keep it green gmbh. Partner der Energiewirtschaft*
- *Montan University Leoben* (Chair of Thermal Process Technology)
- *HR Dipl.-Ing. Dr. Bernhard Schneider* (expert)
- *Technical University Vienna* (Institute for Energy Technology and Thermodynamics; Institute for Fluid Mechanics and Heat Transfer)

International partnerships enhance local expertise. As many issues cannot be resolved in isolation, the ÖVGW relies on European collaboration across the entire initiative and is in close contact with its sister industry associations in Germany and Switzerland, *Deutscher Verein des Gas- und Wasserfaches e.V. (DVGW)* and *Schweizerischer Verein des Gas- und Wasserfaches (SVGW)*. Cooperation such as that which occurs with *DBI Gas- und Umwelttechnik GmbH* – the research institution of the DVGW – offers the opportunity to tap into German potential and expertise.

The ÖVGW is also a founding member of the *ERIG – European Research Institute for Gas and Energy Innovation* research platform, founded in 2018 and based in Brussels. Here, colleagues work alongside others from Denmark, Germany, the Netherlands, Switzerland and Slovakia. The aim of *ERIG* is to promote the decarbonisation of the gas supply and to define the role of renewable gases in the future energy system through cross-border research and the exchange of national research results.

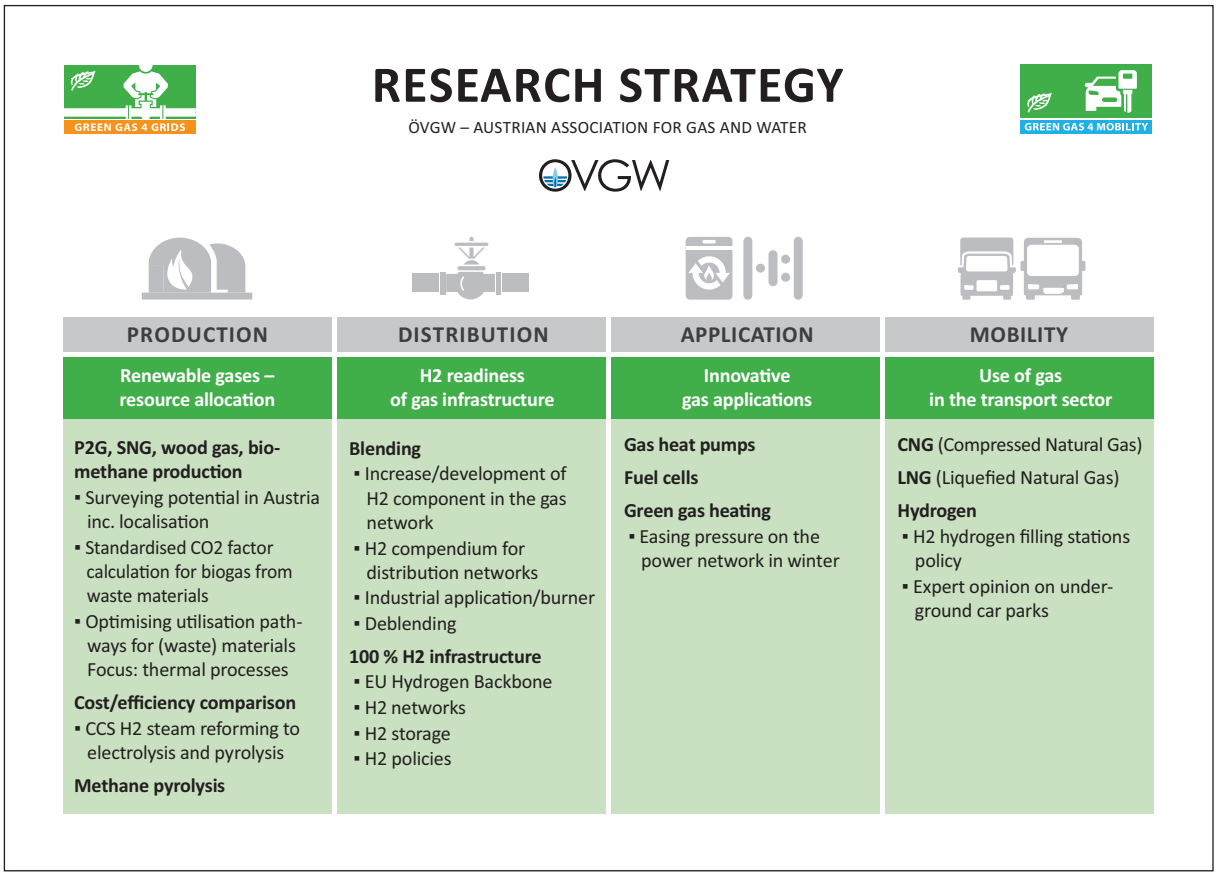
THE RESEARCH STRATEGY

ÖVGW's research strategy is developed and approved by the Gas Research Council, the body set up specifically to manage and support the *Greening the Gas* initiative. The research strategy defines which topics are relevant for the market penetration of renewable gases and which outstanding questions of a technical, organisational or economic nature are to be scientifically examined and clarified by suitable research projects.

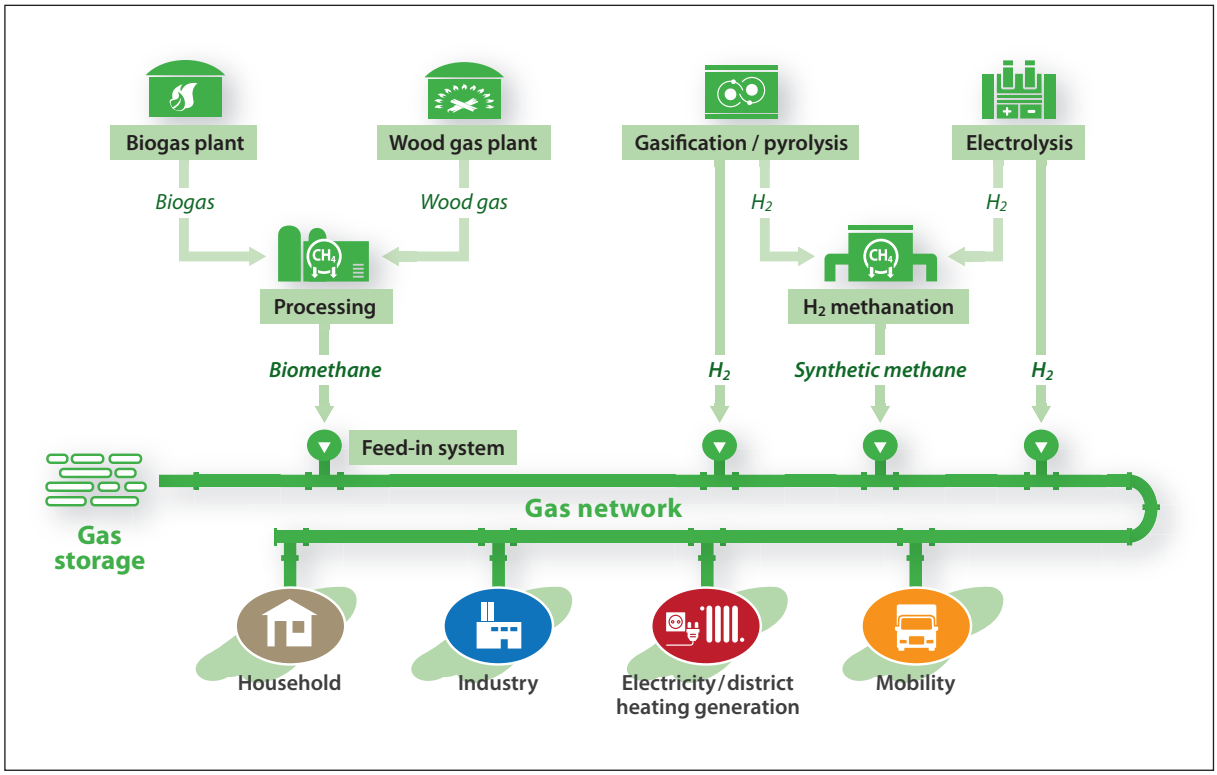
The strategy also includes the gas roadmap, which describes the timeline of the gradual phase-out of fossil gas and the simultaneous switch to biomethane and hydrogen.

The research activity specified by the research strategy extends to the four areas of production, distribution, application and – as a special area of application – the mobility sector and deals, for example, with issues of resource allocation and the H_2 readiness of the gas infrastructure, with innovative gas applications on the consumer side and with legal aspects of the use of gas in transport.

The research strategy is supplemented by the publication strategy, which determines the extent to which the research results released for publication are made accessible to the various interest groups.



ÖVGW research strategy



Interactive research overview at www.ovgw.at

Interactive research overview

An interactive overview graphic was implemented on the ÖVGW homepage, which depicts the areas of generation, transport/storage and use of renewable gases. By clicking on the individual elements, the research projects assigned by ÖVGW on the corresponding topic are displayed in a pop-up window. This contains the basic information on each project (title, research assignment, project partners, duration and status) as well as a further link to the summary in the respective year of the research report. The content is updated annually.

The interactive graphic supplements the annual reports, which show the research activities chronologically, with their systematic access. Together, they provide a quick overview of the activities and priorities of the Greening the Gas initiative and the current state of research.

www.ovgw.at/gas/ueber-gas/interaktive-gasgrafik/

‘GREEN GAS DOES THAT!’ INFORMATION CAMPAIGN

Green gas does that!

Everything green gas can do was presented to the general public in 2021/2022 with the campaign slogan ‘Green gas does that!’. The information campaign conveys the advantages of green gas. The messages are placed in social media, as banner advertising in digital media networks and in public spaces in the form of digital outdoor advertising.

The central goal of the campaign supported by ÖVGW and FGW is to raise awareness of green gas as an indispensable part of the energy transition for security of supply, to raise public awareness of the topic of ‘renewable gases’ and to create awareness that now is the time to start leveraging our green gas potential and that politicians must now create the right framework conditions for this.

Each of the three ‘Green gas does that!’ campaigns featured several advertising elements in the form of video clips. The design deliberately focused on short, memorable messages with the slogan ‘Green gas does that!’, the human factor and the advantages of green gas for Austria and the energy transition. The aim was to make it clear that renewable gases make a stress-free switch to a climate-neutral energy source possible without additional costs, without requiring equipment to be replaced, all while maintaining supply security, generating jobs and covering the entire value chain.

These campaigns mainly used digital advertising media in order to achieve nationwide reach. Digital city lights in busy places throughout Austria, advertising banners in various online media and the social media channels of FGW and ÖVGW were used to carry the messages to ensure the right appearance. The distribution of advertising was expanded with native advertising and podcasts on online daily newspapers.

Social media presence

At the same time, the social media channels were expanded to include LinkedIn, Instagram and Twitter accounts, as well as Facebook, to use reach and interaction to share information and hold a dialogue. News on the topic, relevant and useful content, best practice examples, and so on were presented as posts in the form of images, statements and videos, to enhance the image, boost the profile and raise awareness of alternatives to fossil gas.

Subject matter from the ‘Green gas does it!’ campaign: a focus on education

RESEARCH PROJECTS

2021

01

GREEN GAS 4 GRIDS
RESEARCH PROJECT **01/2021**

Meta study on production of climate-neutral gases

RESEARCH CONTRACT: Survey and compilation of green gas production projects worldwide which may be directly or indirectly relevant to Austrian gas supply.

PROJECT PARTNER: Johannes Kepler University Linz
Dr. Karin Fazeni-Fraisl, Andreas Zauner, MSc, MMag. Francisco Villagarcia, DI Hans Böhm

TERM: 2021

STATUS: Completed, end report ÖVGW GF 65

THE PROJECT

The Austrian gas industry has set itself the target of only transporting climate-neutral gases – i.e. biomethane, hydrogen and bio-SNG – in its networks by 2040. While biomethane production should largely take place domestically, due to limited renewable energy sources, the lion's share of hydrogen will likely need to be imported from abroad. It would be expedient to ensure diversification of hydrogen imports.

The object of the study is therefore to survey and compile power-to-X (P2X) implementation projects with a focus on generation of climate-neutral gases. As well as surveying and pinpointing current implementation projects, this project will also look at planned projects. The focus is on implementation projects that offer potential for supplying Austria with climate-neutral gases. The geographic system boundary is global. A project is therefore included in the illustration if there is estimated to be potential for supplying Austria with possible imports.

Method

The investigation is based on a literature review and database research. The starting point for the survey is identifying potential export countries for P2X products. A major source for identified projects is the IEA Hydrogen Projects Database, which offers an up-to-date overview of P2X projects planned and implemented worldwide.

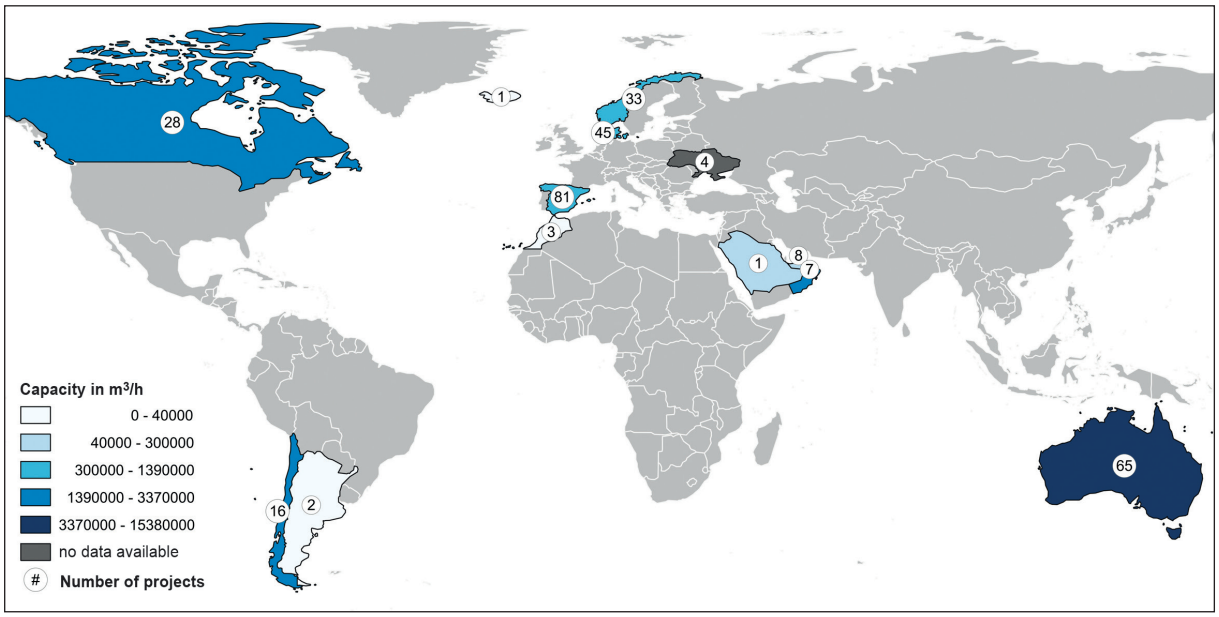
FINDINGS

According to a current estimate from the World Energy Council, a majority of countries in central Europe – including, alongside Austria, Germany, the Netherlands, Poland, Italy, France and Belgium – and other EU countries are more or less heavily dependent on hydrogen imports.

On the other hand, there are export countries, which, for instance, due to large swathes of 'unused' land, offer extensive potential for the production of renewable energy and are also developing specific strategies and projects for using these dormant areas of potential for P2X generation for the export market.

These potential export countries include:

- *Europe:* Norway, Spain, Iceland, Ukraine, Denmark
- *Middle East:* UAE, Saudi Arabia, Oman, Morocco
- *North America:* Canada
- *South America:* Chile, Argentina
- *Australia*



The map shows the countries where P2X generation projects are planned or taking place and where export to Austria could be considered.

OUTLOOK

Although there is extensive evidence available on the future necessity of importing H_2 and other P2X products, the details on potential quantities and countries of origin remain unclear in Austria. Accordingly, the next step is a specific assessment of future import requirements. In any case, diversification of sources is worth recommending in order to involve unilateral dependencies. A general recommendation for Austria's future supply is the combination of the best possible use of domestic possibilities and the broadest possible diversification in the origins of imports.

02

GREEN GAS 4 MOBILITY
RESEARCH PROJECT **02/2021**

Expert opinion on risk assessment for hydrogen vehicles in underground car parks

RESEARCH CONTRACT: Preparation of an expert opinion to show that the current legal situation, according to which hydrogen-powered vehicles are not allowed to enter underground car parks, is not justified from a safety perspective, and a reassessment of the situation.

PROJECT PARTNER: *Councillor Dipl.-Ing. Dr. Bernhard Schneider, expert*

TERM: 2021

STATUS: Completed, end report ÖVGW GF 66

THE PROJECT

While the parking of natural gas-powered vehicles is permitted without further restrictions in the relevant OIB guidelines 2.2 and 3 – with ventilation conditions to be assumed as set out by the specifications regarding carbon monoxide concentration control – vehicles powered by liquid gas or hydrogen are generally not permitted to be parked on the levels beneath the adjacent site.

In the EU Directive 2014/94/EU on the development of infrastructure for alternative fuels, hydrogen in road traffic is also mentioned as a strategic goal. To accelerate the market launch of fuel cells, the '*Fuel Cells and Hydrogen Joint Undertaking*' program was established, which has seen the EU Commission, industrial partners and research institutions join forces. In this context, various research programmes were initiated in the EU. Those worth mentioning are *HyLaw* (which shows legal barriers that exist within the EU), *HyResponder* (which deals with the consequences and requirements for emergency services) and above all *HyTunnel* (which focuses on the development of tools for risk analysis and strategies and technical solutions for the prevention of critical processes).

With regard to the current legal situation (as documented in *HyLaw*), it can be seen that in many places the matter is not regulated at all. Of the 16 EU countries documented, four report no restrictions. However, it is usually left to operators to impose restrictions, which are then usually motivated by insurance-related reasons. Some countries impose restrictions such as a ban on driving into underground car parks or a link to specific ventilation requirements.

FINDINGS

Hydrogen vehicles in underground car parks have a manageable risk potential, which can be reduced to a negligible level in the same way as with natural gas by increasing the air exchange rate by a factor of three to six. The current situation, a general ban on hydrogen-powered vehicles entering underground car parks, is not justified from a technical point of view. Overall, the worst-case scenarios for hydrogen and methane have very similar probabilities of occurrence and effects. A comparable risk can therefore also be assigned to the scenarios, as can be seen from the following summary of the results of this study.

Criterion	*Assessment*
Container security	Equivalent
Extension of the gas cloud with critical concentration	For an equivalent risk, an air exchange rate three to six times higher for hydrogen is required
Flammability	Hydrogen is more flammable, but the impact of this property on the risk cannot be derived from existing experience
Severity of an explosion	In principle, more severe for hydrogen; equivalent for typical released quantities and/or concentrations
Impact of a car park fire	Equivalent
Firefighting aspects	Equivalent

Comparison of natural gas-powered vehicles and pressurised hydrogen-powered vehicles

03

GREEN GAS 4 GRIDS
RESEARCH PROJECT **03/2021**

Current technologies and applications of gas heat pumps and electric heat pumps in combination with gas condensing boilers for end customers

RESEARCH CONTRACT: Decarbonisation of gas-supplied households that are not suitable for purely electric heat pump operation due to insufficient insulation or the built-in radiator system.

PROJECT PARTNER: Forschung Burgenland GmbH
DI Dr. Sebastian Schuh, BSc

TERM: 2021f.

STATUS: In progress

THE PROJECT

A heat pump works more efficiently the smaller the temperature difference between the heat source and the heat sink. Therefore, the use of a low-temperature heat emission system (e.g. underfloor heating) is also preferable. In older buildings with radiator heating, a conversion is only possible with great structural effort. If the heat pump is used to supply a radiator heating system, the building may be undersupplied on very cold days. The combination of heat pump and gas boiler – known as a 'hybrid system' – is an interesting option here.

In the calculations in this study, the electric heat pump took precedence, provided it was able to deliver the required amount of heat and flow temperature and achieve the minimum required COP (*Coefficient of Performance*). Otherwise, the gas boiler took over the heat supply.

Another possibility is the use of gas-powered heat pumps (gas absorption, gas adsorption and gas engine heat pumps).

The focus of the study was on older building stock with a heat emission system designed for a standard flow temperature of 70°C. Detached houses and apartment blocks (complexes with 4, 8 and 10 residential units) were considered. To take into account the age of the building and the degree of renovation, 5 classes were analysed for each house type:

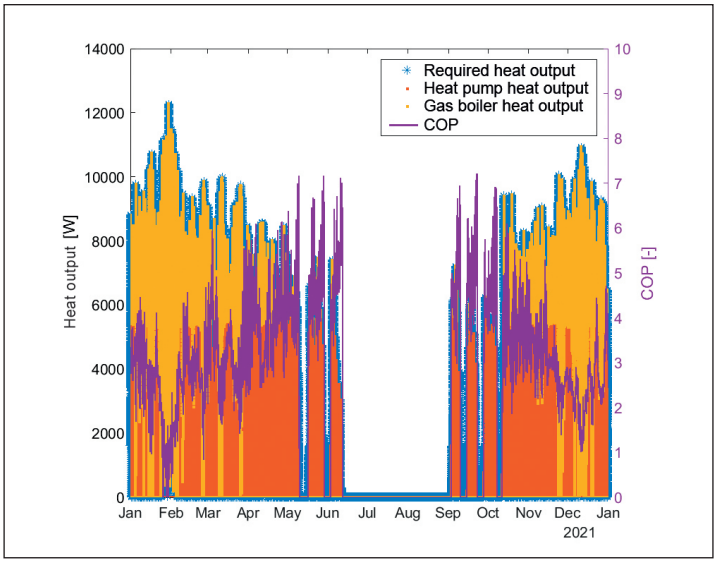
- Class 1: built before 1979
- Class 2: built between 1979 and 2001
- Class 3: built after 2001
- Class 4: built before 1979, good renovation measures
- Class 5: built before 1979, excellent renovation measures (ultra-low energy building)

FINDINGS

When using a standard flow temperature of 90°C for the heat emission system, a high-temperature heater is required, which is a criterion for ruling out the use of a heat pump. At temperatures of 55°C and lower, a heat pump can be used as the sole heating device.

At 70°C, heat supply shortages can occur on cold winter days if only one heat pump is used to supply the heat emission system. In order to still be able to benefit from the savings effects of a heat pump in older buildings and at the same time ensure year-round heat supply, the use of a hybrid system ***(electric heat pump and gas boiler)*** is an interesting option. Assuming the outside temperatures are low and the electricity mix at this point contains only a small proportion of renewable energies, it can make economic and environmental sense to heat the building with gas instead of operating the heat pump with electricity. However, if the electricity mix contains a high proportion of renewable energies (e.g. due to windy weather conditions) and if electricity prices are low due to high levels of electricity production, it can make economic and environmental sense to heat the building with the help of the electric heat pump, although the heat pump can only operate with relatively low efficiency due to the low outside temperature. A variation of the minimum required COP value made it possible to determine that the maximum cost savings are achieved when the COP value roughly corresponds to the ratio of electricity and gas prices. The figure shows what operation with a hybrid system of this nature would look like over the course of the year.

Another way to benefit from the lower gas costs in relation to electricity costs and still benefit from the advantages of a heat pump, thus reducing CO_2 emissions compared to conventional gas boilers, is the use of ***gas-operated heat pumps (gas absorption, gas adsorption and gas engine heat pumps)***. A detailed consideration as part of the study was able to show that gas absorption heat pumps have the greatest potential for saving gas, costs and thus also CO_2 when used in detached family homes and small apartment blocks compared to a gas boiler.



Hybrid system heating capacity: gas boiler + heat pump

04

GREEN GAS 4 GRIDS
RESEARCH PROJECT **04/2021**

Current technologies and uses of fuel cells as CHP in commercial and industrial use

RESEARCH CONTRACT: Determining the potential for decentralised heating and electricity generation using fuel cells in commercial and industrial use.

PROJECT PARTNER: Forschung Burgenland GmbH
Prof. DI (FH) Dr. Christian Heschl, DI Christian Seidl, BSc

TERM: 2021f.

STATUS: In progress

THE PROJECT

The reaction processes in fuel cells, often referred to as 'cold combustion', are a promising take on the direct conversion of chemical energy into electrical energy. The previous study, 'Current technologies and applications of fuel cells and small-scale CHP for end customers', investigated fuel cell systems, including a market overview with the latest developments, tailored for end customers in detached family homes and apartment blocks. In this study, the focus is on fuel cell systems in commercial and industrial applications.

FINDINGS

In the course of the product research, several available products could be identified worldwide, in a power range from 50 kW to 1 MW, including some from European manufacturers. In terms of technology, primarily SOFCs and PEMFCs are used, but also AFCs, MCFCs and PAFCs. The electrical efficiency of the products is between 40 and 60%, and hydrogen is the main fuel used.

The use of FC CHP systems is very versatile, which is also confirmed by the manufacturers. Possibilities for use range from CHP use in hospitals, commer-

cial operations, industry and residential buildings to grid stabilisation and emergency power supply. With regard to possible applications, the 2020 energy requirements of Austrian companies in different sectors were also examined in relation to the distribution of electricity and heat. In the case of thermal energy requirements, particular consideration was given to the category 'process heat < 200 °C', as it is more likely that the demand here will remain the same over time. The temperature range of heat extraction of a high-temperature fuel cell in the range mentioned is also well-suited. Based on the power-to-heat ratio of 60 to 40 derived from the product overview, the following sectors were identified:

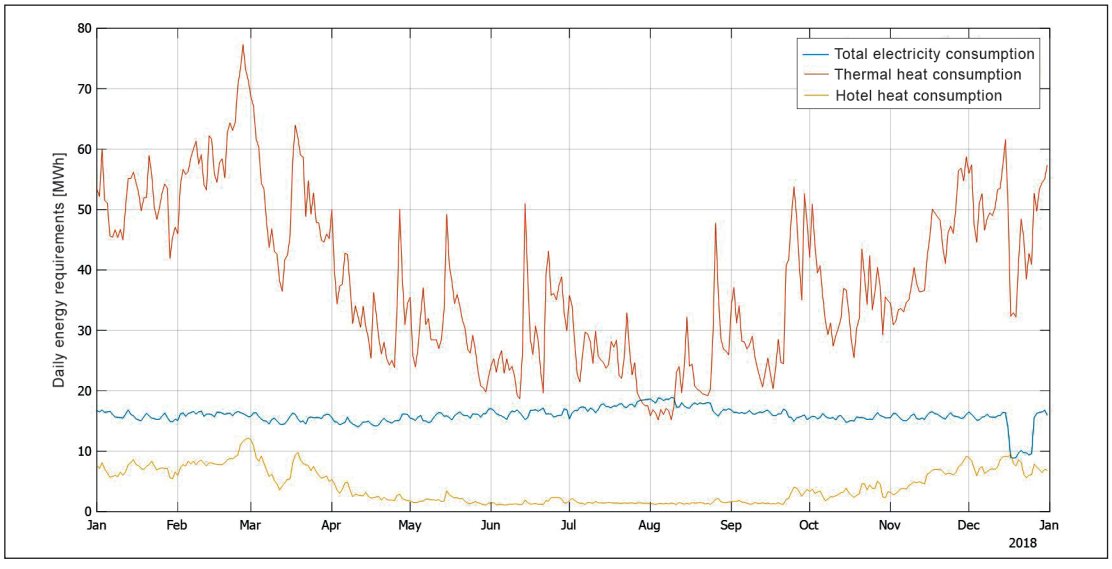
- Textile and leather
- Food and drink, tobacco
- Mining
- Chemicals and petrochemicals

Compared to internal combustion engine CHP, greater degrees of electrical efficiency can be achieved with fuel cell systems. They also require fewer moving parts, which reduces maintenance and noise pollution.

In order to assess how a fuel cell CHP system can be integrated most efficiently into commercial or industrial operations, the load profiles of two thermal operations including hotels and a fertiliser production company were analysed in more detail. In order to achieve the maximum possible level of fuel utilisation, the electricity generated and the heat provided must be fully used.

The operations considered in this study had a very heat-heavy power-to-heat ratio, which meant that full thermal coverage was avoided and the focus was placed on electricity production. Since commercial and industrial operations have a very specific energy and load distribution, the power-to-heat ratio can vary greatly. For this reason, individual consideration of the relevant operations (energy distribution, timing, general conditions) is recommended.

An optimally designed fuel cell CHP system can contribute significantly to covering the electrical and thermal base load. Above all, high-temperature systems are appropriate for extracting process heat. It should be noted that their performance can only be varied to a limited extent. A high-temperature FC CHP system is rather unsuitable for operations whose load profiles reflect strong fluctuations combined with low base loads (as the example of the fertiliser production operations shows). A fast-reacting PEM fuel cell would be a more suitable choice here.



Thermal energy consumption

05

GREEN GAS 4 GRIDS
RESEARCH PROJECT **05/2021**

Market analysis for determining the calorific value of a gas mixture

RESEARCH CONTRACT: Presentation of cheaper alternatives to gas chromatographs for determining the calorific value of gas for billing-relevant hubs, taking into account future feed-in points into the gas network for biomethane and hydrogen.

PROJECT PARTNER: Montan University Leoben – Chair of Thermal Process Technology
Univ.Prof. DI Dr.techn. Harald Raupenstrauch, DI Gregor Berger

TERM: 2021f.

STATUS: In progress

THE PROJECT

Gas consumption is currently recorded using gas meters in cubic metres. These are then converted into kWh using the condition number (ratio of standard to operating cubic metres) and the calorific value and billed to the customer. A fuel gas analysis is carried out quarterly using gas chromatography. The determined gas composition determines what is known as the calorific value, which is valid for the forthcoming billing period.

However, the integration of renewable gases such as hydrogen and biomethane requires – due to the resulting volatility of the calorific value – an adjustment of the frequency and nature of determination of this calorific value. This study deals with the question of which devices are available on the market for the ongoing determination of the calorific value of gases.

Only devices that meet the OIML R 140 Group B or equivalent certifications are named in this overview. A distinction is made between continuous measuring methods (without changing the measuring gas) and discontinuous measuring methods (with changing the measuring gas). The analysis times, acquisition, operating and maintenance costs as well as the measuring accuracy of the most suitable devices are examined. Finally, the various methods and associated measuring devices are compared and the benefits and drawbacks are discussed.

05

FINDINGS

According to the market analysis carried out during the study, the following were found to be the most promising from the large number of devices considered.

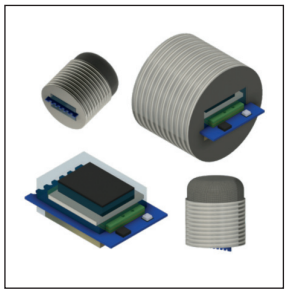
Continuous measuring devices

Continuous measuring devices do not change the measuring gas, which can therefore be supplied to the customer after the measurement. It has been shown that only correlative measurement methods are effective here. By measuring a number of physical variables, correlative relationships are used to draw conclusions about other physical variables. The most promising devices are:

- gasQS flonic measuring device (mems AG)
- BlueEye OEM and BlueEye IoT (BrightSensors)

Discontinuous measuring devices

The fuel gas in the measuring device is changed in such a way that it is no longer possible to return the analyte to the system. In the course of the study, the MGCflex (Meter-Q Solutions GmbH) is presented as the most promising device in the chromatographic field, and the CWD2005 CT (Union Instruments GmbH) in the field of calorimetric measurement.



Promising continuous measuring devices: Left: gasQS flonic. Right: BlueEye OEM

Promising discontinuous measuring devices: Left: MGCflex. Right: CWD2005 CT

Comparison of measurement procedures

Correlative measurement methods convince with very little maintenance. In addition, the devices are usually much cheaper to buy (€5,500 to €20,000). In a direct comparison, the T90 time of approx. 30 seconds is in the middle. However, note that recalibration in the field is not possible. This means that any long-term drifts cannot be corrected, nor is it possible to validate the measurement results. The decision of the approval authorities (OIML or PTB) must be awaited.

Determining the measuring gas using a ***calorimetric method*** appears to be the most direct method for a given requirement. There are two procedures for this: measurement of the residual oxygen in the flue gas and measurement of the heat flow generated during combustion. Both methods achieve unprecedented T90 times of around 15 seconds. However, the disadvantage of this measuring method is that no conclusions can be drawn about the components in the measuring gas. A calorimeter approved for official measurement is between €35,000 and €50,000 (non-explosion-proof version) or between €100,000 and €250,000 (explosion-proof).

Gas chromatographs achieve outstanding accuracies in gas analysis thanks to their complex measurement setup. The MGCflex presented in the market analysis achieves a T90 time of 45 seconds that is unsurpassed in the industry – but still the longest compared to the other measurement methods. Costly carrier gas is required to operate the devices. In addition, the purchase price is around €170,000.

06

GREEN GAS 4 GRIDS
RESEARCH PROJECT **06/2021**

HyGrid pilot study
Analysis of impurities in hydrogen in transport in repurposed pipelines

RESEARCH CONTRACT: Analysis of which impurities occur in hydrogen when it flows through pipelines repurposed from natural gas pipelines to pure hydrogen pipelines.

PROJECT PARTNER: HyCentA Research GmbH
DI Dr.techn. Thomas Stöhr

TERM: 2021f.

STATUS: In progress

THE PROJECT

When transporting pure hydrogen in the repurposed natural gas network, the achievable H_2 quality plays a crucial role. Depending on the consumer, high demands are sometimes placed on purity. This is in contrast with the history and use of the natural gas pipelines. Experience shows that various groups of substances, e.g. from odorisation, can still be detected long after the end of the input due to adsorption processes on the pipeline wall and as deposits at low points. When transporting hydrogen, these will desorb into the gas.

The aim of the 'HyGrid Pilot Study' project is to analyse these impurities introduced into the hydrogen and to identify suitable cleaning methods. The newly developed Boltzmann laboratory at HyCentA, with its highly precise analysis methods, provides the ideal conditions for a systematic investigation and answers to these current questions. Cleaning methods as well as the analysis of the causes of each contamination will be examined by the DBI in the course of this project.

Various pipeline elements from the natural gas network were registered by the gas network operators for examination and prepared for the analysis. The specifications of these subjects cover a wide range of the Austrian gas network, e.g. the pressure range from MOP 5-70 bar, years of construction 1965-2008, operation with odorised (THT, mercaptans) and non-odorised natural gas. A comprehensive test plan was developed on the basis of the specifications.

06

FINDINGS

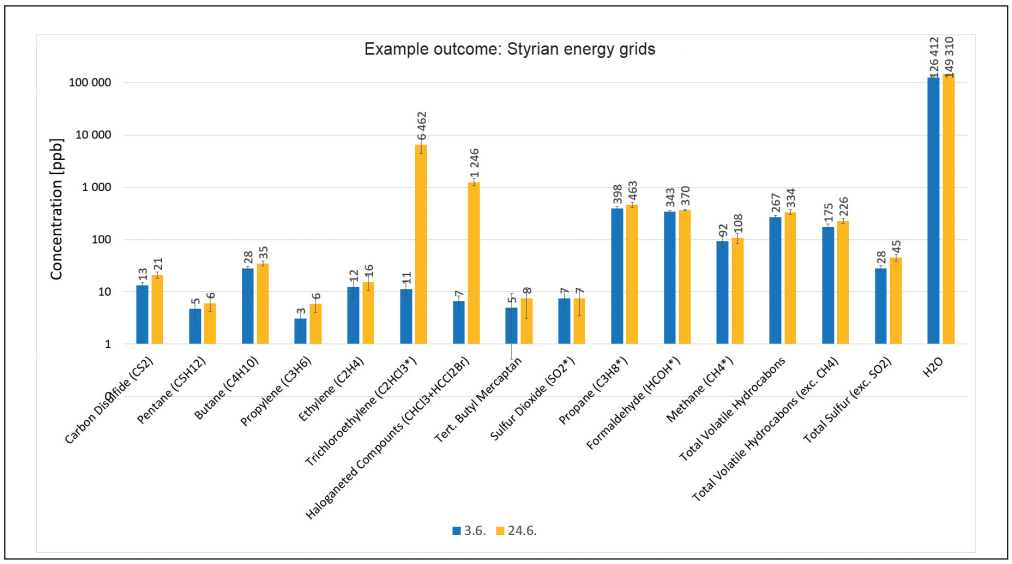
The results of the HyGrid Pilot Study answer fundamental questions regarding the successful repurposing of natural gas infrastructure for the transport of pure hydrogen. The specific framework conditions in Austria, such as odorisation of high-pressure lines, are particularly taken into account.

The measurement results confirm that Grade A (98% H_2, according to ISO 14687) can be maintained with the existing natural gas pipelines without additional cleaning measures in the event of repurposing.

The results of the static tests indicate that cleaning measures must be provided in order to achieve a degree of purity suitable for fuel cells, Grade D (99.97% H_2, according to ISO 14687). The following relevant impurities were measured:

- Odour substances (can be measured again in H_2)
- Natural gas components
- Higher hydrocarbons from solid deposits
- Water from the atmosphere
- Formaldehyde

All impurities identified as relevant can be removed from the hydrogen using standard purification processes such as adsorption, chemisorption, absorption and filters.



Impurities in a natural gas pipeline section filled with pure H_2

OUTLOOK

To successfully implement pipeline repurposing in Austria for the first time, the ***HyGrid²*** research project was also applied for – with the aim of enabling the transport of pure hydrogen in used natural gas infrastructure in Austria. The areas of inspection and cleaning of the pipelines, quality of the transported hydrogen, application-oriented purification and H_2 compatibility of the individual components and materials used are addressed methodically and conditions specific to Austria (e.g. odorisation) are taken into account.

A manual for the successful repurposing of natural gas pipelines is being developed and will serve as a guide to accelerate further repurposing.

07

GREEN GAS 4 GRIDS
RESEARCH PROJECT **07/2021**

Analysis of mixing and demixing of hydrogen in methane

RESEARCH CONTRACT: Determination of the distance after which complete mixing can be assumed when hydrogen is fed directly into the methane network.

PROJECT PARTNER: TU Vienna – Institute for Fluid Mechanics and Heat Transfer (ISW)
Dr. F. Zonta et al.

TERM: 2021

STATUS: Completed, end report ÖVGW GF 64

THE PROJECT

Injecting hydrogen into gas pipelines used to transport methane is a strategy for reducing CO_2 emissions and primarily serves as an immediate and ubiquitous source of hydrogen offtake. Known as blending, this serves as an important enabler for ramping up the renewable hydrogen economy.

Hydrogen has significantly different combustion properties than methane and therefore pure hydrogen or a hydrogen/natural gas mixture also burns differently than pure natural gas. It is therefore important that the hydrogen fed into a gas network is well mixed and remains mixed until the gas reaches the end customer.

In the first part of the project, which is already mentioned in the 2020 research report, it was confirmed that there is no independent demixing of a methane/hydrogen mixture in the gas network. The second part of the study described here examined the distance after which complete mixing can be assumed with a simple direct feed – without a static mixer.

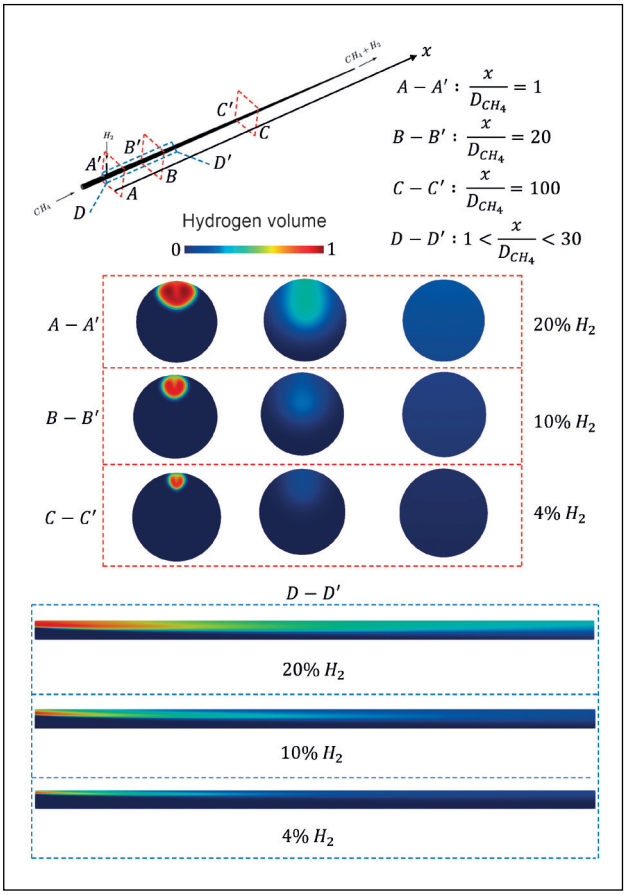
07

FINDINGS

Numerical simulations were performed to determine the minimum length of pipe required after the feed point to produce a fully homogeneous H_2/CH_4 mixture. The simulations carried out are calculated for three different valuesof the hydrogen volume fraction (4%, 10% and 20%) and with two different hydrogen volume flows (170 Nm³/h and 4,000 Nm³/h). Two different feed pipe diameters (6 mm and 25 mm) and a wide range of methane pipe diameters (between DN20 and DN300) were considered in the numerical simulations.

The H_2/CH_4 mixture is not homogeneous near the feed point (*see figure*). However, a homogeneous mixture is achieved at a sufficient distance from the feed point. The general trend is that the lower the degree of hydrogen admixture and the larger the diameter of the gas pipeline, the sooner complete mixing occurs.

The results show that, conservatively calculated, for all variants considered here, a distance of about 100 times the diameter of the gas pipe ($L \approx 100 D_{CH_4}$) is sufficient to obtain a homogeneous mixture of hydrogen and methane.



Distribution of the hydrogen volume fraction on different cross-sections and a longitudinal section for different hydrogen volume fractions

08

GREEN GAS 4 GRIDS
RESEARCH PROJECT **08/2021**

Standardisation of biomethane compressors

RESEARCH CONTRACT: Presentation of uniform variants of compressors if biomethane is to be brought to higher network levels in order to increase the possible purchase quantities.

PROJECT PARTNER: keep it green gmbh
Thomas Wagner

TERM: 2021f.

STATUS: In progress

THE PROJECT

As fossil raw materials are coming to their end, the development of an alternative energy supply will play a central role in the coming years. After biogas moved somewhat out of the spotlight of the energy transition in recent years, it is once again playing a more important role due to rising natural gas prices. Efforts to reduce greenhouse gas emissions and at the same time reduce dependence on fossil fuels are increasing both at national and international level.

Biogas can either be used directly to generate electricity and heat using a CHP or fed into the natural gas network. The biogas first goes through a cleaning and processing step and then has to be adjusted to the respective network pressure using natural gas compressor systems. If the feed-in quantity exceeds the consumption of the consumer network, the biogas must be compressed in the upstream high-pressure network. This is called recompression.

Four common compressor systems are primarily used for the compression of biogas: rotary vane compressors, screw, piston and diaphragm compressors. In the study, a generally valid basic concept is to be developed that can be used by all Austrian gas network operators. The aim is to lay the foundations for recompression systems as well as a technical and economic assessment of the compressor systems.

FINDINGS

The focus of the study is on the development of system variants for recompression systems and on the elaboration of the technical and economic parameters.

In the first part, the common types of compressors are presented and basic system parameters are worked out using a basic concept. In a next step, the study goes into the safety aspects of the upstream and downstream network. The necessary protective devices for the system technology and possible external conditions are then shown. Finally, the investment expenditure for each compressor variant is determined.

The core of the study is a calculation tool for determining the investment and operating costs of compressor systems. This is intended to make pre-selection easier for gas network operators and planning offices. In order to restrict the compressor selection, these are evaluated according to their probability of use and the technically most probable compressor type is shown.

The inlet and outlet pressure is determined by the usual network pressures in the Austrian natural gas network. Based on the desired flow rate (10 to max. 1,400 Nm^3/h), the user is shown the technically most reasonable type of compressor.

One or more compressor blocks/units are required depending on the desired flow rate and/or the required pressure level. The CAPEX and OPEX are determined according to the selection of the technically most reasonable type of compressor. The investment costs include the complete operational system technology, EI&C technology and the building (standard concrete building or steel container). The operating costs are divided into planned maintenance and repair costs as well as costs for any necessary upkeep.

The energy requirement of the compressor system depends on the operating time of the system and the electricity purchase costs and is given as specific energy consumption per compressed standard cubic metre of biogas (kWh/Nm^3). All applied energy consumption and costs were determined as average valuesfrom various manufacturers and apply to the technically most probable type of compressor. Depending on the annual requirement of the relevant system, the user can determine the energy costs independently.

Experience has shown that the technically most probable compressor types have the most economical combination of specific energy consumption, CAPEX and maintenance and repair costs.

In general, it can be seen that the specific investment and maintenance costs ($€/Nm^3$) per compressor unit decrease with higher throughput. Furthermore, it can be stated that rotary vane compressors are preferred for compression up to 8 bar. Depending on the capacity, screw compressors are the technically most reasonable variant up to a maximum of 12.5 bar, while piston and diaphragm compressors represent the technically most reasonable and therefore most economical compressor type from an outlet pressure of 28 bar(g).

09

GREEN GAS 4 GRIDS
RESEARCH PROJECT **09/2021**

Increasing efficiency of Austrian gas distribution – best practice examples and deriving measures for improvement

RESEARCH CONTRACT: Which measures can boost the efficiency of the gas network and how it operates? Developing optimised scenarios for how feeder biogas plants can be connected and fed into the gas network at different levels in future.

PROJECT PARTNER: TU Wien – Institute for Energy Technology and Thermodynamics
Univ.Prof. Dipl.-Ing. Dr.techn. René Hofmann, Dipl.-Ing. David Huber, Nikola Antonijevic BSc

TERM: 2022

STATUS: In progress

THE PROJECT

In the Austrian gas network, there are isolated measures that are in operation, e.g. concerning gas preheating, which make the ongoing operation of the gas network more efficient. In order to summarize this information and make it available to all network operators, this study gives an overview of possible measures; they are then evaluated according to their impact on efficiency. In addition to the optimisation measures of current gas network operations, a significant focus is placed on the future development of the gas network. The goal of the gas industry is to only transport renewable gases via the infrastructure by 2040. In this case, it becomes relevant to connect a large number of biogas plants to the gas network in order to feed in green gas produced from biogenic residues. The second part of this study therefore deals with the optimisation of the interconnection of biogas plants and their connection to the gas network.

FINDINGS

09

Energy saving by minimising the preheating capacity

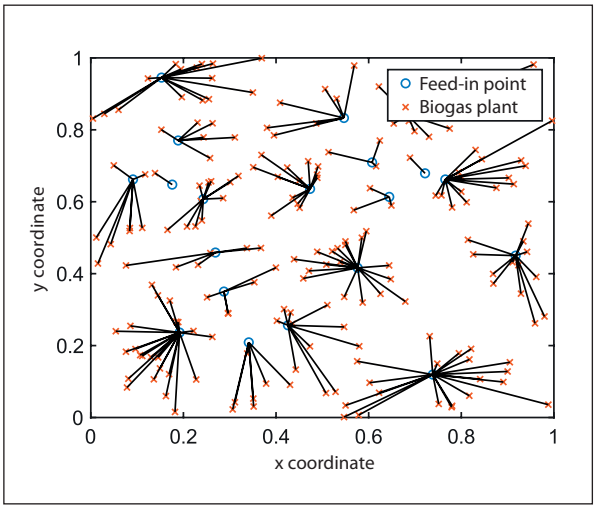
When expanding to a lower network pressure, the gas cools down due to the Joule-Thomson effect. To avoid condensation on the piping, the gas temperature after expansion must be above the dew point. This is ensured by preheating the gas before it is expanded. Taking into account the ambient temperature and humidity, the dew point has been calculated on the basis of a test reference year. The cooling caused by the expansion depends, among other things, on the gas composition. Under these conditions, hydrogen has an inverse Joule-Thomson effect. This means that hydrogen heats up when it expands.

It turns out that an increase in the H_2 concentration in the gas mixture leads to a reduction in the required preheating energy. From this perspective, in addition to decarbonising the gas supply, an increase in the H_2 concentration can also lead to a reduction in energy use for gas transport and distribution.

Optimising the biogas feed

Exactly where existing or future biogas plants should be connected to the distribution or transmission network is a complex optimisation issue. As part of this project, a framework for optimisation has already been created in MATLAB with YALMIP and Gurobi. First and foremost, it is important to keep the distance between the biogas plant and the feed-in point to a minimum. If further data is provided, the existing model is supplied with relevant secondary conditions. For example, specific line costs, pressure stages and compressor costs can be taken into account.

The figure below shows the results of a test with fictitious data. In this model, without any additional constraints, the shortest connection between the biogas plant (x) and the feed point (o) was found. If the data on potential feed points and their feed capacity are available, the framework that has already been developed can deliver meaningful results.



Optimising the biogas feed (fictitious data)

10

GREEN GAS 4 GRIDS
RESEARCH PROJECT **10/2021**

Participation in:
Ready4H2

RESEARCH CONTRACT: The role of distribution network operators in a future hydrogen economy
PROJECT PARTNER: DNV, 91 distribution network operators in Europe
TERM: 2021–2022
STATUS: Completed, www.ready4H2.com

THE PROJECT

91 gas distribution network operators and specialist organisations from a total of 18 countries are participating in the Ready4H2 project – including the ÖVGW. The aim of the cooperation is to support the development of a strong hydrogen market. The large-scale use of green hydrogen is an important contribution to achieving the goals set by the EU climate initiative 'Fit for 55' and thus to reducing greenhouse gas emissions.

The project comprises three studies with the following focal points:

1. Grouping together the 'hydrogen knowledge' of the distribution network operators;
2. Identifying how distribution network operators can contribute to the hydrogen value chain;
3. Creating a roadmap of how and when distribution networks will become a primary hydrogen distribution infrastructure in Europe.

The cost-effective distribution of hydrogen is crucial for market development. 96% of European pipelines – the equivalent of pipelines spanning a length of over one million kilometres – are already suitable for the transport of hydrogen. One of the studies conducted by Ready4H2 shows that hydrogen can be transported to consumers four times more cheaply by pipeline than by lorry.

FINDINGS

10

Hydrogen economy creates employment and reduces CO_2 emissions

A report by the Ready4H2 project compares two decarbonisation scenarios for 2031–2050: one that includes significant amounts of hydrogen and green methane, and one that relies almost entirely on electrification. This shows that the annual investment required for coupling the electricity and gas infrastructure is EUR 41 billion less than in the electricity scenario. The project of decarbonising Europe and achieving climate neutrality can therefore be achieved most cost-effectively through the use of renewable gases.

The transition to a hydrogen economy would have significant environmental and economic impacts in Europe. Accordingly, CO_2 emissions would be reduced by over 500 million tons per year, and at the same time, almost a million jobs would be created across Europe: 290,000 jobs in green hydrogen production, 135,000 in operations and maintenance and 542,000 jobs in power generation required for green hydrogen. Green hydrogen production can also support European industry threatened by offshoring by offering a cost-effective path to decarbonisation.

Hydrogen enables seasonal balancing

Renewable energies are the key to European energy independence. The Ready4H2 initiative is ready to support this goal with expertise on local gas distribution systems and to show how green hydrogen can be used in the energy system of the future.

The gas infrastructure is able to balance the rapidly growing share of variable wind and solar energy and also handle highly fluctuating seasonal demand. This ensures a reliable supply of hydrogen even in the coldest of winters. Seasonal hydrogen storage would help Europeans reduce their dependence on fossil fuel imports. Large-scale underground hydrogen storage facilities, connected to gas networks, are the only rapidly deployable, long-term storage facilities capable of handling seasonal fluctuations in production and demand.

Hydrogen needs a suitable legal framework

Despite the promising potential that hydrogen offers, there are still numerous technical, commercial and organisational barriers to market development. These include uncertainties about the quantities and prices at which the CO_2-free energy source can be offered on the hydrogen market in the future. The benefits of decarbonisation using hydrogen are also often not yet recognized. Ready4H2 wishes to see a suitable legal framework at EU level so that distribution network operators can work together across borders in the future and play their important role in the development of the future hydrogen market. Flexible design options would also be advantageous, so that the network operators could develop suitable solutions for their customers.

In addition to the transport of hydrogen-methane mixtures, i.e. blending, the network operators must also be able to operate pure hydrogen networks. In addition, EU member states should allow distribution network operators to set the gas quality in their respective networks.

Ready4H2 would like to see the creation of an independent European organisation for gas distribution network operators, responsible for methane and hydrogen. This would ensure better coordination and harmonisation of planning, engineering and other issues across Europe, in cooperation with the transmission network operators. The two bodies must be able to work together on 10-year national development plans, as is already the case in the electricity industry.

11

GREEN GAS 4 GRIDS
RESEARCH PROJECT **11/2021**

Participation in:
BioEcon – Innovative wood-based value chains

RESEARCH CONTRACT: Investigation of the occurrence and possible uses of wood-based residual and waste streams. Including exploring the potential for biogas production.

PROJECT PARTNER: BESTresearch – Bioenergy and Sustainable Technologies GmbH
Dr. Strasser

TERM: 2019–2022

STATUS: Completed

THE PROJECT

Political ambitions to counteract climate change and limit its consequences include the European *Renewable Energy Sources Directive (RED)* and the Austrian *Renewable Energy Sources Expansion Act (EAG)*, which promotes the expansion of renewable energies in the domestic energy mix. In addition, the idea of a bioeconomy is being promoted, the success of which depends largely on technological advances, cost efficiency and the availability of sustainably obtained biomass.

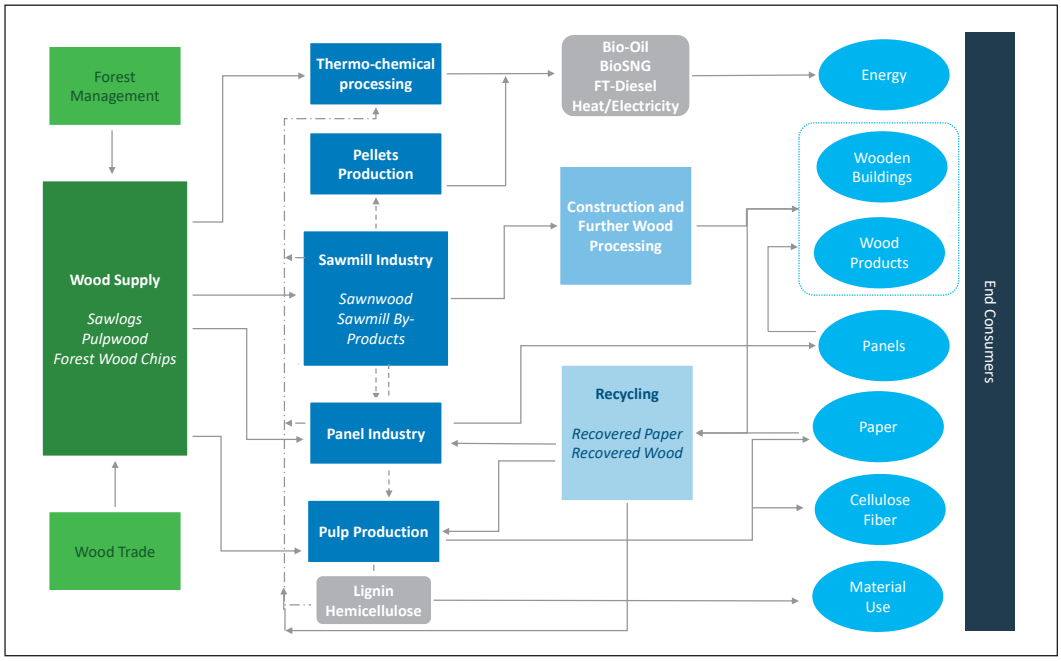
The BioEcon project identifies and evaluates the challenges and opportunities for different value chains of the wood-based sector as well as the integration of innovative technologies under the changing framework conditions.

A promising innovative technology is the gasification of wood and subsequent synthesis into bio-SNG (bio synthetic natural gas), which has already been successfully demonstrated but has not yet reached a commercial level. Frequently used technologies are dual fluidised bed gasification and entrained flow gasification with steam as the gasification medium. After gasification, comprehensive gas cleaning includes adjustment of the H_2:CO ratio and desulphurisation. The resulting syngas is used for the subsequent synthesis to bio-SNG.

11

FINDINGS

As part of the project, Austrian wood biomass potential – including an overview of production and trade in selected European countries – was presented and evaluated. A potential of 1.3 billion m^3 for the production of bio-SNG from wood residues was determined for Austria. In addition, risks and opportunities for wood-based raw materials and (by-)products were evaluated, interactions between already established and innovative value chains were examined, and the supply and demand behaviour of the relevant stakeholders was analysed using econometric models. As a basis for strategic decisions as to whether and how the proportion of biomass use in the industrial processes under consideration can be increased, an instrument for technical and economic evaluation based on predefined modules was developed: the 'Wood Value Tool'. The Excel calculation tool makes it possible to specify selected processes, such as bio-SNG production, with regard to technical parameters, and to select the desired inputs. The technical and economic evaluation based on this includes the consideration of investment costs, operating costs and raw material costs as well as the calculation of expected product prices and profitability.



Links between established and innovative wood-based value chains.
(Dashed lines represent by-product streams: sawdust and wood chips from the sawmill industry, Lignin and hemicellulose from pulp production.) Source: BEST

OUTLOOK

In the follow-up project 'SusBioEcon', further functions are to be integrated into the 'Wood Value Tool' based on social and economic sustainability criteria (e.g. calculation of the CO_2 balance). This project is expected to start in April 2023.

12

GREEN GAS 4 GRIDS
RESEARCH PROJECT **12/2021**

Participation in: Hydrogen compendium in gas distribution networks

RESEARCH CONTRACT: Analysis of the compatibility of the gas distribution network components with hydrogen in the gas mixture in steps of up to 100% (Part A) and creation of profiles on the hydrogen compatibility of materials and products used in the gas supply (Part B).

PROJECT PARTNER: DBI Gas- und Umwelttechnik GmbH
Dipl.-Ing. (FH) Gert Müller-Syring et al.

TERM: 2017ff. (with participation of ÖVGW 2019 et seq.)

STATUS:
Compendium Part A: completed
Compendium part B: The 2021 work packages are complete. The project continues.

CURRENT STATUS

Below are the results from the various follow-up activities achieved in the period from mid-2021 to mid-2022.

Odorisation of hydrogen

A distinction is made between sulphur-containing and sulphur-free odorants. Sulphur-containing odorants essentially consist of organic sulphur compounds such as sulphides and mercaptans. The only sulphur-free odorant on the market, Gasodor® S-Free, consists of a mixture of methyl and ethyl acrylate.

No chemical incompatibility problems with hydrogen are known for all odorants available on the market that have been specifically approved for the odorisation of natural gases. Hydrogen does not cause any negative interactions with odorous substances. The influence of the background gas on the odour intensity and character of odorants is considered to be small. According to manufacturer information and the results of previous theoretical and practical investigations, there are no restrictions on the applicability of the available substances for the odorisation of hydrogen. In practice, however, there are currently no odorants specially developed for hydrogen.

None of the odorants available on the market are compatible with PEM fuel cell technology, so removal prior to these applications is imperative. Also, according to the current status, no approvals for new odorants are known. There are many reasons for using conventional odorants. Resistance in hydrogen is given and an olfactory influence is not to be expected.

Sealing

In a survey of gas network operators, the most commonly used seal types (combination of seal type and seal material) and shut-off valves were investigated. The following list resulted for the seal types, taking into account the weighting of the (total) number of fittings and the prioritisation given by the respective network operator:

1. Kammprofil seal with carbon
2. Flat seal with NBR
3. Flat seal without inner border with Refalit
4. Kammprofil seal with PTFE
5. EPDM O-rings

The survey of the most common shut-off valves resulted in the following ranking for the 3 pressure levels:

	< DP1	DP1 to DP16	> DP16
1.	DAV from PE	DAV from PE	Steel gate valve
2.	DAA from PE	DAV from steel	Steel ball valve
3.	PE ball valve	DAA from PE	DAA from steel
4.	Ball valve from main shut-off devices	PE ball valve	Cast iron gate valve
5.	–	Steel gate valve	–

Metallic materials

In another survey, the project partners recorded the operating conditions and materials frequently used in steel pipelines. Over 45 different materials were identified. The minimum yield point varied between 207 and 485 MPa, with the largest proportion (approx. 72%) being less than 300 MPa and 85% being less than 360 MPa.

According to the weighting according to the number of denominations and installed lengths, the following steels were used most frequently:

1. StE 290.7
2. St 37
3. L360NB
4. StE 240.7
5. L485MB

A method for testing hydrogen suitability using hollow tensile specimens that supplements the fracture-mechanical investigation is currently being discussed in the cooperation between DBI and the Federal Institute for Materials Research and Testing (BAM). A corresponding test stand is being set up at BAM, independently of the H_2 Compendium.

In the *HyDeploy* project, the suitability for cast iron up to 20% by volume was demonstrated, based on a 6-week sample loading with pure natural gas, pure hydrogen and 20% by volume hydrogen and subsequent tensile test of grey cast iron (EN 1561-GJL250).

OUTLOOK

The basic content has been developed for the setup of an H_2 database. It is currently being created and should include: more than 20 user stories and the previous profiles from the H_2 compendium: Component profiles (currently around 75), system aspect profiles (currently around 10), material profiles (currently 4) and product profiles (currently around 105). In addition, the manufacturers can make statements about the hydrogen suitability of their products; this keeps the content up to date. Furthermore, users are also given the opportunity to suggest changes to the content.

RESEARCH PROJECTS

OUTLOOK 2022

OVERVIEW 2019–2021

OUTLOOK 2022

PLANS / ONGOING PROJECTS

Hydrogen compatibility in gas distribution networks

Continuation of project 12/2021 – ***Hydrogen compendium in gas distribution networks***
DI (FH) Müller-Syring et al., DBI

HyGrid²

Continuation of project 6/2021 – ***HyGrid pilot study***
Dr. Thomas Stöhr, HyCentA
Dr. Baumann, DBI
Dr. Marsoner, MCL

Ready4H2- Phase 2

Continuation of project 10/2021 – ***Ready4H2***
DNV, 91 European distribution network operators

OVERVIEW 2019–2021

GREEN GAS 4 GRIDS
RESEARCH PROJECTS **2019–2021**

RESEARCH PROJECT 01/2019
Cost assessment of integrating existing biogas systems into the Austrian gas network

RESEARCH PROJECT 02/2019
Developing a standard concept for preparing raw biogas for feeding

RESEARCH PROJECT 03/2019
Combustion and safety-related requirements with regard to an increased biogas and hydrogen component in natural gas

RESEARCH PROJECT 04/2019
Expertise for feeding 10% volume hydrogen into the Austrian gas network – customer natural gas systems and domestic gas equipment

RESEARCH PROJECT 05/2019
Hydrogen compendium in gas distribution networks *(participation)*

RESEARCH PROJECT 01/2020
Consequences of a fluctuating hydrogen component in natural gas on industry

RESEARCH PROJECT 02/2020
Producing green gases from sludge: case study for hydrogen from DFB steam gas generation

RESEARCH PROJECT 03/2020
Standardised biogas preparation and methanisation

RESEARCH PROJECT 04/2020
Current technologies and uses of fuel cells and small-scale CHP for end customers

RESEARCH PROJECT 05/2020
Greenhouse gas emissions from biomethane from microbiologically generated biogas for various substrates

RESEARCH PROJECT 07/2020
Analysis of mixing and demixing of hydrogen in methane

RESEARCH PROJECT 08/2020
BioEcon – Innovative wood-based value chains *(participation)*

RESEARCH PROJECT 09/2020
Hydrogen compendium in gas distribution networks – continuation *(participation)*

RESEARCH PROJECT 01/2021
Meta study on production of climate-neutral gases

RESEARCH PROJECT 03/2021
Study on current technologies and applications of gas heat pumps and electric heat pumps in combination with gas condensing boilers for end customers

RESEARCH PROJECT 04/2021
Current technologies and uses of fuel cells as CHP in commercial and industrial use

RESEARCH PROJECT 05/2021
Market analysis for determining the calorific value of a gas mixture

RESEARCH PROJECT 06/2021
HyGrid pilot study – Analysis of impurities in hydrogen in transport in repurposed pipelines

RESEARCH PROJECT 07/2021
Analysis of mixing and demixing of hydrogen in methane

RESEARCH PROJECT 08/2021
Standardisation of biomethane compressors

RESEARCH PROJECT 09/2021
Increasing efficiency in Austrian gas distribution

RESEARCH PROJECT 10/2021
Ready4H2 *(participation)*

RESEARCH PROJECT 11/2021
BioEcon – Innovative wood-based value chains – continuation *(participation)*

RESEARCH PROJECT 12/2021
Hydrogen compendium in gas distribution networks – continuation *(participation)*

GREEN GAS 4 MOBILITY
RESEARCH PROJECTS **2019–2021**

RESEARCH PROJECT 06/2019
Overall economic assessment of alternative drive technologies with a focus on the use of natural gas lorries in Austria

RESEARCH PROJECT 07/2019
Hydrogen in mobility – research into existing provisions on use of hydrogen as fuel in vehicles

RESEARCH PROJECT 06/2020
CNG home refuelling stations – identifying regulatory hurdles

RESEARCH PROJECT 02/2021
Expert opinion on risk assessment for hydrogen vehicles in underground car parks

Green gas is the key to a climate-neutral future for energy. As part of its *Greening the Gas* strategy, the Austrian gas industry is working in a consistent and focused way to gradually replace the fossil fuel natural gas with green gas in every area of use. Obstacles and limitations must be identified and removed to ensure the rapid spread of green gas. The role of the ÖVGW is to create a regulatory framework for its use. To clarify the technical questions involved, the ÖVGW is agreeing partnerships with entities from the world of science and commissioning specific research projects. It's also a member of the network *ERIG – European Research Institute for Gas and Energy Innovation*, designed to tap into synergies on a European level. The results of the studies are presented in the annual research report.