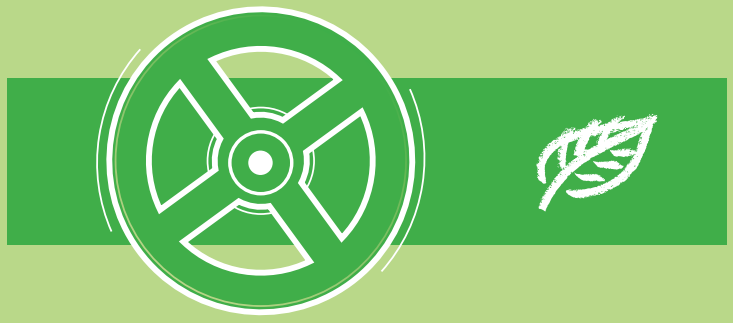

GREEN GAS

RESEARCH REPORT 2024

AUSTRIAN ASSOCIATION
FOR GAS AND WATER

ÖVGW
ÖSTERREICHISCHE VEREINIGUNG
FÜR DAS GAS- UND WASSERFACH

Legal notice

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PREFACE

Foto: Gas Connect Austria

Ing. Mag. Stefan Wagenhofer

President ÖVGW
CEO Gas Connect Austria GmbH

Decarbonisation does not mean giving up gas; on the contrary, the transformation of the energy system is only possible with the help of gaseous energy sources. This is because the existing gas infrastructure, with its transport pipelines and large-volume storage facilities, will continue to be of paramount importance for maintaining security of supply. This makes the switch to climate-neutral gases all the more urgent. The Austrian gas industry has developed a strategy to gradually reduce natural gas consumption and, from 2040 onwards, only use green gas – biomethane, synthesis gas and hydrogen.

Extensive research into the production, feed-in, distribution, and application of green gases is necessary to implement this project. To this end, ÖVGW has launched the Green Gas 4 Grids and Green Gas 4 Mobility research initiatives and has been successfully carrying out projects with renowned scientific partners from Austria and abroad since 2019. The additional funding granted since 2023 underscores the importance and significance of the program.

In 2024, 12 research projects were either continued or newly launched. The focus was on the future use of hydrogen – from quality assurance for electrolytically produced hydrogen to various aspects of converting the existing gas infrastructure for hydrogen transport and use – while other projects addressed issues relating to the use of biomass in gas production and methane emissions. All in all, this is a broad spectrum that highlights the need for in-depth research.

The research activities and the findings obtained in the individual projects must also be communicated. This is done through the marketing activities and public relations work of the ÖVGW and the Fachverband Gas Wärme (FGW) – summarized under the umbrella brand "Zukunft Grünes Gas". This annual research report also serves this purpose by summarizing the projects and thus providing an overview of the progress made in laying the foundations for the transformation of the energy system

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RESEARCH

FOR GREEN GAS

ÖVGW research initiatives

ÖVGW RESEARCH INITIATIVES AS PART OF THE "GREEN GAS" STRATEGY

Background

Following the Paris Climate Conference, the Austrian federal government also set ambitious goals, first with #mission2030 and then in its 2020–2024 government program: From 2030, Austria's electricity is to come from 100 percent renewable sources, at least in terms of balance, and by 2040, the entire energy system is to be largely decarbonized. The planned energy transition with the phase-out of fossil fuels also means the end of natural gas in the long term, which has been a mainstay of security of supply in the energy landscape to date.

However, the transition to renewable energies such as wind energy, photovoltaics, and hydropower poses a serious problem: since their generation is highly dependent on weather and other natural factors, a secure, reliable, and affordable energy supply cannot be based solely on these alternative sources. Particularly in periods of high energy demand (during the winter months), production cannot meet demand, while (during the summer months) surplus electricity cannot be stored for technical reasons.

Variety and role of gas as an energy source

The use of existing gas infrastructure offers a realistic, rapidly implementable, and economically viable solution to this problem. Surplus electricity from volatile renewable sources can be converted into hydrogen using electrolysis and fed into the gas grid as such – or, in a further step, converted into methane. As a result of this sector coupling, the energy obtained from renewable sources can be fed into the gas infrastructure's extensive distribution network and enormous storage capacities.

Not all gas is the same. Even though imports of natural gas still cover the majority of consumption at present, renewable gas produced in Austria is becoming increasingly important. This "green gas" consists of biogas from waste, which is refined into biomethane and fed into the grid, as well as synthetic gas or hydrogen produced in power-to-gas plants.

Electricity production in Austria has already been largely converted from coal and oil to natural gas, re-

Gas Roadmap 2040

sulting in significant reductions in CO_2 and pollutant emissions. The task now is to gradually replace fossil natural gas with climate-neutral gases in all sectors of use. The Austrian gas industry is pursuing this goal with its Green Gas Strategy.

The role of the ÖVGW

In order to implement the green gas strategy, a number of technical and safety-related issues relating to the use of biomethane, synthetic gas, and hydrogen need to be clarified, in addition to establishing a suitable economic and legal framework. This task falls within the remit of the ÖVGW. As the technical arm of the Austrian gas industry, it must work to create the conditions in this area that will enable gas to play the decisive role it needs to play in order for the energy transition to succeed. Comprehensive measures are required to accomplish these tasks. From an organizational perspective, a working group dealing with this topic – "TAK Green Gas" – was set up, the coordinating "Gas Research Advisory Board" was created, and the financial and human resources were expanded.

ÖVGW research initiatives

This topic requires extensive research. The ÖVGW has launched two initiatives to this end. They are intended to clarify fundamental issues and set the timetable for the gradual replacement of natural gas with renewable gases. Detailed questions will then be addressed.

In 2019, at the start of the research projects, the ÖVGW awarded 7 projects, followed by 9, 12, 13, and 8 more in the four years that followed; in 2024, 12 projects were on the agenda. Projects were continued in some key research areas, but new topics were also addressed.

The organization 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 – 'Green Gas'
Chair: Dr. Gerald Kinger
Deputy: DI Stefan Fink
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 Michael Obermann, PhD

Duration and financing
The research initiative was originally designed to run for 5 years and was extended for a further 5 years. The research funds are raised on the one hand through membership fees and, on the other hand, since 2023, the distribution network operators have been granted a general research budget by the regulatory authority, which is administered by the ÖVGW and used for green gas research.

ÖVGW research initiatives – remits and responsibilities

Green Gas 4 Grids

The aim of the ÖVGW research initiative Green Gas 4 Grids is to clarify open questions regarding the production and grid feed-in of renewable gases. This begins with efficient gas production and gas processing and extends to a possible redefinition of gas quality and the creation of a corresponding technical regulatory framework in the ÖVGW rules and regulations and ÖVGW certification.

Green Gas 4 Mobility

In the mobility sector, research projects within the Green Gas 4 Mobility initiative aim to lay the foundations for the use of renewable gases in the transport sector. The fundamental question to be clarified is the extent to which renewable gases can be used and what opportunities and limitations exist in this regard.

The research partners

When redesigning the energy landscape and implementing the green gas strategy, a wide variety of aspects must be taken into account: primarily technical aspects (such as material issues, combustion technology, P2G technology, gas processing, and CO_2 separation), infrastructure and safety aspects, but also economic, socioeconomic, business, and ecological aspects. The projects to clarify the issues at hand must therefore be carried out in collaboration with universities, research institutions, companies, and experts from various disciplines.

In 2024, research projects were carried out with the following partners:

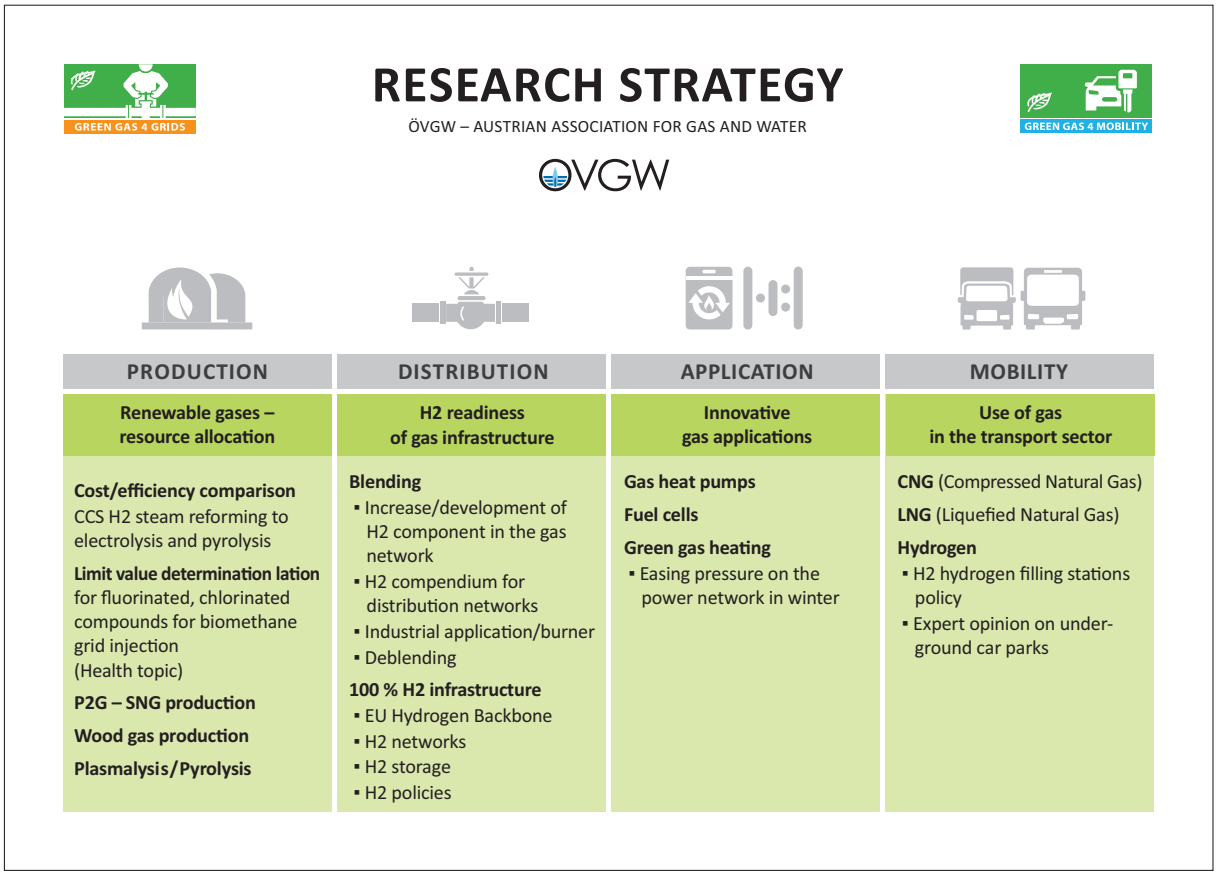
- *agru Kunststofftechnik GmbH*
- *BESTresearch GmbH*
- *Borealis AG*

ÖVGW cooperation partners in Green Gas research initiatives 2024

- *DBI Gas- und Umwelttechnik GmbH*
- *Doka Österreich GmbH*
- *ERIG – European Research Institute for Gas and Energy Innovation*
- *FEN Research GmbH*
- *HyCentA – Hydrogen Center Austria*
- *JKU Linz*
- *MCL – Materials Center Leoben*
- *Montanuniversität Leoben (MUL)*
- *Nawaro Energie Betrieb GmbH*
- *PCCL – Polymer Competence Center Leoben*
- *Pipelife Austria GmbH & Co KG*
- *Technische Universität Graz*
- *Technische Universität Wien*
- *WIVA P&G*

Cooperation at the international level complements domestic expertise. Since many of the issues cannot be resolved in isolation, there is close cooperation with sister organizations such as the *Deutscher Verein des Gas- und Wasserfaches e.V. (DVGW)* and the *Schweizerischer Verein des Gas- und Wasserfaches (SVGW)*. For example, cooperation with *DBI Gas- und Umwelttechnik GmbH* – the DVGW's research institute – offers the opportunity to participate in Germany's wealth of experience.

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



ÖVGW research strategy

THE RESEARCH STRATEGY

ÖVGW's research strategy is developed and adopted by the Gas Research Advisory Board, a committee set up specifically to manage and support the Green Gas Initiative. The research strategy defines which topics are relevant for the market penetration of renewable gases and which questions of a technical, organizational, or economic nature should be scientifically investigated and clarified through appropriate research projects. Part of the strategy is also the gas roadmap, which describes the timeline for the gradual phase-out of fossil gas and the simultaneous switch to biomethane and hydrogen.

The research activities specified in the research strategy cover four areas: production, distribution, application, and – as a special area of application – the mobility sector. They address issues such as resource allocation and the H_2 readiness of gas infrastructure, innovative gas applications on the consumer side, and legal aspects of gas use in transportation.

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

Interactive research overview at www.ovgw.at

Interactive research overview

The overview of the research initiative and the production, transport/storage, and use of renewable gases, which is available on the ÖVGW website, was updated in 2024 and replaced by a 3D model that provides a clear insight into the subject matter. The feature was implemented on the ovgw.at and gruenes-gas.at websites at the end of October. It invites visitors to embark on a journey toward a climate-neutral future and explore how green gas is produced, what resources are needed for this, and in which areas it is used.

When navigating through the landscape section in the model, you can select relevant stations or facilities from production to consumption at a total of 19 positions (e.g., "methanation plant," "electrolysis plant," "gas network," "CNG/LNG/H_2 filling station," "Industry," "Household," etc.) and display brief information about them. These explanatory texts also list the ÖVGW research projects for each position. From here, links lead directly to the corresponding project description in the annual research report. The intuitive and playful approach is intended to further increase interest in green gas and in the ÖVGW's research activities aimed at shaping a climate-neutral energy future.

With its systematic approach, the interactive graphic complements the annual reports, which present research activities in chronological order. Together, they provide a quick overview of the activities and priorities of the Green Gas Initiative and the current state of research.

ZUKUNFT GRÜNES GAS PUBLIC AFFAIRS

Initiative Zukunft Grünes Gas

The activities within the framework of "Zukunft Grünes Gas" (Future Green Gas), the joint platform of ÖVGW and FGW, continued in 2024. The focus remains on raising awareness of green gas. Green gases such as biogas and hydrogen will gradually replace fossil fuels. Austrian gas suppliers are working to put this change into practice in the coming years and will thus continue to play a central role in the future energy industry in terms of security of supply. In addition to the website www.gruenes-gas.at and newsletters, social media is used specifically to inform the general public about green gas and its potential for climate-friendly energy supply.

„HALLO"-campaign

The campaign – carried out in two parts, "HALLO Grünes Gas" (Hello Green Gas) and "HALLO Politik" (Hello Politics) – was the result of a communication strategy workshop organized by ÖVGW in February 2024 with around 20 representatives from the Austrian energy industry. The aim was to develop concrete proposals for a successful energy transition from the perspective of gas network operators. These proposals were then to serve as a basis for future communication with politicians and the public by presenting convincing and clearly argued content based on data and facts.

Policy paper

As part of the campaign, a list of demands was drawn up for politicians and presented at a press conference in October 2024. Green gases are crucial to avoiding supply gaps in the transition from fossil fuels to a climate-neutral energy future. Even if electricity generation is doubled and renewable energies are expanded, fossil fuels cannot be completely replaced. Without climate-neutral and renewable gases such as hydrogen, biomethane, and synthesis gas, less energy will be available in the future than is needed. At the press conference, the ÖVGW presented its proposed solutions and the measures required for a secure and climate-friendly energy supply.

Information brochure

The 12-page publication "Hydrogen – Biomethane – Synthesis Gas. Green gases enable a climate-neutral energy system" presents the gas industry's proposed solutions for achieving a climate-neutral energy system in an appealing format. The brochure answers the question "Why our energy future needs gas," emphasizes the importance of gas infrastructure for the future transport of biomethane, synthesis gas, and hydrogen, highlights the need for cross-sector planning for the energy transition, and provides information on the necessary framework conditions.

FORUM special

To mark the extension of the research initiative for a further five years, the ÖVGW commissioned a special edition of its association magazine *FORUM Gas Wasser Wärme*. The *FORUM special*, entitled "ÖVGW Research Green Gas. Key to the Energy Transition," was published at the end of October and provides a concise summary of the activities to date. It highlights the initial situation as well as the tasks, objectives, organization, and process of the initiative. Using selected reference projects, the 100-page magazine provides insight into the research fields of production, feed-in, distribution, and application (industry, space heating, and mobility) of green gas. The presentation is rounded off with interviews with key participants and an appendix containing a list of projects and a glossary.

Umbrella brand "Future of Green Gas" | Press briefing on 14 October 2024 with ÖVGW Research Council Chair Manfred Pachernegg and ÖVGW Vice-President Stefan Wagenhofer || Themes of the social media campaign „HALLO Grünes Gas" und „HALLO Politik" on the topics of sustainability, independence and security of supply || Information brochure of the initiative "Future of Green Gas" | Special edition of the association's journal on the topic of green gas research

ÖVGW / Max Slovencik

Second ÖVGW Hydrogen Forum: 120 participants on 6 November 2024 at the ThirtyFive event centre in Vienna | Speakers: ÖVGW Vice-President and Spokesperson for the Gas Sector Stefan Wagenhofer | ÖVGW Research Council Chair Manfred Pachernegg | Martin Bredebusch (Open Grid Europe) || Bettina Bordenet (SVGW) | Hans Rasmussen (ERIG) | Stefan Fink (Energienetze Steiermark) | Richard Bauer (Wien Energie) | Helmut Wernhart (AGGM) | Christoph Macho (Liebherr)

ÖVGW Forum Wasserstoff

The ÖVGW has been organizing the Hydrogen Forum since 2023 to communicate the current state of research and as a platform for expert discourse on the topic of renewable hydrogen. In 2024, 120 participants gathered at the ThirtyFive event center in Vienna on November 6 to exchange experiences and learn about the implementation of specific hydrogen projects.

The event covers the entire hydrogen value chain with presentations of projects from the ÖVGW's "Green Gas" strategy: from production, feed-in, transport, and storage to distribution and application. This year, the focus was on the plans and current status of the development of a hydrogen network in Austria, Germany, and Switzerland. Furthermore, the new ÖVGW training program in the field of hydrogen was presented and, with regard to certification, the publication of the ÖVGW's own quality standards for hydrogen was announced, in which the relevant requirements for obtaining the ÖVGW quality mark are specified.

RESEARCH ACTIVITIES

2024

01

GREEN GAS 4 GRIDS
RESEARCH PROJECT **01/2024**

SusBioEcon

RESEARCH CONTRACT: Economically and ecologically optimal utilization paths of wood biomass in a sustainable circular economy based on selected indicators

PROJECT PARTNERS:
BEST – Bioenergy and Sustainable Technologies GmbH, *Dr. Dißauer*
Doka Österreich GmbH, *DI Zeppetzauer*
Nawaro Energie Betrieb GmbH, *Schreiber MA*

DURATION: 2023–2025

STATUS: project year 2 completed; in progress

FFG Forschung wirkt.

THE PROJECT

SusBioEcon aims to identify economically and ecologically optimal utilization pathways for woody biomass in a sustainable circular economy using selected indicators. A key focus of the project is the ecological and economic assessment of BioSNG production, for example, compared to electricity and heat generation in CHP plants. The methodological approach involves evaluating relevant woody biomass value chains using the „Wood-Value-Tools" developed in the ÖVGW initial study (BioEcon). Based on current biomass availability and prices, as well as future scenarios, the costs and efficiency of the considered wood biomass chains can be comprehensively assessed. Additionally, the Wood-Value-Tool is expanded with sustainability indicators to identify optimized usage strategies for wood biomass, considering economic and ecological criteria.

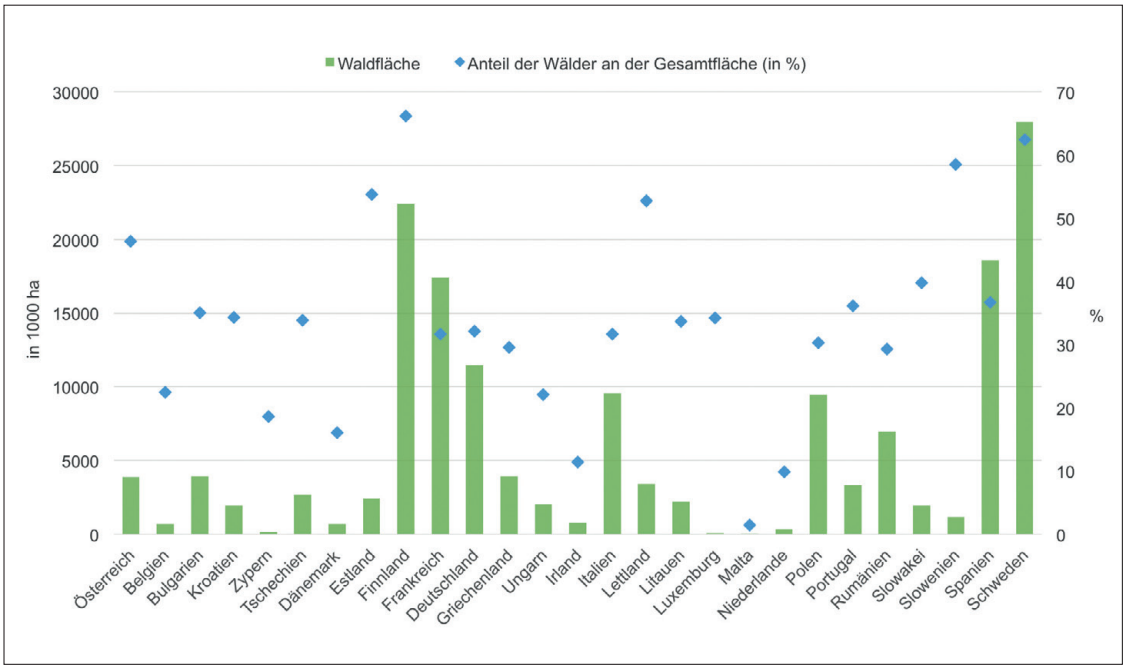
In the second year of the project, an overview of the European forest landscape, as well as wood production and trade, with a particular focus on Austria, was created. Another emphasis was placed on the life cycle assessment of selected wood-based value chains, quantifying greenhouse gas emissions and cumulative energy demand for various bioenergy pathways. The analysis examines different raw materials and energy conversion processes, including the production of BioSNG (Synthetic Natural Gas from biomass), and highlights the potential of modern gas purification technologies concerning the CO_2 balance.

FINDINGS

The forest area in the EU-27 covers approximately 160 million hectares, accounting for 39 % of the EU-27's land area. Six member states—Sweden, Finland, Spain, France, Germany, and Poland—make up two-thirds of the EU's forest area. Unlike many other parts of the world, the forest area in the EU-27 is increasing, although the growth rate is slowing down. Additionally, the forest area available for timber use has been stagnant for several years. Most European forests (60 %) are privately owned, but the forms of public and private ownership vary across Europe due to different historical, legal, and social frameworks. In Northern and Western Europe, forests are predominantly privately owned, whereas in Southern and Eastern Europe, a significant portion is publicly owned.

The greenhouse gas emissions (Global Warming Potential) and cumulative energy expenditure along selected wood-based value chains were calculated for biomass provision, conversion, and potential end-use paths. The greenhouse potential increases with further processing steps. The impacts are lowest for the provision of bark, as it is a residual material and only transport is relevant for the greenhouse potential. Similarly, the cumulative energy expenditure partly reflects the greenhouse potential.

The life cycle assessment of BioSNG was modeled based on the operation of the Syngas Platform Vienna and related process simulations. Two simulated variants of fine gas cleaning are compared—the gas cleaning using a biodiesel scrubber (representing the state of the art) and a cleaning step using Temperature Swing Adsorption (TSA, currently being technically tested). In the conventional gas cleaning route, the main drivers of the greenhouse potential are electricity at 58 % and biodiesel at 36 %. When TSA is used and the process further optimized, electricity accounts for 75.4 % of the total greenhouse potential and biodiesel for 16.9 %. The use of renewable electricity could significantly reduce the greenhouse potential in the future.



Forest area (in 1000 ha) and proportion of forests in total area (in %) in the EU-27
(Data source: BEST GmbH)

02

GREEN GAS 4 GRIDS
RESEARCH PROJECT **02/2024**

HyQuality

RESEARCH CONTRACT: Process development for quality assurance of electrolytic hydrogen for fuel cell applications

PROJECT PARTNER: FEN Research GmbH, *Dr. techn. Fleischhacker*

DURATION: 2023–2024

STATUS: completed, final report ÖVGW GF83

THE PROJECT

This project aims to develop an affordable and robust method for quality assurance of electrolytic hydrogen. By analysing the potential impurities in electrolytic hydrogen production, measures for systematic impurity prevention will be discussed. These include proactive steps in the operational management of the individual processes as well as corresponding purity measurements, which can be divided into continuous monitoring of key parameters on site and full analyses in external laboratories.

A probabilistic model is to be used to extend the continuous recording of key parameters in order to predict quality deviations based on the evaluation of the limited measurement data. Therefore, the probability of failure defined in the model should be used to determine the need for additional certified laboratory analyses with sampling to validate the continuous data recording.

The probabilistic model thus forms the basis for a quality assurance process with a corresponding safety concept that evaluates the interaction between continuous monitoring of key parameters and laboratory analysis with sampling. For the latter, a minimum level has to be chosen so that the cost of quality assurance is minimised as an optimisation variable for a given level of safety. Overall, the procedure to be developed should take into account different types of supply chains for electrolytic hydrogen in order to provide a basis for a future ÖVGW-Guideline on quality assurance of hydrogen.

FINDINGS

Due to its production process, electrolytic hydrogen is very pure or hardly contaminated. However, this research project shows that many factors along the value chain influence hydrogen quality and therefore need to be monitored. The main potential contaminants are summarised in Figure 1 with a qualitative assessment of their probability of occurrence. The elaboration of this project shows that the selection and design of the system components are of essential importance. This starts with the appropriate purification of the feed water. This is a basic prerequisite for the production of pure hydrogen and is decisive for the life-

time of the electrolysis stack. Depending on the exact composition of the water source, specific purification processes must be applied, which must be monitored by continuous conductivity measurements and, if necessary, sample-based TOC measurements.

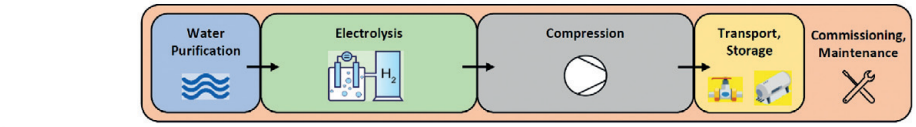
In addition, proactive measures can be taken in the operation of the electrolysis to increase the purity of the hydrogen produced. Despite these design and operational measures, there will always be some impurity gas, consisting mainly of O_2, H_2O and, in the case of frequent inertisation, N_2. Several purification processes can be used to separate the impurity gases. In practice, a deoxo process is usually used for O_2 removal and an adsorption drying process for H_2O removal.

Robust measuring sensors are already available for the continuous monitoring of O_2 and H_2O. For the detection of N_2 or the differentiation between N_2 and O_2, there is still a need for further technical development, which will be covered by the follow-up project "ÖVGW HyQuality2".

In the compression sector, non-mechanical compressors would be advantageous for ensuring H_2 purity, as they usually also have a purification function. However, these are rarely available. Conventional mechanical compressors can be contaminated by wear particles or lubricants. Online particle measurement is not yet fully developed in most cases, so visual inspections of particle filters must be carried out. In order to determine an appropriate level for such checks, a suitable database is required, which is not yet available. With regard to penetrating lubricants, it is necessary to monitor the oil levels in the compressors, in addition to plant engineering measures.

The model developed in this project shows that the required interval for laboratory analysis with sampling can be reduced by implementing robust on-line measurement systems for monitoring key parameters. However, the actual interval between laboratory analyses cannot yet be determined due to insufficient data. For this purpose, it is necessary to build up a database by long-term measurement of the systems.

Further efforts are therefore aimed at establishing a suitable database for the development of a fully defined quality assurance process for electrolytic hydrogen, which can be transferred into a corresponding ÖVGW-Guideline. For this purpose, it is necessary to install measuring systems in operating electrolysis plants in order to build up the corresponding database. The model developed here can then be used to derive the need for additional laboratory analyses. In addition, the technological readiness of continuous measurement systems needs to be improved, especially with regard to robust nitrogen measurement, which is why the follow-up project „ÖVGW HyQuality2" has been initiated.



Contamination through	Probability of Occurrence at						
	Water Purification	AWE-Electrolysis	PEM-Electrolysis	Mechanical Compression	Electrochemical Compression	Strorage, Transport, Cooling, Filling	Commissioning, Maintenance
O_2		xxx	xxx				xx
N_2	x						xxx*
CO_2	x						x
Ar	x						x
H_2O		xxx	xxx				x
CO	x						x
Hydrocarbons	x						x
Halogens							x
Particles				xxx		xx	
Oil/Lubricants				xx			

*Switching the electrolysis system on/off according to the manufacturer's instructions

Evaluation of the occurrence probabilities of impurities for individual processes in the production of electrolytic hydrogen (x/xx/xxx: low/medium/high probability)

03

GREEN GAS 4 GRIDS
RESEARCH PROJECT **03/2024**

HyGrid²

RESEARCH CONTRACT: Conversion of an existing natural gas pipeline for 100 % hydrogen and construction of a demonstrator facility to test various technologies and gain new insights

PROJECT PARTNERS:
DBI Gas- und Umwelttechnik GmbH, *Dr. Baumann*
HyCentA Research GmbH, *Dr. Stöhr*
Materials Center Leoben (MCL), *Dr. Marsoner*
Montanuniversität Leoben, *Ao.Univ.-Prof. Dr. Mori*
WIVA P&G, *DI Matzer*

DURATION: 2022–2026

STATUS: in progress

FFG Forschung wirkt.

THE PROJECT

HyGrid² aims to facilitate the conversion of natural gas pipelines in Austria for the transport of 100 % hydrogen. This will be achieved through the development of new methods and processes, as well as the creation of an internationally recognized flagship project for hydrogen pipeline activities.

The following insights and technologies will be developed:

1. Pipeline inspection and cleaning,
2. Quality of transported hydrogen,
3. Application-oriented on-site cleaning,
4. H_2 suitability of components and materials used.

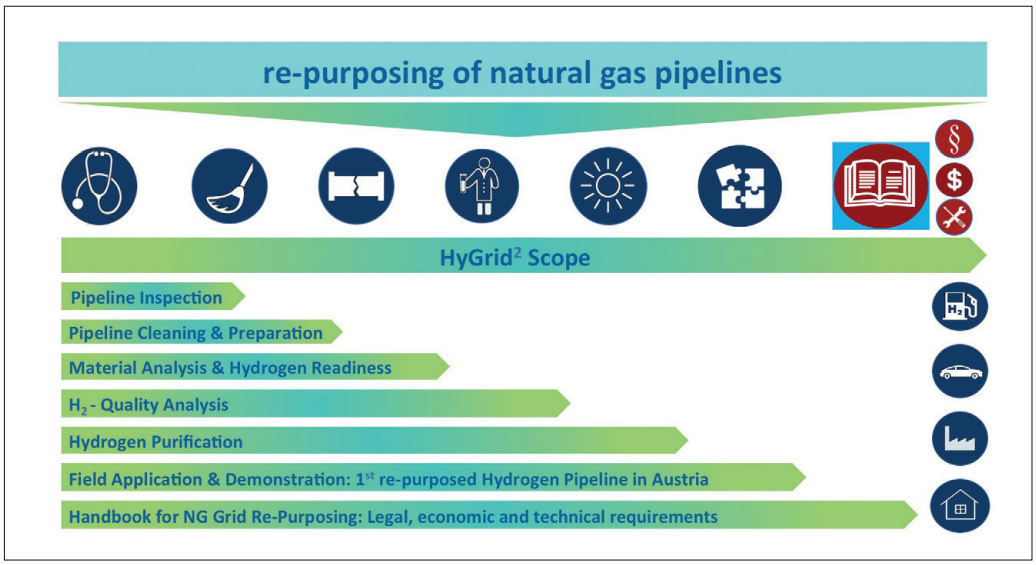
For the first time in Austria, an existing natural gas pipeline will be repurposed for the transport of 100 % hydrogen. This pipeline will be upgraded to a real-test facility, serving to identify critical points and develop countermeasures for the conversion. To accelerate the successful transition of the energy system and strengthen Austria's position within a European hydrogen backbone, a guide for the successful conversion of natural gas pipelines will be created. HyGrid² aims to advance the transition of the energy system to green hydrogen. For this purpose, an optimally structured consortium of gas network operators and interest groups will be formed.

INSIGHTS AND OUTLOOK

The project requirements are thoroughly analyzed and integrated into a manual based on the ÖVGW-Guideline H E210 „Conversion of Gas Pipelines for Hydrogen Operation“ to ensure a systematic and successful conversion process. Various screening methods and criteria are tested to accurately determine investment needs and expenses, enabling informed decision-making. An „Experts Board“ is established to connect with international and European projects and stakeholders. The hydrogen compatibilityof various materials and components within the infrastructure is assessed, along with the development of a robust strategy for non-destructive testing of defect characterization.

Additionally, a systematic investigation of achievable hydrogen quality is conducted, focusing on factors such as steel type and gas composition. Safety tests are prioritized. Innovative cleaning methods, including electrochemical hydrogen cleaning, are developed and tested in practice to ensure the required purity levels.

A specific pipeline section, operated by Energienetze Steiermark, is repurposed for the transport of 100 % hydrogen and expanded into a test facility. Results from small-scale and laboratory experiments are validated in the demonstration facility to showcase applicability and success.



Project Scope for the conversion of a natural gas pipeline and the construction of a demonstrator for the transport of 100 % hydrogen

04

GREEN GAS 4 GRIDS
RESEARCH PROJECT **04/2024**

H_2toPipe

RESEARCH CONTRACT: Impact of green hydrogen on domestic gas networks and the materials used for PE pipes, as well as their design to minimize losses

PROJECT PARTNERS:
Montanuniversität Leoben, *Dr.mont. Arbeiter*
Polymer Competence Center Leoben GmbH (PCCL), *Dr. Bredács*
DBI Gas- und Umwelttechnik GmbH, *DI (FH) Schütz*
agru Kunststofftechnik GmbH, *Fechtig, PhD*
Borealis AG, *Bresser, BSc*
PIPELIFE Austria GmbH & Co KG, *DI Fuchs*

DURATION: 2022–2025

STATUS: in progress

FFG Forschung wirkt.

THE PROJECT

A central challenge of future and sustainable energy supply based on renewable systems is to make the required quantities of energy available at the right place and at the right time. One way of utilizing surplus energy from renewable sources that cannot find a consumer at the immediate time of generation is to convert it into hydrogen (H_2) by means of electrolysis. The disadvantage of using H_2 is that it is difficult to store or transport without losses. One storage and transportation option for gaseous H_2 is to feed it into existing gas grids, which consist largely of polyethylene (PE) pipes. For a large-scale use of existing gas networks, however, there are two major questions that need to be answered to ensure efficient, resource-saving, and safe use: Is there a negative impact on the PE pipe materials used, and can the efficiency of such systems be optimized?

Based on these questions, the project goals of H_2toPipes arise: The analysis of the impact of transported H_2 on the overall service life of existing pipeline systems and the development of new polymer pipe materials with minimized permeability to sustainably increase the efficiency of the transport systems.

In order to assess a possible influence on the expected service life, pipes are examined using fracture mechanics methods – the so-called "cracked round bar" (CRB) test – before and after they have been in contact with gaseous hydrogen for a longer period of time. For this purpose, pipes from previous projects of the partner DBI will be made available, which have already been operated for two or five years with pure gaseous H_2 at the maximum operating pressures.

At the same time, the partners are working on optimizing the permeation properties (Pe) of PE. The primary aim would be to influence the inner structure of the material by means of process control or reinforcing materials in such a way that the permeability to H_2 is reduced while the service life of the material remains the same.

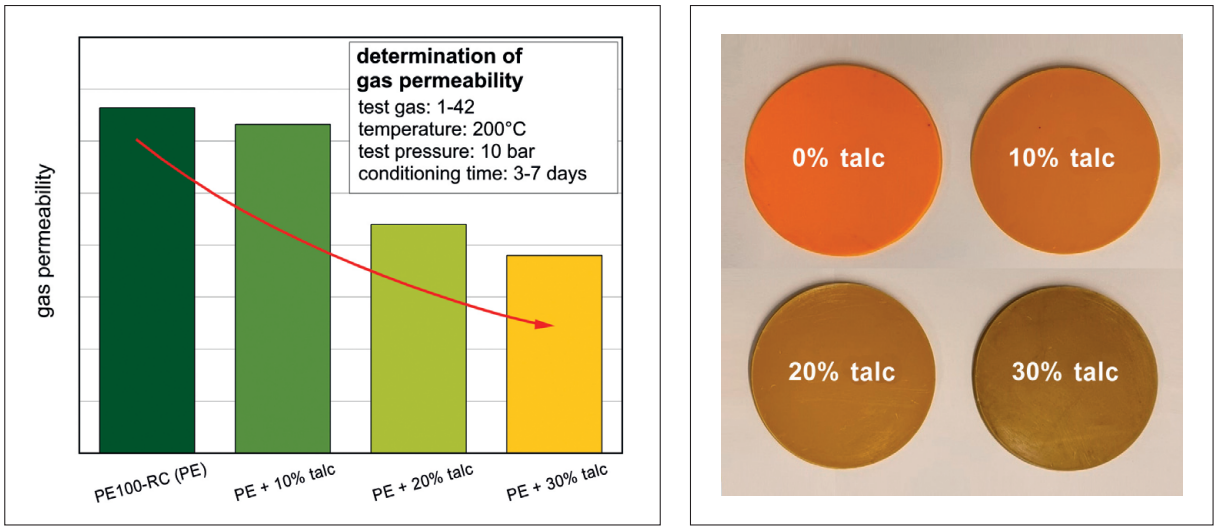
04

FINDINGS

The previous tests on the pipes operated with 100 % hydrogen for 2 years have so far not shown any serious negative effects on the tested polyethylene material. In the CRB tests, a slight change in the slope of the failure curve was observed. However, investigations on pipes that were operated under comparable conditions with water under internal pressure showed a similar trend. This suggests that the applied internal pressure – and not the transport of H_2 – is primarily responsible for these changes.

In the area of material optimization, pipes and moulded parts were produced together with the company partners with processing parameters that were as different as possible in order to determine a potential influence on the permeation properties. The selected parameters made it possible to achieve differences in the degree of crystallinity of the material of up to 10 percentage points. The changes introduced in the morphology led to a maximum change in the permeation coefficient of approx. 10-15 %.

However, tests on talc-reinforced materials showed reductions in gas permeability of approx. 10, 30 and 40 % compared to the unreinforced material at filler levels of 10, 20, and 30 weight percent. When incorporating fillers, however, there is a possibility that the mechanical properties may also change, especially with regard to the expected service life. For this reason, analyses are also carried out on these samples using CRB tests in order to be able to assess the influence on the possible service life of the gas pipes.



Left: Determination of the gas permeability of polyethylene (PE) during material optimization by increasing the addition of talc under hydrogen. Right: Test material with varying amounts of talc added

05

GREEN GAS 4 GRIDS
RESEARCH PROJECT **05/2024**

Involvement in:
Compendium on hydrogen in gas distribution networks

RESEARCH CONTRACT: Analysis of the compatibility of gas distribution network components with hydrogen content in the gas mixture, up to 100 %

PROJECT PARTNER:
DBI Gas- und Umwelttechnik GmbH, *DI (FH) Müller-Syring*

DURATION: 2017–2024 (mit Beteiligung der ÖVGW seit 2019)

STATUS: completed, final report ÖVGW GF 57

THE PROJECT

DBI Gas- und Umwelttechnik GmbH was commissioned to compile a compendium, i.e., a reference work, on the current state of knowledge regarding the compatibility of assets operated by network operators and downstream assets, as well as selected system aspects, with natural gas-hydrogen mixtures and pure hydrogen.

In accordance with the task at hand, the compendium consists of two parts:

- Part A summarizes the current state of knowledge regarding the hydrogen compatibility of the materials and components used in the network.
- Part B determines the compatibility of specific products. To this end, manufacturers are contacted and asked to provide statements on the hydrogen compatibility of their products.

The component profiles provide information on material resistance to natural gas, natural gas-hydrogen mixtures, and pure hydrogen, based on the pressure and temperature ranges commonly found in gas distribution networks. This information is based on resistance tables, technical regulations, and specialist literature. A specially developed online survey collected the experiences and information of component manufacturers on specific products, which were then summarized in product profiles. These are closely based on the format of the component profiles. The aim is to create a comprehensive pool of specific product profiles and manufacturer declarations that confirm the suitability of a particular product for a specific hydrogen content.

A total of over 60 manufacturers were invited to participate and provide information on 153 products, and 102 product profiles were created. Meta-analysis of these profiles revealed that around half of the products are technically suitable for up to 100 vol.% hydrogen. One-third of manufacturers were unable to comment on material compatibility. Nevertheless, manufacturers see the greatest challenges in regulations and certifications. In 13 % of cases, it was stated that a product was not suitable for pure hydrogen. However,

The consortium in numbers

evaluation of the comments shows that the unsuitability was only justified in a comprehensible manner for five products, for example due to the functional limitation of a gas quality measuring device or the use of an unsuitable housing material made of gray cast iron. For the remaining products, reference was often made to a lack of long-term experience, so that the assessment is more "no statement possible at present" than "technically not possible." This assessment can also be applied to specifications up to 20 vol.% hydrogen, as only half of eight products were given an explanation for their unsuitability.

Through the creation of product profiles and bilateral discussions, the project was able to collect 37 binding statements from manufacturers regarding the suitability of their products for hydrogen. These vary between the desired conformity assessment (about two-fifths) and a manufacturer's own template (about one-third), but are legally binding in all cases. In the manufacturer declarations, over 95 % of the products cover a share of at least 30 % by volume of hydrogen in natural gas, and as many as 73% cover all natural gas-hydrogen mixtures and pure hydrogen. However, the response rate for conformity assessments received from just under one-third of the products requested shows that support is needed with regard to missing test bases and unresolved material issues, even though some manufacturers have already initiated investigations on their own. In the course of follow-up activities, the topics of internal and external tightness of shut-off valves, detection of hydrogen leaks with foaming agents, and odorization of hydrogen were also examined in more detail.

06

GREEN GAS 4 MOBILITY
RESEARCH PROJECT **06/2024**

BioGrid

RESEARCH CONTRACT: Optimization of the integration of biogas plants into the Austrian gas grid. The project consists of two parts: technical modeling of the optimal integration of existing plants and analysis of legal and regulatory framework conditions.

PROJECT PARTNERS:
Energieinstitut an der Johannes Kepler Universität Linz (JKU)
TU Wien, Institut für Energietechnik und Thermodynamik, *Univ. Prof. Dr. Hofmann, DI Huber*

DURATION: 2023–2025

STATUS: in progress

THE PROJECT

In order to decarbonize the gas sector, decentrally produced biogas should be fed into the gas distribution and transmission network. This requires the construction of new gas transportation infrastructure, which causes considerable investment costs. To keep these costs as low as possible and to realize the project with high efficiency, the optimal network topology for connecting existing biogas plants with defined feed-in points should be determined.

A framework for optimization was created for this purpose. The aim is to minimize investment and operating costs. The costs of the following components are taken into account: biogas treatment and feed-in systems, pipelines, compressors, and calorific value adjustment. In addition, the maximum feed-in capacity and the pressure level at the respective feed-in points must be met. Modelling this problem leads to a highly complex, non-linear coupled optimization problem. For an efficient solution, piecewise linear approximation of non-linear cost relationships is applied. By using Boolean multiplication, the problem can be formulated as a Mixed Integer Linear Programming (MILP) problem. The modelling was done with the optimization toolbox YALMIP in MATLAB, Gurobi was used as the solver.

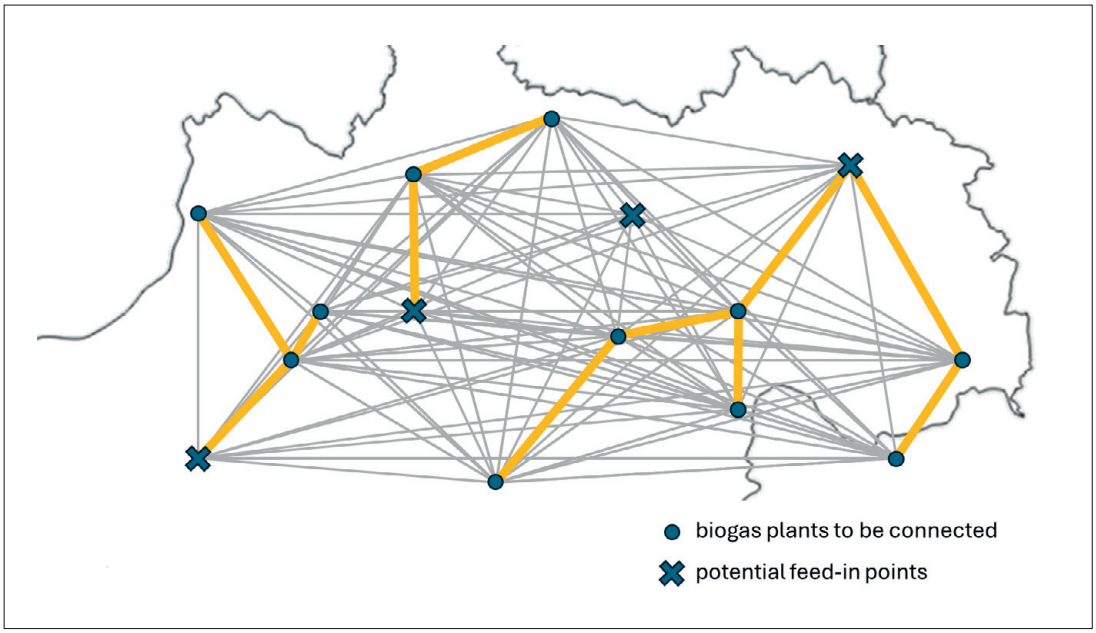
FINDINGS

06

As a case study, 14 biogas plants and 13 potential feed-in points in a 70 x 70 km area in Upper Austria were examined, and an electricity price of 20 ct/kWh was assumed in the basic scenario. The cost-optimized network topology combines the biogas plants into 4 feed-in clusters.

The influence of the assumed electricity price on the network topology was analyzed by varying the parameters. Different electricity price levels between 5 and 80 ct/kWh were examined. Only the operating costs of the compressors are influenced by the electricity price. All other cost centres were modelled as independent of the electricity price. In the case study, the optimal network topology changes at an electricity price of 50 ct/kWh. Instead of connecting a cluster of biogas plants to the nearest feed-in point, a longer and more expensive pipeline is now accepted in order to achieve a cheaper overall solution. The reason for the overall cost saving is the changed utilization of the compressors. This means that higher costs for the piping can be compensated for by saving costs for the compressors. Using the optimization problem, the specific feed-in costs in €/MWh can be determined. Furthermore, the cost allocation to the various components can be examined. A key result is the high cost share of biogas treatment, which accounts for over 77 % of the total costs under the assumptions made. Pipelines are the second largest cost centre at around 10 %, followed by compressors at 8%. The high cost share of biogas treatment offers the greatest leverage for further cost reduction.

Therefore, different technological approaches for biogas treatment will be considered in subsequent studies. In addition, the possibility of processing the biogas in central treatment plants instead of directly processing it at the biogas production site will be modelled. This allows for the use of economies of scale, which can lead to less expensive connection concepts.



The fictitious arrangement of several biogas plants at several potential feed-in points, using Upper Austria as an example, illustrates the highly complex mathematical calculation with many theoretical connection options.

07

GREEN GAS 4 GRIDS
RESEARCH PROJECT **07/2024**

Participation in:
Ready4H2

RESEARCH CONTRACT: European initiative to strengthen the role of distribution system operators in future hydrogen distribution

PROJECT PARTNERS:
Ready4H2, *Director: Jinks, MSc, M.LL.*
>60 Gasverteilnetzbetreiber in Europa

DURATION: Phase 4: 2024–2025

STATUS: in process, ready4h2.com

THE PROJECT

The Ready4H2 project consists of more than 60 European gas Distribution System Operators (DSOs) and national organizations in 10 countries in Europe, working together to support a hydrogen market for future energy delivery – through the transformation of local gas distribution networks to deliver hydrogen – and a common European understanding of the role of gas distribution grids in delivering hydrogen.

The goal of Ready4H2 is to support Europe towards climate net-zero with the belief that DSOs are crucial to accelerating the use of hydrogen to achieve a future energy independence of Europe. By transforming local gas distribution networks, the major benefits of a large-scale hydrogen economy can be facilitated.

Members of Ready4H2

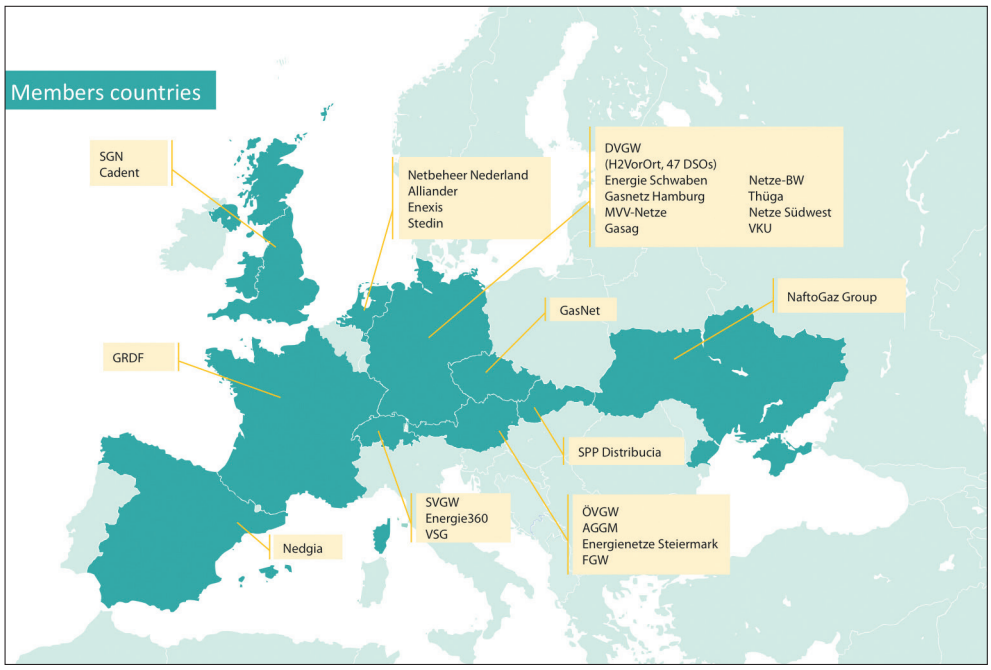
- operate 1.6 M km distribution pipelines (including 55 % of Europe's total). Gas distribution is an essential part of Europe's energy supply. More than 99 % of industrial and commercial customers that are connected to gas are served by distribution networks.
- serve 90 M gas consumers in all sectors, including power generation, industry, transportation, and heating, which have no feasible alternatives to hydrogen to decarbonize.
- are getting ready to deliver hydrogen, with over 50 projects underway.

Ready4H2 is an ongoing initiative with current phase 4 running in 2025. The main project parts are organized as follows:

Advocacy and Communications: Create a common understanding of the value of DSOs in the hydrogen value chain to support the development of the hydrogen market at national and EU levels. Work with members and partner associations to demonstrate the hydrogen-readiness of DSOs.

Technical Knowledge Sharing: Share knowledge among DSOs on the technical and commercial aspects of the transition of distribution gas networks to hydrogen.

Research: Conduct research on technical, commercial, and other issues that affect the business case for DSOs to transform to hydrogen and strengthen relationships with relevant stakeholders to seek solutions.



Ready4H2 members as well as the respective participating network operators and organizations

08

GREEN GAS 4 GRIDS
RESEARCH PROJECT **08/2024**

BIG Green Gas

RESEARCH CONTRACT: The production of synthetic natural gas and green hydrogen via gasification from biogenic residues is presented in the BIG – Green Gas project to raise the regional potential for climate-neutral gases in Austria

PROJECT PARTNERS:
BEST – Bioenergy and Sustainable Technologies GmbH, *Dr. Fürsatz*
TU Wien, Institut für Verfahrenstechnik, Umwelttechnik und technische Biowissenschaften, *Dr.techn. Benedikt*

DURATION: 2022–2025

STATUS: project year 2 completed; in progress

FFG Forschung wirkt.

THE PROJECT

The goal of the BIG Green Gas project is to research new processes for upgrading biogenic residues into green gas, thereby enhancing the regional potential for climate-neutral gases in Austria. To this end, the regional availability of biogenic residues suitable for use in gasification was first determined. Selected residues were tested in a 1 MW gasification plant for their suitability. The resulting product gas was subsequently tested for the production of synthetic natural gas (SNG). The production of hydrogen is planned for 2025.

FINDINGS

For the injection into the Austrian gas grid, the biomass potential for the production of green gases via gasification amounts to around 3.5 million tonnes of dry mass or 12 TWh of CH_4 per year. Woody biomass types account for almost 55 % of the calculated methane output. The identified relevant residue potentials are mostly thermally processed. Here, the possibility exists to generate a higher value energy carrier – green gas – through thermochemical gasification.

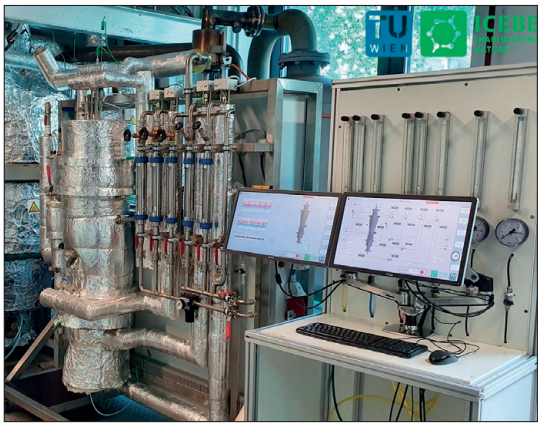
Based on the biomass potential, paper sludge was selected as the second fuel (after bark in the first project year) for a demonstration at the Syngas Platform Vienna. Due to its high water and ash content, a 3:1 mixture of paper sludge and wood chips was used. Gasification using paper sludge was successfully carried out, and the stable operation was comparable to previously used wood chips. As a result, a H_2:CO ratio of 2.3 was achieved. With further operational optimization, it will be possible to optimize the product gas composition with regard to methanization. In the course of gasification operation with paper sludge, the temperature swing adsorption was operated to store cleaned product gas for methanation. The tests showed promising cleaning efficiency to separate tar and sulphur compounds.

The production of SNG was consequently demonstrated with real product gas. After a preliminary parameter variation, a long-term operation was performed. The operating point chosen for long-term operation (340 °C, 1.3 Nl/g/h, 20 vol.% H_2O, no H_2 addition) promises a good raw SNG composition while simultaneously keeping the energy requirement for H_2O evaporation low and having a low/medium risk of catalyst coking. Over a period of approximately 16 hours, constant raw SNG was synthesized during long-term operation. With increasing test duration, a slight change was observed in the conversion rate. Further investigations into the long-term stability of the catalyst are planned.

A life cycle assessment has already been carried out for gas production from wood chips and bark and the subsequent SNG synthesis. The main difference between the raw materials is that emissions from the upstream chain (forestry, harvesting, debarking) are not attributed to bark as a residual material. In the case of wood chips, the supply chain accounts for 32 % of the total Global Warming Potential (GWP). However, the main share of total emissions for both raw materials comes from the use of electricity (wood chips 37 %, bark 54 %).

Additionally, relevant to the GWP are: RME for gas cleaning, transport, and amine for CO_2 washing.

In the final year of the project, the missing data (e.g., hydrogen production) will be generated to provide recommendations for an ÖVGW sustainability guideline for green gases. The last gasification campaign was performed with corn cobs and is currently being evaluated. The experiments regarding hydrogen separation are planned for spring 2025. The results obtained will be incorporated into cost and more detailed LCA evaluations to determine the potential of gasification followed by synthesis for the Austrian gas network.



Left: Methanization fluidized bed of TU Vienna.
Right: Syngas Platform Vienna – 1 MW gasification platform

09

GREEN GAS 4 GRIDS
RESEARCH PROJECT **09/2024**

HyTool

RESEARCH CONTRACT: The HyTool project aims to develop a practical web tool for the preliminary design of power-to-gas (PtG) plants.

PROJECT PARTNERS:
HyCentA Research GmbH, *DI Radner, DI Weber*
GUEP Software GmbH, *DI Pregartner*

DURATION: 2023–2024

STATUS: completed, final report ÖVGW GF 82

THE PROJECT

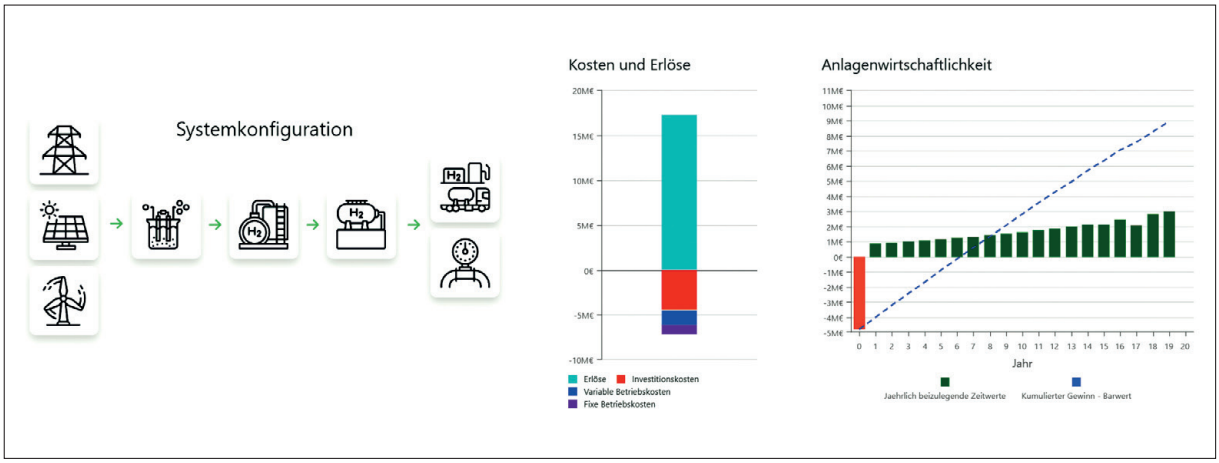
HyTool supports gas network operators and other players in the energy sector in the planning and preliminary design of hydrogen infrastructures. It enables techno-economic analyses of various PtG plant configurations and addresses challenges such as dimensioning, cost estimation, and economic evaluation, especially in early planning phases with uncertain parameters.

The tool is based on heuristics derived from preliminary analyses and simulation models. It offers two usage variants: "demand-driven" and "supply-driven." The demand-driven mode is based on hydrogen demand, while the supply-driven mode optimizes available energy sources. The calculations are based on predefined technical and economic standard values that can be adjusted.

HyTool enables fast, easy, and free plant design and delivers comprehensive technical and economic results. These are presented graphically to enable intuitive interpretation. The results can be exported as PDF or Excel files, with additional information on relevant standards and regulations provided.

HyCentA was responsible for developing the calculation engine, and the GUEP Group implemented it on the grünes-gas.at website. After a successful beta testing phase, the tool was put into active operation. Since its release, several hundred plant designs have already been carried out within just a few weeks. The tool was presented at the ÖVGW Forum Wasserstoff 2024 and has been publicly available free of charge ever since.

09



Left: Exemplary block diagram of the hydrogen value chain depicted in HyTool
Right: Cost and revenue shares as well as the economic efficiency of the entire plant

10

GREEN GAS 4 GRIDS
RESEARCH PROJECT **10/2024**

H_2 Field bend

RESEARCH CONTRACT: This research project investigates, whether residual stresses induced during production may have any significant influence on hydrogen-assisted cracking of bent spiral-welded pipes.

PROJECT PARTNER:
TU Graz – Leichtbau- und Umformtechnologien, *Assoc.Prof. Dr.mont. Domitner*

DURATION: 2024–2025

STATUS: in progress

THE PROJECT

Spiral-welded pipes may possess complex residual stress conditions, especially after cold bending. Residual stresses can be induced not only by the pipe production process (forming, welding, sand blasting) but also by cold bending at the construction site, which makes predicting the actual local stress condition quite difficult. To understand the influence of residual stresses on hydrogen-assisted cracking of pipes requires determining the stress magnitude and the most critical location of the pipe. Then a reliable methodology for considering the effect of these residual stresses on hydrogen-assisted cracking of the pipe can be defined.

With the framework of the project, the bending process of a spiral-welded pipe was modeled using a finite element software to study the role of the bending process on the residual stress conditions. A high-strength pipe bend (material L485) was specially manufactured for the research project. Microhardness measurements and macro-etching were performed on the cross-section of the pipe bends weld to reveal the positions of the weld metal and of the heat-affected zone (HAZ). For this purpose, specimens were cut, mounted, ground, and polished. The microhardness was then measured in a line over the cross-section using the Vickers method. Furthermore, residual stresses near the surface were measured at different circumferential positions inside and outside of the pipe and at different zones of the spiral weld using the hole-drilling method.

Based on the results of simulation and experiments, the critical stress location of the pipe can be determined. The microhardness measurements and the macro-etching enable the specification of the location of bolt-loaded compact tension specimens inside the pipe. These specimens are oriented parallel and perpendicular to the weld line, the HAZ, and the base metal. Wire cutting will be employed for extracting the specimens from the pipe. After creating a fatigue pre-crack in the bolt-loaded compact specimens, they will be loaded by constant displacement and then stored in gaseous hydrogen for several weeks at defined pressure (around 100 bar) and temperature to determine the threshold stress intensity factor in hydrogen, K_{IH}.

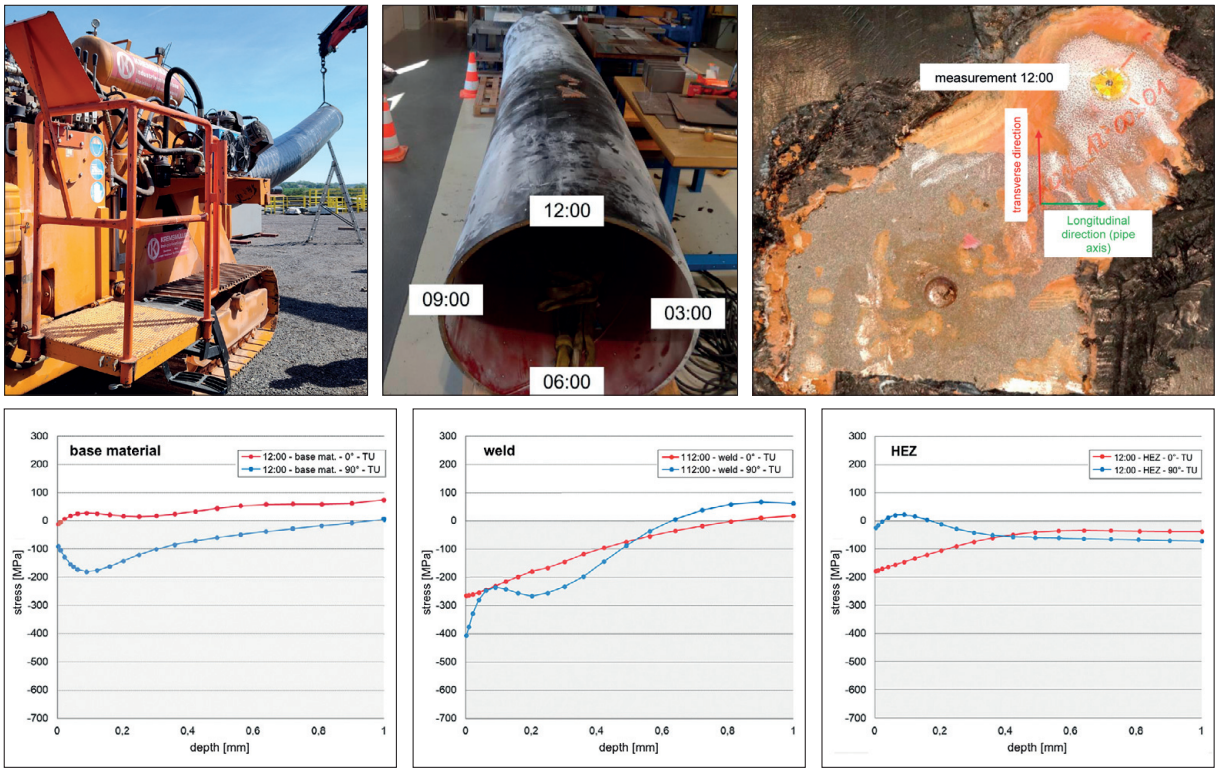
10

FINDINGS

The first results of the simulation show that cold bending of the spiral-welded pipe rather plays a minor role on the final state of the residual stresses. The measured residual stresses are mainly caused by the pipe manufacturing process, including spiral bending, welding, and surface blasting. Furthermore, the results obtained from microhardness measurements and from macro-etching reveal a repeatable hardness pattern at the spiral weld, which indicates that the automated welding process was quite stable.

After completing the residual stress measurements, the critical location of the pipe and the orientations of the bolt-loaded compact tension specimens for testing hydrogen-assisted cracking will be specified. Subsequently, these specimens will be prepared, and the static tests will be performed under defined hydrogen pressure and temperature.

As part of the project, a separate working group on the topic of „Residual stresses in pipe production“ has been formed with research partners from the DVGW and the pipe manufacturer. The results of the research project are exchanged and discussed on a regular basis. For example, the pipe manufacturer's special residual stress measurement methods can be tested at the university. This results in valuable findings for science and the manufacturer.



Top: Pipe bending machine with bent pipe (left), high-strength field bend with designation (center), measurement of stresses using the drill hole method (right)
Below: Stress diagrams over the material depth in base material, weld seam, and heat-affected zone.

11

GREEN GAS 4 GRIDS
RESEARCH PROJECT **11/2024**

Venting vs. flaring of H_2

RESEARCH CONTRACT: Identification of valid standards and applicable guidelines for the discharge of hydrogen from pipelines as well as transferability of these for the framework conditions in the gas stations and consideration of implementation examples

PROJECT PARTNER:
HyCentA Research GmbH, *Dr. Stöhr*

DURATION: 2024

STATUS: completed, final report ÖVGW GF 85

THE PROJECT

The report from HyCentA Research GmbH analyzes international standards and norms for the safe venting of hydrogen from pipelines, providing a methodical comparison between gas flares and venting solutions. The aim is to evaluate the transferability and applicability of relevant safety requirements—such as those from ANSI/AIAA G-095, API Std 537, ASME B 31.12, CGA G-5.5, various DVGW guidelines, as well as the EU Directive 2024/1787—for hydrogen networks in Austria.

Initially, the physical parameters and the necessary pressure relief rates were defined to establish a basis for the safety assessment. This was followed by a comprehensive review of standards, during which international and European norms were systematically examined for their transferability to hydrogen applications. The focus was on how the technical requirements for venting ducts, flame stability, explosion protection, and environmental protection are represented in the existing standards. Additionally, research was conducted on representative implementation examples worldwide, particularly in Europe and the USA. Finally, a technical-economic comparison of the two venting systems was carried out to evaluate the operational effort and the safety potential of both approaches.

FINDINGS

The study demonstrates that hydrogen's low ignition energy and high diffusivity entail specific risks that traditional calculation methods often do not adequately capture. Conventional gas flares face limitations in hydrogen applications due to high investment costs and the challenge of invisible flames, whereas chimney solutions offer benefits through stable venting and reduced explosion risks—provided that sufficient safety distances are maintained.

The report recommends adapting pressure relief strategies, evaluating dispersion calculations through

measurement techniques, and further developing innovative flare concepts (e.g., catalytically supported combustion) to establish safe, standard-compliant, and economically viable venting systems for future hydrogen infrastructures.

	Specific hydrogen standard	Applicable to hydrogen	Explicit requirements for venting devices	Explicit requirements for flares	General safety requirements	Requirements for explosion protection
ANSI/AIAA G-095	✓	–	✓	✓	✓	✓
API STD 537	×	○	×	✓	×	×
ASME B 31.12	✓	–	×	×	✓	×
CGA G-5.5	✓	–	✓	×	×	×
Directive (EU) 2024/1787	×	○	✓	✓	✓	×
DVGW G 1001 (A)	✓	–	×	×	✓	×
DVGW G 220 (A)	×	✓	×	×	✓	○
DVGW G 265-3 (M)	✓	–	✓	×	○	×
DVGW G 440 (M)	✓	–	○	×	×	✓
DVGW G 442 (M)	×	×	✓	×	×	✓
DVGW G 491 (A)	×	✓	○	×	✓	✓
DVGW G 731 (A)	✓	–	○	×	✓	✓
EIGA Doc 211/24	✓	–	✓	×	×	×
ÖNORM EN 1594	×	✓	×	×	✓	×
VDI 3783 Blatt 1	×	✓	×	×	×	○

Overview of the applicability of various standards and guidelines with regard to specific requirements in the field of hydrogen technologies and the design of flares or blowdown valves: Standard applicable (green), partially applicable (yellow), or not relevant (red)

12

GREEN GAS 4 GRIDS
RESEARCH PROJECT **12/2024**

Methane emission measurements in Austria

RESEARCH CONTRACT: Measurement of methane emissions from gas pressure regulation and metering systems, as well as from leak points in underground natural gas pipelines

PROJECT PARTNER:
DBI Gas- und Umwelttechnik GmbH, *Dr. Rockmann*

DURATION: 2023–2024

STATUS: completed, final report ÖVGW GF 80

THE PROJECT

In preparation for the EU regulation on reducing methane emissions, methane emissions were measured at selected gas pressure regulating stations and from leaks in underground pipelines over a period of 10 measurement days. For the gas pressure regulating stations, measurements of methane emissions were taken both at source level and at site level.

Training sessions for gas network operator personnel were also held during the measurements.

FINDINGS

The EU regulation on reducing methane emissions in the energy sector, which came into force in August 2024, sets out requirements for operators of gas installations to measure and document methane emissions. A distinction is made between:

- Measurement of methane emissions at source (source level) and
- measurement of methane emissions at the site level.

Source-level measurements are taken directly at individual plant components (flange connections, regulators, etc.). In contrast, site-level measurements are taken at a greater distance from the emission source at an entire plant or site and thus usually cover more than one potential source of methane emissions. Site-level measurements complement source-level measurements to ensure that all sources of emissions have been detected.

Source-Level

In this project, the source-level measurement method used is EN 15446 "Fugitive and diffuse emissions of general interest for industrial sectors - Measurement of fugitive emissions of gases and vapors from leaks in operating equipment and pipelines." All accessible

plant components and assemblies are scanned. If a leak is detected, the emission rate is then calculated in accordance with EN 15446.

Site-Level

The "site-level extraction method" is used as a site-level measurement, which records the methane emissions of the entire plant, including all components located within the building envelope. To determine the emission rate within the GDR(M)A, its openings to the outside are closed and sealed. The cross ventilation, which is usually present, remains unclosed. The extraction flange is attached to the upper cross ventilation. The lower cross ventilation remains unclosed and is used to draw in fresh air. The room air is then extracted via a fan while simultaneously measuring the methane concentration in the extracted volume flow.

Once the methane concentration in the extracted volume flow is constant, the emission rate in l/h is calculated from the measured concentration and the extraction volume flow. Furthermore, the exhaust vents are measured – here, an air flow is sucked in through the lower opening of the exhaust vent and the emissions from the exhaust vent pipe are completely captured by the extraction flow. The volume flow and methane concentration are recorded. The methane emission rate is calculated from the volume flow and the detected methane concentration.

The measurement of methane emissions from a leak in an underground gas pipeline is based on extracting soil air at a defined volume flow rate and simultaneously measuring the methane concentration in the extracted volume flow. The methane emission rate can then be calculated from the volume flow and the methane concentration. As part of the project, the measurement was carried out on a test section.

Based on the measurements taken, emission factors were established which can subsequently be used for the required reporting.

Measurement setup blower (left) and probe array for measuring the leak location on an underground gas pipeline "test section" (right)

RESEARCH ACTIVITIES

OUTLOOK 2025

OVERVEW 2019–2024

OUTLOOK 2025

CONTINUED PROJECTS 2025

SusBioEcon

Continuation of project 01/2024
BEST – Bioenergy and Sustainable Technologies GmbH, Dr. Dißauer; Doka Österreich GmbH, DI Zeppetzauer; Nawaro Energie Betrieb GmbH, Schreiber MA

HyGrid²

Continuation of project 03/2024
HyCentA, Dr. Stöhr; DBI, Dr. Baumann; MCL, Dr. Marsoner; MUL, Ao.Univ.-Prof. Dr. Mori; WIVA P&G, DI Matzer

H_2toPipe

Continuation of project 04/2024
PCCL, Dr.mont. Arbeiter; DBI, DI (FH) Schütz

BioGrid

Continuation of project 06/2024
TU Wien, Univ.Prof. Dr.techn. Hofmann; Energieinstitut an der JKU

Ready4H2

Continuation of project 07/2024
European initiative involving more than 60 European gas distribution system operators (DSOs) and national associations in 10 European countries

BIG Green Gas

Continuation of project 08/2024
BEST GmbH, Dr. Fürsatz; TU Wien, Dr.techn. Benedikt

H_2 Field bend

Continuation of project Projekt 10/2024
TU Graz, Dr. mont Domitner

PLANS

HyQuality2

Status: 2025–2026
Project partners: *FEN Research GmbH, Dr. techn. Fleischhacker; HyCentA, Dr. Stöhr*
Details: A theoretical model was developed to ensure the quality of electrolytically produced hydrogen (HyQuality, Project 02/2024). This model is now to be validated and put into practice. To this end, a measurement setup is to be developed and used to build up a measurement database of existing electrolysis plants in Austria.

HyBS – Hydrogen Blending Simulation

Status: 2025–2026
Project partner: *AGGM Austrian Gas Grid Management AG, DI Haider*
Details: The project idea aims to develop a simulation method to model the spread of hydrogen in the existing gas network. The goal is to make predictions about the maximum hydrogen feed-in to the gas infrastructure. Project partners are RAG, Netz OÖ, E-Netze STMK, and TIGAS.

BioGrid2 – Biogas upgrading technologies and clustering

Status: 2025–2026
Project partners: *TU Wien, Univ. Prof. Dr. Hofmann; Energieinstitut an der JKU Linz, DI Böhm*
Details: The study examines various biogas treatment technologies in terms of energy requirements and costs. It compares central purification using amine scrubbing and decentralized treatment using membrane scrubbing, focusing on the overall systemic costs. The existing optimization problem (BioGrid, Project 06/2024) is expanded to include new parameters in order to model optimal connection and optional clustering of multiple plants.

SuSNG – Sustainable Synthetic Natural Gas

Status: 2025–2027
Project partner: *BEST – Bioenergy and Sustainable Technologies GmbH, DI Hannl*
Details: The project deals with the methanization of biogenic residues, including gas purification, to enable feed-in to the gas grid. Gas production takes place using the DFB fluidized bed process. To this end, campaign tests with selected residues at the Syngas Platform Vienna, long-term tests, scale-up investigations for industrial plants, and further development of simulaiton software are planned.

Hydrogen firefighting training and testing centre

Status: 2025–2026
Project partner: *Analytical Control Service GmbH (ACS), DI Ortbauer*
Details: As part of the project, the development of a standardized safety concept and safety guidelines for an H_2 firefighting training and testing center is being considered. Since natural gas-powered firefighting training facilities already exist in the federal states, a concept for converting these facilities to H2 is particularly relevant.

OVERVIEW 2019–2024

GREEN GAS 4 GRIDS
RESEARCH PROJECTS **2019–2024**

RESEARCH PROJECT 01/2019
Cost analysis of integrating existing biogas plants into the Austrian gas grid

RESEARCH PROJECT 02/2019
Development of a standard concept for processing raw biogas into a gas suitable for feed-in

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

RESEARCH PROJECT 04/2019
Expertise for feeding 10 vol.% hydrogen into the Austrian gas grid – customer natural gas systems and domestic gas appliances

RESEARCH PROJECT 05/2019
Compendium on hydrogen in gas distribution networks *(participation)*

RESEARCH PROJECT 01/2020
Effects of fluctuating hydrogen content in natural gas on industry

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

RESEARCH PROJECT 03/2020
Standardized biogas upgrading and methanation

RESEARCH PROJECT 04/2020
Current technologies and applications of fuel cells and small-scale combined heat and power generation for end customers

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

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

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

RESEARCH PROJECT 09/2020
Compendium on hydrogen in gas distribution networks – continuation *(participation)*

RESEARCH PROJECT 01/2021
Meta-study on the 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 applications of fuel cells as KWW in commerce and industry

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

RESEARCH PROJECT 06/2021
HyGrid Pilot Study – Analysis of contaminants in hydrogen during transport in repurposed pipelines

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

RESEARCH PROJECT 08/2021
Standardization of biomethane compressors

RESEARCH PROJECT 09/2021
Increasing the efficiency of 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
Compendium on hydrogen in gas distribution networks – continuation *(participation)*

RESEARCH PROJECT 01/2022
Gas heat pumps and hybrid heating systems

RESEARCH PROJECT 02/2022
Study on fuel cells and CHP in commercial enterprises

RESEARCH PROJECT 03/2022
HyGrid Pilot Study und Outlook Hygrid[2]

RESEARCH PROJECT 04/2022
Efficiency of air source heat pump systems in different building classes

RESEARCH PROJECT 05/2022
Increasing the efficiency of Austrian gas distribution – best practice examples and derivation of optimization measures

RESEARCH PROJECT 06/2022
Determination of the calorific value of a gas mixture

RESEARCH PROJECT 07/2022
HyPipe

RESEARCH PROJECT 08/2022
BIG Green Gas

RESEARCH PROJECT 09/2022
Standardisation of biomethane compressors

RESEARCH PROJECT 10/2022
Ready4H2 phase 2 *(participation)*

RESEARCH PROJECT 11/2022
Compendium on hydrogen in gas distribution networks – continuation *(participation)*

RESEARCH PROJECT 13/2022
H_2toPipe *(participation)*

RESEARCH PROJECT 01/2023
SusBioEcon

RESEARCH PROJECT 02/2023
HyQuality

RESEARCH PROJECT 03/2023
Hygrid^2 – continuation

RESEARCH PROJECT 04/2023
H_2toPipe – continuation

RESEARCH PROJECT 05/2023
Compendium on hydrogen in gas distribution networks – continuation *(participation)*

RESEARCH PROJECT 07/2023
HyPipe – continuation

RESEARCH PROJECT 08/2023
BIG Green Gas – continuation

RESEARCH PROJECT 01/2024
SusBioEcon – continuation

RESEARCH PROJECT 02/2024
HyQuality – continuation

RESEARCH PROJECT 03/2024
Hygrid^2 – continuation

RESEARCH PROJECT 04/2024
H_2toPipe – continuation

RESEARCH PROJECT 05/2024
Compendium on hydrogen in gas distribution networks – continuation *(participation)*

RESEARCH PROJECT 06/2024
BioGrid

RESEARCH PROJECT 07/2024
Ready4H2 – continuation *(participation)*

RESEARCH PROJECT 08/2024
BIG Green Gas – continuation

RESEARCH PROJECT 09/2024
HyTool

RESEARCH PROJECT 10/2024
H_2 Field bend

RESEARCH PROJECT 11/2024
Venting vs. flaring of H_2

RESEARCH PROJECT 12/2024
Methane emission measurements in Austria

GREEN GAS 4 MOBILITY
RESEARCH PROJECTS **2019–2024**

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

RESEARCH PROJECT 12/2022
ReHaul *(participation)*

RESEARCH PROJECT 06/2023
ReHaul – continuation *(participation)*

Green gas is the key to a climate-neutral energy future. Within the framework of its Greening the Gas strategy, the Austrian gas industry is working purposefully and consistently to replace fossil natural gas with green gas in all application areas step by step. To enable the rapid adoption of green gas, it is important to identify and remove barriers and obstacles. The task of the Austrian Association for Gas and Water (ÖVGW) is to establish a technical framework for the use of green gas. In order to address technical questions, the ÖVGW enters into collaborations with partners from the scientific community and commissions specific research projects. Additionally, it is a member of the ERIG network – the European Research Institute for Gas and Energy Innovation – to leverage synergies at the European level. The results of these studies are presented in the annual research report.