DVGW

WISSENSWERT

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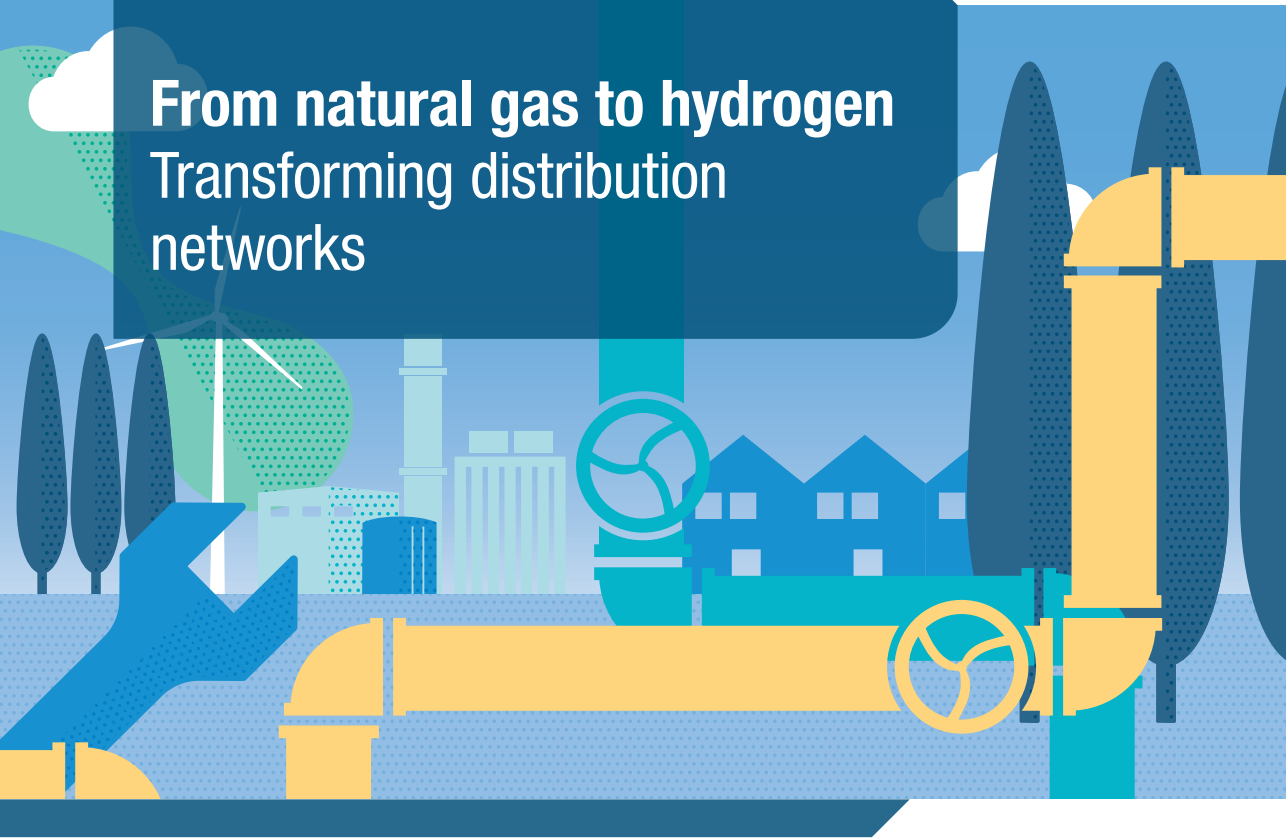
From natural gas to hydrogen

Transforming distribution networks



The technology is ready. Now we need clear regulatory frameworks.

At a glance

- The existing gas infrastructure can be used in a climate-neutral way with hydrogen.
- Converting distribution networks is technically feasible and cost-effective.
- Pilot projects have already shown that it works.
- However, the transition is complex and takes time. To achieve climate targets, action must be taken now.
- Clear reliable regulatory and financing frameworks are essential for a successful transition.

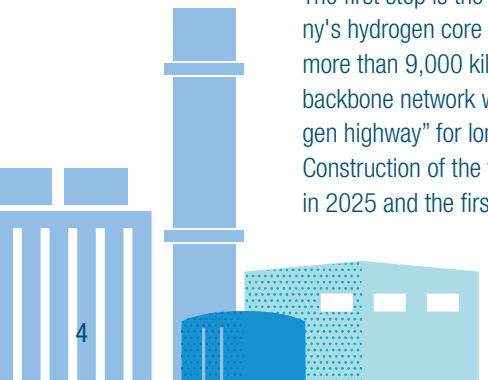
Hydrogen can make our energy supply climate-neutral

As part of the energy transition, fossil fuels such as natural gas must be replaced by renewable gases by 2045. Hydrogen will play a key role in this transformation and will gradually replace natural gas, together with biomethane and other new gases.

It is widely recognized that we will continue to need molecules in our energy mix. Renewable gases are indispensable for industrial feedstocks, for processes that cannot easily be electrified and for ensuring a reliable supply of electricity and heat. Power plants as well as many industrial and commercial facilities will depend on a secure hydrogen supply. To deliver hydrogen to where it is needed, a reliable and efficient gas network is needed.

The first step is the development of Germany's hydrogen core network, which will cover more than 9,000 kilometres by 2032. This backbone network will serve as the "hydrogen highway" for long-distance transport. Construction of the first new sections began in 2025 and the first pipes are already transporting hydrogen. However, the core network alone will not be enough to ensure comprehensive hydrogen supply. DVGW studies show that most power plants and industrial sites, which will need hydrogen, are located too far from the core network. This is why hydrogen distribution networks are essential – the "local roads" of our future energy supply.

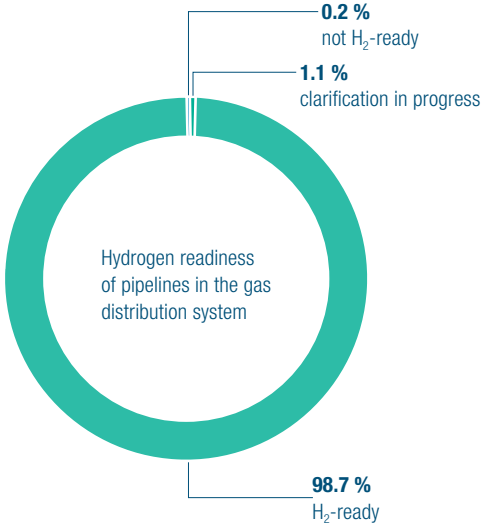
Germany's gas network consists of the transmission network (white) and the distribution network (green).



Existing pipelines can still be used

The good news is that most of the required infrastructure is already in place. Germany's natural gas distribution network spans more than 560,000 kilometres and currently supplies around 1.8 million industrial and commercial customers as well as 21 million households. That's a total of 99 % of all gas consumers. With a replacement value of more than €270 billion, it is a strategic asset for the energy transition.

From a technical perspective, the existing natural gas distribution network can be adapted to transport hydrogen. A survey conducted by the H2vorOrt initiative and findings from DVGW research projects show that around 99 % of the existing pipelines are already suitable for use with hydrogen, irrespective of whether the pipelines are made of steel, plastic, copper, ductile cast iron or aluminium alloy.



Source: www.h2vorort.de; DVGW research projects

Conversion to hydrogen is also economically viable. Although investments will be required, the cost is reasonable. The development of the core network will cost around €19 billion. The additional cost of upgrading distribution networks for operation with hydrogen will only be €4 billion. The total cost of the transition will be less than 10 % of the estimated replacement value of the German gas grid.

From theory to practice: converting distribution networks to hydrogen

Numerous research projects and large-scale demonstration initiatives have already shown that hydrogen is compatible with most existing pipeline materials and network components. The focus is now shifting to practical implementation: How can a gas distribution network be converted to hydrogen? Which technical, organisational and regulatory aspects need to be considered? And how can the transition be carried out while keeping the network in operation?

These questions were addressed by the DVGW research project **H2-Umstellung** ("H2-Transformation"). Its key finding is clear: Converting distribution networks to hydrogen is technically feasible, yet is a complex, long-term process that requires careful planning and coordination. The project identifies three key phases:

1

ANALYSIS AND TRANSITION PLANNING

The first step is to carry out a detailed assessment of the existing network and develop a roadmap for the transition – the conceptual basis for all subsequent stages.

2

ADAPTATIONS AND REGULATORY APPROVAL

The second stage includes specific modifications such as the replacement of components or the construction of individual pipeline sections, as well as the submission of applications to the energy regulatory authority.

3

IMPLEMENTATION

Finally, the network is converted to hydrogen section by section and can then be operated with hydrogen.

Phase 1:
Planning starts with data

Before a gas network can be converted to hydrogen, careful planning and reliable data are essential. Network operators need to answer questions such as:

- Which customers are connected to the network and how do they use gas today? Are there apartment buildings, industrial facilities or power plants that rely on natural gas?
- How much hydrogen will they need in the future and when?
- Are the existing network and the connected appliances H_2-ready? What needs to be replaced?
- How will hydrogen be fed into the system? Will it come from local electrolysers and/or from the hydrogen backbone?
- How can a safe and reliable gas supply be ensured before, during and after the transition?

Once these questions have been answered, the network operator can plan the future hydrogen network and prepare a detailed transition plan. This defines when each section of the network will be converted and what modifications are required beforehand.

One of the biggest challenges is access to reliable data on installed gas appliances, especially heating systems in buildings. In the future, every replacement of a gas appliance should be documented and shared with the network operator. Hydrogen-ready appliances can later be converted for hydrogen use.

ANALYSIS AND TRANSITION PLANNING

Customer analysis
↓
Assessment of H_2-readiness
↓
Supply analysis
↓
Planning of H_2-network
↓
Transition plan

Phase 2:
Adaptations and regulatory approval

The measures planned in Phase 1 are now put into practice. Network components such as filters and meters are adapted or replaced. Where necessary, new pipelines are installed and additional components, such as shut-off valves, are added.

Before the actual conversion can begin, the project must be notified to the energy regulatory authority and an independent expert assessment must be obtained. The possibility of abolishing the latter requirement for pipelines below 16 bar is currently being discussed, as the DVGW codes of practice now cover all safety requirements for the conversion to hydrogen. Additional approvals may be requiered, depending on the scope of the modifications and for any new pipelines. As some regulatory requirements are still evolving and practical experience is limited, network operators should engage with the relevant authorities at an early stage. Early coordination and thorough preparation are essential to avoid delays.

One issue that remains unresolved is the required notice period for customers before the conversion. Periods of between three and ten years are currently under discussion. A long notice period would further delay the transition. A timely decision is therefore essential to provide planning certainty for network operators.

The regulatory guidance developed as part of the DVGW research project PORTAL GREEN II provides detailed information on the relevant approval procedures, responsible authorities and applicable deadlines (available in German).

ADAPTATIONS AND REGULATORY APPROVAL

Approval procedures
↓
Replacement/ modification of non-H_2-ready components
↓
Construction of new pipelines (if necessary)
↓
Additional approvals (if necessary)

Phase 3:
Implementation

The final phase of the transformation involves the actual conversion of the network to hydrogen. This is carried out section by section, progressing step by step between two junctions. Each section is temporarily disconnected from the network and purged with an inert gas such as nitrogen to completely remove all existing natural gas. All connected devices, such as heating systems, gas stoves and industrial burners, must then be replaced with hydrogen-compatible alternatives. The pipeline section is subsequently filled with hydrogen and tested for leaks. Finally, the network and connected systems are recommissioned.

This process is complex, as many networks are not sufficiently equipped with shut-off valves. Therefore, additional valves often need to be installed during Phase 2, which requires civil engineering works.

An alternative approach would be direct purging with hydrogen, without the use of nitrogen and without shutting down the system completely. This method could significantly accelerate the conversion, as the gas only needs to be replaced once and fewer shut-off points are required. This would reduce costs and would also eliminate the logistical effort and costs associated with the provision and handling of nitrogen.

ONTRAS has already successfully tested this method on 25 kilometers of transmission pipeline at the Bad Lauchstädt Energy Park. However, for this approach to be widely implemented, the relevant technical regulations still need to be adapted.

IMPLEMENTATION

Decommissioning of the conversion area
↓
Purging with inert gas
↓
Replacement of appliances
↓
Filling with hydrogen
↓
Testing
↓
Commissioning

Between ambition and stagnation: lack of regulation and shortage of specialists challenge the H_2 transformation

The conversion of gas infrastructure to hydrogen is feasible – but in practice, progress is stalling. One of the key obstacles is the lack of a **clear legal and financing framework**. Without defined regulatory guidelines that also address practical challenges, every distribution network conversion becomes a case-by-case exercise. The issue of financing also remains unresolved: while the hydrogen core network is funded through the amortization account, there are no comparable mechanisms in place yet for distribution networks.

The amortisation account
The core hydrogen network is being financed privately and the cost will be distributed to customers via network utilisation charges. This arrangement means that the few customers connected in the early stages would need to pay prohibitively high charges. To prevent this, network tariffs are legally capped. The resulting financing gap is bridged through the amortization account. As more customers are connected over time, the additional revenue offsets the initial losses.

Another major challenge is the **shortage of skilled personnel**. Thousands of technicians are required nationwide to adapt gas appliances, meters and connections. However, there is already a lack of qualified personnel in many relevant professions. Estimates of the shortfall by 2030 range from 12,000 to 70,000 people. Addressing this challenge will require measures on multiple levels: from early career orientation in schools and targeted training programs to incentives for companies to create apprenticeships and training opportunities.

Time is running out
Given the large number of technical details, small-scale adjustments and involved stakeholders, it is crucial to start work on the transition now. Even with substantial resources, such as 36,000 technicians deployed, the complete conversion of the entire infrastructure will take more than ten years. If the start is delayed further, the pressure to implement all measures within a shorter timeframe will increase – along with the associated risks of bottlenecks, delays and rising costs.

With
36,000 technicians,
the conversion will take more than
10 years.

To ensure a successful transition, action must be taken now: with a reliable regulatory framework, a viable financing solution and a comprehensive skilled workforce strategy. Only with extensive distribution networks can hydrogen reach all the areas where it is needed, which will be essential if our industry is to remain competitive in the long term.

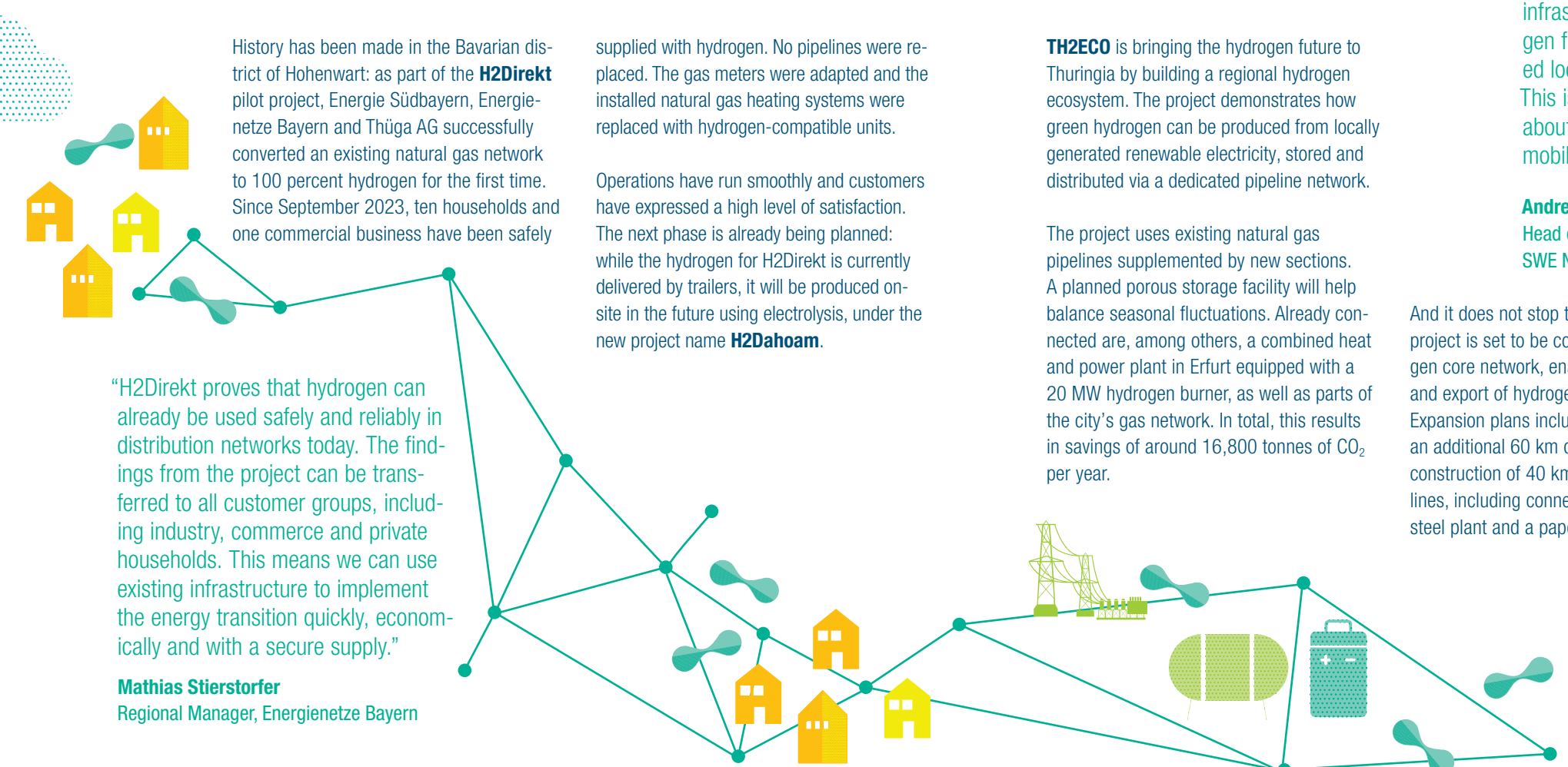
H_2 distribution systems are already in operation today

History has been made in the Bavarian district of Hohenwart: as part of the **H2Direkt** pilot project, Energie Südbayern, Energienetze Bayern and Thüga AG successfully converted an existing natural gas network to 100 percent hydrogen for the first time. Since September 2023, ten households and one commercial business have been safely supplied with hydrogen. No pipelines were replaced. The gas meters were adapted and the installed natural gas heating systems were replaced with hydrogen-compatible units.

Operations have run smoothly and customers have expressed a high level of satisfaction. The next phase is already being planned: while the hydrogen for H2Direkt is currently delivered by trailers, it will be produced on-site in the future using electrolysis, under the new project name **H2Dahoam**.

"H2Direkt proves that hydrogen can already be used safely and reliably in distribution networks today. The findings from the project can be transferred to all customer groups, including industry, commerce and private households. This means we can use existing infrastructure to implement the energy transition quickly, economically and with a secure supply."

Mathias Stierstorfer
Regional Manager, Energienetze Bayern



A holistic H_2 system in Thuringia

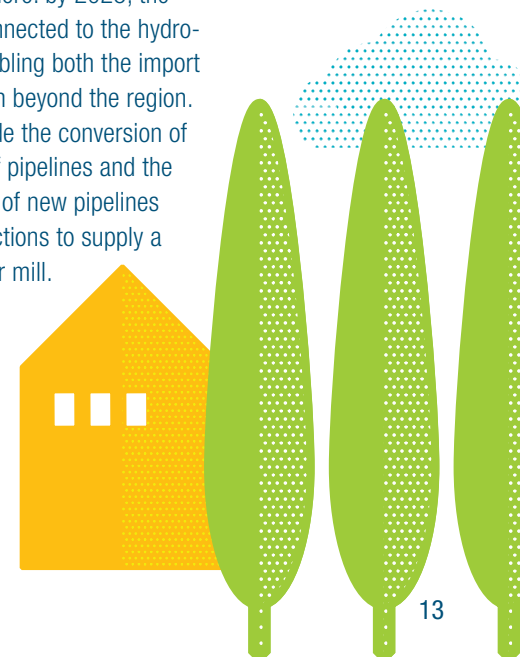
TH2ECO is bringing the hydrogen future to Thuringia by building a regional hydrogen ecosystem. The project demonstrates how green hydrogen can be produced from locally generated renewable electricity, stored and distributed via a dedicated pipeline network.

The project uses existing natural gas pipelines supplemented by new sections. A planned porous storage facility will help balance seasonal fluctuations. Already connected are, among others, a combined heat and power plant in Erfurt equipped with a 20 MW hydrogen burner, as well as parts of the city's gas network. In total, this results in savings of around 16,800 tonnes of CO_2 per year.

"With TH2ECO, we are creating the infrastructure that brings green hydrogen from concept to application – rooted locally and connected across Europe. This is not about symbolic policy, but about concrete solutions for industry, mobility and climate protection."

Andreas Huhn
Head of Gas Network Technology,
SWE Netz GmbH

And it does not stop there: by 2028, the project is set to be connected to the hydrogen core network, enabling both the import and export of hydrogen beyond the region. Expansion plans include the conversion of an additional 60 km of pipelines and the construction of 40 km of new pipelines lines, including connections to supply a steel plant and a paper mill.



DVGW Wissenswert: Specialist knowledge made simple

Hydrogen is set to play a central role in achieving climate neutrality and driving Germany's energy transition. For more than a decade, DVGW has engaged in hydrogen research and innovation. Our research institutes are working on numerous projects to advance the production, transport, distribution and application of hydrogen. In addition, many of the DVGW codes of practice have already been adapted to cover hydrogen.

With "DVGW Wissenswert", we present this expertise in a compact and accessible format. We explain current research findings, technological developments and regulatory frameworks across the energy and water sectors. If you are interested in the latest developments in renewable gases and water, you can find the information here – in brochures, short studies, webinars, fact sheets and audio or video features.

More information at: www.dvgw.de/wissenswert

Published titles in the series (in English):

- Energy storage – but how? Ensuring a reliable energy supply with the right storage mix
- Enough hydrogen – or is legislation restricting potential?
- Hydrogen: Demand and Procurement Pathways
- Largely H_2-ready now: grids, storage facilities, components
- Hydrogen reduces the CO_2 footprint – in many ways

Source

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