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ENERGIEN SPEICHERN
INES

INES webinar on MAHS

Background, aim, methodology and results of the MAHS - Market Assessment for Hydrogen Storage

April 9th, 2024

Organizational Information

Questions

- Written questions can be submitted at any time via the Q&A function. Questions are answered directly after each section or collected for the Q&A session at the end.
- Verbal questions after the call for questions in the Q&A session. Please write "Question" in the Q&A area.

Quotations

- Statements can be quoted freely (under one).
- Individual quotes are possible afterwards.

Recording of the webinar

- The webinar will be recorded.
- Participant data will not be captured as long as the audio/video function remains switched off.

Materials available afterwards

- Today's presentation slides (German/English)
- Recording of the webinar

Outline

Outline

Background and aim

Legal background

In future, storage operators will be obliged under Article 8 ("Market assessment for renewable gas and low-carbon gas by LNG and storage system operators") of the EU Regulation on internal markets for renewable gases and natural gas and for hydrogen ("EU Gas Package") to carry out a market assessment for investments in storage facilities for renewable and low-carbon gases, including hydrogen, at least every two years.

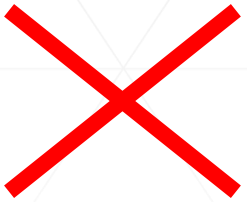
Market economy background

The "Long-term scenarios for the transformation of the energy system in Germany" of the Federal Ministry of Economics and Climate Protection (BMWK) quantitatively described the hydrogen storage demand required to implement the energy transition. Supplementing the long-term scenarios and identifying specific demand structures of the market players by surveying the market would appear reasonable.

Aim of the MAHS (Market Assessment for Hydrogen Storage)

Survey of the demand for hydrogen storage in Germany and identification of the requirements of market players for hydrogen storage in order to create a basis for decision-making for politics and industry and to promote an efficient and demand-oriented development of hydrogen storage.

Use of data

		Who?		
		INES-Employees	Storage operators and authorities	The public
How?	Company-specific entries	• Plausibility check • Modeling • Aggregation and anonymization • Creation of key figures and diagrams		
	Aggregated and anonymized entries	• Generate documentation for storage operators, authorities and the public	• Basis for political and economic decisions	• Information

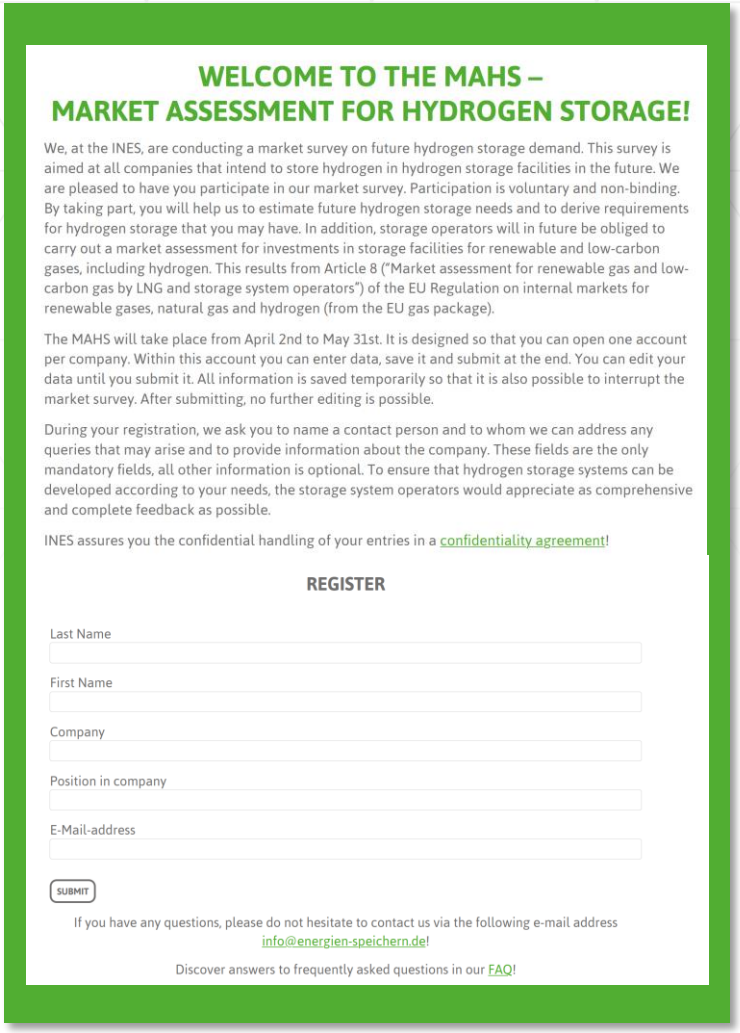
This use of data is guaranteed in the downloadable confidentiality agreement.
Further explanations can be found in our FAQ.

Outline

Target group

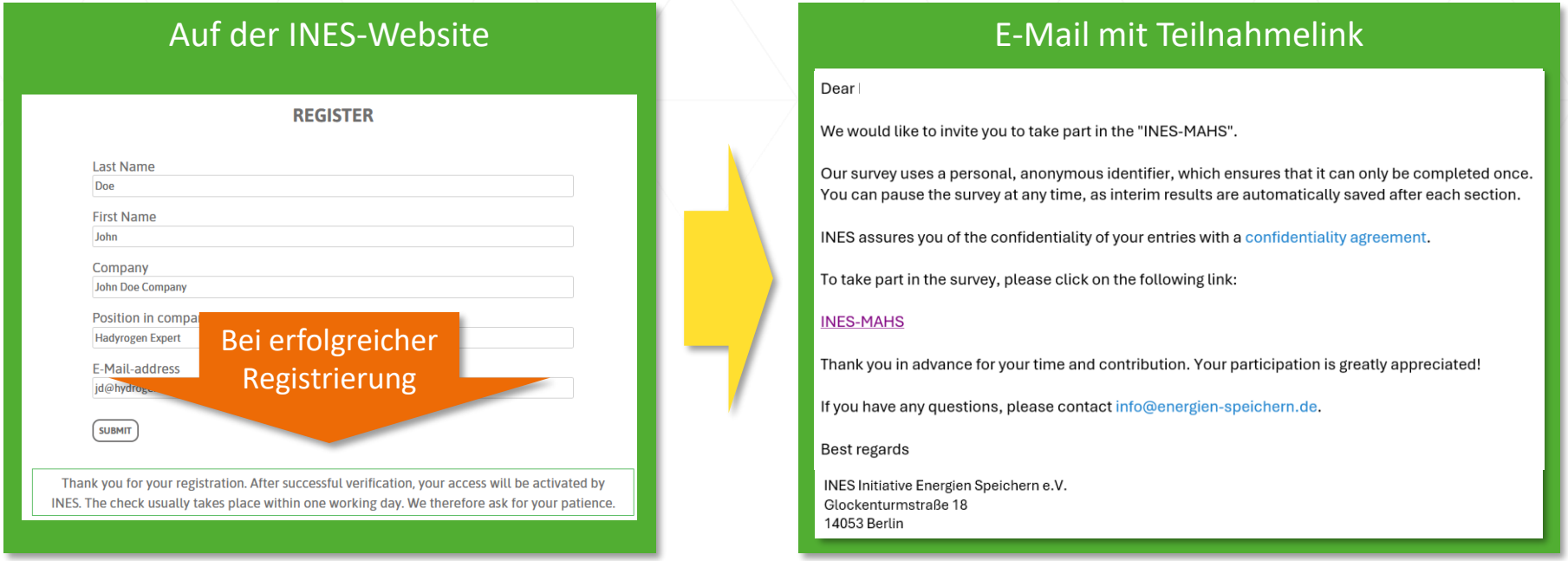
- All companies from Germany or abroad that intend to store hydrogen in Germany in the future can participate in the MAHS.
- In order to participate in the MAHS, it is not absolutely necessary to be able to quantitatively estimate your own hydrogen storage demand. In addition to direct information, the MAHS also provides indirect ways for companies to report hydrogen storage demands by providing information on the volume of hydrogen and its intended use.
- Registration is required to take part, which can be done at the following link:

https://energien-speichern.de/en/mahs-survey/



Registration process

- Your registration is complete when the green-framed confirmation is displayed.
- INES checks incoming registrations for plausibility and activates the registrations (usually within one working day).
- After activation by INES, participants receive an e-mail with an individual participation link from info@energien-speichern.de.
- The link enables one-time participation. So please do not share this link!



Outline

The MAHS questionnaire at a glance

Struktur des Fragebogens

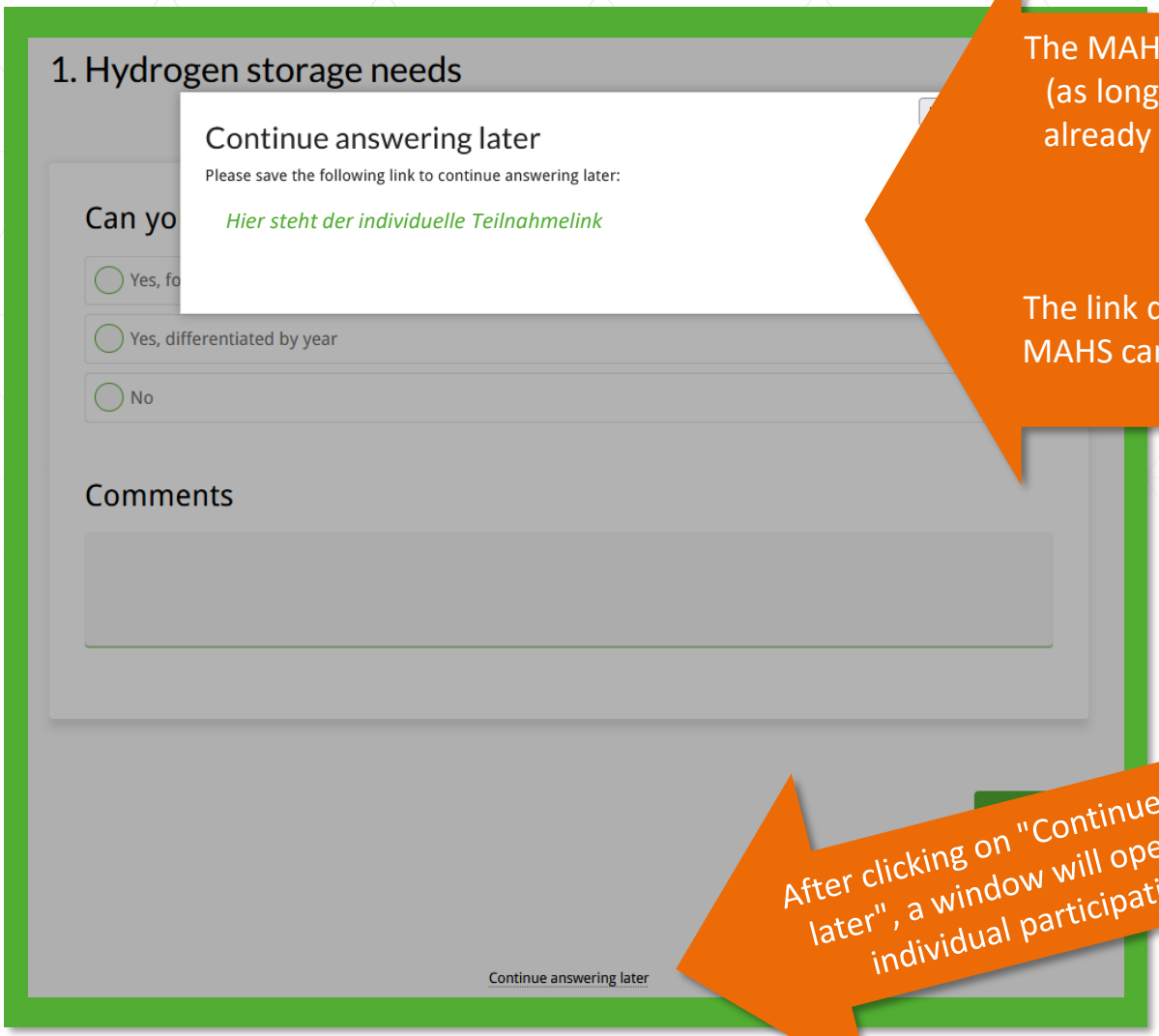
1. **Hydrogen storage demand**
2. **Requirements for the product "hydrogen storage capacity“**
   - 2.1. Injection capacity
   - 2.2. Withdrawal capacity
3. **Hydrogen volume**
   - 3.1. Hydrogen Volumes (Production/Supply)
   - 3.2. Hydrogen from renewable energies?
   - 3.3. Peak load of the hydrogen feed-in
4. **Usage**
   - 4.1. Usage of the hydrogen volume
   - 4.2. Peak load of the hydrogen demand
5. **Grid connection**
6. **Additional Information**

Indirect query of hydrogen storage demand.

Direct query of hydrogen storage demand.

Please note:
Information enables modeling of hydrogen storage demand and plausibility checks.

Participation can be interrupted at any time



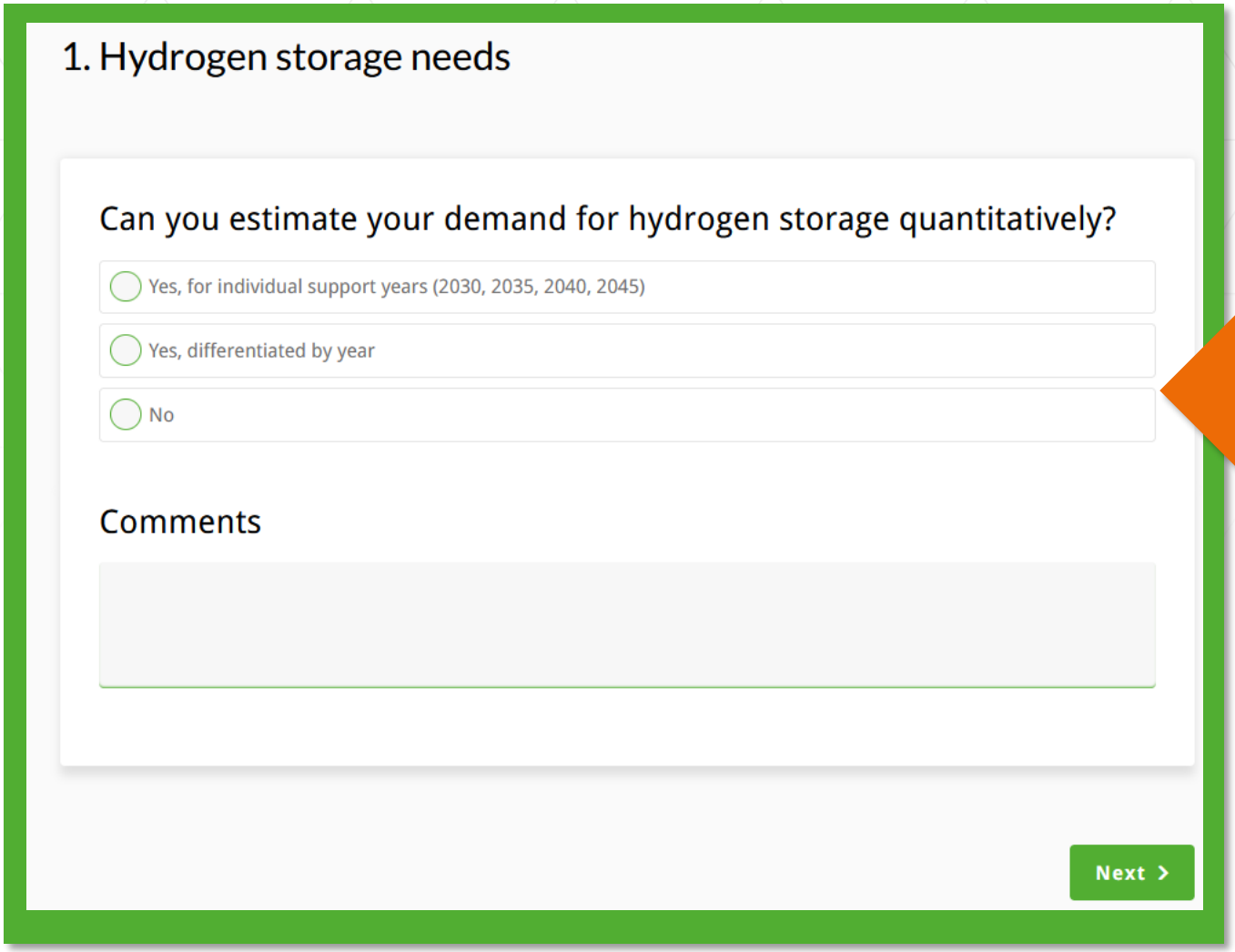
The MAHS can be reopened via the participation link (as long as it has not yet been completed). Entries already made are saved and are not lost when the survey window is closed.

Please note:
The link displayed should be saved. Alternatively, the MAHS can also be reopened via the participation link in the e-mail.

After clicking on "Continue answering later" , a window will open with the individual participation link.

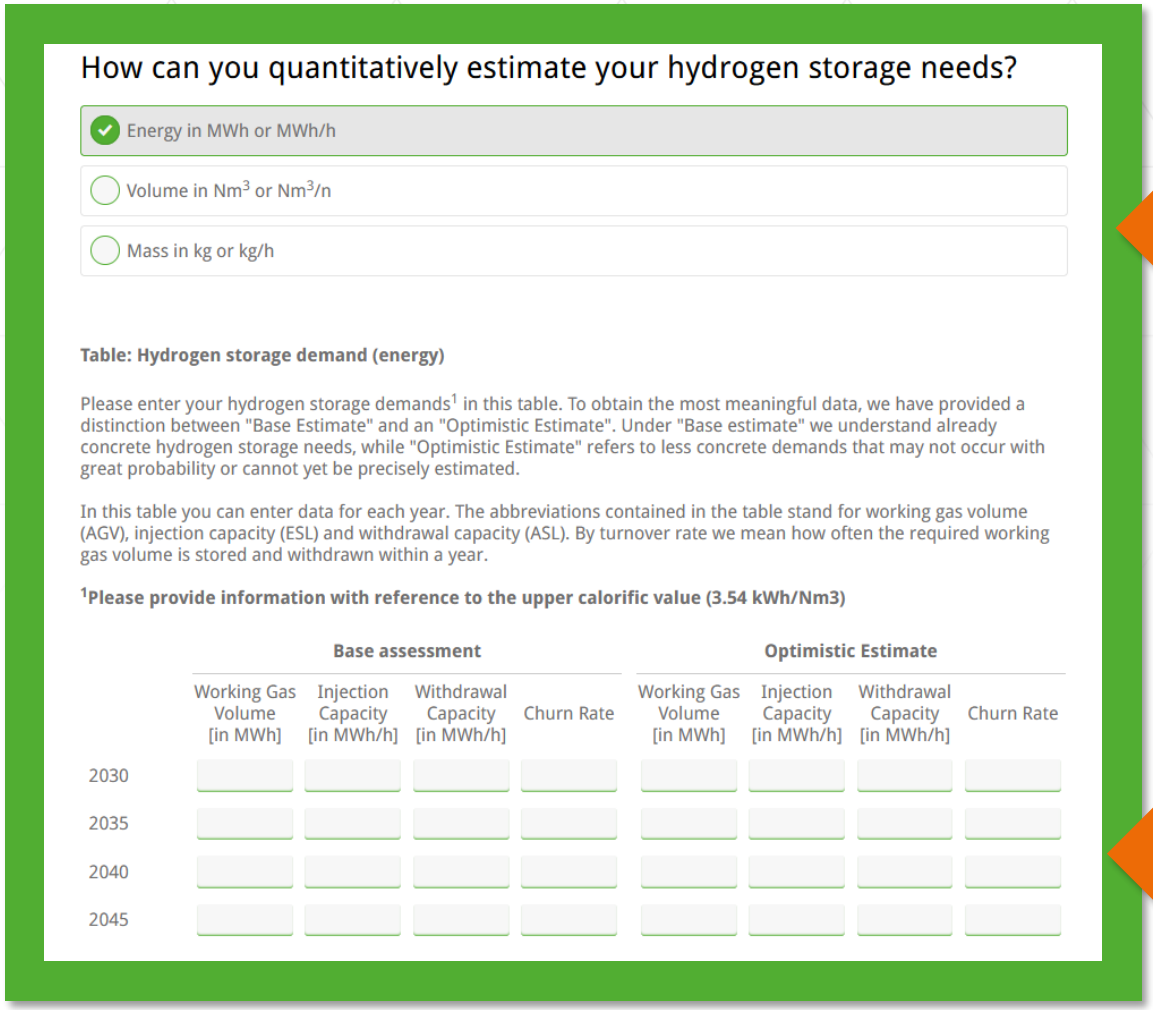
Outline

Block 1: Hydrogen storage demand (1/4)



The selection determines the further input option

Block 1: Hydrogen storage demand (2/4)



How can you quantitatively estimate your hydrogen storage needs?

- [x] Energy in MWh or MWh/h
- [ ] Volume in Nm^3 or Nm^3/n
- [ ] Mass in kg or kg/h

Table: Hydrogen storage demand (energy)

Please enter your hydrogen storage demands[1] in this table. To obtain the most meaningful data, we have provided a distinction between "Base Estimate" and an "Optimistic Estimate". Under "Base estimate" we understand already concrete hydrogen storage needs, while "Optimistic Estimate" refers to less concrete demands that may not occur with great probability or cannot yet be precisely estimated.

In this table you can enter data for each year. The abbreviations contained in the table stand for working gas volume (AGV), injection capacity (ESL) and withdrawal capacity (ASL). By turnover rate we mean how often the required working gas volume is stored and withdrawn within a year.

[1]Please provide information with reference to the upper calorific value (3.54 kWh/Nm3)

	Base assessment				Optimistic Estimate			
	Working Gas Volume [in MWh]	Injection Capacity [in MWh/h]	Withdrawal Capacity [in MWh/h]	Churn Rate	Working Gas Volume [in MWh]	Injection Capacity [in MWh/h]	Withdrawal Capacity [in MWh/h]	Churn Rate
2030								
2035								
2040								
2045								

Data can be entered in different units.

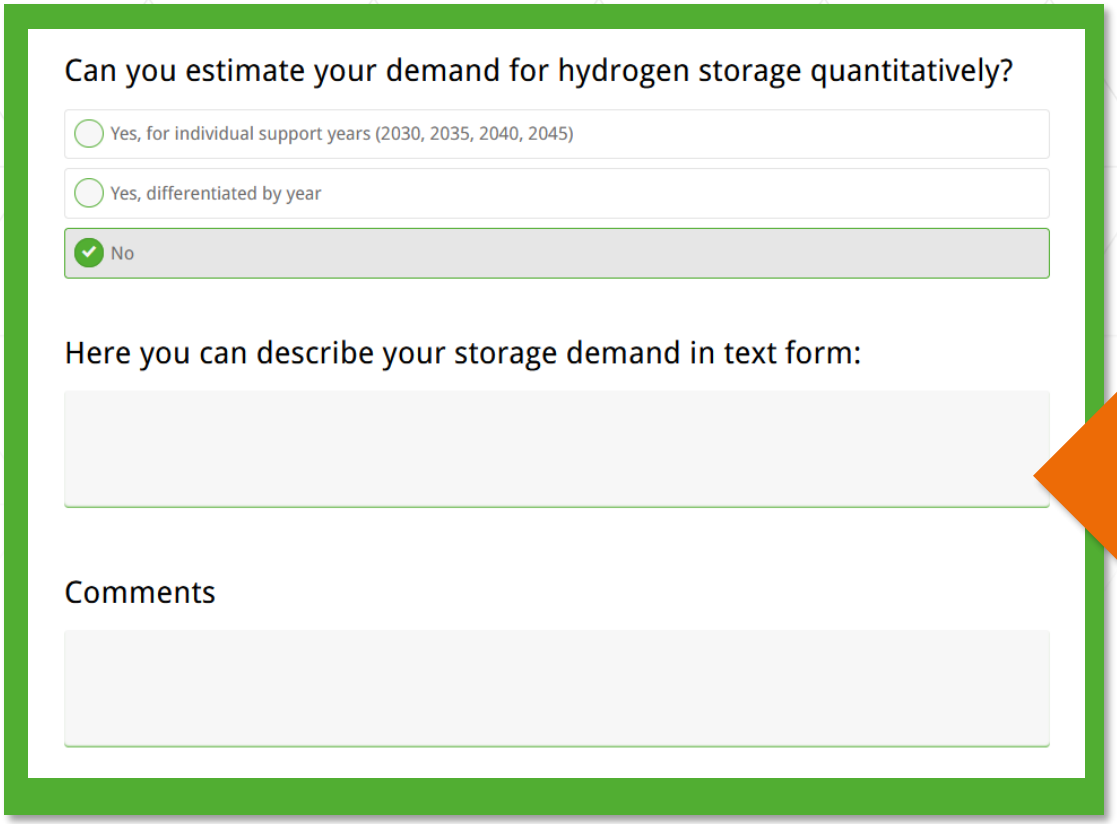
If an entry is only required for support years, the MAHS only shows the years 2030, 2035, 2040 and 2045

Block 1: Hydrogen storage demand (3/4)

	Base assessment				Optimistic Estimate			
	Working Gas Volume [in MWh]	Injection Capacity [in MWh/h]	Withdrawal Capacity [in MWh/h]	Churn Rate	Working Gas Volume [in MWh]	Injection Capacity [in MWh/h]	Withdrawal Capacity [in MWh/h]	Churn Rate
2027								
2028								
2029								
2030								
2031								
2032								
2033								
2034								
2035								
2036								
2037								
2038								
2039								
2040								
2041								
2042								
2043								
2044								
2045								

As an alternative to selecting support years, entries can also be made for other years.

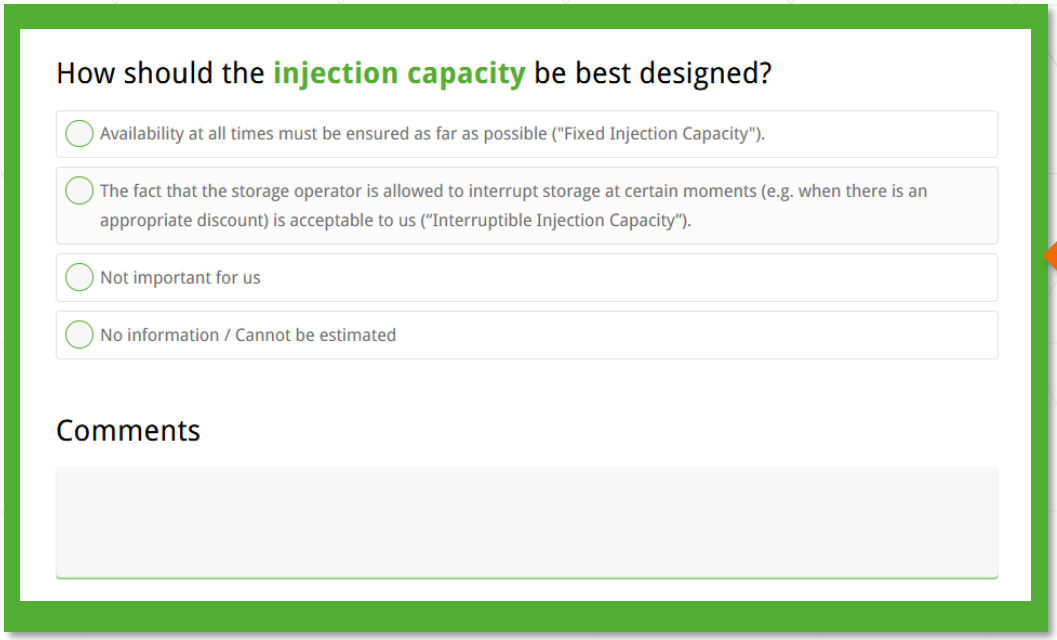
Block 1: Hydrogen storage demand (4/4)



If the storage requirements cannot (yet) be quantified, it is possible to verbalize them.

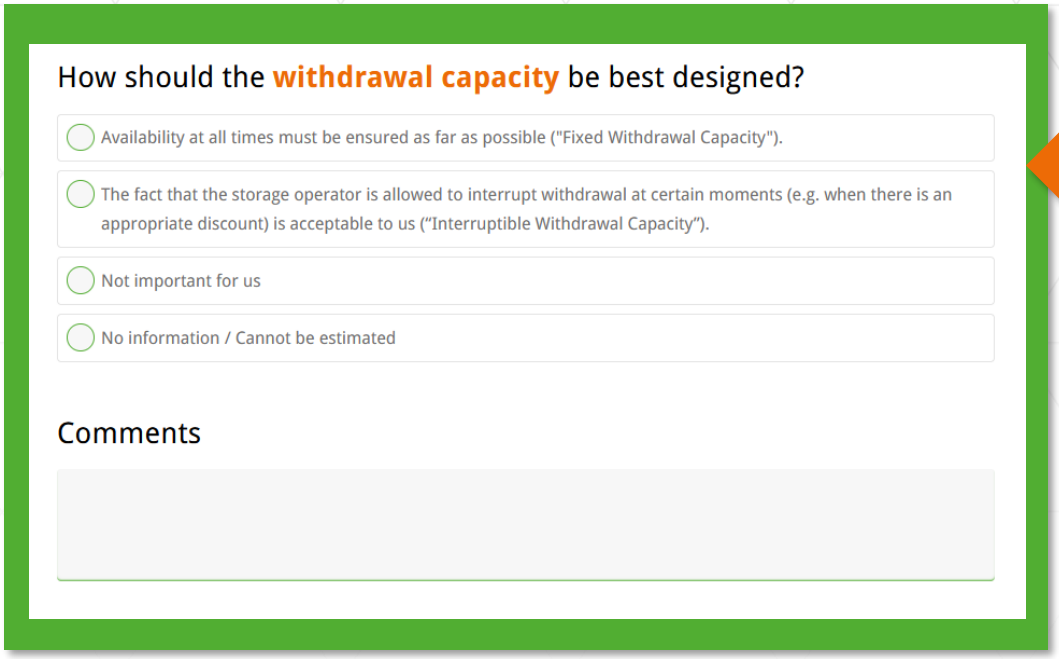
Outline

Block 2: Product requirements (1/2)



Information on the "availability" of injection capacity can be entered here.

Block 2: Product requirements (2/2)



Information on the "availability" of the withdrawal capacity can be entered here.

Outline

Block 3: Hydrogen volume (1/4)

How can you quantitatively estimate your **hydrogen volumes**[1]?*

[1]Please provide information with reference to the upper calorific value (3,54 kWh/Nm³) or to standard cubic meters at 0 degrees Celsius.
*mandatory question

- ◯ Energy in MWh or MWh/h
- ◯ Volume in Nm³
- ◯ Mass in kg

Table: Volumes

Please indicate in the table below where the hydrogen is sourced from or how the hydrogen is produced and how much hydrogen is involved. The sources are listed in the rows and the base years are listed in the columns. Please provide information about the sources that apply to you. If you are unsure about the sources from which you will obtain the hydrogen, please use the "Unknown" row.

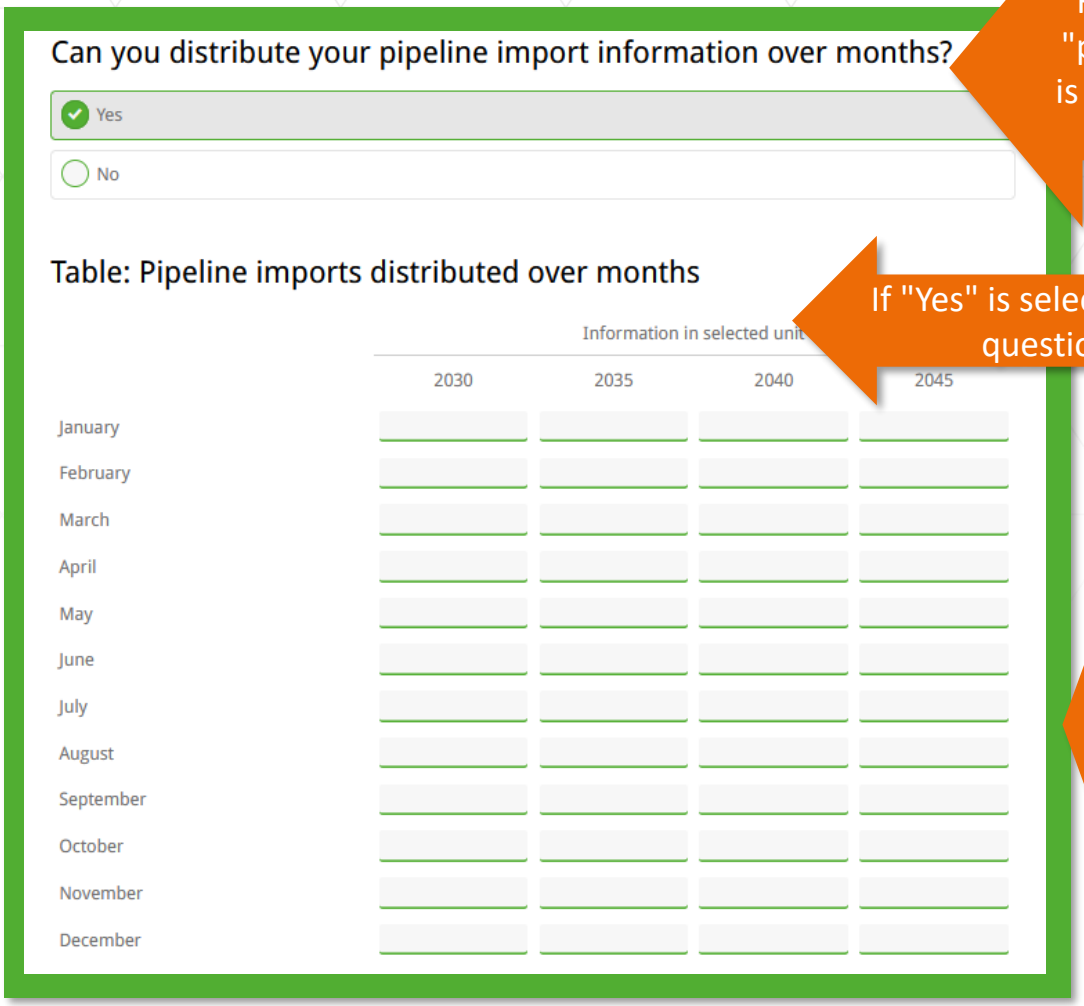
	Information in selected unit per year			
	2030	2035	2040	2045
Electrolysis from wind onshore domestic				
Electrolysis from wind offshore domestic				
Electrolysis from photovoltaics domestic				
Grid-compatible electrolysis from surplus domestic electricity				
Other domestic production				
Pipeline imports				
Ship imports				
Procurement on the commercial market				
Other (please explain in the comments)				
Unknown (please explain in the comments)				

You can decide again for the volume in which unit you want to make the entries.

If entries are made for "Other domestic production", "Pipeline imports" or "Ship imports", follow-up questions appear.

If the hydrogen requirement is procured on the market in future, details can be provided under "Procurement on the trading market".

Block 3: Hydrogen volume (2/4)



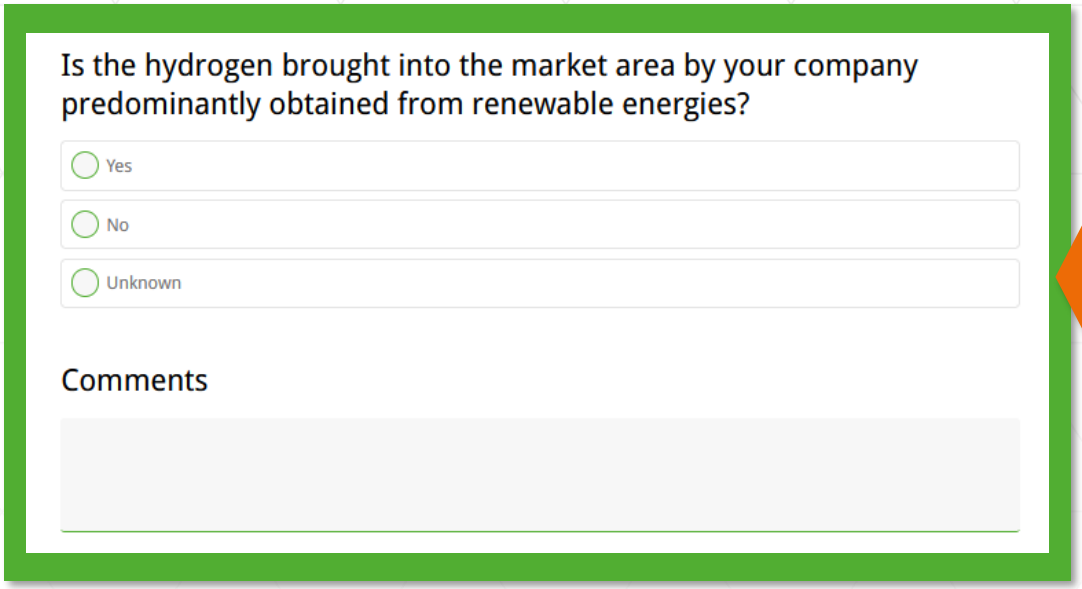
Follow-up question using the example of "pipeline imports". The follow-up question is identical for "other domestic production" and "ship imports".

If "Yes" is selected as the answer to the above question, this table will appear.

Here, the entry for "Pipeline imports" (see previous slide) can be split into months. The monthly entries should correspond in total to the entry for "Pipeline imports".

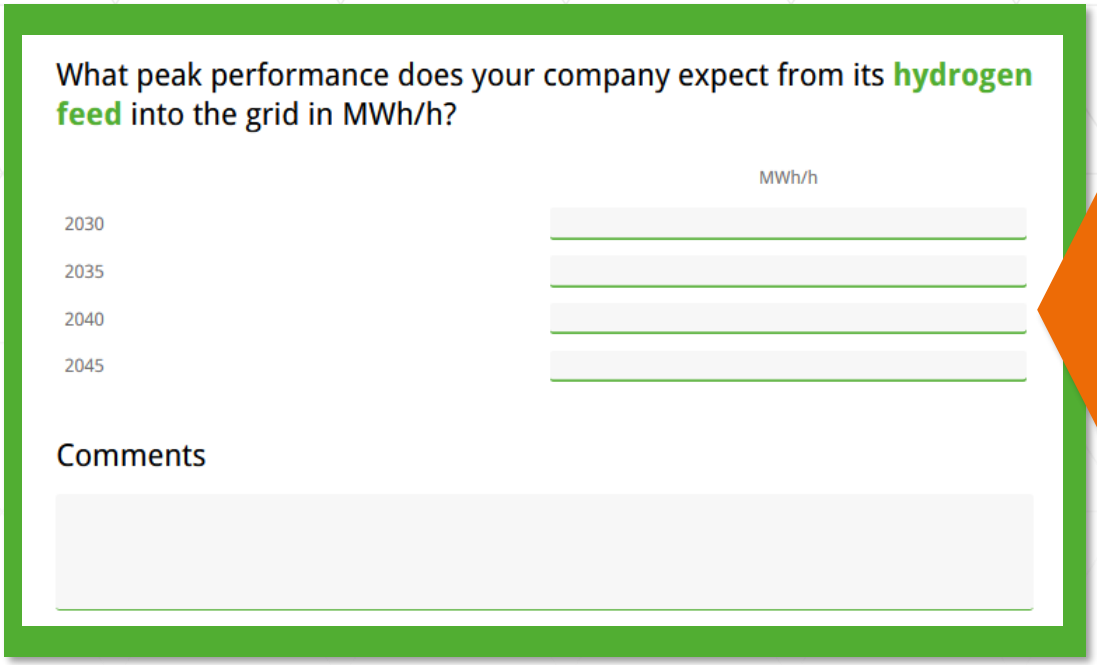
<u>Please note:</u>
The information on the structure of the volume is of particular importance for modeling.

Block 3: Hydrogen volume (3/4)



Funding programs for the development of hydrogen storage systems sometimes place increased requirements on the origin of the stored hydrogen (e.g. only green hydrogen). This data helps operators to assess whether such funding programs could be used for development.

Block 3: Hydrogen volume (4/4)

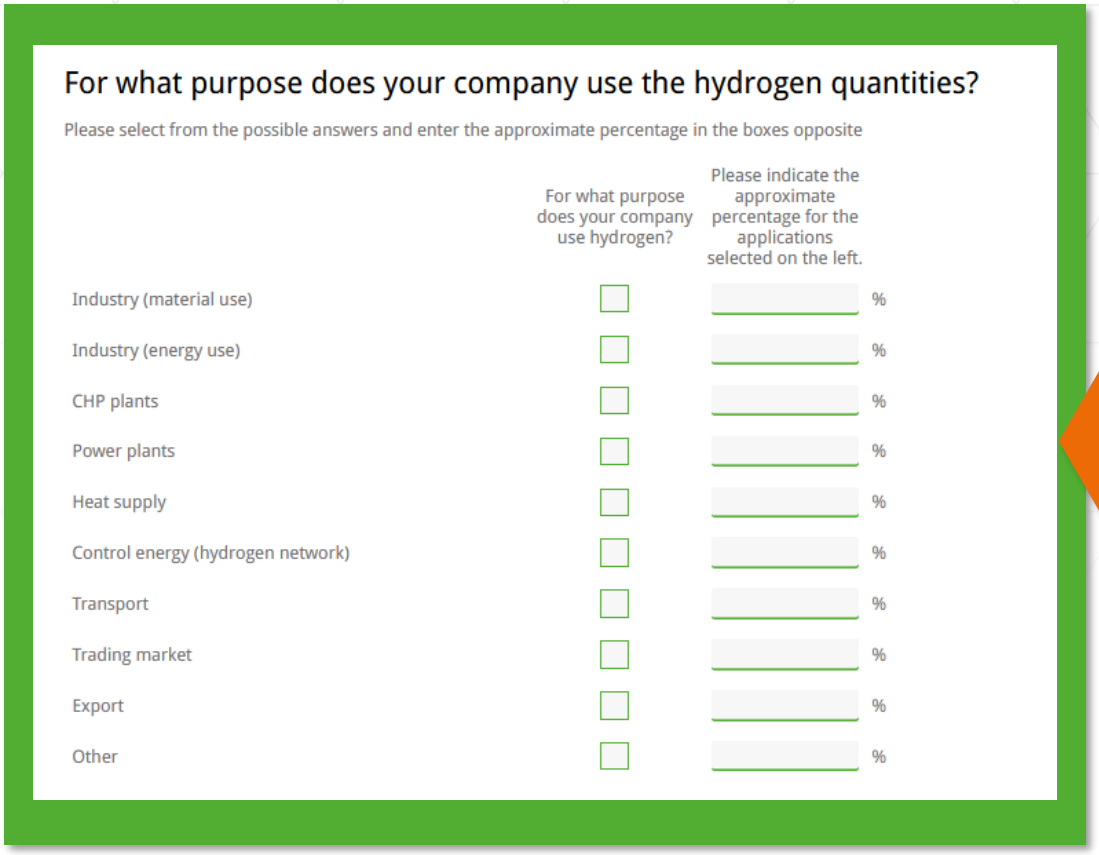


Information on the maximum hydrogen feed-in per hour (peak output) is particularly important for deriving the required storage options.

Please note:
Information is requested in the unit previously selected for the volume.

Outline

Block 4: Usage (1/4)



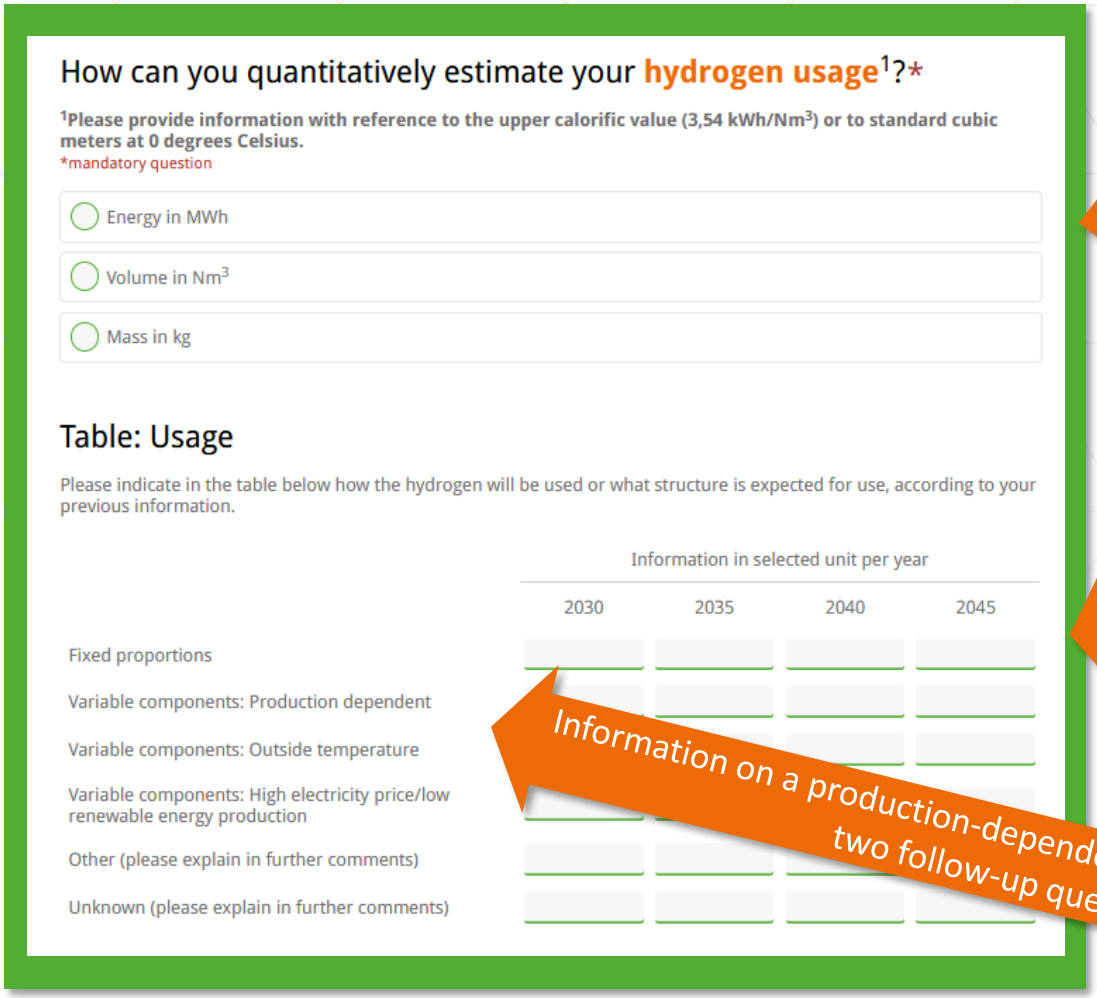
For what purpose does your company use the hydrogen quantities?

Please select from the possible answers and enter the approximate percentage in the boxes opposite

	For what purpose does your company use hydrogen?	Please indicate the approximate percentage for the applications selected on the left.
Industry (material use)	☐	____ %
Industry (energy use)	☐	____ %
CHP plants	☐	____ %
Power plants	☐	____ %
Heat supply	☐	____ %
Control energy (hydrogen network)	☐	____ %
Transport	☐	____ %
Trading market	☐	____ %
Export	☐	____ %
Other	☐	____ %

The specification of the intended use (multiple selection possible!) helps to assess which requirements result from the possible storage use (e.g. nomination times, degree of purity).

Block 4: Usage (2/4)



How can you quantitatively estimate your **hydrogen usage**[1]?*

[1]Please provide information with reference to the upper calorific value (3,54 kWh/Nm³) or to standard cubic meters at 0 degrees Celsius.
*mandatory question

- Energy in MWh
- Volume in Nm³
- Mass in kg

Table: Usage

Please indicate in the table below how the hydrogen will be used or what structure is expected for use, according to your previous information.

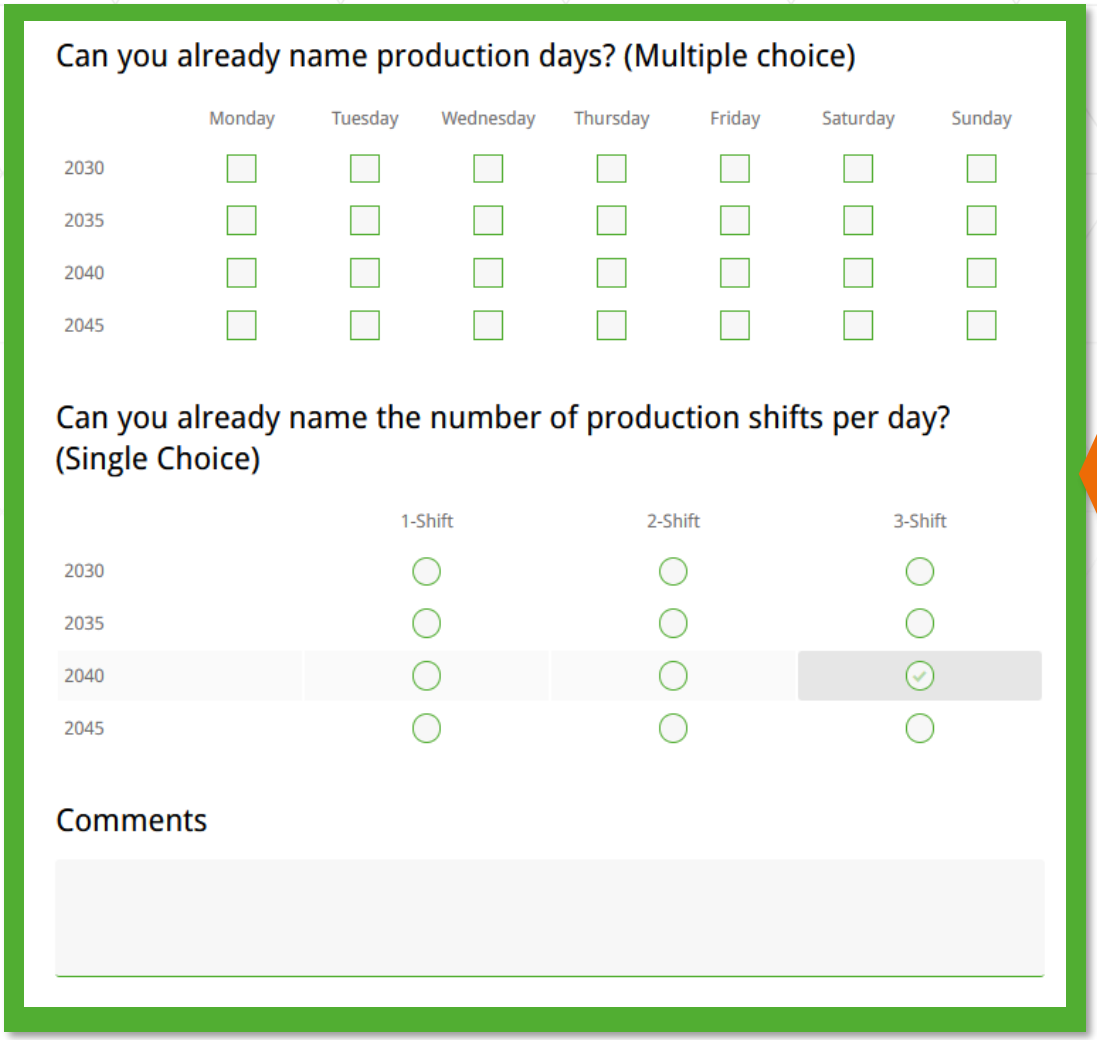
	Information in selected unit per year			
	2030	2035	2040	2045
Fixed proportions				
Variable components: Production dependent				
Variable components: Outside temperature				
Variable components: High electricity price/low renewable energy production				
Other (please explain in further comments)				
Unknown (please explain in further comments)				

You can decide again for the usage in which unit you want to make the entries.

Usage can be differentiated according to "fixed" and "variable" proportions. Variable components are specified depending on the relevant influencing factor (e.g. "outside temperature").

Information on a production-dependent use of hydrogen lead to two follow-up questions.

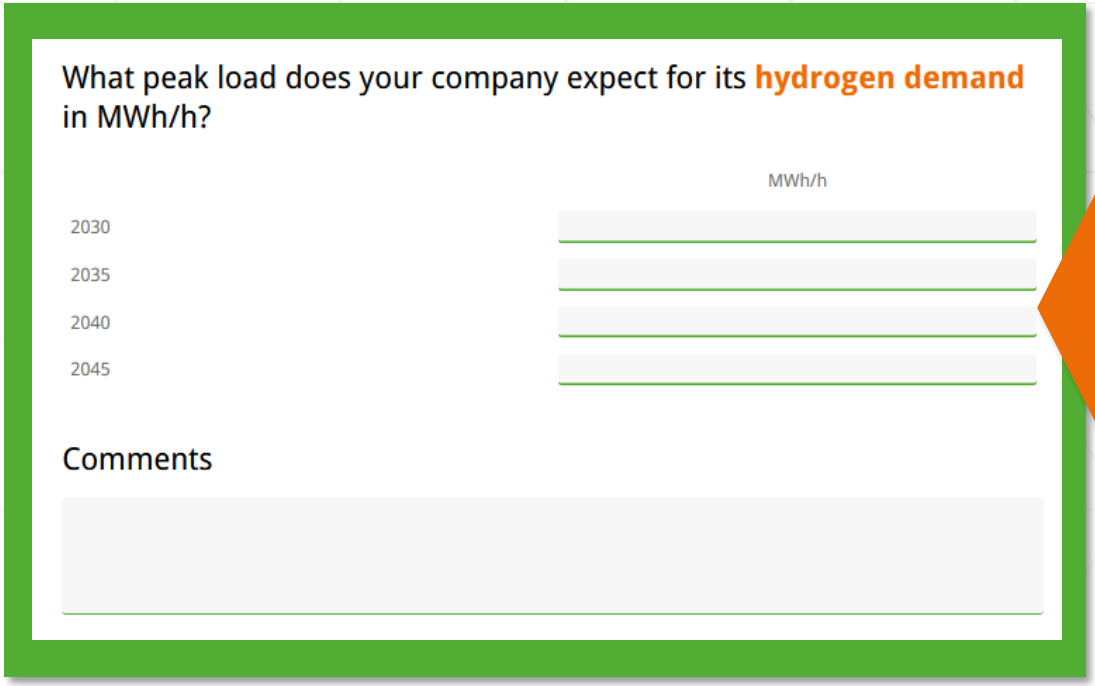
Block 4: Usage (3/4)



These two follow-up questions are shown when entries are made for "Variable shares: Production-dependent".

Please note:
In order to derive a consumption structure from the production-dependent usage shares, it is helpful to specify the production days and shifts.

Block 4: Usage (4/4)



Information on the maximum hydrogen consumption per hour (peak load) is particularly important for deriving the necessary storage options.

Please note:
Information is requested in the unit previously selected for use.

Outline

Block 5: Grid connection (1/2)

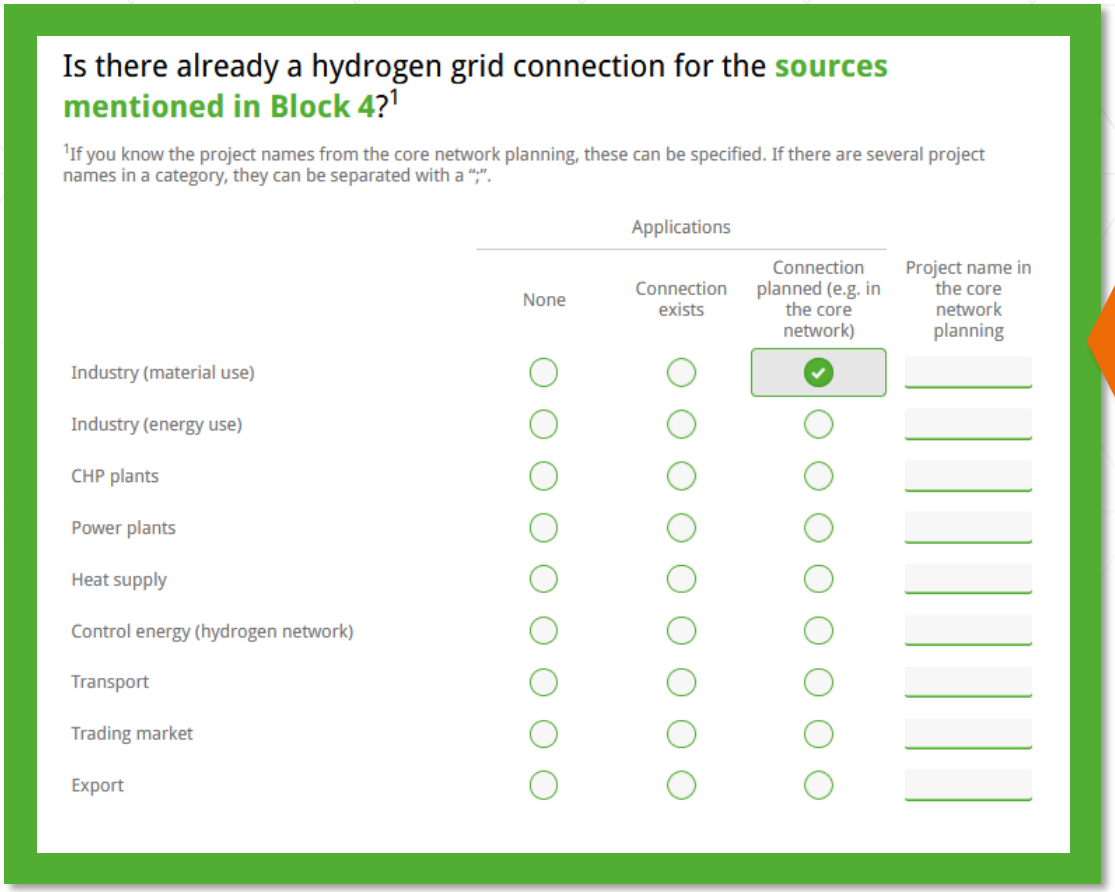
Is there already a hydrogen grid connection for the **sources mentioned in Block 3**?[1]

[1]If you know the project names from the core network planning, these can be specified. If there are several project names in a category, they can be separated with a ";".

	Sources		
	None	Connection exists	Connection planned (e.g. in the core network)
Electrolysis from wind onshore domestic	○	○	○
Electrolysis from wind offshore domestic	○	○	○
Electrolysis from photovoltaics domestic	○	○	○
Grid-compatible electrolysis from surplus domestic electricity	○	○	○
Other domestic production	○	○	○
Pipeline imports	○	○	○
Ship imports	○	○	○
Procurement on the commercial market	○	○	○
Other (please explain in the comments)	○	○	○
Unknown (please explain in the comments)	○	○	○

For the sources previously specified in block 3, entries can be made for a possible connection to a hydrogen network. The project name is requested as soon as "Connection planned" has been selected for a source.

Block 5: Grid connection (2/2)



Is there already a hydrogen grid connection for the **sources mentioned in Block 4**?[1]

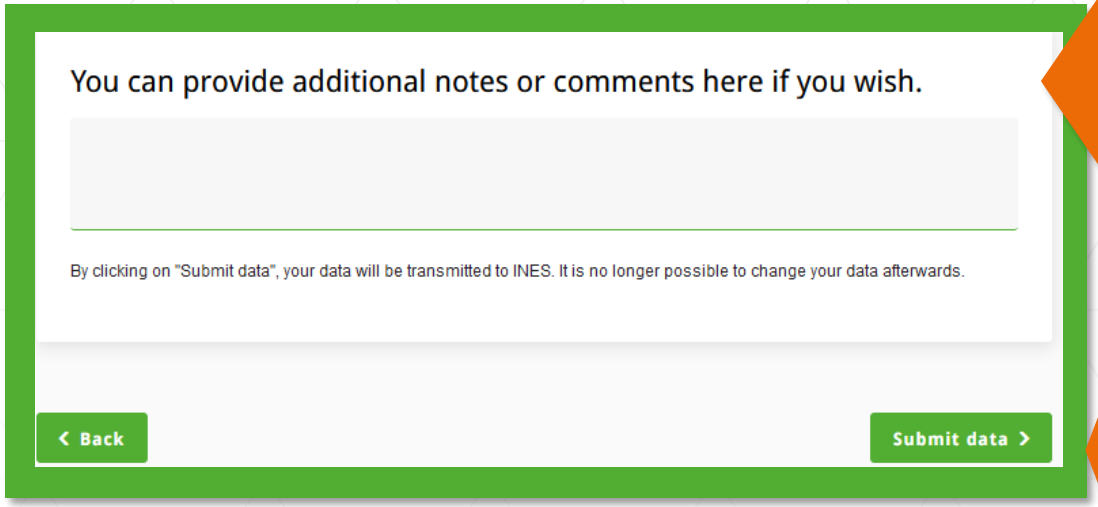
[1]If you know the project names from the core network planning, these can be specified. If there are several project names in a category, they can be separated with a ";".

	Applications			
	None	Connection exists	Connection planned (e.g. in the core network)	Project name in the core network planning
Industry (material use)	○	○	●	
Industry (energy use)	○	○	○	
CHP plants	○	○	○	
Power plants	○	○	○	
Heat supply	○	○	○	
Control energy (hydrogen network)	○	○	○	
Transport	○	○	○	
Trading market	○	○	○	
Export	○	○	○	

Entries can be made for a possible connection to a hydrogen network for the purposes previously specified in block 4. The project name is requested as soon as "Connection planned" has been selected for a source.

Outline

Block 6: Additional Information (1/1)



Here you can provide information that could not previously be entered.

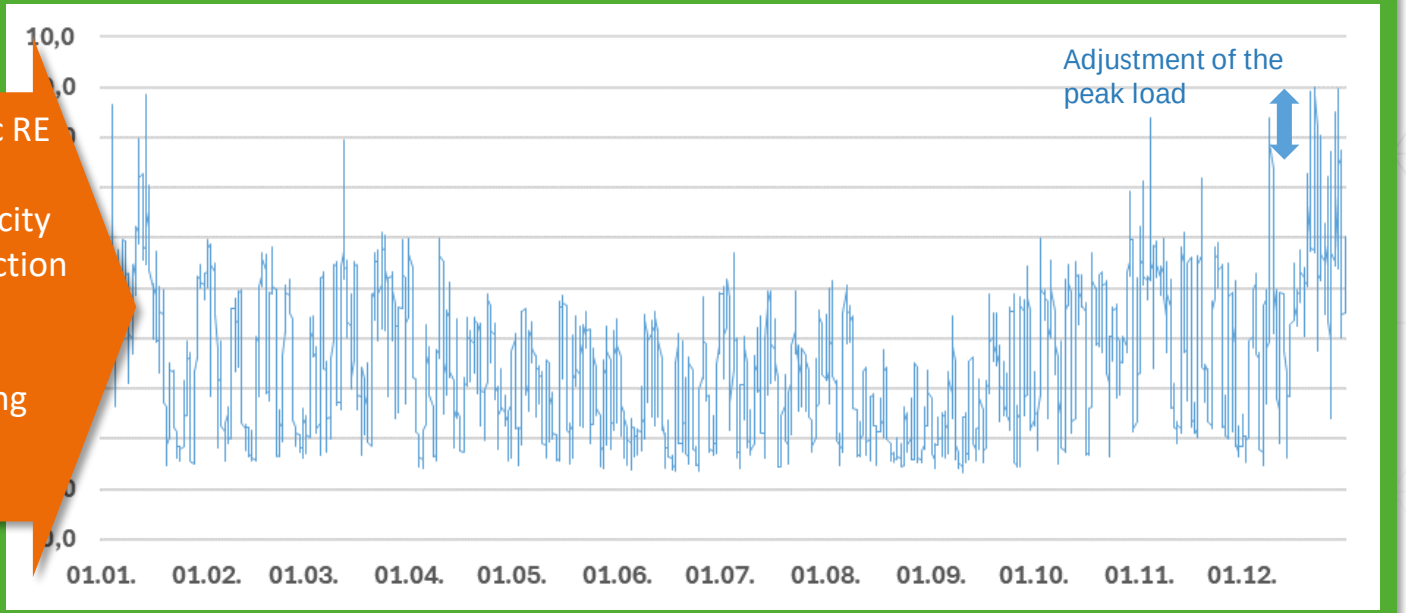
Click on "Submit data" to complete and submit the entry.

Please note
It is no longer possible to edit or change the entries afterwards!If entries need to be corrected, please contact us: info@energien-speichern.de

Outline

Modeling volume (according to block 3)

- Electrolysis from domestic RE (onshore/offshore/PV)
- Electrolysis surplus electricity
- Other domestic H2 production
- Pipeline imports
- Ship imports
- Procurement on the trading market
- Other

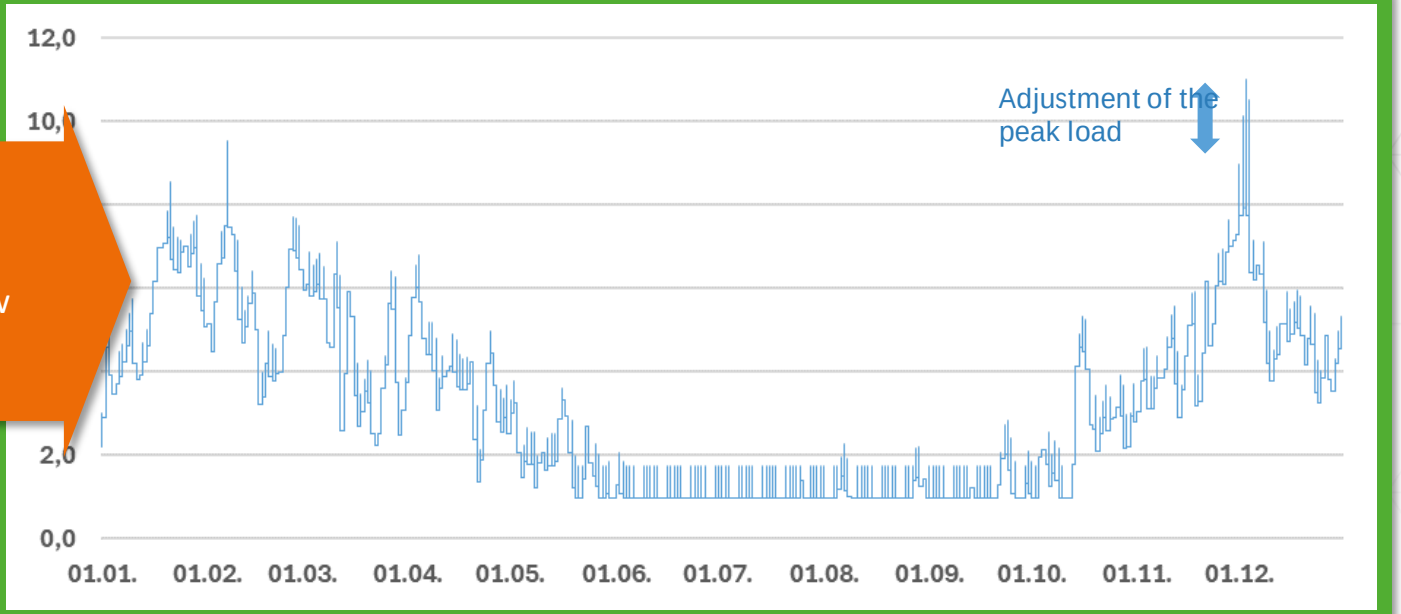


- Average/economic vs. company-specific hourly profile depending on data availability
- Weighting of corresponding standard profiles for the various sources

Derivation of an hourly structure of the hydrogen volume, Adjustment of the hourly structure to the hydrogen peak output

Modeling usage (according to block 4)

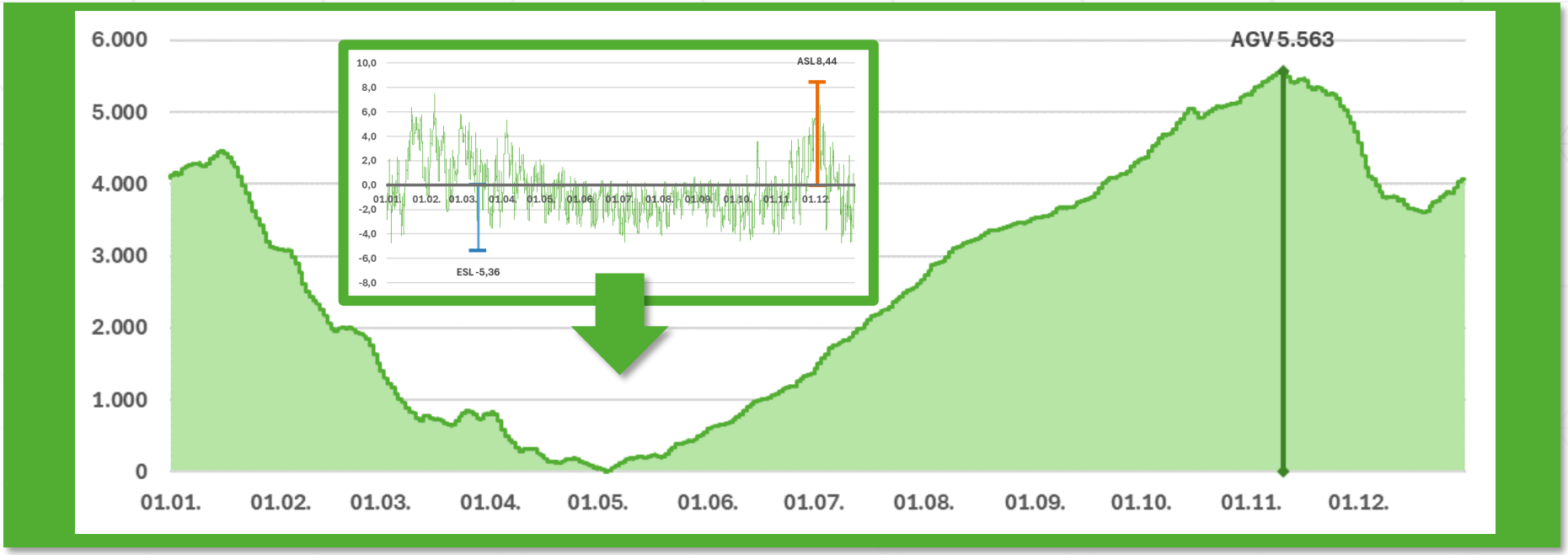
- Fixed share
- Production
- Outdoor temperature
- High electricity price or low RE generation
- Other



- Average/economic vs. company-specific hourly profile depending on data availability
- Weighting of corresponding standard profiles for various fixed and variable influencing factors

Derivation of an hourly structure of hydrogen use, Adaptation of the hourly structure to the hydrogen peak load

Determining the residual load



- Calculation of the hourly storage balance to determine the storage curve and the necessary cumulative injection and withdrawal for the hydrogen supply.
- First determination of the storage curve with the assumption storage level = 0 on January 1 and subsequent parallel shift (so that no negative storage levels occur).

Comparison of hydrogen production and use ("hydrogen balance") to derive the storage process, working gas volume, injection and withdrawal rate, storage turnover

Result of modeling

Results

The modeling describes the hydrogen storage demand in concrete terms via the required working gas volume, the necessary injection and withdrawal capacity as well as the expected storage turnover and level development.

Outline

Documentation and quality requirements

„Direct" hydrogen storage demand
Direct data reports on hydrogen storage demand do not require any further modeling. Data for blocks 3 and 4 are used for plausibility checks.

„Indirect" hydrogen storage demand
Data for blocks 3 and 4 are used in the modeling to derive residual loads. Hydrogen storage demands are calculated on the basis of the residual loads.

Documentation
Aggregation and anonymization of direct and indirect hydrogen storage demands and preparation of the results as part of a documentation (bundled for Germany).

Feedback with participants
Each participant receives their own input in edited form and in the context of the documentation (bundled for Germany). This enables final feedback.

Quality requirement
As complete and concrete/specific a description of the hydrogen storage demands as possible.

Outline

Round of questions

You can now ask your questions…

… via the Q&A function

or

verbally after a request. Please write "*Question*" in the Q&A area.

Contact

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