

Central European Gas Hub



CEGH GreenHydrogen Index

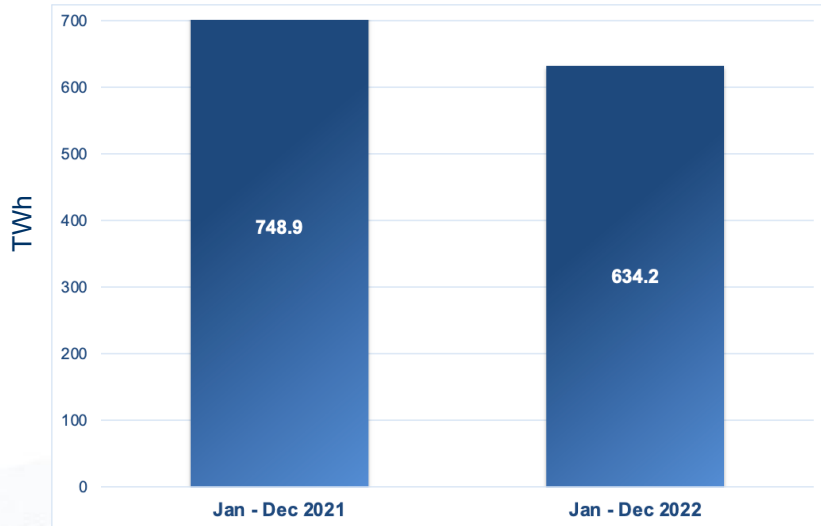
20 December 2022

CEGH Volume Development 1-12/2022*



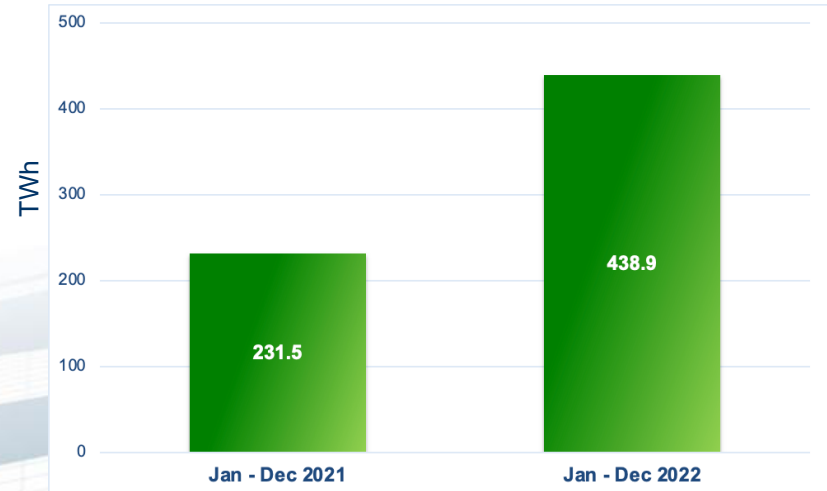
CEGH VTP Market:

1-12/2022: 634.2 TWh
(y-t-y: -15.3%)



EEX CEGH Gas Market:

1-12/2022: 438.9 TWh
(y-t-y: +89.6%)



(*Dec 2022 ~linear Forecast)

Central European Gas Hub (CEGH) - Development



June
EEX CEGH VTP EGSI Financial futures listed on EEX CEGH

October
22.05 TWh traded on EEX CEGH Futures Market (all-time high)

December
34.58 TWh traded on CEGH EEX Market, highest volume ever!

April
Launch of CEGH GreenGas Platform

October
Change to the New Austrian Balancing System as of 1 October 2022

December
Launch of CEGH GreenHydrogen Index

January
Powernext Integration into EEX

March
VTP monthly all-time high with 83.9 TWh

June
EEX CEGH Gas market with monthly all-time high of 19.2 TWh

December
Launch of CEGH App

February
3.16 TWh nominated at CEGH VTP on 23 Feb (all-time high)

December
Czech Exchange products listed on PEGAS

February
Launch of Saturday and Sunday Contracts at CEGH Gas Exchange of Wiener Boerse

May
Launch of CEGH Czech Spot Market

January
Start of Within-Day Market

Operator of Virtual Trading Point for Austria

December
Start of CEGH Czech Gas Futures Market

January
Sum of net traded volume since 2005 in total 100bcm

December
Start of Gas Exchange Spot Market

June
Vienna Stock Exchange acquires 20% share in CEGH

November
Start of Gas Exchange Futures Market

July
Start of Trayport ETS

September
Eustream joins CEGH with 15% share

October
Launch REMIT platform

January
Launch of CEGH VTP Confirmation Service

August
Launch of Quarter, Season & Year Products at the Gas Exchange Futures Market

September
Relaunch of CEGH CMT nomination platform

June
Signing of Exchange cooperation with Powernext

December
CEGH Exchange products listed on PEGAS

October
Start CEGH
Start OTC Market

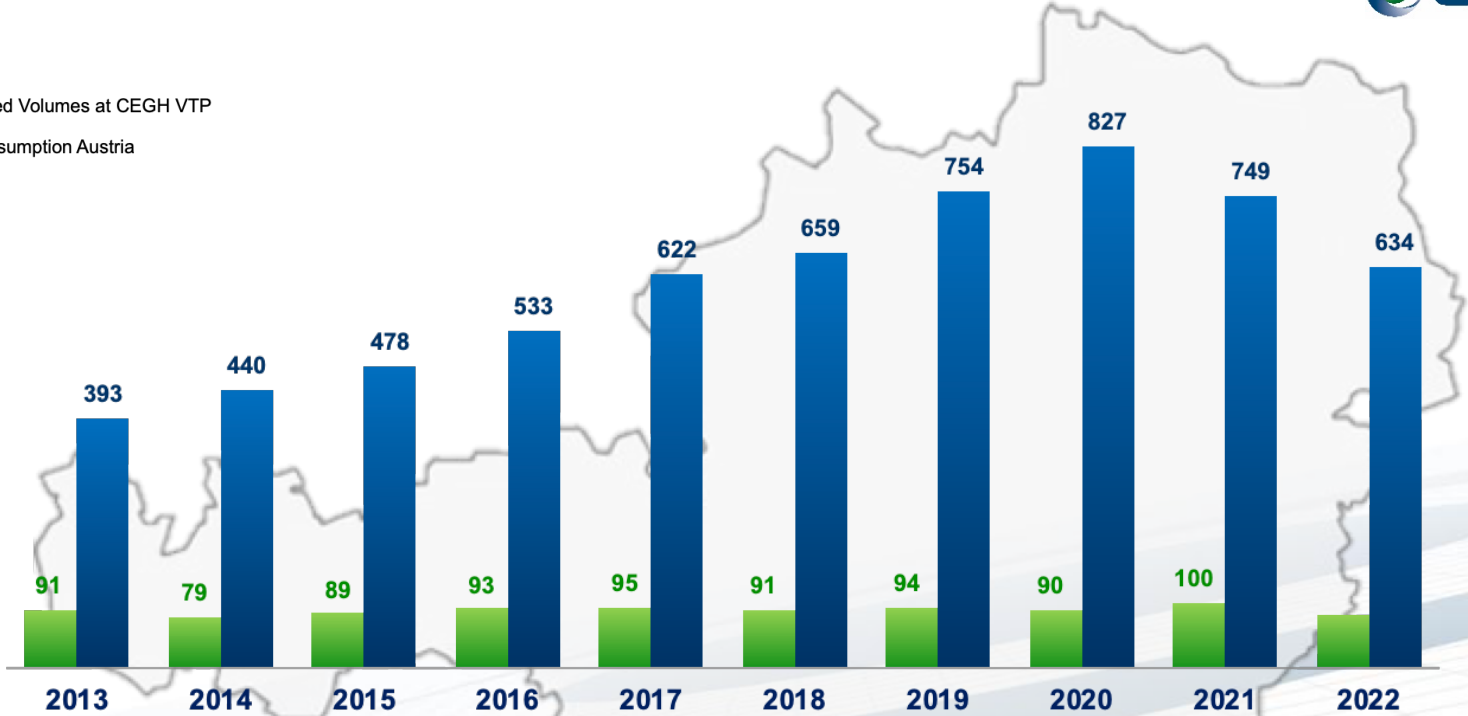
May
First Gas Release Program for EconGas

November
First time monthly net traded volume more than 1bcm

CEGH VTP Volumes and Austrian Gas Consumption



■ Nominated Volumes at CEGH VTP
■ Gas Consumption Austria

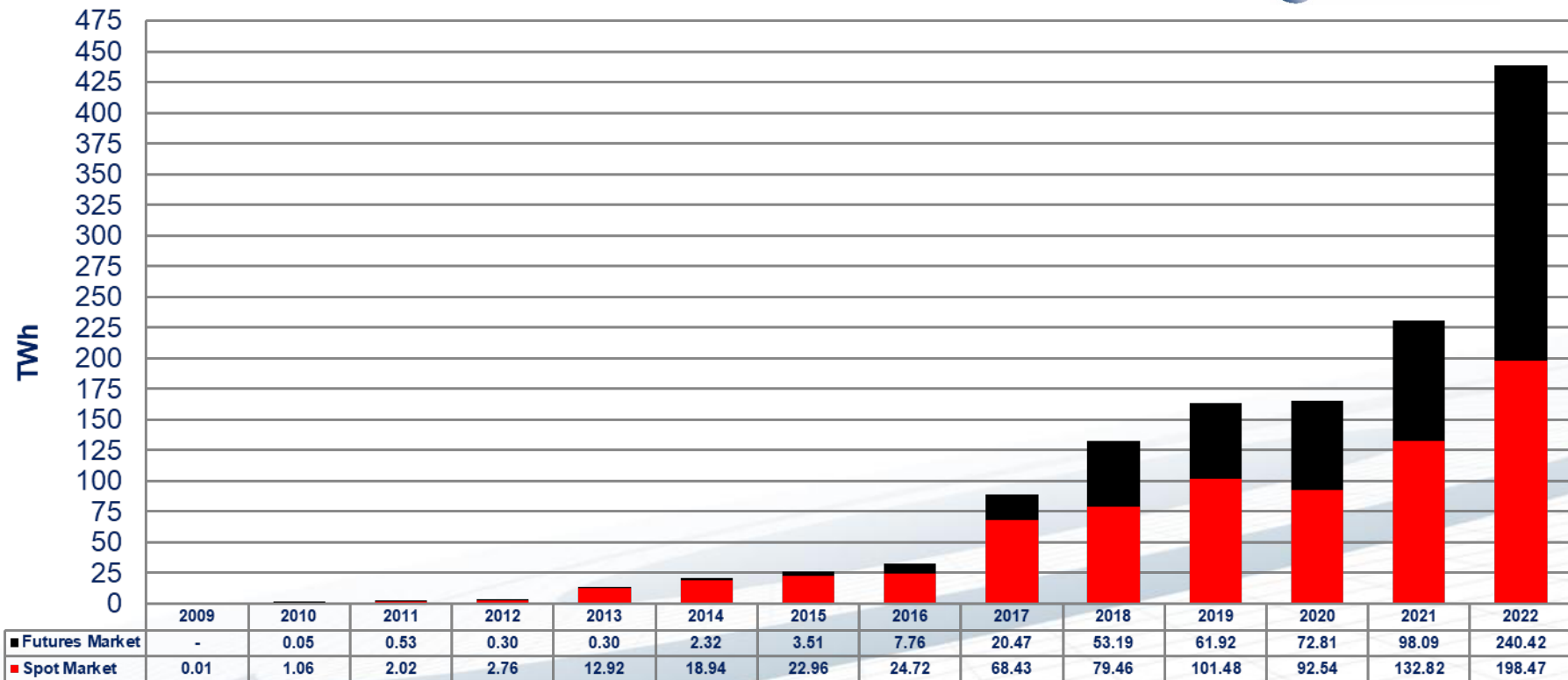


In [TWh]

Source: CEGH, E-Control Austria

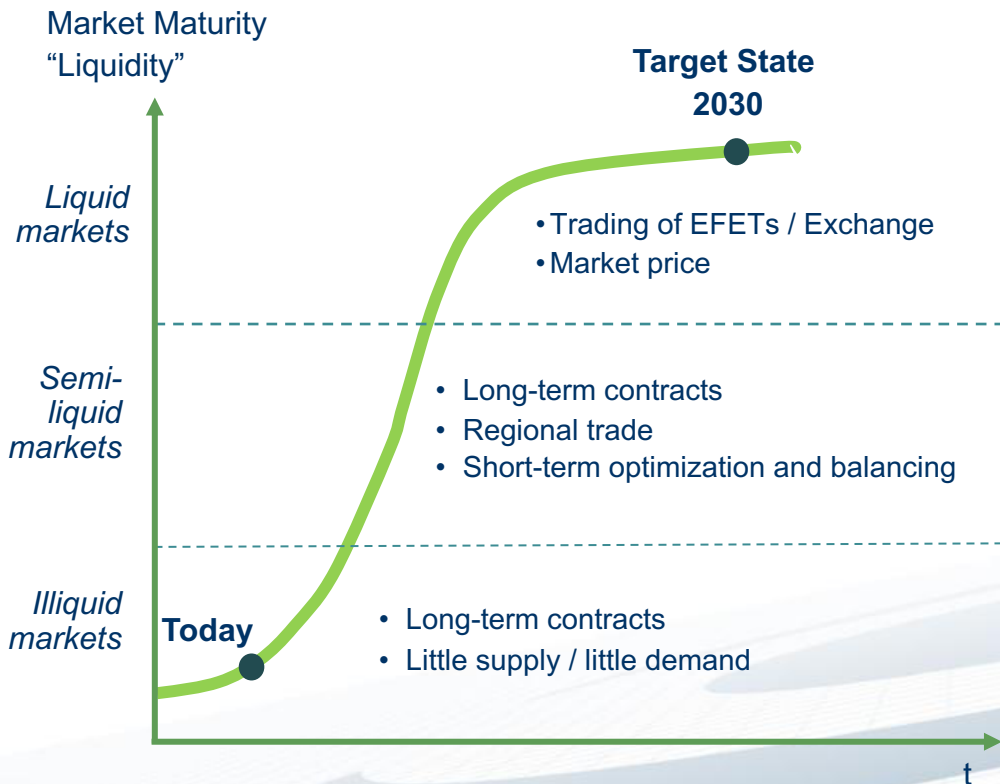
Graph: Wikimedia.org

EEX CEGH Austrian Gas Market: Development of Liquidity / Yearly Trading Volume: 2009 – 2022*



*(linear forecast)

Development of Liquidity: Different Instruments are needed in different Market Maturity stages



Green hydrogen / GOs of green hydrogen

Useful trading instruments to be offered:

Exchange (financial Clearing / Clearinghouse)

Platform based trading (Broker)

Balancing instruments

Standardized contracts (EFET)

Build-up of institutional & regulatory requirements

Price Information & Transparency

Auction- / Bulletin-Board / "Physical" Services

CEGH GreenGas Platform for Marketing of Green Gases



CEGH GreenGas Platform – Green Trading with more transparency & liquidity

- **Scope:** CEGH GreenGas Platform for marketing of green gases, such as biogas and green hydrogen.
- **Development:** CEGH GreenGas Platform is based on market feedback to meet current needs and wishes of stakeholders.
- **Location:** Service offering for Austria and Germany; gradual expansion to Central- and Eastern Europe is planned.
- **Functions:** Basic functions available from the start; new features will be added in line with the needs of the evolving green gas market.
- **Costs:** CEGH GreenGas Platform is free of charge!

CEGH GreenGas Platform



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CEGH GREENGAS PLATFORM OVERVIEW CREATE OFFER MEMBERS ADMINISTRATION

Filter Clear

Status

- open
- closed
- published
- not published
- cancelled

Company

Offer ID

Side

Bid **Ask**

Registry

Certificate

Country

Publication date

 to

Bidding period

 to

Filter

OPEN FOR BIDDING UNTIL REVOKED

Wien Energie Vertriebs GmbH & Co KG Publication date: 31.05.2022 13:50 Offer ID: 627

Product: Guarantees of origin

Registry / Certificate / Country of origin: AGCS Biomethan Register Austria / Certificate of origin / Austria

Bidding period until revoked

Ask Minimum price: **40.00 € / MWh**

Volume: **876 MWh** Production period: 01.12.21 - 01.01.22 Biomethane from biogas (B110000)

OPEN FOR BIDDING UNTIL REVOKED

Wien Energie Vertriebs GmbH & Co KG Publication date: 31.05.2022 13:50 Offer ID: 628

Product: Guarantees of origin

Registry / Certificate / Country of origin: AGCS Biomethan Register Austria / Certificate of origin / Austria

Bidding period until revoked

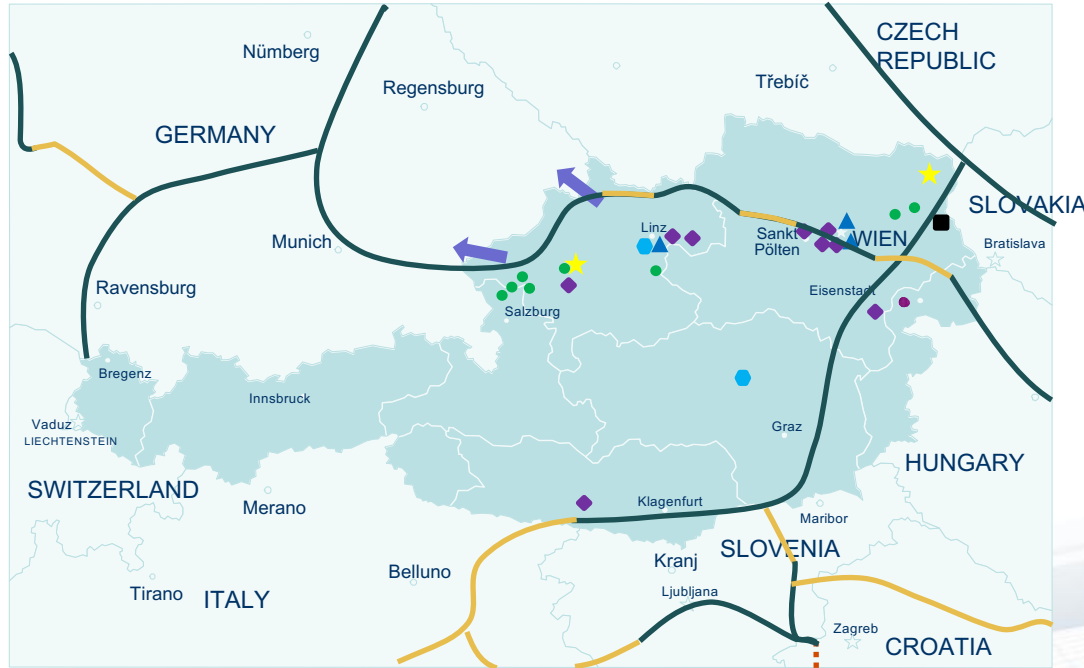
Ask Minimum price: **40.00 € / MWh**

Volume: **848 MWh** Production period: 01.11.21 - 01.12.21 Biomethane from biogas (B110000)

« < 1 > »

- CEGH is offering the CEGH GreenGas Platform in German and English language
- CEGH GreenGas Platform “Users” can easily publish their Guarantee of Origins (GOs) or bio-methane volumes with or without the GOs (bid/ask) or can place bids/offers for existing offers via the CEGH GreenGas Platform
- Wien Energie Vertriebs GmbH & Co KG placed two different sale offers for Guarantees of Origin on the CEGH GreenGas Platform!

CEGH's Market Area is strategically well located within the European Hydrogen Market



- ▲ Domestic electrolyzer projects in Austria
- Existing gas storage facility
- ★ Planned H2 Storage
- ◆ Chemical Industries
- Steel production
- Baumgarten Gas Hub

Source: PwC Research, European Hydrogen Backbone

CEGH's Hydrogen Hub connecting regional markets into a wider hydrogen market located in the center of Europe

- **Large offtake potential from metals & steel industry in Austria** which cannot be fully matched by local hydrogen production.
- **Ambitious hydrogen consumption targets in Germany** will require substantial hydrogen import to bridge the shortfall in local production.
- **High potential for green hydrogen supply** from Italy, from the East / South-East and access to North Africa (via Italy)

CEGH supports the Development of Hydrogen Markets



Provision of CEGH Hydrogen Indices

- Publication of **CEGH Hydrogen Indices facilitates** monitoring the „cost gap“ between hydrogen and alternative sources of energy supply and enables market participants to evaluate business cases for investing in hydrogen projects.
- **Further enhancements of price assessments** planned once the hydrogen market becomes more liquid leading to new requirements by index users (e.g. benchmarking costs of supply, “net-back pricing”).

Set Up of a Marketing Platform

- **Launch of the CEGH GreenGas Trading Platform** to facilitate trading of Biomethane Guarantees of Origin (GoOs) with or without biogas for the first time in Austria.
- Gradual expansion into other markets in Central - and Eastern Europe planned.
- Upgrade of functionalities according to market feedback.
- **Addition of trading of Green Hydrogen once Green Hydrogen becomes available.**

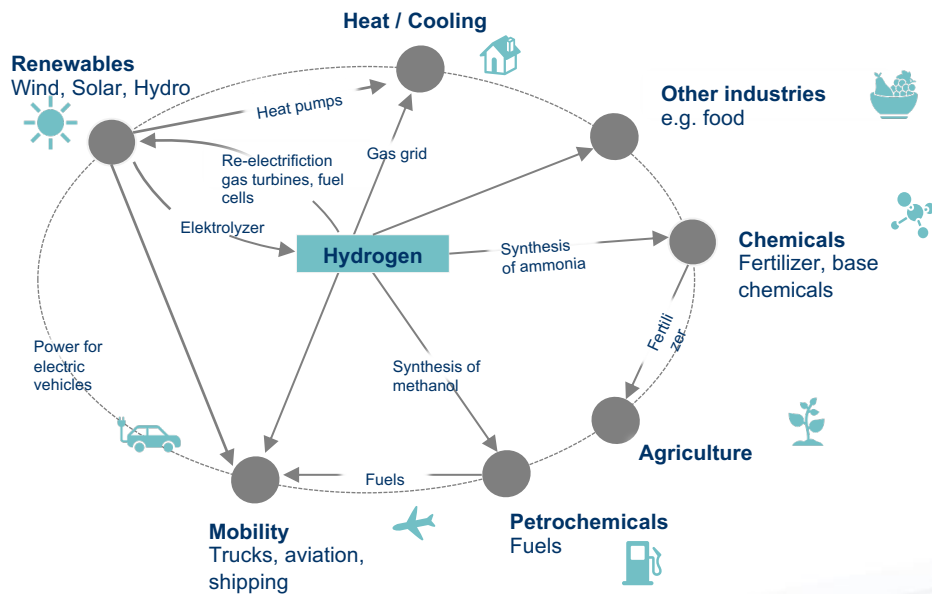
Continuous Stakeholder Dialogue

- **CEGH engages with key stakeholders within the emerging hydrogen ecosystem** including politicians, regulators, producers and offtakers.
- Key areas for alignment include regulatory frameworks (e.g. third-party access to hydrogen infrastructure), market model (entry-/exit system vs. physical hub), balancing code, design of framework agreements etc.

Potential Hydrogen Market Development and Implications for Modeling Green Hydrogen Indices

PwC – Strategy&

Hydrogen plays a Key Role in the Energy Transition



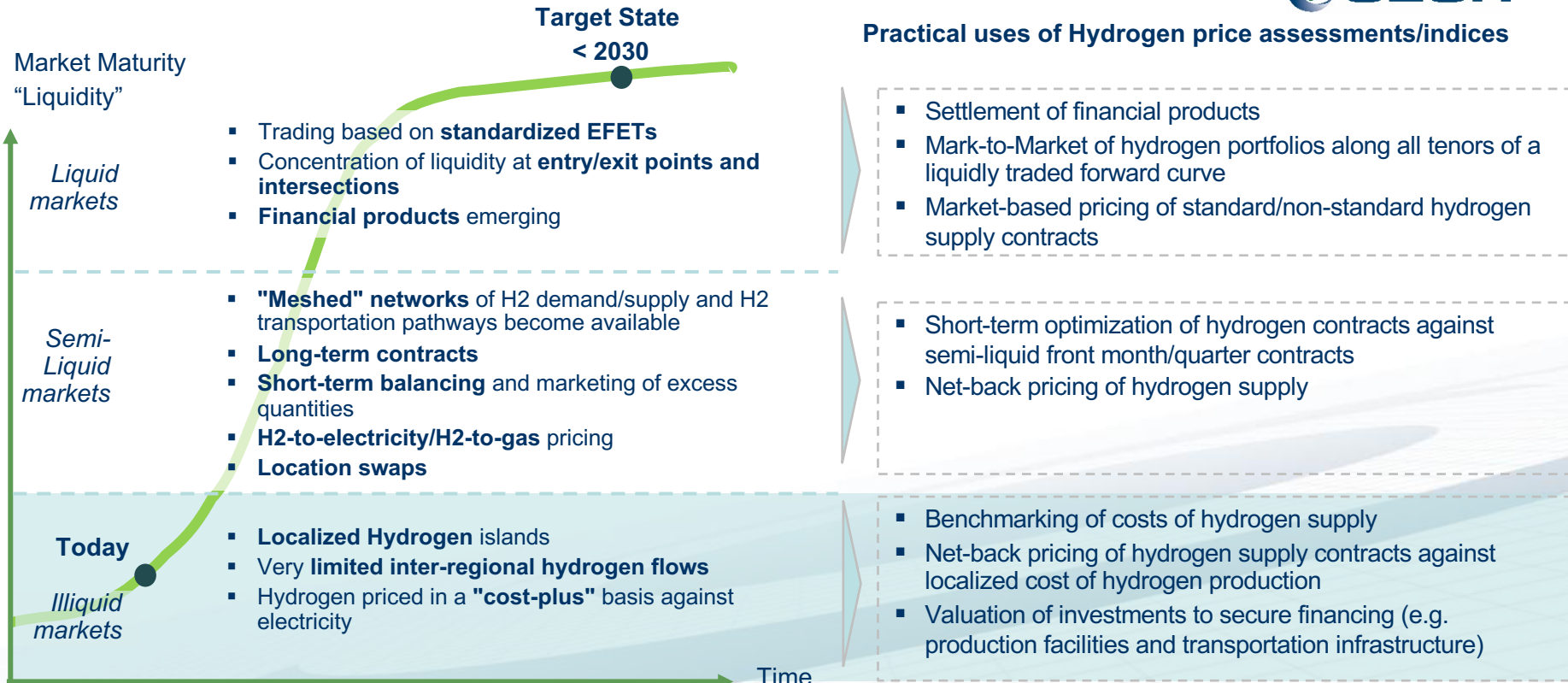
- Decarbonization of **high-temperature process heat** required in chemical and steel industry
- Use as a **feedstock** in the chemical industry, replacing methane gas
- **Power-to-X Technology** enabling sector coupling

EU's Green Deal defines measures for setting up a pan-European hydrogen market by 2030

- Subsidies / grants for scaling up electrolyzer capacities across Europe
- Speeding up adoption of green hydrogen via subsidies / grants bridging the cost gap between conventional energy sources and green hydrogen
- Adoption of regulatory frameworks
- Development of infrastructure forming the physical backbone of the future hydrogen market
- Support of technology development and R&D

Translation of EU objectives at the level of member countries taking country-specific energy needs into account

Hydrogen Price Indices for Different Purposes at Different Development Stages of the Hydrogen Market



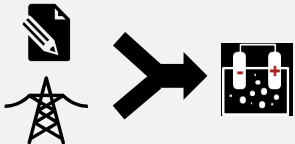
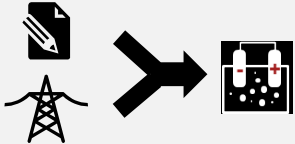
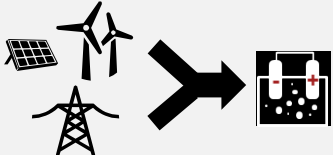

The Main Driving Force for different “Hydrogen Colors” are Regulatory Requirements

	“Grey” H ₂	Green H ₂	H ₂ Blend	Renewable H ₂ ¹
Illustration				
Electricity procurement	Electricity is procured from the grid, therefore the hydrogen produced does not meet any requirements for labelling	Electricity is procured from the grid and, additionally, GoOs are purchased from market places	Green electricity is either procured via direct line or PPA as well as regular (“grey”) electricity from the grid	Green electricity is either procured via direct line or PPA
(Regulatory) requirements	No additional requirements concerning the operation of the electrolyzer	No additional requirements concerning the operation of the electrolyzer	Balancing of renewable electricity and hydrogen production for min. 40% of the production volume	Hourly balancing of renewable electricity and hydrogen production for 100% of the production volume
CEGH Index	-	CEGH Green Hydrogen Forward Index	CEGH Green Hydrogen PPA 40 Index	CEGH Green Hydrogen PPA 100 Index

¹In line with requirements REDII Delegated Act Article 27.3.

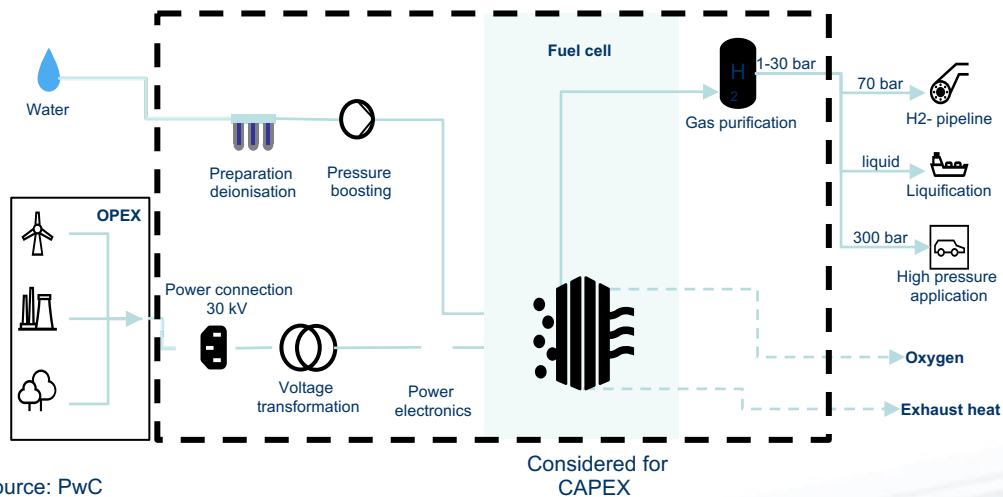
CEGH Green Hydrogen Indices measure the Value of the various “Shades” of Green Hydrogen



Index	Green Power Supply for Hydrogen Production	Product Definition	Update
CEGH Green Hydrogen Spot Index	 <ul style="list-style-type: none"> ▪ Sourcing of “grey” power in the day-ahead market ▪ Sourcing of guarantees of origin via exchange / platforms 	<ul style="list-style-type: none"> ▪ Over 24 hours optimized average baseload H2 Delivery 	<ul style="list-style-type: none"> ▪ Daily
CEGH Green Hydrogen Forward Index	 <ul style="list-style-type: none"> ▪ Sourcing of “grey” power in forward markets ▪ Sourcing of guarantees of origin via exchange / platforms 	<ul style="list-style-type: none"> ▪ Monthly, Quarterly, Seasonal and Yearly Products ▪ Baseload delivery 	<ul style="list-style-type: none"> ▪ Daily
CEGH Green Hydrogen PPA 40 Index	 <ul style="list-style-type: none"> ▪ 40% of green power (renewable PPA) and 60% “grey” power (forward) ▪ Sourcing of guarantees of origin via exchange / platforms 	<ul style="list-style-type: none"> ▪ 10 Year Baseload H2 	<ul style="list-style-type: none"> ▪ Daily
CEGH Green Hydrogen PPA 100 Index	 <ul style="list-style-type: none"> ▪ 100% sourcing of green power via power purchase agreements (renewable PPA) 	<ul style="list-style-type: none"> ▪ 10 Year Baseload H2 	<ul style="list-style-type: none"> ▪ Daily

At the Current State of Market Development, a “Cost-Plus”-Approach is Considered for Hydrogen Indices

Battery Limits applied for Capex Calculation



Cost of green power supply
+ Capex
“Cost-Plus”-Value of Green Hydrogen

- Estimated Capex for electrolyzer is re-assessed on a regular basis
- Consideration of learning curve effects for „forward“ hydrogen price assessments

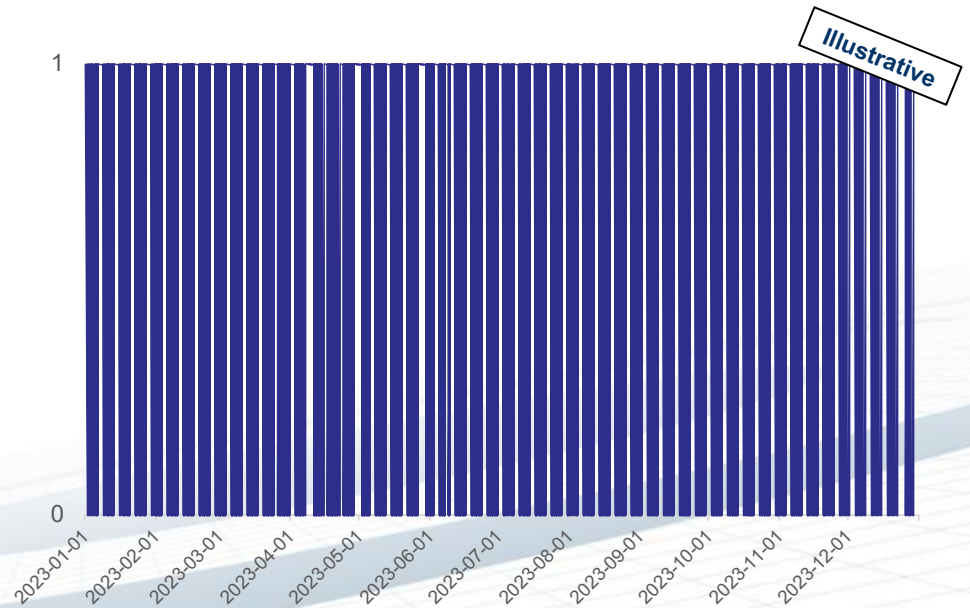
The Operation of the Electrolyzer for “Market Hours” is determined by Utilization and Price Forward Curve



Modelling electricity procurement costs

- It is assumed that there is no seasonal demand structure and that the electrolyzer produces 6,000 hours/ year and 500 hours/ month
- These 500 hours are sorted over the individual delivery hours in ascending order according to the respective hourly forward prices
- The basis for optimizing the operation of the electrolyzer is the price forward curve

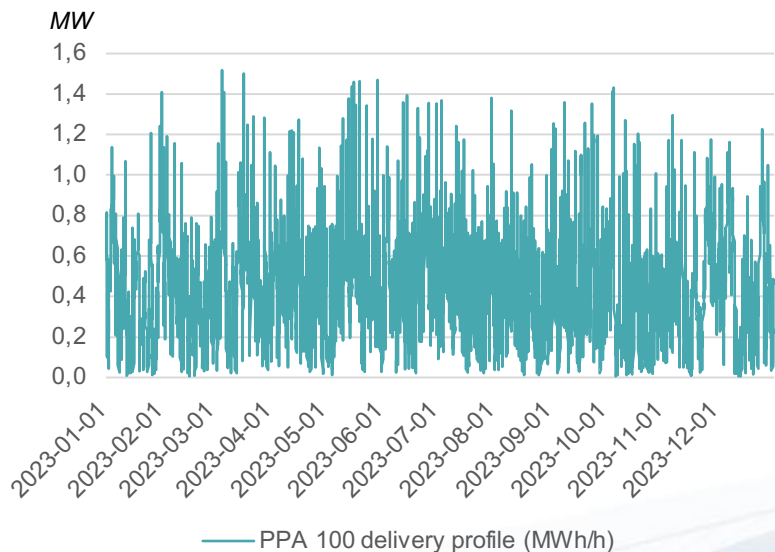
Optimized electrolyzer production profile



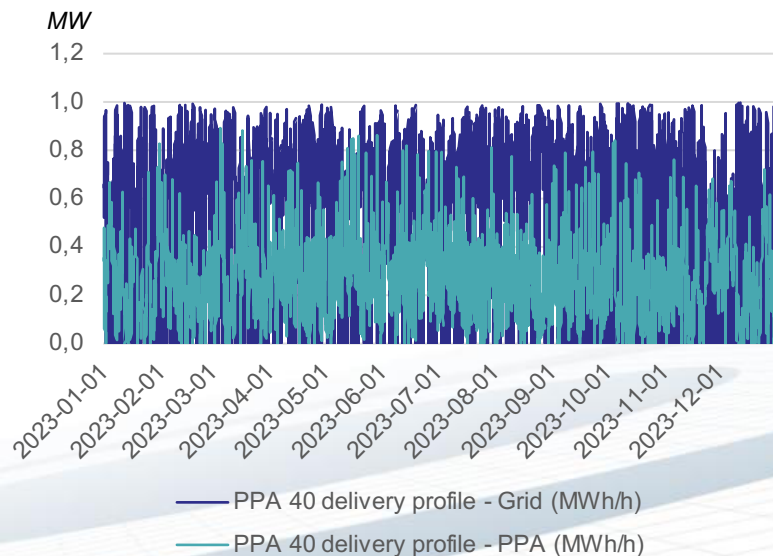
The Difference between the PPA 40 and the PPA 100 Index is additional Procurement of “Cheap” Market Volumes



PPA 100 Electricity Procurement



PPA 40 Electricity Procurement

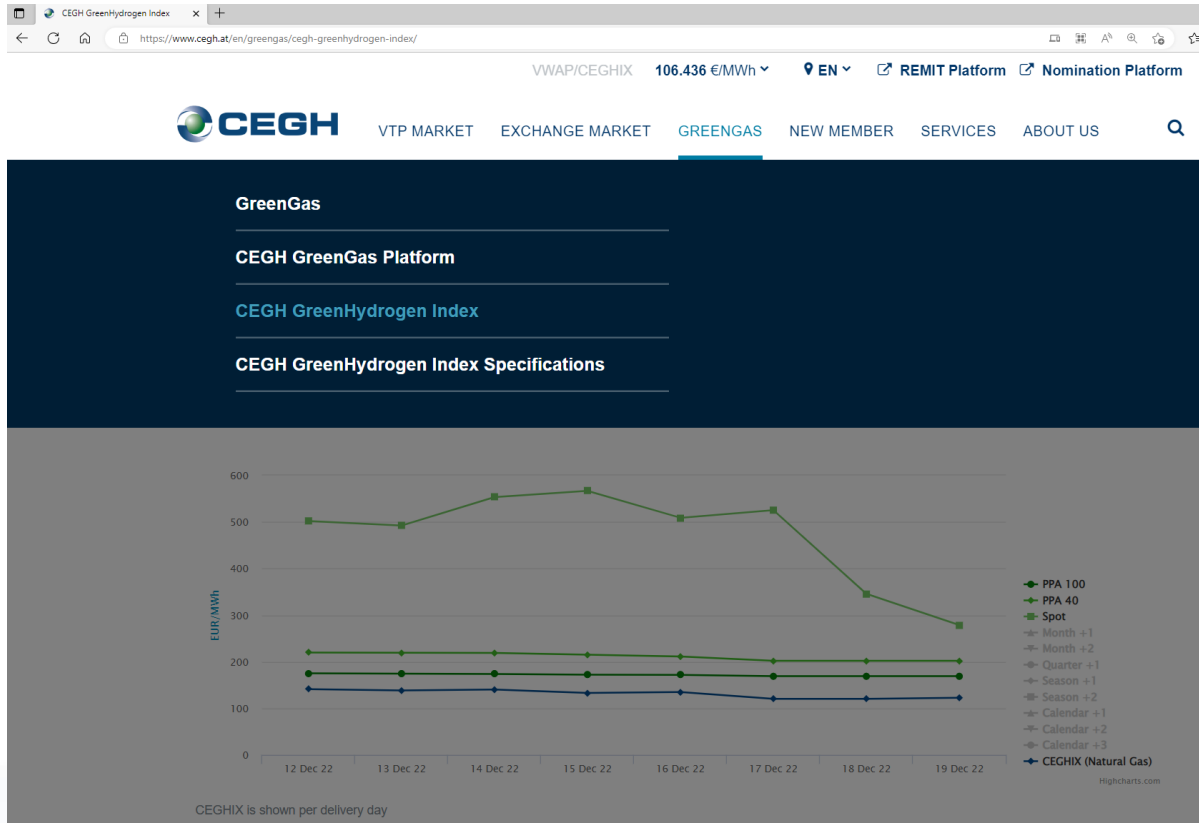


In the CEGH Green Hydrogen PPA 100 Index, the number of full-load hours is reduced to approx. 4,000 leading to an economic lifetime of the electrolyzer of approx. 15 years

The background of the image consists of numerous water droplets of various sizes scattered across a light green, slightly textured surface. The droplets are in focus, showing highlights and reflections, and are set against a soft, out-of-focus green background.

CEGH GreenHydrogen Index

Access to CEGH GreenHydrogen Indices is Provided by Using CEGH's existing Website



- Access to CEGH GreenHydrogen Index:

<https://www.cegh.at/en/green-gas/cegh-greenhydrogen-index/>

- Access to Index specification and Index description:

<https://www.cegh.at/en/green-gas/cegh-greenhydrogen-index-specifications/>

Overview CEGH GreenHydrogen Indices



WVAPICEGHX 101.924 €/MWh EN REMIT Platform Nomination Platform

CEGH VTP MARKET EXCHANGE MARKET GREENGAS NEW MEMBER SERVICES ABOUT US

Home GreenGas CEGH GreenHydrogen Index

CEGH GreenHydrogen Index

Publication date: 20-Dec-2022

CEGH GreenHydrogen PPA 100 Index [.CSV](#)

Delivery Period	EUR/MWh
10-Year Baseload	168.019

CEGH GreenHydrogen PPA 40 Index

Delivery Period	EUR/MWh
10-Year Baseload	199.859

CEGH GreenHydrogen Spot Index

Delivery Period	EUR/MWh
20-Dec-2022	292.080

CEGH GreenHydrogen Forward Index

Delivery Period	Maturity	EUR/MWh
Jan 2023	Month +1	365.632
Feb 2023	Month +2	443.165
Q1 2023	Quarter +1	420.905
Summer 2023	Season +1	391.788
Winter 2023	Season +2	441.405
Calendar 2023	Calendar +1	416.597
Calendar 2024	Calendar +2	337.057
Calendar 2025	Calendar +3	239.809

Graph View

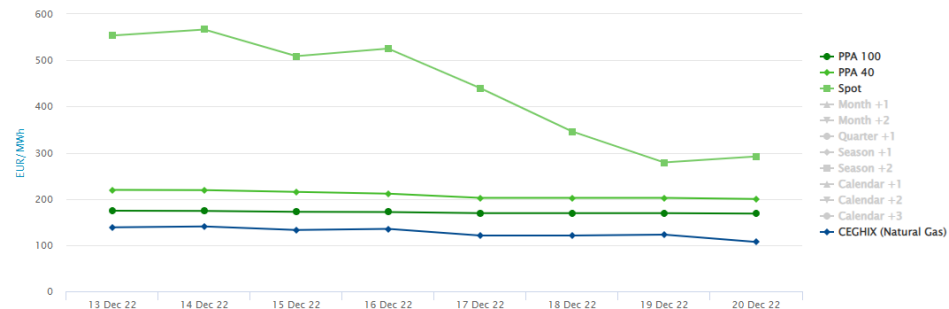
Start Date

13.12.2022

End Date

20.12.2022

Apply



CEGHIX is shown per delivery day

CEGH GreenHydrogen Indices: PPA 100 versus PPA 40



Graph View

Start Date

02.12.2022

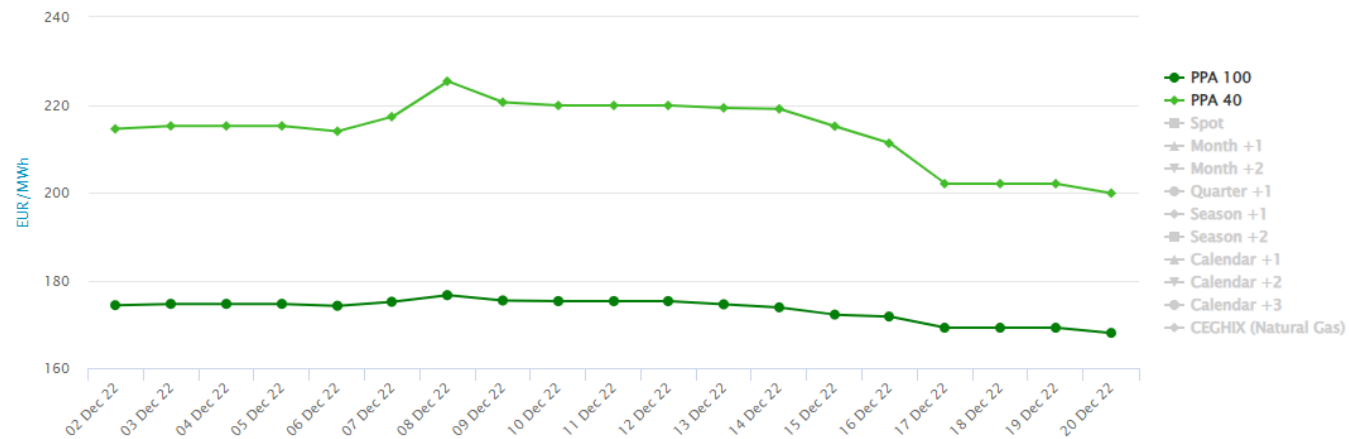


End Date

20.12.2022



Apply



CEGHIX is shown per delivery day

Highcharts.com

CEGH GreenHydrogen Indices: CEGH GreenHydrogen Spot Index versus CEGHIX



Graph View

Start Date

02.12.2022

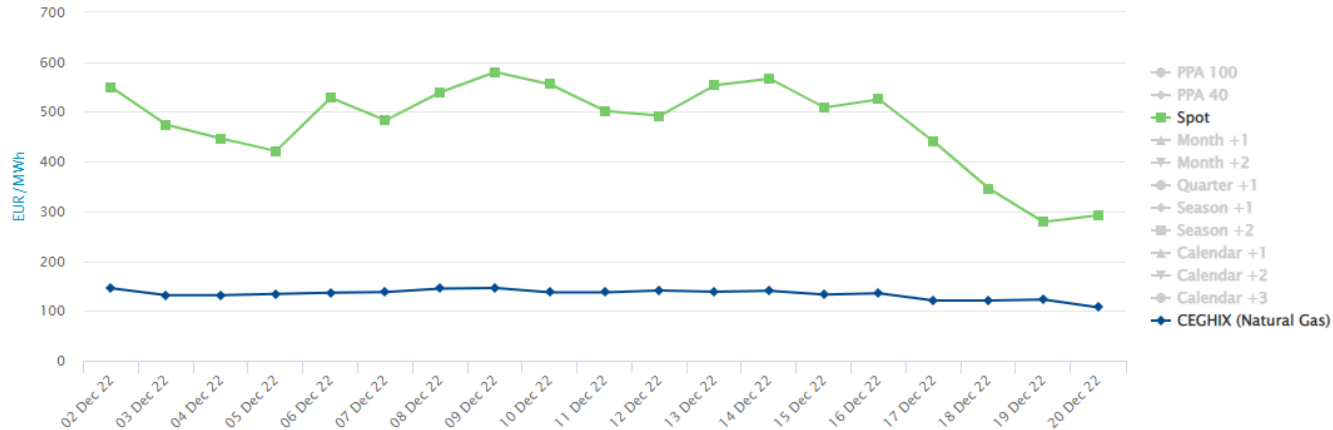


End Date

20.12.2022



Apply



CEGHIX is shown per delivery day

Highcharts.com

CEGH GreenHydrogen Indices: Forward Prices



Graph View

Start Date

02.12.2022

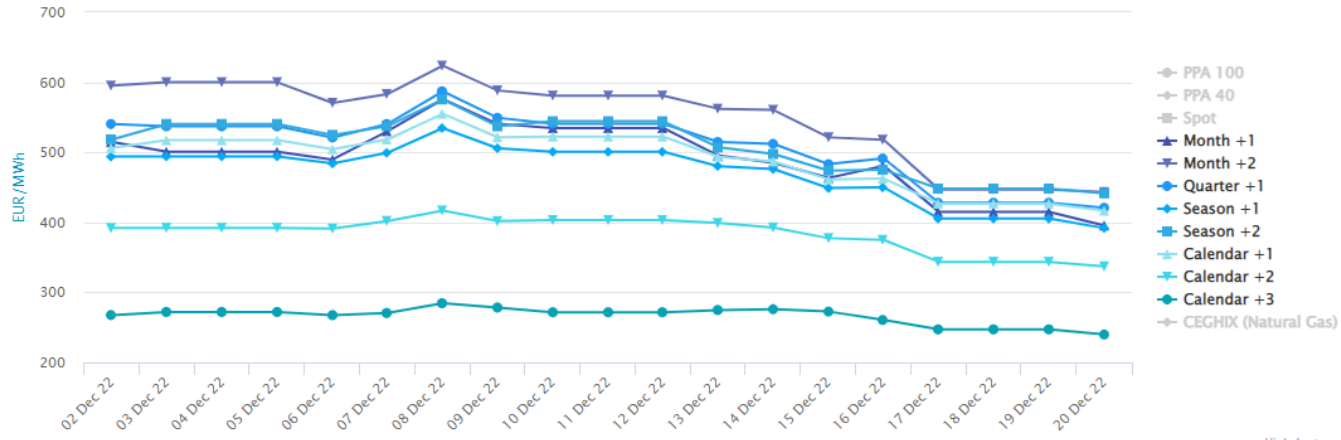


End Date

20.12.2022



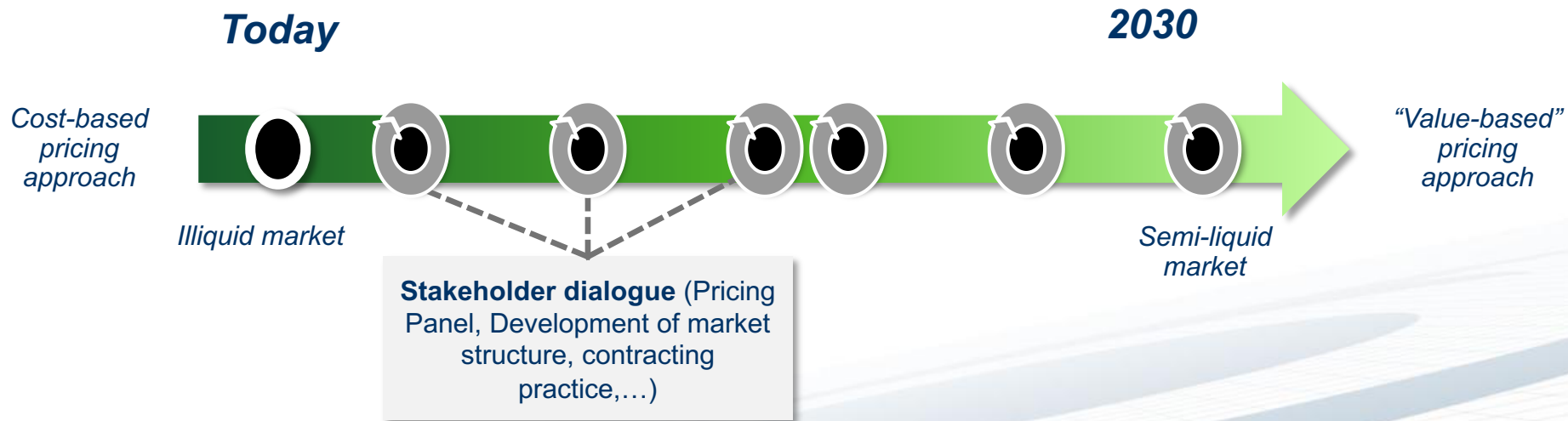
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CEGHIX is shown per delivery day

Highcharts.com

Ongoing Stakeholder Dialogue ensures continuous Alignment of Index Design to evolving Hydrogen Market



**Thank you very much
for your attention**

