
CEGH & AGGM
HYDROGEN WEBINAR:
Facilitating the Development
of a Market for Hydrogen

Austrian Gas Grid Management AG

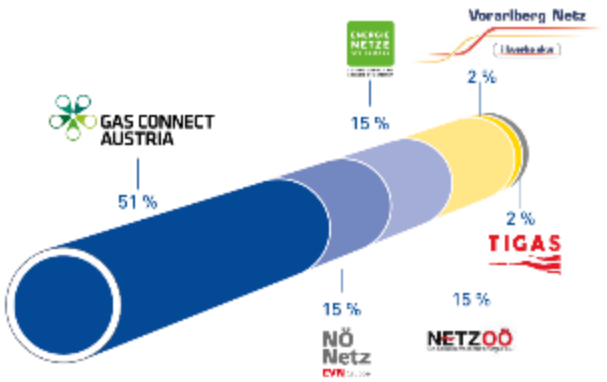
H_2-Roadmap for Austria

Green Hydrogen Webinar
Facilitating the development of a market for hydrogen

Vienna, 19 April 2023

Market and Distribution Area Manager for the Austrian Gas Market

AGGM Austrian Gas Grid Management AG



Gasflow control & System Responsibility

- We are responsible for the control of gasflows in Austria
- We make sure that the injected gas is savely delivered to the customers – 24/7, 365 days a year

High-performance and reliable gas-infrastructure for the energy future

- We are planning and optimizing the Austrian gas grid for the future in cooperation with the grid operators.
- We are driving forward the integration of renewable gases into the energy system

Transparency

- The AGGM-Platform provides actual and historic data on gas flows, storage levels, the availability of transport capacities and much more.

Enabler

- We contribute to shaping the gas market model and the systems for the gas market and are responsible for network access and capacity management

ONE^{100}: Austria's sustainable energy system – 100% decarbonized

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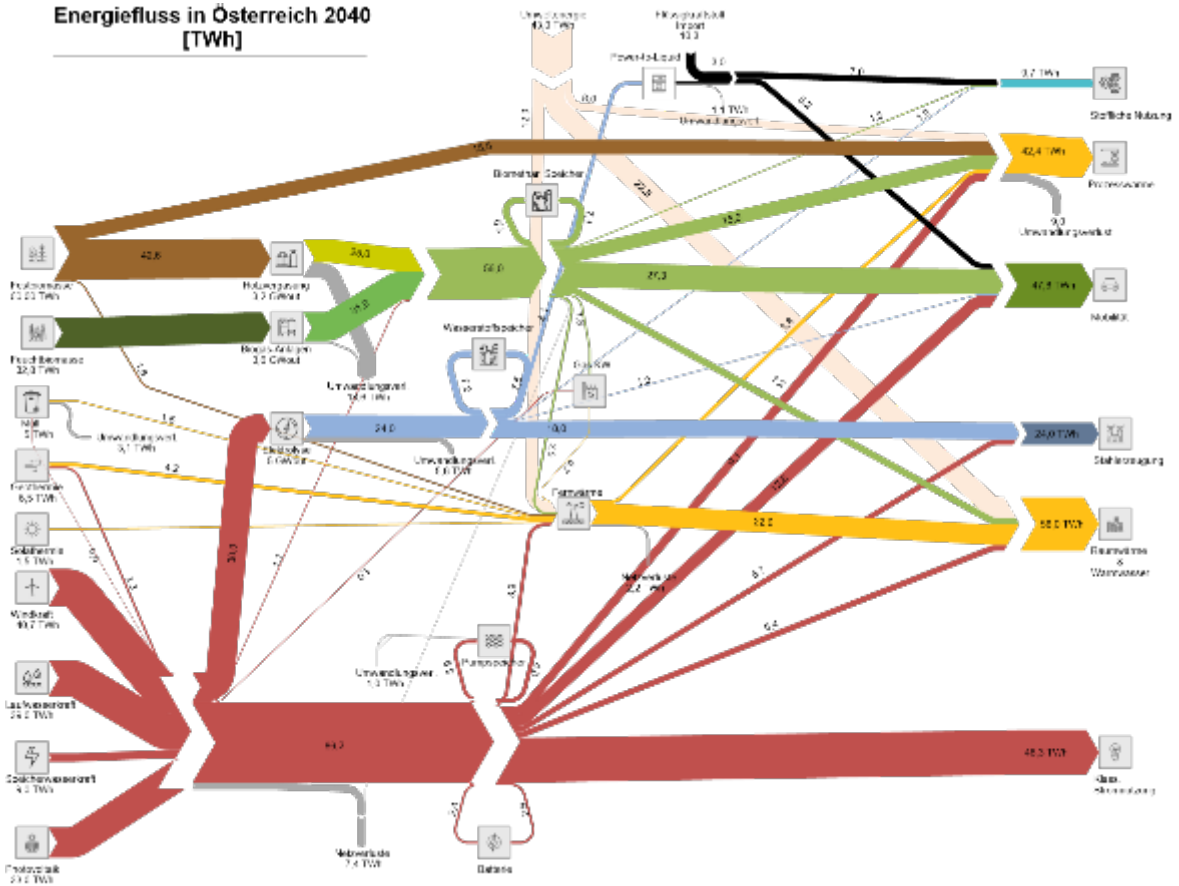

www.aggm.at/en/energy-transition/one100

ONE^{100} – the optimized outcome

- Fundamental increase of renewable power production, in particular generation from wind and photovoltaics
- massive expansion of the electricity grid
- renewable gas (methan and hydrogen) as essential part of the Austrian energy system
- Ramp up biomethane production from wet and solid biomass (wood gasification) is essential
- More than 6 GW regional electrolysis capacity is possible - electrolysis sites close to renewable electricity production
- **a dedicated hydrogen network is needed** for
  - Imports, transit, the intake of locally produced hydrogen and
  - the efficient transport of hydrogen to the customer and storages

H_2-Roadmap: Planning Framework – Gas Demand in Austria 2040

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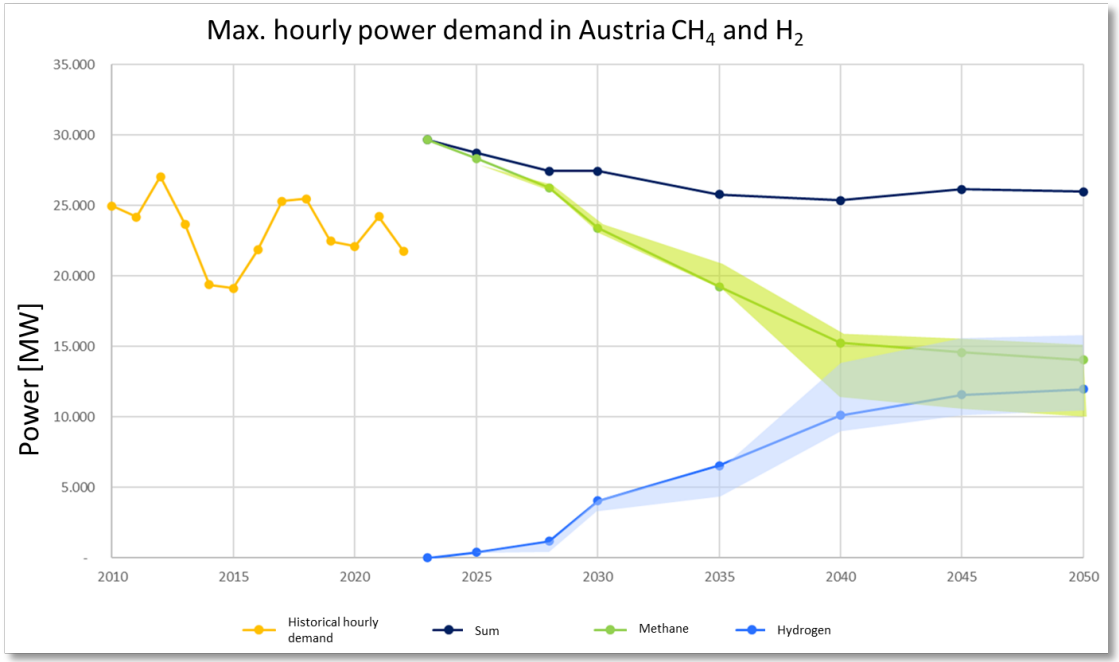
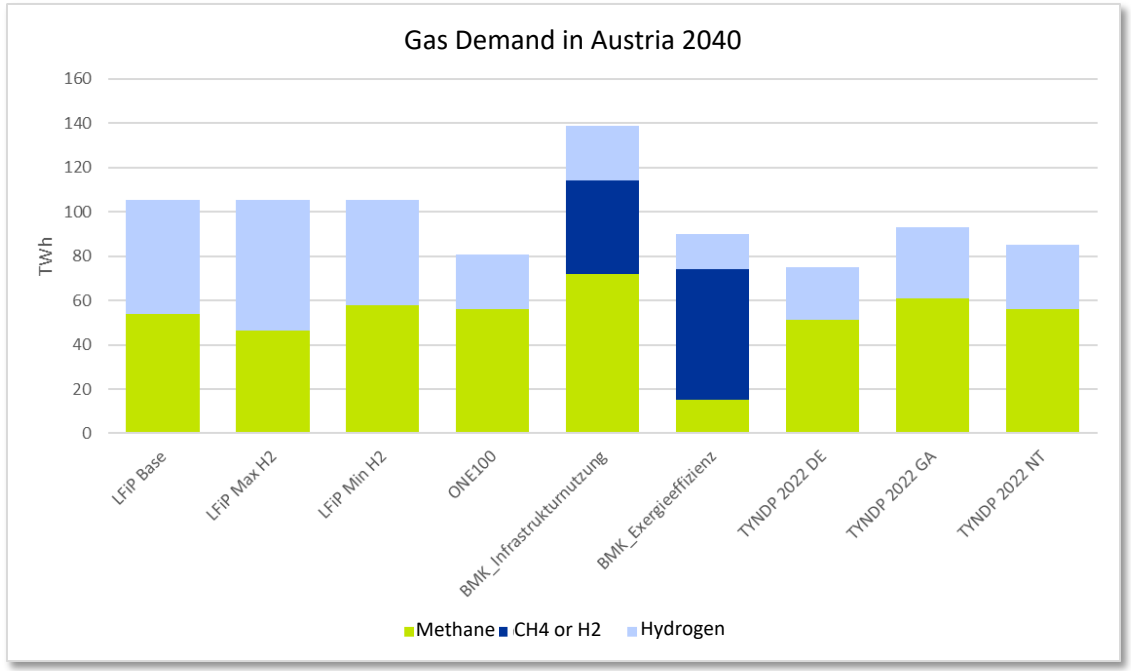
- The study "Renewable Gas in Austria 2040" by the Austrian Energy Agency (AEA) - prepared on behalf of the Austrian Federal Ministry for Climate Action - concludes that in 2040 there will be an energy demand for gaseous energy sources of 89-138 TWh
- This study result of the AEA was confirmed in the study "ONE100 Austria's sustainable energy system - 100% decarbonised“ mentioned before
- in 2022 we have carried out an industry demand survey in cooperation with network operators





H_2-Roadmap for Austria based on the existing gas grid

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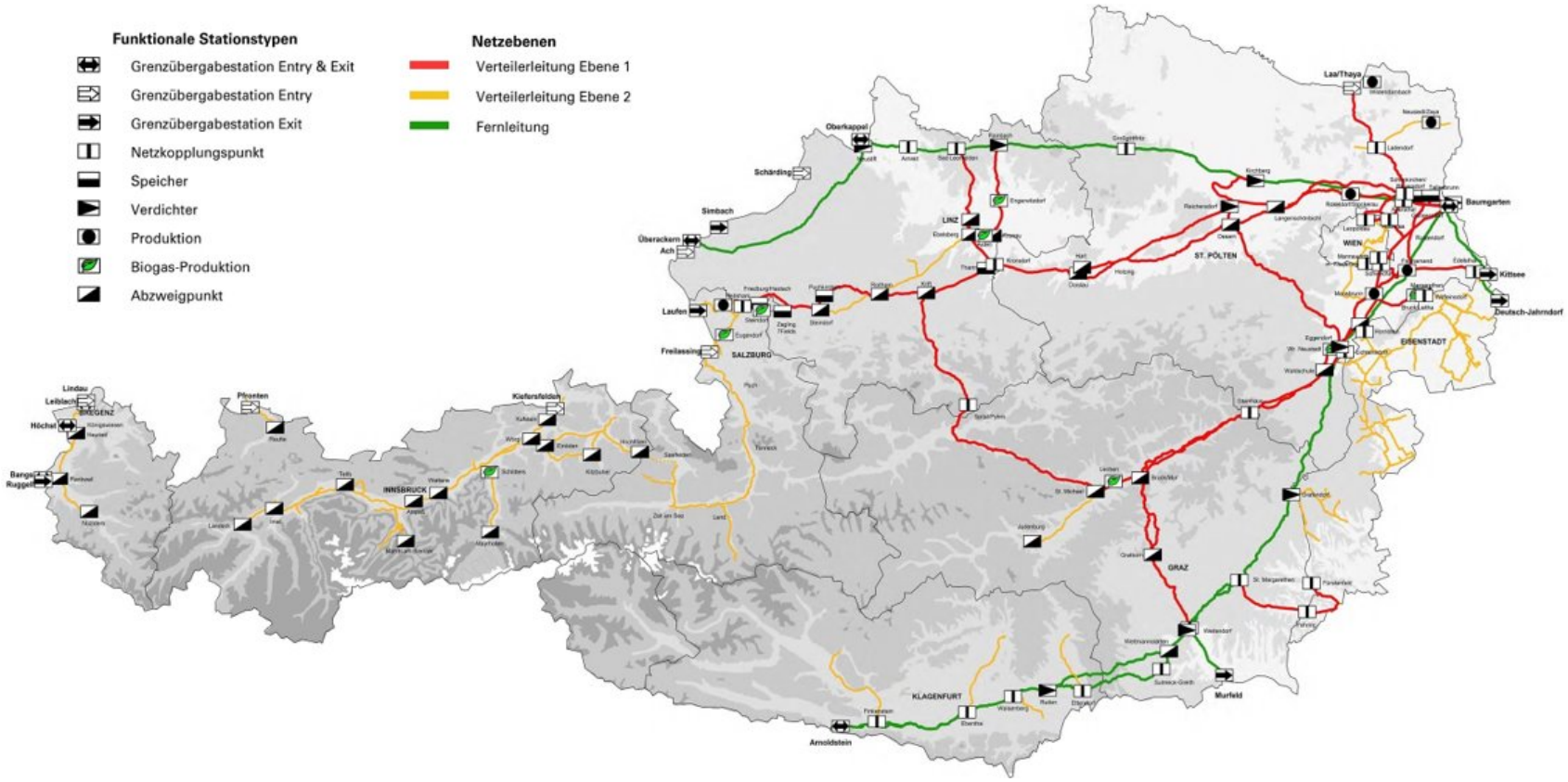

Based on:

- the existing gas grid
- 3 demand scenarios and 3 supply scenarios
- hydraulic simulations were carried out in five-year steps starting with 2025

Target:

- Create a CH_4 and dedicated H_2 network which meets the future transport needs

H_2-Roadmap for Austria: Hydrogen Peak-Demand 2025

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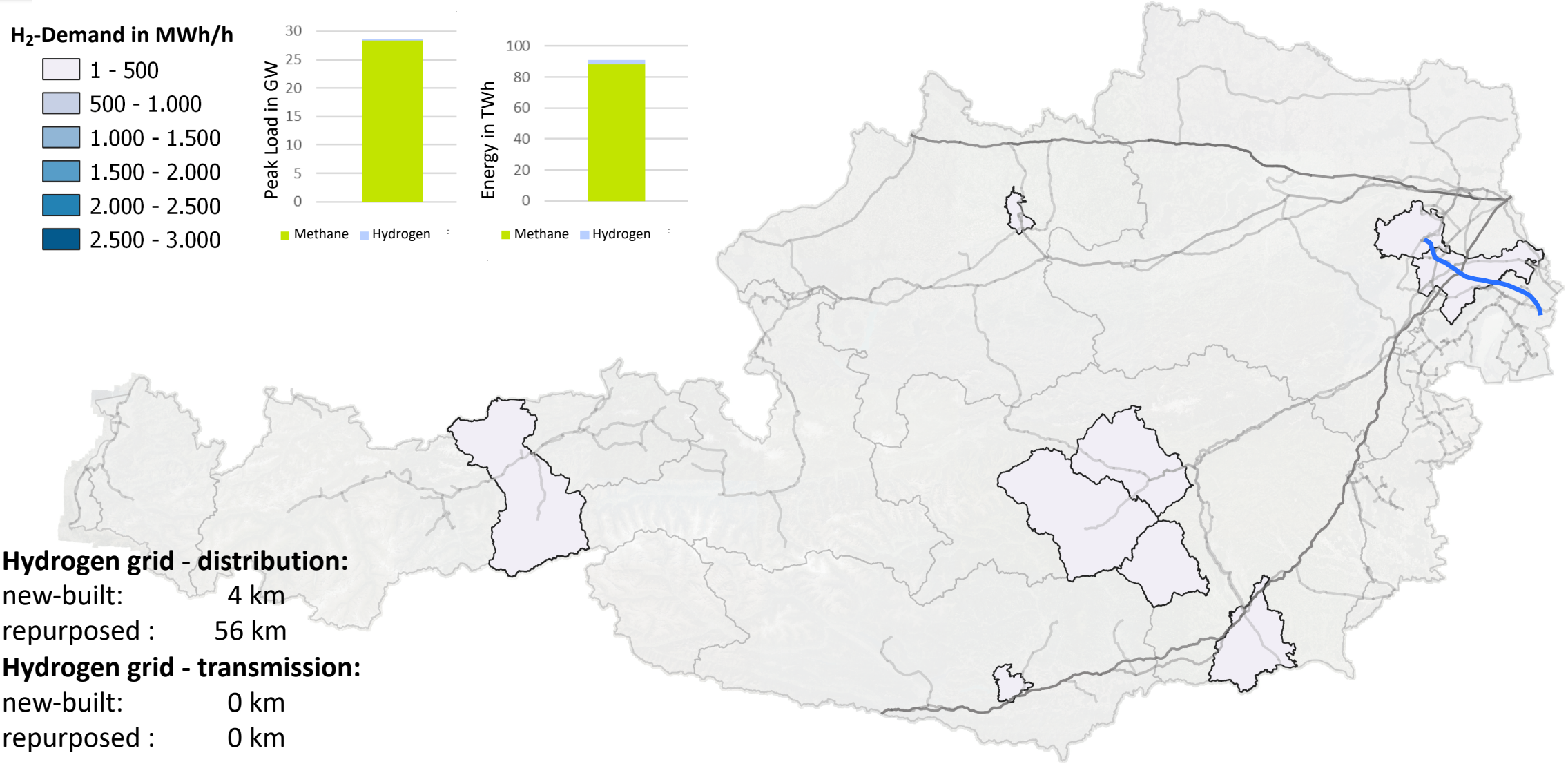

Hydrogen grid - distribution:

new-built: 4 km

repurposed : 56 km

Hydrogen grid - transmission:

new-built: 0 km

repurposed : 0 km

H_2-Roadmap for Austria: Hydrogen Peak-Demand 2030

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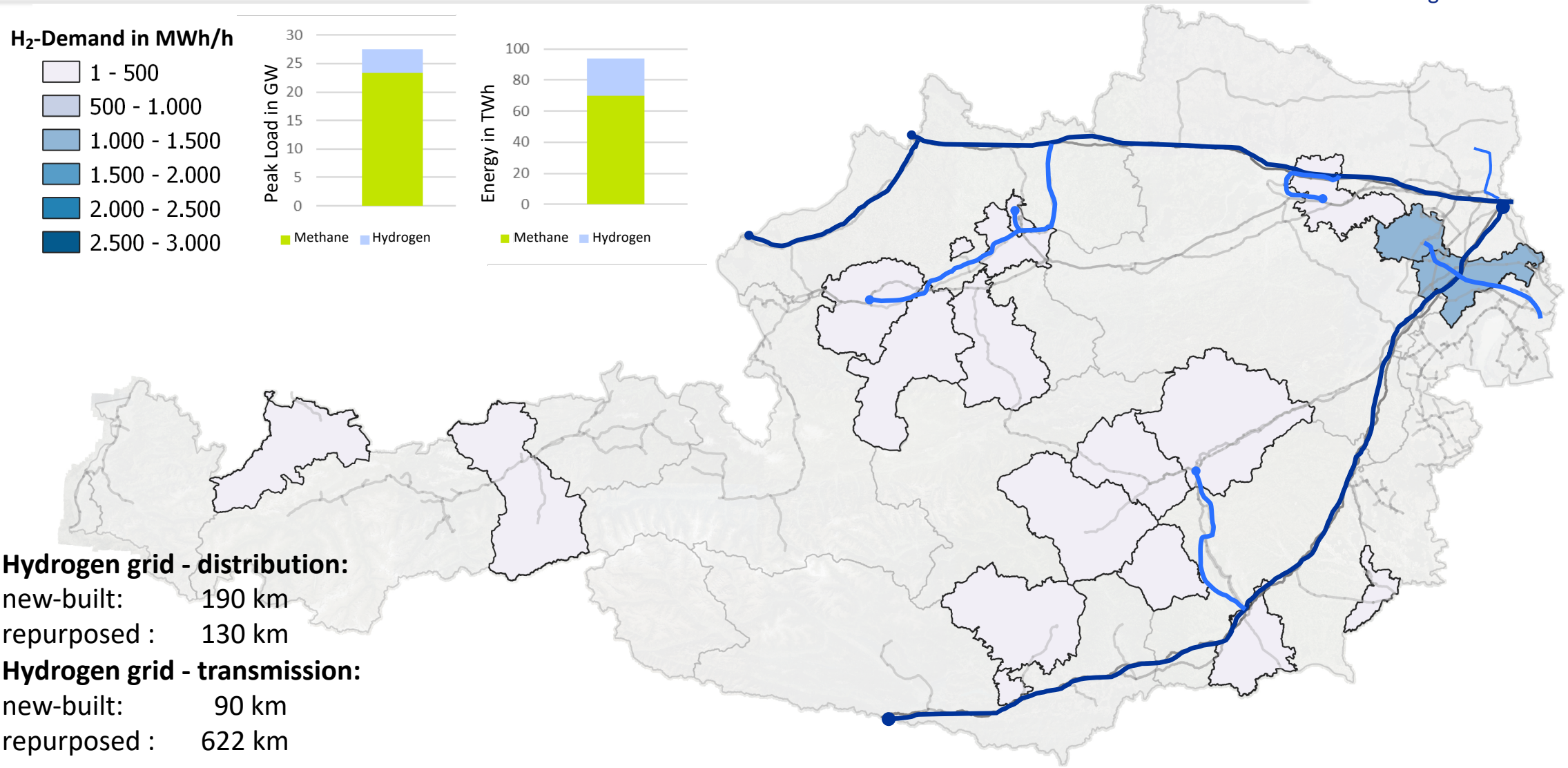

Hydrogen grid - distribution:

new-built: 190 km

repurposed : 130 km

Hydrogen grid - transmission:

new-built: 90 km

repurposed : 622 km

H_2-Roadmap for Austria: Hydrogen Peak-Demand 2035

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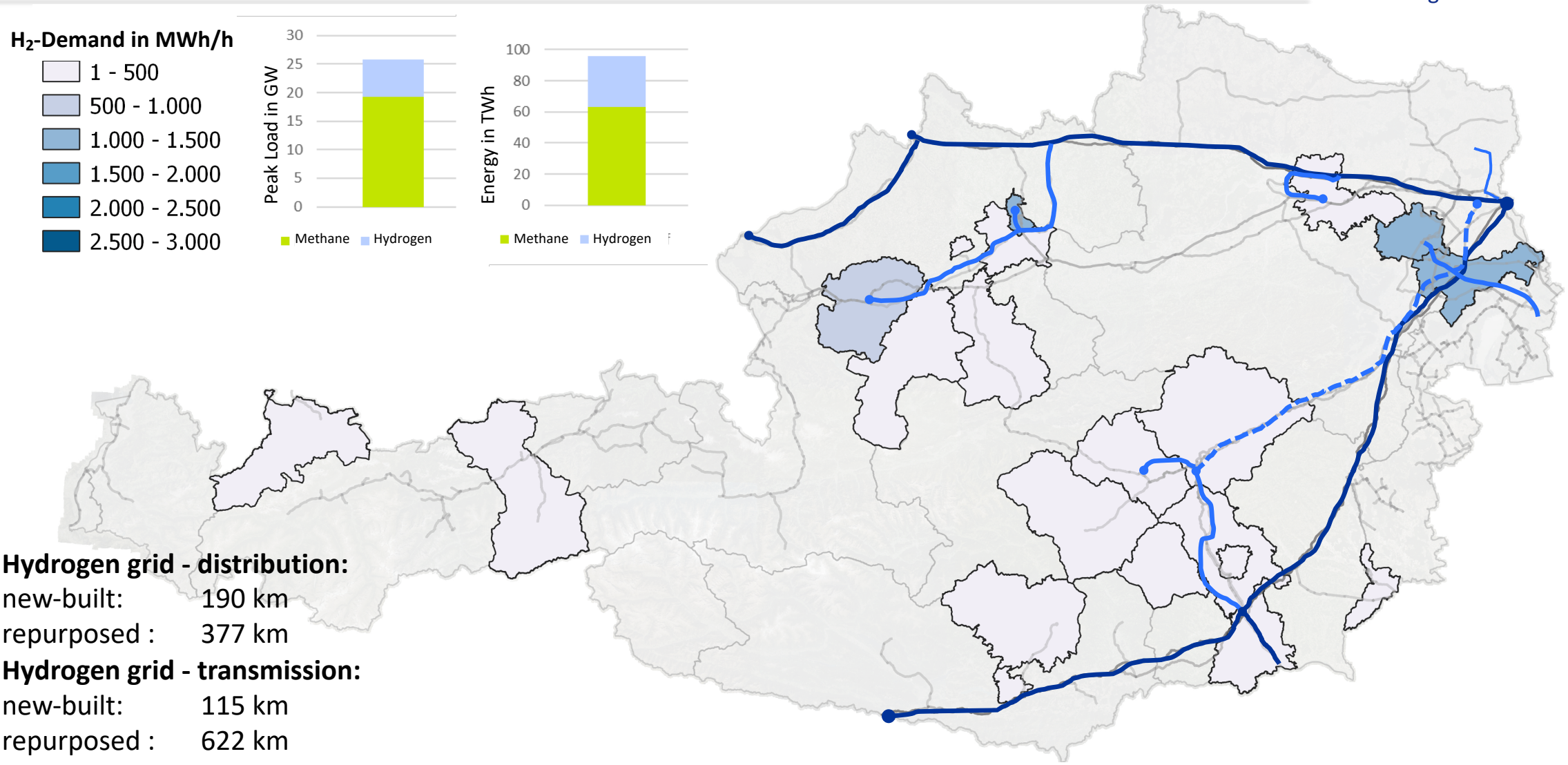

Hydrogen grid - distribution:

new-built: 190 km

repurposed : 377 km

Hydrogen grid - transmission:

new-built: 115 km

repurposed : 622 km

H_2-Roadmap for Austria: Hydrogen Peak-Demand 2040

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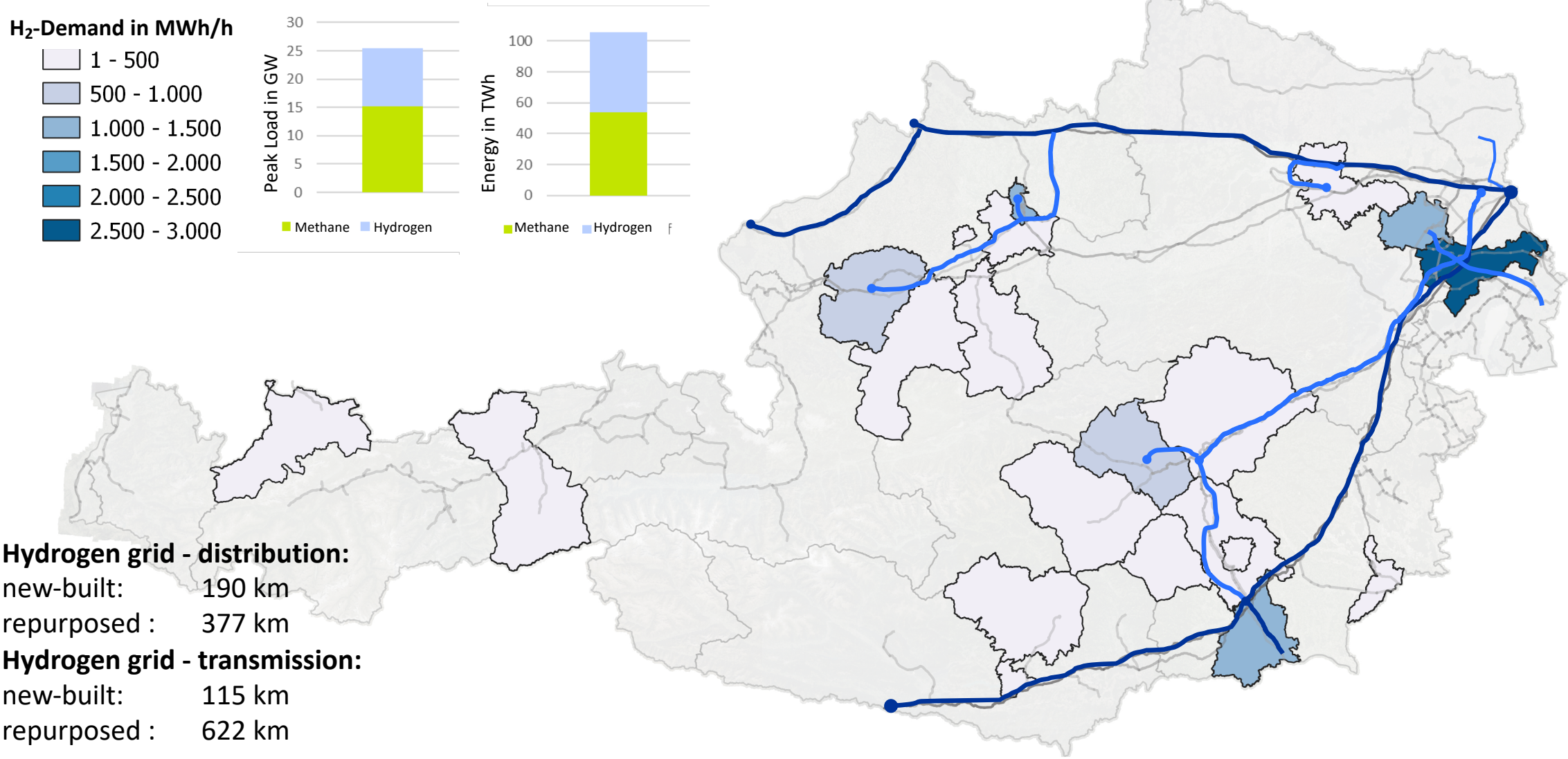

Hydrogen grid - distribution:

new-built: 190 km

repurposed : 377 km

Hydrogen grid - transmission:

new-built: 115 km

repurposed : 622 km

H_2-Roadmap for Austria: Hydrogen Peak-Demand 2050

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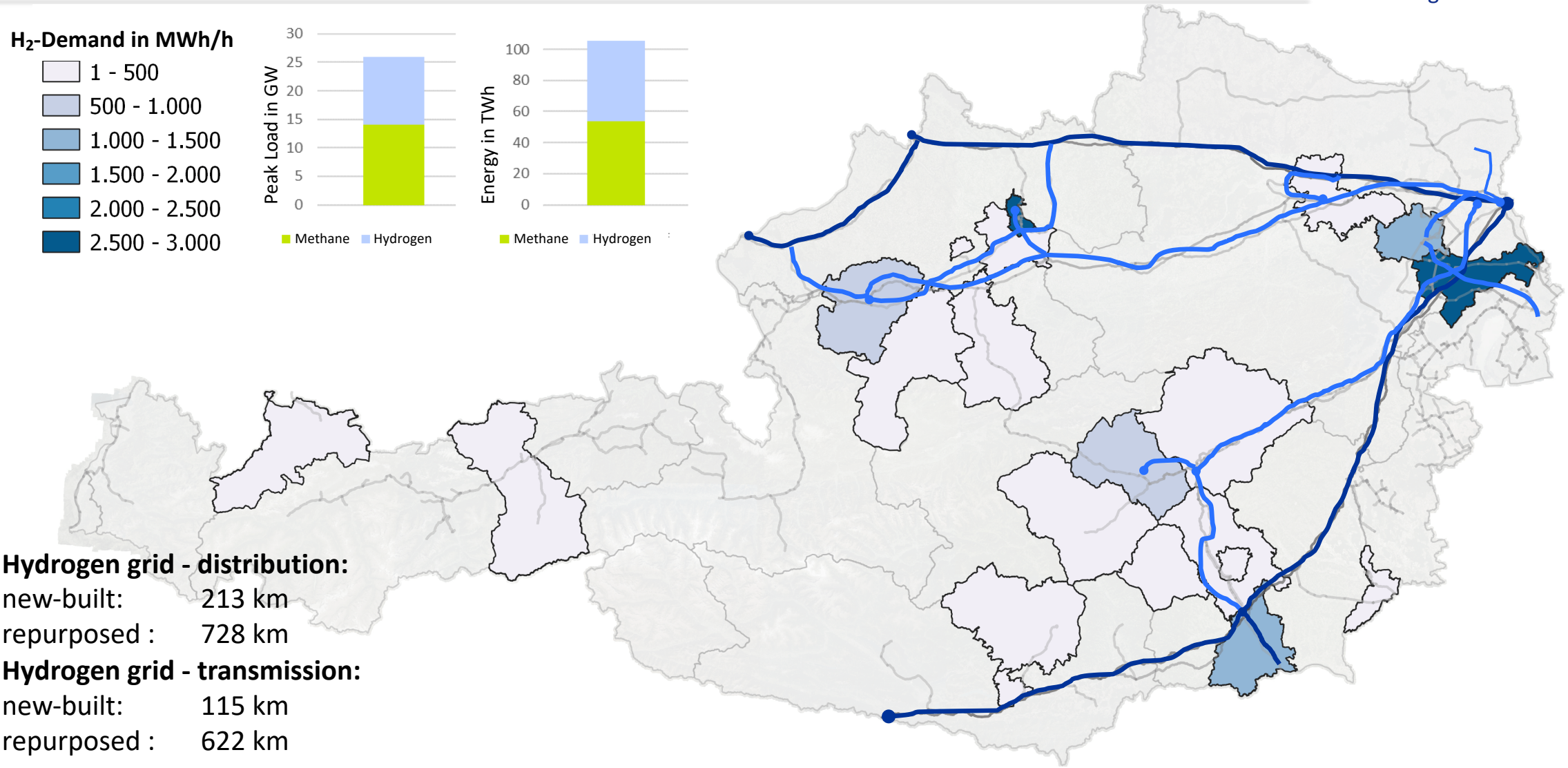

Hydrogen grid - distribution:

new-built: 213 km

repurposed : 728 km

Hydrogen grid - transmission:

new-built: 115 km

repurposed : 622 km

H_2-Roadmap for Austria: Hydrogen Domestic Production 2040

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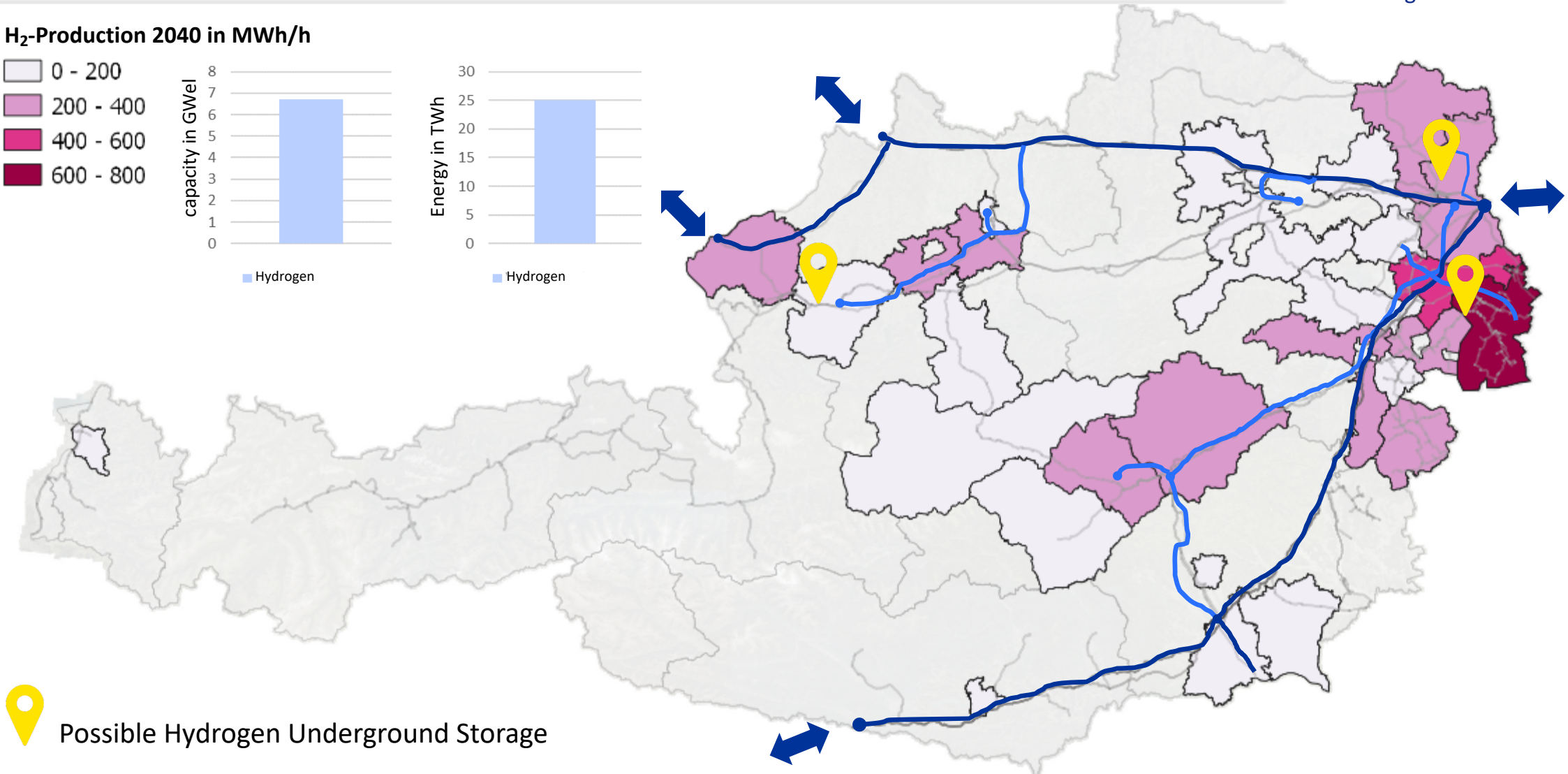

H_2-Roadmap for Austria - Conclusions

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- The H_2-Roadmap shows that the organic transformation from the existing gas grid to separated methane and hydrogen grids is possible and efficient
- The existing gas infrastructure is technically suitable for hydrogen transport with appropriate adaptations
- The repurposing of about 1,400 km of existing gas pipelines and about 300 km of new gas pipelines allow to cover the entire future transport needs for methane and hydrogen in Austria
- The storage of hydrogen in Austrian gas storage facilities enables the seasonal shifting of energy surpluses

- **Regulatory and commercial burden have to be removed to make this development happen in order to support the decarbonization of the energy system**
- **Brave and swift decisions from the industry, the regulators and policy makers are of great importance**

Further information as to the H2-Roadmap for Austria: AGGM integrated Long Term Planning 2022, page 17 et. seqq.

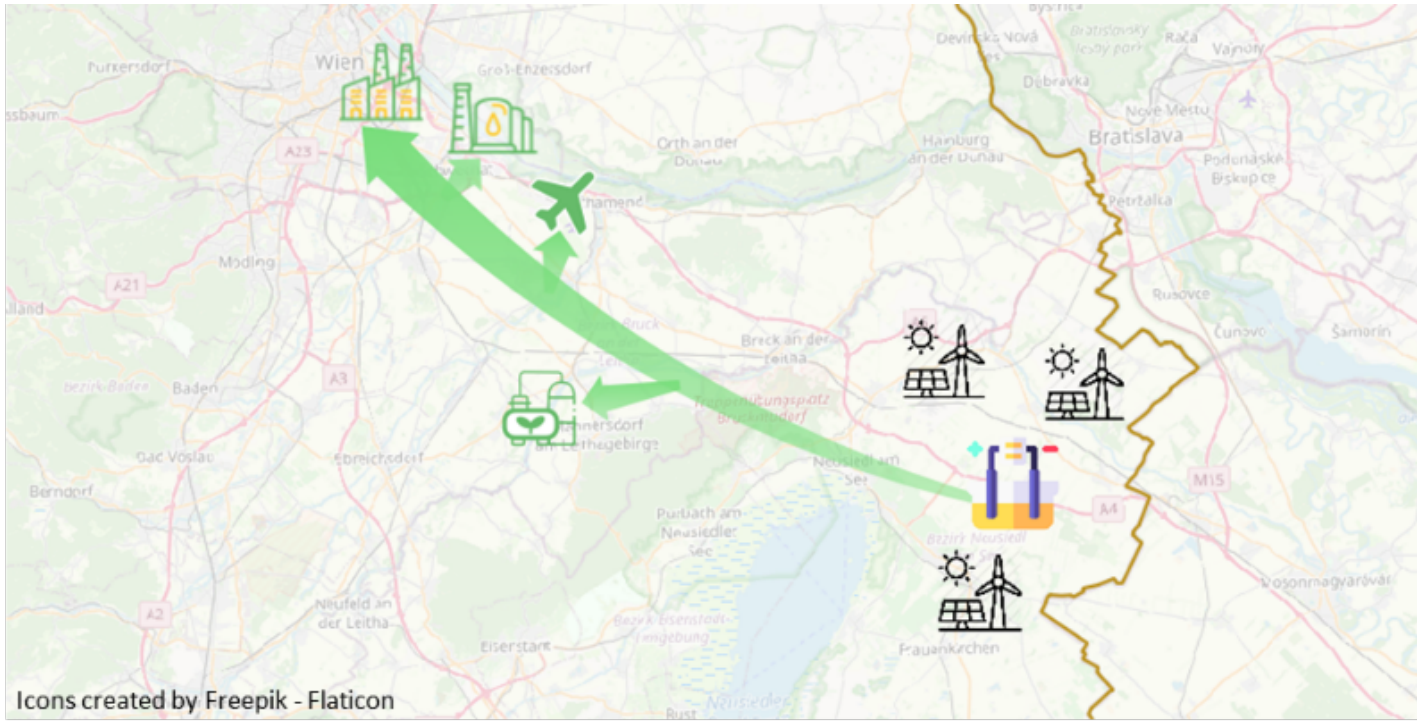
H_2Ready transmission pipelines until 2030

- The West-East and North-South transit routes through Austria of the TSOs Gas Connect Austria and Trans Austria Gasleitung GmbH as essential part of the European Hydrogen Backbone are 100%-H_2Ready

- The projects
  "**H_2 Backbone WAG + Penta-West“,**
  “H_2 Backbone Murfeld” and
  “H_2 Readiness of the TAG Pipeline System”
  are submitted to the EU Commission
  as Projects of Common Interest

H_2Collector East – transport of renewable hydrogen from 2026

- **Pannonian Green Hydrogen - PanHy** is a project of VERBUND and Burgenland Energie. It is currently the largest planned Austrian electrolysis plant (60 MW in the first expansion stage, final 300 MW)
- 56 km new 100% H_2-ready gas pipeline + 4 km adapted gas pipeline
- **H_2Collector East** allows the acceleration of the expansion of renewable energy through sector coupling:
  7 transformer stations – potential sites for additional electrolysis plants – are located along the route



How can you support the H_2-Roadmap for Austria?

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- Please inform us about your projects!

  Under this Link you can find questionnaires for additional H_2 demand and H_2 injection projects

  - Fragebogen H2 Absatz V2 (XLSX, 68 KB)
  - Fragebogen H2 Aufbringung (XLSX, 66 KB)

- We will include your projects in the next H_2-Roadmap update!

Impressum

- Follow us on linked-in!
- stay up to date with our Newsletter!
- attend the AGGM Competence Center Training and learn more about the Austrian gas market!

DI Helmut Wernhart

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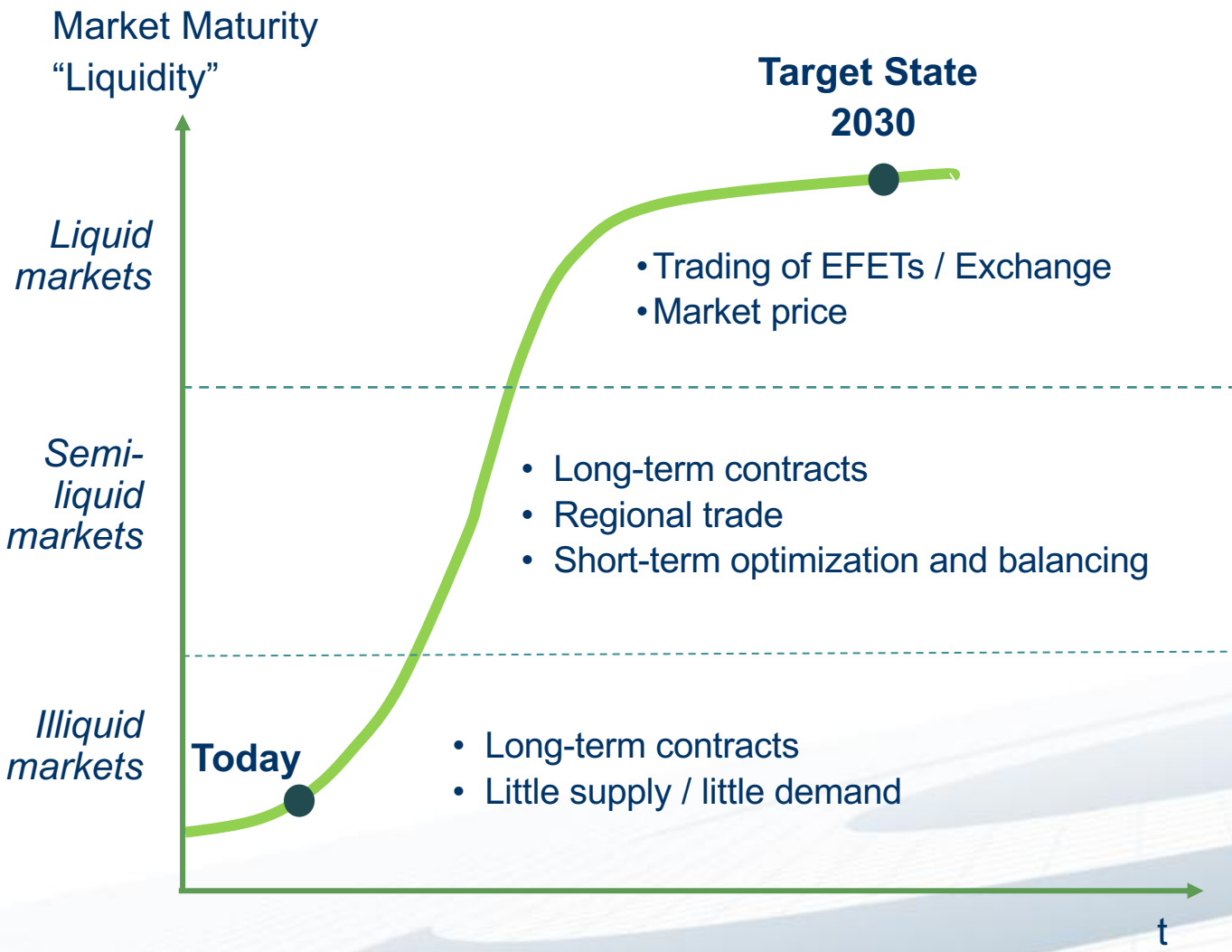
CEGH GreenHydrogen Index

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.

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

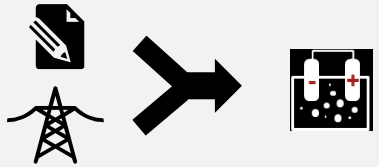
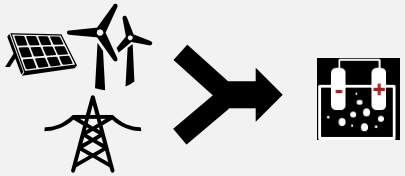
Standardized contracts (EFET)

Build-up of institutional & regulatory requirements

Price Information & Transparency

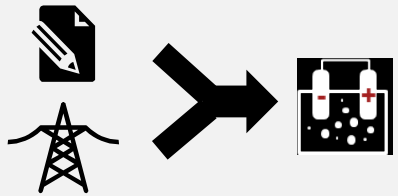
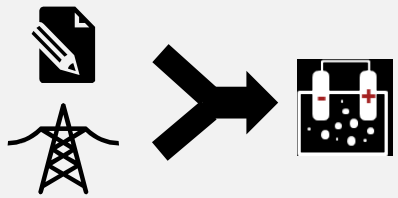
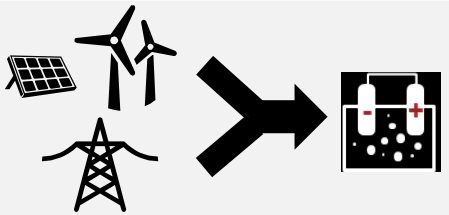
Auction- / Bulletin-Board / "Physical" Services

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

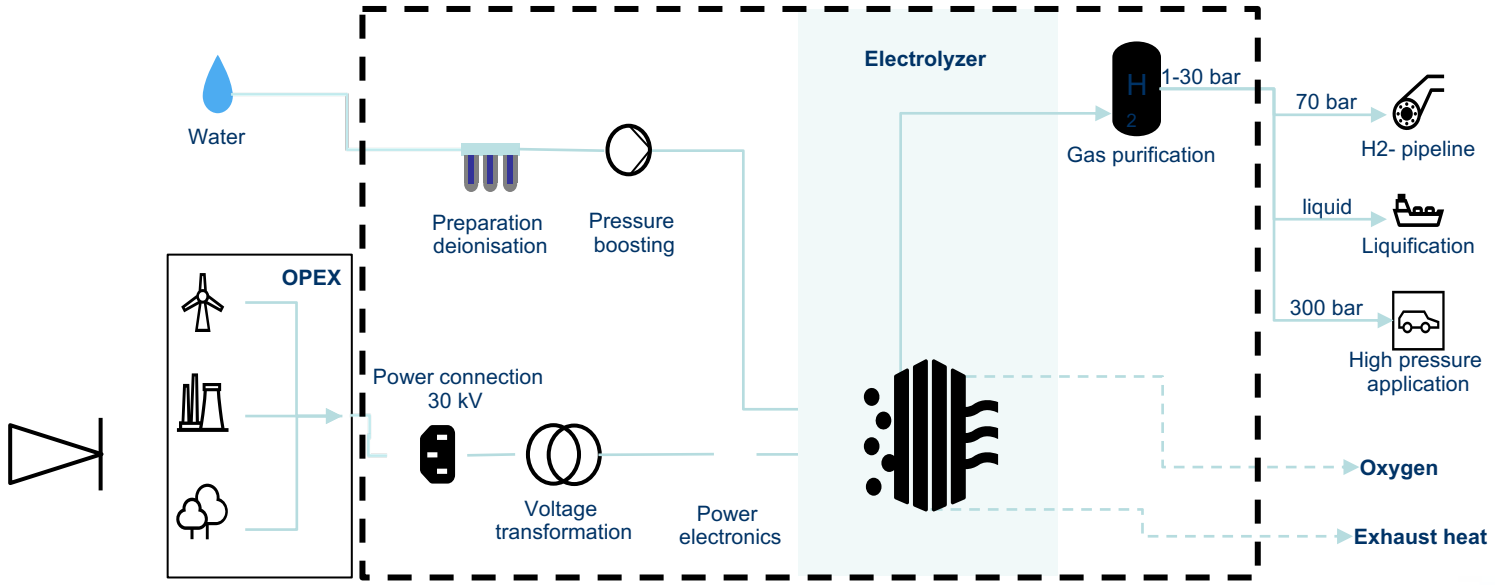
[1] *In line with requirements REDII Delegated Act Article 27.3.*

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	 ▪ Sourcing of "grey" power in the day-ahead market ▪ Sourcing of guarantees of origin via exchange / platforms	▪ Over 24 hours optimized average baseload H2 Delivery	▪ Daily
CEGH Green Hydrogen Forward Index	 ▪ Sourcing of "grey" power in forward markets ▪ Sourcing of guarantees of origin via exchange / platforms	▪ Monthly, Quarterly, Seasonal and Yearly Products ▪ Baseload delivery	▪ Daily
CEGH Green Hydrogen PPA 40 Index	 ▪ 40% of green power (renewable PPA) and 60% "grey" power (forward) ▪ Sourcing of guarantees of origin via exchange / platforms	▪ 10 Year Baseload H2	▪ Daily
CEGH Green Hydrogen PPA 100 Index	 ▪ 100% sourcing of green power via power purchase agreements (renewable PPA)	▪ 10 Year Baseload H2	▪ Daily

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

Battery Limits applied for Capex Calculation



Source: PwC

Cost of green power supply

+ Capex

"Cost-Plus"-Value of Green Hydrogen

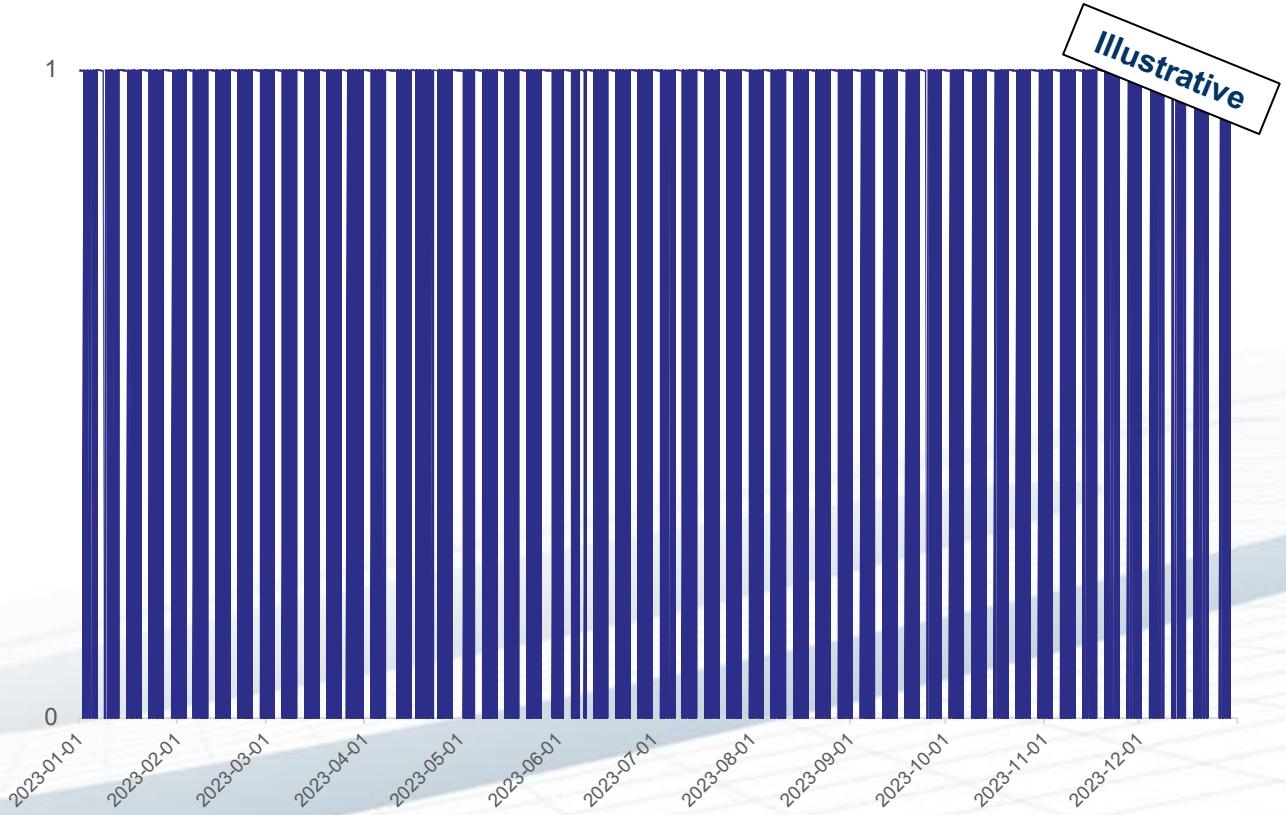
- Estimated Capex for electrolyzer is re-assessed on a regular basis
- Consideration of learning curve effects for „forward" hydrogen price assessments

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

Modelling electricity procurement costs

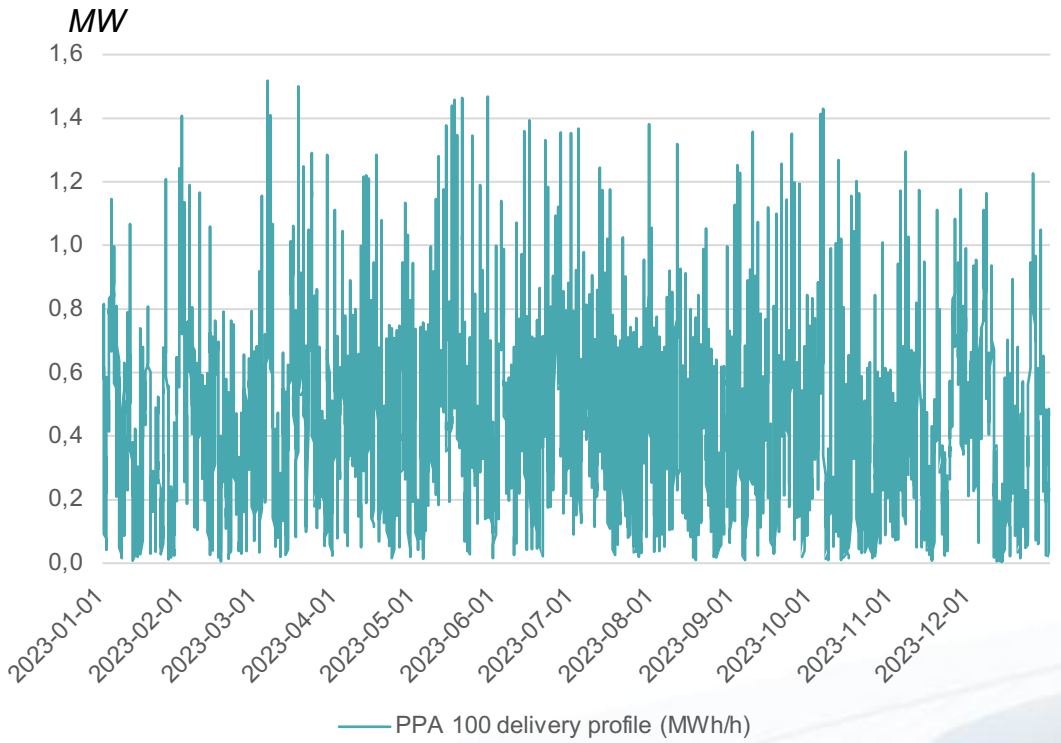
- It is assumed that there is no seasonal demand structure and that the electrolyzer produces 6,000 hours/ year and 500 hours/ month
- These 500 hours are sorted over the individual delivery hours in ascending order according to the respective hourly forward prices
- The basis for optimizing the operation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

Optimized electrolyzer production profile

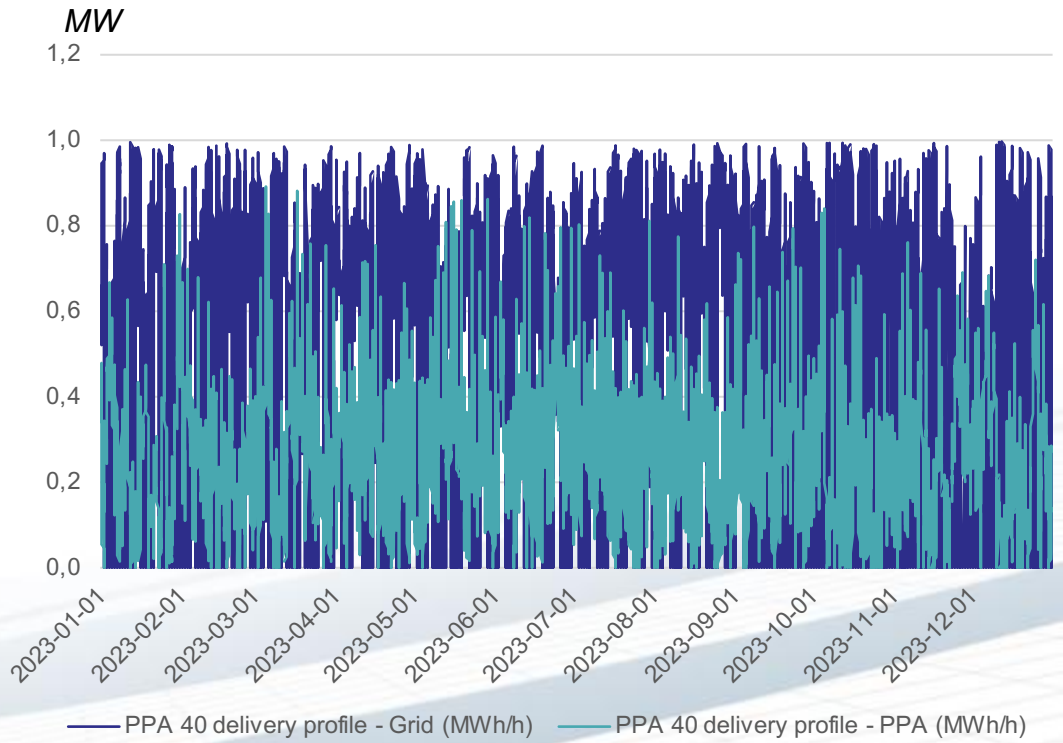


The Difference Between the PPA 40 and the PPA 100 Index is Additional Procurement of "Cheap" Market Volumes

PPA 100 Electricity Procurement

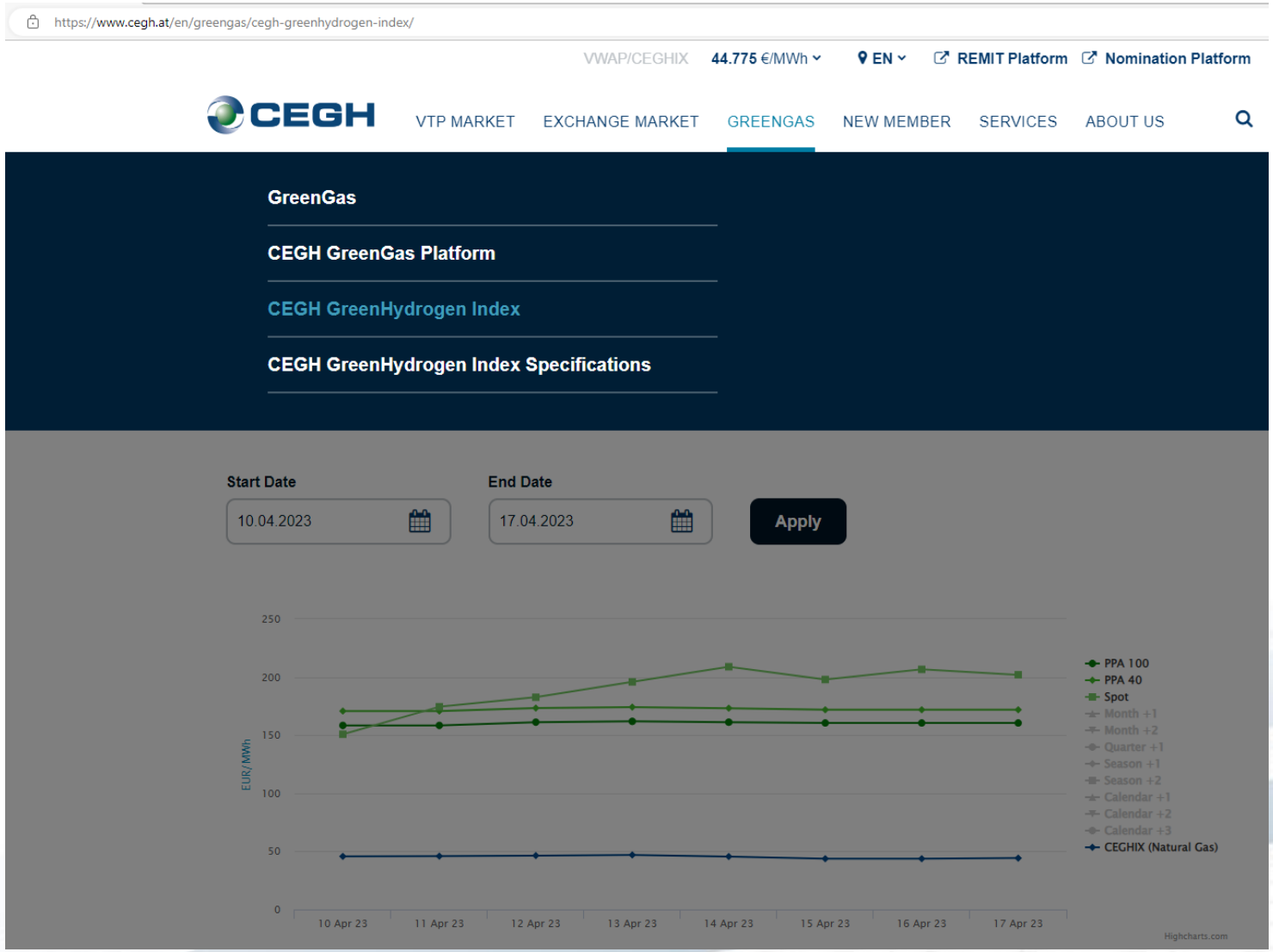


PPA 40 Electricity Procurement



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

Access to CEGH GreenHydrogen Indices is Provided by CEGH's Existing Website



- Access to CEGH GreenHydrogen Index:

  https://www.cegh.at/en/greengas/cegh-greenhydrogen-index/

- Access to Index specification and Index description:

  https://www.cegh.at/en/greengas/cegh-greenhydrogen-index-specifications/

CEGH GreenHydrogen Indices – Website

CEGH GreenHydrogen Index

Publication date: 18-Apr-2023

CEGH GreenHydrogen PPA 100 Index

Delivery Period	EUR/MWh
10-Year Baseload	160.463

CEGH GreenHydrogen PPA 40 Index

Delivery Period	EUR/MWh
10-Year Baseload	171.915

CEGH GreenHydrogen Spot Index

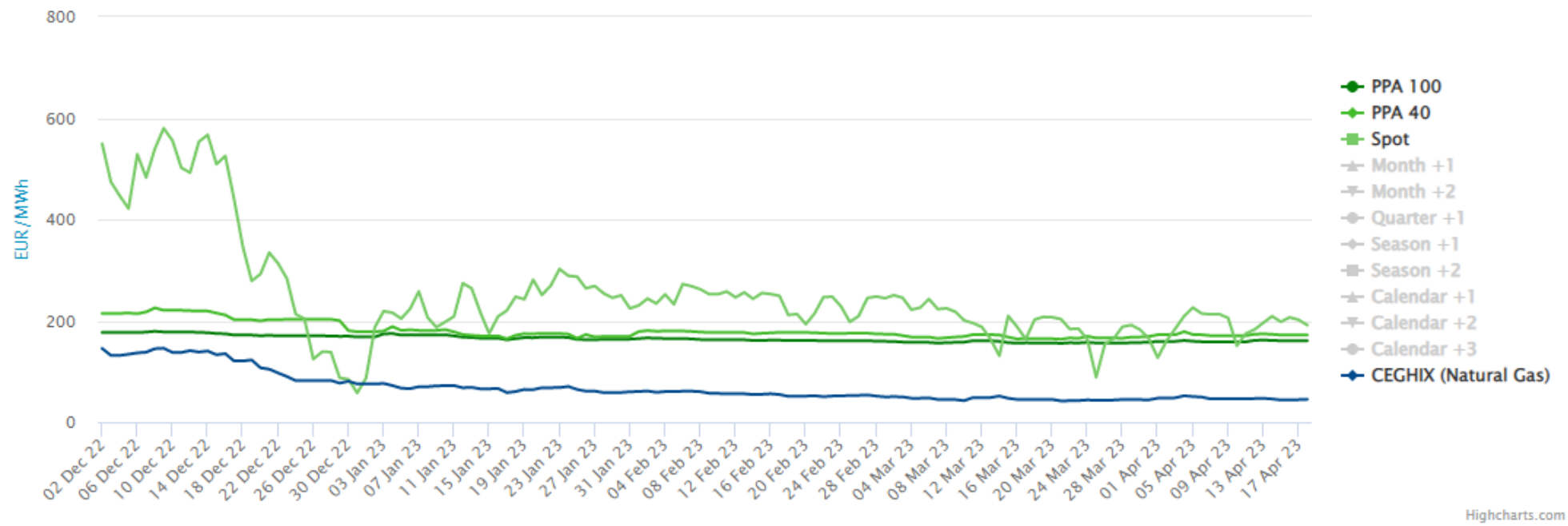
Delivery Period	EUR/MWh
18-Apr-2023	191.416

CEGH GreenHydrogen Forward Index

Delivery Period	Maturity	EUR/MWh
May 2023	Month +1	176.133
June 2023	Month +2	191.470
Q3 2023	Quarter +1	206.516
Winter 2023	Season +1	257.241
Summer 2024	Season +2	220.858
Calendar 2024	Calendar +1	243.269
Calendar 2025	Calendar +2	207.169
Calendar 2026	Calendar +3	189.057

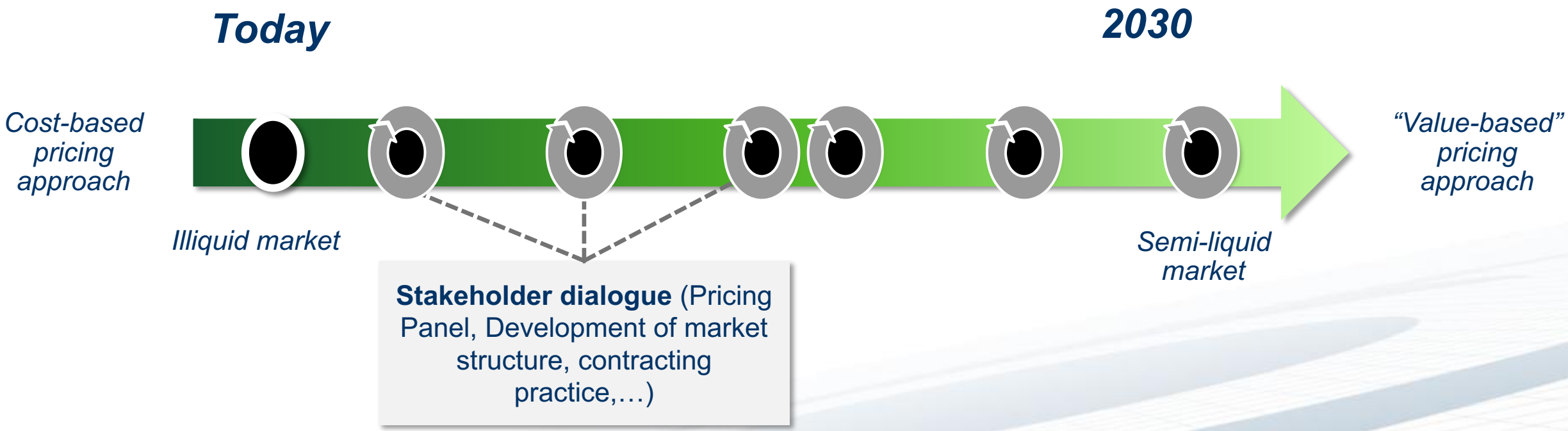
CEGH GreenHydrogen Indices – Graph View

Start Date 01.12.2022 End Date 18.04.2023 Apply



CEGHIX is shown per delivery day

Ongoing Stakeholder Dialogue Ensures Continuous Alignment of Index Design to Evolving Hydrogen Market



Thank you very much for your attention