

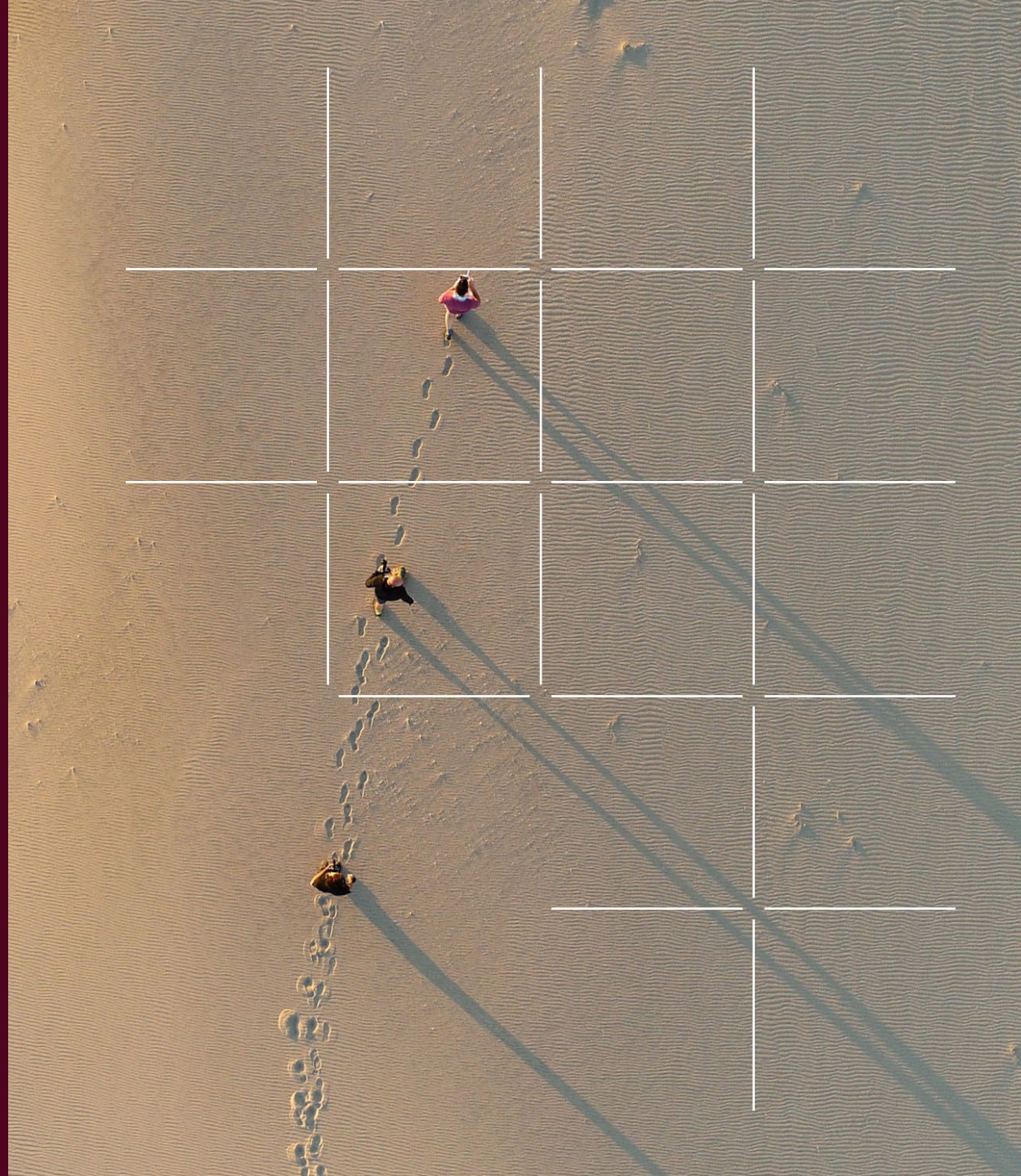


# ISO TC197 WG36

## Cryo-compressed hydrogen

Convenor: Daniel Duschek

Hardthausen - Wasserstofftag  
August 8, 2023





# ISO TC 197 Hydrogen technologies

ISO/TC 197/WG 1 ⓘ	Liquid hydrogen - Land vehicles fuel tanks	Working group
ISO/TC 197/WG 5 ⓘ	Gaseous hydrogen land vehicle refuelling connection devices	Working group
ISO/TC 197/WG 15 ⓘ	Cylinders and tubes for stationary storage	Working group
ISO/TC 197/WG 18 ⓘ	Gaseous hydrogen land vehicle fuel tanks and TPRDs	Working group
ISO/TC 197/WG 19 ⓘ	Gaseous hydrogen fueling station dispensers	Working group
ISO/TC 197/WG 21 ⓘ	Gaseous hydrogen fueling station compressors	Working group
ISO/TC 197/WG 22 ⓘ	Gaseous hydrogen fueling station hoses	Working group
ISO/TC 197/WG 23 ⓘ	Gaseous hydrogen fueling station fittings	Working group
ISO/TC 197/WG 24 ⓘ	Gaseous hydrogen - Fuelling protocols for hydrogen-fuelled vehicles	Working group
ISO/TC 197/WG 27 ⓘ	Hydrogen fuel quality	Working group
ISO/TC 197/WG 28 ⓘ	Hydrogen quality control	Working group
ISO/TC 197/WG 29 ⓘ	Basic considerations for the safety of hydrogen systems	Working group
ISO/TC 197/WG 31 ⓘ	O-rings	Working group
ISO/TC 197/WG 32	Hydrogen generators using water electrolysis	Working group
ISO/TC 197/WG 33 ⓘ	Sampling for fuel quality analysis	Working group
ISO/TC 197/WG 34 ⓘ	Hydrogen generators using water electrolysis test protocols and safety requirements	Working group
ISO/TC 197/WG 35 ⓘ	Liquid Hydrogen Land Vehicle Fueling Protocol	Working group
ISO/TC 197/WG 36 ⓘ	Gaseous hydrogen land vehicle refuelling connection devices - Cryo-compressed H2 gas	Working group
ISO/TC 197/WG 37 ⓘ	Gaseous hydrogen - Fuelling stations - Mobile fueling stations	Working group
ISO/TC 197/WG 38 ⓘ	Gaseous hydrogen - Fuelling protocols for hydrogen fuelled vehicles: communications between the vehicle and dispenser control systems	Working group
ISO/TC 197/WG 39 ⓘ	Hydrogen technologies - Interoperability - Interface between gaseous hydrogen trailer and hydrogen fuelling station	Working group

[Link: ISO/TC 197 - Hydrogen technologies](#)

## International harmonized stage codes

STAGE	SUBSTAGE						
				90 Decision			
	00 Registration	20 Start of main action	60 Completion of main action	92 Repeat an earlier phase	93 Repeat current phase	98 Abandon	99 Proceed
00 Preliminary stage	00.00 Proposal for new project received	00.20 Proposal for new project under review	00.60 Close of review			00.98 Proposal for new project abandoned	00.99 Approval to ballot proposal for new project
10 Proposal stage	10.00 Proposal for new project registered	10.20 New project ballot initiated	10.60 Close of voting	10.92 Proposal returned to submitter for further definition		10.98 New project rejected	10.99 Approval to New project approved
20 Preparatory stage	20.00 New project registered in TC/SC work programme	20.20 Working draft (WD) study initiated	20.60 Close of comment period			20.98 Project deleted	20.99 WD approved for registration as CD
30 Committee stage	30.00 Committee draft (CD) registered	30.20 CD study initiated	30.60 Close of comment period	30.92 CD referred back to Working Group		30.98 Project deleted	30.99 CD approved for registration as DIS
40 Enquiry stage	40.00 DIS registered	40.20 DIS ballot initiated: 12 weeks	40.60 Close of voting	40.92 Full report circulated: DIS referred back to TC or SC	40.93 Full report circulated: decision for new DIS ballot	40.98 Project deleted	40.99 Full report circulated: DIS approved for registration as FDIS
50 Approval stage	50.00 Final text received or FDIS registered for formal approval	50.20 Proof sent to secretariat or FDIS ballot initiated: 8 weeks	50.60 Close of voting. Proof returned by secretariat	50.92 FDIS or proof referred back to TC or SC		50.98 Project deleted	50.99 FDIS or proof approved for publication
60 Publication stage	60.00 International Standard under publication		60.60 International Standard published				
90 Review stage		90.20 International Standard under periodical review	90.60 Close of review	90.92 International Standard to be revised	90.93 International Standard confirmed		90.99 Withdrawal of International Standard proposed by TC or SC
95 Withdrawal stage		95.20 Withdrawal ballot initiated	95.60 Close of voting	95.92 Decision not to withdraw International Standard			95.99 Withdrawal of International Standard



[Link: International harmonize stage codes \(iso.org\)](https://www.iso.org)





# Standardisierung - Kryodruck Wasserstoff

# Motivation für die Anwendung von Kryodruck Wasserstoff (CcH<sub>2</sub>)

## Hauptmerkmale der CcH<sub>2</sub>-Speicher- und -Betankungstechnologie:

- Speicherbetrieb ist Kryodruck, Druckversorgung für Brennstoffzelle und HICE (1 - 3 MPa)S
- Speicherdichten bis zu 80 kg/m<sup>3</sup> bei Verwendung einer LH2-Kryopumpe, bis zu 70 kg/m<sup>3</sup> mit einem Kryokühler
- Thermisch robust, weniger strikte Isolierungsanforderungen als flüssige Speichertechnologien
- Synergien zu CGH<sub>2</sub>, (H35-Standard) Verwendung von flüssigem Wasserstoff und Verteilung von gasförmigem Wasserstoff; Option für CcH<sub>2</sub>-Verteilung

### Personenkraftwagen, Betankung mit geringem Durchfluss (TRL7)



Picture Sources: BMW

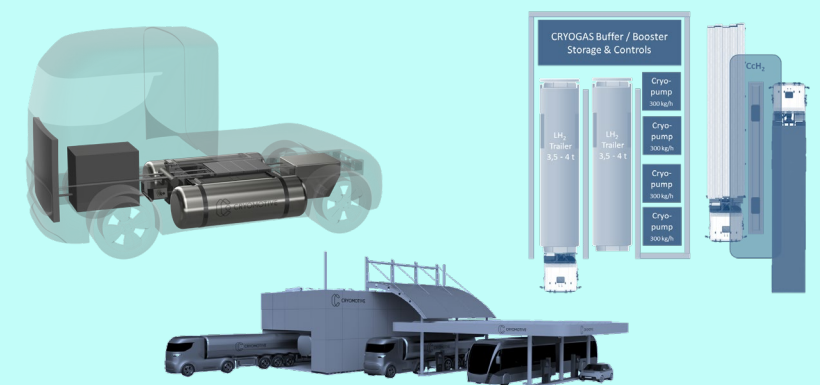
2015

TRANSFER TO HDV

2024

CcH<sub>2</sub>-Speichersystem,  
Tankstelle

### Schwerlastfahrzeug, Schnellbetankung (TRL7)

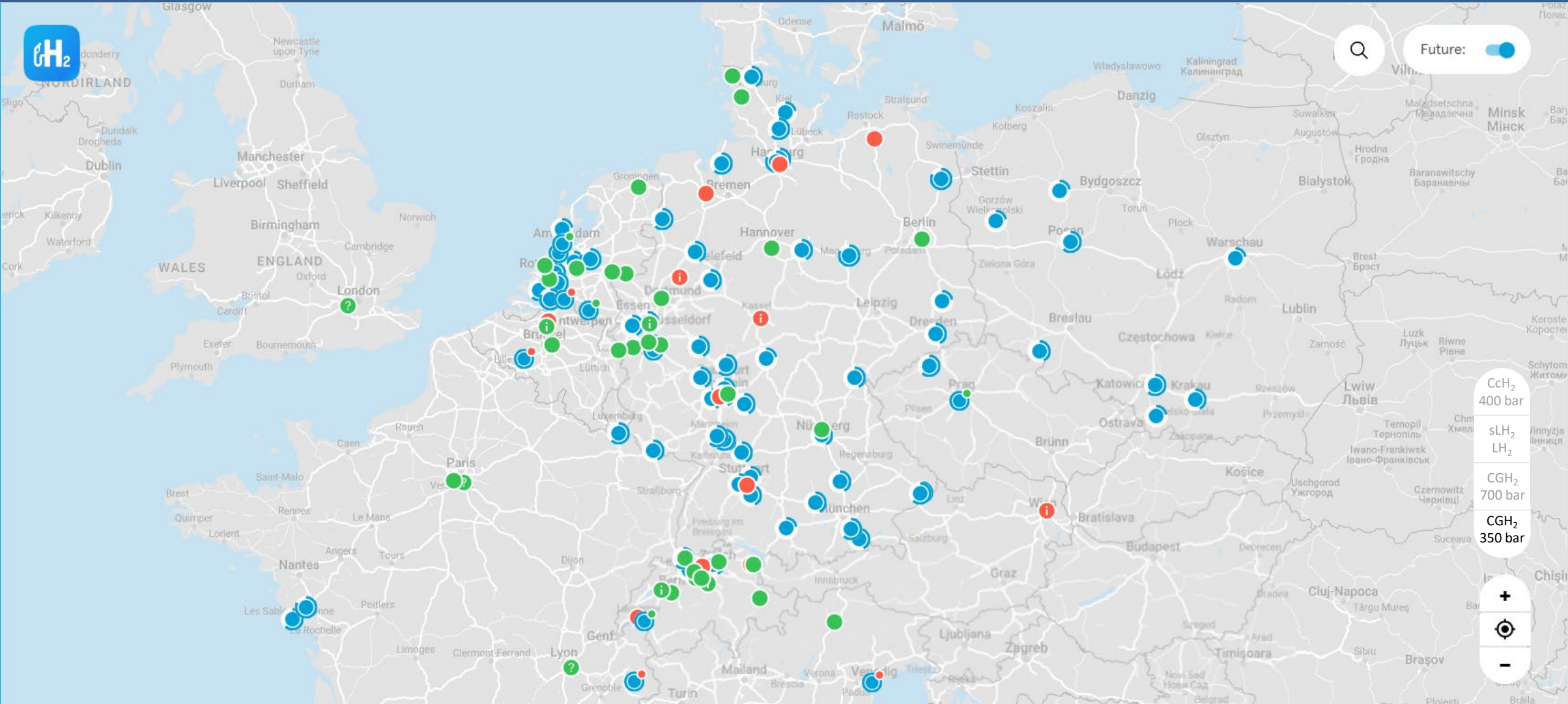


Picture Sources: Cryomotive, 2021

# Wasserstoff Tankstellen (Stand 2023)

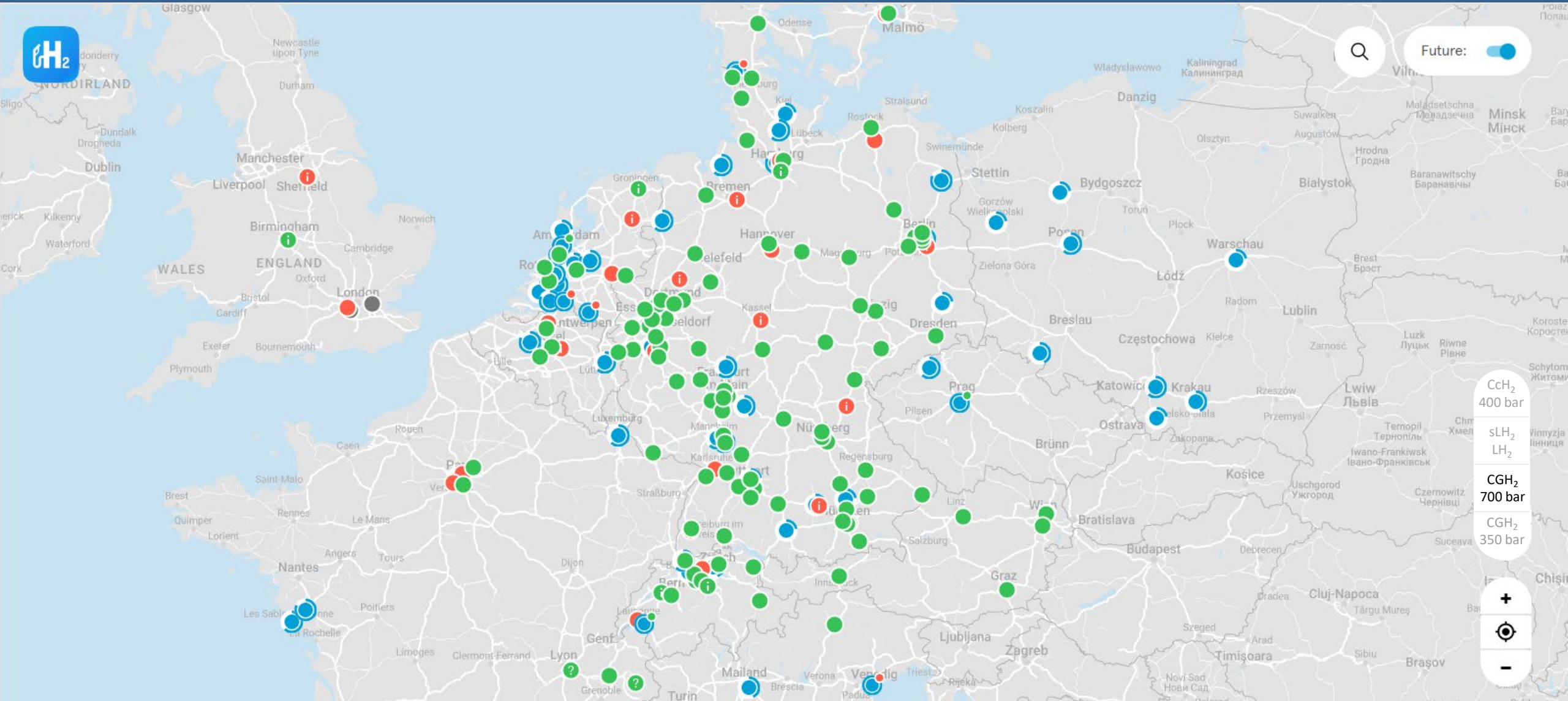


# WASSERSTOFF TANKSTELLEN (STAND 2023)



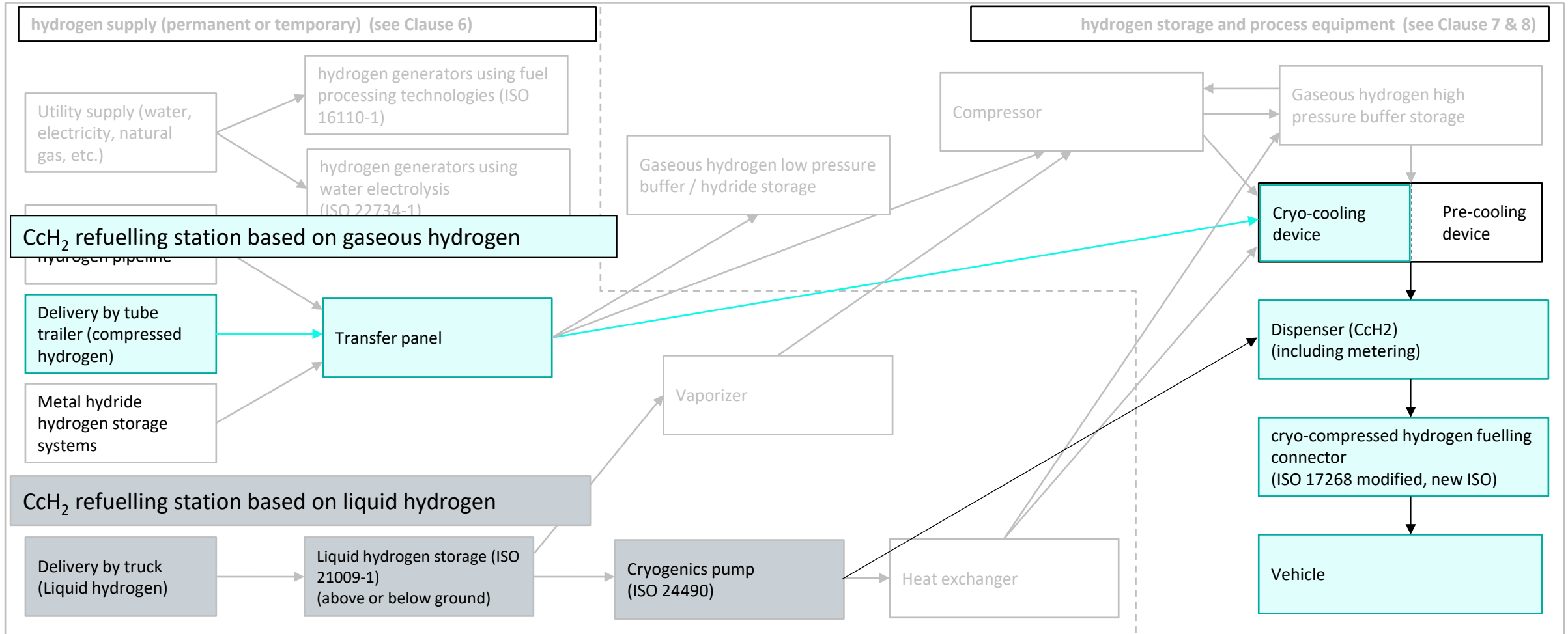


# WASSERSTOFF TANKSTELLEN (STAND 2023)



# SYNERGIE ZU CGH<sub>2</sub> (H35-STANDARD)

## ISO 19880 – DEVIATION OF STANDARD



Source: figure based on ISO 19880-1:2020(en), Gaseous hydrogen — Fuelling stations — Part 1: General requirements



# Ansatz zur Standardisierung des CcH<sub>2</sub>-Prozesses

AC TECH GMBH, FREIBERG, GERMANY	AIR LIQUIDE GMBH, DÜSSELDORF, GERMANY
BIN BOYSEN GMBH & CO KG, NAGOLD, GERMANY	BP EUROPA SE; HAMBURG, GERMANY
BRUGG GROUP AG BRUGG, SWISS	CHART INDUSTRIES, BALL GROUND, USA
CELLCENTRIC GMBH & CO KG, KIRCHHEIM UNTER TECK, GERMANY	CONTTECH AG, HANNOVER, GERMANY
COOPER STANDARD, MANNHEIM, GERMANY	CRYOMOTIVE GMBH, GRASBRUNN, GERMANY
CRYOTHERM GMBH & CO KG KIRCHEN/SIEG, GERMANY	DAIMLER TRUCK AG, STUTT GART, GERMANY
ELAFLEX GMBH & CO KG, HAMBURG, GERMANY	FAURECIA AUTOMOTIVE GMBH, STADTHAGEN, GEMANY
GOETZE KG ARMATUREN, LUDWIGSBURG, GERMANY	HYUNDAI MOTOR EUROPE GMBH, RUESSELSHEIM, GERMANY
LUDWIG-BÖLKOW-SYSTEMTECHNIK GMBH, MÜNCHEN, GERMANY	LIFTEH2, HAMBURG, GERMANY
LINDE GMBH, PULLACH, GERMANY	MAGNA INTERNATIONAL EUROPE GMBH, WIEN, AUSTRIA
MAN NUTZFAHRZEUGE AG, MÜNCHEN, GERMANY	M-TECH GMBH FORCHTENBERG, GERMANY
REGO GMBH GLADENBACH, GERMANY	RTE GMBH & CO KG, GRABENSTÄTT, GERMANY
SAG, LEND, AUSTRIA	SHELL GLOBAL SOLUTIONS INTERNATIONAL B.V., GK RIJSWIJK, THE NETHERLANDS
STÖHR ARMATUREN GMBH & CO KG, KÖNIGSBRUNN, GERMANY	TRELLEBORG AB, TRELLEBORG, SWEDEN
TOYOTA MOTOR EUROPE, BRÜSSEL, BELGIUM	UNITROVE LIMITED, SHEPSHED LEICESTERSHIRE, UNITED KINGDOM
VITESCO TECHNOLOGIES GERMANY GMBH, BERLIN, GERMANY	VOLVO GROUP TRUCKS CENTRAL EUROPE GMBH, ISMANING, GERMANY
WALTHER PRÄZISION – CARL KURT WALTHER GMBH & CO KG, HAAN, GERMANY	WEH GMBH, ILLERTSEN, GERMANY



## White Paper Process



### Schnittstelle

(basiert auf ISO 17268)

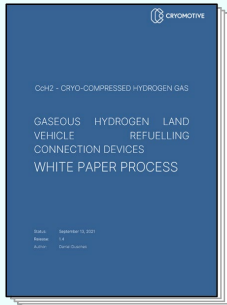


### Betankungsprotokoll

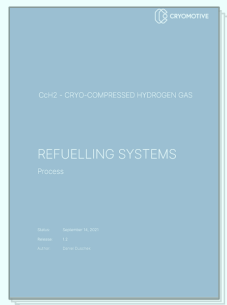
(~ 36 involvierte Partner)



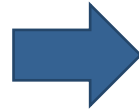
## White Paper Process



Interface  
(basiert auf ISO 17268)



Betankungs-  
protokoll



**Information** | **Participation**

### Metadata

Reference	ISO/NP 20151	Committee	ISO/TC 197
Type	NP (New Work Item Proposal (ISO and ISO/IEC JTC1))	Version number	1
Voting stage	Proposal	End date	2023-01-17
Start date	2022-11-22		
Opened on	2022-11-22 03:26		
Status	Open		

**Note**

Dear P-members,

This NP ballot is for a new project under ISO/TC 197. In accordance with ISO/TC 197 established practice we run 8-weeks NP ballots that are preceded by extensive TAB reviews. This project will be part of the future ISO 17268 series

TAB advises this is an important topic that was discussed at the last TC197 plenary in December 2021. Germany was invited to submit a new work item proposal to address novel kind of vehicle refueling connection devices for cryo-compressed (CcH<sub>2</sub>) hydrogen gas. For reference and as seed documents, revised CEP papers (abstract and full document) are attached to this NP ballot.

Also, Mr. Daniel Duschek from Cryomotive (Germany) recommended by the German mirror committee as convener for this project has sufficient qualifications to serve in the convener's role (see attached CV for reference). TAB advises this project meets market needs and is necessary for global deployment and commercialization of heavy duty road vehicles, and is also relevant for other large scale mobility applications using liquid hydrogen fueling stations.

Please note, per ISO Directives clause 2.3.1, a sequential CIB will be run upon the completion of the NP ballot to formally:

- Approve the creation of new WG
- Approve new WG convener.

Andrei V. Tchouvelev, Co-chair (convener) TAB, ISO/TC 197  
Amelie Pinard, ISO/TC 197 TC Manager



ISO 17268  
GASEOUS HYDROGEN LAND VEHICLE REFUELLING  
CONNECTION DEVICES

Part 1: Compressed gaseous hydrogen  
TC197-WG 5: Convenor Livio Gambone

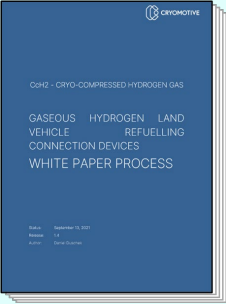
Part 2: High flow compressed gaseous hydrogen  
(Entwurfsphase)

Part 3: Cryo-compressed hydrogen gas  
TC197-WG36: Convenor Daniel Duschek

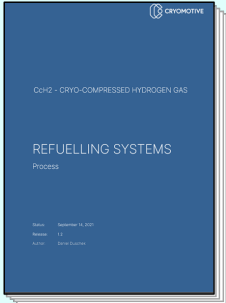


## CEP - ARBEITSGRUPPE

**White Paper Process**



Interface  
(basierend auf  
ISO 17268)



Refuelling  
process

(~ 36 beteiligte Unternehmen)


## ISO - WORKING GROUPS

**Standardisierungsprozess**


- Interface CcH<sub>2</sub>
  - Änderung ISO 17268
  - Start Q1/2023
- Betankungsprotokoll
  - Änderung
  - NWIP (Q4/2022)

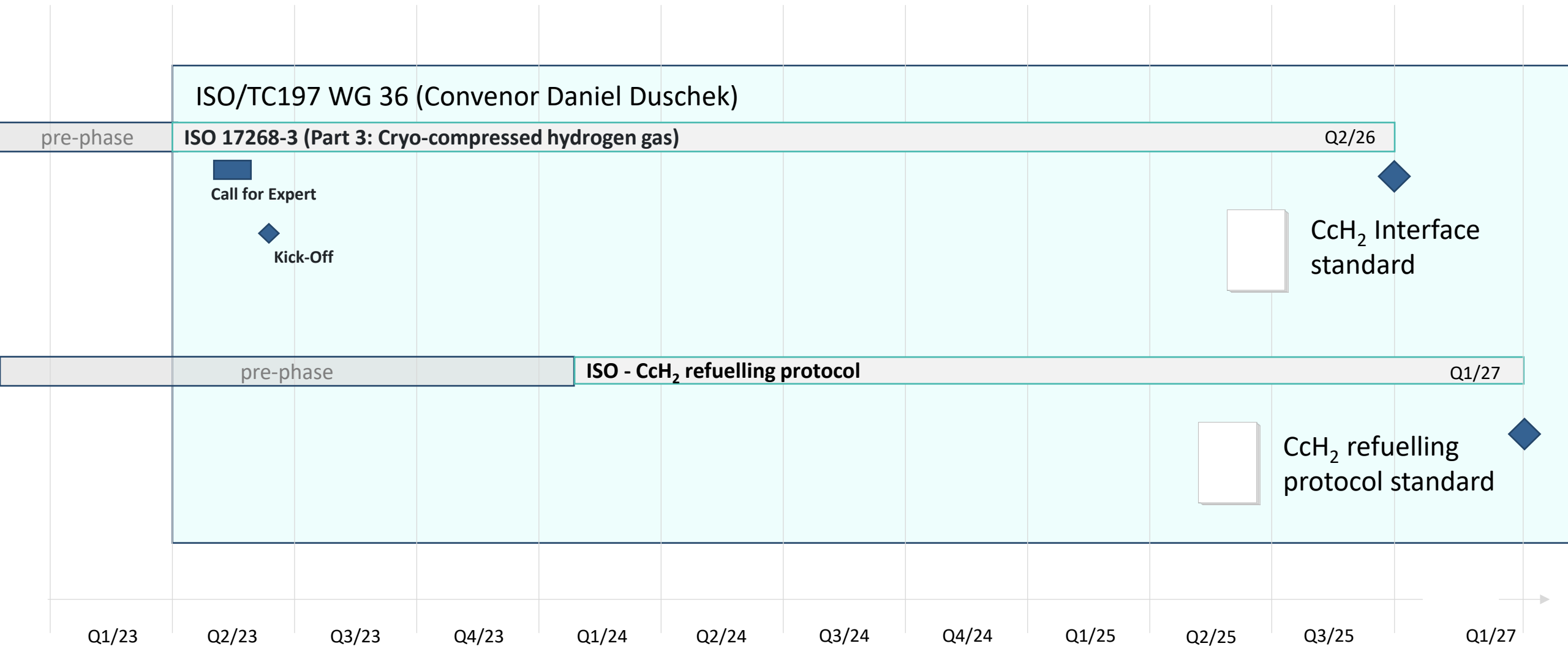
## 2024 – 2027

**CcH<sub>2</sub> Standard**



TARGET





# ZUSAMMENFASSUNG UND AUSBLICK



## Standardisierung ist

- ein wesentlicher Beitrag für eine erfolgreiche Markteinführung
- Standardisierung als Innovationstreiber:
  - Förderung ist Geld in Wissen zu transferieren
  - Technologiemarketing ist das Wissen in Geld umzuwandeln
- ein Prozess, welcher mittels WIPANO gefördert wird
- eine gemeinsames Projekt
  - Vertreter aus Industrie, Forschung- und Lehre

## Daniel Duschek



Leiter Anforderungsmanagement, funktionale Integration und RCS

Cryomotive GmbH



Convenor

ISO TC197 / WG 36: Cryo-compressed hydrogen

