



Federal Ministry  
for Economic Affairs  
and Climate Action



MITTELSTAND  
**GLOBAL**  
ENERGY SOLUTIONS  
MADE IN GERMANY

# Role of Green Hydrogen in Clear Glass Manufacturing

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Facilitator

**giz**

Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH

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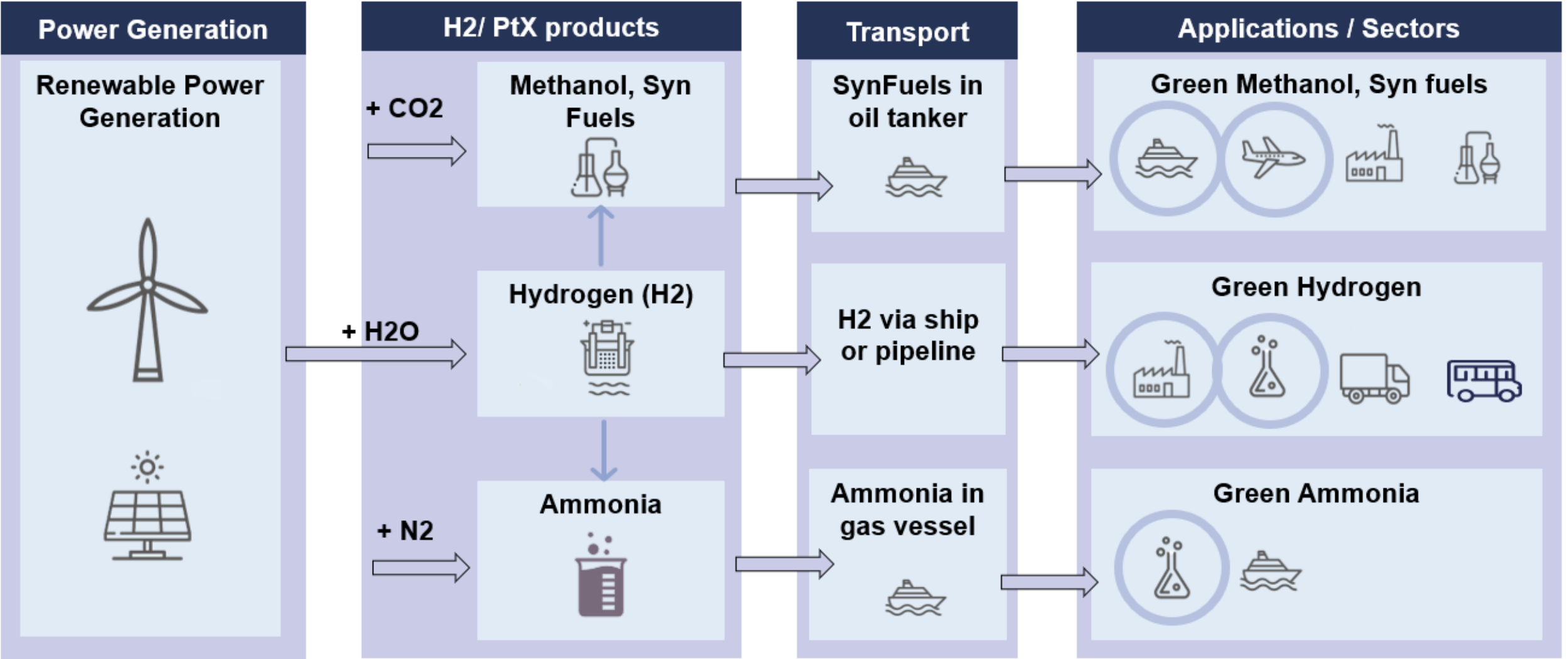
# About GIZ

- A public-benefit federal enterprise in international cooperation with a focus on sustainability.
- Over 50 years of experience in economic development and employment promotion, energy and the environment, and peace and security.
- Sustainable development worldwide: 25422 employees work in 120 countries.
- Vision: “We work to shape a future worth living around the world.”

# Objectives

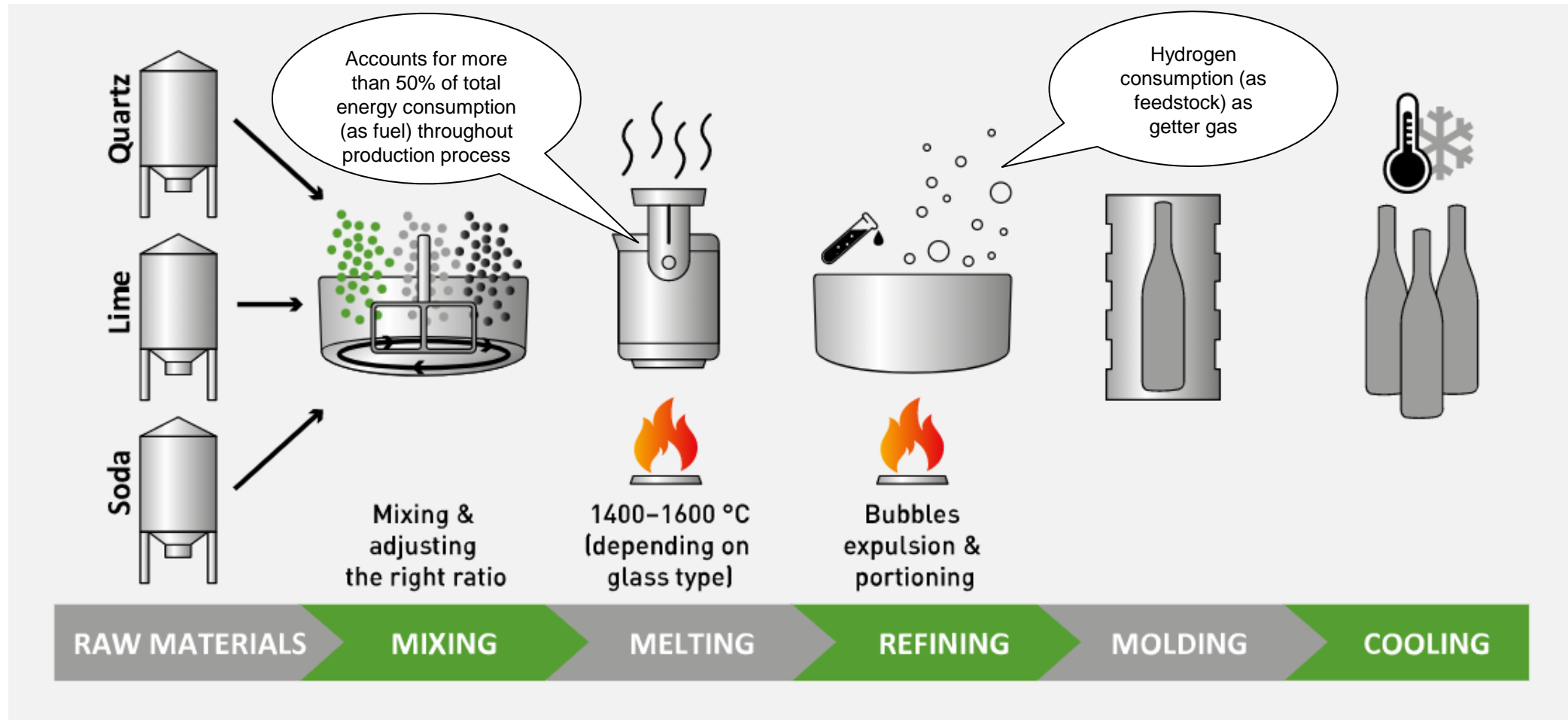
- Understand the conventionally applied processes in glass industries
- Obtain an overview of processes potentially to be decarbonized with green hydrogen
- Get an overview of the requirements for needed data from the corresponding industry
- Overview of the GIZ H2Uppp- Dppp

# Green hydrogen value chain



# H2 in the Glass Manufacturing

# Conventional Glass manufacturing process





# Glass manufacturing - Overview

- Usage: food containers, drinks, vaccines, windows (buildings/vehicles), IT, insulation
- Production is energy-intensive and requires process temperatures of up to 1,600 °C to melt the glass
- Combustion of gas (75%) and oil (in some cases) for process heat requirements
- Hydrogen is used as feedstock for creating a deoxidizing environment with nitrogen in the float and sintered glass manufacturing
- Different subsectors (e.g., container glass, flat glass, special glass, etc.) have different requirements in terms of energy consumption, process options and product quality

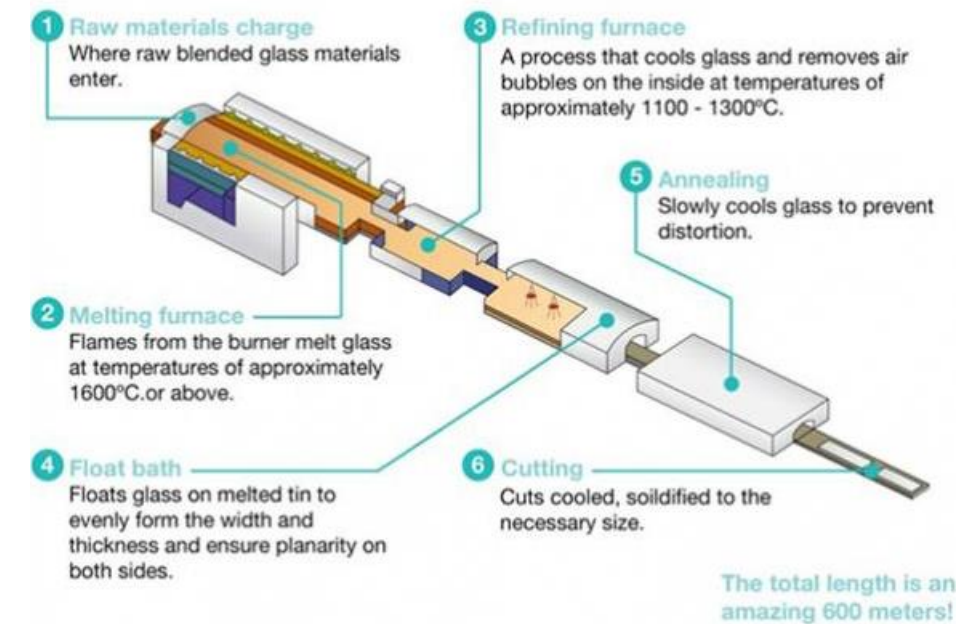


Source: SZG Professional glass manufacturer (2022)



# Float glass production (float bath)

- Hydrogen is used as a getter gas to prevent oxidation over the tin baths → resulting in defect-free production of glass
- Protective atmosphere usually consists of 90% N<sub>2</sub> and 10% H<sub>2</sub>
- N<sub>2</sub> remains non-reactive, H<sub>2</sub> is reacting with any oxygen present
- Most H<sub>2</sub> in this process is produced via coal gasification (CG) or steam methane reforming (SMR) (fossil fuels as feedstock)/ Or by delivered to plant in tube trailers?
- Disadvantage: high cost of equipment, impurities in the H<sub>2</sub> → requires additional purification equipment/ external dependency, high GHG emission intensity



# Green H2 in the glass manufacturing

# Scope of Green Hydrogen in Glass Manufacturing – Overview, India

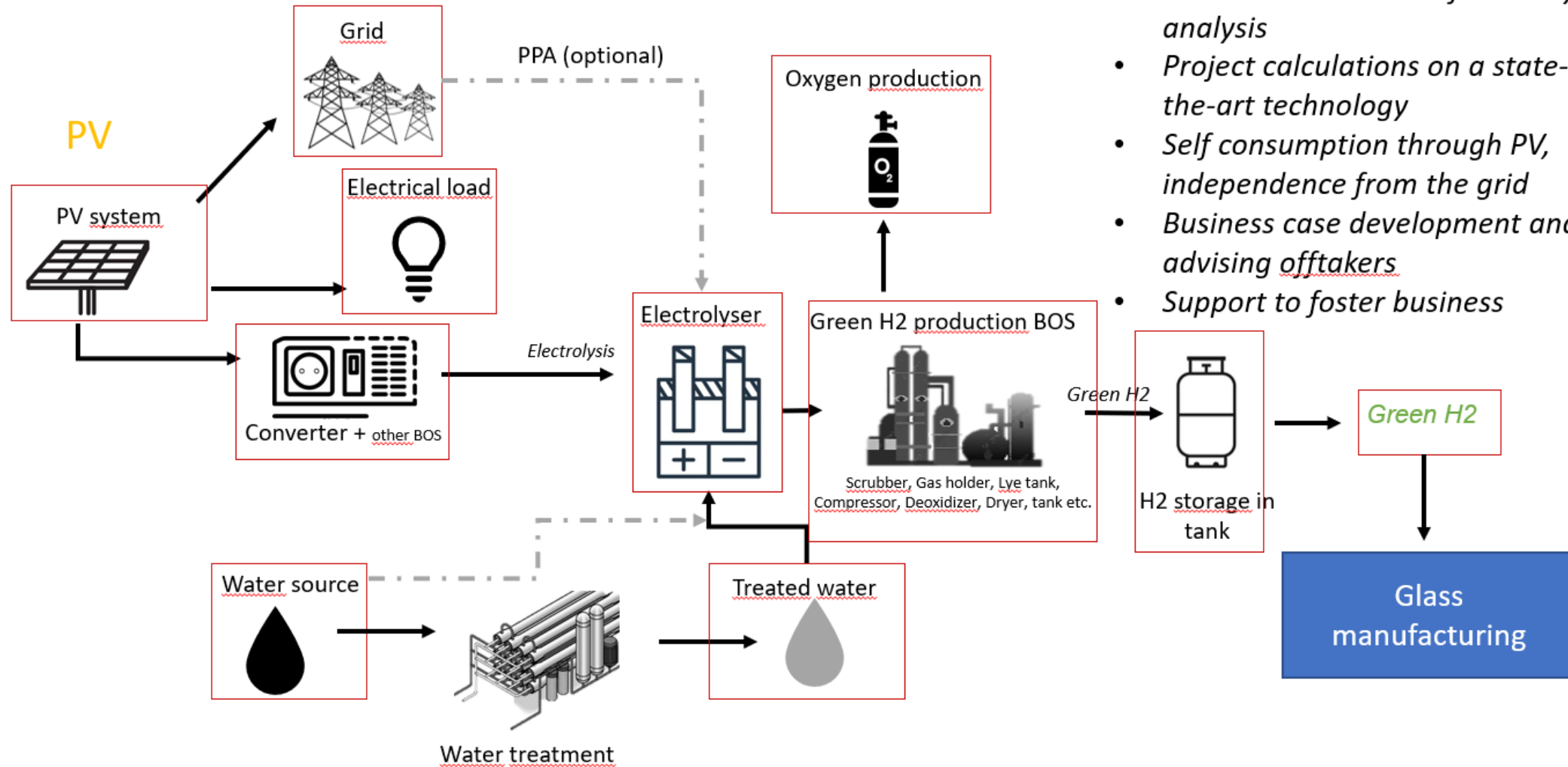
- A recent report shows annual consumption of 90k and 80k MT of Hydrogen in float and sintered glass manufacturing respectively
  - Green Hydrogen blending with Natural Gas already has a scope to decarbonize the process heat
  - Substitution of Hydrogen as feedstock (getter gas) by Green H<sub>2</sub>?
  - The techno commercial viability need to be ascertained on a case-to-case basis
  - Use of green H<sub>2</sub>: No need for additional purification and treatment equipment, self-sufficient operations
- ✓ Potential exists for green hydrogen co production for captive use;
  - ✓ Co-located modular electrolyser powered by rooftop PV/other RE source
  - ✓ In house production and consumption of Green H<sub>2</sub>

Table 1-1: Industry-Wise Hydrogen Consumption (MMT)

Industry	2015	2016	2017	2018	2019	2020	2021
Fertiliser	1.83	1.88	1.91	2.04	2.06	2.13	2.14
Petroleum Refinery	2.56	2.63	2.81	2.94	3.06	3.05	3.12
Methanol	0.52	0.42	0.42	0.35	0.34	0.48	0.53
Hydrogen Peroxide	0.21	0.21	0.22	0.24	0.24	0.24	0.29
Steel	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Optic Fiber	0.02	0.02	0.03	0.03	0.04	0.05	0.05
Float Glass	0.07	0.07	0.07	0.08	0.08	0.09	0.09
Sintered Glass	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Others	0.18	0.29	0.19	0.23	0.27	0.26	0.13
<b>Total Hydrogen Consumption</b>	<b>5.59</b>	<b>5.73</b>	<b>5.85</b>	<b>6.11</b>	<b>6.30</b>	<b>6.49</b>	<b>6.55</b>

(Source- Primary survey by ICF India)

# Project concept – Glass industry

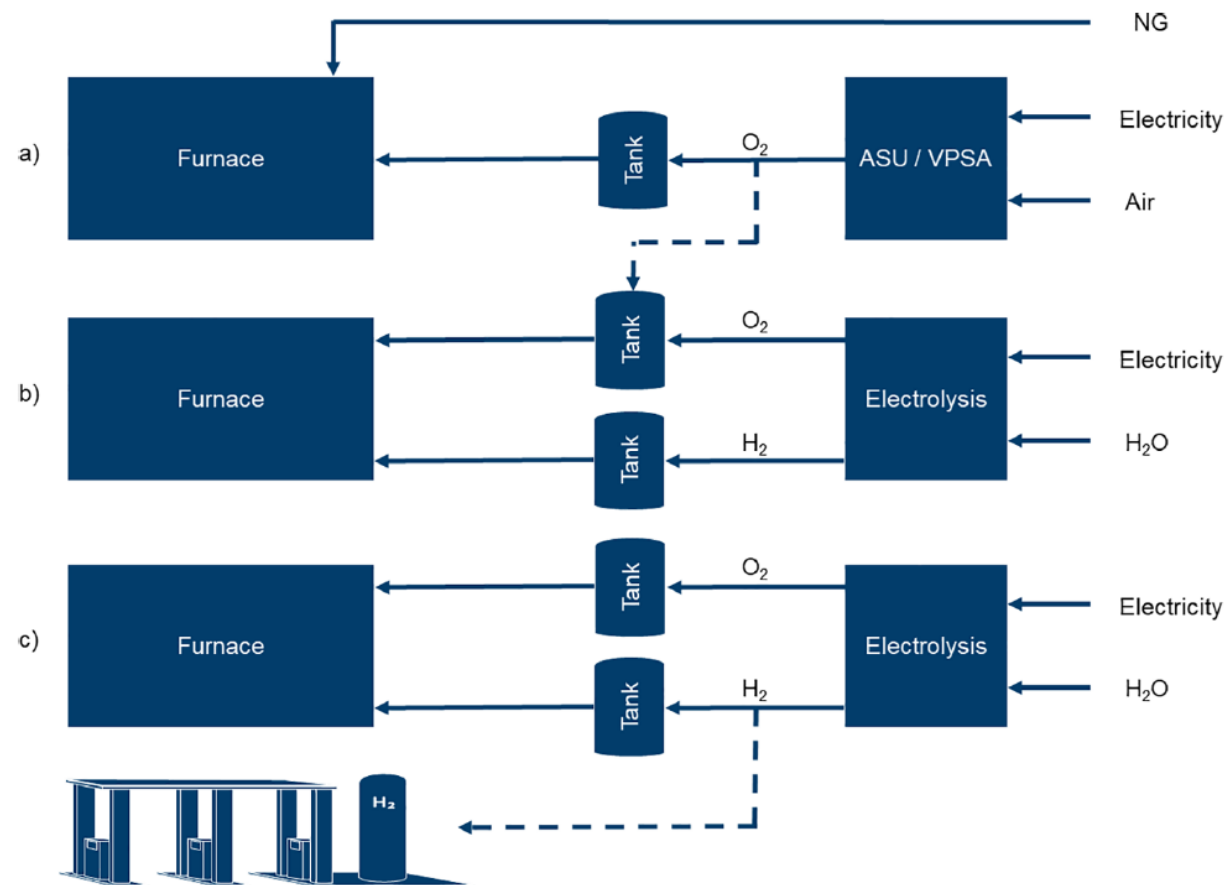


## Added value:

- Full techno-economic feasibility analysis
- Project calculations on a state-of-the-art technology
- Self consumption through PV, independence from the grid
- Business case development and advising offtakers
- Support to foster business

# H2 and Oxygen for the glass manufacturing industry

- Electrical melting and hydrogen combustion, or a combination of both, are the most promising options to decarbonize the glass industry
- In the case of combustion, electrolysis provides hydrogen and oxygen in a different ratio than that in combustion
  - either electrolysis is designed in accordance with hydrogen demand and additional oxygen is required
  - or electrolysis is designed according to the oxygen demand, and hydrogen is produced in excess



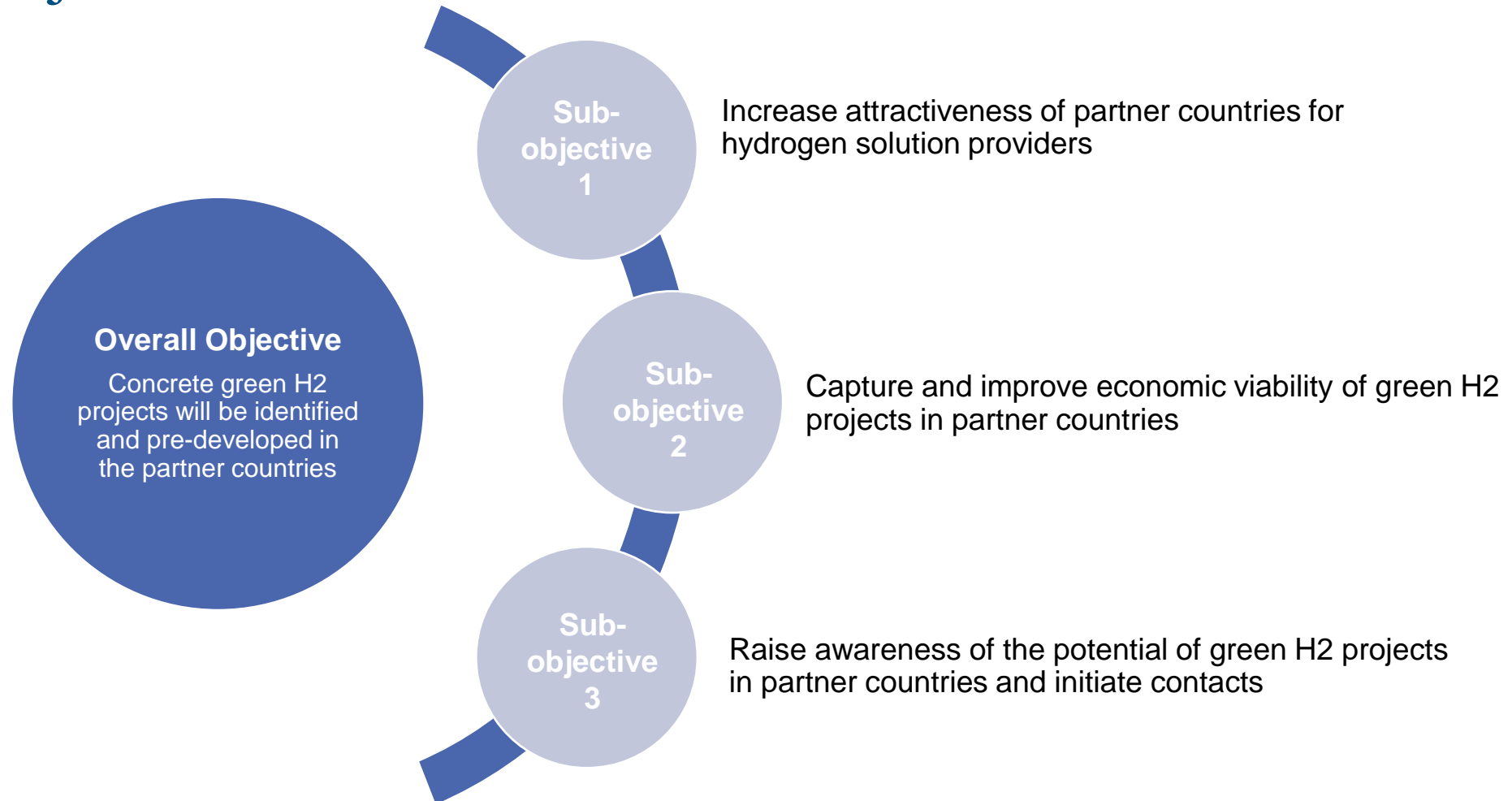
Source: M. Zier et al. (2021), A review of decarbonization options for the glass industry

# HyGlass project by BV Glas- Reflections



- BV Glas and the GWI research institute in Essen (GWI) successfully completed their collaborative HyGlass project
- Using hydrogen in regenerative glass furnaces as a long-term replacement for gas
- hydrogen-gas mixtures and pure hydrogen were examined
- Use of hydrogen has only moderate impacts on combustion
  - As long as fuel-air ratio and burner output are maintained at a constant level
- Use of hydrogen can lead to higher NOx emissions
  - Countermeasure: technical measures at the furnace
- H2 can indirectly cause changes in glass quality such as discoloration
  - Adjustment by changing the composition of the glass batch

# Project Objectives





# We accompany you along all steps of hydrogen project development



## PDP-H2 service portfolio

We help you assess whether green hydrogen is the right choice for you at no cost for our services



### Assessment of hydrogen needs

- Analysis of current and future hydrogen and energy needs
- Assessment of current hydrogen costs
- Assessment of site suitability for green hydrogen system

→ Is on-site hydrogen production right for you?



### Technical optimization

- System specification (PV + Electrolyzer)
- Optimum system size
- Technical requirements
- Space requirements

→ What system is best for you?



### Investment models

- Business case analysis
- Cash flow model
- Evaluation of investment options

→ How big is your economic advantage?



### Finding suitable partners


- Project dossier
- Requirements for EPC
- Lead presentation
- Finding suitable partners

→ How to implement?

**Finding the best system for your business and ensuring successful project implementation**

# Benefits for Local Customer

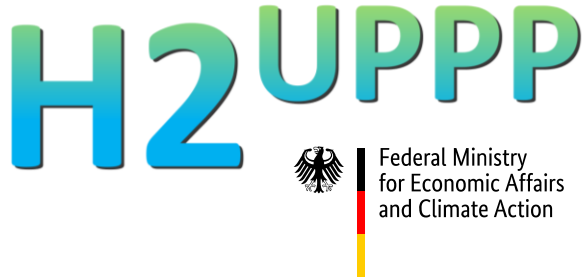
- Access to German components and system engineering
- Access to reliable energy
- Independency from local electricity supplier
- Contribution to climate protection
- Compliance with CSR obligations



Increasing  
Competitiveness

# Since 2022 Indo-German Cooperation on Green Hydrogen

Political partner is the Ministry of New and Renewable Energy (MNRE)



- Focus on private sector and specific green hydrogen project development under PPP model
- Up to 2 million EUR grant for IND-GER green H2 projects
  - At least 100,000 EUR (in-kind) contribution by German partner required
  - CAPEX participation in exceptional cases
  - More info: [pooja.bose@giz.de](mailto:pooja.bose@giz.de)

# Thank you for your attention!