See below and choose your topics along the value chain. The length of topics depends on your individual specifications. Feel free to contact us on conception matters: h2academy@dvgw.de

1. Introduction

1.1 Globale Role of Hydrogen

- Background
- Motivation: hydrogen in industry
- Color and production of hydrogen
- Storage technologies
- Hydrogen today and worldwide
- Energy transformation
- Power-to-X

1.2 Physical and Chemical Properties

- Basics
- Material properties
- Comparison with other materials
- Hydrogen outside and inside pipes
- Storage
- Ignition behavior
- Explosion behavior

1.3 Gas Blends

- Burner types
- Characteristic values
- Combustion of hydrogen
- Combustion of mixtures
- Classification
- Experience in laboratory and field tests

1.4 Material Compatibility

- Polymers
- Steel
- Fracture mechanics, fracture toughness and crack growth
- Example projects

2. Production

2.1 Electrolysis

- Basic principle
- Electrolysis process
- From the cell to the stack
- Functional principle of alkaline electrolysis (AEL)
- Functional principle of proton exchange membrane electrolysis (PEM)
- Functional principle of solid oxide electrolysis (SOEC) or high-temperature electrolysis of steam (HTES)
- Summary and outlook: process parameters, costs, TRL

2.2 Reforming

- Basics of reforming
- Reforming processes
- Costs of blue hydrogen (case study roadmap gas 2050)
- Assessment of greenhouse gas emissions

2.3 Pyrolysis

- Basics of reforming
- Technical evaluation of pyrolysis processes
- Assessment of greenhouse gas emissions

2.4 GHG

- Fundamentals of greenhouse gas (GHG) emissions assessment
- Energy balances for the assessment of GHG emissions from green hydrogen
- Energy balances for the assessment of GHG emissions from blue hydrogen
- Energy balances for the assessment of GHG emissions from turquoise hydrogen

3. Regulatory Requirements & Compliance

3.1 Codes and Standards

- Standardization
- H_2 Readiness
- ISO TC 197
- ISO TC 22
- ISO TC 105

3.2 Occupational Health, Safety, Risk

- Basics
- Material properties
- Comparison with other materials
- Hydrogen outside and inside pipes
- Storage
- Ignition behavior
- Explosion behavior

4. Transport & Infrastructure

4.1 Transportof Hydrogen

- Comparison of hydrogen carrier technologies
- Common routes for hydrogen transport in various scales
- Suitability and scales of transport routes
- Gas grids

4.2 High Pressure Grids

- Suitability of pipeline material
- Standards for new construction and operation of hydrogen
- Pipelines standards for conversion of existing natural gas Pipelines to hydrogen
- Fracture mechanics safety concept

4.3 Low Pressure Grids

- Gas infrastructure areas
- Requirements for H_2 Readiness
- DVGW regulations, requirements and technical rules for hydrogen

5. Compressor Stations

5.1 Compressor Stations

- Compressor technology for hydrogen avilable today
- Compressor drivers
- Turbo compressors in case of blending hydrogen with natural gas
- Safety devices conforming to regulations
- Commissioning and hydrogen-specific test for commissioning
- Maintenance and periodic inspections

5.2 Gas Storage Systems

- Storage of Large Amounts of Hydrogen
- Hypes of Hydrogen Storage
- Market for Underground Gas Storage
- Underground Hydrogen Storage: Geological Capacity
- Characteristics and Challenges of UHS Systems
- Additional Aspects: Conversion vs. New Construction, H2 Mixing, Differences to TSOs

6. Grid Management

6.1 First Experience of the Transformation Process of Local Gas Grid

- Overview: H_2 – pilot projects
- Schopsdorf
- H_2Direkt
- Results from research projects and pilot projects

6.2 Grid Control

- Capacity assessment
- Design limits

6.3 Network Balancing

- Balancing of transmission system operators (TSO)
- Schedules (nominations) for energy
- Consumption forecast
- Gas network simulations including calorific value Reconstructions for mixed gases containing hydrogen
- Network monitoring and control

7. Safety, Regulation &Hydrogen Integration

7.1 Explosive Atmosphere

- Organizationel measures – maintenance work
- Maintenance work in gas systems
- Maintenance work in the distribution network
- Specific protective measures for explosion safety

7.2 Gas Pressure Regulation and Metering Stations

- Example for a pressure regulating and metering station
- Technical rules and practices DVGW G 491
- Technical rules and practices DVGW G 492
- Placement temperature-transmitter
- Manufacturer's declaration and manufacturer certificate for measuring instruments

7.3 Custody Transfer and Fiscal Metering

- Calibrated gas meter for natural gas and hydrogen
- Determination of the volume in the standard state Vn (example germany)
- Determination of high calorific value
- Hydrogen effects on calibrated meters
- Determination of purity and high calorific value by legal requirements

7.4 Gas Pressure and Flow Regulators

- Background regulations
- Differences gas pressure regulator and gas flow regulator
- Gas pressure regulator function
- Design of gas pressure regulator
- Gas flow regulator function

7.5 Custody Transfer and Fiscal Metering

- Princip of the power to gas station (PtG)
- Components of the hydrogen injection station
- Special hazards due to hydrogen
- Requirements for parts and components

8. Power-to-X & Hydrogen Applications

8.1 Power-to-Ammonia

- Sector coupling
- Decarbonization pathways with Power-2-X
- Advantages and disadvantages of Ammonia (NH_3) as energy carrier
- Haber-Bosch process for e-Ammonia Synthesis
- Ammonia – an attractive fuel – Transport and On-Site Energy Storage
- Fuel Properties of Ammonia Compared to Natural Gas and Hydrogen

8.2 Power-to-Liquids (Methanol, SAF, Olefine, E-Fuels)

- Overview
- Power-to-methanol and methanol economy
- Sustainable aviation fuel (SAF) (e-based)
- Example of pilot project Haru Oni
- Outlook

8.3 Mobility

- Fuel Stations
- Fuel Cells
- Propulsion Systems

8.4 Industrial Applications

- Why hydrogen in industry?
- Applications for green hydrogen in industry
- Industry's share of greenhouse gases
- CO_2 emissions in industry
- Cement and lime industry
- Steel industry
- Glass industry

8.5 Hydrogen Re-Electrification

- Reasons for hydrogen re-electrification
- Overview technology options for hydrogen re-electrification
- Gas turbines and combined-cycle power plants
- Fuel cells
- Comparison gas turbines, fuel cells, engines