NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Proton Exchange Membrane H2 Production

Reference Flow: 1 kg of Hydrogen, >99.999 vol-%, 435 psia, 60°C

Brief Description: Energy use, feedstocks (including feedstock and water use), and emissions associated with proton exchange membrane (PEM) electrolysis to produce 1 kg of Grade 5.0 gaseous hydrogen (99.999 vol-%) at 435 psia and 60°C.

Section I: Meta Data

Geographical Coverage: Germany **Region:** N/A

Year Data Best Represents: 2017

Process Type: Basic Process (BP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: Individual Relevant Flows Recorded

Flows Aggregated in Data Set:

☒ Process ☒ Energy Use ☐ Energy P&D ☐ Material P&D

Relevant Output Flows Included in Data Set:

Releases to Air:	☐ Greenhouse Gases	☐ Criteria Air Pollutants	☒ Other
Releases to Water:	☐ Inorganic Emissions	☐ Organic Emissions	☐ Other
Water Usage:	☒ Water Consumption	☒ Water Demand (throughput)	
Releases to Soil:	☐ Inorganic Releases	☐ Organic Releases	☐ Other

Adjustable Process Parameters:

facility_lifetime

[years] Lifetime of PEM facility

Tracked Input Flows:

Water, purified

[Technosphere] Water filtered to acceptable purity by water treatment train. See Assumption 2.

Electricity, AC, 120 V

[Technosphere] Electricity required, scaled to reference flow.

PEM, Construction

[Technosphere] PEM facility construction, scaled to reference flow.

Tracked Output Flows:

Hydrogen, >99.999 vol-%, 435 psia, 60°C

[Reference flow]

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_O_PEM Electrolysis_2022.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process provides a summary of relevant input and output flows associated with PEM electrolysis to produce hydrogen. The process contains an electrolyzer stack with inputs of electricity and water. Cells are connected electrically in series and hydraulically in parallel to make up a stack. The reference flow of this unit process is: 1 kg of Hydrogen (H_2), >99.999 vol-%, 435 psia.

Boundary and Description

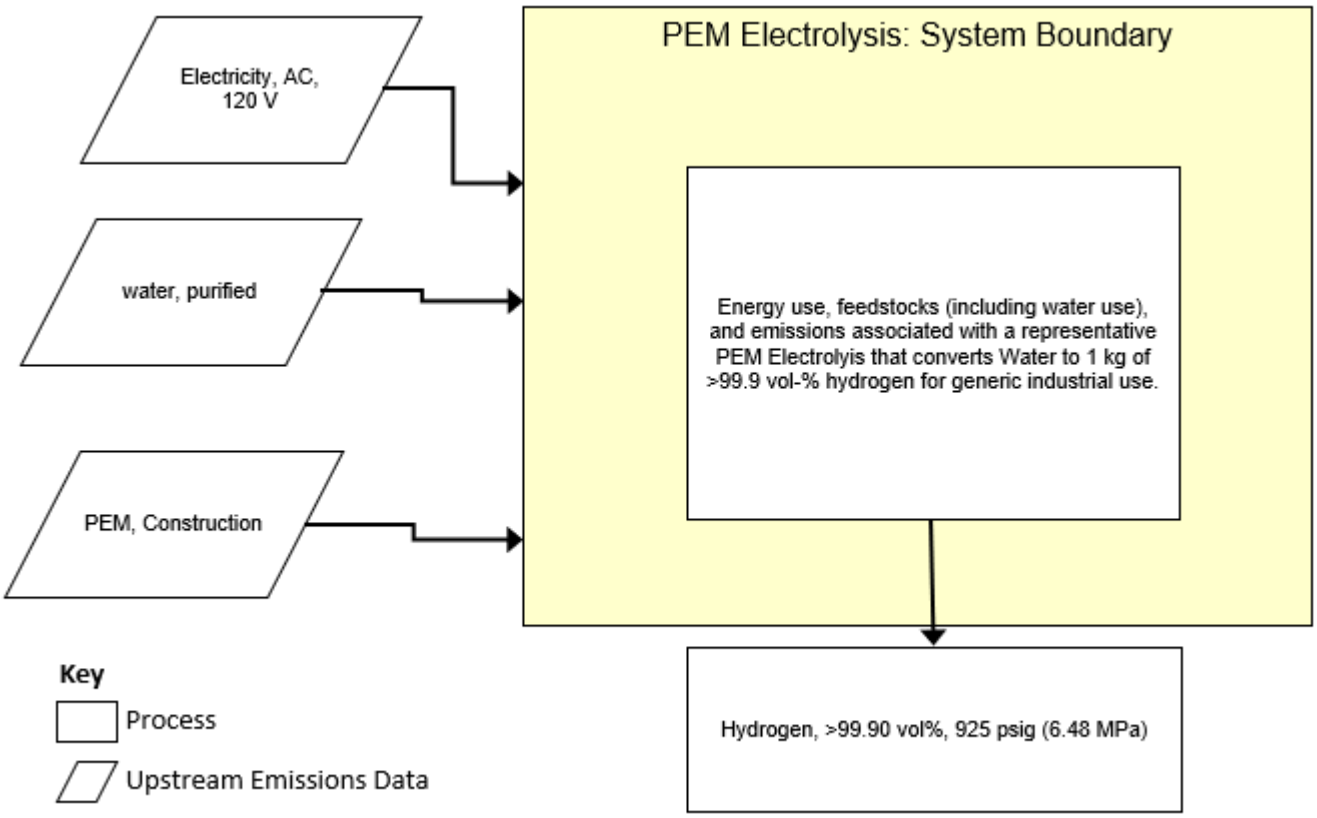
This unit process provides a summary of hydrogen production from PEM – a method of electrolysis that uses membrane technology to split water into gaseous hydrogen and oxygen. The cathode produces hydrogen while the anode produces oxygen. This process typically operates at temperatures between 60 and 80°C and pressures up to around 5 MPa.

Input water to the system is de-ionized and must have conductivity less than 0.1 µS/cm. Cells are connected electrically in series and hydraulically in parallel to make up a stack. More information on the construction of a PEM system and facility can be found in a separate documentation file (DF): *DF_C_PEM Electrolysis Construction_2022.01.*

The material and energy details were pulled from Bareiß et al. (2019). The reference material calculated environmental impacts based on the average electricity profile of Germany, but the technology profile is generic and representative of state-of-the-art low-temperature PEM electrolyzers of the year 2017.

Inputs and outputs have been scaled to a reference flow of 1 kg of Grade 5.0 gaseous hydrogen (99.999 vol-%) at 435 psia and 60°C.

Figure 1: Unit Process Scope and Boundary



Embedded Unit Processes

None.

References

Bareiß, K., de la Rua, C., Möckl, M., & Hamacher, T. (2019). Life cycle assessment of hydrogen from proton exchange membrane water electrolysis in future energy systems. Applied Energy, 237, 862-872.

Smolinka, T., & ISE, S. E. (2010). PEM Water Electrolysis-Present Status of Research and Development. Review lecture.

Section III: Document Control Information

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None.

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