



# EU harmonisation activities - high-temperature electrolyser

Recent and on-going efforts: terminology, testing procedures  
and protocols

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Joint Research Centre*

# EU harmonisation for water (steam) electrolysis – Objectives

- ❑ Creating commonly accepted set of EU wide terminology, testing protocols and procedures for assessing performance and durability of water (steam) electrolyser (low-temperature and high-temperature) particularly in energy storage applications (grid-services and off-grid)
- ❑ Not intended to replace existing testing practices available in various industries and research establishments but to allow for an objective comparison of results emanating from different projects and research efforts



# EU harmonised water (steam) electrolysis terminology and testing protocols – Recent outcome



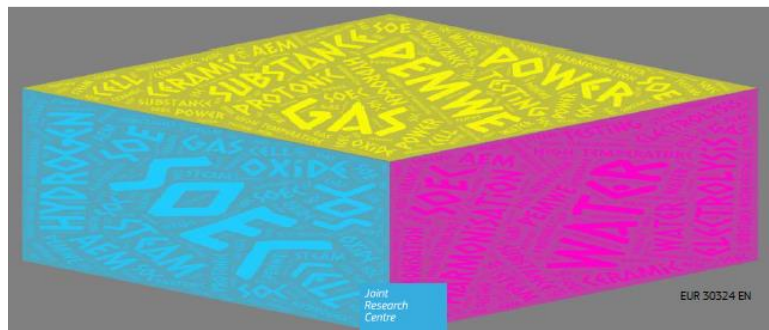
JRC VALIDATED METHODS, REFERENCE METHODS AND MEASUREMENTS REPORT

EU harmonised terminology for hydrogen generated by electrolysis

*An open and comprehensive compendium*

Malkow, K. T., Pilega, A., Blagoeva, D.

2021



JRC TECHNICAL REPORT

EU harmonised protocols for testing of low temperature water electrolyzers

G. Tsotridis, A. Pilega  
2021



# EU harmonised water (steam) electrolysis testing procedure and protocols – Current activities

- JRC's AWP 2022 deliverables to Clean H2 JU – status and time line
  - B.2 Report on **EU harmonised testing procedure for determination of water electrolyser energy performance - Energy consumption of electrolyser systems - ongoing with collection of expert comments and feedback - draft report by September**
  - B.3 Report on EU harmonised testing protocols for high temperature electrolysis: performance and durability of stacks and systems – **yet to start - draft report for public stakeholder by December**



with expert input by Working Group  
from partners of EU funded projects

# EU harmonised testing procedure: Determination of water electrolyser energy performance - scope

## Water (steam) electrolyser system

Balance of plant

Water (steam) electrolyser(s)

Instrumentation & control

## Water electrolysers/high-temperature electrolysers in a plant

Balance of plant

WE/HTE 1

...

WE/HTE N

Instrumentation & control

# EU harmonised testing procedure: Determination of water electrolyser energy performance – content

➤ Water (steam) electrolyser system (AWE, AEMWE, BPMWE & PEMWE as well as SOE & PCE):

- Specific energy consumption per unit of output (mole, volume and mass) of generated hydrogen and energy efficiency based on HHV and LHV under SATP conditions (298,15 K and 100 kPa) as reference

for comparing different systems and technologies

- Assessing R&D progress,
- Monitoring technology evolution,
- Setting or adjusting R&D targets, milestones, priorities, ...

# EU harmonised testing procedure: Determination of water electrolyser energy performance – content

- Specific energy consumption per unit of output (mole, volume, mass) of hydrogen generated by a water (steam) electrolyser or system under SATP conditions:

$$\frac{\text{Difference in power between all inputs and hydrogen output, kW}}{\text{molar (volumetric, gravimetric) flow rate of hydrogen, } \frac{\text{mol}}{\text{h}} \left( \frac{\text{m}^3}{\text{h}}, \frac{\text{kg}}{\text{h}} \right)}$$

to be reported as average in kWh/mol (kWh/m<sup>3</sup>, kWh/kg) + k times standard uncertainty acquired under steady-state at rated operating conditions (input power, hydrogen pressure and temperature) as specified by manufacturer

# EU harmonised testing procedure: Determination of water electrolyser energy performance – content

- Water (steam) electrolysers (AWE, AEMWE, BPMWE & PEMWE as well as SOE & PCE) and systems:
  - Specific (electric, thermal) energy consumption per unit of output of (mole, volume and mass) of generated hydrogen under actual hydrogen output conditions (temperature and pressure)

## for a tested electrolyser or system

- To assess technological developments in target applications,
- To verify meeting specifications through acceptance testing in factory or on-site,
- To monitor performance losses by increased energy consumption or lower hydrogen output.



# EU harmonised testing procedure: Determination of water electrolyser energy performance – content

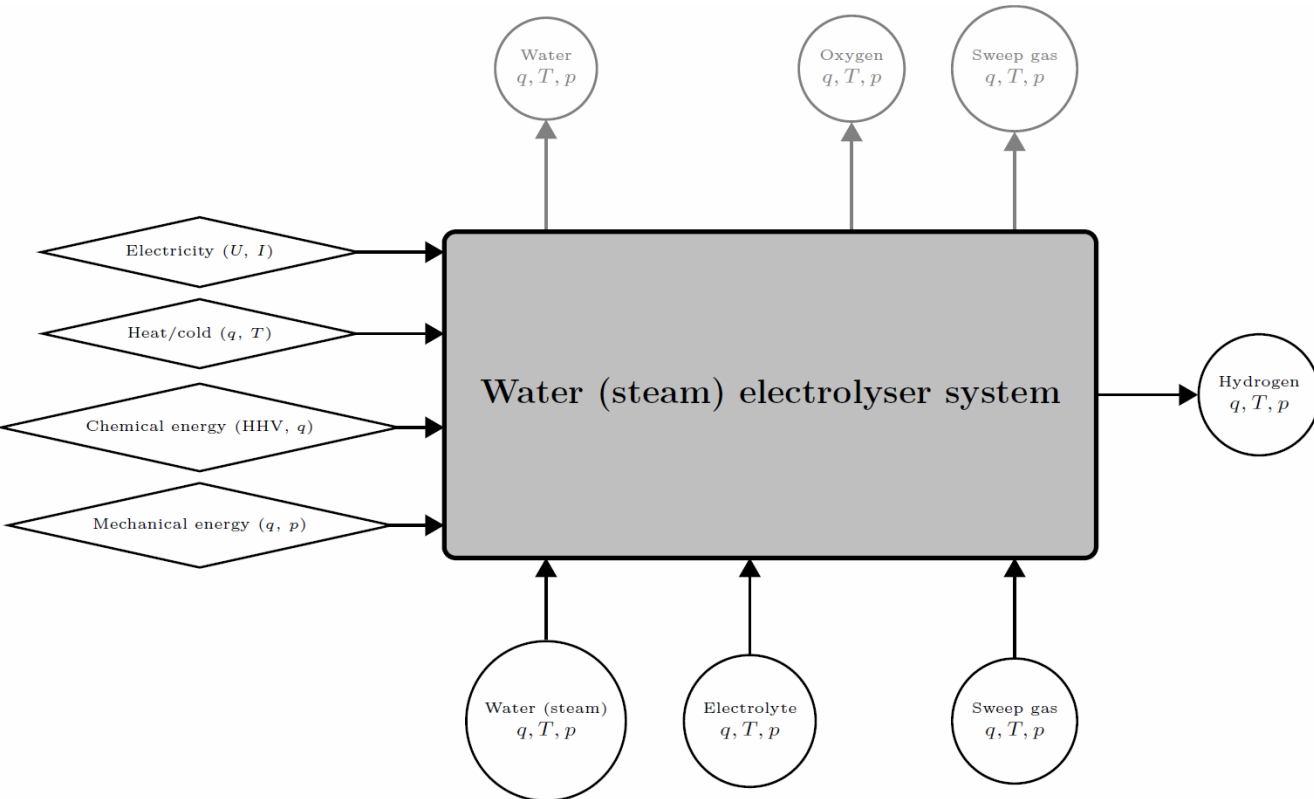
- Specific (electric, thermal) energy consumption per unit of output (mole, volume and mass) of hydrogen generated by a water (steam) electrolyser or system under hydrogen output conditions:

$$\frac{\text{(electric, thermal) input power, kW}}{\text{molar (volumetric, gravimetric) flow rate of hydrogen, } \frac{\text{mol}}{\text{h}} \left( \frac{\text{m}^3}{\text{h}}, \frac{\text{kg}}{\text{h}} \right)}$$

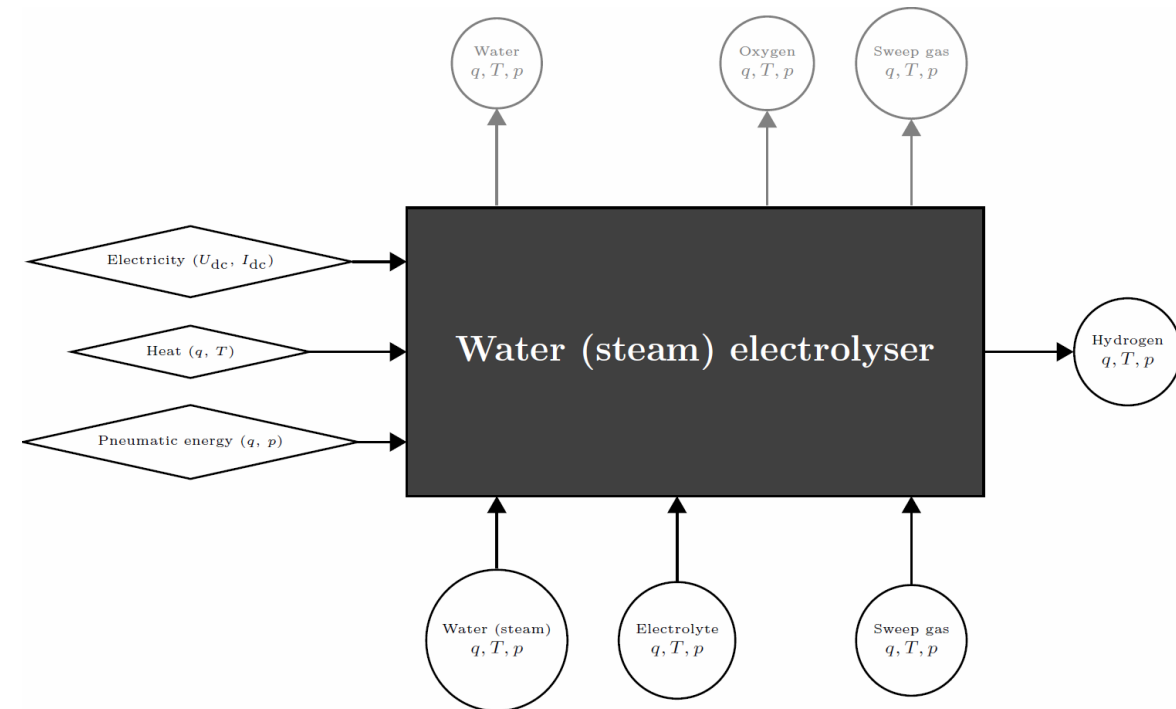
to be reported as average in kWh/mol (kWh/m<sup>3</sup>, kWh/kg) + k times standard uncertainty acquired under steady-state at rated operating conditions (input power, hydrogen pressure and temperature) as specified by manufacturer

# EU harmonised testing procedure: Determination of water electrolyser energy performance - content

## Water (steam) electrolyser system input & output scheme

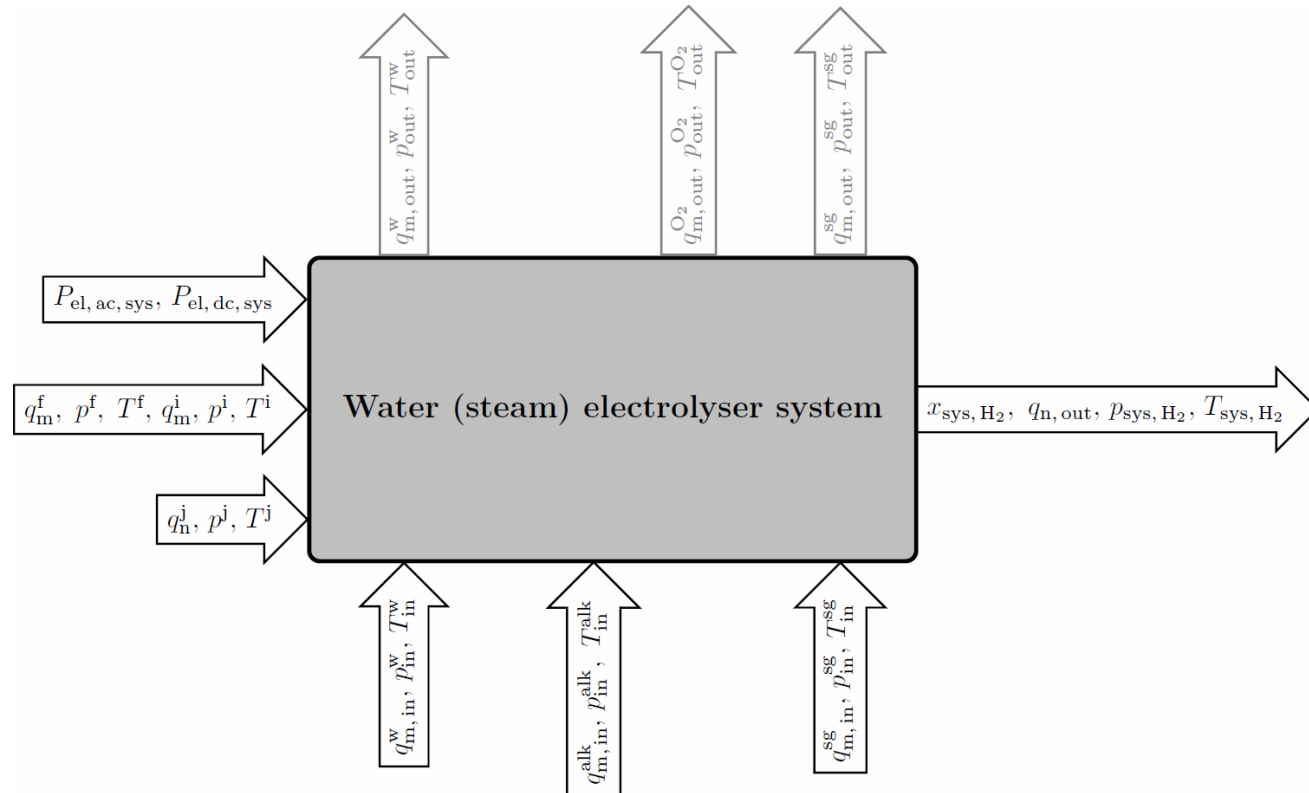


## Water electrolysers/high-temperature electrolysers

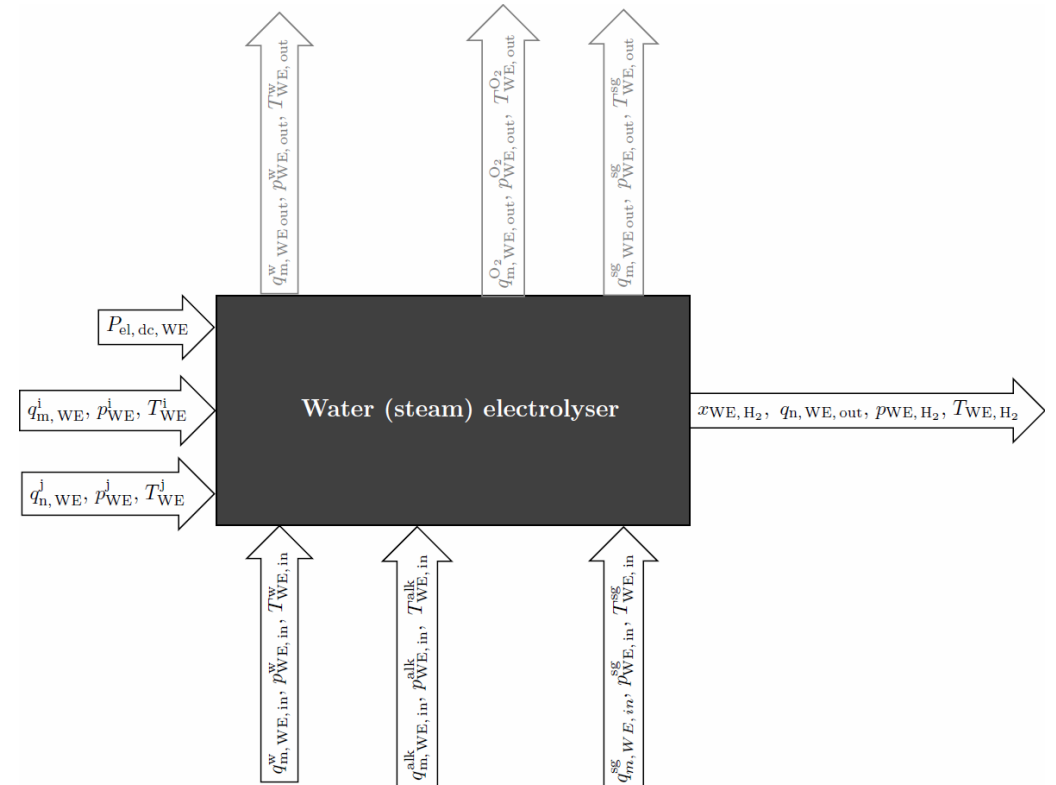


# EU harmonised testing procedure: Determination of water electrolyser energy performance - content

## Water (steam) electrolyser system test parameters



## Water electrolysers/high-temperature electrolysers



# EU harmonised testing procedure: Determination of water electrolyser energy performance - outlook



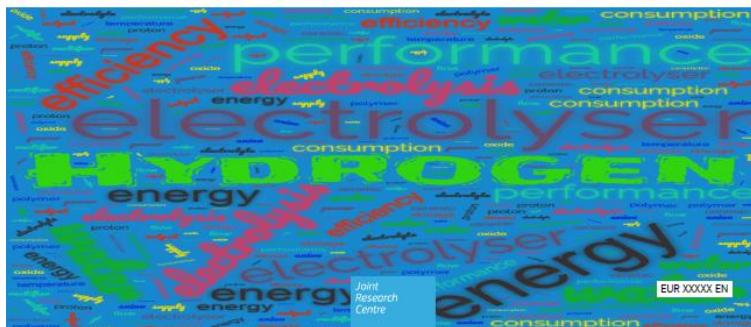
JRC VALIDATED METHODS, REFERENCE METHODS AND MEASUREMENTS REPORT

EU harmonised testing procedure:  
Determination of water electrolyser energy performance

*Specific energy consumption and energy efficiency*

Malkow, T., Pilenga, A.

2022



- Collection of expert comments and feedback **ongoing**
- Public stakeholder consultation on Clean Hydrogen JU website **by September 2022**
- Testing protocols on HTE performance and durability of stacks and systems **to be started**

with financial support of



# Thank you

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