IEA Bioenergy
Technology Collaboration Programme

Task 33 - Gasification of biomass and waste for a sustainable future

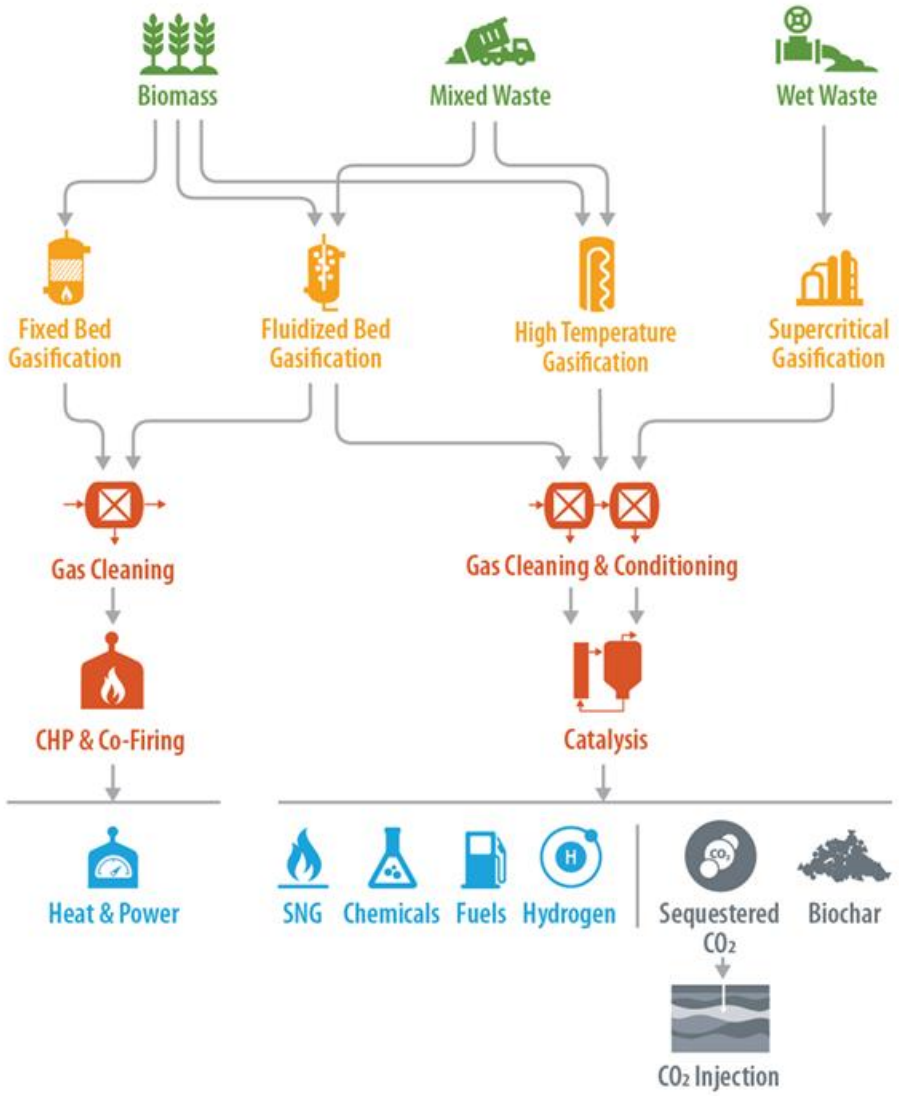
Joakim Lundgren, co-task leader and NTL Sweden Task 33
Professor, Energy Engineering, Luleå University of Technology
Guest research scholar, International Institute of Applied Systems Analysis (IIASA)

Bio+ Conference, Stockholm, September 4, 2025

Participating countries 2025-2027

	Austria (Jitka Hrbek, new task leader) jitka.hrbek@boku.ac.at		Belgium (Benjamin Berger) brg@ecam.be
	USA (Robert Baldwin) Robert.Baldwin@nrel.gov		France (Chourouk Nait Saidi) c.naitsaidi@atee.fr
	India (Ramachandra Rao) ram@hpcl.in		Italy (Donatella Barisano) donatella.barisano@enea.it
	Sweden (Joakim Lundgren, co-task leader) Joakim.Lundgren@ltu.se		Germany (Sabine Fleck) Sabine.fleck@kit.edu
	The Netherlands (Berend Vreugdenhil) berend.vreugdenhil@tno.nl		UK (Patricia Thornley) p.thornley@aston.ac.uk
	Canada (Travis Robinson) travis.robinson@NRCan-RNCan.gc.ca		China (Guanyi Chen) chen@tju.edu.cn

Gasification of biomass and waste for a sustainable future

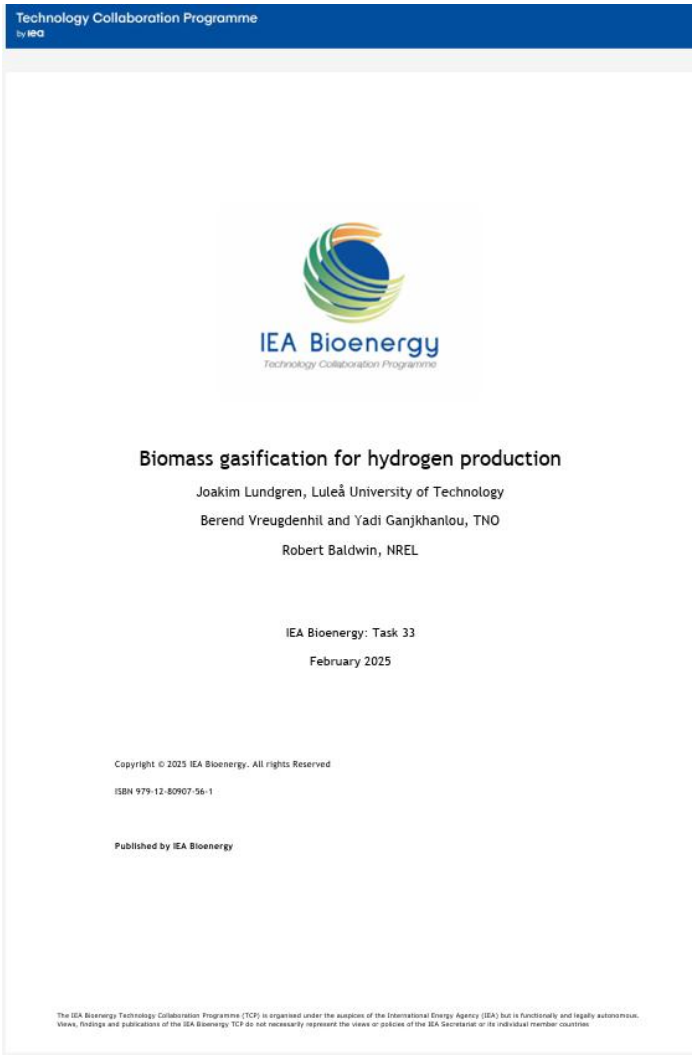


- An objective platform for technology providers and other stakeholders interested in biomass and waste gasification.
- Disseminate knowledge on **opportunities and challenges** for various gasification applications.
- R&D needs to mitigate challenges.

Ongoing project: Overcoming challenges for gasification technology deployment

- Analyse **various types of challenges** and identify measures to mitigate or overcome these.
- International workshop ("MGGA") to **share learnings and insights** from successful as well as failed projects around the world.
    - Technical learnings
    - Policy and regulatory issues
    - Finance and market issues
- Much of the learnings from past projects appears to remain fragmented and under-utilized, leading to recurring mistakes – **need for improved knowledge transfer**

Recent reports from Task 33


Technology Collaboration Programme
by iea

IEA Bioenergy
Technology Collaboration Programme

Biomass gasification for hydrogen production

Joakim Lundgren, Luleå University of Technology

Berend Vreugdenhil and Yadi Ganjkhanlou, TNO

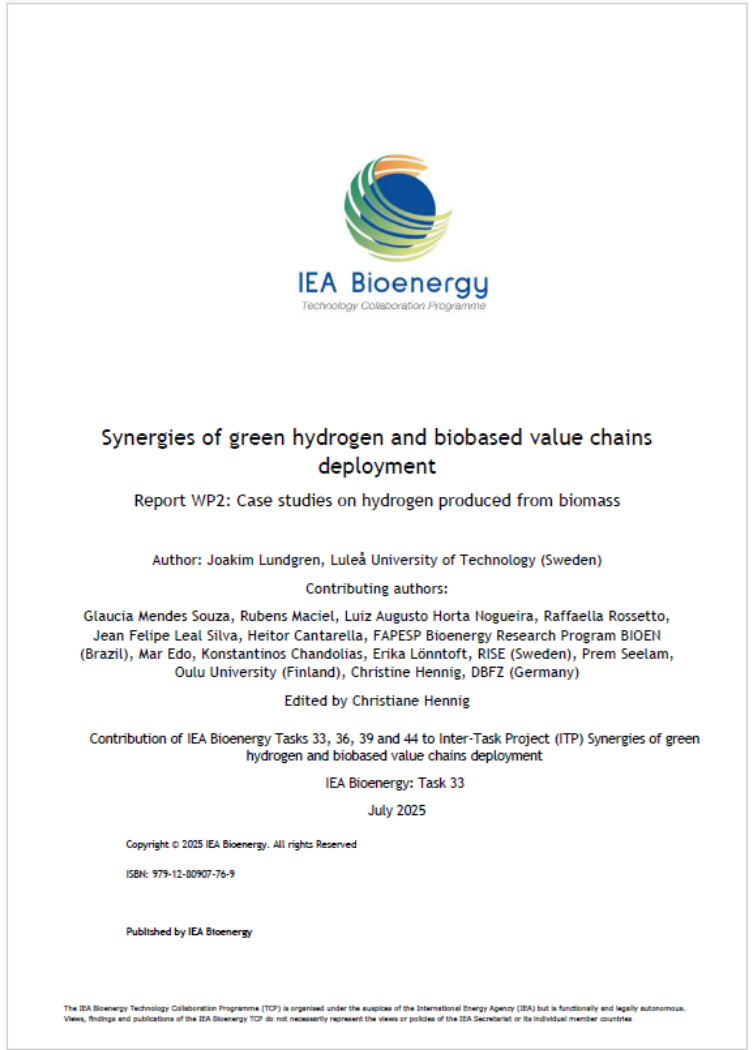
Robert Baldwin, NREL

IEA Bioenergy: Task 33

February 2025

ISBN 979-12-80907-56-1

Published by IEA Bioenergy


IEA Bioenergy
Technology Collaboration Programme

Synergies of green hydrogen and biobased value chains deployment

Report WP2: Case studies on hydrogen produced from biomass

Author: Joakim Lundgren, Luleå University of Technology (Sweden)

Contributing authors:

Glaucia Mendes Souza, Rubens Maciel, Luiz Augusto Horta Nogueira, Raffaella Rossetto, Jean Felipe Leal Silva, Heitor Cantarella, FAPESP Bioenergy Research Program BIOEN (Brazil), Mar Edo, Konstantinos Chandolias, Erika Lönntoft, RISE (Sweden), Prem Seelam, Oulu University (Finland), Christine Hennig, DBFZ (Germany)

Edited by Christiane Hennig

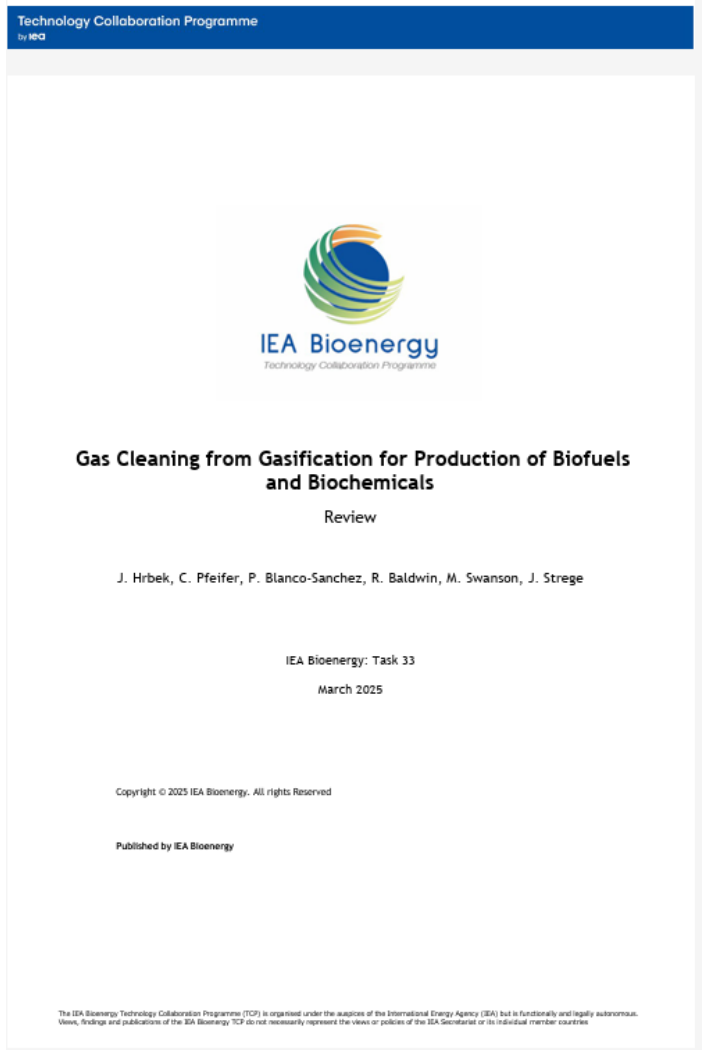
Contribution of IEA Bioenergy Tasks 33, 36, 39 and 44 to Inter-Task Project (ITP) Synergies of green hydrogen and biobased value chains deployment

IEA Bioenergy: Task 33

July 2025

ISBN: 979-12-80907-76-9

Publtshed by IEA Bioenergy


Technology Collaboration Programme
by iea

IEA Bioenergy
Technology Collaboration Programme

Gas Cleaning from Gasification for Production of Biofuels and Biochemicals

Review

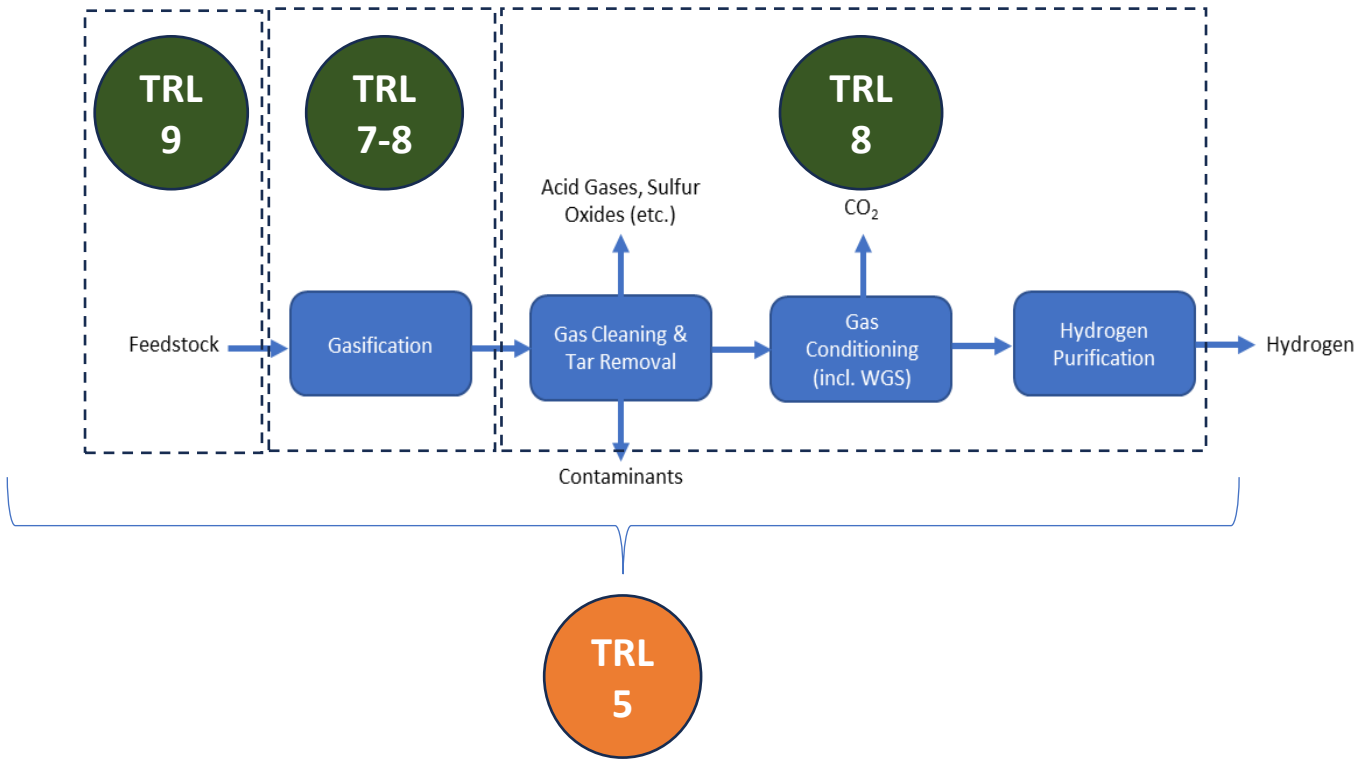
J. Hrbek, C. Pfeifer, P. Blanco-Sanchez, R. Baldwin, M. Swanson, J. Strege

IEA Bioenergy: Task 33

March 2025

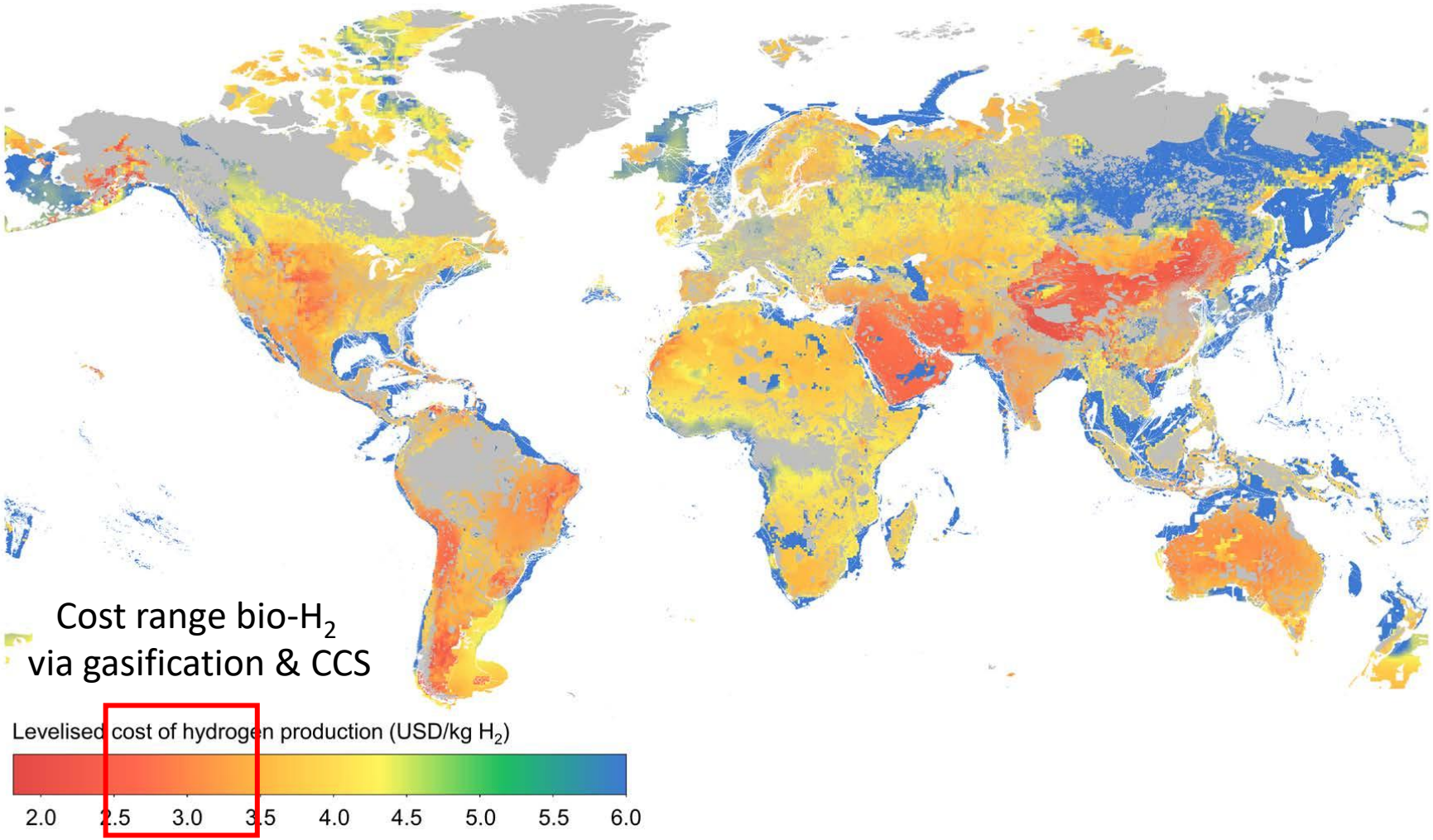
Published by IEA Bioenergy

Hydrogen produced via biomass gasification - State-of-the art technology



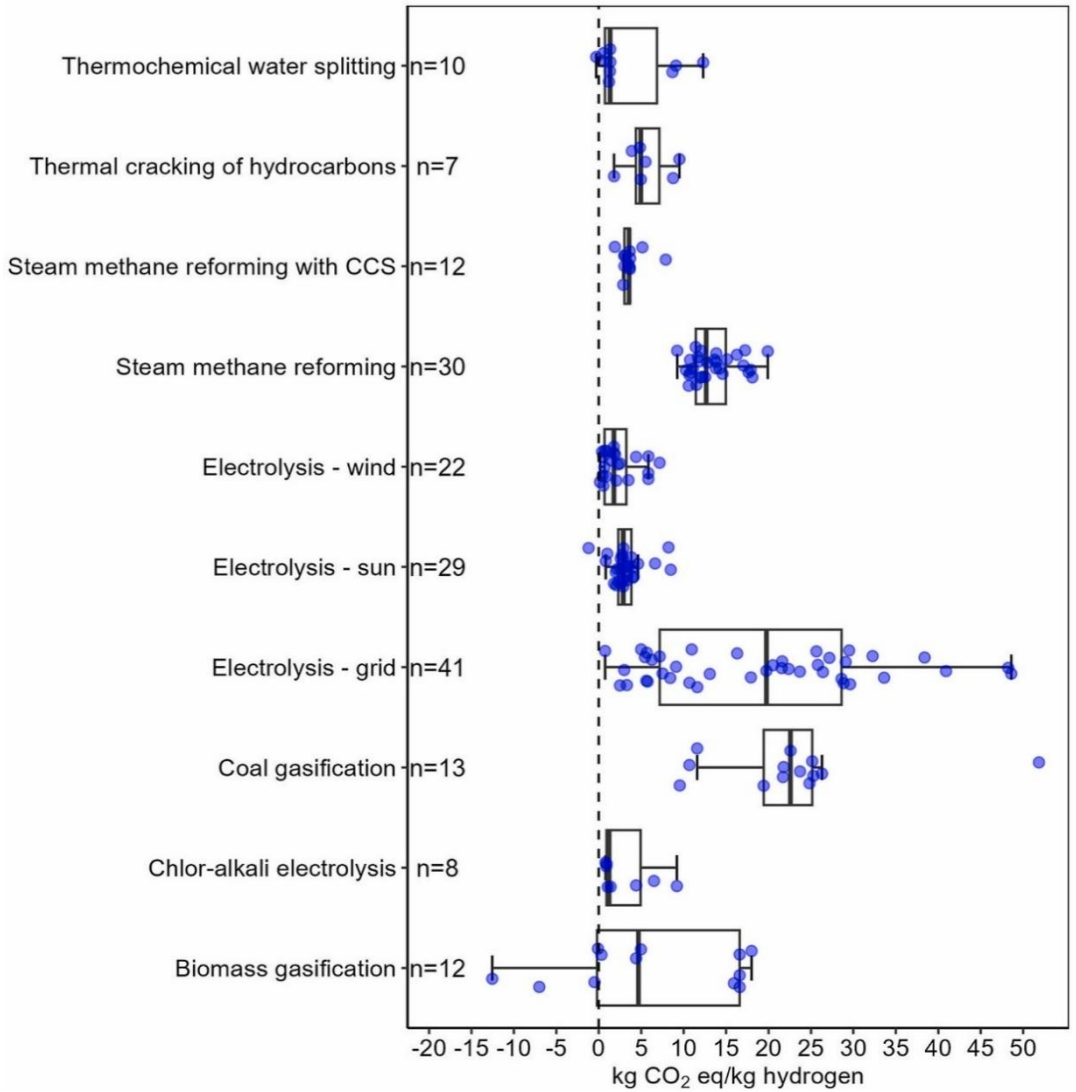
- High quality biohydrogen produced in lab-scale.
  - Indian Institute of Science & Indian Oil Ltd demonstrated hydrogen production of fuel-cell quality - system operated more than 250 hours.
  - Advanced Biofuel System Ltd (ABSL) upgraded slipstreams of synthesis gas to PEM fuel cell quality.

Estimated cost of hydrogen based on solar cells and onshore wind power beyond 2040-2050



Ref: IEA Hydrogen Outlook

Opportunity for climate positive hydrogen production



Solar electrolysis = avg 2.9 kg CO_2/kg H_2

Wind electrolysis = avg 1.8 kg CO_2/kg H_2

Bio-H_2 w CCS = -18.8 kg CO_2/kg H_2

Ref: Puig-Samper et.al (2024)

Summary - General biohydrogen insights

- Hydrogen can be produced from **a variety of biogenic feedstocks** in a **wide capacity range.**
- Production of **additional value-added commodities** such as biochar, biomethane etc – often neglected in "hydrogen KPIs" (for ex. CH-JU).
- Opportunities to obtain **negative CO_2-emissions.**
- **Costs likely to be equal or lower than the costs of renewable power based H_2** in many world regions.
- Bio-H_2 production **is a complement** to renewable electrolytic H_2 and **deserves more attention!!**

Upcoming study visit: Bio-electro-methanol demonstration project in Taonan, China, Sept 17-18

- Owned by Shanghai Electric's subsidiary Lvyuan Technology (Jilin) Co., Ltd.
- Agricultural biomass residues for green methanol via gasification and integrated wind-to-hydrogen systems.
- Pressurized oxygen-blown fluidized bed gasifier (2*300 tonnes/day).
- Capacity: 50,000 tonnes methanol (demo phase 2025),
- 680 MW wind power, 250,000 tonnes methanol + 10,000 tonnes SAF per annum by 2027.
- First batch of produced methanol reported in July 2025.

Reference and picture: https://fuelcellsworks.com/2025/07/14/green-hydrogen/shanghai-electric-produces-first-batch-of-green-hydrogen-based-methanol-at-the-680mw-taonan-plant-in-jilin

Questions?

Joakim Lundgren, Co-task leader and NTL Sweden Task 33

Professor, Energy Engineering, Luleå University of Technology

Guest research scholar, International Institute of Applied Systems Analysis (IIASA), Austria

joakim@ltu.se

+46 72 2391307