HyBalance
Environmental performance

Patrick Schmidt | LBST
Werner Weindorf | LBST

Webinar on Power-to-X: The HyBalance project, 24 September 2020

The HyBalance project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 671384. The Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation program. www.fch.europa.eu. The HyBalance project has furthermore received funding from the Danish EUDP program, which is administered by the EUDP Board.

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HyBalance pathways for H_2 production & supply

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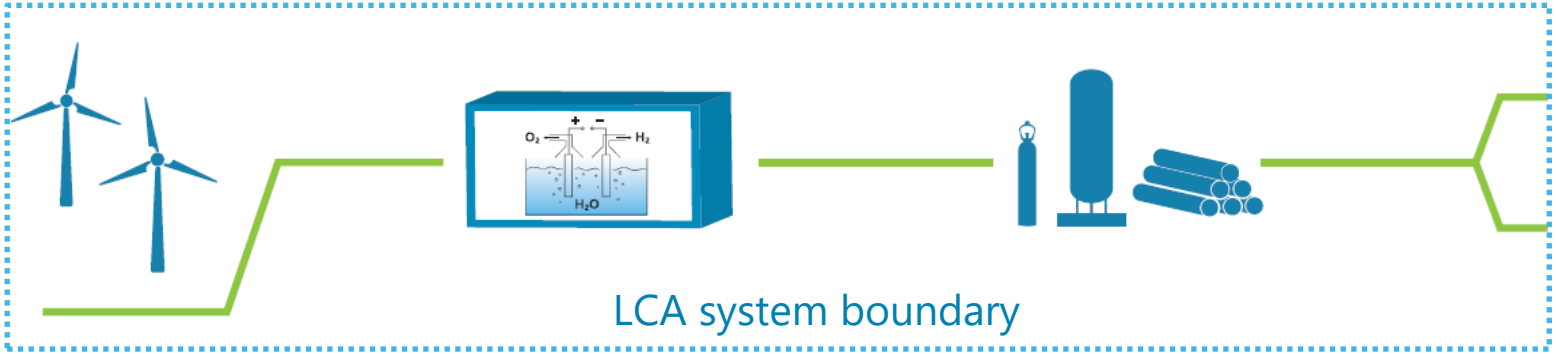

2 use cases

- Trailer filling
- Pipeline supply

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Greenhouse gas emissions ‘well-to-tank’

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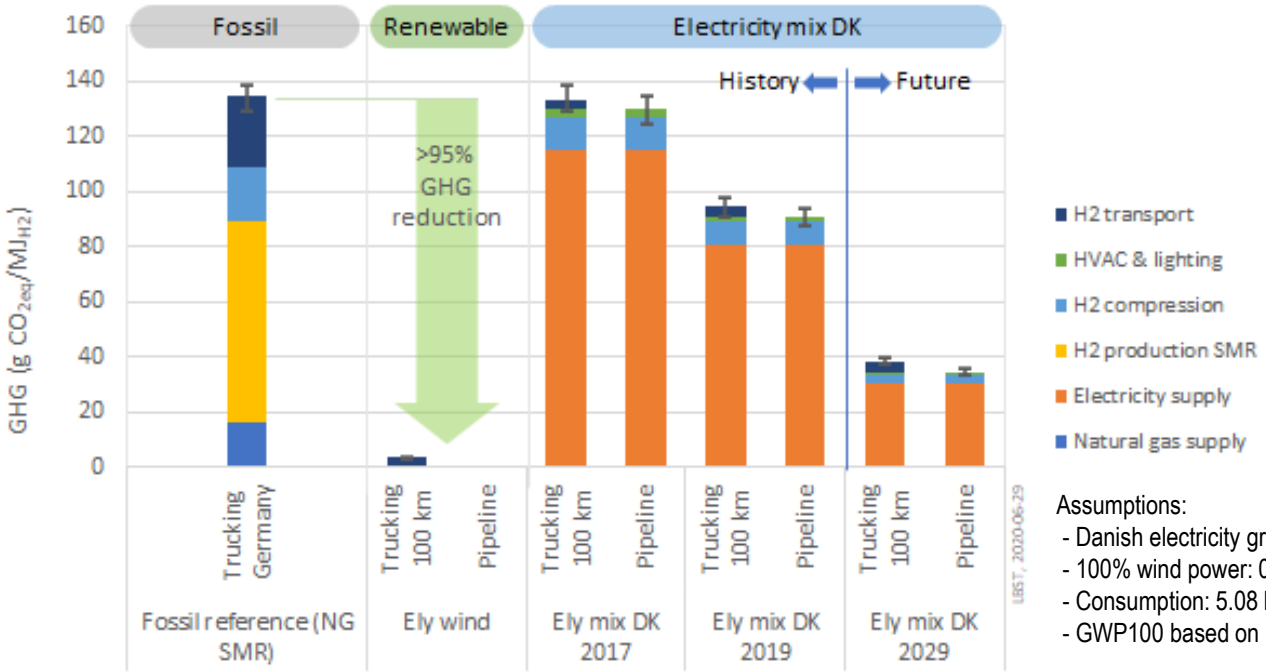

Assumptions:
- Danish electricity grid mixes [Energinet.dk]
- 100% wind power: 0 g_{CO2eq}/kWh [JEC 2014]
- Consumption: 5.08 kWh/Nm³ @ 100% load
- GWP100 based on IPCC AR4 (RED II compliant)

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Greenhouse gas emissions 'well-to-tank'

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- **Danish electricity grid production mix**
  - Renewables have grown significantly in recent years (>70 % share)
  - H_2 production greenhouse gas emissions broke-even with
    - NG-SMR-H_2 trucked in from Germany (in 2017)
    - NG-SMR-H_2 produced in DK (in 2018)
    - EU RED fossil diesel/gasoline (in 2019)
  - Renewables are set towards 100 % by 2030 (plan)
  - Remaining GHG emissions from bio-CHP
- Using **100 % wind** power for hydrogen production reduces greenhouse gas (GHG) emissions by almost 100 % compared to the fossil reference

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Low grid prices strongly correlate with low CO_2 emissions in Danish grid at current electricity market design

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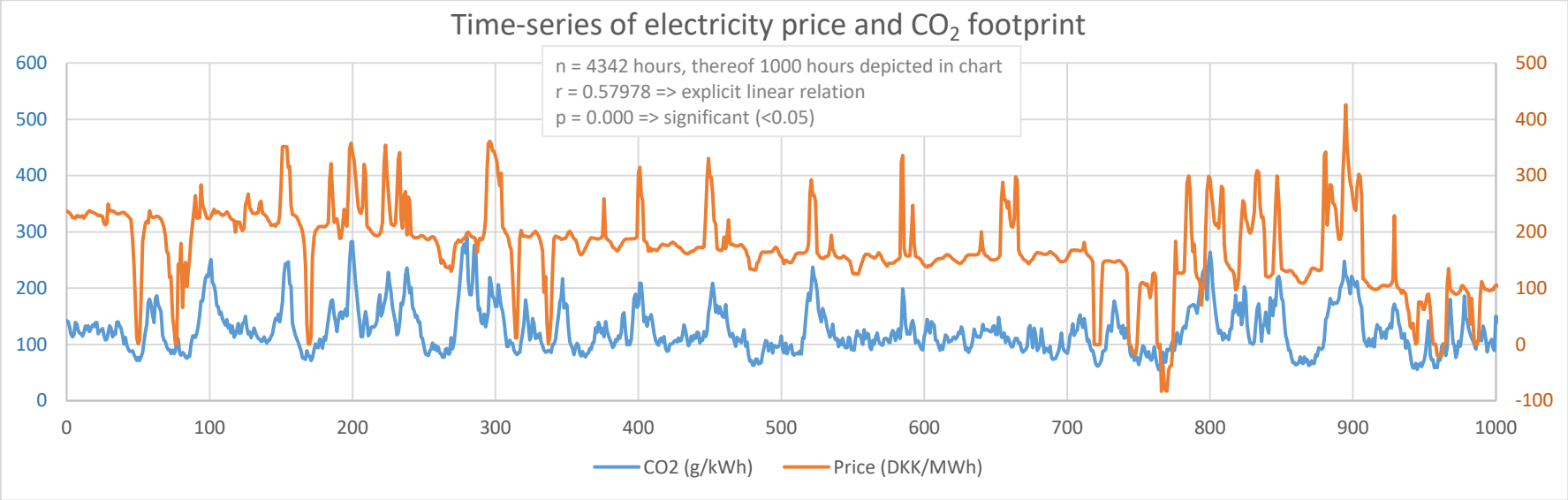
- Correlation analyses of 1st half 2020 (thereof 1000 h depicted in chart)



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Scheduling plant operation according to CO_2 / price signals significantly reduces the CO_2 footprint of PtH_2 production in DK

- **Annual average**
  Danish grid mix 2019 (135 g_{CO2eq}/MJ_e): 90 g_{CO2eq}/MJ_{CGH2}
- **Demand-side management**
  Simulation using CO_2 time-series of DK grid mix through 1st half 2020:
  PtH_2 production at <120 g_{CO2eq}/kWh_e: 40 g_{CO2eq}/MJ_{CGH2}
  - 70 % GHG reduction vs. natural gas steam methane reforming
  - PtH_2 plant operation (extrapolated to 1 year): approx. 4750 h_{eq}/a

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Take-away

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- Denmark is on a renewable power deployment track for net zero carbon in electricity well before 2050
- Power-to-hydrogen is a key building block for energy system integration, notably via demand-side management => grid connection
- Simple but robust sustainability framework needed to give stakeholders confidence for building value chains, and for public acceptance

⇒ Current policy tracks that could positively shape PtH_2 markets:

  - Electricity market regulatory (taxes/levies on storage/other uses)
  - EU RED II national implementation and delegated acts
  - EU sustainability taxonomy

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Thank you for your attention

Questions?

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hybalance.eu

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Annex

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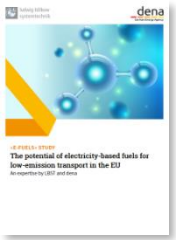

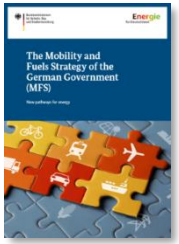

Profile

- Independent expert for sustainable energy and mobility for over 30 years
- Bridging technology, markets, and policy
- Renewable energies, fuels, infrastructure
- Technology-based strategy consulting,
  System and technology studies,
  Sustainability assessment
- Global and long term perspective
- Rigorous system approach – thinking outside the box
- Serving international clients in industry, finance, politics, and NGOs

References

- EU – *CertifHy – Green H_2 guarantee of origin scheme*
- JRC/Eucar/Concawe – *Well-to-tank analyses*
- VDA – *E-Fuels Study*
- UBA – *Power-to-Liquids for Aviation*
- BMVI – *Mobility & Fuels Strategy*

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HyBalance plant

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- Plant: 1.2 MW_e PEM electrolyser incl. 2 filling bays for CGH_2 trailer
- Product: Power-to-Hydrogen
  - Industry (chemical feedstock)
  - Transportation (transport fuel)
- Budget: € 15 million, thereof
  - € 8 m European Union (FCH-JU)
  - € 2.6 m Danish Government (EUDP)
- Duration: 2015-2020

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