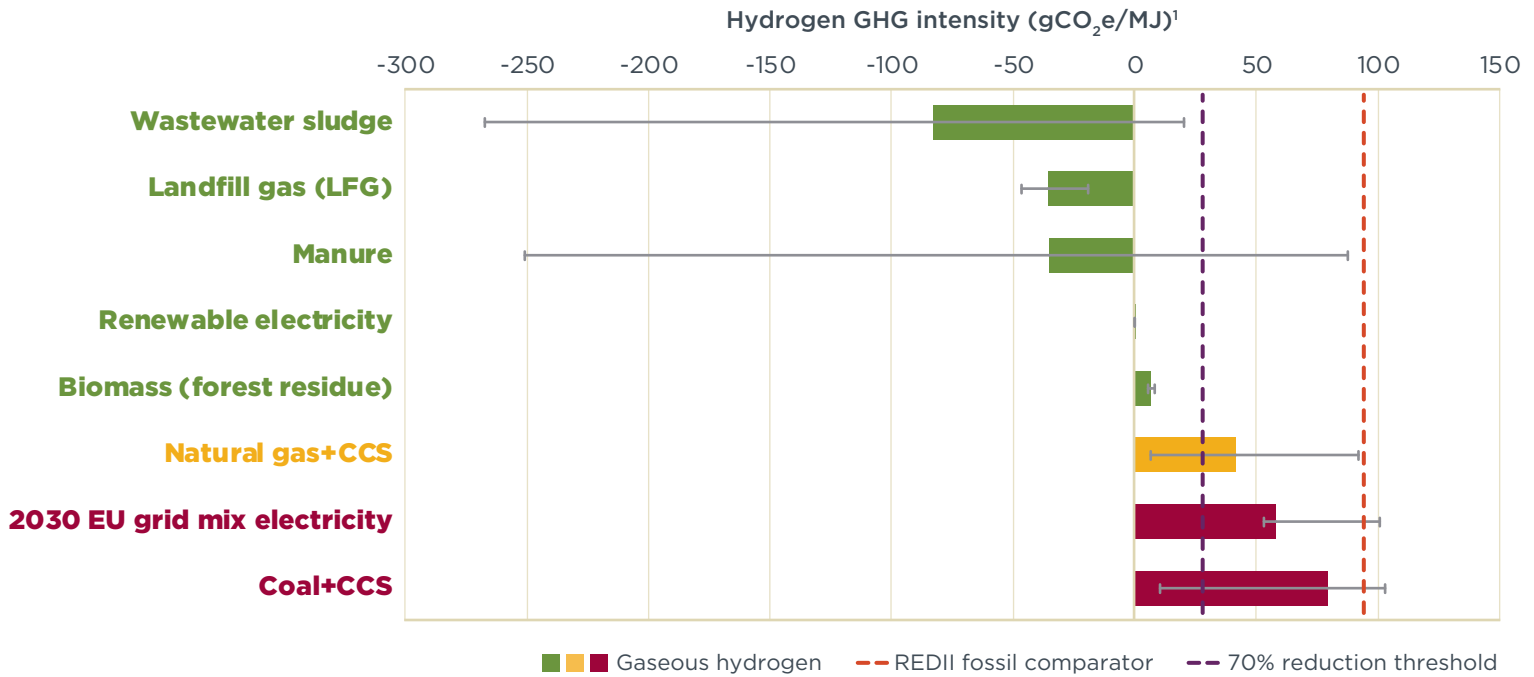


Greenhouse gas emissions from hydrogen production in Europe



Wastewater sludge biomethane-to-hydrogen

- GHG 😊
- High upstream methane leakage increases GHG intensity



Water electrolysis-to-hydrogen using renewable electricity

- GHG 😊
- Crucial to use only additional renewable electricity



Residual biomass-to-hydrogen

- GHG 😊
- Crucial to use only waste biomass, not feed crop



Natural gas-to-hydrogen combined with carbon capture and storage

- GHG 😞
- High upstream methane leakage increases GHG intensity
- Typical industrial practice only captures carbon at 50% rate



Landfill gas-to-hydrogen

- GHG 😊
- High upstream methane leakage increases GHG intensity



Manure biomethane-to-hydrogen

- GHG 😊
- High upstream methane leakage increases GHG intensity



Water electrolysis-to-hydrogen using grid electricity

- GHG 😞
- Emissions from fossil share of electricity are amplified by the energy losses in production



Coal-to-hydrogen combined with carbon capture and storage

- GHG 😞
- Typical industrial practice only captures carbon at 50% rate



¹ As originally published, the top figure showed higher GHG emissions for hydrogen made from wastewater sludge, landfill gas, and manure, thereby underestimating their potential contributions to decarbonization. The evaluation of GHG emissions in the "Landfill gas-to-hydrogen" and "Manure biomethane-to-hydrogen" boxes were originally yellow, with non-smiling faces.