



Assessing Green Hydrogen Production Power, Natural Gas Displacement, O₂ Value, and IRS Credit Potential

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<https://infinityturbine.com/heat-treating-steel-ng-hydrogen-production-savings-using-solar-pv-by-infinity-turbine.html>

Calculate kWh per kg for green hydrogen electrolysis, O₂ output, NG displacement potential, savings in Illinois, and value of oxygen, in the context of the IRS hydrogen credit.



This webpage QR code

PDF Version of the webpage (maximum 10 pages)

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Introduction

To assess the financial viability of producing green hydrogen (and claiming the IRS credit), it is helpful to run through a back-of-envelope engineering and economic model. Below I walk through the key conversions and assumptions you'd need, estimate the magnitude of savings from displacing natural gas (NG) in a steel heat-treating facility, and estimate the possible credit from the IRS.

Electrolysis: Power Required and O₂ Production

Theoretical and practical energy need for H₂

The thermodynamic (ideal) enthalpy input required to split water into H₂ and O₂ corresponds to about 39.4 kWh per kg H₂ (based on 141.9 MJ/kg HHV) ([National Academies Press][1])

In practice, due to inefficiencies, real electrolyzers consume more. Many commercial systems today operate in the range of 50 to 55 kWh per kg H₂ ([Hydrogen Program][2])

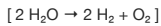
Some advanced systems or pilot units claim somewhat lower consumption (e.g. ~ 37–42 kWh/kg) under favorable conditions, but that is optimistic and may exclude balance-of-plant losses. ([Bloom Energy][3])

Thus, a reasonable assumption for a full-system baseline is ~ 50 kWh per kg H₂ (or in a well-optimized plant perhaps slightly lower).

Hence, for each kg H₂ produced, you'd need on the order of 50 kWh of electricity from solar PV (or other source).

Mass of O₂ produced

From the balanced reaction:



Molecular weights:

H₂O: 18,

H₂: 2,

O₂: 32.

For every 2 moles (≈36 g) of water, you get 2 moles (≈4 g) hydrogen and 1 mole (≈32 g) oxygen.

Thus, per mass of hydrogen:

If you produce 1 kg (1000 g) of H₂, that's 500 moles of H₂. That came from 500 moles of water input (each yields one H₂ and ½ O₂). The corresponding O₂ is 250 moles, i.e. 250 × 32 = 8,000 g = 8 kg of O₂.

In short: 1 kg H₂ yields about 8 kg O₂ (assuming pure separation, ideal stoichiometry).

