An estimation of carbon emissions from dihydrogen production, or: *we are saving the world*

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75 million metric tons of hydrogen are produced globally every year.[1] This is equivalent to 75×10^{12} g of hydrogen, or (at 2 g/mol), 37.5×10^{12} moles of hydrogen.

Let's assume all of the hydrogen is produced via steam reformation of natural gas (which is probably not far off). The reaction for this is:

$$CH_4 + H_2O \rightarrow CO + 3H_2$$

Additionally, the carbon monoxide is further reacted with water:

$$CO + H_2O \rightarrow CO_2 + H_2$$

So, the overall reaction is:

$$CH_4 + 2H_2O \rightarrow CO_2 + 4H_2$$

So, 1 mole of CO_2 is produced for every 4 moles of H_2. This is 9.375×10^{12} moles of CO_2 based on 37.5×10^{12} moles of hydrogen, or 412.5×10^{12} g of CO_2 (at 44 g/mol), or 413 million tons of CO_2.

From stoichiometry alone, 5.5 g of CO_2 are emitted per gram of H_2 produced.

In 2007, world carbon dioxide emissions were 4.63 tons per capita[2]. This amounts to 30.5 billion tons globally; so the emissions from hydrogen generation are *about 1.3% of the total human emissions of carbon dioxide.*

In 2005 the Department of Energy wrote a report on greenhouse gas emissions from hydrogen production[3]. Over the entire life cycle of production, the report estimated a total of 8.9 g CO_2 released per gram of H_2.

Based on the 2007 world emissions data, the life-cycle emissions are *2.3% of the total human emissions of carbon dioxide.*

It is remarkable that the majority of these total emissions–62%–can be attributed to the stoichiometry of the reaction!

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[1] Extrapolated from `http://en.wikipedia.org/wiki/Hydrogen_economy`

[2] `www.google.com/publicdata`

[3] "Life-Cycle Analysis of Greenhouse Gas Emissions for Hydrogen Fuel Production in the United States from LNG and Coal", DOE/NETL-2006/1227