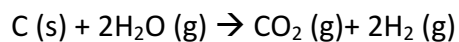


What is the atom economy of the following reaction to make hydrogen gas? (Assume the reaction undergoes full conversion)



The atom economy is defined as

$$\text{atom economy} = \frac{\text{molecular mass of desired product}}{\text{molecular mass of all reactants}} \times 100\%$$

In this case, the reactants are carbon and water, and the desired product is H<sub>2</sub>:

$$\text{atom economy} = \frac{2 \times MW_{\text{H}_2}}{MW_{\text{C}} + 2 \times MW_{\text{H}_2\text{O}}} \times 100\% = \frac{4}{12 + 36} = 8.3\%$$

Hence the atom economy of the reaction is 8.3%

Atom economy is the second principle of green chemistry (remember the posters?), and it is an important concept in reaction design because it considers reaction efficiency on a molecular level. The higher the atom economy of a reaction, the more the reactants are incorporated into the product instead of being wasted. In an ideal situation, all the reactants will be incorporated into the product, giving an atom economy of 100%.

However, there are multiple factors that atom economy did not take into account, such as reaction yield, solvent use, catalyst turnover, energy consumption, etc. Atom economy is a useful metrics in examining the efficiency of a reaction, but other metrics such as atom efficiency, E-factor, etc. should also be taken into account to fully examine the “greenness” of a reaction.