# Biological hydrogen production

## Why hydrogen?

Hydrogen is seen by many as the fuel of the future because it has a very high energy density, three times that of petrol or diesel, and because its use produces only water instead of greenhouse gases and other exhaust pollutants. Furthermore, using petrol and diesel in combustion engines waste at least two thirds of the energy in the fuel, whereas hydrogen can be used in fuel cells, which are about twice as efficient, so much more of the fuel's energy is put to good use and less fuel is needed.

However, hydrogen is not an energy source but an energy carrier; it's a useful way of carrying energy from renewable sources such as sun, wind and water to useful applications such as a car. Many types of microbe can convert renewable energy sources into hydrogen.

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Find out more about biological hydrogen production.
(Press play and expand window using the icon at the bottom right of the video.)

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**How do Microbes make biohydrogen?**

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## What is Biohydrogen?

Hydrogen produced through the action of living organisms is called biohydrogen. This is a type of biofuel, like bio-ethanol, bio-diesel or bio-gas or bio-oil. There are three classes of biofuels:-

1. First generation – made from food crops
2. Second generation – made from non-food crops or wastes
3. Third generation (advanced) - made using microbes

Advanced biofuels have several advantages over 1st and 2nd generation biofuels. Whereas first generation biofuels have caused increases in food prices, advanced biofuels would not. In comparison to second generation biofuels, advanced biofuels could capture sunlight energy 10 times more efficiently, meaning that smaller areas or land are needed to produce enough fuel.

Biohydrogen is an example of an advanced biofuel (or third generation biofuel). In advanced biofuel technologies, microbes are grown in special bioreactors and provided with the energy and nutrients that they need including, sunlight, waste organic material, $CO_2$ from the air or from conventional gas plants. As they grow the microbes produce the biofuel.

Among the advanced biofuels, biohydrogen is particularly attractive because of the excellent properties of hydrogen as a fuel and because biohydrogen is very easy to collect from the bioreactor. Conversely, biofuels such as bio-oils have to be purified from the microbial cells which is complex and expensive.