Water as an alternative fuel

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Climate change represents the biggest single challenge to mankind today. Unchecked, global warming will threaten the existence not only of human beings but also of every living thing on the planet.

Many scientists are convinced that the main cause of this phenomenon is the inexorable increase in carbon dioxide and other so-called greenhouse gases in the atmosphere, caused by the burning of fossil fuels, primarily oil and coal.

Since the dawn of history, man has been sending such gases skyward, but never on such a scale as in modern times. Witness the Industrial Revolution of the 18th and 19th centuries through to the growth in large-scale manufacturing, the invention of the internal combustion engine, and the rise in motorized transport throughout the 20th century. Nowadays, we witness the destruction and torching of millions of acres of tropical and other forests. At the same time, man's demand for energy remains insatiable.

Every year, the world pumps an estimated 28 billion tons or more of carbon dioxide into the atmosphere[1] [Figure 1] – that is, around 4 tons for every man, woman and child – and this figure continues to rise. With the greenhouse effect, more of the Sun's heat remains trapped between the Earth's surface and the upper atmosphere, causing temperatures to rise and ice sheets and glaciers to melt, pushing up sea levels and leading to higher tides and flooding in low-lying landscapes such as those bordering the Bay of Bengal.

As habitats change, the breeding and migration patterns of wildlife are also affected. Some species simply cannot adapt to their new environment and therefore face extinction. Similar seismic changes are taking place in rivers and seas. Ocean currents could well be influenced, causing further disruption to the world's weather patterns. The fact remains – nobody knows for certain where all of this is leading to but the prognosis is depressing.

However, the world may still be diverted from its path to self-destruction. "Dirty" fossil fuels are a finite resource and will run out one day, and with certain nations still reluctant to commit to and invest in nuclear power, the longer-term future may well hinge on ending civilization's almost total dependence on fossil fuels and finding alternative sources of clean, cheap and renewable energy.

A start has been made with the development of "green" technologies such as wind and wave power, solar panels, and tapping into heat from geothermal reservoirs. Even taken together, though, these measures barely scratch the surface of the problem. However, there is one potential source of energy that has long been one of the "holy grails" of science. This is to release the vast energy locked up in the planet's most plentiful resource – water. A process to split water into its two components, hydrogen and oxygen, and use the hydrogen to power the planet would most likely meet all of the world's energy needs at a stroke and, at the same time, consign fossil fuels to the dustbin of history.

Using water as a fuel is a far from recent concept. Indeed, one application dates back to more than 200 years to a Swiss inventor. François Isaac de Rivaz is credited with creating the world's first internal combustion engine, fueled by a mixture of hydrogen and oxygen. He used his brainchild to develop the world's first vehicle to be propeled by such an engine [Figure 2].

Over the next two centuries, however, oil and coal became the undisputed heavyweight champions of the energy market as the world industrialized. Moving into modern times, with such fuels still relatively cheap and plentiful, there was always little urgency or desire to look elsewhere for different sources of energy. But here in the 21st century, priorities have shifted and the need to unlock the vast potential of water is now more pressing than ever and the stakes are infinitely higher.

The attractions of taking water to produce usable energy are evident. Undoubtedly, the idea would tick all of the boxes for mankind and its environment. It sounds incredible, but in energy terms, a simple glass of water may be considered a power station in miniature. One scientific estimate suggests, "an eight-ounce glass of water can yield as much energy as half a million barrels of petroleum"[Figure 3].[2]

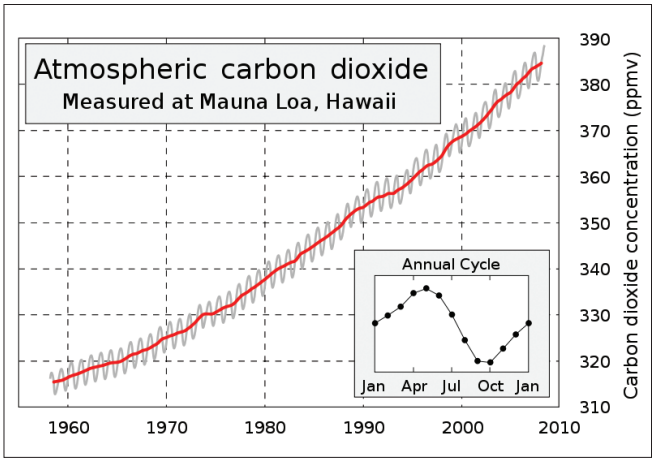

Figure 1: A graph to show how the levels of carbon dioxide in our atmosphere are increasing (from http://en.wikipedia.org/wiki/File:Mauna)_Loa_Carbon_Dioxide-en.svg)

Figure 3: One glass of water could produce as much energy as half a billion barrels of petrol (from http://en.wikipedia.org/wiki/File:Glass-of-water.jpg)

To the layman it all sounds like science fiction, yet at the same time achievable. However, the route to producing energy from water on an industrial scale and in a sustainable and viable way is far from straight forward. (Had it been, somebody would have done it by now!) Water can certainly be reduced to its constituent parts. However, breaking those covalent bonds that hold the atoms of hydrogen and oxygen together – even using the most efficient process known to man – requires an input of energy far larger than the amount that would be released.

A look at the chemistry involved offers some explanation. Every schoolboy knows that water is made from hydrogen and oxygen, but this does not present the total picture of what really goes into the creation of a molecule of water [Figure 4]. The chemical equation tells us:

$2H_2 + O_2 \leftrightarrows 2H_2O$

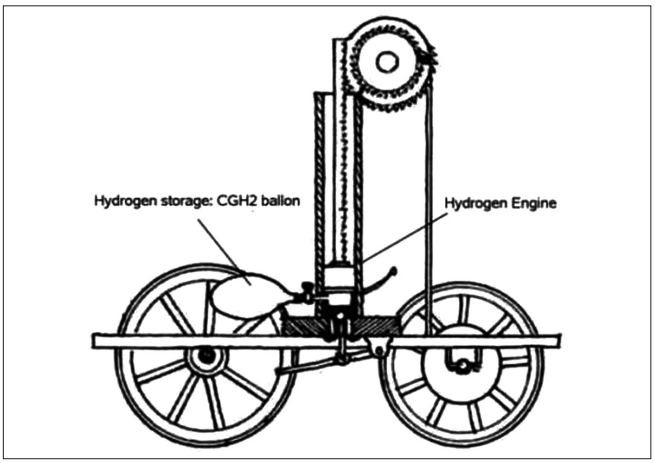

Figure 2: An automobile built by François Isaac de Rivaz - the first use of an internal combustion engine (from http://ttmax.zikforum.com/t229-datas-da-historia-do-automovel-english)

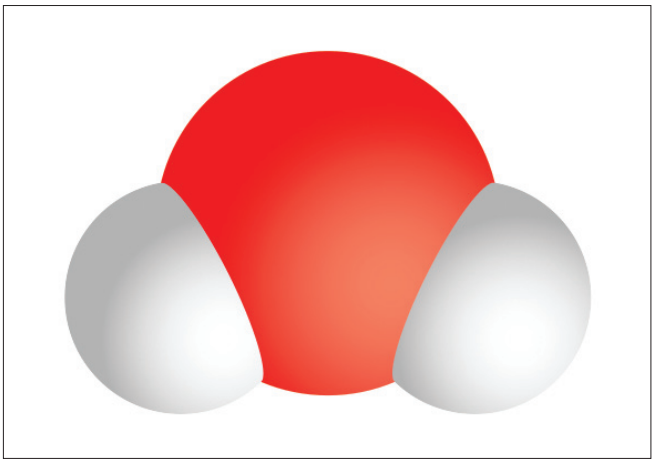

Figure 4: A water molecule (red represents the oxygen atom and white the hydrogen atoms) (from http://commons.wikimedia.org/wiki/File:Water_molecule.svg)

However, something is missing from this equation – energy. The formation of water from its elements produces, in addition to water, a tremendous amount of energy. Thus,
$2H_2 + O_2 \leftrightarrows 2H_2O$ + energy

So, to reverse the process and break the bonds would require considerable energy. That is the crux of the problem, and solving that conundrum makes the medieval alchemist's efforts to turn lead into gold seem like a stroll in the park by comparison.

Conclusion

So, what is the way forward? As things stand, time is running out for planet Earth. Yet, the solution to its energy needs – and, as a consequence, an end to global warming – might appear tantalizingly within reach. However, the issue is rarely, if ever, publicly debated by politicians and/or business leaders. While billions of pounds, dollars, and Euros are diverted into all corners of society at large, and science in particular, the sums spent on research in this vital area remain a mere drop in the ocean.

Across the nations, there seems precious little political will to commission meaningful research into discovering the key. And, of course, there are powerful vested interests in the petrochemical lobby which would be severely inconvenienced if the bottom suddenly fell out of the hydrocarbons market – and with it, the massive economic and political clout enjoyed by Organization of the Petroleum Exporting Counties (OPEC) countries and other such producers.

I believe that governments everywhere should invest considerably more than at present in research into obtaining energy from water. Given an affordable and sustainable process to create limitless supplies of clean, cheap and renewable energy in this way, this would go far toward combating global warming. In the process, it would alleviate many of the greatest challenges confronting mankind – overpopulation, poverty and famine, dwindling natural resources and threats to biodiversity – and contribute to sustainable development.

If all nations acting alone refuse to respond, for whatever reason, then, it should be the duty of a global body such as the United Nations or UNESCO, or maybe the Nobel Foundation or G20, to pick up the gauntlet instead.

The scientific obstacles may appear insuperable, but it is said that even the longest journey must start with the first step. Mankind, in whatever guise, should commit to taking that first step and to driving the process forward, thereby heralding a new dawn for all of us on Earth. The prize, when it is gained, will be well worth the effort.

References

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About the Author

Sandy Clark studied Maths, Physics and Chemistry at A Level at Tonbridge School.