The Paris Agreement last December set out a global action plan to limit the amount of greenhouse gases in the atmosphere, most significantly CO₂, in order to keep global warming well below 2°C. To achieve this, it was recognized that it was not only necessary to reduce emissions but also that one needed to start removing emissions, the so-called negative emissions, the greenhouse gases which are already in the atmosphere (see: https://theconversation.com/the-paris-climate-agreement-at-a-glance-50465).

Implicit in the above conclusion is that we need to Close the Carbon Cycle by developing technologies that would allow us to remove CO₂ already present in the atmosphere (see Global Thermostat’s article on page xx).

We can now implement a Human Designed Carbon Cycle Run by Renewable Energy (HDCCRRE) that can enable a Renewable Energy and Materials Economy (REME) that in the 21st Century will:

1. provide energy security
2. increase global prosperity so that global equity can be achieved
3. significantly mitigate the environmental degradation due to resource extraction
4. remove the threat of climate change.

There are three technologies needed, whose implementation can begin today, for HDCCRRE to enable the REME era of global security and prosperity in a way that is environmentally sustainable. In REME:

1. renewable energy will be used and fossil carbon use will be phased out;
2. CO₂ from the air and hydrogen from water will be used as the feedstock to produce our liquid fuels for our transportation sector as well as our hydrocarbon-based chemicals, pharmaceuticals and polymers; and
3. CO₂ from the air will be used to make carbon intensive building materials such as carbon fibre, replacing overtime many current uses of metals and concrete while enabling the removal and sequestering of carbon from the air.

It is also now understood that the implementation of the three technologies have the very desirable property of creating a positive feedback loop between meeting human needs and environmental improvement and long-term sustainability (Chichilnisky and Eisenberger, Int. J. Green Economics, Vol. 3, Nos. 3/4, 2009 [pp414-446]. This is because there is enough renewable energy from the sun and other sources to drive the conversion of CO₂ from the air and water to meet the energy and material needs of 9 billion people. When we use gasoline made from CO₂ from the air, we return CO₂ and water back into the earth’s ecosystem. When we use the carbon from the air to make our materials we sequester carbon like nature does. Thus in REME, contrary to today’s fossil energy based economy, the more of the sun’s energy we use, the more carbon based-materials we use, the more we address the threat of climate change. This enables the developing countries to achieve global equity with the developed countries and address the threat of climate change at the same time. Our HDCCRRE-enabled REME can run in full harmony with the carbon cycle that supports the rest of life and can be adjusted so that the impact of the two carbon cycles removes the threat of climate change that endangers all life in the short-term and the long-term (Eisenberger, P. Energy & Environment. Vol. 25, No. 5, pp 971-990, 2014). In addressing the short-term threat of climate change we will develop the capacity to fix the concentration of CO₂ at a level of our choosing and thus stabilize the average temperature of the planet.

REME transforms our fight against climate change from a burden to the catalyst for humans to achieve a future of reduced conflict and unprecedented global prosperity with a stable climate.

The HDCCRRE approach will be successful in issuing in the REME by making energy and materials comparable and even lower cost than their fossil based equivalents. This will be the case if we develop processes that can be implemented at large scale and achieve the following performances:

- renewable energy produced electricity at 2-3 cents per kWh and heat for 1cts per kWh
- a process to capture CO₂ from the air at US$25- US$50 per tonne (see our other article)
- a set of processes that can produce hydrogen at US$1-1.50 per kilogramme.

This in turn will enable us to make:

- liquid synthetic fuels from CO₂ and hydrogen for around US$3 per gallon
- our plastic and hydrocarbon-based chemicals and pharmaceuticals at less cost than they are currently produced from fossil-based carbon
- carbon fibre-based construction materials from CO₂ from the air with cost/performance properties that are cost competitive with steel, aluminum, and concrete for construction use as well as for our vehicles and furniture.

Humans made it to the moon by deciding to do so. In adopting REME this century we will create a future in which both humans and the rest of nature will prosper more than any other era, including those before our species appeared.

The path to the future

The HDCCRRE approach will be successful in issuing in the REME by making energy and materials comparable and even lower cost than their fossil based equivalents. This will be the case if we develop processes that can be implemented at large scale and achieve the following performances:

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The path to the future

Dr Peter Eisenberger is a renowned scientist, corporate research executive, business entrepreneur and leading academic. He started his career at Bell Labs during his heyday, where he used particle accelerators to conduct basic research on the fundamental properties of materials. Dr Eisenberger was then recruited by Exxon following the oil shocks of the late seventies to lead their Physical Sciences R&D laboratory, where he led a team of international scientists looking at alternative energy technologies that reluctantly concluded in 1989 that solar energy would not be commercially viable until 2012. He left Exxon for Princeton University, where he was appointed Professor of Physics and founded the Princeton Material Institute, which focused on multidisciplinary applied research in environmental technologies among others. Dr Eisenberger then joined Columbia University where he was appointed Professor of Earth and Planetary Sciences, Vice-Provost, and founding Director of the Columbia Earth Institute. In 2006, he co-founded Global Thermostat, which has developed a unique technology for the capture of carbon dioxide from air. Dr Eisenberger holds degrees in physics from Princeton and Harvard.