

Opportunities for business in a low carbon future

PNG ADVANTAGE INVESTMENT CONFERENCE 6
AUGUST 2018

Melanesia is a very special place to do business.

2



Tradition/culture & agreements.

3



Carbon Negative Technologies

LECTURE SIX: THE GRADUATE INSTITUTE

Professor Tim Flannery
Melbourne Sustainable Society Institute
University of Melbourne

The Virgin Earth Challenge

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First Trump budget. February 2018

- ▶ US \$50.00 tax credit per tonne for 'geological sequestration' of carbon.
- ▶ US \$35.00 tax credit per tonne for 'profitable use of carbon.
- ▶ Program runs for 12 years
- ▶ Definitions to be determined by relevant agencies.

Biological and Chemical Pathways to remove CO₂

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↑ Soil Carbon

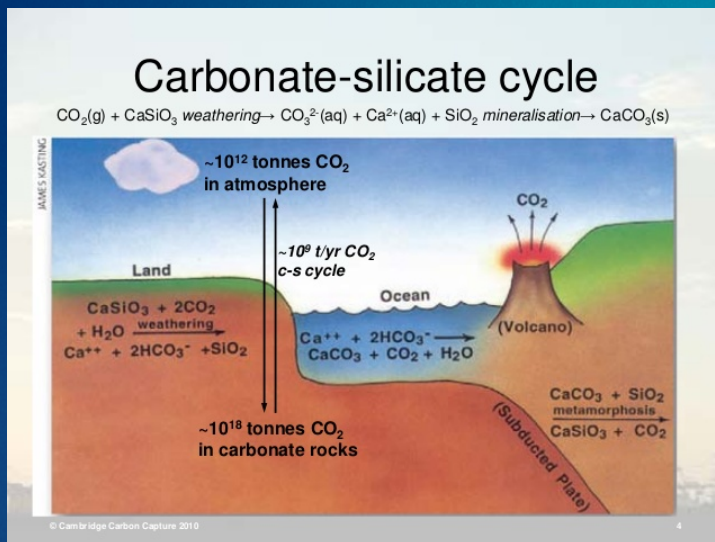


Reafforestation

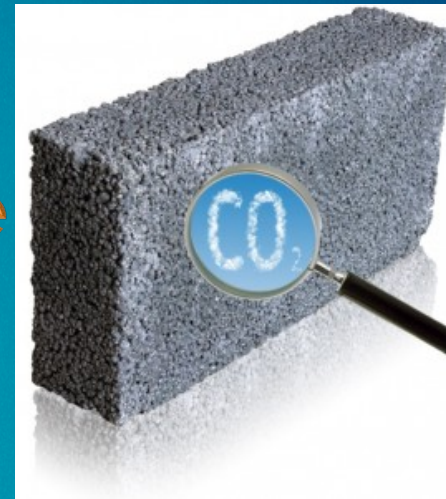


Seaweed Farming

Biological and Chemical Pathways to remove CO₂

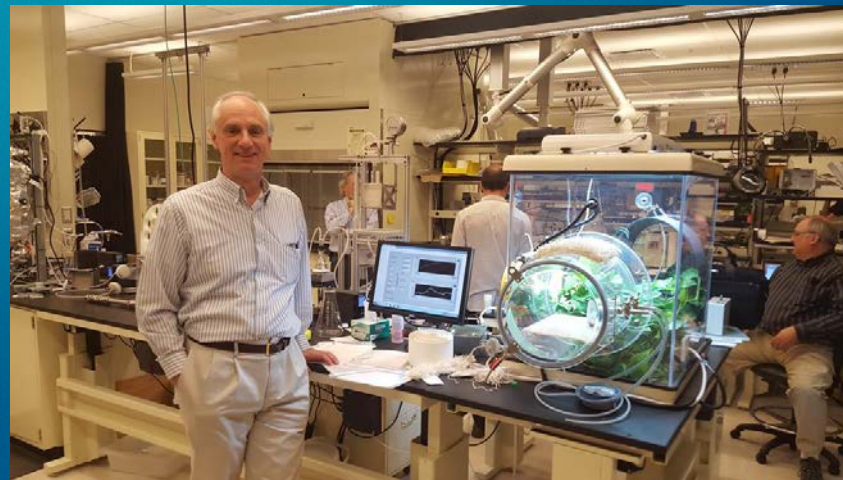


**Silicate
Rocks**



**Carbon
Negative
Concrete**

**Direct Air
Capture to
make plastics,
carbon fibres**



Trees, Trees and More Trees

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North America

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Kelp Farm

12

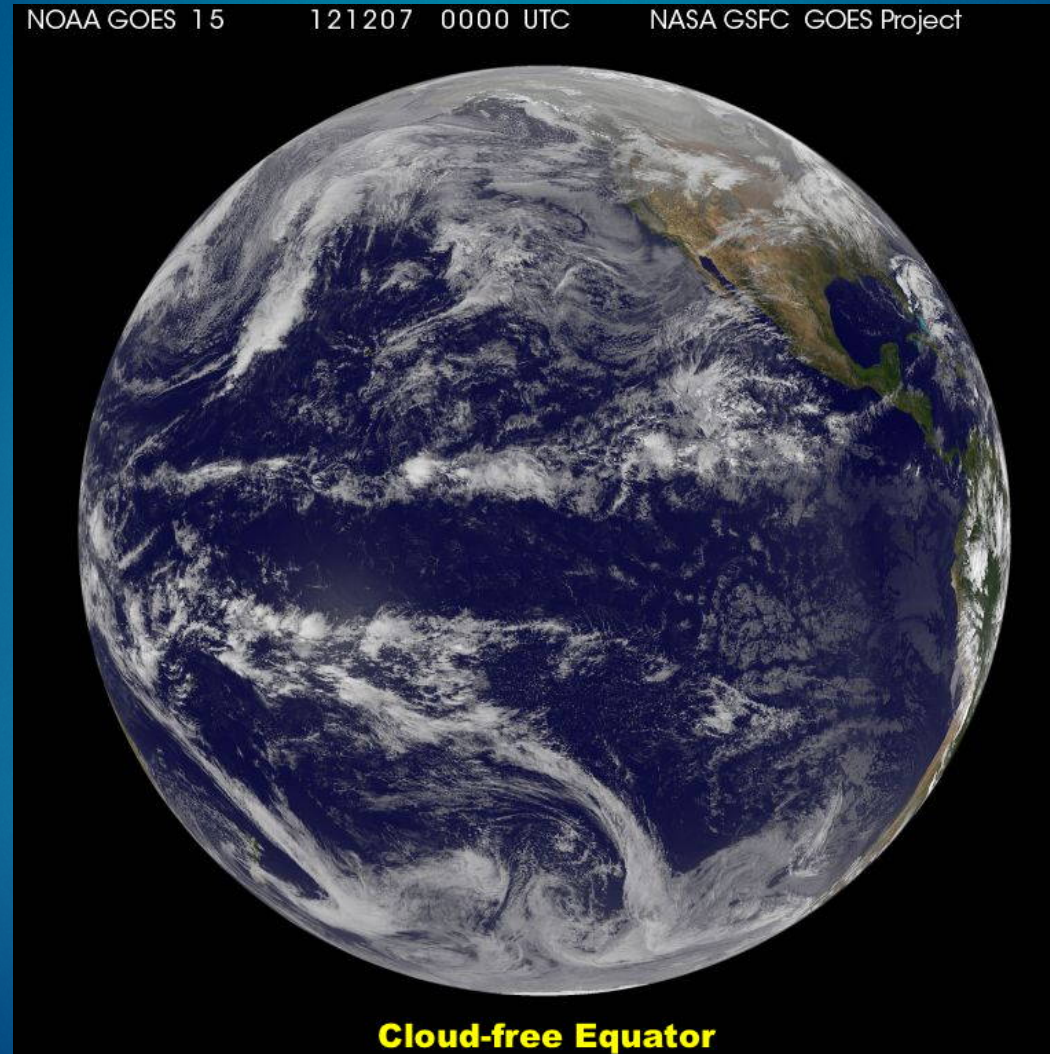


Only mid-ocean kelp farming offers storage

- ▶ If 9% of the ocean could be covered in seaweed farms, the farmed seaweed could produce 12 gigatonnes per year of biodigested methane for use as natural gas, while storing 19 gigatonnes of CO₂. A further 34 gigatonnes per year of CO₂ could be captured if the methane is burned to generate electricity.
- ▶ This would produce sufficient biomethane to replace all of today's needs in fossil fuel energy, while removing 53 billion tonnes of CO₂ per year from the atmosphere...This amount of biomass could also increase sustainable fish production to potentially provide 200 kilograms per year, per person, for 10 billion people. Additional benefits are reduction in ocean acidification and increased ocean primary productivity and biodiversity.
- ▶ N'Yeurt, A. *et al.*, (2012). 'Negative Carbon via Ocean Afforestation', *Process Safety and Environmental Protection* 90, 467–74, 2012.

Mid Pacific Ocean

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The Deep Sea

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Carbon Capture and Storage (CCS) Plant

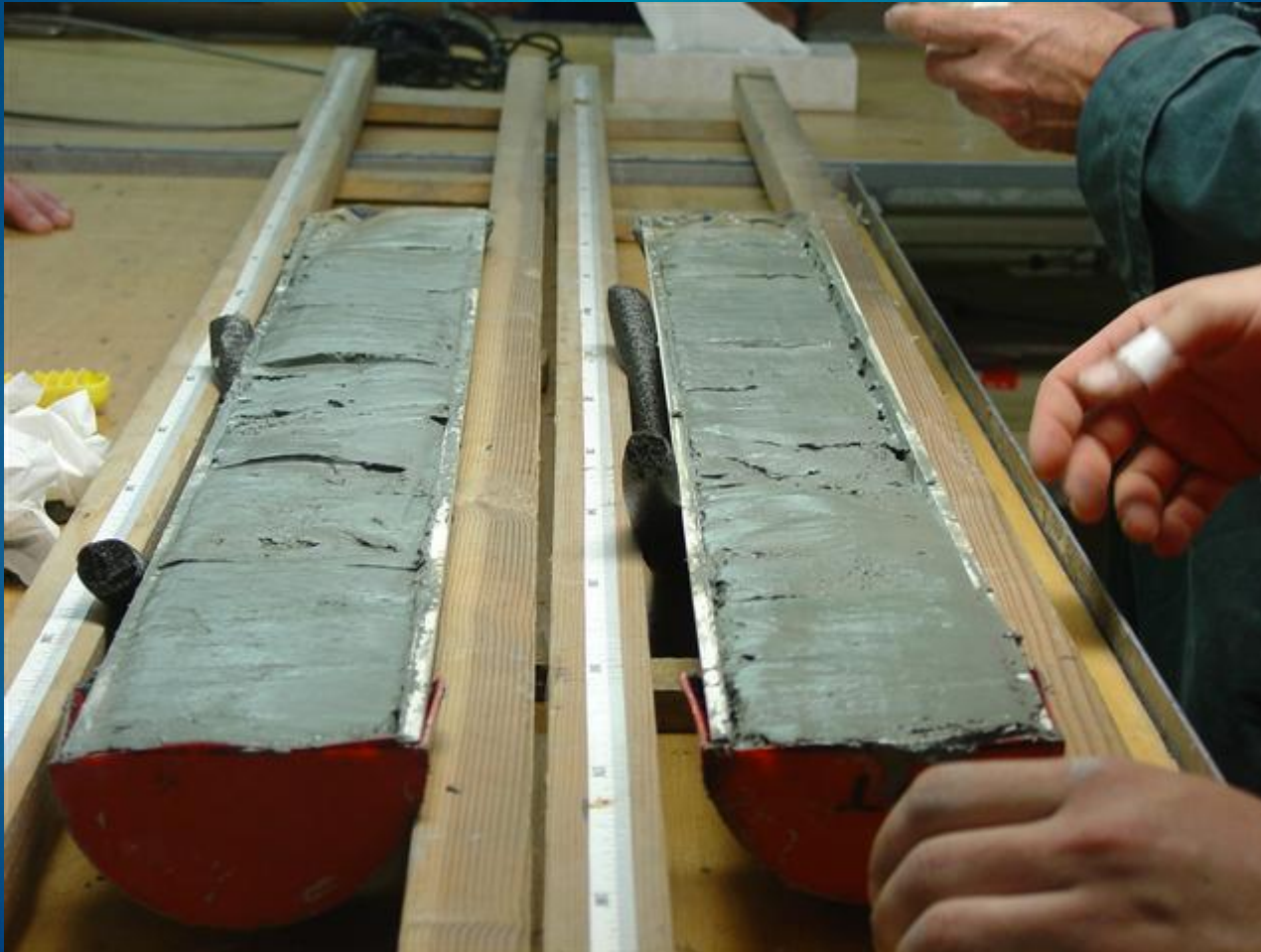
16



Source: SaskPower CCS

Sediment Core From the Deep Ocean

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Wind Turbines in the Antarctic

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Carbon Negative Cement!

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2013. First carbon negative building blocks

- ▶ The product idea is based on a research carried out at the University of Greenwich's School of Science, which focused on the reuse of thermal residues from waste to energy plants. By mixing the residue with water and carbon dioxide, the Carbon8's experts were able to transform the residue material into an environmentally friendly substitute for conventional building aggregates. The company's carbonation plant was erected in Brandon, Suffolk, next to Lignacite's masonry plant. Two companies joined forces to manufacture the Carbon Buster block which is made out of carbonated residues, mixed with binders and fillers.
- ▶ -14 kg per tonne

Silicate Rocks

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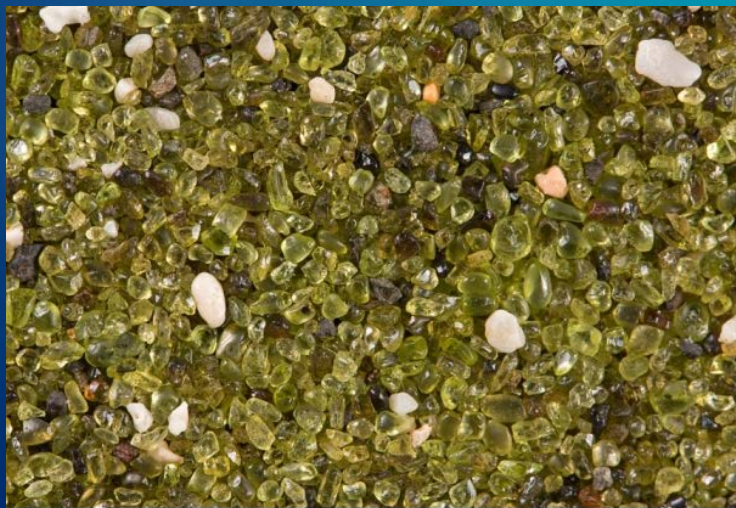
International Journal of Greenhouse Gas Control

Volume 3, Issue 6, December 2009, Pages 757–767



Coastal spreading of olivine to control atmospheric CO₂ concentrations: A critical analysis of viability

Suzanne J.T. Hangx  , Christopher J. Spiers



Sim Sepp/Alamy

nature

International weekly journal of science

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NATURE | NEWS

Rock's power to mop up carbon revisited

Experts push for more research into olivine weathering.

Daniel Cressey

21 January 2014

James Hanson et al. see a solution

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Enhanced weathering could lower atmospheric CO₂ by 30–300 ppm by 2100, depending mainly on silicate rock application rate (1 kg or 5 kg m⁻² yr⁻¹) and composition. At the higher application rate, end-of-century ocean acidification is reversed under RCP4.5 and reduced by about two-thirds under RCP8.5. Additionally, surface ocean aragonite saturation state, a key control on coral calcification rates, is maintained above 3.5 throughout the low latitudes, thereby helping maintain the viability of tropical coral reef ecosystems

Layla et al (2016). Enhanced Weathering strategies for stabilising climate... Nature Climate Change 6:204-6

Carbon Negative Roof Paint

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Olivine



Debigium in
the
Netherlands

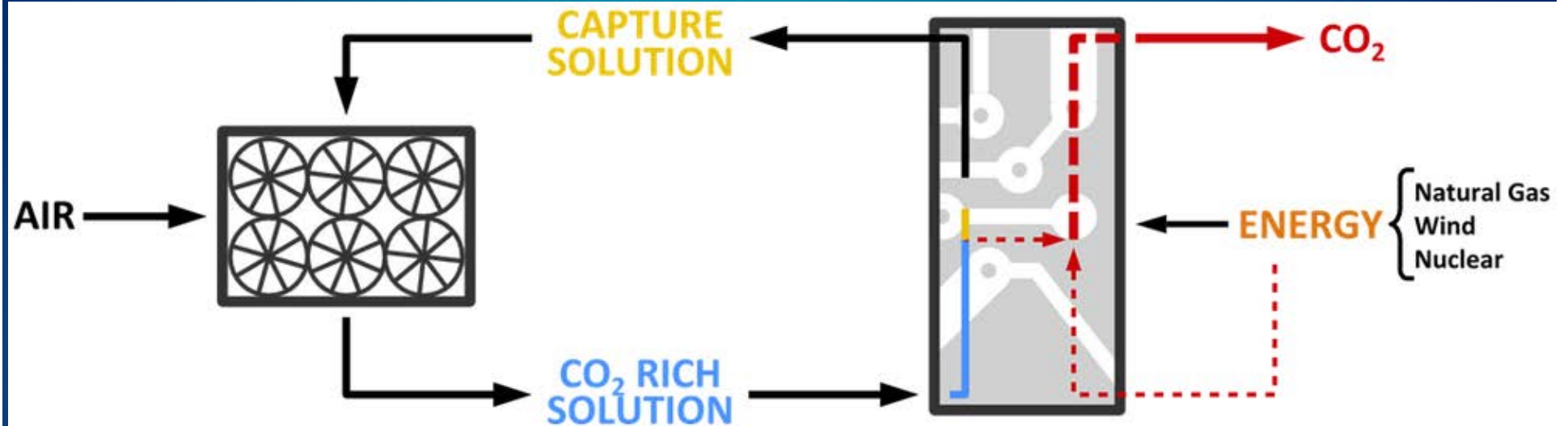
Greenland rockflour.
Sequestration value: est 125kg
per tonne

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Direct Air Capture CO₂

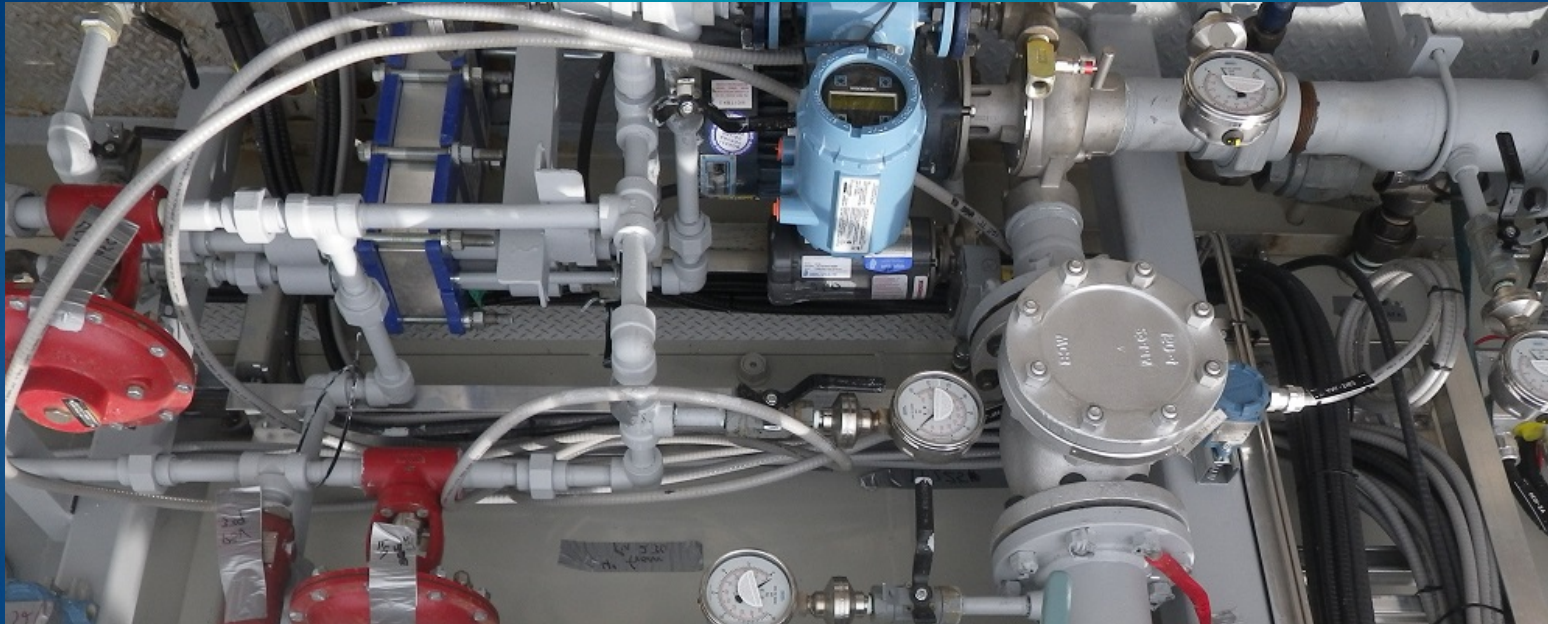
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Source: <http://carbonengineering.com/air-capture/>

CE and Greyrock partner to deliver commercial ait to fuel system

26



October 5, 2016

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- ▶ Carbon Engineering has developed an industrial process for the extraction of CO₂ from the atmosphere, and is leading integration of this system with hydrogen production and fuel synthesis steps. Greyrock Energy is recognized as the leader in small scale gas-to-liquids systems that produce clean, specification liquid fuels from gas feedstocks.

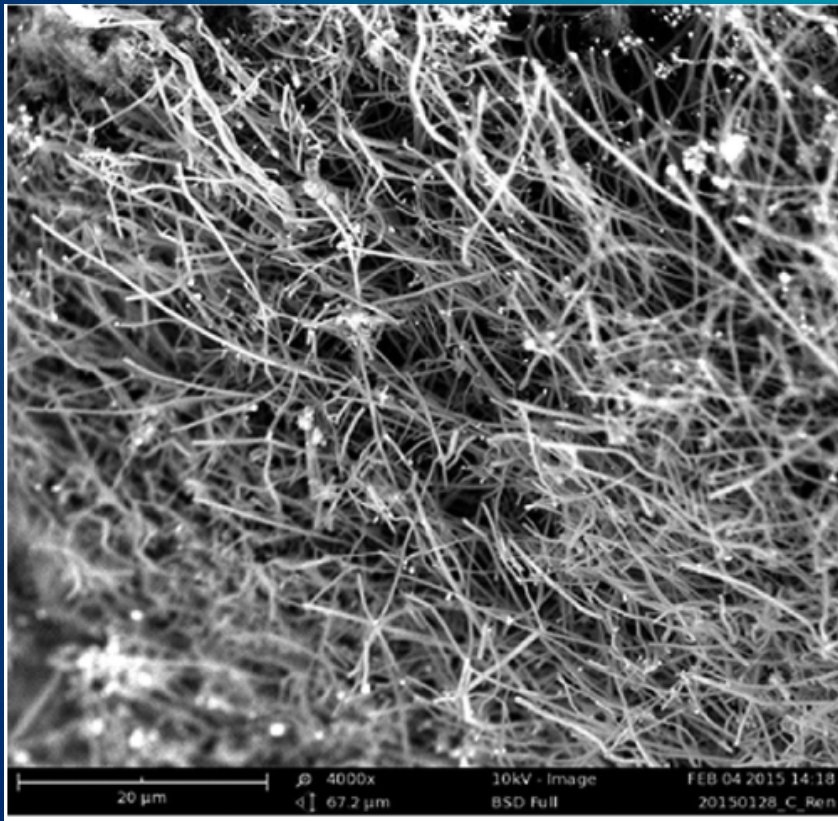
Carbon Engineering break through the \$100 per barrel barrier. 07/06/18

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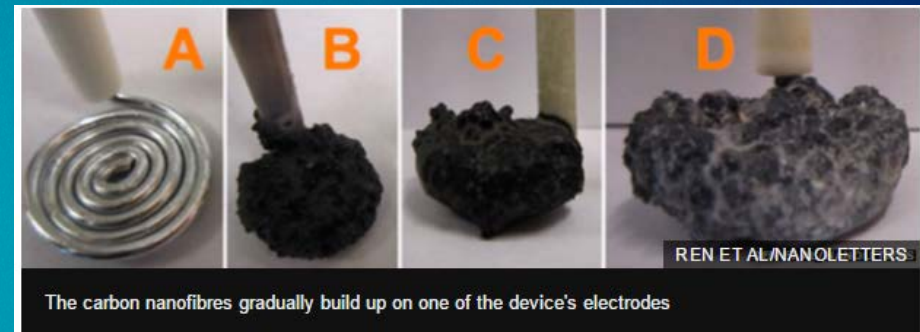


Sahara CST Licht Technologies: CO₂ and Nanofibres

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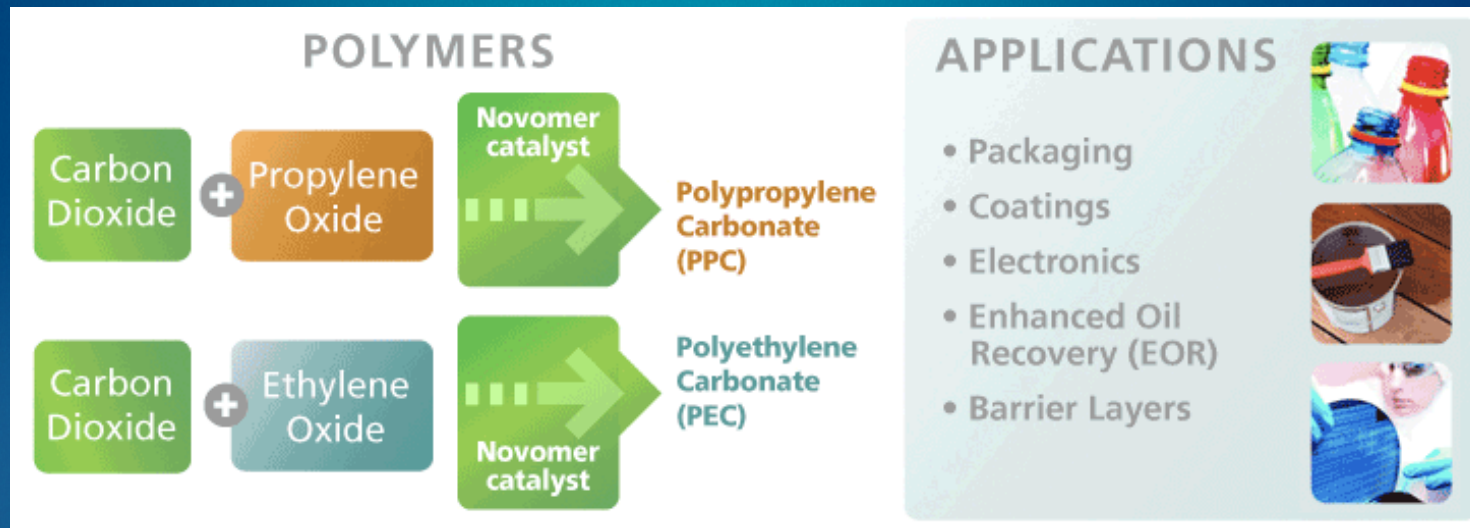


Source: **One-Pot Synthesis of Carbon Nanofibers from CO₂**
Jiawen Ren, Fang-Fang Li, Jason Lau, Luis González-Urbina, and Stuart Licht, *Nano Letters* **2015** 15 (9), 6142-6148



Bioplastics (Plastics from CO₂)

30



Source: <http://www.climate-kic.org/case-studies/plastics-project-potential-co2-reduction-of-2-9m-tons->

Source: <http://bioplasticolor.blogspot.com.au/2011/03/polymers-from-carbon-dioxide.html>

Artificial photosynthesis?

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REPORT

A synthetic pathway for the fixation of carbon dioxide in vitro

Thomas Schwander¹, Lennart Schada von Borzyskowski^{1,2}, Simon Burgener^{1,2}, Niña Socorro Cortina¹, Tobias J....

+ See all authors and affiliations

Science 18 Nov 2016:
Vol. 354, Issue 6314, pp. 900-904
DOI: 10.1126/science.aah5237



- ▶ Optimised in vitro photosynthetic pathway using 17 enzymes (3 engineered)
- ▶ 5 times more efficient than existing pathways