



The Energy Storage Challenge

Which contribution from Chemical Sciences?

Closing Remarks

David Cole-Hamilton
President-Elect
EuCheMS



Oil and gas are running out



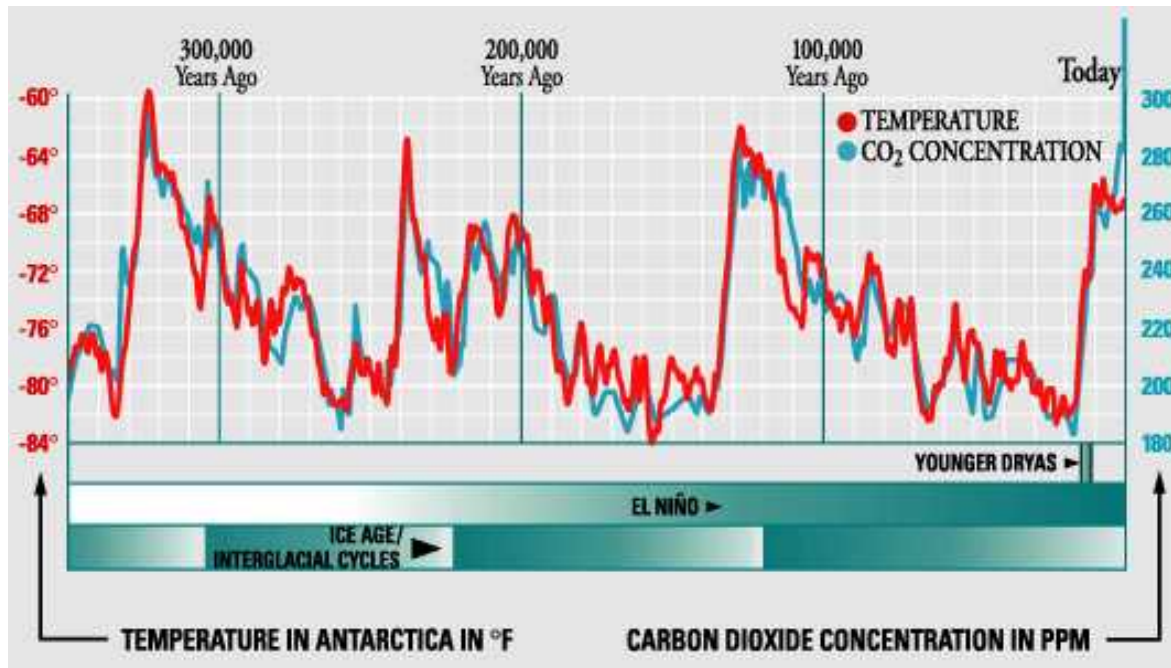
Oil lifetime – 40-50 years

BP Review of World Energy

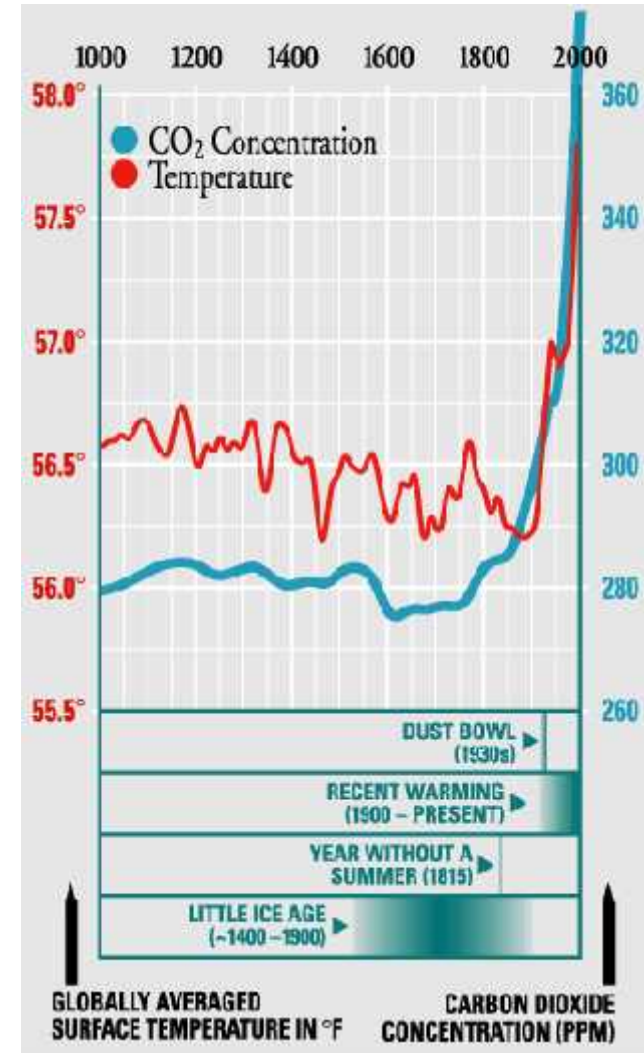
Global warming is happening



Analysis of ice cores in Greenland



Milankovitch cycles
CO₂ rise follows warming



CO₂ rise precedes warming

Tidal Energy



The sun provides all the energy coming into the earth

New Year's Day, 2104, Midday

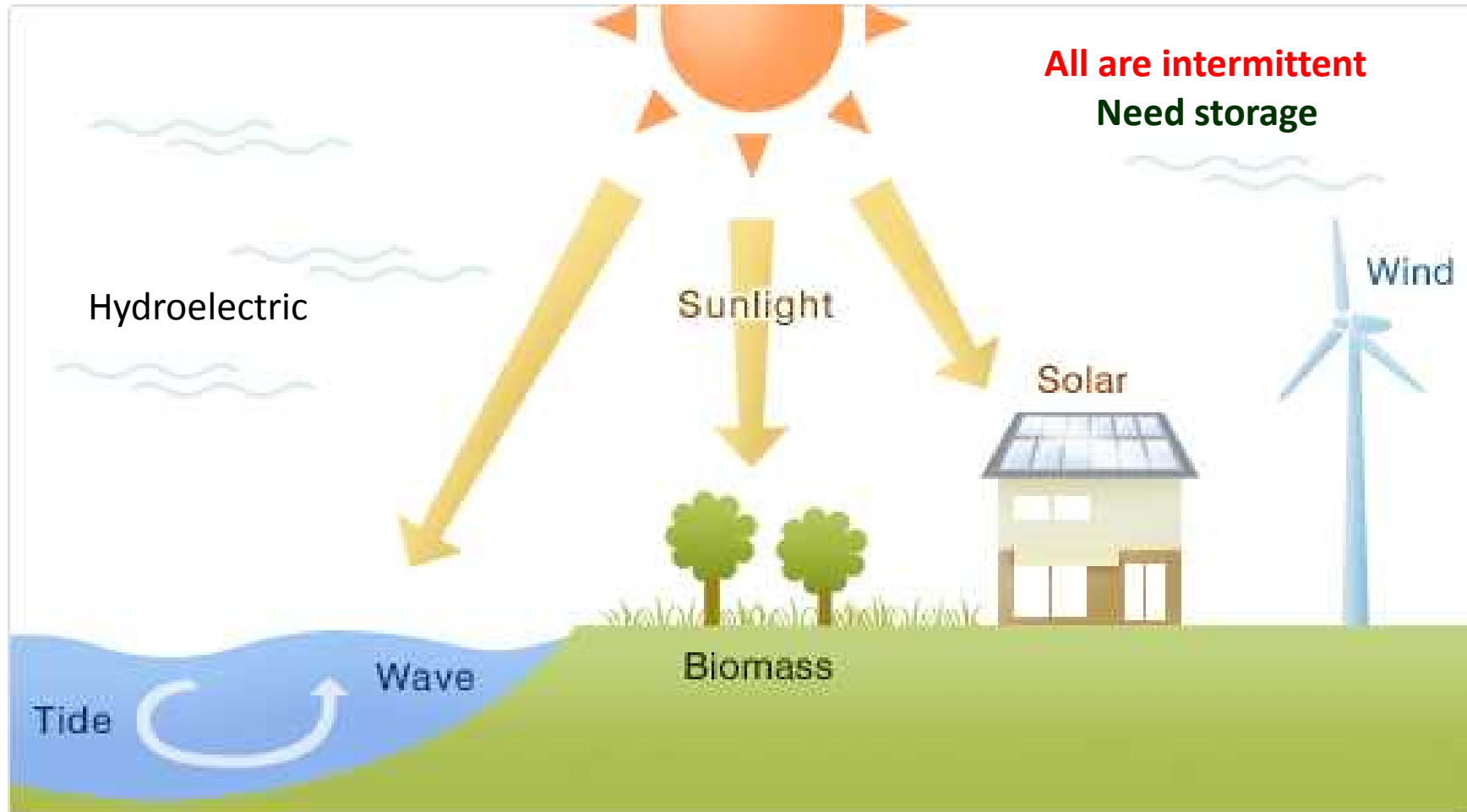


At 10 % conversion, all the world's energy needs could be met by the sun falling on an area the size of Libya



http://upload.wikimedia.org/wikipedia/commons/thumb/a/a3/Map_of_the_world_1998.jpg/512px-Map_of_the_world_1998.jpg

Solar energy conversion



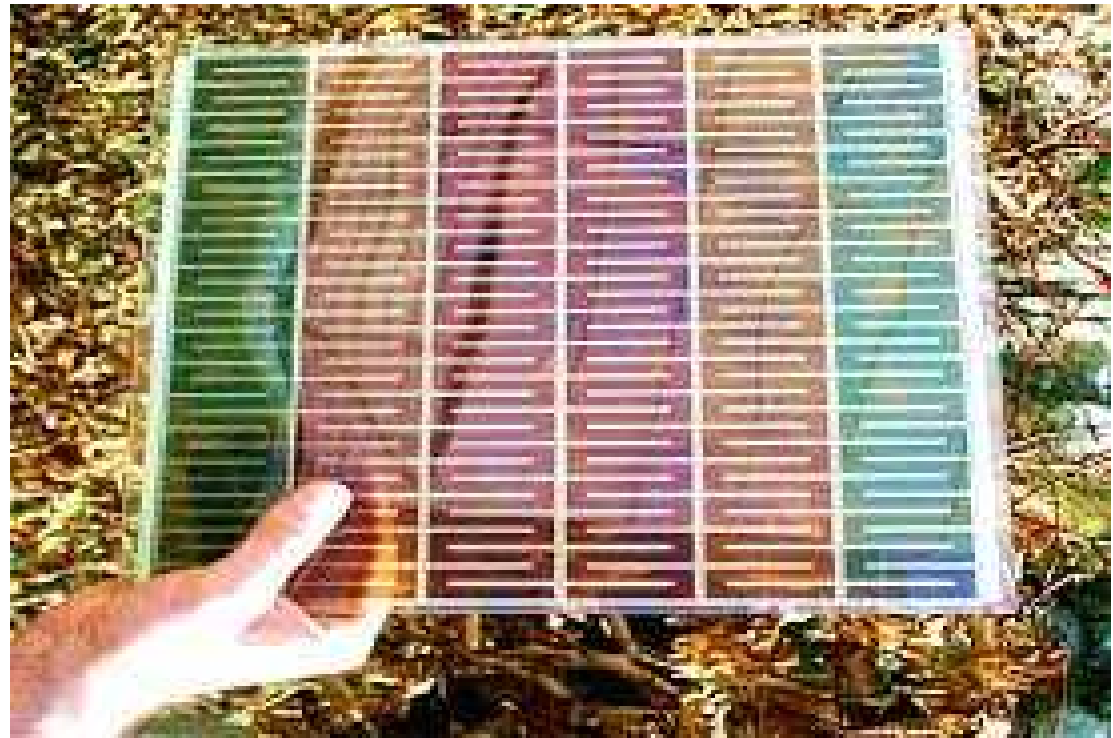
Solar panels



Dye sensitised solar cells



Michael Grätzel
EPFL



Solaris

Chemical Energy storage

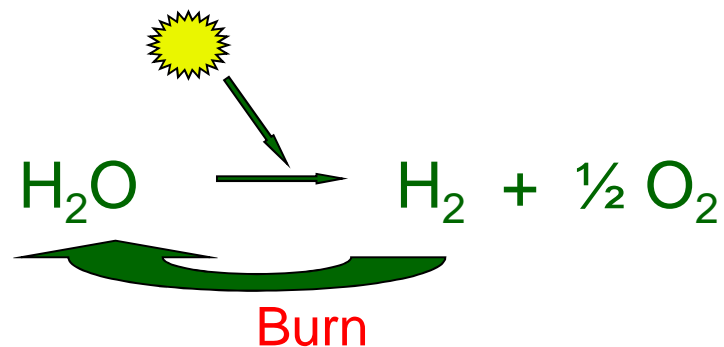
Batteries

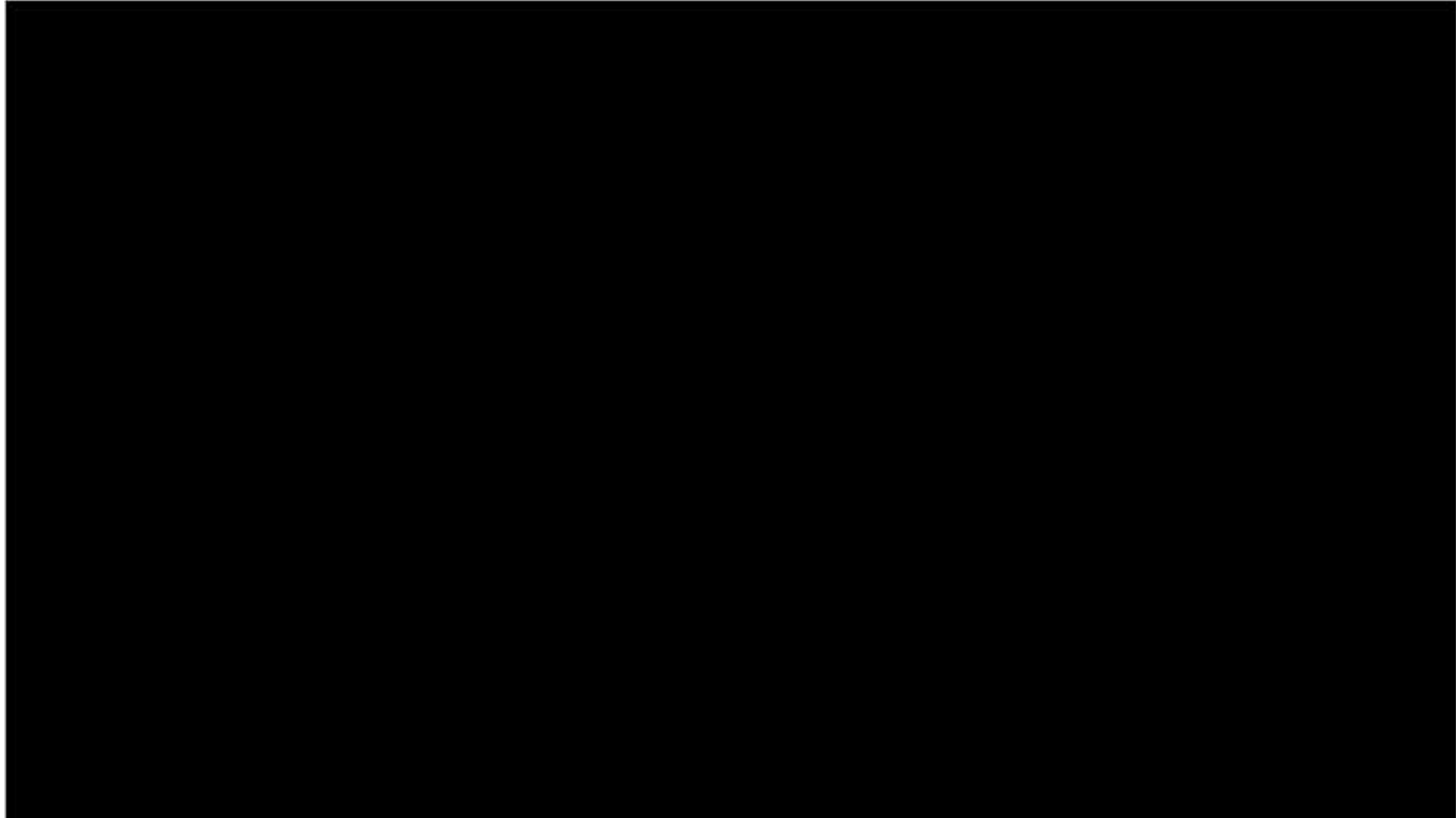
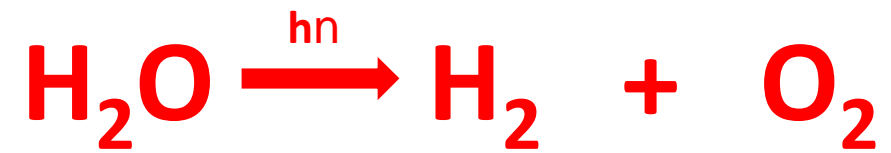


www.wordlesstech.com

Fuel	Energy density / kw h kg ⁻¹	Energy at wheels / kw h kg ⁻¹
Petroleum	13	1.7
Lithium – air battery	12	1.7

Hydrogen



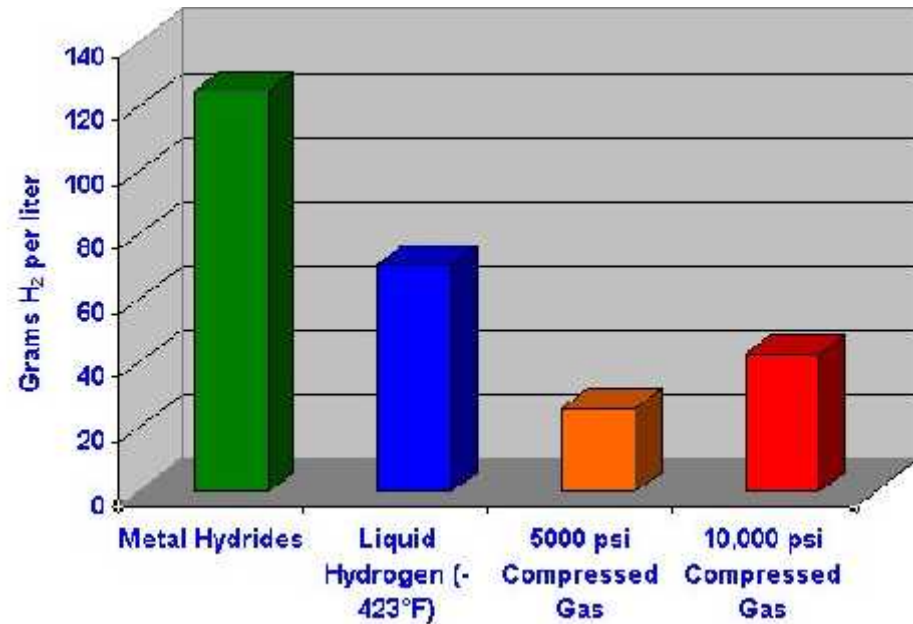
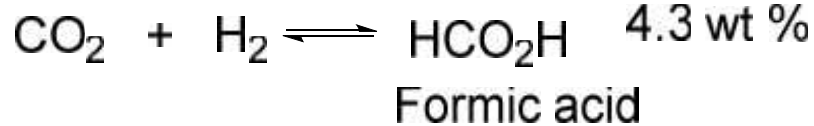
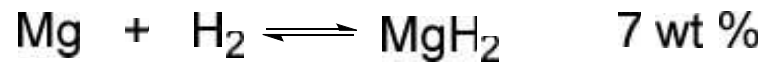


S. Y. Reece, J. A. Hamel, K. Sung, T. D. Jarvi, A. J. Esswein, J. J. H. Pijpers and D. G. Nocera, *Science*, 2011, **334**, 645

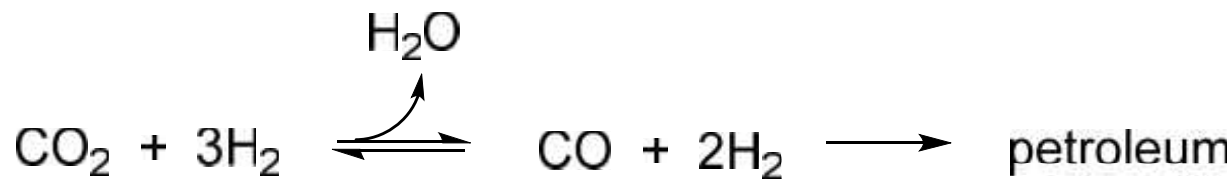
Hydrogen storage

Reversible

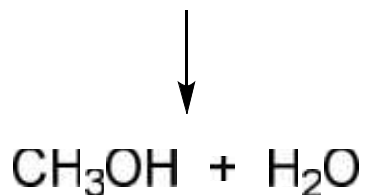
www.energywithoutcarbon



As fuel



Fischer Tropsch process



140,000 barrels / day

www.sasol.com



The Energy Storage Challenge

Which contribution from Chemical
Chemistry

is developing all the answers



<http://www.euchems2014.org/>



Themes

Resources and Environment
Chemistry and Society
Materials
Synthesis and Catalysis
Chemistry for and in Life Sciences
Understanding Matter and Reactions

Plenary Lecturers

Luisa da Cola, Strasbourg
Luis M. Liz-Marzán, San Sebastian
Sir Venki Ramakrishnan, Cambridge
Yusuf Yagci, Istanbul
Alexander Zehnder, Edmonton
Don Hilvert, Zurich
Dan Schectman, Haifa (TCS Lecturer)
Maurizio Prato, Trieste (EuCheMS Lecturer)

European Sustainable Chemistry Award Winner

<http://www.euchems.eu/awards/european-sustainable-chemistry-award.html>