



COMINO FOUNDATION

Newsletter - Developments in technology to address environment issues Issue 08/4 - September 2008

Compiled by the Environment Fellow: Anthony Darbyshire MA (Oxon) FRSA

The Comino Foundation is concerned to help address current issues regarding the environment. To address these issues the Foundation encourages people to modify their lifestyle but it is the Foundation's view that advances in technology will eventually provide the solutions. This newsletter seeks to highlight advances in environment technologies in the recent months that will have a part to play.

Developments in understanding climate change

The scientific principles which underpin climate change are not understood to the levels that are necessary to predict the impact of high carbon dioxide levels on the future climate, temperature and topography of the world. This section of the newsletter highlights current developments in these scientific principles.

Geoscale engineering to avert dangerous levels of climate change

[\(<http://publishing.royalsociety.org/index.cfm?page=1814>\)](http://publishing.royalsociety.org/index.cfm?page=1814)

[\(\[http://www.economist.com/science/displaystory.cfm?story_id=12052171\]\(http://www.economist.com/science/displaystory.cfm?story_id=12052171\)\)](http://www.economist.com/science/displaystory.cfm?story_id=12052171)

The developed world is struggling to meet its carbon-reduction targets, while emissions by China and India have soared. Meanwhile, signs suggest that the climate is even more sensitive to atmospheric CO₂ levels than was previously thought.

Frustrated by the delays of politicians, scientists, which include some at the highest levels, have for a number of years been proposing major 'last minute' schemes that might be needed if it were suddenly shown that the climate was in a state of imminent collapse. These geo-scale interventions are undoubtedly risky: but the time may come when they are universally perceived to be less risky than doing nothing.

The Royal Society has, therefore, drawn together a number of papers that debate current possibilities. These range from fertilising the oceans with iron, or growing more trees, to increase photosynthesis to absorb carbon dioxide, to using the Earth's magnetic field to eject carbon dioxide, to seeding sulphur particles in the stratosphere to reflect sunlight or to increase the reflectivity from clouds.

Carbon dioxide and methane levels rise sharply in 2007

[\(<http://news.mongabay.com/2008/0423-ghg.html>\)](http://news.mongabay.com/2008/0423-ghg.html)

Atmospheric concentrations of carbon dioxide and methane —greenhouse gases — rose sharply in 2007, according to NOAA. The U.S. weather agency said that global levels of carbon dioxide, the primary driver of global climate change, climbed by 0.6 percent, or 19 billion tons in 2007. Methane levels increased by 27 million tons after nearly a decade with little or no increase.

NOAA said that atmospheric CO₂ levels currently stand at 385 parts-per-million, or about 38 percent higher than pre-industrial levels. It noted that the rise in CO₂ concentrations has been accelerating since the 1980s when annual increases were around 1.5 ppm per year. Last year the increase was 2.4 ppm. On the other hand, the increase in methane levels is a relatively new trend. Emissions had been flat since 1998.

Rising carbon dioxide levels may increase crop yields

(<http://www.ibdeditorials.com/IBDArticles.aspx?id=300409593211234>)

Researchers at the Johann Heinrich von Theunen Institute in Germany find that the rise in carbon dioxide levels may in fact be a boon to plant life on Earth. They have been monitoring the phenomenon since 1999 by training CO₂ jets on plants and raising CO₂ concentrations in the air around them to 550 ppm, significantly higher than today's levels.

The researchers found that increased exposure to carbon dioxide appeared to boost crop yields with output increasing by about 10% for barley, beets and wheat. They concluded that higher CO₂ enables plants to grow faster and larger and to live in drier climates. That the Earth is getting greener due to higher CO₂ levels has been confirmed recently by satellite data analyzed by scientists at the University of Montana and NASA. They found that over a period of almost two decades, the earth's vegetation increased by 6.2%.

Moving towards central electricity generation with near zero green house gas emissions

Worldwide electricity generation generates 40% of green house gas emissions with worldwide demand for electricity increasing at 3% per annum. The technology already exists to near eliminate these emissions by 2050 although it is likely that emissions from central electricity generation will increase before 2020 before progressively falling thereafter. This section of the newsletter highlights current developments in moving towards electricity generation with near zero green house gas emissions.

The World's first carbon capture and storage plant goes operational

(<http://www.businessgreen.com/business-green/news/2225642/world-first-ccs-plant>)

(<http://www.timesonline.co.uk/tol/news/uk/science/article4710941.ece>)

The world's first power plant to demonstrate end-to-end Carbon Capture and Storage (CCS) technology will start operating in the third week of September 2008. The plant has been built next to the 1,600MW lignite fired Schwarze Pumpe power station in Spremberg, north Germany. It will capture some 100,000 tonnes of CO₂ a year from the station, and store it deep underground in the Altmark gas field.

The plant is operated by Swedish utility giant Vattenfall and the performance of the \$100m pilot plant will be carefully monitored globally as the use of CCS is considered as vital to reducing global CO₂ emissions by bodies such as the International Energy Agency and the European Commission.

The demonstration plant will provide much needed practical information on CCS, and is the key link towards developing a full scale commercial project, which would be about ten times the size.

The plant uses an oxyfuel boiler, which involves burning fuel in almost pure oxygen, turning the waste gas to liquid, then compressing and burying it. It is one of three types of CCS technology currently vying for dominance in the embryonic market for the technology. The other methods are post-combustion capture, which sees flue scrubbed from power station chimneys and turned into a transportable gas, and pre-combustion capture, which involves the removal of CO₂ from a fuel prior to combustion

Exxon developing alternative carbon capture and storage technology

(<http://www.businessgreen.com/business-green/news/2215963/exxon-unveils-plans-100m-carbon>)

ExxonMobil is planning to invest \$100m in a carbon capture and storage demonstration, natural gas treatment plant in Wyoming that will use new technology in this field. It is hoping to demonstrate that carbon capture and storage can become more affordable in reducing greenhouse gas emissions. The plant is scheduled to come on stream in 2009

The technology, called Controlled Freeze Zone, aims to use a single-step cryogenic separation process that freezes and then melts the carbon dioxide, while also removing other components found in so-called sour gas such as hydrogen sulphide. The carbon dioxide and other components will then be discharged as a high-pressure liquid stream, which can be injected into geological features for underground storage or alternatively pumped into oil fields to help bolster yields.

ExxonMobil claims that the approach represents a more cost-effective means of capturing carbon dioxide from natural gas than current techniques

Deep water wind turbines

(<http://www.technologyreview.com/Energy/20854/>)

Floating wind turbines far offshore is becoming a reality with the announcement of collaboration between Norwegian oil and gas producer StatoilHydro and Siemens, a major wind-turbine producer. The new partners plan to install what could be the world's first commercial-scale wind turbine located offshore in deep water. The plan is to float a Siemens turbine in more than 200 meters of water which is 10 times the depth that conventional offshore wind-turbine foundations can handle.

By late 2009, the project aims to operate a 2.3MW wind turbine in the North Sea about 10 kilometers offshore from Norway's southwestern tip. The power output is relatively small but will prove the possibility of deep offshore wind which can extend the range of wind power when there are a declining number of sites available onshore and in shallow waters. There are also regions of the world where offshore is not shallow, for example California, Japan and Norway.

Large solar farm planned for California

(<http://www.technologyreview.com/blog/editors/22116>)

Two linked solar installations producing 800MW of electricity are planned in California. This generating plant will be the same size as a medium sized nuclear power plant. The main drawback is that it will only produce electricity in the daytime when the sun is shining so that it is actually producing less electricity than the nuclear equivalent. Research and development of solar powered electricity is rapidly expanding including the technology to store solar electricity.

Wave Power projects expanding

(http://business.timesonline.co.uk/tol/business/industry_sectors/utilities/article4449287.ece)

(<http://www.pr-inside.com/ocean-power-technologies-and-griffin-energy-r595511.htm>)

Ocean Power Technologies Inc. (OTP) are one of four companies to participate in Wavehub - a project off the Cornish coast which should start to produce electricity for the grid in 2010. The projects include one which involves a floating platform in which waves push air through turbines. A second exploits tidal flow rather than waves. The third system - from Pelamis in Scotland — uses a series of floating tubes joined by hinges: as they move relative to one another, power is generated.

The fourth technology is OPT's system which consists of a steel column that sits vertically in the water. A collar like a huge doughnut moves up and down the column as waves pass. That movement drives a generator and electricity is then taken ashore. This is a proven system, by a quoted company, which is being also being deployed with the European Marine Energy Centre (EMEC) of Orkney in Scotland. In this case OPT's PB150 PowerBuoys will be installed and connected with EMEC's dedicated 2 megawatt subsea cable which is already connected to the Scottish grid. This may lead to further investment in PowerBuoy technology.

OTP have also agreed with Griffin Wave Power Ltd. in Australia to jointly develop a wave power station off the coast of Western Australia. The wave power station is planned to produce up to 10 MW, with potential expansion to 100 MW. The energy generated will be fed into the State's main power grid.

Investment in geothermal electricity

[\(<http://uk.reuters.com/article/oilRpt/idUKN1926407420080819>\)](http://uk.reuters.com/article/oilRpt/idUKN1926407420080819)

Google Inc. is investing \$10 million to produce electricity from underground heat with breakthrough technology. New technology called enhanced geothermal systems, or EGS, will improve upon the century-old technology of tapping geothermal energy from geysers, hot springs or volcanoes to generate electricity. With EGS, engineers drill their own geothermal outlets and pump in water to create steam to power a turbine.

The \$6.25 million of Google's first geothermal investment will help finance EGS company AltaRock Energy Inc of Sausalito, California. A further \$4 million will go to Potter Drilling Inc, a California company which has a hard rock drilling technology. The enhanced geothermal systems that AltaRock is developing work in a wider range of geographies than conventional geothermal ones. The key to keeping geothermal costs down is to find hot rocks that lie close to the surface. Nevada has good geothermal resources as do some Eastern states including West Virginia and Pennsylvania. To help locate good geothermal resources, Google is also providing a \$0.5 million grant to Southern Methodist University's Geothermal Lab so that they can update geothermal mapping of North America.

Developing microgeneration at the local level

There is 10,000 times more sunlight than we need to meet the world's energy requirements. The technology to collect and deploy solar energy it is about to advance exponentially in a similar way to the development of silicon chips for computers. It is possible that 50% of domestic and commercial buildings, worldwide, could be generating their own energy from solar panels by 2050.

There is already an exponential progression in the use of solar energy. Installations are doubling every two years. This section of the newsletter highlights current technology developments in microgeneration and, in particular, solar panel manufacture and deployment which is an important aspect of moving towards electricity generation with zero green house gas emissions.

Solar Power Breakthrough

[\(<http://www.technologyreview.com/Energy/21155/?a=f>\)](http://www.technologyreview.com/Energy/21155/?a=f)

Researchers have made a major advance that could lead to a cheap way to store energy from the sun. In so doing, they have solved one of the key problems in making solar energy a dominant source of electricity. Solar power is ultimately limited by the fact that the solar cells only produce their peak output for a few hours each day. The proposed solution uses sunlight with a catalyst to split water, storing solar energy in the form of hydrogen. Previous similar solutions haven't been practical because the process required too much energy, and suitable catalysts were too expensive or used extremely rare materials.

The new process catalyst clears the way for cheap and abundant water-splitting technologies. Daniel Nocera, a professor of chemistry at MIT, has developed a catalyst that can generate oxygen from a glass of water by splitting water molecules. The reaction frees hydrogen ions to make hydrogen gas. The catalyst, which is easy and cheap to make, could be used to generate vast amounts of hydrogen using sunlight to power the reactions. The hydrogen can then be burned or run through a fuel cell to generate electricity whenever it's needed, including when the sun isn't shining.

There's also still much development work to be done before Nocera's catalyst is able to be incorporated into commercial devices. Nocera and others are confident that the engineering can be done quickly because the catalyst is easy to make, allowing a lot of researchers to start working with it without delay.

This scientific advance is said to be a key discovery in an effort by many chemical research groups to create artificial photosynthesis which mimicks how plants use sunlight to split water to make usable energy. One scientist in the field considers the discovery to be groundbreaking for solar power and probably the most important single discovery of the century in this field.

Windows to become more efficient, cheaper solar panels

<http://www.independent.co.uk/news/science/new-windows-double-as-solar-panels-865592.html>

A new type of solar panel that allows light to pass through it like a pane of glass has been invented by scientists who said that it is 10 times more powerful than conventional methods of producing energy from sunlight. The discovery raises the prospect of using ordinary domestic windows to generate electricity with minimum structural alterations, although scientists have not yet worked out how much it would cost to convert a domestic home to a solar-powered generator.

The new solar panel works on the principle of concentrating the light, and the energy, at the edges of a pane of glass where it can be collected by the solar cells. Scientists from the Massachusetts Institute of Technology (MIT) in Boston said that the "solar concentrator" is made from a film of organic molecules that can be coated on to glass window panes or other surfaces exposed to sunlight. This allows light to pass straight through the window even though it is being used to generate power. It also means that the expensive solar cells need only be placed around the edges of the collecting area, so that there is little need to track the movements of the Sun for generating maximum power, as well as reducing overall costs.

Solar power is seen as one of the greenest sources of energy but it has been dogged by the relatively high costs of installing photovoltaic cells on houses and buildings, which can take years to pay off in terms of energy savings. Their efficiency in low-light conditions is also a problem for countries such as Britain where sunlight is a rare commodity in the coldest months of winter.

Steady expansion of in ground source heat pumps

<http://www.cornwallpurebusiness.co.uk/business-sectors/environmental-technology/kensa-heat-pumps.htm> (<http://www.kensaengineering.com/>)

Kensa Engineering are expanding their Cornwall based business having moved to a 20 acre disused mine site in Cornwall. The move allows Kensa to expand as the demand for renewable energy technology increases. The company considers that their heat pump engineers are the best in the business, and their award winning products can compete directly with gas and oil boilers in any new buildings that have under floor heating. Being based in Cornwall has many advantages for the company. The county truly is at the forefront of renewable technology developments, is open to new ideas and innovation and is seeking to be the home of heat pump technology in the UK."

Kensa Engineering build ground source heat pumps for any size of building, with a choice of heating or cooling optimisation, depending upon the loads. Kensa's systems are specifically designed so that no specialist training is required to install them and therefore general builders/contractors and plumbers can provide the installation service and are encouraged to do this. Every ground source heat pump that Kensa manufactures is tested to BS EN 255 (parts 1, 2 or 4 as applicable) using a calorimeter. Kensa prides itself in its testing which is far more rigorous and taken over a much longer time period and at a much greater range of temperatures than the standard requires.

[Reducing green house gas emissions from transport](#)

25% of green house gas emissions come from transport and it is important that the internal combustion engine is replaced with a form of energy that is free of emissions. This section of the newsletter highlights current developments in moving towards transport that is powered with zero, or near zero, green house gas emissions.

Guidelines established for sustainable biofuel standards

[http://www.businessgreen.com/business-](http://www.businessgreen.com/business-green/news/2223970/sustainable-biofuelstandards)

[green/news/2223970/sustainable-biofuelstandards](http://www.businessgreen.com/business-green/news/2223970/sustainable-biofuelstandards)

(Criteria - <http://cgse.epfl.ch/Jahia/site/cgse/op/edit/lang/en/pid/70341>)

Guideline standards have been designed and published by the Roundtable on Sustainable Biofuels. This organisation includes representatives from green groups, oil companies and the UN Environment Programme. The preparation of these International standards for guaranteeing that biofuels originate from environmentally sustainable sources drew on input from more than 300 experts.

The draft criteria, called Version Zero, set out 12 criteria that biofuel producers must adhere to if they are to label their fuels as sustainable. These criteria include provision of evidence their fuel delivers reductions in carbon emissions compared with fossil fuels and does not adversely impact food supplies, the adoption of measures to limit impacts on biodiversity, soil quality and water supplies and compliance with local laws.

The draft standards are currently open to consultation but questions remain about how the standards will be enforced. The standards are likely to be welcomed by green groups and politicians who have repeatedly argued that sustainability criteria are essential to ensure that demand for energy crops does not contribute to deforestation and food shortages

Electric cars move towards mainstream use

http://www.time.com/time/specials/packages/article/0,28804,1841778_1841780_1841787,00.html

http://business.timesonline.co.uk/tol/business/industry_sectors/transport/article4407182.ece

Both Denmark and Israel have agreed to work with Shai Agassi of Project Better Place in California to replace petrol driven cars with electric cars manufactured by Renault and Nissan. Both countries will see the first vehicles on the road in 2009, with production moving up into thousands in 2010, by which time the fuelling infrastructure will be starting to emerge. Portugal is also considering a similar move.

Both the Israel and Danish governments will be offering tax breaks on the vehicles. According to Agassi, the average price of a car in Denmark is \$60,000 (about €38,000), while the tax break could price an electric car as low as \$20,000 there. The Project Better Place formula for success appears to be getting a power company to provide the network, and securing the tax breaks that will make electric vehicles a compelling proposition compared to petrol.

The intention of this newsletter is to advance knowledge and understanding of some issues associated with climate change. Any views expressed are those of the author and do not, necessarily, represent the views of the Comino Foundation.

The Denmark infrastructure will consist of approximately 500,000 charging spots and 150 battery swap stations, allowing vehicles to be charged overnight, and the swap stations to be used as a petrol station equivalent for longer journeys. It is seen as important that using an electric vehicle is at least as convenient as using a petrol driven one, so the battery swap should take no longer than it would to fill a tank of petrol.

In the UK General Motors is considering switching production at its Ellesmere Port factory to building electric hybrid vehicles. At today's prices the batteries in the Flexreme car will cost £5,000 with the car costing £20,000. General Motors is discussing its plans with the UK Government with a view to securing purchasing incentives. Project Better Place are involved in the arrangements for refuelling.

Hydrogen fuel-cell cars losing ground

[\(\[http://www.economist.com/science/tq/displaystory.cfm?story_id=11999229\]\(http://www.economist.com/science/tq/displaystory.cfm?story_id=11999229\)\)](http://www.economist.com/science/tq/displaystory.cfm?story_id=11999229)

Hydrogen fuel-cell cars have been the subject of government funding for several years but mass production prospects are receding for a number of reasons, not least of which is the production and delivery of hydrogen in large quantities. Those who believe in this new form of energy for transport still believe it will play a part as an automotive fuel for the future.

Air powered car in production early 2009

[\(<http://news.bbc.co.uk/2/hi/science/nature/7241909.stm>\)](http://news.bbc.co.uk/2/hi/science/nature/7241909.stm)

[\(\[http://www.positivenews.org.uk/artman/publish/article_1559.shtml\]\(http://www.positivenews.org.uk/artman/publish/article_1559.shtml\)\)](http://www.positivenews.org.uk/artman/publish/article_1559.shtml)

A French inventor has designed the OneCAT five-seater car with a fibre-glass body, weighing just 350kg and with a prospective cost of just over £2,500. It will be driven by compressed air stored in carbon-fibre tanks built into the chassis. The tanks can be filled with air from a compressor in just three minutes - much quicker than a battery car. Alternatively, it can be plugged into the mains for four hours and an on-board compressor will do the job.

For longer journeys the compressed air driving the pistons can be boosted by a fuel burner which heats the air so it expands and increases the pressure on the pistons. The burner will use all kinds of liquid fuel. The designers say on long journeys the car will do the equivalent of 120mpg. In town, running on air, it will be more efficient.

Mr Negre, the inventor, has recently secured backing from the giant Indian conglomerate Tata to put the finishing touches to the engine. Tata will be licenced to sell the car in India. For the rest of the world investors are currently being sought. Moteur Development International (MDI) is currently finishing the construction of a small factory near Nice with production starting early in 2009

'Good' biofuel could be produced from landfill waste

[\(<http://www.timesonline.co.uk/tol/driving/news/article4369355.ece>\)](http://www.timesonline.co.uk/tol/driving/news/article4369355.ece)

Ineos, the UK chemicals company, has patented a method of producing fuel from municipal solid waste, agricultural waste and organic commercial waste. The company claims that it can produce about 400 litres of ethanol from one tonne of dry waste. The new process works by heating the waste to produce gases, then feeding the gases to bacteria, which produce ethanol that can be purified into a fuel.

Ineos plans to sell the fuel in commercial quantities by the end of 2010 and roll out the technology around the world. This source of producing a biofuel does not conflict with food production and will help meet biofuel targets.

Solar plane flies non stop for 3 days

(<http://www.telegraph.co.uk/news/2613248/British-solar-plane-sets-record-by-flying-non-stop-for-three-days.html>)

A British built plane powered entirely by solar power has set a world record for an unmanned flight by staying in the air for more than three days. The unpiloted plane was able to run day and night due to solar panels glued to its wings and in-built lithium batteries that store power from the sunlight ready for when it is dark.

Initially, the US is looking for new defense technology to help support its troops on the ground. It is likely that the unmanned plane will also be used by the UK armed forces once it is ready. The 30kg plane has a 18 metre wingspan and has sophisticated technology to enable it to be guided remotely up to 60,000ft. before being flown on autopilot with satellite communication.

Boeing test flight of fuel celled airplane

(http://www.boeing.com/news/releases/2008/q2/080403a_nr.html)

In April 2008 Boeing flew a manned airplane powered by hydrogen fuel cells near Madrid for the first time in aviation history. This new airplane is the work of an engineering team at Boeing Research & Technology Europe (BR&TE) in Madrid, with assistance from industry partners.

The fuel cell used is an electrochemical device that converts hydrogen directly into electricity and heat with none of the products of combustion such as carbon dioxide. Other than heat, water is its only exhaust. A two-seat Dimona motor-glider with a 16.3 meter wingspan was used as the airframe. Built by Diamond Aircraft Industries of Austria, it was modified to include a Proton Exchange Membrane (PEM) fuel cell/lithium-ion battery hybrid system to power an electric motor driving a conventional propeller.

Three test flights took place in February and March at the airfield in Ocaña, south of Madrid, operated by the Spanish company SENASA. During the flights, the pilot of the experimental airplane climbed to an altitude of 1,000 meters (3,300 feet) above sea level using a combination of battery power and power generated by hydrogen fuel cells. Then, after reaching the cruise altitude and disconnecting the batteries, the pilot flew straight and level at a cruising speed of 100 kilometers per hour for approximately 20 minutes on power solely generated by the fuel cells.

According to Boeing researchers, PEM fuel cell technology potentially could power small manned and unmanned air vehicles. Over the longer term, solid oxide fuel cells could be applied to secondary power-generating systems, such as auxiliary power units for large commercial airplanes. Boeing does not envision that fuel cells will ever provide primary power for large passenger airplanes, but the company will continue to investigate their potential, as well as other sustainable alternative fuel and energy sources that improve environmental performance.

Anthony Darbyshire MA(Oxon), FRSA
Environment Fellow – Comino Foundation
September 2008