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Some Observations on Emissions Trading

Introduction

According to James Hansen et al. "Paleoclimate data show that the Earth's climate is remarkably sensitive to global forcings. Positive feedbacks predominate. This allows the entire planet to be whipsawed between climate states. Some forcings are especially effective at high latitudes, so concerted efforts to reduce their emissions could still "save the Arctic", while also having major benefits for human health, agricultural productivity, and the global environment."(Hansen, Makiko et al. 2007)

The climate during the Holocene has been remarkably stable compared to earlier epochs and has been a major factor in the evolution of civilization as we know it. We are however agents of our own downfall as emissions since the beginning of the industrial revolution are having a major greenhouse effect on climate first brought to the attention of the world by Arrhenius (Arrhenius 1896) and now confirmed by thousands of scientists.

Some governments are in fear of change yet modern economic theory (evolutionary economics in particular) is based on the fact that change is the major driver of economic growth. This process, called creative destruction by Schumpeter (Schumpeter 1954), is whereby new innovation destroys old and less efficient process and is the drive engine of modern economies.

The Australian and US governments have failed to recognise the urgency of global warming, the economic truth that that change is a driver not a brake and have denied innovative Australian businesses the opportunity to participate in the growing international market for carbon credits.

As custodians of the future it is the responsibility of governments to do something about anthropogenic forcings of climate. The paper discusses policy misunderstandings and basic failures in the political and economic system in the way of the vital role of planetary maintenance.

The role of governments is to add value to change that maintains homeostatis in planetary systems and for the same reasons that we require a national system for carbon trading in Australia we need a global system.

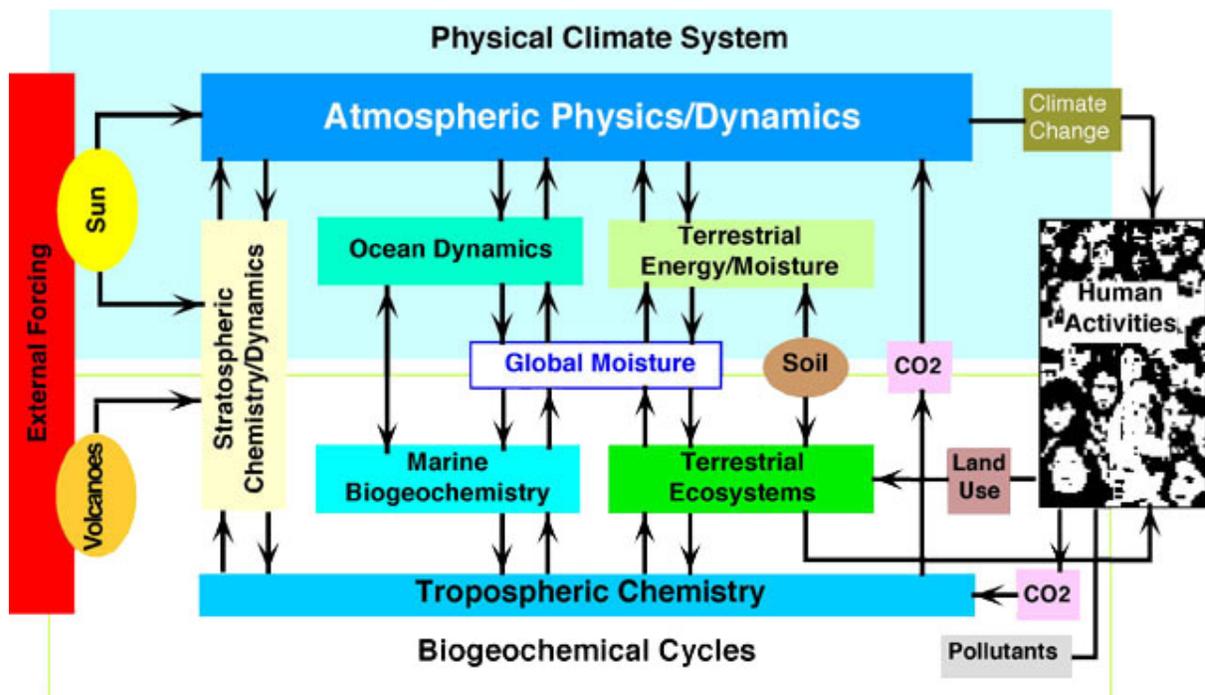
Earth Systems

The Earth is a complex system of interacting physical, chemical and biological processes, and provides a natural laboratory whose experiments have been running since the beginning of time.

It was probably Buckminster Fuller¹ who got us all thinking of earth as a connected independent entity requiring maintenance. His story is a fascinating one as throughout his life he was concerned with the question "Does humanity have a chance to survive lastingly and successfully on planet Earth, and if so, how?"

James Lovelock² in his various books on Gaia theory brought to the attention of many the importance of viewing earth in such a holistic way. Lovelock's books are forerunners of what we now call earth systems science.

Earth systems science treats the entire Earth as a system in its own right, which evolves as a result of positive and negative feedback between constituent systems and is being confirmed by computer models which are giving scientists the tools to develop and test hypotheses that explain past and possible future behaviour.



Earth Systems Science (NASA 1988)

The Earth system is often represented by interlinking and interacting "spheres" of processes and phenomena. The atmosphere, hydrosphere, biosphere and geosphere form the simplest collection, though some would add the cryosphere as a special element dealing with polar regions and processes, and others would add the anthroposphere emphasizing human dimensions and impact on the planet.

¹ Richard Buckminster ("Bucky") Fuller (July 12[1], 1895 – July 1, 1983) was an American visionary, designer, architect, poet, author, and inventor. Fuller devoted his life to the question as to whether humanity had a chance to survive lastingly and successfully on planet Earth, and if so, how. Pursuing this lifelong experiment, Fuller wrote twenty-eight books, coining and popularizing terms such as "spaceship earth".

² Dr James Ephraim Lovelock CH CBE FRS, was born on July 26, 1919 and is an independent scientist, author, researcher, environmentalist and futurologist who lives in Cornwall, in the south west of Great Britain. He is most famous for proposing and popularizing the Gaia hypothesis, in which he postulates that the Earth functions as a kind of super organism (a term coined by Lynn Margulis)



Figure 1 - A simplistic representation of Earth Systems after Ruzek, USRA

The difficulty with simplistic representations such as the one above is that they divide the system artificially continuing a deconstructed perception of what is in reality a more holistic total Earth system in which no part should be considered in isolation from any other part.

Chemistry, physics, biology, mathematics and applied sciences are all drawn upon in our attempts to understand Earth as an integrated system.

We now need economists and politicians to understand what we are doing to earth systems. I have some hope for economists after the release of the Stern Review.³

The Problem of Externalities

“For that which is common to the greatest number has the least care bestowed upon it. Every one thinks chiefly of his own, hardly at all of the common interest; and only when he is himself concerned as an individual.” (Aristotle 350 BC)

The issue of looking after and therefore valuing the commons, first discussed by Plato, Aristotle’s teacher, continues as one of the main topics for debate amongst modern political philosophers and is far from resolved. A more recent book “The Tragedy of the Commons” by Garrett Hardin (Hardin 1968) raised the problem in relation to the population debate. He argued that the “invisible hand” (laissez-faire) approach to resource problems does not always provide optimal solutions. In Hardin's hypothetical commons, the action of self-interested individuals cannot promote the public good. A more recent book by John Ralston Saul (Saul 2005) discusses globalism and highlights the current inadequate response to issues of the common good.

³ The Stern Review on the Economics of Climate Change was released to the British government on the 30 October 2006 by Sir Nicholas Stern, Head of the Government Economics Service and Adviser to the Government on the economics of climate change and development. It advises that not taking action will cost a lot more than taking action. A summary is included in Newsletter 64 available for download from the TecEco web site at www.tececo.com

As sustainability issues become more urgent, studied and understood by the masses a cultural drift is noticeable resulting in a will to embrace change. The legal, political and institutional mechanisms are however lacking to bring about change on a timelier basis, thereby matching the urgency of the problem.

The major problem today is not so much one of use but of degradation of the commons, on a global rather than village green scale.

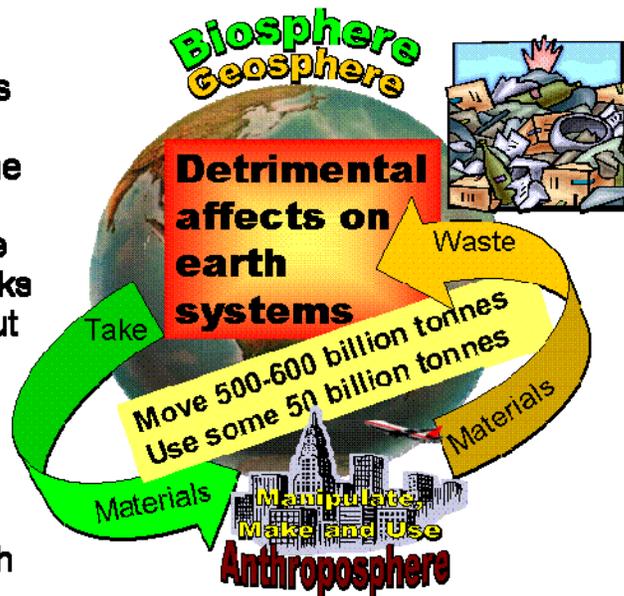
Defining Externalities

Economists like me call the costs associated with pollution (some of which cannot easily be measured in monetary terms) externalities. Definitions abound but a good one from About: Economics⁴ is that an externality is an effect of a purchase or use decision by one set of parties on others who did not have a choice and whose interests were not taken into account.

Pollution, generated by productive enterprises affects others who had no choice and were probably not taken into account. Emissions are a classic externality that a carbon tax would legally factor into the cost of energy, but which can be traded out by the purchase of credits. A carbon tax would bring the externality (emissions) into the market place whereby the forces of supply and demand once given value, can modify the quantity.

The Techno-Process

Underlying the techno-process that describes and controls the flow of matter and energy are molecular stocks and flows. If out of tune with nature these moleconomic flows have detrimental affects on earth systems.



Earth System Science

Earth system science treats the entire Earth as a system in its own right, which evolves as a result of positive and negative feedback between constituent systems (Wiki)

To reduce the impact on earth systems new technical paradigms need to be invented that result in underlying molecular flows that mimic or at least do not interfere with natural flows and that support rather than detrimentally impact on life.

Figure 2 – The Techno-Process (Harrison 2005)

Underlying the vast 600 billion tonne flow of materials through our take-make-use-waste techno-process (see Figure 1), 70 % of which is the construction industry, are molecular flows that are damaging the planet such as too much CO₂ in the air or heavy metals

⁴ <http://economics.about.com/cs/economicsglossary/g/externality.htm>

released to our common waters (See Figure 2). These impacts are external to our economic system and not costed.

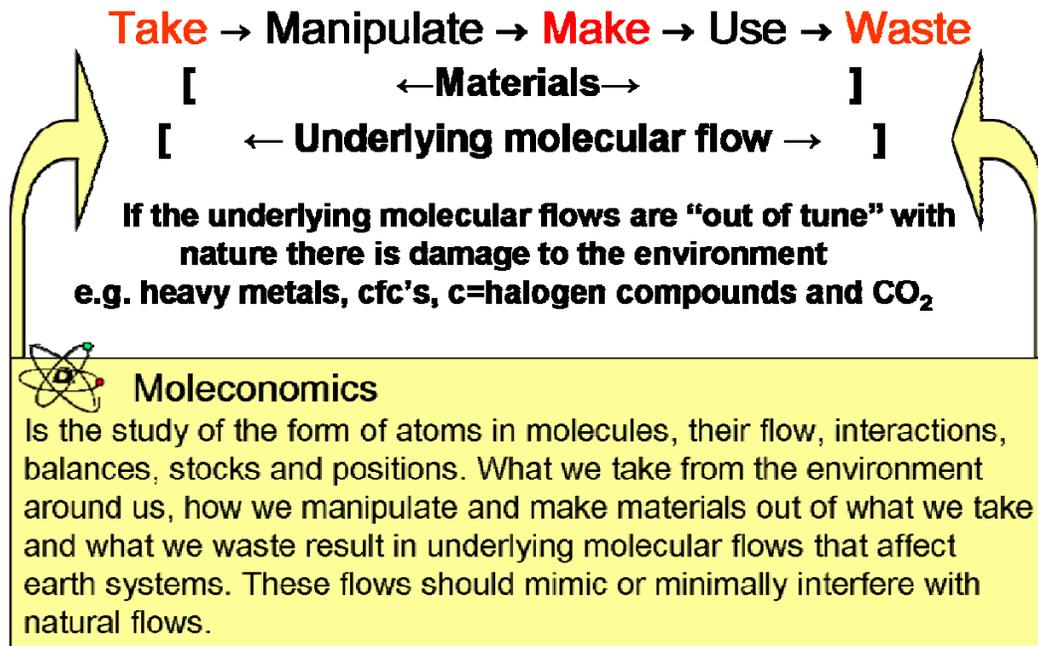


Figure 3 - Moleconomic⁵ Flows that are Damaging Underlay Materials Flows (Harrison 2005)

We will all however feel the brunt of global warming as the climate changes, as individuals we do not consider ourselves responsible, but with 6.5 billion of us all collectively polluting we are changing the planet. To prevent this continuing a system of putting a cost on detriments to the global commons is essential

⁵ Moleconomics Is the study of the form of atoms in molecules, their flow, interactions, balances, stocks and positions. What we take from the environment around us, how we manipulate and make materials out of what we take and what we waste result in underlying molecular flows that affect earth systems. These flows should mimic or minimally interfere with natural flows.

The word ‘moleconomics’ is a new word for a new and still evolving discipline involving the study of the situation of atoms in molecules, their flow, interactions, balances, stocks and positions on scales ranging from local to universal [1]

A molecule is the smallest unit of a substance that can exist alone and retain the character of that substance. The suffix economics is derived from the Greek words ἴκος [okos], 'house', and νόμος [nemo], 'rules' hence household management. Moleconomics is molecular management pertinent to the earth (the household)

Unnatural moleconomic imbalances have resulted in stocks of some molecules such as carbon dioxide, CFC’s, and heavy metals in undesirable positions such as the global commons.

Anthropoid technical paradigms, driven by fossil fuels and used by techno-processes in the techno-sphere result in an underlying flows of molecules. Flows are to positions and result in stocks, some of which are unnaturally high or low. The study of this process is the science of moleconomics

By changing the technical paradigms we can redefine the moleconomics of the planet.

Externalities related to the techno-process are characterised by causes and effects in different time and geographical scales. The causes take place essentially in market places and have a cost of 'causing' and a value from having 'caused' Unfortunately many of the effects or consequences of 'causing' do not take place locally or in the same short time frame and are thus disassociated from market places and do not have a cost or value to individuals in the shorter term as Aristotle so astutely observed.

'Causes' affecting the global commons take place with the here and now benefit or loss being measured in market places but the long term consequence being ignored as not being condensable to present value.

This is where putting a legal cost on emissions is so useful, it bring cause and effect into he same market place so that quantities can be dealt with.

The main aim of the National Emissions Trading Taskforce should be to address the complex and as yet unsolved problem of externalities first enunciated by Aristotle and now threatening to annihilate us with irreversible climate change.

Doubters should stop for a moment to consider the consequences of not addressing the issue of climate change.

Solution Multipliers and Connectivity

A relatively congenial climate during the holocene or recent period is what has allowed the development of civilisation as we know it. Tackling climate change by curbing CO2 emissions will actually help resolve a number of other problems and the reason is because they are all connected.

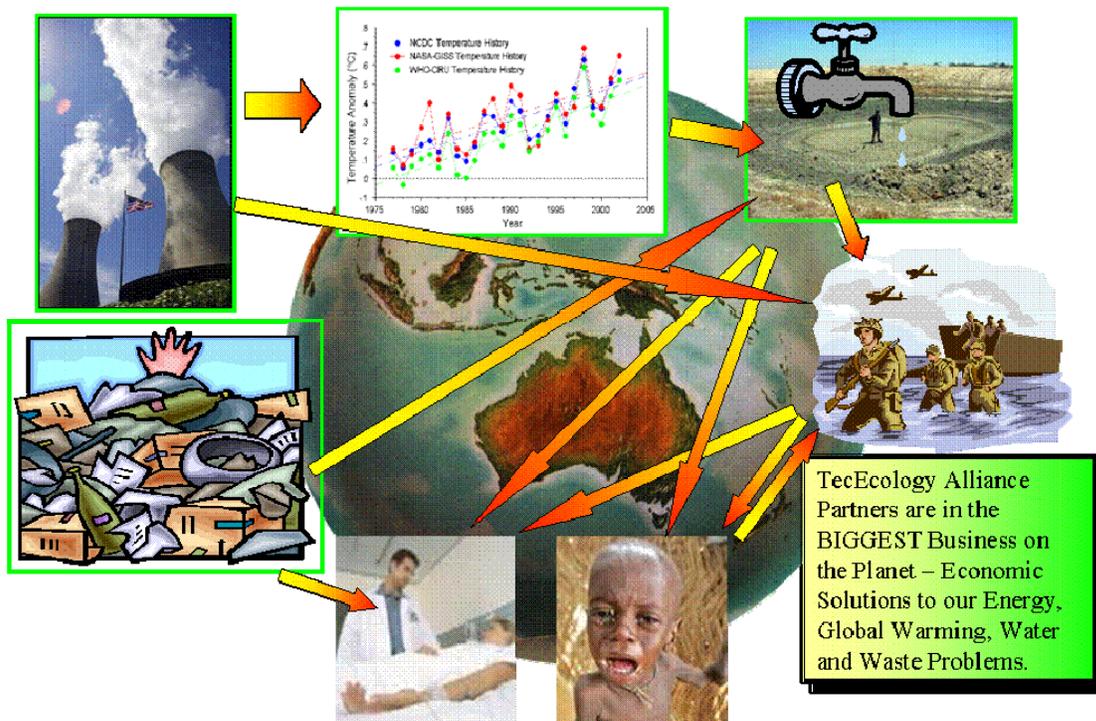


Figure 4 - Climate Change has Major Connectivity with Other Global Issues

Climate change will not just affect sea level and polar bears. It is already having an affect on health, agriculture and many other global issues due to this interconnectivity.

De-Politicising the Planetary Custodian Role – Towards a Charter?

Governments are elected for short terms and under pressure to deliver short term outcomes to the electorates of each member - a process not conducive to long term planetary maintenance.

To solve problems of the global commons such as too much CO2 it is essential to take a wider, longer term view, wider than that of regional governments and longer than that of successive short term power plays. Contrary to the parochial political view held by the Australian government this is best achieved on a global rather than national scale, however on a national scale better than no scale at all. We are therefore making some progress that we are considering a trading scheme at all.

The author made a submission to the Committee of Enquiry into a Sustainability Charter that would have enshrined fundamental postulates or principles that translate as means to deliver valuation of the natural capital not only of Australia but the world (as much of it is “common”) and thereby facilitate incorporation into our value exchange system that we call accounting.

A charter would define policies whereas a trading scheme is a tool to bring about these policies, and supported by a legal price on carbon emissions would have the function of bringing into the market place externalities. Whether a charter should address issues of the global commons because it is the right thing to try to do or for some other reason such as satisfying human survival needs is not determinable as all of these currents are flowing. By facilitating mechanisms that enshrine value for externalities a charter, at the very least, will help address the problem of accounting for them enunciated by Aristotle. One very important tool for this new way of thinking and acting is a trading scheme supported by taxes on carbon.

The political process in western democracies is too short term in outlook to adequately address solutions to problems like global warming and this is a good reason to consider a charter which just as the reserve bank sets out to regulate the economy would strive to achieve global homoestasis. A charter supporting a trading scheme would de-politicise and give dimension to the urgency of response to the problem and could be a way forward for the Howard government allowing it to reverse it's decision not to join Kyoto or its successor.

To adequately consider wider impacts than carbon alone there remain questions as to whether a charter should spell out values, a process for arriving at the values required or act a mere guide to legislation that does so on a more flexible basis. Our initial view is that defining the urgency, principles and process for addressing the problem will more likely ensure that a national emissions trading scheme survives and that those trading in such a scheme prosper and grow. As for most good ideas there is otherwise a danger the charter is little more than rhetoric warming the air. Processes like a real money here and now trading scheme are also generally better than prescriptions as they are less adversarial and more flexible.

There are few scientists in government and more lawyers than any other profession. Lobbyists abound. They are the largest group of short term gainers and sadly

governments listen to them instead of the grass roots. But there is change afoot, the mischief of their false economic arguments designed for their own profit is becoming understood and even energy companies like Santos are saying we need to join Kyoto or its successor.

Beyond Globalisation - Addressing the Common Good

Globalisation implies that commerce will lead civilizations, that every activity, once released from government interference will find its own natural balances and that nation states would become irrelevant and the power of markets would determine the course of human events.

According to John Ralston Saul, globalism is “an inevitable form of internationalism in which civilization is reformed from the perspective of economic leadership.”Saul then argues that AIDs, the African debt, the return of fundamentalism and terrorism, and many other common problems are not disappearing in spite of a theoretical resulting rise in global prosperity (Saul 2005).

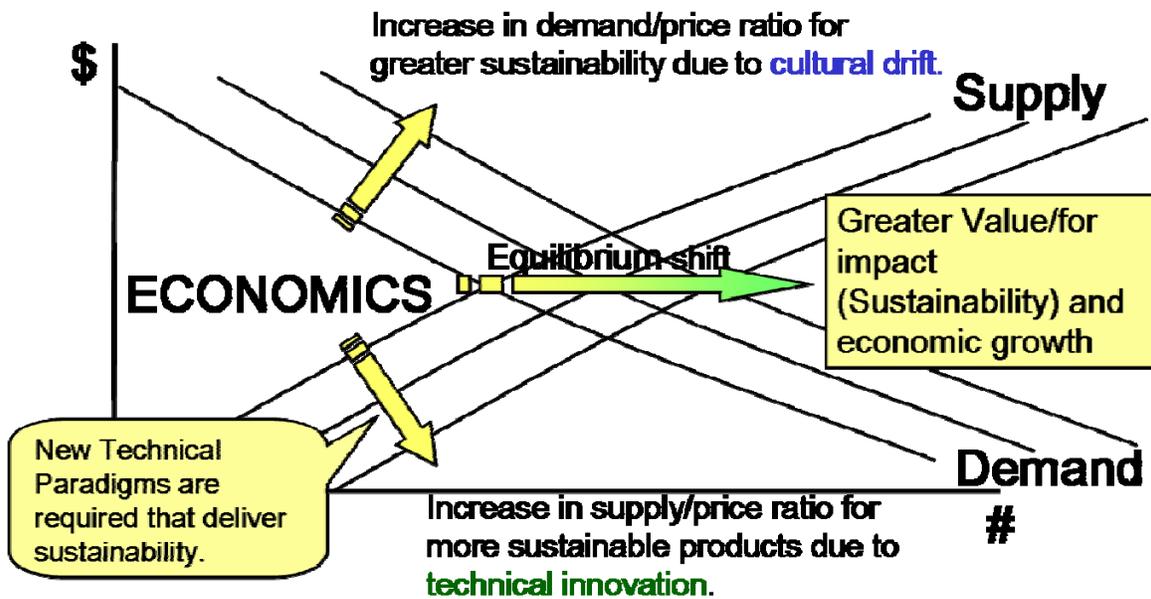
According to Karl Polanyi “the idea of a self-adjusting market implied a stark utopia” (Polyani 1944). Amongst other failures of globalism, the failure to address issues of the commons is paramount. Evidence of this is the rise of more nationalistic approaches to environmental and societal problems and the collapse of globalism.

Many countries have fallen into the false belief that globalism will solve problems in markets, yet markets do not address common needs as clearly pointed out in this document. The way forward may be to cherry pick globalism, maintaining free trade (the why Australia should not grow rice argument) but take into account social and sustainability values. If nothing else, a charter, local carbon trading scheme and eventually joining Kyoto or its successor will reinforce this process of understanding that we live in one world and the capacity of that world to support us is rapidly diminishing.

The Economics of Imperfect Markets and Innovative Change

Modern economic theory (evolutionary economics in particular) is based on the fact that change is the major driver of economic growth. This process, called creative destruction by Schumpeter (Schumpeter 1954), is whereby new innovation destroys old and less efficient process, is the drive engine of modern economies.

This explanation for growth, first espoused by Schumpeter, is more important today than ever as the level of sustainability in a society is economically related to the cultural demand for sustainability and the technology used.



A measure of the degree of sustainability of an industrial ecology is where the demand for more sustainable technologies is met by their supply.

Figure 5 – Sustainability is a Direction defined by the Intersection moving towards greater Supply and Demand

Throughout history, economic growth and the level of sustainability of a society has been connected to the level of innovation and cultural demand or acceptance of that innovation.

Through innovative change we not only grow our economies in the manner enunciated by Schumpeter but as demand shifts through cultural change, move towards greater sustainability through changes in the technological basis of our economies by a combination of innovative paradigm shifts and slower evolutionary development.

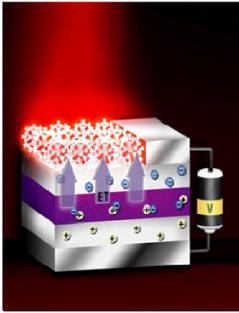
Examples of paradigm shifts include the invention of the bow and arrow, wheel, metals, glass and gunpowder whilst the development of cooking recipes, crops, breeds of cattle and sheep and many minor inventions are examples of slower, more evolutionary change.

The need for innovation delivering greater sustainability has never been greater. Specific examples of recent innovation that are also more sustainable include the development of neon light globes, the recent breakthrough in solar technology and the materials that are being developed by TecEco including eco-cements and shear binders for robotics.

Incandescent	Fluorescent	Led Light
		
100 watts 1700 lumens	25 watts 1700 lumens	<20 watts 1700 lumens

Light Globes

Light Globes in the last 10 years have evolved from consuming around 100 watts per 1700 lumens to less than 20 watts per 1700 lumens. As light globes account for around 30% of household energy this is a considerable saving.



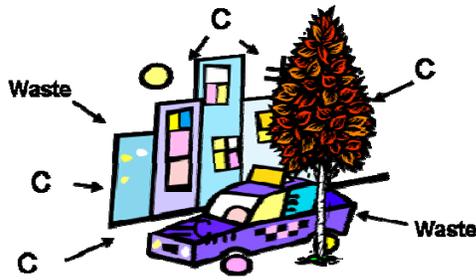
Solar Panels Producing More than one Electron for each Photon of Light

In all solar cells now in use - in everything from satellites to pocket calculators - each incoming photon contributes at most one energised electron to the electric current it generates. This barrier has now been broken by Victor Klimov of Los Alamos National Laboratory, New Mexico USA .

Figure 6 - Recent Paradigm Shifts in Technology (Harrison 2005)

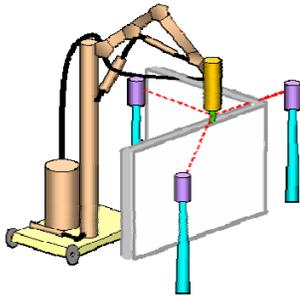
Unfortunately many economists do not understand that change and economic growth are compatible. Our imperfect markets do not optimise sustainability. They are short term and the value of sustainability is hard to recognise in them. Larger established businesses based on older technologies such as the power and coal industries have evolved means to maintain market share such as political clout and are scared of innovation and change. Countries (including the U.S and Australia) have not ratified the Kyoto protocol on the false presumption that restricting carbon emissions would be a burden for their economies. Change and economic growth are compatible.

Fortunately many processes have been forced to change because of their impact on the “common” environment. The result has often been the substitution by more efficient processes, even on a purely economic basis (e.g. since the ban of CFCs, fridges have become more efficient, although manufacturers warned that nothing could effectively replace them). However the shift toward more efficient and sustainable technologies does not always happen naturally and must be encouraged by policy initiatives of government. This is explained, using an evolutionary framework, by Mulder & van den Bergh (Mulder and van den Bergh 2001) who emphasizes that: “One of the most important insights of evolutionary thinking is that current systems are not necessarily optimal from an efficiency perspective, even if prices are “correct” (I.e. prices reflect externalities, are based on perfect competition, etc.). The reason is that systems can be locked-in, that is to say that they are the result of unique, historical, path-dependent processes. Present inefficient technologies may be locked in as a result of network externalities and sunk costs. Well-known examples are systems which require a significant amount of private and public investment and network support such as transport and infrastructure, energy generation and provision.”



Eco-Cements

Eco-cements set by absorbing CO₂ out of the air and are suitable for the Pareto proportion (80%) of materials used for construction in the built environment. Coupled with capture of CO₂ during manufacture the resulting sequestration is significant



Robotics

Construction in the future will be largely done by robots because it will be more economic to do so. Like a color printer different materials will be required for different parts of structures, and wastes such as plastics will provide many of the properties required for the cementitious composites of the future used. A non-reactive binder such as TecEco tec-cements can supply the right rheology, and like a printer, very little will be wasted.

Figure 7 - Recent Paradigm Shifts in Technology (2) (Harrison 2005)

Biomimicry/Geomimicry

An overriding principle that must be considered is that of biomimicry. Sustainable processes are more efficient and therefore more economic. Natural ecosystems can be 100% efficient. If we wish to survive in harmony with nature for the longer term, what is needed are new ideas for policies that foster the development of processes and technologies that allow material and energy flows to more closely mimic and support flows in natural ecosystems. We have lost the connection with the planet and live in a surreal techno-world. Our air conditioned homes and offices leave nature outside and we have been lulled by such comfortable 'civilised' surroundings that all is well. It is not. Nature is a living library of wisdom and we must learn by connecting and evolving more harmoniously.

Economic rationality and an emissions trading scheme are harmonious with the principle of biomimicry as nature is the most frugal economist of all.

Encouraging the Development of Tececologies - What if industry were working together?

An industrial ecology is a localised or regional network of partnered organisations benefiting from an exchange of resources, information and/or expertise. Even if we colour this definition green as Tom Graedel [2] and others have done and say industrial ecologies involve actions taken to reduce the impact of industrial systems on the environment; in particular creating a closed industrial system, analogous to a natural ecosystem, where waste from one industry can be used as input for another.

To change global flows such as that of CO₂ relentlessly going into the atmosphere we need more than industrial ecologies; we need new technologies designed to economically substantially reverse damaging moleconomic flows outside the system.

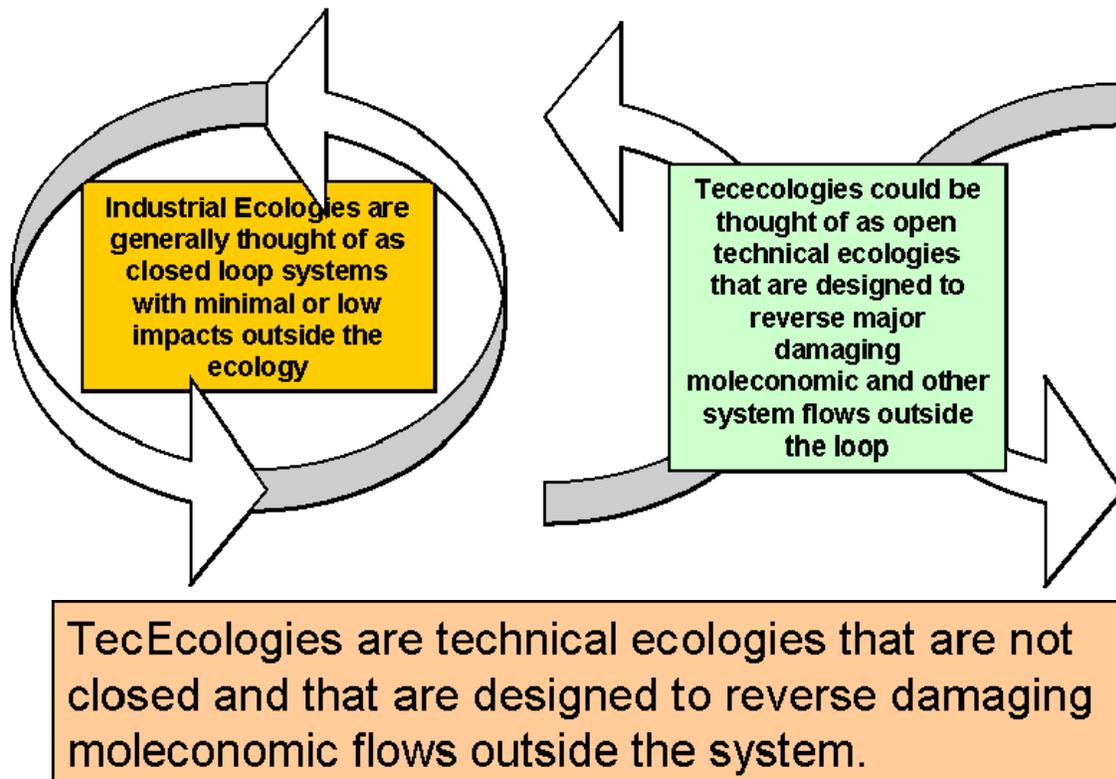


Figure 8 – TecEcologies – Global system pumps reversing damaging moleconomic flows.

The objective of the Global Sustainability Alliance is to develop Gaia Engineering technologies that work together in a tececology that substantially reverses damaging moleconomic flows going on mostly in the global commons. We owe it mainly to Lovelock (although he cites other earlier similar thinking) for the promotion of the idea of the connectivity in earth systems and our Gaia Engineering TecEcologies reverse the flow of CO₂ and waste redefining both as resources.

TecEcologies are different to industrial ecologies because they are deliberately designed to economically reverse damaging moleconomic flows outside what were generally thought of as closed industrial systems. They go much beyond what the concept of an industrial ecology embraces and could be likened to ecological pumps. Industrial ecologies recycle but do not reverse flows outside what could be considered as a closed system with a flow greater than required for their own inputs.

Global Sustainability Alliance partners have developed Gaia Engineering TecEcology that can lead the world, economically reversing damaging moleconomic flows such as that of CO₂ into the atmospheric global commons and wastes into the commons generally.

The initiation of carbon trading in Australia would help foster this exciting new Australian TecEcology as an exemplar as to how we can solve the problem to the rest of the world.

The Gaia Engineering Technology is explained in detail in Appendix 1
The Gaia Engineering Process (formerly CarbonSafe) on page 16.

Energy Sustainability and Emissions

The electricity debate is to some extent an argument between centralized, large generating organizations and localized small producers and is currently raging in countries like Germany. The centralists provide base load power, usually from coal but sometimes hydro or nuclear and the local producers are generally using more sustainable solar or bio power. I have nothing against fusion nuclear, although I am concerned about nuclear waste.

Because of power transmission losses, at some point, the generation of electricity on a decentralized basis is more efficient than generation from large power plants. This point will only be crossed by innovation encouraged by the right institutional support.

Many countries have privatized transmission and this has been a grave error as it will stand in the way of the evolution of more efficient forms of power such as recently announced by Los Alamos National Laboratory in the US⁶.

Unfortunately, sustainable energy other than from hydro so far does not suit large centralized power generation power plants and is therefore discredited by them further slowing their introduction.

Policies are therefore needed to encourage more sustainable generation of electricity such as a system of eco credits and debits discussed below as which is broader even than carbon trading.

The Role of Governments

Governments must consider externalities or who else will? The people have had enough of the avoidance of this responsibility for short term political gain.

What is needed is a return to the fundamental role of government as existed for the common good; an efficient attempt to govern by action as well as legislation.

Governments must take the lead in maintaining earth system homeostasis and to perform this function it is essential that they:

- Consider de-politicising the planetary custodian function.
- Improve education about sustainability
- Bring to account externalities through mechanisms such as legal cost and trading of exchangeable credits earned through mitigating action against such cost,
- Connect public good needs with a growing sense of Australian Nationalism.

To get over the short term outlook of successive governments mentioned earlier we suggest a charter coupled with commitment to long term binding international agreements such as Kyoto or its successor is appropriate.

⁶ More than one electron for each photon of light.

A charter in conjunction with a trading scheme as the main tool would de-politicise the process. We have a reserve bank board to look after our financial system so why not a charter and board of governors charged with maintaining the environment. It's a big step but by depoliticising the role the problem of short term politics and long term need is to some extent obviated.

Many would also argue that the power of economics will the most quickly improve Australian and global sustainability. By invoking Pilzer's first law (Pilzer 1990) which states that the technical paradigm defines relative resource values, it follows that to convert waste to resource new technical paradigms are required. To initiate this process a legal cost to detrimental externalities such as CO2 emissions would be extremely helpful. Technical paradigms are evolving to economically utilise CO2, they just need to evolve a whole lot quicker to prevent further rises in temperatures. Whatever governments can do to encourage the development of sustainable technologies they must do.

Culture shift is leading us a way from heavy consumerism, but is not happening quickly enough and a further role of governments should therefore be education about the environment and the planet⁷

The challenge is to harness human behaviours which underlay economic supply and demand phenomena. This can occur through innovation. By changing the technical paradigm in favour of making, for example, carbon dioxide and other wastes resources new materials with lower take and waste impacts and more energy efficient performance will emerge. Putting a legal value of carbon will initiate this process.

Unfortunately sustainability will not happen because it is the right thing to do, it will only happen if forced by legislation and brought into our value system of exchange by the imposition of a legal cost.

A carbon trading scheme is a first step, however governments need to think beyond, and with the replacement of Kyoto a few short years away, consider a broader based scheme of eco-credits and debits as discussed in Appendix 3 A Broad Based System of Eco-Debits and Credits on page 27.

Conclusion

The great task of the future will be that of global maintenance as we are now planetary engineers as Tim Flannery (Flannery 2005) puts it so well. The problem of the future will be that of maintaining the common good and the scene it will be staged on is the global commons.

Governments are the structure with the mandate and the power to direct the behaviour of individuals in particular directions unfortunately the need for government to drive programs to overcome problems such as global warming is not well understood and perhaps better focus could be achieved through the adoption of a charter. The first major tool should be an emissions trading.

One way of reducing the political one-upmanship that seems to have stolen the stage is to depoliticise the process and our responses to it and a charter could also have this role. The Sustainability Charter should set Australian governments the target of implementing programs that discourage undesirable externalities and encourage behaviour that results in commonly enjoyed benefits.

⁷ Interestingly NASA is taking a lead role funding universities to teach the subject.

Our natural capital, vital to sustain life and all economic activity is becoming seriously diminished. Virtually all improvements in sustainability have associated reductions in energy and reductions in energy are associated with reductions in emissions and for this reason if no other, any new global system to replace Kyoto should be broadly based. A broad based scheme of eco-credits and debits is discussed in Appendix 3 on page 27.

We need to start somewhere as we are lagging behind the rest of the world and a National Carbon Trading scheme is a good start. We can then consider broadening the markets and joining Kyoto or its replacement. Australia cannot stay out of global sustainability treaties forever. The market is less likely to fail if it is international (Kyoto or its successor) and broadly based (eco credits and debits).

There should also be serious consideration as to how to assist new and emergent technologies that are more sustainable and resource efficient so they can compete with existing technically paradigms that have the advantage of economies of scale.

The Eco Credits and Debits Scheme that I am proposing is an example of a tax on behaviour that we wish people to avoid; namely, manufacturing or building using unsustainable technologies. Energy reductions pay and are low hanging fruit. An objective of a broader based scheme would be to try and also improve sustainability generally. The scheme could be extended on a global scale to encourage adoption of a wider range of sustainable technologies in a diverse range of industries. Eco Credits and Debits could conceivably attach to energy generation, transport systems, manufactured goods, food and services that embody or result in low levels of GHG emission, embodied-energy and embodied-water, or which have any other positive impact on the environment, such as improved biodiversity or waste utilisation as well as overall greater sustainability.

The more general system of debits and credits proposed would harness the huge energies that Australians employ towards paying less tax and direct it towards solving our common problems. In this way, much of the change towards sustainability would occur with a minimum of government intervention.

In the meantime I give my wholehearted support to a carbon trading scheme being the first small step of many required to guarantee survival in the future. Otherwise climate change will hit us with more force than of many atomic catastrophies. The proof is in the paleo climate record.

John Harrison B.Sc. B.Ec. FCPA

Chairman, July 2006

Appendix 1

The Gaia Engineering Tececology Process (formerly CarbonSafe)

"The economic solution to global warming and waste"

Gaia engineering is a **tececology** enterprise being undertaken by **Global Sustainability Alliance** Partners.

Humanity has unprecedented powers to damage planet earth and affect the well-being of present and future generations. Few people realise the extent to which existing technical paradigms driven by fossil fuels are causing havoc. At TecEco we believe that in order to live more sustainably we need to make our economic consumption behaviours work for the planet, instead of against it. We can do this by changing the technical paradigms of our many industries. Technical paradigms define what energy and matter are valued as resources and what is emitted or discarded as a waste and thus the underlying molecular flows that are so damaging.

Cultural change has increased the demand for more sustainable products. To meet this increasing demand new innovative technical paradigms are evolving. The **Gaia Engineering** Geo-Photosynthetic Process is not a single process or paradigm but a **tececology** which embraces a number of new technical paradigms and processes designed to solve global warming and waste problems by changing the underlying **moleconomic** flows involved. **Gaia Engineering** will work because combined correctly these new processes will allow people to make money using them.

If adopted on a large scale the **Gaia Engineering** process would sequester significant amounts of atmospheric CO₂ and convert significant volumes of waste to resource. **Gaia Engineering** is an agglomeration of new technologies including TecEco's Tec-Kiln technology and cements, bioreactor technologies, carbon dioxide scrubbing technologies, a seawater separation technology from **Greensols Pty. Ltd.** that can produce fresh water, and a number of industrial commodity products including gypsum, sodium bicarbonate and various other salts as well as building materials based on calcium and magnesium carbonates that also utilise wastes.

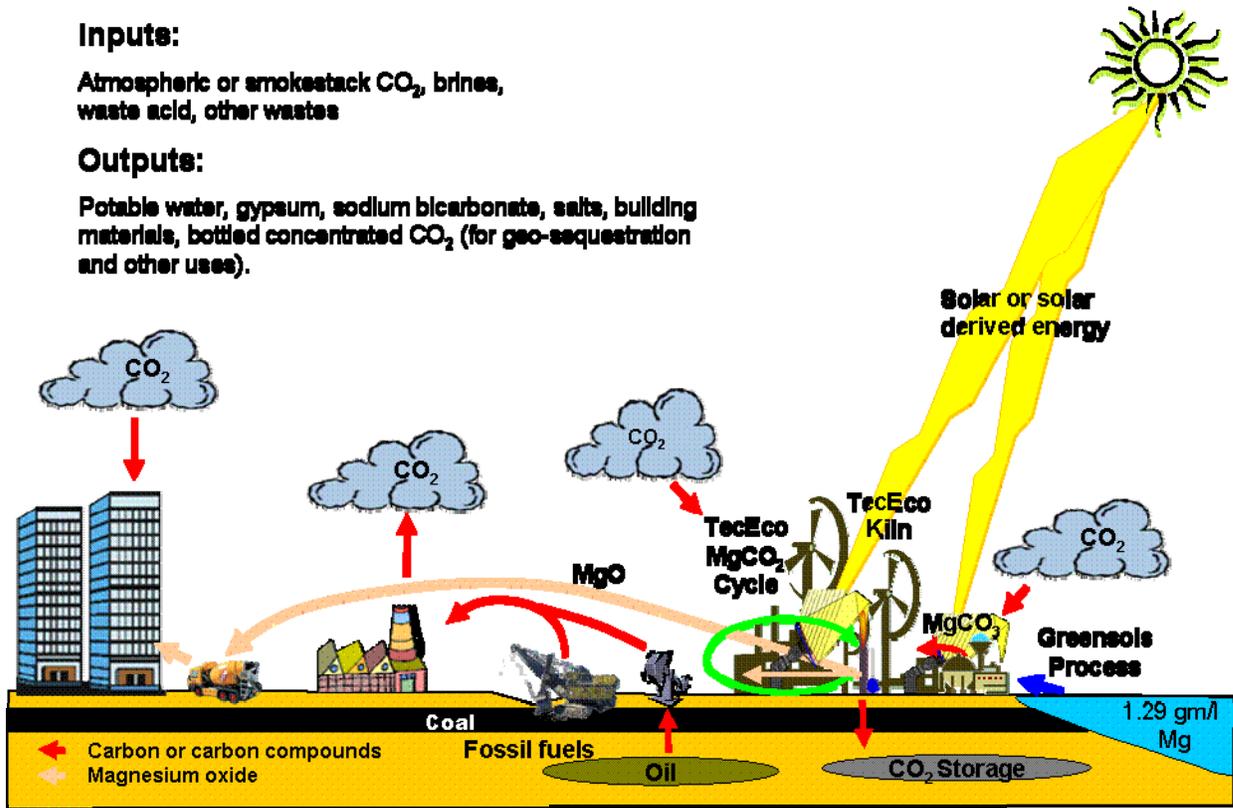
The TecEcology Process

Inputs:

Atmospheric or smokestack CO₂, brines, waste acid, other wastes

Outputs:

Potable water, gypsum, sodium bicarbonate, salts, building materials, bottled concentrated CO₂ (for geo-sequestration and other uses).

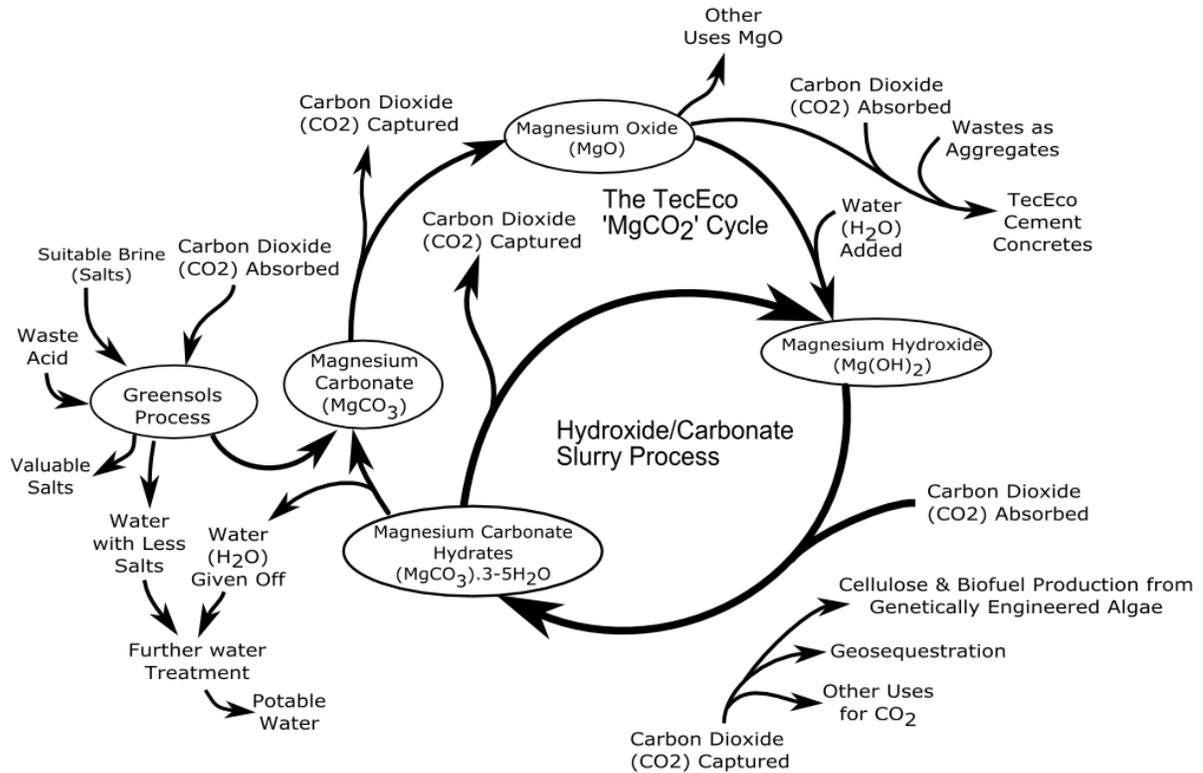


Graphic Illustration of the Gaia Engineering Process for Seawater

The **Gaia Engineering** process starts with either magnesium silicates or the Greensols process. In the case of silicates, magnesium carbonates are produced using proven mineral sequestration technology and then transferred to the **MgCO₂** cycle. The Greensols process on the other hand uses carbon dioxide from for example power stations and waste acid to extract magnesium carbonate and valuable salts from seawater or suitable brines and produce potable water as a by-product. The MgCO₃ from either process is then calcined in the TecEco Tec-Kiln which removes and captures carbon dioxide (ready for incorporation into cellulose, fuel or other compounds and produces magnesium oxide. The magnesium oxide can either be used to make TecEco cements which utilise other wastes and in the case of eco-cement absorb more atmospheric CO₂ as they harden or alternatively can be used to sequester more CO₂ in a **hydroxide/carbonate slurry** capture process.

The hydrated carbonates produced by the **hydroxide/carbonate slurry** process can be decarbonated and cycle around that process indefinitely as in the diagram

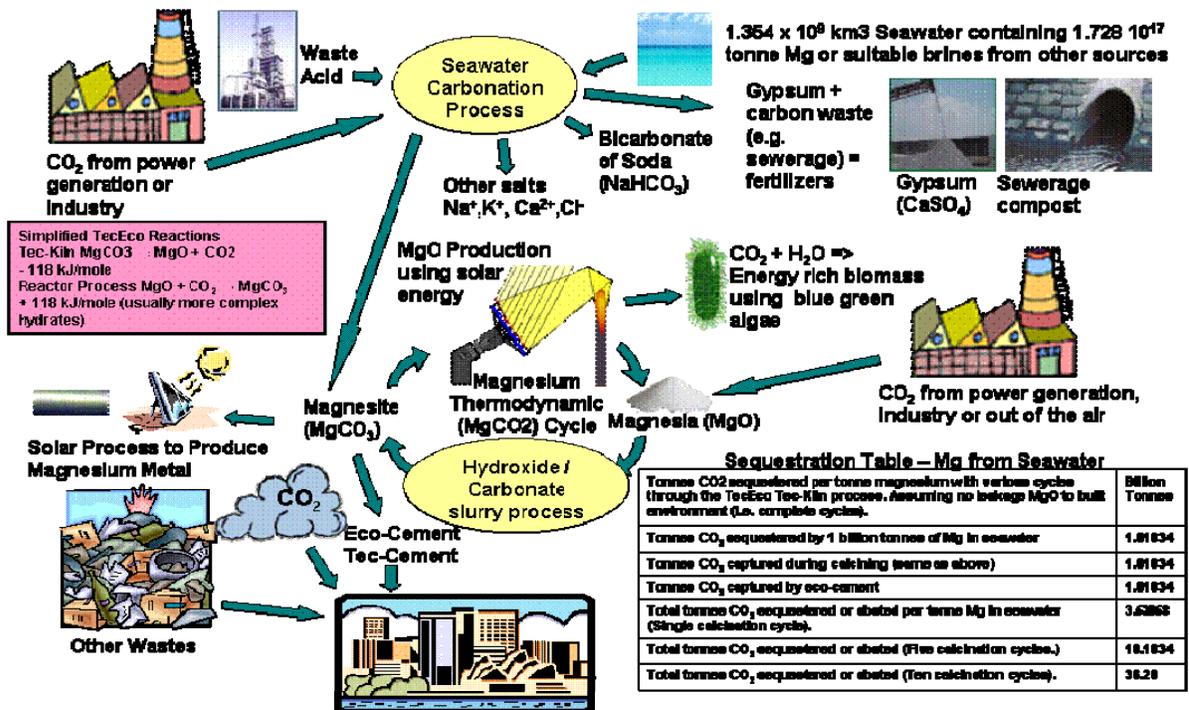
below.



Gaia Engineering Process Vector Diagram for Seawater

Technologies are still evolving to use the CO₂ produced by **Gaia Engineering**. A particular future use that we are monitoring is to force rapid growth of algae able to convert CO₂ and water into oxygen and energy rich biomass.

The **MgCO₂** and **hydroxide/carbonate slurry process** cycles mimic photosynthesis using the same central atom (magnesium). They can go around and around like a bicycle wheel as together, mass and energy are neither created nor destroyed, energy is only lost outside the system through inefficiencies. There is an exothermic part of the MgCO₂ cycle where heat is required and an endothermic part where heat is released. To make the process as efficient as possible it is desirable to capture the heat from the exothermic parts and as efficiently as possible transfer it to the endothermic parts of the cycle.



The Gaia Engineering (formerly CarbonSafe) Process Diagram for Seawater

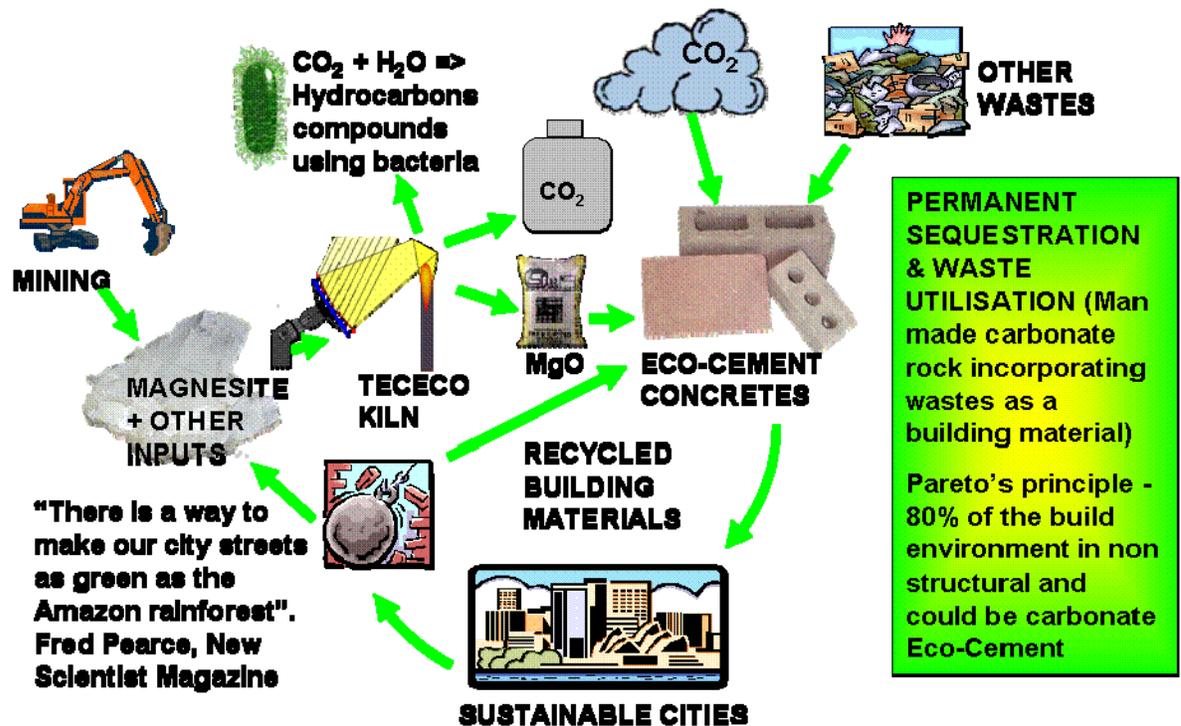
The efficiencies of the various sub-processes are fundamental to making the **Gaia Engineering tececology** economic and minimizing the amount of energy required overall. An important area of research we are engaged in is to develop technologies for the efficient collection, concentration and transfer of heat energy and more follows about this (See **Transferring Heat from the Exothermic Part to the Endothermic Part of the MgCO₂ Cycle**).

We call the **Gaia Engineering** process is **geo-photosynthetic** because it mimics the way that plants, algae and some bacteria capture and store carbon using photosynthesis. In 1796, Jean Senebier, a French pastor, showed that CO₂ was the "fixed" or "injured" air and that it was taken up by plants. Soon afterwards, Theodore de Saussure showed that the increase in mass of the plant as it grows could not be due only to uptake of CO₂, but also to the incorporation of water.

It followed that the process of photosynthesis achieves the following:



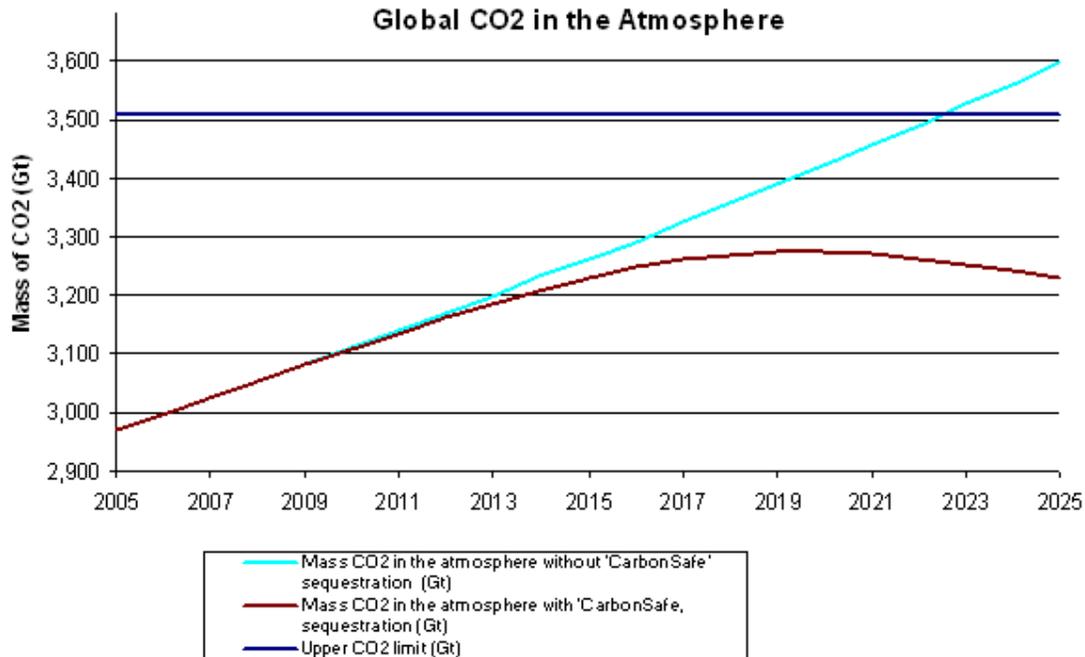
Basing our tececologies on **Gaia Engineering** will result in sustainable cities that store carbon and are constantly recycled.



Sustainable Cities

The TecEco Model of the Gaia Engineering (formerly CarbonSafe) Process

TecEco have developed an Excel model of the Gaia Engineering process to work out the plant and process requirements to sequester enough CO₂ to avoid reaching a concentration of 450 parts per million in the atmosphere, considered by many as an upper limit to avoid the most dangerous effects of global warming and irreversible change. It relies on several assumptions, including a forecast for magnesia sales for use in concrete and the extent to which global abatement programs will be successful. Outputs include the number of plants of a given capacity that will be required as well as the costs and revenues involved in running the process. If you would like to review the model please go to the TecEco web site and look under **tools**.



Gaia Engineering (formerly CarbonSafe) Sequestration

Transferring Heat from the Exothermic Part to the Endothermic Part of the MgCO₂ Cycle

In a continuous cyclic process such as the **MgCO₂** (magnesium thermodynamic cycle) sub-process of the Gaia Engineering **tececology** it is important to be able to transfer the heat produced in the exothermic sub-processes in the system to the endothermic sub-processes or at least transform it into a useful form such as electricity with minimal losses.

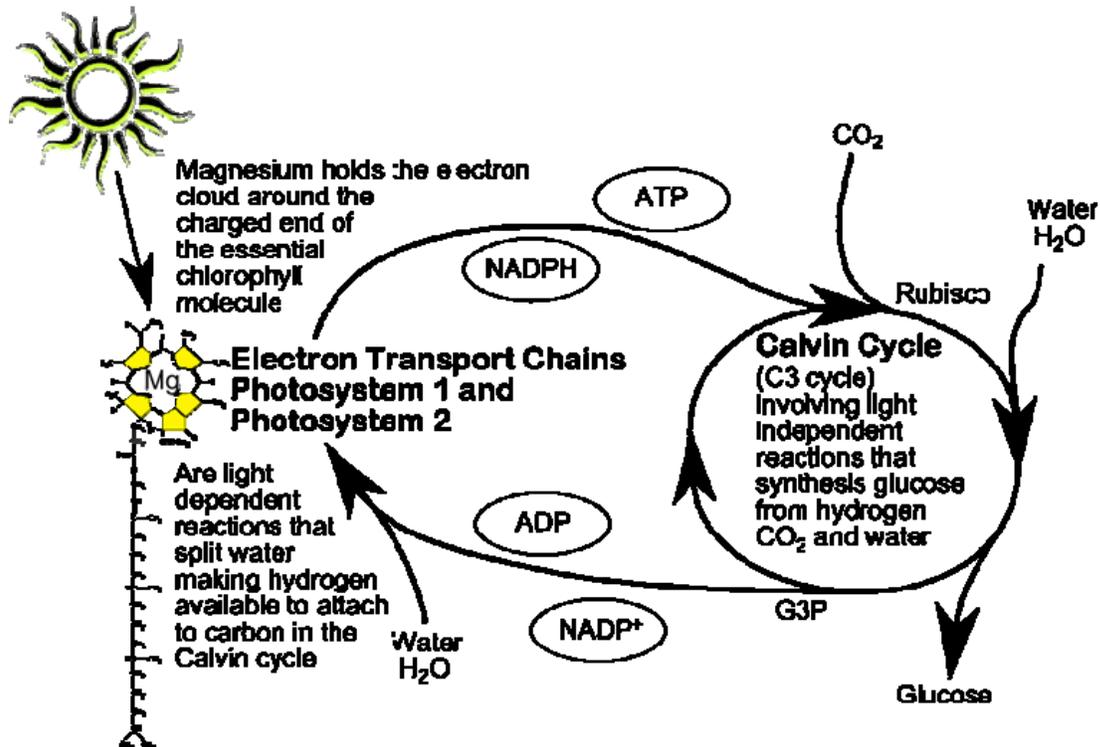
There are several exciting new technology contenders for capturing low grade heat including a pyroelectric process being promoted by CANMET in Canada and various modified liquid/vapour pressure processes including the Newcomen engine and non water Rankine engines. As the liquid used in the latter is normally an organic compound they are often referred to as Organic Rankine Energy Cycle engines or ORCE's. The Newcomen engine is particularly attractive to TecEco as one of the outcomes is potentially the production of potable water.

Power stations waste a lot of low grade heat and should consider retrofitting the Newcomen or Non Water Rankine engines discussed under **Newcomen Engines**.

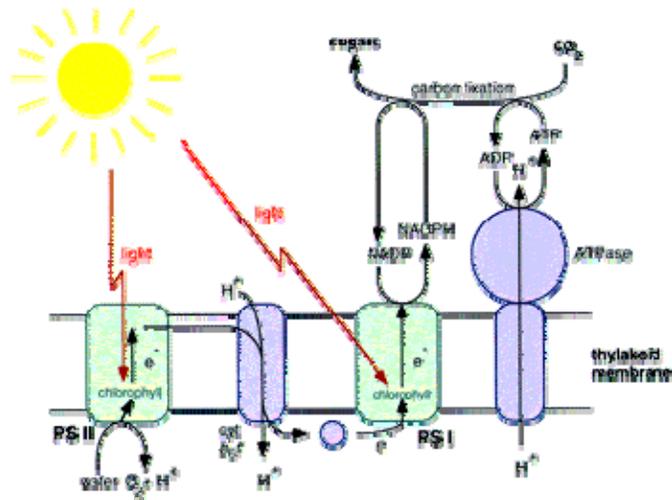
How the MgCO₂ cycle in Gia Engineering TecEcology is Geo-Photosynthetic (mimicking Photosynthesis)

In nature respiration consumes organic molecules and oxygen to produce energy and CO₂. Before the industrial revolution this process was essentially balanced by photosynthesis, which combines CO₂ and water to create molecules such as glucose and oxygen. We burn fossil fuels for energy in a manner similar to respiration but we provide no process to remove the damaging amounts of CO₂ that we introduce into the air. The Gaia Engineering **teceology** was designed for this purpose and could therefore be likend to an ecological pump with many features analogous with photosynthesis.

The diagram below summarises photosynthesis in terms of inputs and outputs. The explanation of the complex reactions that take place is for the purpose of comparison simplistic.



Magnesium ions are important in the chlorophyll molecule as their strong charge holds an electron cloud around a porphyrin ring that supplies electrons to the process. PSII as it is referred to is a photosynthetic process that splits water thereby supplying hydrogen ions and electrons to this cloud. These electrons pass through the process powering the Calvin cycle via $NADP \rightleftharpoons NADPH$ in the PS1 process. The hydrogen ions are incorporated in glucose via the $(ADP \rightleftharpoons ATP)$ cycle.



The $MgCO_2$ and hydroxide/carbonate slurry process cycles in the Gaia Engineering **teceology** depicted above similarly use magnesium compounds to fix CO_2 as carbonates..

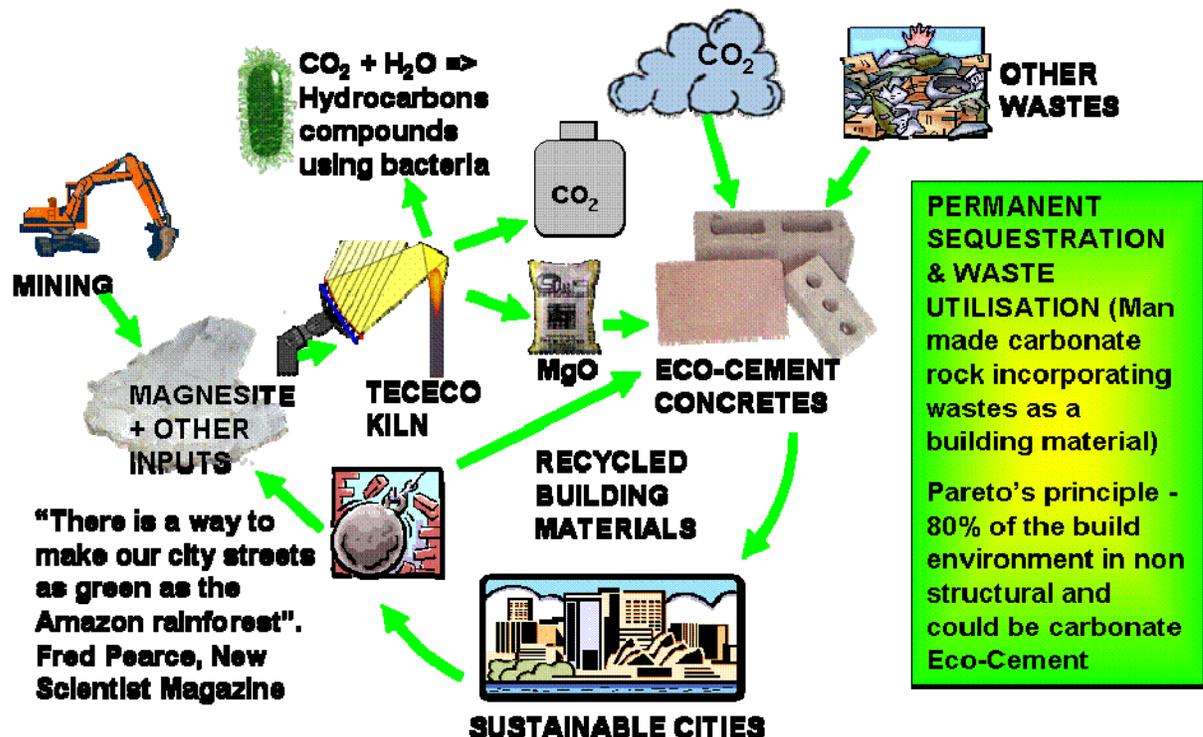
Both the Gaia Engineering and photosynthesis processes are powered by light and hence photosynthetic. Common to both are energy transfer mechanisms. In photosynthesis electrons move around the process whereas in the $MgCO_2$ and hydroxide/carbonate slurry process cycles it is intended to use heat transfer technologies such as Newcomen engines.

Appendix 2 Eco-Cement

Eco-Cement is a new more environmentally sustainable type of cement developed by John Harrison of TecEco which incorporates reactive magnesia[1] and wastes that is more environmentally sustainable. Eco-Cement used to make porous concretes absorbs CO₂ from the atmosphere to set and harden and in this way mimic nature (See **geomimicry**). It can also be recycled back to Eco-Cement. Wastes such as fly and bottom ash, slags etc. can also be included for their physical properties as well as chemical composition without problems such as delayed reactions.

The **Global Sustainability Alliance** plan to make the magnesia that is used in Eco-Cements using solar energy in a new kiln that combines heating and grinding and captures CO₂ known as the **Tec-Kiln**. Given this production scenario Eco-Cement concretes have the capacity to become a huge carbon sink and they will be used in the **Gaia Engineering tececolgy** to bind wastes and the carbonate building components made using **Greensols** technology..

As stated by Fred Pearce in the article on Eco-Cements published in the New Scientist magazine (Pearce 2002[2]) “There is a way to make our city streets as green as the Amazon Forest. Almost every aspect of the built environment from bridges to factories to tower blocks, and from roads to sea walls, could be turned into structures that soak up carbon dioxide – the main greenhouse gas behind global warming. All we need to do it is the change the way we make cement.”



Making the built environment a repository for recyclable resources (referred to as waste) as well as a huge carbon sink is an alternative that is both politically and economically viable.

John Harrison got the idea of using carbon and wastes in building materials from his observations of nature. During earth's geological history, large tonnages of carbon were put away as limestone

and coal by the activity of plants and animals. Shellfish build shells from it and trees turn it into their wood. These same plants and animals wasted nothing, the waste from one was the food or home of another. John concluded that the answer to the problems of greenhouse gas and waste was to use them both in building materials.

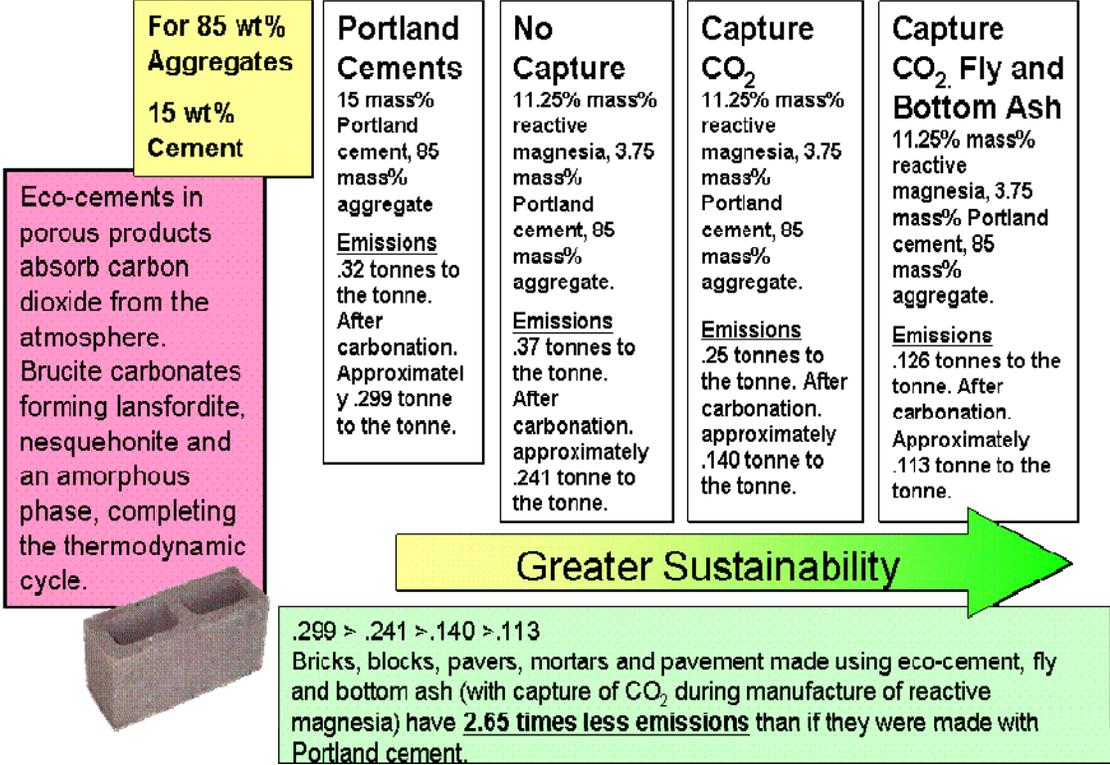
Eco-Cements are made by blending reactive magnesium oxide with conventional hydraulic cements like Portland cement. They are environmentally friendly because in porous concretes the magnesium oxide will first hydrate using mix water and then carbonate forming significant amounts of strength giving minerals in a low alkali matrix. Many different wastes can be used as aggregates and fillers without reaction problems. The reactive magnesium oxide used in Eco-Cements is currently made from magnesite (a carbonate compound of magnesium) found in abundance and that in the **Gaia Engineering tececolgy** will be produced from seawater.

When added to concrete reactive magnesia[1] hydrates to magnesium hydroxide, but only in porous materials like bricks, blocks, pavers and porous pavements will it absorb CO₂ and carbonate. The greater proportion of the elongated minerals that form is water and carbon dioxide. These minerals bond aggregates such as sand and gravel and wastes such as saw dust, slags, bottom ash etc.

Eco-Cement can include more waste than other hydraulic cements like Portland cement because it is much less alkaline, reducing the incidence of delayed reactions that would reduce the strength of the concrete. Portland cement concretes on the other hand can't include large amounts of waste because the alkaline lime that forms causes delayed and disruptive reactions.

The more magnesium oxide in an Eco-Cement and the more porous it is, the more CO₂ that is absorbed. The rate of absorption of CO₂ varies with the degree of porosity. Carbonation occurs quickly at first and more slowly towards completion.

CO₂ Abatement in Eco-Cements



A typical Eco-Cement concrete block would be expected to fully carbonate within a year. Eco-Cement also has the ability to be almost fully recycled back into cement, should the concrete structure become obsolete.

Appendix 3

A Broad Based System of Eco-Debits and Credits

Carbon Trading is an important precursor enabling process for a wider based system necessary in the longer run. What follows are the main elements of a previous submission to the House Standing Committee on Environment and Heritage Inquiry into a Sustainability Charter

Sustainability Auditing and “Eco Credits”

We mention earlier that sustainability tools need to be broadened because of their connectivity and multipliers on each other and that there should be other factors than CO₂ with institutionalised value in relation to the well being of the global environment.

We therefore propose a Sustainability Charter run by a Commission or Board that includes enabling clauses for the establishment by the Commission of a process of “Sustainability Assessment” to determine the allocation of broad based “Eco Credits” or “Eco-Debits”. i.e internalises externalities generally.

A Sustainability assessment process should be used to determine the overall environmental impact of a process or development, based on a wide range of factors. The results of the assessment would then be used to determine the number of Eco Credits or Debits that are granted upon completion of a project. It differs from Environmental Impact Statements (EIS) in that it relates to any business undertaking or construction and the process should be more simple and informal – codified yet flexible. For example systems for determining the relative sustainability merits of structures already exist. What is proposed is a mechanism for putting a value on these ratings.

Initiating carbon trading is a good start towards a more broad based Sustainability Assessment Scheme which could focus initially on just building construction as we already have current rating systems. In time a broadening is envisaged to include landscaping, subdivisions, utilities etc.

Land Titles Offices

In many cases causes tend to be localised and could be considered with land whereas the effects tend to be regional or even global.

By localising the economic impact of global effects, costs and benefits can be incorporated as values in an economic system providing strong incentive or disincentive as required for making more sustainable decisions in what are short term markets

One possibility is that more broadly based Eco Credits or Debits attach to the title of the land. The formal registration of credits would be conducted via the respective State Land Titles Offices, similar to the way that a mortgage or covenant may be registered so that it attaches to the registered title, under the Torrens system. The Eco Credit or Debits would be able to be:

- Left registered on the title,
- If Credits offset against the payable stamp duty and other government charges, or

- Traded on a market.

Just like with carbon trading market trading of Eco Credits would be a useful way to establish a mechanism for charging developers who are responsible for significant environmental impacts. If a developer wants to build a resort in an environmentally sensitive area or with unsustainable technologies then, if it is to be approved, the developer can be required to purchase a certain number of Eco Credits as part of the approval conditions to meet the Debits he would be penalised with. This would tend to drive up the price of Eco Credits and thereby provide further incentive for more sustainable construction. The idea is to make the adoption of sustainable construction techniques the most cost effective way to build.

Determinations by the Sustainability Commission

The ambit of an Eco Credit/Debit ought to be as wide as possible, and flexibility should be built in to the system such that the definitions can expand. The Sustainability Commission would have a role to play in establishing the system and in the ongoing determination of what factors can count towards Eco Credits and how such factors are measured. People would be able to appear before the Commission seeking a determination on any matter in relation to the Sustainability Audit or Eco Credits and Debits. Home owners and builders should be able to argue their case for more Eco Credits and developers of new construction materials and technologies should be able to petition the Commission requesting that their product be registered as a source of Eco Credits when used in construction.

The range of factors that would attract Eco Credits or Debits could be very broad. They would include an assessment of the source of the materials used, their embodied energies, embodied water and any Greenhouse Gas (GHG) emissions that result from their manufacture and transport to the construction site. Use of waste materials would be viewed positively, as would aesthetic factors such as sensitivity to the surrounding natural environment. The correct management of stormwater and grey-water, use of solar-passive design techniques, insulation, renewable energy systems and native plants are further examples of factors that would attract Eco Credits or Debits.

Measurement by Designers

The actual measurement of the factors that count towards Eco Credits could be undertaken by architects, building designers or other authorised contract assessors.

Auditing by Inspectors

The system should be as insulated as possible against graft. The auditing of assessments could be undertaken by municipal council building inspectors or some other government agency. As municipal councils already undertake routine inspections and assessments of new constructions they would be well placed to service this aspect of the job.

National Database

The collation of this information into a National Database will provide useful and detailed metrics of industry. Once a picture of the sustainability of the industry is constructed the

data can be analysed in detail to identify areas for improvement and refinement. Areas that are identified as in need of improvement can be ascribed a higher rate of Eco Credits.

The database will also be a useful resource for the administrators of the system to determine what each factor is worth in terms of Eco Credits at the time of the assessment.

Software tools could be designed to hook into the designer's CAD software and calculate the number and value of the Eco Credits or Debits that relate to the factors registered within the system.

Factors

The term 'factors' is the suitably vague term used to describe the properties that count towards the allocation of Eco Credits or Debit for a project. Rather than using 'products' as the primary measure, the term 'factors' can include the way that the huge variety of different products are used. Solar-passive heating is a simple example, where standard construction products can be used in a way that dramatically lowers the heating and lighting requirements of buildings. Once a standard product has an Eco Credit/Debit rating then that rating can be used by the designer in the assessment.

Trading

The Sustainability Commission in parallel with establishing a value system would need to consider the establishment of a trading system so the value attached to Eco Credits or Debits can be realized in the marketplace. We consider that Debits as well as credits are required otherwise trading will not occur.

Advantages of a Sustainability Value System

Information Leveraging

The promotion of sustainable materials in construction is usually hampered to a large extent by a lack of information. The people making the purchasing decisions within the housing market are generally uneducated about the environmental impacts of their decisions.

The environmental situation we are faced with today, particularly with reference to global warming, requires high quality decision making. We simply cannot afford to leave decisions with large cumulative environmental impacts in the hands of non-experts without any form of guidance.

The classical conception of a market with an 'invisible hand' has broken down with respect to sustainability in construction because of our failure to account for the externalisation of costs to the environment. The generation of wastes that are not correctly re-integrated into natural systems has in the past been free when it should have been a cost. The result is that the 'invisible hand' of Adam Smith has been 'blind', as well as invisible; having no idea as to what activities to avoid, because it can not see the cost.

We need to discover new ways of incorporating those costs into our accounting systems. Costs are very useful as people prefer to avoid them. They much prefer benefits.

By framing the Sustainability Auditing Scheme primarily in terms of benefits and costs – Eco Credits and Debits – we can structure the economics of the construction industry in a way that takes advantage of the best information that we have about the hidden and distributed costs of environmental impacts.

Self-Interest Leveraging

The idea of Eco Credits and Debits is also designed to harness the motivational power of tax avoidance. The theory is: if people were to direct as much effort towards sustainability as they do towards minimising their taxation bills then the problem would soon vanish.

Flexibility

The Sustainability Commission will make determinations in relation to the Scheme in much the same way that a court makes its decisions, based on rules of precedent to ensure a balance between certainty and flexibility. Owners, builders and construction technology vendors will have the ability to seek determinations from the Commission as to their eligibility to register with the Scheme. Legal representation ought to be permissible only on appeal, in order to keep the determinations short and informal.

The system should be as flexible as possible so it can be readily adapted to an international system should one be adopted.

Recycling of Government Instrumentalities

The proposed Sustainability Auditing Scheme would need to ensure that the sort of unnecessary duplication of roles that has plagued the Australian federal system in the past is avoided. Whilst we see the role of the Sustainability Commission as being crucial in terms of establishment of the Scheme and ongoing arbitration, the actual machinations of it can best be performed by existing government instrumentalities that already perform similar tasks; namely, municipal councils and the state land titles offices. There will likely be roles for the AGO⁸, ANSI⁹, ABGR¹⁰, AASMIC¹¹ and various other government and non-government organisations.

The Sustainability Commission will be in a position to determine other possible connections and synergies that can be utilised in a similar manner.

Industry Standards and a Sustainability Value System

As an adjunct to the Scheme, a review of the various construction industry standards will be useful. This is an area in which a lot of ink has already been spilt, as there are difficult issues involved. There is a general consensus that a move towards performance-based standards is far preferable to maintaining formula-based standards, which tend to act as barriers to innovation. The question is how to do this in a cost-effective manner, as the cost of performance testing can be prohibitive.

⁸ Australian Greenhouse Office

⁹ Australian National Sustainability Initiative

¹⁰ Australian Building Greenhouse Rating scheme

¹¹ Association for the Advancement of Sustainable Materials in Construction

The mechanisms of the Sustainability Auditing Scheme may be able to help solve this dilemma.

The main issue is the delayed effect of any new problems. When problems only present after several decades from the date of construction, the original owner will most likely have sold the property to a third party. If the original owner/builder used a technology that was outside of the formula-based standard, perhaps in order to gain more Eco Credits under the Scheme, then subsequent purchasers of the building need to understand that they are accepting the attendant risks.

Innovation Caveats

A condition of the granting of Eco Credits on innovative technologies that fall outside of formula-based standards ought to be the registration of a caveat against the title that specifies that the innovative technology that was used. The caveat will provide specific details of the technology, what level of performance is expected of it and the results of any subsequent testing that has been performed during the period of registration. This will give the third party purchaser notice of the risk and will be a prompt to find out whether the risk is likely to impact in any way on his or her enjoyment of the property.

In effect, the costs associated with possible risk remain with the original owner/builder. In return for taking the risk, the original owner/builder has the right to redeem any Eco Credits or choose to leave them on the title for the benefit of the purchaser who may then agree to take on the risks.

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