

Climate Change and Energy: Can We Weather the Switch to Sustainable Energy?

Whilst the linkages between climate change and sea level rise continue to be controversial, working on the basis of the *precautionary principle* sustainable energy use is unequivocally central to preventing the anthropogenic causes of climate change. Burning of fossil fuels for industrial, commercial and domestic energy use, as well as transportation, is the primary human source of greenhouse gases (GHG) (75% of all GHG emissions).

As the primary emitter *industrialised countries* must look to change the *production and consumption* of energy and seek sustainable solutions. *Developing countries* need adequate energy provision to *reduce poverty*, for basic human needs, as well as economic and social development. Currently an estimated 1.5 - 2 billion people globally lack adequate energy supplies – these are primarily people from developing country populations. To achieve sustainable development and redress this inequitable access, and recognising that developing country emissions are likely to rise dramatically in the next 50 years, these countries must adopt strategies for a sustainable future.

A global culture of sustainable energy would allow for *greater* energy production and consumption whilst *decreasing* the negative aspects such as targets on reducing carbon dioxide (CO₂) emissions. Countries have a '*common but differentiated*' responsibility towards reduction of fossil fuel use and GHG emissions. Thus industrialised countries bear the initial burden of responsibility to radically alter their energy use – allowing developing countries to increase their access to energy, via as sustainable means as possible, to support poverty alleviation and economic and social development.

Current energy use is unsustainable due to its environmental affects, but energy is a driver of development so its provision is vital to maintaining developed economies and allowing developing economies to achieve greater development. So, the question is, how do we create a sustainable energy culture from the current unsustainable one?

THE PROBLEM OF CLIMATE CHANGE

The principle problem of an increasingly unstable climate is generally accepted to be caused by global warming from an enhanced greenhouse effect (see Box 1). The debated question is whether the change in natural climate cycles and CO₂ emissions arises from natural or anthropogenic sources. This debate continues to be controversial. The International Panel on Climate Change (IPCC), the official scientific body concerning climate change, concluded in its Third Assessment Report (TAR)¹ that "*There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities...Human influences will continue to change atmospheric composition throughout the 21st Century*".

However, opponents continue to refute this link. Therefore the FCCC operates its mandate on the premise of taking a precautionary approach to human impact. This means that governments should still act to reduce GHG emissions until such a time as conclusive proof of principle sources of climate change are presented and further that such actions will positively benefit both environment and society regardless.

Box 1. The Global Greenhouse

The Greenhouse Effect	The 'Basket' of Greenhouse Gases and Increase in Atmospheric Concentration Since 1750																			
<p>A layer of gases suspended in the atmosphere around the Earth prevents the Sun's rays being reflected from the Earth's surface back in to space. This means that the warmth of these rays is trapped within the Earth's atmosphere, creating a layer of insulation that maintains warmth enough for plants, animals and people to exist. Greenhouse Gases (GHGs) enhance the heat retaining ability of this insulating layer, and hence the average temperature on Earth increases.</p>	<p>(IPCC 3rd Assessment Report)</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td>Carbon Dioxide</td> <td>[CO₂]</td> <td style="text-align: right;">31%</td> </tr> <tr> <td>Methane</td> <td>[CH₄]</td> <td style="text-align: right;">151%</td> </tr> <tr> <td>Nitrous Oxide</td> <td>[N₂O]</td> <td style="text-align: right;">17%</td> </tr> <tr> <td>Hydrofluorocarbons</td> <td>[HFCs]</td> <td></td> </tr> <tr> <td>Perfluorocarbons</td> <td>[PFCs]</td> <td></td> </tr> <tr> <td>Sulphur Hexafluoride</td> <td>[SF₆]</td> <td></td> </tr> </table>		Carbon Dioxide	[CO ₂]	31%	Methane	[CH ₄]	151%	Nitrous Oxide	[N ₂ O]	17%	Hydrofluorocarbons	[HFCs]		Perfluorocarbons	[PFCs]		Sulphur Hexafluoride	[SF ₆]	
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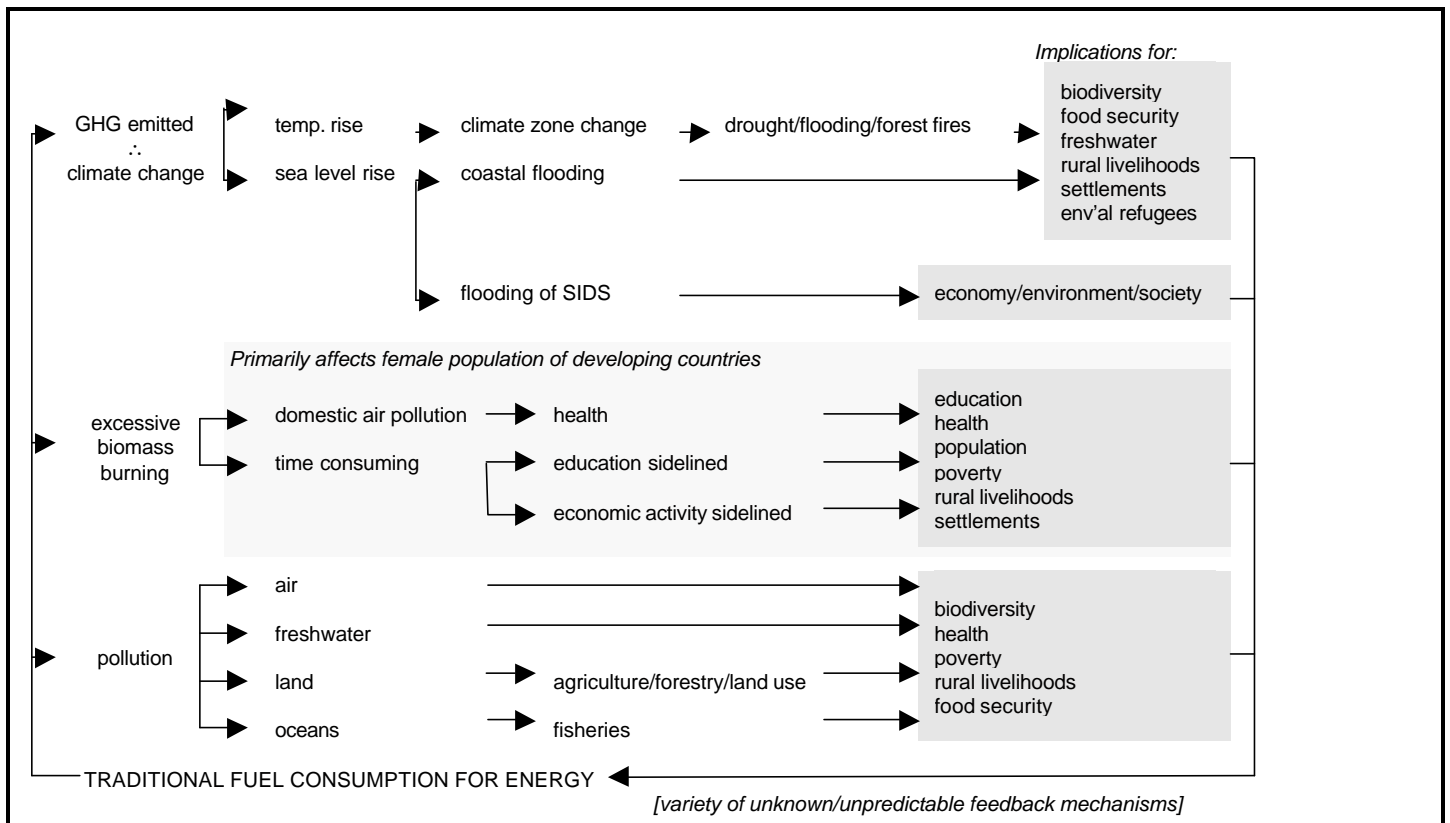
Rising Global Mean Temperature & Sea Level?

In the past few decades the world has experienced a glut of extreme weather events: drought, torrential rain, hurricanes, floods, typhoons, monsoons and forest fires. It is widely perceived that these events are due to changing weather patterns brought about by global warming. However the IPCC's report indicates that extreme weather events are not increasing in frequency. Rather, it is the gradual changes in mean temperature and sea level which are occurring, and it is clear these will have long term effects, as illustrated in Figure 1.

The IPCC's report highlights the following trends in concerning changing temperature and weather patterns:

- Global average surface temperature is predicted to increase by 1.4 – 5.8°C during 21st Century (on top of 0.6°C rise since 1861). Warming will be greater in northern North America and northern/central Asia, and less in southern and south-eastern Asia as well as southern South America.
- The 1990s was the warmest decade, and 1998 the warmest year, since instrumental records began in 1861. The increases in temperature over of the 20th Century are likely to be the largest of any century in past 1,000 years.
- Precipitation is projected to increase during the 21st Century, with mid to high latitudes of the Northern Hemisphere having already experienced a likely 2 - 4% increase in frequency of heavy precipitation events over the latter half of the 20th Century.

Figure 1. Some Consequences of Current Energy Consumption



Any temperature change affects the temperature differentiation between the Tropics and the two Poles - a difference which drives the global climate system. This has knock on effects for oceanic currents, wind and precipitation. Unusual weather events will increase, such as greater frequency and intensity of El Niño² type weather patterns. However the IPCC concludes that even a small change in El Nino is likely to result in more extreme events, of droughts and heavy rainfall, which typically occurs during an El Nino event.

Even a subtle change will alter and shift climate zones over the longer term. Human activity needs to adapt to these conditions – which impact economic activity, food security, rural and urban settlements, and freshwater supply. This shift also affects biodiversity. Many species adapt long term temperature changes very gradually and as such will be unable to adapt to more rapid changes in climate conditions. There may be a number of unpredictable feedback effects to natural systems, such as the irreversible loss of key habitats and species.

The second major impact from climate change is a rise in global seal level. The IPCC report estimates that:

- Average sea level will rise globally by 0.09 to 0.88 metres between 1990-2100. During 20th Century it rose between 0.10 and 0.20 meters, primarily due to thermal expansion and melting from glaciers and ice caps.
- Since the 1960s snow cover decreased by about 10% and recent decades have seen a 40% reduction in sea ice. Scientists have recorded increased melting in the Arctic, Antarctica, and Greenland, as well as in the Andes, Alps, Rockies and Himalayas. Recently the largest recorded iceberg broke away from Antarctica's Ross Ice Shelf – it was 11,000 square km. Speculation is abound on the unknown feedback mechanisms that may result from this melting and sea level rise, based on such climatic interactions such as through the “albedo effect”, changes in water vapour and the differential volumes of ice and water.

However, the immediate effects of ice melt area loss of biodiversity in Polar and Sub-Polar ecosystems and the flooding of coastal areas (where over half the world's population are settled). Small Island States (SIS) and Small Island Developing States (SIDS) would be especially vulnerable to sea level rise – SIDS would impacted most critically because of their limited economic capacity to mitigate and protect against such change . These states are likely to experience impacts upon their economies, societies and environment. There is the further risk of total island submersion. Some Pacific islands are already considering evacuation within five years, such as on the Duke of York Islands in Papua New Guinea.

<i>Table 1. Regional Energy & GHG Emission Trends</i>	
	Energy Consumption & Greenhouse Gas Emission Trends
<i>Asia & Pacific</i>	<ul style="list-style-type: none"> - High use of low-quality traditional fuels in rural areas. - 80% of energy generation from fossil fuels. - Last quarter of 20th Century saw huge rise in energy consumption – economic growth and greater car use meaning some regions are experiencing a doubling of per capita use. - Industrial use of fossil fuels is growing 60% faster than anywhere else. - CO₂ emissions are rising due to heavy use of poor quality coal, the ever-increasing number of cars in use and extensive forest fires and land clearance. - Per capita emissions are only slightly over 50% of the World average. - The most serious problems are in urban areas and least developed countries in the region. - China and India are currently largest emitter in the region.
<i>Europe & Central Asia</i>	<ul style="list-style-type: none"> - Post World War II Western Europe has relied on oil, gas and nuclear. In Central Europe local, often poor quality, fossil fuels e.g. brown coal and oil shale support heavy industry. In Eastern Europe and Central Asia oil, gas, hydro and nuclear fuels are key. - Europe accounts for about 1/3rd of GHG emissions. - Over 20th Century industrial emissions have shifted from 'hot spots' in Western and North Western Europe to Eastern and Southern regions. - Emissions fell in early 1990s due to recession, a move to service industries, the switch to natural gas in Western Europe, and through a drop in consumption and production from the economic crisis of the Former Communist Bloc. - Sources from transport are increasing through greater car use. - CO₂ emissions expected to rise in all sub-regions in the near future.
<i>Latin America</i>	<ul style="list-style-type: none"> - Deforestation, land use change and agriculture are main causes of GHG emissions. - Only about 50% of CO₂ emissions are from industrial production and energy generation. - Responsible for 4.3% of global industrial CO₂ emissions but 48.3% of global land use change emissions. - Per capita CO₂ emissions are 2.55 tonnes, compared to World average of 4.0. - Deregulation and privatisation of energy sector shows a trend away from renewables towards greater fossil fuel use for industry and transport due to lower capital costs and quicker returns. - Widespread use of hydropower. There is considerable potential for increased hydro and biomass energy sources as well as major reforestation programmes.
<i>North America</i>	<ul style="list-style-type: none"> - USA is the World's largest emitter of GHG, both cumulatively and per capita. - A century of massive GHG emissions since the car, low cost fuels and industrial expansion took off. - A decline in CO₂ emissions in early 1980s was due to oil shortages but since then it has increased - Both Canada and USA will exceed 1990 emission levels in 2000 – due massive economic growth, low energy prices, and the slow up-take of efficient and renewable energy. - Emissions expected to continue to rise as energy consumption and number of cars users increase.
<i>Polar Regions</i>	<ul style="list-style-type: none"> - Severe consequences of global warming are predicted – including melting of polar ice caps, glaciers and ice shelves, as well as sea level rise and the thawing of permafrost. These effects will release further methane and CO₂ in to the atmosphere.
<i>West Asia</i>	<ul style="list-style-type: none"> - Post World War II an expanded oil industry, rapid socio-economic and industrial development and population growth have led to high energy consumption. - The region has seen rapid increases in urban vehicle use, fossil fuel intensive industries, power stations. - Per capita CO₂ emissions are above average and greatest in the Arabian Peninsula. - Qatar, United Arab Emirates and Bahrain have the highest commercial energy use per capita globally. - Most nations are net energy exporters but many have pledged implementation of cleaner production technologies and processes.

(Source: after GEO 2000, UNEP 2000)

GHGs & “Common But Differentiated Responsibility”

It is known that natural GHGs insulate the Earth, and but it is also known that the activities of the human race emit GHGs in to the

atmosphere - primarily this emission is CO₂ from the burning of fossil fuels for industrial and transport energy and also from deforestation. The desire of the developed nations for energy to fuel the Industrial Revolution and to increase the standard of living of their populations has led to a mass consumer culture which needs high energy input to sustain itself. It is emissions from this culture which are creating an unnaturally high rise in temperature and sea level.

Prior to the Industrial Revolution (1750) the concentration of CO₂ in the atmosphere was 280ppm (parts per million), by 2000 this had risen to 367ppm. Anthropogenic emissions are thought to currently add 6 billion tonnes of CO₂ to this concentration per year - with two thirds of these coming from developed nations. By 2100 CO₂ concentrations in the atmosphere need to be under 500ppm, or ideally under 450ppm, to be sustainable. Continuing as at present the TAR predicts concentrations of 540ppm to 970ppm.

Undoubtedly the developed nations are the biggest energy consumers in the world - the US alone consumes one quarter of all energy produced annually. This means 5% of the world's population consumes 5x the world average per capita energy use. In Western Europe the per capita consumption is 3x the average, but in sub-Sahara Africa it is 1/10th of the average. See Table 1 for regional trends in energy consumption and production and related GHG emissions. It is undoubtedly the duty of the developed world to initiate reducing GHG emissions but it is predicted that by the 2020s the developing world's total annual emissions will far exceed those of the developed nations and that they will be the site for 80% of new energy technology investment. However, these emissions will not exceed the cumulative emissions attributed to the developed nations since 1750 and will be the result of development to provide universal basic needs.

The developed nations are now moving to service economies and their populations already have well above average standards of living, and so initial reductions in emissions are seen as their historical responsibility are purportedly easier to achieve and will not prevent basic needs provision. Under common but differentiated responsibility it is the responsibility of the developed nations to take the lead in cutting CO₂ emissions - particularly as developing nations will be hardest hit by the effects of climate change and have to also expend major resources in the mitigation of these effects.

Social, Economic & Environmental Consequences

While GHGs can primarily be attributed to industrial nations the environmental effects of climate change and sea level rise and economic and social costs are likely to impact developing nations most heavily. As Figure 1 illustrates, GHG pollution ultimately affects biodiversity, health, poverty, rural livelihoods and food security globally, but primarily in the south where mitigation of the effects of pollution is not an affordable option. Of the 2 billion people without access to adequate energy, most live in rural areas of developing nations and rely on fuel wood and biomass to meet their basic energy needs. The burning of biomass releases CO₂, but also has other environmental, economic and social consequences for its users. In general fuel is collected by female members of the community - an activity that is both time and energy consuming. Educational and economic activities for these women are sidelined. Families, particularly women, are subjected to high levels of indoor air pollution from the burning of these fuels that results in considerable respiratory health problems. With education, health and economic activity all intrinsically related and vital components of development, this deficiency in energy provision creates a cycle of stagnated development which damages whole populations and rural livelihoods.

For the sake of clarity and brevity, many more inter-linkages and implicit links exist between energy use and development than are shown here. It is clear however that energy use has local to global consequences. This in turn highlights that locally sustainable solutions can have positive feedback globally.

CREATING A SUSTAINABLE ENERGY CULTURE

Since energy is still a key driver for development the primary solution to the anthropogenic influence on climate change is to alter the forms of production and consumption in energy use, to achieve a 'decarbonisation' of fuels, and reduce CO₂ emissions per capita, while not reducing energy production and even allowing it to rise in the South. To achieve this two action areas are advocated:

1. Increased energy efficiency: including efficient production and consumption and use of cleaner fossil fuel technology.
2. Diversification of the energy mix.

Within specific sectors, transport is a major energy consumer and the source of one third of all anthropogenic GHG emissions. This sector is predicted to markedly increase energy use over the next few decades - therefore policies that target this sector should help reduce energy use substantially as well.

1. Energy Efficiency

Energy efficiency measures are the cheapest, simplest and fastest way to cut GHG emissions and have the potential to save 40% of energy used worldwide. Policies could be implemented through a mixture of financial incentives and disincentives, direct investment in energy efficient technology RDD (research, design and demonstration) and implementation, legislation and institutional frameworks. For example a reduction or elimination of fossil fuel subsidies would help to internalise the full cost of supply from this en-

ergy source. If consumers paid the real price of fossil fuels they would be encouraged by budgetary concerns to increase the efficiency of their use and to use alternative fuels.

Production and Consumption

To encourage efficiency in the production and consumption of energy in a range of sectors the following package of measures could be considered:

- a. Utilisation of efficient technologies in production, transportation and end-use of energy, e.g. preventing loss of energy lost during transportation.
- b. Introduction and promotion of Combined Heat and Power (CHP) where the heat generated in energy production is also harnessed to provide heating.
- c. Introduction of energy auditing for businesses and tax credit allocation for achieving set levels of efficiency.
- d. Increased taxation of polluting, unnecessary and excessive fuel use.
- e. Introduction of energy efficiency labelling for manufactured goods - thus allowing consumers to identify and compare efficiently produced goods.
- f. Implementation of public awareness campaigns to promote energy efficiency at home and work and to create a 'culture of conservation'.
- g. Decreasing material usage in production of goods and encouraging recycling of waste products.
- h. Promotion of energy efficient architecture. Maximising heat insulation and enhancing the efficiency of internal heating and air conditioning systems.
- i. Introduction of minimum standards of energy efficiency for both building and manufactured goods.

Cleaner Fossil Fuel Technology

It is clear that fossil fuel combustion will continue in the near future, so policies that encourage the utilisation of, and punish the non-utilisation of, cleaner fossil fuel technology are needed. This would limit GHG emissions from the combustion of fossil fuels, for example via and the desulphurisation, denitrofication, underground gasification, and vaporisation by combustion of coal.

2. Diversification of the Energy Mix

The use of alternative fuels (emitting low or no CO₂) is growing . Initially these will help reduce reliance on fossil fuels and eventually allow for cessation of all fossil fuel combustion. However, unless either fossil fuel subsidies are phased out or alternative fuel sources are also subsidized, the financial playing-field remains unbalanced and consumers will continue to take the cheaper option. Alternative and renewable fuels will account for a greater share of the fuel mix than fossil fuels in the long-term. However it is predicted that new fuels will not dominate the sector till 2020 and possibly later if further policies are not introduced to encourage their development and marketability.

Substitution

Use of natural gas is growing. This is relatively cleaner than coal or oil, and is seen as an interim alternative until new technologies are more readily available . It can be utilised in conjunction with energy efficiency measures to generate more immediate GHG emission reductions.

Fuel Cell Technology

Hydrogen is thought to be the fuel of the future. Fuel cells use a reaction between hydrogen and oxygen to release electricity, with only waste produced being water . Natural gas can also be used in this process but some GHGs are emitted as a result. Leading technologies include the Proton Exchange Membrane Fuel Cell (PEMFC), the Solid Oxide fuel cell and the Alkaline Fuel cell. In the future the fuel cell will primarily be used to replace the internal combustion engine but may also suitable for local electric power generation.

Renewable Fuels Technology

Renewable sources include solar - thermal and photovoltaic, wind - on and off shore, tidal, wave, hydro, geothermal, aqua-thermal, biomass and waste-to-energy - agricultural waste, energy plantations, landfill gas, sewage sludge digestion, municipal solid waste combustion, and thermo-photovoltaic cells.

There are several barriers to widespread renewable energy use, for example the need for regulation and the setting of standards for the sale of excess energy. However, the most important obstacle to overcome is their economics - the cost of these technologies, taxation and negative depreciation rates. Currently renewable technologies are expensive to produce as there is a relatively small market for them. However, with technology improving constantly their manufacture is becoming cheaper (as well as making these technologies easier to install/use/maintain). Thus, their marketability is constantly increasing. Policies are needed to encourage this trend - such as funding of RDD, financial incentives to the energy consumer, and for fossil fuel taxation issues to be resolved

Other policies for government and producers to encourage of renewables development and utilisation are: institutional frameworks for promotion of their development; allocation of human resources; raising public awareness of the benefits of renewable energy sources; setting of standards and guidelines for technology use; support for integration in to current energy infrastructure; and in-

creasing the simplicity of small installation set up. With such complimentary policy measures to support the introduction of "new renewables" (not including large scale hydro) to the energy mix it is predicted that this sector of the energy industry would rise in value from \$40 billion per year to \$60 billion by 2010 and could be providing 30-60% of global energy by 2050. However, unless policies are introduced in support of this, these targets will be unrealistic. With 2010 being the target year for national renewable energy programmes under the KP it is hoped that governments will seriously begin development of these policies in the near future.

Nuclear

The continued role of nuclear reactors for energy supply remains a source of contention. Although many countries are no longer investing in new nuclear plants. Some argue that if reactor safety could be assured, including the transport and disposal of radioactive waste and the non-proliferation of nuclear weapons technology assured, then nuclear is a viable alternative as it is a relatively clean energy producer. However, radioactive waste is a bi-product with a lifetime of thousands of years.

Transportation

Approaches to the reduction of GHG emissions from transportation are also based on efficiency measures and new fuel types.

1. Efficiency and reduction of energy use

This can be achieved by reductions in the number and distance of journeys and non-technological measures to improve efficiency. The first two measures below are particularly important for cities in developing nations, where lower income groups typically use public transport and the number of car owners vastly increase in the near future unless measures are taken to reduce the need for individual transport.

- a. Improved Public Transport: reducing single passenger journeys.
- b. Better Urban Planning: Integrating urban and transport planning. where integrated planning can reduce the distance between work/home/social centres and therefore 'trip reduction'. It should improve public/mass transport infrastructure, for example via dedicated bus lanes. Also transit-orientated infrastructure, for example setting of traffic lights and junction location (for example, emissions of GHGs from the 16.5 million light duty vehicles utilised in Canada would be reduced by 336 million kg annually if idling by each at junctions/lights were reduced by 1 minute per day).
- c. Consumer Energy Awareness: multi- media outreach to highlight the need to eliminate unnecessary car journeys, the benefits of public transportation use, car pooling, etc.
- d. Taxation: for example through road pricing schemes and fuel tax.

2. Cleaner Fuels

In the longer term it is predicted that transport technology will allow the use of cleaner fossil fuels (e.g. compressed natural gas, liquefied petroleum gas) or alternative fuels with little or no GHG emissions (e.g. methanol, ethanol, rape seed oil, dimethyl ether). In the shorter term more cars will be run on electricity, hydrogen or by fuel cells such as the PEMFC. However, RDD and marketing of these technologies could be slow, e.g. it would require a renovated 'service station' infrastructure for refuelling. The continued subsidy of fossil fuels, may further hinder uptake of alternative until the middle of this century. More immediate measures include increasing vehicle fuel economy, filtering of emissions and the phasing out of unleaded petrol.

The Fringe Benefits

The future of energy is perceived as 'micropower' - mobile phones and personal computers highlight a trend to place technology as near to the end user as possible. Technology which is small, user-friendly, clean, cheap and reliable, using local production for local consumption. Renewable and alternative energy sources lend themselves to small-scale local technology linked 'microgrids', -a network of local generators which could supply 5,000 - 7,000 people. This would increase energy efficiency, minimising transmission losses and enabling CHP. Infrastructure-intensive energy sectors, i.e. the national grids of industrial countries, are expensive to install. They would cost developing countries around \$1,500 per kilowatt to build. Through new technologies these countries can leap-frog straight to this efficient and decentralised energy economy - benefiting national expenditure and providing energy to historically energy-poor rural areas.

Particularly in developing economies policies targeted at GHG emission reduction have been implemented as part of wider social and economic strategies. Evidence suggests that GHG emissions policies have positive effects on social and economic development, in terms of job creation, public health, transportation, education, agricultural productivity, freshwater provision, rural livelihoods and urbanisation. Politically they can help stabilise energy supply, reducing reliance on imports and therefore enhance national security. In general GHG emission reduction policies are likely to have a neutral or even positive impact on overall country development.

Indicators & The Role of Other Players

The effectiveness of GHG reduction can be illustrated with a variety of indicators, measured internationally or domestically in terms of total, national, household, per capita or other appropriate units. Target or benchmark levels are identified and progress is measured on a positive or negative movement from this level. Indicators for climate change and energy could include the following:

- Climate Change: Mean temperature; Mean sea level
- GHG Emissions: Emissions of specific GHGs; Atmospheric concentrations of GHGs
- Diversification of the Energy Mix: Share of consumption of renewable energy resources; Energy production and consumption by fuel type; Price per unit of energy by source fuel; Expenditure on energy mix policies
- Energy Efficiency; Energy consumption; Efficiency of new appliances; Thermal efficiency of housing stock; Expenditure on energy efficiency policies

Table 2. Institutions & Stakeholders: Roles & Responsibilities

<i>Business & Industry</i>	<p>European Business Council for a Sustainable Energy Future [www.e5.org] - to open untapped business opportunities, create extra jobs and serve the cause of environmental and climate protection.</p> <p>Global Climate Coalition [www.globalclimate.org] - an organization of trade associations established to coordinate business participation in the international policy debate - climate change sceptics.</p> <p>GREENTIE (Greenhouse Gas Technology Information Exchange) [www.greentie.org] – international information network of suppliers whose technologies help reduce GHG emissions.</p> <p>International Emissions Trading Association (IETA) [www.ieta.org] - dedicated to the establishment of effective systems for business trading in greenhouse gas emissions.</p> <p>Safe Climate, Sound Business [www.wri.org/wri/cpi/scsb/] - BP, General Motors, Monsanto and World Resources Institute collaboration on implementing internal actions to combat climate change.</p> <p>US Business Council for a Sustainable Energy Future [www.bcse.org] - advocates policies that promote the nation's economic, environmental and national security goals.</p> <p>WBCSD GHG Protocol Initiative [www.ghgprotocol.org] – international corporate standard for GHG emissions.</p>
<i>Indigenous Peoples</i>	<p>International Forum of Indigenous Peoples and Local Communities on Climate Change - accessible via World Rainforest Movement [www.wrm.org.uy], Indigenous Environment Network [www.ienearth], Unrepresented Nations and Peoples Organisation [www.unpo.org] and others.</p>
<i>Local Authorities</i>	<p>Cities for Climate Protection [www.iclei.org/co2/index] – International Council on Local Environmental Initiatives programme empowering cities and local governments to inventory and reduce GHG emissions.</p>
<i>Multilateral Organisations</i>	<p>Climate Technology Initiative [www.climatech.net/home] – multilateral initiative to promote fostering of international cooperation in the development and diffusion of climate friendly technology and practises.</p> <p>G8 Renewable Energy Taskforce [www.renewabletaskforce.org] - to identify actions that can be taken to promote a step change in the supply, distribution and use of renewable energy in developing countries.</p> <p>Global Environment Facility [www.gefweb.org] – FCCC financial mechanism for projects designed to reduce the risks of global climate change while providing energy for sustainable development.</p> <p>International Energy Agency [www.iea.org] - autonomous agency linked with the OECD - members committed to taking joint measures to meet oil supply emergencies and cooperate in energy information and programmes.</p> <p>World Energy Council [www.worldenergy.org] - promoting sustainable energy use and supply.</p>
<i>NGO</i>	<p>Climate Action Network [www.climateactionnetwork.org] - largest coalition of climate change NGOs.</p> <p>Climate Voice [www.climatevoice.org] – giving global citizens a voice in demanding the end of global warming.</p> <p>Corporate Watch Climate Justice [www.corpwatch.org/climate/] – local & global justice of global warming.</p> <p>Global Commons Institute [www.gci.org.uk] – promotion of Contraction and Convergence as the solution to allocation of allowable GHG emissions.</p> <p>Global Energy Marketplace [gem.crest.org] – gateway to sustainable energy information on the internet.</p> <p>INFORSE [www.inforse.dk] – international network promoting sustainable energy and social development.</p> <p>International Institute for Energy Conservation [www.iiec.org] - working to bring the power of sustainable energy solutions to developing countries and economies in transition.</p> <p>Tiempo [www.cru.uea.ac.uk/tiempo] - to promote communication between the nations of the North and South on the issue of climate change and to promote the interests of developing nations in the climate debate.</p> <p>UN Commission on Sustainable Development (CSD) NGO Energy Caucus [www.igc.org/csdngo/energy/ene_index.htm] – promoting energy and climate change issues in the CSD.</p>
<i>Scientists & Technologists</i>	<p>Intergovernmental Panel on Climate Change [www.ipcc.ch] - WMO/UNEP body to assess the scientific, technical and socio-economic information relevant for greater understanding of human-induced climate change.</p>
<i>Trade Unions</i>	<p>ICFTU [www.icftu.org] – coordinating input to CSD 9th Session from Trade Union Advisory Committee to OECD, Federation of Chemical, Energy, Mine and General Workers Unions, International Metal Workers Foundation, International Transport Workers Federation, and Public Services International.</p>
<i>United Nations</i>	<p>Ad Hoc Open-ended Intergovernmental Group of Experts on Energy and Sustainable Development [www.un.org/esa/sustdev/enexpert] – established to prepare inputs to CSD's 9th Session.</p> <p>Committee on Energy & Natural Resources for Development [www.un.org/esa/sustdev/enrcm] – government nominated experts meeting biennially on issues relating to energy and water.</p> <p>UNCTAD Greenhouse Gas Emissions Trading scheme [www.unctad.org/en/subsites/etrade/index.htm] - the development of an integrated global emissions trading system in which all countries could participate.</p> <p>UNEP 'The GHG Indicator' [www.unep.ch/etu/finserv/insura/CO2-Main-Page] - guidelines for calculating GHG emissions for business and non-commercial organisations.</p> <p>UNEP/International Energy Agency [www.unep.ch/etu/econ/energy/enind.htm] - convene regional workshops on energy subsidy reform and sustainable development.</p> <p>UNESCO World Solar Commission [www.worldsolar.org] - to promote renewable energy technology use via World Solar Programme 1996-2005.</p>
<i>Women</i>	<p>Energia [www.energia.org] - international network linking those concerned with energy, environment and women.</p>
<i>Youth</i>	<p>The Bet [www.thebet.org] – European campaign betting they can save 8% of CO₂ emissions in only 8 months.</p>

- Transport: Consumption of fossil fuels by motor vehicles; Production of new motor vehicles by propulsion technology;
- Production of new motor vehicles by fuel efficiency; Average journey length

Monitoring of such indicators help encourage the implementation of GHG reduction policies and highlight when emissions are moving in the wrong direction. This is a key for government and international institutions as well as stakeholders. Many stakeholders also initiate individual and group measures to tackle GHG emissions. Table 2 lists the principle institutions and nine major stakeholder groups, identifying their actions on climate change and energy.

THE WAY FORWARD

Some of the measures described above would undoubtedly lead to a more sustainable international energy culture and contribute to a reduction in GHG emissions. However much work needs to be done for the incentives and drivers for implementing these policies. Industrial countries don't want hinder economic progress and developing countries, while often more open to implement such policies, need significant financial and technology transfer to do so.

The Framework Convention on Climate Change and the Kyoto Protocol

The Framework Convention on Climate Change (FCCC) is the primary international mechanism for encouraging use of sustainable solutions to the climate change. Opened for signature in 1992 it is one of the key outcomes of the UNCED Earth Summit in Rio that same year. Box 2 shows how the regime has developed, outlining information on the two central tenants - FCCC and Kyoto Protocol (KP). The Convention has no legally binding commitments for GHG emission reductions, but outlines the principles, aims and institutional procedures for developing a sustainable climate change regime. It also promotes reporting and reviewing of national

Box 2. Framework Convention on Climate Change & the Kyoto Protocol

<u>Meetings & Documents</u>			
1992	United Nations Conference on Environment & Development <i>Framework Convention on Climate Change (FCCC) opened for signature.</i>		(Rio de Janeiro)
1994	Framework Convention on Climate Change enters in to force		
1995	COP 1 – 'Berlin Mandate' <i>To launch a process toward appropriate action for the period after 2000.</i>		(Berlin)
1996	COP 2 – 'Geneva Declaration' <i>Endorsement of IPCC conclusions plus call for legally binding objectives and significant reductions in GHG emissions.</i>		(Geneva)
1997	COP 3 – 'Kyoto Protocol' <i>Legally binding commitments for reduction of GHG emissions for Annex B countries and flexible mechanism frameworks.</i>		(Kyoto)
1998	COP 4 – 'Buenos Aires Plan of Action' <i>Two year plan outlining deadlines for finalising the details of the Protocol.</i>		(Buenos Aires)
1999	COP 5		(Bonn)
2000	COP 6 (<i>suspended to July 2001</i>)		(The Hague)
2001	COP 7		(Marrakech)
2002	Kyoto Protocol enters in to force at Earth Summit 2002?		
<u>Status & Annexes</u>			
FCCC	Signed by 186 governments Ratified by 186 governments	Annex I Annex II	36 developed/transition countries 25 developing countries
Kyoto Protocol	Signed by 83 governments and EU Ratified by 29 (developing) governments (in force when 55 nations accounting for 55% of 1990s CO ₂ emissions sign)	Annex B	39 developed/transition countries
<u>Related Bodies</u>			
Conference of the Parties (COP) = <i>body of the FCCC to promote and review implementation.</i>			
Meeting of the Parties (MOP) = <i>body of the Protocol to promote and review implementation. Will resume overall responsibility once the Protocol is ratified.</i>			
Subsidiary Body for Implementation (SBI) = <i>assists COP in assessment and review of effective implementation.</i>			
Subsidiary Body for Scientific and Technological Advice (SBSTA) = <i>provides advice and information to COP on related scientific and technological matters.</i>			

emissions and projections. Annex 1 countries (industrial and transitional) were to stabilise GHG emissions at 1990 levels. KP introduced legally binding commitments to the Convention. If the Protocol is ratified 33 Annex B countries (industrial and transitional) are committed to a reduction of 5.2% of GHG emissions (from 1990 levels) during the first Commitment Period (2008-2012).

Three mechanisms, known as the “flexible” or “Kyoto” mechanisms will be put into place to facilitate reductions:

1. *Activities Implemented Jointly* (Article 6): GHG reduction projects financed by one Annex B country and taking place in another Annex B country. The financing nation receives credits according to reductions achieved in meeting their own targets.
2. *Clean Development Mechanism* (Article 2): GHG reduction projects financed by an Annex B country but implemented in a non-Annex B (developing) country. Reductions are accredited by an independent third party as “certified emissions reduction credits”. To be banked until 2008 when they will count toward reductions under the First Commitment period.
3. *Emissions Trading* (Article 17): Allowing countries to trade in emissions. Those that fail to meet their targets can “buy” reductions from others who achieve reductions beyond their target.

These mechanisms are controversial. There are also several other unresolved elements that are acting as barriers to ratification. The Protocol requires 55 signatories to come into force, but ratification by nations is hampered by disagreements on:

1. Design of the modalities of the Kyoto Mechanisms: Developing workable mechanisms, ensuring they are not too “flexible” and perceived as a way to avoid domestic reductions and devalue the commitments made.
2. Differentiation between national reduction commitments, particularly for developing countries.
3. Setting and implementing targets and timetables
4. How LUCF and CO₂ sources and sinks can be integrated in to emission reduction strategies.
5. Compensatory provisos for those countries, primarily developing, negatively impacted by reductions, i.e. oil exporting nations, SIDS and others affected by climate change impacts, and in countries where development may be impeded.

Modalities and national differentiation remain the principle barriers to ratification and prevented the recent COP6 meeting from leading to meaningful agreement. There are two key issues upon which the process is most severely stalled. Firstly, the small print of the flexible mechanisms needs to be clarified i.e.- how to make them drivers of innovation rather than avoidance tools, making them enforceable and imposing ceilings on their use. The danger is that a country's emissions may actually rise while “reductions” are achieved by credits from external projects and emissions trading. As the flexible mechanisms are seen as the primary means for financing and technology transfer many countries are eager to see these finalised and implemented, but this fine-tuning of mechanisms needs to be a rigorous and transparent process to ensure commitments are realistic and fair. On the other hand, many see this process as an excuse to delay, and even prevent, concrete action for the sake of national interests, at the expense of the climate change regime.

Second is the adequacy of commitments, and not just whether the commitments made by developed nations under the KP are significant, but also developing country commitments. Due to the potential rise in developing country emissions over the next few years some industrial developed countries, primarily the USA, are determined not to ratify until the “meaningful participation” of developing nations is assured - especially China and India. Some developing nations, including Argentina and Kazakhstan, are keen to commit to voluntary reductions but discouraged by others of the G77. For example, China opposes commitments because of the historical responsibility of industrial nations. One of the proposals to break the deadlock in negotiations include a suggestion that initial negotiations on developing country commitments, due to begin in the Second Commitment Period of 2012 - 2016, actually be brought forward - an idea that is unlikely to be met with much developing country support.

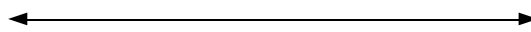
Even if these roadblocks to the FCCC and Protocol can overcome there are still other barriers to a sustainable energy culture. At the heart of this are northern consumers. Vested interests and a supply biased process, along with a decline in RDD spending, and the current initial expense of installing efficient and new fuel technologies offer a clear message of complacency and indifference to the full cost of unsustainable energy use.

2002 AND BEYOND...

With the suspension of COP6 negotiations public perception is of an international process in dire straits. However, the foundations are being laid for renewed negotiations in the second quarter of 2001. Many involved are aiming to negotiate for ratification without damaging the environmental integrity of the KP and ensure the process proceeds in the right direction. It seems far better to get the details right at the outset to ensure a process that is realistic and achievable. In the words of Jan Pronk, COP 6 Chair, “*we did not succeed...[but] looking back, I think it is better to say that perhaps we did not yet succeed*”. Never the less, these are urgent times. The sooner the regime begins implementation the better. The 6th COP (part II), and following meetings must iron out the implementation, technology transfer and financing issues of the FCCC to ensure full entry into force of the Protocol. There is talk of ratification without US support (if the EU, Russia, Japan, the Ukraine and others can account for the required 55% of emissions), and along with the proactive interest shown by business at COP6, there is hope for the climate change and energy process to move forward.

The 9th Session of the Commission on Sustainable Development (CSD) may help to clarify some of the more difficult elements. Its sectoral theme for 2001 is Atmosphere and Energy, and the economic sector is Energy and Transport, thus stakeholders can actively discuss the practical implementation of sustainable energy policies and innovative solutions to the problems of climate change. The Ad Hoc Open-ended Intergovernmental Group of Experts on Energy and Sustainable Development has been convened as the discussion forum in advance of the meeting to consider these issues and policy areas within the CSD process. As asserted by the Malmö Environment Ministers Declaration and the General Assembly's Millennium Declaration, as well as several global networks (including ICLEI, Globe parliamentarians, RIO +8 NGO coalition, and ANPED), it is hoped that Earth Summit 2002 will provide an opportunity to finalise discussion around KP and see it entered into force. It could also provide the space for international, regional and more local initiatives, such as a Climate Change Index or Renewable Energy Declaration with development targets and financial commitments, complimenting the ratification with concrete plans for implementation. Thus, 2003 could see a reinvigorated process with the first Meeting of the Parties of KP, initialising implementation of legally binding commitments and steps toward the first commitment period between 2008 and 2012. If ratification does not occur 2002 will need to see voluntary implementation programmes from those nations serious about climate change, otherwise it will be unlikely that the KP targets will ever be met.

Moving ahead international and domestic climate change and energy programmes is no small task, but one that must be made workable. The facts are clear - over 2 billion people need access to energy and the rest of the world's population need to reduce their consumption of it. Such a dichotomy can only be resolved through significant international will in mobilising an equitable and sustainable energy culture.



Footnotes

1. Conclusions based on the recognition that further modelling and research are still required.
2. El Niño is a natural hydro-climatic event that slows and reverses the Equatorial westward currents of the Pacific Ocean every 4-5 years. El Niño warms sea surface temperatures in the Eastern Pacific – and has resulting knock-on effects to the global climate system. The strength El Niño determines the kinds of changes it leads to globally. Scientists are trying to uncover whether global warming is causing the El Niño effect to increase its frequency and ferocity?
3. This is not an exhaustive listing for each stakeholder group. Due to space constraints only website contacts are listed. Please contact the author for full information.

Key Literature & Links

Framework Convention on Climate Change and Kyoto Protocol – full texts available in Arabic, Chinese, English, French, Russian and Spanish from address below or www.unfccc.int/resource/convkp.html

Intergovernmental Panel on Climate Change – definitive scientific reports available from www.ipcc.ch/pub/reports.htm or address below.

First Assessment Report: 1990

Second Assessment Report: Climate Change 1995

Third Assessment Report: Volume I "Climate Change 2001: The Scientific Basis" available now. Volume II (impacts) available mid-February 2001. Volume III (response strategies) available early March 2001.

World Energy Assessment – United Nations Development Programme, Department of Economic & Social Affairs and World Energy Council report on the scientific and academic background for international negotiation on energy and development. Can be downloaded from www.undp.org/seed/eap/activities/wea/ or contact UNDP, Energy & Atmosphere Programme, 304 East 45th Street, New York, NY 10017, USA Tel: +1 212 906 6068 Fax: +1 212 906 5148

Key Organisations

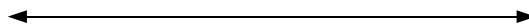
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