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The nature of energy

Biofuels: friend or foe?

China's energy future

Women's business?

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Next issue
The next issue of *World Conservation*, to be published in December 2007, will explore diversity – how natural diversity underpins the world's social fabric, cultural diversity and economic progress. Submissions and article suggestions are welcome; please send them before 31 August 2007.

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The nature of energy

The world is facing twin energy-related threats: that of not having adequate and secure supplies of energy at affordable prices and that of environmental harm caused by consuming too much of it.
World Energy Outlook 2006

International attention to the energy crisis is heightening by the day. While the planet indisputably heats up, so does the energy debate. Politicians and the media are full of it: escalating oil prices; disputes over gas supplies; nuclear power re-emerging and renewable energy targets. Alternative energy markets are doing brisk business as the world tries to shed its reliance on fossil fuels while still meeting growing global energy demand.

Our systems of energy production, distribution and consumption are changing rapidly because of burgeoning development, concerns over security of supplies and climate change. Ecosystems, which underpin many of our energy supplies, are under pressure from energy production (such as more intensive cropping for biofuels) which in turn affects livelihoods. And if ecosystems are unable to provide their full range of services, we could be seriously limiting our future energy options.

Climate change is the most significant indirect impact on biodiversity from energy production and consumption, but direct impacts continue to take a major toll. Pipeline construction, coal mining and fuelwood extraction all degrade habitat. And there is no sign of a let-up. The *2006 World Energy Outlook* warns that global energy demand could increase by more than half from 2004 to 2030 with fossil fuels likely to dominate the global energy mix until 2030. But just because there's plenty of oil and coal left, shouldn't mean we delay the switch to cleaner alternatives. As we all know, the Stone Age didn't end because we ran out of stone.

Political instability is fuelling the push to energy self-sufficiency, but there is a danger that the self-sufficiency goal is driving energy development that doesn't consider its social and environmental impacts. The world's leaders make bold statements about the need for a clean energy future, but reconciling energy security and environmental protection requires far more concrete government action and public support. What's needed is a serious shift from the 'business as usual' approach, as called for by the Gleneagles G8 meeting. Some leaders are doing the right thing, but most are opting for quick fixes, shying away from the long-term planning and policy that is necessary to bring positive change well beyond their term of office.

While politicians grapple with energy security, environment and development organizations tackle another dilemma. How can the world cut its carbon emissions while providing energy to the millions of people who lack access to it? With energy provision central to achieving the Millennium Development Goals, they are joining forces in a drive towards energy systems that are equitable, affordable and ecologically sustainable.

Frustratingly, the resources and technologies are available for us to overcome our energy challenges. Biofuels, wind, solar and geothermal power can all become part of the future energy mix. But the impacts on biodiversity from current and future energy sources must be better recognized and addressed, and the opportunities that conservation provide in meeting sustainable energy needs, promoted. Emerging technologies such as carbon capture and storage (CCS) are likely to play an important role in reducing greenhouse gas emissions from fossil fuels in the foreseeable future, and should be explored as part of the solution to minimize emissions generated by the energy sector. But the potential risks to biodiversity of these technologies must be identified and managed.

This issue of *World Conservation* takes a broad look at the role of energy in sustainable development, and outlines the importance of biodiversity in the energy debate. We cover the energy chain from the producers to the consumers; rich country to poor country perspective; high tech solutions to low tech approaches. Climate change crops up in nearly all the articles as an energy impact or an agent for change. We hear the latest projected climate change impacts on people and ecosystems, but while climate change underlies many shifts in the energy agenda, it is not explored in detail in this issue. We provide perspectives on a range of energy options but don't have the space for a comprehensive analysis of the impacts of every energy source on people and nature.

We hear from an Australian senator on how her country is struggling to break its addiction to fossil fuels, a Harvard professor from Kenya on how technology can go a long way in solving Africa's energy problems, and from Norway's Energy Minister on how his country is forging a path to energy sustainability. With energy efficiency offering a relatively easy and cost-effective weapon in the arsenal, we cover some of the innovative measures the private sector is taking.

What energy future do you imagine? Will it be a decentralized system where our homes and villages produce their own power? Or will we see a world crisscrossed by more pipelines and dotted with nuclear plants and coal power stations? What are you or your organization doing on energy? As always, we welcome your views. Please write to us at worldconservation@iucn.org.

www.iucn.org/energy

The **Organization of the Petroleum Exporting Countries (OPEC)** is an international organization made up of Iraq, Indonesia, Iran, Kuwait, Libya, Angola, Algeria, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela. According to OPEC, its mission is to coordinate the petroleum policies of its member countries and ensure the stabilization of oil prices to secure an economic and regular supply of petroleum to consumers, a steady income to producers, and a fair return on capital to those investing in the petroleum industry.

www.opec.org

What a mess

How did we reach this current energy crisis?

We can blame it on the steam engine. From the time of its invention, people in the industrialized world learnt to live beyond the ecological and raw material limits of their surroundings and became rich by doing so. The industrial revolution, powered by cheap, plentiful energy, separated people from their environment. While civilizations like that of Easter Island disappeared by exceeding local natural limits, burning coal, gas and oil allowed us to overcome local resource and ecological limits seemingly without penalty.

With fossil fuel energy, we could build our dream machines, travel the world, trade globally, eat foods regardless of the season and consume more and more goods. There seemed to be no limit to the resources that could be exploited and the waste that could be dumped into the atmosphere or our rivers and oceans. Environmentalists' warnings that the Earth is a fragile planet that cannot withstand infinite exploitation without ecosystem collapse were ignored. For 200 years, humanity forgot the very idea of ecological or resource limits and the interconnectedness of people and nature. The consequences for remote people, places, other species or the global atmosphere were conveniently far away in either distance or time.

Now they are not. Climate change, driven by the profligate use of fossil fuels, and oil depletion have delivered a wake-up call. As we all suffer water shortages, droughts, crop failures, storms, sea level rise, bushfires, species extinction and disease, we have been forced to remember that in spite of economic growth, without natural systems to sustain us, human civilization will collapse.

Energy from fossil fuels is the root of the problem and energy from renewable sources is central to the solution. We are running out of oil, gas is at best a transitional fuel, and we cannot afford to use the coal we have left if we are to avoid catastrophic climate change. We are at a crossroads. We can continue with business as usual and watch the world descend into energy wars, waves of environmental refugees, and an increasingly uncertain future. Or we can see climate change as an opportunity to change the way we live by consuming less in the developed world and providing access to sustainable energy options in the developing world.

We know that we have to change; we know that we have to rethink the economy so that it operates within the Earth's ecological limits. What is less understood is that this transformation also gives us the opportunity to act as a global community to address poverty and inequality, species extinction, and to create enormous economic benefits. These changes can make us happier, healthier and more secure in the knowledge that our children will inherit a world that is a joy to live in. ■

The **International Energy Agency (IEA)** is a Paris-based intergovernmental organization founded by the Organisation for Economic Co-operation and Development (OECD) in 1974, in the wake of the oil crisis. It aims to maintain and improve systems for coping with oil supply disruptions; promote rational energy policies through relations with non-OECD countries, industry and international organizations; provide an information system on the international oil market; and improve the world's energy supply and demand structure by developing alternative energy sources and increasing energy efficiency. The *World Energy Outlook* is the IEA's flagship publication.

www.iea.org

North and south

Government Ministers from Norway and Cameroon highlight the energy challenges and opportunities facing countries on both sides of the economic divide.

Norway

Norway is rich in both renewable energy sources and in oil and gas. Of our electricity generation, 99% is from renewable hydro power. Norway has long been one of the world's major oil exporters and we are the world's third largest gas exporter, soon to overtake Canada to second place. Our objective is to be a stable and predictable energy supplier. We have always resisted the temptation to turn energy into more of a political or strategic commodity than it already is. This has served our interests well, solidifying our reputation in global energy markets as a reliable supplier.

Due to Norway's large-scale production of hydro power (which we have developed over more than a century), our domestic stationary energy mix (excluding transport and offshore oil and gas activities) is dominated by electricity. Most of our hydro power potential, about 70%, has already been developed. Although there is still considerable activity in the hydro power sector, including upgrading and extension of existing plants, and projects for new medium-sized and small hydro power plants, of which we're seeing a boom, we're striving to achieve a more diversified and flexible energy system. We have put in place extensive programmes to stimulate increased energy efficiency, and to significantly increase the use of other renewable energy sources like biomass, onshore and offshore wind, solar, wave and tidal. I am pleased that Norway is increasing its efforts in the renewable energy sector, particularly hydro power, in its overseas development assistance.

Energy security is a complex issue. It affects energy choices, trade and political relations between countries, as well as the

environment. Our personality as a State is determined both by our role as a major energy supplier, and by our ambition to be a leader in safeguarding the environment – not least through the development of low-carbon and green technologies. Will global resources be sufficient to meet future energy demand? Particularly for oil, this is a much-debated issue. Most experts believe that oil reserves should be sufficient for several decades yet. I share this view. I think we will meet the demand through research, improved technology, and development of non-conventional resources.

Norwegian oil exploration began in the North Sea some 40 years ago and since then, has gradually moved northwards. As our oil sector is maturing, we now venture along the Atlantic Margin to the High North, beyond the Arctic Circle into the frontier areas of the Barents Sea. There are estimates that the Arctic holds a quarter of the world's undiscovered hydrocarbons. Considerable oil and gas reserves have already been found in the Barents, Pechora and Kara Seas. But oil and gas extraction in the Arctic faces significant challenges – technological challenges related to low temperatures, long distances and darkness, and environmental ones. With the human footprint in the Norwegian Barents region being so far small, there is widespread public concern about allowing petroleum activity in such a sensitive area. We're addressing these challenges with an integrated management plan for the marine environment in our northern and Arctic waters which considers the effects of all human activities including fishing, maritime transport and oil extraction.

In terms of climate change mitigation, Norway has extensive experience in storing carbon dioxide (CO_2) in geological structures. Since 1996, one million tonnes of CO_2 per year have been separated from gas production on the Sleipner Vest field in the North Sea for storage in a geological formation 1,000 m below the seabed. We have monitored the formation for more than 10 years and it is clear that the CO_2 stays in place. Through economic measures and research, Norway will contribute to the development and implemention of efficient technologies for carbon capture and storage (CCS). The aim is to develop CCS technologies that are cost effective and can be used in a wide range of applications at home and abroad. Two gas-fired power plants under construction in Norway will be the first full-scale applications of CCS technology.

While technology will be a vital component of a sustainable energy future, improved energy efficiency is critical to all countries, including Norway. We support efforts to increase energy-efficiency policies and measures internationally. The solutions to our energy-related climate change challenges have to be sought on a political level in cooperation with key stakeholders, both nationally and internationally. ■

Norway's Minister of Petroleum and Energy, H.E. Mr Odd Roger Enoksen

Cameroon

With Cameroon's economic growth closely tied to power supply, we urgently need to devise strategies to improve the security of this supply and greatly increase access to energy. We must develop new capacities for the production, storage and distribution of modern energy sources, and schedule the gradual transition from fuelwood and other biomass sources to liquid and gas fuels like domestic kerosene and liquefied petroleum gas.

Cameroon has experienced a fairly steady decline in its domestic oil production over the past 20 years and could soon become a net oil importer unless new reserves are brought online. The country does not currently produce any natural gas, but we plan to develop our gas reserves for electricity generation in the future.

The majority of electricity generated in Cameroon comes from hydroelectric stations, although droughts can leave us vulnerable to power cuts. We have the second largest hydroelectric capacity after the Democratic Republic of Congo, with three hydroelectric dams at Edea, Songloulou and Lagdo. These meet most of the country's current energy demand but there is potential to greatly increase the efficiency of these stations and we have numerous sites suitable for smaller hydro systems.

The Ministry of Energy and Water in Cameroon is working closely with the Ministry for Scientific Research to develop new and renewable energy sources. Currently, we are reliant on fuelwood and this resource could be further exploited. Cameroon is home to a large forested area, south of the Adamaoua region and fuelwood remains the main source of energy for homes, especially in rural areas. But the northern part of the country, which borders on the deserts of Nigeria, has limited wood supplies so other sources must be developed. Wind speeds in the country have been found to be too low for wind power to be a feasible energy option but there is great potential to exploit solar power in Cameroon. ■

Cameroon Minister of Energy and Water Resources, H.E. Mr Jean-Bernard Sindeu

Statoil, the Norwegian oil and gas company has had a role in pioneering carbon capture and storage technology, and in finding ecologically-sensitive ways of developing oil and gas reserves. Statoil was one of four oil and gas companies to take part in the Energy and Biodiversity Initiative, a partnership (convened by Conservation International) designed to produce practical guidelines, tools and models to improve the environmental performance of energy operations, minimize harm to biodiversity, and maximize opportunities for conservation wherever oil and gas resources are developed.

www.theebi.org

Energy on the agenda

Gleneagles 2005 – a watershed for energy and climate debate

In July 2005, the G8 leaders, together with the leaders of Brazil, China, India, Mexico and South Africa pledged to act *"with resolve and urgency now to meet our shared and multiple objectives of reducing greenhouse gas emissions, improving the global environment, enhancing energy security and cutting air pollution in conjunction with our vigorous efforts to reduce poverty."* This commitment, based on the realization of the severity of the consequences of climate change and the recognition of the role of human activity in increased greenhouse gas emissions, has had a ripple effect throughout the energy world.

International Energy Agency (IEA) – a different outlook

IEA's 2006 *World Energy Outlook* is a departure from past outlooks which had provided forecasts for future energy markets, largely based on past trends, and predictions in growth in demand. On the request of the G8+5 leaders, IEA included two additional scenarios in the 2006 report – an *Alternative Policy Scenario* which forecasts the level of carbon emissions reductions (compared to the *Reference Scenario* levels) if all existing government energy efficiency and renewables policies were fully implemented, and a *Beyond Alternative Policy Scenario* which looks at what it would take to cap CO_2 emissions in 2030 at today's levels. The reason? Twin priorities of achieving energy security and minimizing environmental impacts from energy production and consumption.

The UN Commission on Sustainable Development – faltering along the way

Charting an international policy path towards more sustainable, equitable and acceptable energy and climate change options is proving a challenge, though. The 15th Session of the CSD faltered in its negotiation of an agreed Chairman's text on the subjects of energy for *sustainable development* and *climate change*. Differing views on how to achieve a more sustainable energy future emerged within the G77 and between the G77 and the G8. Stumbling blocks included the role of fossil fuels in a sustainable energy future; the potential for, and risks of, carbon capture and storage; who should move first on committing to reducing greenhouse gas emissions; and who should bear the costs of emissions reductions.

The **UN Development Programme (UNDP)** focuses on the policies needed to support energy options for sustainable development and poverty reduction. Its four priority areas are: strengthening national policy frameworks, promoting rural energy services, promoting clean energy technology, and increasing access to financing for energy.
www.undp.org/energy

The **UN Environment Programme (UNEP)** Energy Programme addresses the environmental consequences of energy production and use, such as global climate change and local air pollution. Focus areas are renewable energy, energy efficiency, transport, energy finance, and policy issues.
www.unep.org/themes/energy

The **UN Foundation's Energy Future Coalition** is a broad-based, non-partisan alliance that seeks to bridge the differences among business, labour and environmental groups, and identify energy policy options with broad political support.
www.unfoundation.org
www.energyfuturecoalition.org

UN-Energy was established to help ensure coherence in the UN system's multi-disciplinary response to the World Summit on Sustainable Development (WSSD) and to ensure the effective engagement of non-UN stakeholders in implementing WSSD energy-related decisions.
http://esa.un.org/un-energy

Conjecture to reality

The energy sector is under major pressure to change as the impacts of climate change become increasingly visible and understood. But the industry is unlikely to transform fast enough to avert further global warming, leading to greater attention to mitigation and adaptation. The world needs to move rapidly from scientific understanding of the problem to multi-stakeholder action on an unprecedented level.

The 4th Assessment Report of the Intergovernmental Panel on Climate Change Working Group II makes it clear that climate change will have severe consequences for ecosystems. This will greatly affect human livelihood, wellbeing and our ability to adapt. Dr Martin Parry, Working Group II co-chair, outlines some of the key findings.

A decade ago, the typical view was that climate change is something that will affect our grandchildren but not us. Now, for the first time, we can confidently detect the effects of man-made warming on plants and animals around the world.

Apart from these detectable impacts, we also know that the poor, the elderly and the most vulnerable will be hit hardest, including those in the most developed countries. Changes in rainfall patterns and the disappearance of glaciers are projected to significantly affect water availability for human uses such as food production and energy generation. By mid-century, hundreds of millions more people are expected to be short of water, especially in the mid-latitudes and dry tropics. Our health will be seriously affected, particularly in areas of current poverty and poor provision of health services, from a combination of poorer quality water, increased stress from high temperatures, and increased incidence of disease.

For biodiversity, the outlook is equally bleak. By mid-century, between a fifth and a third of plant and animal species could be on a path to extinction unless rapid and major efforts in emissions reduction are agreed and implemented. The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances such as flooding, drought, wildfire, insect invasions and ocean acidification, and other factors such as land use change and resource over-exploitation.

Ecosystems most affected by climate change are those of the tundra, boreal forest, mountains and Mediterranean-type environments including southern Europe, the Cape Region of South Africa, and California, and along coasts, notably mangroves and salt marshes. For increases in global average temperature exceeding 1.5–2.5°C there are projected to be major changes — mostly negative — in ecosystem structure and function, species' interactions and geographic ranges.

Our ambitions for achieving sustainable development will be severely restricted by climate change in many countries as it compounds the pressures on natural resources and the environment stemming from rapid urbanization, industrialization and economic development. On the other hand, sustainable development can reduce vulnerability to climate change by enhancing our capacity to adapt and increasing the resilience of our natural systems.

There are many mitigation and adaptation responses available to us: technological (such as the construction of sea defences), behavioural (including changes in food and recreational choices), managerial (like altering farming practices), and policy-based (for example, appropriate planning regulations). Even the most stringent mitigation efforts cannot avoid further impacts of climate change in the next few decades, which makes adaptation essential. A response 'package' could combine policies with incentive-based approaches, and would need action at all levels from individual citizens to national governments and international organizations.

Whilst most technologies and strategies are known and developed, their effectiveness in reducing the risks of climate change is largely unknown, particularly at higher levels of warming. There are also formidable environmental, economic, informational and social barriers to adaptation.

Much depends on mobilizing major efforts especially in the transfer of knowledge and resources from developed to developing regions where impacts are expected to be greatest. They may even be occurring now although we cannot clearly detect them above the 'noise' of current disasters. Adaptation alone is not expected to cope with all the projected effects of climate change, especially in the long term as most impacts increase in magnitude. But it may be the only effective weapon against climate impacts for the next three or four decades because reducing emissions will take time to agree on and implement and then to slow the rate of warming. Mitigation is essential to avoid reaching levels of temperature increase that would, in time, exceed our ability to adapt.

www.ipcc.ch

Power to the people

Innovation can help secure the universal access to modern energy and sustainability that Africa so sorely needs, says Calestous Juma.

Africa's aspirations for economic growth are becoming one of the most pressing international policy challenges. Providing for basic needs such as nutrition, clean water and health care, and participating in the global economy will require massive increases in energy use.

The continent has abundant new and renewable energy resources – hydropower, geothermal, biomass, solar, and in some countries, wind potential. In contrast to fossil fuels, renewable sources are better distributed throughout the continent. But policy makers are realizing that efforts to disseminate renewable energy technology in Africa have fallen far short of expectations. Despite drops in investment costs, the technology remains inaccessible to the majority of Africans.

Currently Africa accounts for only about 5% of world primary energy demand and this is unevenly distributed. Only about 36% of the population has access to electricity and most of this is in urban areas. Nearly 80% of the continent's rural population has no access to electricity. The majority of these people rely on traditional biomass such as wood and agricultural residues as their main energy source with far-reaching ecological implications.

While renewable energy technology cannot solve all of the continent's energy problems, it has major potential to enable African countries to meet their growing needs. Frustratingly, the challenges relate to technological inefficiency in exploitation and resource use at a time when critical developments have occurred elsewhere in the world.

Much of the discussion about Africa's energy situation focuses on trends in supply and demand and their environmental implications. What is often ignored is the importance of technological innovation associated with energy use which can be a springboard for technology used to tackle wider conservation challenges. Discussions should be placed in the context of using technological innovation to boost the transition to sustainability.

Geothermal energy is a good example. Using existing technology, Eastern Africa (Djibouti, Eritrea, Ethiopia, Kenya, Tanzania, Uganda and Zambia) has the potential to generate over 2,500 MW of electricity from geothermal energy (out of the current global output of 8,100 MW). Geothermal energy production involves building capacity in a wide range of fields including ecology, chemistry, geology, engineering and electronics. The expertise needed is largely the same as that needed for natural resource management. Building geothermal energy capacity can therefore go hand in hand with efforts to meet longer-term sustainable development goals as well as sustainable energy targets.

There is great scope for the use of energy-efficient, light aircraft in place of road transport. Not only will such technology help Africa build competence in aviation-related fields, but it can also help reduce the overall ecological footprint of moving goods and services. Democratic Republic of the Congo whose area is comparable to western Europe (2.3 million km^2) has only 2,250 km of surfaced road network. Instead of expanding ►►

The language of energy

The importance of energy in achieving sustainable development has been hailed in many international arenas, including the World Summit on Sustainable Development, with high-level calls to action. All recognize that none of the Millennium Development Goals can be met without major improvements in the quality and quantity of 'energy services' in developing countries. But with more than 2 billion people still relying on traditional biomass (plant or animal material) for cooking and 1.6 billion having no access to electricity, can we claim any real progress?

Energy is central to nearly all aspects of our lives but it means different things to different people and the language of energy varies. In the developed world energy can mean petrol to run cars, electricity for lights and computers. In the developing world, it can mean survival: being able to boil water to avoid disease. Millions of people, mostly women and children, spend many hours a day collecting fuel for heating and cooking. When they do have access to modern energy, poor people pay disproportionately high prices for it.

Energy services are the benefits we gain from energy including lighting, cooking, refrigeration, telecommunications, healthcare, education, transport, access to water, and power to run machinery. Energy 'carriers' include fuels and electricity and can be derived from both conventional and renewable energy sources. As consumers, it is the availability and affordability of these services and carriers, not the source of energy, that's of interest.

If gaining access to modern energy can have such a profound impact on people's lives, why is it taking so long to fix the problem, especially when the technology and resources are available? This has been puzzling governments and NGOs alike for years. Governments still face serious challenges and are now teaming up with a wider group of stakeholders to try to overcome them.

mobility by road building, innovations that have lower ecological impacts should be brought on line.

Production of sustainable energy such as biofuel can help drive economic and community development. Today, much of the discussion on ethanol is viewed in terms of its ability to replace gasoline. But biofuel systems can help rural development by building rural transportation networks necessary for access to educational and health facilities. Rural schools and hospitals are often located closer to existing populations because of the lack of transportation. Community biofuel ventures could also make it easier to concentrate them in fewer areas, bringing significant cost reductions.

But none of these transformative benefits will be realized unless African governments design policies that focus on the use of science, technology and innovation to promote sustainability in the long term. Such an approach will involve prospecting for energy technologies that can contribute to wider conservation objectives. Investments in major energy projects should be treated as foundations for technological innovation.

Higher learning institutions will need to play a greater role as engines for sustainable development. Although technology transfer from developed countries must be fast-tracked, Africa needs its own centres of excellence producing home-grown innovation suited to local needs. The expansion of geothermal energy in Eastern Africa could be linked to the creation of university programmes that focus on sustainability science. There is a strong case for creating an institute dedicated to sustainable energy, one whose expertise is harnessed in energy policy making and planning. Critically, it could help strengthen the link between energy research and the formation and implementation of energy policy in Africa.

African diplomatic relations with the rest of the world will also need to focus on forging technological alliances aimed at promoting the use of innovation in sustainable development. Africa's transition to sustainability will not only help address global ecological problems, it will also address urgent economic ones.

Dr Calestous Juma of Kenya is Professor of the Practice of International Development and Director of the Science, Technology and Globalization Project at Harvard University's Kennedy School of Government. He is a former Executive Director of the UN Convention on Biological Diversity.

Forest fuel

Jacques Somda, Aimé Nianogo and Clarisse Honadia-Kambou look at whether traditional energy provision can be a force for conservation and development in West Africa.

The challenges of sustainable development are particularly acute in West Africa where countries face economic constraints in supplying modern energy to their people, 60% of whom live in rural areas and about half who are too poor to pay. So much depends on access to modern energy: income-generating activities, improvements in health, access to drinking water, gender equality and natural resource conservation. Natural resources, particularly fuelwood, are critical for national economies but are under constant pressure from growing energy demand.

In 2005 a project was launched in the region which contributed to the Economic Community of West African States (ECOWAS) and West African Economic and Monetary Union (WAEMU) White Paper on energy access for economic development in rural and semi-urban areas. An ambitious target has been set: by 2015 to provide around 216 million additional people (50% of the Western African population) with access to modern energy. Multi-sector energy committees have been established, responsible for identifying and meeting energy demand.

The White Paper aims to make energy provision a force for regional integration and cohesion. It identifies four major areas of activity: strengthening capacity building of private and public players; mobilizing public and private financing; disseminating experiences from within the region; and boosting production of the necessary equipment.

It's early days and on the ground, the effects are not yet perceptible. The majority of West African countries still rely on traditional biomass (plant and animal matter) to satisfy the energy requirements of their growing populations. Wood, as well as dung or agricultural waste, is burnt for cooking, contributing to deforestation (particularly through unsustainable harvesting around major urban areas) and causing health problems.

With fuelwood likely to dominate this region's energy mix for some time, the focus is on sustainable forest management. This must be a concern not just for environmentalists, but for the region's policy makers if they are to achieve economic development and improve livelihoods. It is increasingly recognized that successful natural resource conservation can help reduce poverty, secure energy supplies and contribute to sustainabilty.

Most countries in the region have reframed their natural resource management policies to involve local communities. Mali, Niger and Burkina Faso have extensive experience in community-based natural forest management for firewood production and supply to urban consumers. In handing over natural forests from government to community control, the important question is whether such a move can balance conservation needs with poverty reduction. Experience shows it can, but the results take time to appear.

In 1974, Burkina Faso began commercial tree plantations for fuelwood supply to its urban population. But these State production units collapsed because of inappropriate ecological monitoring, mismanagement and financial problems. In 1990, the Government began to hand over management of its forests to community schemes. Incentives and training were put in place to show communities how to manage their forests effectively. Fuelwood is now regularly supplied through organized marketing, transport and distribution to urban areas where about 60% of households still rely on biomass energy because of the high cost of oil and gas.

A Regional Programme of Traditional Energy is also being implemented in Burkina Faso which aims to improve fuelwood production from natural forests under a community-based management scheme. In addition to direct support for forest development and management, this Danish-funded project helps IUCN work with the ministries of Environment and Energy and with local communities granted resource exploitation rights. A socio-economic and ecological impact assessment is underway to measure the extent to which this scheme has so far balanced the needs for traditional energy, forest resource conservation and rural poverty reduction.

While producing fuelwood is traditionally a job for women, with the introduction of community-based forest management, there are now more men involved and the practice is changing from a social activity to an economic one. There has also been a noticeable decrease in migration from rural areas because of the employment opportunities created. The potential of community forest management to increase the income of rural populations is region-specific however.

An important lesson has been learnt about the risk to natural resources caused by inappropriate pricing schemes put in place by the government. Individuals involved in fuelwood management initiatives have to pay high taxes. Up to 50% of the fuelwood unit price is levied from individual producers. Although part of it is meant for community infrastructure, this can discourage participants, as traditional fuelwood producers do not pay such taxes. The tax payers may be inclined to cut down more trees to offset this levy, and if they're prevented from harvesting more wood, may disregard the management rules they originally agreed on.

The impact of community forest management on biodiversity is not clearly established because of differences in sampling methods and a scarcity of data. But local surveys show an increase in the number and diversity of animal species in forests under community management. It is clear that in the process of handing over natural forest management, the government must ensure monitoring and evaluation measures are established to gauge the ecological impact, as local communities do not yet have the necessary capacity.

With so many people relying on natural resources for subsistence in West Africa, should the emphasis shift from income generation to maintenance of that natural diversity to prevent further degradation? If so, should the concept of community-based forest management provide a basis for changing the way we design our conservation and development projects? Looking at its potential to generate income without paying attention to ecological impacts and setting the price of natural resources without considering social and environmental impacts is risky business.

Biomass will continue to be a key renewable energy source in West Africa until full implementation of the White Paper, and this is not expected for another 10 to 20 years because of financial constraints and political instability. Progress is being made in countries such as Burkina Faso which has interconnected energy sources with neighbouring Côte d'Ivoire and Ghana, but the benefits are mostly felt in urban areas. Rural populations are left waiting, and will continue to use fuelwood as their main energy source. Even in urban areas, biomass will remain the only energy choice for marginalized poor people.

In the medium term, community-based forest management can help boost energy provision as long as certain conditions are met. Rural populations need the technical and management skills to improve the exploitation of fuelwood while ensuring trees are replaced. Capacity building is needed to produce energy-efficient technology to reduce demand, and greater attention needs to be paid to the pricing of fuelwood. It must also be recognized that a community-based approach to forest management is costly and time-consuming and needs proper government support. Commitment from external donors is also critical in providing both financial and technical support.

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The **Centre de Suivi Ecologique (CSE)** in Senegal is a public interest association, created under the supervision of the Ministry of Environment to combat the effects of drought, desertification and natural resource degradation. CSE collects and disperses information on sustainable natural resource management and promotes technology, including cleaner energy technology.

www.cse.sn

Recipe for a region

How can Central America achieve energy security and sustainable development? *World Conservation* interviewed José María Blanco, Director of the Central America Energy Foundation.

Central America must reduce its dependence on imported oil for both power generation and transport. It is critical that we increase the role of renewable sources in the energy grid and this must be led by State governments implementing clear and long term policies to mobilize private investment. A new energy paradigm would even consider revitalizing the role of public utilities in the provision of energy services, for instance, by supporting public power generators. Clear regulations would be needed to support a mix of private and public investment.

Central government needs to strengthen tax collection to increase investment in public infrastructure. Improved urban planning, land use management, environmental regulation, highway construction, and public transport systems, among others, can all be achieved through a mix of government policies and private investments.

The region's rapid increase in biofuel production needs immediate attention by international cooperation agencies. Industrialized countries are implementing ever-stronger rules and targets for the use of biofuels in the transportation and industrial sectors to reduce their oil consumption. In seizing this economic opportunity, developing countries are producing biofuels without considering all the environmental and social impacts at the local level. We need a coordinated and sustainable policy for biofuel development – one that avoids competition with food production and other land uses such as ecotourism and biodiversity conservation.

Many lessons have been learned by Central and South American countries in their drive for sustainable energy. A regional information platform would allow us to share these lessons, for example, Brazil's experience in developing biofuel from sugarcane. This would also help the general public understand the region's energy vulnerability and introduce ways to reduce consumption.

Technology must be transferred between countries and financial incentives put in place for small rural enterprises to use it. We need to move beyond only considering expanding our existing energy capacity. Energy efficient technologies and best practices in energy use should be incorporated into the policy agenda, as an easy and cost-effective way to reduce demand. Efficiency standards and labels, financial incentives that promote the use of energy-efficient technologies, and capacity building for policy makers, engineers and financiers, are all critical measures in triggering energy-efficient markets.

All energy developments have an impact on the environment but this can often be minimized with careful planning and consultation. Monitoring of all energy infrastructure is needed. This requires strengthening the authorities responsible for issuing construction permits and ensuring they have the capacity to carry out post-construction monitoring and evaluation.

Increased public investment is needed to increase access to clean energy sources for off-grid rural communities. Indigenous energy sources such as small scale hydro can be brought online with public funding providing the initial investment and business capacity. There is also great scope to increase the efficiency of wood-powered stoves used in homes and kilns used in family-run businesses such as bakeries. In countries like Nicaragua and Honduras where reliance on biomass energy is greatest, local NGOs, which have the right technical and social knowledge, should strengthen their cooperation with international development agencies to mobilize the necessary resources and technologies.

The Central America Energy Foundation (www.bun-ca.org) is working with IUCN's Regional Office for Mesoamerica (www.iucn.org/places/orma) on an analysis of the region's energy situation.

Women's business?

It would be far easier to alleviate poverty and promote economic development if women had a greater say in energy decision making, according to Gail Karlsson from ENERGIA.

For most people, 'energy' means electricity, oil, natural gas and motor fuels, and dealing with these things is generally viewed as men's work. Yet in many developing countries, especially in the poorest areas, most of the energy comes from traditional biomass fuel such as wood and charcoal, and collecting it is strictly 'women's business'. This has far-reaching implications for economic and social development.

The links between energy supplies and gender roles are strongest in countries with low availability of basic electricity and modern fuels, and a high dependence on biomass fuels for cooking, heating and lighting. In Mali, for example, firewood and charcoal represent about 80% of the country's energy consumption and in rural areas women spend more than a third of their time collecting wood.

This is not an issue affecting only a few isolated areas. Close to two billion people in developing countries rely on traditional biomass fuel as their primary energy source. Ignoring women's roles in the energy sector can lead to 'gender-blind' policies that stand in the way of greater prosperity.

Economic opportunities

The fact that women rather than men are responsible for gathering fuel in most developing countries is largely a matter of traditional cultural roles. It is considered part of women's unpaid work in managing the family and household.

One of the most important ways of reducing poverty and promoting national development is by involving women in productive economic activity rather than having them waste so much of their time and effort securing fuel for survival. Achieving this requires a shift in government thinking from a 'subsidy mindset' regarding women, such as 'helping them with their housework' to one that promotes new enterprises for women, including within the energy sector.

Collecting traditional fuel is not only physically demanding for women, but also uses up valuable time that could be spent caring for their families, educating themselves and their children, and earning income. Most wood is burned on open fires producing indoor air pollution that is a major cause of sickness and death in women and children.

Increased access to clean, affordable fuel and technology for cooking and heating, as well as motorized equipment for grinding grain and pumping water can bring immediate benefits, especially for women and girls. Household lighting and communications equipment allows women, who often run home-based businesses, to expand their working, leisure and education time, and engage more fully in community affairs.

Women's roles as energy providers can be upgraded if they are offered incentives and training to engage in new enterprises. These could include managing fuelwood or oil seed plantations, building better stoves and solar cookers, distributing modern fuels such as liquefied petroleum gas (LPG) or managing small-scale electricity generation and distribution systems. In Mali and neighbouring countries, the Multifunctional Platform Project for village power has enabled women's groups to use diesel generators to operate a variety of machines, including grinding mills, oil pressers and battery chargers, and to run lights and water pumps. By charging for these services, they have increased their own incomes and gained respect, while bringing

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► significant benefits to their villages. In Bangladesh, a project where battery-operated lamps are produced by rural women was designed with input from local women after they had identified household lighting as a priority in their remote off-grid location. The women learned to produce the lamps in a micro-enterprise factory and distributed them through rural markets.

International advocacy

The energy contributions and requirements of women are generally not recognized in national policy and planning, even in industrialized countries, and are rarely taken into account in foreign development assistance. In many countries, the traditionally lower status of women makes it difficult for them to reach positions of authority, or to have their energy concerns taken seriously, even when women are responsible for the vast majority of the country's energy supply.

It is time for national energy and development policies to acknowledge the links between energy, women's work and national economies. It is also time for greater attention to gender in energy investments and initiatives. The goal is not to remove women from the energy sector, but actually to involve them more, and in different ways, so that they can better manage their energy supplies, their businesses and their lives.

One avenue for raising awareness about gender and energy links has been to increase the representation of women at international meetings, including the UN Commission on Sustainable Development. International processes can be used to engage women in consultations with their own governments about natural resource management and the dissemination of new energy technologies. Another priority is to build national and regional networks of experts, government officials, academics and civil society organizations in a drive towards gender-sensitive energy and development policies.

Glimmers of progress

A number of governments are already starting to address inequities in their energy policies. Uganda's government has recently established strategies in its Renewable Energy Policy to ensure that women play an important role. Zambia's draft revised National Energy Policy also promises to provide more gender-balanced development in the energy sector.

In Botswana, since a 'gender audit' of government policies and programmes revealed that the national energy policy was formed without the involvement of women, the government has moved to address gender equity – at least in its household energy supply policies. In Uganda, the National Gender Policy had a significant influence on the country's Photovoltaic Pilot Project for Rural Electrification, which was designed to overcome financial, social and institutional barriers to access to solar technologies.

Some countries have also begun to use subsidies to address the need for alternative fuels for cooking. In Senegal, the government has implemented a 'butanization' programme that has reduced overall dependence on biomass. This is important because even when access to electricity is available, women in rural areas generally have to continue to collect fuelwood for cooking.

Despite some encouraging signs of progress, much more work is needed at the national level to include women's concerns in energy planning and expand their participation in decision making. Gender sensitivity in energy policy means accepting the economic realities for women and boosting financial investments in infrastructure and services that best promote economic and social development – for men as well. Many women are constrained in their ability to acquire better fuels and technology due to limited income opportunities and legal restrictions on women's rights. These include rights to own land, borrow money, and make their own economic decisions. Addressing these inequities will require changes well beyond the energy sector, but it is a good place to start.

Gail Karlsson is an Advisor to ENERGIA – the International Network on Gender and Sustainable Energy, and a member of IUCN's Commission on Environmental Law.

www.energia.org

Did you know?

> In Guatemala, the introduction of electric mills has reduced the time women spend grinding corn to make tortillas, from two hours to 15 minutes.

> Women spend three times more time transporting fuel and water than men, and women carry four times more than men in volume.

> Energy-related institutions have significantly fewer female professionals at all levels. Estimates for the North indicate that women make up less than 20% of the professional energy workforce; figures for the South are likely to be much lower.

> Direct and indirect household energy consumption is reduced and fuel substitution programmes are more effective when women are the target clients because they are the main decision makers for household energy use.

Friend or foe?

Biofuels are being widely touted as a panacea to our energy problems. Barbara Bramble of the National Wildlife Federation explains some of the risks and opportunities.

After many years of labouring in obscurity, the producers of biofuels have suddenly entered the international spotlight. The speed of the industry's expansion has been breathtaking over the last year or two, sparked by high oil prices, fears of further volatility in many of the oil-producing regions and the promise of a reprieve for farming communities who have suffered from decades of low commodity prices.

Many experts and lawmakers are now looking to biofuels as part of the solution to climate change. While policies to reduce greenhouse gas emissions should include raising fuel efficiency standards and increasing funds for public transport, substituting low carbon biofuels can be done within the current infrastructure.

Although some biofuel feedstocks and technologies are controversial, those following the industry have been encouraged by recent advances in technologies which convert cellulose from crop and municipal waste into ethanol. Other advanced technologies are also expected to speed the transition to the 'next generation' biofuels which could replace a greater portion of gasoline and diesel.

Along with transportation fuels, a range of bio-energy technologies are being developed to use biomass in the production of heat and electricity. While these may turn out to be more efficient ways to use biomass, at present most attention is concentrated on the simple conversion of sugars, starches and oils to liquid fuels for use in vehicles. The quantities of ethanol and biodiesel produced globally have jumped from under 5 billion gallons in 2000 to around 15 billion gallons in 2006 with expansion continuing to skyrocket.

But controversy confronts this industry, and in just 18 months the biofuels debate has swung from obscurity to euphoria to concern. The extraordinary speed of the expansion has bred fears that biofuels may create new environmental problems. Challenges to the industry include the large amount of water needed for irrigation and refinery processing, how to avoid biodiversity loss and hikes in food prices for impoverished consumers, and how to ensure that small farmers and other workers get a fair share of the profits.

The quantities of ethanol and biodiesel produced globally have jumped from under 5 billion gallons in 2000 to around 15 billion gallons in 2006.

Experts are studying ways that these challenges can be surmounted, with appropriate policies that safeguard environmental and community interests. Many of the problems can be minimized or solved now, and promising research is under way to deal with others. The biofuels industry will benefit from taking

these concerns seriously and responding positively to the call for safeguards.

One of the major debates is the question of 'net energy' balance – whether biofuels provide more energy than it takes to produce them. Recent research shows that the 'energy balance' argument is often portrayed in a misleading way, by both sides. While some claim that certain biofuels take more energy to make than they produce and others who disagree leave out some of the major variables, it turns out that the answer is: "it depends". Most biofuel feedstocks and technologies, even those of the first generation, can produce at least a little more energy than it takes to make them. But the range of energy balance calculations is sensitive to the conditions of feedstock production, distance from fields to refineries and whether bioenergy is used to power the refineries. The more that conservation practices such as "no-till" cropping and perennial native crops are used, the better the net energy will be.

The key factor in the calculation of greenhouse gas reductions that biofuels can provide may turn out to be land use conversion, including deforestation, and especially indirect conversion (when energy crop production in one place pushes other uses to virgin land). This has the potential to undo all the benefits of using biofuels, especially by creating a "carbon belch" if millions of acres of forests, peatlands or deep-rooted prairies are ploughed up to produce energy crops. Experts recently calculated that Indonesia is the third largest emitter of greenhouse gases in the world, and the major cause is clearing forests and peatlands for palm oil. Importing palm oil to reduce greenhouse gases associated with fossil fuels in vehicles, is simply exporting the problem.

Biofuels development must not exacerbate the pressures for deforestation or increase biodiversity loss. But the right policy solutions are available. They include incentives and monitoring to direct energy crops and plantations to degraded lands, which could be restored to productivity through planting of palms, jatropha and other crops appropriate to the location. With careful planning, biofuel feedstocks can take their place in a mixed landscape that provides food, fibre and fuel, and conserves nature.

There are other concerns over the impacts of the biofuels industry on poverty and development. Some claim there is an unavoidable conflict between using crops for food or fuel. But both fuel and protein products can be extracted from many first generation crops, making good use of the whole plant (soy, maize and sorghum). And the second generation of cellulosic feedstocks for ethanol will be especially suited to growing on land that is less productive for food.

Others are worried about the trade-off between the potential of biofuels to provide access to modern energy for underserved local communities (which is often most successful with small scale production under local control) and the drive for solutions to global warming and energy security (which argues for large scale industrial production and international investment and trade). One possibility is to preserve special incentives for small producers in national level programmes, as is done with the Social Fuel Stamp of Brazil's National Program of Biodiesel Production and Use.

With appropriate public policies, many of the negative impacts can be minimized but environmental and social safeguards are needed to ensure benefits across the board. These may be provided through laws and regulations or through market-based mechanisms such as certification.

The need for safeguards has already been recognized by the governments of the Netherlands, the UK, California, and the European Union, all of which have called for, or already begun working towards, sustainability standards for biofuels. Others have called for a voluntary third party independent certification system, possibly modeled on the Forest Stewardship Council, which recognizes well-managed forests with an eco-seal, and rewards products from those forests in the marketplace.

While there are high hopes for advanced biofuels, such as cellulosic ethanol, they are not likely to be widely available for seven to 10 years. Since first generation crops and refineries will not be displaced for many years, the biofuels industry needs to get the safeguard policies right early on, for both people and the environment.

Climate change is the paramount challenge of the new century. So if biofuels can play a useful part in slowing greenhouse gas emissions, it is essential that they are deployed as effectively as possible to become part of "the solution".

Barbara Bramble is Senior Programme Advisor, International Affairs at the National Wildlife Federation.

www.nwf.org

The **Roundtable on Sustainable Biofuels,** launched in April 2007, is a multi-stakeholder dialogue among economic, environmental and social interests, dedicated to building a consensus around fair and credible sustainability standards. The dialogue is open to anyone interested in participating, and comments on drafts of the standards are welcome. The Roundtable's Secretariat is based in Switzerland, at the Federal Polytechnic in Lausanne.

www.energycenter.epfl.ch/biofuels or **www.bioenergywiki.net**

Energy and climate change are a focus of the **International Institute for Environment and Development (IIED)**, an international policy research institute working for more sustainable and equitable global development. It has published on trade-related issues for biofuels including *International trade in biofuels: Good for development? And good for environment?*

www.iied.org

The Worldwatch Institute is a leading source of information on the interactions among key environmental, social and economic trends. It published *Biofuels for Transportation: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century*, a comprehensive assessment of the opportunities and risks associated with the large-scale international development of biofuels.

www.worldwatch.org

Brazilian power

Even with rapidly-growing demand, Brazil will soon become self-sufficient in fuel by increasing production from petroleum and biofuels. Luis César Stano and Maria Cláudia Grillo of oil giant Petrobras, describe how the company is managing its environmental and social impacts.

Rapid growth of the Brazilian economy is driving an increase in energy demand including from fossil fuels – Petrobras predicts that between 2007 and 2011, around US$ 56.8 billion will be invested in its exploration and production activities. This inevitably means expanding into socially- and environmentally-sensitive areas – much of Brazil's oil reserves are found in very deep offshore basins. Our success in obtaining licences to operate in these areas depends on transparency and proof that we will operate responsibly.

We face many challenges in trying to achieve sustainability. The company must manage environmental issues through the entire life cycle of its operations and products, better understand these issues, and promote awareness of the importance of biodiversity to the industry's core business.

But our understanding of the natural complexity of tropical systems must be improved and this is not easy given the limited information available about ecosystems. We have to improve models that allow us to see the relationship between the company's activities and biodiversity, and develop indicators that can guide effective environmental management. Demonstrating proper biodiversity management can result in new opportunities and reduced risks to our business.

Besides the concerns our society voices over expansion into sensitive areas, there is an ever-growing demand to deliver ecologically-sustainable products. This means the company has to continually improve its processes and products, limit the use of natural resources such as freshwater, and reduce waste. We're working on several material re-use techniques and five of our refineries have advanced waste water treatment systems that reduce ammonia levels. We're also developing a filtration system to

Depleting stocks and rising prices mean that oil and gas companies are going further and further afield to find viable reserves to exploit. Recently, the Sakhalin shelf on the far eastern coast of Russia has been opened up. **Sakhalin Environment Watch** is a local NGO committed to conserving the salmon spawning grounds, whale migratory routes and feeding grounds, and the island's other critical environmental features. The group has linked with international conservation organizations to play a watchdog role in the Sakhalin shelf oil and gas developments.

www.sakhalin.environment.ru

promote the re-use of effluents in steam generation and cooling systems and a new method to treat oil slicks from off-shore installations. The company is using underwater 'capping' to isolate contaminated layers of sediments in lakes, and a new system to clean up polluted water is being used in two of our refineries.

On the social front, stakeholder engagement in project planning must be improved so we can best tailor our operations to local cultures and expectations. To obtain a licence to operate we have to give assurances about our impacts. The company has to know the populations that will be affected by its operations, their way of life, culture, traditions and their livelihoods. It has to understand the relationships between local people and their natural resources such as freshwater and fisheries so that we can minimize interference. We have to guarantee that our presence will not jeopardize their resources and if we can't do that, negotiate alternative sources of income that guarantee the same quality of life. Petrobras has provided some opportunities for community development such as *Projeto Agricultura Familiar* which promotes family agriculture in pipeline areas and Pomar, a project that promotes aquaculture in areas close to one of its terminals.

Secondary impacts are just as much a concern as primary impacts. There is a risk that the company's operations will result in sensitive areas being opened up by migrants looking for new opportunities. In response, the company has adopted strategies that avoid opening up of new roads, using aerial transport and underground pipelines instead.

The massive push for biofuels and other renewables means major changes in Petrobras. By investing in wind, solar and biofuels, the company aims to diversify the Brazilian energy mix. It aims to become the market leader in biofuels in Latin America and is investing heavily in research. The company is adapting some existing plants to produce H-Bio (technology which allows the blending of up to 20% of vegetable oils during the production of diesel from petroleum), processing 425 million litres of vegetable oils a year by 2011. It is also improving its pipeline network to transport 3.5 billion litres of ethanol per year by 2011.

The company is also building three biodiesel plants which will produce 855 million litres a year by 2011, following the criteria of the *Social Combustible Label*, a Brazilian Government Programme that recognizes industries which use small producers to supply raw materials.

With so much debate raging about biofuels, Petrobras is engaged in discussions about the potential environmental and social impacts and how to prevent them. It has joined IPIECA (the International Petroleum Industry Environmental Conservation Association) which is discussing the roles and responsibilities of the industry regarding biofuel production and use.

These are exciting times for the company, but we cannot underestimate the environmental challenges ahead in securing energy self-sufficiency and sustainability.

Luis César Stano and Maria Cláudia Grillo are members of Petrobras' Health, Safety and Environment team.

www.petrobras.com

In response to the growing opposition to large dams, the **World Commission on Dams (WCD)** was established by the World Bank and IUCN in 1998 to: review the development effectiveness of large dams and assess alternatives for water resources and energy development; and develop internationally acceptable criteria, guidelines and standards for the planning, design, appraisal, construction, operation, monitoring and decommissioning of dams. The Commission's final report, *Dams and Development: A New Framework for Decision-Making*, provides a framework for decision making on water and energy projects based on recognizing the rights of, and assessing the risks to, all stakeholders.

www.unep.org/dams/WCD

Many vulnerable and endangered bird species suffer the negative impacts of electricity utility structures in Southern Africa. Today there is an alarming mortality rate in birds such as Cape Griffons and Blue Cranes which are susceptible to electrocution and collision with power lines. South Africa's **Endangered Wildlife Trust** has formed a partnership with energy utility, ESKOM, to develop and implement mitigation measures.

www.ewt.org.za

Energy impacts – at a glance

The relationships between energy production, biodiversity and people are complex and our knowledge about them is evolving. This is not meant as a comprehensive overview but rather a snapshot of some of the most recognized impacts.

		Impact on biodiversity	Impact on people and livelihoods
Fossil fuels (Oil, coal and natural gas; New hydro carbons – oil shale, tar sands)	Negative	Habitat loss and fragmentation through oil, gas and mining infrastructure – refineries, ports, pipelines, etc. Biodiversity-rich remote areas such as deep seas and the Arctic, disturbed by new exploration Introduction of alien invasive species Accelerating biodiversity loss from increasing resource use, climate change and extreme weather events Forests and habitats polluted by acid rain Aquatic and marine ecosystems damaged or destroyed by oil spills	Changes in distribution and loss of natural resources that support livelihoods Respiratory disease due to poor air quality Gastrointestinal diseases from polluted water Pollution of agricultural lands by acid rain
	Positive	**Potential use of carbon and biodiversity offsets to compensate for adverse impacts**	**Increased access to energy for economic development** **Reduced indoor pollution from switching from biomass to modern sources such as liquefied petroleum gas**
Biomass (Combustibles, renewables and waste; Biofuels)	Negative	Habitat loss and degradation, and species loss from unsustainable production and consumption Habitat loss through land conversion for biofuel crops such as sugarcane and fast-growing trees Chemical pollutants released into the atmosphere; carbon emissions from burning biomass Removal of essential soil nutrients, reduced soil organic matter and water-holding capacity through burning crop remnants Soil and water pollution and degraded habitat from additional fossil fuel use for machinery, fertilizers and pesticides. Spread of alien invasive species	Respiratory disease and death caused by indoor air pollution from wood burning stoves Declining food availability and increasing prices
Hydroelectric power	Negative	Loss of forests, wildlife habitat and species populations through large dam construction Disruption to migratory fish species Disruption of river flows and river basin conditions such as reduced oxygen levels downstream and erosion of sediments that provide habitat Greenhouse gas emissions from reservoirs due to rotting vegetation	Displacement of people through dam construction Changes in availability of freshwater resources (both improved and declining depending on situation) for human use
	Positive	**Some dam reservoirs can provide productive ecosystems with fish and waterfowl habitat**	
Nuclear energy	Negative	Direct ecosystem impacts through uranium mining Ecosystems damaged by water used to cool reactors being released into the environment at higher than natural temperatures	Radiation-related diseases in the event of a nuclear accident
	Positive	**Some nuclear plants are surrounded by protected areas that are important sanctuaries for plant and animal populations**	
Alternative sources	Negative	**Wind (onshore and offshore):** Ecosystem disruption, habitat loss at large wind farm sites, undersea noise pollution Deaths in migratory species, both terrestrial and marine, from wind power rotors **Tidal:** Disruption of fish migration and breeding grounds, reduced feeding areas for waterfowl, disrupted sediment flows and other ecosystem changes caused by tidal power plants **Solar:** Competition with agriculture, forestry and protected areas for land for large photovoltaic farms Risks of toxic chemical pollution from the manufacture and disposal of solar energy cells **Geothermal:** Pollution of surface and ground water supplies from geothermal plant waste water	Declining species populations used for basic materials of life Decreased economic value of land near wind farms due to visual impact Impacts on fisheries Public health problems caused by toxins released to the environment

Clean ambitions

Can China achieve a sustainable energy future? Rachel M. Wasser investigates.

In November 2005, Chinese President Hu Jintao enthusiastically welcomed participants to the Beijing International Renewable Energy Conference. "China attaches great importance to the utilization and development of renewable energy and considers it one of the most important instruments to promote socio-economic development," he declared. "It is an indispensable measure to deal with the increasingly serious issues of energy and environment."

China has good reason to view renewable energy as indispensable. In 2006, the country's power-generating capacity soared by about 20%. The world's second largest electricity consumer after the US, China added some 100 GW of new capacity – roughly the equivalent of Thailand and the UK's total capacities combined. This year, in order to keep pace with rapid economic growth and avoid electricity shortfalls, it is expected that China will add about 90 GW.

The vast majority of this electricity, nearly 90%, is produced by inefficient coal-fired power plants. But despite having rich coal reserves and until recently being a net oil exporter, China today spends billions each year on foreign fossil fuels, last year importing nearly 50% of its oil needs. Air and water quality are already pressing concerns, and coal-based energy production exacerbates the pollution, having a major impact on agriculture and health. China also faces increasing international pressure to limit its greenhouse gas emissions, which are expected to surpass those of the US within two years.

Concerns about energy security, environmental quality and global warming are driving China's aggressive push for a sustainable energy future. Government policy is ambitious, calling for the country to quadruple national GDP by 2020, while 'merely' doubling energy consumption from 2000 levels. Striving to meet this goal, the nation's leaders emphasize both improved energy efficiency and renewable energy resources.

They have set bold targets. China's 11th Five-Year Plan (2006–2010) calls for a country-wide energy efficiency improvement programme with a target of reducing energy consumption 20% per unit of GDP by 2010. And in January 2006, just a few months after President Hu's remarks, China's landmark Renewable Energy Law came into effect. The law itself does not set targets, but since its passage an ambitious objective has been set: by 2020, China aims for 20% of its electric power capacity to come from renewables, excluding large hydropower. In 2005, this figure stood at just 8%.

The 20% target represents a major leap forward for China, and industry experts believe that it is attainable – perhaps even ahead of schedule. With the surges in China's energy demand, there is a need to further tap the nation's abundant renewable energy potential from solar, wind and other sources. Not only are these prodigious resources a partial answer to the demands of China's growing industries and cities, but they are also a promising source of electricity for the millions who live without power in China's underdeveloped countryside, particularly in the remote western regions. There, renewables can provide clean, reliable and affordable energy while contributing to sustainable livelihoods.

China has already had great success with rural renewable electrification. As of 2005, excluding large hydropower, China was the world's largest renewable power producer. Most of this capacity was in small hydropower – the country has more than half of the global total. Full rural electrification is planned by 2015, primarily through small hydropower and off-grid photovoltaic and wind installations.

Both domestic and international companies have been attracted to China's rapidly-expanding wind power sector. Wind energy capacity is targeted to reach 30 GW in 2020, which is likely to make China the world's largest wind power producer. "This poses huge potential," says Han Juanli, Marketing Manager for Azure International, a Beijing-based advisory and investment firm specializing in sustainable energy technologies. "The government's goal is ambitious but achievable."

But there are major challenges to China's renewable energy development. "The Renewable Energy Law is a framework," explains Dr He Ping, Energy Programme Manager for UNDP China. "The country still needs regulations, and the regulations are very challenging work." Often they are seen as too general to be practical and policy uncertainty continues to be a barrier to market entry.

Another challenge comes from China's weakness in the area of technology and know-how. For now, with the notable exceptions of household solar water heaters, micro and small wind turbines, and photovoltaics, renewable energy equipment is largely imported, resulting in higher costs. Lack of financing mechanisms is another hurdle for would-be renewable energy developers, as risk averse State-owned banks are reluctant to make the necessary loans.

Biodiesel, another promising renewable power source, is in a very early stage of development. By 2020, capacity is slated to reach 40 times that of 2005. PetroChina, along with other leading Chinese oil and gas conglomerates, is entering the field. In mid-April, PetroChina began building an experimental biodiesel production plant in southwestern China. "These companies want to be like Shell and BP – leading investors in renewable energy in addition to oil and gas," says Han, who worked with PetroChina to develop their "new energy" strategy.

The new facility will contribute to research and development, a key challenge for the biodiesel sector. Many experts are concerned about food security, fearing competition between oil and food crops. "We need to do a lot of work on resource and land assessment," says Dr Wang Zhongying, Director of the Center for Renewable Energy Development of China's Energy Research Institute. "We don't know how much non-food cropland is available for the biodiesel industry."

A potentially promising avenue for biodiesel is woody energy plants which can be grown in mountainous areas unfit for food crops. As part of a larger Green Poverty Alleviation initiative, UNDP and China's Ministry of Science and Technology are supporting a biodiesel production project in China's poor, biodiverse southwest. By encouraging farmers to cultivate the native *Jatropha curcas* tree, they aim to produce fuel, reduce poverty, combat soil erosion and environmental degradation, and improve the fragile local ecosystems.

The Nature Conservancy (TNC), among other organizations, has been successful in using different renewables — primarily biogas — to similar effect. In 2001, TNC started a rural alternative energy programme in Yunnan Province, a biodiversity hotspot. TNC collaborates with local communities,

government, and NGOs to set up solar-powered water heating systems, micro-hydropower systems, and household biogas digesters that run on agricultural waste. Some 10,000 alternative energy systems have been installed, improving quality of life and conserving local ecosystems.

The government is heavily involved in this sort of rural electrification, and it is widespread. In 2005, China was the world leader in solar hot water capacity and there were some 17 million Chinese biogas users. By the end of 2010, as specified by the government, the number is expected to reach 40 million. Environmental NGOs like TNC have an important role to play in helping reach government goals and in mainstreaming biodiversity conservation into rural development practices. "We want to work where fuel collection threatens biodiversity conservation, so we work in more remote rural areas," says Xia Zuzhang, Director of Operations for TNC's China Programme. "We've significantly cut demand for wood and improved indoor air quality."

The micro-hydropower systems that TNC installs are relatively small — nothing bigger than 10 KW — and "environmental effects are almost negligible" according to Xia. But the ecological impacts of large installations and even of small hydro, as opposed to micro, can be dramatic. China has tremendous untapped resources in this sector, which is also mature in terms of technology and local experience. But while environmental impact assessments are required of all large-scale Chinese hydropower projects, many are unsatisfied with these assessments and with enforcement of regulations, or lack thereof. Given that the government aims, by 2020, to increase hydropower generating capacity by nearly 200 GW from 2005 levels, mitigating the environmental impacts of installations is yet another crucial challenge China faces.

But for all the hurdles on the road to China's sustainable energy future, that future nonetheless looks bright. According to Dr Yang Fuqiang, Vice President of The Energy Foundation and head of its Beijing-based China Sustainable Energy Programme, "China faces a big challenge. We have to leapfrog the developed countries, to develop new technology, new ideas, a new approach. We are leading the way for the rest of the world's developing countries – finding a sustainable path."

Rachel M. Wasser is a Princeton in Asia Fellow, based at IUCN's Beijing office.

The **Energy Foundation** is a partnership of major donors interested in solving the world's energy problems. Its mission is to advance energy efficiency and renewable energy, focusing on the US and China.

www.ef.org

Fear of the dark

India's unprecedented economic growth may be stopped abruptly in its tracks without a major shift in energy policy. Leena Srivastava, Executive Director of The Energy and Resources Institute, outlines the challenges ahead.

While India's economic growth breaks all records, there can be little room for complacency as energy shortfalls hang over the country like an oppressive cloud. Power shortages and blackouts plague India's major cities while in rural areas there is still an overwhelming reliance on fuelwood for energy.

India is the world's sixth largest energy consumer with a growing impact on both energy trade (it's the seventh biggest oil importer) and greenhouse gas emissions (4.4% of global CO_2 emissions in 2001). Increasing energy imports make the country vulnerable to fluctuations in prices and uncertainties in supply.

On a per capita basis, electricity consumption is modest – a mere 561 kWh compared to a world average of 2,361 kWh (highly developed countries average 8,520 kWh). Traditional energy still constitutes 24% of total energy requirements against a world average of 10%. Over 50% of India's population has no access to electricity while 90% of rural cooking needs are still met by fuelwood.

Despite global concerns about India's burgeoning energy demand and its own efficiency drives, the country will still need to consume substantially higher levels of energy to achieve sustainable development. The Government's Integrated Energy Policy estimates energy requirements in 2030 will be four to five times higher than today's levels. To meet this, electricity generation capacity would need to hike from the current installed capacity of around 135,000 MW to between 800,000 and 950,000 MW. This would mean huge imports of oil – anywhere between 300 to 450 million tonnes, and coal imports that could reach a billion tonnes.

Can we afford to follow this energy path? How can we ensure that these supplies remain available to us? What are the investment and foreign exchange implications? India urgently needs to define a new development paradigm for its energy sector.

Sustainable options

The solution to India's energy challenge cannot be found by focussing exclusively on the energy sector. Our mobility levels today are extremely low and urbanization increasing rapidly. So it is of utmost importance that we plan our urban development well and put in place efficient intra-city transport solutions that will limit the increase in cars.

Much research is needed on agricultural crop productivity taking into account the country's alarming water scarcity, growing population and increasing pressure on land, in order to restrict the resource-intensive agricultural development currently taking place.

Building design could be another major focus with rapid growth in both commercial and residential complexes. The potential for efficiency improvements in the building sector can be as high as 50–60% in direct use and more if the right construction materials are used.

With nearly 57% of households in rural India without access to electricity and a goal of electrifying all homes by the year 2012, it is obvious that this could contribute to a large and growing energy demand in the medium term. Decentralized Distributed Generation (DDG) options would not only promote the use of local biomass resources for meeting this demand but could significantly reduce the demand for expensive and energy-intensive infrastructure. Many challenges however, face this transition – not least of which is the capacity in India's villages to sustain the DDG business. ►►

Efficiency drives

While significant energy efficiencies have been achieved in the country's large industrial sector driven largely by the competitive pressures of globalization, significant scope exists for efficiency improvements in small and medium enterprises (SME) and in the transportation sectors. Here, the two key interventions required relate to technological and financial support to the SME sectors and corrections in pricing policies of the government. The existence of perverse and poorly-targeted subsidies has been well documented. The government needs to muster the political courage to introduce rational pricing which would also help reduce poverty.

Renewables and nuclear

India has been an active user of renewable energy both in its traditional forms and in newer technologies. Biomass and solar energy are still major portions of India's energy pie. The government has recognized the enormous potential of renewable energy for national development and has even created a Ministry dedicated to it.

There have been several measures to promote renewable energy. Under new regulations, every electricity distribution utility in the country has to procure a percentage of its electricity needs from renewable energy. Significant research is being undertaken on ethanol and biodiesel production and there are moves afoot to expand India's nuclear energy programme.

There is no doubt that India's energy problems and solutions are complex. They require a multi-sectoral and multi-stakeholder approach and the urgency in addressing them cannot be overstated.

www.teriin.org

Another key player in India's search for a sustainable energy future is **Development Alternatives** which promotes sustainable national development through the promotion of appropriate technologies, effective institutions and resource management.

www.devalt.org/index.htm

Delays Down Under

The community is way ahead of its political leaders on climate and energy issues in Australia, says Green Party Senator and IUCN Vice President Christine Milne.

Australia in the wider Oceania region is a microcosm of global energy problems and solutions. We are a nation with one of the best solar resources in the world but a political class and business sector with such vested interest in fossil fuels that we remain blind to the opportunities that the transition to a low carbon economy offers.

Our isolation from the vigorous debates in Europe and California and our close ties with the US administration have resulted in a false sense of security and a lack of urgency and serious debate. We think we can separate our political national sovereignty from our global ecological interconnectedness. As a result, our economy is poorly prepared to deal with either climate change or the oil squeeze.

Australia's per capita emissions of greenhouse gases is one of the highest in the world due to our dependence on coal for electricity and oil for transport. In Australian cities 75–90% of all trips are made by car. Even as the world's largest coal exporter, Australia still experiences trade and current account deficits, mainly because our rich natural resource base has made us complacent about developing competitive advantage in manufacturing. We have increased the rate of logging of our native forests for woodchip exports and reduced our spending on higher education and skills formation from which new high-tech industries could develop.

Australia has a proud history in renewable energy research, particularly in solar energy. But most of the technologies developed here have gone offshore for commercialization because of the overwhelming influence of fossil fuels in determining Australian energy policy. Zhengrong Shi, a solar billionaire, is part of the exodus of solar expertise from Australia to China where renewable energy targets are driving massive

expansion in the sector. Inventions like solar sliver cells developed at the Australian National University are set to reduce the cost of solar panels by 75% and may well revolutionize the industry globally but will be developed in Europe or the US. This is in spite of the ever-increasing visibility of climate impacts in Australia.

Global warming of less than 1°C has already exacerbated drought conditions especially in the south west of Western Australia, and southeastern Australia where devastating wild fires this year have burnt thousands of hectares of national parks and rural properties. An additional temperature rise of between 1.1°C and 6.4°C would lead to further reduced water flow in the Murray-Darling River, decreased rainfall across the southern half of the country, reduced agricultural production, and major losses of plant and animal species. Tropical cyclones, fires and droughts will also increase. Already the warm nutrient-poor eastern Australian current has displaced the colder nutrient-rich sub-Antarctic current along Tasmania's coast, threatening food supplies to sea birds and bringing with it the invasive sea urchin which is destroying the giant kelp forests.

Salt water incursion into Kakadu's wetlands and further coral bleaching across most of the Great Barrier Reef are inevitable as sea levels and temperatures rise. Australia's tourism industry depends on the natural environment with Kakadu and the Great Barrier Reef at the heart of the nation's appeal. Tourism related to the Great Barrier Reef employs 30,000 people and generates AU$ 5.8 billion.

The risk to jobs and economic returns is compounded by concern about what impacts the transport carbon penalty implicit in food miles and 'guilt miles' might have on agriculture, shipping, aviation and tourism which depend on long-haul flights and long-distance freight transport. Yet Australia refuses to ratify the Kyoto Protocol and resists introducing mitigation targets or emissions trading.

Meanwhile, domestic oil supplies are under pressure and national oil demand is rapidly rising. After the discovery of large quantities of oil in Bass Strait in the 1960s, relatively little has been found in Australia since. Consequently, oil self-sufficiency will fall from 84% to about 20% during the next two decades resulting in national oil trade deficits even larger than the AU$ 12 billion deficit of 2005–06. At the same time, national oil consumption is likely to rise from the current level of 750,000 barrels per day to 1.2 million barrels per day by 2029–30 unless major changes are made.

The good news is that the community is way ahead of its political leaders on climate and energy issues. Civil society is demanding that the federal government join global action to reduce emissions and develop policies to embrace energy efficiency and renewable energy. However, the political debate

remains focussed on clean coal technology, the expansion of uranium exports and possible development of nuclear power.

This disconnect is likely to dominate Australia's national election this year. Since the release of the Stern and IPCC Reports on climate change, local government authorities and community groups have been exploring purchasing green power and carbon offsets, whilst driving sales of water tanks, water efficient shower heads, dual-flush toilets, and solar hot water heaters. People are demanding investment in public transport and biofuels, provision of cycle ways, and the setting of national targets for renewable energy and energy efficiency.

Emissions trading is under discussion with Australian States willing to set a target of 60% below 1990 levels by 2050. It is clear that in Australia, like the US, real action on changing to a low carbon economy will be driven by community demand, innovative research institutions and the new generation of business leaders who want certainty in a globalized economy that sets targets and works collaboratively to achieve them.

While Australia continues to protect its coal exports, it is incurring the frustration not only of global negotiators but also of its Pacific island neighbours who have small carbon footprints but are first to suffer the impacts of global warming. These nations want to preserve their cultures and remain on their land as long as they can but are vulnerable to sea level rise, storm surge and salt water incursion into their fresh water. They want global action to reduce greenhouse gases from fossil fuels now. They also need help adopting renewable energy and environmental management technologies particularly for water collection and purification, protecting natural habitats and eradicating alien invasive species. They look to Australia and New Zealand as rich nations for help in overseas development aid and as future resettlement options. It is inevitable that conflict borne of energy, water scarcity and climate change will arise in the Oceania region just as it has elsewhere in the world. The British initiative to bring climate change to the UN Security Council is timely.

How different it could be if we all agreed that whatever the cost in redesigning our economies to address climate change and oil depletion, it will be less than the consequences of not addressing it. Just as importantly, how different it could be if we all recognized that the transition to a low carbon economy could create a healthier, happier, more peaceful and equitable future.

Seeing the light

It's time for people to see the light and switch to energy-efficient technology. That's the message from Harry Verhaar of Philips Lighting, who spoke to *World Conservation.*

There are not many people who think about the effect they are having on the environment every time they turn on a light. You flick the switch, the light comes on; end of story. But it is time to wake up to reality. We have got to change our lighting habits, and change them fast, according to Harry Verhaar.

"The point is that the technology exists today to create a 'win, win, win' situation, saving cost, energy and the environment," he says. "We simply need to switch over to it." The European Union (EU) plans to reduce energy consumption by 20% by 2020 and since electrical lighting uses 19% of all the world's electricity, it is not a bad place to start.

Ordinary household light bulbs use four times the energy as new fluorescent ones and about 95% of the energy they produce is wasted in heat. Yet we cannot seem to stop using them. In the EU alone, we install two billion of them every year. It is not as if the new technology doesn't exist, it is just not being taken up very quickly.

Philips is trying to speed up the process and is calling for the replacement of all old light bulbs within 10 years. It is easy to see why. Not only would each household save on average €72 on their electricity bill over the six-year lifetime of a fluorescent bulb, they would not have to buy five replacement old-style bulbs in between. If the world saved 20% of the energy it uses to light homes, offices and roads, we could save €53 billion every year – the equivalent of 296 million tonnes of carbon dioxide or the output of 265 medium-sized power stations.

But it is not just in our homes that we need to change our ways. About 75% of all Europe's office lighting is based on old technology from the 1950s, which wastes €2 billion a year. We don't use computers from the 1950s, so why should we still be using lighting from that era? The technology exists to install control sensors that automatically turn lights off when there is no one in the room. They can also adjust light levels in the office according to natural daylight. These are simple systems which can save up to 75% of energy. It is a sobering fact that despite all this technology, only 1% of offices use lighting controls of any sort.

And the problem extends to our streets. About one third of Europe's roads and motorways are still lit using cheap and inefficient technology from the 1960s. But public authorities are beginning to wake up to the benefits of making the change, like the northern German city of Vechta. It upgraded its street lighting from the older, less energy-efficient mercury lamps to a state-of-the-art CosmoPolis system, saving 50% in energy use and improving the quality of light dramatically.

The technology is clearly there. The problem is that the switch-over to it is just not happening fast enough. There is only a 3% change-over rate from old to new technology for street lighting every year and a 5–6% annual change-over rate for office lighting.

So what's holding it up? The biggest problem is undoubtedly money. There are high initial investment costs for energy-efficient lighting, but the EU action plan to reduce energy consumption by 20% by 2020 will help. Its new financing incentives and energy pricing initiatives should remove the cost barrier. Mr Verhaar says the introduction of new minimum energy performance standards is also a good idea and should be backed up with tax incentives to discourage old, inefficient technology.

"New lighting technology offers a triple win – consumers, the environment and business: all will gain and benefit," says Mr Verhaar. "However, these gains also require a triple effort. The lighting industry has to replace old technologies with new, consumers should be aware of the benefits of newer technologies, and the financial sector needs to offer more products to support this switch-over." A huge business opportunity exists as the same energy efficiency story can also be told for retail, industrial and hotel lighting, he adds.

New efficient lighting is the key to saving more energy in our world. Mr Verhaar believes we could even surpass the 20% energy reduction target set by the EU. "We feel that there are even more opportunities than that," he says. "The Kyoto targets for lighting could easily be achieved. It just needs action and it needs action now, so let us take on that responsibility and act."

www.lighting.philips.com

Harry Verhaar is Senior Director of Energy and Climate Change for Philips Lighting.

A realistic energy saving of 20% on all the lighting currently installed in the following regions would save:

Region	Money saved per year	CO_2 emissions reduction per year	Barrels of oil saved per year	Equivalent to annual output of
Europe	€14 billion	59 million tonnes	196 million	67 power stations
Asia Pacific Region	€17 billion	121 million tonnes	247 million	84 power stations
USA and Canada	€17 billion	90 million tonnes	244 million	83 power stations
Latin America (including Mexico)	€4 billion	9 million tonnes	51 million	18 power stations

Fuelled by cocaine

Making cement is heavy work, but leading cement supplier Holcim is taking some innovative steps to clean up its act involving confiscated drugs, used tyres and discarded medicines.

With the cement industry responsible for about 5% of man-made carbon dioxide emissions (CO_2), Swiss company Holcim is eager to reduce its environmental footprint. It's reducing the use of fossil fuels and has set ambitious targets to cut greenhouse gases. Since 1990, CO_2 emissions per tonne of cement have dropped by 16% (the goal is 20% by 2010).

This is being achieved partly by co-processing, the use of alternative fuels and raw materials to generate energy and produce clinker (which makes up cement). There are many benefits: cuts in fuel costs and the amount of natural resources used, reduced emissions, and a solution for waste that otherwise would have to be landfilled or incinerated. Holcim has invested in facilities to process alternative fuels such as used tyres which can become an eye-sore, fire hazard and health risk.

Customs officials and cement makers may seem unlikely partners but in Ecuador, where the only legal way of disposing of seized drugs is to incinerate them, Holcim's cement kilns provide a useful service and get a free fuel supply in return. With its high calorific value, cocaine is an ideal energy source; in 2005 the Cerro Blanco plant burned 26,380 kg of cocaine. The Government of Ecuador also asked Holcim to incinerate 16 tonnes of shark fins that had been confiscated and 12 tonnes of tuna abandoned at a port.

After the Indian Ocean tsunami and the earthquake that rocked the island of Nias in 2004, medical aid flooded into Indonesia. But much of the medicine was unusable – past its expiry date or damaged. Large quantities were left over, and the Indonesian government needed a way to dispose of it. Holcim stepped in, and is now exploring the possibility of working with the Indonesian Ministry of Health to provide ongoing processing of out-of-date medicines from the country's hospitals.

In another strange turn of events, Holcim's Philippines Davao plant is co-processing money for the Davao city branch of the country's central bank, Bangko Sentral Ng Pilipinas (BSP). This began when BSP gained ISO14001 certification which requires that the bank use a recognized waste handler to dispose of worn-out bank notes, instead of dumping the shredded material in landfill.

The level at which alternatives have replaced traditional fuel stood at 12.8% last year compared to 4% in 1990 and almost 12% in 2000. But Holcim's motives are not solely philanthropic; efforts towards environmental sustainability are proving to be good for business. The company was nominated 'Leader of the Industry' in the Dow Jones Sustainability Index in 2005 and 2006.

www.holcim.com

Under the sun

Most of us feel pangs of guilt when we stay in hotels and see the energy wasted in washing towels and linen, inefficient air conditioning units and heaters, and lights permanently left on in corridors and bedrooms.

As a major energy consumer, Accor, the worldwide hotel, tourism and corporate services group believes that it is morally and economically obliged to become more sustainable. In 2005, Accor consumed over 3.7 million MWH of energy in its hotels. This is equivalent to the domestic consumption of more than 450,000 people. In response, the group is phasing in energy-efficient measures that bring substantial environmental and economic savings. Following are a few examples.

> In France, Brazil and North Africa, solar-powered heating is being developed with the Agency for the Environment and Energy Resources. In the 41 hotels where it has been installed, between 40% and 60% of hot water for bathrooms is supplied by solar energy.
> In the US, the 75,000 20-watt-light bulbs used to light hotel Exit signs were replaced by 6-watt LED (light emitting diode) lights, resulting in a saving of 1,000 MWH.
> An energy management system has been installed in the Motel 6 and Red Roof Inn chains. It controls the room's air-conditioning and heating systems using a detector that adjusts the temperature to a pre-set level whenever the guest leaves the room. The installation provides a return on investment in 30 months.
> In France, 25% of the energy used in 200 hotels is produced from renewable sources. In Switzerland, water power produces all the electricity used in Accor's hotels in Geneva.

www.accor.com

African innovation

There are many examples worldwide of promising, locally-adapted approaches to energy sustainability. Here are just three of them.

Improving wood stoves in DRC

The NGO Amis de la Forêt et de l'Environnement pour le Développement, an IUCN member, is promoting the construction and use of improved wood stoves in North Kivu Province in the Democratic Republic of Congo. A pilot workshop has been built in Kiwanja, near the Virunga National Park, and a community approach is being used that allows anyone interested, to learn how to build the stoves. The project aims to reduce to 60% the demand for fuelwood for cooking to help protect household income, reduce the use of natural resources, and improve the health of women by reducing indoor air pollution. In all, 500 households are being trained on production techniques. They can then start their own small business producing the stoves.

Future fuels – Tanzania

In Tanzania, a consortium of organizations is helping produce an alternative fuel source from wood waste, reducing dependency on forest products and opening a new market.

Original concerns over continuing deforestation led to the idea of using sawdust from a regional sawmill as an alternative source of fuel. Some 20 community-based organizations joined forces to set up the Environmental Enterprise Development Initiative, with the aim of creating a source of income for youth and women through the production of briquettes. Made from sawdust, charcoal dust and agricultural wastes, these briquettes are produced using hand-presses or low-input machinery, providing a high-energy and long burning fuel that can substitute for the traditionally-used charcoal or wood without having to change cooking stoves.

www.seedinit.org

Cows to Kilowatts – Nigeria

In Nigeria, a local NGO and a community-based organization have joined technology innovators from Thailand and the Sustainable Ibadan Project to install a biogas plant running on abattoir effluents to create a source of domestic energy, and reduce pollution and greenhouse gas emissions.

Abattoir effluent has a significant impact on human health, agriculture, drinking water and aquatic species, and is a major problem for many urban communities in Nigeria. There are currently no waste treatment plants for abattoirs in Nigeria. Legislation for the protection of water sources is inadequate and there is no clearly established, coordinated policy framework to tackle water pollution and greenhouse gas emission.

The pilot plant in Ibadan treats waste water and produces biogas (mainly methane and carbon dioxide). The biogas will be upgraded, compressed and used as a substitute for natural gas in household cooking and could also be used to generate electricity. The sludge from the reactor will be used as organic fertilizer.

It is estimated that the biogas would cost households half the current market price of natural gas. The pilot plant in Ibadan will be the first in the world to simultaneously treat abattoir effluent and provide domestic energy and organic fertilizer. It has great potential to be replicated in other urban areas of Nigeria, across Africa, and beyond.

www.seedinit.org

Guilt-free flying?

If tour operators reduced their energy consumption, could we fly without such a guilty conscience? Jane Ashton outlines some steps being taken by First Choice Holidays.

It's an unfortunate paradox that the world's developing countries which depend on tourism for revenue will be worst affected by climate change – and yet transporting tourists contributes to the problem.

As guzzlers of fossil fuels, the aviation and travel industries are key contributors to greenhouse gas emissions. But there are moves within them to accept responsibility for their environmental impact. One company, First Choice Holidays, is changing its day-to-day operations and it's beginning to make a real difference, says Jane Ashton, Head of Corporate Social Responsibility at First Choice.

"We have switched the majority of our head office and travel agency premises to 'green' energy. In our airline, the pilots of our 33 aircraft have, over the past year alone, improved fuel efficiency by 1% by taking such measures as flying the most direct routes, exercising careful speed control and shutting down one of their aircraft's engines when taxiing at airports. Crucially, we fly with passenger loads of over 95% and go to great lengths to minimize on-board weight, all of which saves fuel and reduces pollution."

While technological alternatives to aviation fuel are proving elusive, there have been significant breakthroughs. In 2009, First Choice will be the first European carrier to fly the Boeing 787, which will use 20% less fuel, produce 20% less carbon dioxide and 40% less nitrogen oxide than current jets.

"One of our most effective measures is an innovative offset scheme for our customers," says Jane. "They are encouraged to contribute £1 per person to support carbon reduction projects in the developing world, with the company matching this amount, and 40% of our passengers are choosing to do this."

Tour operators can also make a difference by persuading their suppliers to reduce their carbon emissions, Jane adds. "We are encouraging our top hotel suppliers to improve their practices and working hard with industry peers both in the UK and in Europe to develop common supply chain standards, and engage destination governments on issues such as climate change."

We fly with passenger loads of over 95% and go to great lengths to minimize on-board weight.

But she says there is a limit to what airlines or tour operators can do to tackle climate change; much is up to Government.

"Governments need to put in place national and international frameworks for addressing society's emissions in ways which encourage individuals and business to reduce their carbon footprint, manage the forecast steep growth in aviation, and meet internationally-agreed greenhouse gas stabilization targets. We believe the proposed EU Emissions Trading Scheme, scheduled to begin in 2011, could be a good way to achieve these goals if managed well."

www.fcenvironmentandpeople.com

Looking to our energy futures

Scenarios can help us anticipate the ecological and social impacts of different energy futures. Angela Wilkinson of Oxford University explains.

In the 1970s, one of the seminal publications shaping the early days of the modern environmental movement was the Club of Rome's *Limits to Growth*. This was criticised by some as portraying an overly Malthusian perspective – viewing the environment as fragile and population growth locking the world into a path of accelerating decline.

Those in the non-Malthusian camp emphasised our ability to overcome the limitations of Earth's natural capacity. They pointed to human ingenuity, scientific progress, technological development, economic efficiency and the endless possibility to create more from less. Others highlighted the robustness of nature and its ability to bounce back.

Nearly 40 years on, despite developments in environmental science, widely differing perspectives (or world views) on the outlook for the environment and the approaches we should take to address environmental management are in evidence. Debates rage on the existence or not of 'safe' limits, on the fragility or resilience of nature, and on catastrophic or incremental rates of global change.

Left unrecognized, such differences can lead to a paralysis in policy making. When decisions are made without effective engagement of a diversity of perspectives, they are inevitably based on narrow understandings or crude compromises and doomed to fail.

Thinking intelligently about the future

There are no facts about the future. The challenge, however, is not one of better prediction and ever-improving scientific knowledge, but of using such knowledge and exploring what might happen, in the form of alternative futures.

Scenario thinking and planning, which originated in the military sector, is being increasingly used in corporate, public and multi-stakeholder arenas. Scenarios are relevant, challenging and sometimes uncomfortable stories about how the future might unfold. Scenarios have been used for conflict avoidance, in decision support and strategic planning, and in recent scientific assessments of global environmental change, such as the Millennium Ecosystem Assessment.

Scenarios come in sets, of two, three or more. This contrasts with other futures methods such as forecasting where the focus is on a single future, often an extrapolation of the past or a prediction of things to come. The approaches taken to building scenarios vary considerably: they include plausible, probable, preferable and wildcard futures.

Scenarios can help us think of ways in which the future might be a continuation of, or a break from the past and pay attention to the way we frame present day challenges. A set of equally plausible scenarios can help us keep an open mind and stop us attending only to signals of what we hope and expect to see. They can prepare us for situations we might otherwise not be able to see or think about and open conversations in the safe space of 'the future' that we are unable to talk about today.

By respecting differences in world views, rather than seeking consensus, scenarios can help different organizations work together to build common ground and common vocabularies. Seeing the future as an open possibility can help change the way different groups relate to one another. In turn, this transforms the options and the problem!

Rather than focusing on more precise definition of the problem, scenarios encourage us to look at the problem from the perspective of the 'what if' and 'so what' of alternative futures.

Rethinking the energy security challenge

Scenarios can help us identify the questions we should be asking ourselves about the future. For example, considering the energy security challenge we get different solutions offered depending on whether we ask: *What will most likely happen? What is possible? What kind of energy system do we want?*

Building equally plausible futures has the advantage of encouraging us to be more open-minded and, in the process, find more options, and develop a wider range of responses than if we were to focus on one particular future.

Solutions to the energy security challenge will differ according to whether we frame the problem as one of supplementing supply, reducing demand, or a combination of both. On the supply side we have the prospect of an increasingly diverse energy mix, comprising conventional oil and gas, 'new' hydrocarbons such as oil shales and tar sands, nuclear power, hydroelectricity and bio-energy. On the demand side, there are the prospects of improved energy efficiency and lower-energy lifestyles.

Options will also vary depending on whether or not we consider the wider context of the energy supply-demand equation. Responses to the global energy security challenge carry profound implications for ecosystems, as well as the species and genetic diversity and human development they support. Conversely, the natural systems of the world set the context for future energy systems and may either place limits on the development of certain energy options, or enable others to develop. For example, the production and consumption of all forms of energy require significant amounts of water. Many countries are already experiencing water stress. Similarly, the increased interest in crops for energy production is causing food security concerns.

If developments in energy systems are considered in isolation from food and water security, the result is likely to be progress towards short-term energy security and unintended consequences, in the form of wide-ranging and longer-term impacts. Whilst this combination represents a fundamental challenge to civilization in the 21st century, it is one that currently falls between policy domains and national jurisdictions.

The combined energy security, climate change, and biodiversity management challenge is a complex one requiring convoluted and hard-thought solutions. Scenarios offer a way to appreciate the longer term and bigger picture in a way that encourages us to rethink our relationships with one another and consider a wider set of possibilities for action.

We have the means, but do we have the will? Who will forge the courageous and joined-up conversation that is needed to rethink the energy-water-food security challenge facing civilization today?

Dr Angela Wilkinson is Director of Scenario Planning and Futures Research at Oxford University's James Martin Institute for Science and Civilization.

The **Rocky Mountain Institute** is a US-based organization dedicated to research, publication, consulting and lecturing in the general field of sustainability, with a focus on profitable innovations for energy and resource efficiency.

www.rmi.org

Taking the plunge

While public money has been flowing into renewable energy projects for some time, many banks are still sitting on the sidelines. Eric Usher of UNEP explains what's needed to convince them.

Renewable energy offers many benefits – increased access to energy, diversification of supply and alleviation of major environmental problems such as air pollution. So why is it still the smallest sector of the world's energy industry?

Although the sector is developing quickly with US$ 70 billion invested globally in 2006, most renewable energy projects are still not competitive with conventional fossil fuel sources in the short to medium term. Banks balance the high up-front capital costs with the benefits of lower or zero fuel costs. They are not always ready to finance these 'high risk' options, or only under unfavourable terms for the project sponsor. Raising enough capital to allow renewable energy to reach its potential is fraught with difficulty, particularly in developing and transition economies where public capital has been needed to move most projects forward. Investors are plagued by geo-political, economic and regulatory risks.

Not yet viable?

For developing countries which have to spend much of their export earnings on oil imports, the shift to indigenous renewable energy sources is appealing. Fossil fuels are often heavily subsidized, so reducing their use provides an immediate benefit for government treasuries. Surprisingly, the economics of renewable energy are often better in the developing world than in OECD markets.

Solar photovoltaic lighting systems, solar water heaters and biogas digesters are a few of the small scale technologies that have been successfully commercialized in many developing countries and are being used in millions of households. On a larger scale, wind, geothermal, small hydro and biomass plants are all beginning to displace fossil fuel power generation. But on a global scale, uptake of these technologies is modest. We are only scratching the surface today of what can and needs to be done to mainstream new and cleaner supply options into the energy mix.

Even though the financing needs and potential is greatest in developing countries, renewable energy proponents are often frustrated by the lack of bank interest in the sector, either to finance their operations or to lend to their customers. They claim that banks don't understand their business, their technology or their customers and lack incentives to mobilize the services they could offer.

Tempting the banks

Financial institutions view themselves more as instruments of change rather than initiators. Before they shift their interest away from carbon-emitting technologies and towards clean energy, they need to feel comfortable that enough demand exists to achieve economies of scale. For small scale financing of renewables, a bank may need to build a portfolio of 10,000 household loans before it starts to make money lending to the sector. For larger projects, five to 10 plants might need to be financed before a bank is fully on board.

Banks in many developing countries have sufficient capital and in general are seeking to develop new loan products. But a combination of the newness of renewable energy technology, uncertainty of how to manage risks and inconsistencies in the quality of product or service offered by the provider, can make lenders reluctant. Development agencies and International Financial Institutions can help here. But they need to stop relying on conventional credit line approaches and focus more on industry engagement. They can help banks set up their first loan portfolios and gain experience of putting their own capital to work in the clean energy sector.

There is no standard strategy for engaging banks but there are a range of support activities that can be useful. These include general awareness raising, loan officer training, technical support for setting up dedicated loan instruments and financial support mechanisms in the form of interest rate reductions or risk sharing. Interest rate softening, guarantees, collateral support and extension of loans can all be useful in ▶▶

expanding credit markets, depending on the situation. The right finance intervention should encourage the market to grow and vendors to develop their products and services but should not substantially distort the market. It should also include a predetermined exit strategy.

When banks begin to scale up lending to a renewable energy sector it sends a positive signal to policy makers that the technology is mature and ready to play a significant role in the country's energy mix. This can go a long way towards convincing them of the need for shifts in policy, often from a narrow technology demonstration approach to a broader fiscal or regulatory approach. This contradicts the conventional wisdom that investment only engages once the right policies are in place. Financing and policy development can evolve in parallel, with one constantly influencing the other.

High level support

Despite all the drawbacks, investment in clean energy is starting to take off in most regions of the world with the strongest activity in the US, Europe and large emerging economies such as China and India. Nevertheless, without moves to address some of the key barriers, and a concerted effort to boost large-scale financing, investment in clean and sustainable energy will not be enough to make a difference in the global energy mix. A mandate exists for policy makers and organizations such as the UN to help spur markets towards a greener energy mix. They can implement market and financial measures to help financiers share risks, reduce transaction costs, build capacity and clear many of the other hurdles that line the road to a sustainable energy future.

Changing the way financial organizations consider new investments in clean energy will require better information and new mandates to combine social and environmental factors — both risks and returns — as integral measures of economic performance.

www.unep.org

Eric Usher heads the UN Environment Programme's Renewable Energy and Finance Unit.

Rwanda's rescue remedy?

Methane could prove a surprising solution to Rwanda's energy problems. The deep waters of Lake Kivu on the country's northwestern border are home to vast quantities of methane produced by lake bed bacteria. Engineers are planning to suck out the methane and burn it to produce electricity. The gas reserve should be enough to supply the country's electricity needs for 400 years. This could mean a reprieve for the country's forests as Rwanda currently gets 90% of its energy from wood burning. Extracting the gas would also reduce the risk of a massive gas explosion which could harm people living near the lake.

Fusion – the ultimate challenge?

Arguably one of the major research challenges of the 21st century, fusion is the energy source of the sun and stars. Fusion research aims to show that this energy source can be used to produce electricity in a safe and environmentally benign way. Fusion scientists from the European Union, India, China, Japan, Korea, Russia and the US are going ahead with the construction of an experimental plant (ITER) in France.

Carbon capture and storage

Carbon capture and storage (CCS) is gaining increasing attention as a way of mitigating climate change. Carbon dioxide (CO_2) can be captured (separated) from industrial and energy-related sources such as power plants and stored instead of being released into the atmosphere. Potential storage options include geological formations such as oil and gas fields, unminable coal beds and deep saline formations, oceans (direct release into the ocean water column or onto the deep seafloor), or for industrial use. CO_2 storage in the sea can risk greatly increasing ocean acidification. CCS in a modern conventional power plant could significantly reduce CO_2 emissions but capturing and compressing CO_2 requires much energy and would increase the fuel needs of the plant.

Clever capital

Bhavika Vyas of Acumen Fund explains how philanthropic capital can be matched with business skill to provide energy for the poor.

As the increasing public focus on climate change shows, energy issues affect everyone on Earth. Yet the negative impacts of climate change are disproportionately felt among those at the bottom of the economic pyramid – individuals who earn less than US$ 4 a day. Low income communities face greater vulnerability when confronted by climate changes and extreme weather as they often lack access to sturdy housing, insurance or savings.

Beyond climate change impacts, energy also presents challenges for the poor who often pay more for inadequate or unreliable energy supplies than middle or high income consumers. Reducing expenditure on energy sources can help raise the disposable income of the poor, increase productivity, and reduce the time spent on mundane tasks like collecting wood. The need for affordable and renewable energy provision that targets these four billion people is clear.

Access to energy is also linked to school attendance, improved health, affordable housing and access to safe water. In Bangladesh, the installation of electricity in schools corresponded with a four-year increase in enrollment for boys and girls. In India, if poor households replace biomass with clean energy, they could see a 50–90% reduction in indoor air pollution and reduce the level of respiratory illness.

But giving poor consumers access to energy will take more than good intentions. As it becomes clear that the challenges will not be solved by commercial or policy players alone, more and more institutions are looking to use entrepreneurial approaches that harness business skills.

One such player is Acumen Fund, a global non-profit venture fund focused on investing in enterprises that deliver affordable, critical goods and services through innovative, market-oriented approaches in East Africa and South Asia. By combining philanthropic capital and business acumen, the organization seeks to build sustainable and thriving enterprises that serve vast numbers of the poor.

Such investors fill a gap for energy enterprises geared toward serving the poor, as most social entrepreneurs cannot access affordable commercial capital and local financiers are often not willing to take the risks of new products and new markets. Flexible capital, coupled with strategic management support, can help take these enterprises to the next level.

Acumen Fund is in the early stages of developing a portfolio of investments in the energy sector, but it has considerable experience in using market-based approaches to investments in health, water and housing. In water, for example, Acumen Fund has invested in WaterHealth International (WHI), which installs water treatment plants with an

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innovative, cost-effective technology designed to provide safe water for the poor. WHI's community water systems provide clean, affordable water to more than 100,000 consumers in rural India on a financially sustainable basis.

Energy projects are well suited to these market-based approaches for several reasons. Given the productivity increases that come with access to electricity and energy, consumers are often more willing to dedicate financial and human resources to energy services than other basic needs such as water. Markets promote innovation and productivity. Traditional philanthropic capital or foreign aid alone will not be able to meet the tremendous need for energy services among poor consumers – more innovative business models must be used to reach scale and sustainability.

There is a robust pipeline of clean energy enterprises and in response to clear opportunity, a number of 'social entrepreneurs' have emerged who combine business and technology skills with a commitment to serving the poor. Renewable energy technologies such as biofuels, solar, micro-wind and micro-hydropower, offer real profit-making opportunity whilst generating significant social gains.

Investing in any business involves risk, but financing social enterprises in the renewable energy sector presents specific challenges – unproven technologies, dependence on global markets for inputs, and challenges measuring the direct and indirect impact of these initiatives. However, as clean energy enterprises that serve the poor continue to emerge, their financial viability and social impact will grow, attracting more resources to the sector. The question is how to create more 'patient' flows of capital – capital with the rigour and discipline of venture capital, but with more modest expectations of return and longer pay-back periods. This form of capital, along with specialized knowledge and local leadership, will be needed to deliver solutions to the global energy challenge.

www.acumenfund.org

Nature's recipes

Learning *from* nature, not just *about* nature, could provide the solutions for many of our energy problems, says Janine Benyus.

"Organisms have done everything we humans want to do but without guzzling fossil fuels, polluting the planet, or mortgaging their future", says Janine Benyus, a pioneer of biomimicry – a rapidly-growing field of research and development. Biomimicry studies nature's best ideas and imitates these designs and processes to solve human problems. Some believe it could help solve global energy problems, reduce waste and promote sustainability.

In learning *from* nature, instead of just *about* nature, humans can live sustainably on this planet, says Janine. She explains that biomimicry is starting to make a significant impact in fields such as medicine, defence and building construction, and has enormous potential in the quest for sustainable energy.

There are already numerous examples of proven energy technology inspired by nature: solar cells that mimic leaves and the process of photosynthesis; wave energy harvesters inspired by kelp and tuna; batteries in the works that emulate the electric eel's capacity to deliver 600 volts instantly; and wind turbine optimization inspired by the fin scallops of the humpback whale.

Since buildings create about 48% of global carbon dioxide emissions, a major focus is now on designing more energy-efficient buildings. One leading example is the Eastgate Building, a shopping and business centre in Zimbabwe's capital, Harare. It has no air conditioning or heating, only ventilation channels modelled on termite mounds. Termites maintain the temperature inside their nest at 31°C, day and night, while the external temperature varies between 3°C and 42°C. The Eastgate building uses 90% less energy than a conventional building of its size.

A British university is digitally scanning termite mounds to map their three dimensional architecture in microscopic detail. A computer model will help understand how the termites' tunnels and air conduits exchange gases, maintain temperature and regulate humidity. This research may in the future influence the design of self-regulating buildings.

"We are witnessing a change in our relationship with the natural world, to one in which we are now the students and the organism is the teacher. Before, if a species was useful to us we would harvest it or domesticate it. Now we are using nature as an inspiration for innovation," says Janine. Emulation of natural processes is changing the way we design our own technologies and systems. Ecosystems can be seen as 'sustainable economies' in the way they deal with critical functions such as energy generation and waste treatment.

Engineers at Mercedes-Benz and DaimlerChrysler Research teamed up to produce the first bionic concept car that is 40% lighter than comparable cars, does more than 70 miles per gallon, reduces some pollutants by 80% and can seat four people. Their inspiration was the box fish, which despite its cube shape, is extremely streamlined and stable. Biologists helped the engineers emulate the fish's anatomical structure to design the car's light but strong body.

Plant biologists and engineers are looking to leaves to help make smaller and more ubiquitous solar cells. A leaf has tens of thousands of tiny photosynthetic reaction centres that operate at 93% quantum efficiency, capturing energy silently with water, sunlight, and no toxic chemicals. Mimics of these molecular-scale solar batteries could one day be used to split water into clean-burning hydrogen and oxygen. Many companies have commercialized dye-sensitized solar cells that mimic photosynthesis to maximize light harvesting at low light levels and reduce the cost of converting sunlight to electricity.

Researchers are developing ways of obtaining water without the use of energy-intensive pumps. Their work is modeled on a beetle found in the Namibian desert that can harvest water from fog. Water aerators

and computer fans that mirror the shape of spirals found in nature, including seashells have also been developed. In some cases, designs modelled on natural shapes can use up to 80% less energy, while reducing noise by 75%.

The main barrier to progress in biomimicry, says Janine, is the lack of a bridge between scientists and the people who need their information, mainly industry innovators. "What's needed is far greater interaction between biologists and engineers. Sadly, few people get to work in the fertile estuary between those two intellectual habitats."

"I don't think there is a lack of research but I think there is a lack of access to it – biological knowledge needs to be made available in a form that, for example, an engineer can use." Janine believes it essential that engineering students take a biology course and conversely, biologists need to better understand design challenges. Biologists could also do a better job of describing and promoting the outstanding characteristics of species, and sharing their knowledge, she adds.

Janine would also like to see greater investment in, and incentives for biomimicry research, particularly in the proven technologies. "We need to remove the perverse incentives for fossil fuels and channel the money to sustainable technology."

Janine's visions are starting to become a reality. Cross-disciplinary research centres are springing up all over the world that bring together the languages of biology and design. The biomimetic revolution is gathering pace as industry becomes more alert to the potential gains of learning from nature.

Emulating nature is not just about mimicking form but also nature's processes and ecosystem strategies, says Janine who has a deep commitment to conservation and sustainability. And there's a powerful conservation message emerging: "We can learn and benefit from the embodied wisdom of nature's systems and we need to keep them so that we can continue to learn from them."

This message will translate into benefits for nature, she says. "It's my belief that if an innovator derives a lesson or an idea from an organism and creates a product based on it, there should be some sort of thanksgiving. Some of the proceeds should go back to preserve the organism's habitat, a new programme we call Innovation for Conservation. That way, innovation becomes an engine for preserving the source of ideas."

Janine Benyus is co-founder of the Biomimicry Guild and Institute. She is a biologist and author.

www.biomimicry.net

Banking on green growth

Katherine Sierra, Vice President, Sustainable Development at the World Bank outlines its new platform for promoting a low carbon economy.

The gap between developed country and developing country energy use is alarming. Poor countries consume only 5% per capita of the modern energy consumed by the rich world. Rich countries have developed more than 70% of their economically-viable hydroelectric potential; developing countries only 20% and Africa, less than 5%.

In bridging this gap, the challenge is to make the necessary energy growth sustainable both locally and globally. The World Bank is taking up this challenge and as a follow-up to the 2005 Gleneagles G8 Summit, has been working with partners on a new *Investment Framework for Clean Energy and Development.* Its goal is to stimulate investment from public and private sources to increase access to energy in developing countries and stimulate development while using cleaner technologies to protect the environment.

According to the International Energy Agency (IEA), meeting the energy needs of developing countries and transitional economies will take US$ 300 billion per year during the next 25 years. Energy sector policy reform is also needed to attract private investment and additional public finance.

Meeting the developing world's burgeoning energy demand without further damaging the Earth's climate or risking energy shortages, requires concerted action over the long term by industry, finance, government, academia and international organizations. But sustainable development through clean energy is still being addressed with short-term financing and regulatory frameworks that are not appropriate to the scale of the challenge.

In response, the Framework incorporates three main pillars: *Energy for development and access to the poor; transition to a low-carbon economy; and adaptation to climate change.*

Developing countries will need an estimated annual investment in electricity supply of US$ 165 billion to 2010, increasing at about 3% per year through to 2030. Only half of this is readily identifiable. International financial institutions, aid donors and the private sector can close the gap by US$ 11 billion per year, the rest depends on a combination of policy advice, technical assistance and lending to support national power sector reform. In addition, to move to a lower carbon economy, US$ 30 billion is needed, only for the power sector.

Rich and poor countries alike need to apply energy-efficient technologies to cut future greenhouse gas emissions and meet energy demand but rich countries must take the lead. Because a low-carbon economy is of global benefit, it is in the global interest to provide incentives to rapidly-growing developing countries to invest in cleaner energy technologies. This can be done best by 'buying down' the incremental cost of such technologies over conventional ones. A well-functioning carbon market would allow the buy-down of such costs using current financial

mechanisms. To function well, however, these markets need a post-2012, long-term, stable, global regulatory framework, with differentiated responsibilities.

One of the Framework's key features is the focus on how to ensure that development efforts are not undermined by climate change. According to recent research, 20–40% of Overseas Development Assistance and public concessional finance (or US$ 20–40 billion per year) could be at some level of climate risk.

One thing is certain: the answer cannot lie in a futile effort to restrict energy consumption. People, their homes, farms and factories must be given the energy they need, but with a smaller environmental footprint.

There is general agreement that the world already possesses the fundamental scientific and technical know-how to address the energy-carbon problem in the next half century. While many new energy technologies are being implemented at full industrial scale, others are still in pre-commercial stage and need accelerating so that they can be applied worldwide. This calls for an intelligent blend of public and private sector investment targeting the most promising innovations, creating incentives for private sector investment (including through market-based instruments and carbon finance), and promoting research and development for the next generation of clean energy technologies. Incentives during market build-up can involve pre-commercial public financing to stimulate this development. Promotion of energy efficiency through measures such as efficiency standards, education and product labelling would help address both environmental and pricing issues.

People, their homes, farms and factories must be given the energy they need, but with a smaller environmental footprint.

Greenhouse gas emissions can be reduced using a range of technologies including fuel switching (coal/oil to gas), increased power plant efficiency, carbon dioxide capture and storage, and increased use of renewable energy. Within the fossil-fuel domain, several avenues appear promising including gasification of coal. But policies and programmes are needed to stimulate the widespread deployment of these climate-friendly technologies. These may include pricing strategies, removing subsidies that increase emissions, and incorporating the costs of environmental damage into the price of fossils fuels. Continued development of emerging carbon markets will reduce the cost of compliance for industrialized countries and contribute to sustainable growth in developing countries.

We believe that credible, stable and predictable regulatory frameworks operating wherever possible in a market environment will help attract private investment. When addressing the social consequences of market pricing, a shift from broad-based subsidies (currently estimated to exceed US$ 200 billion per year worldwide) to targeted interventions that help the poor will release substantial resources for use elsewhere.

Economic growth — development — must be sustainable in order to answer the needs of growing populations while caring for the climate and the environment. If we dare to think and act differently, a greener development path can be achieved.

www.worldbank.org

Bringing down the barriers

Several countries are beginning to remove the barriers to renewable energy implementation through a range of legislative and voluntary measures. Professor Richard Ottinger and Nadia Czachor outline some successful approaches from around the world.

With almost no renewable energy industry in 1990, **Germany** is now an industry leader, partly because of its feed-in tariff laws that guarantee a minimum price for the purchase of renewable energy. In 2006, the share of renewable energy in gross electricity consumption reached 11.8%, an increase of 13.4% on the year before, which resulted in an estimated reduction of 97 million tonnes of carbon dioxide emissions. Under the EU target, by 2020, Germany's renewable energy portfolio will reach 20%. Even more encouraging are predictions that the share could reach 50% by 2050.

Feed-in tariffs have also been successful in **India** (six states now have feed-in tariff policies) and **China** where the feed-in law took effect at the start of 2006. Tariffs in China are set according to the average coal price for the relevant province with a premium of around 3 cents per kWh.

In developing countries with remote rural populations, off-grid renewable energy technologies often need subsidizing to be successful. In Inner Mongolia, each household received a 30% subsidy funded by the Chinese government as part of a household photovoltaic/wind hybrid system pilot project. Between 1996 and 2001, 400 household systems were installed in six counties.

Low interest government loans have proven successful in **China**. Interest rates are typically half those of a standard loan and the incentive has targeted biogas, solar energy, small hydro and wind projects. A greater reduction in the interest rate is available for projects installing over 3 MW of grid-connected renewable energy.

Subsidies have also been effective in **Nepal** where the government subsidizes 75% of the cost of family-sized biogas plants and solar-powered drinking water pumps.

When coupled with a promise to purchase renewable energy at a fixed rate, government loans can be particularly effective. In **South Korea**, the nation's largest wind farm was built with the help of a government loan and a promise to purchase the energy at more than twice the price paid for coal and oil.

The Grameen Bank of **Bangladesh** began a loan programme for photovoltaic home systems in 1996. This has been used as

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a model for micro-lending in other developing countries including India where five-year loans are awarded, with a 15% down payment and interest charged at 12% per year. There are 79 million rural households in India without electricity and it is estimated that 75% could afford a Grameen-type loan for a photovoltaic system.

Countries including the **UK**, **Ireland**, **France**, the **US** and **China** have used tendering schemes for the supply of renewable energy. These usually involve the government running a competitive bidding process, in which renewable energy producers bid for a contract to supply a certain amount of renewable energy. While this system is successful in stimulating competition between renewable energy producers and reducing prices, in the UK, some producers reduced their prices too low and were not able to complete their projects.

Competitive tendering has been successful in **Thailand** where the biggest hurdle is the cost of implementing renewable energy technology. Recognizing the energy potential of the country's large stores of sugar cane and paddy husk, the government in 2001 dedicated 2.06 million Baht (approximately US$ 63,500), to be administered by the National Energy Policy Office, for biomass fuel. Through a tendering process, potential biomass projects were arranged in order of price and those quoting the lowest price were given priority until the funds were used up.

Governments can impose renewable energy use by including it as a building standard. Since 1980, **Israel** has mandated solar hot water collectors in most buildings. In early 2006 **Spain** enacted a building code requiring solar photovoltaic cells on certain new and renovated buildings. In **London**, the borough of Merton requires certain buildings to meet at least 10% of their energy needs with on-site renewables.

Many developing countries impose high duties on equipment imports, including equipment required for renewable energy. If renewable energy use is to be promoted, these duties should be eliminated. Import duties on wind turbines have been successfully waived in **Pakistan**.

Professor Richard Ottinger is Dean Emeritus at Pace Law School and Chair of the IUCN Commission on Environmental Law's Energy Law and Climate Change Specialist Group. Nadia Czachor is a Pace Law School Student Research Assistant.

To capture the substantial economic benefits provided by conserving energy, the Government of Pakistan established the **National Energy Conservation Centre (ENERCON)** to serve as a focal point for all energy conservation activities, including policy formulation. ENERCON conducts energy conservation activities in Pakistan with the support of UNEP, the Global Environment Facility and the Ministry of Petroleum's Hydrocarbon Development Institute of Pakistan. They target a range of economic sectors including agriculture, buildings, industry, power and transport, and apply a combination of strategies including technical assistance, awareness campaigns and financial incentives.

www.enercon.gov.pk

Joining the conversation

IUCN's Global Programme Director, William Jackson, introduces the Union's newly-emerging Energy, Ecosystems and Livelihoods Initiative.

In this issue we have seen how ecosystems provide the goods and services critical for many of our energy supplies, which in turn drive economic development. Ecosystem resilience or fragility will have a significant bearing on what energy options are available to us in the future and with the unsustainable energy choices we're currently making, we could be severely limiting those options.

The language of energy is constantly changing and the talk is getting louder. The G8 talks of a "cleaner, more clever and more competitive energy future". But still, the decisions being taken by our politicians are rarely grounded in science or guided by sound conservation knowledge. Societies around the world are at a crossroads. The decisions made in the next five years on how to produce, distribute and consume energy will have significant implications for the future of ecosystems, the livelihoods of people that depend on them, and economic growth.

IUCN is joining the energy conversation. Through our Energy, Ecosystems and Livelihoods Initiative, we will mobilize our conservation knowledge to help limit the impact of expanding energy needs on nature while identifying opportunities for biodiversity to respond to the growing demand. We're aiming to accelerate the transition to energy systems that are ecologically sustainable, socially equitable and economically viable. As the world's biodiversity representative, we want to influence policy making where the links between energy systems and ecosystems are most critical.

There are many important issues to engage in but for now we're focusing on three main areas: identifying the social, economic and ecological implications of rural energy options available to poor communities to better inform national and local investment; transforming the risks of biofuels into opportunities; and expanding best practice in managing biodiversity in the context of energy developments such as oil and gas exploration, mining operations and dam construction – areas in which IUCN already has a proven track-record. We will also work on promoting energy efficiency in our own activities and in conservation more generally.

Energy affects all our areas of work, be it species, forest or water conservation, protected area management, or poverty reduction. Any form of energy has an impact on biodiversity, even those portrayed as 'green' such as wind power or biofuels. We need to map out a role in finding ways to manage the ecological and social impacts of new energy options that are emerging.

Biodiversity conservation knowledge can and should be an important consideration in future energy choices. We can use the expertise in our protected areas network to advise on corridors or buffers around biofuel crop plantations, or promote energy efficiency options for parks. The expertise of our ecosystem management commission and forest programme could be paired with technical partners on fuel stove efficiency to make sure wood fuel becomes a sustainable and healthier energy option. Our species experts can advise on how to minimize the impacts of wind and wave power farms on birds and marine life.

The energy initiative will help us forge new partnerships, and mobilize the knowledge and expertise of IUCN's members, many of whom have been working on energy issues for years. The aim is to provide a service to members by offering a coordinated international approach to influencing the energy agenda.

There is so much at stake, IUCN must have a voice in the energy debate – a coordinated and powerful one. We can't control the energy future but we are uniquely placed to influence it for the benefit of people and nature.

www.iucn.org/themes/energy

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