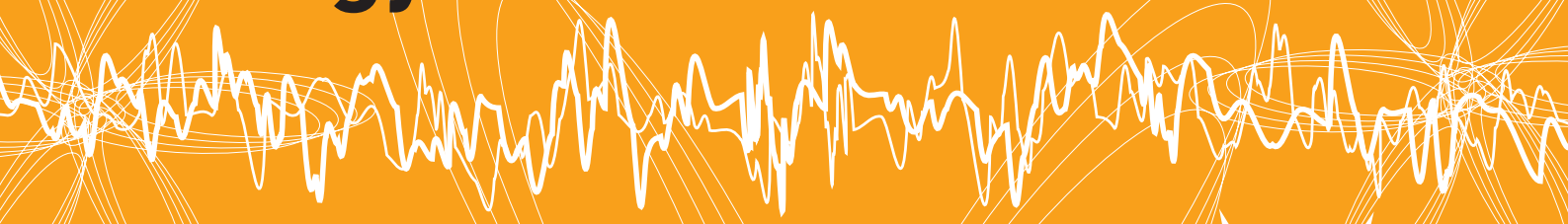
The UNEP Magazine for Youth

TUNZA

UNEP

for young people • by young people • about young people

Energy



Micropower in action

Fuels of the future

Infinite power

Green goal

Energy savers

Solar star:
Edward Norton

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Contents

Partners for Youth and the Environment

UNEP and Bayer, the German-based international enterprise involved in health care, crop science and materials science, are working together to strengthen young people's environmental awareness and engage children and youth in environmental issues worldwide.

A partnership agreement lays down a basis for UNEP and Bayer, who have collaborated on projects in the Asia and Pacific region for nearly 10 years, to step up current projects, transfer successful initiatives to other countries and develop new youth programmes. Projects include: TUNZA Magazine, the International Children's Painting Competition on the Environment, the Bayer Young Environmental Envoy in Partnership with UNEP, the UNEP TUNZA International Youth Conference, youth environmental networks in Asia Pacific, the Asia-Pacific Eco-Minds Forum and a photo competition, 'Ecology in Focus', in Eastern Europe.

Editorial

Every day we burn energy that took millions of years to produce. It took that long for countless billions of plants and creatures to decompose and be turned by heat and pressure into the oil, gas and coal that now go up in smoke. And almost all of it took place more than 285 million years ago, during the Carboniferous period, long before even the dinosaurs roamed the Earth.

We cannot go on much longer bingeing on the energy laid down by the sun so long ago. What we take is not being replaced and will one day run out. Experts predict that within a few decades – maybe even within a few years – oil production will peak, turning 145 years of growth in its use into decline. At that point, ever-increasing and generally cheap supplies will turn into shrinking, increasingly expensive ones. If the world is not properly prepared, economies will slump and conflicts erupt as nations tussle over what is left.

The binge is all the worse because only a minority benefits from it. Roughly a fifth of the world's people have grown rich – in both developed and developing countries – by using up the Earth's fossil fuel capital. The poorest 2.5 billion people have virtually no access to it at all. Instead they have to burn wood and dung, ruining their health and the environment in the process.

And even greater damage is being done by the fossil fuels bonanza itself. For the carbon dioxide that they release when they are burned is the main cause of global warming, which threatens to change the world beyond recognition. It looks as if we may be the last generation to benefit from the benign, stable climate that has allowed civilization to take root and flourish over the last 11,000 years.

Fortunately the solution is known, and to hand. The answer, as the song put it, really is blowing in the wind – and shining in the sun, too. Natural, renewable, clean sources constantly provide the world with far more energy than we will ever need, and we are increasingly developing sophisticated ways of harvesting them. They do not run out, they do not cause climate change, and they are available to the poor as well as the rich, because nature distributes them free.

Ours has to be the generation that moves from plundering millions of years of fossil fuels to harnessing the energy that is constantly on tap. It is a huge transition, but achievable – particularly if we cut down on the massive present waste of energy. It will enable us both to tackle dire poverty and to increase prosperity, to advance technology and yet combat climate change. It is time to turn on the sun.

We want to hear from you – your views, your news and your ideas. E-mail us at: tunza@ourplanet.com

energy poverty

energy wealth

C. Santos/UNEP/Topham

suffering people

D.A. Frans/UNEP/Topham

endangered

UNEP/Topham

Energy use, which is doubling with every generation, affects the planet – and society – more than any other human activity. It has the greatest impact of all on the environment, is one of the main causes of ill health worldwide, and provides one of the clearest indications of the gap between rich and poor.

Two out of every five people on Earth – some 2.5 billion – have to live without modern forms of energy, resorting instead to firewood, charcoal, animal dung and other forms of 'traditional biomass' to cook their food and heat their homes. They usually have to burn it on open stoves and fires, and the smoke – a cocktail of poisonous chemicals – swirls around their homes, bringing disease with it.

Every year a million children under five die from breathing it in, and so do many older children and adults. Young Tanzanian children who die as a result of respiratory infection have been found to be three times more likely than healthy children to have slept in a room with an open cooking stove. And the use of wood and dung helps cause deforestation and takes nutrients from the earth, leading to soil erosion, falling harvests and rising hunger. Yet the poorer a country is, the more its people have to rely on these fuels, and so the more they have to denude their land, and the more they sicken and die.

At the other side of the world's vast income gap, a fifth of its people are using energy so wastefully that they are not only damaging their health through pollution that causes respiratory disease, but are even changing the climate that has enabled humanity to flourish as a species. Burning oil, gas and coal – which provides four fifths of the energy used each year – emits carbon dioxide, the main cause of global warming. There is now more of it in the atmosphere than at any time in the last 650,000 years.

Sure enough, the Earth is heating up. The hottest 10 years ever recorded have occurred since 1990, and 2005 was the warmest ever. In recent decades, the Arctic ice cap has shrunk by more than a quarter and lost half its thickness, while vast Antarctic ice shelves have disintegrated, changing the outline of the frozen continent. And there are worrying signs that both the Greenland and West Antarctic ice sheets are beginning to melt, a process that could eventually raise sea levels by nearly 12 metres worldwide, flooding coastal land and cities around the globe.

Already the seas are rising twice as fast as ever before in human history, mainly because their water is expanding in the heat, as railway tracks do in summer. As waves break ever higher onto the shore, the people of low-lying Pacific atolls are preparing to leave their islands forever, before they become inundated and uninhabitable.

As temperatures rise, so does the amount of energy in the world's weather system, spawning increasingly violent storms. The 2005 hurricane season in the Atlantic was a

J. Sullivan/UNEP/Topham

K. Tanumitardja/UNEP/Topham

B. Kreis/UNEP/Topham

planet

UNEP/Topham

record – and it sent three of the six most violent storms ever slamming into the United States of America, including Hurricane Katrina, which flooded New Orleans. And as the Earth warms up, there is also an increasing danger of sudden, catastrophic change – such as a disturbance of the Gulf Stream, which could plunge much of Europe into a subarctic climate even as the rest of the world warms up.

As if all this were not enough, the rising levels of carbon dioxide emitted by burning fossil fuels are also poisoning the seas, through an entirely separate process. The oceans are absorbing much of the carbon dioxide, and as they do – incredible as it may seem – they are turning into very dilute carbonic acid. Their chemistry is changing in ways not seen for 20 million years, and this is killing plankton, on which all marine life depends.

It is the worst of both energy worlds. Energy poverty and energy wealth – two sides of the same coin – are wreaking immense damage on people and the planet.

The rich urgently need to reduce the burning of fossil fuels and cut back on waste by saving energy; many experts call for a rapid, fourfold increase in efficiency. And the poor need to increase their energy use, unwastefully, so as to develop their way out of poverty. A new, equitable energy revolution is long overdue: modern accessible energy for the poor, clean alternatives to fossil fuels for the rich, and the fight against global warming for everyone.

And what do YOU know about it?

1. Burning which fossil fuel emits the least carbon dioxide (CO_2)?
a. Natural gas
b. Oil
c. Coal

2. How much oil does it take to produce the 100,000,000,000 plastic bags used in the United States of America every year?
a. 190,000 litres
b. 19,000,000 litres
c. 190,000,000 litres
d. 1,900,000,000 litres

3. Which uses the most energy each year worldwide?
a. Motor vehicle transport
b. Air travel
c. Home heating
d. Home air-conditioning

4. Which country developed the first windmills?
a. The Netherlands
b. Egypt
c. Iran
d. India

5. What percentage of energy used around the world comes from fossil fuels?
a. 10 per cent
b. 25 per cent
c. 50 per cent
d. 90 per cent

6. Where does geothermal heat come from?
a. Earth's core
b. Sun
c. Wind
d. Ocean

7. How much has global energy use grown in the last 30 years?
a. 55 per cent
b. 70 per cent
c. 85 per cent
d. 100 per cent

8. How much of the energy used by the world's people currently comes from renewable sources?
a. 33 per cent
b. 20 per cent
c. 10 per cent
d. 5 per cent

ANSWERS: 1a, 2d, 3a, 4c, 5d, 6a, 7b, 8c

Enrico Bartolucci/Still Pictures

Power switch

Chris Marais/WWF-Canon

Dr Claude Martin, Chair of the International Sustainability Innovation Council of Switzerland (ISIS), talks to Cécile Bordier, Tunza Youth Advisor for Europe

'EVERYTHING, EVERYONE, EVERYWHERE is affected by the way we use energy,' says Claude Martin. 'The challenge is to protect the world from climate change, while pursuing people's development. We must bring energy to all, but energy that is environmentally sound.'

As populations rise and economies expand – particularly in China and India – the demand for energy is expected to grow by 60 per cent by 2030. Meeting that, he says, will mean remodelling our entire energy system and moving away from dependence on fossil fuels.

Biomass, biofuels, and geothermal, solar and wind power can all help replace fossil fuels and ensure countries' energy self-sufficiency, he says – and the transition must be a political priority.

'But,' he adds, 'humanity should not fall into the trap of replacing one problem with another. We now know that renewable energies can upset the delicate equilibrium of ecosystems.

'In Brazil, for example, large forest areas have already been sacrificed to sugarcane plantations to produce ethanol for cars. Or in Indonesia and Malaysia, the soaring production of palm oil – in part for use as a biofuel – is to the detriment of tropical forests and the species that live in them.'

A Round Table, organized by WWF – the global conservation organization which Martin headed for 12 years – has brought together planters, producers, processors, banks and civil society groups to promote the sustainable production and use of palm oil. 'We have a promising partnership with Unilever, which is imposing certain standards on palm oil production,' he says.

'But we have to be realistic. Renewable energy can meet only a part of the ever-increasing demand. So there must be investment in energy-saving technologies. Energy efficiency is not just an important part of the solution – it is probably the most important aspect.'

People in the industrialized world can do an enormous amount, relatively simply, through such steps as insulating their homes properly, switching off appliances, eating local produce – which has not been transported over long distances – and driving fuel-efficient cars.

But Martin adds that individuals alone cannot save the planet. 'Of course people must be encouraged to consume more thoughtfully, but this must happen alongside a commitment on the part of industry. And there needs to be a governing framework and intergovernmental agreements, like the Kyoto Protocol, to encourage energy saving.'

Countries, he adds, could increase investment in cleaner transport and introduce minimum standards of energy efficiency for buildings, industrial processes and new appliances. But, above all, they must end all subsidies to the fossil-fuel industry.

'Governments need a clear long-term vision for energy planning. Today's response to the energy crisis is just to look for an alternative to our dwindling supplies – such as nuclear – rather than seeking efficiency.'

Car research should focus, for example, on energy-efficient models running on clean renewable fuels, he says, while people should switch their perception of cars from status symbols to something to be used with prudence. And governments should encourage local authorities to develop practical and economic public transport systems geared to people's needs.

So when might the world achieve energy sustainability? Martin is optimistic. 'Younger generations have not grown up in a system of continuous expansion, and are increasingly aware of the planet's limits. This will help in making the essential shift from an exclusively economic worldview to a broader perspective – one which must have the entire weight of society behind it.

'We all must engage with this as a matter of urgency. No one can afford to sit back and watch. We all must develop a conscience; there is no other way of respecting our environment.'

Green Goal


PA/EMPICS


Oeko Institute


Bundesregierung/Bergmann


Oeko Institute


DB AG/Louis

The tumult and the shouting have died. The captains and their players have departed. But the drama-filled 2006 FIFA World Cup will have a lasting significance far beyond Italy's victory. For not only was it the world's biggest sports event, but its first-ever climate-neutral international tournament.

Green Goal, an ambitious initiative spearheaded by Franz Beckenbauer – the only person to have won the Cup both as a player and a manager, and the leader of the organizing team for this year's tournament – set out to minimize the World Cup's environmental impact. It was a formidable task. More than 3 million fans descended on the 12 German cities hosting the 64 matches, generating vast amounts of traffic. And then there were the staggering amounts of electricity the fans consumed, and that were needed to run each stadium and televise up-to-the-second coverage.

'The eyes of the world were on Germany. We wanted to set an example in terms of environmental protection, and show what could be done,' says Beckenbauer – who played in his first World Cup final in 1966 and captained Germany to victory in 1974.

His team started work in 2002. Stadiums were renovated to make them more energy efficient. A new photovoltaic system at Dortmund's Westfalenstadion, for example, produces 550,000 kilowatt hours of solar energy per year, enough to have lit up the six World Cup matches held there, and save at least 430 tonnes of carbon emissions. And at the Berlin Olympic Stadium, the final venue, the floodlighting system of 500 lights was consolidated into 310, reducing power consumption by 40 per cent.

World Cup sponsors joined in. Deutsche Telekom installed solar-powered phone boxes in stadiums, while Coca-Cola used only CFC-free, energy-efficient refrigerators to chill beverages. Electric company EnBW Energie Baden-Württemberg climate-neutralized the 13 million kilowatt hours needed to power all the stadiums, media centres and hospitality areas by diverting the equivalent electricity from renewable sources into Germany's national grid.

Public transport was heavily promoted. Match tickets also served as travelcards for buses, the metro and trains around the host city on match days. Deutsche Bahn, the German railway network, offered fans heavily discounted rail tickets – and even extended the 25 per cent fare discount offered by its Weltmeister BahnCard 25 railcard to the end of October – a month for every round the German team stayed in the Cup.

Even so, more needed to be done to offset the total 100,000 tonnes of greenhouse gasses the tournament emitted. So FIFA, the German Football Association (DFB) and a number of the World Cup's sponsors and partners pledged a total of $1.6 million for climate protection projects elsewhere in the world. The projects help to build biogas plants to produce cooking fuel from cow dung – replacing kerosene and wood – for 700 families in Tamil Nadu, India; to replace the use of coal on a South African citrus farm with sawdust waste from the paper industry; and to collect methane from a sewage plant in Sebokeng Township, southwest of Johannesburg, to generate electricity. Together, over time, these projects will save enough greenhouse gas emissions to make World Cup 2006 completely climate neutral.

Klaus Toepfer, former UNEP Executive Director and German Environment Minister – who is a keen supporter of the Bundesliga club Mainz – signed on as Green Goal Ambassador in 2005. 'Green Goal is football's contribution to climate protection,' he says. 'Athletes need a healthy environment, but the flip side is that sports events and facilities have a negative impact on the environment. FIFA, Franz Beckenbauer and his team, and their partners, deserve the highest praise for their Green Goal initiative.'

Green Goal sets a vital standard. The newly energy-efficient stadiums and the projects in India and South Africa will conserve resources into the future, while organizers of other events will be able to learn from the World Cup's example. Above all, it showed millions round the globe what can – and should – be done.

Franco Sacconier/UNEP/Topham

Östgötatrafiken

Infinite power

RENEWABLE ENERGY SOURCES are as good as infinite: 6,700 times as much energy as humanity uses reaches the Earth from the sun. Winds, tides, waves, falling water and the growth of plants also provide huge amounts.

The problem has always been tapping it. But ways of doing so are beginning to come of age. A sixth of the world's electricity now comes from small-scale renewable sources, and more still comes from big hydroelectric dams. The International Energy Agency reckons that by 2030 renewable sources could produce 30 trillion kilowatt hours a year – the entire amount of electricity expected to be consumed worldwide by then. And that could be just the start.

Renewable energy is distributed for free by the sun and the winds and is often most abundant in developing countries. China plans to get a tenth of its electricity from small-scale renewables within four years.

Here's some more on particular sources, with some innovative technologies being developed.

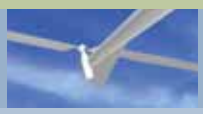
Biogas

Some 16 million families in developing countries already cook their food and light their homes with biogas – methane produced by fermenting excrement, food or crop wastes in a sealed tank called a biodigester. A clean fuel, it can be used like natural gas to provide heat or generate electricity. And the sludge left over from the biodigestion process is valuable as a rich natural fertilizer.

Biodigesters can help conserve forests that would otherwise be used for fuel, and by capturing the methane (the natural by-product of decomposing organic matter), they prevent this potent greenhouse gas from getting into the atmosphere and increasing global warming. Biodigesters can also be employed in farms and industry.

Innovation: The world's first biogas-fuelled commuter train is now running between the Swedish cities of Linköping and Västervik, 80 kilometres apart. The gas is produced from beef slaughterhouse waste that would otherwise end up in landfills. All of Linköping's buses run on it, too. In all, Sweden boasts at least 20 plants that break down manure, food and other wastes to fuel motor vehicles – part of a Government push to switch the country to renewable energy by 2020.

Wind power



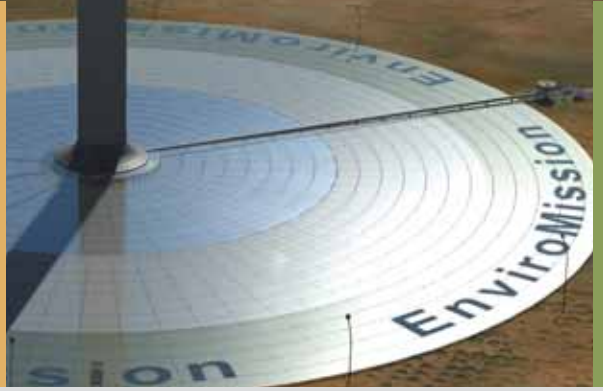
Wind is the world's fastest-growing source of energy; its capacity is now doubling every two and a half years. Generating electricity from windmills on land is now cheaper than getting it from fossil fuels or nuclear power, as well as being far cleaner.

Wind farms sited at sea around the coasts – where winds are steadier and fewer people complain about them spoiling the view – are more expensive than those on land, but hold even greater promise in the long term. Wind power has drawbacks: the wind does not blow all the time, for example, so its supply is intermittent. But studies show that this is not as serious as it seems, as weather conditions tend to average out over a country or region – and no one suggests it should be the sole source of power. A UNEP study shows that wind power would be possible on 13 per cent of the land area of developing countries surveyed.

Innovation: High-altitude winds are far stronger and more constant than ones closer to the ground. Sky WindPower is developing a Flying Electric Generator, a helicopter-like craft that holds wind turbines about 4,500 metres up, anchored to the ground by a cable that brings down the electricity.

Sky WindPower Corporation

Marine Current Turbines Ltd



EnviroMission Ltd

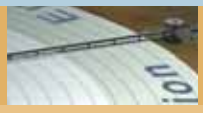
Hydro, tide and wave power

Power can be generated from moving water in several ways. Large dams – like the new one in China's Three Gorges – trap water and use it to drive turbines. They are much the biggest existing source of renewable energy, but they often displace people and cause environmental damage, and their reservoirs also tend to silt up, reducing their effectiveness. Small-scale hydropower and turbines placed in rivers avoid these hazards: in 2004 China added as much capacity through these alone as the whole world did in nuclear power.

The power of the tides has been generating electricity for decades at La Rance, France, where the rising and falling tides are forced through turbines built into a barrage. And there are several approaches to exploiting the enormous power of waves, including floating tubes that bob up and down on the surface and installations that exploit them as they crash onto the shore. The world's first commercial wave power station stands on rocks on the coast of the Scottish island of Islay, and works by letting the waves flood a small chamber, making the water rise and fall and forcing air through a turbine in a hole in the roof.

Innovation: Tidal turbines – looking rather like wind turbines on land, but bolted to the seafloor about 30 metres down – are being developed by Marine Current Turbines to generate electricity from tidal streams in the open sea. They turn automatically to face the current and the 11-metre blades move so slowly that they don't harm wildlife. A prototype turbine off the coast of Devon, United Kingdom, is generating enough electricity to power 200 homes.

Solar power



Increasing numbers of modern buildings are oriented to make use of the sun's warmth in winter. Solar thermal panels absorb the sun's rays, mainly for heating water. But the greatest potential is in photovoltaic cells, which convert sunlight into electricity. They are still relatively expensive, but as their costs have fallen they have entered the mainstream. The numbers feeding into electricity grids worldwide increased more than 11-fold between 2000 and 2004 alone.

Much of photovoltaics' promise is in sunny developing countries, but the sun does not need to be out for them to work, and their use is rapidly increasing in temperate zones. Solar cells cover 400,000 roofs in Japan, Germany and the United States of America – and this is just a beginning.

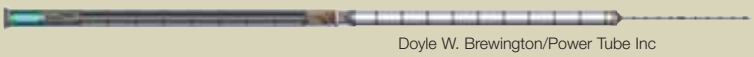
Innovation: Successfully tested on a small scale for seven years in Spain, revolutionary German engineering is moving to Australia. A New South Wales sheep farm will be home to the Solar Tower which, if built, will be one of the world's tallest structures – surrounded at its base by a vast greenhouse-like Solar Collector. Heated by the sun, air inside the Collector will rise, driving turbines around the base of the tower to generate enough electricity to power 80,000 homes.

Earth energy

Ground source heat pumps rely on the Earth's relatively constant underground temperature to heat water and both heat and cool buildings. Underground pipes filled with fluid bring the Earth's heat indoors in winter, where it is collected by heat exchangers. In summer heat drawn from indoors is taken out, cooling the building.

More dramatically, geothermal energy taps the heat of the Earth's core. Up to now it has mainly used steam or hot water from underground reservoirs. In Iceland it heats 87 per cent of the nation's homes, and generates 17 per cent of its electricity.

Innovation: The Power Tube Argus, a turbine shaft 1.2 metres wide and 56 metres long, promises to tap geothermal energy for electricity from areas where there are no hot water or steam reservoirs. The end of the shaft, containing a hydrocarbon liquid, is placed against hot rock. This boils the liquid and produces vapour that spins a turbine in the tube. It is still being developed, but each tube is designed to produce enough electricity for up to 10,000 homes.



Doyle W. Brewington/Power Tube Inc

Q What is the average consumption of energy per person in an industrialized country, and how does this compare with the average in a developing country?

A Each person in the world's richest 22 nations consumes almost a thousand times as much energy, on average, as someone in the least developed countries. Indeed, 1.6 billion people lack access to electricity and some 2.5 billion can get no modern fuels for cooking and heating. Enabling the poor to get the energy they need – and going some way to bridge the inequitable energy gap – is essential if extreme poverty is to be eradicated and the goals of sustainable development met.

Q If renewable energy is the best and most effective way of living sustainably, why is it so expensive?

A Renewable energy comes from naturally replenished sources – which must be good for the Earth's well-being – but harnessing it requires innovation, which is always expensive. By contrast the technology for getting our energy from fossil fuels is relatively simple, and our systems for exploiting them are well established. But renewable energy will get cheaper as we increase investment, and intensify research and development into longer-term renewable sources and new technologies.

Q Given that fossil fuels are likely to dry up and nations will inevitably compete for the last drops, what plans are in place to ensure a stable transfer to a solar hydrogen economy?

A We are not merely competing for the Earth's resources, but ruthlessly exploiting them! So we should also be asking whether we are competing with the planet itself for survival.

A solar hydrogen economy is likely to be cleaner, but it is only at the earliest stages of development. We need to intensify and increase the use of such renewable energy sources as solar, wind, geothermal and biomass – all of them less polluting. The shift is gradually taking place, but the pace and direction of the transition will be determined not just by technological developments, but by how industries, governments and people respond to them.

Meanwhile we must all make strenuous efforts to use less energy as we maintain and improve all lifestyles for everyone.

Q Are the big oil companies at present part of the problem or part of the solution to the energy crisis?

A Pointing fingers does not really help, but with oil prices at an all-time high, we must hope that energy companies are ploughing their increased profits back into the search for renewable energy technologies. Some are indeed investing substantially in research and development of renewable sources – from biogas, through solar energy to hydrogen. This makes sense, because otherwise they will suffer as oil and gas begin to run out. Consumers and governments must also support policies and industries that devote the resources, the will and the entrepreneurial skill to such innovation.

Q The massive economic growth of some Asian countries and others in the past couple of decades has increased demand for oil and other fossil fuels. How can countries balance environmental sustainability and the imperative to reduce poverty through economic growth?

A Access to energy not only helps economic growth and reduces poverty but is also fundamental to attaining education for all, empowering women, reducing child mortality, improving maternal health, and combating diseases – to name but a few. Rapidly developing economies with large populations provide both an imperative and a great opportunity to seek sustainable solutions. We need a responsibility pact between the developing and developed world – to share and put to use available information, knowledge and technologies, and to invest in and create incentives for opportunities geared towards renewable energies.

Q In some areas, people use vegetable oil instead of petrol to fuel their cars. If this process is emissions-free, why don't more people do the same? Are there any negative consequences? And would it be possible to grow enough corn and other crops to provide the world with energy for transportation?

A Vegetable oil is regarded as a cleaner, safer and less expensive alternative to petrol. It emits less carbon dioxide and cuts sulphur dioxide emissions, a primary cause of acid rain, by at least half. Indeed UNEP and DaimlerChrysler have a joint programme for developing its use as a fuel. Nevertheless, there is no one single, perfect fuel. Growing more fuel crops can interfere with cash and subsistence harvests for people and livestock, creating intense competition for cultivated land. And converting virgin land can seriously damage biodiversity. In fact we are moving to a new era in which our fuel needs will be met by a variety of sources: biofuels, wind and wave power, solar energy and hydrogen.

TUNZA answers your questions

Do you have any QUESTIONS on environmental issues that you would like the experts at UNEP to answer?

Please send them to **uneppub@unep.org**, and we will try to answer them in future issues.

City lite

TopFoto/ImageWorks

Arup

Right now, Dongtan is covered with cabbage fields, reed beds and a bird sanctuary stretching out into the South China Sea. But in the background, as a hint of things to come, are three wind turbines.

Before the end of 2006, the authorities from the nearby megacity of Shanghai will start the first stage of building the world's first eco-city here. And by 2010, when Shanghai hosts a major world Expo on green living, this will be the showcase – the real thing, with tens of thousands of people actually living an environmentally friendly lifestyle.

The starting gun will be the construction of a new bridge from Shanghai to Chongming Island, a quiet farming community. It now takes a two-hour drive plus a one-hour ferry ride to reach it, but in two years' time, the bridge will bring it to just 20 minutes' drive from the centre of the world's fourth largest, fastest growing and most densely packed city.

Shanghai is bursting at the seams, with 18 million people and 4,000 buildings more than 30 storeys high. It's like a backdrop to a futurist film. The authorities want to move people out – to Dongtan, which will eventually be home to half a million people.

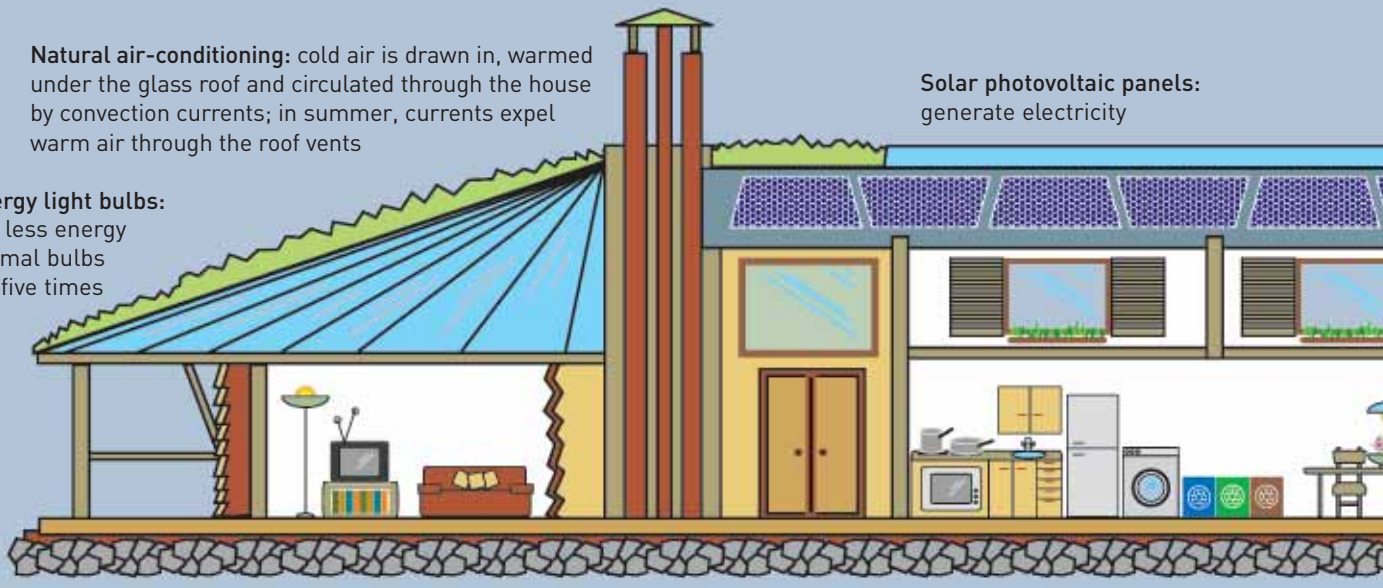
'It won't look anything like Shanghai,' says Dongtan's master planner Ma Cheng Liang, head of the Shanghai Industrial Investment Company. No high rise. No big freeways. No city smogs. 'The first thing you'll notice when you go there is that it'll be quiet, because there will be so few cars.' It will have almost zero pollution, and electricity will come from wind turbines and solar panels. Water from sinks and baths will be recycled for flushing the lavatory.

Cars won't be banned, but all the neighbourhood schools, shops and workplaces will be within walking distance. Most Chinese don't have cars yet – and the idea is that they won't need them here.

Farms within the city limits will provide most of its food, and its sewage will fertilize the fields. It will be dotted with parks, lakes and pagodas. There will be a yachting marina, a golf course and an equestrian centre. So living green will be fun, too.

Ma says he expects Dongtan to become a tourist centre where millions of Chinese will go to see how a green city can work in practice – and, it is hoped, will go home demanding the same green lifestyle for themselves.

Peter Head, Sustainability Director of Arup, the master planners and designers of Dongtan, says: 'It's an incredibly audacious project. Nobody has done anything like it before. It could become a blueprint for other cities round the world. It's not just a showcase for green technology. It's a place where people will want to live.'



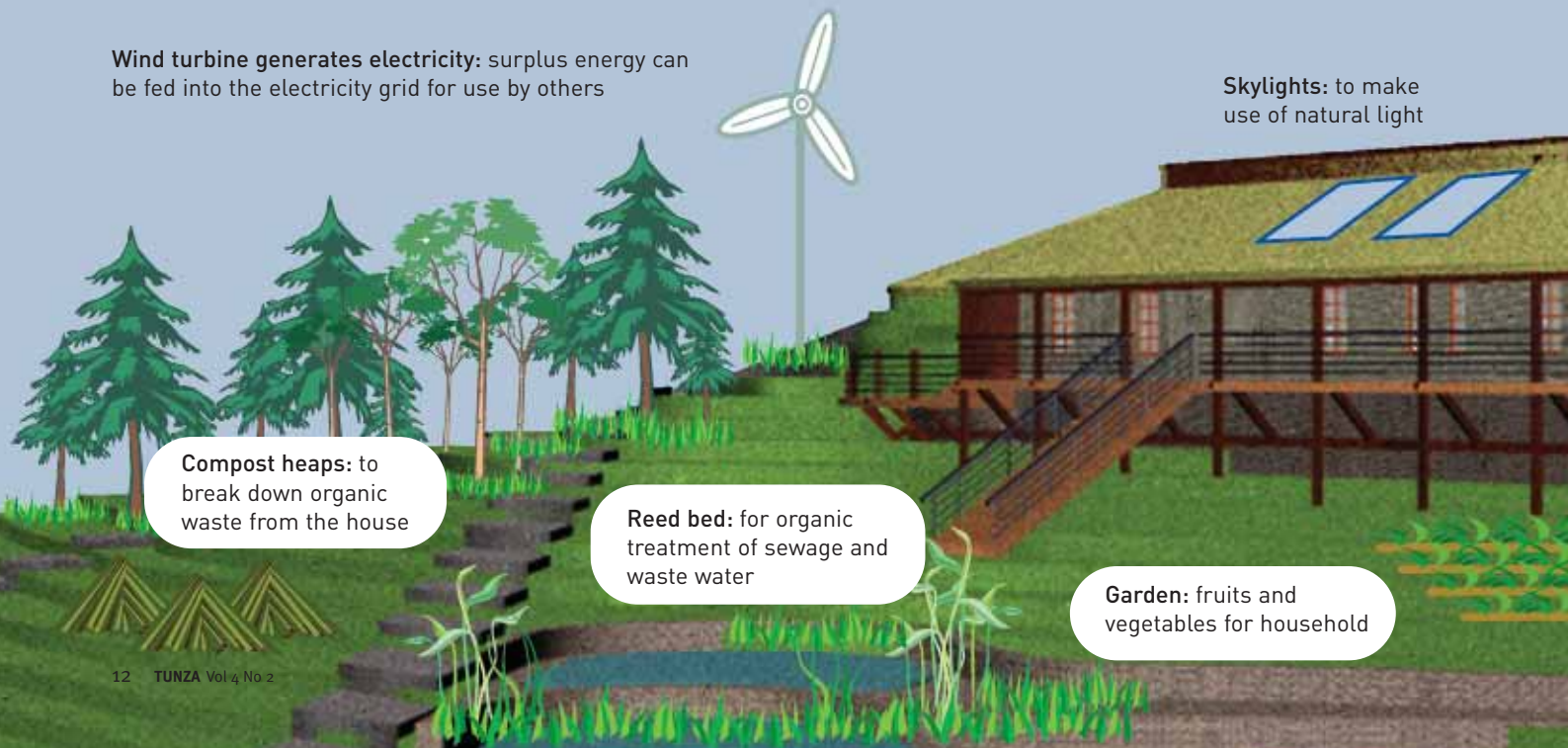
From **energy** eater to **green** machine

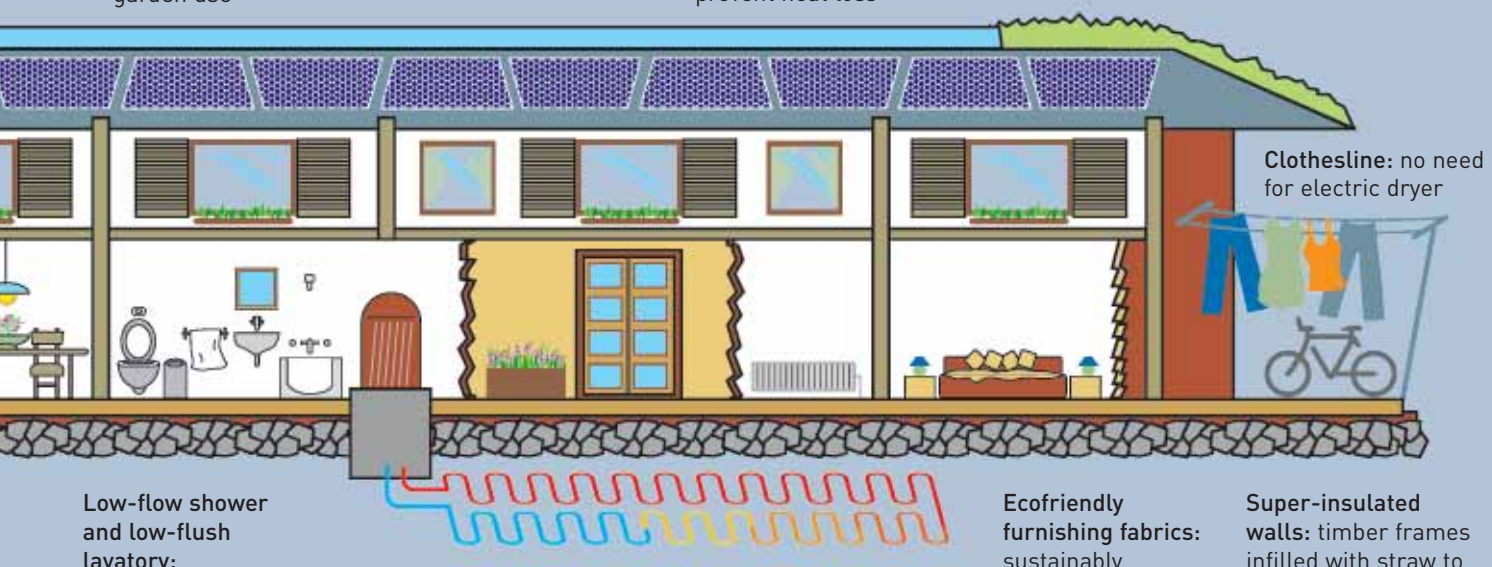
Homes guzzle energy. But they could produce it. They are now the consumers of up to a quarter of all the energy used in developed countries – and even more in developing ones – but can instead become generators of green power, effectively becoming mini power stations.

Architects are designing more sustainable buildings all over the world, while governments are demanding better energy performance. In Sweden the Government intends to phase out the use of fossil fuels in home heating completely by 2020, while one of the first measures taken by the new German Government was to announce that all old housing was to be systematically brought up to modern standards of energy efficiency. And in many African and Asian communities, sustainable housing is the norm.

This house – designed by Jiří Vaculík from the Czech Republic – is carbon positive because it produces more energy than it consumes. And an increasing number of designs are doing the same thing worldwide, getting their energy from such sources as solar photovoltaic panels, wind turbines, ground source heat pumps and biogas digesters.

A ground source heat pump delivers 5 to 10 times as much energy

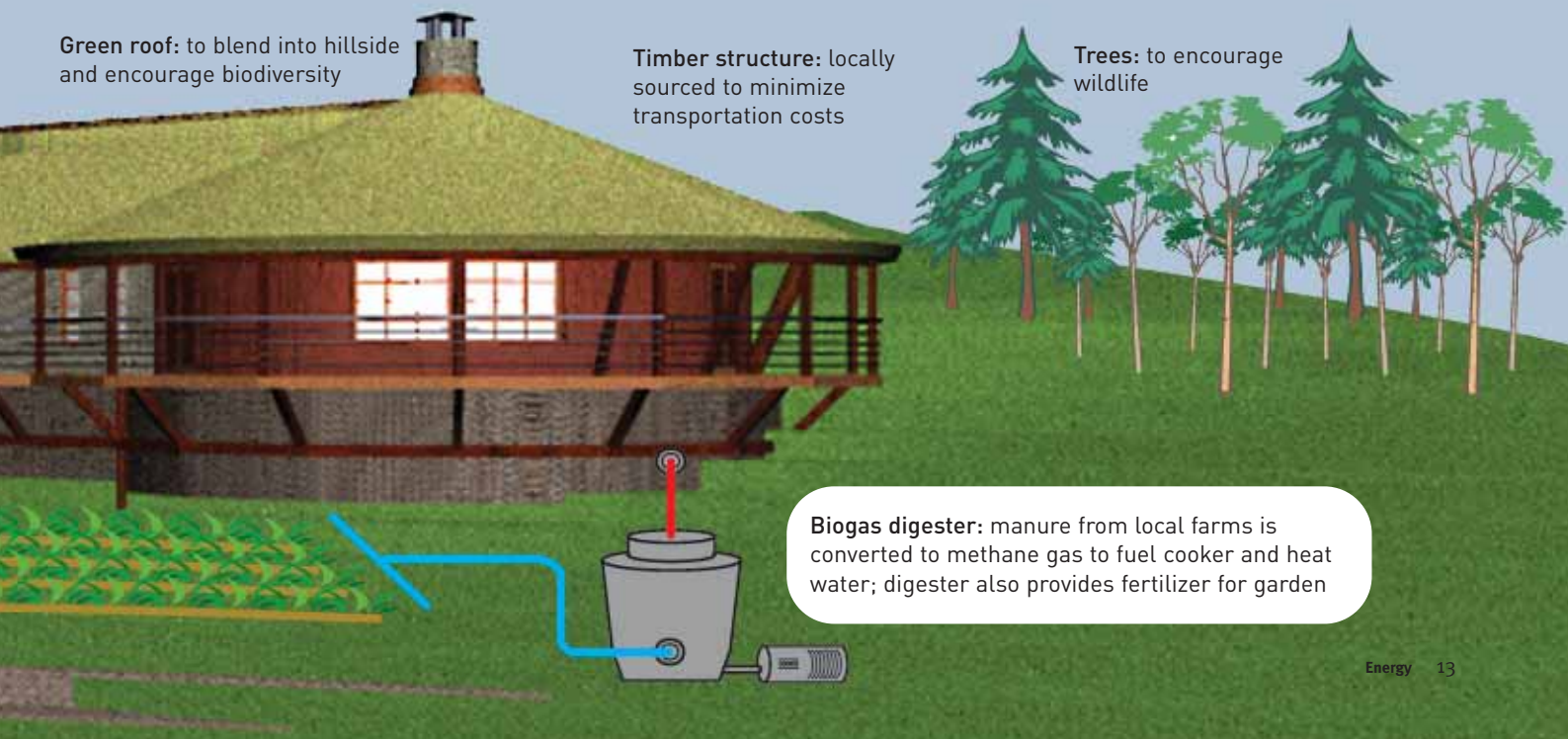




as the compressor needs to create it – energy freely available from just a metre underground. A biogas digester makes use of organic waste: 20 cows produce enough manure to cook a family's food and heat their water. Wind turbines and solar panels are not cheap to install, but they can pay for themselves in a decade, especially if, as in many countries, the extra electricity generated can be sold back to the grid, running meters backwards. And as more are produced and installed, they will become cheaper.

But the most important thing – for both carbon-positive and conventional homes – is to make sure that as little energy is wasted as possible. That means insulating roofs, walls and windows. Millions upon millions of families waste money heating the sky, because they do not have enough insulation in their lofts: efficient and environmentally friendly insulating materials include recycled newspapers, straw and sheep's wool. Cavity wall insulation is the next most important measure for houses that require it, while double or triple glazing can reduce heat loss from windows and skylights by as much as 50 per cent. And new combined heat and power boilers will generate electricity and heat the house and its water from the same fuel at the same time, making great savings.

Not everyone can live in the growing numbers of carbon-positive homes. But everyone can make a contribution by cutting back heavily on energy waste and, increasingly, by getting both heat and electricity from renewable sources.



BP Solar

Solar star

EDWARD NORTON, one of the biggest stars of his generation, eschews the trappings of fame but readily uses his celebrity to promote renewable energy and other green causes. Indeed, if anything, he is even more passionate about the environment than about his acting.

Nominated for his first Oscar at the age of 26, he earned his reputation playing psychologically complex, often dark, characters in his early movies *Primal Fear* and *Fight Club.* More recently he's starred in such massive Hollywood blockbusters as *The Italian Job* and *Red Dragon*, as well as smaller productions like his most recent releases, *Down in the Valley* and *The Illusionist.*

Meanwhile, while researching solar energy systems for his Los Angeles home in 2003, Norton came up with a remarkable idea to provide environmentally friendly energy free to low-income families. He negotiated a deal with the energy company BP and the Enterprise Foundation – a non-profit organization that helps people out of poverty by creating affordable housing – where Norton worked before becoming an actor. Every time a celebrity buys a solar system from BP, one is given to a poor family in South Los Angeles. Soon he was convincing other stars – Daryl Hannah, Pierce Brosnan, Brad Pitt – to install solar electricity systems, for the good of both the planet and families in need.

'Each system essentially eliminates the family's electricity bill,' says Norton. 'Solar energy not only benefits the environment, it puts money back in people's pockets for necessities like groceries and school supplies.' In its first year, BP Solar Neighbors – as the programme is called – installed 26 systems and is working on at least 40 more. Norton hopes it will serve as a model that will help convince state authorities to fund similar projects. 'It was so easy,' says Norton. 'It made me wonder: why isn't everybody doing this?'

Norton is a third-generation environmental activist – with the experience and know-how to make a bigger difference than many of the celebrities who lend their names to favourite causes. His grandfather, urban planner James Rouse, was famous for pioneering the indoor shopping mall and rejuvenating impoverished city centres, using his assets to establish the Enterprise Foundation after he retired.

His father – also Edward Norton – was also a big influence. 'All through my childhood, the environment was my father's work,' Norton says. 'He founded the Grand Canyon Trust, an environmental advocacy group, co-founded the Nature Conservancy's pioneering Yunnan Great Rivers conservation project in China, which works to protect the area's amazing biodiversity and cultural heritage, and now leads the Conservancy's overall Asia-Pacific programme. He talked to my brother, sister and me about environmental policy from a very early age.'

Norton is famously reluctant to embrace the celebrity lifestyle – he doesn't even own a car. 'I ride the subway at home in New York, and when I'm in Los Angeles to work, I go to a place that rents hybrids,' he says. He doesn't often walk the red carpets, court the paparazzi, or make time for TV chat shows. But he does make himself highly visible when it comes to the environment.

Early in 2006, he helped break ground on the High Line, a project to transform an abandoned stretch of elevated rail line in New York City into a public green space. The year before, he hosted and collaborated on *Strange Days on Planet Earth*, a four-part National Geographic documentary that examines humanity's impact on the planet, linking alarming environmental events to each other – such as an asthma epidemic in the Caribbean and dust storms in Africa – showing how everything on Earth interconnects.

Norton hopes *Strange Days* will encourage people to learn about and face the challenges ahead. 'I don't want to be the person saying "the end is near",' he comments. 'But we all tend to deal with everyday needs until something really serious makes us all lift our heads up to say: "This is for real – let's do something about it."'

Save **energy**... ...save the **world**

We need energy for everything, but burning fossil fuels – our main source of energy – releases carbon dioxide, causing global warming. Fossil fuel reserves are spread unevenly around the world, and some are running low. The world needs to change over to clean forms of energy, but this takes time. The immediate and best solution is to use less fuel.

It is something that everyone can and needs to do. Direct actions – like turning down the heat or walking instead of driving short distances – add up to big savings. But indirect ones – such as buying locally grown food, which is not driven or flown long distances to reach our plates – are just as important. Everything we consume – including its packaging – requires energy to create and transport, so even though the energy savings from indirect actions are harder to see, they are still vital. Here are some suggestions for everyday direct and indirect savings that will make a difference.

Direct saving

✷ Turning off lights when leaving a room.
✷ Completely turning off electronic equipment like VCRs and TVs; standby modes use huge amounts of electricity, often more than actually running the appliance.
✷ Walking, cycling or using public transport – or sharing rides.
✷ Using the shortest, coolest cycle possible for washing machines or dishwashers, and only running a full load.

✷ Filling the kettle with only as much water as needed.
✷ Preventing heat – and air-conditioned cooling – escaping from homes by keeping doors and windows shut, closing curtains and stopping draughts.
✷ Hang-drying clothes instead of tumble-drying.
✷ Buying solar-powered or rechargeable batteries.
✷ Investing in a pressure cooker – it speeds up cooking times.
✷ Inflating car tyres to the recommended levels to improve fuel efficiency.

✷ Taking shorter showers, and showers rather than baths.
✷ Using compact fluorescent light bulbs; one lasts as long as five or six incandescents and uses about 70 per cent less energy.
✷ Turning off PC monitors; one left on overnight consumes enough energy to laser-print about 800 pages.
✷ Turning the thermostat down by 1˚C; this could cut the heating bill by 10 per cent.

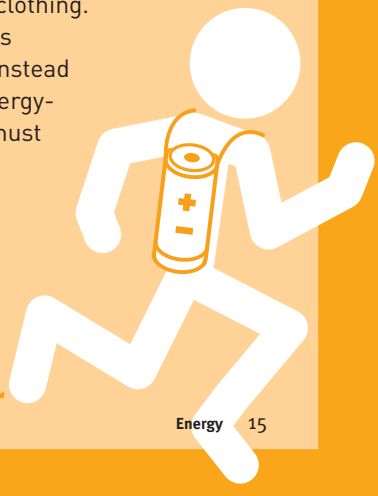
✷ Shutting the refrigerator door; when opened, up to 30 per cent of the cold air escapes.
✷ Insulating homes. About half of their heat can escape through the roof and walls.

Indirect saving

✷ Recycling glass, paper, plastics and metals at home, work and school; it takes more energy and resources to create new items. Recycling one aluminium can saves enough energy to power a TV for three hours.

✷ Using cloth bags for shopping instead of the plastic ones at the store.
✷ Trying to buy goods that use little or no packaging.
✷ Printing on both sides of a sheet of paper.
✷ Reusing all materials, such as food containers, when possible.
✷ Participating in a carbon-offsetting scheme, such as Climate Care. This involves using the organization's website (www.climatecare.org) to calculate carbon emissions – for example from a flight or from driving a certain number of kilometres a year – and the amount it would cost to make up for them. Pay up the money and it will be used to fund sustainable energy projects around the world.

✷ Buying recycled products, such as paper.
✷ Shopping at second-hand clothes shops.
✷ Using rewritable CDs instead of single-use ones, or investing in a data stick.
✷ Recycling/refilling printer cartridges.
✷ Buying locally grown, seasonal food and locally made goods such as furniture and clothing.
✷ Repairing damaged items such as electronics, furniture and clothes, instead of buying new, and upgrading to energy-efficient models when appliances must be replaced.
✷ Spreading the word, such as by holding parties to share green tips, or volunteering with an environmental group.



Small **is powerful**

Two and a half billion people throughout the developing world have no access to modern sources of energy. Without them, they are doomed to stay trapped in poverty, with no hope of economic progress and very limited education and health care. And the fuels they can get – such as wood, dung and kerosene – damage both their health and the environment.

There is little hope that they will ever be reached by the modern electricity grids that people in rich countries – and the more prosperous areas of developing ones – take for granted. Even if they were reached, they could not afford to pay the high price of energy. But renewable sources are distributed free by nature.

These are normally best exploited on a small scale. Such 'micropower' lets people and communities meet their needs for heat and power with clean sources of energy. Often these are the sun and the wind, but they also include mini hydroelectric power, and making biogas from dung and other wastes. Typically they are sustainable and inexpensive to run and have little impact on the environment, while still providing reliable access to energy.

Increasingly – as the cost of energy rises, and worries about security of supplies increase – people in rich countries are also installing their own micropower windmills and solar heaters and cells. But the greatest need is still in areas gripped by poverty, where, as it happens, renewable sources are also usually most abundant. Here are a few examples of successful micropower from literally thousands already working around the world.

Food on rooftops

Problem:
Fewer than 12 per cent of Mali's people have reliable electricity. Without refrigeration, much food spoils.

Solution:
Mali enjoys 300 days of sunshine a year. Businessman Bamba Coulibally uses a solar dryer – an oblong frame that concentrates the heat of the sun – to preserve fruits, vegetables and meats, which he sells throughout Bamako, the capital city.

Benefits:
- Food is preserved using clean, free energy.
- The company provides much-needed employment.

UNEP/Topham

www.uneptie.org

Klein/Still Pictures

Alinari/TopFoto

Light from wind

Problem:
Some 4 million Egyptians in remote areas have no electricity, and rely on kerosene lamps for light.

Solution:
The Egyptian Solar Energy Society (ESES) designed and built two demonstration hybrid wind-turbine/solar-panel systems for a Bedouin settlement near Nuweiba, on the Gulf of Aqaba.

The complementary power sources (when it is not sunny it is often windy, and vice versa) provide a reliable electricity supply, generating enough for 10 households to each have a lamp, as well as to run a collective refrigerator and television.

Benefits:
- Refrigeration preserves fresh food and medicines, improving health and the quality of life.
- The project demonstrates how sun and wind can bring power to isolated areas.

Baking bread with rice

Problem:
More than 90 per cent of Sri Lanka's bakeries use firewood to heat their ovens. Meanwhile, rice mills regularly dump mountains of paddy husks in public areas. They decompose and are eventually burned, polluting the air with carbon dioxide and ash.

Solution:
Several specially modified ovens – invented by a Sri Lankan baker – that burn rice paddy husks instead of wood were successfully installed in bakeries.

Benefits:
- Each oven saves a medium-sized tree per bakery per day.
- Paddy husks are free, so daily fuel costs dropped from $4 to ¢28 per baker.
- The ash collected from the new ovens can be used as fertilizer.
- Emissions of the greenhouse gas methane, generated by decomposing husks, are prevented.
- When burned, the husks produce fewer carbon emissions than firewood.

Cooking with sewage

Problem:
Sewage from the 1,200-pupil Santa María del Fiat school and orphanage, perched on a cliff overlooking the Pacific in Ecuador, flowed directly into the ocean.

Solution:
A biodigester now produces biogas for cooking, and the school's stoves have been modified to run on it. The system is supplemented by manure from local farms during school holidays.

Benefits:
• The school stoves now use 60 per cent less butane, reducing greenhouse gas emissions.
• Sewage no longer gets dumped into the Pacific.
• The students at the school have learned about alternative energy, and have begun educating the local community about biogas and the environment.

Sun in the rainforest

Problem:
Caboclo Indians in the Amazon's Xixuaú-Xipariná Ecological Reserve wanted to replace kerosene, diesel and wood with a dependable, sustainable source of energy that would not damage the forest, their most valuable asset.

Solution:
The community installed solar panels that now power refrigerators for medicines, computers and lights for the local school, a pump to supply freshwater and a satellite dish that gives access to the Internet.

Benefits:
• Their new power supply is free, clean, healthy and reliable.
• The Internet enables them to get medical information and education, and opens up economic opportunities, such as promoting ecotourism and selling handicrafts.

Dung and water

Problem:
The people of the Kizil-Charba village, in northern Kyrgyzstan, have too little electricity, yet they rely on electric heaters in the winter, when temperatures are around -6ºC.

Jessica Watts

Jacques Jangoux/Still Pictures

Guus Geurts/Still Pictures

PURE Energy Centre

Solution:
Biogas digesters convert the plentiful supply of animal dung in this agricultural area into fuel for cooking, lighting and heating. But they don't work when cold, so the village built a 5-kilowatt microhydro system on the nearby Urmaral River and attached it to four biogas units to keep them going in winter. In warmer weather, the hydroelectricity is used for lighting.

Benefits:
• Twenty-two families have a more reliable source of energy, and are less dependent on fossil fuels and wood.
• The units produce 15,000 cubic metres of fertilizer per year, saving farmers money on expensive chemical nutrients.
• Drinking water quality has improved because dung is not left to contaminate groundwater.

Bottling wind power

Problem:
The 700 people who live on the remote island of Unst, the northernmost of the Shetland Islands, spend an average of 18 to 20 per cent of their income on energy, mostly on heating and transportation. The community also needs jobs now that a Royal Air Force radar station, which employed 114 people, has closed.

Solution:
Local engineering graduate Ross Gazey conceived of the PURE (Promoting Unst's Renewable Energy) system, a way to harness the area's powerful winds and abundance of rain to split hydrogen from water using wind-generated electricity (which is also used to heat and power buildings). Hydrogen can be stored and used to produce cheap, clean electricity for the community and to power zero-emission cars.

Benefits:
• The community-owned system, which is still expanding, now provides 2 per cent of Unst's power, helping the town to meet its own needs and lowering its dependence on expensive fossil fuels.
• The project has already provided much-needed local jobs.
• PURE's hydrogen-powered car demonstrates the feasibility of vehicles that run on emissions-free fuel.
• One of the obstacles to using hydrogen as an alternative fuel is that it takes a lot of energy to extract it from water. That's why PURE – the world's first off-grid, renewable hydrogen-generating plant – holds great potential for the future of the fuel, and could even grow into an important hydrogen-exporting industry, which would greatly benefit the community's economy.

Juan Hoffmaister

University challenge

Juan Hoffmaister, Tunza Youth Advisor for North America, works through a youth network to persuade schools and colleges to make the switch to clean energy

Our generation absolutely must overcome the world's dependency on fossil fuels. If we are to halt climate change we will need to reduce emissions of carbon dioxide by 90 per cent by 2050 worldwide.

When I realized that small, vulnerable communities are hardest hit by the effects of climate change – and that renewable energy can mitigate its impact – I decided to start making a difference by helping to bring wind and solar power to my part of the world.

I became National Programs Coordinator for SustainUS, a youth network trying to advance sustainable development within the United States through advocacy and grassroots work. It is part of Energy Action, which organizes young North Americans to campaign for clean energy, and tries to convince adults in the United States and Canada to invest in it.

One of its projects, Campus Climate Challenge, for example, helps universities to switch to renewable energy sources and reduce emissions of greenhouse gases. Through it, young people track energy consumption on 400 campuses and persuade them to save energy, such as by reducing heat loss through windows and doors and buying energy-efficient appliances. It also helps students encourage their universities to build with energy efficiency in mind and create a culture of conservation on campus, and to buy energy from clean sources and install renewable technologies – like ground source heat pumps and solar panels.

It shows that small communities working together can make a difference, and that young people can encourage and educate each other.

Renewable energy provides hope. At present its cost is an obstacle, so better and more accessible technologies are needed to make it cheaper. But increasing demand, as more people are encouraged to buy it, will spur the necessary research and development. By working together in this way, we can make it accessible right round the planet.

THE GRAND PRIX

The race is on... to create personal transport that cuts greenhouse gases and then stops contributing to climate change.

Hybrids – made cool by Cameron Diaz and other celebrities – are up and running using small internal combustion engines together with electricity generated by the car's momentum and braking. A computer switches between them, choosing whichever is most efficient for the driving conditions, typically getting 8.5 to 12.8 more kilometres from each litre of fuel than standard cars, and so emitting less pollution; more efficient hybrids still are on the way. They are more expensive than ordinary cars, but plenty of people seem willing to pay extra. More than 200,000 hybrids – Fords, Hondas, Renaults and Toyotas – were sold in the United States in 2005, and this is expected to grow to 750,000 annually by 2011.

Biofuels are up there too, and don't require revolutionary technology. There are two kinds: biodiesel, processed mainly from rapeseed, soybean and palm oils; and bioethanol, an alcohol produced from crops including sugarcane, sugarbeet and corn. Henry Ford planned to run his Model T on ethanol, and the first ever diesel engine burned peanut oil.

Some vehicles run on pure biofuels. The Austrian city of Graz powers its public transport entirely on fuel made from waste cooking oil. Two and a half million cars in Brazil run on pure ethanol alone and half the country's automobile production is of flexi-fuel cars able to run either on ethanol, or on a blend with petrol; all fuel must contain 25 per cent ethanol. Five million cars in the United States of America can already use a rich mixture of 85 per cent ethanol and 15 per cent petrol, and 'gasohol', containing 10 per cent of the biofuel, is even more widely sold. The United States has quadrupled its ethanol production in recent years and has just opened its 100th production plant.

Biofuels burn cleaner, but take up agricultural land. So researchers from DaimlerChrysler – in cooperation with UNEP – and D1 Oils are investigating using nuts from a tree, *Jatropha curcas*, which grows on marginal or degraded land and thus could help halt desertification.

But the long-term winner may yet be hydrogen. Bill Ford, Henry Ford's great-grandson and Chairman of the Ford Motor Company, says hydrogen is 'poised to end the 100-year reign of the internal combustion engine'. Again there are two different types of hydrogen car. Most manufacturers are working on models that use fuel cells in which hydrogen reacts with oxygen to generate electricity that powers the car, but BMW plans to burn it directly in engines.

Prototype hydrogen cars exist, but the gas has to be made using renewable energy sources if it is to be truly clean. Fuel cells are expensive and building the infrastructure to distribute hydrogen would be costly too.

'It's chicken and egg,' says Katsuhiko Hirose, head of fuel system development for Toyota. 'No one wants to invest in hydrogen filling stations because there are no cars around, but no one is going to buy a hydrogen car when they cannot refuel it easily.'

'The transition will be very messy, and will take many technological paths, but the future will be hydrogen fuel cells,' says Herman Kuipers, Shell's Manager of Exploratory Research. It may take several decades, but hybrids and biofuels are ready to fill the gap while we wait.


Ford Motor Company

Ford Escape, hybrid


Toyota (GB) PLC

Toyota Prius, hybrid


Renault

Renault Koleos, hybrid


Joerg Boethling/Still Pictures

Biofuelling, Brazil


Honda

Honda FCX, fuel cell


BMW AG

BMW 750hL, hydrogen combustion

ENERGETIC ACTION

Caroline Taylor/UNEP/Topham

Where there's sunshine

In Poland, as part of her studies, Dorota Banaś successfully researched and designed a solar power system to work in conjunction with the heating of one of the student halls of residence at the Gdynia Maritime University.

The project, for which Dorota was selected as a Bayer Young Environmental Envoy (BYEE), involved conducting

Seeing the light

Five 16-year-olds in Ladysmith, South Africa, have saved the equivalent of the impact of seven transatlantic flights on global warming by persuading members of their community to use energy-saving light bulbs instead of ordinary incandescent ones. Pearl Bedhasie, Nokuthaba Ncube, Alex Fang, and Kimantha and Lavanya Naidoo – who formed the Ladysmith Enviro Club – distributed 4,000 low-energy compact fluorescent bulbs to local households, schools and businesses. This won them the 2005 Volvo Adventure award, endorsed by UNEP and given annually for environmental action by young people.

They calculate that the new bulbs – donated by Climate Care, which offsets pollution by funding conservation projects – are saving the town a total of 1,584,000 kilowatt hours and reducing carbon emissions by 1,742 tonnes,

www.volvoadventure.org

Waste not...

Three students from Acarlar College, just north of Istanbul, are providing cheap fuel to nearby villagers and cleaning their environment by using dung from local sheep and cattle, and food waste from their school cafeteria. Basri Can Esen, Merve Yildirim and Duygu Akgün built a biogas generator to generate methane, demonstrated how to use it for cooking, and got the villagers involved.

The practice has taken off in the community. Collecting

Rethinking rubbish

Patricia Velasco was alarmed by the amount of waste being produced at her university in Quito, Ecuador, and by quite how many resources we all use – often briefly but in ever-increasing amounts – only to throw them away.

'It's not just the things we buy, like mobile phones,' says Patricia, 'but all the unsolicited "junk mail", and the paper and packaging that ends up blowing around the streets. Why should our precious forests, whose health is so important for our well-being, be turned into a waste product of our consumer lifestyles?'

Through a study, for which she was made a Bayer Young Environmental Envoy, Patricia worked out that recycling paper can use just a quarter of the energy needed to produce virgin paper. 'That surprised me,' Patricia tells TUNZA, 'and inspired me to campaign for the Science Faculty, where I

www.volvoadventure.org

Bamboo benefits

Bamboo can be used as a biofuel, and five students in Aichi prefecture, Japan, are investigating it. Hiroki and Tomohiro Hiramatsu, Tomoaki and Ikuyo Hasegawa and Tomoya Sasaki want to exploit it to heat bath water and for cooking because, as it grows very quickly, it can be used as a continuous, renewable source of fuel.

All over the world, young people are finding ways to produce and use sustainable energy in their own communities. Here are some recent initiatives.

experiments using a small-scale prototype system to measure solar energy conversion into heat. She used this as well as meteorological data to find the optimum positioning for her system on the building's roof and calculate the number of solar panels needed.

Dorota's project also analyzed the economic viability of the solar system in a country not always blessed by sunshine. 'What I found was promising,' Dorota tells TUNZA, 'despite the fact that in Poland solar power at present can only supplement, not replace, fossil fuels. My study demonstrated that investment in the system would be cost-effective in the long run, even in a country that has long, cold, dark winters when we need a lot of heat and light. I feel that is positive news for the future of solar energy in Europe.'

equivalent to those from seven New York to London flights. They also saved money for the community at a time of fast-rising electricity prices. And, since they are four times more efficient and last five or more times longer than incandescents, they take less materials and energy to manufacture, and require less waste disposal at the end of their lives.

The friends used money from households that volunteered to pay for the energy-saving bulbs to buy and plant 267 trees around their town.

JohanWingborg/www.wingborg.se

the dung and food waste has made the school surroundings noticeably cleaner. The villagers have an inexpensive and renewable source of cooking fuel. And the residue left after using the gas is a useful fertilizer, which they sell.

Something similar is planned by three students at St Paul's in New Delhi. Vandit Vijay, Akshay and Kishore Kumar decided to tackle household waste, unhygienic and smelly because it was not being disposed of properly in their community. Over two years, households learned to separate domestic waste into containers: for biodegradable waste to be turned into compost and materials to be sent for recycling.

The project has already made a big difference, but Vandit – who attended the 2005 children's summit in Aichi, Japan – and his friends want to go further. They are designing a biogas plant and hope to have one for every 16 to 20 houses in the community. They calculate that its 250 families already generate enough biodegradable waste to produce 10 cubic metres of biogas daily, enough to cook 30 meals for a family of five or six.

study at Central University of Ecuador, to recycle all its paper and cardboard.'

But this is just a start. Patricia now wants paper recycling to expand throughout the University, and is meanwhile investigating ways of using other waste produced on campus for biogas production, as well as possibilities for recycling the constituents of everyday items like batteries. And it's all backed up by awareness-raising aimed at students, University staff and administrators alike.

Edward Cooper

Burning bamboo died out some 30 years ago in the face of the increasing use of fossil fuels. When no longer cut for fuel, the overgrowth blocked sunlight from other trees – such as gingko. The group is now measuring increased light for other plants as bamboo is cut for fuel. And they are looking into using bamboo chips as a mulch to improve soil.

7 energy wonders

Design Continuum

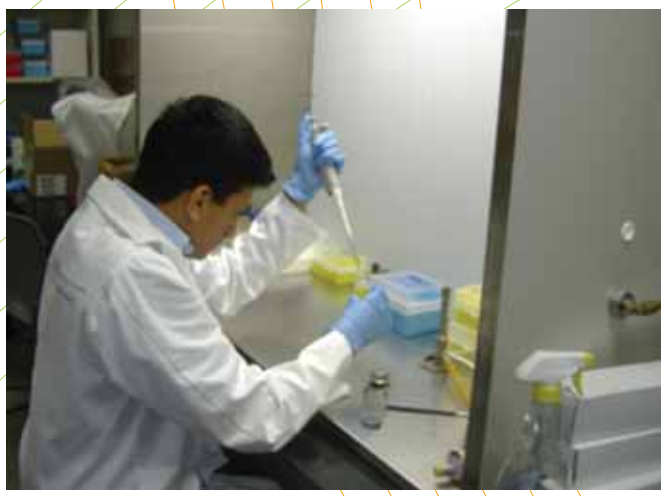
Low-powerbook

No it's not a wind-up. Or, rather, it is. This laptop, costing less than $100, has been designed for use in parts of developing countries without electricity. The paperback-size, rubber-encased machine can be recharged by winding a crank, uses flash memory instead of a fragile hard drive, and requires very little power. Its designer, Professor Nicholas Negroponte of the Massachusetts Institute of Technology, has set up a non-profit body – One Laptop Per Child – to market and develop it in order to help bridge the technology and information gaps.

Touch the sky

Is it a bird? No, it's a plane! Helios, NASA's 75-metre-long, solar-powered aircraft, can fly higher than any conventional plane. Its single wing is covered with 62,000 photovoltaic cells, generating electricity to run 14 small propeller motors which hold the ultra-light, remote-controlled plane aloft in very thin air. It won't revolutionize air travel, but could be used for investigating the surface of Mars, studying Earth's atmosphere for data on climate change and ozone layer depletion, and carrying telecommunications equipment without having to launch costly satellites.

Nick Galante/PMRF/NASA DFRC



Kartik Madiraju

Charged bugs

Sixteen-year-old Kartik Madiraju, from Montreal, has invented his own clean, renewable energy source. He read about magnetic bacteria – which have minuscule crystals of magnetite in their bodies and are found in water worldwide – in a science journal. He placed the bacteria into tiny boxes with metal strips on the sides, causing them to spin and generate an electric current about half the voltage of an AA battery for 48 hours. There are many potential uses for this technology, but Kartik hopes it might someday help generate green energy in developing countries.

Racing green

Emissions-free motoring is a great idea, but doesn't it seem just a little bit boring? Not any more. Greens longing to put the pedal to the metal can look to BMW's Hydrogen Racer H2R. In September 2004, the single-seater, hydrogen-fuelled 12-cylinder racing car broke nine speed records at France's Miramas Proving Grounds, zooming to 100 kilometres per hour in six seconds, and reaching a top speed of 302.4 kilometres per hour. And all while emitting only water vapour. BMW plans to market a similar vehicle that will run on both hydrogen and petrol.

BMW AG

D1 Oils/www.d1plc.com

Living well

Jatropha curcas is a living oil well. Long cultivated as a hedge plant in the tropics and subtropics, its seeds are already used to make soap, cosmetics and fuel for oil lamps. But it is now coming into its own because its oil also makes excellent biodiesel. It is easy to grow, matures quickly and lives more than 30 years – and can produce up to 2,700 litres of oil per hectare. It thrives on marginal land – even on sandy, stony or saline soils – and even helps reverse desertification by improving soil quality.

Solar Century

Hot roof

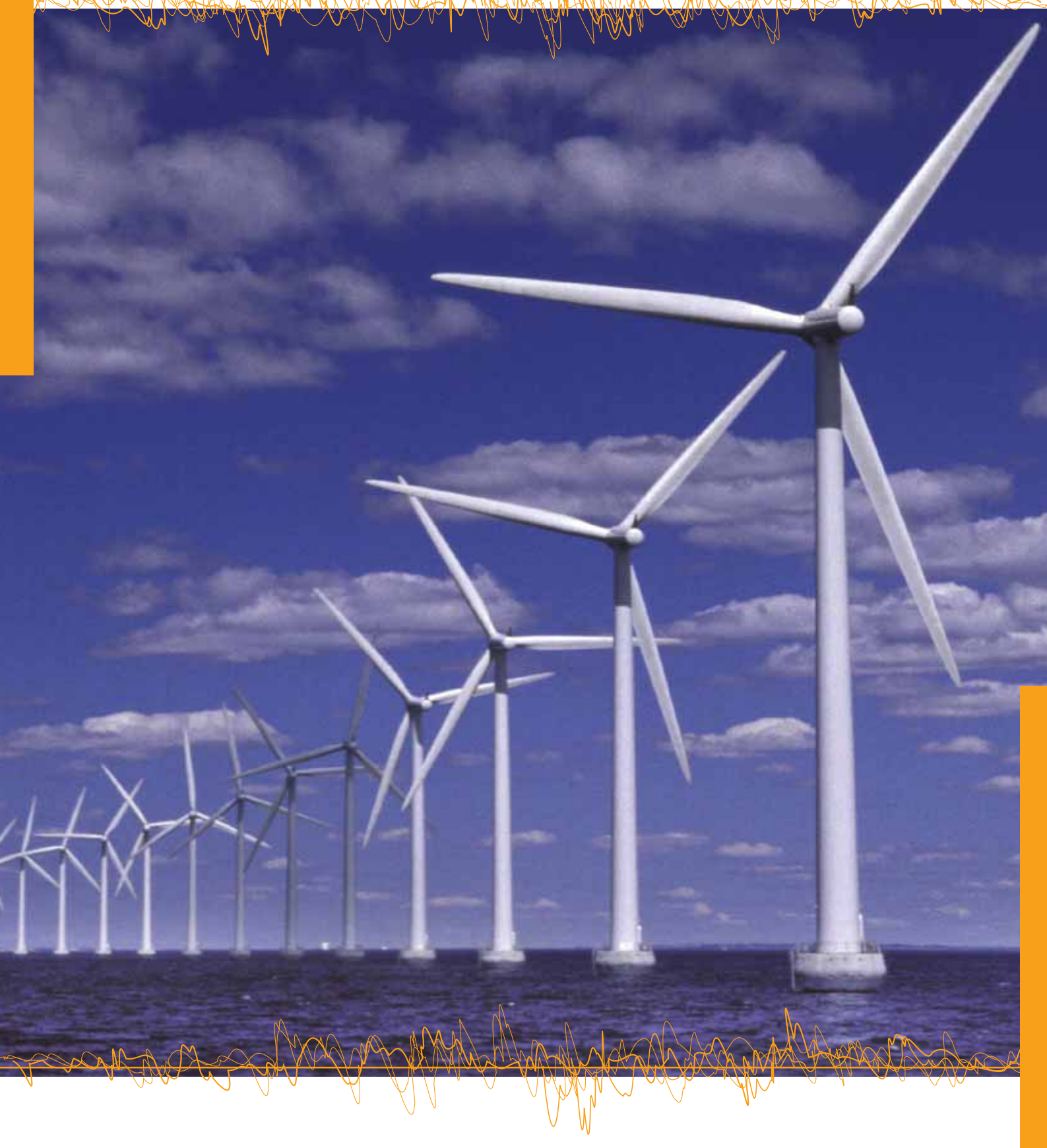
It keeps out the showers, while heating your shower. The Complete Solar Roof by Solar Century provides electricity and hot water using standard-size roof tiles with built-in photovoltaic and solar thermal technology. Each roof can produce about 60 per cent of the hot water of a three-bedroom home and 800 kilowatt hours of electricity a year in UK conditions. Solar Century hopes that the tiles will make it easy for architects, developers and contractors to build renewable energy into the design of new buildings.

Small is beautiful

Some like, some loathe the look of the giant modern wind turbine with its three blades – but everyone agrees that it is impractical in cities, where its power is most needed. Step forward XCO2's Quiet Revolution – an innovative wind turbine which looks like a high-tech egg-whisk. Just 3 metres wide – tiny compared to a standard wind turbine – it generates 6 kilowatts, enough to power five energy-efficient homes. And it even doubles as an illuminated billboard that can project public art or advertising.

Quiet Revolution/XCO2

VALUE YOUR **ENERGY**



Jørgen Schytte/Still Pictures

RE-ENERGIZE OUR **PLANET**