



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 atmos-

phere 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.

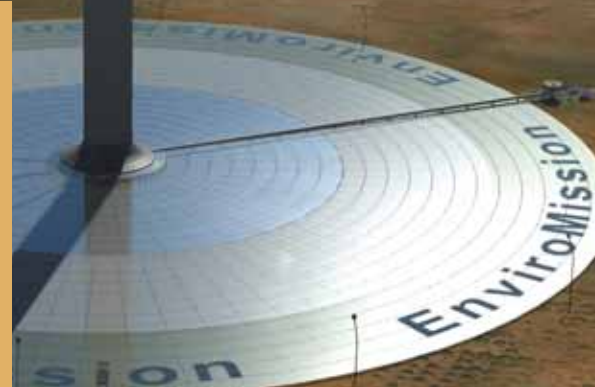




Sky WindPower Corporation



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.

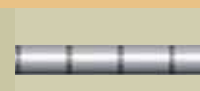


Earth energy

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