Solving the Energy Crisis Sustainably – what are our options?

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Much is made of needing to move to genuinely sustainable energy in our country, but many people are either misinformed by vested interests (fossil fuel industry and the nuclear industry), or have not got access to information that outlines what our options are for future energy sources.

The sources contained in this document are all working somewhere in the world, with many being used in commercial / industrial baseload electricity generation. All of these technologies will increase South Africaôs global competitiveness, while building a stronger local economy with many more jobs than is currently the case.

Saving Energy

Saving energy is the cheapest, quickest and best intervention we can make right now. It is relatively easy to reduce demand by 20% or 30% by making very small changes.

Energy Efficiency

If we use less electricity to do the same jobs we are being energy efficient. Compact Flourescent Lights (CFLs), which use less electricity for the same amount of light are now widely available,. If we put in ceilings and insulation in homes and buildings, and build them so they are North facing, we can also reduce the energy we use for heating or cooling our homes and factories. Eskom was able to reduce their electricity consumption at the head office by 34%, by implementing energy efficiency.

Solar energy

If we used 2 percent of the worldôs deserts for electricity generation, we could supply the whole world. The annual global solar radiation average received by South Africa is approximately 5.5 kWh/m2/day, one of the highest national levels in the world. The annual 24-hour global solar radiation average is about 220 watts per square meter in South Africa, only 150 watts per square meter in parts of the United States, about 110 watts in the EU.

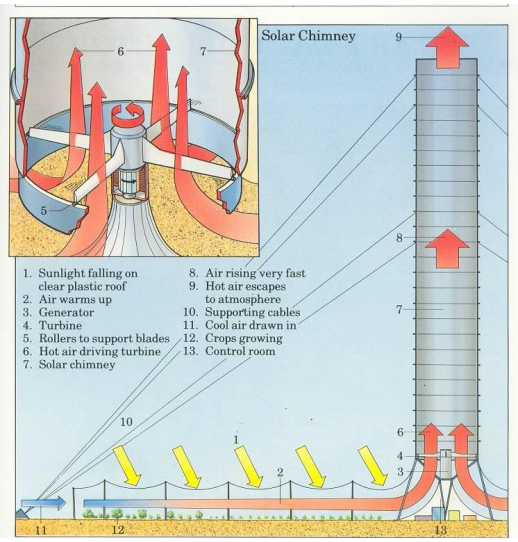
Solar Water Heating

If we were to use energy directly from the sun to heat water in our homes and factories, we would save roughly half of the total domestic electricity consumption. If everyone were to use Solar Water Heaters (SWH) in South Africa, we could do away with at least one 2000 Megawatt coal-fired power station, or 12 pebble-bed nuclear reactors. Solar cooling can also be used in some areas instead of normal airconditioners.

Solar Thermal

Solar power can also be used to generate large amounts of electricity, by concentrating the power of the sun with mirrors or lenses, like a giant magnifying glass. This very hot process easily and quickly turns water into steam, which can then drive a turbine ï it is exactly the same generating process as coal fired power stations, except that the source of heat is the sun. Some people are concerned that this particular (unlike some others) can only generate power during the day, but it must be remembered that the best energy solutions include a mix of many different technologies, so that we do not end up (like now) relying only on one technology. However, technologies do exist to allow heat storage (in salts, for example). See also Solar Chimneys, next.

Solar Thermal Chimneys



Solar chimney power stations can function effectively due to the fact that warm air rises. Solar radiation heats air underneath a glass ceiling so that it rises through a chimney. To replace the air, which has risen, air from the edge of the glass ceiling flows inward, and then itself begins to heat up. In this way the sunôs heat radiation is converted into kinetic energy, or a ómotorô of constantly rising air. A turbine built into the chimney then converts the wind power by means of a generator into electrical energy. A prototype in Manzanares, south of Madrid, (below) delivered power practically uninterrupted between 1986 and 1989. Australia is building a 200MW unit (larger than the proposed Pebble Bed Modular Reactor) ï and this technology works all night too, as heat is stored in the ground during the day.

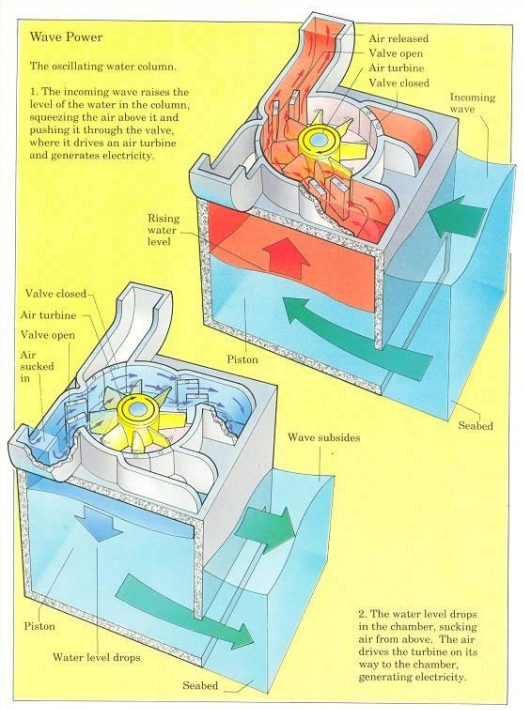
Solar Panels (PV – Photovoltaic - left)
Sunlight can also be changed directly into electricity through solar panels, called photovoltaic panels Solar panels are great for people who live far away from grid electricity, but many large panels together can also generate great amounts of electricity useful for grids, currently one of the largest suppliers of renewable energy worldwide. Since the demand for solar energy is growing all the time, the cost of manufacturing solar panels is coming down every year, with SA having developed world class low cost thin film technology ï this is a great job creation and export opportunity too..

OCEAN ENERGY

Ocean Current
Another good answer to those who say that "all renewable energy is intermittent" (comes and goes) is to suggest that Ocean Currents are a good source of non-stop energy. Water in the oceans is constantly moving, at different levels underwater, and never stops (Agulhas and Benguella Currents off our coast) These currents are very strong, and are partly responsible for some of our plastic bags being found in Australia! Similar technology as used for micro-hydro, wind and wave energy can be used here, and is already being tested commercially. It must be remembered that water is about 10 times more dense than air, so the turbine needed to generate electricity can be 10 times smaller than that used for wind energy, making it even more attractive. A superb turbine design, the Gorlov, is even safe for sealife!

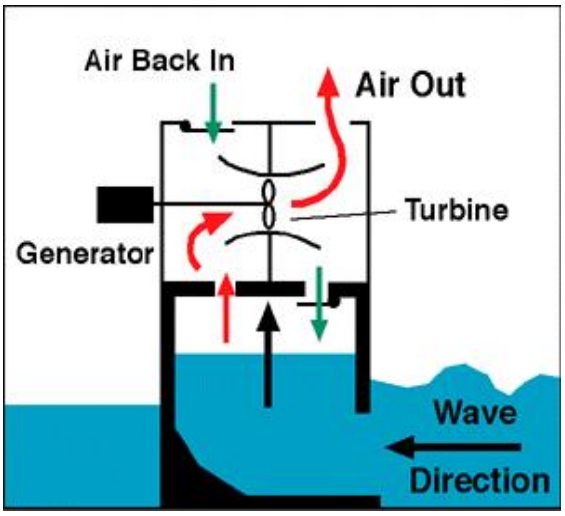
Tidal energy

Tidal energy relies on the movement of water when the tide comes in and goes out ï the technology used is much like that used for ocean current. However, as the tides only rise and fall a few metres in South Africa, this will not be a great source of our energy.



Wave Energy

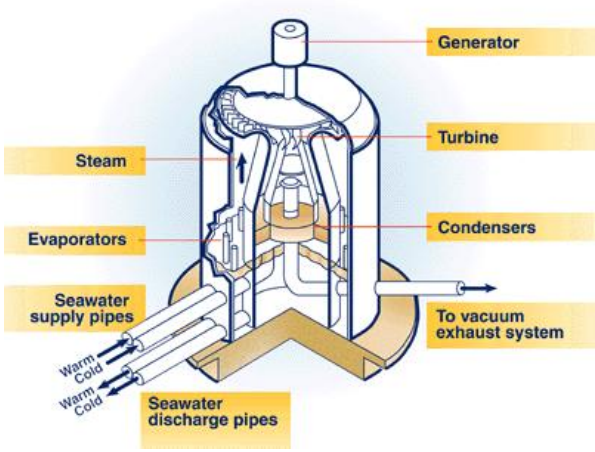
The waves at the edge of the ocean can also generate electricity, as can the swells on the surface of the ocean. This is the energy held in rising and falling waves at sea, which makes a wave generator go up and down, and so make electricity. This is already happening commercially, as throughout the world, governments and businesses are conducting more research on wave energy, and beginning to implement exciting solutions. South



Africaôs coastline has excellent potential for wave power generation, and Stellenbosch University has already produced working models. For example, it is estimated that 2% of the oceanôs wave energy could supply the current worldwide demand for electricity.

OTEC

OTEC stands for Ocean Thermal Energy Conversion, which is the greatest untapped environmental energy source on the planet. This technology uses the natural temperature differences between warm tropical water at the surface of the oceans and the cold deep waters below. The greatest advantage to using this energy source is the fact that it requires NO FUEL. A bonus is that the waste product from OTEC is potable (drinking) water!



Wind Energy

Wind energy is one of the fastest growing industries in the world, and the cost of wind power has been coming down every year. It is also competitive with coal and gas. If you take into account the health costs of coal, wind has already been found to be cheaper than coal and gas fired power stations in the USA. In some countries wind already produces over 10% of peopleôs energy needs and by 2010, wind energy will supply over 10% of Europeôs power needs. Wind is better than coal and nuclear power because it can often create electricity close to where it is used; there are very few impacts on the environment; it creates local jobs; and South Africa has great wind resources along our coastline and the escarpment. In 1998, the International Energy Association predicted 45 GW (more than our whole country uses at present) installed wind by 2020ï this was achieved in 2004, 16 years before target. The market is growing at 34% per annum on average. All SA studies are based on flawed calculations (measured too low) and also exclude offshore wind

potential. Further calculations confirm that the practical application of wind power in SA is in the order of 50GW, not forgetting that only 1% to 2% of the land is actually used ï the balance is still productive land.

Methane

Methane is produced when organic matter decomposes in the absence of air (anaerobic decomposition / composting). Sources of methane include human and animal sewage, and collected organic material. This is a far better option than both normal flush toilets (which add to the pollution, while not recovering either water or nutrients for food and other agricultural uses) or dumping organic matter in ñlandfills ñ ï another name for a rubbish dump.

Biogas digesters can be used to generate copious amounts of gas from farm wastes and residues, sewage, municipal biodegradable wastes and food industry wastes. Another advantage of this process is that the ñwasteò is actually an high quality compost, which can be used to grow mushrooms or fish food, and then even a second use, as it is still a good quality compost.

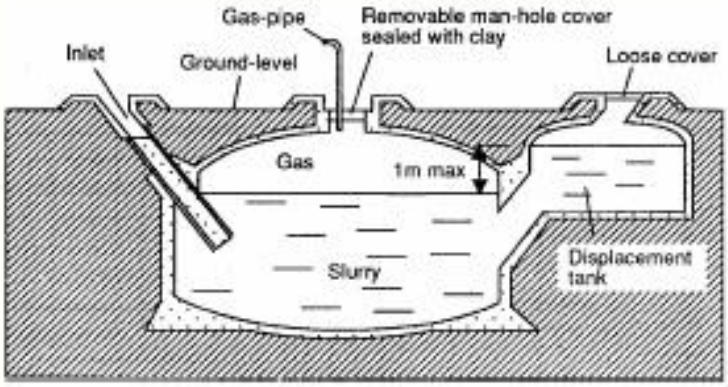


Figure A 1.4: Schematic of a typical Chinese biogas digester[36]

Bio-diesel

A very exciting alternative to using food crops as a renewable oil source, is that of oil produced from algae, that green scum normally seen on stagnant ponds. Simply put, algae is grown on media such as sewage, and then harvested (depending on the type, up to 80% of the algae can be oil) and then converted, as can any vegetable oil, into biodiesel. South Africa covers 122,3 million hectares ï the current estimate is that about 0.01% of the country will produce all our liquid fuel needs if we use the biodiesel from algae process, based on sewage as the feedstock .(90 000 hectares is needed ï the size of a few game farms) A single acre of algae ponds can produce 60 000 litres of biodiesel; in comparison, Soybeans produces up to 240 litres of biodiesel per acre, Jatropha produces up to 800 litres per acre (while also poisoning the land, depending on the variety) and Coconuts produce just under 1200 litres per acre. Palm oil -- currently the best non-algal source -- produces up to 2600 litres per acre. That is to say, algae is up to 25 times better a source for biodiesel than palm oil, and 300 times better than soybeans. Not bad for a liquid fuel from waste!

Conclusion

It is hoped that our decisionmakers take heed of the information provided, and help move our country to a sustainable energy future, away from dangerous nuclear power and problematic fossil fuels, with more sustainable livelihoods for our people; increased local manufacturing; increased global competitiveness; and a dramatic decrease in our Greenhouse Gas emissions.

The choice is clear.