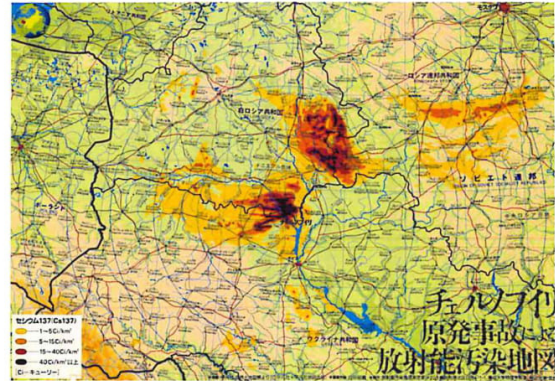




THE CHERNOBYL DISASTER

In the early hours of 26 April 1986, a safety test being carried out at the Chernobyl Nuclear Power Plant in the Ukraine went tragically wrong. A massive explosion in Reactor Number 4 caused 190 tons of radioactive materials to be released into the environment. The radioactive cloud drifted north into neighbouring Belarus, and then moved east across Western Russia and west across Europe.



Chernobyl is situated in the north of the Ukraine, near the border with Belarus. At the time of the disaster, both the Ukraine and Belarus were part of the Soviet Union. Now they are independent countries.

THE IMMEDIATE AFTERMATH

The fire at the reactor burned for a full ten days and a major emergency operation began. Scientists were worried that a further explosion could occur, producing a force of 3-5 megatons (90-150 times greater than the force of the Hiroshima bomb). An explosion of this magnitude would have resulted in the whole of Europe being exposed to enormous radioactive contamination. Around 250 fireman were called and, despite being exposed to dangerous levels of radiation, many of them stayed and risked their lives to bring the situation under control.

Tens of thousands of coal miners were conscripted because of their expertise in tunneling and working underground. Their task was to dig out a tunnel under the reactor, install a cooling coil to cool the reactor's concrete base and reinforce any cracks appearing in the slab. The miners had to work in appalling conditions, not only in extremely high temperatures but also very high levels of radiation. Many of them died between the ages of 30 and 40 and the majority of them became invalids.



The raging fire was eventually put out on 7 May 1986. The contribution of hundreds of thousands of miners, soldiers and firemen – known as *'the liquidators'* – prevented a highly likely nuclear explosion. Their self-sacrifice cannot be overstated. With inadequate protective clothing, they were exposed to horrific levels of radioactivity and are now paying a terrible price.

EMERGENCY EVACUATION

While the liquidators were risking their lives to prevent an even bigger catastrophe, the authorities decided that some people living in the surrounding area should leave. On Sunday 27 April, the day after the explosion, the neighbouring town of Pripjat was evacuated. Because of the speed of the evacuation, the town's 40,000 residents had to leave most of their belongings behind. Furniture, books, toys and televisions were left and pets and livestock abandoned.

Over the following weeks, other towns and villages had to be abandoned as radioactive hotspots were discovered further away. Even now, 20 years later, these areas in the Chernobyl 'Dead Zone' are highly radioactive and uninhabitable. Most of the 400,000 men, women and children who were relocated after the accident have never returned home. The evacuees are, for the most part rural people who had been used to a traditional self-sufficient way of life, producing their own food, and living in villages where their families had lived for several generations. The skills of these peasant farmers are useless in a city and as a result unemployment is high. This adds to the pressures of family life: six out of every ten marriages among evacuees ends in divorce. Many are stigmatised by the local population and referred to as "Chernobyls". Nobody wants to marry them, employ them or be friends with them, for fear of contamination and because of ignorance.



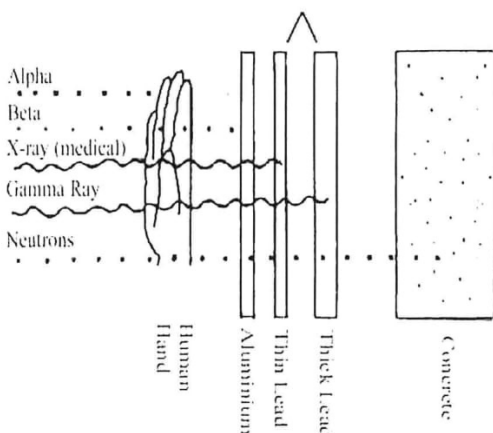
RADIOACTIVE CONTAMINATION

The effects of the ensuing disaster continue relentlessly, making it, in the words of the United Nations, "*the greatest environmental catastrophe in the history of humanity*". Because the initial explosion was so powerful, plumes of radioactive material were thrown high into the atmosphere and carried by the wind for many miles. Over 70% of the radiation fell on Belarus. The people of Belarus have been exposed to radioactivity 90 times greater than that released by the Hiroshima bomb. The nine million people living in the affected areas of the Ukraine, Belarus and Russia have received the highest known exposure to radiation in the history of the atomic age.

3-4 million of those affected are children and the full consequences of their exposure may not be seen for another 50 years. There has already been a massive increase in the rates of cancer, blood circulation diseases and disorders of the nervous system but some of these may take years to develop. Since radiation levels in the contaminated areas are still extremely high, many children are being born with birth deformities 20 years later.

The future of the men, women and children in the affected areas is now a bleak one. Having to cope with contaminated land, water and agricultural foods, a near economic collapse and a serious widespread health crisis, means the people of Belarus are in dire need of assistance.

Penetrating Power of Different Types of Radiation



Courtesy of Dr. Rosalie Bertell

Many radioactive elements appear to have the same composition as the natural and vital minerals that our bodies need. For example:

Plutonium is the most toxic substance man has ever produced, and it does not exist in nature. The body treats it as iron, due to the chemical similarity. It gets distributed by the blood system to feed growing cells. It can cause a variety of cancers and blood disorders.

Caesium 137 is mistaken by the body as potassium, which is needed by every living cell. It then concentrates in the muscles.

Iodine 131 is absorbed by the thyroid gland, which cannot determine whether it is natural or radioactive iodine. The thyroid gland makes important hormones to help the body function. Iodine 131 causes cancer and other disorders in the thyroid gland.

Strontium 90 – The body is fooled into accepting this element as calcium. It gets distributed throughout the bone structure and can cause leukaemia and a number of cancers, along with numerous other health problems.



RADIATION CONTAMINATION

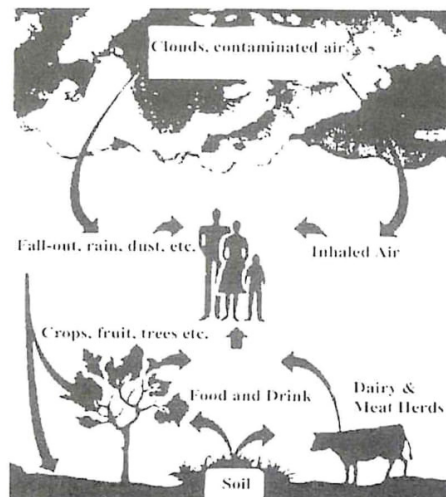
Radioactive contamination can enter the body through ingestion, inhalation, absorption or injection. Radiation also enters the body through the food chain via crops and livestock, wind, forest fires, rivers and streams. Radiation poisoning can induce cancer and other diseases. It also increases the rate of deformities in new babies.

- In Belarus alone, 2,200,000 people have been permanently radioactively contaminated.
- No people have ever been exposed to long-lived, man-made radiation for such a consistent amount of time.
- The people of Chernobyl were exposed to radioactivity 90-150 times greater than that of the **Hiroshima** atomic bomb.
- The UN has declared it to be the greatest environmental disaster in human history.

THE DANGERS OF RADIATION

Under certain conditions, **radioactive** materials can be used for beneficial purposes - for example, medical diagnostics (x-rays and MRI scans), smoke alarms and space travel. And because radiation kills cells, radioactive materials are used to kill cancer cells and the germs in food. But, when treating cancer, the radioactive material is often directed very accurately to a specific part of the body. It is frequently used in relatively small doses and often has a very short **half-life**.

But the Chernobyl disaster released the long-lived Caesium-137 (with a half-life of 30.07 years) and Strontium-90 (with a half life of 28.78 years) into the environment in huge doses. The radiation reached the general public in the initial cloud or through radioactive elements deposited in the soil. The internal exposure occurred through inhalation of the 'dust' from the cloud and through ingestion via contaminated food. It was this internal radiation that caused the most damage. Once integrated into the body, the **radioisotopes** can change the metabolism of tissues and vital organs, causing cancer, blood circulation diseases and disorders of the nervous system.



THE CHAIN REACTION STARTED BY RADIATION

GLOSSARY:

Hiroshima: One of two Japanese cities that was atom-bombed by the United States at the end of World War II.

Radiation: Energy that is emitted in the form of electromagnetic waves or particles.

Radioactive: Material that gives out radiation.

Half-Life: The time it takes for half of the atoms in a radioactive material to decay.

Radioisotope: An unstable form of an element that decays or disintegrates spontaneously, emitting radiation.

RADIATION EFFECTS ON HEALTH

"The health condition of the affected population is a disaster, but being a physician myself, I cannot accept the situation as hopeless. With all my faith in God and life, I appeal to anyone who can help: do your best to improve the situation. There is nothing more precious in this life than life and we should do everything we can to protect it."

Professor Bandazhevsky, who spent years working in the affected areas.



After extensive study, Professor Yuri I. Bandazhevski, the former Rector of the Medical Institute in Gomel, explained the correlation between the easy penetration of caesium into the soil, its absorption by plants and its incorporation into animal and human bodies through food and water. Human absorption occurs when fruit, grains, meat, vegetables, milk, fish, mushrooms, berries or water are ingested. Cells of different organs intensively incorporate caesium, primarily the thyroid and other endocrinal organs, and then the heart, kidneys, liver, brain, spleen, bones and muscles. Through his specific heart research he discovered a life-threatening heart disorder called caesium cardiomyopathy in people from the contaminated regions.

- During the 1990's an alarming increase in heart problems and birth defects among children in Belarus was recorded. Children as young as six years of age were suffering from strokes and heart attacks.
- Based on analysis of the amount of caesium children were ingesting, the necessity for clean food products became a matter of urgency.
- Women of childbearing age who live in the contaminated areas consume strontium-90 via food which can pass through the placenta and into the foetus where it can lodge in the bones and the bone marrow. The developing cells in the foetus/embryo are particularly at risk and the mother's exposure to radiation can lead to severe organ and brain damage in newborn babies.
- Children share the same menu as adults but are more at risk since they receive 5-6 times more radioactivity than adults because of their smaller weight, height and more active metabolism.
- The silent killer, radiation, is threatening the gene pool and the future of the people.
- According to the United Nations, seven million people are affected, half of whom are children. In Belarus alone, 90 percent of children are deemed to be victims of Chernobyl.
- Because of severe damage to the immune system, there is deep concern over the body's inability to fight cancer cells.
- Already Belarus has seen such soaring levels of thyroid cancer that it is considered to be of epidemic proportions. Nearly a quarter of all children up to three who were exposed in the highest fall-out areas can be expected to develop thyroid cancer, instead of the usual rate of one in a million children. Thyroid cancer has also increased among adults.



"We are now seeing genetic changes, especially among those who were less than six years of age when the accident happened. These people are starting to have families, so we are witnessing the effects of the disaster move to the next generation."

*Dr Vladislav Ostapenko,
Head of Belarus' Radiation Medicine Institute*



THE HUMAN COST

WHAT WENT WRONG?

On 25 April 1986, while Reactor Number 4 at Chernobyl Nuclear Power Plant was shut down for routine maintenance a safety test was run. Due to human error and terrible safety violations which included the withdrawal of control rods, the reactor became unstable and a huge power surge could not be controlled.

- The power level ran to a 100 times its maximum rating for this kind of reactor, which led to a steam explosion, blowing the lid off Reactor Number 4. The lid weighed 1000 tons.
- Seconds later there was another explosion, during which the core of the reactor largely disintegrated.
- The ensuing fire burned for ten full days, consuming a minimum of 10 percent of the reactor's graphite core.
- It is conservatively estimated that 100 million curies of radiation were released, although many scientists believe it was closer to 250 million curies. A curie is a unit of radioactivity.
- 70% of the radiation fell on the population of Belarus.
- In the days following the accident, 99% of the land of Belarus was contaminated to varying degrees by the radioactive fallout.

Poem by Lyubov Sirota to Vasily Deomidovich Dubodel, who passed away in August 1988, and to all past and future victims of Chernobyl

They did not register us
and our deaths
were not linked to the accident.
No processions laid wreaths,
no brass bands melted with grief.

They wrote us off as
lingering stress,
cunning genetic disorders . . .
But we--we are the payment for rapid progress,
mere victim (of someone else's sated afternoons.

It wouldn't have been so annoying for us to die
had we known
our death would help
to avoid more "fatal mistakes"
and halt replication of "reckless deeds"
But thousands of "competent" functionaries
count our "souls" in percentages,
their own honesty, souls, long gone--
so we suffocate with despair.
They wrote us off.
They keep trying to write off
our ailing truths

But nothing will silence us!
Even after death,
from our graves
we will appeal to your Conscience
not to transform the Earth
into a sarcophagus!

Peace unto your remains,
unknown fellow-villager!
We'll all end up there sooner or later.
Like everyone, you wanted to live.
As it turned out,
you could not survive . . .

Your torment is done.
Our turn will come:
prepare us a roomier place over there.
Oh, if only our "mass departure"
could be a burning lump of truth
in duplicity's throat! . . .

May God not let anyone else
know our anguish!

THE FATE OF THE LIQUIDATORS

"What you have is not your husband, the man you love, but a reactor. Forget that is your husband. That is a radioactive object - do not talk to that, do not touch, do not kiss or you both burn to death."

In contrast to the firefighters who died tragically on September 11th at the World Trade Centre, and who were subsequently hailed as heroes, the countless men who died extinguishing the Chernobyl fires have been largely forgotten. A nurse talking to the wife of one of the dying fire-fighters explained the hopelessness of the situation as quoted above. Simply by being in the proximity of her husband, the wife became dangerously contaminated.

Liquidators or 'bio-robots' are the names commonly given to the 800,000 young men conscripted from the former Soviet Union to 'liquidate' or blot out the released radiation. The men were brought in after robots used to remove the radioactive graphite from the reactors core ceased to function because the radiation levels were too high.

- To date, according to the governments of the three affected countries (Ukraine, Belarus and Russia), 25,000 of these men have died. 20% committed suicide.
- 70% of the surviving men have been permanently disabled. Many are still campaigning for support in their claim that their illnesses are a result of the extraordinary levels of radiation to which they were exposed.
- The conscripted men were given insufficient protective clothing and, in some cases, none at all in order to carry out their perilous work.
- Their jobs included the following:
 - Containing and fighting the 300 fires at the reactor site
 - Removal of highly radioactive material from the roof of the burning reactor
 - Evacuating contaminated villages of people and livestock.
 - Bulldozing and burying entire villages and their contents.
 - Laying asphalt roads in and out of the evacuated villages to keep dust down
 - Killing family pets

Ivan Shavre was one of the first liquidators to arrive on the scene and vainly helped to fight the fire from the roof of the blazing reactor. He is one of the fortunate survivors.

"After about forty or fifty minutes of fighting there were two more explosions. There was a big black cloud, followed by an intense blue light. Then a ball of fire covered the moon. I felt sick and fell unconscious. I woke up in a hospital in Moscow with forty other firefighters. At first we joked about radiation. Then we heard a comrade had begun to bleed from his nose and mouth and his body turned black and he died. That was the end of the laughter."

The 600 men of the plant's fire service received radiation 13,000 times higher than the European Union's recommended maximum dose of radiation to which people living near a nuclear power plant should be exposed. They were promised weekly check-ups, but for fear of causing panic among the workers the tests were not conducted. When their blood was finally tested, it registered a very high level of radiation. At no stage were the men given iodine, which would have at least protected their thyroid glands.



The banner reads "The task of the government is completed"

The researches of the Physics of Reactors Department of the Institute of Atomic Energy at the Academy of Sciences of Belarus explained the unparalleled importance of the work carried out by the horribly equipped, but incredibly heroic liquidators.

"The self-sacrifice of these men cannot be overstated as they prevented a highly likely nuclear explosion. Many of them died between the ages of 30-40 and the majority of them became invalids...I believe we missed a nuclear explosion by a hair's breadth. If the actions of both scientists and liquidators had not been carried out, Europe would have become uninhabitable."



LONG-TERM EFFECTS

CONTAMINATION

"If the Ukraine would implement the international accepted standards for the strontium-90, we would have to evacuate Kiev."

Russian geological chemist Waleri Kopejkin

- In Belarus, two million people, of whom 500,000 are children, still live in heavily contaminated zones of between 1 and 40 curies per square kilometre.
- The radioactivity has accumulated in the upper soil layer and marking on top 5cm below the surface where plants have their roots. A quarter of the land of Belarus has been affected.
- Radioactive polluted lands are divided into four areas known as "contaminated zones".
- Radioactive substances from the Chernobyl accident are spreading out into the environment much more quickly than was expected.
- Because of the severe economic situation in Belarus, the government is unable to import 'clean' food for its population, and so the people have no choice but to eat the food produced by their own farmers.
- In addition to rainfall, rivers carried the radiation on their surfaces for days after the accident, so that there is now the added dilemma posed by contamination of river networks, lakes, ponds and dams. The main fallout was concentrated in the watershed territory of the rivers Dnieper, Pripyat and their tributaries.
- After severe winters with heavy snowfalls, spring-time brings the problem of radioactive elements being carried in runoff water from the melting snows.
- Then there is the issue of slow-moving rivers and streams which hold a higher concentration of contamination than faster-flowing rivers.

CRIPPLED ECONOMY



The disaster has financially crippled Belarus and costs the country 20% of its annual budget.

The total economic cost of the Chernobyl disaster is several billion dollars - a cost which is being carried by the survivors and in turn will be inflicted on their children for the foreseeable future.

According to the Institute of Economics of Belarus, their economy will suffer losses of \$43.3 billion in the first 30 years after the disaster. Ukrainian economists estimate that the economic damage to

Ukraine between 1986 and 2015 will be in the region of \$201 billion and in Russia it is estimated that from 1986 to 1998 it cost their economy \$3.8 billion.

THE SARCOPHAGUS - ANOTHER DISASTER WAITING TO HAPPEN?



The Chernobyl disaster may have happened nearly 20 years ago, but an even greater disaster is looming and is threatening Europe and beyond.

The sarcophagus, which encases the damaged nuclear reactor, is now cracking open and leaking out lethal doses of radiation. Some of the holes and fissures are large enough to drive a car through. The intense heat inside the reactor, which is still over 200 degrees Celsius, is exacerbating the problem.

Scientists now agree that it is a matter of when, and not if, the twenty thousand tons of concrete will

collapse. The concrete floor will fall on a mix of radioactive lava and dust, which resulted from the dropping of tons of sand in the early attempts to extinguish the fire. The worst-case scenario would entail rubble falling into reactor 3, triggering a core meltdown, which would send another radioactive plume into the atmosphere, covering Europe and beyond. Because the sarcophagus is not properly sealed, rain and melting snow pours through, causing corrosion and creating a radioactive soup, which is leaking on a regular basis.

After seventeen years an agreement to rebuild the sarcophagus was reached at the cost of over one billion dollars. The people of Chernobyl and Europe must surely hope the work is done in time.

"If it collapses, there will be no explosion, as this is not a bomb. But a pillar of dust containing irradiated particles which will shoot 1.5 kilometres into the air and will be spread by the wind"

Professor Alexei Yablokov, a member of the Russian Academy of Sciences and former advisor to ex-President Boris Yeltsin explaining the threat of the collapsing sarcophagus.

IGNORING THE PROBLEM

Seventeen years after the accident, a resolution was passed by the Council of Ministers of the Republic of Belarus which redefined the status of many of the villages in the contaminated zones. This political decision has had an appalling effect because 146 villages, home to 66,000 people, including 17,000 children, are now excluded from the special 'Chernobyl Zone' status. The impact for those living in these villages is that they are now deprived of the special aid, which normally is granted to Chernobyl Zone areas. It also deprives children of free nourishment at schools and kindergartens, and they are now exempted from their regular visits to sanatoria for medical care and rest.

The Belarus Institute of Radiation Security in Minsk carried out measurements of the levels of caesium-137 in the inhabitants and their food in twenty of the newly exempted villages (villages with 'no' Chernobyl affects) and 17 villages where the radiation status had been lowered. The scientific measurements gave conclusive evidence that all the settlements should have remained in their previous status. The future of the 146 villages, now known as the 'forgotten villages' and home to 74,290 people, including 24,000 children, remains in the balance.

What is so worrying about this new political trend is that it is an attempt to scale down the situation. The long-term objective seems to be that the Chernobyl Zone disappears altogether. It now appears there is a concerted effort to blot out the consequences of Chernobyl.



ALTERNATIVE ENERGY

Chernobyl Children's Project International believes that nuclear power is a dangerous and damaging energy source. The use of nuclear power is controversial because of the problem of storing radioactive waste for very long periods of time. The waste produced is very dangerous and must be sealed up for many years to allow the radioactivity to die away. Simply burying radioactive materials just leaves a problem for future generations to clear up.

Safety at a nuclear power plant is paramount. A nuclear accident – and the consequent radioactive contamination - can be a major disaster, as was the case with Chernobyl, and the consequences can last for generations. It is also possible that, in some countries, the use of nuclear power could lead to the proliferation of nuclear weapons.

CCPI believes that nuclear power is an unsound and potentially dangerous energy source, but there is no doubt that, rather than continuing to burn fossil fuels which result in pollution, new energy sources need to be found. Nuclear power and the burning of fossil fuels can both cause harm to our environment. There are many sources of energy which have a much less damaging impact on the planet.

HYDROPOWER

Hydropower is energy obtained from flowing water. There are a number of types of water power most common being Hydroelectric.

Hydroelectric energy is a term usually reserved for hydroelectric dams. It now supplies 19% of world electricity. However, while a few countries have an abundance of it, hydroelectric power is probably not a major option for the future in the developed nations because most potential major sites are either already being exploited or are unavailable for other reasons such as environmental considerations.

Hydroelectric energy produces essentially no carbon dioxide (CO₂), in contrast to burning fossil fuels or gas, and so is not a significant contributor to global warming through CO₂ emissions. Recent reports have linked hydroelectric power to methane, which forms out of decaying submerged plants.

Hydroelectric power can be far less expensive than electricity generated from fossil fuel or nuclear energy.

The chief advantage of hydroelectric dams is their ability to handle seasonal (as well as daily) high peak loads. When the electricity demands drop, the dam simply stores more water.

SOLAR ENERGY

Solar energy uses sunlight to generate electricity, provide hot water, and to heat, cool, and light buildings.

Photovoltaic systems (solar cells) convert sunlight directly into electricity. A solar or PV cell consists of semi-conducting material that absorbs the sunlight. These cells are normally combined into modules that hold about 40 cells. About 10 of these modules are mounted in PV arrays that can be used to generate electricity for a single building or, in large numbers, for a power plant.

A power plant can also use a *concentrating solar power system*, which uses the sun's heat to generate electricity. The sunlight is collected and focused with mirrors to create a high-intensity heat source. This heat source produces steam or mechanical power to run a generator that creates electricity.

WIND ENERGY

Wind energy uses the energy in the wind for generating electricity and pumping water. Large, modern wind turbines operate together in wind farms to produce electricity for utilities. Small turbines are used by homeowners and remote villages to help meet energy needs.

Wind turbines capture the wind's energy with two or three propeller-like blades, which are mounted on a rotor, to generate electricity. The turbines sit atop high towers, taking advantage of the stronger and less turbulent wind at 100 feet (30 meters) or more above ground.

Stand-alone turbines are typically used for water pumping or communications. However, homeowners and farmers in windy areas can also use turbines to generate electricity. For practical purposes, a large number of turbines are usually built close together to form a wind farm. Several electricity providers today use wind farms to supply power to their customers.

Wind energy is considered a green power technology because it has only minor impacts on the environment. Wind energy plants produce no air pollutants or greenhouse gases. The energy consumption for production, installation, operation and decommissioning of a wind turbine is usually earned back within 3 months of operation. Turbines cause no long-term effects on climate or local environment, and after decommissioning wind turbines, even their foundations are removed.

Although it is the most rapidly-growing means of alternative electricity generation, wind energy accounts for only 0.4% of the total electricity production on a global scale (2002). As of 2005, Europe accounts for 72% of worldwide wind turbines. Denmark generates over 20% of its electricity with wind turbines - the highest percentage of any country, and Germany already produces 40% of the entire world's wind power.

The cost of producing wind energy has dropped by 85% during the last 20 years. However, maintenance of wind turbines can be difficult and expensive and many potential sites for wind farms are far from demand centres, requiring substantially more money to construct new transmission lines and substations. There is also resistance to the establishment of land based wind farms on the grounds of "visual pollution". Newer wind farms, however, space turbines further apart due to the greater power of the individual wind turbines. They no longer have the cluttered look of early wind farms. Moving the turbines offshore mitigates the problem, but offshore wind farms are more expensive to maintain and there is an increase in transmission loss due to the longer distances of power lines.

TIDAL POWER is a means of generating electricity by capturing the energy contained in moving water mass due to tides. Harnessing the tides in a bay or estuary has been achieved in France, Canada and Russia, and could be achieved in certain other areas where there is a large tidal range. However, worldwide this technology appears to have little potential, largely due to environmental constraints.

WAVE POWER uses the energy of waves to generate electricity. Harnessing power from the motion of waves may yield far more energy than tides. While much research has been conducted into its feasibility, numerous practical problems have frustrated progress.

GEOTHERMAL POWER is a renewable energy that generates electricity by utilising naturally occurring geological heat sources. It is generally harnessed in one of three ways. Large scale electrical generation is possible in areas near geysers or hot springs by utilising naturally occurring steam, super-heated ground water or using geothermal heat to heat a heat-transfer fluid. Currently there are few geothermal resource areas capable of generating electricity at a cost competitive with other energy sources. However, geothermal power is generated in over 20 countries, including Iceland (producing 17% of its electricity from geothermal sources), the United States, Italy, France, New Zealand, Mexico, Nicaragua, Russia, the Philippines, Indonesia and Japan.

BIOFUEL is any fuel that derives from biomass - recently living organisms or their metabolic by-products, such as manure from cows. Agricultural products specifically grown for use as biofuels and waste from industry, agriculture, forestry, and households — including straw, lumber, manure, sewage, garbage and food leftovers - can be used for the production of bioenergy. Bioenergy covers about 15% of the world's energy consumption. Most bioenergy is consumed in developing countries and is used directly for heating, as opposed to electricity production. However, Sweden and Finland supply 17% and 19% respectively, of their energy needs with bioenergy, quite high for industrialized, countries. Biomass can be used both for the centralized production of electricity and heat, and for local heating.