



General Certificate of Education
Advanced Level Examination
January 2010

General Studies (Specification A)

GENA4/PM

Unit 4 A2 Science and Society

Case Study Source Material

To be issued to candidates on or after 1 November 2009

For use with Section A

- The material consists of five sources (A, B, C, D and E) on the subject of **Britain's Future Energy Needs**. These extracts are being given to you in advance of the Unit 4 examination to enable you to study the content and approach of each extract, and to consider issues which they raise, in preparation for the questions based on this material in Section A.
- A further Section A Source (F) will be provided in the examination paper.
- Your teachers **are** permitted to discuss the material with you before the examination.
- You may write notes in this copy of the Source Material, but you will **not** be allowed to bring this copy, or any other notes you may have made, into the examination room. You will be provided with a clean copy of the Source Material at the start of the Unit 4 examination.
- You are not required to carry out any further study of the material than is necessary for you to gain an understanding of the detail that it contains and to consider the issues that are raised. It is suggested that three hours' detailed study is required for this purpose.
- In the examination room you will have approximately one hour and fifteen minutes in which to read a previously unseen extract and answer a range of questions based on all the source material.

Case Study Source Material on **Britain's Future Energy Needs.**

SOURCE A

Figure 1: The options: where Britain gets its power

Coal 37%

A major source of carbon dioxide. A number of companies are looking at building power plants which use cleaner coal technology, producing less CO₂ when coal is burned. The government is running a competition for the development of a commercial-scale CO₂ capture and storage plant, vastly reducing carbon emissions from coal.



Gas 36%

The easy option, cleaner than coal, and the infrastructure to allow Britain to import more gas is expanding rapidly. However, there are longer term concerns about security of supply of imported gas due to either political factors or competition from other countries.



Nuclear 18%

The most controversial option because of safety and security implications and, according to opponents, the economics. The government says that without nuclear generation Britain's carbon dioxide emissions would have been up to 12% higher in 2004. It worries that losing nuclear, as ageing reactors close, would increase dependence on imports of gas.



Renewables 4%

Primarily from onshore wind farms. The government wants to encourage offshore wind generation and biomass – plant matter used for biofuel – and believes Britain has great potential to exploit wave and tidal technology. This can be controversial: opposition to onshore wind farms is growing.



The remaining 5% of electricity generation comes from oil and imports.

Source: *The Guardian*, 'The options: where Britain gets its power', 14 May 2007

Figure 2: First coal-fired power stations for a generation to be given green light

- It is likely that the Government will approve plans to build Britain's first coal-fired power station since 1984 at Kingsnorth, Kent.
- Green campaigners view the £1 billion proposal as a vital test of the government's commitment to the environment.
- The energy company E.ON UK wants to demolish an outdated plant and replace it with two units using cleaner coal to supply electricity to 1.5 million homes by 2012.
- E.ON claimed it would cut carbon emissions by nearly 2 million tonnes a year and could be a ground-breaking "clean coal" plant, with the carbon emitted being stored under the North Sea.
- Clean coal technology (CCT) is being developed to reduce the environmental impact of coal-fired power stations. The most important CCT scheme is carbon capture and storage (CCS), a process designed to trap CO₂, preventing greenhouse gases entering the atmosphere, and storing the carbon deep underground.
- Critics are worried that the new technology remains unproved and a new coal programme would undermine efforts to secure a new worldwide agreement to combat global warming.
- A further seven coal-fired plants are in the pipeline.

Source: Adapted from ANDREW GRICE, 'First coal-fired power stations for a generation to be given green light', *The Independent*, 10 March 2008

Figure 3: Development of nuclear energy

- The world's first commercial-scale nuclear power station was opened at Calder Hall, Cumbria, in 1956, continuing to operate until 2003. This earliest kind of nuclear power station – 'Magnox' – was followed by seven 'advanced gas-cooled reactors' and one 'pressurised water reactor', as well as a variety of experimental prototypes.
- Nuclear energy is the newest of the major energy technologies and globally it has been the fastest-growing of the major sources of electricity in every decade since the 1970s.
- In France, so badly caught out by the 1973 oil shortage, nuclear energy now provides about 75% of electricity production.
- In the UK, nuclear energy now provides around 18% of the UK electricity mix.
- The USA, with over 1000 reactors, has the world's biggest nuclear industry. Nuclear energy is also important in Germany, Switzerland, Finland, Sweden and Japan.
- Uranium reserves will last at least a century and probably much longer, as little effort has been put into exploration in recent years and we might assume that there is a lot still to be discovered.
- Public concerns have grown as a result of accidents at Three Mile Island (USA, 1979) and Chernobyl (Ukraine, 1986).
- As assumptions made in the 1970s that fossil reserves would run short, and prices rise, turned out not to be correct the rate of building new nuclear power stations decreased in most areas of the world (the Asia-Pacific region being the main exception).
- However, following the dip in building there has been a significant rise in the number of planned stations (known as the worldwide nuclear renaissance). In 2009 around the world there were 439 reactors operating, 36 being built, 97 on order or planned and 221 proposed.

Source: Adapted from *Energy, Society and the Nuclear Alternative*, The Nuclear Industry Association, 2004
Updated figures supplied by the Nuclear Industry Association, 2009

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Figure 4: Nuclear Power



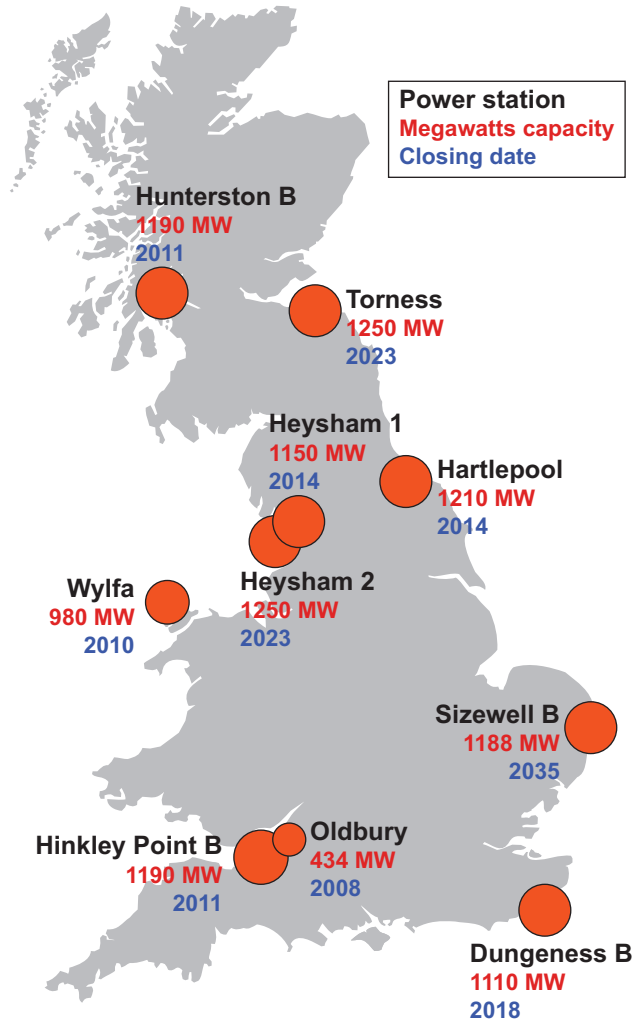
- The government supports a new generation of nuclear power stations, arguing that we need nuclear power to tackle climate change and provide a secure future energy supply.
- They're wrong. Even the most optimistic estimates suggest that a new generation of nuclear power stations will only reduce our emissions by 4% by 2024: far too little, far too late, to stop global warming or address the predicted energy gap.
- Instead, a new generation of reactors will create tens of thousands of tonnes of the most hazardous radioactive waste, which remains dangerous for up to a million years.
- It will establish new targets for terrorists, including nuclear waste trains carrying deadly cargoes along our public rail networks for years to come.
- It will keep the threat of a nuclear reactor accident hanging over us and risk the proliferation of weapons-grade plutonium.
- It will render the public liable for the enormous cleaning costs.

Source: Adapted from <http://www.greenpeace.org.uk/nuclear>, 2008

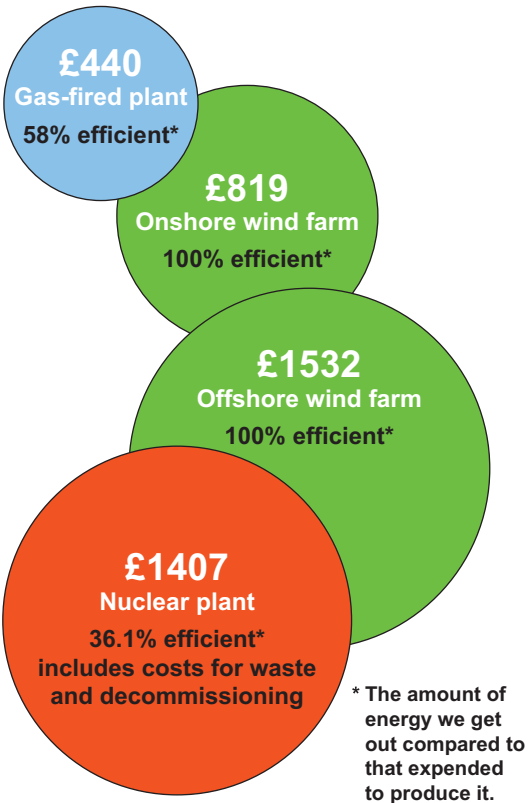
Figure 5



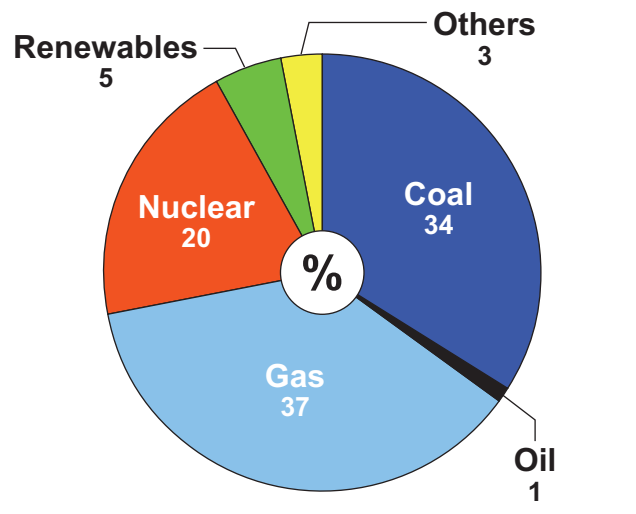
When Britain's nuclear power stations close



How much does it cost to build?
Construction costs, per kW of capacity



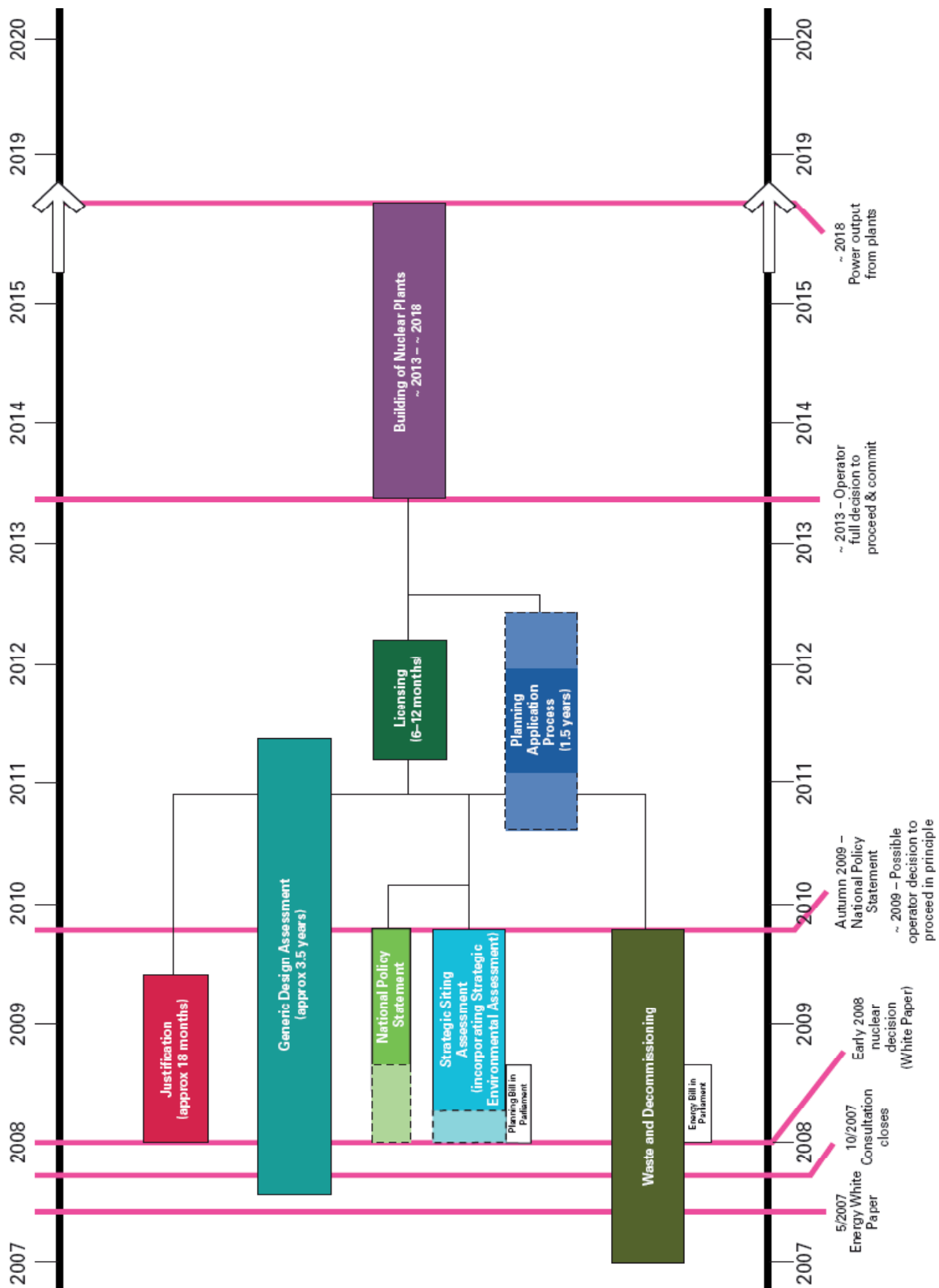
Where we get our electricity from



Source: *The Guardian*, 16 February 2007

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Figure 6: Indicative pathway to possible new nuclear power stations



Source: Department for Business, Enterprise and Regulatory Reform, *Meeting the Energy Challenge*, A White Paper on Nuclear Energy, 2008

SOURCE B

British energy seeks partners for new wave of nuclear power plants

In an announcement yesterday, British Energy called for partners to join forces with the company to bid for a new generation of nuclear power stations. Its chief executive, Bill Coley, says that the offer is open to fellow energy groups, construction companies, even businesses with a rapacious demand for electricity and an interest in investing in capacity.

With an increasing realisation among policymakers that cutting carbon emissions is essential, Mr Coley believes that his time has come. He says that even with the emissions that activity such as building nuclear plants and mining uranium produces, nuclear power accounts for just 5 grams of carbon dioxide per kilowatt of electricity generated, comparable to windpower. By contrast, gas generates 400 grams and coal 900 grams.

British Energy has previously been bailed out by the Government and recently benefited greatly from high electricity prices. However, it has had to concede that it may not be able to justify keeping the troubled Hinkley Point and Hunterston power plants open beyond 2011 due to cracking at the boilers which means that they will come back on line at only 70% capacity.

British Energy now needs the Government to approve new construction. Part of the problem with nuclear power – or any other major project of any kind in the UK – remains the tortuous approval process, requiring strategic government approval, safety approval and planning approval.

The Government has promised action to streamline its processes because delays and complications before work can get under way can add hundreds of millions to the cost of building a new plant. British Energy has the advantage of a bank of existing sites which are suitable for the building of new power plants (usually next to old ones).

Mr Coley also adds that because the company has made efforts to build relationships with the locals

– and provides jobs to significant numbers of them – there tends to be far less hostility than building a plant on a greenfield site.

Once built – and the first plant may be on line by 2018 – Mr Coley says that British Energy will be able to rely on the experiences of generators in other countries to help with any difficulties.

The first two generations of British nuclear power stations were gas-cooled reactors when most of the world was building water-cooled reactors. This meant that advice and help when it came to dealing with operational and technical difficulties was all but impossible to find. New plants will base their designs on those used for other nuclear stations operating around the world.

In 2015 tough new EU environmental rules are due to come into operation, forcing many UK plants to close. That leaves a desperate need for new capacity.

Waste also concerns environmentalists such as Friends of the Earth and a spokesman said that British Energy had not taken into account the “hidden costs” of nuclear energy, particularly that of dealing with waste. According to FoE, “the UK does not have a good history of building nuclear reactors to time and cost. The last time Britain built a series of nuclear power plants they took an average of nearly 13 years from start of construction to first power.” In saying this, the environmental movement is voicing the fear and concerns of many Britons, and many Labour MPs who got their start in politics in the anti-nuclear movement view the prospect of a new generation of plants with horror.

But alternative energy (such as wind power) is still expensive and often has vocal opponents of its own. And with lurid and frightening predictions over what will happen to the planet if we fail to act to curtail carbon emissions, the likes of Mr Coley will continue to argue that nuclear power has a vital role to play.

Source: Adapted from James Moore, ‘British energy seeks partners for new wave of nuclear power plants’, *The Independent*, 14 February 2007

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SOURCE C

Where does he find the energy?

Try as he might, energy minister Malcolm Wicks cannot escape Greenpeace, avowed enemy of everyone – especially him – who backs nuclear power. In the middle of a train journey last Thursday evening, a man came over and handed Wicks a press release and thick report from the environmental lobby group about renewable energy. ‘It will help you come up with a response,’ he said helpfully.

Wicks is a worried man. He is worried that OPEC, which is holding an emergency summit this weekend in Saudi Arabia, can’t pump enough oil. He’s worried about soaring fuel prices. He’s worried about old people not being able to keep their homes warm in a cold winter.

And no wonder. Oil prices have doubled in a year and this month hit \$140 a barrel. In the UK, utility bills are heading in the same direction and last month the worst power cuts for a decade plunged parts of the country into darkness. Britain is in the grip of a global energy crisis that seems to get worse by the day.

Wicks looked pained. “I always hesitate a bit to use the word crisis,” he says. “But if some used the word I wouldn’t necessarily quarrel. This is totally unprecedented. If oil prices double, you are in a totally different ball park. It worries me greatly, not least because of the impact on vulnerable households.”

Wicks, a former university lecturer, wrote a book called *The Old and the Cold* after the oil crisis of the 1970s, when fuel bills soared as now and the elderly struggled to heat their homes. So he knows all about oil shocks. But he’s not confident that oil prices will slump again, as they did in the 1980s.

When a Liberal Democrat MP asked Wicks in the House of Commons to predict what price oil would be in 2020 the minister responded by saying that he couldn’t predict what its price was going to be in the next week. Now the government will issue what Wicks calls its ‘greenprint’ to bring about ‘a renewable energy revolution’. According to Wicks “we are talking about a revolution in how we build a house in the future, the kinds of cars we drive.”

It is fighting talk, but this week’s consultation is by all accounts a radical departure from current policy. It has to be. The government has signed up to a binding EU target to source 15% of its energy from renewable, non-fossil fuel sources.

That requires a more than 10-fold increase from current levels. Because it is difficult to heat homes or power cars using renewable energy, the heaviest burden for meeting the 15% target will fall on power generators. Analysts estimate that at least a third of all electricity generated will have to come from renewable sources, such as wind or solar energy, to meet the overall target in 2020. Only 5% of the UK’s electricity comes from renewables today.

Wicks was on his way to the site of the proposed electricity project on the Severn Estuary. Bird lovers represented by the RSPB, are already up in arms about the barrage, which could involve the construction of a dam, or series of dams, across the estuary, which they say would destroy the habitat for birds and fish.

However, the controversy over the fate of the Severn estuary’s mudflats is nothing compared to that over building new nuclear reactors. ‘I find it genuinely disappointing and sad that some organisations seem to put their hatred of nuclear power above their concern for global warming.’

Wicks insists that his support for nuclear power – which results in low-carbon emissions – does not extend to intervening in the stalled £11 billion auction of nuclear generator British Energy. The government owns a 35% stake in the company, whose sites are best to build more reactors. French nuclear giant EDF is the only remaining bidder, and a link-up seems likely.

Asked if he was relaxed about the situation, he replies: ‘Relaxed is not a word I would use. It’s not a particularly relaxing time in energy at the moment.’ Quite.

Adapted from: TIM WEBB, ‘Where does he find the energy?’, *The Observer*, 22 June 2008

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SOURCE D

Nuclear threat to world 'rising'

Five years of international headlines tell of growing turmoil in the Middle East, international terrorism in Western capitals and more countries seeking the ultimate national security insurance policy. Now climate change and oil insecurity is driving countries to seek nuclear power, bringing with it new dangers of proliferation in volatile parts of the globe.

Today the Doomsday Clock, devised by the Chicago-based Bulletin of the Atomic Scientists in 1947 at the dawn of the nuclear age, will make official what most thinking citizens feel in their bones – that the world has edged closer to nuclear Armageddon than at any time since the most precarious moments of the Cold War in the early 1980s.

In London and Washington the symbolic clock will be moved forward from its present seven minutes to midnight, where it has stood since 2002 when the clock was advanced because of crumbling arms control treaties and the terrorist threat.

At the start of 2007, not only is the picture darker on both these scores. The nuclear threat has also acquired an added and unquantifiable dimension thanks to global warming, prompting the Bulletin to warn of a "Second Nuclear Age"

The existing dangers could not be more obvious: the problem is where to start. What about Iran's quest for nuclear weapons and the thinly veiled warnings from the undeclared but assumed nuclear power Israel that it will strike first to remove what it sees as a threat comparable to the Holocaust?

Or the nuclear test last year by North Korea, a member of George Bush's "axis of evil"? Or the nuclear arsenal of the unstable Pakistan where Islamic extremists have staged several assassination attempts against President Pervez Musharraf?

Or – perhaps the greatest danger of all – that having visited conventional terror on an unprecedented scale upon New York City on 11 September 2001, Al-Qa'ida or some similar organisation will either get hold of a ready-made nuclear device or build one of its own, and then use it?

And why not? Grave doubts surround Russia's ability to secure its nuclear materials, many of them dating from the Soviet era, and to prevent its nuclear scientists from selling their skills to the highest bidder. If a terrorist group did explode even a crude dirty bomb the taboo that has prevented states from using nuclear weapons since 1945 might be broken.

In 1947, the Doomsday Clock was first set at seven minutes to midnight. On the Bulletin's reckoning, the planet's closest brush thus far with Armageddon came in 1953 when the clock's hands moved to two minutes to midnight after the US and the Soviet Union tested hydrogen bombs within nine months of each other.

Thereafter the clock has tracked the chills and thaws of the Cold War, and the successive arrival of Britain, France, China, India and Pakistan as recognised nuclear powers.

Global warming, argues the Bulletin, indirectly increases the risk. Civil nuclear power, which produces no greenhouse gases, is back in fashion and hundreds of nuclear reactors will be built. Yet the enriched uranium necessary to power them, and plutonium are also the vital raw materials for nuclear weapons.

In this Second Nuclear Age, there will be more of these deadly commodities around. Small wonder the hand on the Doomsday Clock will move towards midnight. The only question is, how close will it get?

Source: Adapted from: RUPERT CORNWELL, 'Nuclear threat to world 'rising'',
The Independent, 17 January 2007.

SOURCE E**Search for site to take Britain's radioactive waste gets under way**

Wanted: communities to volunteer to host a giant underground nuclear bunker. Guaranteed jobs for thousands of years; attractive annual payment package; should be in geologically stable area.

Need to know: £10 billion plus construction package will involve excavation of hundreds of millions of tonnes of rock, and the building of new roads, railway lines and workshops. Site may attract terrorists; potential safety risk for one million years.

The potential drawbacks did not stop West Cumbria, which has historic links to the nuclear industry, emerging as the favourite to host an underground bunker to bury nearly 500 000 cubic metres of British radioactive nuclear waste up to one kilometre below ground level. But the government stressed it was eager for other regions to compete for the plant.

The site for the proposed plant is expected to take five years to identify with 15–20 years before any construction work starts and possibly 30 years before the first waste is transported there. Communities on any shortlist of sites could expect generous “community benefit packages”, described yesterday by opponents of the waste facility as “bribes”.

“The proposed disposal facility will be a high technology, multi-billion pound project that will bring investment and jobs for generations,” said environmental minister Ian Pearson. Cumbria is one of England's most economically depressed communities and its geology, although imperfect, is considered stable at depths of 1000 feet.

Other areas suggested in the past include Essex, Humberside, Norfolk, two offshore locations and sites in Scotland. The first concerted opposition to the consultation came within hours of its publication when the new Scottish Nationalist executive of the Scottish Parliament said it would use its legal powers to block any attempt to evaluate sites in Scotland and would even refuse planning permission for a test site.

Source: Adapted from: JOHN VIDAL and SEVERIN CARRELL, ‘Search for site to take Britain's radioactive waste gets under way’, *The Guardian*, 26 June 2007.

END OF SOURCES

There are no sources printed on this page