Appendix A5. Nuclear power: security and other concerns

Nuclear power is a very controversial energy supply option for a number of reasons – several of which are directly connected to the priority threats listed in the National Security Strategy.[*]

A key example is the potential link to the 'Tier One' threat of a nuclear or radiological attack by terrorists. The UK government has been criticised, in particular by The Royal Society, for accumulating a huge stockpile of plutonium reprocessed from civilian nuclear waste which, although not military grade, could still be used to fabricate crude nuclear bombs (Royal Society, 2007). The possibility of theft for terrorist purposes is all too real.

The wider links between civilian and military nuclear technologies and processes are also a serious security problem. Currently, numerous governments – including the UK – are pursuing stringent economic sanctions against Iran over the possibility that its civil nuclear programme might be being diverted for weapons production. However, the UK's current nuclear plans – to build new power stations and develop a replacement for its Trident weapons system – leave it open to accusations of double standards. There are legitimate fears that the UK's actions will undermine the Nuclear Non-proliferation Treaty (Sands and Law, 2006). Furthermore, with the civilian nuclear industry planning to use a new UK programme to expand its export market, there is potential for this too to contribute to the proliferation risk. The broad nuclear proliferation concerns feed into a 'Tier Two' threat in the NSS assessment – the risk of a nuclear or radiological attack on the UK or its overseas territories by another state or its proxy. A wider concern is obviously that international proliferation would increase the risk of any nuclear attack.

The Fukushima nuclear disaster in Japan has reawakened concern about the widespread potential damage such an accident would cause if it were to happen in the UK. While the risk of an earthquake and tsunami triggering such an accident in the UK is of marginal significance, the possibility of an extreme flood (a risk magnified by climate change) or a terrorist attack on a nuclear facility is rather more plausible. This could lead to a major release of radioactive material from a civil nuclear site – which is a 'Tier Three' threat in the NSS assessment.

There are also a range of other significant concerns about nuclear power. These include:
- Environmental and safety risks related to the disposal of radioactive waste (Wallace, 2010);
- Carbon emissions from the nuclear power lifecycle being significantly higher than those from renewables (Sovacool, 2008); and
- Poor economics – especially related to the range of reactor designs under consideration for the UK – and the unreliability of industry cost estimates (Schneider et al, 2012).

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[*] This list is given in box 2.1.

Appendix A6. Sustainable security challenge: competition for resources

Competition over natural resources is not a new source of conflict. Wars have long been fought over water, food, fuel or precious minerals (Smith, 2003; Pacific Institute, 2009). However the global pressure on resources is now greater than ever.

The world's consumption of natural resources has been growing at a rapid rate especially in the last few decades, driven by economic expansion and population growth. For example, to keep up with rising global energy demand, since 1973, oil production has risen by 40%, coal production by 156% and natural gas production by 176% (IEA, 2012).

This massive growth has been accompanied by a shift in trading patterns as industrialised countries import a greater proportion of their resources from developing countries because domestic supplies have become insufficient. This has become known as the 'resource shift' (Abbott et al, 2006), and can markedly decrease the security of supply of such resources.

Insecurity can be even more severe in the developing countries where resources are situated, due to what has been called the 'resource curse'. Too many countries, rich in resources have had this wealth funnelled away into the pockets of corrupt elites who repress their population to maintain their power, and use the money from exporting the resource to fund weapons to fight rival factions to maintain control. This pattern has become well known with certain resources. For example, public campaigning on 'blood diamonds' has raised a great deal of awareness of the conflicts in Sierra Leone and Liberia, the Ivory Coast, Angola, Central African Republic, Democratic Republic of Congo, Republic of Congo and Zimbabwe. It is also a rare case where some positive progress has been made in curbing the flow of resources to fund conflict through the Kimberly Process (although even this pioneering effort is now in crisis) (Vircoulon, 2010).

High consumption levels not only feed insecurity through depletion of resources, but also by contributing to regional and global environmental problems. We discussed the ways in which global climate change can contribute to insecurity in section 5.1 and appendix A4, but there are numerous other concerns as well. Water pollution can reduce the availability of clean water supplies, leading to conflict. Similarly, land contamination and soil erosion can lead to food insecurity.

So wide is the range of environmental problems, and so great is the level of human impact, that environmental scientists have begun to talk of the threats caused by breaching 'planetary boundaries'. An international team of environmental scientists has coined this term to describe nine biophysical environmental limits which, if crossed by human activities, is likely to lead to a greatly amplified risk of "disastrous consequences" for human society (Rockstrom et al, 2009). Of the nine boundaries, they estimate that three have already been crossed. The first is a 'safe' level for atmospheric carbon dioxide concentration, leading to dangerous climate change. The second is an allowable level for the extinction rates of plant and animal species, and the third is a measure of nitrogen pollution, whose consequences include massive contamination of global fresh water supplies and agricultural land.

In this appendix, we give more details about examples of where competition over resources is leading to conflict – in the areas of oil, water and food. We then give an overview of UK government policies for tackling these problems, including noting significant R&D programmes.

A6.1 Oil resources, peak oil and security

Mineral oils such as crude oil are non-renewable resources, with cheap, easy-to-reach 'conventional oil' being a highly prized source of energy in the global economy. The world's conventional oil reserves are concentrated in a limited number of states, mainly in the Middle East, and the history of many of these states has involved much politically instability and war as different interests have vied for control. Indeed, during World War II British officials proclaimed that Middle Eastern oil was "a vital prize for any power interested in world influence or domination" (Muttitt, 2005).

One salutary example of instability was the overthrow in 1953 of the Mohammed Mossadegh, the democratically elected prime minister of Iran, following Mossadegh's attempted nationalisation of the country's oil industry (Risen, 2000). According to leaked CIA documents, the coup was organised by the US and British intelligences services to maintain Western access to Iran's oil resources, as fears were growing that Mossadegh was becoming a close ally of the Soviet Union. He was replaced by the Shah, whose human rights abuses eventually became a key factor in the Islamic revolution of 1979 (Kinzer, 2003). Iranian hostility to the West has remained ever since.

As we have already highlighted – see chapter two – access to and control of oil resources is widely believed to be a major factor in some of the more recent wars in the region – such as the 1990-91 Gulf war and the 2003 US-led invasion of Iraq (Smith, 2003; Webber and Spedding, 2003; Abbott et al, 2006; Rogers, 2010). Although this link is strongly denied by, for example, US and UK government officials, such thinking can be discerned from, for example, US military sources (e.g. US Central Command – see Abbott et al, 2006) or think-tanks with close government ties (e.g. Project for a New American Century – see Webber and Spedding, 2003). In general, it is hard to believe that such huge military resources as were deployed by Western powers in these wars would have been committed without access to oil being a major consideration.

Concern over the size of the world's remaining oil resources has been labelled the 'peak oil' problem. Peak oil is the point at which the supply of oil can no longer be increased (in response to growing demand) due to the depletion of its reserves. After this point, the price is likely to rise markedly (Mobbs, 2005: pp.35-56). Opinions still wildly differ as to when peak oil will happen, with some claiming that it is decades away, especially if unconventional sources of oil – such as shale oil, tight oil and oil/tar sands – are included.

Estimating the timing is problematic because the size of the world's reserves is very difficult to measure accurately. This is compounded by the fact that some Middle Eastern governments are less than transparent in how they derive their reserve estimates. Indeed, questions have even been raised about the reliability of the estimates made by the International Energy Agency (IEA), the leading advisory organisation working in this area. A

senior whistleblower claimed in 2009 that the organisation has been deliberately underplaying a looming shortage for fear of triggering panic buying (Macallister, 2009).

Nevertheless, in 2011, the IEA's chief economist stated that conventional crude oil output could plateau in 2020, a development that was "not good news" for a world still heavily dependent on petroleum (Vidal, 2011). The UK Energy Research Centre has also concluded that the consequences of reaching the peak of world oil production had been largely ignored by governments, despite evidence of significant risks (UKERC, 2009). The report found that this peak could be expected before 2030, but that there is a "significant risk" of a peak before 2020. The UK government has no contingency plans for oil peaking before 2020.

But the very recent, rapid rise of unconventional oil is leading to further shifts in thinking on peak oil. The 2012 World Energy Outlook (IEA, 2012c) highlights the rapid increase in US oil production of tight oil and predicts the USA will surpass Saudi Arabia to become the world's largest oil producer by about 2020. However, analysis published in the journal *Nature*, based on detailed US well data, paints a much less optimistic picture of the potential for unconventional fossil fuel resources to be cheaply extracted (Hughes, 2013). Consequently, it seems very unwise to depend on a future scenario of low-cost, abundant oil.

The expansion in the exploitation of unconventional oil resources also raises wider security concerns (IEA, 2012c). Firstly, more energy is consumed in extraction and refining, leading to a marked increase in greenhouse gas emissions per unit of energy. Hence these fuels drive more rapid climate change. Secondly, water consumption within the extraction process is significantly higher than for conventional oil resources, and the pollution of groundwater can be a major problem close to drilling areas. Both of these factors decrease water security. Also relevant here is the increased drilling of deep sea oil and the rush towards securing fossil fuel resources in the Polar Regions. The risk of accidents is much increased, and the consequences very severe, as the BP Deepwater Horizon accident in 2010 demonstrated. Hence, while there may be a short-term economic benefit from developing these oil resources, the longer term threats to security through more rapid climate change and reduced water security, for example, are very high prices to pay.

Of growing concern for the UK is the country's increased dependence on imported oil (and natural gas), including from the Middle East, given the much reduced production from the North Sea since the 1990s (DECC, 2012c). A disruption to oil and gas supplies has been classed as a 'tier three' threat in the National Security Strategy (see chapter two). One key response of the government in the last two decades has been to further cement relations with oil states, including Saudi Arabia, despite their very poor human rights records (e.g. Amnesty International, 2012). Indeed, Saudi Arabia has been a top UK arms customer for many years (CAAT, 2012).

This situation highlights the deep problem with the approach of many industrialised countries to oil dependence. Rather than giving a much higher priority to the shift to a range of sustainable and renewable energy options – many of which are indigenous – governments in the UK and elsewhere favour two main responses. The first is the use of military options, including major arms sales to friendly oil regimes, the installation of

military bases/ assets in regions of instability, and the use of military force as considered necessary. The second is to support further exploration and extraction of fossil fuel resources (including unconventional ones) which accelerate climate change and other environmental problems.

A6.2 Food Security

Oil and other fossil fuels are not the only scarce resources over which there is strong competition. Food and water are universal requirements, and the demand for these is increasing while numerous factors, such climate change, poor agricultural management and migration, exacerbate supply problems. An additional problem for food security is the increasing diversion of food crops to be used as biofuels – especially for use in road vehicles. A key indicator of food security is global grain prices. In 2008, there was an abrupt doubling of these prices, causing food riots across the world (McKie and Stewart, 2008). The situation improved temporarily but pressures on grain prices are very unlikely to go away. For example, in July 2012, just 26% of the US corn harvest could be rated 'good' to 'excellent', as a disastrous summer of extreme heat and drought wreaked destruction on crops (Brown, 2012). Soil moisture readings in the corn-belt were among the lowest level ever recorded. This is particularly disturbing considering that corn is the most important grain globally, with production well above that of wheat and nearly double that of rice. Indeed, the US corn crop exceeds China's rice and wheat harvests combined. The hope was that the year would deliver high crop yields and allow the already dangerously low grain stock to be replenished. Instead grain stocks fell even further.

The rise in food prices obviously concerns UK consumers, but it can be devastating internationally, especially in the developing world where in some areas it is not uncommon to find half of a person's income spent on staple food. According to Oxfam, the average Indian paid the equivalent in British prices of £10 for a litre of milk and £6 for a kilo of rice (Bawden, 2011).

The growth in demand for certain types of biofuels has had a devastating impact on international food prices. While biofuels can be synthesised from a range of organic materials, including agricultural waste, non-food crops, and algae, it is the production from food crops that is having such a negative impact on food security. For example, in the USA, significant proportions of the corn harvest are now being diverted to manufacture bioethanol. Studies by the World Bank and others have reported that more than 70% of recent food price increases were due to the effects of biofuel production (Farrell et al, 2006; Mitchell, 2008). A further report found that 33% of the increase in US corn price from 2007-2008 was related to US bioethanol production (Tollens, 2009).

Population growth is also exacerbating food insecurity. By 2030, the global population is projected to increase by 17% with the majority of growth occurring in the poorer tropical regions, where food insecurity is most severe. A further pressure is that, as incomes rise, individual food preferences change leading to an increased average consumption of animal products. Such diets increase demand for grain (as animal feed) compared to diets low in these products. Thus, world food production would have to increase by 50% to satisfy these demands. Similar increases in demand are projected for energy and water (International

Food Union of Science and Techonology, 2010).

A6.3 Water Security

Conflict over water resources is a recurring feature throughout human history (Pacific Institute, 2009). In particular, water security has played its part in Middle East politics, where for instance Israel has taken action against Syria and Lebanon over supplies from the River Jordan. Tension has also arisen between Israel and Palestine which both rely on the same water resources, not least because the Israeli-built 'separation barrier' has restricted Palestinian access to essential water supplies (Amnesty International, 2011).

Water has also been a major factor in one of the twenty-first century's most violent conflicts, that in Darfur, Sudan. Long periods of drought in the 1970s and 1980s resulted in mounting poverty and widespread population movement. In particular, nomadic herders in search of water began to encroach on the land of sedentary farmers. This combined with ethnic tensions, especially between Arab groups on the one hand and non-Arab identity groups on the other, and with the introduction of modern arms led to a major armed conflict breaking out in the early 2000s (Saeed, 2004). Solutions to Darfur's water crisis are now being actively promoted as peacemaking tools in the conflict.

In this context, it is salutary to note that in the world's wealthiest countries one person uses an average of nearly 400 litres of water per day. In Darfur, a similar amount is shared between 20 people who often have to travel great distances to find it (Schlein, 2011).

Water security problems can also be caused through the ill-considered exploitation of energy resources. As mentioned earlier, fossil fuel extraction and use can cause significant water-related problems. Much care is also needed in the use of hydroelectricity – especially large dams, which can have devastating impacts on the local environment, water supplies and local populations. Again Sudan provides an important example. The government plans to use hydroelectric dams to both generate power and to improve the area of fertile land around the Nile, forming a chain of five reservoirs. One of these dams, the Merowe, was built by Chinese, German and French companies and completed in 2009. The project doubled Sudan's electricity generation, but displaced more than 50,000 people from the Nile Valley to arid desert locations (International Rivers, undated). Protests were violently suppressed and those who did not leave had their homes flooded. The UN Rapporteur on Housing Rights expressed "deep concern" about the human rights violations in the project (UN Human Rights Council, 2007).

Global water consumption is increasing with economic and population growth, putting further pressure on resources. Nevertheless, in cases of international tensions over water, cooperation and negotiation have generally proven to be the most effective way of solving these issues (Cosgrove, 2003).

A6.4 Mineral extraction

Mineral resources have repeatedly been a source of conflict, especially in Africa. Wars have been fought over familiar minerals such as diamonds and gold, and less familiar materials

such as cassiterite, coltan and wolframite, the ores of tin, tantalum and tungsten (the 'three Ts').

Tin is very familiar, most commonly being used to prevent corrosion. Tantalum is a key element in electronics and can be found in most mobile phones and computers. Tungsten is best known for its use in light bulb filaments but it is also used in welding, super-alloys and, ironically, armour piercing ammunition. The extraction of these minerals in the Democratic Republic of Congo (DRC), together with gold, diamonds, uranium and timber has long funded the simmering conflict in the region, known as Africa's 'Great War' (Feinstein, 2011). It has been the most deadly conflict since the end of World War II. By the end of 2003 it was estimated that 3.3 million people had died as a result of violence, starvation or disease due to the conflict. Those left alive were impoverished, with the average citizen living on less than 18 US cents a day in the eastern DRC. More than 2.3 million Congolese have been displaced internally, while a further 330,000 have taken refuge outside the country. Nearly 400,000 children have been forced to flee the violence. Troop behaviour has been brutal: tens of thousands of women were raped by the different militias. Girls as young as ten were forced into sexual or domestic slavery – those who resisted had limbs amputated or were killed as a warning to others. Extensive use was made of child soldiers.

The conflict continues to rage in the eastern part of the DRC, fuelled by an uncontrolled influx of arms and ammunition. Funding for this military hardware has come through the illicit sale of minerals. For example, one party to the conflict, Rwanda, is estimated to have funded 80% of its military budget between 2003 and 2006 from resource exploitation in DRC. All parties to the conflict have used their forces to capture and hold mines in their areas of control. War fronts have often been concentrated around localities holding gold and coltan mines (Fruchard, 2007; Feinstein, 2011).

These examples show that, as industrialised societies consume ever greater quantities of scarce resources, the impacts on security in far-flung regions can be devastating. The solutions to such problems are obviously complex. International initiatives such as the Extractive Industries Transparency Initiative and legal measures such as Section 1502 of the US Dodd-Frank Act can help to prevent mineral resources from conflict areas entering international markets, thus restricting funding for the arms which feed these wars. However, it is important to ask deeper questions about the consumption patterns of industrialised societies.

A6.5 UK policies responses

Some of the UK government policies aimed at tackling other drivers of conflict – such as climate change and marginalisation of the majority world – also help to tackle competition over resources, and these have been covered in chapter five and appendix A4. We have also noted – in chapter five and appendix A7 on global militarisation – how some UK policies are compounding resource competition problems. Other areas of UK policy which are also particularly relevant include: energy security; resource security; sustainable public purchasing; sustainable businesses; sustainable products and consumers; and waste and recycling. Here, we provide a brief review of the main policies and note key R&D programmes.

Energy security is the concern of the Department of Energy and Climate Change. In November 2012, it published an Energy Security Strategy (DECC, 2012c), identifying significant risks to the UK's security and proposing:

- Resilience measures to prevent possible disruptions ranging from flooding through to industrial action, and to reduce the impact of incidents if they do occur.
- Energy efficiency measures lower our exposure to domestic and international energy market risks.
- Maximising economic production of our oil and gas reserves to provide reliable energy supplies which are not exposed to international energy supply risks.
- Working to improve the reliability of global energy markets to help ensure that, where the UK does require the supply of energy from overseas, it is dependable and affordable.
- Reliable networks ensure that the energy we need is delivered, where we need it.
- Decarbonising our supplies to help reduce our dependence on international fossil fuel markets in the longer term.

Perhaps the most striking aspect of these proposals is the inconsistency between maximising UK oil and gas production and decarbonising the energy supply. Given the urgent and serious nature of the climate change threat (see appendix A4), the proposals seem distinctly unbalanced. A further problem is that among the steps taken to "improve the reliability of global energy markets" are, as we have seen earlier, building close ties with countries with poor human rights records, including major arms deals.

The other issues are covered by the Department of Environment, Food and Rural Affairs (DEFRA). In March 2012, it published a Resource Security Action Plan (DEFRA, 2012) aimed at addressing rising concerns about the security of supply of key metals and minerals essential to the UK economy and the development of low carbon technologies. Actions include raising awareness of this issue especially within the business sector and identifying new innovation opportunities such as improving resource use efficiency.

Specific policies in other areas include (DEFRA, 2012c):
- Government standards for the sustainable procurement of priority products for the public sector, including information technology, food, construction and transport.
- Waste and Resources Action Programme (WRAP) to give support and advice to business and civil society on improving the efficiency of resource use and reducing waste.
- Product Roadmaps to reduce the environmental impact (through their lifecycle) of specific product groups, including windows, milk and plasterboard.

While all these schemes and programmes have worthy aspirations, the thing that is most striking about them is their lack of ambition. Underlying the whole discussion on resource competition is the very serious problem that the economy of the UK (in common with other industrialised countries) is operating well above a sustainable level of resource consumption. Perhaps the most comprehensive assessment of this question comes from the Living Planet Reports, which use an assessment method called 'ecological footprinting'. The latest report estimates that the UK consumes resources at 2.65 times the sustainable level (WWF, 2012). Hence an average cut of 60% is needed in the UK's levels of resource consumption to bring them down to a sustainable level. While a cut of this magnitude in

greenhouse gas emissions is accepted by government in order to tackle climate change, there is little acknowledgement that similar sized cuts in other areas are also highly advisable.

Appendix A7. Sustainable security challenge: global militarisation

Sustainable security theorists view global militarisation and the proliferation of armaments as fuelling insecurity and being major drivers of conflict (Abbott et al, 2006). The international arms trade drives this proliferation, leading to resources being diverted from other socioeconomic needs. The UK arguably contributes in several ways to global militarisation, through its substantial arms exports, its nuclear arsenal and its development of new military technology, including work related to cyber security. An overview of these broad issues and the UK's involvement is provided in this appendix.

Obviously, both the policies and spending on the UK's military R&D is directly related to these issues. The government's rationale for the support and subsidisation of military R&D through arms exports is discussed at length in the National Security Through Technology (NSTT) white paper, and is covered section 3.5. R&D spending on both conventional weapons and nuclear weapons is discussed in sections 4.3 and 4.4.

A7.1 Conventional weapons

Conventional arms have often been marginalised as a security concern, with nuclear weapons having posed such an apocalyptic threat during the Cold War. However conventional weapons and their proliferation are at the root of many security issues and are the tools used to militarise conflicts every day.

Every year an estimated 526,000 people die from all forms of armed violence, the vast majority from conventional weapons (Geneva Declaration, 2011). About one quarter of these die in wars. This does not even include the enormous impact caused by violence indirectly, such as people made homeless, denied access to scarce resources, or dying due to the loss of healthcare. A commonly accepted figure is that the ratio of indirect conflict deaths to direct deaths is around four to one (Small Arms Survey, 2012). Quality of life, human security and socioeconomic development can be severely damaged for decades after conflict. For example, Africa is estimated to lose $18 billion per year due to armed violence. This is more than the amount of annual development aid sent to the continent every year (Oxfam International, 2007).

The class of weapons which is responsible for more deaths than any other is, perhaps counter-intuitively, 'small arms and light weapons'. This class includes handguns, rifles, machine guns, and grenade launchers. Some senior figures, such as former UN Secretary General Kofi Annan and President Sirleaf of Liberia, have argued that in fact small arms should be thought of as "weapons of mass destruction in slow motion" (UN, 2006; The Informer, 2012).

Conventional weapons are widespread. There are an estimated 875 million small arms worldwide, one for every 10 people (Small Arms Survey, 2012). They are cheap, easily transported, smuggled and are operational for decades. This means they pose a danger for generations to come.

A7.2 The arms trade and UK arms exports

Arms sales are promoted through a worldview which sees military approaches as the way to deal with the world's security problems. Yet, the international arms trade is notoriously under-regulated, thereby increasing insecurity and conflict. According to Oxfam, this trade is less regulated than the trade in bananas (Oxfam America, 2012).

The UK is a major exporter of military equipment. However, data on such exports is notoriously uncertain. For example, according to the respected Stockholm International Peace Research Institute (SIPRI), UK arms exports fell significantly in 2012, meaning that the UK had fallen out of the world's top five exporters for the first time since records began in 1950 (SIPRI, 2013). However, according to a MoD press release, UK arms exports *rose* significantly in 2012, to a level of £8.8 billion (MoD, 2013b). Many sources suggest that the annual worth of UK arms exports is around £5 billion.[†] The UK's largest military customers have recently been Saudi Arabia, the USA and India. The UK also hosts the headquarters of the third largest arms supplier in the world, BAE Systems.

Critics argue that the UK's arms trade does not, as the UK government claims, enhance security but instead is a significant driver of increased tensions and the militarisation of conflict worldwide. The intentional trade in arms is often carried out in a less than scrupulous manner. This happens especially when the recipient of the arms is perceived to be a significant ally, and there are strategic gains to be made. The Cold War logic of using arms transfers to militarily strengthen allies in opposition to a perceived threat did little good in securing peace during those years and it helps even less today in the multi-polar world. Instead the proliferation of arms promotes militaristic solutions to security problems and often provokes arms races and decreased security.

All too often arms exports can be at the centre of what US academic Chalmers Johnson has termed 'blowback', a term with origins at the CIA (Johnson, 2000). Blowback is where actions taken by a government, often without public knowledge, leads to events which eventually threaten that country's security. Weapons that are made to be durable are a prime culprit in blowback. Perhaps the most famous example of blowback was the secret arming of the rebel Mujahadeen in Afghanistan, fighting Soviet forces in a 'proxy' war in the 1980s. Arms and money flowed from the United States and Saudi Arabia to these rebel groups, which later formed the core of the Taliban government and Al Qaeda (Coll, 2004). Weapons supplied then have remained a threat to US, UK and other forces still in Afghanistan at the time of writing. The UK's arms exports could similarly have very serious consequences in the long run, especially in the Middle East and North Africa. They could both undermine the security of those in the region who may have British weapons turned upon them, or undermine our own security if those repressed by regimes supplied with British military equipment decide to take revenge on the source of the arms. This is discussed further in the next section.

[†] In 2008, the UK government stopped publishing regular data on arms deliveries. However, figures prior to that oscillated around £5bn (DASA, 2008), and the lack of any notable change between 2008 and 2011 can be seen in Grimmett and Kerr (2012).

UK arms exports are often justified by the UK government in terms of their benefit to the economy, the employment they provide, and the perceived requirement both to maintain a domestic industry to supply military essentials in case of war and to subsidise the development of equipment for the UK armed forces. However, serious questions can be raised about each of these justifications.

The UK's arms exports receive exceptional government support. Total subsidies have been conservatively estimated at around £700m per year and the industry receives extremely close political support. Most notably, the principle route through which the arms export industry receives its subsidy is through public funding for R&D. A study carried out by SIPRI in 2011 for the UK Campaign Against Arms Trade (CAAT) estimated that £562.4m per year could be considered to be a subsidy for arms exporters (Jackson, 2011). It should however be noted that this figure is an approximation.

Using the overall figure of £700m, the disproportionate weight of this arms export subsidy can be seen as the industry employs only around 55,000 people (see figure 6.1), 0.2% of the UK workforce. The subsidy is thus an extraordinarily £12,700 per job per year. The subsidies required and the relatively poor job creation associated with arms exports even led a report co-written by MoD economists to conclude that "the economic costs of reducing defence exports are relatively small and largely one-off" and "the balance of argument about defence exports should depend mainly on non-economic considerations" (Chalmers et al, 2001). The MoD also acknowledged this in its Defence Industrial Strategy in 2005. In the words of the Financial Times' Alan Beattie, "You can have as many arms export jobs as you are prepared to waste public money subsidising" (Beattie, 2010).

The MoD's procurement is also biased towards UK arms manufacturers. There is an avowed policy of procuring certain equipment from UK suppliers. This is clearly stated in the NSTT in the case of equipment for which the government feels the UK must have an uninterrupted supply (MoD, 2012c). This is the case even when the technical or cost merits of non-British equipment are greater. The most striking publicly known case was the UK's procurement of 20 new BAE Hawk fighter jets in 2003, a contract worth £3.5bn (Schofield, 2008). Internal cabinet level deliberations were divided. The Treasury advocated an open competition to bring costs down. However, other departments, among them the MoD and Department of Trade and Industry, argued that securing jobs at BAE Systems, both through the UK deal and by helping to promote an Indian export contract, was more important. The Treasury warned that the deal could cost considerably more that it should if it were not opened to competition as a favoured competitor, the Aermacchi jet, would be £1bn cheaper (a figure that BAE disputed). BAE threatened to make 470 staff redundant from the design team at Brough and potentially cut a further 2,200 jobs at the factory. In the end, the government decided to procure the Hawks.

This distortion of the MoD budget, which may be systemic, is impossible to accurately estimate. The closed nature of the decision-making which characterises military procurement around the world obscures the weight given to such factors in the vast majority of cases (Feinstein et al, 2011). This leads to the conclusion that the SIPRI estimate above of the level of export subsidy seems likely to be conservative.

It has been argued that the arms trade is "hard wired for corruption" and as a result it may account for up to 40% of corruption cases in world trade (Roeber, 2005). High profile recent and ongoing corruption cases against major British arms exporters in UK government-backed deals make corruption an important issue when considering the nation's arms trade. The reasons for the arms trade's particular tendency towards corruption are many, including the cloak of secrecy related to matters of national security, the technical detail and obscurity of decision-making, the relatively few individuals who make the decisions on what can be enormous deals, the financial rewards and pitiful penalties for corruption (Feinstein et al, 2011).

Corrupt arms deals globally pose an even greater threat to security and damage governance. Excessive armaments bought for the wrong reasons can stoke regional tensions due to the aggressive appearance of large arms purchases. Corrupt arms deals almost always result in too much weaponry being purchased for too high a price while they are often either of the wrong type or cannot be used. The cost of a corrupt arms deal is not only the wrong equipment for the armed forces but a theft from the people of a nation by the seller and the official taking the bribe. Money spent on a corrupt deal could have been spent on healthcare, education, infrastructure or environmental protection. The scale and impact can be devastating (Holden and Van Vuuran, 2011).

A7.3 UK arms export controls

The government defends its support for UK arms exports on the basis that these arms exports are licensed according to criteria that are strictly drawn up. Indeed the UK's arms export criteria do appear fairly strong on paper, requiring consideration of the risk of whether a proposed export would:

- contravene the UK's international commitments;
- be used for internal repression;
- provoke or prolong armed conflicts or aggravate existing tensions in the destination country;
- be used aggressively against another country;
- adversely affect the national security of the UK or allies;
- be diverted or re-exported under undesirable conditions;
- seriously undermine the economy; and
- seriously hamper the sustainable development of the recipient country.

However the government only has to consider and balance these considerations against national security and economic considerations with only one exception. The UK Export Control Act 2002 does say exports should be stopped in the case of a "clear risk" the arms might be used for internal repression. However even in this case the decision are subjective, allowing political pressure to be brought to bear in favour of exports and the decision to be guided by the viewpoints of those in charge. Were the UK to instead apply the tests more carefully, considering the very high risks that arms exports violate might of the factors listed above then the UK would be obliged to vastly limit its arms exports compared to its current situation (Committees on Arms Exports Controls, 2012).

There is clear evidence that the risks in arms exports are not taken seriously enough by the UK government. Most notably, the UK's largest arms export customer is Saudi Arabia, an absolute monarchy with severe human rights problems (Amnesty International, 2012). UK arms supplied to the Saudi government are believed to have been used in supporting the Bahraini government repress pro-democracy activists in 2011 (Committees on Arms Export Controls, 2011).

Furthermore, Amnesty International has reported that it was "extremely likely" that Tornado fighter/ bomber jets were used by Saudi Forces in 2009 in attacks on civilians in Yemen. These attacks constitute possible war crimes by the Saudi Arabian Air Force (Amnesty International, 2010). The Tornado aircraft were exported to Saudi Arabia under the Al Yamamah arms deal between the UK government and Saudi government, which is also considered possibly the single most corrupt transaction of all time, with over £6bn in illicit commissions being paid according to police estimates (Feinstein, 2011). This deal, administered by the British government is part of a wider perceived policy of support for the Saudi government. Indeed, unlike many other countries accused of repression during the 'Arab Spring', Saudi Arabia did not even see arms exports from Britain suspended (Committees on Arms Exports Controls, 2012). The closure of the UK corruption investigation into the Al Yamamah arms deal was in response to threats that "British lives on British streets" were at stake as Saudi Arabia would cut off intelligence cooperation should alleged corruption continue to be investigated. Official correspondence from Tony Blair's desk also included Saudi Arabia's role in oil supply as a factor in favour of closing the UK investigation.

These factors all cast grave doubts over whether it is either ethical or positive for UK security to continue arming the Saudi Arabian regime. By a fair interpretation of the UK's export laws, Britain should not be exporting to such a country, much less actively promoting and administrating such deals. The main reasons given for promoting the arms trade with Saudi Arabia as a regional ally seem centred largely on oil supplies. A greater focus on energy conservation and exploiting the UK's renewable energy resources would be a much more constructive approach to this concern.

Following the alleged use of UK-made arms in repression against several Arab Spring movements, the UK government conducted a review of its arms export control policy. The government's concession to greater export control consisted of measures to revoke arms export licenses where the security situation in a given recipient country deteriorates, such as an internal conflict. However this measure entirely fails to address the key problem with arms exports to countries at risk of conflict. Once the arms have been exported, the UK has no control over their use and little control over their further movements. A prudent arms export policy would not allow arms to be transferred anywhere where there is a risk of the control criteria being violated at any time during the lifetime of the weapons in question.

The 2012 report of the Committees on Arms Export Controls summed up some of the key flaws in this policy move and ongoing issues in UK arms export policy (Committees on Arms Exports Controls, 2012). The report said:
- Neither the Coalition nor the previous Labour government paid proper attention to human rights issues when considering arms export licences.

- There was a conflict between strongly promoting arms exports to authoritarian regimes while strongly criticising their lack of human rights at the same time.
- There were no significant changes in the repressive regimes where the UK approved arms export licences – the Arab Spring simply exposed the true nature of these regimes.
- The government must apply more cautious judgements when considering arms sales to authoritarian regimes which might use them for internal repression.

The Arms Trade Treaty (ATT) has been proposed as a possible solution to many of the problems around the international arms trade. While there is a desperate need for international regulation, it seems unlikely that the ATT in its current form will solve many of the major problems around international trade (Pace, 2013).

A significant counter-point to the UK's subsidies for, and poor control of, arms exports is the funding of the 'conflict prevention pools', as discussed in the NSS, which can help to improve political stability in fragile states. This work is aimed at improving governance and security, although the funding is still markedly smaller than even the arms export subsidies discussed above.

A7.4 Nuclear weapons

Another side of the threat that militarisation and arms proliferation poses to us all is the proliferation of unconventional arms. This includes nuclear, radiological, chemical and biological weapons.

Ever since their first use 70 years ago nuclear weapons have represented one of the greatest threats to security in our history. The UK is one of the nine countries that possess nuclear weapons, the others being the United States, Russia, China, France, India, Pakistan, Israel and North Korea (Federation of American Scientists, 2012). Together, they possess 17,000 weapons, with 95% held by the USA and Russia. At present the UK is not threatened by any nuclear-armed state, and this is acknowledged in the NSS. However the UK's continued possession and the threat of the use of nuclear weapons will add to the motivation for more countries to also seek their own nuclear weapons.

Critics argue that the UK's nuclear weapons currently make the country less safe, with the danger of an accident or attack on a nuclear facility in the UK posing a significantly greater danger than any danger that could be resolved by the UK's use of nuclear weapons or their supposed deterrent effect. Moreover the greatest threat for the world with regards to nuclear weapons is in fact nuclear terrorism, according to the independent Weapons of Mass Destruction Commission (Cirincione, 2004). Nuclear terrorism cannot be deterred by Britain's nuclear arsenal and indeed the proliferation of nuclear material, especially nuclear weapons, makes a nuclear terrorist attack far more likely. The best way to minimize this risk would be the UK to dismantle its current nuclear arsenal and move rapidly towards international disarmament.

The logic of the deterrent effect, always questionable, has become even less convincing with the end of the Cold War over 20 years ago. The situation post-Cold War is a multi-polar nuclear world, complicating a direct deterrence between two hostile groups of nations.

Instead, the greater threat is that of nuclear weapons being fired from a 'rogue state' or non-state group where deterrence is not a factor. The UK has committed to not using nuclear weapons against a non-nuclear state that is part of the Nuclear Non-Proliferation Treaty (HM Government, 2012) and the UK's nuclear weapons does not appear to have deterred conventional conflict in the Falklands, for example.

As a signatory of the NPT, the UK is committed "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament" (Federation of American Scientists, 2008). Yet the UK currently plans to retain a stockpile of 180 nuclear warheads, with 120 operational (HM Government, 2010b). Critically, it plans to renew the Trident nuclear weapons system, currently made up of four submarines each carrying eight trident missiles and up to 40 warheads, by the late 2020s.

If the UK decided not to replace Trident, it would lead to huge cost savings according to a recent study conducted by BASIC (Hartley, 2012). The study reported that the UK could make "substantial cost savings of £83.5bn over the period 2016 to 2062, equivalent to an annual average saving of £1.86bn a year". Without significant changes, replacing Trident is expected to consume up to 30 percent of the Ministry of Defence's equipment budget by the end of the decade according to some experts. The alternative uses of this vast quantity of money are of course manifold.

Public opinion tends to be against renewing Britain's nuclear weapon system. For example, 63% of the British public want spending cuts to include scrapping Trident according to a BPIX/ Mail on Sunday poll in 2010. A significant proportion of military opinion is also opposed to nuclear weapons (CND, 2012). Field Marshal Lord Bramall, backed by two senior generals wrote in 2009 that "Nuclear weapons have shown themselves to be completely useless as a deterrent to the threats and scale of violence we currently face or are likely to face, particularly international terrorism" (Telegraph, 2009).

Nuclear weapons are by design an indiscriminate weapon. The devastation and long lasting irradiating effects of nuclear weapons make it impossible for non-combatants to escape the destruction (Webber, 2013). The use and the threat of the use of nuclear weapons are legally questionable, and contrary opinions exist for the UK. While the government believes that the Trident renewal is fully compatible with Britain's treaty commitments and international law, two other legal opinions by eminent British lawyers contradict this (Singh and Chinkin, 2005; Sands and Law, 2006). Should the UK go ahead with replacing Trident its nuclear arsenal would last until 2060, 90 years after the UK committed to the idea of disarmament. This action would certainly give further legitimacy to other states that claim that nuclear-armed states are not holding up their side of the bargain in the NPT, to move towards disarmament, and this could be used to justify other states arming themselves with nuclear weapons. While the UK claims that it must protect against a future threat, one that does not yet exist, by retaining its nuclear weapons, might not other states argue that they too have to protect themselves in the same way?

Perhaps the most pertinent example however for a British decision on nuclear weapons would be Sweden, being comparable to the UK in its economy, its position under threat during the Cold War and its nuclear industry.

The Swedish government after World War II decided that nuclear weapons would improve the nation's ability to maintain its strategy of neutrality and help protect itself from the nearby Soviet Union. In the 1960s Sweden faced budgetary issues and its military, politicians and people questioned the supposed security benefits of developing nuclear weapons. Swedish military strategists reasoned that were the Soviet Union to attack Europe or a military attack be aimed at Sweden it would almost certainly be by conventional means. They then concluded that if such a conflict took place it would be exceedingly unlikely to escalate into a nuclear war. Furthermore even if Sweden had nuclear weapons this would not change the outcome, especially as Sweden was unlikely to be able to match the arsenals of the other nuclear powers. Indeed the scenarios plotted out by Swedish military thinkers where Sweden used tactical nuclear weapons in defence against an invasion would result in the death of a quarter of the Swedish population, an absurd proposition for true security. Finally military planners concluded that Sweden would almost certainly only find itself involved in a war if NATO and the Eastern bloc were already in conflict and there would not be any additional deterrent effect to be gained by Sweden having nuclear weapons, indeed it might make the country a target (Arnett, 1998).

Therefore, as a consequence of this analysis together with the political realities in Sweden at the time, it was concluded that a far better investment would be to plan for a conventional attack and equip themselves accordingly rather than try to invest in an expensive nuclear arsenal. The UK could learn from this example, especially as the UK faces even less of a threat from a state-based nuclear attack than Sweden did.

Finally, it is worth noting that the UK government is funding some work on monitoring and verification processes for nuclear disarmament, but only on a small scale (Nuclear Information Service, 2012).

A7.5 Cyber security

A further, new form of militarisation has also become a new security threat. The uncontrolled proliferation of state-controlled cyber attack capabilities is a threat to our society now that we are so dependent on communication technologies. The NSS identifies threats emanating from cyberspace as a Tier One threat. The SDSR has called for a greater focus on cyber warfare, both offensively and defensively. While cyber security is clearly important the danger of a widespread, possibly indiscriminate cyber attack could be catastrophic.

There is also a perceived higher risk of cyber attacks being put to use covertly and more freely than conventional attacks. Indeed the Stuxnet attack on the Iranian nuclear programme is only one of several recorded cyber attacks with likely state involvement. There are even more examples of cyber espionage in which technology and information has been stolen in with the suspected support of states.

Intellectual property theft, often through cyber espionage has been estimated by a Cabinet Office commissioned report to cost the UK £27bn per year, widely thought to be an underestimate (Warren, 2012). A determined attack could theoretically cripple key parts of our economy and infrastructure. Some military approaches to cyber warfare appear to treat cyber conflict as a form of conflict that is undetectable and void of the normal considerations around aggression and force. But an attack that could do so much harm should be treated like other forms of conflict. Furthermore these attacks are now being treated as potential acts of war by some states and therefore we must consider them to be just as dangerous as a more visible display of aggression.

The UK's move into cyber security has not been limited to purely aggressive and defensive technology. There are also concerns about proposals regarding data mining and propaganda capabilities that the UK may be developing. Such capabilities, whether used on UK citizens or elsewhere may violate basic civil liberties and human rights standards related to the right to privacy and freedom of speech. UK government involvement in the highly controversial US Prism surveillance programme is the most prominent example of such problems (Hopkins, 2013). Such matters should be discussed openly and be open to democratic scrutiny.

The development and use of cyber warfare technology pose major dangers due to their potential to spark an armed conflict or cause property damage. Like conventional weapons, cyber technology is also being actively exported around the world. The controls for cyber technology is covered by the same laws in the UK as arms exports, though there is a legitimate concern that, with software being even easier to transport than conventional weapons, these could evade controls even more easily. Cyber surveillance technology has already found to have been transfer from UK based companies to regimes which cracked down on Arab Spring protestors (The Guardian, 2013).

Cyber security should certainly be thought of as a significant threat but the UK's response should not be to allow and participate in the proliferation of this dangerous set of technologies which could be devastating and spark a conventional conflict as well.

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Appendix A8. Additional R&D spending related to sustainable security

As part of our analysis of UK public spending on R&D directly related to sustainable security – see chapter five – we also compiled figures for the financial year 2007-8 as shown in table A8.1. For references, see section 5.2.

Table A8.1. R&D spending on sustainable security in the UK, 2007/8 (cash terms)

£m	2007-8
Dept for Energy and Climate Change (DECC)	0
Dept for Environment, Food and Rural Affairs (DEFRA)	21
Dept for International Development (DFID)	151
Engineering and Physical Sciences Research Council (EPSRC)	214
Natural Environment Research Council (NERC)	364
Economic and Social Research Council (ESRC)	30
Biotechnology and Biological Sciences Research Council (BBSRC)	10
Total	*790*