Edexcel GCE

Geography

Advanced
Unit 3: Contested Planet
ADVANCE INFORMATION

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Paper Reference
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Information

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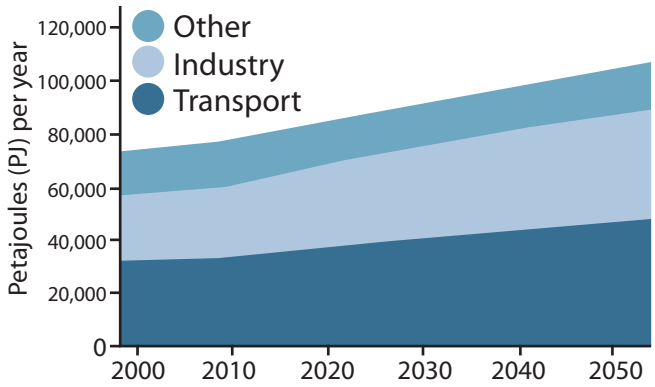
SECTION B

The following resources relate to Question 6.

ENERGY SECURITY
ENERGY SECURITY OPTIONS FOR NORTH AMERICA

North America is hungry for energy. The three countries of Mexico, Canada and the USA had a combined population of 448 million people in 2008 and a combined GDP of $16.8 trillion – around 27% of global GDP. Figure 1 shows one projection for total energy demand growth in the three countries to 2050.

Figure 1: Projected energy demand in North America



Mexico, Canada and the USA work closely together as a **regional bloc**, especially on economic issues. On January 1 1994 they signed the North American Free Trade Agreement (NAFTA) creating a free trade bloc. Other **trilateral** agreements deal with the following policy areas:

- North American Agreement on Environmental Cooperation (NAAEC) relating to conservation issues.
- North American Agreement on Labour Cooperation (NAALC) relating to working conditions.
- Security and Prosperity Partnership of North America relating to agriculture, immigration and other issues.

In 2001 the **North American Energy Working Group**, led by Natural Resources Canada (a government department), was set up to increase cooperation on energy related issues.

Figure 2: Fossil fuel production and demand

Crude oil (thousand barrels / day) **Natural gas** (billion cubic ft / yr) **Coal** (million tonnes / year)		Production 1990	Production 2000	Production 2010	*Demand 2010*
Canada	Crude Oil	1,667	2,197	3,083	***1,880***
	Natural Gas	3,494	5,920	7,050	***3,940***
	Coal	68	69	65	***53***
Mexico	Crude Oil	2,548	3,012	4,024	***1,920***
	Natural Gas	1,333	1,713	3,184	***3,000***
	Coal	8	19	20	***28***
USA	Crude Oil	7,355	5,822	5,080	***23,000***
	Natural Gas	17,810	19,403	23,000	***28,000***
	Coal	1,590	1,968	2,260	***1,130***

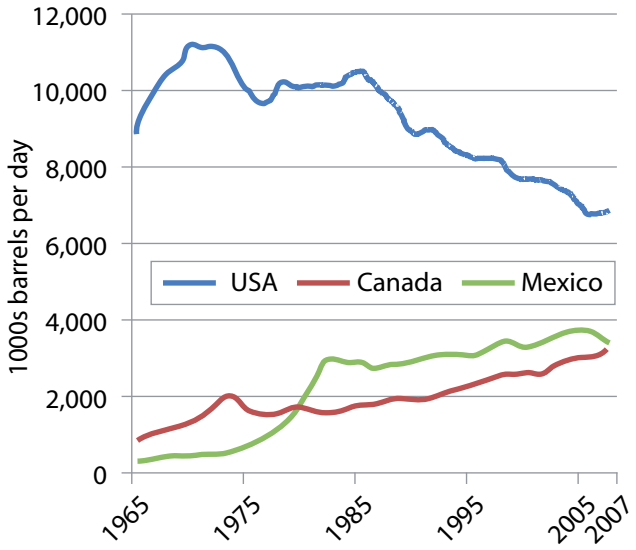
(Source: North American Energy Working Group)

North America has rich fossil fuel reserves and Mexico, Canada and the USA are major players in the global petroleum industry. Production has changed significantly in recent years (Figure 2) although crude oil production may have peaked in some countries (Figure 3, page 4).

There are a number of risks to energy security in North America:

- the short term dependence of the USA on imported natural gas
- the growing dependence of China and India and others on imported oil, creating a very competitive market and high prices
- the need to control carbon emissions making traditional energy sources politically difficult
- the **proliferation** risks from commercial nuclear power
- vulnerability of energy infrastructure to terrorist attack
- the power of the environmental lobby.

Figure 3: Crude oil production, 1965–2007



As the USA relies on imported oil and gas there is awareness that maritime trade could be disrupted by the threats of terrorism and piracy (Figure 4, page 5). Choke points, narrow shipping routes through which large volumes of tanker-borne oil pass, are vulnerable to political and terrorist disruption.

Mexico, Canada and the USA are all commercial nuclear powers (Figure 5). No new nuclear power plant was constructed in the USA between 1996–2008. Many nuclear plants constructed in the 1960s and 1970s have either been shut down or will be decommissioned soon. Planned reactors will tend to replace older power plants going off-line rather than add to nuclear capacity.

Figure 5: North American nuclear power, 2008

Country	USA	Canada	Mexico
Number of reactors 2008	104	18	2
MW capacity	100,600	12,600	1,300
% of all electricity generation	19%	15%	4.6%
Planned reactors	31	10	2

Supporters of nuclear power argue that it is clean in terms of carbon emissions when compared to fossil fuels. Nuclear power plants operate in all weather conditions unlike some renewable sources.

In addition, the fuel source uranium, is available from some nations which are generally viewed as 'friendly and stable' (Figure 6).

Figure 6: World uranium production (% of global production, 2007)

Canada	23%	**Niger**	7.5%
Australia	21%	**Uzbekistan**	5.5%
Kazakhstan	18%	**USA**	4%
Russia	8%	**Ukraine**	2%
Namibia and South Africa	8%	**China**	1.5%

Declining fossil fuel production in some areas and the pressure to maintain energy supply has led some analysts to argue for increased use of **unconventional** and **technically difficult** fossil fuel resources (Figure 7, page 5). These resources have the benefit of being domestic rather than foreign. Within the USA there is an ongoing debate over drilling for oil in the outer continental shelf areas. New continental shelf developments were stopped in 1990 but allowed again in 2008.

In addition the **Arctic National Wildlife Refuge** (ANWR) is estimated to contain 6–16 billion barrels of recoverable oil. Oil exploitation is currently banned in the ANWR. However, if high oil prices continue and older fields increasingly cease production, pressure may grow to open up further areas of the Arctic to oil and gas development.

Biofuel production has expanded in North America especially in the USA. **Bioethanol** is made from crops such as maize. **Biodiesel** is manufactured from soy or oilseed rape and other crops.

Figure 8: USA Bioethanol production

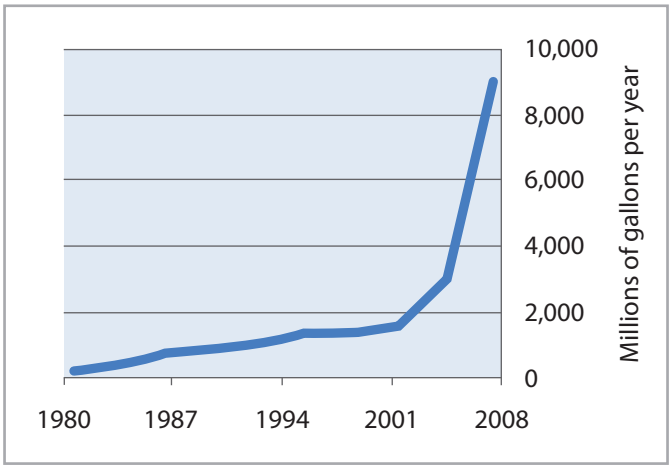
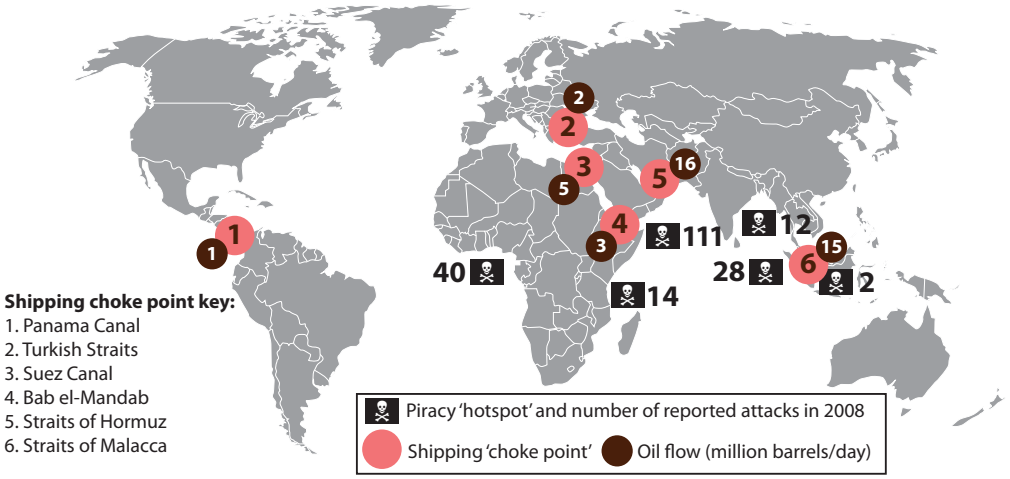


Figure 7: Unconventional and technically difficult fossil fuel sources and reserves in North America

CANADIAN TAR SANDS There are extensive tar sand deposits in Alberta, covering an area of 140,000 sq km at three locations: **Athabasca**, **Cold Lake** and **Peace River**. Around 25% of the total area has been leased for exploration and recovery.		**Reserves:** 1.7 trillion barrels? ***Economic at $80-90 per barrel***
Extraction:	Extraction is by either **opencast mining** or 'in situ' recovery. In situ mining involves 'steaming' the sticky bitumen out of the sands and pumping it to the surface. Natural gas is often used as the fuel source for steam generation.	
Environment:	The area is mostly undisturbed **boreal forest** which is lost due to mining activities although it can be restored to some extent.	
USA OIL SHALE Oil shales of the **Green River Formation** extend across vast swathes of Utah, Wyoming and Colorado in the Rocky Mountains. Sedimentary rocks contain solid hydrocarbon material known as kerogen.		**Reserves:** 800 billion to 1.5 trillion barrels? ***Economic at $100+ per barrel***
Extraction:	Oil shale must be heated to at least 400°C in order to capture the resultant liquid oil; this takes place after the rock has been mined but 'in situ' technologies are being developed. Coal, gas or even nuclear power could be used as a heat source.	
Environment:	The oil shale area covers much of the wild, mountainous and forested Colorado River basin, itself an important **water source**.	
MEXICAN DEEP WATER OIL Mexico has significant offshore oil in the Gulf of Mexico, west of the Yucatan Peninsula. These include the huge Cantarell field discovered in 1976. In 2006 **Pemex** discovered the **Coatzacoalcos field** in the Gulf, in 600m+ of deepwater.		**Reserves:** 30 billion barrels? ***Economic at $60 per barrel***
Extraction:	Offshore drilling has a long history although deepwater drilling is more costly and technically challenging. **Drillships** and **Floating Production**, **Storage** and **Offloading** (FPSO) vessels tend to be used rather than fixed oil platforms.	
Environment:	Minor offshore oil spills are common, and wastes from drilling vessels frequently pollute the sea bed. Most incidents are small but over time can be significant.	

Figure 4: Maritime trade 'choke points' and piracy incidents in 2008



Today most biofuel comes from processed food crops and the area of cropland used for this purpose has expanded in the USA and Canada (to supply the US market). Increasing food prices in 2007–08 were partly blamed on the rapidly rising use of food crops as **biofuel feedstocks**. In 2007 'tortilla riots' broke out in Mexico as people protested against rising maize prices.

- In February 2007 up to 70,000 people marched in Mexico City to protest against rising food prices.
- In May 2008 the Mexican Government began monthly payments of 120 pesos to help the poorest buy food.
- A basket of food costing $80 in January 2006 cost $115 by Jan 2008.

The USA has encouraged biofuel production using farm subsidies. So-called **second generation biofuels** could break the link with food crops. Cellulosic biofuels are being developed which could use stalks and leaves and other 'waste' products.

Clean coal technology is another option being explored by some in the energy industry as coal reserves are large. However the fuel has the reputation as being 'dirty'. Clean coal is a catch-all term which includes technologies such as flue gas desulphurisation (FGD), selective catalytic reduction (SCR) to remove nitrogen oxides and carbon capture and storage (CCS).

North America has significant renewable energy potential (Figure 9). Many suitable hydroelectric sites have already been developed but other technologies could be expanded significantly. Many renewable sources are geographically constrained and considerable investment is needed to move towards a greener energy future. In some cases fossil fuels remain cheaper than renewable alternatives. Costs are likely to converge in the future due to improved renewable technology and possibly rising fossil fuel costs. Figure 10 shows one possible future renewable scenario for electricity generation in North America. In 2000 Canada consumed 550 TWh; Mexico 155 TWh and the USA 3,620 TWh of electricity.

Figure 9: Solar, wind and geothermal potential

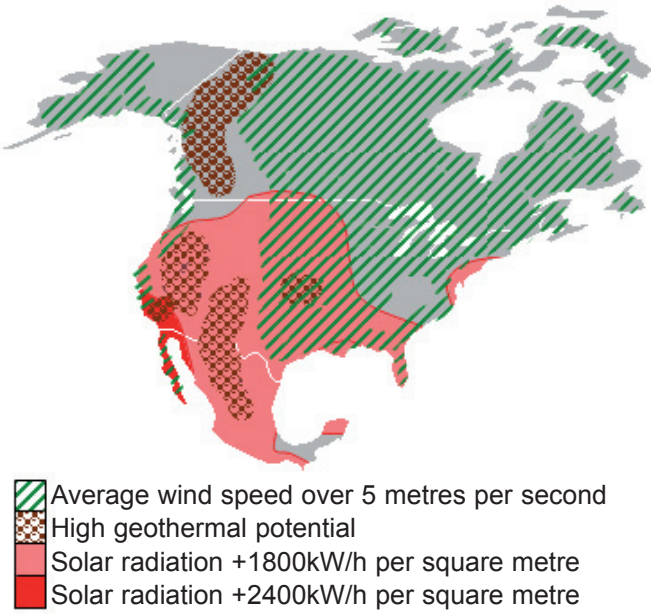
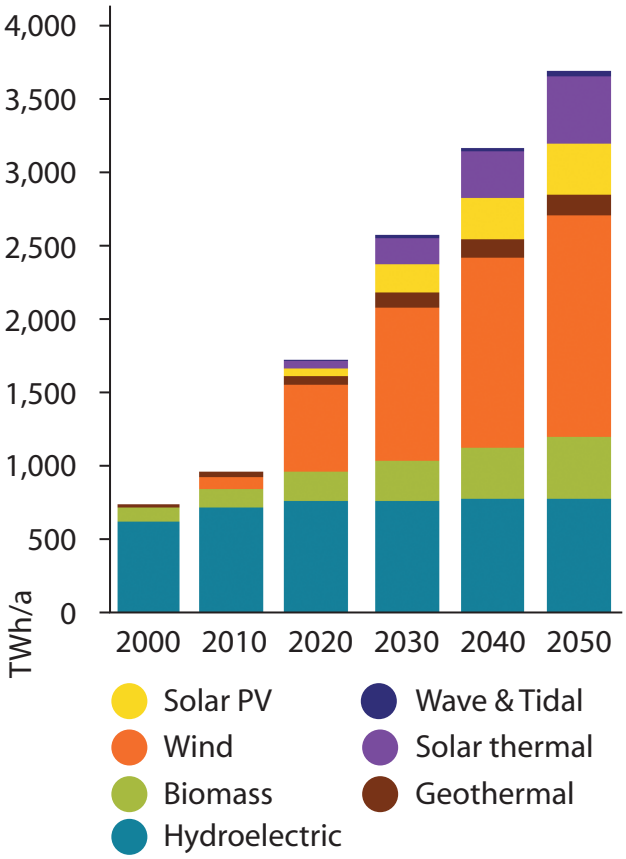


Figure 10: Renewable energy scenario for electricity generation for North America to 2050



(Source: adapted from Greenpeace / EREC, "*A Sustainable OECD North America Energy Outlook*", 2007)

Views on energy security in North America

View 1
"Of all the environmental impacts of oil shale development, the most serious appears to be the extent to which land will be disturbed. Regardless of the technical approach to oil shale development, a portion of the land over the Green River Formation will need to be withdrawn from current uses, and there could be permanent topographic changes and impacts on flora and fauna."
Oil Shale Development in the United States Prospects and Policy Issues (Rand Corporation, 2005)

View 2
"The idea of a North American or continental energy policy has been around for years. Today, the George W. Bush administration is again talking up what it calls North American energy security, with an eye to meeting as much of the United States' imported energy needs as possible from Canada and Mexico, thereby reducing dependence on the Middle East."
***The Toronto Star*, 2004**

View 3
"The green message - use less energy - is not going to solve the problem unless economic growth stops at the same time. If it does not (and it won't), any efficiency saving will soon be eaten up by higher consumption per head. Wind power is taking on natural gas, which has risen in price in sympathy with oil. Wind is closing in on the price of coal, as well. Solar energy is a few years behind, but the most modern systems already promise wind-like prices. Indeed, both industries are so successful that manufacturers cannot keep up, and supply bottlenecks are forcing prices higher than they otherwise would be."
***The Economist*, 2008**

View 4
"At present around 80% of global energy demand is met by fossil fuels. The unrelenting increase in energy demand is matched by the finite nature of these sources."
Greenpeace / EREC 2008

View 5
"One can provide good social, environmental and economic rationales for why the commercialisation of unconventional oils by rich developed countries is wrong headed, but the long and short of it is that it is plain and simply 'wrong'. How can we expect the developing world to emerge along a low carbon path when (a) the vast bulk of CO_2 already in the atmosphere is from us and (b) we then go on to exploit even more climate hostile sources of energy."
Foreword to: "Unconventional Oil - Scraping the bottom of the barrel?" WWF/ Cooperative Bank 2008

View 6
"By 2025 the world will be in the midst of a fundamental energy transition—in terms of both fuel types and sources. Non-OPEC liquid hydrocarbon production (i.e., crude oil, natural gas liquids, and unconventionals such as tar sands) will not be able to grow commensurate with demand."
Global Trends 2025, USA Department of National Intelligence, 2008

Websites for further research

- *www.energyblueprint.info* provides a range of information on energy in North America, and globally, including energy future scenarios. It is run by Greenpeace and the European Renewable Energy Council.
- *www.eia.doe.gov* and *www.energy.gov* are the US Government's energy department websites. Both have information and statistics on Mexico and Canada as well as the USA.
- *www.nrcan-rncan.gc.ca* is the Canadian Government's energy department website.
- *www.api.org* The website of the American Petroleum Institute representing over 400 energy companies.
- *www.nrel.gov* The US National Renewable Energy Laboratory has the latest on renewable research.

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