# Public attitudes to coal use in the context of global warming

**Rohan Fernando**

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## Abstract

Though coal remains the main fuel for power generation worldwide, concerns regarding the contribution of coal-fired power generation to global warming have also increased considerably in recent years. These concerns have somewhat eclipsed the many advantages of the use of coal for power generation. The attitudes of the public towards power generation from a particular fuel is an important factor in shaping government policy. For example, such attitudes are crucial in determining whether new coal-fired projects can proceed.

This report describes current public attitudes towards coal-fired power plant in several countries both in the developed and developing world. It compares these attitudes with those reported in an earlier report on this subject produced in 2006. Since then, the publication of the IPCC report in 2007 and the greater worldwide consensus on the reality of global warming following the change in administrations in the USA and Australia would be expected to affect public attitudes. However, events in late 2009 have increased the levels of public scepticism. The report principally collates opinion poll data available on the public's attitude towards energy, environment and the use of coal for power generation. Whereas before 2006, surveys of attitudes towards energy sources commonly included coal-fired plant, more recently coal plant are rarely included, presumably as it is assumed that the public would be overwhelmingly opposed. Hence the subject has been broadened to include attitudes to climate change. The report includes attitudes towards CCS. It also reports what national and international organisations say about the use of coal. This type of information will influence public attitudes. It investigates what the general public and concerned organisations say should be done to reduce the greenhouse effect. Countries and regions chosen for particular focus are the USA, the European Union, the UK, India, Thailand and Australia.

# Acronyms and abbreviations

| | |
|---|---|
| ACA | Australian Coal Association |
| ACCCE | American Coalition for Clean Coal Electricity |
| AMD | acid mine drainage |
| CATF | Clean Air Task Force |
| CHP | combined heat and power |
| CCS | carbon capture and storage |
| CFBC | circulating fluidised bed combustion |
| EDF | Environmental Defense Fund |
| ETS | Emissions Trading System |
| FBC | fluidised bed combustion |
| FoE | Friends of the Earth |
| IGCC | integrated gasification combined cycle |
| IPCC | Intergovernmental Panel on Climate Change |
| MoE | margin of error |
| NCC | National Coal Council |
| NGO | non-governmental organisation |
| PCC | pulverised coal combustion |
| WCI | World Coal Institute |
| WWF | World Wildlife Fund |

# Contents

# 1 Introduction

Coal remains the main fuel for power generation worldwide with a 42% share in 2007. In recent years, most of the growth in coal-fired generation has taken place in non-OECD countries, notably in China where it doubled between 2000 and 2006. However, concerns regarding the contribution of coal-fired power generation to global warming have also increased considerably in recent years, particularly since the publication of the IPCC (Intergovernmental Panel on Climate Change) report in 2007 which strongly suggested that, without further mitigation, global temperatures would increase between 1.8ºC and 4.0ºC by the end of this century. These concerns have somewhat eclipsed the many advantages of the use of coal in a balanced portfolio for power generation. Coal is easy to store and transport and can be obtained from a diverse range of reliable suppliers worldwide. Pulverised coal combustion (PCC) units are able to operate at varying loads, which is particularly useful in meeting peak demand, and they can compensate for the intermittency of some renewable sources. In addition, with widely fluctuating high prices for oil and natural gas, coal-fired generation is frequently the lowest cost option for power generation.

The attitudes of the public towards power generation from a particular fuel are an important factor in shaping government policy. For example, such attitudes are crucial in determining whether new coal-fired projects can proceed. Public attitudes towards coal-fired power generation vary significantly from country to country. In developed countries where information is freely available on the operation and emissions from a given energy source, where the availability of electricity is taken for granted and it is openly possible to voice concerns, local or national pressure groups may form to oppose a given type of plant. In developing nations in which there may be a shortage of electricity, the need for additional power may limit any public opposition to a proposed power plant. Within a country, demographic variables such as education, income and age will play some role in shaping the public's attitudes to matters concerning energy and the environment. The young and the well educated tend to be most concerned about the environment.

Though coal remains the world's most abundant, safe and secure form of energy, the public's perception of coal-fired power plant has not always been favourable. The coal industry is much older than many other energy industries and, for many, coal still conjures up belching chimney stacks and smogs. Though the industry has made considerable improvements in cleanliness, efficiency and safety over the past forty years, the public is not always aware of these improvements in environmental and social performance. Much of the environmental concerns regarding coal-fired plant used to focus on emissions of pollutants such as $SO_2$ and NOx, mercury, particulates and on ash disposal. However, by far, the greatest current concerns are those relating to $CO_2$ emissions leading to the greenhouse effect. Until recently, coal-fired power plant operators hoped that these concerns could be assuaged to some extent by reducing $CO_2$ emissions per unit of energy generated by improving the efficiency of the plant, cofiring biomass or utilising IGCCs. New PCC plant were then designed to be carbon capture ready so that carbon capture and storage (CCS) could be installed when the technology was perfected on a large scale. However, concerns regarding global warming have reached such levels that, in the developed world, any new coal-fired power plant will soon need to reduce a significant proportion of its $CO_2$ emissions from its first day of operation. Retrofitting CCS on existing coal-fired power plant seems inevitable in the future.

This report describes current public attitudes towards coal-fired power plant in several countries both in the developed and developing world. It compares these attitudes with those reported in an earlier report on this subject produced in 2006 (Fernando, 2006). Since then, the publication of the IPCC report in 2007 and the greater worldwide consensus on the reality of global warming following the change of administration in Australia in 2007 and in the USA in 2009 would be expected to affect public attitudes. However, events in late 2009 have increased the levels of public scepticism. The report principally collates opinion poll data available on the public's attitude towards energy, environment and the use of coal for power generation. It only includes surveys conducted by major organisations, sampling at least 1000 respondents, with results having margins of error of a few per cent. Hence the methodology of the surveys is not assessed. The majority of the surveys have been conducted face-to-face or by telephone. A few have been conducted online. Whereas before 2006, surveys of attitudes towards energy sources commonly included coal-fired plant, more recently coal plant are not usually included, presumably as it is assumed that the public would be overwhelmingly opposed. Hence the subject of this report has been broadened to include major surveys on attitudes to climate change. It includes a chapter reviewing attitudes towards CCS.

When considering public attitudes, it is instructive to consider that information is freely available to the public on relevant topics which would influence their views. It is impractical to try to assess all the information presented to the public on television, radio and in the newspapers but it is possible to describe what information is published by major national and international organisations which are either in favour or against the use of coal. It is inevitable that environmental groups will oppose the construction of new coal-fired plants or the operation of existing ones without significant reductions in $CO_2$ emissions. The report examines what information is available to the public from the industry itself. It investigates what the general public and concerned organisations say should be done to reduce the greenhouse effect. It addresses whether some types of coal-fired plant have a greater degree of acceptability than others. The report surveys how arguments in favour and against the use of coal have changed in different countries in recent years. The countries or regions chosen for particular focus are the USA, the European Union, the UK, India, Thailand, Australia and global surveys. These encompass different regions of the world, represent the developed and the developing nations, include economies of different sizes and are either coal users or suppliers.

# 2 Global opinions

In recent years, several international opinion polls have been held to determine global opinions on the reality of global warming, its causes and what action should be taken to mitigate its effects. The detailed findings on individual issues are given below.

## 2.1 Is climate change a threat to the global environment?

In 2006, the results of an opinion poll of thirty countries in all major regions conducted by GlobeScan Incorporated was published by World Public Opinion.org (2006a ) and presented in Table 1. The poll of 33,237 people was conducted between October 2005 and January 2006 and claimed a margin of error (MoE) for each country of ±3%. Across all countries, an average of 90% considered that climate change or global warming, due to the greenhouse effect, was either a very serious or somewhat serious problem. Countries expressing very high levels of concern included Nicaragua (99%), Turkey (98%), Brazil (93%), France (94%), Italy (94%), Germany (93%), UK (91%) and Canada (90%). Only in the USA (76%), South Africa (72%) and Kenya (65%) did fewer than 80% endorse this view. On average, only 5% said it was not a serious problem and only in the USA (21%) did more than one in five share this view. The other countries which had high percentages considering the issue not to be serious were Kenya (19%), China (17%) and Nigeria (16%). On average, 65% considered climate change to be a very serious problem with a majority considering so in twenty-three countries. The only countries in which a minority held this view were China (39%), Indonesia (44%), Kenya (44%), South Africa (44%), Philippines (46%), Nigeria (47%) and the USA (49%). The 2006 poll showed that concern regarding climate change had grown sharply compared to an earlier poll conducted in 2003. In the sixteen countries which were also polled earlier, on average the percentage saying the problem was very serious increased from 49% to 65%. In three countries the increases were modest: China (37 to 39%), Brazil (74% to 78%) and Italy (63% to 68%). In two countries the percentage decreased: India (67% to 65%) and Mexico (71% to 67%). This poll demonstrated that by 2006 there was substantial global consensus that climate change was a serious problem and that the concern had increased significantly since 2003.

Similar results were obtained in a Pew poll conducted in 2007 and shown in Table 2 (Pew, 2007). In this 47 nation survey, 45,239 people were questioned and the sample size in each country varied from 500 to 3142. Substantial majorities in twenty-five of the thirty-seven countries said that global warming was a very serious problem. Concern regarding climate change was especially acute in the Americas and Western Europe, whereas in Asia and the Middle East the views were mixed. In North America and Latin America, majorities in every country, except the USA, said that global warming was a very serious problem including 88% in Brazil, 78% in Venezuela, 75% in Chile, 69% in Argentina, 57% in Canada and 57% in Mexico. In the USA, 47% considered global warming as very serious with 28% as somewhat serious. Significant majorities in all but one Western European country considered global warming as being very serious, ranging from 57% in Italy to 70% in Spain. In the UK, as in the USA, less than half (45%) said it was very serious while another 37% considered it as being somewhat serious. Attitudes in Eastern Europe were similar. Clear majorities in Bulgaria (66%), Slovakia (65%), the Czech Republic (61%) and the Ukraine (59%) saw it as a very serious problem. Only in Russia and Poland did a minority (40%) regard it as being very serious though relatively high proportions thought it to be serious (Russia 33%, Poland, 47%). In Asia, public opinion was more divided. Large majorities in Bangladesh (85%), Japan (78%) and South Korea (75%) viewed global warming as a very serious problem. The issue was seen as less pressing in China (42%), Malaysia (46%), Indonesia (43%) and Pakistan (41%) where only a minority regarded it as being very serious. In China (46%), Malaysia (32%) and Indonesia (32%), relatively high proportions thought it to be serious. Opinion was also divided in the Middle East. Only about a third of those interviewed in Egypt and Jordan saw climate change as being very serious. In contrast the majorities in Morocco (69%), Kuwait (69%) and Turkey (70%) were substantial.

Another global survey was conducted by the Chicago Council on Global Affairs and World Public Opinion.org and published in 2007 on public attitudes to global warming (Figure 1) (World Public Opinion.org, 2007). Respondents in ten countries were asked to evaluate the threat posed by global warming.There were large majorities in all countries agreeing that the threat was important but there was less agreement on whether the threat was critical. Majorities considered it critical in Mexico (70%), Australia (69%), South Korea (67%), Iran (61%), Israel (52%) and India (51%). Pluralities agreed in Armenia (47%), China (47%) and the USA (46%). In each of these countries, in addition to those considering the issue to be critical, a significant fraction of the respondents, varying from 39% in the USA to 16% in Iran, considered the issue to be important but not critical. The Ukraine was the only country which was divided on whether the problem was critical (33%) or important but not critical (33%).

A poll of five European countries and the USA was conducted by the Financial Times and the Harris organisation to determine attitudes towards global warming (Financial Times/Harris, 2009). A total of 6463 adults were questioned online in September/October 2009. The European countries were France, Germany, The UK, Italy and Spain. The results are shown in Table 3. The results show that over 90% of those questioned from the five largest countries in Europe and slightly less in the USA considered that climate change was at least some threat to the world. Over 80% of the French, Italian and Spanish questioned thought it was a large or fair amount of threat and nearly half of French and Italians thought it was a large threat. In the UK, Germany and the USA the perceived threat level was considered slightly lower

**Table 1 Global attitudes to seriousness of climate change** (World Public Opinion.org, 2006a)

| | Very serious, % | | Somewhat serious, % | | Not very serious, % | | Not at all serious, % | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2003 | 2006 | 2003 | 2006 | 2003 | 2006 | 2003 |
| Argentina | 80 | 64 | 14 | 21 | 2 | 7 | | 1 |
| Brazil | 78 | 74 | 15 | 18 | 4 | 5 | 1 | 2 |
| Canada | 57 | 40 | 33 | 41 | 6 | 11 | 3 | 5 |
| Chile | 86 | | 10 | | 2 | | | |
| China | 39 | 37 | 41 | 42 | 15 | 17 | 2 | 1 |
| Costa Rica | 84 | | 11 | | 4 | | 1 | |
| El Salvador | 81 | | 16 | | 3 | | | |
| Finland | 59 | | 30 | | 8 | | 1 | |
| France | 70 | 46 | 24 | 43 | 3 | 8 | 1 | 1 |
| Germany | 73 | 54 | 20 | 33 | 5 | 10 | 1 | 2 |
| Guatemala | 83 | | 12 | | 3 | | 1 | |
| Honduras | 58 | | 23 | | 10 | | 4 | |
| India | 65 | 67 | 25 | 24 | 8 | 5 | 1 | 1 |
| Indonesia | 44 | 36 | 37 | 43 | 14 | 16 | 2 | 1 |
| Italy | 68 | 63 | 26 | 30 | 4 | 5 | 1 | 1 |
| Japan | 75 | | 23 | | 2 | | | |
| Kenya | 44 | | 21 | | 13 | | 6 | |
| Mexico | 67 | 71 | 21 | 23 | 4 | 3 | 4 | 1 |
| Nicaragua | 90 | | 9 | | | | | |
| Nigeria | 47 | 35 | 33 | 32 | 13 | 18 | 3 | 8 |
| Panama | 73 | | 22 | | 5 | | | |
| Philippines | 46 | | 40 | | 12 | | 1 | |
| Poland | 66 | | 26 | | 3 | | 1 | |
| Russia | 59 | 43 | 29 | 34 | 7 | 15 | 1 | 1 |
| Saudi Arabia | 63 | | 33 | | 3 | | | |
| South Africa | 44 | 30 | 28 | 32 | 9 | 18 | 5 | 6 |
| South Korea | 63 | | 31 | | 4 | | | |
| Turkey | 64 | 37 | 34 | 40 | 2 | 16 | | 1 |
| UK | 70 | 50 | 21 | 35 | 6 | 9 | 2 | 3 |
| USA | 49 | 31 | 27 | 40 | 12 | 13 | 9 | 11 |
| Average | 65 | 49 | 25 | 33 | 3 | 11 | | |

with the most popular option being that climate change was some threat rather than a fair or large threat. The proportion thinking that climate change was no threat at all was in the 2–6% range in France, Italy, Spain and Germany. It was higher in the UK at 8% and highest of all in the USA at 11%.

At the time of the Copenhagen summit in 2009, the World Bank's World Development Report 2010 commissioned an international poll on public attitudes to climate change. This poll specifically targeted developing countries and was undertaken by World Public Opinion.org in collaboration with PIPA. The survey questioned 13,518 respondents in fifteen countries between September and October 2009. When questioned on the seriousness of climate change, the

**Table 2 Global attitudes to seriousness of global warming** (Pew, 2007)

| | Very serious, % | Somewhat serious, % | Not too serious, % | Not a problem, % | Don't know, % |
|---|---|---|---|---|---|
| USA | 47 | 28 | 13 | 9 | 2 |
| Canada | 58 | 29 | 8 | 4 | 2 |
| Argentina | 69 | 21 | 2 | 1 | 7 |
| Bolivia | 68 | 24 | 4 | 1 | 3 |
| Brazil | 88 | 8 | 1 | 2 | 2 |
| Chile | 75 | 17 | 2 | 1 | 5 |
| Mexico | 57 | 24 | 10 | 2 | 7 |
| Peru | 66 | 20 | 4 | 1 | 9 |
| Venezuela | 78 | 17 | 1 | 2 | 1 |
| UK | 45 | 37 | 10 | 5 | 3 |
| France | 68 | 27 | 4 | 1 | 0 |
| Germany | 60 | 26 | 8 | 4 | 2 |
| Italy | 57 | 35 | 2 | 1 | 6 |
| Spain | 70 | 25 | 2 | 0 | 3 |
| Sweden | 64 | 25 | 5 | 2 | 4 |
| Bulgaria | 66 | 19 | 5 | 1 | 8 |
| Czech Republic | 61 | 29 | 8 | 3 | 0 |
| Poland | 40 | 47 | 8 | 2 | 4 |
| Russia | 40 | 33 | 19 | 6 | 3 |
| Slovakia | 65 | 28 | 5 | 1 | 1 |
| Ukraine | 59 | 30 | 7 | 1 | 2 |
| Turkey | 70 | 18 | 3 | 1 | 8 |
| Egypt | 32 | 37 | 18 | 8 | 6 |
| Jordan | 32 | 32 | 25 | 8 | 3 |
| Kuwait | 69 | 19 | 6 | 6 | 1 |
| Lebanon | 41 | 42 | 15 | 2 | 1 |
| Morocco | 69 | 13 | 6 | 3 | 10 |
| Palestinian Territories | 59 | 22 | 5 | 7 | 7 |
| Israel | 48 | 37 | 11 | 2 | 2 |
| Pakistan | 41 | 21 | 5 | 3 | 30 |
| Bangladesh | 85 | 12 | 2 | 0 | 1 |
| Indonesia | 43 | 32 | 9 | 3 | 12 |
| Malaysia | 46 | 32 | 10 | 2 | 10 |
| China | 42 | 46 | 7 | 1 | 4 |
| India | 57 | 28 | 4 | 1 | 10 |
| Japan | 78 | 19 | 2 | 1 | 1 |
| South Korea | 75 | 22 | 2 | 0 | 0 |

**Table 3 Concerns regarding climate change** (Financial Times/Harris, 2009)

**How big a threat does climate change pose to the world?**

| | UK, % | France, % | Italy, % | Spain, % | Germany, % | USA, % |
|---|---|---|---|---|---|---|
| A large threat | 31 | 46 | 49 | 35 | 23 | 27 |
| A fair amount of threat | 25 | 38 | 33 | 50 | 32 | 29 |
| Some threat | 36 | 12 | 13 | 12 | 39 | 33 |
| No threat | 8 | 4 | 6 | 2 | 5 | 11 |

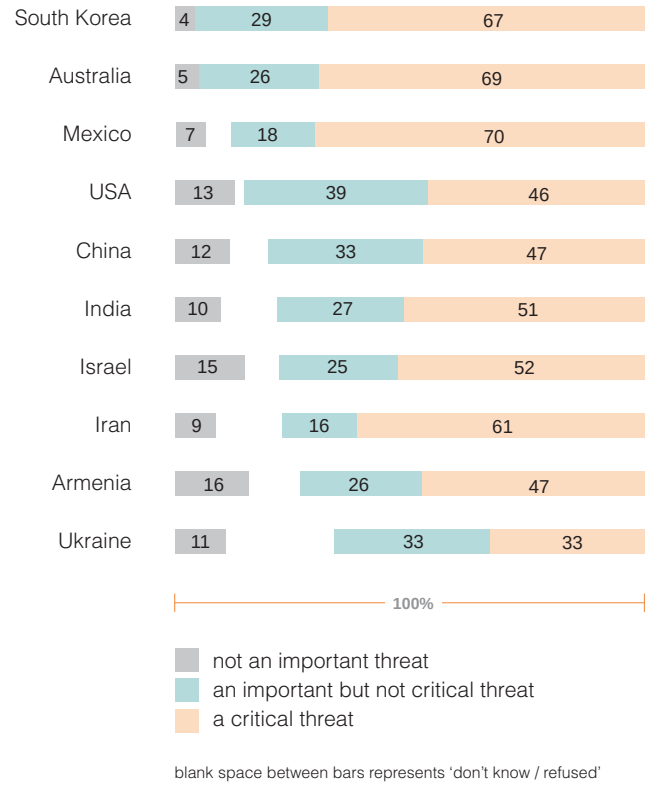


**Figure 1 Threat assessment of global warming** (World Public Opinion.org, 2007)

responses obtained are shown in Figure 2. Majorities in every country called it either a very serious or somewhat serious problem. Notably large majorities in Mexico (90%), Bangladesh (85%), Turkey (79%) and Kenya (75%) thought it a very serious problem. Indeed in Bangladesh practically everyone who was sampled thought climate change was either very serious or somewhat serious.This was not surprising given how susceptible Bangladesh is to a rise in sea level. Countries in which the fewest number who considered climate change to be very serious were the USA (31%), Russia (30%) and China (28%). The survey also asked what the respondents thought scientists around the world thought about climate change. They were asked to chose between three propositions namely whether most scientists thought the problem was urgent and enough was known to take action or most thought the problem was not urgent and not enough was known to take action or views were pretty well evenly divided. The responses are shown in Figure 3. In nine of the fifteen countries sampled, at least half the population thought that there was scientific consensus on the urgent need to take

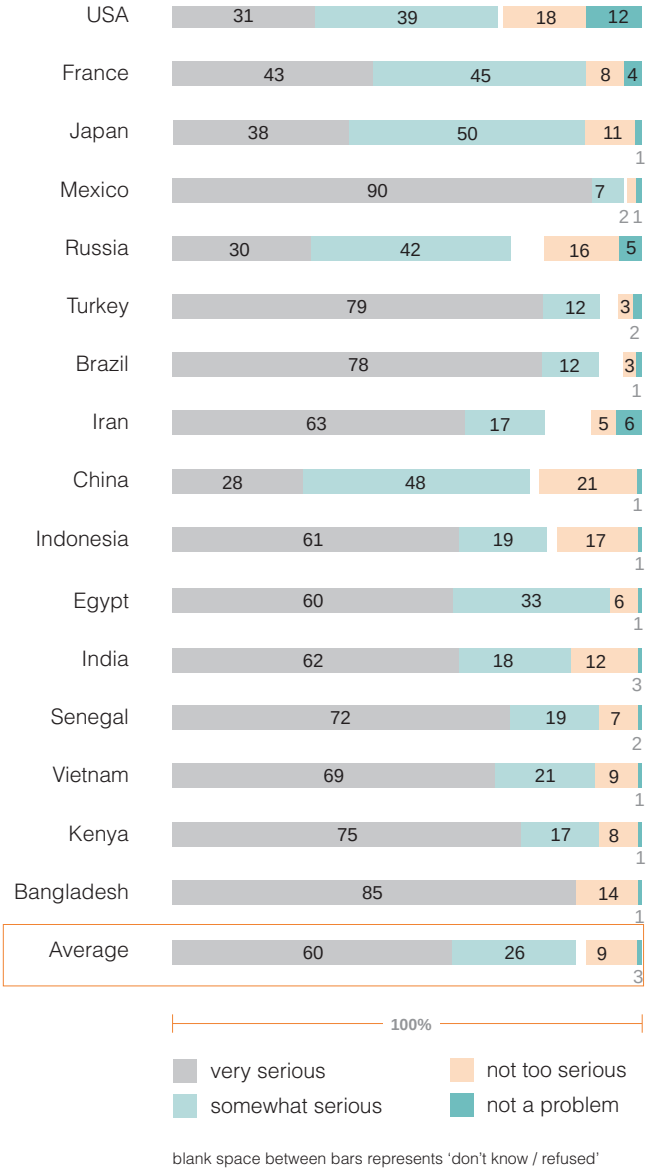


**Figure 2 Views on seriousness of climate change** (World Bank, 2009)

action. Bangladesh (70%), Vietnam (69%), Senegal (62%) and Kenya (61%) had the greatest percentages agreeing with this proposition. The countries in which only a minority supported this proposition were Russia (23%), Indonesia (33%), the USA (38%) and Japan (43%). Indeed, 34% of Russians felt that most scientists thought that the problem was not urgent and not enough was known for action (World Bank, 2009).

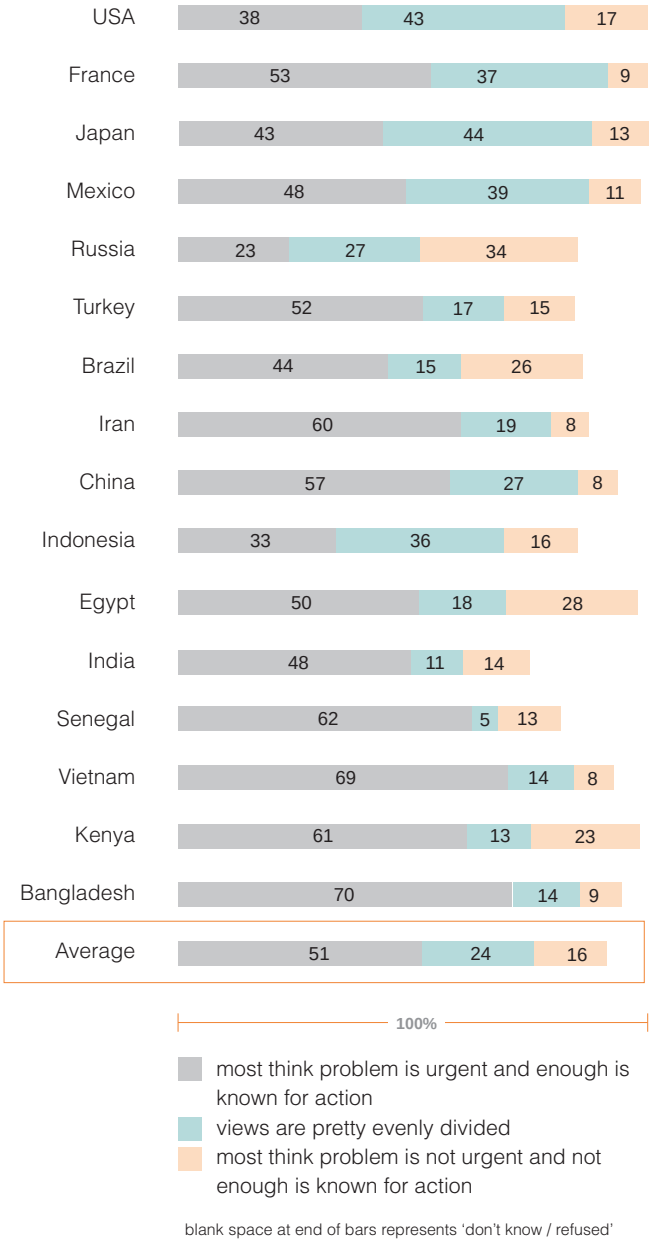


**Figure 3 Views on scientific consensus** (World Bank, 2009)

The BBC World Service in conjunction with GlobeScan also conducted a poll at the time of the Copenhagen summit of 24,071 people in twenty-three countries on their concerns regarding climate change (BBC, 2009). The results are shown in Figures 4, 5 and 6. Overall, 63% of those polled said that climate change was a very serious concern, 61% wanted their government to invest in measures to address climate change even if it hurt the economy, 44% wanted their government to play a leadership role to address climate change as quickly as possible and only 6% did not want their government to conclude any international agreement. In China, a lower proportion (57%) than the global average regarded climate change as being very serious. The Chinese were also less keen for their government to play a leadership role but they were by some distance the most enthusiastic in calling for their government to address the problem even if it hurts the economy with 89% in favour and only 8% against. The Indians and Americans were the nations least likely to regard climate change as being very serious with only 45% in both countries viewing it in that light. Indeed, one in four

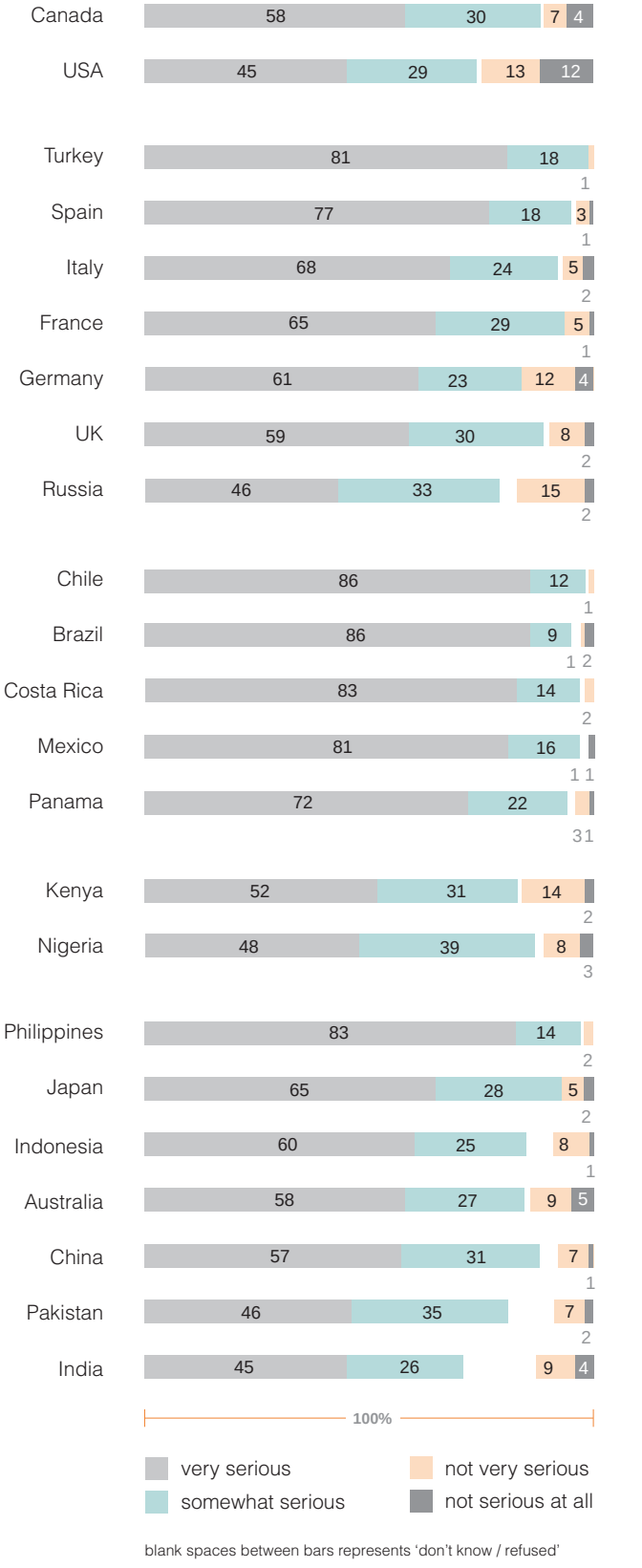


**Figure 4 Views on seriousness of climate change** (BBC, 2009)

Americans regarded it as being not very or not at all serious. The USA was also the country with the highest proportion opposing an international agreement (14%). The support for measures to address climate change was also relatively low in India (56%) and the USA (52%).

The Europeans were broadly in line with the international

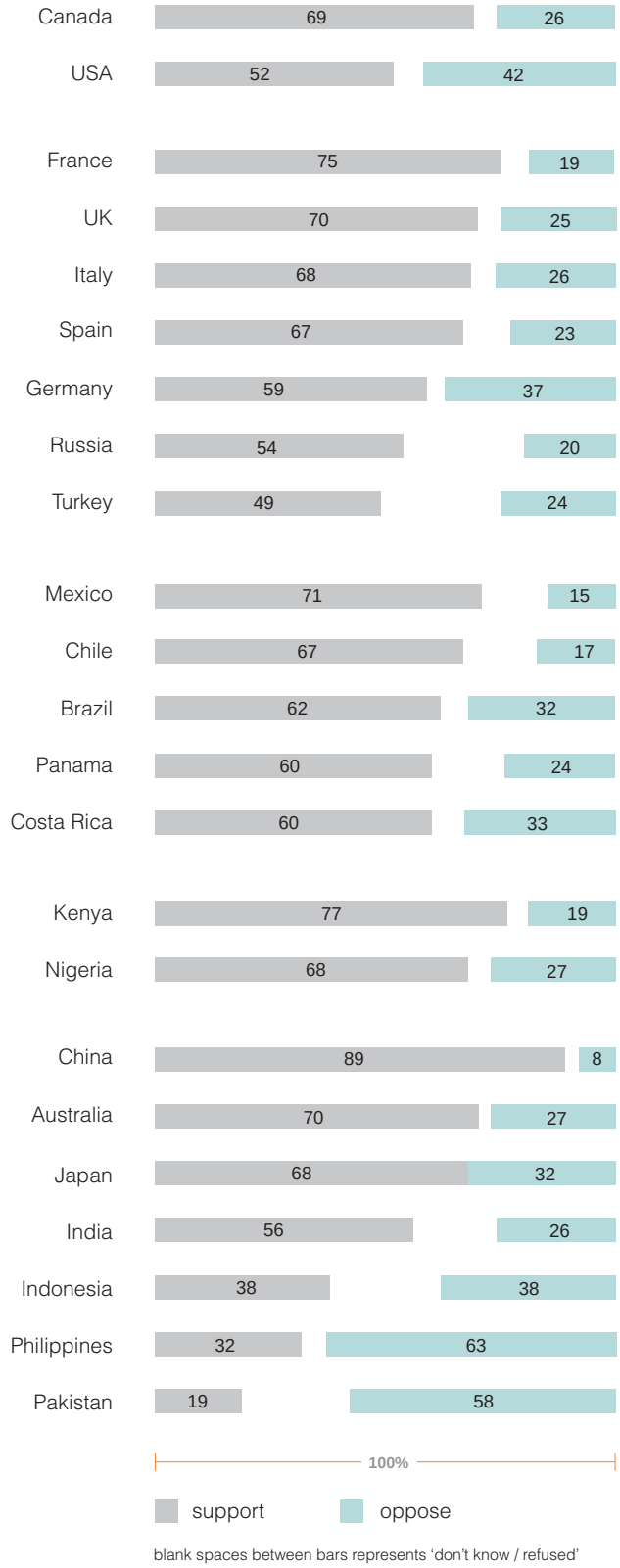


**Figure 5 Support for government action** (BBC, 2009)

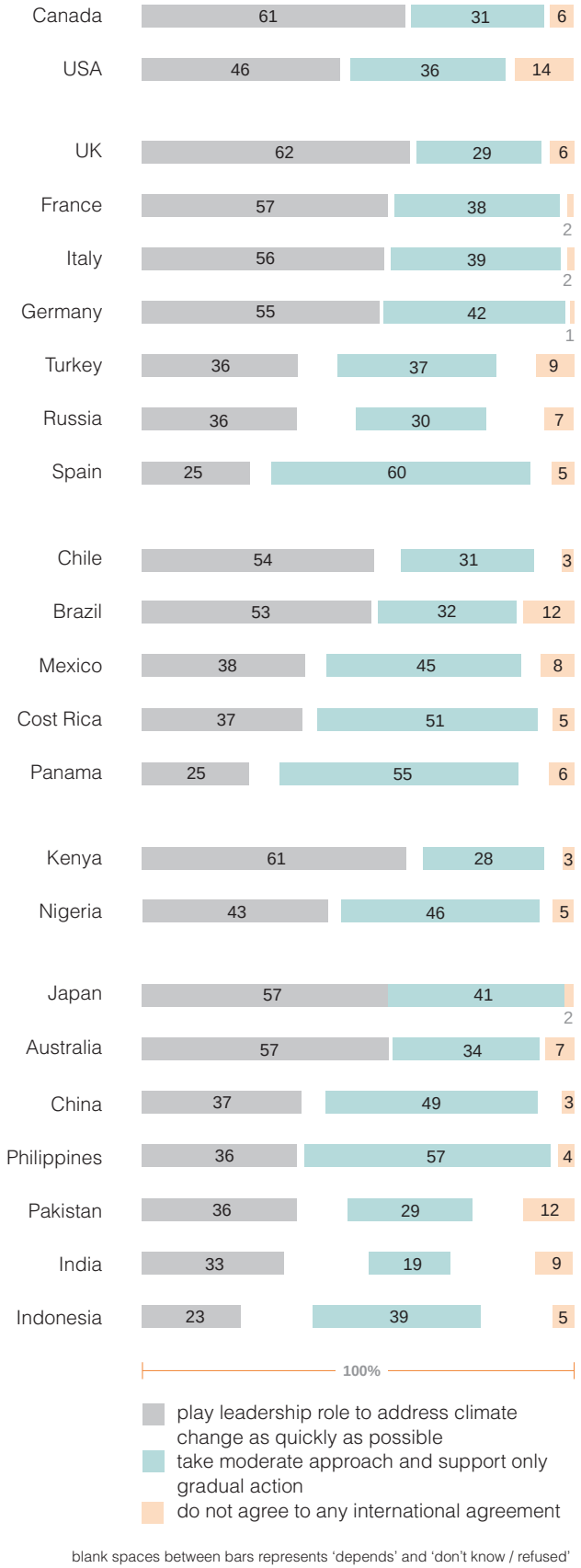


**Figure 6 Preferred strategy at Copenhagen Summit** (BBC, 2009)

average in their assessment of climate change as a very serious problem with 77% of Spanish, 68% of Italians, 65% of French, 61% of Germans and 59% of British regarding it so. Europeans were well above the average in their desire for their government to play a leadership role in the negotiations. Except for the Germans, Europeans were also more likely than most other nations to support government investments to address climate change even if it harmed the economy. Of all the regions, the Latin Americans were the most concerned about climate change with 86% of Brazilians and Chileans, 83% of Costa Ricans, 81% of Mexicans and 72% of Panamanians regarding it as very serious. They also showed average or above average willingness for their governments to address climate change even if it harmed the economy.

The Pew organisation also investigated global attitudes to climate change in 2009. Respondents in twenty-five countries were questioned between May and June. Large majorities in every country believed that global warming was a serious problem and majorities in fifteen thought it was very serious. Brazilians were most concerned with 90% considering it to be very serious. Approximately two-thirds or more thought it was very serious in Argentina (69%), France (68%), South Korea (68%), India (67%), Turkey (65%), Japan (65%) and Mexico (65%). Concern about global warming was least among some of the big polluters. Only 44% of Americans and Russians thought it was very serious. The Chinese expressed the least concern with only 30% considering it to be very serious. Concern about climate change had increased in seven countries since 2008. The proportion of Egyptians believing global warming to be very serious increased from 38% in 2008 to 54% in 2009. Similar increases were observed in Lebanon from 43% to 53%, Jordan from 41% to 54% and Nigeria 45% to 57%. In most countries, concern regarding global warming remained constant or had decreased since 2008. The decline was steepest in Turkey where the percentage decreased from 82% in 2008 to 65% in 2009. In Poland there was a reduction in those expressing very serious concern from 51% to 36% over the same period. The Japanese had steadily become less concerned with the proportion expressing very serious concern falling from 78% in 2007, 73% in 2008 to 65% in 2009 (Pew, 2009a).

In every international poll taken since 2006, majorities in all countries polled have said that global warming was a problem or threat and only a minority have said that it was not a problem. The countries that tend to be most concerned are Western Europe, Canada, Australia, Brazil, Bangladesh and South Korea. On the whole the USA, China, Russia and India seem to be less concerned. The countries most concerned about climate change tend to be the ones most likely to be affected by droughts or sea level rise and ones having governments who are also very concerned. What limited information that exists on global trends would suggest that in most countries scepticism regarding global warming has increased since 2008.

## 2.2 Awareness of global warming

A survey conducted by the Pew Research Centre in 2006 (Pew, 2006) investigated how much the public in fifteen countries had heard of several international issues. In total, 16,710 respondents were questioned. The results for global warming are shown in Figure 7. There was nearly universal awareness of the subject in most industrialised countries. In the UK, Japan and France the proportion of respondents who had heard of global warming was 100%, 99% and 97% respectively. However, the proportions who had heard of this issue in Russia (80%), China (78%) and India (57%) were considerably lower. In the Muslim world, with the exception of Turkey where 75% had heard, the percentage who was aware was less than 50% and in Pakistan only 12%.

A poll in 2007 was conducted for the BBC by GlobeScan together with Program on International Policy Attitudes (PIPA) (BBC, 2007). This poll questioned 22,182 citizens.

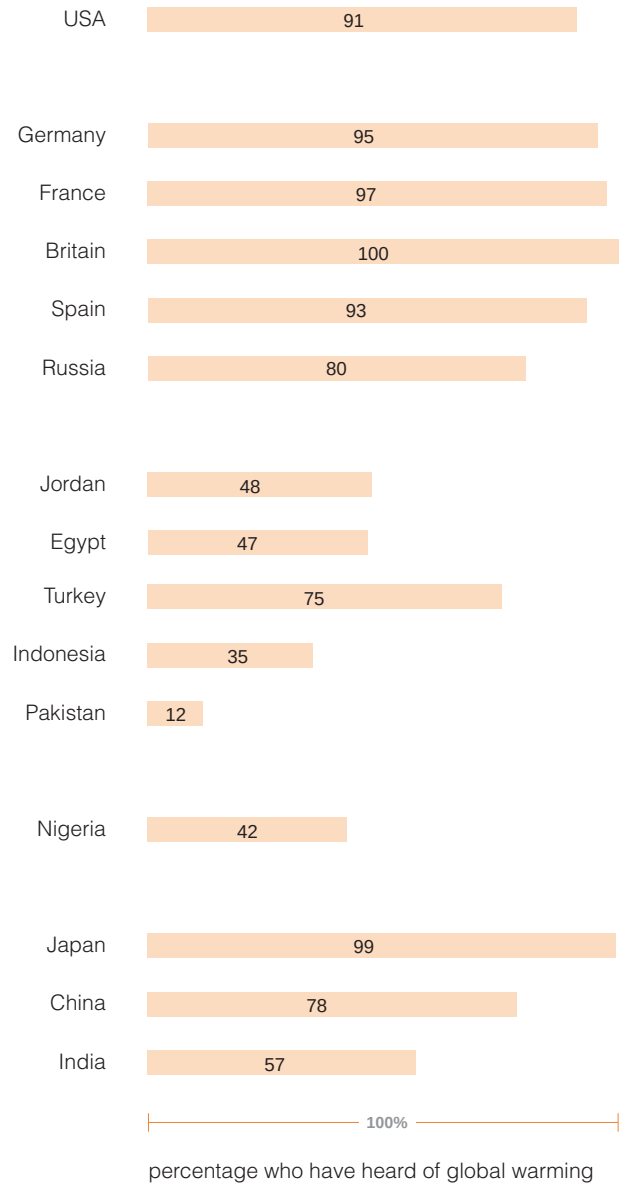


**Figure 7 Awareness of global warming** (Pew, 2006)

Interviews were face to face or by telephone and took place between May 29 and June 26 2007 and in eight of the twenty-one countries, the sample was limited to major urban areas. One question asked was how much the respondents had heard of global warming or climate change. The results which are shown in Figure 8, were very variable. In some countries, for example, South Korea (94%), France (92%), UK (90%), Australia (90%), USA (89%), Canada (89%) and Italy (87%), the bulk of the respondents had heard either some or a great deal. In some countries the figure was significantly lower: Brazil (78%), Spain (77%), Germany (76%) and China (72%). In four countries only a minority of the respondents had heard at least something of global warming: India (48%), Kenya (44%), Russia (35%) and Indonesia (28%). The overall average was that 70% had heard of global warming. Though this constitutes the majority, a significant minority was not informed.

Though the overall conclusions of the two polls were similar in that the vast bulk of respondents from the developed world had heard of global warming but a smaller proportion were aware in the less developed world, there were significant

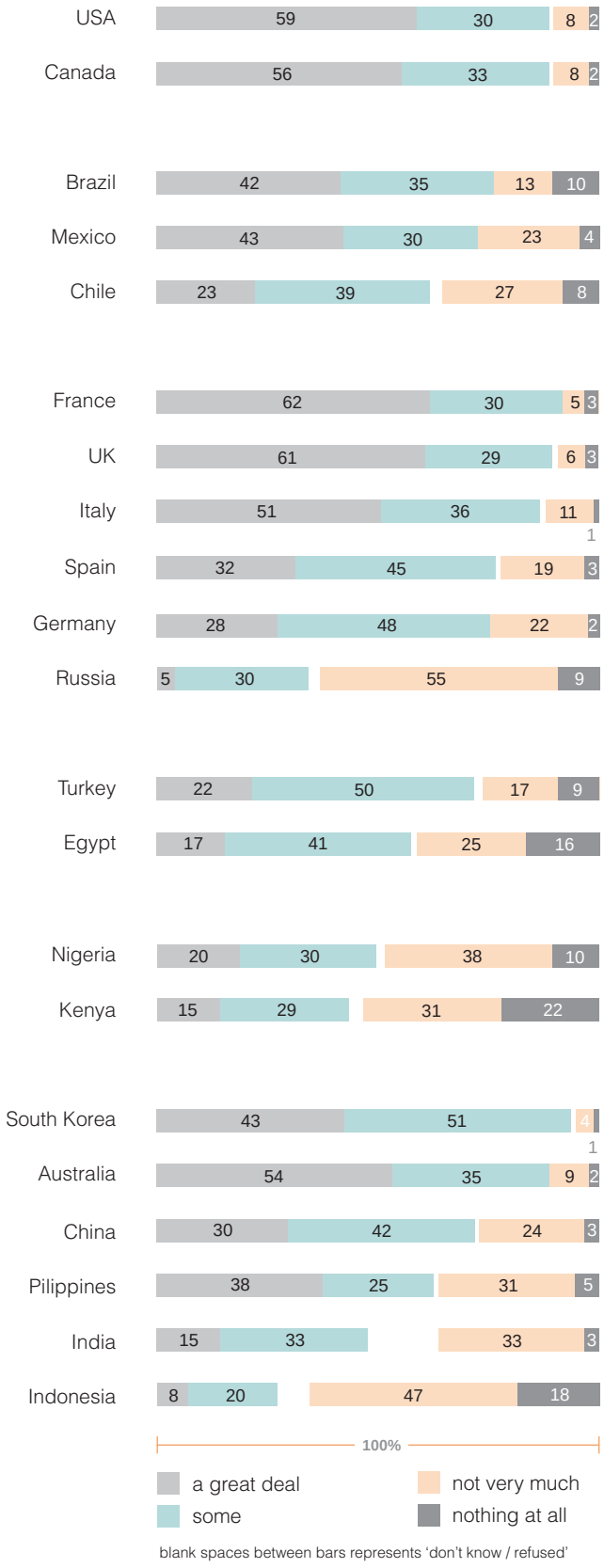


**Figure 8 Knowledge of global warming** (BBC, 2007)

discrepancies for the data for individual countries. For example, though both polls indicated that the proportion having heard of global warming in Russia was low compared to industrialised countries, in one the figure was 80% and in the other only 35%. Similarly for Germany, one poll gave 95% and the other 76% as having heard of it.

## 2.3 Is climate change caused by human activity?

On the eve of the 2006 G8 summit in St Petersburg, Russia, a poll was conducted across nineteen countries for the BBC World Service by the international polling firm GlobeScan and PIPA at the University of Maryland, USA on global attitudes on how energy use could affect the environment, the world economy and peace. In total 19,579 citizens were interviewed and the sample sizes in all but one country were greater than 1000. The data were obtained either face-to-face or by telephone. In most countries the sample was national but in four, the sample was limited to major urban areas. The overall results showed that in all the countries polled, significant majorities expressed concerns that existing energy policies posed the triple threats of harming the Earth's environment and climate, destabilising the global economy and sparking conflict and wars. There was overwhelming support for developments in alternative energy as well as higher fuel efficiency standards in automobiles. In some countries, there were concerns that particular energy suppliers, especially Iran and Venezuela might withhold oil exports.

Examining the results in detail which are given Table 4, it is apparent that large majorities expressed concerns on the impact of energy policy on the environment. Robust majorities in all countries expressed concerns that the way the world produced and used energy was causing environmental problems including climate change. The most concerned were those with higher levels of education. Overall, an average of 81% expressed concern about this with 47% saying they were very concerned. The highest levels of concern were found in Australia (94%, 69% very), UK (93%, 66% very), Canada (91%, 62% very) and Italy (91%, 60% very). The figure for the USA was somewhat lower (82%, 53% very). Least concerned were the Poles (58%, 17% very). The Indians (61%, 41% very) and the Russians (66%, very 20%) were relatively unconcerned. The countries having the highest proportions who were not very concerned or not at all concerned regarding the consequences of energy production on the environment were Poland (31%), Russia (24%), Mexico (23%), Egypt (22%), Israel (22%) and India (21%) (World Public Opinion.org, 2006b).

Another poll which addressed the same issue was the BBC (2007) poll in which 22,000 people in twenty-one countries were asked their views of human activity as a significant cause of climate change. The answers are shown in Figure 9. On average, in the countries in the survey, 79% held the view that human activity was responsible for climate change. In all countries but one, over two-thirds were of this view. In some countries, Mexico (94%), Spain (93%), Italy (92%) and South Korea (91%), the overwhelming majority thought so. In others, though this view was widespread, there was a significant minority who thought that human activity was not responsible, for example, UK (78% yes, 17% no), Canada (77% yes, 21% no) and USA (71% yes, 24% no). There was only one country in which fewer than half the population thought that human activity was responsible, namely India (47% yes, 21% no). The country which had the highest

**Table 4 Concerns about energy** (World Public Opinion.org, 2006b)

| Energy production/use harming environment/climate | | | | |
|---|---|---|---|---|
| | Very concerned, % | Somewhat concerned, % | Not very concerned, % | Not at all concerned, % |
| Australia | 69 | 25 | 5 | 1 |
| Brazil | 61 | 20 | 10 | 8 |
| Canada | 62 | 29 | 4 | 4 |
| Chile | 50 | 28 | 10 | 6 |
| Egypt | 41 | 36 | 15 | 7 |
| France | 45 | 45 | 7 | 3 |
| Germany | 43 | 40 | 13 | 3 |
| India | 41 | 20 | 13 | 8 |
| Israel | 42 | 33 | 12 | 10 |
| Italy | 60 | 31 | 7 | 2 |
| Kenya | 55 | 24 | 11 | 5 |
| Mexico | 35 | 39 | 18 | 5 |
| Philippines | 47 | 41 | 8 | 2 |
| Poland | 17 | 41 | 23 | 8 |
| Russia | 20 | 46 | 20 | 4 |
| South Korea | 43 | 47 | 7 | 1 |
| Ukraine | 35 | 38 | 14 | 3 |
| UK | 66 | 27 | 4 | 2 |
| USA | 53 | 29 | 10 | 8 |
| Global Average | 47 | 34 | 11 | 5 |

proportion thinking that human activity was not responsible was Egypt (66% yes, 33% no).

Both polls indicated that large majorities in most countries, both in the developed and developing world, considered that climate change was caused by human activity. Data for individual countries can be contradictory. In one poll, Mexico was the country which was most concerned whereas in the other it had a high proportion of sceptics. In both polls, India and Egypt seemed sceptical. The figures for the USA were lower than for other developed nations.

## 2.4 Urgency of action

In the BBC (2007) poll, respondents were also asked whether it was necessary to address climate change very soon, in modest steps in coming years or not at all. The results are shown in Figure 10. Overall, on average, nearly two-thirds of those sampled (65%) thought that it was necessary to take major steps very soon. In fifteen countries, majorities favoured this option. The largest majorities were found in Spain (91%), Italy (86%), France (85%) and Mexico (83%). In the USA, though a majority (59%) were in favour, it was not substantial. The Germans were evenly divided (50%) on this option or whether it was necessary to take modest steps in the coming years (45%). Countries with the smallest proportions favouring this option were Russia (43%), Egypt (43%) and India (37%). In each of these countries there were similar proportions favouring the modest steps option. On average, only 6% of those sampled thought it was not necessary to take any action. In Italy, France and Mexico only 1% were of this opinion. Countries in which relatively high proportions favoured no action were Nigeria (16%), Egypt (14%), Kenya (12%), India (12%) and Turkey (11%).

The World Public Opinion (2007) asked respondents in twelve countries whether global warming was such a serious problem that immediate action should be taken even if it incurred significant costs, whether the problem should be addressed gradually or no steps that incurred economic hardship should be taken until they were certain of the seriousness of the problem. The results are shown in Figure 11. Countries favouring immediate action were Australia (69%), Argentina (63%), Israel (54%) and USA (43%). Countries favouring a more gradual approach were Philippines (49%), Thailand (41%), Poland (39%), Ukraine (37%) and India (30%). Opinions in two countries were divided, namely Russia (32% immediate, 34% gradual) and China (42% immediate, 41% gradual). Countries which had the highest proportions favouring delaying action were India (24%), Russia (22%), Armenia (19%), Philippines (18%) and USA (17%).

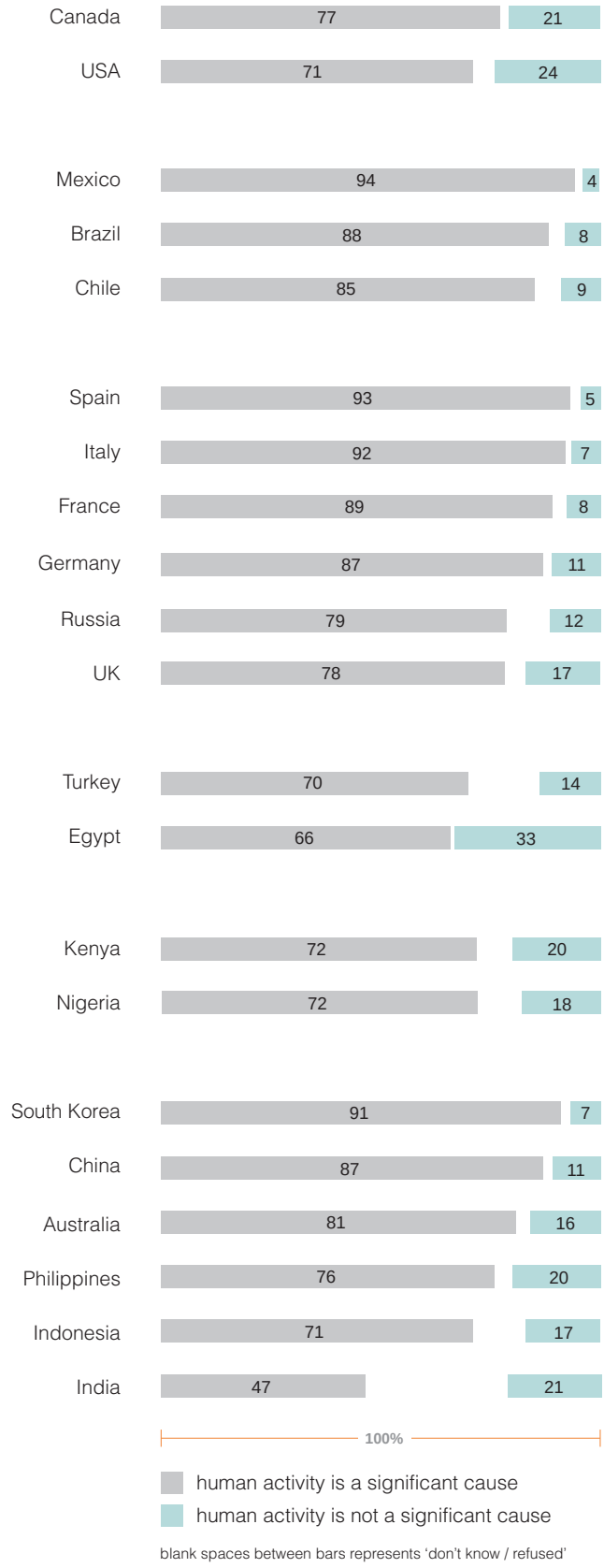


**Figure 9 Influence of human activity as a significant cause of global warming** (BBC, 2007)

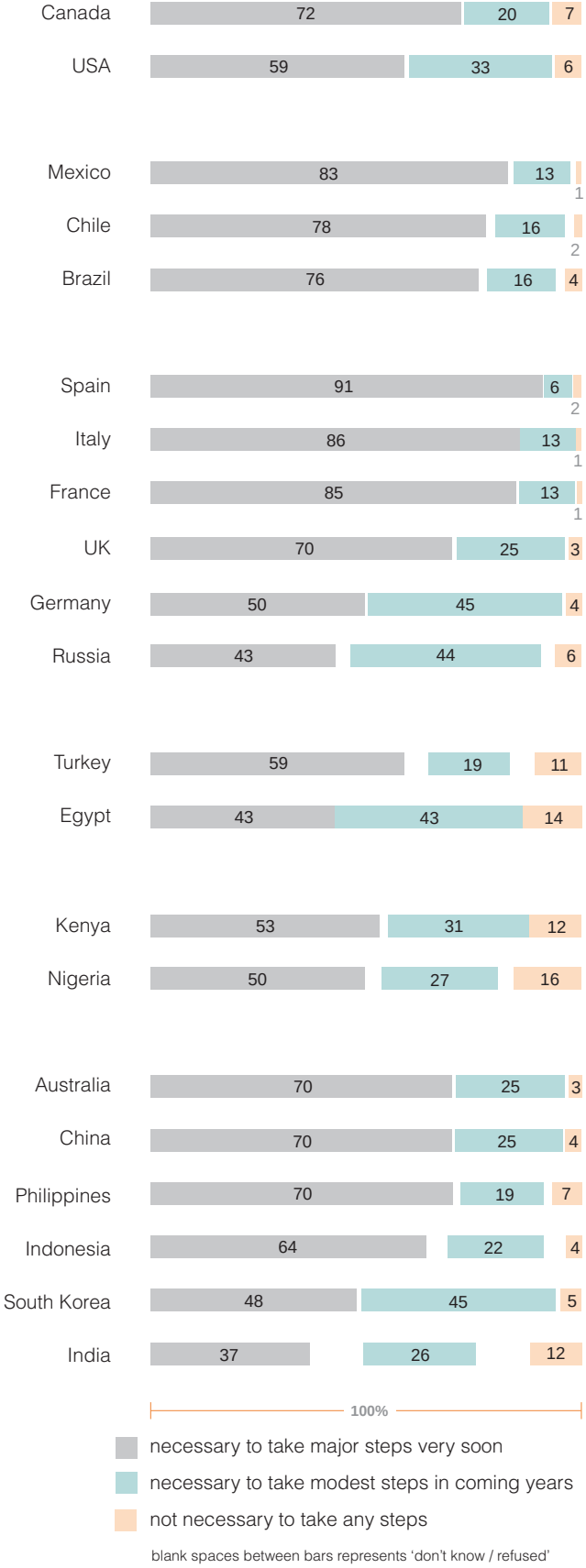


**Figure 10 Actions to reduce impact of climate change** (BBC, 2007)

A recent 2009 poll has been conducted by World Public Opinion.org in which 18,578 people in nineteen countries were questioned to find out whether the public desired their governments to do more on climate change (World Public Opinion.org, 2009). The results are shown in Table 5. In fifteen of the nineteen countries, majorities thought that their government should give a higher priority to climate change and in no nation did more than one in three of those sampled want their government to give a lower priority. On average, across all the nations sampled, 60% wanted climate change to

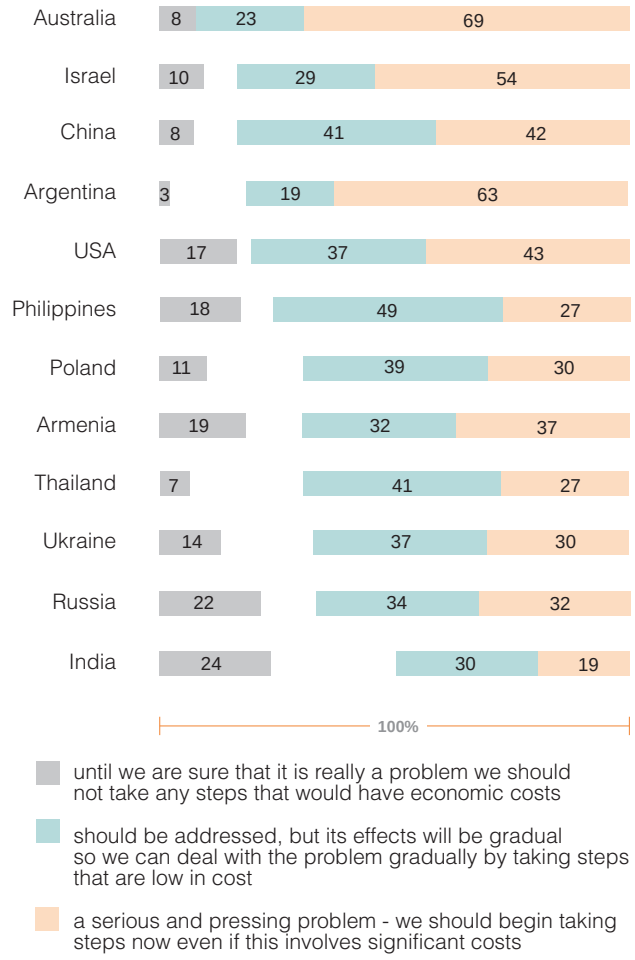


**Figure 11 Urgency of actions** (World Public Opinion.org, 2007)

be given a higher priority, 12% wanted a lower priority and 18% thought that the existing priority was about right. The largest majorities wanting a higher priority were in South Korea (81%), Mexico (79%), UK (77%), Taiwan (77%), France (76%), Kenya (71%) and Nigeria (70%). The countries having the largest proportions thinking that their government should have a lower priority were Germany (27%), USA (21%), Palestinian Territories (20%) and India (18%). This proportion was relatively high in Germany as its government already had implemented many measure to reduce GHG emissions and the public may have considered this to be sufficient. In the USA, it was more likely that a significant proportion of the public were not convinced of the seriousness of global warming. In India many may have considered that action should first be taken by the developed world.

The same poll compared the respondent's own priority regarding climate change with their perception of the priority given by the average person in that country. If each respondent overall was comparing correctly, the numbers saying more and less would be equal. The results show that in all but three countries (Iraq, Palestinian Territories, India) those rating themselves having an above average priority outweighed those who said they were below average. For all nations sampled as a whole, the percentage saying that they were above average exceeded those saying that they were below average by more than a ratio of two to one (42% to

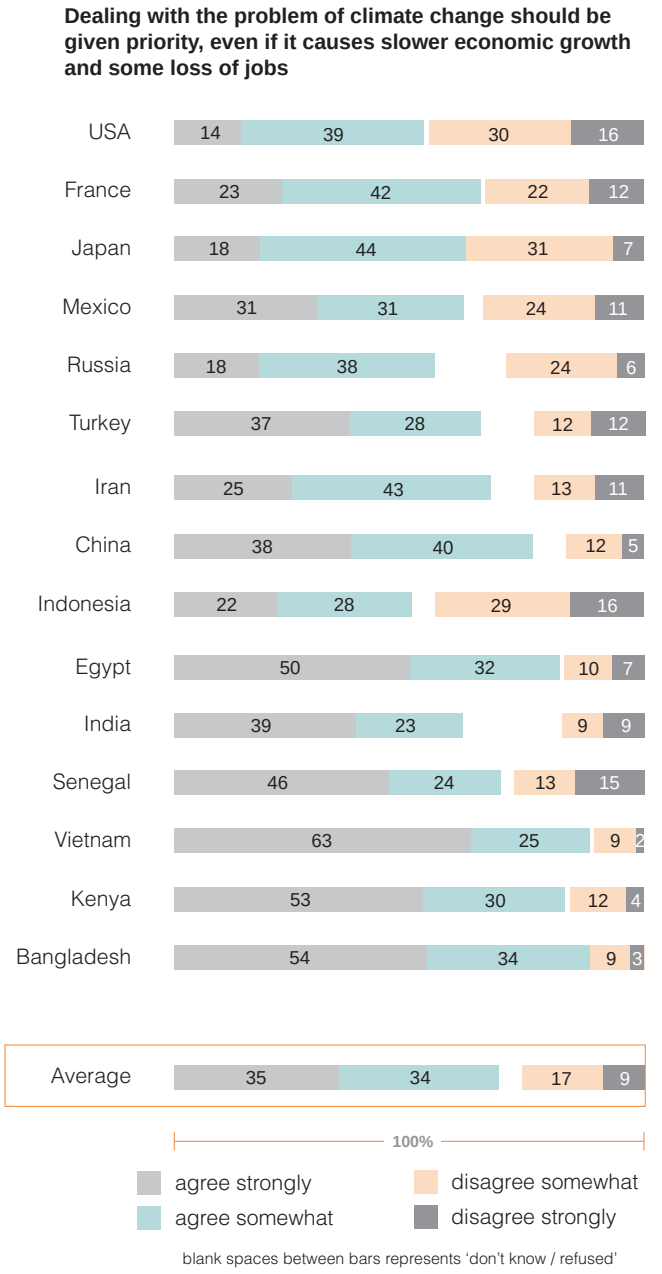


**Figure 12 Priority of actions** (World Bank, 2009)

19%). Clearly most people tend to overestimate their own commitment and underestimate that of others.

The World Bank (2009) poll also addressed the public priority regarding climate change. When asked if dealing with climate change should be given priority, even if it causes slower economic growth and some loss of jobs, the responses obtained are given in Figure 12. Though there was majority support for this proposition from all countries, there was marked differences in the extent of support. The most enthusiastic having the greatest proportion strongly agreeing were Vietnam (63%), Bangladesh (54%) and Kenya (53%). The least supportive having the smallest proportion strongly agreeing were the USA (14%), Japan (18%) and Russia (18%).

Overall, it is apparent that in many countries in Western Europe and some in the developing world such as Mexico, Bangladesh and South Korea, the bulk of the population are

**Table 5 Views on government priority for addressing climate change** (World Public Opinion.org, 2009)

| | Should place higher priority, % | Has placed correct priority, % | Should have lower priority, % | Don't know, % |
|---|---|---|---|---|
| Chile | 62 | 13 | 8 | 18 |
| Mexico | 79 | 13 | 3 | 5 |
| USA | 52 | 24 | 21 | 2 |
| France | 76 | 18 | 4 | 3 |
| Germany | 46 | 27 | 27 | 0 |
| UK | 77 | 14 | 8 | 1 |
| Poland | 54 | 25 | 10 | 10 |
| Russia | 56 | 16 | 4 | 23 |
| Ukraine | 68 | 5 | 2 | 24 |
| Egypt | 60 | 27 | 13 | 2 |
| Iraq | 39 | 23 | 17 | 20 |
| Palestinian Territories | 29 | 17 | 20 | 34 |
| Turkey | 65 | 16 | 8 | 11 |
| Kenya | 71 | 8 | 19 | 3 |
| Nigeria | 70 | 10 | 16 | 4 |
| China | 62 | 30 | 6 | 2 |
| Hong Kong | 67 | 21 | 5 | 6 |
| Macau | 52 | 20 | 6 | 23 |
| Taiwan | 77 | 16 | 7 | 0 |
| India | 43 | 24 | 18 | 16 |
| Indonesia | 53 | 23 | 8 | 16 |
| South Korea | 81 | 13 | 6 | 1 |
| Average | 60 | 18 | 12 | 10 |

convinced of the urgency of action. These polls suggested that the Germans, Americans, Russians, Chinese and Indians were less convinced.

## 2.5 Necessity of changing lifestyle

The BBC (2007) asked respondents whether individuals in that country would need to make changes in lifestyle and behaviour in order to reduce the amount of greenhouse gases they produced. The results are shown in Figure 13. In all countries large majorities agreed with this statement: 83% on average said it would be necessary and 46% said it would be definitely necessary. The countries with the largest percentages saying it would definitely be necessary were Spain (68%), Mexico (64%), Canada (63%), Italy (62%) and China (59%). In each of these four countries between 28 and 31% thought it would probably be necessary. The countries with the largest percentages saying that such changes would not be necessary were Nigeria (33%), Egypt (29%), Kenya (25%), USA (19%) and India (18%). Once again there was a significant minority in both the USA and India who were not convinced of the necessity of change of lifestyle.

## 2.6 Other measures to reduce greenhouse gas emissions

The 2006 BBC/PIPA/GlobeScan poll investigated public attitudes towards measures for combating global warming, which are shown in Tables 6 and 7. In all countries there was strong support, rising with education and income for governments to play a more active role in addressing the problem of energy supplies (World Public Opinion.org, 2006b). Some solutions, however, were considerably more popular than others. There was overwhelming support for creating tax incentives to encourage the development and use of alternative, renewable, sources such as solar and wind. On average, 80% favoured this approach, 50% strongly. Its most enthusiastic supporters were Italians (95% in favour, 75% strongly) followed by Australians (93% in favour, 74% strongly), Canadians (91% in favour, 66% strongly) and the

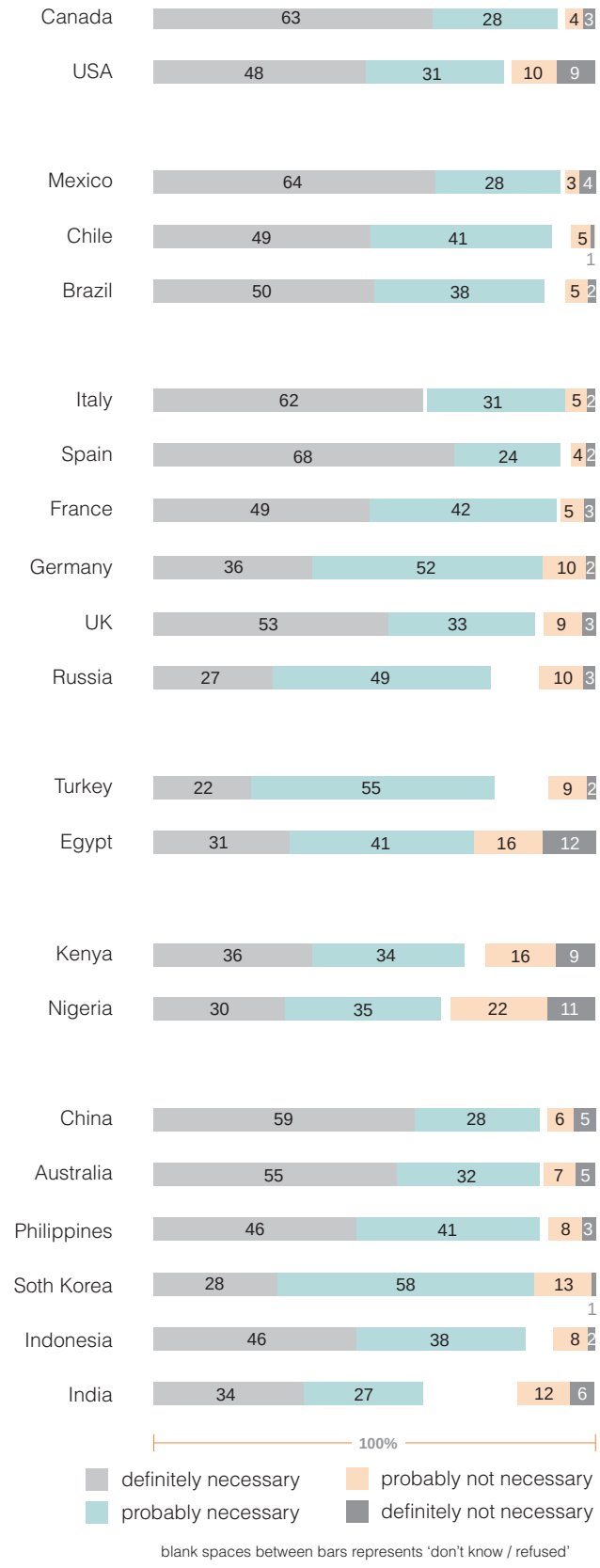


**Figure 13 Necessity of lifestyle changes** (BBC, 2007)

French (91% in favour, 31% strongly). The least enthusiastic supporters were the Chileans (62% in favour, 31% strongly) and Egyptians (66% in favour, 32% strongly).

The proposal to require the automotive industry to increase fuel efficiency standards, even if it meant increasing the price of cars also had reasonable support. This support rose sharply with education and modestly with income. Overall, an average of 67% favoured such standards, 34% strongly. The most enthusiastic supporters were Australians (88% in favour, 59% strongly), Italians (86% in favour, 47% strongly), Ukranians (81% in favour, 38% strongly) and Germans (80% in favour, 38% strongly). Americans were also very supportive (77% in favour, 50% strongly). Countries which were least favourable were Egypt, where a slight majority (51%) opposed it (47% favour) and the Philippines, where opinion was evenly divided (49% in favour, 50% oppose). The policy that received the lowest support was increasing energy taxes to encourage conservation. In only four countries did a majority support it – Australia (69%), UK (62%), Kenya (60%) and India (51%). On average only 37% were in favour (14% strongly) while 59% opposed it (34% strongly). Opposition was particularly strong in Poland (87%), Brazil (86%), Ukraine (86%) and Russia (84%).

There was only lukewarm support for building new nuclear plants to reduce reliance on coal and oil. Overall, 49% were in favour (20% strongly) and 44% were opposed (23% strongly). This support increased slightly with income but not education. The highest support came from Egypt (69%), India (66%), Kenya (65%) and South Korea (65%). The strongest opposition came in Ukraine (67%), which is not surprising given the Chernobyl disaster, and in Germany (63%), Russia (60%) and France (57%).

The BBC (2007) poll also questioned respondents regarding their attitudes to increasing the cost of energy in order to combat climate change. They were asked whether it would be necessary to increase the cost of the types of energy that most cause climate change, such as coal and oil, in order to encourage individuals and industry to use less. The results are shown in Figure 14. Large majorities in most of Europe and the Americas agreed with this proposition. The proportions who considered this definitely or probably necessary ranged from Chile (79%), UK (76%), Canada (72%), Germany (71%), USA (65%), Brazil (64%), Mexico (61%) and France (61%). In Spain only a small majority (52%) agreed with the proposition. In Italy (47% yes, 50% no) and Russia (36% yes, 50% no) only a minority agreed with the proposition. This may be because Italy has high energy costs due to the absence of nuclear power and in Russia, energy costs had increased significantly in the recent past. Support in Asia for increasing energy costs ranged from overwhelming in China (83%), Indonesia (83%) and Australia (80%) to divided views in India (49%), South Korea (49%) and Philippines (48%). The only country with a majority against increasing the cost of energy was Nigeria, a major oil producer whose government subsidises domestic fuel sales. 51% of Nigerians did not think that such an increase was necessary, while 47% thought it was. A modest majority of Kenyans (53%) said that higher costs were necessary. In the Middle East, a majority of Egyptians (61%) thought it was necessary whereas in Turkey, a small majority (41% yes, 44% no) were against.

Though there was widespread support for increasing energy costs, reactions were much more mixed to the proposition that taxes on energy should be raised. Initially, majorities or pluralities in only nine countries favoured an energy tax

**Table 6 Support for different measures – strongly or somewhat in favour** (World Public Opinion.org, 2006b)

| | Increasing energy taxes, % | Building new nuclear power plants, % | Tax incentives for renewable energy, % | Increasing automobile fuel efficiency, % |
|---|---|---|---|---|
| Australia | 69 | 53 | 93 | 88 |
| Brazil | 13 | 47 | 88 | 58 |
| Canada | 47 | 51 | 91 | 78 |
| Chile | 40 | 41 | 62 | 58 |
| Egypt | 47 | 69 | 66 | 47 |
| France | 30 | 38 | 91 | 55 |
| Germany | 47 | 35 | 85 | 80 |
| India | 51 | 66 | 68 | 55 |
| Israel | 36 | 49 | 84 | 65 |
| Italy | 22 | 52 | 95 | 86 |
| Kenya | 60 | 65 | 77 | 61 |
| Mexico | 26 | 54 | 67 | 68 |
| Philippines | 39 | 60 | 70 | 49 |
| Poland | 7 | 31 | 85 | 48 |
| Russia | 12 | 28 | 74 | 77 |
| South Korea | 42 | 65 | 82 | 74 |
| Ukraine | 12 | 24 | 78 | 81 |
| UK | 62 | 50 | 86 | 74 |
| USA | 47 | 63 | 86 | 77 |
| Average | 37 | 49 | 80 | 67 |

**Table 7 Support for different measures – strongly or somewhat opposed** (World Public Opinion.org, 2006b)

| | Increasing energy taxes, % | Building new nuclear power plants, % | Tax incentives for renewable energy, % | Increasing automobile fuel efficiency, % |
|---|---|---|---|---|
| Australia | 30 | 44 | 7 | 11 |
| Brazil | 86 | 50 | 10 | 39 |
| Canada | 51 | 43 | 8 | 20 |
| Chile | 48 | 44 | 25 | 27 |
| Egypt | 51 | 30 | 32 | 51 |
| France | 65 | 57 | 7 | 41 |
| Germany | 52 | 62 | 13 | 18 |
| India | 36 | 21 | 19 | 20 |
| Israel | 57 | 41 | 11 | 28 |
| Italy | 76 | 43 | 4 | 11 |
| Kenya | 35 | 27 | 19 | 31 |
| Mexico | 70 | 33 | 24 | 24 |
| Philippines | 60 | 38 | 27 | 50 |
| Poland | 87 | 56 | 7 | 34 |
| Russia | 84 | 60 | 13 | 12 |
| South Korea | 57 | 31 | 17 | 23 |
| Ukraine | 86 | 67 | 13 | 10 |
| UK | 34 | 43 | 11 | 23 |
| USA | 51 | 33 | 12 | 21 |
| Average | 59 | 44 | 14 | 26 |

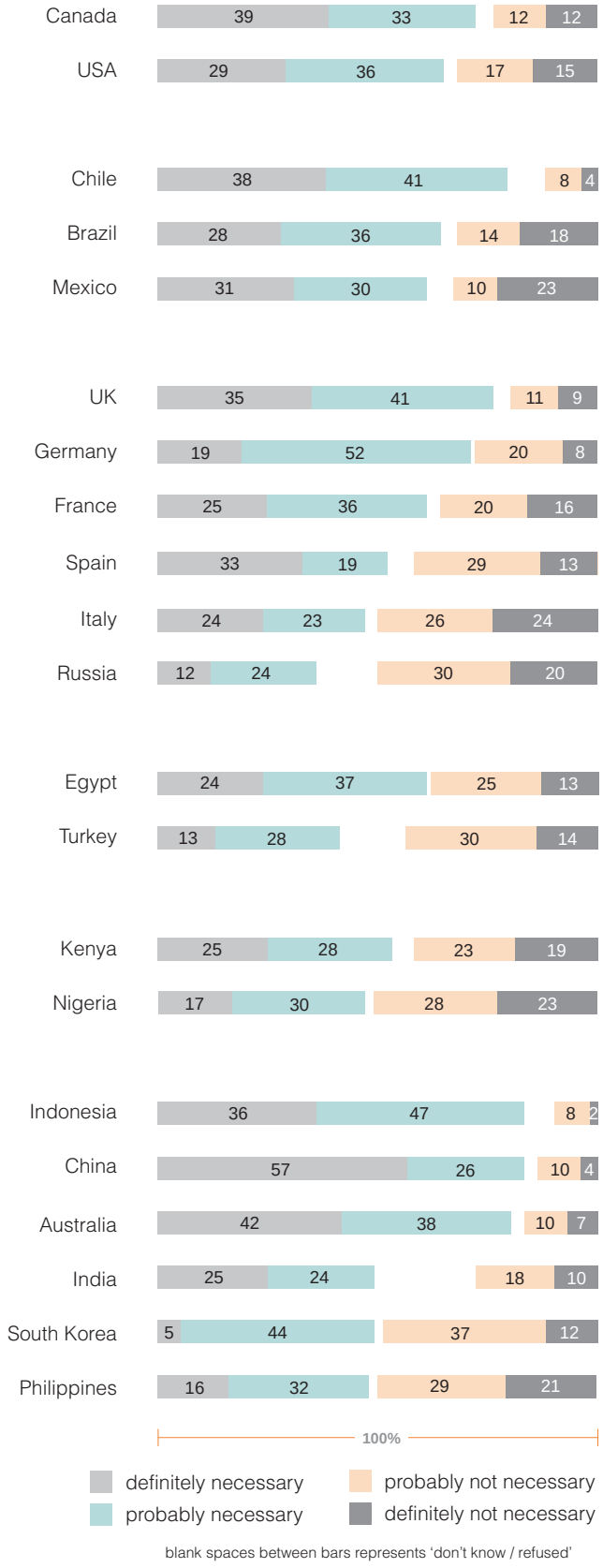


**Figure 14 Necessity of increasing energy costs** (BBC, 2007)

increase. Six were divided and six were opposed. Overall, only 50% were in favour and 44% were opposed. The largest majority was in China where 85% supported an energy tax. The next largest majorities (61%) were in Australia and Chile. This was followed by Germany (59%), Canada (57%), Indonesia (56%), UK (54%), and Nigeria (52%). There was modest support in Mexico (50% yes, 46% no). The public was closely divided in Kenya (50% yes, 48% no), Spain (49% yes, 47% no), France (47% yes, 48% no), Turkey (42% yes, 43% no), Russia (41% yes, 44% no) India (38% yes, 36% no). These attitudes changed significantly under certain conditions. Half of those who did not initially support tax increases were asked if they would do so if the revenues were 'devoted only to increasing energy efficiency and developing energy sources that do not produce climate change'. The other half were asked if they would do so if 'your other taxes were reduced by the same amount, keeping your total taxes at the current level'. With these provisions significant numbers changed their minds and favoured tax increases. Majorities in every country by a margin of at least two to one supported tax increases. On average, 77% favoured the measure if revenues were earmarked and 76% if the tax increases were offset.

The Financial Times/Harris (2009) poll of five European countries and the USA asked the respondents whether they would be willing to pay more in tax to cut greenhouse gas emissions. The results are shown in Table 8. Majorities in France, Germany and the UK, half of Italians and a plurality of Americans and Spaniards all disagreed with the proposition that they should pay more taxes to reduce greenhouse gas emissions. The disagreement was most pronounced in The UK, France and Germany and somewhat less in Italy, Spain and the USA. The same poll sought the views of the respondents on whether governments, businesses, individuals or NGOs (non-government organisations) should bear the responsibility or all should take responsibility for combating climate change. The results are given in Table 9. Majorities in all the countries and almost half of Italians believed that all have equal responsibility. More respondents in the European countries than the USA thought that the government should have taken the lead. The country considering that individuals should take the greatest responsibility was the USA.

It is apparent that majorities in most countries realise that increases in the cost of energy will be necessary to combat climate change. The idea of raising taxes had a mixed response but had greater levels of support if the revenues were earmarked for specific purposes. It is possible that when respondents are questioned in a survey they give a more altruistic response than they really believe.

Another poll was conducted by World Public Opinion.org (2008) to determine the public support for various approaches to address problems of energy production and global warming. This involved questioning 20,790 respondents in twenty-one countries between July and November 2008. For each of these approaches, respondents were asked whether their country should emphasise it more, less or the same. When asked regarding solar and wind energy systems, on average in all the countries, 77% wanted more emphasis, 7% the same as now and 8% wanted less emphasis. The results are shown in Table 10. Majorities favoured this proposition on twenty of the twenty-one nations sampled. The most supportive nations were South Korea (89%), Kenya (88%), France (88%), Italy (88%) and the USA (87%). The least supportive were Russia (50%), Palestinian Territories (59%) and Hong Kong (59%). The respondents were then asked the same question with the possibility that this would increase the

**Table 8 Attitudes to paying more taxes** (Financial Times/Harris, 2009)

| | UK, % | France, % | Italy, % | Spain, % | Germany, % | USA, % |
|---|---|---|---|---|---|---|
| Strongly agree | 3 | 4 | 4 | 7 | 3 | 3 |
| Somewhat agree | 13 | 11 | 18 | 22 | 12 | 18 |
| Neither agree nor disagree | 27 | 24 | 28 | 29 | 24 | 30 |
| Somewhat disagree | 19 | 21 | 19 | 16 | 22 | 19 |
| Strongly disagree | 38 | 40 | 30 | 26 | 39 | 30 |

**Table 9 Responsibility for combatting climate change** (Financial Times/Harris, 2009)

| | UK, % | France, % | Italy, % | Spain, % | Germany, % | USA, % |
|---|---|---|---|---|---|---|
| Governments | 24 | 18 | 33 | 27 | 20 | 9 |
| Businesses | 10 | 19 | 8 | 7 | 17 | 10 |
| Individuals | 10 | 2 | 9 | 6 | 5 | 13 |
| NGOs | 1 | 1 | – | 1 | – | 3 |
| All of above | 53 | 58 | 48 | 59 | 57 | 62 |
| Others | 2 | 2 | 1 | 1 | 1 | 3 |

**Table 10 Approaches to solving energy problem** (World Public Opinion.org, 2008)

**Installing solar and wind energy**

| | Emphasise more, % | Emphasise less, % | Same as now, % | Don't know, % |
|---|---|---|---|---|
| Argentina | 82 | 4 | 6 | 8 |
| Mexico | 86 | 4 | 6 | 3 |
| USA | 87 | 5 | 6 | 3 |
| France | 88 | 3 | 9 | 0 |
| Germany | 82 | 5 | 12 | 2 |
| UK | 81 | 6 | 10 | 4 |
| Italy | 88 | 7 | 4 | 2 |
| Poland | 85 | 7 | 1 | 7 |
| Russia | 50 | 4 | 12 | 35 |
| Ukraine | 67 | 6 | 7 | 20 |
| Azerbaijan | 64 | 10 | 13 | 14 |
| Jordan | 76 | 11 | 3 | 10 |
| Palestinian Territories | 59 | 30 | 8 | 4 |
| Turkey | 84 | 4 | 3 | 9 |
| Kenya | 88 | 11 | 0 | 1 |
| Nigeria | 77 | 17 | 4 | 3 |
| China | 84 | 4 | 4 | 8 |
| Hong Kong | 59 | 16 | 18 | 8 |
| Macau | 64 | 9 | 15 | 12 |
| India | 62 | 13 | 16 | 10 |
| Indonesia | 64 | 16 | 8 | 13 |
| South Korea | 89 | 2 | 9 | 1 |
| Taiwan | 82 | 2 | 10 | 5 |
| Thailand | 75 | 7 | 5 | 13 |
| Average | 77 | 8 | 7 | 8 |

cost of electricity in the short term. Even with the costs highlighted, majorities in all but two nations supported the proposition but the average level of support reduced to 69%. The highest levels of support were in South Korea (96%), France (88%) and Kenya (87%). Opinion was divided in Russia (36% yes, 36% no) and lukewarm in Azerbaijan (48% yes, 43%, no). Both these countries are major oil/gas producers and this may explain why the general public is not particularly keen on renewable energy. Germany also had a significant minority (36%) against the proposition.

When asked whether their government should require buildings to be modified to make them more energy efficient, on average, 74% favoured this approach and only 11% did not. Support ranged from UK (89%), France (89%) and Italy (88%) to Indonesia (55%), India (54%) and Palestinian Territories (54%). The survey also asked respondents whether they favoured their government requiring businesses to use energy more efficiently, even if this might make some products more expensive. Highlighting the cost implications as well as making the effort mandatory meant that, on average, a majority of 58% favoured the idea. The support was not overwhelming with a significant minority of 31% opposing. Twenty countries favoured the idea with majorities in eighteen, led by Taiwan (80%), UK (79%) and South Korea (74%). Four countries opposed the idea, one with a majority (Azerbaijan, 55%) and three with pluralities (Mexico, 49%; Indonesia, 47% and Russia, 43%).

Another measure that could promote energy conservation is to have an extra charge for models of appliances and cars that are not energy efficient. When asked to consider this option, there was modest support with, on average, 48% supporting and 39% opposing. Fifteen countries favoured it, eleven with majorities. However, it was opposed in eight countries, six with majorities. Support for this proposition was highest in Kenya (74%), Italy (69%), Indonesia (61%) and France (60%). Nations with majorities opposing were Thailand (64%), Argentina (62%), Palestinian Territories (58%), Mexico (57%), Germany (54%) and the USA (52%). Countries in both the developed and developing world supported and opposed the proposition.

A further approach to reduce the emissions of greenhouse gases is to put more emphasis on building nuclear plants. In all the countries sampled, on average, 40% wanted more emphasis on nuclear power and 33% wanted less. Respondents in nine countries favoured this approach, eight majorities and one plurality. The most enthusiastic supporters were China (63%), Jordan (58%), Kenya (57%) and Nigeria (56%). Five nations favoured less emphasis. These was a majority opposing in Germany (63%) and pluralities in Mexico (50%), Ukraine (49%), Macau (44%) and Indonesia (40%).

There were similar levels of support for putting greater emphasis on building coal and oil-fired plant, as shown in Figure 15. On average, 40% wanted more emphasis on building coal and oil-fired plant and 33% wanted less. Respondents in seven countries favoured doing so with majorities in five (Kenya, 69%; Jordan, 63%; Argentina, 60%; Nigeria, 56%; Turkey, 52%) and pluralities in two (Indonesia,

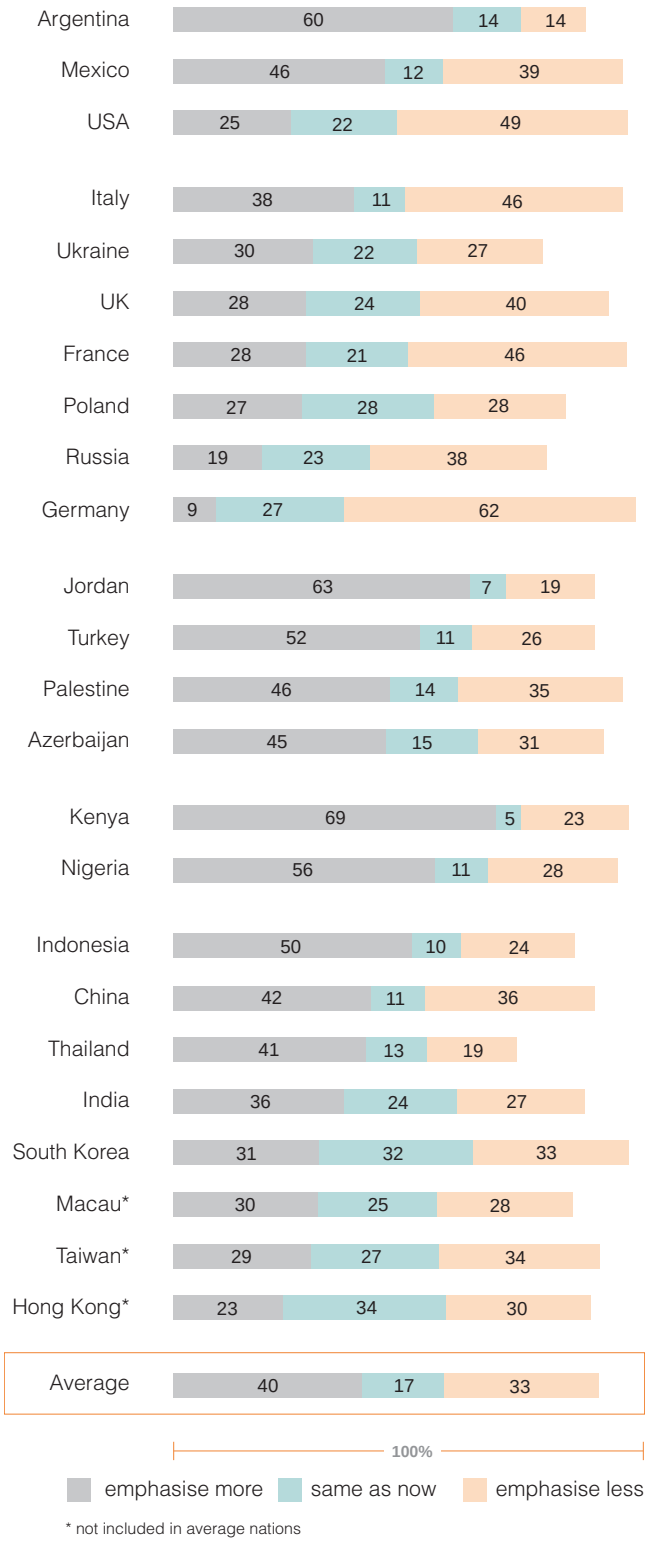


**Figure 15 Views on building coal and oil-fired plant** (World Public Opinion,org, 2008)

50%; Thailand, 41%). In Germany (62%) and the USA (49%), those wanting less emphasis exceeded those wanting more or the same emphasis. On the whole, the most popular option in other countries in the developed world was less emphasis on coal and oil (France, 46%; Italy, 46%; UK 40%). The countries favouring coal and oil tended to be in the less developed world.

Overall, the poll findings show considerable support in both the developed and developing world for more emphasis on

sources of renewable energy such as solar and wind. There was strong support for making buildings more energy efficient in the developed world but less so in warmer climates. There was only modest support for having an extra charge on appliances and cars that are not energy efficient. The support for building more nuclear, coal or oil-fired plant was lukewarm.

## 2.7 Role of developing nations

Regarding the role of developing nations in combating climate change, it is interesting to find out whether the public in different parts of the world considers that since the developed world is wealthier and has produced the majority of greenhouse gases presently in the atmosphere that it should bear the brunt of reducing emissions or that the developing world should also be involved since they will become some of the major emitters in the future. The BBC poll (2007) asked respondents in twenty-one countries to consider two propositions. The first proposition was that because total emissions from less-wealthy countries are substantial and growing, these countries should also limit their climate changing gases. The second was because countries that are less wealthy produce relatively low emissions per person, they should not be expected to limit their emissions of climate changing gases. The answers are shown in Figure 16. In eighteen countries the number agreeing with the first proposition exceeded those agreeing with the second. The overall average was 59% for the first and 29% for the second. The first proposition was endorsed most strongly by the USA (75%), Mexico (75%), Spain (72%), Australia (71%) and UK (70%). This was also the dominant view in China (68%), Kenya (64%) and Brazil (63%). India was more divided with a plurality (33%) agreeing to the first and 24% agreeing with the second, though many Indians (43%) did not have an opinion. In three countries there was more support for the second proposition. These three were Egypt (53%), Nigeria (50%) and Italy (49%).

The same poll asked the respondents whether wealthy countries should give financial assistance and technology to less wealthy countries that agree to limit emissions. In all countries a plurality supported this proposition with majorities in nineteen. The overall degree of support was 73% which is considerable but not overwhelming. The countries expressing the greatest support were China (90%), Canada (84%), Australia (84%) and the UK (81%). Surprisingly, there was least enthusiasm in developing nations: Nigeria (50% yes, 46% no) and India (47% yes, 19% no). The relatively low figure for India may be linked to the earlier low figure for whether they should be reducing at all. These respondents may have felt that if they were willing to accept funds, they would be forced to limit emissions. Of the developed nations, the respondents in the USA (70% yes) were the least keen to assist.

Similar trends were found in the World Public Opinion.org (2007) poll. As part of a larger survey, respondents in five developing nations were asked, if the developed countries were willing to provide substantial aid, did they think that the less-developed countries should commit to limit their

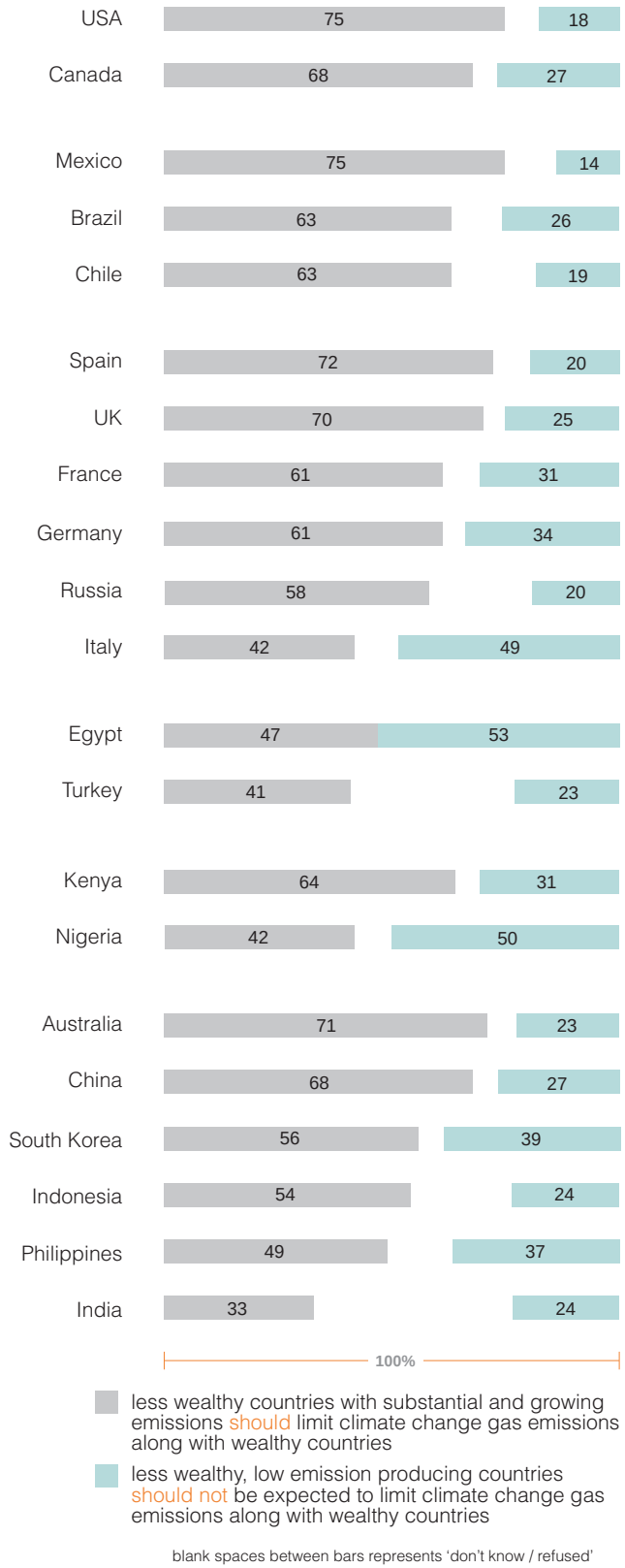


**Figure 16 Role of developing nations** (BBC, 2007)

greenhouse gas emissions. The results obtained were as follows: Argentina (68% yes, 7%, no); Armenia (63% yes, 21%, no); China (79% yes, 8%, no); India (48% yes, 29% no); Thailand (49%, yes, 9% no). The same survey asked three developed nations if the less-developed countries made a commitment to limit their greenhouse gas emissions, did they think the developed world should provide substantial aid to help them. The respondents in all three countries were in support (USA 64% yes, 32% no; Poland 84% yes, 1% no;

**Table 11 Attitudes towards aid to the developing world** (Financial Times/Harris, 2009)

| | UK, % | France, % | Italy, % | Spain, % | Germany, % | USA, % |
|---|---|---|---|---|---|---|
| Strongly agree | 7 | 15 | 15 | 23 | 13 | 4 |
| Somewhat agree | 24 | 36 | 39 | 30 | 38 | 16 |
| Neither agree or disagree | 42 | 32 | 27 | 30 | 32 | 40 |
| Somewhat disagree | 17 | 10 | 13 | 12 | 10 | 23 |
| Strongly disagree | 9 | 6 | 6 | 5 | 7 | 17 |

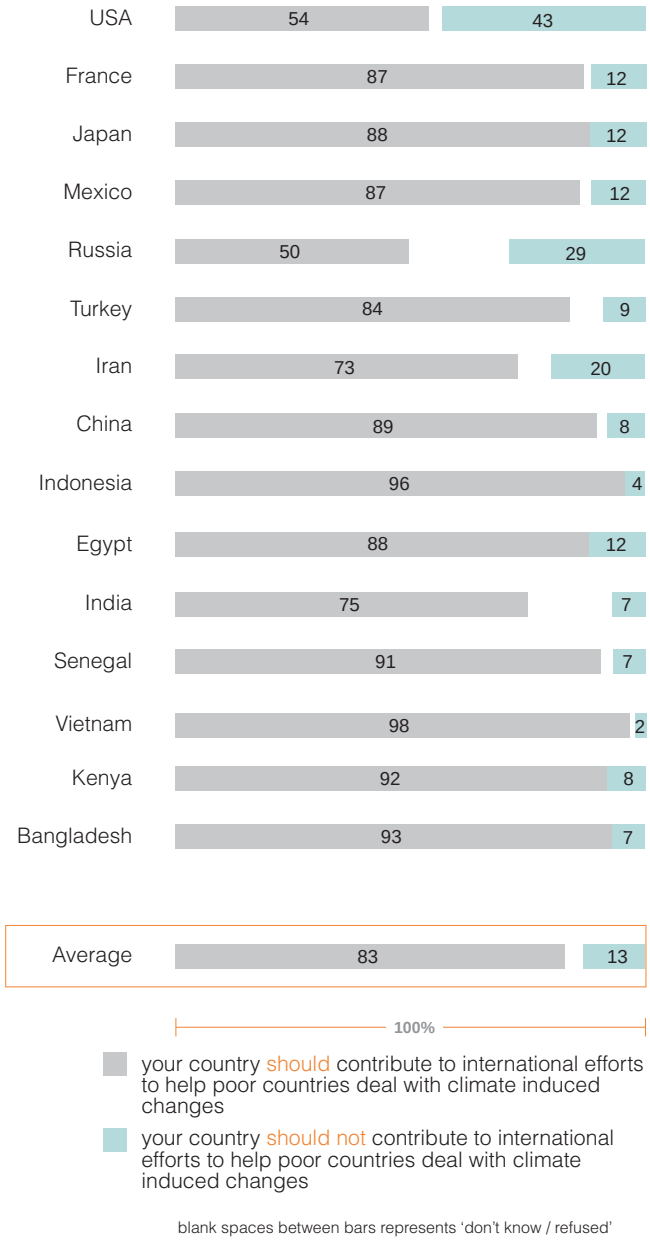


**Figure 17 Assistance to developing nations** (World Bank, 2009)

Ukraine 72% yes, 4%, no). Once again, Indian respondents were reluctant to limit emissions and US respondents were reluctant to aid the developing world to do so.

The Financial Times/Harris (2009) poll also addressed this issue and asked their respondents whether they agreed or disagreed with the statement that since China was the biggest carbon emitter that they should cut emissions the most. Nearly two-thirds of those questioned in the UK and the USA agreed that China should cut its emissions the most. The proportion agreeing rose to about three-quarters in Italy, Spain and Germany and was as high as 80% in France. The same poll asked respondents whether the USA should make the most emission cuts. Two-thirds of French and Spaniards and 70% of Italians and Germans agreed with this proposition. In the UK, half the population agreed and in the USA, the proportion agreeing was only just over a quarter. The poll went on to ask, given that developing countries have not caused much climate change, whether developed countries should be prepared to give them more aid to deal with the consequences. The results are given in Table 11. These show that in Italy, Spain, France and Germany just over half the respondents agree. In the UK, the number agreeing is less than a third and in the USA only one-fifth. When asked if India and China do not make emissions cuts, whether other countries should not have to either. The majority of respondents in all the sampled countries disagreed. In The UK, Spain and the USA the proportion disagreeing was about a half. In France, Italy and Germany, the proportion disagreeing was about 70%.

The World Bank poll (2009) also surveyed whether the respondents in the countries sampled thought that their country should assist with international efforts to help poor countries deal with climate change. The responses obtained are shown in Figure 17. The results show that most countries had very large majorities supportive of contributing to international efforts. The highest support in the 90% range came from Vietnam, Bangladesh, Indonesia, Kenya and Senegal. Support in the 80% range came form Japan, France and China. The countries least willing to help were the USA (54%) and Russia (50%).

The results suggest that majorities both in the developed and developing world consider that developing countries should also make a contribution towards reducing greenhouse gas emissions. India was more equivocal on the issue. Substantial majorities in all countries thought that the developed world should assist the developing world in doing so. This majority was smaller in the USA. There was considerable support worldwide for the proposition that the developing world should be assisted in dealing with the effects of climate change. This proposition also had less support in the USA.

## 2.8 Concerns regarding energy supplies

In addition to concerns regarding global warming, in many countries there are concerns about the security of their energy supplies. These were probed in the BBC 2006 survey of nineteen countries (World Public Opinion.org, 2006b). At the time oil prices were hitting record levels and majorities of 60% or more in all but one country expressed fear that energy shortages and prices would destabilise the world economy. On average, 77% expressed concern, including 39% who were very concerned. The countries with the highest levels of concern were the Philippines (95% concerned, 60% very), South Korea (93% concerned, 43% very) and Canada (85%, 45% very). The least concerned were the Russians where 48% were concerned and 41% were not. This was probably due to the fact that Russia is an oil and gas producer which was benefitting from the high oil prices. In all countries, significant majorities were concerned that competition for energy would lead to greater conflict and war between nations. The countries which were most concerned were South Korea (90% concerned, 34% very), the Philippines (88% concerned, 50% very) and the UK (83% concerned, 46% very). The countries in which there were least concerns were Poland (52% concerned), Russia (56%), India (59%), Mexico (60%) and Israel (62%).

In many countries there were also concerns that major energy suppliers, especially Iran, might withhold energy supplies. Respondents were shown a list of energy exporting countries (Canada, Russia, Saudi Arabia, Venezuela and Iran) and asked how much did they trust them to follow through on their commitments to deliver energy to other countries. Iran was the least trusted, and in seventeen of the nineteen countries a majority or plurality said that they had not much trust or no trust at all in Iran following through on its commitments. On average 62% did not trust Iran with 29% expressing not much trust and 33% expressing no trust at all while only 26% trusted Iran with 18% expressing some trust and 8% expressing lot of trust. The level of trust dropped sharply with education. Only in Egypt (73%) and India (52%) did majorities trust Iran as an energy supplier. The Germans (86%), Americans (84%), Brazilians (83%), Italians (80%) and Israelis (80%) were especially distrustful.

Venezuela was also widely considered untrustworthy, though by a more modest margin. On average, 43% did not trust Venezuela, including 17% with no trust at all, while 35% had trust with 7% having a lot of trust. The level of trust increased with education. Overall, five countries leaned in favour of trusting Venezuela, eleven leaned against and three were divided. The countries expressing the greatest degree of trust were Australia (55%) and Mexico (52%). In spite of the war of words between the two governments, nearly half of Americans (49%) had some level of trust with 42% having not much or no trust. The only other countries where pluralities trusted Venezuela were Canada (48%) and Poland (35%). Majorities in Brazil (77%) and Egypt (54%) lacked trust in Venezuela as did pluralities in Germany (49%), the Philippines (49%), Italy (47%), South Korea (43%), Israel (42%), Ukraine (42%), Russia (38%) and India (37%).

Though Saudi Arabia is the world's largest oil exporter, the majority of respondents in the survey leaned against trusting it (42% expressed trust, 46% did not). Five countries (Egypt (82%), the Philippines (63%), Australia (58%), Kenya (55%) and India (48%)) trusted Saudi Arabia. Seven countries did not, including Brazil (81%), Israel (61%), Italy (57%), France (56%), USA (56%) and South Korea (55%). The figure for the USA is surprising given that the two countries are meant to be close allies.

World opinion was evenly divided on whether or not to trust the Russians with 45% having some level of trust and the same figure not having any. The countries with the greatest degree of trust were Australia (62%), India (61%) and Ukraine (59%). The last figure is unexpected given the disputes the Ukranian Government has had with Gazprom, the Russian state-controlled gas supplier. Majorities in the USA (54%) and Canadians (52%) also expressed trust in Russia. Majorities in six countries did not trust Russia including Brazil (76%), South Korea (67%) and Poland (61%).

The country that was most trusted was Canada. In seventeen of the nineteen countries majorities or pluralities expressed confidence that it would meet its obligations. Overall, 60% trusted Canada and only 25% did not. The Americans (90%), Germans (85%) and the British (79%) were overwhelmingly confident. Countries in which trust was more equivocal were Ukraine (38% trust, 34% distrust), Russia (37%, 31%), India (41% , 29%) and South Korea (44%, 30%). The only countries where majorities distrusted Canada were Brazil (68%) and Egypt (53%).

It is apparent that Iran and Venezuela are widely distrusted. There is also a significant degree of distrust towards Saudi Arabia and Russia. The only country that is widely trusted is Canada but, even here, the degree of trust is not universal.

## 2.9 Global organisations supporting the use of coal

When considering public attitudes, it is instructive to assess what information is freely available to the public on relevant topics which could influence their views. It is impracticable to try to analyse all the information presented to the public on TV, radio and newspapers but it is possible to assess information available from major national and international organisations which are either in favour or against the use of coal. The World Coal Institute (WCI) is a global industry association, comprising of major international coal producers and stakeholders, and was founded in 1985 to provide a forum for exchange of information and the discussion of challenges relating to the coal industry. Their mission is to engage constructively and openly with governments, the scientific community, multilateral organisations, the media and others on global issues such as $CO_2$ emissions reductions and sustainable development and local issues environmental and socio-economic benefits and effects from coal mining and coal use (World Coal Institute, 2010).

In considering the use of coal, WCI considers that access to modern energy services not only contributes to economic

growth and household incomes but also to improved quality of life that comes with better education and health services. All sources of energy will be needed to meet future energy demand, including coal. Coal has many important uses worldwide, the most significant being, electricity generation, steel production and cement manufacturing. The five largest coal users, China, USA, India, Japan and Russia account for 72% of total coal use. The biggest market for coal is Asia, which accounts for 56% of global consumption. Other important uses of coal include alumina refineries, paper manufacturing and the chemical and pharmaceutical industries.

Regarding the societal issues on coal use, WCI reports that 1.6 billion people worldwide do not have access to electricity. Coal plays a central role in supporting global economic development, alleviating poverty and is an essential resource to meeting the world's energy needs. Coal currently supplies 26% of primary energy and 40% of electricity generation. It is important to maximise the value to society from the production and use of coal while minimising any negative impacts. Electricity is one of the most effective and environmentally responsible ways of delivering modern energy. Its absence necessitates the domestic use of biomass which is not sustainable. People have to spend much of their time gathering wood and other biomass fuels, reducing time that could be spent on more productive activities. Furthermore the use of wood fuel leads to deforestation and ecological damage. The indoor use of these fuels can lead to respiratory disease. Instead, countries with large, indigenous sources of energy could use this affordable source of energy to raise electrification levels. The rapid electrification of South Africa, India and China has been heavily dependent on affordable coal.

Coal has also an important role in meeting the demand for a secure energy supply. Coal is abundant and widespread. It is present in almost every country in the world with commercial mining taking place in over fifty. At current production levels, coal will be available for at least the next 130 years which is far longer than oil and gas. Coal is also readily available from a wide variety of sources in a well-supplied worldwide market. It can be transported quickly, safely and easily by ship and rail. A large number of suppliers are active in ensuring competition. It can be easily stored and stocks can be drawn on in emergencies. Coal is a very affordable fuel with lower and more stable prices than oil or gas. Coal-based electricity is well-established and highly reliable. It can be used as an alternative to oil. The development of the conversion of coal to liquid products can serve to hedge against oil-related energy security risks.

WCI recognises that coal, like all other sources of energy, has a number of environmental impacts both from coal mining and coal use. The nature of the impact includes land and water resource use, pollutant emissions, waste generation and public health and safety concerns. Viable and highly effective technologies have been developed to reduce the release of pollutants such as $SO_2$, NOx, particulates and trace elements such as mercury. In the case of $SO_2$, FGD technologies have been installed in many countries and have led to considerable reduction in emissions. The oxides of nitrogen can be reduced by use of primary measures such as low NOx burners or burner optimisation. Alternatively SCR or SNCR can lower NOx by post-combustion treatment in the flue gas. A number of technologies have been developed to control particulate emissions and deployed in both developing and the developed world. These include ESPs, fabric filters, wet scrubbers and hot gas filtration systems. Trace elements can be further reduced by activated carbon injection. The production of waste from coal combustion can be minimised by coal cleaning prior to combustion. A wide range of uses have been developed for the waste that is generated including boiler slag for road resurfacing and the addition of fly ash to cement.

WCI reports that a range of advanced coal combustion technologies have been developed to improve the efficiency of coal-fired power generation. New, more efficient plant reduce emissions of $CO_2$ as well as $SO_2$, NOx and particulates. Increases in the efficiency of electricity generation are essential in tackling climate change. A 1% improvement in efficiency of a PCC power plant results in a 2–3% reduction in $CO_2$ emissions. Highly efficient modern coal plants emit almost 40% less $CO_2$ than the average coal plant currently installed. The average global efficiency of coal-fired plants is currently 28% compared with 45% for the most efficient plant. Efficiency improvements have the least cost and lead times for reducing emissions from coal-fired electricity. This is a particular advantage in developing and transition countries where plant efficiencies are low and coal use in increasing. Efficient plants are a prerequisite for retrofitting CCS as capturing, transporting and storing $CO_2$ consumes significant quantities of energy. Improving the efficiency of the oldest and most inefficient coal-fired plants would reduce $CO_2$ emissions from coal use by almost 25%. The efficiencies of coal-fired power plants can be improved by utilising supercritical and ultra-supercritical boilers, IGCC plant and fluidised bed combustion. In the case of CFBC boilers, these can achieve efficiencies over 40%. New PCC plant utilising supercritical and ultra-supercritical technologies operating at increasingly higher temperatures and pressures achieve significantly higher efficiencies than conventional PCC plant. Research and development is under way to increase these efficiencies to around 50%. IGCC plant efficiencies are typically in the mid-40% range, although plant designs offering up to 50% are achievable. Reliability and availability have been challenges facing IGCC development and commercialisation. Cost has also been an issue as IGCC plant are significantly more expensive than conventional plant.

WCI admits that coal mining, particularly surface mining, requires large areas of land to be temporarily disturbed. This raises a number of environmental challenges including soil erosion, dust, noise and water pollution and the impact on local biodiversity. The impact can be minimised by pre-planning projects, implementing pollution control measures, monitoring and rehabilitating mined areas. Mining subsidence can be a problem with underground coal mining. The industry uses a range of engineering techniques to design the layout and dimensions of the underground mine workings so that surface subsidence can be anticipated and controlled. Acid mine drainage can be a challenge at coal mining operations but mine management methods can minimise the problem. These include active treatments involving water treatment

plants and passive treatments to treat effluent without human intervention. Dust levels can be controlled by spraying water on roads, stockpiles and conveyors. It is also vital that rehabilitation of land takes place once mining operations have ceased. Where mining is underground, the surface area can be used for other purposes, such as agriculture, with little or no disruption to existing land use. Mine reclamation operations, such as shaping and contouring spoil piles, replacement of top soil and seeding with grasses can be gradually undertaken. As mining operations cease in one section of surface mines, bulldozers and scrapers are used to reshape the disturbed area. Drainage within and off site is carefully designed to make the new surface as stable and resistant to soil erosion as possible. The land is suitably fertilised and revegetated and used for agriculture, forestry and recreation.

WCI has addressed climate change specifically in a report entitled *Coal meeting the climate challenge* (World Coal Institute, 2007). WCI recognises that climate change is a significant global issue requiring concerted global action. They suggest that climate change must be dealt with across all sectors and cannot be considered in isolation. They support policies that meet the issue of climate change with the need for secure, reliable and affordable energy supplies. They acknowledge that emissions reductions resulting from the use of coal are required and are achievable over time within a sustainable energy future. Technology solutions will require large-scale investments which, in turn, need international energy and climate change policies to provide certainty for long-term investments to be made. According to WCI, carbon capture and storage (CCS) needs to be the cornerstone of any effective post-2012 climate change regime. Fossil fuel use has to be made climate compatible if climate change objectives are to be met. The two primary ways of reducing $CO_2$ emissions from coal use are carbon capture and storage, which can reduce $CO_2$ emissions by 80–90%, and improving efficiencies at coal-fired power stations. WCI considers that CCS offers the potential of moving towards near- zero emissions from coal and gas-fired power plant. The geological features considered for storage are deep saline formations, depleted oil and gas fields and unmineable coal seams. They report that storing $CO_2$ in geological formations is a secure option. They quote the 2005 IPCC special report on capture and storage stating that the risk of leakage from geological storage was very likely to be less than 1% over 100 years and likely to be less than 1% over 1000 years. They quote a current cost of CCS as being 40–90 $/t$CO_2$ removed,with capture and compression costs dominating the overall cost. They suggest that over the next decade, with the utilisation of new technologies under development, these costs will reduced by 20–30% with further reductions resulting from economies of scale.

To achieve the vision of the sustainable use of coal, WCI suggests that more policy certainty is required. Governments need to provide supportive policy frameworks that recognise the continuing role of coal and the need to work with industry in accelerating the development and adoption of low emissions coal technologies. A collaborative framework involving a public/private partnership route is going to be critical to a sustainable energy future. There is a pressing need for significantly more large-scale, integrated coal-based CCS demonstration projects if commercial readiness is to be achieved by 2020. A commitment to CCS needs to be complemented by regulatory and legal frameworks for $CO_2$ storage that provide policy certainty for project proponents. In addition, actions are needed by governments, industry and financial institutions to create a sustainable investment framework (World Coal Institute, 2010).

## 2.10 Global organisations opposing the use of coal

Greenpeace International have campaigned for many years against the use of coal. In a report entitled *The true cost of coal* (Greenpeace, 2008a) they claim that coal is used to produce nearly 40% of the world's electricity but burning coal is one of the most harmful practices on earth. They say that the coal industry is not paying for the damage, the world at large is. The report states that coal is the most polluting of available energy sources and is the dominant source of the world's $CO_2$ emissions. Across the world, 11 Gt of $CO_2$ are released from coal-fired power generation which represents 41% of all fossil fuel $CO_2$ emissions. Though coal may be the cheapest fossil fuel, the market price ignores the true cost of coal, namely the tremendous human and environmental damage it may cause. The entire process from mining, through combustion to waste disposal is considered by Greenpeace to have a dire impact on the environment, human health and the social fabric of communities living near mines, power plant and waste sites. At the request of Greenpeace, the Dutch research institute, CE Delft, conducted a preliminary analysis of the external costs of damages attributable to climate change, human health impacts and fatalities due to mining. The analysis suggested that coal-fired power plant caused an estimated US$356 billion worth of damage in 2007.

In some areas, mining causes widespread deforestation, soil erosion, water shortages, and pollution, smouldering coal fires and the emission of methane, an even more potent greenhouse gas than $CO_2$. Massive excavation operations strip land bare, lower water tables, generate huge waste mountains and blanket surrounding communities with dust particles and debris. It also leads to loss of fertile soils through erosion, while runoff clogs rivers and smothers aquatic life. Mining kills miners quickly through accidents and more slowly through black lung disease. It also displaces whole communities who are forced to abandon their homes because of coal mines, coal fires, landslides and contaminated water supplies. Coal combustion leaves a similar trail of destruction in its wake. The huge volumes of water needed to wash coal and provide cooling water for power plant cause water shortages in many areas. Pollutants emitted from smokestacks threaten public health and the environment. Fine dust particles are the main cause of pulmonary disease. Mercury harms neurological development in children and the unborn, and coal-fired power plants are the single biggest source of pollutants such as $CO_2$, $SO_2$, NOx, and methane thus contributing to global warming, acid rain and smog. In the USA, air pollution is believed to cut short the lives of 30,000 people every year. In India, a study in 2001 showed that in fourteen of the country's biggest cities, people breathe air the

government deems dangerous. In China, pulmonary disease is the largest cause of adult deaths. One of the main reasons for this pollution is coal.

The damage caused by coal doesn't end once it is burnt. At the end of the chain are coal combustion wastes (CCW), abandoned mines, devastated communities and ravaged landscapes. CCW are toxic and laced with lead, arsenic and cadmium that can cause poisoning, kidney disease and cancer. Acid mine drainage (AMD) damages soils and makes water unsafe for consumption. The report quotes a 1989 estimate that about 19,300 km of streams and rivers and 72,000 hectares of lakes and reservoirs across the world had been seriously damaged by AMD. As sources of AMD remain toxic for centuries, these numbers would have increased since then. Collapsing mines cause subsidence resulting in structural damage to homes and building and infrastructure such as roads and bridges. Attempts to mitigate this devastation is inadequate at best; reclaimed land never quite recovers. Coal mining also requires such high levels of water that land areas as well as rivers are drained. Surface mining operations such as Mountain Top Removal (MTR) causes streams to disappear by covering them under mounds of dirt. The report alleges that, in the USA, 1200 miles of streams have already been buried and this figure is expected to increase to 2400 miles by 2013.

The report gives specific examples of the Cerrejón mine in Colombia. The report claims that the environment at the mine is filled with fly ash, sulphur and methane fumes while the waters are contaminated by sludge and noxious chemicals. Mining operations have made much of the surrounding land uninhabitable. Collective displacements have been carried out of the Wayuu community. In India, the largest coal belt is at Jharia, Jharkhand. Before coal mining commenced, Jharia contained dense forests inhabited by tribes. Once a treasure trove of high-quality coking coal, uncontrollable coal fires have turned the mine into a slow-burning inferno. India accounts for the world's greatest concentration of coal fires. Rising surface temperatures and toxic by-products in groundwater, soil and air have turned the densely populated Raniganj, Singareni and Jharia coal fields into wastelands. The report also quotes the example of Borneo where coal mining is causing deforestation. In East Kalimantan, mining companies have been land grabbing and these areas overlap with the remaining rainforests. Deforestation maps for the period 2000-07 show recent clearance outside active mining concessions, indicating that strip ming activities are expanding. They quote one forecast that Kalimantan's production could triple by 2020. If this happens, the coal industry will become the leading cause of deforestation in Borneo. They conclude that leaving coal is the only way forward. The world simply cannot afford to continue with it – the cost to the climate, the planet and ourselves is too high (Greenpeace, 2008a).

Greenpeace are highly sceptical of CCS. Though CCS has been widely promoted by the coal industry as a justification of new coal-fired plant, Greenpeace consider the technology to be largely unproven and unlikely to be ready in time to save the climate. They have produced a report entitled 'False Hope' which is based on peer-reviewed independent scientific research and claims to show that CCS cannot deliver in time to avoid dangerous climate change as its earliest possible deployment at utility scale is not expected before 2030. To avoid the worst impacts of climate change greenhouse gas emissions need to start falling after 2015. Furthermore, CCS wastes energy as the technology uses between 10 and 40% of the output of the power station, thus erasing the efficiency gains of the past 50 years and increasing fuel consumption by a third. Storing $CO_2$ underground is risky as safe and permanent storage cannot be guaranteed. Even very low leakage rates could undermine climate mitigation efforts. CCS is expensive and could lead to a doubling of plant cost and an electricity price increase of 21–91%. Money spent on CCS will divert investment away from sustainable solutions. CCS carries significant liability risks as it poses a threat to health, ecosystems and the climate and it is unclear how severe these risks will be. They contend that renewable energy and energy efficiency are safe, cost-effective solutions that carry none of the risks of CCS and are available today to cut emissions and save the climate (Rochon, 2008).

Friends of the Earth also campaign against the operation of coal-fired power plant. They stress that the impacts of global warming are already being felt. If we don't act now, the climate crisis will become much worse, dramatically impacting on people around the world and causing irreversible damage to the environment. They claim that coal is inherently dirty, from the mining process, to the combustion at a power station, to the disposal of the combustion wastes. No amount of advertising or technology can make coal anything resembling a clean fuel. It devastates air, land, water and wildlife and poisons human health. They suggest that the mountains of West Virginia and Kentucky are being blown to smithereens through the practice of mountain top removal. Already 1000 miles of rivers and streams in West Virginia have been eliminated by this assault on biologically diverse forested mountains of Appalachia. They claim that over 150 million Americans live with dirty air in their communities and an estimated 25,000 or more have their lives cut short each year as a result of power plant pollution. Coal power plants are the biggest source of mercury emissions in the USA (Friends of the Earth, 2010).

Friends of the Earth are particularly opposed to the production of liquid fuels from coal. They report that the coal industry is pushing governments to subsidise the conversion of coal into liquid fuels as a fuel source for the future. Liquid coal carries all the health and environmental problems of traditional coal, while creating new pollution and waste through its dirty production process. They claim that the production of liquid coal emits six times more greenhouse gases than the production of conventional gasoline. Liquid coal wastes water in production with government studies estimating that its production consumes 50% more water than the fuel produced with some plants using ten times more water than the fuel produced. The coal lobby in the USA, for example, has already won tax credits for producing this dirty fuel. The industry has also lobbied the government to guarantee loans to build liquid coal plants. This would enable coal companies to gain financing for risky projects while the taxpayer and residents pay the financial and environmental costs.

Friends of the Earth are opposed to subsidies given to fossil fuels which they claim come in many forms. The US Government subsidises fossil fuels through loan guarantee programmes such as the ones funded by the Department of Energy and the rural utility service. Federal export credit agencies such as the US Export-Import Bank (Ex-Im) and the Overseas Private Investment Corporation (OPIC) provide significant levels of funding for fossil fuels. In 2008, Ex-Im authorised $1.6 billion and OPIC authorised $202 million for such projects. The World Bank continues to fund fossil fuel projects with funding nearly doubling in the period 2007-08 to US$3.8 billion.

Overall, The WCI emphasise the vital role coal currently plays in global energy supply and stresses other advantages such as affordability and security of supply. It contends that with the latest technologies it is possible to minimise the environmental impact of both coal mining and power generation. It details the considerable reductions that have taken place in emissions of pollutants by the installation modern technologies over the past two decades. It is confident that CCS will prove to be technically feasible and financially viable and will address the major remaining issue of $CO_2$ emissions. The opponents of coal take the diametrically opposing viewpoint. They highlight the many parts of the world where due to lack of government regulation or the resolve for its implementation or due to lack of funds, modern control technologies have not been installed. Here considerable damage is caused both to the environment and the human population from mining and coal-fired power generation. They contend that the economic case for coal does not account for this damage. They are deeply sceptical of CCS which has not as yet been proved to be technically feasible nor economically viable on the large scale and, in any case, there is no assurance that the $CO_2$ which will be stored will remain so indefinitely. They further state that the considerable funds which are currently directed towards CCS will be better spent on developing renewable technologies.

# 3 USA

## 3.1 Background

Nearly 50% of electricity generated in the USA comes from domestic coal and there has been renewed interest in building new coal-fired projects in this decade, largely due to the fluctuating costs of natural gas (which had been the near unanimous fuel of choice for new plant in the previous decade). In addition to cost, there are reasons relating to supply and security which also favour coal. The USA has coal reserves sufficient for 250 years' supply at the current consumption rate and since the events of 9/11, the ability to use a domestic resource is an additional advantage. The actual plant capacity commissioned since 2000 has been far less than the new capacity announced. In 2002, 36,000 MWth of coal-fired capacity was announced to be installed by 2007, whereas only 4,500 MWth were completed. The delays and cancellations have been due to regulatory uncertainty regarding climate change, public opposition and strained project financing due to escalating costs in the industry (Shuster, 2010). Though there have been considerable reductions in $SO_2$ and NOx emissions in the USA over the last 40 years, there are intense concerns worldwide regarding US $CO_2$ emissions which account for 20% of energy-related total global emissions. The Obama Administration accept the need to address the pressing issue of climate change. Their initiatives announced to reduce $CO_2$ emissions include the American Recovery and Reinvestment Act which is hoped to fund more than US$80 billion in clean energy investments and The Clean Coal Power Initiative (CCPI) is one in which the government will co-finance new coal technologies to reduce emissions. In June 2009, Secretary Chu announced agreement on the FutureGen project which advances the construction of the first commercial-scale, fully integrated carbon capture and sequestration project in the USA. In July, two further projects were announced from the first round of CCPI solicitation at an existing power plant in North Dakota and a new facility in California which will incorporate CCS technologies. In January 2010, three projects were selected form the second solicitation. The Southern Company project announced in January has since withdrawn but has been replaced by an NRG Energy project.

Public attitudes in the USA up to 2006 have been discussed by Fernando (2006). The available poll data at the time suggested that the environment was not a major priority for the US public. Even for those concerned about the environment, global warming was not the major concern. However, the poll data following Hurricane Katrina suggested a shift in attitudes. There was considerable concern among the public about US dependence on imported oil. There was substantially more support for the automotive industry manufacturing more fuel efficient cars than for building more coal-fired power plant. The public was not aware that the majority of their electricity was generated from coal but, following the energy crises in the early part of the decade, there were increasing levels of support for the use of coal to generate electricity. Even in California, the level of opposition to the construction of new coal-fired plant was less than in the 1970s and the 1980s. The renewed interest in PCC plant met with some public opposition, mainly on health and environmental grounds. The opponents also cited the superior environmental performance of gas-fired plant and IGCC technology. The proponents of coal plant emphasised that coal was a secure source of energy that was available domestically and should last several hundred years. As to global warming, they claimed that it was debatable whether it was due to natural variations or man-made. Even if global warming was a reality, the solution was sequestration and that natural reservoirs could be used to store carbon effectively.

Since the 2006 report, there has been regular polling conducted in the USA on public attitudes to global warming, energy and the environment. The results in relation to individual issues are listed below.

## 3.2 Priority of Issues

There have been regular polls conducted in the USA to ascertain which issues the public consider are the most important ones which the country faces. All these polls have questioned at least 1000 people and claimed margins of error in the 3–4% range. The question asked was either 'What do you think is the most important problem facing the country today?' or 'What do you think are two most important issues for the government to address?' Sample results are shown in Table 12. It is apparent that before 2007 most respondents considered that the wars in Iraq/Afghanistan to be the most important issue, and after 2008 the focus shifted to the financial crisis. In some of the polls a few respondents did mention energy issues but these probably related to the price of gasoline or the dependence on foreign energy supplies. The environment or global warming were hardly ever mentioned. In the two cases where these issues were considered to be important, less than 5% of those sampled thought so (Polling Report.com, 2010a). A similar set of surveys has been conducted by the Pew Research Centre. They have annually questioned over 1500 US adults in a national survey (MoE, ±3%) on what they consider the top priorities are for the US Government. The results from 2007 to 2010 are shown in Table 13. The results show that over this period there has been a shift of the top priority from defending against terrorism to improving the economy. Concerns about the environment have decreased significantly, though there has been a slight increase in 2010. Not only has dealing with global warming been the concern of least priority but the level of concern has decreased monotonically (Pew, 2010).

## 3.3 Reality and seriousness of global warming

Several polling organisations have conducted regular opinion polls in the USA to assess public attitudes towards the reality of global warming, whether it is caused by human activity and

**Table 12 Polling data on the most important issues facing the USA** (Polling Report.com, 2010a)

| | Gallup April 2007, % | Harris July 2007, % | CBS/ New York Times April 2008, % | CNN/ ORC December 2008, % | CBS/ New York Times January 2009, % | Bloomberg September 2009, % | CBS October 2009, % | CNN/ ORC November 2009, % | MIT February 2010, % | CNN/ ORC March 2010, % | NBC/ Wall St Journal May 2010, % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Economy | 14 | 20 | 37 | 75 | 60 | 46 | 45 | 47 | 31 | 43 | 35 |
| Health | 20 | 19 | 6 | 7 | 2 | 23 | 20 | 17 | 16 | 23 | 10 |
| Iraq/Afghanistan | 66 | 37 | 15 | 6 | 3 | 10 | 12 | 12 | 5 | 7 | 7 |
| Budget deficit | 3 | – | – | – | 2 | 16 | 3 | 11 | 6 | 8 | 20 |
| Immigration | 14 | 13 | 3 | 5 | – | – | – | – | 6 | – | 7 |
| Education | 4 | 7 | – | – | 2 | – | – | 6 | 3 | 11 | – |
| Energy | 7 | 5 | 7 | – | 2 | – | – | 2 | 4 | 1 | 4 |
| Environment | 5 | – | – | – | – | – | – | – | 3 | 1 | – |
| Global warming | – | – | – | – | – | 2 | – | – | – | – | – |
| Terrorism | 8 | 7 | – | 6 | – | – | – | 4 | 4 | 3 | 12 |
| Other | 25 | 7 | 30 | 1 | 24 | 3 | 20 | 1 | 22 | 2 | 1 |

**Table 13 Top domestic priorities for US Government** (Pew, 2010)

| | January 2007, % | January 2008, % | January 2009, % | January 2010, % |
|---|---|---|---|---|
| Strengthening the nation's economy | 68 | 75 | 85 | 83 |
| Improving the job situation | 57 | 61 | 82 | 81 |
| Defending the US against terrorism | 80 | 74 | 76 | 80 |
| Securing social security | 64 | 64 | 63 | 66 |
| Improving the educational system | 69 | 66 | 61 | 65 |
| Securing medicare | 63 | 60 | 60 | 63 |
| Reducing the budget deficit | 53 | 58 | 53 | 60 |
| Reducing healthcare costs | 68 | 59 | 59 | 57 |
| Dealing with problems of poor | 55 | 51 | 50 | 53 |
| Strengthening the military | 46 | 42 | 44 | 49 |
| Dealing with the US energy problem | 57 | 59 | 60 | 49 |
| Protecting the environment | 57 | 56 | 41 | 44 |
| Dealing with global warming | 38 | 35 | 30 | 28 |

how serious they consider the problem to be. The polls mentioned below have sampled at least 1000 adults and have a MoE of 3–4%. The results are shown in Table 14. It is apparent that in the period 2006-09, the proportion believing that global warming is taking place has decreased. The CNN/ORC polls have shown that this proportion has reduced from about 75% to 68% and the ABC/Washington Post polling demonstrates a similar reduction from about 85% to 72%. It is also apparent that between 2007 and 2009, the proportion believing that global warming is being caused by human activity has also decreased significantly and the proportion of non-believers has increased. The CNN/ORC polling shows that the percentage blaming human activity has decreased from about 55% to 45% in this period. The Pew survey shows a corresponding reduction from 47% in 2006-08 to 36% in late 2009. The Rasmussen data suggest that by December 2009, the proportion believing that global warming was caused by human activity had decreased to only a third and half of those sampled considered that it was caused by planetary trends. The data also indicate that in 2008 about

**Table 14 US polls on reality of global warming** (Polling Report.com, 2010b)

**A CNN/ORC polls**

**Which of the following statements comes closest to your view of global warming? Global warming is proven fact and is mostly caused by emissions from cars and industrial facilities such as power plants and factories. Global warming is a proven fact and is mostly caused by natural changes that have nothing to do with emissions from cars and industrial facilities. Global warming is a theory that has not yet been proven.**

| | Fact industry, % | Fact natural changes, % | Unproven theory, % | Unsure, % |
|---|---|---|---|---|
| December 2009 | 45 | 23 | 31 | 1 |
| June 2008 | 54 | 22 | 23 | 1 |
| October 2007 | 56 | 21 | 21 | 2 |
| May 2007 | 54 | 20 | 22 | 4 |

**B ABC/Washington Post polls**

**You may have heard about the idea that the world's temperature may have been going up slowly over the past 100 years. What is your personal opinion on this? Do you think this has probably been happening, or do you think it probably has not been happening?**

| | Has been, % | Hasn't been, % | Unsure, % |
|---|---|---|---|
| November 2009 | 72 | 26 | 2 |
| July 2008 | 80 | 18 | 2 |
| April 2007 | 84 | 13 | 3 |
| March 2006 | 85 | 13 | 2 |

**C Pew Survey**

**From what you've read and heard, is there solid evidence that the average temperature of the earth has been getting warmer over the past few decades, or not? If yes, do you believe that the earth is getting warmer mostly because of human activity such as burning fossil fuels or mostly because of natural patterns in the earth's environment?**

| | Yes, human activity, % | Yes, natural patterns, % | Yes, don't know, % | No, % | Unsure, % |
|---|---|---|---|---|---|
| September/October 2009 | 36 | 16 | 6 | 33 | 10 |
| April 2008 | 47 | 18 | 6 | 21 | 8 |
| January 2007 | 47 | 20 | 10 | 16 | 7 |
| August 2006 | 47 | 20 | 10 | 17 | 6 |
| July 2006 | 50 | 23 | 6 | 17 | 4 |
| June 2006 | 41 | 20 | 8 | 20 | 10 |

**In your view, is global warming a very serious problem, somewhat serious, not too serious, or not a problem?**

| | Very serious, % | Somewhat serious, % | Not too serious, % | Not a problem, % | Unsure, % |
|---|---|---|---|---|---|
| September/October 2009 | 35 | 30 | 15 | 17 | 3 |
| April/May 2009 | 47 | 26 | 11 | 13 | 2 |
| April 2008 | 44 | 29 | 13 | 11 | 3 |
| January 2007 | 45 | 32 | 12 | 8 | 3 |
| July 2006 | 43 | 36 | 11 | 9 | 1 |
| June 2006 | 41 | 33 | 13 | 11 | 2 |

| D Rasmussen Reports | | | |
|---|---|---|---|
| **Is global warming caused primarily by human activity or by long-term planetary trends?** | | | |
| Date | Human activity, % | Planetary trends, % | Other reason, % |
| April 2010 | 33 | 48 | 11 |
| March 2010 | 33 | 48 | 8 |
| February 2010 | 35 | 47 | 8 |
| January 2010 | 37 | 50 | 5 |
| December 2009 | 34 | 50 | 6 |
| November 2009 | 37 | 47 | 5 |
| October 2009 | 38 | 46 | 3 |
| September 2009 | 42 | 47 | 5 |
| July 2009 | 39 | 47 | 6 |
| June 2009 | 42 | 40 | 10 |
| May 2009 | 39 | 44 | 7 |
| April 2009 | 34 | 48 | 7 |
| March 2009 | 41 | 43 | 7 |
| February 2009 | 38 | 45 | 7 |
| January 2009 | 44 | 41 | 7 |
| December 2008 | 43 | 43 | 6 |
| April 2008 | 47 | 34 | 8 |

three-quarters considered global warming to be a very serious or somewhat serious problem and about a quarter were of the opinion that it is not so serious or not at all serious. Again, the proportion considering it to be very or somewhat serious has fallen significantly between 2008 and 2010. The April 2010 Rasmussen poll showed that only 54% considered global warming to be a very serious or somewhat serious problem and 43% thought it was not very serious or not at all serious. The increasing trend of scepticism concerning global warming has continued into 2010 as demonstrated by a series of polls conducted by Gallup which are also shown in Table 14. Each of these polls involved a sample of at least a 1000 (MoE, ±4%). The percentage thinking that global warming has been exaggerated has increased markedly from only 30% in 2006 to nearly half the sample in 2010 (Polling Report.com, 2010b; Pew, 2009b; Rasmussen Reports, 2010; Gallup, 2010).

Another national poll conducted in late 2009 was The Associated Press-Stanford University environment poll. In this poll, 1005 respondents were interviewed between 17–29 November 2009 (MoE, ±3.1%). By a sizeable majority (75% to 22%), the respondents believed that global temperatures have been increasing over the last 100 years. However, when asked whether this was due to human activity or natural causes, 30% attributed to it to human activity, 28% to natural causes and 40% to both equally. When those saying both equally were pressed to say which factor they leaned towards by a margin of 53% to 38% they said human factors. When questioned as to whether scientists agreed with one another or not that global warming was happening, only 31% thought that scientists agreed and 66 % thought that scientists disagreed. A similar proportion thought that most scientists disagreed about the causes of global warming (Stanford, 2009). The 2009 MIT survey, which questioned 1296 people in September 2009, also asked the respondents whether they thought that scientists agreed with one another or not about global warming. The responses obtained showed that only 27% thought that scientists mostly agreed, with 53% thinking there was a lot of disagreement. The corresponding results in 2006 were 34% mostly agreeing and 45% mostly disagreeing. These polls demonstrate that the American public greatly overestimate the level of disagreement amongst scientists (Stauffer and others, 2009).

The rising scepticism towards global warming prior to 2009 was probably due to changing opinions of Republicans and was more likely to be a reaction to having a Democrat President and fears of big government rather than a shift in underlying attitudes towards global warming (CNN, 2009). However, the dramatic reduction in those believing in global warming between 2009 and 2010 was almost certainly caused by the increased scepticism about the scientific basis for global warming resulting from the release of emails between scientists at the Climate Research Unit, based at the University of East Anglia (UEA), in November 2009. This allegedly showed manipulation and suppression of data contrary to global warming. The doubts were re-emphasised by the admission in early 2010 that the 2007 IPCC report had exaggerated the speed at which Himalayan glaciers were

melting. The cold winter in 2009 and the exceptionally cold winter in 2010 might also have increased the levels of scepticism regarding global warming. A subsequent independent panel cleared the staff at UEA of any scientific impropriety, but the damage caused to scientific credibility will probably be long lasting.

## 3.4 Necessary actions to combat climate change

Given that a majority of the American people does consider that man-made global warming is taking place, some of the issues that need to be addressed are: does the Federal Government need to pass legislation, how urgent is the necessary action, should the USA take unilateral action and is cap and trade the best mechanism to combat global warming. Polling data have been obtained on each of these issues.

A series of polls conducted by ABC News/Washington Post in April, June and December 2009 of 1001 adults (MoE 3.5%) asked whether the Federal Government should or should not regulate the release of greenhouse gases from sources like power plants, cars and factories in an effort to reduce global warming. The results obtained were, in chronological order: should (75, 75, 60%), should not (21, 22, 29%) and unsure (4,3,6%) (Polling Report.com, 2010b). Another poll which addressed this issue was the 2009 MIT survey. When asked whether the Federal Government should do more to combat global warming, 58% thought they should do more, 15% thought they should do less and 25% thought they were doing the right amount at present. The proportion who thought they should be doing more was 10% lower than in a similar poll in 2006. The 2009 poll also found that 49% thought that the USA should join other industrialised nations in an international treaty to reduce greenhouse gas emissions (Stauffer and others, 2010). The polls showed that a substantial majority of Americans thought that the Federal Government should take action but this majority reduced significantly in late 2009.

A similar theme was investigated by an ABC News/Planet Green/Stanford University poll in March 06, April 07 and July 08 (1000 adults, MoE 3%). It asked whether the Federal Government should be doing more or less regarding global warming or was it doing about the right amount. The results obtained, in chronological order, were more (68, 70, 61%), less (5,7,10%), about right (25, 21, 27%) and unsure (1,2,2%). The 2009 Associated Press/ Stanford University environmental poll also addressed the issue of Federal Government action. When asked how much the Federal Government should do about global warming, the answers obtained were a great deal (31%), quite a bit (21%), some (23%), a little (10%) and nothing (15%). It is apparent that over this period a sizeable majority of those questioned thought that the Federal Government should be doing more but that this proportion decreased over time. The Stanford poll also asked respondents what actions the Federal Government should be taking to reduce global warming. By a substantial majority of nearly four to one the respondents opposed increasing taxes on electricity or increasing energy prices to encourage lower use. They opposed an increase in gasoline taxes to discourage car use by a margin of 64% to 35%. However, by a considerable margin of 88% to 12% they favoured giving companies tax breaks to produce more electricity from water, wind, solar power. A significant majority (65% to 31%) favoured giving tax breaks to companies that burn coal to produce electricity if they use carbon capture and storage. Some of the answers given were contradictory. Though the respondents were opposed to increasing energy prices, when asked whether power companies should be asked to pay an extra tax for each tonne of air pollution they emitted causing global warming, the respondents were in favour by a margin of 59% to 40% (Stanford University, 2009).

Regarding the urgency of action, an NBC/Wall Street Journal questioned 500 adults in October 2009 (MoE 4.4%). The respondents were asked whether immediate action, some action, more research on global warming was warranted or whether concern was unwarranted. The results are shown in Table 15. The results showed that over half the respondents considered that immediate or some action was necessary. Nearly a third considered that more research was sufficient and about a tenth thought that concern was unwarranted (Polling Report.com, 2010b). The MIT 2009 survey found

**Table 15 US perspectives on urgency of action** (NBC/Wall St Journal, Dec 2009 poll – Polling Report.com, 2010b)

**From what you know about global warming, which one of the following statements come closest to your opinion? Global climate change has been established as a serious problem and immediate actions is necessary. There is enough evidence that climate change is taking place and some action should be taken. We don't know enough about global climate change and more research is necessary before we take any actions. Concern about global climate change is unwarranted.**

| | Immediate action, % | Some action, % | More research, % | Concern unwarranted, % | Unsure, % |
|---|---|---|---|---|---|
| December 2009 | 23 | 31 | 29 | 12 | 5 |
| October 2009 | 29 | 27 | 29 | 13 | 2 |
| January 2007 | 34 | 30 | 25 | 8 | 3 |
| June 2006 | 29 | 30 | 28 | 9 | 4 |
| July 1999 | 23 | 28 | 32 | 11 | 6 |

that only 23% of those sampled thought that global warming had been established as a serious problem and immediate action was necessary. This proportion was lower than the 26% who agreed with this statement in 2006 but higher than the 17% in 2003 (Stauffer and others, 2010). This series of polls confirmed the trend in other polls in that the proportion wanting immediate or some action had significantly decreased since 2007 and the proportion of sceptics had increased. The Rasmussen poll in April 2010 confirmed this trend. Only 43% of those sampled thought that immediate action should be taken to combat global warming; the same proportion thought that the USA should wait a few years to see if global warming is a reality before making major changes. Fifty-two per cent thought that there continued to be significant disagreement within the scientific community over global warming and an even greater proportion (59%) thought that it was at least somewhat likely that some scientists had falsified research data to support their own theories about global warming (Rasmussen Reports, 2010). This may have been a reaction to the alleged malpractice at the University of East Anglia, where scientists were accused of attempting to conceal data casting doubt on global warming.

## 3.5 Attitudes to cap and trade

In the system known as cap and trade, the government issues permits limiting the amount of greenhouse gases companies can emit. Companies which do not use all their permits can sell them to other companies. The intention of this system is that companies would find ways of reducing their emissions as this would be cheaper than buying permits. In theory, those who can reduce emissions most cheaply will do so, achieving the pollution reduction at the lowest cost to society. A Pew poll of 1500 adults (MoE 3%) conducted in September-October 2009 investigated how widely known was cap and trade in the USA. When asked whether they had heard a lot, a little or nothing at all, the response was: a lot (14%), a little (30%), nothing (55%) and unsure (1%). The same organisation polled 678 adults in February 2010 and asked the same question and the answers obtained this time were: a lot (17%), a little (37%), nothing (46%) and unsure (1%). This poll suggested that the proportion of Americans having heard of cap and trade is increasing and constitutes a majority in 2010 but the extent of knowledge is low. In the ABC News/Washington Post poll of 1001 adults in November 2009 (MoE 3.5%), having explained the system of cap and trade, respondents were asked whether they would support the system. The results are shown In Table 16. The results suggested that though the majority of respondents supported the system, a significant minority opposed it and the extent of support has decreased significantly and the opposition increased significantly in the past year. This polling organisation has also investigated how the level of support for cap and trade is affected with rising electricity bills (Table 17). It is apparent that support for cap and trade is maintained for a modest increase in bills of 10 $/month but is not for a greater increase of 25 $/month (Polling Report.com, 2010b).

## 3.6 Attitudes to energy sources

The US public's attitudes towards energy options have been determined by Ansolabehere and Elting (2007). The 2007 survey was a follow up to the 2002 Massachusetts Institute of Technology (MIT) survey on The Future of Nuclear Power which surveyed attitudes towards nuclear and other power sources. Both surveys had sample sizes of about 1200. The respondents were told that some ways of generating electricity may be harmful to the environment because they produce air pollution, water pollution or toxic wastes. When asked how harmful each of the power sources were, the answers are given in Table 18. The results for 2002 are given

**Table 16 US attitudes to cap and trade** (ABC News/Washington Post, 2008-09 polls – Polling Report.com, 2010b)

| | Support cap and trade, % | Oppose cap and trade, % | Unsure, % |
|---|---|---|---|
| November 2009 | 53 | 42 | 5 |
| August 2009 | 52 | 43 | 6 |
| June 2009 | 52 | 42 | 6 |
| July 2008 | 59 | 34 | 7 |

**Table 17 US attitudes to cap and trade with cost implications** (ABC/Washington Post, 2008-09 polls – Polling Report.com, 2010b)

| | Support cap and trade, % | | Oppose cap and trade, % | | Unsure, % | |
|---|---|---|---|---|---|---|
| Cost | 10 US$/month | 25 US$/month | 10 US$/month | 25 US$/month | 10 US$/month | 25 US$/month |
| August, 2009 | 58 | 39 | 40 | 59 | 1 | 1 |
| June, 2009 | 56 | 44 | 42 | 54 | 2 | 1 |
| July, 2008 | 57 | 47 | 41 | 51 | 2 | 2 |

**Table 18 US attitudes towards energy sources** (Ansolabehere and Elting, 2007)

**How harmful do you think each of these power sources is? The 2002 figures are in parentheses.**

| | Coal, % | Gas, % | Nuclear, % | Hydro, % | Oil, % | Solar, % | Wind, % |
|---|---|---|---|---|---|---|---|
| Very harmful | 33.5 (32.9) | 4.5 (6.9) | 36.8 (45.1) | 2.6 (6.0) | 24.9 (23.4) | 1.3 (2.7) | 1.5 (1.7) |
| Moderately harmful | 27.4 (31.7) | 17.8 (18.0) | 17.1 (22.5) | 7.2 (12.0) | 30.0 (37.1) | 1.8 (3.1) | 1.7 (2.9) |
| Somewhat harmful | 24.9 (24.2) | 33.4 (35.0) | 17.9 (17.3) | 17.9 (19.0) | 25.9 (28.0) | 4.0 (8.9) | 5.2 (6.9) |
| Slightly harmful | 9.7 (9.0) | 27.5 (29.4) | 17.5 (10.4) | 27.0 (29.2) | 14.9 (8.6) | 8.9 (14.0) | 10.8 (12.8) |
| Not at all harmful | 4.5 (2.3) | 16.8 (10.8) | 10.7 (4.7) | 45.3 (33.8) | 4.3 (2.8) | 84.0 (71.2) | 80.8 (75.8) |

**Should the USA increase, reduce or not use the following fuels at all? The 2002 figures are in parentheses.**

| | Coal, % | Gas, % | Nuclear, % | Hydro, % | Oil, % | Solar, % | Wind, % |
|---|---|---|---|---|---|---|---|
| Not use | 6.6 (4.8) | 3.5 (1.3) | 11.3 (9.2) | 4.0 (1.4) | 6.4 (3.4) | 2.7 (1.4) | 3.8 (1.6) |
| Reduce a lot | 22.1 (23.3) | 6.8 (6.3) | 14.1 (19.2) | 2.1 (3.8) | 36.4 (19.7) | 3.1 (2.3) | 1.6 (2.5) |
| Reduce somewhat | 25.6 (29.9) | 19.7 (24.1) | 13.9 (18.6) | 8.8 (11.2) | 31.3 (33.6) | 4.4 (4.9) | 3.6 (4.7) |
| Keep same | 27.0 (25.0) | 38.8 (37.2) | 25.0 (24.6) | 45.1 (31.1) | 18.1 (30.2) | 13.1 (13.6) | 14.2 (13.9) |
| Increase somewhat | 11.4 (10.7) | 21.4 (22.7) | 21.4 (18.3) | 27.3 (34.2) | 4.7 (9.5) | 25.3 (27.0) | 24.0 (24.4) |
| Increase a lot | 7.4 (6.0) | 9.9 (8.1) | 14.3 (9.8) | 12.6 (18.0) | 3.1 (3.2) | 51.5 (50.4) | 52.8 (52.6) |

in parentheses. This particular question did not address global warming. The results show that coal, oil and nuclear were perceived as being most harmful with natural gas being significantly less harmful. Opinion was favourable regarding hydroelectric power and solar and wind were considered largely unharmful. Comparing the figures for 2002 and 2007, it is seen that the proportion considering the fuel as being significantly harmful has decreased slightly for all the fossil fuels and decreased significantly for nuclear power.

The survey then determined how much the respondents supported or opposed various energy sources. They were informed that new power plant would have to be built in order to meet the country's energy needs over the next 25 years. For each power source they were asked whether the USA should increase, decrease, keep the same or not use at all. The results are also given in Table 18. Nuclear power evoked the most divided response. In 2007, 39% wanted to reduce its use and 35% wanted to increase. The most unpopular fuel was oil for which 74% wanted to reduce its use followed by coal for which 54% wanted to reduce its use. Despite their unpopularity, fewer chose the option not to use these fuels compared with nuclear. Fewer than a third of those sampled wanted to reduce the use of natural gas and less than a sixth wanted to reduce the use of hydro. For these two energy sources, there was considerable support to keep them at their present levels or to increase their use. The two sources which attracted the highest level of support were solar and wind. For both these fuels, majorities chose the option to increase their use a lot. Comparing the results with those obtained in 2002, it is apparent that the scepticism regarding coal and the universal popularity of solar and wind are nearly unchanged. Natural gas was modestly more popular in 2007 than in 2002. Hydro, nuclear and oil showed noticeable changes in support. The popularity of hydro decreased significantly and that of nuclear increased significantly since 2002. The latter result is almost certainly due to the absence of greenhouse gas emissions from nuclear power. Oil shows the greatest decline with the proportion wanting to reduce it increasing from over half to nearly three-quarters. This unpopularity was not surprising given the concerns regarding global warming and the insecurities concerning the reliability of oil supplies from the Middle East.

In the MIT 2008 Energy Survey, Ansolabehere and Konisky (2009) investigated public attitudes towards the siting of new power plant. When the respondents were asked how would they feel if a particular type of plant were built within 25 miles of their homes, the results in Table 19 were obtained. It is apparent that the public were overwhelmingly opposed to

**Table 19 US attitudes towards new power plant** (Ansolabehere and Konisky, 2009)

| | Coal-fired plant, % | Natural gas-fired plant, % | Nuclear plant, % | Wind power facility, % |
|---|---|---|---|---|
| Strongly oppose | 45.0 | 25.7 | 55.3 | 11.2 |
| Somewhat oppose | 32.1 | 32.3 | 21.2 | 14.3 |
| Support | 20.2 | 38.3 | 18.5 | 48.8 |
| Strongly support | 2.7 | 3.7 | 5.0 | 25.7 |

the construction of coal or nuclear plant near their homes. There was less opposition to gas-fired plant. There was considerable, though not universal support, for the construction of wind turbines.

## 3.7 Unilateral action

Given that the bulk of the greenhouse gases in the atmosphere have been produced by the developed world which industrialised in the 19th century, many in the developing world consider that present action to combat climate change should be confined to the developed world. However, since some countries in the developing world such as China and India are major current greenhouse gas emitters, some in the developed world think that they should also contribute to reductions. Hence several polling organisations have questioned the American public whether they think that the USA should reduce $CO_2$ emissions unilaterally or only with others. The 2009 CNN/Opinion Research Corporation and the 2009 ABC News/Washington Post polls have addressed this issue in a series of polls conducted between 2007 and 2009. The results are contained in Table 20. The figures demonstrate that a significant majority (about 60%) of Americans thought that the USA should reduce greenhouse gas emissions unilaterally even if other countries did less. About a fifth of those polled thought that reduction should be made only with others and about the same proportion thought that the USA should not reduce at all. The results also showed that the proportion willing to act had decreased significantly and the proportion unwilling to act had increased significantly over that period (Polling report.com, 2010b).

## 3.8 US Public Information

The assessment of available public information in the USA in 2006 (Fernando, 2006) showed that the organisations in the USA which campaigned against coal-fired power plant concentrated mainly on health and environmental issues. They

**Table 20 US attitudes to unilateral action** (Polling Report.com, 2010b)

**A CNN/ORC poll (December 2009)**

**Which of these positions do you agree with most? The USA should reduce emissions of carbon dioxide and other gases that may contribute to global warming even if it does so by itself. The USA should reduce emissions of carbon dioxide and other gases that may contribute to global warming only if other countries do so as well. The USA should not reduce emissions of carbon dioxide and other gases regardless of what other countries do.**

| | Reduce even if alone, % | Reduce only with others, % | Should not reduce, % | Unsure, % |
|---|---|---|---|---|
| December 2009 | 58 | 17 | 24 | 2 |
| October 2007 | 66 | 16 | 15 | 3 |

**B ABC News/Washington Post poll (November 2009)**

**Do you think the USA should take action on global warming only if other major industrial countries such as China and India agree to do equally effective things, that the USA should take action even if these other countries do less, or the USA should not take action on this at all?**

| | Action if others agree, % | Action even if others do less, % | No action, % | Unsure, % |
|---|---|---|---|---|
| November 2009 | 21 | 55 | 22 | 3 |
| June 2009 | 20 | 59 | 18 | 3 |
| July 2008 | 18 | 68 | 13 | 2 |

claimed that asthma attacks, respiratory disease, heart attacks and premature deaths were among the serious health problems caused by air pollution from the electric power sector. They further claimed that the power sector caused damage to water supplies both as large users and polluters. In particular, they claimed that areas used for landfilling power plant waste had polluted aquifers. Power plants in the USA were said to be the largest source of mercury and several hundred thousand newborn babies had unsafe levels of mercury in their blood. The organisations campaigning in favour of coal emphasised that it was a secure source of energy in that it was available domestically and should last several hundred years. It was also used to generate more than half the electricity produced in the USA. They claimed that since the 1970s considerable sums had been invested in emissions control technologies and that though coal use had doubled, emissions of major pollutants had decreased by over a third. They also refuted some of the health concerns by saying that in recent years dramatic improvements in air quality had taken place and that the US utilities were responsible for only 1% of the mercury emitted into the air. As to global warming, they claimed that there was still debate as to whether increasing levels of $CO_2$ were due to natural variations or man-made. They suggested that sequestration was the answer and that natural carbon reservoirs could be used to store carbon effectively.

### 3.8.1 US organisations opposing coal-fired power plant

There are a myriad of local organisations that highlight pollution from a given coal-fired power plant or oppose the construction of a new plant. It is impractical to cover all these, hence this section will describe national organisations which oppose coal-fired plant.

Environmental Defense Fund (EDF) was founded in 1967 to propose long-lasting solutions to environmental problems based on the best scientific research. They work directly with businesses, government and communities. Their present focus is on global warming, which they consider the most critical environmental challenge of our time. They are also concerned about factors affecting land, water and wildlife, especially the fate of endangered species. They campaign to protect critical areas of oceans and on issues affecting public health such as air pollution. They claim their approach is based on sound science, through corporate partnerships, economic incentives and getting the correct legal framework. They suggest that the climate crisis is nearer and scarier than previously believed. Among the facts that they claim emerged during 2009 are that the current levels of $CO_2$ in the atmosphere at 390 ppm are higher than at any time in measurable history. The 2000–09 decade was the hottest ever with 2009 one of the five hottest years. The Arctic ice cover is vulnerable to further melting and it could be ice-free in the summer by mid-century. The East Antarctica ice sheet, which was thought to be more stable than the western one, is also shrinking. They report that climate change is already observed in the USA, and coastal wetlands from New York to North Carolina could be lost by sea level rise. Furthermore climate change could result in US production of corn, soybeans and cotton decreasing by as much as 82%. In 2007, they campaigned successfully to prevent TXU building 8 coal plants in Texas. In 2009, they published a report 'Foreclosing the future-coal, climate and international finance' in which they urged international organisations to stop subsidising coal plants. In the report they stated that coal was the most carbon-intensive of all energy sources. The difference in $CO_2$ emissions between older and newer coal plants was marginal compared to the difference between coal and renewable alternatives. They also urged the deployment of public international finance to support renewable technologies, energy efficiency and other alternatives to coal. However, EDF are realists and accept that the transition away from fossil fuels is likely to take a very long time and they foresee a long-term need to deal with coal-based emissions (Rich, 2009).

EDF are very supportive of the 2009 American Clean Energy and Security Act which they consider a historic step in fighting climate change. Its key benefits are to cap and reduce carbon emissions, create jobs in the USA, cut imports of foreign oil, enhance national security and encourage other countries to act. They are in favour of cap and trade which they consider is the only option which guarantees lower emissions. Cap and trade will trigger a race among innovators and entrepreneurs to find the most efficient, cost-effective technologies to reduce emissions. They prefer it to either a carbon tax, government subsidies for clean energy technologies or a Manhattan Project-style initiative to fund the search for a technological solution. They are in favour of CCS which they suggest has the potential to be a win-win solution for the economy and the environment (Environmental Defense Fund, 2010a,b).

Another organisation that campaigns for a cleaner environment is the Clean Air Task Force (CATF). This was founded in 1994 and is non-profit-making and has the aim of restoring clean air and healthy environments through scientific research, public education and legal advocacy. Controlling power plant emissions has been a major focus of their efforts. They publish reports regularly which are well-written, well-presented, adequately referenced, seemingly authoritative and are at times very critical of coal-fired power plant. Since 2005 they have published several reports on the impact of water quality from coal combustion waste. They report that coal-fired power plants in the USA generate 130 Mt of solid power plant waste, which is enough to fill the Grand Canyon. This waste is laden with heavy metals and harmful toxics which contaminate water supplies and cause injury and death to livestock and threaten human health with birth defects, cancer and neurological damage. The problem, they say, is compounded by the absence of federal legislation. Regulation is left entirely to the states which set low standards and enforce haphazardly. CATF have been fostering aggressive public education, investigation and citizen advocacy in states where the largest amounts of power plant wastes are produced and disposed of, including Pennsylvania, Indiana, West Virginia, Texas, New Mexico, Massachusetts and Florida.

More recently, in September 2009, they have addressed climate change with two reports entitled *Innovation policy for climate change: A report to the nation* and *Coal without carbon: An investment plan for federal action* (Clean Air Task

Force 2009a,b). CATF claim that America's 500 coal-fired power plants are its largest industrial source of harmful air pollution. Ranging from lung damage to asthma attacks to acid rain, haze and global warming, no economic sector has a greater impact on the US environment. They are particularly opposed to conventional PCC plant which they say threaten to create a 60-year stream of new $CO_2$ which cannot be easily sequestered, as well as a multi-decade stream of toxic waste. To this aim CATF, in conjunction with other organisations, have mounted aggressive campaigns to oppose proposed PCC projects in Wisconsin, Montana, New Mexico, Wyoming, Colorado and Utah. They claim that they have worked to prevent the EPA from prohibiting States from subjecting new coal plant proposals to scrutiny against alternatives such as IGCC. As a result of their efforts, the Illinois EPA changed its permitting procedures to require developers of new conventional PCC plants to evaluate IGCC as an option for meeting best available control technologies. CATF are, however, very supportive of advanced clean coal technologies, in particular, IGCC with CCS. They have collaborated with MITs Energy and Environment Laboratory to explore the potential applications and effects of IGCC/CCS in conventional energy production and its viability in today's marketplace. Their report *Coal without carbon* focuses on underground coal gasification, surface-based coal gasification, advanced technologies for post-combustion $CO_2$ capture and geological $CO_2$ sequestration (Clean Air Task Force, 2009a,b).

An organisation that has been campaigning for the environment for even longer is the Sierra Club. This was founded in 1892 and has the aim of protecting communities, wild places and the planet itself. They claim to be the most influential environmental grassroots organisation in the USA. They consider coal to be the dirtiest energy source in the USA. They run a 'Beyond Coal' campaign which states that coal is the source of more than 30% of US global warming pollution; it causes asthma and other health problems and mining it destroys mountains and releases toxic mercury into communities. The Sierra Club are campaigning to stop the construction of dirty, new coal plants by educating investors and decision makers about the economic and environmental risks of investing in new coal. They want to retire old plants that are the worst contributors to health-harming soot and smog pollution and replace them with clean energy solutions. They are working with communities to protect mountains, lands and waters by keeping the vast US coal reserves in the ground. Their campaign includes running a coal plant tracker website which contains a map and database with information and the latest status on proposed coal plants across the country. Their website (www.sierraclub.org) also contains a mountaintop removal permit tracker which has a list of pending permits in Appalachia and possible impacts on the environment and nearby communities and a coal ash sites map showing every coal ash storage facility in the country.

As part of their 'Beyond Coal' campaign, they have published a report entitled *The Dirty Truth about Coal* in which they claim that the mining and burning of coal scars lungs, tears up the land, pollutes water, devastates communities and makes global warming worse. The report states that the first stage of the dirty life cycle of coal begins when it is mined irresponsibly from the earth. Beyond the damage to the land, water and air, coal mining also jeopardises the health and safety of workers and nearby communities. Apart from conventional air pollution, coal mining is also a source of global warming as mining releases 26% of US methane emissions, which is 20 times more potent a global warming agent than $CO_2$. The report says that 90% of the coal that is mined in the USA is burnt in power stations which are one of the largest sources of air pollution in the USA. The consequences for human health are staggering especially regarding particulate pollution or soot, which is one of the most deadly types of air pollution. The report also blames coal-fired power plant for being one of the largest contributors to smog pollution which leads to increased risk of asthma attacks and permanent lung damage. Additionally, coal-fired power plants emit large quantities of toxic air pollutants and are one of the largest sources of man-made mercury. The contribution to global warming is also mentioned. The report asserts that though coal-fired power plants generate just over half the nation's electricity, it accounts for 80% of $CO_2$ pollution from electricity generation. Coal-fired power generation has the highest carbon intensity per unit of electricity generated among all fossil fuels. The report also highlights the legacy of coal combustion wastes. It considers the annual amount of wastes produced (120 Mt) as staggering. Not only is it a challenge to store all this waste, but even after storing, toxic elements such as lead, mercury and arsenic can leak and pollute the surrounding environment and groundwater. It suggests that toxins in drinking water have been linked to increased cancer, respiratory disease, neurological damage and developmental problems in local people.

The report is highly sceptical of CCS. Although, in theory, CCS sounds promising, the challenges are enormous, ranging from separating out the $CO_2$, transporting it and ensuring that it remains sealed for thousands of years. In addition, the scale needed to store all $CO_2$ emitted from US power plants is massive. According to the report, at present, CCS has not been demonstrated at the rate of emissions of a coal-fired power plant and the technology must be considered to be unproven. It is equally critical of IGCC which they suggest emits just as much $CO_2$ as a conventional PCC plant. The report considers coal-to-liquids (CTL) technology in a similar vein in that it creates about double the $CO_2$ emissions as conventional gasoline. On top of this CTL needs billions of dollars of government subsidies to be viable, money that could be much better spent cleaning up current uses of coal and moving towards cleaner sources of energy. The clean energy solutions which the Sierra Club supports are repowering America with green renewable sources of energy such as wind, solar, geothermal and biomass. They also recommend rebuilding America with high-performance homes and buildings which eliminate greenhouse gas emissions, reduce utility bills and generate renewable electricity. They also favour linking homes to a smart grid powered by clean energy with an energy internet. This 21st century electranet can reduce electricity consumption through a national transmission network that supports large-scale renewable energy and local energy generation that frees homes and businesses to produce their own energy (Sierra Club, 2007).

### 3.8.2 US organisations favouring coal-fired power plant

Amongst the organisations which report information in support of the coal industry in the USA is the National Coal Council (NCC). This advisory council was founded in 1985 to advise, inform, and make recommendations to the Secretary of Energy with respect to any matter relating to coal or the coal industry that he may request. The members of the Council are appointed by the Secretary of Energy. It has a membership of about 125 individuals who represent all segments of the coal interests, including coal producers and shippers, coal users, technology developers, academia, research institutions, environmental and consumer groups, state regulatory experts and others. It has produced a series of short reports advocating the use of coal. In a report entitled *Coal: Energy security for our nation's future* (National Coal Council, 2010a) they state that coal is the largest fossil fuel resource in the country and is mined in twenty-six states and represents 33% of all domestic production. It is used in forty-eight states to meet 22% of the domestic energy market and fuels more that 50% of US electricity generation. At current production rates, the estimated recoverable reserve will last for about 240 years. It claims that maximising and expanding coal production will build a platform for strong new economic growth and job creation in the USA. NCC have assessed coal in the global context in a report entitled *The global realities of energy* (National Coal Council, 2010b). In this they claim that, thanks to coal-based generation, the USA has the most reliable electric power supply system in the world. Other nations have seen these benefits and there are now over 660 GW of new coal-based generation either planned or under construction worldwide. China and India are rapidly moving to use their own coal reserves to produce electricity, liquid fuels, synthetic natural gas and chemicals. Using their domestic coal for a broader range of applications will enable both countries to reap substantial economic benefits by significantly reducing imports of oil and natural gas. The world has never experienced an energy demand surge to compare with what will be experienced in the next 30 years. It will be impossible to meet this demand without the use of coal. Billions of people will be relying on coal to meet their needs and improve their quality of life.

The NCC recognise the need to limit man-made $CO_2$ emissions to combat global warming. In their opinion $CO_2$ capture and geological storage is the key enabling technology for the reduction of $CO_2$ emissions from coal-based power generation. In a report entitled *Carbon dioxide capture and storage: the future of sustainable coal use* (National Coal Council, 2010c), they predict that CCS is likely to become commercially available for base load power generation around 2025-30 following the construction and operation of several demonstration plants during the next ten years. NCC fully supports all the current R&D efforts that the US DOE National Energy Technology Laboratory (NETL) has been conducting since 1997. These programmes include the Carbon Sequestration Leadership Forum, the Regional Carbon Sequestration Partnerships and the overall CCC R&D programme. It also collaborates with industrial groups involved with R&D of CCS technologies such as EPRI. Until CCS technologies are commercially available, NCC suggest in their report, *Advanced coal technologies* (National Coal Council, 2010d), that options for efficient coal based generation include PC combustion in ultra-supercritical cycles (USCPC) and IGCC. Though the average efficiency of PCC plant in the USA is 32%, efficiencies of USCPC plant can be 44%. Hence they are 35% more efficient than some of today's US fleet of coal-fired power plant. They report that IGCC technology is being demonstrated in the USA, Europe and Asia. Currently, without CCS, IGCC is more expensive and has lower availability than PCC plant but if CCS were available, it may be less costly. Large-scale demonstrations of both PCC and IGCC with CCS will be important to make these technologies commercially available.

The American Coalition for Clean Coal Electricity (ACCCE) is a partnership of industries involved in producing electricity from coal. They consider that coal, the country's most abundant energy source, plays a critical role in meeting the growing need for affordable and reliable electricity. Their stated goal is to advance the development and deployment of advanced clean coal technologies that will produce electricity with near-zero emissions. ACCCE combines the assets and missions of two earlier campaigning organisations, namely, the Center for Energy and Economic Development (CEED) and Americans for Balanced Energy Choices (ABEC). They believe that the robust utilisation of coal is essential to providing affordable and reliable electricity for US consumers and the industry. They claim to be committed to the continued and enhanced US leadership in developing and deploying new advanced clean coal technologies. They report that coal-fired power plant generate half of the electricity that America relies upon. Coal is their most abundant fuel and the nation has supplies to last 200 years. Coal is also uniquely important in satisfying electricity demand in that renewable sources such as solar and wind are not suitable for supplying baseload supply due to their intermittent nature. Unlike natural gas, which is needed for domestic heating and industrial purposes, the use of coal for electricity generation does not drive up costs for other consuming sectors. The cost associated with coal-fired generation is one-third the cost of most other fuels. They quote recent studies by the Coal Utilization Research Council and Electric Power Research Institute (EPRI) that with prudent investments in technology, the cost of using coal to generate electricity with CCS in 2020 will be cheaper (adjusted for inflation) than the cost of electricity produced by coal today without CCS. They mention that there has never been an environmental challenge facing the coal-based electricity sector for which technology has not provided the ultimate solution. There have been dramatic reductions in emissions in recent years. Today's fleet is 77% cleaner regarding the emissions regulated under the Clean Air Act. They state that technologies to capture carbon are already under development and experts agree that $CO_2$ can be safely stored underground.

ACCCE's strategy to combat global warming is to:

- Promote rapid, and widespread research, development, deployment and commercialisation of innovative, advanced clean coal and other technologies – including carbon capture, transportation, safe storage and terrestrial carbon sequestration.

- Recognise any policy addressing climate change which is inextricably linked to broader US energy security, economic development and environmental interests and goals.
- Acknowledge that climate change is a global issue requiring leadership by the USA and actions by all nations in a spirit of shared responsibility to devise and carry our practical and cost-effective measures by government, business and citizens to slow, stop and then reverse man-made greenhouse gas emissions.
- Value coal's vital role in America's energy future and recognise the importance of energy efficiency and conservation, as well as diverse other domestic energy sources to generate electricity including nuclear, natural gas and renewables (American Coalition for Clean Coal Electricity, 2010).

ACCCE highlight recent research into clean coal technologies. They quote a 2009 study produced in conjunction with Management Information Services which is highly complementary to the Federal Government's Clean Coal Technology programme (Management Information Services, 2009). They suggest that the programme has a wide range of well-documented technological successes and has produced substantial benefits to the US tax payer, which far exceed the initial investment. The benefits include cleaner air, reduced pollution, increased energy efficiency, support for US manufacturing, increased US exports, enhanced national security and job creation. They have also released a study conducted with several industrial partners on the economic benefits from advanced coal electric generation (BBC Research and Consulting, 2009). The research suggests that, depending on how many CCS-equipped plants are deployed, five to seven million man years of employment could be created and a quarter of a million permanent jobs could be added during operations.

It is apparent that the objections of the organisations opposing coal-fired plant are very different. EDF focus on global warming and are in favour of cap and trade and CCS. CATF concentrate on pollution associated with power plant waste and health effects of air pollution. They are supportive of advanced clean coal technologies such as IGCC and CCS. The Sierra Club highlights global warming, power plant waste and air pollution. They are highly sceptical of IGCC and CCS and would prefer the USA not to use coal at all. Both the organisations supportive of coal use emphasise that coal is a secure, affordable and abundant source of energy. It is vital for meeting America's present energy needs and will be so for the foreseeable future. Both are confident that CCS will be technically feasible and economically viable and will address the challenges of climate change. Till CCS is available, other advanced technologies such as IGCC will significantly reduce emissions.

# 4 European Union

Though fossil fuels continue to play an important role in the energy supply of the European Union (EU), a rapidly increasing share comes from imports rather than domestic production. Since 1990, the overall production of fossil fuels has declined by 25%, mainly because the decline in coal production has not been met by increases in oil and gas production. It is now expected to fall by another 45% by 2020 as a further decline in coal will be reinforced by a decline in gas production. Between 1990 and 2005, the total quantity of coal consumed in the EU decreased by 64% with the share produced domestically falling from 81% to 61%. Regarding power generation in the EU about 30% is from nuclear and 30% from coal. The share of coal has decreased from about 40% in 1990. Natural gas has been the main source replacing coal and its share increased from 7% in 1990 to 20% in 2005 and is likely to reach 25% in 2010. Renewable sources are becoming increasingly important with their share increasing from 12% in 1990 to 15% in 2005. However, whereas in 1990 renewable energy was almost entirely hydro-power, in 2005 about a third was from wind and biomass. In terms of generating capacity, the EU fuel mix is more diversified than it appears looking at the generation volume. In 2005, for coal and natural gas, the capacity shares were about the same as the generation output. However, for nuclear power, though the installed capacity is only 18%, its share of generation was 30%. This corresponded to an average capacity factor of 84%, which was significantly greater than the average capacity of 72% in 1990 and indicated the improvements made in the economic performance of the plants. The average capacity factors for coal and gas were 54% in 2005. This reflects the fact that some coal plant are old and see little utilisation but are still a source of flexibility. Gas plants are often used as mid-merit plant, with utilisation rates depending on the price of gas. Coal capacity has decreased 11 GW since 2000. An Emissions Trading Scheme (EU ETS) is in operation in the European Union. This is the world's first mandatory scheme for trading carbon. The main components of the EU ETS are:

- Mandatory caps on all large sources including the power sector and other carbon intensive industries such as chemicals, steel, aluminium and cement.
- Allowances corresponding to the total level of $CO_2$ that can be permitted are allocated by National Allocation Plan which is based on a country's Kyoto commitment.
- Companies included in the scheme are given pollution allowances. If they emit less $CO_2$ than their permits, they can sell their permits. Companies emitting more must purchase permits form the market. This should give a clear financial incentive to reduce emissions.
- A fine for companies that exceed their permit.
- A pilot phase was conducted between 2005 and 2007 (Phase 1). The scheme is fully operational between 2008 and 2012 (Phase 2). It possible to trade with other regions of the world after 2102 (Phase 3).

Increasingly demanding environmental performance standards of the Large Combustion Plant Directive, together with the expected impact from the move towards full auctioning in the next phase of the Emissions Trading System will hinder investment in new coal plant as long as CCS is not a commercial technology (International Energy Agency, 2008).

## 4.1 Public attitudes in Europe

The attitudes of the citizens of all the countries in the European Union on a variety of subjects are regularly polled and published in Eurobarometer reports. These surveys were requested by the European Commission and the European Parliament and co-ordinated by the Directorate-General for Communication of the European Commission. A Eurobarometer survey was published entitled *Attitudes towards energy* in 2006 on the attitudes of respondents from the 25 member states towards energy issues for which 29,430 people were sampled. The fieldwork was conducted between October and November 2005. The survey included asking respondents, given that in order to reduce dependency on imported energy, governments have to choose from alternatives which are sometimes costly, which of the following should their government mainly focus on in the years to come. The interviewees were allowed to support a maximum of two of the propositions. The answers obtained for all the countries are shown in Figure 18. Almost half (48%) supported the focus of developing solar power followed by advanced research, including clean coal, for new

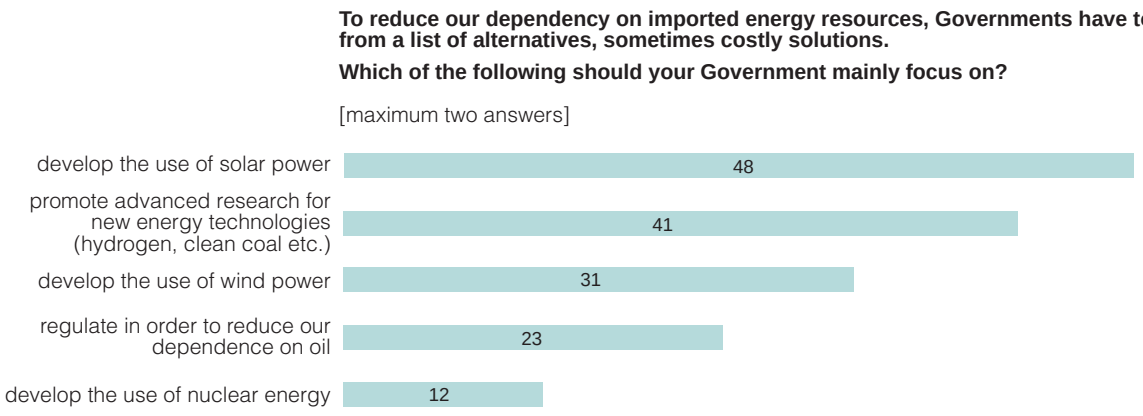


**Figure 18 Attitudes towards measures to reduce energy imports** (Eurobarometer, 2006)

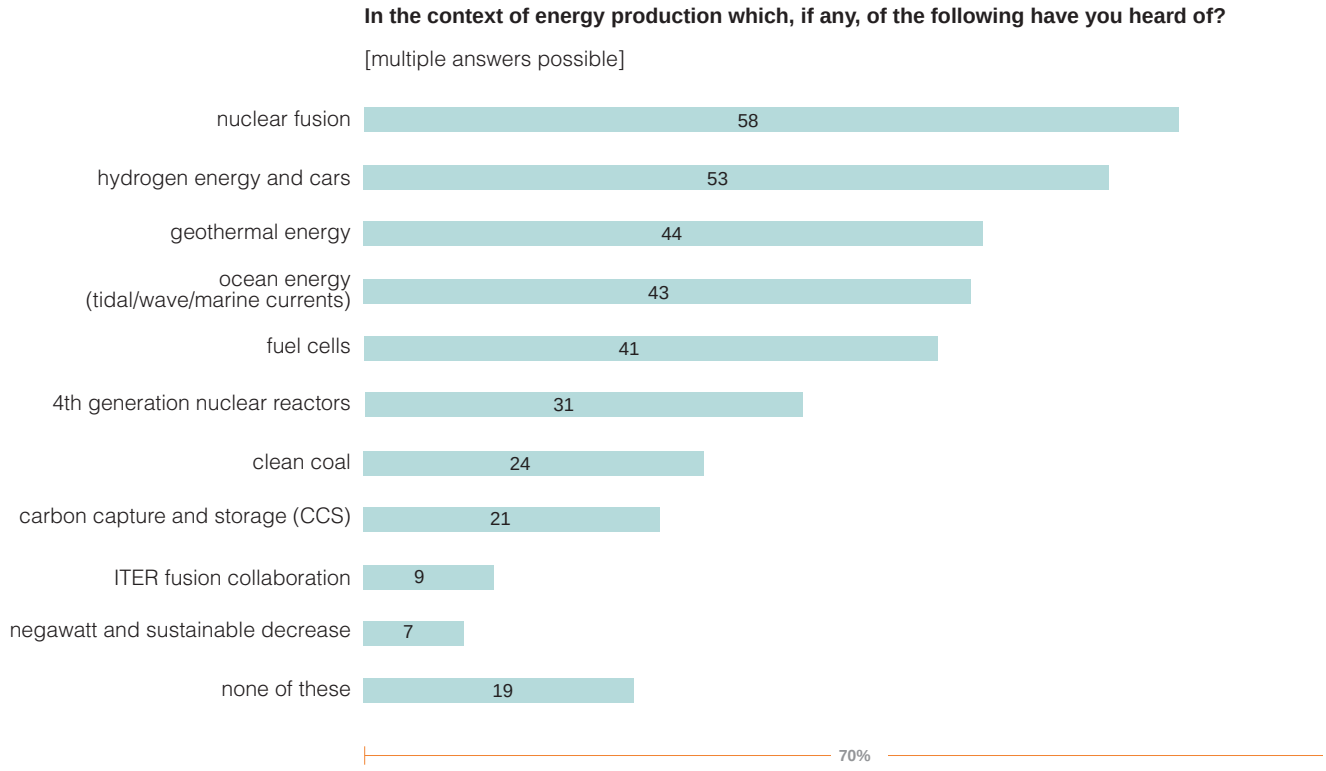


**Figure 19 Familiarity with new energy technologies** (Eurobarometer, 2007a)

technologies (41%). The least popular option (12%) was developing nuclear power. Respondents in Cyprus (76%) and Greece (70%) were the most in favour of solar power and those in the Netherlands (62%) and Denmark (61%) were the most in favour of advanced research. The Swedes (32%) and the Finns (27%) were the most in favour of nuclear power. Regarding renewable energy, 54% of Europeans were not prepared to pay more. However, 27% were prepared to do so provided that the price increase was limited to 5%. The new member states were the most reluctant to pay for green energy (Eurobarometer, 2006).

A later Eurobarometer survey entitled *Energy technologies: knowledge, perception measures* (2007a) addressed general perception of energy issues including knowledge and attitudes. This survey was conducted in the 25 member states and took place May-June 2006 with 24,815 people being questioned. When asked which issues they considered were the most important their country faced, only 14% said energy and 12 % said environment. There was far more concern about unemployment (64%) and crime (36%). The low figure for energy did not necessarily imply a low perception of its importance but reflected its ranking among other issues which impacted more directly on their lives. When the respondents were asked about what came to their mind when they thought of energy issues, the most common issue was energy prices (33%). The next three were renewable energy (14%), electricity supply (12%) and limited energy sources (9%). The survey also examined EU citizens' knowledge of energy related issues. When asked, in the context of energy, which of the following have you heard of (multiple answers allowed), the answers obtained are shown in Figure 19. Europeans appear to be quite familiar with some technologies; over half had heard of nuclear fusion and hydrogen energy. Over two-fifths had heard of geothermal, ocean energy and fuel cells but less than a quarter had heard of clean coal (24%) or CCS (21%). An examination of results for individual countries showed that citizens in northern Europe tended to be more familiar with these technologies than those in southern Europe or in the new member states.

The issue of whether the public trusts information given to them either by scientists, governments or environmental groups is of increasing importance and the survey addressed this. When asked to what extent you would trust information about energy related issues from each of the following sources, the answers in Figure 20 were given. It is evident that, at the time, Europeans tended to trust scientists most with 71% either trusting them totally or a lot. They also tended to trust environmental groups with 64% having some measure of trust. On the other hand national governments had the confidence of only 29% and political parties were trusted on this issue by only 13% of the respondents. A higher proportion (34%) trusted energy companies. Given the need to change the pattern of energy consumption to reduce greenhouse gas emissions, the respondents were asked whether they were in favour or opposed to the use of different sources of energy in their countries. The results are given in Figure 21 and show that the respondents were highly positive about the use of renewable sources: solar energy (80%), wind energy (71%) and hydroelectric energy (65%). There was also positive support for ocean energy (60%) and energy from biomass (55%). Considering fossil fuels, there was a reasonable degree of support for natural gas (42%) but only about a quarter supported oil (27%) or coal (26%). Nuclear energy had the lowest level of support (20%) with nearly twice that proportion (37%) opposing it. The detailed results for the attitudes towards coal in individual countries are shown in Figure 22. The countries with the greatest support for coal were Poland (49%) and Lithuania (43%). The

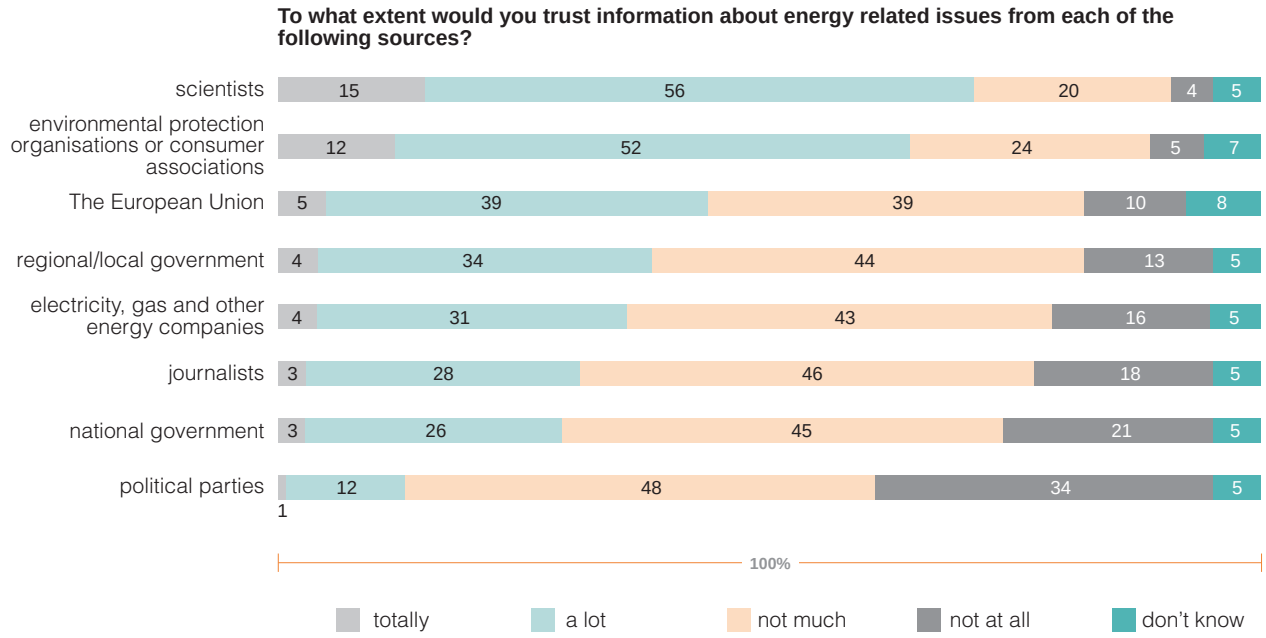


**Figure 20 Trust in sources of information** (Eurobarometer, 2007a)

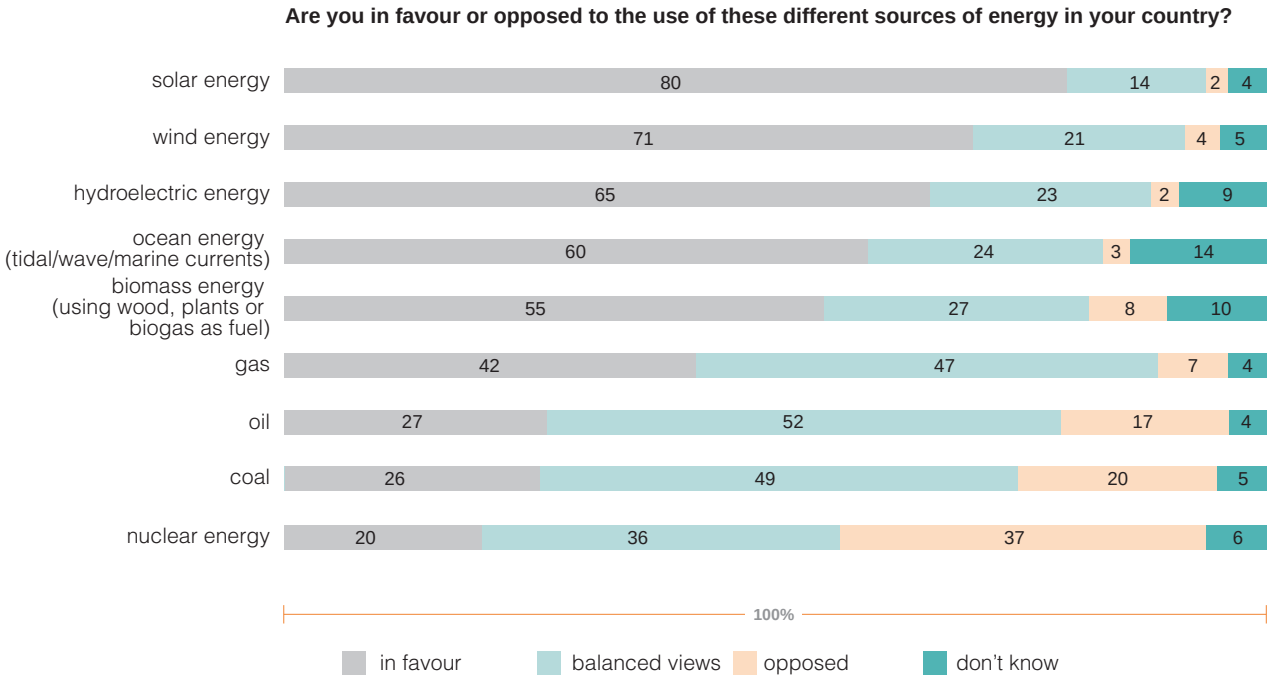


**Figure 21 Attitudes to energy sources** (Eurobarometer, 2007a)

countries in which there was least support were the Nordic countries: Denmark (11%), Finland (8%) and Sweden (2%) and The Netherlands (9%). The support for coal use in Poland is not surprising given that over half of its primary energy is supplied from it. For the nordic countries, this proportion is in the 10-20% range.

The survey also investigated which measures EU citizens thought their governments should take regarding policy. When those questioned in the survey were asked which two measures should be top priority for their government's energy policy, the most popular answers were guaranteeing low prices for consumers (45%), guaranteeing a continuous supply of energy (35%) and protecting the environment (29%). The need to reduce energy supply (15%) and fight global warming (13%) came sixth and seventh in order of popularity. When asked specifically whether energy related research should be a priority for the European Union, Sixty per cent considered it to be a high priority, for the members as a whole. The highest levels of support were found in Cyprus (86%), Malta (79%), Denmark (75%) and Germany (68%). The levels of support in France (63%) and UK (59%) were close to the average. The level of support in The Netherlands was low at 52%. The lowest levels of support were in the new members such as Hungary (49%) and Lithuania (47%).

The EU commissioned another poll in 2007 to find out to what extent citizens linked the way energy was produced and used to cause global climate change and assessed perceptions regarding various possible actions in saving energy. The survey covered all 27 member states and 25,800 individuals were interviewed by telephone in February 2007. The report

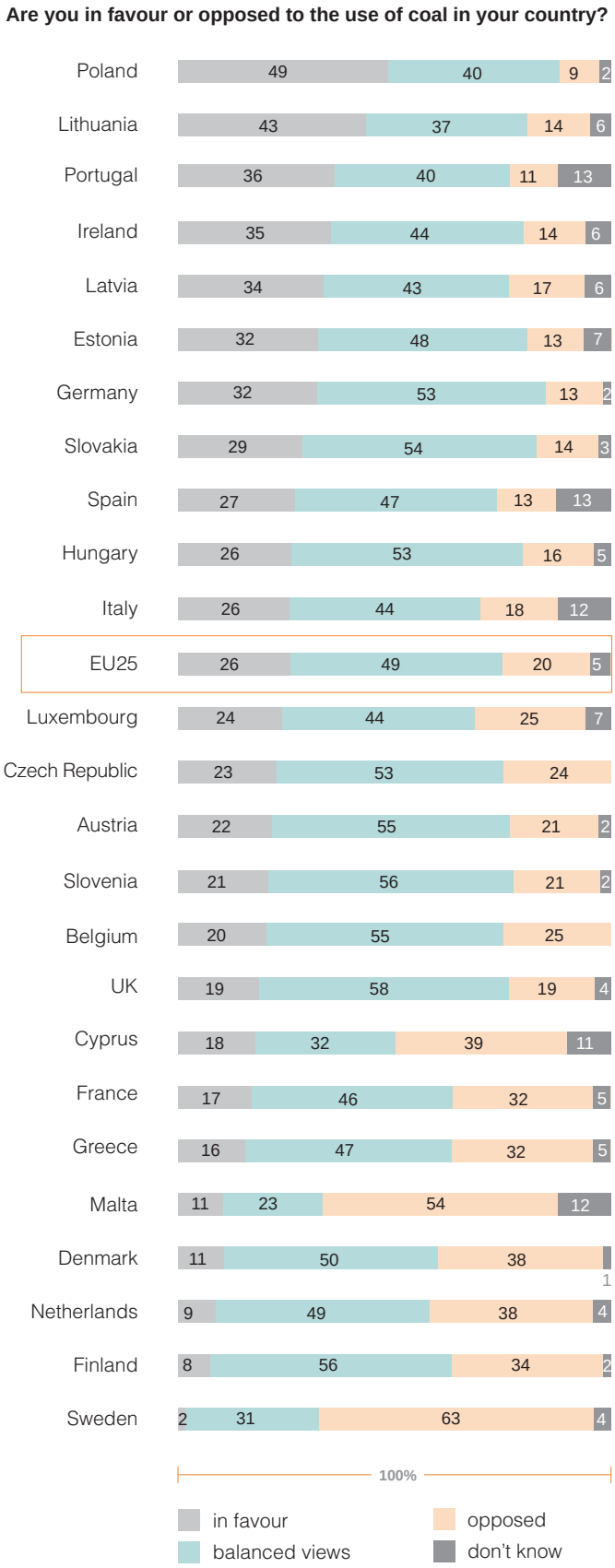


**Figure 22 Attitudes to the coal industry** (Eurobarometer, 2007a)

entitled *Attitudes on issues related to EU energy policy* was published in April 2007 (Eurobarometer, 2007b). When asked whether climate change and global warming were a concern to them, across the EU as a whole, 50.2% said yes very much, 36.7% said yes to some degree and 12.4% said no. The countries which had the largest proportion saying yes very much were Spain (70.3%), Cyprus (69.9%), Malta (67.9%), Greece (67.8%) and Portugal (64.5%). It is only to be expected that these Mediterranean countries were the most concerned as they are likely to be the most to be affected by global warming. The countries having the smallest proportion in this category were Estonia (19.7%), Latvia (24.3%) and Finland (24.4%). This again is not surprising as in these very cold countries, citizens may not be unduly concerned about the climate becoming warmer. When asked whether the way in which their country produced and consumed energy had a negative impact on climate change and global warming, overall 38.2% said it had a big negative impact and 44.2% said it has some negative impact. Only 7.8% said it had almost no negative impact and 4.6% thought it had no negative impact at all. The survey addressed the issue of renewable energy and when the respondents were asked whether the EU should set a minimum percentage use in each member country to come from a renewable source, overall 82.8% said yes. The proportion saying no was 11.9% which consisted of 2.8% who said no as that would raise energy prices, 4.4% thought they should be able to decide independently of the EU, 1.9% thought this should not be regulated at all and 2.8% for other reasons. The countries with the lowest levels of support for renewable energy were Latvia (49.9%), Estonia (51.8%), Bulgaria (53.1%) and Lithuania (56.4%). These new accession countries all have cold winters and sizeable populations on low incomes who would be very concerned about any rise in energy prices. The respondents were also asked whether their government should support the development of new and cleaner energy technologies and products. There was overwhelming support with 92.2% answering in the affirmative with almost equal support for public funding for research (31.2%), tax incentives for energy efficient products and technologies (31.3%) and prohibiting the use of energy inefficient products and technologies (29.7%). The survey finally investigated EU citizens' attitudes towards nuclear energy. The options the respondents were given were that the share of nuclear energy should be increased as it does not contribute towards climate change or whether its share should be decreased as it poses safety problems. Only 29.5% of the respondents overall supported increasing the share and 60.7% supported decreasing it. The most support for nuclear power came from Bulgaria (50.8%, in favour), Czech Republic (47.6%), Sweden (43.9%) and Slovakia (41.9%). These are all countries which are used to having energy supplied by nuclear power (Eurobarometer, 2007b).

Eurobarometer conducted a survey in 2009 specifically to determine the attitudes of Europeans towards climate change (Eurobarometer, July 2009). Interviews were conducted in August to September 2009 involving 26,719 citizens in the 27 member states of the European Union, the three candidate countries for accession (Croatia, Turkey and Macedonia) and the Turkish Cypriot community. In the survey, respondents were asked what they considered the most serious problem facing the world as a whole. They were allowed to give four answers. The answers are shown in Figure 23 which includes data from similar surveys conducted in January/February 2009 and March/April 2008. The most serious problem as mentioned by 69% of respondents was poverty, and the lack

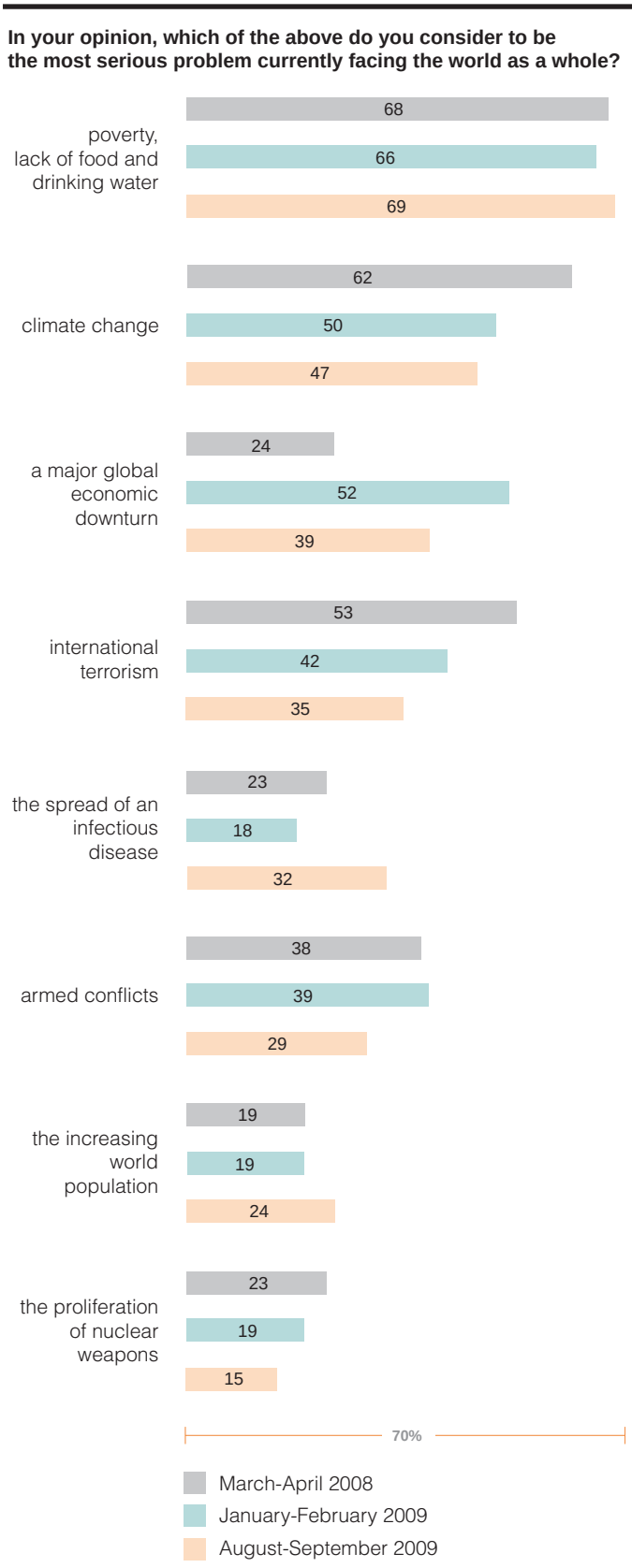


**Figure 23 Priority of issues** (Eurobarometer, 2009)

of food and drinking water. Ranking second was climate change (47%) and third was major global economic downturn (39%). It can be seen that there has been a significant reduction in those considering climate change as the most serious problem over this period from 62% to 47%. The proportion considering the economic downturn as the most serious problem has also changed considerably over this period firstly with an increase from 24% to 52%, then a reduction to 39%. Looking at individual EU countries, climate change was regarded as the top concern only in Slovenia, Denmark and top equal in Austria. Climate change was also regarded very seriously in Sweden, Greece and Luxembourg. In contrast, respondents in Portugal, Latvia, Estonia and Poland were the least likely to mention climate change as their top concern.

The survey then focused on climate change and asked the respondents to rate their perception of climate change on a scale of 1 to 10 with 10 being extremely serious. Almost two-thirds (63%) of those questioned considered it to be very serious, 24% considered it fairly serious and 10% did not consider it to be a serious problem. The proportion considering climate change to be very serious was 75% in the 2008 survey and 68% in the earlier 2009 survey. There has clearly been a significant reduction since 2008. Examining the data for individual countries, the Greeks and the Cypriots were the most likely to consider it to be very serious. Slovenia, Malta, Spain, France, Austria, Luxemburg and Hungary were also well above the average for rating climate change as very serious. Estonia and Latvia were the countries considering it least serious. The survey investigated socio-demographic factors. Respondents considering climate change to be very serious tended to be:

- aged between 25 and 39;
- have completed their education aged 20 or over;
- to be managers, white-collar workers or students;
- to access the internet at least occasionally.

Groups most likely not to consider climate change to be a serious problem tended to be;

- aged 55 or older;
- have completed education prior to 16;
- retired;
- never use the internet.

Regarding what should be done about climate change, the interviewees were asked whether various organisations were doing enough. The majority (55%) felt that the EU was not doing enough. Nearly a third (30%) thought that the EU was doing enough and a small proportion (3%) thought that it was doing too much. An even greater proportion overall (62%) considered that their national government was not doing enough, 27% thought it was doing the right amount and a small proportion (3%) thought it was doing too much.

The respondents were asked to give their views on a range of statements about various aspects of climate change. The majority of Europeans (62%) disagreed with the statement that climate change was an unstoppable process. In only four countries – Estonia, Latvia, Romania and Lithuania – did fewer than 50% think that climate change could be stopped. Just under a third (31%) thought that nothing could be done to stop it. Almost two-thirds (62%) thought that the seriousness of climate change had not been exaggerated, whilst 29% believed it had. The Dutch were the most sceptical with 46% holding this view. Respondents in Estonia, UK, Latvia, Luxembourg and Denmark were also relatively sceptical. Overall, the majority (63%) thought that tackling climate change could have a positive effect on the European economy.

The Cypriots were the most positive, as were Danes, Austrians, Belgians, Greeks and Swedes. The least positive were the Latvians, Dutch and Estonians. Finally, almost half of those sampled (49%) were willing to pay more for alternative, greener, forms of energy. When asked how much more they were willing to pay, on average, Europeans were willing to pay 6.6% for energy from renewable sources.

## 4.2 Organisations in Europe opposing coal-fired power generation

Greenpeace is one organisation which campaigns against the use of coal for power generation in Europe. They claim that although Europe has sought to position itself as a global leader on the issue of climate change, EU nations are slow in shifting away from carbon-intensive energy sources and the region is witnessing the resurgence of coal. They admit that the EU is expected to meet its mandated 8% reduction in greenhouse gas emissions by the first commitment period of the Kyoto Protocol (2008-12). The EU has also committed to reduce its emissions by 20% by 2020 and is willing to reduce by 30% if industrialised nations outside the EU follow suit. They have also pledged to meet 20% of its energy needs from renewable energy over the same period. Though on the surface, the EU appears to be a poster child for tackling climate change, EU targets are incompatible with their continued subsidies for coal and the building of new coal-fired power plants. They suggest that the coming two decades will witness the largest turnover of electricity generation in history. An analysis undertaken by Greenpeace

**Table 21 Dirty Thirty – Europe's worst climate polluting power stations** (World Wildlife Fund, 2007a)

| | Power plant | Country | Fuel | Operator | Relative emissions ($gCO_2/kWh$) | Absolute emissions ($MtCO_2/y$) |
|---|---|---|---|---|---|---|
| 1 | Aglos Dimitrios | Greece | lignite | DEH | 1.35 | 12.4 |
| 2 | Kardia | Greece | lignite | DEH | 1.25 | 8.8 |
| 3 | Niederaußem | Germany | lignite | RWE | 1.2 | 27.4 |
| 4 | Jänschwalde | Germany | lignite | Vattenfall | 1.2 | 23.7 |
| 5 | Frimmersdorf | Germany | lignite | RWE | 1.187 | 19.3 |
| 6 | Wiesweiler | Germany | lignite | RWE | 1.18 | 18.8 |
| 7 | Neurath | Germany | lignite | RWE | 1.15 | 17.9 |
| 8 | Turów | Poland | lignite | BOT GIE S.A. | 1.15 | 13 |
| 9 | As Pontes | Spain | lignite | ENDESA | 1.15 | 9.1 |
| 10 | Boxberg | Germany | lignite | Vattenfall | 1.1 | 15.5 |
| 11 | Belchatow | Poland | lignite | BOT GIE S.A. | 1.09 | 30.1 |
| 12 | Prunerov | Czech Republic | lignite | CEZ | 1.07 | 8.9 |
| 13 | Sines | Portugal | hard coal | EDP | 1.05 | 8.7 |
| 14 | Schwarze Pumpe | Germany | lignite | Vattenfall | 1 | 12.2 |
| 15 | Longannet | UK | hard coal | Scottish Power | 0.97 | 10.1 |
| 16 | Lippendorf | Germany | lignite | Vattenfall | 0.95 | 12.4 |
| 17 | Cottam | UK | hard coal | EDF | 0.94 | 10 |
| 18 | Rybnik | Poland | hard coal | EDF | 0.93 | 8.6 |
| 19 | Kozienice | Poland | hard coal | state owned | 0.915 | 10.8 |
| 20 | Scholven | Germany | hard coal | E.ON | 0.9 | 10.7 |
| 21 | West Burton | UK | hard coal | EDF | 0.9 | 8.9 |
| 22 | Fiddlers Ferry | UK | hard coal & oil | Scottish & Southern | 0.9 | 8.4 |
| 23 | Ratcliffe | UK | hard coal | E.ON | 0.895 | 7.8 |
| 24 | Kingsnorth | UK | hard coal & oil | E.ON | 0.892 | 8.9 |
| 25 | Brindisi Sud | Italy | coal | ENEL | 0.89 | 14.4 |
| 26 | Drax | UK | hard coal | AES | 0.85 | 22.8 |
| 27 | Ferrybridge | UK | hard coal | Scottish & Southern | 0.84 | 8.9 |
| 28 | Großkraftwerk Mannheim | Germany | hard coal | RWE, EnBW, MVV | 0.84 | 7.7 |
| 29 | Eggborough | UK | hard coal | British Energy | 0.84 | 7.6 |
| 30 | Didcot A&B | UK | hard coal & gas | RWE | 0.624 | 9.5 |

in June 2007 showed that of the 210 proposed power projects in Europe, 68 were coal fired. There were 188,883 MW of capacity in pipeline, 64,026 MW (34%) were coal and 16,239 MW (9%) were renewable. The largest number of proposed projects were in Germany (33), followed by UK (8), Italy and Poland (6) and Netherlands (5). They insist that one way of ensuring that energy decisions are appropriately focused is to eliminate subsidies for dirty energy. State aid for coal is permitted under a special derogation from EU that expired in 2010. In effect, this creates a loophole through which governments can ask the Commission to allow an extension of state aid for many years. In 2005, eight member states granted state aid for coal totalling US$4.1 billion. Germany and Spain granted the most with smaller amounts given by Poland, Czech Republic, Slovakia, Slovenia, Hungary and the UK. If Europe is serious about fighting climate change, it must divert public money and support from polluting energy sources such as coal to clean technologies such as renewables and energy efficiency measures. Greenpeace do compliment Denmark and Spain for making considerable progress in developing renewable industries. The EU could still use its climate package to trigger an energy revolution around Europe and inspire the world (Rochon, 2007; Greenpeace, 2008b).

The World Wildlife Fund (WWF) have also reported on greenhouse gas emissions from coal-fired plant in Europe. In a report entitled *Dirty Thirty* they ranked the 30 worst climate polluting power plant in Europe, which were all coal fired (Table 21). The plant are ranked in order of their relative emissions ($gCO_2$/kWh). They used data provided by the European Pollutant Emission Register (EPER) and the Community Independent Transition Log (CITL) of the EU Emissions Trading Scheme and refer to the period 2004-06. They consider that the next 20 years will offer an historic opportunity for Europe to reduce its $CO_2$ emissions dramatically as most of Europe's dirtiest coal-fired power plant will need to be replaced. They investigated three scenarios. The first was to replace plant reaching the end of their technical lifetime with the most modern available coal-fired plant. The efficiencies for these were assumed to be 45% (hard coal) and 43% (lignite). The second was to replace them with gas-fired plant and the third was to replace them with renewable plant. The results of this analysis are shown in Table 22. The WWF considers that the coal replacement scenario is fully inadequate, the gas replacement scenario is insufficient and the renewable replacement scenario is unrealistic but necessary if the EU is going to meet the 80% $CO_2$ reduction by 2050 (World Wildlife Fund, 2007a).

The WWF is generally in favour of the principles behind the European Emissions Trading Scheme (EU ETS). They consider the EU ETS as a significant example of how market-based mechanisms can instigate low carbon investment in polluting companies. However, to be effective and deliver results, the EU ETS needs to be dramatically strengthened. Unfortunately, according to WWF, European Governments have so far succumbed to pressure from the highest polluting industries and imposed very weak limits on carbon pollution. As a result, the scheme is far from meeting the highest potential for economic efficiency and environmental effectiveness. Only with tougher limits and scarcity of allowances will the market deliver results. Also, currently allowances are allocated free to companies thus reducing incentives to cut emissions. Another requirement is to harmonise allocations across Europe to avoid unfair competition between companies from different countries. This should be coupled with the full auctioning of pollutant rights with the revenues reinvested in climate protection and clean energy development. Overall WWF considers it essential that the EU maintains its efforts to reduce greenhouse gas emissions and its climate policy's international credibility through a stronger market (World Wildlife Fund, 2007b, 2008 2010).

## 4.3 Organisations in Europe in favour of coal-fired power generation

EURACOAL is the umbrella organisation representing the European coal industry. It comprises of 28 members from eighteen countries comprising of national producer and import associations, companies and research institutes. EURACOAL's objective is to highlight the important role of coal for security of energy supply within the enlarged EU. It actively demonstrates the importance of coal for a balanced energy mix, for national and regional added value and the protection of the environment. They publish position papers, press releases and free publications. In a recent paper entitled *Coal industry in Europe 2008* (EURACOAL, 2008) they highlight the importance of coal in the world energy mix. The total global resources of coal are estimated at 8719 Gtce of which only 3% has been extracted so far. Coal reserves are distributed more widely throughout the world than oil or gas and the coal market is a free commodity market which is hardly affected by politics or cartel formation. Europe holds 5% of the world total. As a source of energy, coal is vital for

**Table 22 Coal plant replacement scenarios** (World Wildlife Fund, 2007a)

| Emissions, $MtCO_2$/y | 2006 | 2010 | 2020 | 2030 |
|---|---|---|---|---|
| Scenario 1 | 393.4 | 355.2 (–9.7%) | 325.5 (–17.3%) | 309.8 (–21.3%) |
| Scenario 2 | 393.4 | 340.4 (–13.5%) | 233.9 (–40.5%) | 179.2 (–54.4%) |
| Scenario 3 | 393.4 | 330.7 (–15.9%) | 167.3 (–57.5%) | 82.4 (–79.1%) |

Scenario 1 – replacing coal with new coal
Scenario 2 – replacing coal with gas
Scenario 3 – replacing coal with renewables
Figures in parentheses refer to % reductions compared to 2006 emissions

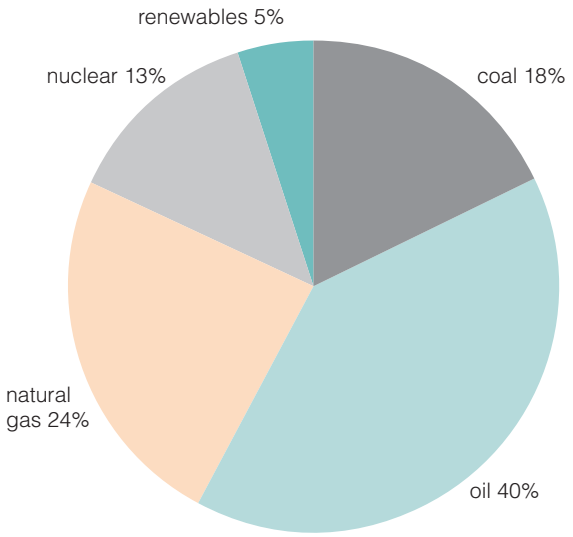


**Figure 24 EU energy consumption** (EURACOAL, 2008)

Europe with a demand including Russia totalling 750 Mtce which is the third biggest world consumer behind North America and China. In the 27 EU member states coal supplies about a fifth of primary energy demand as shown in Figure 24. Europe is capable of providing a significant proportion of its coal demand from its own resources. Poland and Germany are the main producers in the EU with nearly two-thirds of production. However, about 200 Mtce are imported each year mainly from South Africa, Colombia and the Ukraine. Indigenous hard coal and lignite contribute significantly to stable prices and to the security of EU's energy supply. More than 90% of the lignite and 67% of the hard coal used in the EU is for power generation and this accounts for 29% of electricity generated in the EU. This average figure masks major differences between member states. In Poland over 90% of electricity is generated from coal whereas the proportion on Sweden is only 1%. Coal-fired generation is especially advantageous for base and medium load demand as renewable generation fluctuates and differs considerable from demand.

The EU is developing an integrated European climate and energy strategy linking the objectives of security of supply, competitive energy and reduction of $CO_2$ emissions. In 2007, the European Council adopted a binding agreement to emit at least 20% less greenhouse gas emissions by 2020 than in 1990. This target will be increased to 30% if other industrial nations commit themselves to comparable emission reductions and economically more advanced developing countries contribute adequately according to their responsibilities and respective capabilities. At present the EU is responsible for 14% of global emissions in a downward trend. EURACOAL, in concert with coal-fired power plant operators, is pursuing a Clean Coal concept that seeks to promote the progressive introduction of a series of technologies designed to reduce $CO_2$ emissions. The first stage is to modernise existing installations and construct new power plants according to Best Available Technology with the objective of increasing efficiency and reducing emissions of $SO_2$, NOx and particulates. The second is to further increase plant efficiencies by raising steam temperatures, pre-drying lignite and introducing IGCC plant. In the longer term, the possibility of virtually zero $CO_2$ emission coal-fired power generation could be realised by CCS. Research and development on this technology is ongoing. Both technical and legal obstacles have to be overcome. Politicians, authorities and industry have to make sure the technology will be accepted by the public. EURACOAL supports the construction and operation of a series of CCS demonstration plants by 2015 and the introduction of the technology to the market after 2020 (EURACOAL, 2007).

# 5 UK

Energy use in the UK over recent years has been affected both by the recession and by concerns over global warming. The effect of the recession has been that total UK energy consumption decreased by 1.1% in 2008 with coal consumption falling by 7.5%. There was a 9% reduction in consumption of coal by major power producers and the proportion of electricity generated from coal decreased from 34% in 2007 to 32% in 2008. During the same period, the amount of electricity generated by gas-fired plant increased from 43% to 46%. Renewable sources generated 5.5% of UK electricity in 2008. In the same year, the UK passed two pieces of legislation which were necessary to meet its climate change obligations. The Climate Change Act 2008 introduced the world's first long-term legally binding framework to reduce $CO_2$ emissions. It provided a legally binding target of at least an 80% cut in greenhouse gas emissions by 2050 to be achieved through action in the UK and abroad and a reduction of 34% by 2020. A carbon budgeting system which caps emissions over five-year periods, with three budgets set at a time has been established. The Energy Act 2008 created regulations that enable private sector investment projects in CCS. In May 2009, the Government also set out proposals for the basis on which coal-fired power plant will be permitted in the future. This specifies that no new coal firing without CCS demonstration from day one will be allowed. Furthermore, there will be full-scale retrofit of CCS within five years of the technology being independently judged as being technically and commercially proven. In addition, to the existing competition to build a post-combustion demonstrator, up to three further projects, including pre-combustion technology, will be funded by a new levy mechanism (Department of Energy and Climate Change 2008a,b; Modern Power Systems, 2009).

Since 2006, there has been regular polling in the UK to find out the public's attitudes towards various aspects of global warming and the environment. These recent polls seldom mention the possible construction of coal-fired plant, presumably because it is assumed that the public will be overwhelmingly opposed. The number of polls which have addressed some of the topics is limited, hence too much cannot be read into the trends. Moreover, the questions asked are not identical in different polls which also raises difficulties in determining trends.

## 5.1 Priority of issues

Several polls have asked respondents which issues facing the country are of greatest concern for them. For example, at the time Gordon Brown became Prime Minister in 2007, ICM conducted a poll in mid-June for the Guardian in which 1007 respondents were asked which two or three things should be his main priorities. The following replies were obtained; health service (48%), education (35%), economy (20%), Iraq (19%), immigration (14%), crime (12%), environment/climate change (7%), taxation (7%). The remaining topics were of less concern (ICM Research, 2007). A similar poll was conducted by Ipsos MORI in which a 1000 respondents were asked in January 2009 which were the three biggest issues facing them and their family today. The replies obtained in order of decreasing importance were financial insecurity (54.2%), economic downturn (49.7%), unemployment (31.8%), healthcare (21.1%), taxation (20.4%), crime (19.2%), education (17.5%), climate change (17.4%) and immigration (14.6%). When asked which was the single biggest issue, the replies were financial insecurity (39.1%), economic downturn (20.1%), unemployment (9.0%), education (4.1%), healthcare (4.0%), taxation (3.6%), crime (3.5%) and global warming (3.5%). The remaining topics were of less concern. Ipsos MORI conducted a similar survey in January 2010 involving 1043 respondents and the replies obtained when asked to give their three principal concerns were financial insecurity (48%), economic downturn (42%), unemployment (31%), taxation (28%), healthcare (21%), crime (19%), immigration (19%), climate change (17%) and pensions (16%). The replies, in order of importance, for their principal concern were financial insecurity (33%), economic downturn (14%), unemployment (14%), taxation (7%), immigration (6%), healthcare (4%), climate change (4%) and pensions (4%). When assessing these figures, it is apparent that since 2007, with the near collapse of the global economy, economic concerns have come to the fore. Though climate change is always in the top ten in the list of concerns, in these polls in the range 7th to 8th, it never makes the top five (Ipsos MORI 2009, 2010).

## 5.2 Reality and seriousness of global warming

Several polls have addressed the issue of whether the public thinks climate change is taking place and how serious it is. Populus conducted a poll for the BBC Daily Politics programme in July 2006 and interviewed 1002 adults (Populus, 2006). When asked whether it was clear that climate change was already having an effect on the environment and it was urgent for the government to take steps to address it, 89% agreed, 10% disagreed and 2% did not know. An Ipsos MORI poll questioning 1002 adults in August 2006 also showed that 88% believed in climate change with 44% very concerned, 38% fairly concerned,12% not very concerned and 3% not at all concerned (Ipsos MORI, 2007). A YouGov poll in November 2006 in which 1619 people were sampled, showed that 38% thought that global warming was a big and urgent issue which required steps, 49% thought that global warming was a big issue but more work needs to be undertaken before we take radical steps and 9% thought that there was no clear evidence of global warming (YouGov, 2006). A Ipsos MORI poll in May 2008 of 1039 adults showed a decrease in the level of concern. In this poll, 30% were very concerned, 47% were fairly concerned, 14% not very concerned and 9% not at all concerned (Ipsos MORI, 2008). The UK Department of Environment, Food and Rural Affairs (Defra) commissioned a series of polls, which were conducted by ICM, on public attitudes to climate

change. Seven surveys were undertaken between March 2005 and March 2008 and over 3000 people were questioned in each survey. In response to the question whether they agreed or disagreed that the world's climate was changing, the answers given are shown in Figure 25. It is apparent that the overwhelming majority of >90% agreed with this proposition with a substantial majority agreeing strongly. The figures did not change significantly over this period. These polls were particularly useful as the same question was asked throughout (Defra, 2008). In an Ipsos MORI poll in January 2009 in which 1000 adults were questioned, 44.3% thought that climate change was definitely a reality, 29.4% thought it looked like it could be a reality, 21.5% thought it was a bit over-exaggerated and 2.3% thought it was not a reality (Ipsos MORI, 2009). The Tyndall Centre for climate change research has investigated the UK public's attitudes to various aspects of climate change. They questioned 550 adults between August and October 2008. When presented with the statement 'I do not believe climate change is a real problem', 72.7% disagreed with 25.2 strongly disagreeing and 13.3 agreed with 3.2% strongly agreeing. The remaining 14% neither agreed nor disagreed (Whitmarsh and others, 2009a).

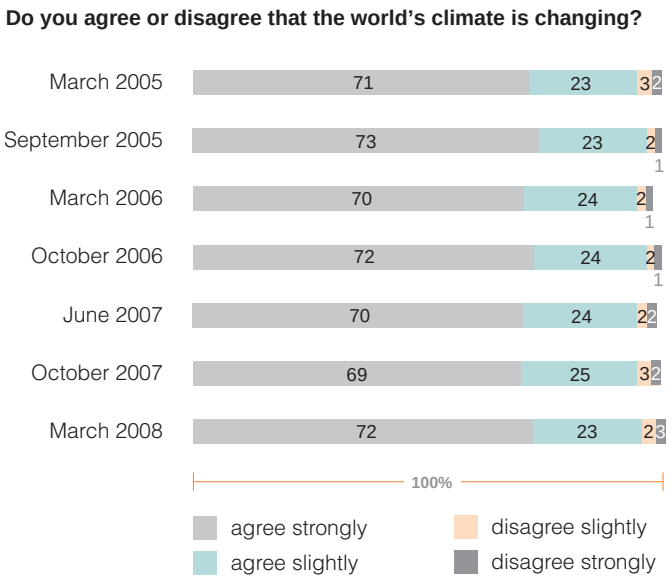


**Figure 25 UK attitudes to climate change** (Defra, 2008)

In an ICM poll for the Guardian in August 2009, 1011 adults were questioned. The results showed that 37% thought that the amount of climate change we have already experienced was a threat to the world, 48% thought that climate change was not currently a threat but would be for future generations unless something was done soon and 11% thought that climate change was not a threat (ICM Research, 2009a). A poll conducted for The Times in November 2009 questioned 1504 adults. When asked do you think that the climate is changing and global warming is taking place, 83% said yes and 15% said no (Populus, 2009). A YouGov poll in December 2009 of 2095 adults showed that 24% thought that global warming was a big and urgent issue requiring immediate radical steps, 54% thought that though it was a big issue, more work needed to be done before radical steps were taken and 18% thought that there was no clear evidence of global warming (YouGov, 2009). An ICM poll for The Sunday Telegraph conducted in December 2009 in which 1001 adults were questioned showed that 92% thought that climate change was happening and 7% thought it was not (ICM Research, 2009b). An Ipsos MORI poll in January 2010 in which 1043 adults were questioned, showed that 31% thought that climate change was a definite realty, 29% thought it looked like it could be a reality, 31% thought it was a bit over-exaggerated and 6% thought it was not a reality (Ipsos MORI, 2010). A Populus poll conducted for the BBC in February 2010 in which 1001 adults were sampled produced a dramatic reduction in the proportion believing that climate change was taking place. The results showed that only 75% though that climate change was taking place and 25% thought it was not (BBC, 2010). The marked increase in scepticism in 2010 regarding the seriousness of global warming has also been demonstrated by a series of polls conducted for Electicité de France (EDF) by YouGov annually between 2007 and 2010. Each of these polls interviewed over 4000 adults. The results are given in Table 23. During the period 2007-09, there was a steady 37–38% who believed that global warming was serious and urgent, 29–30% who thought it was happening but not urgent and 24–27% who were not sure it was happening and the scientists were divided on the issue (EDF, 2010). The 2010 survey shoes that the proportion thinking that global warming is urgent has fallen by ten percentage points to only 28% and the proportion thinking scientists were divided has increased by six percentage points

**Table 23 UK attitudes to global warming 2007-10** (EDF, 2010)

| | 2007, % | 2008, % | 2009, % | 2010, % |
|---|---|---|---|---|
| It is a serious and urgent problem and radical steps must be taken now to prevent terrible damage to the planet | 38 | 37 | 37 | 28 |
| Climate change is definitely happening but there is time to work out the best actions to take and we should not do anything that could harm our standard of living | 29 | 30 | 29 | 29 |
| It is not clear whether climate change is happening or not – scientists are divided on this issue | 25 | 24 | 27 | 33 |
| I don't believe climate change is happening at all – it is simple scaremongering and we should ignore it | 4 | 5 | 5 | 7 |
| Don't know | 3 | 4 | 3 | 3 |

to 33%. This trend is confirmed by a recent Ipsos MORI poll for Cardiff University in which 1822 respondents were questioned between January and March 2010. When asked, do you personally think the world's climate is changing, 78% said yes and 15% said no. The corresponding answers in their 2005 survey were 91% yes and 4 % no. It is apparent that the number believing in climate change has fallen significantly. The level of concern also decreased with the numbers who were either very concerned or fairly concerned also falling from 82% in 2005 to 71% in 2010 (Spence and others, 2010).

The trends in the quoted polls suggest that in the period 2006 to 2009 there was a reasonably constant percentage of the population in the high 80s who believed that climate change was taking place and about 10% thought it was not. Among those who believed it was taking place about a quarter to a half thought that, though it was happening, the danger was exaggerated. However, in the short period from late 2009 to early 2010, the percentage of those believing in climate change decreased further to the mid-70s with those disbelieving rising sharply to the mid-20s and those believing it was happening but not serious also increased. The dramatic reduction in those believing between 2009 and 2010 was almost certainly caused by the increased scepticism about the scientific basis for global warming resulting from the same reasons as stated in Section 3.3.

## 5.3 Role of human activity

The August 2006 Ipsos MORI poll asked its respondents to what extent global warming was due to human activity. The results were compared with an earlier 2002 survey and are shown in Figure 26. In both years only 9% thought that it was caused by natural causes. A considerable majority of those sampled (85% and 87%) thought human activity played a role and opinion was fairly evenly divided between those who thought it was partly caused by human activity and mainly caused by it (Ipsos MORI, 2007). In the 2008 Tyndall Centre survey, when the respondents were asked their attitude to the claims that human activities are changing the climate are exaggerated, 32% agreed and 52.1% disagreed. The Tyndall Centre results for 2003 and 2008 have also been compared and shown in Figure 27. It is apparent that scepticism has slightly increased especially about exaggerated claims. There is particular suspicion concerning alarming reports in the media. An analysis of the backgrounds of the respondents demonstrated that scepticism was most likely from men, older people, rural dwellers and high earners. Scepticism decreased with increasing levels of educational attainment. Scepticism is strongly linked to both political and environmental values. Sceptics are less likely to lead green lifestyles (Whitmarsh and others, 2009a). The Defra (Department of the Environment, Food and Rural Affairs) poll also sought the public's attitudes towards the role of human activity. When asked to what extent do you think climate change is a result of human behaviour, the answers shown in Figure 28 were obtained. The results show that about two-thirds of those sampled thought that it was mainly due to human activity with over a half thinking it was entirely so. The proportion believing this peaked in 2006 reaching three-quarters but has slipped back since then (Defra, 2008). An Ipsos MORI poll in January 2009 questioned a 1000 adults and of the 973 people who believed that climate change was a reality to some degree, 21.6% thought it was man-made, 67.5% thought it was due to a combination of man and natural causes and 7.5% thought it was caused by natural changes in the environment (Ipsos MORI, 2009). A poll conducted by ICM for The Guardian in August 2009 questioned 1011 adults and asked whether climate change was caused by man or mainly by non-man-made factors. The answers given were that 71% thought it was man-made, 23% thought it was non-man-made and 6% did not know(ICM Research, 2009a). The Populus poll conducted for The Times in November 2009 showed that 50% thought that it was an established scientific fact that climate change was largely man-made, 39% thought that the contention that it was largely man-made had not yet been conclusively proven and 9% thought that man-made climate change was environmental propaganda (Populus, 2009). The YouGov poll in December 2009 reported that 21% thought that the planet was warming and human activity was mainly responsible, 62% thought that though the planet was warming and human activity was partly responsible, 8% thought that other factors were totally responsible and 4% thought that the planet was not warming (YouGov, 2009). The ICM poll for the Sunday Telegraph conducted in December 2009 showed that 52% thought that climate change was happening and was established as being man-made, 39% thought that it was happening but it was not yet proven it was man-made and 7% thought that it was not happening (ICM Research, 2009b). An ICM poll conducted for The Guardian gave very similar results with 56% thinking it was due to human factors, 33% due to natural forces and 5% thought it was not happening (ICM Research, 2009a). An Ipsos MORI poll in January 2010 interviewed 1043 adults and of the 977 who believed that climate change was taking place to some degree, 19% thought it was man-made, 68% thought it had both man-made and natural causes and 10% thought it was due to natural changes (Ipsos MORI, 2010). Following this, there was a considerable decrease in the belief of man-made climate change in the February 2010 Populus/BBC poll. In this only 26% thought that climate change was happening and is established as largely man-made, 38% thought it was happening but not yet proven to be man-made, 10% thought it was happening but it was environmental propaganda that it was man-made and 25% thought it was not happening (BBC, 2010). Similar results were obtained in the 2010 Ipsos MORI poll for Cardiff University which found that less than a third of respondents (31%) thought that climate change was either mainly or entirely caused by human activity, nearly a half (47%) thought it was caused partly by natural causes and partly by human activity and about a fifth (18%) caused mainly or entirely by natural processes (Spence and others, 2010)

It is difficult to discuss the trends during this period as the questions asked were not identical. It would appear though that in all these polls up to 2009, a large proportion of the respondents, in the upper 80%, believed that climate change was man-made or possibly man-made but not proven or that man-made factors had some part in it. But there has been a reduction in this percentage to below 70% in the later 2010 polls. The reasons are probably the same as in the previous section namely the alleged impropriety at the University of East Anglia, the IPCC exaggerations and the recent cold winters.

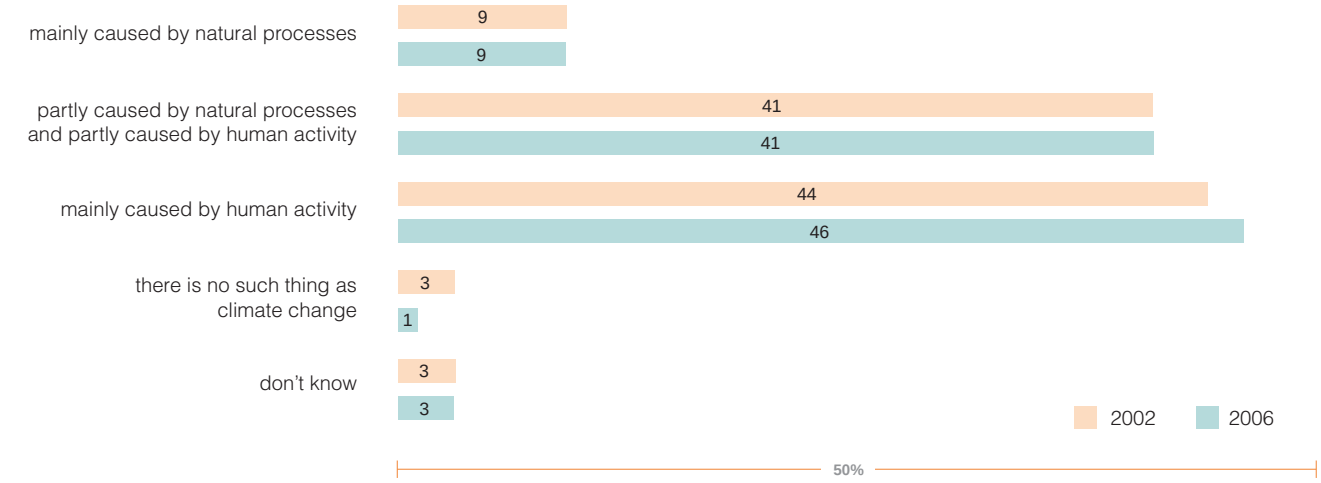


**Figure 26 Causes of climate change** (Ipsos MORI, 2007)

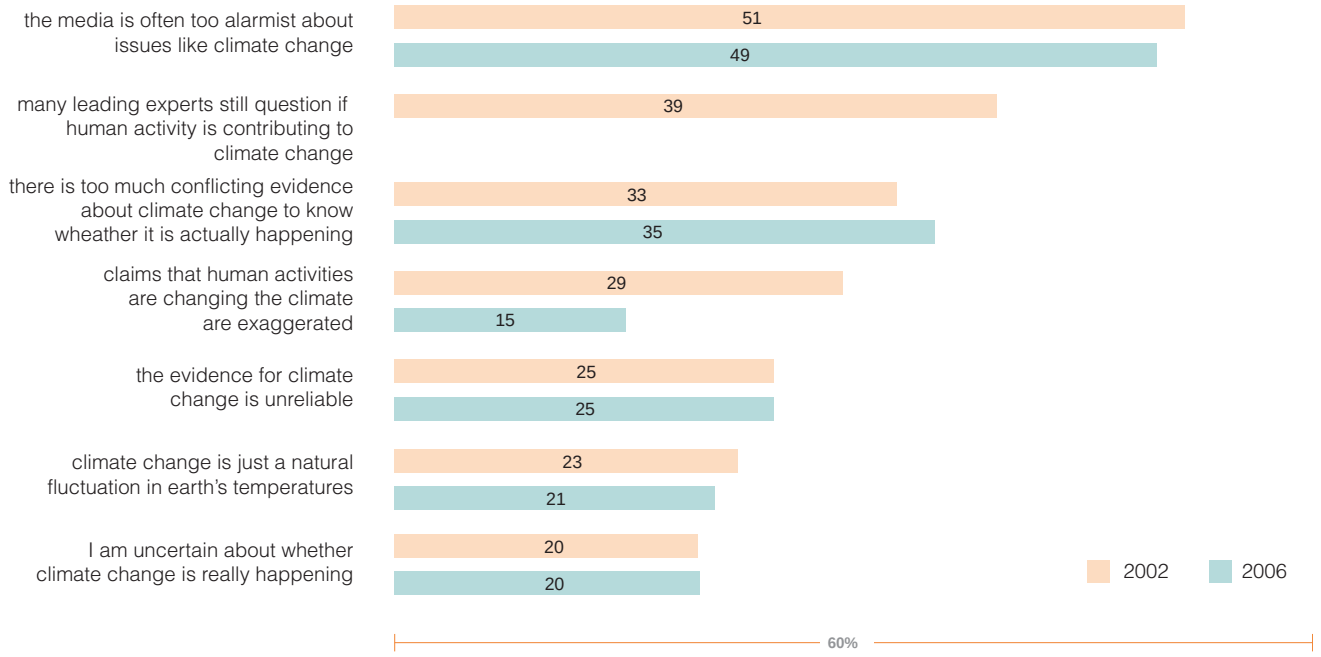


**Figure 27 Views on climate change** (Whitmarsh and others, 2009a)

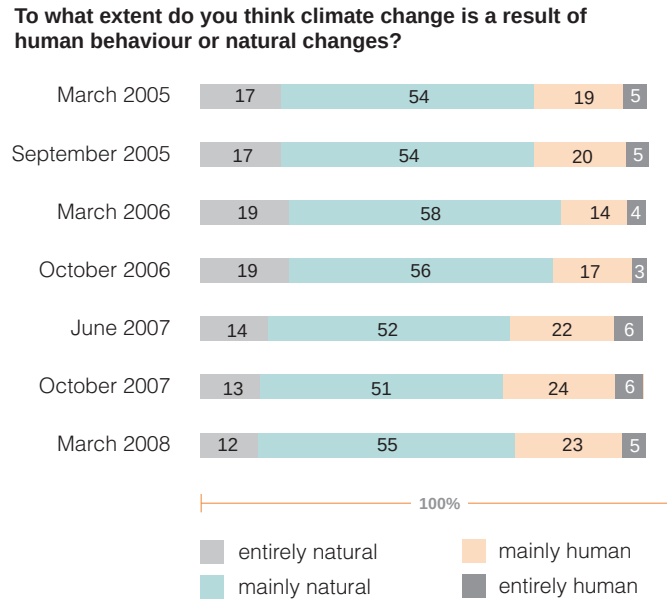


**Figure 28 Role of human activity** (Defra, 2008)

## 5.4 Trust in sources of information

Several of the polls have investigated the degree of trust the public has towards their sources of information about climate change, particularly towards scientists. A YouGov poll in November 2006 which questioned 1619 people found that 15% thought that those who drew attention to global warming were scare-mongers and alarmists but 76% thought they were people who had good reasons to be concerned (YouGov, 2006). The results of a Ipsos MORI poll conducted in June 2006 in which 2037 people were questioned are shown in Figures 29 and 30. These demonstrated that the complexities of climate change lead 40% to think that the system was too complex to be modelled and predicted accurately. The same poll showed that 56% believed that many leading experts still questioned if human activity was contributing to climate change; a view clearly at odds with the IPCC consensus (Ipsos MORI, 2007). A very similar result was obtained in another Ipsos MORI poll taken in May 2008 in which 1039 people were questioned. In this poll, 60% thought that many

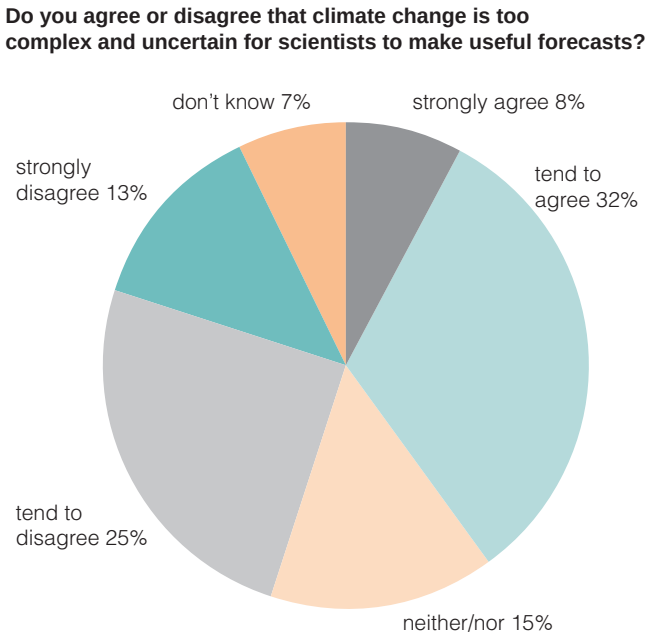


**Figure 29 Complexity of climate change** (Ipsos MORI, 2007)

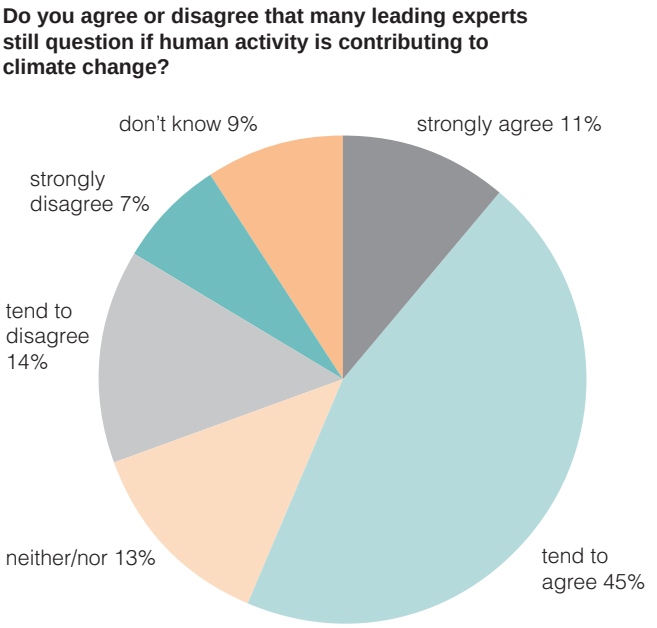


**Figure 30 Public views of the scientific debate** (Ipsos MORI, 2007)

scientists questioned if humans were contributing to climate change and only 22% disagreed with this sentiment (Ipsos MORI, 2008). The Tyndall survey in 2008 also addressed these views. When the respondents were asked about their attitudes to the statement 'Climate change is too complex and uncertain for scientists to make useful forecasts', 40.2% agreed and 37.9% disagreed. Regarding the statement that many leading experts still question if human activity is contributing to climate change, 43.9% agreed and 29.3% disagreed (Whitmarsh, 2009a). Following the controversy at the University of East Anglia, several polls were taken at the time of the Copenhagen summit in December 2009 to find out how much the public trusted scientists. An ICM Research poll for The Guardian in which 1009 adults were questioned asked the respondents whether they trusted scientists to tell the truth about climate change. The answers obtained were that 36% trusted a lot, 47% a little and 14% not at all. Clearly scientists are held in relatively high esteem but not completely trusted (ICM Research, 2009a). The YouGov poll which questioned 2095 people in December 2009 was less complimentary. Only 41% trusted scientists to tell the truth and 44% did not trust them (YouGov, 2009). The 2010 Populus poll for the BBC asked whether the risks of climate change and its possible consequences have been presented proportionately or have been understated or have they been exaggerated. The results showed that 35% of those sampled thought the facts had been presented proportionately, 25% understated and 36% exaggerated. A significant number obviously thought that the facts had been overstated (BBC, 2010). Clearly the scientific community is not completely trusted and the public overestimate the extent of scientific disagreements regarding climate change.

## 5.5 Actions to combat global warming

When polling organisations currently ask the public in the UK what should be done to combat global warming, as far as their personal lifestyles are concerned, the public are asked whether they are willing , for example, to drive less, buy smaller cars, use more public transport, fly less, insulate homes better, and fit solar panels. Regarding energy production, they are generally asked whether they are in favour of renewable sources such as solar, wind, tidal and nuclear. The possibility of clean coal technologies is not usually addressed. There is separate polling on attitudes to CCS.

A comprehensive survey of public opinion towards future energy options for the UK was conducted by the Tyndall Centre for Climate Change Research and the School of Environmental Science, University of East Anglia. The survey questioned 1491 adults between October and November 2005. When asked about their general impressions of different energy sources, renewable sources were seen as much more favourable than conventional sources, with nuclear energy being least favourable. In particular, 87% had a very or mainly favourable impression of solar power, 82% of wind power and 76% of hydroelectric power. By contrast, only 56% were very or mainly favourable about gas, 38% of coal and 39% about oil. Only 35% were very or mainly favourable about nuclear power. When asked about future options and to what extent the various energy sources will make a substantial contribution to reliable and secure supplies for the UK in the future, a different picture appeared with nuclear power ranking above coal and oil. A substantial majority felt that solar (78% agree or strongly agree), wind (78%) and hydroelectric (69%) will make a substantial contribution. Around half (49%) thought nuclear power would make a substantial contribution. Regarding fossil fuels, 49% thought gas, 39% thought oil and 33% thought coal would make a substantial contribution. The respondents were also asked specifically to consider various characteristics regarding coal-fired power generation and the answers obtained are shown in Table 24. A majority and in many cases a substantial

majority agreed with all the unfavourable characteristics regarding coal-fired power. For example, 79% thought it caused air pollution, 65% climate change, 52% hazardous to human health and 56% spoils the landscape. Even features which are sometimes regarded as favourable to coal generation were not recognised as such. Only 36% thought it was cheap and only 34% thought it good for the economy. The only features for which the survey was positive were that 56% thought coal-fired generation was reliable and 48% thought it safe (Poortinga and others 2006).

Most recent opinion polls have not addressed attitudes to coal-fired plant and generally ask about wind and nuclear power. For example, the August 2009 ICM poll for the Guardian asked the respondents whether they would support or oppose the building of a wind farm or a nuclear power plant within 20 miles of their home. In the case of a wind farm, 79% supported and 19% opposed. The response was reversed for a nuclear power plant with 32% supporting and 65% opposing (ICM, 2009a). One series of polls that questioned the public over several years on their attitudes to coal-fired plant were the YouGov polls for EDF. These polls were conducted every year between 2007 and 2010 and found out the respondents' attitudes to coal, gas-fired, nuclear plant and wind farms. The results for coal-fired plant for each of the years and for the other sources for 2010 are given in Table 25. The results are fairly stable regarding coal-fired plant during this period. About a fifth of the respondents were favourable, about a third were ambivalent and two-fifths were opposed. Comparing the results for coal with the other fuels, gas was

**Table 24 UK attitudes to coal-fired power plant** (Poortinga and others, 2006)

**To what extent do you agree or disagree that generating electricity from coal has the following characteristics?**

| | Strongly agree, % | Tend to agree, % | Neither agree or disagree, % | Tend to disagree, % | Strongly disagree, % | No opinion, % |
|---|---|---|---|---|---|---|
| Causes air pollution | 32 | 47 | 9 | 5 | 2 | 4 |
| Causes climate change | 23 | 42 | 16 | 10 | 2 | 6 |
| Creates dangerous waste | 10 | 28 | 22 | 27 | 4 | 4 |
| Is hazardous to human health | 15 | 37 | 21 | 19 | 2 | 4 |
| Is cheap | 6 | 30 | 23 | 24 | 6 | 9 |
| Is clean | 1 | 8 | 11 | 50 | 25 | 3 |
| Is good for local communities | 2 | 15 | 24 | 36 | 19 | 3 |
| Is good for the economy | 3 | 31 | 31 | 20 | 5 | 6 |
| Is inefficient | 5 | 31 | 27 | 23 | 4 | 8 |
| Is reliable | 6 | 50 | 17 | 17 | 4 | 4 |
| Is safe | 5 | 43 | 19 | 21 | 5 | 5 |
| Spoils the landscape | 16 | 40 | 21 | 14 | 4 | 3 |

**Table 25 UK attitudes to energy sources** (EDF, 2010)

| | Coal 2007, % | Coal 2008, % | Coal 2009, % | Coal 2010, % | Gas 2010, % | Nuclear. 2010, % | Wind 2010, % |
|---|---|---|---|---|---|---|---|
| Very favourable | 3 | 6 | 5 | 4 | 3 | 15 | 37 |
| Mainly favourable | 14 | 18 | 15 | 15 | 21 | 27 | 35 |
| Neither favourable or unfavourable | 32 | 32 | 30 | 32 | 38 | 25 | 13 |
| Mainly unfavourable | 29 | 24 | 28 | 26 | 22 | 15 | 6 |
| Very unfavourable | 16 | 13 | 16 | 14 | 8 | 11 | 5 |
| Never heard of it | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| Don't know | 5 | 6 | 6 | 7 | 7 | 7 | 4 |

favoured by a slightly greater proportion and opposed by significantly less. The proportion favouring nuclear energy was over twice as much and that opposing was significantly less. The most favoured option, by far, was wind farms (EDF, 2010)). Similar results were obtained in the 2010 Ipsos MORI poll for Cardiff University. When asked to what extent the respondents would support the construction of a particular type of power plant in their area, in the case of a coal-fired power station, 20% either strongly or tended to support, 17% were ambivalent and 60% strongly or tended to oppose. The results were similar for nuclear plant but there was considerable support for wind farms with 73% supporting. (Spence and others, 2010). These polls all demonstrate that the UK public are much more supportive of wind farms than coal or nuclear plant.

## 5.6 UK organisations opposed to coal-fired generation

Greenpeace campaigns in the UK on a wide range of environmental issues. They published a report on their case against coal-fired power generation in 2008 which was then updated in 2009 (Greenpeace, 2009). In the summary of this report they quote J E Hansen's comment that the single threat to the climate comes from burning coal. Coal-fired generation is historically responsible for most of the fossil-fuel $CO_2$ in the air today, about half of all fossil-fuel $CO_2$ emissions globally. They also refer to IPCC data which they claim shows that coal-fired power generation is the most environmentally damaging means of generating electricity yet devised. In fact, in carbon terms, coal is the dirtiest fuel known to man. They give a guarded welcome to the UK Energy Secretary's announcement in April 2009 that the era of new unabated coal is over and that new coal plant will have to install CCS to 20–25% of their output from day one and, when it is independently judged as economically and technically proven, that these plant will have five years to retrofit CCS to their entire output. However, they consider that this policy still has loopholes and that there still was no guarantee that power stations would not be emitting high levels of $CO_2$ in the future. Greenpeace are insistent that an emissions performance standard is required for coal-fired plant which will limit emissions from all new coal plants from day one and then reduce emissions over time such that emissions from coal plant will be totally phased out by the early 2020s. Greenpeace also regard CCS as a technology which has not been demonstrated at full scale anywhere in the world and is fraught with uncertainty. They do not accept that coal power is needed to maintain the security of supply. They quote research from one of Europe's leading independent energy experts showing that if the UK hits its existing 2020 renewables and efficiency targets, there is no need for new coal capacity. They also say that many studies, including government ones, show that UK's energy needs could be met through energy efficiency, cleaner use of fossil fuels, renewables and decentralised power as in Scandinavia. They refute the claim that renewables are unreliable. They quote a spokesman for National Grid saying that, based on recent analysis of the incidence and variation of wind speed, the expected intermittency of wind does not appear to pose a major problem for stability. They are critical of the European Emissions Trading Scheme which, although it is up and running, is not working well enough to stop new coal plants. Once these plants are constructed, it will be hard to get rid of them. Greenpeace have also taken direct action. Their activists shut down the existing Kingsnorth coal-fired power station in October 2007 as part of their protest to stop the construction of a new coal plant and 30 activists were arrested. In 2008, a Greenpeace armada carried out an amphibious incursion of Kingsnorth carrying the flags of the thirty least polluting countries in the world, the equivalent combined emissions of which matched the proposed Kingsnorth plant.

Friends of the Earth (FoE) also campaign to solve environmental problems and they claim that they are the UK's most influential national environmental campaign organisation. Though they welcomed the UK Government's targets to reduce $CO_2$ emissions, FoE say that these commitments are not reflected with actions at home. As part of their response to the Government's energy review in 2005, FoE undertook a modelling exercise to create realistic and transparent scenarios for the future energy sector. They used credible industry assumptions concerning the development of renewable technologies and the impact of policy on current major electricity generation methods. The aim was to see whether the UK could make massive cuts in $CO_2$ emissions without resorting to nuclear power at the same time as reducing fossil fuels, including natural gas. They considered three fuel mix scenarios. The first scenario, known as the 'gas' scenario, was one in which old coal-fired and nuclear stations were replaced mainly with advanced gas-fired stations. In the second 'mix' scenario, the outstanding demand was met by some gas stations. In addition to these, coal-fired stations were completely upgraded with the newest technologies to improve efficiency and allow for cofiring 20% biomass. In the third 'coal' scenario, a new generation of coal plants or upgraded ones were built on the sites of old inefficient ones, including an upgraded plant at Drax and a new advanced coal one. In addition, gas-fired generation grew far less and gas was almost solely burnt in efficient CHP schemes. For each of the scenarios, two policy futures were modelled, one in which there was good progress and all market conditions were favourable and the other in which implementation is less effective. The modelling showed that in all six scenarios electricity demand was met and emissions of $CO_2$ were reduced by 2020 by at least 48% from 1990 levels in the slow coal scenario reaching 71% in the good gas scenario. In all but one scenario, gas demand was stabilised and then began to decline. As a result of the modelling, FoE concluded that the UK already had the technology to meet its electricity needs, reduce dependency on gas and tackle climate change without resorting to new nuclear power. FoE called on the UK Government to ensure that fossil fuels were used in the most efficient way possible through the promotion of CHP schemes, decentralised energy systems and technologies for 'cleaner coal' making power stations 'capture ready' for when CCS became available. At the time FoE recognised that new cleaner technologies for using coal and gas had the potential to reduce $CO_2$ emissions. The cleaner technologies included were IGCC, biomass cofiring and advanced supercritical boilers (Webster and Cunzi, 2006). More recently, FoE are taking a harder position regarding coal-fired plant. They welcomed the UK Governments April 2009 statement

regarding coal-fired plant. However, FoE felt there was still uncertainty about CCS including whether it would work at all. They urged the government to adopt an emissions performance standard, tightened up over time to provide a cast-iron guarantee that fossil fuel power stations either capture all carbon emissions or close down. The existing proposals contain loopholes that could allow power stations to avoid capturing all its emissions, which would risk saddling the UK with carbon-belching dinosaurs that could have a catastrophic effect on UK efforts to tackle climate change (Atkins, 2009a). Commenting on E.ON's shelving plans in October 2009 to build a new coal-fired plant in Kingsnorth, FoE welcomed the decision but added that the plans to build this plant had seriously undermined the UK's credibility ahead of the Copenhagen summit and the Government should say no to all coal-fired plants which were not fitted with 100% CCS from day one (Atkins, 2009b).

The World Wildlife Fund (WWF) UK is also an environmental campaigning organisation in the UK. They consider coal to be the most polluting of all fossil fuels and they are greatly concerned about proposals for a new generation of coal-fired plant in the UK and the EU. They suggest that new coal plants will operate for 40–50 years and pose a serious risk of locking the UK in a pathway of high emissions, threatening fatally its efforts to show leadership on climate change. Though the power sector and the UK Government hope to ensure that all new stations are capture ready, so that CCS could be retrofitted at a later date once the technology is proven, WWF consider CCS to be a promising technology but has not yet been demonstrated on a large scale integrated with a power plant anywhere in the world. As a result many observers fear that capture ready may be little more than a fig leaf that would open the door to a new generation of polluting coal stations while giving no assurance to when, if ever, CCS would be fitted. CCS is unlikely to be a cheap option, even after the initial demonstration phase is complete. Full CCS retrofit at a power plant like Kingsnorth is likely to cost more than £1.1 billion. It is very unlikely that the carbon price under the EU ETS will be sufficiently high to cover the full costs (Allot and Kaszewski, 2008).

WWF have commissioned the Scottish Centre for Carbon Storage (SCCS) to investigate the concept of CCS readiness and the way the term is used. SCCS concluded that CCS readiness should be more than a technical assessment. For a project to be credible, the economic and regulatory framework must also be favourable. The five main areas which must be included are:

- Modifications to the power plant – the plant should be designed to enable easy conversion to CCS. This is the area most people concentrate on.
- Transport of $CO_2$ – detailed plans should be prepared showing how $CO_2$ will be transported to the storage site.
- Storage – Geological storage should be appraised in outline, using existing data, to provide assurances on timing, volume and performance and to obtain outline approval by regulators.
- System integration and the business model – plans for system integration and operation should be set out including clear and convincing financial plans to cover retrofit costs.
- Stringent regulatory criteria to enforce early conversion to capture, transport and storage – there should be a requirement that capture ready plant be operational by 2020. If not, the plant should be closed down (Markusson and Haszeldine, 2008).

WWF consider that a more robust approach is needed to effectively rule out unabated coal in both the UK and EU. Their preferred approach is based on the emissions standard introduced in California in 2006. This sets a limit on the amount of $CO_2$ that a new or replacement power plant can emit. Though there is a need to demonstrate the feasibility of commercial-scale CCS, this objective should not justify the use of a small CCS demonstration to provide a smokescreen for a much larger new coal plant. They believe that the best way of demonstrating CCS is to retrofit an existing plant rather than build a new large plant with a small scale test. Hence they support the CCS project at Longannet but are suspicious of anything that might enable the construction of a new plant at Kingsnorth. WWF welcomed the UK Government's April 2009 announcement regarding CCS, which they considered a huge step forward but they were still concerned that policies were not in place to ensure that all coal plants would be capturing at least 90% of $CO_2$ by the early 2020s (World Wildlife Fund, 2009a,b,c, 2010).

It is evident that all three organisations object to the use of coal for power generation on the grounds of climate change. They are not raising issues regarding mining, air pollution or waste disposal. Greenpeace appear to be more hostile to coal than FoE and WWF though FoE seems to be hardening its attitude recently.

The UK has no national organisation whose remit is to make the case for coal use in the UK. Individual companies such as RWeNpower or E.ON make their own case when they propose coal projects. The Government has convened a Coal Forum which is an independent advisory group to bring together interested parties to facilitate dialogue within the industry and interact with the Government to secure the long-term future of coal-fired power generation in the UK but it has no remit to inform the public. The fact that the World Coal Institute is based in the UK does mean that information relating to the coal industry is readily accessible in the UK but it does not have a specific UK role.

# 6 India

Coal continues to be the principal source of power generation in India. India's coal reserves amount to 267 Gt of which 105 Gt are proven. It has the fifth largest coal reserves after USA, Russia, China and Australia and is the third largest producer following China and the USA. The state-owned Coal India Corporation is responsible for 82% of coal production in India. Over two-thirds of the total installed power capacity is thermal and is dominated by coal which represents 52.4% of the total (77,400 MW). Natural gas and diesel trail behind at 10% and 0.8% respectively. India has a significant installed hydropower base of 36,900 MW which represents about a quarter of installed capacity. India's renewable energy capacity is currently close to 15,500 MW which includes small hydro, biomass, solar and wind. India has never signed the Kyoto Protocol on the basis that, as a developing nation, a legal requirement to cut $CO_2$ emissions would severely damage its economy. Electricity demand in India is currently growing at 8% annually and the country is suffering from a peak deficit of 16%. Coal will continue to be the country's main fuel source for the foreseeable future; the power industry is embracing supercritical technology and, in the future, may incorporate ultra-supercritical technology (Global Power Review, 2010a).

## 6.1 Opinion surveys in India

There have been very few opinion surveys conducted solely in India to ascertain the attitudes of Indians to global warming, pollution or energy production but many global surveys have included India. World Public Opinion.org undertook an India specific poll in 2005 to find out the public's attitudes to several subjects including climate change. The nationwide poll of 1452 Indians was fielded in November 2005 by the Indian polling organisation C-Voter. Overall, the respondents said they had heard a substantial amount about climate change. When asked how much have you heard about the idea that emissions from cars and factories are causing global warming, only 27% said they had not heard, of whom 13% had not heard very much and 14% had heard nothing at all. A relatively large 73% had heard, of whom 35% had heard a great deal and 38% to some extent. A very high percentage of 85% saw global warming as an important threat, with 45% saying it was extremely important. Only 10% said it was not important at all. Perhaps the most significant finding of the poll was that the respondents rejected the view, expressed at the time by their government, that developing nations did not have responsibility to limit their emissions. The respondents were presented with two positions on this issue and asked which was closer to theirs. Only 26% endorsed the view that less developed nations like India should not be expected to limit their emissions. A large majority of 69% endorsed the opposite view that all countries had a responsibility to make some efforts to limit their emissions. When questioned about India's own role, a larger minority of 45% endorsed the view that India should not be expected to limit its emissions because it produces relatively low emissions per person. Nonetheless, a plurality of 50% endorsed the view that India should limit its emissions because India's total emissions are quite substantial and growing. Asked further on what particular steps India should take, 25% thought India should not take any steps that had economic costs, 41% thought only limited steps having low economic costs should be taken and 30% thought strong steps were required even if they had significant costs (World Public Opinion.org 2006c).

HANSA Research was commissioned by Greenpeace India to find out the public's attitudes to health and pollution. The target respondents were opinion leaders such as teachers, journalists and government officials as well as the general public and 968 people were questioned. The responses obtained, when asked whether pollution has become a major threat to our environment and health, are shown in Figure 31. There was overwhelming support for this proposition especially by the general public and journalists. The least support came from CEOs, NGOs, government officers and students from premier institutes (Greenpeace, 2006).

There have been several global polls which have included India. In 2006, World Public Opinion.org questioned respondents from thirty countries including 1012 from India. When asked how serious a problem they considered climate change to be, the responses in India were 65% very serious, 25% somewhat serious, 8% not very serious and 1% not at all serious. The corresponding responses for 2003 were 67%, 24%, 5% and 1%. It is apparent that the overwhelming proportion of those sampled considered climate change to be serious and that opinion had not changed very much between

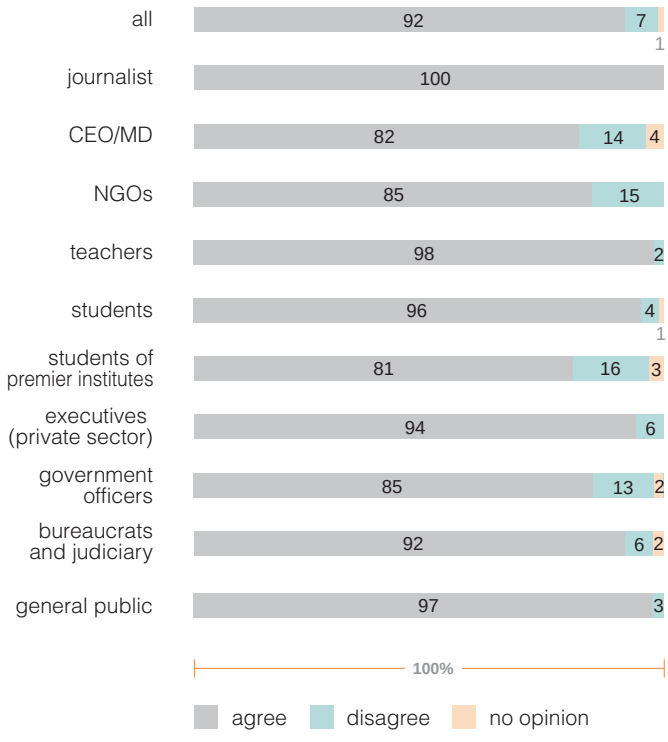


**Figure 31 Indian attitudes to pollution as major threat to environment and health** (Greenpeace, 2006)

2003 and 2006 (World Public Opinion.org, 2006a). A BBC World Service/Globescan/PIPA poll sampled nineteen nations in the same year including 1639 respondents in India on general concerns regarding energy. The detailed results for India showed that 67% were very or somewhat concerned that energy shortages or high prices would destabilise the world economy. Similar concerns were expressed by 59% that competition for energy would lead to conflict and 61% that energy production was harming the climate. When asked which measures should be taken to combat these concerns, 51% were in favour of increasing taxes, 66% for building nuclear power plants, 68% for creating tax incentives for renewable energy, 55% for requiring automakers to increase fuel efficiency. The results showed that those sampled had significant concerns regarding several energy-related issues and there was reasonable support for remedial measures particularly for building nuclear plants and increasing tax incentives for renewable energy (World Public Opinion.org, 2006b).

The same organisations polled 22,182 respondents from twenty-one countries including 1521 adults from India the following year on issues associated with climate change (BBC, 2007). When the Indian respondents were asked whether they had heard of climate change, 15% had heard a great deal, 33% had heard some, 33% not very much and 3% not at all. In answer to whether human activity was a significant cause of global warming, 47% thought it was significant and 21% was not a significant cause. Regarding the issue of whether it was necessary to address climate change, 37% thought it was necessary to take major action very soon, 26% thought it was necessary to take modest action in coming years and 12% thought it was not necessary to take any steps. When asked about the need of less wealthy countries to take action, 33% thought they should and 24% thought they should not. The respondents views on the need for wealthy countries to assist the developing world were that 47% thought that they should and 19% thought they should not. The results showed that a significant minority of Indians admitted that they knew little about climate change. Those believing that human activity was responsible exceeded those who did not by a ratio of more than 2 to 1. Only a small proportion thought there was no need to take any steps. A higher proportion thought that the developing world should act than not and well over double the proportion thought that the developed world should assist the developing world than not. The same poll addressed what changes would be needed to combat global warming. A majority of Indians (61%) thought that individuals would need to modify their lifestyles in order to address climate change. This proportion was less than any other country. Half of Indians (50%) thought that consumers and industry would need to pay more for fuels that cause climate change, such as coal and oil, while 27% disagreed. Regarding increased taxes on energy sources, Indians were divided with 38% supporting higher taxes on such fuels and 36% opposing them.

In 2007, The Chicago Council on Global Affairs and World Public Opinion.org published the results of a survey of seventeen countries including India where 2458 adults were questioned on various aspects of climate change. When asked what should be done about global warming, the Indians were relatively sceptical with only about a half (49%) favouring taking steps to address the issue and of these only 19% saying that the problem was sufficiently pressing to merit immediate measures. The other 30% believed that because the effects would be gradual, only gradual, low-cost measures would be needed. A quarter (24%) said that costly action should be avoided until it was sure that there really was a problem. Another quarter declined to answer. Nonetheless, in answer to a separate question, more than three-quarters (78%) said that global warming could threaten the country's vital interests within the next ten years. Half of them (51%) believed that it could become a critical threat. Indians also tended to favour requiring developing nations to limit greenhouse gas emissions provided developed nations offered assistance: 48% said they would support such a proposal while only 29% would not (World Public Opinion.org, 2007).

In 2008, World Public Opinion.org in conjunction with PIPA surveyed respondents in 21 nations, including 1118 adults in India, on their attitudes to energy production. The poll found that 62% of Indians favoured more emphasis on installing wind and solar energy systems, while 63% supported the government requiring utilities to use more alternative energy sources, even if this might increase costs in the short term. A modest majority of Indians (54%) favoured greater emphasis on modifying buildings to make them more energy efficient, but an even larger majority (62%) supported the government requiring businesses to use energy more efficiently, even if this might make some products more expensive. Nearly half (47%) of those questioned favoured having an extra charge on models of appliances and cars that are not energy efficient with 27% opposing the measure. A majority of Indians (51%) favoured building new nuclear power plant, while 16% said there should be less. Over a third of the respondents (36%) believed greater emphasis should be given to building more coal and oil plants, while 27% said there should be less (World Public Opinion.org, 2008). In a more recent survey, World Public Opinion.org (2009) questioned 1049 Indians on what priority the government should place when addressing climate change. The results showed that 43% thought the government should have a higher priority, 24% thought it had placed the right priority and 18% thought there should be a lower priority. Further polling in India has been undertaken by Gallup between October and November 2009 during which 3010 people were questioned. When asked how much do you know about global warming or climate change, only 32% knew something or a great deal about it. This was lower than the corresponding of 37% in 2008 and 34% in 2007. When those who were aware of climate change were asked which group of countries, given the choice of developed countries like the USA, Germany and Japan or fast growing economies like China, India and Brazil should reduce emissions first, 13% thought that the developed nations should reduce first, 14% thought the fast growing ones should and 44% thought both should at the same time. The poll went on to ask whether the respondents thought their government was doing enough to reduce emissions. Indians were divided on this question with 42% thinking that they were and 40% thinking that they were not (Pugliese and Ray, 2009).

Overall the polls have found that between a third and a half of Indians have heard of global warming. About two-thirds of

Indians are concerned about climate change and other issues regarding energy supplies such as energy shortages. A majority of Indians realise the need to modify their lifestyles and about two-thirds support the use of renewable energy. More reliance on nuclear power is supported by a majority but only about a third support the construction of more coal-fired plant. A plurality of Indians support the proposition that the developing world should also reduce greenhouse gas emissions but that they should be assisted in doing so by the developed world.

## 6.2 Indian organisations opposing coal-fired power generation

Greenpeace India have been campaigning for many years about the hazards of climate change caused by the excessive use of coal. They opposed the setting up of the $1 billion Clean Energy fund by the Asian Development Bank in 2006 as it included coal projects. Direct action has involved masked Greenpeace activists protesting at the 6th CoalTrans India conference held in Mumbai in 2007. Also in 2007, their flagship, Rainbow Warrior, painted the words 'CUT COAL SAVE CLIMATE' on a bulk coal carrier which was unloading coal at the Ennore north of Chennai. They joined the national network of movements opposing coal-fired power plants in December 2008 and their spokesman said that India should rethink its addiction to coal power because it is one of the dirtiest sources of energy today. They claim that coal involves displacement of communities and disregard to their constitutional right to life and livelihood, causes irreparable damage to the local environment and health of people and is now established as a major contributor to climate change (Greenpeace, 2008c).

In 2009, Greenpeace released the second edition of *Energy Revolution: A sustainable India Energy Outlook* which they claimed was a practical energy blueprint on how India could provide secure affordable energy supply without compromising economic development as well as ensuring that India's carbon growth was significantly reduced (Teske and others, 2009). The report considered two scenarios. The first was the reference scenario published by the IEA World Energy Outlook in 2007. The second was the Energy Revolution Scenario (ERS) which had the target of reducing global $CO_2$ emissions by 50% of 1990 levels by 2050. Currently about 68% of India's primary energy supply comes from fossil fuels and 31% is from renewable sources, mainly biomass. The ERS described a development pathway which turned the existing situation into a sustainable pathway through the following measures:

- Exploitation of the existing large energy efficiency potential to ensure that primary energy demand increases more slowly despite a very high GDP growth rate of 10%/y. The demand under ERS would increase from 22,344 PJ/y (2005) to 62,577 PJ/y in 2050, compared to 109,698 PJ/y in the reference scenario. Enhanced efficiency was identified as a crucial prerequisite for achieving a significant share of renewable energy sources in the overall energy system and for compensating the phasing out of nuclear energy and reducing the consumption of fossil fuels.
- Increasing the use of CHP to improve energy conversion efficiency, increasingly using natural gas and biomass.
- Pioneering the use of renewable energy in power production. By 2050, 69% of electricity to be produced from renewable sources.
- In the heating/cooling sector, the contribution of renewables to be increased to 70% by 2050. Fossil fuels to be increasingly more efficient technologies, in particular biomass, solar and geothermal.
- By 2050, 54% of primary energy to be produced from renewable sources.

The report suggests that the cost of electricity generation would be lower from 2010 under ERS due to independence from world market fossil fuel prices. It predicts by 2050, the annual cost of electricity supply would be $462 billion per year below those in the reference scenario. The comparison of fuel use under the two scenarios is shown in Figure 32. Greenpeace made the following proposals to implement ERS:

- Phase out all subsidies and other measures that encourage inefficient energy use and support for fossil fuels and nuclear power production.
- Set stringent and ever-improving efficiency and emissions standards for appliances, buildings, power plants and vehicles.
- Establish legally defined targets for renewable energy and CHP generation.
- Reform of the electricity market to allow better integration of renewable energy technologies on the market.
- Provide stable return for investors through fixed price mechanisms for renewable energy.
- Develop and implement market transformation policies that overcome current barriers and other market failures to reduce energy demand.
- Support innovation in energy efficiency, low-carbon transport systems and renewable energy production.

The report considered that though there was much speculation about the potential of CCS, its overall cost would serve as a major barrier to its development.

Greenpeace have also investigated the relative contributions of the different income classes in India with respect to their $CO_2$ emissions. India has a rapidly growing consumer class which makes it the 12th largest luxury market in the world. At the same time it is home to 800 million poor people. Greenpeace published a report in 2007 entitled *Hiding behind the poor* based on face-to-face surveys on domestic and transportation issues across the country ranging from metropolitan areas to medium and small towns and rural areas (Ananthapadmanabhan, and others, 2007). The energy consumption patterns of 819 households were converted into $CO_2$ emissions and assigned into seven different income classes. The findings illustrated that the considerably significant carbon footprint of a relatively small wealthy class comprising 1% of the population is camouflaged by the hundreds of millions of poor who keep the overall per capita $CO_2$ emissions below 2 t/y. The richest classes were found to produce four and a half times more $CO_2$ than the poorest and almost three times more than the average. While even the richest income class, earning more than 30,000 Rs per month,

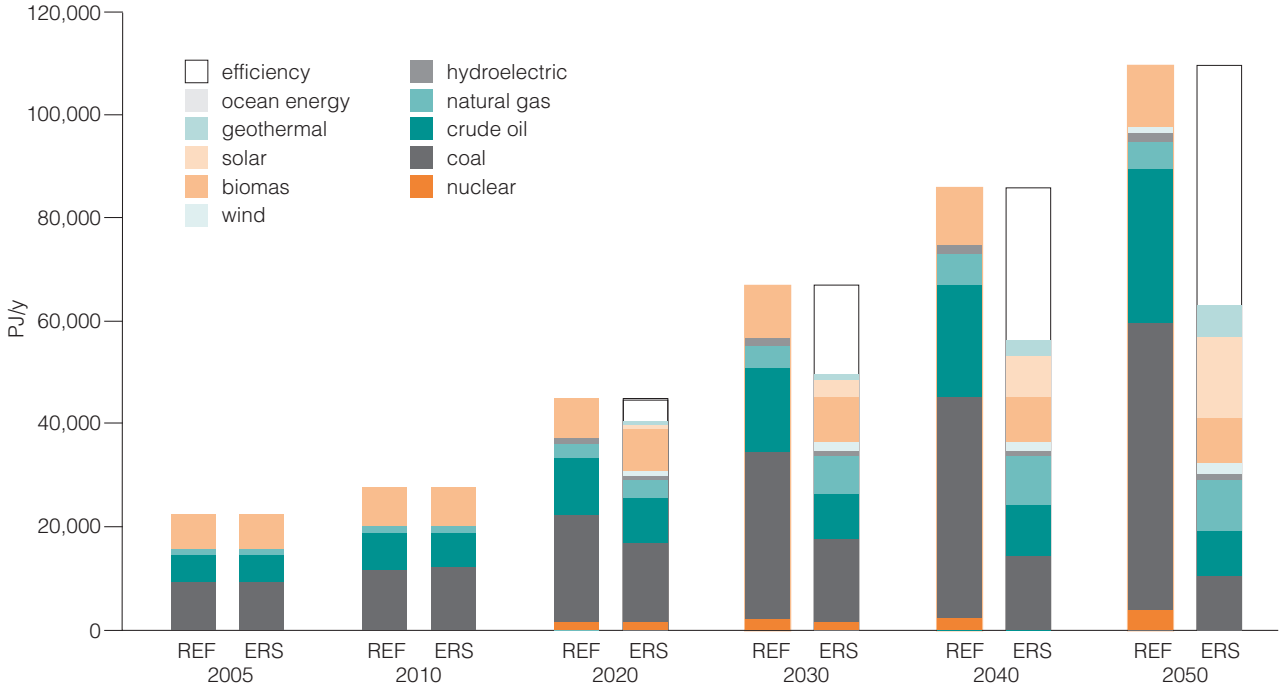


**Figure 32 Development of primary energy demand in India under different scenarios** (Teske and others, 2009)

produce slightly less than the global average $CO_2$ emissions of 5 t/y and considerably less than the developed world, as shown in Figure 33, this amount already exceeds the suggested sustainable limit of 2.5 t/y that needs to be reached to limit global warming to less than 2ºC. The carbon footprint of the four highest income classes, earning more than 8000 Rs per month, representing a population of 150 million people, already exceeds sustainable levels.

Greenpeace suggest that while India had a right to demand a 'common but differentiated' responsibility at an international level, there was an urgent need for intra-national common but differentiated responsibility too. Just as developed nations need to cut their $CO_2$ emissions not only to prevent climate change but allow developing nations catch up, the same is true within India. If the upper and middle classes do not check their $CO_2$ emissions, they will not only contribute to global warming, but they will deny hundreds of millions of poor Indians access to development. The study clearly illustrated the growing schism of carbon emissions between the two Indias; the poor bearing the biggest climate impact burden and camouflaging the other India's lifestyle choices. Greenpeace's response to the results of the study was not that India should stop developing or the wealthy should stop consuming but to make the clear case to decarbonise its development. The existing 11th and 12th Five-Year Plans proposed by the Indian Government continued to base the future energy production in the country on coal power plants. A major revision of the future of the power sector was needed, shifting investment from coal and nuclear to renewables and energy efficiency, to create the carbon space for the poor to develop.

The World Wildlife Fund also campaigns in India on a multitude of activities for the protection and conservation of the environment in India. Climate change and energy conservation are among the chief areas of concern for the organisation. They have considered the future of coal in India in a report entitled *Re-thinking coal's rule in India* (Pozon and Shukla, 2008). In this report, WWF concluded that India faced a potential energy crisis and the blame rested largely with its overdependence on coal. It suggested that India's coal reserves had been grossly overestimated. This had compromised India's argument for depending on indigenous coal for energy security reasons. But worse than the imminent shortage of domestic coal was the severe social and environmental impacts inherent to India's coal sector – not least of which was the mounting problem of climate change. The report quoted IEA data showing that India and China then account for 45% of world coal use and would be responsible for over three-quarters of the increase by 2030. India would become the world's third largest $CO_2$ emitter by 2015. WWF claimed that there was a tremendous gap between India's reported coal reserves and the actual amount of indigenous coal available for use. The Indian Government had relied on methods dating back to 1956 which assumed that all proven reserves were extractable, which would imply that India had enough coal to last 200 years. This assumption was invalid and, in 2006, India's Energy Policy Report estimated that if domestic production continued to grow at 5%, the total extractable coal reserves would run out in 40 years. Underground mining had also been neglected in India primarily due to government policies aimed at increasing coal production in a very short span of time. The report claimed that there were huge environmental and social costs attached to coal use in India but the market price of coal did not reflect the value of ecological and social resources implicit in the exploitation and use of coal. Communities living in close proximity to coal mines and coal plants received the brunt of the industry's negative impacts. The report favoured low emissions coal technologies which were considered to have an enormous potential to alleviate many of the environmental and social problems stemming from coal. The favoured technologies included supercritical, ultra-supercritical, IGCC plant and CCS. Though newer PCC plants in India had been fitted with ESPs, a comprehensive

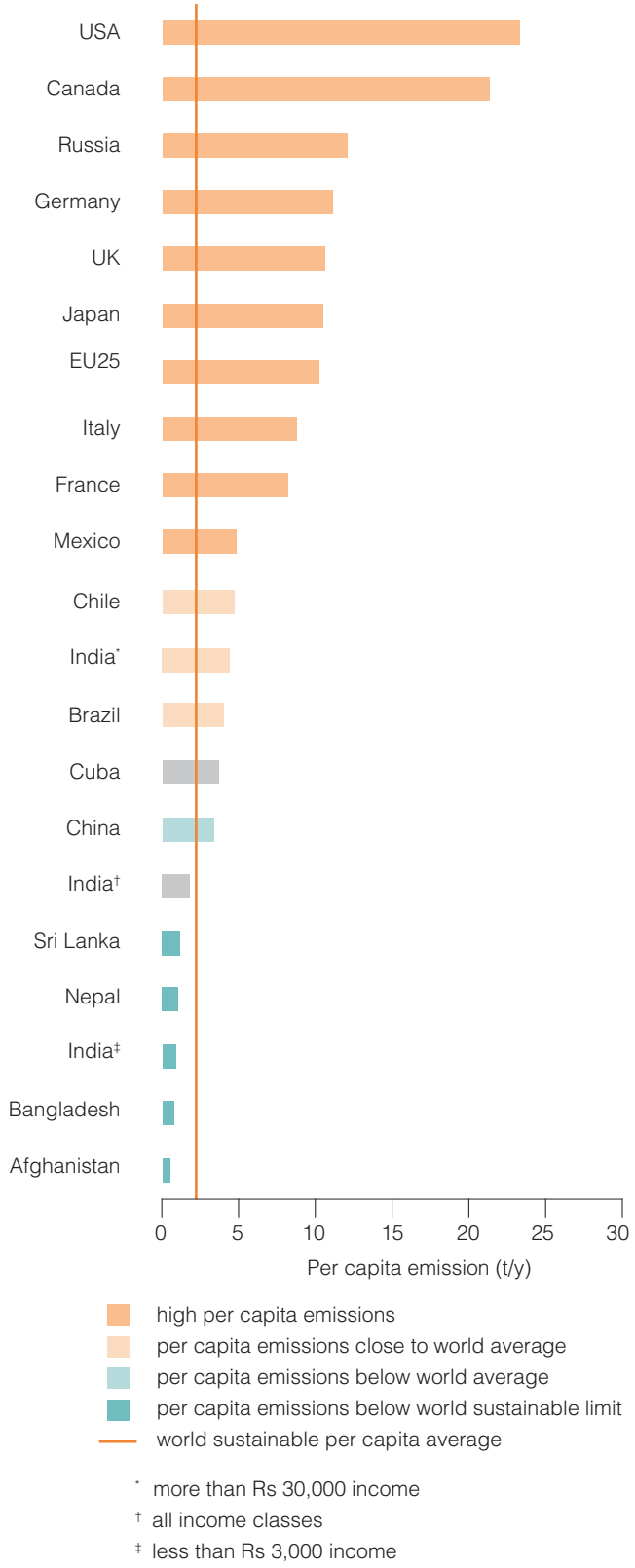


**Figure 33 Comparison of Indian income classes per capita $CO_2$ emissions with global values** (Ananthapadmanabhan and others, 2007)

retrofitting of older plants had not been carried out. The report identified the following impediments to the spread of such technologies in India:

- Intellectual property rights and patents – in many cases parts of the technology needed were protected by international patents.
- Insufficient technology adaptation – the technology needed to be adapted to local conditions.
- Lack of indigenous capacity – there may be a shortage of trained manpower.
- Lack of enabling frameworks – technology transfer requires institutions to share knowledge.
- Lack of government policy and incentives
- Risk aversion – utilities unwilling to take on the risks of new technologies
- Financing problems

In the particular case of CCS, the main barriers include the immaturity of the technology and associated loss of generating capacity, installation and operating costs, virtual absence of data on location and capacity of $CO_2$ storage sites and weak environmental regulation. CCS requires a robust regulatory framework to ensure that it is implemented in a manner that is environmentally sound.

The measures which the report identified to safeguard India's natural environment and spare humanity from the worsening impacts of coal use included internalising the true costs of coal production and use. The present market price of coal ignores social and environmental costs and these should be internalised through pollution levies, charges and taxes and trading permits. In addition there was a need to strengthen environmental regulations by empowering the public. In particular, Environmental Impact Assessments should be designed to protect the environment and public from destructive industrial practices rather than to streamline environmental clearance. Thirdly, what is needed is to implement low emissions coal technology. It is apparent that WWF are not as opposed to the use of coal, with the necessary safeguards in the short term, as Greenpeace.

There are no organisations within India which have a nationwide role to put the case for coal. At the Copenhagen summit the Indian prime minister agreed to voluntary and unilateral targets to reduce the emissions intensity of India's economy. In the February 2010 budget the government announced a coal tax which will go toward establishing a National Clean Energy Fund (NCEF) to finance research and innovative projects in clean technologies.

# 7 Thailand

Thailand is facing major challenges to maintain its electricity supply with a growing energy demand. Between 1986 to 1997, the electricity demand in Thailand grew on average 13%/y and current estimates are that it will grow by 5.7%/y until 2021. Currently, over 90% of electricity is generated by thermal power of which 71% is gas fired and 20% is coal fired. A major challenge facing energy planners is the heavy reliance on gas-fired generation and ensuring long-term energy security as gas supplies from the Gulf of Thailand decline. Thailand has approximately 2 Gt of proven coal reserves of which 1.4 Gt is recoverable. The coal includes lignite and subbituminous but has a high sulphur content leading to serious environmental concerns. Hence it is likely that any new proposed power plant will import higher grade coal from Indonesia, Australia and elsewhere. In recent years the Thai Government has begun to explore a strategy of energy security diversification and increasing consultation with the public over major energy projects. Their long term energy strategy involves development of alternative and indigenous energy resources such as coal, renewables and the use of nuclear power. Although reserve margins are currently relatively high at 25%, there are concerns that power shortages might arise if year-on-year consumption rates continue to climb at 20%. The more immediate risk relates to fuel supply. This issue was highlighted in August 2009 when the country came to the verge of a national blackout following an unscheduled cut in gas deliveries to power plants from two key sources of supply. Imports from two offshore fields in Myanmar and one field in the Gulf of Thailand were disrupted almost simultaneously due to separate technical problems. Blackouts were averted by increasing gas supplies from other sources (Kessels, 2010; Power in Asia, 2010).

EGAT (Electricity Generation Authority of Thailand) is the biggest power generator in Thailand and is owned by the government. EGAT operated the largest coal power plant in Thailand, the Mae Moh lignite plant which comprises of 3 x 75 MW units, 4 x 150 MW units and 6 x 300 MW units with a combined installed capacity of 2625 MW. Mae Moh is the largest coal-fired power plant in Asia and is located in the mountains of Lampang province in northern Thailand where is generates approximately 18% of the national power demand. The Thai people's views on coal-fired power generation have been severely affected by two serious pollution incidents at Mae Moh in the 1990s. The first was in October 1992 when large amounts of $SO_2$ emitted from the plant accumulated above the Mae Moh basin reaching levels as high as 3418 mg/m$^3$. This resulted in respiratory irritation in people and livestock living near the plant and pollution of the land. As a result of this EGAT decided to install FGD on all but the 3 x 75 MW units. However, in August 1998, before the FGD systems were fully installed, while two installed FGD systems were out of service and some were shut for maintenance and the power plant was operating two units without FGD, an abrupt change in atmospheric conditions once more caused high atmospheric levels of $SO_2$ resulting in similar impacts as before. Both incidents caused severe environmental protests and the plant is not now allowed to operate without FGD. Since the installation of the final FGD system in February 2000, $SO_2$ emissions have been reduced considerably from 150 t/h to less than 7 t/h and $SO_2$ concentrations in the Mae Moh basin meet environmental standards. However, following the earlier incidents, in the 2000-01 period there was strong opposition by local communities, especially those living near the sites of two potential coal-fired projects (1400 MW Hin Krut and 734 MW Bo-Nok in Prachuap Khiri Khan province) resulting in fuel-switching to natural gas and relocation of the plants. The only new coal-fired power plant commissioned since 2000 is the Banpu Limited and China Light and Power (BLCP), 2 x 717 MW, subcritical coal-fired plant located in the Map Ta Phut Industrial Estate in the Rayong province which was commissioned in 2007. The plant incorporated low NOx burners, ESPs and seawater washing FGD to address environmental concerns. Glow energy is constructing a 700 MW supercritical coal-fired unit at the same site which is due to be completed at the end of 2011 (Suksumek, 2007; Simachaya, 2008; Kessels, 2010).

There have been very few opinion surveys of the attitudes of the Thai people towards climate change or the use of coal. As part of a World Public Opinion.org survey of twenty-one countries, 2223 Thais were questioned in September 2008 on their attitudes to energy production. When asked whether their government should emphasise the installation of solar and wind power, 75% of Thais thought their government should emphasise more, 8% emphasise less and 7% same as now. The respondents were equally in favour of modifying buildings to make them more energy efficient with 73% thinking that the government should emphasise this more, 8% thinking less and 6% the same as now. However, there was much less support for building coal- or oil-fired plant and only 41% thought the government should emphasise this more, 19% emphasise less, 13% about the same and 28% did not know. There was even less support for building nuclear plant with only 22% thinking the government should emphasise this more, 31% emphasise less, 10% about the same and 37% don't know. When asked whether utilities should use more alternative energy such as wind and solar even if it increased the cost of energy in the short term, 73% were in favour, 9% opposed and 17% did not know (World Public Opinion.org, 2008). A more recent poll has been commissioned by WWF and Greenpeace and conducted by Synovate in which 1003 people were questioned from Thailand in August 2009. When questioned on the role of world leaders, 56% of Thais thought that Mr Obama should lead the global effort and take decisive actions to tackle climate change. When asked which countries were causing the most difficulties for obtaining an agreement at Copenhagen, 54% thought China was the most difficult with 48% naming the USA and 33% naming India. The European countries were named by fewer people as being most difficult (UK 15%, Germany 10%, France 12%). The survey also asked who should be leading the world in tackling climate change: rich developed nations, major developing nations or their own country. The responses of the Thais were that 64%

thought their own country should act, the same percentage thought the rich developed nations should act and 56% thought that major developing nations should act. When asked what actions should be taken to cut emissions, 31% of Thais thought action should be taken to stop deforestation, 30% wanted to address the energy sector, 20% named changing lifestyles and consumption patterns and 19% targeted the agricultural sector. The consequences of climate change that most worried the Thais were worsening health conditions (49%), water shortages (23%), plants and animal extinction (17%) and food shortages (10%). The results of the surveys demonstrate that the Thais think that both the developed and the developing world must tackle climate change. The actions they favour were mainly the use of renewable energy and stopping deforestation. There was little support for coal-fired power plant and even less for nuclear energy (World Wildlife Fund, 2009d).

Following the incidents at Mae Moh in the 1990s and the opposition to the two potential IPP projects in early 2000, the Thai Government has recognised the need for a strategic approach for coal development and utilisation promotion. Public participation would be emphasised in the development of future coal-fired projects in order to reduce conflicts and instead to promote harmony and co-operation between the host communities and potential power project developers. In this regard, a Community Development Fund was established in 2007 with the goal of improving the quality of life of local people and the environment near power plant. In 2008, 105 power plants in 40 provinces paid into the fund and 1778 million baht were contributed. The types of activity involved in the programme include livelihood training, support for education, environmental protection programmes and preventable health care and clinical programmes. The detailed activities are decided in close consultation with the respective host communities to correspond with their needs. The Thai Government has also published new emission standards for new power plants which include the use of continuous emission monitors. There is increased use of imported coal of higher quality. In addition, the Ministry of Energy in Thailand provides limited support for clean coal technologies (Suksumek, 2007; Kessels, 2010).

# 8 Australia

Australia is rich in natural resources and is a net exporter of energy. The main fuels produced in Australia are coal, uranium and natural gas. It is the world's biggest exporter of coal, exporting 252 Mt in 2008. Australia's proven coal reserves amounted to 76,200 Mt or 9.2% of the world's total. There are two types of coal deposits; high quality black coal is found in the Sydney Basin of the states of New South Wales and Queensland and brown coal deposits are located in South Australia, Victoria, Western Australia and Tasmania. Australia meets its domestic consumption and exports the surplus. Australia's natural gas reserves have increased fourfold over the past 20 years and were calculated at 2.51 trillion $m^3$ in 2008. Australia's oil reserves are small by international comparisons and proven reserves amounted to 1.5 billion barrels in 2009. This was sufficient to supply much of its domestic consumption. Australia's primary energy consumption consists of coal and petroleum. Black and brown coal accounted for the greatest share at around 40%, followed by petroleum products (34%), natural gas (20%) and renewable energy sources (5%). The majority of Australia's electricity is produced using coal, accounting for 84% of total production. Australia is the highest per capita emitter of greenhouse gases in the world. Over 50% of its emissions are produced by electricity generation. The government is committed to developing renewable energy. In 2001, a Mandatory Renewable Energy Target (MRET) was established, placing a legal liability on wholesale buyers of electricity to proportionally contribute to an additional 9500 GWh of renewable energy per year by 2010. A further target was set in 2009 to increase the MRET to 45000 GWh by 2020 which is equivalent to a 20% share of renewable energy. The Australian Government intended to establish a cap and trade programme as part of their long-term policy of reducing Australia's $CO_2$ emissions by 2050. However, in 2010 they twice failed to obtain parliamentary approval for its emission trading scheme which was called the Carbon Pollution Reduction Scheme (CPRS). In April 2010, the Government announced that they would be shelving the cap and trade programme for at least three years, until after the next election (Global Power Review, 2010b).

## 8.1 Opinion surveys in Australia

Several opinion surveys, both national and international have investigated the Australian public's attitudes towards climate change. Many have addressed the issue of how serious does the public consider climate change to be. The 2006 World Public Opinion.org survey questioned 1007 Australians and asked their reaction to the statement that the way in which the world produces and uses energy is causing environmental problems including climate change. The response was that 69% were very concerned, 25% somewhat concerned, 5% not very concerned and 1% not at all concerned (World Public Opinion.org, 2006b). The 2007 Chicago Council on Global Affairs also questioned 1007 Australians on their attitudes to global warming. The results showed that 69% thought that global warming was critical, 26% thought that it was important but not critical and 5% thought it was not important (World Public Opinion.org, 2007). A poll was conducted for the Australian National University in September 2008 in which 1000 people were interviewed on their attitudes towards the environment. Asked which of the following was the most serious threat to the future well-being of the world, 41% said global warming, followed by population growth (29%) and terrorism (18%). When asked which was the most serious problem for Australia, the results in Figure 34 were obtained. Drought is one of the most visible aspects of climate change and came at the top of the list with 73% seeing the problem as very serious (McAllister, 2008). In the same year Newspoll conducted a survey for The Australian newspaper in which 1200 adults were interviewed. When asked whether they personally believed or not that climate change was currently occurring, 84% believed it was and 12% did not (Angus-Reid, 2008b). More recently in July 2009, the Lowy Institute conducted interviews of 1003 adults and asked whether climate change was a problem. The response was that 76% answered in the affirmative and 26% thought it was not a problem. Of those answering in the affirmative, 60% thought that the problem of climate change had become more urgent in the past year. The same survey asked the respondents whether they considered the issue of climate change to be very important or not. Only 56% thought it was very important. This proportion was significantly less than the 66% who were of this view in 2008 and the 75% in 2007 (Hanson, 2009). In September 2009, the USA Studies Center (USSC) at the University of Sydney questioned 800 adults and asked whether they agreed with the proposition that the world's climate is getting warmer and 83% agreed (Jackman, 2009). These and more recent surveys seem to suggest that the Australian public's attitudes may be changing. The National Forum questioned a panel of 1737 participants in October 2009 and January 2010. When the panel was asked whether they agreed or disagreed that increasing amounts of $CO_2$ in the atmosphere would increase the earth's temperature, in the October 2009 survey, 62% agreed with 38% strongly agreeing, 9% neither agreed or disagreed and 23% disagreed with 15% strongly disagreeing. In the January 2010 survey, in response to the same question, 57% agreed with 32% strongly

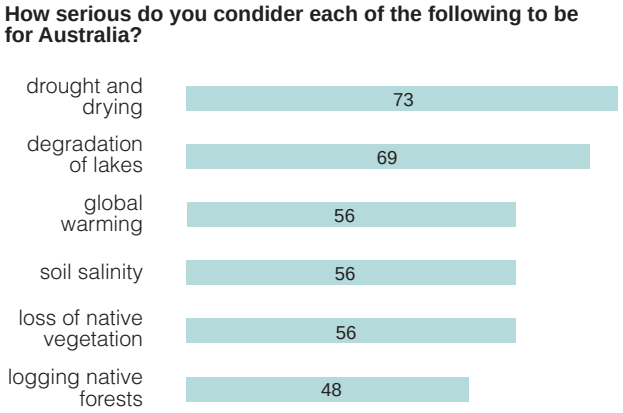


**Figure 34 Australian attitudes to environmental problems** (McAllister, 2008)

agreeing, 12% neither agreed nor disagreed, and 23% disagreed with 14% strongly disagreeing. There is a significant reduction in the proportion agreeing (Young, 2010). This survey was not directly comparable to some of the other surveys as there was a separate category for those neither agreeing nor disagreeing. It is apparent, however, that prior to late 2009, there was a substantial majority of Australians considering global warming to be very serious and that the number holding this views has decreased significantly in 2010.

Several polls have also investigated the public's attitudes as to whether global warming is the result of human activity. The 2007 BBC/Globescan/PIPA survey in which 1000 Australians were questioned determined the respondents views on whether human activity was a significant cause of climate change and 81% of Australians agreed and 16% disagreed (BBC, 2007). In the USSC 2009 survey, those believing that climate change was taking place were asked whether human production of greenhouse gases was a leading cause of climate change. The replies showed that 78% agreed, with 28% strongly agreeing, and 16% disagreed. The National Forum survey also asked the respondents whether man-made $CO_2$ emissions significantly contributed to global warming. The responses showed that, in October 2009, 58% agreed with 36% strongly agreeing, 9% neither agreed nor disagreed and 28% disagreed with 17% strongly disagreeing. The corresponding results for January 2010 were 54% agreeing with 31% strongly agreeing, 11% neither agreeing nor disagreeing and 29% disagreeing with 18% strongly disagreeing (Young, 2010). The figures for those believing that global warming was man-made mirrors the figures for those accepting the reality of global warming in that the number holding this view has decreased in 2010.

Polling organisations have also attempted to determine what the Australian public think should be done about climate change. In the World Public Opinion.org 2006 survey, several options were suggested to the respondents. When asked whether taxes should be increased to encourage conservation, 30% were strongly in favour, 39% were somewhat in favour, 18% somewhat opposed and 12% strongly opposed. Asked whether new nuclear plants should be built to reduce reliance on coal and oil, 19% were strongly in favour, 34% somewhat in favour, 20% somewhat opposed and 24% strongly opposed. Regarding tax incentives to encourage the development of solar and wind power, 74% were strongly in favour, 18% were somewhat in favour, 5% somewhat opposed and 2% strongly opposed. Faced with asking the automotive industry to increase fuel efficiency, even if this increased the price of the car, 59% were strongly in favour, 29% were somewhat in favour, 6% somewhat opposed and 5% strongly opposed. The majority of the public were in favour of all these measures, especially renewable energy and more efficient cars. The least supported measure was building more new nuclear plant (World Public Opinion.org, 2006b). When the Australian respondents were questioned in the Chicago Council survey in 2007 on the urgency of addressing global warming, 69% thought that global warming was a serious and pressing problem and steps should be taken now even if this involves significant costs, 23% thought that global warming was a gradual problem which could be dealt with by gradual low cost steps and 8% thought that until they were sure that global warming was really a problem, steps having economic costs should not be taken (World Public Opinion.org, 2007). In the BBC/Globescan/PIPA survey in 2007, 70% of the Australian respondents said that it was necessary to take major steps to address climate change very soon, 25% thought it would be necessary to take modest steps in coming years and 3% thought it was not necessary to take any steps. The same survey showed that 71% of Australian respondents thought that less wealthy countries with substantial and growing economies should limit emissions along with wealthy countries with 23% disagreeing. At the same time 84% thought that wealthy countries should give financial assistance and technology to less wealthy countries to limit climate change with 12% disagreeing (BBC, 2007). The Lowy Institute has surveyed Australians on their attitudes to the urgency of tackling climate change in 2006, 2008 and 2009. Each of the surveys questioned at least 1000 adults and the answers obtained are given in Table 26. The results show that there has been a dramatic reduction in the proportion thinking that global warming was so pressing that immediate action should be taken even if it involves significant costs from 68% in 2006 to 60% in 2008 to 48% in 2009. This reduction is particularly noticeable between 2008 and 2009. Over the same period the proportion of people preferring a more gradual approach or who did not believe that any action was necessary correspondingly increased. Indeed the majority of those sampled supported these latter two positions in 2009 (Hanson, 2009).

Several polls have also questioned Australians on whether they think Australia should take unilateral action on climate change. In a poll conducted by AC Nielsen/Sydney Morning Herald in July 2008, 1400 Australian voters were asked

**Table 26 Australian attitudes to greenhouse gas reductions** (Hanson, 2009)

| | 2006, % | 2008, % | 2009, % |
|---|---|---|---|
| Until we are sure that global warming really is a problem, we should not take any steps that would have economic costs | 7 | 8 | 13 |
| Global warming is a gradual problem that should be addressed gradually by taking low cost steps | 24 | 32 | 39 |
| Global warming is serious and pressing. We should begin to take steps even if it involves significant costs | 68 | 60 | 48 |
| Don't know/Refused | 1 | – | 1 |

whether Australia should press ahead and cut its greenhouse gas emissions regardless of what other countries do. The responses showed that 77% said yes and 19% said no (Angus-Reid, 2008a). In the USSC poll in 2009, the question was posed whether Australia should delay any steps toward reducing greenhouse gas emissions until it was clear what countries such as the USA and China would do. The public was fairly evenly divided with 15% strongly agreeing, 31% agreeing, 34% disagreeing and 17% strongly disagreeing (Jackman, 2009). The National Forum poll in 2010 asked how strongly do you support or oppose Australia implementing measures to curb $CO_2$ emissions in the near future before the largest emitting nations such as the USA, China and India agree. The answers showed that 51% supported with 23% strongly supporting, 6% neither supported nor opposed and 41% opposed with 33% strongly opposing (Young, 2010). These polling data would indicate that the support for unilateral action on climate change has decreased over that period 2008 to 2010. There has been polling on the Australian public's attitudes towards their governments plans for emissions trading. Soon after the Green Paper on emissions trading was published, a Newspoll/Australian poll questioned 1200 adults on the subject and the polling showed that 23% thought that Australia should introduce a carbon emissions trading scheme only if other countries also introduced such schemes, 60% thought that an emissions trading scheme should be introduced regardless of what other countries do and 11% thought that Australia should not introduce an emissions trading scheme (Angus-Reid, 2008b). In 2009, the Australian Government announced that it would delay its emissions trading scheme till 2011 and set higher targets if other countries do the same. When an Essential Research poll questioned 1102 adults on this decision, 49% approved and 31% disapproved (Angus-Reid, 2009). More recently in 2010, the Australian Government announced that it would shelve its emissions trading programme for at least three years, until after the next election.

## 8.2 Organisations opposed to coal-fired plant

One of the organisations that campaign nationwide in Australia against the use of coal in Australia is Greenpeace-Australia. They consider Australia to be one of the world's highest per-capita greenhouse polluters, in large part due to its heavy use of fossil fuels. However, Australia is also the developed country most vulnerable to climate change thus having a major stake in reducing emissions. Currently in Australia, renewable energy is forced to compete on an uneven playing field as the bulk of political and financial support is enjoyed by the fossil fuel industry. They have published a report entitled *Energy Revolution* which charts a sustainable Australian energy scenario. The principles behind this revolution are to implement renewable solutions especially through decentralised energy systems, respect the natural limits of the environment, phase out dirty unsustainable energy sources, create greater equity in the use of resources and decouple economic growth from the consumption of fossil fuels. Two scenarios were outlined in the report. The first was the Australian Government's energy projections (reference scenario) and the second was one produced by European Renewable Energy Council and Greenpeace International. Greenpeace states that in order to avoid runaway climate change, Australia needs to reduce its greenhouse gas emissions by 40% by 2020, moving to decarbonise as quickly as possible thereafter. Greenpeace suggest this is possible through the following measures:

- Increasing the share of renewable energy for electricity production to 40%.
- Reduce energy consumption by 16% by increasing energy efficiency.
- Phasing out coal-fired plant by 2030.
- Capitalise on the current wastage of heat by installing CHP plant.
- Using electricity for transport systems.

Their recommendations to the Federal Government include legislating a greenhouse gas reduction of greater than 40% by 2020, establishing an emissions trading scheme, legislating for a national target for renewable energy, massively investing in the deployment of renewable energy and declaring an immediate moratorium on new coal-fired plant. Greenpeace Australia are not in favour of CCS which they say is risky and expensive and cannot deliver in time to avoid catastrophic climate change. They would favour emissions trading only if the target is in line with a 40% emissions reduction by 2020, the scheme must begin in 2010, all the permits must be auctioned and revenue raised must be used to support renewable energy (Teske and Vincent, 2008).

Friends of the Earth Australia also campaign for clean energy solutions to climate change. They suggest that the cheapest and quickest way of reducing greenhouse gas emissions is by being smarter and more efficient with the way energy is consumed. This involves improving industrial processes and ensuring that the least amount of energy is lost. They promote the use of solar energy and they criticise the fact that despite the amount of sunshine Australia enjoys, nations like Japan and Germany are leading the world in solar energy generation. They are in favour of bio-energy and they report that Australia already generates enough bio-energy to supply all the homes in Tasmania. By 2020, bio-energy could supply one-third of Australia's electricity. They also favour wind power as Australia has some of the best wind resources in the world. Australian farms already generate enough electricity to supply 250,000 homes. Some of the less windy sites in Australia would be considered good or excellent in Europe. They are adamantly opposed to the use of coal which currently supplies 85% of electricity in Australia thus making Australia one of the highest greenhouse gas emitters in the world. They are contemptuous of CCS which they say will not be commercially available for another two decades. There are further unanswered questions such as whether the technology will work, how much it will cost, who owns the underground reservoirs, who has the responsibility to prevent leakage. Given these uncertainties, renewable energy and being energy smart provide the most reliable and cost-effective path to a low carbon future (Catchlove, 2010). One particular project which FoE oppose is the proposed HRL/Harbin project to construct an IDGCC (Integrated Drying Gasification Combined Cycle) brown coal plant in Victoria. Though HRL argue that this plant will produce less greenhouse gas emissions than a conventional brown coal

plant, FoE insist that it will produce more $CO_2$ than a conventional black coal-fired plant. They particularly oppose the decision to accept the project under the Federal Government's Low Emission Technology Demonstration Fund (LETDF) and provide a US$100 million subsidy (Corporate Watch Australia, 2008).

## 8.3 Organisations supporting coal-fired power generation

The Australian Coal Association (ACA) is an industry body whose member companies are the black coal producers in Australia. ACA member companies operate predominantly in New South Wales and Queensland but it also has members in Western Australia and Tasmania. The ACA claims that it primarily performs an advocacy role at the national level for the black coal industry with a focus on sustainability and environmental responsibility. In this context the most important issues dealt with for a number of years relate to climate change. ACA contends that the Australian coal industry has long accepted the science of climate change and it acknowledges the role reducing emissions from coal-fired power plant can play in addressing climate change globally. It is investing substantially in viable solutions, specifically in the field of CCS. In 2003, the ACA invited representatives from the coal and electricity industries, unions, federal and state governments and the research community to form the COAL21 partnership. The COAL21 action plan was launched in 2004 to provide the blueprint for accelerating the demonstration and deployment of technologies reducing greenhouse gas emissions from coal-fired power plant. In 2006, the ACA announced the establishment of a COAL21 fund which is raising US$1 billion over ten years from a voluntary levy on coal production to support the pre-commercial demonstration of low emissions technologies (Australian Coal Association, 2010).

The ACA highlights the report *Coal and the Commonwealth – The Greatness of an Australian Resource*, which has been produced by the University of Queensland (Knights and Hood, 2009). The study presents findings on the past and future uses of coal and the role this fuel has played and will continue to play in Australia and globally. Though the study accepts that the majority of greenhouse gases are produced from the burning of fossil fuels, the call for the abandonment of coal and other fossil fuels as an energy source is a totally unrealistic position for Australia and the world. The report contends that a starting point is to recognise that access to energy, mainly in the form of electricity at affordable prices is the key factor that lifts people out of poverty. This first occurred during the Industrial Revolution in England but is now continuing to occur on an unprecedented scale in India and China. Any attempts by countries that have already enriched themselves through the use of cheap fossil fuels to prevent developing countries from raising their living standards are likely to be met with understandable resistance. Currently, 41% of the world's electricity is generated from coal and this percentage is increasing. In capital-intensive industries, such as power generation, it is not technologically feasible to achieve rapid change and therefore any transition away from coal will take decades. The study argues that coal will be just as important an energy source in the future as it was in the past and it is today. Coal is the world's most abundant fossil fuel and its wide dispersal overcomes concerns about energy security. Though renewable energy and nuclear power will play increasing roles in the global energy mix, the world's population growth and the increasing demand will mean that the use of all fuels including coal will continue to increase globally. The solution to global warming is CCS which is already used on a modest scale in a few locations worldwide. When it is exploited on a larger scale, it will allow existing power plant to operate in a pollution free manner.

Australia is blessed with very large reserves of extremely high quality coal and the study reviews the effects that this bountiful resource has on employment and wealth in Australia. In 2006-07, the Queensland and NSW coal industries directly employed over 32,000 people. Australia's trading partners also benefit from importing Australian coal as Australian coal is typically cleaner than indigenous coals as it has a higher calorific value and lower contaminants. The concept of cleaner coal is shifting in Australia towards low emissions coal technologies. Australia is at the forefront of research, development and demonstration technologies for CCS of emissions from coal-fired power plant with 12 programmes costing more than US$1 billion under way in NSW, Queensland and Victoria. In conclusion, the authors concluded that coal will be a principal energy source for the foreseeable future (Knights and Hood, 2009).

# 9 Public attitudes to carbon capture and storage

The major surveys of public attitudes to climate change and options for reducing greenhouse gas emissions undertaken have only recently started to question the public on their attitudes to CCS. This is probably due to the fact that the general public has little knowledge of the technology and until the technology is demonstrated on the large scale as being technically feasible and economically viable, it will not be considered as a realistic option for addressing global warming. As CCS is demonstrated on an increasingly larger scale, assuming these tests are successful, the focus on CCS should increase. However, there have been several projects in which workshops have been held involving stakeholders such as government, industry, environmental NGOs, sometimes the general public and the factors relating to CCS which affect their attitudes have been investigated in detail.

The public's lack of knowledge of CCS is shown in a series of surveys conducted by Reiner and others (2006). The public in the USA, Sweden, UK and Japan were questioned on several aspects of climate change including their knowledge of CCS.

The surveys were conducted in 2003-04 and involved about 1000 respondents in each country. The public were given a series of environmental concerns (global warming, ozone depletion, smog, acid rain, water pollution, toxic waste and resource depletion) and asked if CCS can reduce them. The responses are shown in Figure 35. There was a significant lack of awareness, particularly in the USA. There, nearly three-quarters of those asked were not sure which problem CCS addressed. Those who answered thought it combated all of them with a slight plurality favouring smog reduction. In the UK, over half those sampled were not sure and though a plurality knew CCS addressed global warming, significant minorities thought it combated ozone depletion, smog and acid rain. The Swedes were more informed with only a minority who were unsure. A significant majority knew CCS could reduce global warming but half still thought it also reduced ozone depletion, smog and acid rain. The Japanese were most informed with over 80% knowing CCS addressed global warming but majorities also thought it addressed ozone depletion and acid rain. The same survey informed the

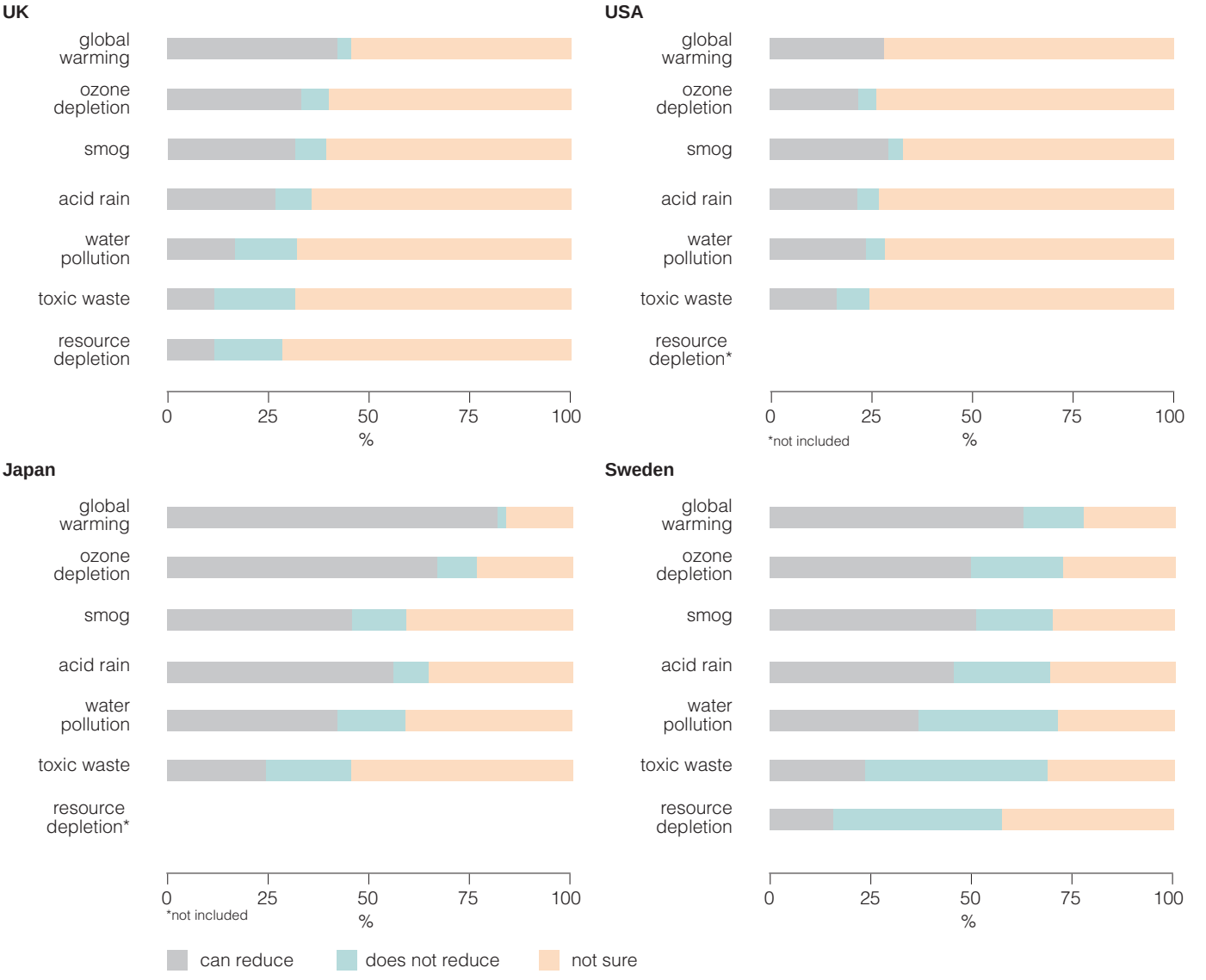


**Figure 35 Knowledge of carbon capture and storage** (Reiner and others, 2006)

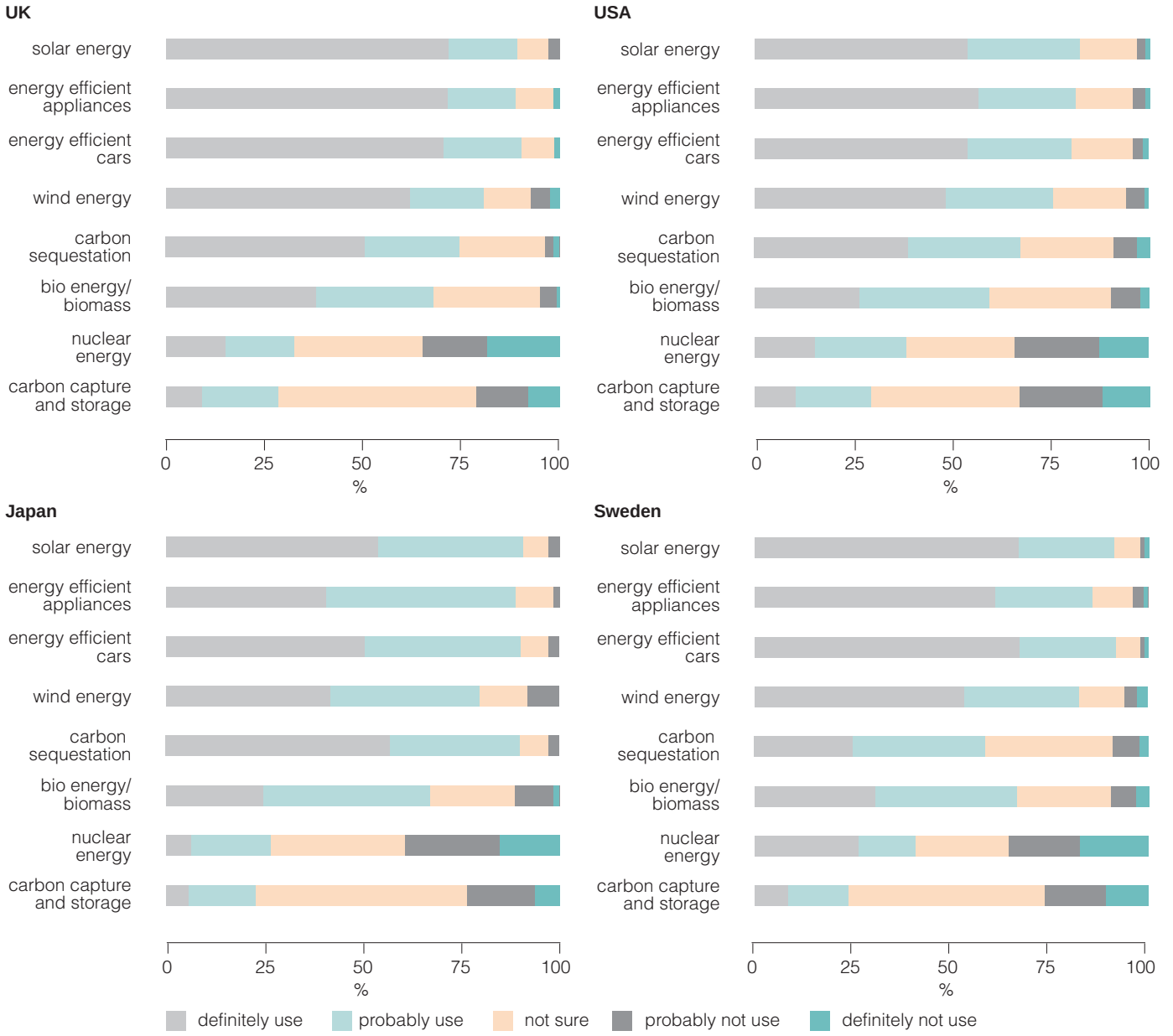


**Figure 36 Attitudes to mitigation technologies to reduce global warming** (Reiner and others, 2006)

respondents of several technologies which have been proposed to address global warming and asked the respondents which would they use. The replies are shown in Figure 36. The four countries displayed similar inclinations. Solar energy, energy-efficiency appliances and energy efficient cars all received 80–90% favourable ratings with virtually no one expressing negative views. Wind energy, carbon sequestration (planting trees) and the use of biomass/bioenergy were all viewed favourably by clear majorities with only a relatively few stating negative views. Nuclear energy and CCS were viewed with considerably more equanimity with comparable levels of support and opposition. The level of active support for CCS was the least of all the technologies. The MIT US survey in 2007 (Ansolabehere and Elting, 2007) confirmed this apparent lack of support for CCS. In this survey, 1200 members of the public were questioned and asked if $CO_2$ were pumped deep underground within 25 miles of their home whether they would support or oppose such a facility. The replies were: strongly support (3.7%), somewhat support (10.0%), somewhat oppose (23.7%), strongly oppose (37.6%), neither support nor oppose (7.3%), not sure (16.5%). These results indicated that there was only a minor degree of support with a significant majority opposing but there was a significant minority who were not sure. The later 2009 MIT survey found that 16.9% had heard of CCS. This figure was considerably higher than the 4% in 2003 and 5% in 2006. However, even in this survey only 31% knew that CCS reduced greenhouse gas emissions. Only a slightly smaller proportion thought it reduced smog or ozone depletion. When asked whether CCS should be used to reduce global warming, the results obtained were: definitely use (10.4%), probably use (17.2%), not sure (48.8%), probably not use (15.7%), definitely not use (7.9%). The respondents were clearly not ready to accept CCS as a viable option for tackling climate change (Stauffer and others, 2010).

Itaoka and others (2009) have conducted a survey of public opinion in Japan on the social acceptance of CCS. The survey involved 334 people who responded to a paper survey in Tokyo and 2156 people who completed an online survey across the nation. The respondents were questioned on the pros and cons of CCS implementation and the survey also

contained five sets of different information to analyse the influence of information on views. The first question was on the recognition of CCS. In the paper survey, 7% said they knew to some extent about CCS and 12% had heard of it but 61% did not know at all. In the internet survey, the figures were 18%, 33% and 49% respectively. When those who had heard of CCS were questioned on its implementation, over two-thirds had a positive opinion. When they were then provided with information such as newspaper articles and the IPCC report, there was a tendency to have more negative views after receiving the information. These results suggested that information on the negative aspects of CCS was not well known to the general public. The survey also explored the factors which influenced the respondent's understanding of CCS. These were found to be: the respondents' concern about the environmental risks caused by the injection of $CO_2$ and the possibility of leakage, their understanding on its effectiveness as a $CO_2$ mitigation option, their awareness of the societal responsibility for $CO_2$ mitigation and their concerns that CCS would allow the continuation of the current usage of fossil fuels. Ashworth and others (2009) have investigated the process of engaging the Australian public on CCS. They were particularly interested in exploring Australian society's acceptance on energy technologies and assessing the effectiveness of dialogue with large groups for informing knowledge and changing attitudes. Two workshops with large groups of up to one hundred people were held in 2008. The workshops were found to be effective in informing the individuals' knowledge and attitudes towards low emission technologies. However, the effectiveness of changing attitudes depended on the strength of their existing attitudes about the technology, whether they were given information that challenged their existing attitudes. The quality and objectiveness of the information, the use of trusted and knowledgeable experts, the use of facilitators to keep the discussion focused and ensuring adequate time for discussion and deliberation were important in reaching an understanding of the issues.

There have been several studies on the views of stakeholders, namely those with a particular interest, on the subject of CCS. In 2006, the EU funded an ACCSEPT (Acceptance of $CO_2$ Capture, Storage, Economics, Policy and Technology) survey of stakeholder perceptions of $CO_2$ capture and storage in the EU. The 512 stakeholders, chosen across Europe, were mainly from the energy industry, research and government sectors with smaller numbers from environmental NGOs and national parliaments. The responses showed that 40% believed that CCS was definitely necessary, 12% that it was only necessary if other options failed to live up to current expectations, 8% that it was probably not necessary and 4% that it was definitely unnecessary. Their belief in the need for CCS tended to increase when moving from the national to the EU to the global scale. They tended to regard the risks of CCS as being moderate or negligible and did not think that investment in CCS would have negative impacts on improving energy efficiency and reducing energy demand. However, the sample was divided on whether CCS might lead to negative impacts for other low carbon technologies with 44% thinking it would and 51% thinking it would not. The NGO respondents tended to be the most sceptical concerning the role of CCS and to have a more negative perception of the potential risks than other stakeholders. In spite of this there were still more NGO respondents who believed that CCS was definitely or probably necessary in their own country (40%) than definitely or probably not necessary (35%). The energy industry stakeholders, closely followed by the government and academic stakeholders were the most optimistic regarding the role of CCS. The parliamentarians were typically somewhere in between the energy industry and the NGO representatives.

The survey identified respondents from three countries (Norway, UK and The Netherlands) as being most enthusiastic about CCS and least concerned about the potential risks. All three countries are actively engaged in CCS projects, either existing as in the case of Norway or planned as in the UK and The Netherlands. Comparing these three countries, the Norwegians were the most favourable towards CCS. However, even in these most pro-CCS countries there was a wide variation in their responses as in other countries. The countries least enthusiastic about CCS were the other Scandinavian nations and Central and East European nations. They were more concerned about risks to health, safety and the environment as well as the impact of CCS on other low carbon technologies. Nevertheless, even in these countries, more were favourably disposed toward CCS than not. Countries with a lower GDP per capita such as those in Central and Eastern Europe may have been more sceptical regarding CCS partly because of the higher costs incurred by CCS but possibly because many of these countries had already met their Kyoto targets. The following recommendations were suggested as a result of the survey. Firstly, there was support from stakeholders in all countries for stronger incentives to support the further deployment and implementation of CCS within the EU. Secondly, as opinion was divided between NGOs and other stakeholders, there was a need to pursue an active dialogue and effective sharing of information as new scientific and technical data became available. There is particular need for focused CCS communication with Cental and East European stakeholders (Shackley and others, 2007a,b).

Studies have been undertaken in The Netherlands on informed public opinion about CCS and how it compares with other mitigation options (Best-Waldhober and others, 2006, 2008). The investigators were particularly concerned that when there is a possibility of low awareness of an issue such as CCS, studying public opinion becomes a delicate balancing act. People tend to give their opinion even if they have no information on the particular issue. Such opinions could be regarded as pseudo-opinions and are unstable and easily changed by contextual information. This study used the Information-Choice Questionnaire (ICQ) method which takes these problems into account. The main aim of the ICQ method is to provide the respondents with the necessary information to reach an informed opinion. This method also helps the respondents make use of the information to form opinions about the different policy options. Respondents are given information regarding a policy problem, the policy options and their consequences. The results of an ICQ do not represent present public support for a given policy. Rather, it assesses how public opinion may be after the public is informed about an issue.

The 2006 study focused on six CCS technologies, including a large modern coal-fired power station with CCS, which were chosen by experts as most likely to be implemented in the next 10 to 20 years. In this study, a representative sample of the Dutch population comprising 995 respondents was questioned. The results of the 2006 study showed that most people knew little about global warming but even less about CCS. However, after processing the information provided, most people evaluated the technologies as being adequate and there did not seem to be any aspect or consequence that had such a negative influence that would reduce the overall evaluation. The 2008 study compared coal or gas-fired power plant with CCS with six other options for reducing greenhouse gas emissions. These options included increasing energy efficiency, wave power, energy from biomass and nuclear energy. For each option, the respondents were given a general description, how the technology worked, when, where and in what form it could be implemented and its likely consequences. The survey was conducted in May 2007 and involved a random sample of 971 members of the public. After evaluating all the options, the respondents were asked to choose three out of the seven options. Most respondents chose increasing energy efficiency (90.2%), wind energy (75.4%) or the biomass option (70.0%). Only 6.9% chose the coal -or gas-fired power plant with CCS option. The respondents were then asked if the large-scale implementation of any of these options was unacceptable to them. The increasing energy efficiency option, the wind power option and the biomass option were found to be unacceptable by very few respondents, these percentages being 0.4%, 1.9% and 1.5% respectively. The most unacceptable was the nuclear option with 20% rejecting it. The large coal or gas power plant with CCS option was rejected by 11.0%. The survey found that the group of respondents who evaluated the CCS options before evaluating the other options were more favourable towards it. The majority of the respondents were clearly most favourable towards the energy efficiency, wind and biomass options. The CCS options were chosen by far fewer but they were not rejected by many either (De Best-Waldhober and others, 2006 and 2008).

Van Alphen and others (2006, 2007) have also investigated the social acceptance of $CO_2$ sequestration in The Netherlands. They, too, decided that, as the public were largely unaware of the technology, it would be more appropriate to find out the acceptance of stakeholders, as their acceptance was crucial to the implementation of the technology. The selected organisations belonged to government, industry and environmental NGOs. The information obtained was on the basis of interviews and a workshop. In general, there was a fundamentally positive attitude towards $CO_2$ sequestration. All groups, with the exception of Greenpeace, agreed that $CO_2$ sequestration should be deployed to mitigate climate change, albeit as a temporary and partial solution. Greenpeace's view was that all possible efforts should be made to improve energy efficiency and to develop the use of renewable energy before turning to $CO_2$ sequestration. Despite the fundamentally positive attitude, all participants posed several conditions for the acceptance and the actual implementation of the technology and there was a remarkable consensus on what these conditions should be. The first was that $CO_2$ sequestration should be safe in the short term as well as in the long term, for people as well as for the environment. The second was that the technology should not be used for more than a couple of decades. The third was the technology should not be made more complex than necessary by making it obligatory to combine with other purposes such as enhanced recovery. The fourth was that financial stimuli were necessary to make the technology attractive and investments acceptable for industry. The fifth was commitment and co-operation between the different sectors and the sixth was acceptance by the Dutch public at large. Several actions were suggested to meet these conditions such as initiating research, developing rules and standards and effective communication with the public.

The authors also analysed the portrayal of CCS in the Dutch media. They concluded that the information on CCS was neither dramatised nor hyped up but presented in a balanced and positive way with great emphasis on the benefits of allowing continued fossil fuel use while addressing climate change concerns. Despite the fact that the concerns about CCS have not overshadowed its promise, the media did point out the possible weaknesses, which were similar to those noted by stakeholders described above. These relate to ecological and health risks through leakage, uncertainty regarding reservoir behaviour, continuing fossil fuel dependency, threat to renewable energy research, high costs, unproven technology and uncertain public acceptance. They concluded that to obtain wider societal acceptance, open, clear, two-way, well-timed communication is needed, putting CCS in the broader context of climate change and the range of possible solutions for a more sustainable future (Van Alphen and others, 2006, 2007).

Torvatn and others (2010) have investigated the impact of CCS communication on the attitudes of the general and the local public. They conducted web and phone-based surveys in six countries (Germany, Greece, The Netherlands, Norway, Romania and UK). There were national samples in each country of more than 1000 respondents and local samples in the four countries (Germany, The Netherlands, Norway and the UK) where CCS demonstrations are planned. The main topics covered included the media preferences for receiving information, the degree of trust in various sources, knowledge of CCS, initial attitudes to CCS and the change in attitude after receiving information. When asked on their choice of media for obtaining information on new energy technologies, the greatest number of people in all countries said they would be most likely to seek information from television. There were national differences in that respondents in The Netherlands, Norway, and the UK were least likely to use blogs and websites whereas the Germans are most likely to do so. Regarding the issue of trust, overall, scientists, environmental protection organisations and consumers were viewed as most trustworthy and political parties, governments and journalists were seen as least trustworthy on average. The Norwegians and the British viewed the EU as less trustworthy than the Greeks and Romanians. The Romanians were particularly distrustful of their political parties whereas the Dutch were more neutral. The Greeks rated environmental NGOs as quite trustworthy compared with the Norwegians who were more neutral. The respondents in all countries were asked if they were aware of CCS and the answers obtained are

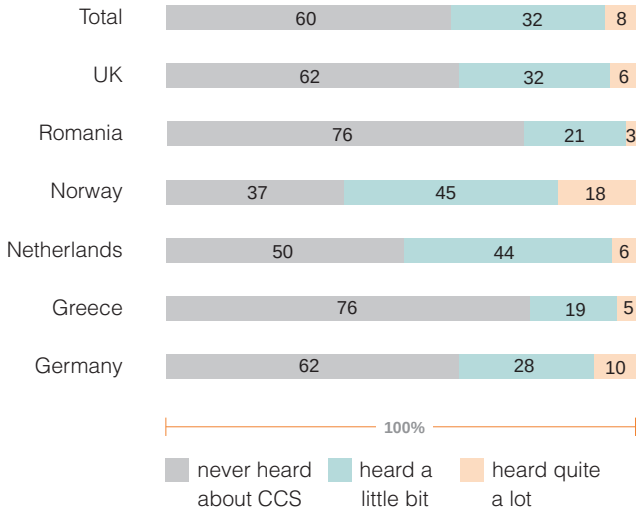


**Figure 37 Awareness of CCS** (Torvatn and others, 2010)

shown in Figure 37. Overall, three-fifths had never heard of CCS, about a third had heard a little bit and less than tenth had heard quite a bit. The lack of knowledge of CCS was greatest in Greece and Romania where there are no specific CCS activities. There is more knowledge in the other four countries in which CCS projects are under consideration. In answer to the question which technologies should be used to address global warming, wind power was the overwhelming favourite in all countries as shown in Figure 38. Nuclear power was least popular and there was a moderate level of support for CCS. The greatest level of support for CCS was from Greece and Romania which had least knowledge of the technology. The other four countries were essentially neutral but the least support was in Germany and Norway where CCS projects are either taking place or most likely to take place. The survey also investigated the influence of information on the respondents attitudes to CCS. The respondents were asked their initial attitude to CCS having only received a very brief description of the technology. Then they were given additional positive or negative information and asked again. As expected the initial attitudes changed in a negative direction after receiving negative information and positively after receiving positive information (Torvatn and others, 2010). Though opinion surveys are relatively favourable to CCS, several CCS projects currently in planning have met considerable local opposition.

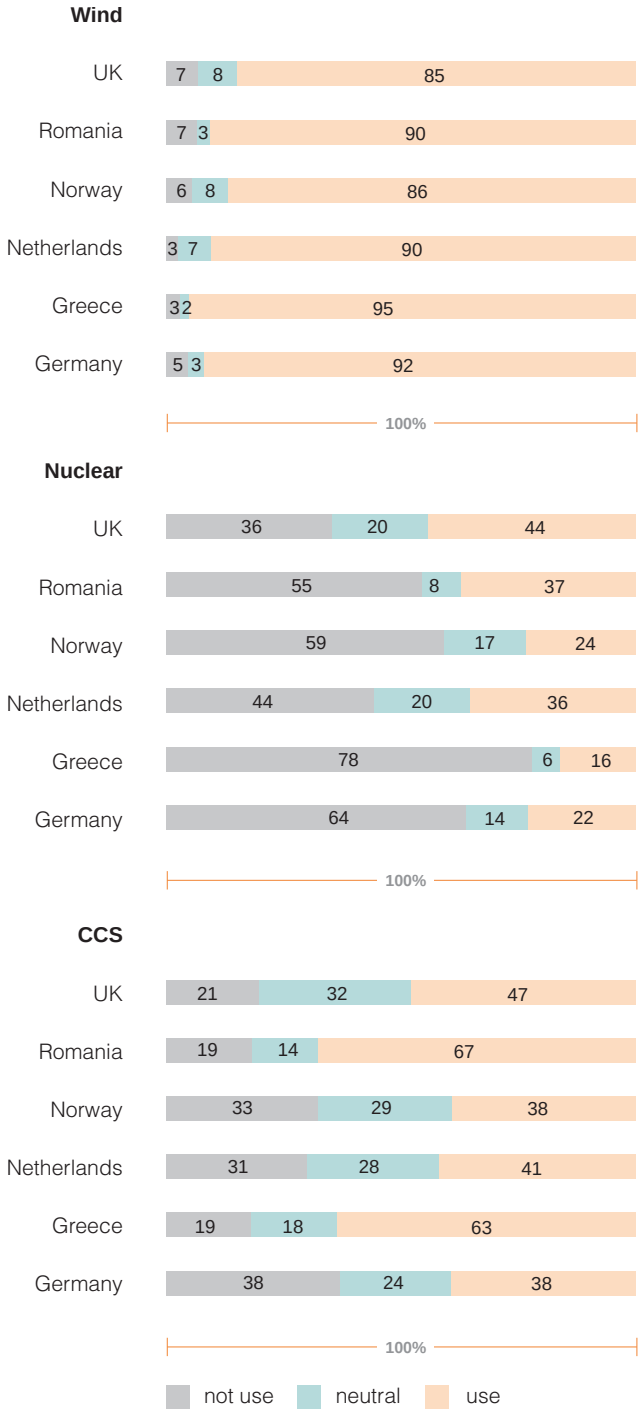


**Figure 38 Attitudes to different technologies to address global warming** (Torvatn and others, 2010)

# 10 Conclusions

Coal remains the main fuel for power generation worldwide and in recent years, most of the recent growth in coal-fired generation has taken place in non-OECD countries, notably in China where it has doubled between 2000 and 2006. However, concerns regarding the contribution of coal-fired power generation to global warming have also increased considerably in recent years, particularly since the publication of the IPCC report in 2007. These concerns have somewhat eclipsed the many advantages of using coal for power generation. The attitudes of the public towards power generation from a particular fuel is an important factor in shaping government policy. For example, such attitudes are crucial in determining whether new coal-fired projects can proceed.

In recent years there have been several international opinion polls held to ascertain global opinions on the reality of global warming, its causes and what action should be taken to mitigate its effects. In every international poll taken since 2006, majorities in all countries polled have said that global warming is a problem or threat and only a minority have said that it was not a problem. The countries that tend to be most concerned are South America, Western Europe, Canada, Australia, Bangladesh and South Korea. On the whole the USA, China, Russia and India seem to be less concerned. The countries most concerned tend to be the ones most likely to be affected by droughts or sea level rise and ones having governments who are also very concerned. What limited information that exists on global trends would suggest that in most countries scepticism regarding global warming has increased since 2008. Polling has also been undertaken to determine the level of awareness of the public in different countries on global warming. The results showed that the vast bulk of respondents from the developed world, sometimes approaching 100%, had heard of global warming but a smaller proportion, sometimes only a minority, were aware in the less developed world, though there were significant discrepancies for the data for individual countries in the different polls. Polling has also been conducted on whether the public believe that climate change is caused by human activity. The results indicated that large majorities in most countries, both in the developed and developing world, considered that climate change is caused by human activity. The figures for the USA were lower than for other developed nations. Polling has also been conducted on the urgency of action on global warming. In many countries in Western Europe and some in the developing world the bulk of the population were convinced of the urgency of action. These polls suggested that Americans, Russians, Chinese, and Indians and Germans were less convinced. Regarding what measures should be taken to combat global warming, global poll findings show considerable support in both the developed and developing world for more emphasis on sources of renewable energy such as solar and wind. The support for building more nuclear, coal- or oil-fired plant was lukewarm. The polling also indicates that large majorities in the developed world and significant majorities in some developing countries agree with the proposition that because total emissions from less-wealthy countries are substantial and growing, these countries should also limit their emissions of climate changing gases. There has been polling on whether wealthy countries should give financial assistance and technology to less wealthy countries that agree to limit emissions. Considerable support for this proposition was found in most developed nations except the USA. Overall, Indian respondents were reluctant to limit emissions and US respondents were reluctant to aid the developing world to do so. Global polling has not been conducted on a regular basis asking the same questions. Hence it is sometimes difficult to assess the trends in global opinion.

In the USA, regular polling is conducted on public attitudes to global warming, energy sources and power production. One subject of inquiry is which set of issues the public consider are the most important ones which the country faces. Before 2007, most respondents considered the wars in Iraq/Afghanistan to be the most important issue and after 2008, the focus has shifted to the financial crisis. The environment or global warming were hardly ever mentioned. In the couple of cases where these issues were considered to be important, less than 5% of those sampled thought so. There is some polling evidence, though that there has been a slight pickup in increased concern regarding the environment in 2010. However, not only has dealing with global warming been the concern of least priority but the level of concern has decreased monotonically over recent years.

Several polling organisations have conducted regular opinion polls in the USA to assess the public attitudes towards the reality of global warming, whether it is caused by human activity and how serious they consider the problem to be. The results demonstrate that in the period 2006-09, the proportion believing that global warming is taking place has decreased. It is also apparent that between 2007 and 2009, the proportion believing in global warming being caused by human activity has decreased significantly and the proportion of non-believers has increased. One poll suggests that by December 2009, the proportion believing that global warming was caused by human activity has decreased to only a third, and half of those sampled considered that it was caused by planetary trends. The polling also shows that the proportion considering global warming to be very or somewhat serious has fallen significantly between 2008 and 2009. This increasing trend of scepticism concerning global warming has continued into 2010. The percentage thinking that global warming has been exaggerated has increased markedly from only 30% in 2006 to nearly half the sample in 2010. The dramatic reduction in those believing between 2009 and 2010 was almost certainly caused by the increased scepticism about the scientific basis for global warming resulting from the release of emails in November 2009 between scientists at the CRU, based at the University of East Anglia, UK, which allegedly showed manipulation and suppression of data contrary to global warming and the admission in early 2010 that the 2007 IPCC report had exaggerated the speed at which Himalayan glaciers were melting. The recent cold winters

might also have increased the levels of scepticism regarding global warming. Given that a majority of the American people do consider that man-made global warming is taking place, some of the issues that need to be addressed are: does the Federal Government need to pass legislation, how urgent is the necessary action, should the USA take unilateral action and is cap and trade the best mechanism to combat the problem. Polling data have been obtained on each of these issues. A substantial majority of Americans thought that the Federal Government should take action but this majority reduced significantly in late 2009. A sizeable majority of those questioned thought that the Federal Government should be doing more but this proportion decreased over time. Between 2007 and 2009 over half the respondents considered that immediate or some action was necessary. However, the polls confirmed the trend in other polls in that the proportion wanting immediate or some action had significantly decreased since 2007 and the proportion of sceptics had increased. The polls suggested that the proportion of the US public having heard of cap and trade is increasing and constituted a majority in 2010 but the extent of knowledge is low. Another poll in 2009 asked whether the respondents would support the system and found that though the majority of respondents supported the system, a significant minority opposed it and the extent of support has decreased significantly and the opposition increased significantly in the past year.

The US public's attitudes towards energy options have been investigated by several polling organisations. The results showed that coal, oil and nuclear were perceived as being most harmful with natural gas being significantly less harmful. Opinion was favourable regarding hydroelectric power and solar and wind were considered largely unharmful. Comparing the figures for the two surveys in 2002 and 2007, it is seen that the proportion considering particular fuels as being significantly harmful has decreased slightly for all the fossil fuels and decreased significantly for nuclear power. Several polling organisations have questioned the US public whether they think that the USA should reduce $CO_2$ emissions unilaterally or only with others. Two polls conducted between 2007 and 2009 demonstrated that a significant majority thought that the USA should reduce greenhouse gas emissions unilaterally even if other countries did less. The results also showed that the proportion willing to act had decreased significantly and the proportion unwilling to act had increased significantly over this period.

The attitudes of the citizens of all the countries in the European Union on a variety of subjects are regularly polled and published in Eurobarometer reports. In a Eurobarometer survey published in 2006 almost half supported the focus of developing solar power followed by advanced research, including clean coal, for new technologies. The least popular option was developing nuclear power. When asked which issues they considered were the most important their country faced, only 14% said energy and 12 % said environment. There was far more concern about unemployment and crime. When asked, in the context of energy, which technologies they had heard of, only about a quarter had heard of clean coal or CCS. When asked to what extent you would trust information about energy related issues from named sources, Europeans tended to trust scientists most. They also tended to trust environmental groups. Given the need to change the pattern of energy consumption and reduce greenhouse gas emissions, respondents were highly positive about the use of renewable sources solar energy, wind energy and hydroelectric energy. There was also positive support for ocean energy and energy from biomass. Considering fossil fuels, there was a reasonable degree of support for natural gas but only about a quarter supported oil or coal. Nuclear energy had the lowest level of support.

Eurobarometer conducted a survey in 2009 specifically to determine the attitudes of Europeans towards climate change and the respondents were asked what they consider the most serious problem facing the world as a whole. The results indicated that the most serious problem was poverty and the lack of food and drinking water, followed by climate change and major global economic downturn. Comparing with an earlier survey in 2008, there was a significant reduction in those considering climate change as the most serious problem over this period. The survey then focused on climate change and asked respondents to rate their perception of climate change and almost two-thirds of those questioned considered it to be very serious with a quarter considering it fairly serious. There was a significant reduction in those thinking climate change to be very serious since 2008. The majority of Europeans disagreed with the statement that climate change was an unstoppable process. Just under a third thought that nothing could be done to stop it. Almost two-thirds thought that the seriousness of climate change had not been exaggerated. Overall, the majority thought that tackling climate change could have a positive effect on the European economy. Finally, almost half of those sampled were willing to pay more for alternative, greener, forms of energy.

Since 2006, there has been regular polling in the UK to find out the public's attitudes towards various aspects of global warming and the environment. Several polls have addressed the issue of whether the public thinks climate change is taking place and how serious it is. The trends in these polls suggest that in the period 2006 to 2009 there was a reasonably constant percentage of the population in the high 80s who believed that climate change was taking place and about 10% thought it was not. Among those who believed it was taking place about a quarter to a half thought that, though it was happening, the danger was exaggerated. However, in the short period from late 2009 to early 2010, the percentage of those believing in climate change decreased further to the mid-70s with those disbelieving rising sharply to the mid-20s and those believing it was happening but not serious also increased.

Several polls in the UK have asked whether global warming is caused by human activity. It is difficult to discuss the trends in these polls as the questions asked were not the same. It would appear though that in all these polls up to 2009 a large proportion of the respondents, in the upper 80%, believed that climate change was man-made or possibly man-made but not proven, or that man-made factors had some part in it. But there has been a reduction in this percentage to below 70% in the later 2010 polls. The reasons for this change are probably the same as those in the case of the USA.

When polling organisations currently ask the public in the UK what should be done regarding energy production, they are generally asked whether they are in favour of renewable sources such as solar, wind, tidal and nuclear. The possibility of clean coal technologies is not generally considered. One set of polls, however, was conducted every year between 2007 and 2010 and found out the respondents' attitudes to coal, gas-fired, nuclear plant and wind farms. The results are fairly stable regarding coal-fired plant during this period. About a fifth of the respondents were favourable, about a third were ambivalent and two-fifths were opposed. Comparing the results for coal with the other fuels, gas was favoured by a slightly greater proportion and opposed by significantly less. The proportion favouring nuclear energy was over twice as much and that opposing was significantly less. The most favoured option, by far, was wind farms.

There have been very few opinion surveys conducted solely in India to ascertain the attitudes of Indians to global warming, pollution or energy production but many global surveys have included India. Overall the polls have found that between a third and a half of Indians have heard of global warming. About two-thirds of Indians are concerned about climate change and other issues regarding energy supplies such as energy shortages. A majority of Indians realise the need to modify their lifestyles and about two-thirds support the use of renewable energy. More reliance on nuclear power is supported by a majority but only about a third support the construction of more coal-fired plant. A plurality of Indians support the proposition that the developing world should also reduce greenhouse gas emissions but that they should be assisted in doing so by the developed world. Opinions in Thailand regarding coal-fired power generation have been affected considerably by two serious incidents of $SO_2$ pollution in recent years. Polling there has shown that Thais consider that they, too, have an obligation to take action on global warming and deforestation is of particular concern to them.

In Australia, several opinion surveys, both national and international have investigated the public's attitudes towards climate change. Many have addressed the issue of how serious the public considers climate change to be. It is apparent that prior to late 2009, there was a substantial majority of Australians considering global warming to be very serious and that the number holding this view has decreased significantly in 2010. Several polls have also investigated the public's attitudes whether global warming is the result of human activity. The figures for those believing that global warming is man-made mirrors that for those believing the reality of global warming in that the number holding this view has decreased in 2010. Polling organisations have also attempted to determine what the Australian public think should be done about climate change. The majority of the public were in favour of increasing taxes to encourage energy conservation, especially renewable energy and more efficient cars. The least supported measure was building more new nuclear plant. When asked about their attitudes to the urgency of tackling climate change there has been a dramatic reduction in the proportion thinking that global warming was so pressing that immediate action should be taken between 2006 and 2009. This reduction is particularly noticeable between 2008 and 2009.

When considering public attitudes, it is instructive to assess what information is freely available to the public on relevant topics which could influence their views. A global organisation supportive of coal use is the World Coal Institute. EURACOAL perform a similar function in Europe. Organisations supportive of the coal industry in the USA include the National Coal Council and the American Coalition for Clean Coal Electricity. The Australian Coal Association performs a similar function in Australia. All these organisations emphasise that coal is essential for supporting global economic development. It is affordable, abundant and widespread and, at current production levels, coal stocks will last over a century. Coal power is also able to satisfy electricity demand throughout the day whereas renewable sources are frequently intermittent. These organisations recognise the need to combat global warming and contend that the application of CCS will meet the challenge. It is interesting to note that many countries, for example, the UK and India do not have comparable national organisations making the case for coal. Global organisations campaigning against the use of coal include Greenpeace, Friends of the Earth and the World Wildlife Fund. Globally, they campaign against widespread environmental damage caused by the use of coal ranging from, global warming, mining, effect on communities, air pollution and waste. These organisations also have branches in individual countries. The concerns of these organisations regarding coal use vary in different parts of the world as do their attitudes to possible remedial steps. In Western Europe opposition to coal use focuses virtually entirely on global warming and there is very little mention of mining, air pollution or waste. In the USA, national organisations opposing the use of coal include EDF, CATF and the Sierra Club but their objections are very different. EDF focus on global warming and are in favour of cap and trade and CCS. CATF concentrate on pollution associated with power plant waste and health effects of air pollution. They are supportive of advanced clean coal technologies such as IGCC and CCS. The Sierra Club highlight global warming, power plant waste and air pollution. They are highly sceptical of IGCC and CCS and would prefer the USA not to use coal at all. In India, organisations opposing the use of coal focus on mining, the effect on communities, air pollution as well as global warming. Greenpeace India claim that coal involves displacement of communities and disregard to their constitutional right to life and livelihood, causes irreparable damage to the local environment and health of people and is now established as a major contributor to climate change. They propose a sustainable pathway which envisages increasing the use of CHP to improve energy conversion efficiency, increasingly using natural gas and biomass and pioneering the use of renewable energy in power production. Campaigns in Australia against coal use focus on global warming. It is inevitable that the media focus on potential problems, hence the arguments against coal use get more coverage than those in favour. Moreover, campaigners opposing coal use take part in direct action which inevitably receives considerable media attention.

The major surveys of public attitudes to climate change and options for reducing greenhouse gas emissions have only recently started to question the public on their attitudes to CCS. This is partly due to the fact that the public has little

knowledge of the technology and until the technology is demonstrated on the large scale as being technically feasible and economically viable, it will not be considered as a realistic option for addressing global warming. As CCS is demonstrated on an increasingly large scale, the situation should change, assuming these tests are successful. However, there have been several projects in which workshops have been held involving stakeholders such as government, industry, environmental NGOs, sometimes the general public and the factors relating to CCS which affect their attitudes have been investigated in detail. The public's lack of knowledge of CCS is shown in a series of surveys conducted in 2006 of respondents in USA, Sweden, the UK and Japan. The public were given a series of environmental concerns and asked if CCS can reduce them. There was a significant lack of awareness, particularly in the USA where a slight plurality thought it combated smog reduction. In other countries significant minorities thought it combated ozone depletion, smog and acid rain.

Workshops were held in Australia to determine how access to information shapes attitudes towards low emission technologies. The effectiveness of changing attitudes was found to depend on the strength of their existing attitudes about the technology and whether they were given information that challenged their existing attitudes. A study in 2006 surveyed stakeholder perceptions of $CO_2$ capture and storage in the EU. The 512 stakeholders, chosen across Europe, were mainly from the energy industry, research and government sectors with smaller numbers from environmental NGOs and national parliaments. The responses showed that a significant minority believed that CCS was definitely necessary. The survey identified respondents from Norway, UK and The Netherlands as being most enthusiastic about CCS and least concerned about the potential risks.

Studies have been undertaken in The Netherlands on informed public opinion on CCS and on its comparison with other mitigation options. The investigators were particularly concerned that when there is a possibility of low awareness of an issue such as CCS, studying public opinion becomes a delicate balancing act. The results of the 2006 study showed that most people knew little about global warming but even less about CCS. However, after processing the information provided, most people evaluated the technologies as being adequate and there did not seem to be any aspect or consequence that had such a negative influence that would reduce the overall evaluation. The 2008 study compared coal- or gas-fired power plant with CCS with six other options for reducing greenhouse gas emissions. Most respondents favoured increasing energy efficiency, wind energy or the biomass option. Less than a tenth chose the coal- or gas-fired power plant with CCS option. Others have also investigated the social acceptance of $CO_2$ sequestration in The Netherlands by stakeholders such as government, industry and environmental NGOs. In general, there was a fundamentally positive attitude towards $CO_2$ sequestration. All groups, with the exception of Greenpeace, agreed that $CO_2$ sequestration should be deployed to mitigate climate change, albeit as a temporary and partial solution.

A survey was undertaken in 2010 on the attitudes of the general and the local public to CCS. They conducted web and phone-based surveys in six European countries. The respondents in all countries were asked if they were aware of CCS and overall, three-fifths had never heard of CCS, about a third had heard a little bit and less than tenth had heard quite a bit. The lack of knowledge of CCS was greatest in Greece and Romania where there are no specific CCS activities. There was more knowledge in the other four countries (Germany, The Netherlands, Norway and UK) in which CCS projects are under consideration. In answer to the question which technologies should be used to address global warming, wind power was the overwhelming favourite in all countries. Nuclear power was least popular and there was a moderate level of support for CCS.

In the developed world, regular polling has been conducted on the public's attitudes towards global warming and energy issues but there is much less information available relating to the developing world. The available data show that there is much more awareness in the developed world of global warming than elsewhere. Until 2009, there was considerable concern in most countries regarding global warming with less concern in the USA, China, Russia and India. Large majorities in all countries believed it was man-made. However, since late 2009, there has been a dramatic reduction in concern about global warming and the belief that it is man-made in the USA, Europe, UK and Australia. This is most likely due to the increased scepticism about the scientific basis for global warming. The opposition to the use of coal varies globally. In many countries it is related to global warming but in others it may be associated with pollution associated with power plant waste and health effects or the effects on local communities from mining. In some countries, such as the UK and India, though there are national organisations opposing coal use, there is no dedicated national organisations campaigning in its favour. Some organisations oppose the use of coal for power generation entirely whereas others are willing to consider clean coal technologies, CCS and cap and trade. Major surveys of public attitudes towards greenhouse gas emissions have only recently started to question on attitudes to CCS, as until it is demonstrated on the large scale as being technically feasible and economically viable, it will not be regarded as a realistic option. However, data obtained from workshops show that when stakeholders are informed about CCS, there is a moderate level of support. It is desirable to have regular polling worldwide using consistent questions to determine trends in public opinion regarding energy sources and global warming.

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