statement

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Addressing the Challenges of Climate Change: an *aide memoire* for policy makers

The European Academies Science Advisory Council (EASAC), which is formed by the National Science Academies of the European Union (EU) Member States, first issued this statement in December last year, urging world leaders, meeting in Durban, to press ahead with the process of international agreement on an effective response to climate change.

EASAC noted the 2009 agreement to limit further global warming to 2 °C but that, despite calls for reduction in greenhouse gases, emissions had risen to a record level in 2010, and by a higher margin than had been expected. This year, the International Energy Agency is again reporting a record year and its Chief Economist is quoted as saying that this new data provide further evidence that the door to a 2 °C trajectory is about to close[6].

This statement is now reissued to remind world leaders meeting in Doha that the issue remains urgent, that there is still time, but that action is needed now on the measures that will ensure global warming remains within the 2 °C limit.

The science of climate change reported by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment (2007) has been thoroughly evaluated by numerous national academies including the Royal Society, Royal Swedish Academy of Sciences, National Research Council of the National Academies of the USA, Institut de France Académie des Sciences, and by international bodies including the InterAcademy Council (IAC) and InterAcademy Medical Panel (IAMP)[1]. Advances in science and technology have increased our knowledge of how to mitigate climate change, uncertainties in the scientific analysis have been identified and are being addressed, co-benefits of mitigation to health have been revealed, and new business opportunities have been found. EASAC remains concerned, however, that turning this substantial evidence base into an international policy response, notwithstanding the uncertainties, has so far failed to match the full magnitude and urgency of the problem.

Assessing the scale of action required

The figure for a limit on global temperature increase, 2 °C, taken from the Copenhagen Accord in 2009 (Conference of Parties, United Nations Framework Convention on Climate Change, COP15[2]), assumes that there will be a level of damage from climate change to which societies must adapt. Even this limit is considered too high by some parties to the United Nations climate change agreement, particularly those whose territory is threatened by rising sea levels. It has, however, provided a starting point for assessing the feasibility of cuts in climate forcing agents required.

Briefly, the IPCC Fourth Assessment of 2007[3] signalled that reductions of CO_2 of at least 50% globally by 2050 from 2000 levels would be required to limit the temperature rise to between 2.0 and 2.4C. An analysis of this aim set out in the 2009 Copenhagen Accord[4] concluded that if emissions do not peak by around 2020, achieving the proposed reduction by 2050 will be considerably more costly. Moreover, because the aspirations for the services that come from energy use within less developed countries limit the reductions that can be achieved globally, an EU Energy Roadmap envisages that an 80–95% reduction in greenhouse gas emissions by 2050 will be needed[5].

The assessment of the pathway to the +2 °C limit, made by the International Energy Agency (IEA) in 2010, assumed that the annual increase in global emissions of CO_2 would be about 3%. By the end of May 2011, estimates show that, after a dip in 2009 caused by the global financial crisis, emissions in 2010 grew by 5% above the previous highest year, 2008. The 2011 estimate, made in May 2012, suggests an increase of 3.2%[6]. Continued global emission of this scale will make it increasingly difficult and costly to achieve the limit of 2 °C.

Consequences for energy systems

Emissions reductions of the scale required to prevent dangerous climate change are huge and will require massive change in energy systems worldwide. The scale of the challenge is heightened by the lack of time to make changes by 2020; the IEA estimates that some 80% of the 2020 emission levels are already 'locked in', which limits the possibilities for reduction measures. This makes it essential that there is an authoritative assessment of the feasibility of emissions reductions.

Much of the technology required is known or in development, and new research is in the pipeline which will expand the technological options for cost analysis and comparison. At the global scale, the mix of supply and demand measures includes renewable energy sources, lower carbon fuels, reduced transmission losses, improved end-use efficiency, carbon capture and storage (CCS) on fossil fuel power stations, nuclear power, and demand reduction. Decisions about one source, for example to reduce dependence on nuclear energy, will place added burdens on the other sources, with rising overall costs.

For EU countries, priorities include de-carbonisation of electricity production by 2050 for transport and heating (industrial and domestic) with heavy investment in nuclear power and CCS, energy from renewable sources (principally wind and sun), and transmission systems that will bring energy from where these sources can best be exploited to consumers. Business opportunities exist both nationally and internationally for the application of innovative technologies[7].

Most debate has centered on the key greenhouse gases and their long-term effects, but there are other forcing agents that work over shorter timescales, including black carbon[8]. This comes primarily from inefficient burning of biomass during cooking and land clearance on a global scale, and from diesel engines on a European scale. Action to reduce levels can play a valuable role locally in producing short-term relief in parallel with longer-term measures, as well as improving human health[9].

Consequences for the natural world

The health and well-being of humankind benefit directly from the natural world in terms of food, biodiversity, materials and recreation. They also benefit indirectly from nature through the role of natural ecosystems, capturing carbon dioxide from the atmosphere and storing it as carbon in the world's oceans and forests and other terrestrial ecosystems.

Pressure from human activities puts these benefits at some risk. Directly, deforestation leads to the loss of carbon storage and releases greenhouse gases back into the atmosphere. There are also indirect effects. Global warming itself risks the transfer of greenhouse gases to the atmosphere from regions where they are stored in permafrost and to an increase in forest fires with consequent deforestation.

The importance of natural ecosystems was recognised in the Copenhagen Accord of 2009 through the development of schemes to reduce deforestation and forest degradation (REDD+). There has been subsequent progress in the development of this concept[10] but global action that will realise the aims of REDD+ remains a distant prospect.

If global warming continues at the present rate there are potential risks for communities through rising sea levels, storm surges and heat waves. In the USA, approximately 0.9 million to 3.4 million people (between 3 and 10% of the total population in the mid-Atlantic coastal region) live on parcels of land or city blocks with at least some land less than 1 metre above monthly highest tides[11], whereas in Bangladesh 15 million people live on land that is less than 1 metre above sea level[12]. Shifts in weather patterns will have an impact on agricultural production, the delicate balance of ecosystems, biodiversity[13] and marine systems including putting at risk corals that will continue to be bleached or degraded in warmer and more acidic oceans[14,15].

EASAC adds its collective voice to the weight of scientific evidence that points to the need to take short-term and long-term action if we are to reduce levels of risk to the natural world in the near future.

Adaptation to climate change

Whatever measures are put in place to reduce the intensity of global human-induced climate forcing, building resilience will be a major factor. Measures will involve the adaptation of infrastructure and human habitation to changes in hydrological cycles (floods and droughts), rising sea levels (abandonment of low-lying areas), and extreme weather events (heat-waves and wind storms, for example). Such measures will require planning and investment recognised in the Copenhagen Accord 2009[4], which called for 'adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation action', particularly in developing nations.

At a European level, technological advances will provide for water use efficiency, building codes for greater resilience to extreme weather, and a mix of biological approaches such as crops that can better resist heat stress and drought, forestry practices that reduce the frequency of fires, carbon sequestration in soils and increases in crop albedo[16].

Greater co-operation and information sharing are key to cost-effective adaptation strategies for the EU and will need active promotion and investment.

Conclusion and recommendations

EASAC supports the consensus view of the world's climate scientists that significant reductions in global emission of carbon dioxide of at least 50% from 2000 levels will be required to achieve the 2 °C limit in global warming[2].

EASAC is concerned that substantiation of the recent increase in global emissions of greenhouse gases[6] will put the world on a path where mitigation and adaptation to climate change are even more costly.

If, to allow a more equitable sharing of this burden between developed and developing countries, the EU countries will have to take a greater proportion of the reduction burden (up to 80% compared with 1990 levels), the consequences of reductions of this magnitude will be radical. De-carbonisation of the electricity generation systems in Europe by 2050 is but one example[5].

Given current uncertainties about the future of nuclear power, the European transmission grid, and renewable energy sources, it is not clear if these aspirations can be achieved.

We therefore recommend that European institutions should expand work on the following:

1. **feasibility assessment of reaching an 80% CO_2 reduction target by 2050;**
2. **control of climate forcers such as black carbon to achieve a short-term emissions reduction by 2020;**
3. **early adoption of schemes for reducing deforestation and forest degradation (REDD+);**
4. **new business opportunities and health co-benefits arising from scientific and technological advances in mitigation and adaptation.**

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Through EASAC, the academies work together to provide independent, expert, evidence-based advice about the scientific aspects of public policy to those who make or influence policy within the European institutions. Drawing on the memberships and networks of the academies, EASAC accesses the best of European science in carrying out its work. Its views are vigorously independent of commercial or political bias, and it is open and transparent in its processes. EASAC aims to deliver advice that is comprehensible, relevant and timely.

The EASAC Council has 28 individual members and is supported by a professional secretariat based at the Leopoldina, the German National Academy of Sciences, in Halle (Saale). EASAC also has an office in Brussels, at the Royal Belgian Academies of Science and the Arts.

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