

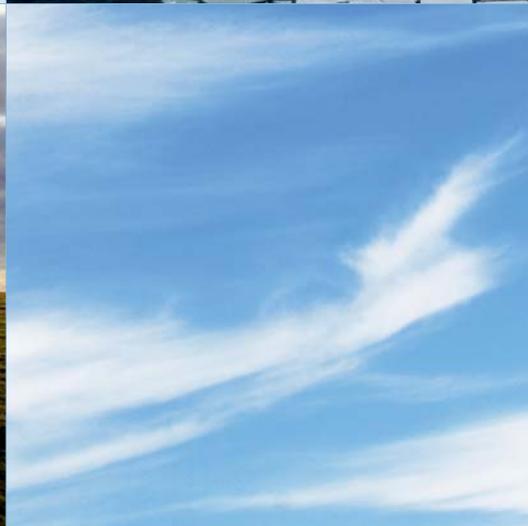
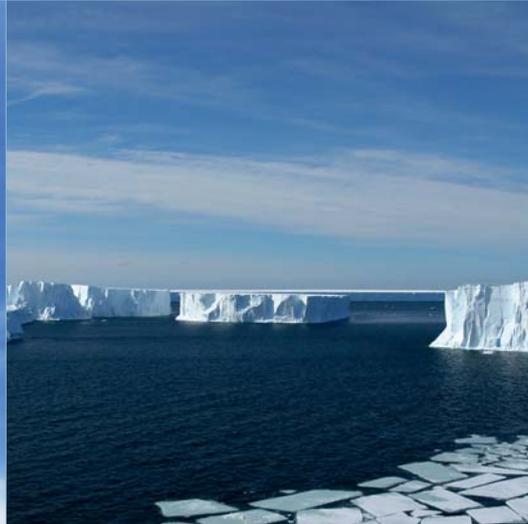


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Energy and Climate Change Executive Summary

World Energy Council 2007

Promoting the sustainable supply and use
of energy for the greatest benefit of all



Energy and Climate Change

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Energy and Climate Change

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World Energy Council
Regency House 1-4 Warwick Street
London W1B 5LT United Kingdom

The world needs urgently to develop a coherent and practical approach to reducing greenhouse gas (ghg) emissions. Energy professionals from across the world have been examining climate change policies to see what works in promoting sustainable development.

The Intergovernmental Panel on Climate Change has recently confirmed that the evidence for global warming is unequivocal and the Stern Report has argued that early action to combat climate change makes economic sense. However, existing efforts are clearly insufficient – most countries with targets under the Kyoto Protocol are not on track to meeting them and many countries do not have Kyoto targets. As a result, **ghg emissions are still rising** and are forecast to go on doing so for decades to come.

The problem is not a lack of policies to deal with climate change – some thousands of policies have been introduced, both by countries within the Kyoto system and those outside, and the effort is under way to develop a successor to the Kyoto Protocol. Yet so far those policies are not proving adequate to the scale of the problem. There is a pressing need to understand why they are failing and to implement measures that are more effective in reducing emissions, particularly from the energy sector, which accounts for around two thirds of total ghg emissions.

The World Energy Council (WEC) has therefore undertaken a Study of **Energy and Climate Change**, drawing on the collective experience and resources of energy professionals worldwide. It has looked in detail at the impact of existing climate change measures and how effective they have been in promoting sustainable development, using the criteria of the three “A’s” – accessibility (to affordable energy); acceptability (of the energy sources used, particularly in environmental terms); and availability (how secure and reliable are those sources?).

It is important to remember that sustainable development is not only about the environment – policies which fail to contribute to economic and social development will themselves prove unsustainable.

What drives greenhouse emissions?

If policies are to be effective, they have to be aimed at **the right targets** – those parts of the energy sector which are significant in terms of their emissions and offer cost-effective reduction opportunities.

Sustainability will not be achieved if lower emissions are achieved only at the cost of social development, especially for the 2 billion people who still lack access to modern energy and all the services it provides.

The analysis in the Study shows how different the emissions trends have been in different regions of the world and how different are the underlying drivers. It is clear that each country will have to develop its own response to climate change – there is **no “silver bullet”** that will solve all the problems for every country.

Of course, there are some overall patterns – greenhouse gas emissions tend to rise as the population grows and gets wealthier. If this were the whole story, reducing emissions would indeed be incompatible with sustainable development – the only way of getting emissions down would be to slow population or economic growth.

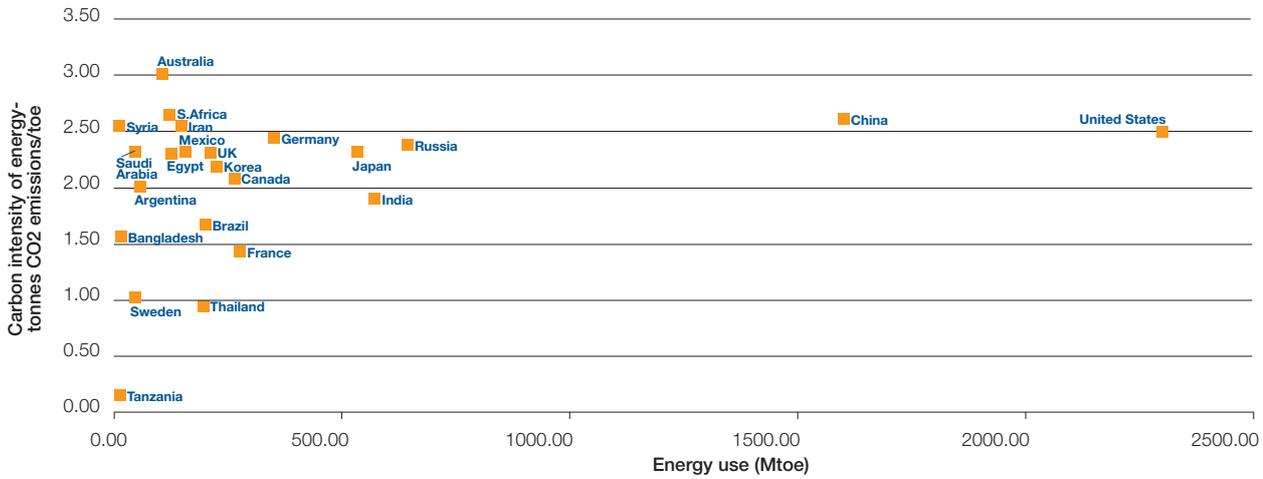
But fortunately, it is not the whole picture. The emissions intensity of economies varies significantly. While big, populous economies like the US and China naturally have the highest level of emissions, there are many examples of economies at similar levels of development but with very different levels of

emissions intensity. France and Sweden, for instance have relatively low levels of emissions compared with broadly similar countries like Germany and Australia; similarly, Brazil's emissions are lower than South Africa's.

The analysis shows that these differences are not due primarily to energy intensity (how much energy is used for each unit of output) or even overall energy demand. The main factor is the **carbon intensity** of energy (the amount of carbon dioxide produced per unit of energy used). Countries with substantial hydro or nuclear resources like Brazil and France have low carbon intensities; countries which use a lot of coal, like China and Australia, show high intensities. See figure one.

Obviously, carbon intensity depends on a country's resource base, and the availability of lower carbon fuels. There are **two key sectors**: transport and electricity, in both of which emissions are growing fast. In fact, though often neglected, electricity generation is roughly twice as important as transport. It is also the most flexible energy sector – both fossil and non-fossil sources can be used to good effect, whereas transport is dominated by oil. Examination of the cases when significant reduction of emissions have been achieved shows that – except where the cause is war or economic collapse – the reductions have been due to changes in the structure of the electricity sector.

Figure 1 Carbon intensity and energy use for representative countries



Analysis of the data gives important pointers as to where efforts should be focused

- ▶ **There is no automatic link between economic growth and energy use, or between energy use and emissions.** This means that emissions in principle might be eventually decoupled from economic growth, or at least the carbon intensity of energy use greatly reduced. To achieve the WEC goal of accessibility to energy services for all people in all regions and a minimum level (such as 1000 kW of electricity for everyone) will take significantly more energy than the world now uses, but this projected increase does not have to result in unabated growth of carbon emissions.
- ▶ The most significant impact on emissions can be made by **reducing carbon intensity** rather than energy intensity.
- ▶ In the short to medium term, the sector which gives most scope for reduced carbon intensity and emissions is **electricity**, because of the availability of low or zero carbon technologies.
- ▶ The **transport sector** is also critical in the longer term, but policy intervention may be more difficult – major technological or behavioural changes may be needed to show significant reductions.

Existing policies and their effectiveness

Some thousands of policies have been introduced, not just in order to meet Kyoto targets, in both developed and developing countries. The choice of policy is sometimes different as between the two groups of countries. Both groups favour energy efficiency and renewables, but economic instruments are more common in developed countries; direct interventions in the developing world.

One major theme is that all policies have their advantages and drawbacks in terms of sustainable development – failure to recognise these complexities has led in many cases to policies which are proving unsustainable and therefore ineffective.

Regrettably, despite (or because of) the complications, **few governments have attempted to assess the effectiveness of their policies** in a comprehensive way against all the criteria of sustainable development; indeed, in many cases there is little attempt even to assess their effectiveness in reducing emissions. In the circumstances, it is not surprising that, despite the huge number of policies introduced, the results are so disappointing.

The WEC Study undertakes such an assessment, drawing on a range of sources and on the wide experience of WEC members across the world. The results are too rich and complex to explore in detail in this summary, but it is hoped that they will help future policy-makers as they develop their climate change strategies.

Figure 2 An example of a summary assessment

Energy and Carbon taxes	Assessment	Remarks
Acceptability	***	Strong theoretical advantages, but many problems in practice, particularly for developing countries.
Availability	***	Impact varies a lot according to circumstances and there are often both positive and negative effects.
Accessibility	*	Taxes usually have adverse impacts on accessibility unless carefully designed and accompanied by offsetting measures.

Each policy measure is assessed against the three WEC criteria outlined above, based on actual experience with the measure concerned across the world, and the results summarised in simple tabular form, as in the example above. Some measures, despite their theoretical advantages, raise great practical difficulties and wider social or environmental problems. See figure 2.

The comprehensive nature of the assessments gives the basis for governments to take an evidence-based approach to policy-making, as well as guidance on how to design policies in such a way as to promote all aspects of sustainable development together.

Policy messages for governments

- ▶ Fuel taxation is important but not a panacea, given the problems of competitiveness and accessibility, and the difficulty of establishing the long term credibility needed to promote investment. Taxes are a particularly difficult option for developing countries, so cannot form the heart of a global approach. Even in developing countries, taxation is easier in theory than in practice. Energy taxes have actually declined over the past decade and bear most heavily on motor fuel, where they have a greater impact on government revenues than consumer behaviour – in practice, the contribution to combating climate change has been limited.
- ▶ End-use energy efficiency is undoubtedly worth pursuing, as it helps meet all three A's. However, it is not clear how much impact existing programmes are having – existing programmes are not effectively monitored – and there is no case of significant emissions reduction through this route. It would be unrealistic to expect energy efficiency to provide the substantial and rapid emissions reduction needed, at least until governments can ensure that their programmes are properly targeted and assessed.

- ▶ Renewables certainly help but there are still enormous practical problems of cost, availability etc, which can prove particularly difficult for developing countries. Renewables can make a useful (and growing) contribution to emissions reduction but in practice, apart from those countries with substantial hydro (or geothermal) resources, it is unlikely that they will deliver a significant overall decarbonisation of electricity quickly enough to meet the climate challenge. The environmental and other impacts of some renewables, like biomass, are complex and need to be assessed carefully.
 - ▶ Emissions trading, while a very strong approach in theory, is fraught with practical complications and at present there is insufficient experience of trading schemes in practice to demonstrate how effective a route they are to significant reductions. A comprehensive, workable, long term global scheme of proven effectiveness would be needed before trading can deliver on the scale required and we are a long way from that.
 - ▶ Subsidies for fossil fuels should be closely scrutinized. Often subsidy removal will be an effective first step in combating climate change in a sustainable manner. Nonetheless, subsidies are introduced for a reason, and simply advocating their removal does not of itself resolve the underlying problem. For many developing countries, this is still a difficult issue.
- ▶ Regulations and standards are also important and will form part of any policy package but they need to be designed and monitored more carefully than in the past to be really effective.
 - ▶ Voluntary agreements, information and awareness and other non-interventionist approaches are important in promoting flexibility and acceptance, and can work very well in some countries. However, they are not sufficient on their own to make a major difference at a global level.

One key area is identified by the analysis as under-exploited – **technology**. The scope for emissions reduction using both existing technologies and those currently under development is immense. Existing mechanisms for transferring those technologies from the developed to the developing world are inadequate. As a result, there is huge but underdeveloped potential for technology to deliver emissions reductions, provided more attention is focused on the development and deployment of appropriate technologies – the developed world will need to take a lead in this area.

The Study concludes that so far, the response from governments and others has not been up to the challenge; policies have been too narrowly focused and short term, failing to provide the right signals for cleaner and more sustainable investment.

Conclusions

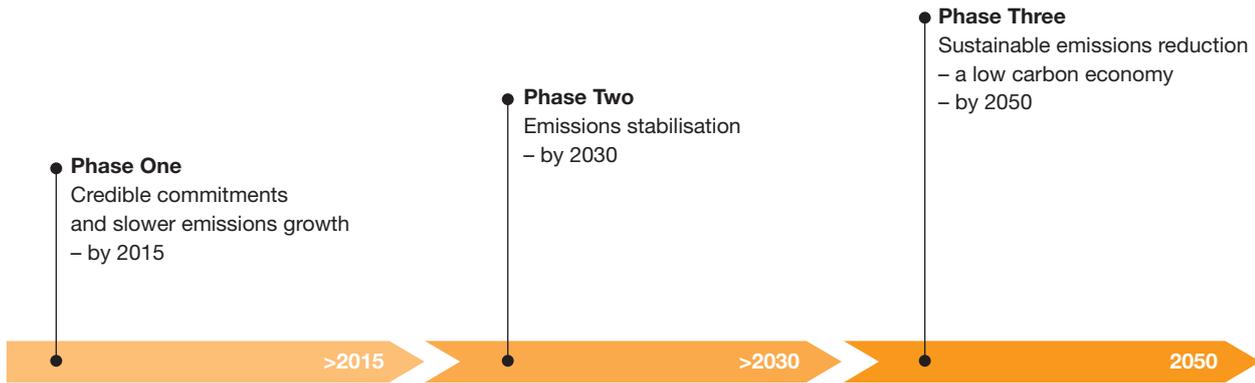
Governments have often ignored the human and social needs which energy fulfils, reducing their credibility and viability, and have failed to respond to the complexity of energy systems, so that the measures have often not had their intended effect.

In developing a successor regime to Kyoto, policy makers will have to learn from these lessons and assess the effectiveness of the measures they introduce much more effectively than in the past. They will need to draw up a global regime which encourages a coherent, comprehensive and sustainable approach, focused on long term, steady reductions in the carbon intensity of the energy system, while ensuring that those systems can still perform the vital task of powering human development worldwide.

Among other things, they will need to bear in mind that:

- ▶ **No single energy source** can meet the needs of the world and its emissions goals at the same time. Thus it is important to **keep all energy options open**.
- ▶ Similarly, there is **no single policy or measure** which can provide the whole solution, or even the main part of the solution. All the measures available have their advantages and drawbacks, as detailed in the WEC analysis.

- ▶ Furthermore, no single approach, or even a common short list of measures, can work everywhere. Countries and regions are different, in geography, in resources, in climate, and in the maturity of their systems. Each country will therefore need to introduce a **range of measures** appropriate to its own circumstances.
- ▶ **Effective, consistent and predictable government policies** will be needed to set a stable framework for long term investment in cleaner technologies. Much more careful monitoring and assessment is needed than has taken place in the past.
- ▶ **International cooperation will be essential** to meet the challenge and in some areas developed countries will need to take the lead.
- ▶ Although there is no “one size fits all” policy route to lower emissions, there are some key **priority areas** which an international strategy on climate change will need to address:
 - decarbonising electricity;
 - containing the growth in transport emissions and developing carbon-free alternatives; and
 - a major new effort at technology development and deployment.



Road Map to a Low Carbon Future

Decades will be required, even with the most effective application of policy and technologies, to achieve significant sustainable reductions in CO₂ emissions from the world’s energy economy, in large part because of the time and cost involved in replacing existing and building new infrastructure. Just to keep pace with the world’s growing energy demands will require \$800 billion per year of investment over the next 25 years, according to the IEA. To make this investment climate friendly is an even greater challenge, but it is possible to scope out a road map enabling the world to meet this challenge, in three stages.

Phase One: Credible commitments and slower emissions growth – by 2015

This phase will effectively begin when there is a universal and credibly sustainable global commitment to curbing ghg emissions, particularly CO₂. In the decade following this commitment, progress will rely significantly on greater efficiency and lower carbon intensity in energy production and use, particularly in the electricity sector. Measures might include long term carbon tax credits with a specific focus on promoting investment; specific schemes of support for low carbon power generation alternatives; and stronger renewable energy portfolio standards facilitated by intelligent electricity delivery technology, along with the broad commercial introduction of advanced clean coal technology, particularly in rapidly industrializing nations such as China and India.

In the transport sector, the aim should be to restraining the growth in emissions by a combination of measures – technical approaches via vehicle

efficiency, hybrid vehicles, and biofuels, along with non-technical measures aimed at changing behaviour to lower carbon transport modes, via taxation, regulation or other means. The result of such approaches would be a demonstrable slowing in the rate of CO₂ emissions growth. Equally important is achieving and maintaining a significantly greater global investment in technology development and deployment. This lays the essential basis for realising subsequent sustainable carbon reductions.

Phase Two: Emissions stabilisation – by 2030

In this phase, CO₂ emissions can be stabilized and the process of absolute carbon emission reduction initiated, by a decoupling of economic growth and ghg emissions, building on the foundations of Phase One and reinforcing the measures introduced at this stage. It will in time be possible to take advantage of new energy related infrastructure and major technology advances, in areas such as advanced nuclear power plants, some utilizing breeder technology, and carbon capture and storage enabling zero carbon emission fossil-fired power plants.

Other important emission reduction technologies will include advanced solar thermal, building-integrated photovoltaics, and micro combined heat and power plants. All of these may be further stimulated by breakthroughs in energy storage technology. In addition, advanced building technologies will produce major energy savings, even including converting buildings from energy consumers to net producers. Hybrid vehicles plus other advanced clean transportation options, including the widely expanded production and use of biofuels that do not

WEC members firmly believe that the energy sector can make a positive contribution to achieving a sustainable future.

interfere with the food cycle, will also significantly contribute to lower carbon emissions while reducing petroleum consumption.

Phase Three: Sustainable emissions reduction – a low carbon economy by 2050

Over the succeeding decades CO₂ emissions will steadily decline below current levels without compromising the universal availability of energy. The combination of ever-cleaner energy resources plus an increasingly robust portfolio of advanced power generation and transportation technologies will facilitate further carbon reductions while enabling sustainable economic growth worldwide. As time goes on, zero carbon technologies, coupled with advanced energy storage, will continue the decline in emissions, leading to a truly post-carbon world. The potential for nuclear fusion and a universal electro-hydrogen energy economy may also be established. All of this continued progress is, however, predicated on sustained major global commitment to technological development with prompt transfer and deployment into the world's energy infrastructure.

This timeline may seem lengthy but it only underscores the urgency needed if global CO₂ emissions are to be returned to or below current levels by 2050. These efforts to curb emissions will not be easy and some will be costly in the short term, even while producing longer term benefits. The sooner society acts against climate change by a real commitment and effective measures to stabilise and reduce CO₂ emissions, the better. WEC members are ready to take their part in this process. They firmly believe that the energy sector can make a positive contribution to achieving a sustainable future.

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World Energy Council

Regency House 1-4 Warwick Street

London W1B 5LT United Kingdom

T (+44) 20 7734 5996

F (+44) 20 7734 5926

E info@worldenergy.org

www.worldenergy.org

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