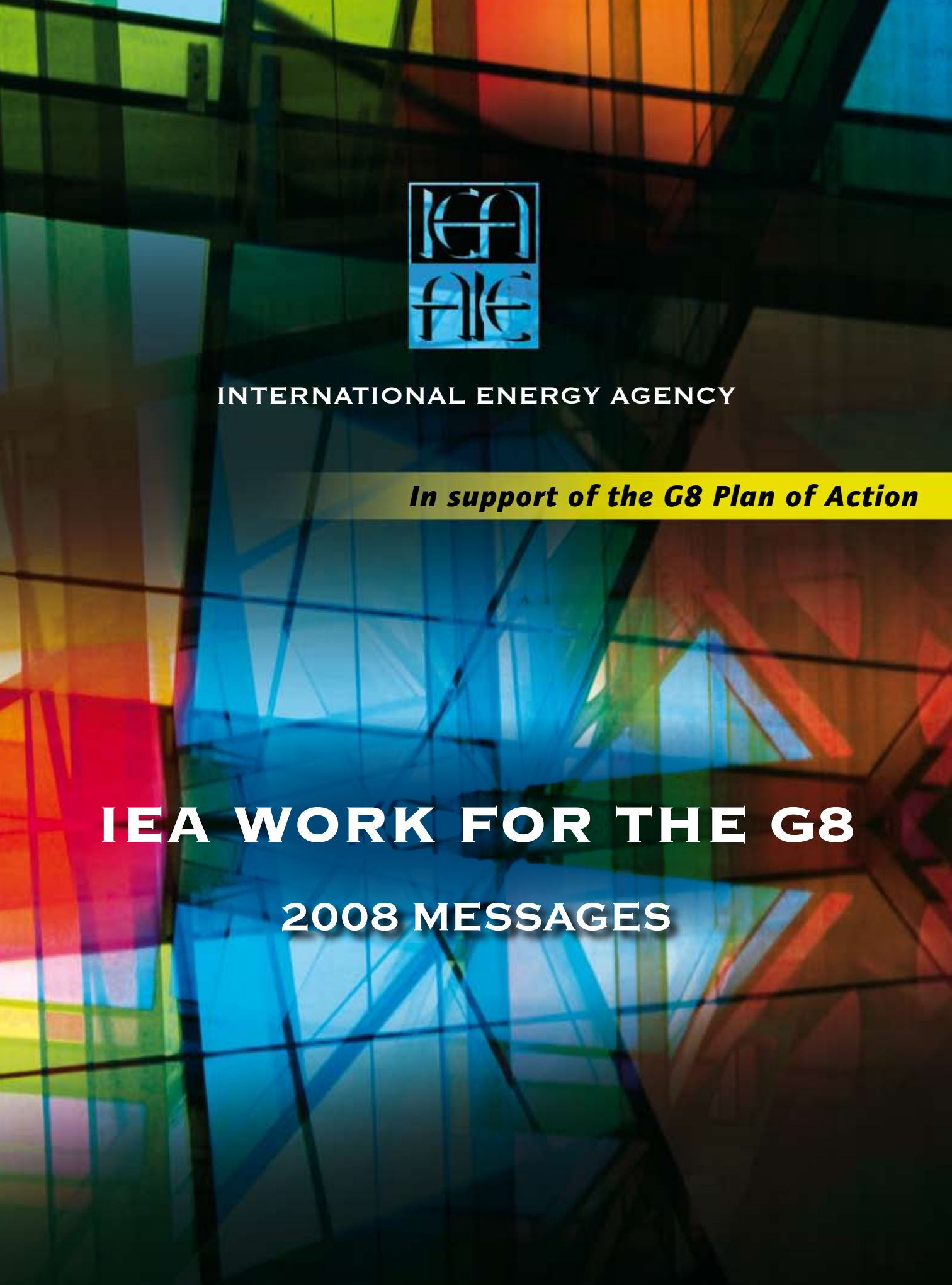


INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

IEA WORK FOR THE G8

2008 MESSAGES

REPORT TO THE G8 SUMMIT

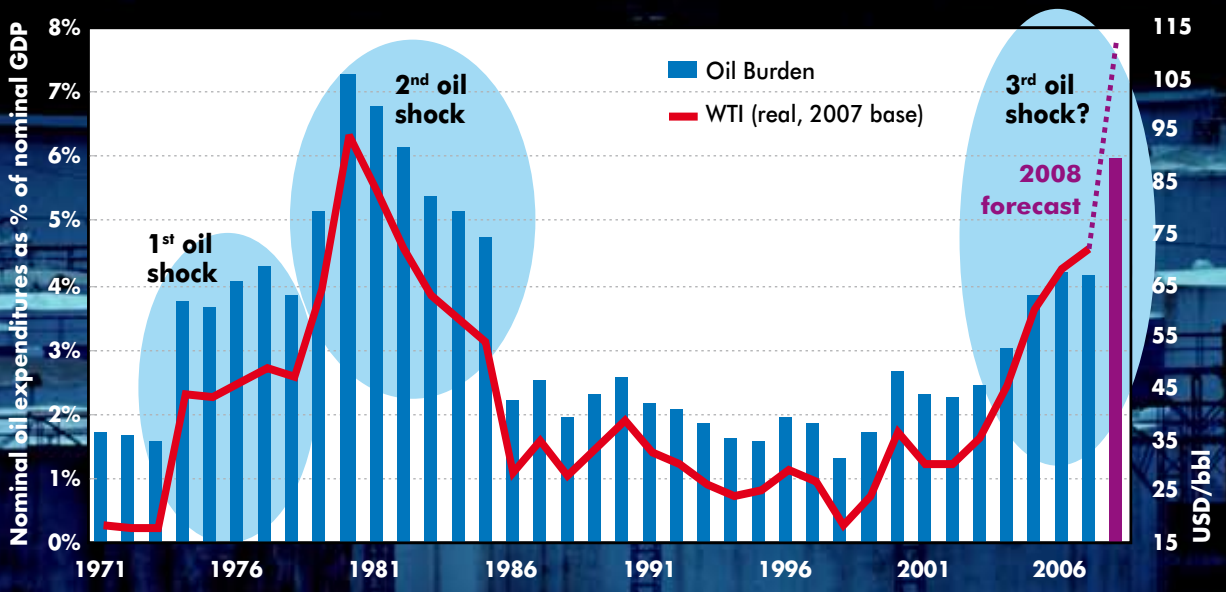
Hokkaido, Japan

The International Energy Agency, supporting the Gleneagles Plan of Action

Concerted global action is urgently needed to address today's daunting energy challenges. Without such action, security of energy supply and economic resilience will deteriorate, and the threat of climate change will become a devastating reality. The world's energy challenges stem naturally from welcome economic growth. But they are leading the world along an increasingly unsustainable energy path.

Current high energy prices exacerbate the situation. Expenditures on oil as a share of GDP are taking a bigger portion than during the first oil shock (1973-75) and are approaching the levels of the second shock (1979-81).

Figure 1 ▶ World: Oil Burden and Prices



In 2005, G8 leaders invited the International Energy Agency (IEA) to contribute to the Gleneagles G8 Plan of Action on Climate Change, Clean Energy and Sustainable Development. They asked the IEA to advise on alternative scenarios and strategies for a "clean, clever, competitive energy future". During the past three years, the Agency has undertaken a range of work assessing the available options and identifying steps to implement them. For the 2008 Summit in Hokkaido, this summary document reviews the major findings of those three years of work and provides further guidance for policy makers.

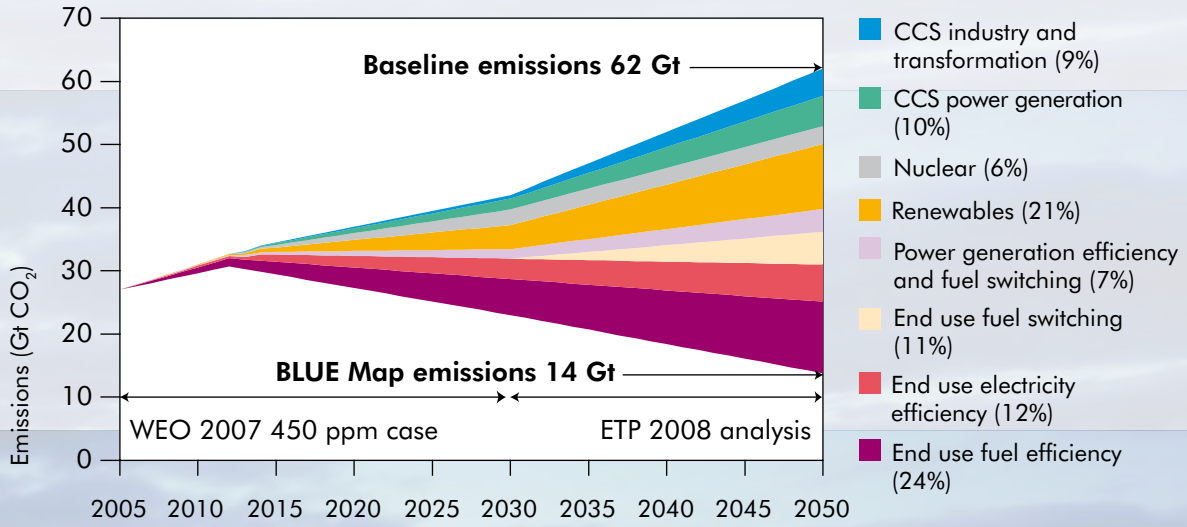
Addressing the Basic Global Challenges

Radically new approaches are needed to the ways energy is produced, transformed, processed and consumed. The majority of growth in energy demand and CO_2 emissions over the coming decades will be outside the OECD. Fossil fuels will continue to provide a large portion of the energy mix. Unless low-carbon options are adopted, the huge capacity additions planned in developing countries such as China and India over coming decades will lock in technologies with high CO_2 emissions for the future.

We know that today's soaring CO_2 emissions reflect the much needed fast economic growth that is lifting populations in developing countries out of poverty and enhancing well-being in all the world's societies. But it is **urgent for industrialised countries to seize today's opportunities to develop a more sustainable energy path that can enable developing countries to leapfrog the polluting phase of economic growth.** All major economies need to be part of a global energy-sector transformation. Figure 2 shows where the crucial CO_2 emissions reductions can be achieved.

Figure 2 ▶ Reducing Global CO_2 Emissions by 50% by 2050

Contribution of Technology Wedges

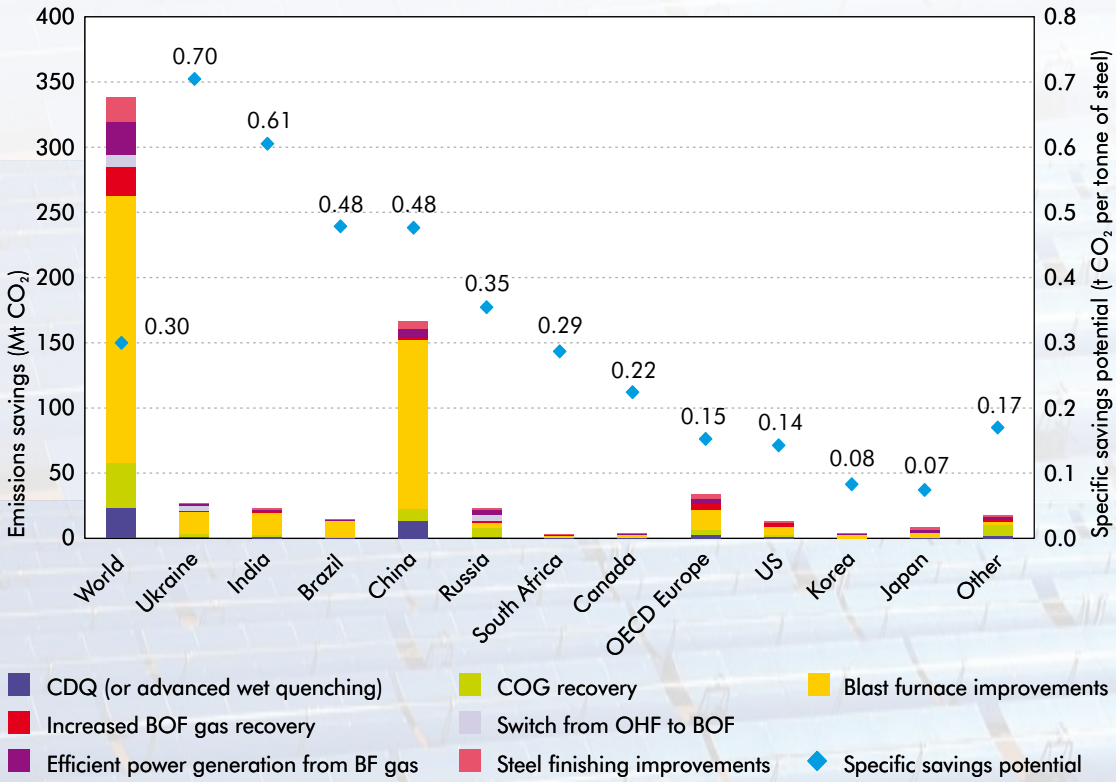


To achieve a 50% cut – as in the ETP BLUE scenario – would also mean revolutionising the transport sector.

Sources: IEA *Energy Technology Perspectives* 2008; IEA *World Energy Outlook* 2007.

Energy efficiency improvements are a top priority throughout the economy and they can be applied right now. In industry alone, application of proven technologies and best practice on a global scale could save 18% to 26% of current industrial energy use. Figure 3 shows how much countries can learn from each other: specific savings potential differs by a factor of ten!

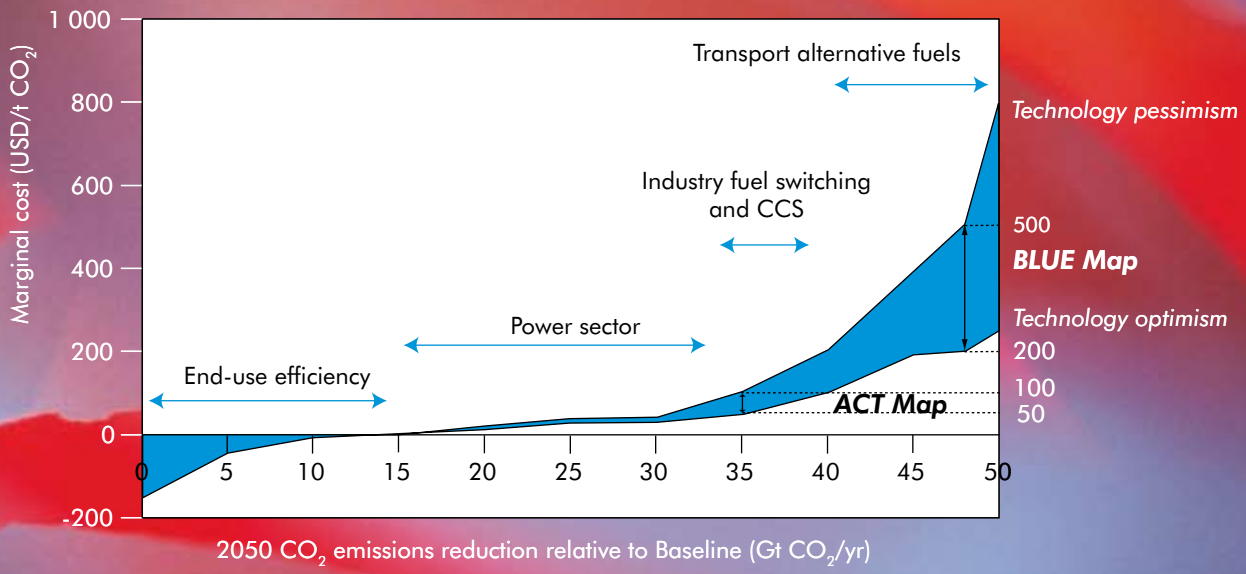
Figure 3 ▶ Energy Indicators - Tracking Trends and Identifying Potentials
The Example of Iron and Steel



Fossil-fuel power generation, renewables, nuclear energy and especially CO_2 capture and storage (CCS) for power stations also have essential roles to play in reducing the carbon intensity of energy and in decoupling energy use from CO_2 emissions. **These technologies could bring emissions back to current levels in 2050. But to achieve a 50% reduction we will also need higher-cost technologies, some of them still under development, such as CCS for industry and alternative transport fuels.**

Figure 4 shows the marginal costs of the technologies needed to return CO_2 emissions to 2005 levels (ACT Map) or to half 2005 levels (BLUE Map) by 2050. Technology breakthroughs and innovative technologies are central to achieving both energy savings and the very deep emission cuts that are needed in the medium and longer term. Predictable, long-term incentives for carbon reduction are necessary and possible. All G8 countries have implemented first steps or even gone beyond, but now a range of further concerted actions is needed.

Figure 4 ▶ What it Costs to Reduce Energy-Related CO_2 Emissions
(Marginal Cost)



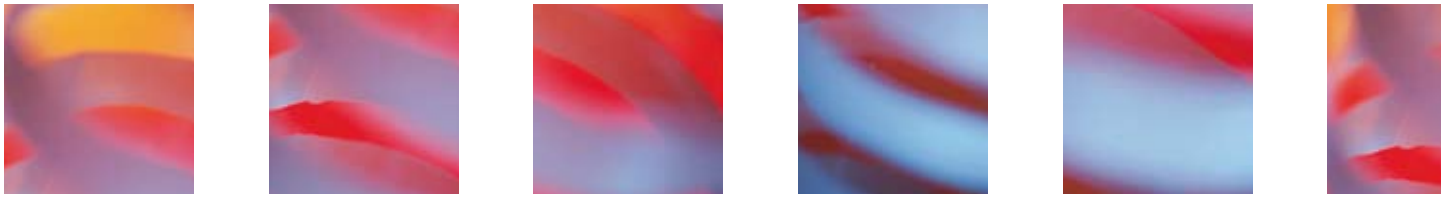
IEA Scenarios

Findings of the Intergovernmental Panel on Climate Change (IPCC) highlight the need to halve energy CO_2 emissions by 2050 if global temperature increases are to be kept below 2-3°C over the coming decades, a target that G8 leaders agreed to "seriously consider" at the 2007 Summit at Heiligendamm. Such a scenario could be consistent with a long-term stabilisation at 450 ppm CO_2. **Stabilising CO_2 emissions in the atmosphere calls for nothing less than a revolution to transform the ways in which energy is produced and used.**

Based on the assumption that economic growth averages 3.3% to 2050, and that current policies remain in place and do not change, IEA reference scenario analysis, published in the *World Energy Outlook* (WEO) and in *Energy Technology Perspectives* (ETP), shows that **global energy-related CO_2 emissions could more than double from 27 gigatonnes (Gt) today to 62 Gt by 2050**.

The WEO (2007) and ETP (2008) provide scenarios that can rapidly curb CO_2 emissions growth. The ETP ACT Map scenario shows how **emissions could be brought back to roughly current levels, using technologies that are already known, at a cost of no more than USD 50 per tonne of CO_2 saved.** With current (2008) energy prices, the costs are considerably lower. Radical action is crucial to increase energy efficiency, to gradually eliminate virtually all CO_2 emissions from power generation, to reduce emissions from industry and to advance non-fossil options for transport. This scenario calls for active international cooperation, but also brings tremendous benefit for energy security. It could be called a win-win strategy.

To achieve a 50% reduction of CO_2 emissions by 2050 requires a number of technologies that are still under development; the most expensive technologies needed would cost between USD 200 and USD 500 per tonne of CO_2 saved. In the ETP BLUE Map scenario, which models the requirements for this 50% reduction, the *additional* total investment required over the period to 2050 is around USD 1.1 trillion per year, which is roughly equivalent to the current GDP of Canada. It represents an average of some 1.1% of global GDP each year from now until 2050. Cumulatively, investments amount to USD 45 trillion above baseline, including commercial investment stimulated by low-carbon incentives. But these investment needs would be balanced by lower expenditure on fossil fuels. As fossil fuel demand growth slows, there will be significant fuel cost savings for importing countries. The net outcome depends on the discount rate for future fuel savings and technology learning benefits, and on fuel prices (market price or production cost). In the most optimistic case (3% discount rate and market fuel prices), savings exceed investment costs.



In Short

An energy revolution is needed. It will not be easy but the first steps are clear. Actions must address the need for energy supplies that are *clean, secure* and adequately fuel *economic growth.* Many of the policies needed contribute to achieving all three. A policy combination that does not provide a balance will not be sustainable. High energy prices provide an unforeseen opportunity to set a new course. We have identified most of the technologies. We recognise the challenges. What we lack is time because the challenges become more daunting the longer we delay. What we now need is implementation!

We summarise below some of the key policy messages that the IEA work for the G8 has generated. The fuller document *Towards a Sustainable Energy Future - IEA Programme of Work on Climate Change, Clean Energy and Sustainable Development* will be made accessible at ***www.iea.org***.

Enabled by the G8 mandate, the IEA has:

- Developed **new scenarios for deep energy greenhouse gas emission cuts** and mapped the policy needs to achieve these ambitious targets.
- Mapped the **technology development and financing needs for halving energy CO_2 emissions in 2050**, compared with 2000. The IEA has developed **roadmaps for 17 key technologies** that need to be developed further and implemented in order to achieve deep emission reductions.
- Developed a **global database with in-depth information on several thousand power units** and assembled data on efficiencies of coal-fired power plants all around the world.
- Developed **energy efficiency indicators** for all end-use sectors and applied them to OECD countries and major emerging economies, thus permitting comparison of efficiencies across countries that can inform the post-Kyoto negotiation process and facilitate assessment of improvement potential.
- Recommended **25 areas for urgent energy efficiency policy action**. As part of this process, the IEA assessed policy needs to accelerate energy efficiency improvements. Our analysis suggests a wide disparity of policy measures and ambition levels today, and widely varying degrees of policy effectiveness. We have pinpointed a number of areas with large energy efficiency improvement potential where policies are lacking or pending.
- Recommended that **CO_2 capture and storage (CCS) play a key role**, and that at least 20 fully integrated industrial-scale demonstration power plants with CCS be committed by 2020.
- Concluded that **high shares of intermittent renewables in the electricity supply are feasible**, provided that the quality and interconnection of the grids and supply structure are improved.
- Started a **dialogue with Brazil, China, India, Russia and South Africa** in order to bring them into the IEA technology co-operation framework and to convince them that sustainable energy policies are in their own interest. We are making especially good progress with South Africa and with China. The Chinese government has expressed interest in participating more closely in the IEA energy technology network.
- Intensified our **dialogue with the private sector** to compare views and establish collaborative approaches to tackling today's energy challenges.

Energy Efficiency Is the Essential First Step

Any path to sustainability begins with improving energy efficiency throughout the global economy. Energy efficiency gains in OECD countries in the past 15 years were only half the average rate in the 1970s and 1980s. **Accelerating energy efficiency has the greatest potential for CO_2 savings at low or negative cost, and with immediate results.** And this is possible and has been done before. If energy efficiency had not improved since 1973, energy use in IEA countries would have been 58% higher in 2005 than it actually was. The equivalent of 59 EJ of energy was saved.

Fortunately, large potential remains for further energy and CO_2 savings across all sectors. **In industry alone**, associated CO_2 emissions savings would be 1.9 to 3.2 Gt CO_2 per year. The iron and steel, cement and chemical and petrochemical sectors offer the largest savings potential.

In the power sector, fossil-fuel consumption for public electricity generation could be reduced by between 23% and 32% if all countries produced electricity at current best practice levels. The largest savings of both energy and CO_2 emissions would come from improving the efficiency of coal-fired plants. Almost half of global savings would be in OECD countries.

What action should governments take to release the energy-saving potential? The IEA has proposed a set of concrete policy recommendations for promoting energy efficiency that could reduce global CO_2 emissions by 8.2 gigatonnes – or 20% – per year by 2030. (This is equal to roughly double OECD Europe's total 2005 CO_2 emissions.) Table 1 provides a summary of these recommendations.

By 2030, **buildings-related measures** recommended by the IEA could alone deliver global savings of 1.4 Gt CO_2/yr (more than Japan's annual CO_2 emissions in 2005). IEA recommendations in **equipment and lighting** would save another 2.2 Gt per year. Even in **transport**, the per-kilometre energy use of light-duty vehicles (cars, SUVs and small vans) can be cut by 50% against 2005 levels by mobilising all available fuel-efficient technologies, including engine/drivetrain improvements, aerodynamics, weight reduction, low rolling resistance tyres and other energy-efficient components.

To promote better energy efficiency policy making and evaluation, the IEA has developed in-depth energy indicators to analyse interaction between economic and human activity, energy use and CO_2 emissions. **These energy indicators are essential statistical tools for measuring national and international performance and for analysing trends and potentials.** Governments should establish and maintain a comprehensive framework to monitor energy-consumption trends at end-use level and support urgent work to address gaps in the available statistical data.

What progress has already been made? Energy efficiency policy activity has increased significantly around the world. But more needs to be done. Our analysis has found that:

- No country appears to have fully implemented the IEA energy efficiency policy recommendations.
- The level of implementation varies – both across countries and across recommendations.
- There are many energy efficiency policies being discussed or proposed; there is an urgent need to implement them.
- Countries need to place greater emphasis on compliance and evaluation systems in order to ensure that energy efficiency policies deliver maximum benefit.

Table 1 ▶ Summary of Consolidated Energy Efficiency Recommendations Prepared by the IEA for the G8 under the Gleneagles Plan of Action

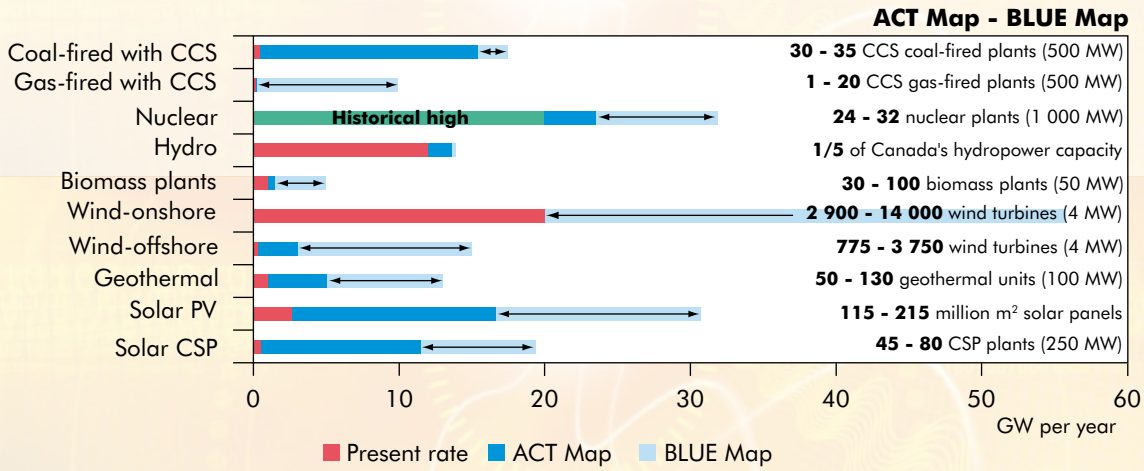
1	**The IEA recommends action on energy efficiency *across sectors*. In particular, the IEA calls for action on:**
1.1	Measures for increasing investment in energy efficiency;
1.2	National energy efficiency strategies and goals;
1.3	Compliance, monitoring, enforcement and evaluation of energy efficiency measures;
1.4	Energy efficiency indicators;
1.5	Monitoring and reporting progress with the IEA energy efficiency recommendations themselves.
2	***Buildings* account for about 40% of energy used in most countries. To save a significant portion of this energy, the IEA recommends action on:**
2.1	Building codes for new buildings;
2.2	Passive Energy Houses and Zero Energy Buildings;
2.3	Policy packages to promote energy efficiency in existing buildings;
2.4	Building certification schemes;
2.5	Energy efficiency improvements in windows.
3	***Appliances and equipment* represent one of the fastest growing energy loads in most countries. The IEA recommends action on:**
3.1	Mandatory energy performance requirements or labels;
3.2	Low-power modes, including standby power, for electronic and networked equipment;
3.3	Televisions and "set-top" boxes;
3.4	Energy performance test standards and measurement protocols.
4	**Saving energy by adopting efficient *lighting* technology is very cost-effective. The IEA recommends action on:**
4.1	Best practice lighting and the phase-out of incandescent bulbs;
4.2	Ensuring least-cost lighting in non-residential buildings and the phase-out of inefficient fuel-based lighting.
5	**About 60% of world oil is consumed in the *transport* sector. To achieve significant savings in this sector, the IEA recommends action on:**
5.1	Fuel-efficient tyres;
5.2	Mandatory fuel efficiency standards for light-duty vehicles;
5.3	Fuel economy of heavy-duty vehicles;
5.4	Eco-driving.
6	**In order to improve energy efficiency in *industry*, action is needed on:**
6.1	Collection of high-quality energy efficiency data for industry;
6.2	Energy performance of electric motors;
6.3	Assistance in developing energy management capability;
6.4	Policy packages to promote energy efficiency in small- and medium-sized enterprises.
7	***Energy utilities* can play an important role in promoting energy efficiency. Action is needed to promote:**
7.1	Utility end-use energy efficiency schemes.

Power Generation Must Be Cleaner

After energy efficiency, the power sector offers the greatest potential for reductions in CO_2 emissions. **Much greater efforts are needed to develop and deploy already available clean power technologies**. Globally, no option can be excluded, from carbon capture and storage (CCS) to cost-effective renewables and nuclear power. Technically, power station emissions can be brought close to zero by combining CCS, nuclear power and renewables. But new policies are needed.

Figure 5 shows the annual average additional electricity generating capacity, for each power source, that will be needed between now and 2050 to achieve a 50% reduction in CO_2 emissions. Many regulatory and public-perception issues need to be addressed if investors are to feel sufficiently confident to adopt more climate-friendly technologies. The full ETP 2008 report provides a number of plausible scenarios, but in practice **countries will need to determine their own balance of low-carbon generating options.**

Figure 5 ▶ Average Annual Power Generation Capacity Additions in the ACT Map and BLUE Map Scenario, 2010 - 2050



Source: IEA *Energy Technology Perspectives 2008*

Where available, coal is a relatively low-cost fuel, especially in dynamic developing economies. Coal-fired power plants currently account for one-quarter of global CO_2 emissions. Our global analysis shows that **CO_2 emissions can be reduced by up to 1.7 Gt per year by retiring the least efficient coal power stations, upgrading middle-ranking plants, ensuring that all new plants are state-of-the-art, and improving plant operation and coal preparation standards.** This is equivalent to more than 22% of CO_2 emissions from current coal-based power and heat production, or over 5.5% of total CO_2 emissions from all sources at present.

But CO_2 capture and storage (CCS) will be essential in securing large reductions in coal power station emissions. Governments must act now to commit, by 2010, to at least 20 fully integrated industrial-scale demonstration projects for the broad deployment of CCS by 2020. Fast decisions are needed. Developers of new fossil-fuel power stations should consider what might be required for retrofit with CCS.

Priorities for Advancing Deployment of CO_2 Capture and Storage

- Demonstrating CO_2 capture and storage and bridging the financial gap
- Taking concerted international action
- Creating a value for CO_2 for commercialisation of CCS
- Establishing legal and regulatory frameworks
- Communicating with the public
- Infrastructure
- Considering requirements for retrofit with CO_2 capture

Renewables have a key role to play in power generation, as they do in space heating and cooling. To improve the effectiveness of national renewables policies, a stable, clearly predictable policy environment should be created, including policies tailored to specific technologies and taking account of their level of maturity. Incentives should decrease over time to promote market competitiveness. It is essential to ease planning and grid-access restrictions, as well as other non-economic barriers.

IEA analysis confirms that **high penetrations of variable renewables such as wind, solar or tidal power are feasible**, provided that they have access to modern, sophisticated electricity grids with strong inter-regional connections. In the ETP Blue Scenario, for example, 46% of electricity comes from renewables in 2050. But the flexibility of the system will also depend on the design and operation of networks, on the supply portfolio as a whole, and on the functioning of electricity markets. Modern, flexible grids also offer supply security benefits.

Nuclear energy must constitute an important portion of the global energy mix because of its low CO_2 emissions and contributions to energy security. Continued support for development of more advanced reactors and secure long-term storage of spent fuel, as well as efforts to build public confidence, will determine how widely it is accepted.

Transport Solutions Are the Most Difficult

De-carbonising transport is more challenging and costly than de-carbonising power generation. In the medium term, cost-effective efficiency improvements of up to 50% are possible. But such savings imply curbing the trend towards heavier vehicles; it means educating drivers and improving on-board appliances. We recommend mandatory tightened fuel-efficiency standards for all vehicles.

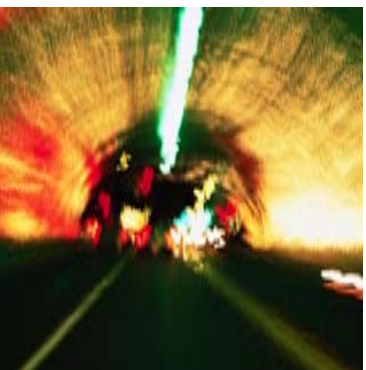
In the medium term, hybrid vehicles and greater efficiency will be crucial. Longer term, **new technology will be needed to de-carbonise transportation fuels**. Advanced bio-fuels, hydrogen fuel cells and electric vehicles are all possible options. Today, it is unclear which technologies will prevail. They all require much more R&D in order to be ready for mass deployment. But one or more of these technologies must displace petroleum products by mid-century if the transport sector is to reduce its current emissions by 26%, as required in scenarios where a 50% reduction in total global CO_2 emissions is achieved by 2050. This underlines the urgent need for public/private partnerships to accelerate R&D advances.

Promoting Innovative Energy Technologies and R&D Networks

Massive global reductions in CO_2 emissions cannot be achieved without technological innovation and significant reductions in costs of existing technologies. **Much more international collaboration will be decisive. All major economies, especially China and India, must be on board.** Government-funded RD&D must play a greater role, linking its efforts with industry. In power generation, buildings and appliances, transport and industry, further R&D and demonstration will be essential to achieve ambitious targets for CO_2 reduction and move towards more secure energy supplies.

In the IEA baseline scenarios, **OECD countries account for less than one-third of global CO_2 emissions in 2050. For a sustainable energy future, all economies must contribute to the effort.** The IEA energy technology collaboration network provides a global framework in which experts work together. Most major developing countries already participate. Through the IEA Networks of Expertise in Energy Technology (NEET) outreach initiative, launched in response to the Gleneagles Plan of Action, the IEA, Brazil, China, India, Mexico and South Africa are already collaborating more intensely on key technologies.

The IEA has also launched initiatives to increase technology co-operation with the private sector. The IEA and the World Business Council for Sustainable Development are working together with chief technology officers of more than 30 leading international energy companies.



Charting the Next Steps in International Collaboration

Governments need to strengthen collaboration at the international level. The IEA supports and encourages current efforts to enhance international co-operation between all major energy-consuming countries on assessing and reinforcing national policies for enhanced energy efficiency. Stronger co-ordination, notably through the IEA NEET initiative, is also needed to advance innovative energy technologies on a broader international scale. In *Energy Technology Perspectives 2008*, the IEA proposes global "roadmaps" for the development and deployment of 17 key energy technologies. These roadmaps need to be developed further, bringing together government technology programmes and private sectors in all major economies to maximise efficiency in developing and deploying key technologies and fostering the much needed transitions to a sustainable future.

Substantial resources will be needed for the demonstration and deployment of low-carbon energy technologies in developing as well as developed countries. This is a pressing issue for international discussion. Agreement on the development of a strong international database is an early priority. It is essential for the development of energy indicators, for monitoring outcomes and trends, and for supporting policy making in the future.

The IEA Secretariat, under the guidance of its Governing Board, stands ready to support these international initiatives, working with industry, through the IEA international energy technology network and other collaborative efforts.

Greater detail on the three-year IEA work programme, its results and detailed recommendations can be found in *Towards a Sustainable Energy Future – IEA Programme of Work on Climate Change, Clean Energy and Sustainable Development*. This report will be made accessible at ***www.iea.org***

World Energy Outlook (WEO) web pages: ***www.worldenergyoutlook.org***

IEA *Energy Technology Perspectives* (ETP) web pages: ***www.iea.org/Textbase/techno/etp/index.asp***

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme. It carries out a comprehensive programme of energy co-operation among twenty-seven of the OECD thirty member countries. The basic aims of the IEA are:

- To maintain and improve systems for coping with oil supply disruptions.
- To promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations.
- To operate a permanent information system on the international oil market.
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use.
- To promote international collaboration on energy technology.
- To assist in the integration of environmental and energy policies.

The IEA member countries are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States. Poland is expected to become a member in 2008. The European Commission also participates in the work of the IEA.

WWW.IEA.ORG