World's Energy System at Crossroads

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Overview

The world's energy system is at a crossroads. Current trends in energy supply and consumption are patently unsustainable – environmentally, economically, socially. But that can – and must – be altered; there's still time to change the road we're on. It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. What is needed is nothing short of an energy revolution. This article – based on the *World Energy Outlook 2008,* which IEA Executive Director Nobuo Tanaka *(photo)* and IEA Chief Economist (and author of this article) Fatih Birol presented in Tokyo on November 14, 2008 – outlines how that might be achieved through decisive policy action. It also describes the consequences of failure. Copies of the *World Energy Outlook 2008* can be ordered at http://www.worldenergyoutlook.org.

More of the same: a vision of a laisser-faire fossil-energy future

The *World Energy Outlook 2008's* Reference Scenario embodies the effects of those government policies and measures that were enacted up to mid-2008, but not new ones, as a means of providing a baseline against which we can quantify the extent to which we need to change course. In such a scenario, world primary energy demand is seen growing by 1.6% per year on average to 2030, from 11,730 million tons of oil equivalent (Mtoe) to just over 17,010 Mtoe – an increase of 45% *(see Chart 1)*. This is slightly lower than envisaged in the previous year's edition of the outlook, mainly due to higher energy prices and slower economic growth, especially in OECD countries.

In terms of the regional breakdown of demand, in the Reference Scenario, China and India account for just over half the increase in world primary energy demand between 2006 and 2030. Middle East countries strengthen their position as an important demand center, contributing a further 11% to incremental world demand. Collectively, non-OECD countries account for 87% of the increase. As a result, their share of world primary energy demand rises from 51% to 62%. Their energy consumption overtook that of the OECD in 2005.

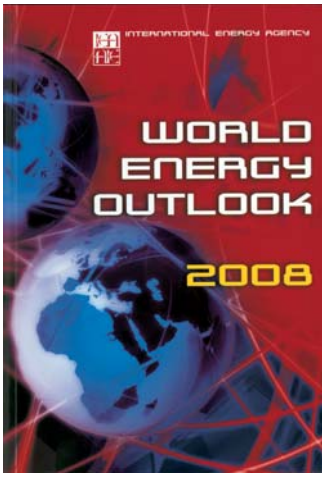
Most of the increase in oil production over the projection period is expected to come from a small number of countries where remaining resources are concentrated. These include several OPEC countries, mainly in the Middle East, and a handful of non-OPEC countries, notably Canada (with vast oil-sand reserves), the Caspian countries and Brazil. The majority of oil-producing countries will see their output drop. The OPEC share in total production in the Reference Scenario rises from 44% today to 51% in 2030, on the assumption that the requisite investment is forthcoming, which over the past decade has not always been the case. The biggest increases in natural gas production are projected to occur in the Middle East and Africa, where large, low-cost reserves are found. Gas production triples in the Middle East and more than doubles in Africa.

These Reference Scenario projections call for cumulative investment in energy-supply infrastructure of more than $26 trillion to 2030, over $4 trillion more than the previous year's edition of the report, as unit capital costs, especially in the oil and gas industry, have continued to surge in the last year. The current financial crisis is not expected to affect long-term investment, but could lead to delays in bringing current projects to completion.

Implications for energy security

The trend in the Reference Scenario of consuming countries growing increasingly reliant on oil and gas imports from a small number of producing countries threatens to exacerbate short-term energy-security risks *(Chart 2)*. Increasing import dependence in any country does not necessarily mean less secure energy supplies, any more than self-sufficiency guarantees uninterrupted supply. Indeed, increased trade could bring mutual economic benefits to all concerned. Yet it could carry a risk of heightened short-term energy insecurity for all consuming countries, as geographic supply diversity is reduced and reliance grows on vulnerable supply routes. Much of the additional oil imports will come from the Middle East, the scene of most past supplying disruptions, and will transit vulnerable maritime routes to both eastern and western markets. The potential impact on

Photos: International Energy Agency (IEA)

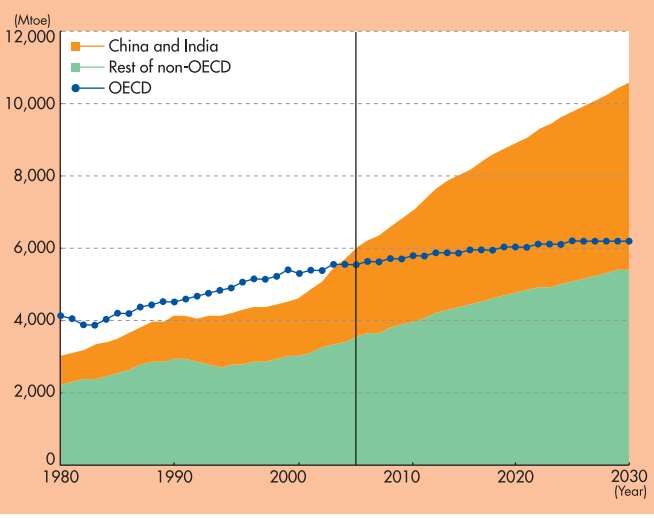


IEA's World Energy Outlook 2008, released on Nov.12 in London.

IEA Executive Director Nobuo Tanaka

CHART 1

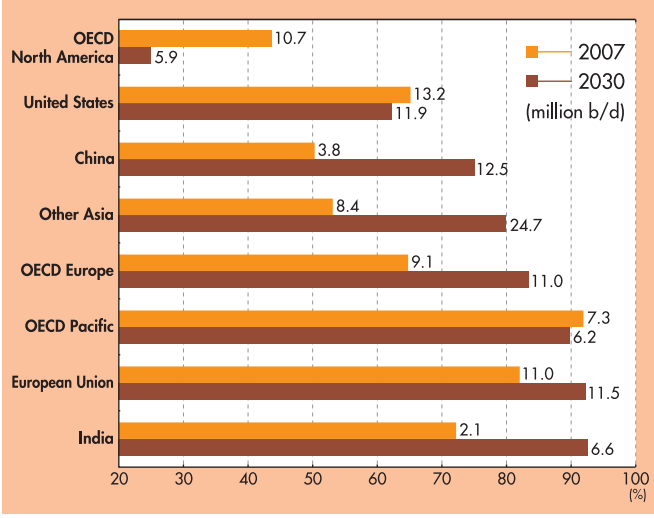
World primary energy demand in Reference Scenario



Note: Mtoe = million tons of oil equivalent
Source : World Energy Outlook 2008

CHART 2

Oil-import dependence in Reference Scenario



Source : World Energy Outlook 2008

international oil prices of a supply interruption is also likely to increase: oil demand is becoming less sensitive to changes in price as the share of transport demand – which is price-inelastic, relative to other energy services – in overall oil consumption rises worldwide.

Longer-term risks to energy security are also set to grow. With stronger global energy demand, all regions would be faced with higher energy prices in the medium to long term in the absence of concomitant increases in supply-side investment or stronger policy action to curb demand growth in all countries. The increasing concentration of the world's remaining oil reserves in a small group of countries will increase their market dominance and may put at risk the required rate of investment in production capacity. The greater the increase in the call on oil and gas from these regions, the more likely it will be that they will seek to extract a higher rent from their exports and to impose higher prices in the longer term by deferring investment and constraining production. Higher prices would be especially burdensome for developing countries still seeking to protect their consumers through subsidies.

Implications for the climate

In addition to increasing concerns over energy security, unfettered growth in global energy demand will have serious consequences for the climate. The projected rise in emissions of greenhouse gases in the Reference Scenario puts us on a course of doubling the concentration of those gases in the atmosphere by the end of this century, entailing an eventual global average temperature increase of up to 6°C. The Reference Scenario trends point to continuing growth in emissions of CO_2 and other greenhouse gases. Global energy-related CO_2 emissions rise from 28 gigatons (GT) in 2006 to 41 GT in 2030 – an increase of 45%.

Three-quarters of the projected increase in energy-related CO_2 emissions in the Reference Scenario arises in China, India and the Middle East, and 97% in non-OECD countries as a whole. On average, however, non-OECD per-capita emissions remain far lower than those in the OECD. Emissions in the OECD reach a peak after 2020 and then decline. Only in Europe and Japan are emissions in 2030 lower than today.

The role of the energy sector in forging a new path

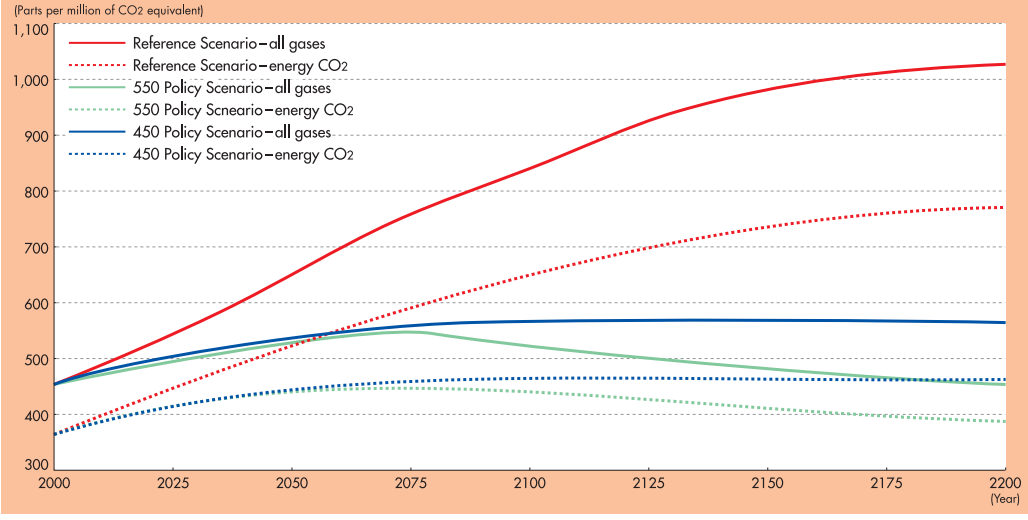
Based on these Reference Scenario projections, it is plain that we have two options. We can accept as broadly inevitable the outcome portrayed and prepare ourselves to adapt to that uncertain, even alarming, future. This path would lead to possible energy-related conflict and social disruption. Or we can plan and implement a new course, drawing on a united determination on the part of governments and action by committed citizens across the globe.

A necessary first step if we are to change course is to take strong, coordinated action to curb the growth in greenhouse gas emissions and the resulting rise in global temperatures. The post-2012 global climate-change policy regime that is expected to be established at the Copenhagen conference in late 2009 will provide the international framework for that action. With energy-related CO_2 accounting for 61% of global greenhouse gas emissions, the energy sector will have to play a pivotal role. The target that is set for the long-term stabilization of greenhouse gas concentration will determine the pace of the required transformation of the global energy system, as well as how stringent the policy responses will need to be. The energy sector has a relatively slow rate of capital replacement in general, due to the long lifetime of much of its capital – for producing, supplying and using energy. As a result, more efficient technologies normally take many years to spread through the energy sector. It will be necessary to face up to the reality of the cost of early capital retirement if radical measures are to be taken to speed up this process so as to deliver deep cuts in emissions.

To demonstrate the extent of this challenge, the *World Energy Outlook 2008* considers two climate-policy scenarios corresponding to long-term stabilization of greenhouse gas concentration at 550 and 450 parts per million of CO_2 equivalent. The 550 Policy Scenario

CHART 3

Greenhouse gas concentration trajectories by scenario



Source : World Energy Outlook 2008

equates to an increase in global temperature of approximately 3°C and the 450 Policy Scenario to a rise of around 2°C. Of course, there is a wide range of international policy mechanisms that could be adopted to meet an agreed climate objective. However, as current political debate shows, and given practical issues in the energy sector, the reality is that nations adopt the approach or approaches that best reflect their varied interests and capabilities. The 550 and 450 scenarios are therefore based on a hybrid policy framework involving one particular combination of cap-and-trade systems, sectoral agreements and national policies and measures.

In the 550 Policy Scenario, world primary energy demand expands by about 32% between 2006 and 2030 with the share of fossil fuels falling markedly. Demand grows on average by 1.2% per year, compared with 1.6% in the Reference Scenario. Global energy-related CO_2 emissions peak in 2025 and then decline slightly to 33 GT in 2030 *(Chart 3)*. The energy mix in this scenario is markedly different from that of the Reference Scenario, with fossil fuels losing market share to renewable energy and nuclear power. In comparison with the 550 Policy Scenario, the scale of the challenge in the 450 Policy Scenario is immense. The 2030 emission level for the world as a whole is less than the level of projected emissions for non-OECD countries alone in the Reference Scenario. In other words, the OECD countries alone cannot put the world onto the path to 450-ppm trajectory, even if they were to reduce their emissions to zero. The technology shift that would be required, if achievable, would certainly be unprecedented in scale and speed of deployment.

The policy response

As outlined above, the world's energy system is on an unsustainable pathway from an economic, environmental and energy security perspective. But things can and must change. Fortunately we already know many of the policies and technologies that can deliver very substantial savings in both energy consumption and CO_2 emissions. For these to be achieved, decisions have to be taken now and implementation has to begin now.

The profound shifts in energy demand and supply that will be required call for a transformation of the way investment decisions are taken. They entail significant changes in the pattern of investment across the supply and demand chains, as well as huge additional spending on new capital stock, especially in power plants and in more energy-efficient equipment and appliances. The sheer scale of the transformation that is required is enormous and would place a substantial burden on both the private and public sectors. Countries must shift away from traditional, carbon-intensive technologies and embrace new ones. It is for governments to galvanize the transformation. Clear price signals, including carbon pricing and, in many non-OECD countries, the removal of subsidised fuel prices, are an important first step. Current high energy prices, if sustained, will facilitate the transition. However, prices alone are not enough. Delivering a low-carbon future requires major breakthroughs in technology development and deployment. Governments have the means to put in place incentives to innovate, encourage promising research activities and break down international barriers. Much of the additional spending will have to be made by households: a huge step change in the attitudes to energy efficiency and consumer purchases by hundreds of millions of people worldwide is therefore needed. Governments, through information provision, sound regulation and targeted fiscal incentives, have a key role to play in ensuring that, worldwide, the right decisions are taken to safeguard the future of the energy sector – and of the planet. **JS**

Dr. Fatih Birol is the chief economist and the director of the office responsible for the economic analysis of energy policy at the Paris-based International Energy Agency. He oversees the World Energy Outlook series which is the IEA's flagship publication. Prior to joining the IEA in 1995, Dr. Birol worked for six years at OPEC in Vienna. He is responsible for the recently founded IEA Energy Business Council which draws together leaders from the world's foremost energy corporations to provide a business perspective on a broad range of energy market challenges.