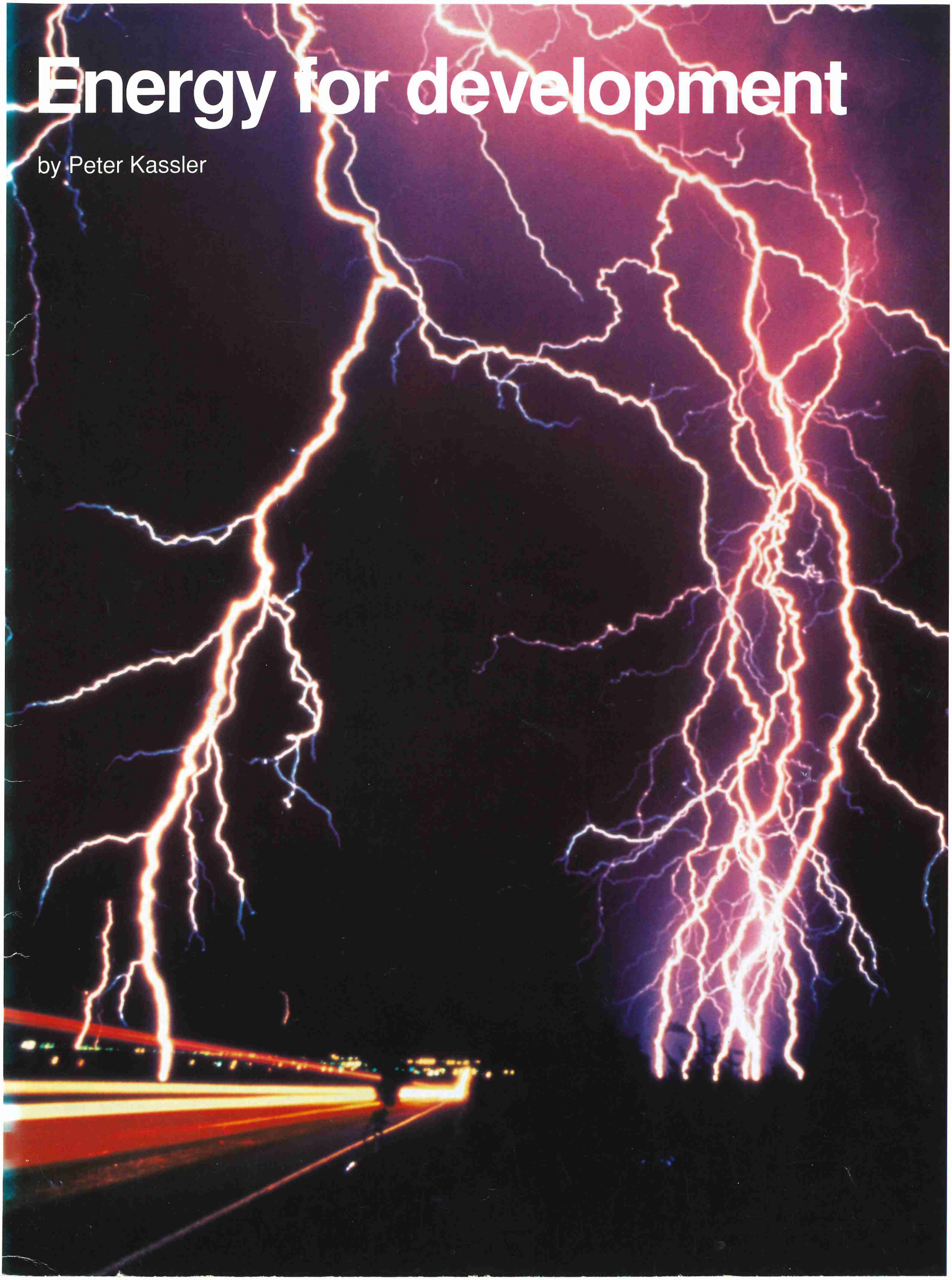
Shell Selected Paper

Energy for development

by Peter Kassler



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ENERGY FOR DEVELOPMENT

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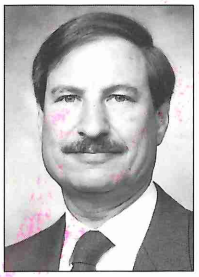


Peter Kassler

Peter Kassler has been Group Planning coordinator in the Royal Dutch/Shell Group of Companies since June 1992 and a director of Shell International Petroleum Company Ltd since September 1987. He joined Shell in 1960 as a trainee geologist in The Hague and following assignments as a geologist in France, Oman and the United States, became chief geologist in Ankara working for N.V. Turske Shell. In 1972, Peter Kassler returned to Shell International Petroleum Maatschappij (SIPM) as an exploration and production economist. Two years later, he took up the post as exploration manager in Shell Prospex Portuguesa SARL. He joined Group Planning in 1976, as a strategic analysis assistant in SIPC for two years, then returned to The Hague as deputy head of New Ventures in SIPM, becoming head of Economics and Planning in the same company in 1980. He was general manager of Norske Shell from October 1983 until September 1987 when he was appointed regional coordinator for Middle East, Francophone Africa and South Asia for SIPC.

Introduction

Energy is a basic essential of life which helps sustain a rapidly growing population. It is vital for economic growth. It contributes to raising living standards and to providing the resources needed for a cleaner world. But what of the future?

Through bitter experience, many people and organisations know how risky it is to predict the future. Instead of predictions, the Shell approach to strategic planning is to use scenarios. These scenarios are 'stories' about alternative possible futures and what they would mean for our business. These are not forecasts, but are built with a 'what if' logic that proceeds from assumptions derived from the present, to implications about a certain kind of future.

The energy history of the past century has been punctuated by surprises, discontinuities and sudden changes, none of which could have been predicted by extrapolation. Scenarios help us to better understand these sea-changes, by providing deeper interpretations of today's events, and of the underlying forces which will change the future.

If such an approach is used to develop a scenario of economic and social development, what would this picture of the future reveal? What would be the impact on energy demand and traditional energy sources? Which technologies will surface to meet society's future energy needs?

This paper summarises the Shell scenarios to the year 2020, discusses the energy requirements for each of them and outlines how energy demand might be met.

An era of revolutions

The 1980s were a period of profound, even revolutionary change in many parts of the world (Figure 1). Political liberalisation has resulted in free elections and civilian governments in much of Latin America and parts of East Asia. The end of the cold war and the disintegration of the Soviet Union has created entirely new relationships all over the world, with some of the political and military results still being violently worked through, as for example in the former Yugoslavia.

Equally profound changes have occurred in the world of economics and markets. The Soviet collapse has been widely interpreted as a failure not only of authoritarian political regimes but also of centrally planned economies. Liberalisation of markets, with varying degrees of interpretation, is now being adopted as the received economic wisdom almost everywhere. Privatisation and deregulation have been introduced with different levels of commitment in, for instance, the UK, United States, Japan, Australia and France. Even more far reaching changes have occurred in some developing countries – for example in Latin America – where the introduction of democratic reforms has often been followed by the privatisation of state companies and deregulation of markets. Economic reforms have been initiated in the world's most populous countries; China and India.

Finally, as with the development of rapid international communications and instant media coverage, trade, financial transactions and companies' market operations have become more global, supported by the framework of international trade agreements like GATT (General Agreement on Tariffs and Trade) and NAFTA (North American Free Trade Area), and the enlargement of the European Union.

Figure 1

An era of revolution – economic and political liberalisation

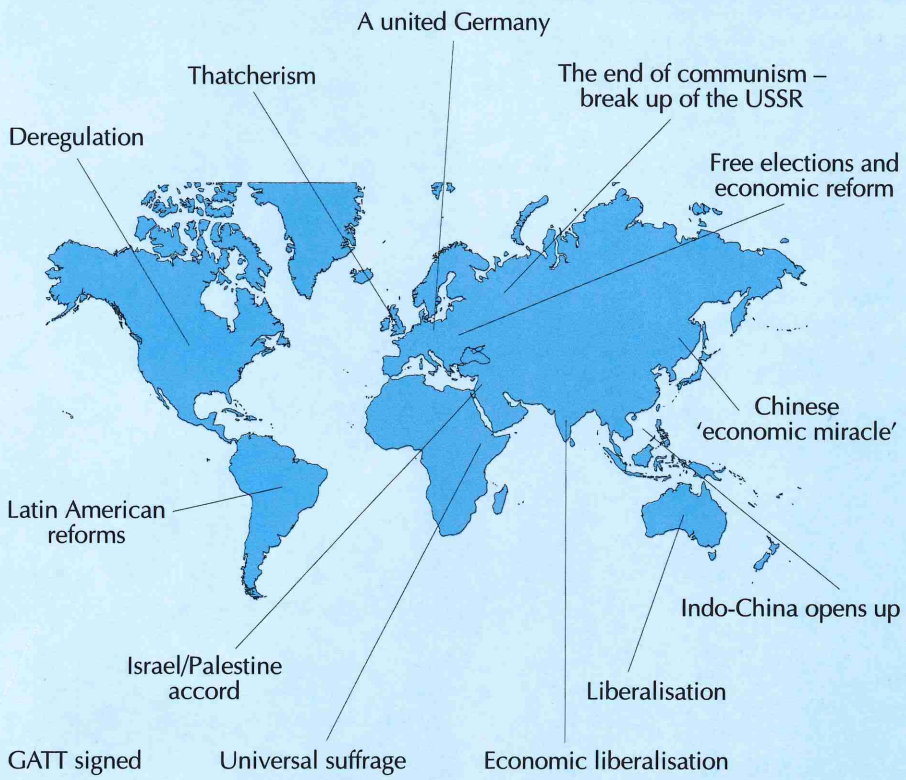
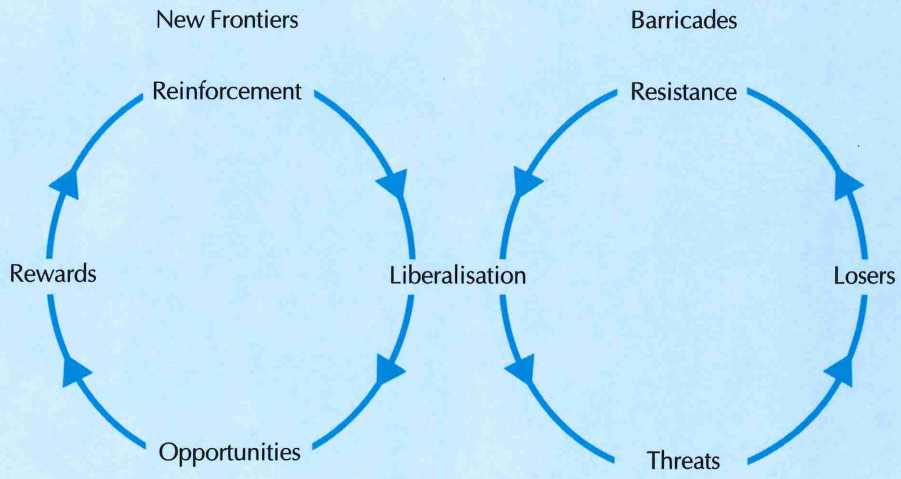


Figure 2

Two responses



Two responses

There are two types of responses to the liberalisation and other reforms described (Figure 2). Some will see liberalisation as providing promising opportunities leading to success and rewards which in turn will reinforce the process. Others will see it as a threat to their position, and fearing to lose will resist it. This leads to two scenarios:

- New Frontiers; and
- Barricades.

New Frontiers

In New Frontiers, liberalisation continues and spreads as many seize the considerable opportunities unlocked. This leads to a virtuous circle of growth but this process is very turbulent. Economic and political reforms are expected to work, in the sense of improving societies' ability to create wealth for their members. Fast economic growth is sustained in the developing countries while new priorities and life-styles are established in mature economies.

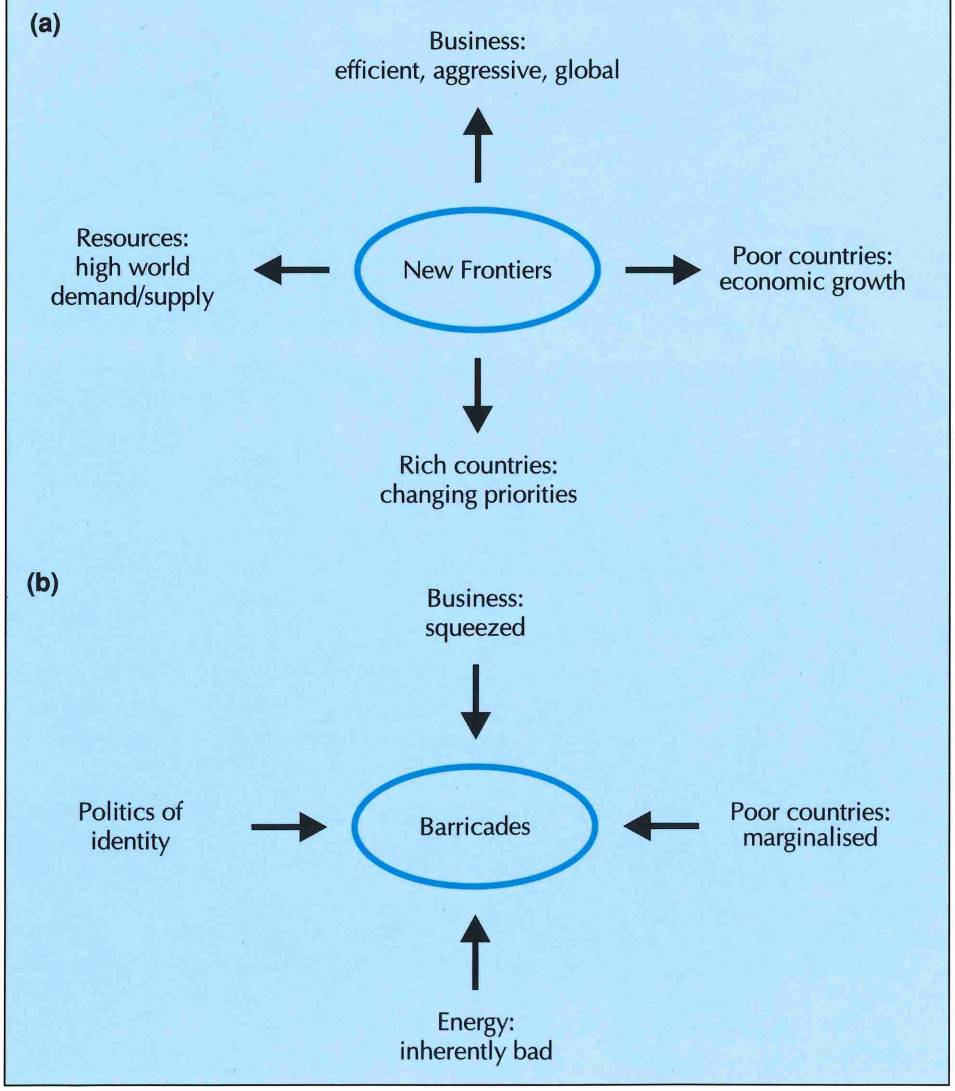
As a result, business is stretched, with an environment of relentless competition and innovation (Figure 3a). High demand and supply of energy is required to fuel this growth. The poor countries gradually claim a larger role on the world's economic and political stage.

Barricades

In Barricades, liberalisation is resisted and restricted because people fear they might lose what they value most – jobs, power, autonomy, religious traditions and cultural identities. This creates a world of regional, economic, cultural and religious division, in which international businesses cannot so easily operate (Figure 3b). There is increasing divergence between rich and poor economies, as many poor countries become marginalised, partly by the lack of foreign investment.

In the developed world, a number of non-governmental organisations, with diverse interests, increasingly cause energy to be regarded as something bad (except for raising taxes) and to be used sparingly, leading to an unfavourable investment climate in this sector. In the Barricades scenario, a new crisis in the Middle-East gives governments the opportunity to implement drastic and irreversible measures, heavily taxing and regulating the use of energy.

Figure 3



Economic growth and energy

The difference in economic growth patterns between these two scenarios leads, by 2020, to two very different pictures of the world when expressed in gross domestic product per capita (GDP/capita, Figure 4).

Under Barricades, economic growth rate in developing countries remains at some three per cent per annum, similar to the 1980s. By 2020, almost 90 per cent of the world population – some 8 billion people by then – have low incomes, and thus no access to basic amenities (water, electricity etc.) while the remaining 10 per cent is split evenly between middle and high income.

By contrast, in New Frontiers, liberalisation leads to growth rates of five

Figure 4

World population: GDP per capita

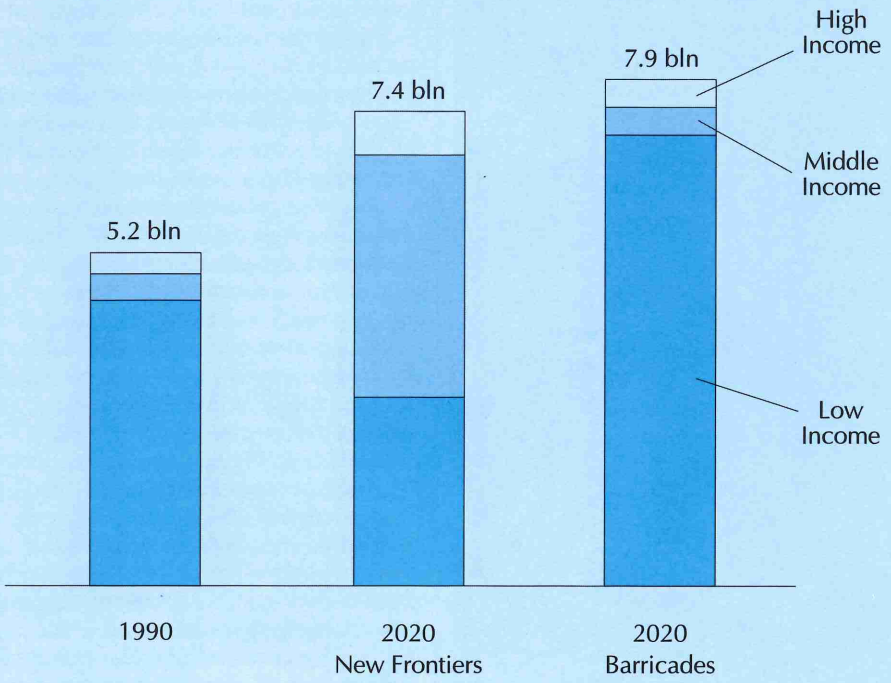
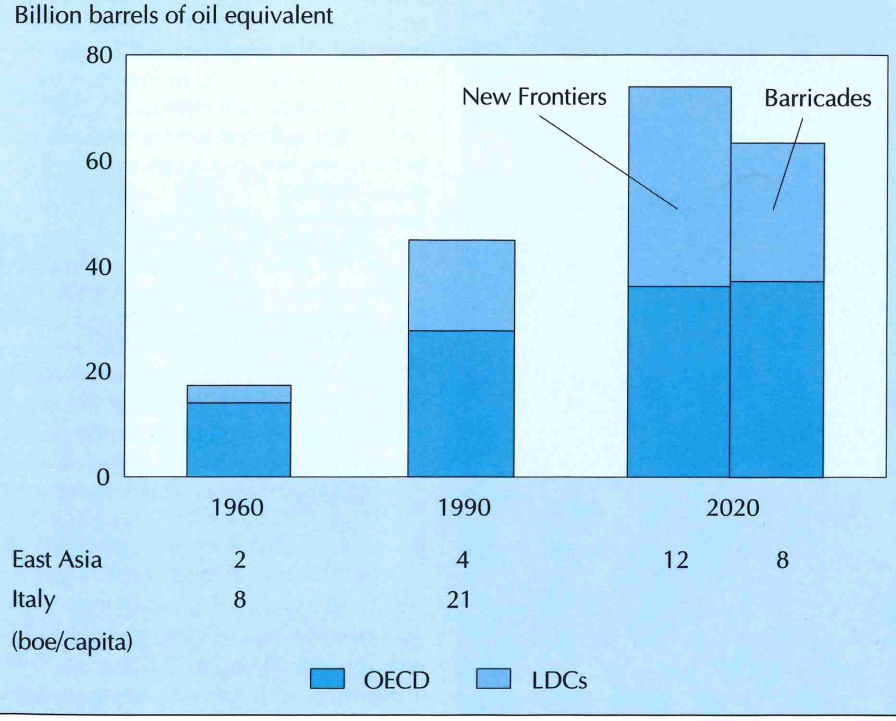


Figure 5

Energy consumption



to six per cent in non-OECD (Organisation for Economic Cooperation and Development) countries, similar to those of the 1960s. By 2020, more than half of the world's population enjoy 'middle' incomes, with low incomes being reduced to some 40 per cent. As a result of this wider economic development and better education, population growth begins to slow down.

For developing countries, the difference in the rate of economic development leads to contrasting energy demand between Barricades and New Frontiers. In Barricades, energy demand in the less developed countries (LDCs) – excluding restructuring economies – grows at an average of three per cent per annum over the next 30 years, somewhat lower than the five per cent estimated over the last 30 years (Figure 5). Improved energy use is assumed to be achieved, both through better technologies and through market-related rather than subsidised energy pricing which, in turn, is accelerated by privatisation of energy and electricity industries.

In New Frontiers, by 2020, developing countries in South East Asia, including China, will have reached similar per capita levels of energy use to that of Italy in 1960. In spite of improvements in energy efficiency which are assumed to occur, the supply challenge to satisfy this demand is considerable.

New Frontiers

Energy supply

Oil and gas will remain the main engine of growth although coal still has a future in New Frontiers. Its share is declining in the OECD countries, but it remains an important cheap indigenous resource in many parts of the developing world (Figure 6). In many countries, public sentiment and market economics continue to be against nuclear and its share declines.

In the OECD countries, gas steadily increases its share of energy supply with an additional capacity of 4.5 million barrels oil equivalent per day (boe/d)

Figure 6

Incremental energy consumption – 1990-2020

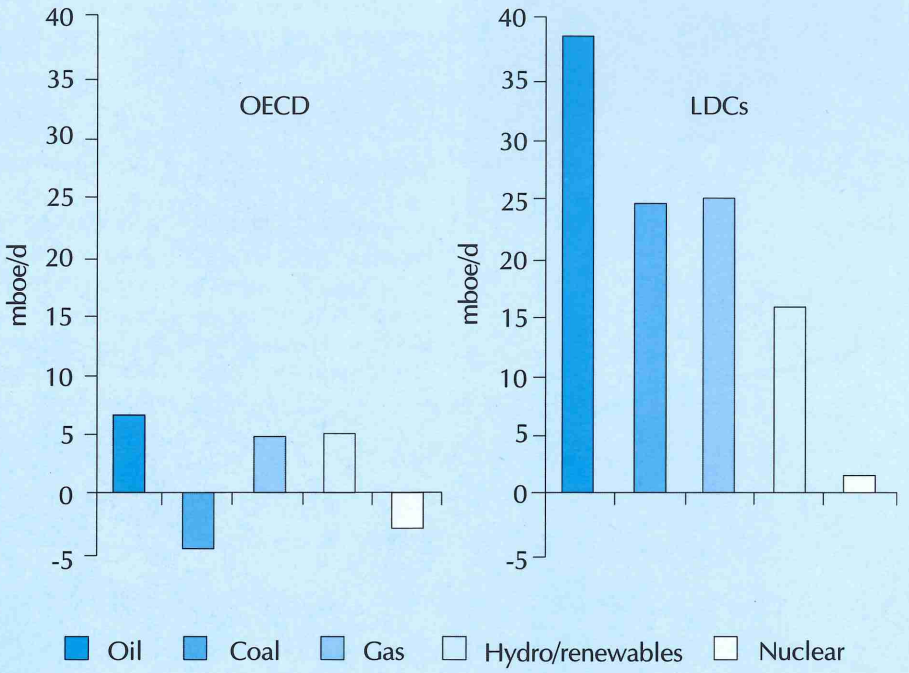
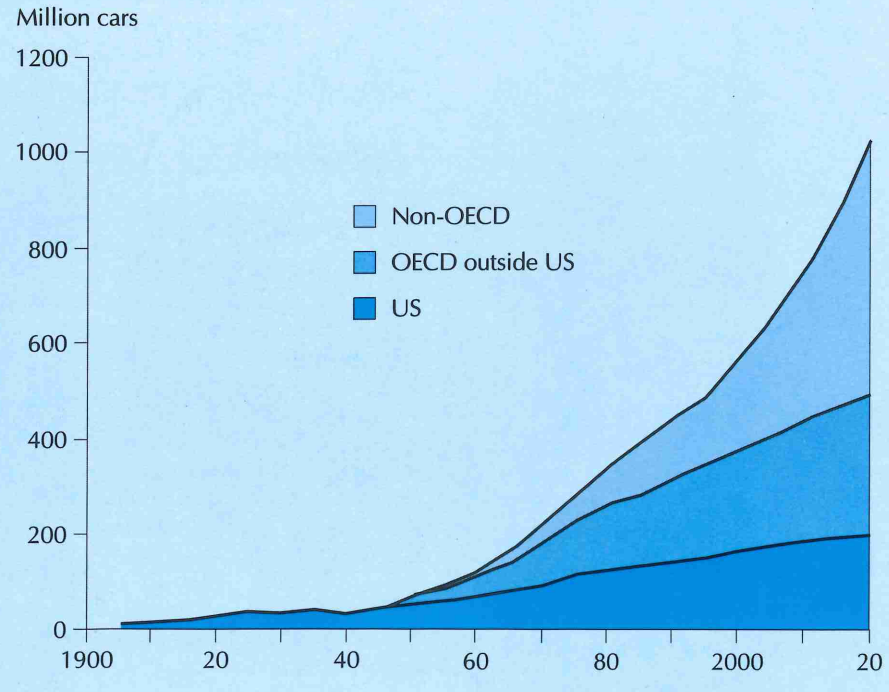


Figure 7

World passenger cars registered – New Frontiers



needed by 2020. Its competitive position relative to coal and oil is strongly enhanced by the efficiency and cleanliness of its use in combined cycle power generation technology, supported by a solid resource base. Undeveloped gas reserves are, however, increasingly distant from markets. Supplying them at a reasonable price will only be possible by taking a long-term view of market stability and technology development. There will also be even greater opportunities for creating new gas markets in developing countries with sufficient domestic resources and this may lead to an increase of 25 million boe/d.

But perhaps the most formidable challenge in New Frontiers is the supply of liquid fuel. For LDCs only, an additional capacity of 40 million barrels/day (b/d) will have to be developed between now and 2020. Compared with current production levels, this corresponds to five Saudi Arabias or eight North Seas of new production capacity. This will require a major long-term mobilisation of the industry's manpower and technology in order to fuel the growth of today's poor countries.

World car population

In this world, there will be millions of new motorists (Figure 7) in developing countries enjoying the benefit of mobility and for whom transport fuel has to be provided. The total demand for liquid fuels could reach 100 million b/d by 2020. To meet such demand, conventional crude production will have to be pushed to its full potential and supplemented by liquid fuels derived from heavy oil and gas to liquids conversion. So how can this challenge be met?

Meeting energy demand

The first difficulty to be overcome is the short-term situation facing the oil industry, namely:

- overcapacity;
- price volatility;
- with more potential for prices to go downwards than upwards.

With the eventual return of Iraq to the market there is ample capacity for the next decade (Figure 8). During this turbulent period, the industry is pushed to

improve its robustness to low prices. Operating and development costs are reduced while low cost areas form an increasing share of the companies' portfolio of assets.

Eventually, early in the next century, this capacity surplus disappears, as the virtuous circle of economic development inherent in New Frontiers drives demand up, especially in the Far East and Latin America (Figure 9). A more relaxed state of affairs in the Middle East greatly decreases the risk of market disruption and helps to restore confidence in oil. The development of considerable reserves produceable at low costs compared to revenues allows this growth dynamic to continue for a number of years.

Of course, countries with less prolific or more costly resources will also wish to contribute; the lower their production cost, the more they will be able to do so. Producing companies and governments can both contribute to making new supplies competitive. Companies can do this by way of cost-cutting technology, and governments by showing restraint in taxation and regulation of the industry.

To sustain acceptable reserves/production ratios during the later part of this scenario, while providing energy at an acceptable price, the industry will be faced with the task of tackling the more costly part of its resource portfolio, namely:

- frontier or heavy oil;
- long distance gas; and
- conversion from gas to liquids.

This could well require a modest increase in oil price (Figure 10), but if prices are allowed to rise too high the competitive position of oil fuels will be eroded compared with alternative energy supplies, and they will lose their place in the market. New technology will play a key role in meeting the challenge of increased oil and gas demand. Nurturing a climate where taking a long-term view on Research and Development (R&D) and investment is possible would give the oil and gas industry the opportunity to bring these difficult resources to market at a competitive price consistent with an appropriate return. Again, this is a task in which both governments and industry need to work together towards similar goals.

Figure 8

OPEC crude production capacity versus call on OPEC

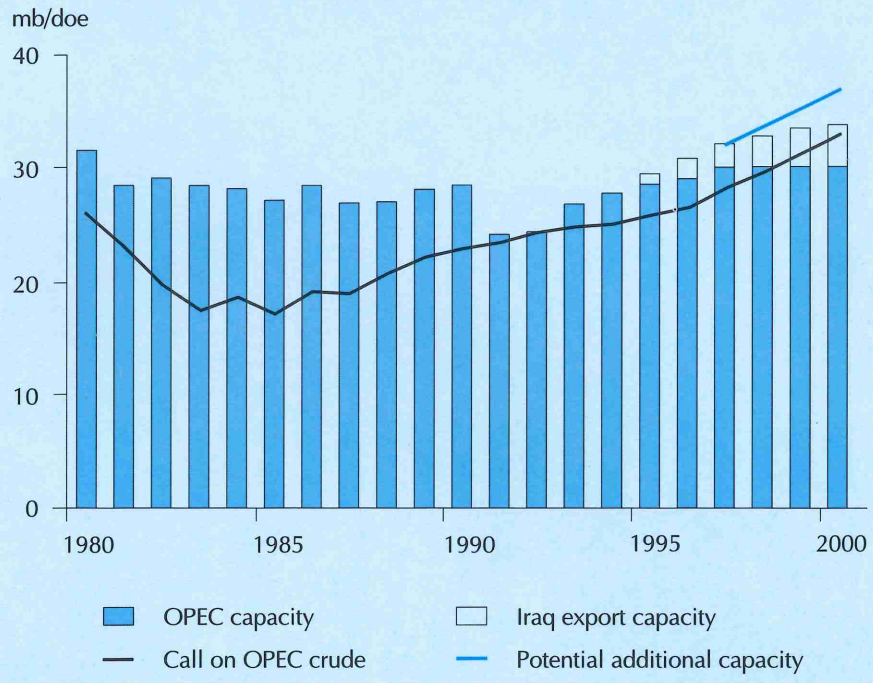


Figure 9

Incremental world oil demand and growth rate by region – 1992-2000

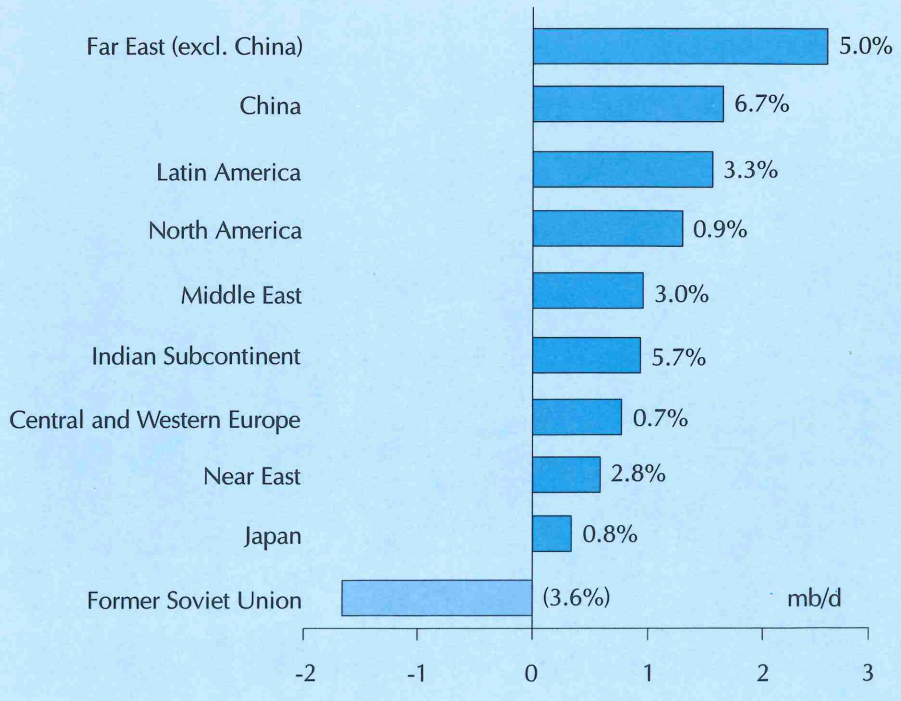


Figure 10

Oil – resource base and cost

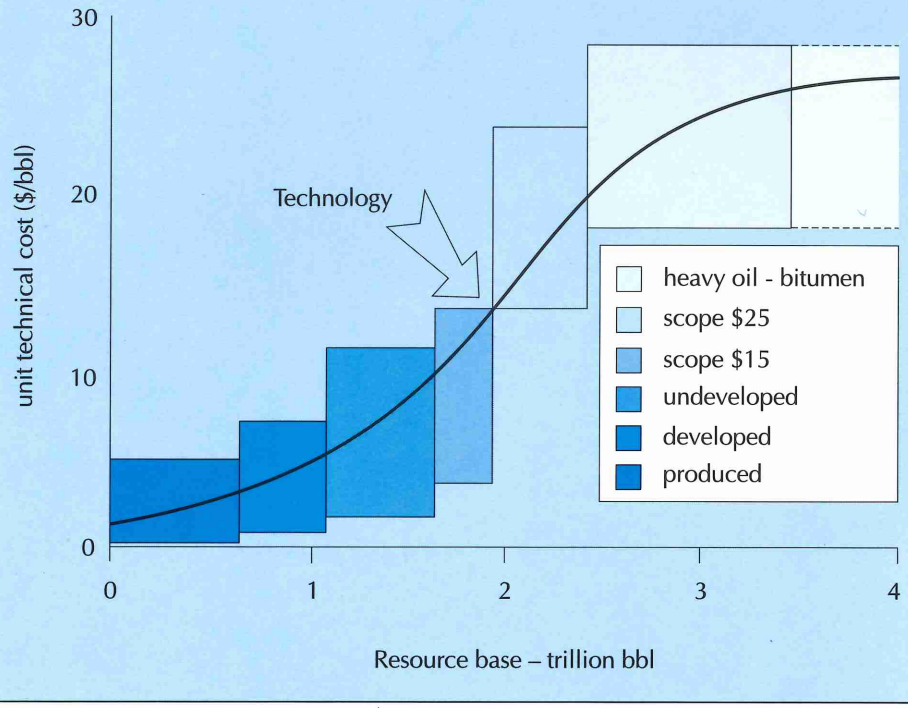
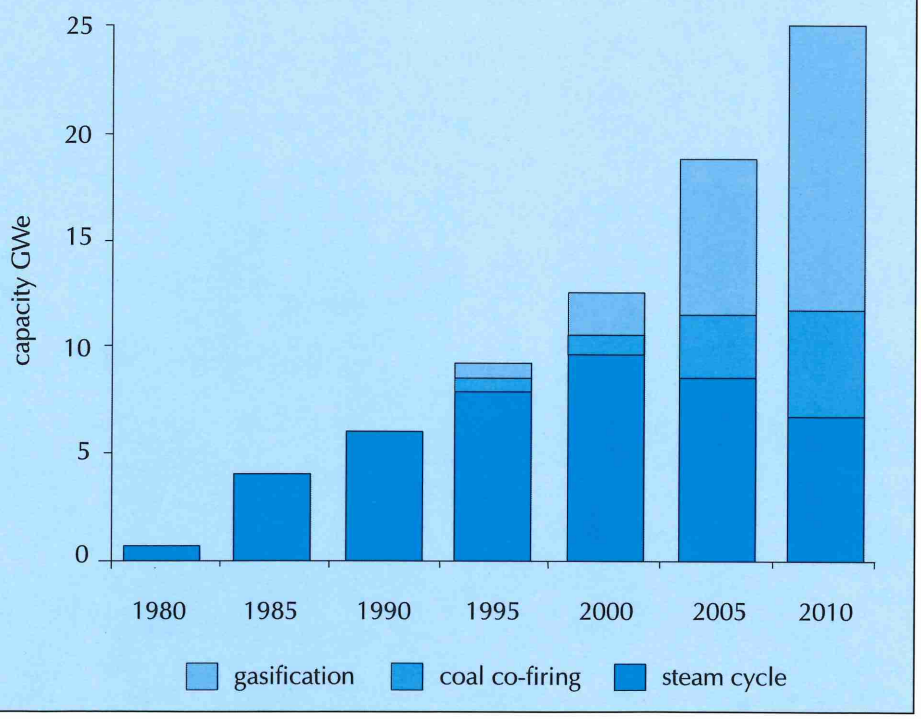


Figure 11

Electricity from biomass – USA



Technology development

Major strides have been made in the development of technology and management capability of the oil companies, particularly over the last 10 years. Fields are being found with three-dimensional (3D) seismic acquisition, processing and interpretation techniques that did not exist only a few years ago. The ability to profitably develop fields now spans a much wider range of conditions than was believed possible 10 years ago.

Particularly in an offshore environment, the need to reduce costs is an ever present driving force. For instance, over the last 10 years, the capacity cost of Troll – offshore Norway – has decreased at a rate of seven per cent per annum in real terms since the conceptual design which led to its declaration of commerciality in 1983.

This applies not only to capital project costs but equally to operating costs throughout field life, which have been lowered by concentrating on reliability and maintainability of equipment and reduction – if not elimination – of operational personnel offshore. Oil companies together with their supporting contractor industries have achieved lower overall costs and accelerated project implementation through innovative contractual and management arrangements.

Therefore, the oil and gas industries, given the right conditions, are well positioned to develop reserves to meet even the demand of the New Frontiers world. But how will energy from renewable sources impact the market?

Renewable energy

Improvements in productivity are not limited to the oil industry. Significant cost reductions have been achieved and will continue to be pursued in renewable energy sources, such as:

- biomass gasification;
- wind power; and
- photovoltaics.

For instance, wind power generation has achieved a 10 per cent per annum cost reduction over the last 15 years (source US DoE). This technology is not fully comparable with conventional power generation sources, as it is not always readily available. Nevertheless, it

has found a niche where it is commercially competitive in selected areas of the USA and Western Europe.

Another example is that of power generation using biomass. Figure 11 shows the impressive growth of electrical capacity from this source already achieved in the USA as well as a projection to 2010 (source US DoE). Originally a side activity to paper and wood product industries, it is anticipated that growth will be sustained as cofiring with coal and integrated gasification with advanced turbine systems develop.

New Frontiers is an environment of technological innovation which is quite favourable to the development of renewable energy, and there may be other commercially competitive technologies just over the horizon.

Sustained growth scenario

As they progress along their learning curve, first capturing niche markets and then gradually expanding, new energy sources may well become commercially competitive over the next decades and start to be visible by around 2020. This would allow growth in energy supplies to be sustained at the time when the contribution from fossil fuels reaches a plateau. It is not necessary, for this argument, to determine which renewable technology has the best prospects. Technologies will compete but the market will decide.

A notional attempt has been made to illustrate how the future energy supply could look like beyond 2020 (Figure 12). This mix however is very likely to be more diversified, following a long established historical pattern. With this perspective in mind, the idea of 'saving hydrocarbons for future generations' is perhaps unduly conservative.

It is also worth noting that this scenario means that the present carbon dioxide (CO_2) emitting energy forms – emissions from which would peak at about 10 gigatonnes per year by 2040 – would be replaced by non-CO_2 ones. This has powerful implications for the climate change debate, which need to be explored more carefully and in greater detail.

There is an exciting challenge lying ahead: reaching New Frontiers following a path which makes economic sense. The industry has the capability and is prepared to tackle this task, as it has

Figure 12

Sustained growth scenario

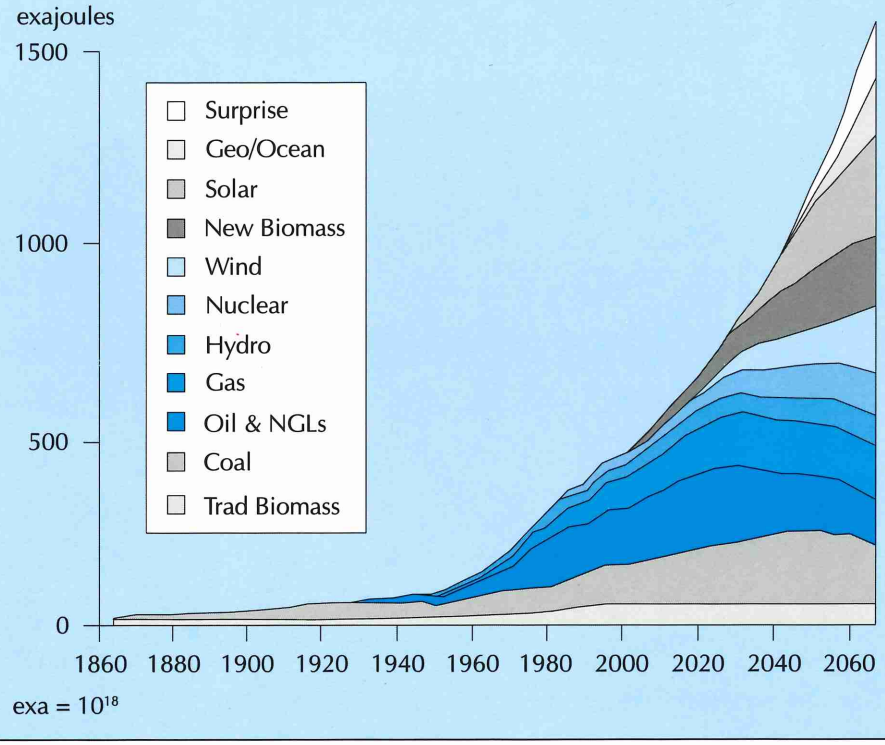


Figure 13

French nuclear growth

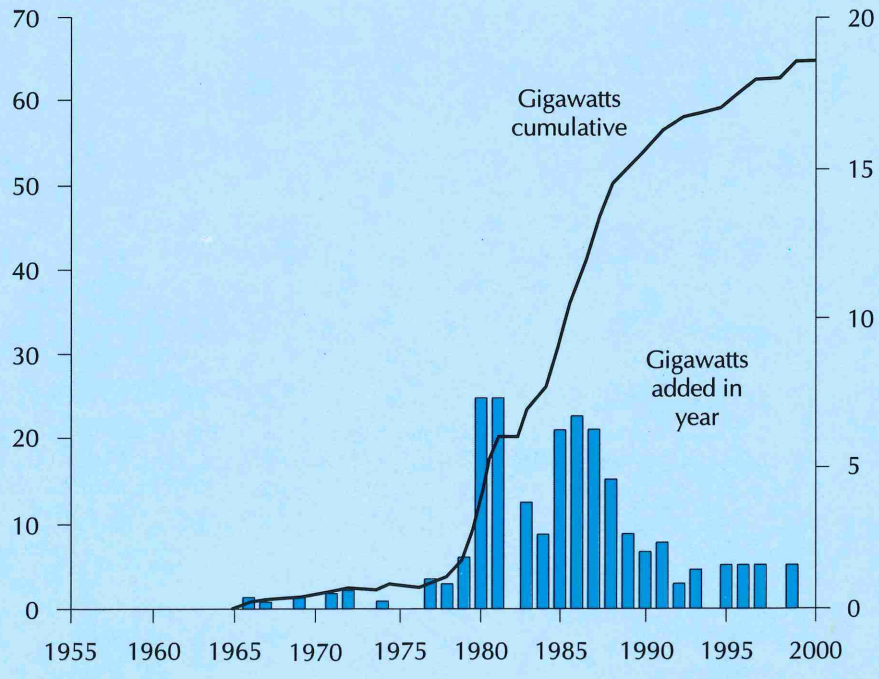
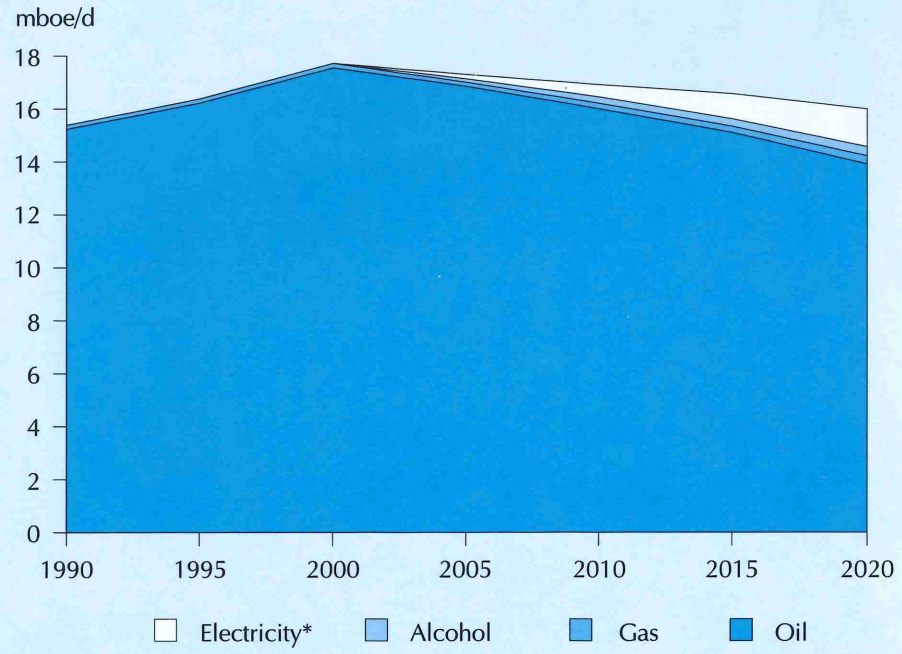


Figure 14

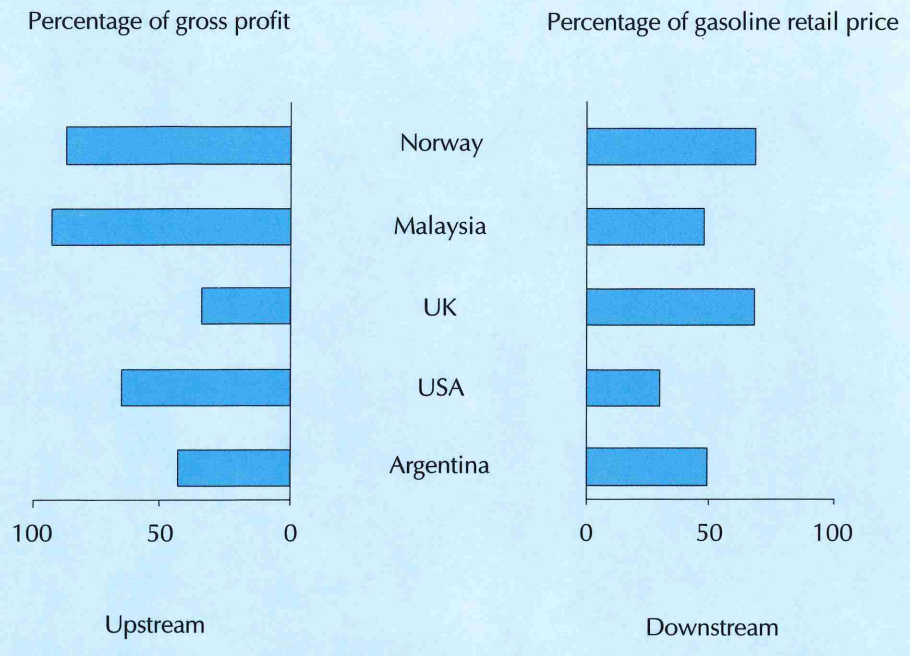
OECD road transport fuels



*Energy input to power system

Figure 15

Hydrocarbons taxation



demonstrated through past and recent achievements. Policy makers must also create the market conditions allowing this to happen.

Barricades

The alternative is a world of supply shortages and price upsets which would cause oil, and perhaps even gas, to be discredited in the eyes of consumers and governments. Like France in the late seventies, where two waves of investment in nuclear electricity followed the two oil price shocks (Figure 13), many will seek national or regional solutions to try to manage without oil and gas. This retreat behind energy Barricades is not a healthy solution for the national economies of either oil producing or consuming countries.

Energy taxation

In Barricades, the use of energy will become heavily taxed and regulated sometimes to the benefit of sub-economic conservation measures or immature and costly alternative energy technologies. This would lead to a premature decline of the oil and gas industry – the decline in gasoline demand for transport fuels is illustrated (Figure 14). In Barricades, high-cost oil and gas will remain in the ground, as some coal resources already do.

Energy in the form of petroleum products is a major contributor to mankind's development, – heat, mechanical power, mobility – and for those aspiring to basic comfort it opens the prospect of clean water, easily cooked food and a warmer (or cooler) house as well as the freedom to travel. Yet, in many countries, the production and use of energy is heavily taxed (Figure 15), hampering economic activities from blossoming to their full potential, with their related creation of jobs and wealth.

Conclusion

The world is in the midst of revolutionary change, whose outcome is uncertain. Part of that uncertainty has to do not just with events but with human attitudes and reactions towards these events. Societies can react with hope and seize the opportunities of New Frontiers; or as the Barricades scenario describes, they can react with fear and try to erect barriers to liberalisation to protect what they value. Of course in any scenario people will react in both ways – but which reaction will dominate?

In New Frontiers, high economic growth leads to a substantial rapid increase in energy demand, especially in developing countries. This is largely supplied by oil and gas and coal, for which resources are believed to be adequate, but depend on political stability and increasingly complex technology for their supply. All energy forms are in demand including renewables. Environmental concerns are resolved through market instruments leading to decreases in global energy intensity.

In Barricades on the other hand, demand growth is much slower and localised, some countries and regions being more successful than others. Environmental problems are resolved by government regulation and global warming concerns lead to some revival of nuclear power.

New Frontiers is a success story for the developing nations; in Barricades they scarcely improve their position compared to today.

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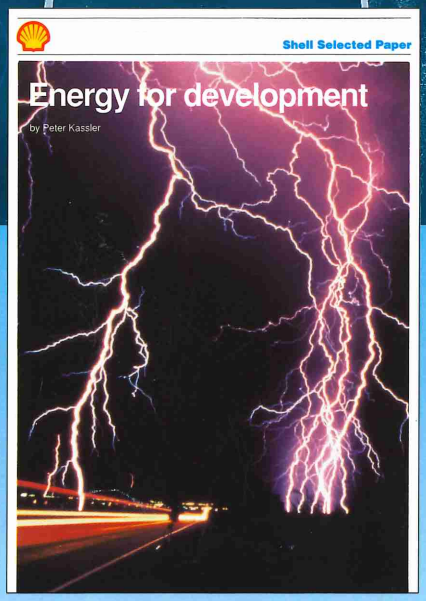

Related publications

Energy for development summarises the Shell scenarios to 2020, discusses the energy requirements for each of them, and outlines how societies' demand for energy might be satisfied. Related publications include three Shell Selected Papers, *Liberalisation, foreign investment and economic growth*, by DeAnne Julius; *Meeting the demand for mobility*, by Roger Rainbow and Henry Tan; and *The private sector investor*, by Peter Hadfield. An issue of the Shell Briefing Service, *Renewable energy*, number one, 1994 and three speeches, *Fossil fuel energy – today and tomorrow*, by Cor Herkströter; and *Facing up to the future* and *New Frontiers* by John Jennings, may also be of interest.

Information on ordering these and other publications can be found on the inside front cover of this publication.