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“New Frontiers for Tomorrow’s World”

by

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An era of revolutions

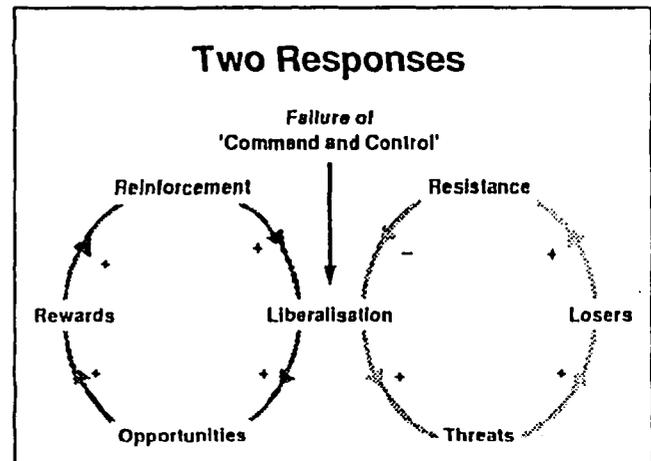
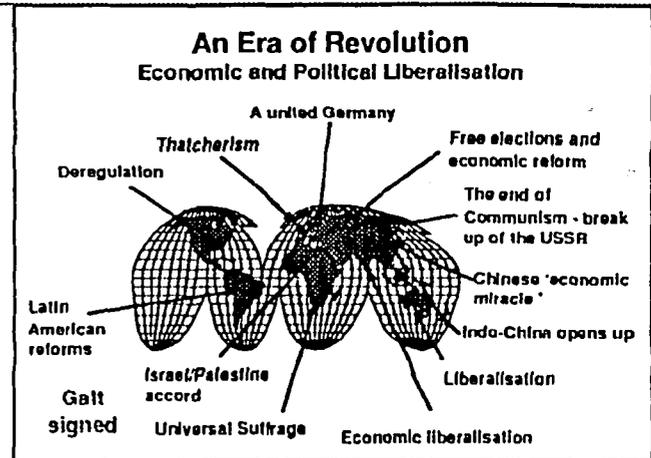
The 1980s were a period of profound, even revolutionary change in many parts of the world. *Political liberalisation has resulted in free elections and civilian governments in much of Latin America and parts of East Asia.* The end of the cold war and the disintegration of the Soviet Union has created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

Equally, profound changes have occurred in the world of economics and markets. 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 the G7 countries. Far reaching changes have occurred in some developing countries (e.g. 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.

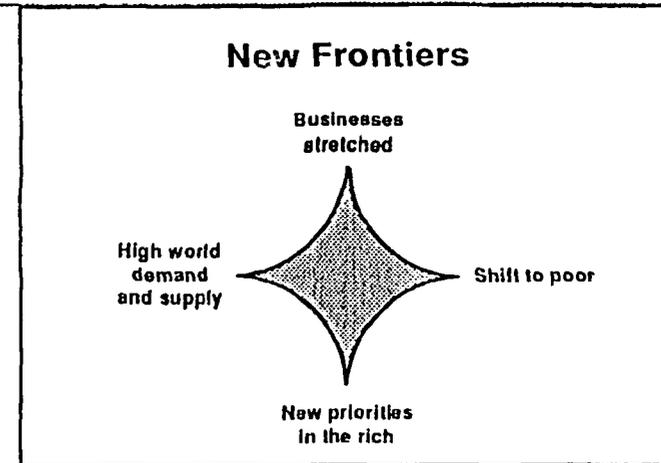
Two responses

There are two types of responses to the liberalisation and other reforms described. 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.



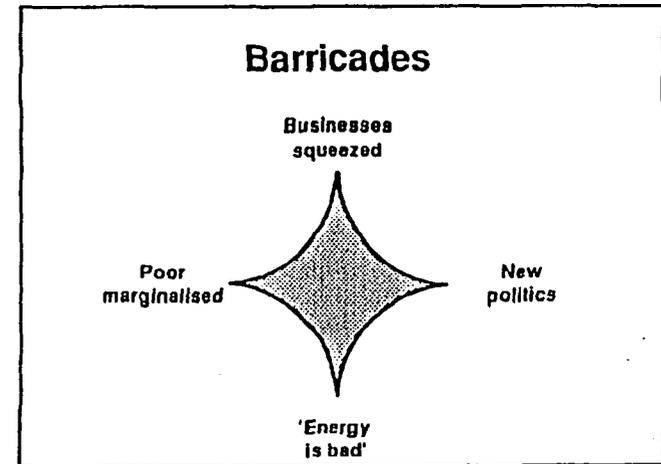
New Frontiers

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. 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. 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 pressure groups, 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. 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.



World population - GNP per head

The difference in economic growth patterns between these two scenarios leads, by 2020, to two very different pictures of the world when expressed in GDP/head.

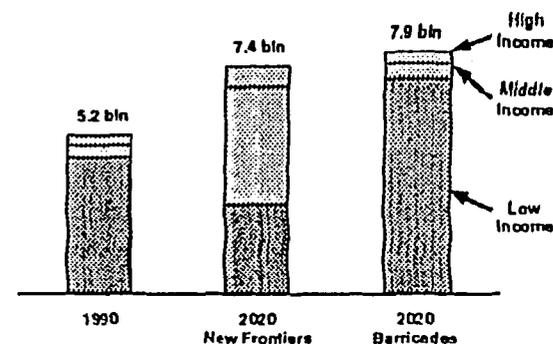
Under Barricades, economic growth rate in developing countries remains at some 3% p.a., similar to the 1980s. By 2020, almost 90% of the world population – some 8 billion people by then – have low incomes, and thus no access to basic amenities (water, electricity etc.) while the remaining 10% is split evenly between middle and high income.

By contrast, in New Frontiers liberalisation leads to growth rates of 5–6% in non-OECD countries, similar to those of the 60s. By 2020, more than half of the world's population enjoy "middle" incomes, with low incomes being reduced to some 40%. As a result of this wider economic development and better education, population growth begins to slow down.

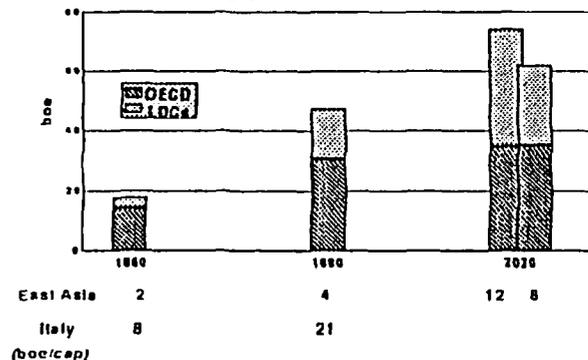
World energy consumption 1960-2020

For developing countries, the difference in the rate of economic development leads to contrasting energy demand between Barricades and New Frontiers. In the latter scenario, energy demand in the LDCs (excluding restructuring economies) grows at an average of 3% pa over the next 30 years, somewhat lower than the 5% estimated over the last 30 years. 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.

World Population: GNP per Head



Energy Consumption



Incremental energy supply - New Frontiers

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. In many countries, public sentiment and market economics continue to be against nuclear and its share declines.

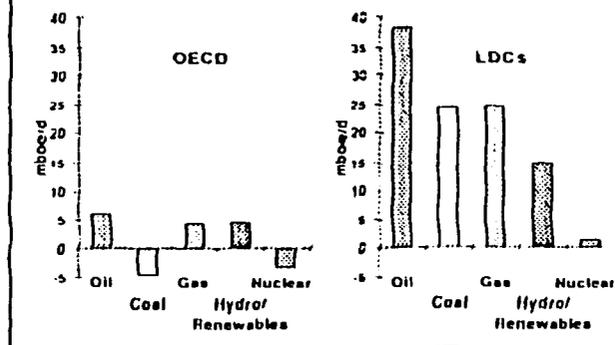
In the OECD countries, gas steadily increases its share of energy supply with an additional capacity of 4.5 million boe/d needed by 2020. Its competitive position relative to coal and oil is strongly enhanced by the efficiency and cleanliness of its use in combined cycle power generation technology, 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 view of market stability and technology development. There will be also 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 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 sustained long-term mobilisation of the industry's manpower and technology in order to fuel the growth of today's poor countries.

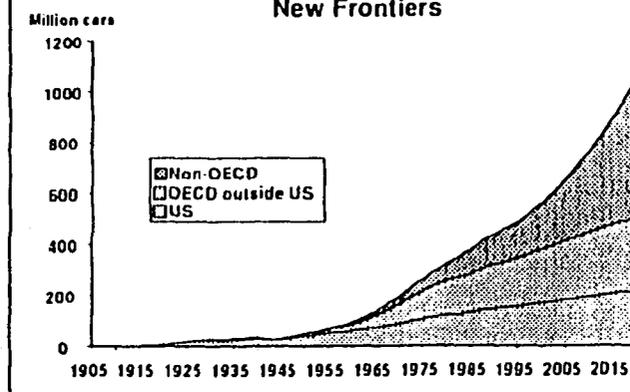
World car population - New Frontiers

In this world, there will be millions of new motorists 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. Let us try to map a path showing how this challenge could be met.

**Incremental Energy Consumption
1990 - 2020**

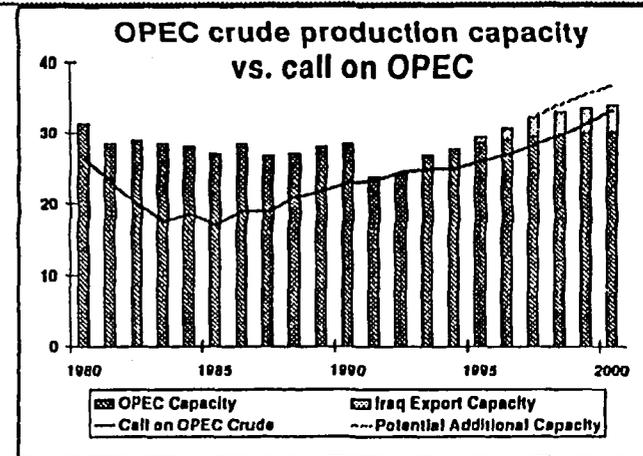


**World Passenger Cars Registered
New Frontiers**



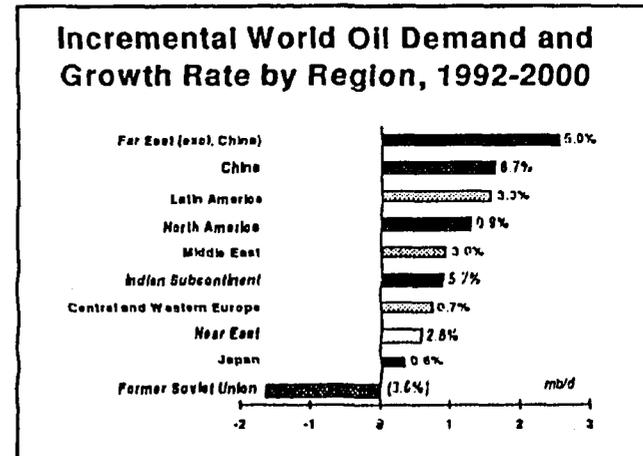
OPEC crude production capacity vs call on OPEC

The first difficulty to be overcome is the short term situation facing the oil industry: one of overcapacity and price volatility, with more potential for prices to go downwards than upwards. 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.



Incremental world oil demand by region 1992 – 2000

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. 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 producible 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. In Norway, the producing companies and the government can both contribute to making new Norwegian supplies competitive. The companies can do this by way of cost-cutting technology, and the government by showing restraint in taxation and regulation of the industry.

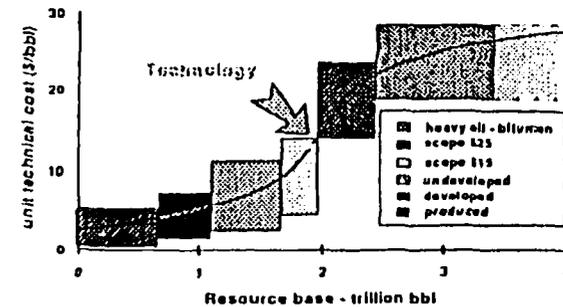


Oil resource cost curve

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 – frontier or heavy oil, long distance gas, conversion from gas to liquids. This could well require a modest increase in oil price, 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.

Nurturing a climate where taking a long view on 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.

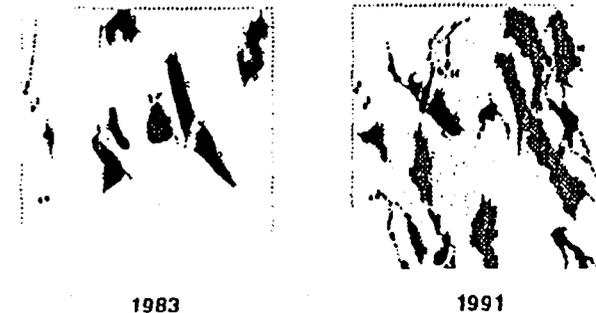
Oil – Resource Base and Cost



Progress in seismic 1983 - 1991

Major strides have been made in the development of technology and management capability of the oil companies, particularly over the last ten years. Fields are being found with 3D seismic acquisition, processing and interpretation techniques that did not exist only a few years ago. In this North Sea example, the original 2D seismic failed to show the scope of the prospects identified by modern techniques. The ability to profitably develop fields now spans a much wider range of conditions than was believed possible ten years ago.

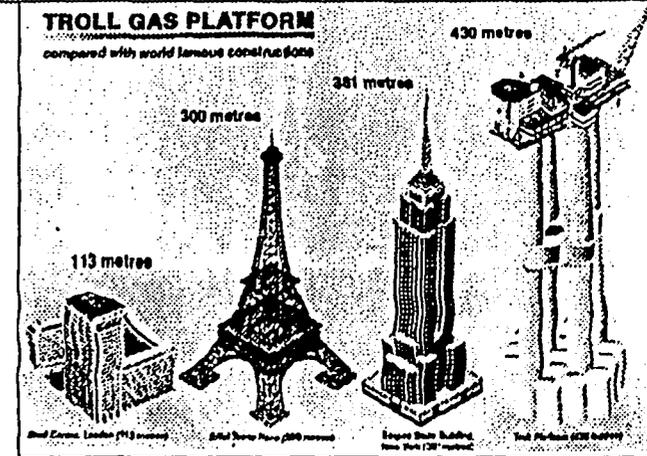
Progress in seismic, 1983-91



Troll picture

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 has decreased at a rate of 7% p.a. in real terms since the conceptual design which led to its declaration of commerciality in 1983.

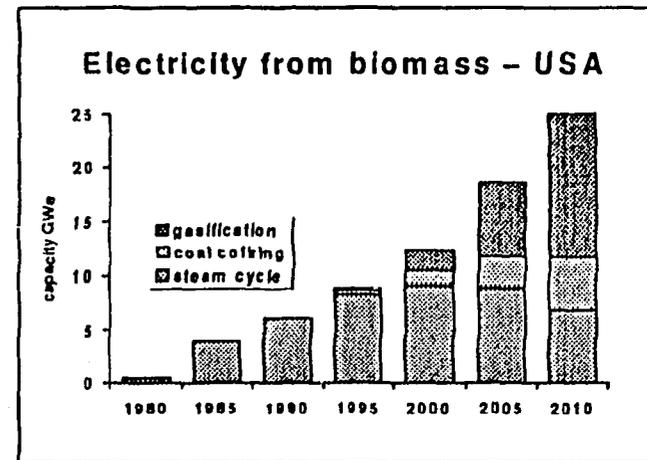
This applies not only to capital project costs but equally to operating costs throughout field life, which have been lowered by concentrating on reliability and maintainability of equipment and reduction – if not elimination – of operational personnel offshore. Oil companies together with their supporting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



Cost reduction in renewables

These improvements in productivity are not limited to the oil industry. Significant cost reductions have been achieved and will continue to be pursued in biomass gasification, wind power and photovoltaics. For instance, wind power generation has achieved a 10% p.a. 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. The illustration 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.



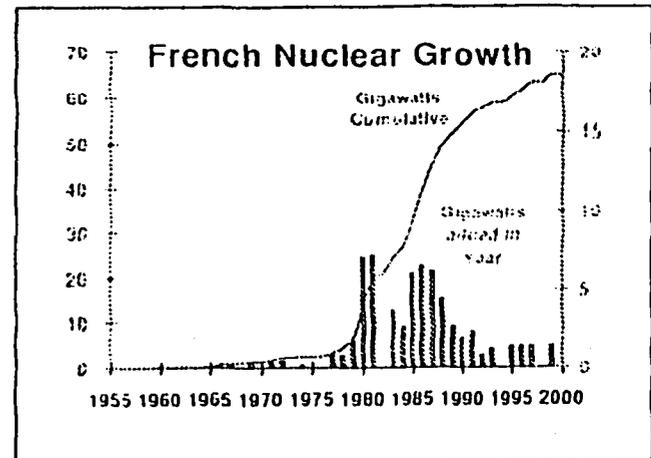
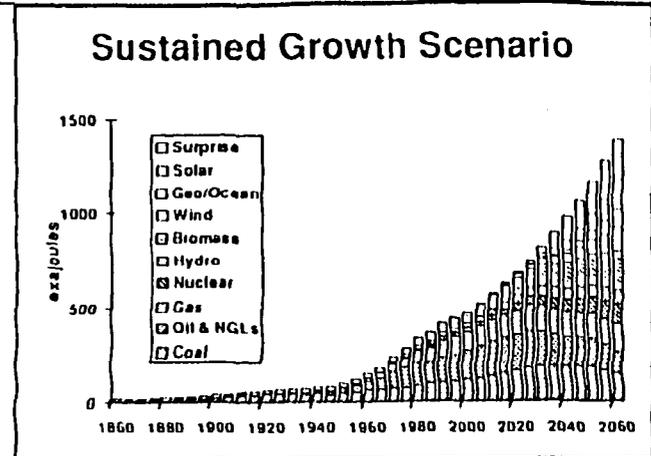
Sustained growth scenario

As they progress along their learning curve, first capturing niche markets and then gradually expanding, these new 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 here to illustrate how the future energy supply could look like beyond 2020. 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 in this scenario, carbon emissions from "fossil fuels" (coal, oil and natural gas) would peak at about 10 GtC/year by 2040.

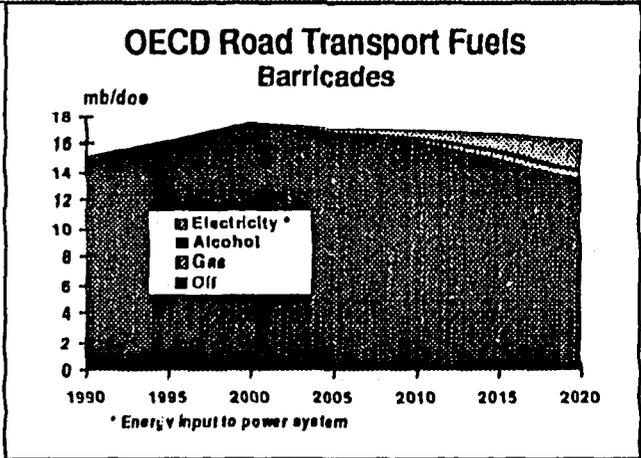
Nuclear electricity capacity – France

There is an exciting challenge lying ahead of us: reaching our New Frontiers following a path which makes economic sense. The industry has the capability and is prepared to tackle this task, as it has demonstrated through past and recent achievements. Policy makers must also create the market conditions allowing this to happen. 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, 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.



OECD Road transport fuels - 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 our industry. In this scenario, high-cost oil and gas will remain in the ground, as some coal resources already do.



Energy taxation

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 house as well as the freedom to travel. Yet, in many countries, the production and use of energy is heavily taxed, hampering economic activities from blossoming to their full potential, with their related creation of jobs and wealth. New Frontiers is all about creating a climate where these opportunities are not missed, where both producing and consuming countries would thrive on a sustained global economic development.

In this world, producing nations, like Norway, may choose to foster a climate where productivity in supplying energy keeps improving for the benefit of consumers, avoiding the potentially misleading distortion of subsidies. This requires investment in new technologies which will only happen if investors' rewards are reasonable. In this way, the industry will achieve its New Frontiers.

