Ending Dependence

Hard Choices for Oil-Exporting States

A Chatham House Report by
John V. Mitchell and Paul Stevens

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Charity Registration No. 208223

ISBN 978 1 86203 205 7

Designed and typeset by Soapbox Communications Limited
Printed by Latimer Trend and Co Ltd

Contents

List of tables

List of figures

Acknowledgments

The authors would like to thank all the participants of the Resource Depletion, Dependence and Development project for their valuable contributions to the study. In particular, they thank researchers Daniela Schmidt and Elisa Cassinadri; the expert commentators, Prof. Richard Auty (Angola and Kazakhstan), Ramin Isayev (Azerbaijan), Tamara Lynch and Dr Gareth Price (Timor-Leste), Jon Marks (Algeria), Prof. Timothy Niblock (Saudi Arabia), Willy Olsen (Norway), Stan Rerri (Nigeria), Dr Umar Said (Indonesia) and Dr Mahani Zainal Abidin (Malaysia) whose working papers are forthcoming; Denny Ellerman, Dermot Gately, Glada Lahn and Tormod Slåtsveen for their comments on the draft; and Margaret May as editor of the report. This project has been made possible by financial support from the Asian Development Bank, the Royal Norwegian Ministryof Petroleum and Energy and BP, none of whom bears responsibility for the analysis and opinions expressed in thereport

July 2008

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Executive Summary

Since 2003, countries whose economies depend on the export of oil and gas have enjoyed a surge of revenue driven by rising oil prices and, in some countries, rising export volumes. The press has captured petroleum-fuelled prosperity in images of futuristic construction plans and the rocketing assets of sovereign wealth funds. However, this obscures important differences among oil and gas exporters in terms of reserves size and social development challenges. Based on a major study of twelve hydrocarbon-exporting countries,[1] this report shows that the boom does not guarantee economic sustainability for these countries, most of which face hard policy choices over domestic consumption, development spending and rates of economic growth. The report estimates the timeframes these countries have in which to make the necessary changes and examine their prospects for success given the existing human, institutional and technical capacity, competitive advantages, infrastructure and access to capital.

Challenging the 'resource curse'

Development based on the export of hydrocarbons presents serious challenges. In the short term, spending the revenues that accrue from oil and gas exports can cause inflation and stimulate unsustainable government expenditure and subsidies. In the long term, depletion of the hydrocarbon reserves will limit what the hydrocarbon sector can do for the rest of the economy. The exploitation of resources may, however, become a cure for the problems of underdevelopment and poverty which affect many hydrocarbon-exporting countries – if the resources are used to develop the non-hydrocarbon potential of their economies so as to replace hydrocarbon income in the long term. This report shows how much change is necessary for the countries studied, and how soon it will need to be implemented to achieve this result.

Oil prices since 2005 exceed those of the 1970s and early 1980s in inflation-adjusted terms. Current high prices reflect the end of the structural surplus of oil production capacity, which has dominated the world oil market since the second oil shock of 1979–81. During this period of surplus, oil exporters sought to cooperate within OPEC to protect revenues by managing supply. The challenge has now changed: what investments will best increase capacity, and how should the surplus revenues which are now being generated be managed? This report places these questions in the larger context of *how to sustain economic growth in the long term* as hydrocarbon exports are increasingly constrained by depletion and rising domestic consumption. This will happen, within varying time frames, as (a) country production flattens and falls and (b) continuing domestic consumption absorbs more of each country's production. The task is extremely difficult because of uncertainty over future additions to their oil and gas reserves, and over future international prices.

To produce now or later?

Some governments are questioning whether to avoid or delay investment in further increases in production, which would contribute to financial surpluses but not necessarily develop the non-hydrocarbon economic sectors. Referring to Saudi Arabia's 2007 decision not to increase production capacity beyond 12.5 million barrels a day in the near future, King Abdullah is reported to have said, 'I keep no secret from you that when there were some new finds, I told them: "No, leave it in the ground, with grace from God, our children need it."'[2] 'Leaving oil in the ground' now for production later would delay and lessen the eventual changes needed to reduce dependence on the hydrocarbon sector. On the other hand, building up foreign investments can provide a strategic hedge against the uncertainties of future reserves and prices.

This report is designed to inform these policy considerations by drawing on a series of depletion, consumption and export simulations and an investigation into the principles of managing resource wealth (for methodology see Box 1, page 10).

The report does not directly forecast a possible range of future oil prices and production. Unless there is a global recession, high oil prices are likely to persist, but how high they will be in the long term is uncertain. The pricing power of the oil exporters will diminish as their share of world energy demand falls. Within the liquid fuel market, alternative demand technologies and fuel supplies (at currently unknown costs and prices) will cap the oil price at some level, for which $100 dollars (2006 $) a barrel is taken here as a benchmark.

Prescribing resource cures

A key conclusion of the report is that, because of their legacy of institutions, their demographic structure and skills, access to other natural and technical resources, and policy frameworks, countries vary greatly in their dependence on hydrocarbon exports. They differ also in their ability to replace oil tax revenues and foreign exchange earnings by diversifying their economies in future. In Part 2, the twelve countries are loosely grouped into four categories according to their stage of depletion and level of dependence on the hydrocarbons sector. These are: 'near sustainable' (Indonesia, Malaysia, Norway), 'soon in transition' (Algeria, Nigeria), 'early dependence' (Angola, Azerbaijan, Kazakhstan, Timor-Leste) and 'long-term depletion options' (Saudi Arabia, Kuwait and Iran). While these groups are facing the challenges of depletion with varying levels of urgency, the report concludes that no country whose economy now depends on oil and gas exports can escape the eventual transition to lower dependence on hydrocarbons, which will involve a combination of:

- Domestic energy policy to restrain the growth of consumption and encourage the development of other fuels;
- More rapid growth of non-hydrocarbon sectors to pay taxes and generate exports (or reduce imports);
- Lower targets for economic growth.

The challenge exists even for Saudi Arabia. The country could cease to export in thirty years' time, on the basis of its planned capacity of 12.5 million barrels per day of crude oil production, if consumption grows on a 'business-as-usual' path. For other countries such as Algeria, Malaysia and Indonesia, whose production is already in or near decline, transition begins very soon.

It is clear that changing the limits of human, institutional and physical infrastructure will take time, money, and coordinated efforts by national governments, business and professional sectors, educational institutions and of course leading individuals. Almost all the solutions require some combination of internal reform and efforts to harness global resources of technology and management. Capital, in most cases, is not now a problem, except in the sense that efficient financial structures are needed to use the available capital efficiently, and access to global technology and management often means admitting global capital. Few governments – except those of countries where production is already in or near decline – seem to be addressing these long-term issues.

Introduction

This report summarizes the main findings of twelve country case studies and commentaries discussed by country experts at a workshop held by Chatham House in April 2008. The report has two parts. Part 1 describes the hydrocarbon challenge. Part 2 sets out some of the key comments on the potential for reducing hydrocarbon dependence and the difficulties evident in the selected countries.

The hydrocarbon challenge

Part 1 shows how growth on 'business as usual' trends in the non-hydrocarbon sectors of ten[3] exporting countries cannot be supported by their hydrocarbon sectors in the long term, under a variety of assumptions. Simulations identify when the fiscal and foreign exchange deficits of the non-hydrocarbon sectors would become untenable, if no action were taken, and how much change would be required over the next two decades (2025 was the benchmark date for modelling) to reduce dependence on hydrocarbons.

The trigger for beginning the transition from economic dependence on oil and gas revenues will be the levelling out of oil and gas production. As this happens, exports will decline as rising domestic energy consumption takes a larger share of output. When production itself declines, dependence must be reduced even more rapidly to sustain the growth of the non-hydrocarbon sectors in which most people live, work, and expect government services.

Reducing dependence

Part 2 discusses the challenges faced by the twelve countries in reducing dependence on hydrocarbons production.

Uncertainty about the value and volume of future oil production makes the idea of 'permanent income' from hydrocarbon 'wealth' difficult to define as a guide for the fiscal deficits of the non-hydrocarbon economy in the way favoured by many IMF reports on these countries.

If the economies of these countries are to continue to grow and avoid long-term decline, oil tax revenues and foreign exchange earnings from hydrocarbon exports will need to be replaced by developing the non-hydrocarbon economy. The challenge is complex:

- The fiscal and foreign currency support from the hydrocarbon sectors will *inevitably* reduce in the future, even at 'high' price levels and with credible additions to reserves;
- *Uncertainties* about price and reserve additions create a long-term risk for economic development on top of the problems caused by short-term fluctuations in oil and gas revenues and foreign exchange earnings;
- The hydrocarbon sector by itself cannot create jobs at a rate to match the growing employable population.

Countries

The twelve countries covered in this study can be grouped as follows:

- **Indonesia, Malaysia and Norway**, where production is already on a plateau or declining, but which have achieved diverse economies and sustainable growth paths;
- **Algeria,** where a shift from oil to gas dependence cannot long postpone a transition to alternative sources of growth;

- **Saudi Arabia, Iran and Kuwait**, which are long-term oil exporters but will soon need to develop supplementary sources of growth;
- **Nigeria and Kazakhstan**, whose production can be extended beyond the next decade;
- **Angola, Azerbaijan and Timor-Leste**, whose economies have been transformed by recent oil developments and are in the early stages of depletion-driven development.

Other important hydrocarbon producers with similar problems may be included in subsequent studies.

Box 1: Project methodology

This report is based on the findings of the Resource Depletion, Dependence and Development project which began in September 2007 and has included contributions from Chatham House researchers, country experts and industry and government actors. A theoretical study, *Resource Depletion, Dependence and Development: Can Theory Help?* provides the background for the research. This and further information about the project are available on the website: www.chathamhouse.org.uk/rddd.

Much of the data contained in this report are based on country simulations of (a) projected oil and gas export constraints due to hydrocarbon depletion and growing domestic consumption, (b) the resulting fiscal account deficit and (c) the resulting current account deficit. These simulations were conducted via a spreadsheet model which projects annual data from an input starting date (2006) for a period of 30–50 years. Norway and Timor-Leste were omitted from the simulation exercise, the former because its circumstances are not comparable and the latter for lack of data. The rules guiding these projections and input assumptions are summarized in Appendix 1.

Part 2 of the report draws on contributions from experts on each of twelve countries (mentioned in the Acknowledgments) who added their evaluations of current policy, capacity and constraints, and the conclusions of a Chatham House workshop (17–18 April 2008) which discussed the technical findings and the potential for diversifying and expanding the non-hydrocarbon economy in varying national contexts. The expert commentaries will be made available on the above website as working papers in summer 2008.

Part 1
The Hydrocarbon Challenge

This part of the report explains and draws out the conclusions of detailed simulations of the hydrocarbon sector carried out for ten of the twelve countries under a variety of assumptions, on reserves, production, and price.[4] The focus here is on:

- The limited window of opportunity which exists before the 'crunch points' when support from hydrocarbon production levels off and eventually declines in each country;
- How much the non-hydrocarbon sectors in each country would have to adapt to reduce dependence on hydrocarbons, to sustain growth while hydrocarbon production levels off, and prevent decline when it falls.

Part 2 discusses the key challenges which these countries face in adapting their non-oil economies to sustain development as the support available from the hydrocarbon sector levels off and then falls.

Dependence

A country's economic dependence on the hydrocarbons sector is best measured in terms of two deficits. Where government revenue generated by the non-hydrocarbon sectors of the economy does not pay for government expenditure in those sectors, a 'non-hydrocarbon fiscal deficit' appears, and where the foreign exchange generated by exports from the non-hydrocarbon sectors cannot cover imports to these sectors, a 'non-hydrocarbon current account deficit' is created. Government hydrocarbon revenues and exports finance these two deficits, with any overall surplus being invested abroad and overall deficits being covered by foreign borrowing. The ratios of the deficits to government expenditure and imports respectively are measures of the dependence of the countries on hydrocarbon revenues.

Table 1 shows the degrees of dependence in 2006 of eleven[5] countries studied in this report: the countries differ from one another in their fiscal and current account dependence, and the two types of dependence are not necessarily similar. In Malaysia and Indonesia, the non-hydrocarbon sector runs export surpluses; in Kazakhstan, in 2006, hydrocarbons provided a lower share of tax revenue than export earnings. No data are available for Timor-Leste.

Table 1: Dependence on hydrocarbons

	Non-hydrocarbon fiscal balance as % NHGDP, 2006	Non-hydrocarbon current account balance as % NHGDP, 2006
Norway	-4	-9
Kazakhstan	-4	-58
Indonesia	-8	1
Malaysia	-13	8
Iran	-27	-25
Azerbaijan	-29	-30
Nigeria	-35	-13
Algeria	-42	-82
Saudi Arabia	-51	-57
Angola	-69	-30
Kuwait	-84	-28

Sources: IMF country reports and national Central Bank statistics.

Changing hydrocarbon balances underpin the dynamics of the transition from depletion-led development to sustainable development. More reserves, and more efficient consumption, will reduce the scale of transition at any particular date, or delay it. The combination of plateau or declining production and rising domestic consumption will reduce the fiscal and current account support which hydrocarbon revenues and earnings give to the other sectors of the

economy, whatever the prevailing international oil price. The scale of support – and the size of the challenge to replace this support in the long term – will, however, depend on the evolution of international oil and gas prices. Oil prices of over $100 per barrel since the beginning of 2008 are two-and-a-half times the average prices, in inflation-adjusted terms, from 1974 to 2004 and more than triple the average from 1986 to 2003 when the present escalation in prices took hold. As revenues have surged ahead of expenditure, almost every exporting country is building financial investments abroad, either through 'sovereign wealth funds' (SWFs) or through investing foreign exchange reserves (discussed later). Expenditure in the non-hydrocarbon economy has also increased in most countries, so that dependence on hydrocarbon revenues has increased since 2003.

Countries which fail to adjust will be unable to sustain their present trends in economic growth. The ultimate 'resource curse' is that the resource dependence cannot outlive the resource.

The dynamics of depletion and dependence

Depletion of known oil or gas reserves is likely to follow a path which changes over time: production increases as investment is made to produce, process and transport the crude oil to an export port or to a local refinery; at some point investment in the process and transport infrastructure for further increases in output becomes uneconomic as the reserves cannot support the higher production for long; finally, despite continuing investment in maintaining the pressure in the field and drilling more wells, production declines. The rate of decline is limited by technical factors: it may be as high as 10%, typical of the private-sector companies in the OECD, where a plateau may not exceed ten years. It may also be limited by policy: Saudi policy is that depletion should not exceed 2–3% of the remaining reserves, so that at some point, after a period of 'plateau production', output will fall at 2–3%. With changes in technology to add to reserves by improving productivity, and through the discovery of new reserves, country production will not follow this profile exactly; but it is closer to reality than the so-called 'peak' oil, in which production rises to a short-lived peak, regardless of the cost of investment in production facilities and infrastructure, and then declines rapidly because of supposed fixed hydrocarbon resources. Figure 1 contrasts typical profiles.

The production plateau gives a basic shape to the future potential of the hydrocarbon sectors to support the non-hydrocarbon sectors of the economy at any given price. The

Figure 1: Typical depletion profiles

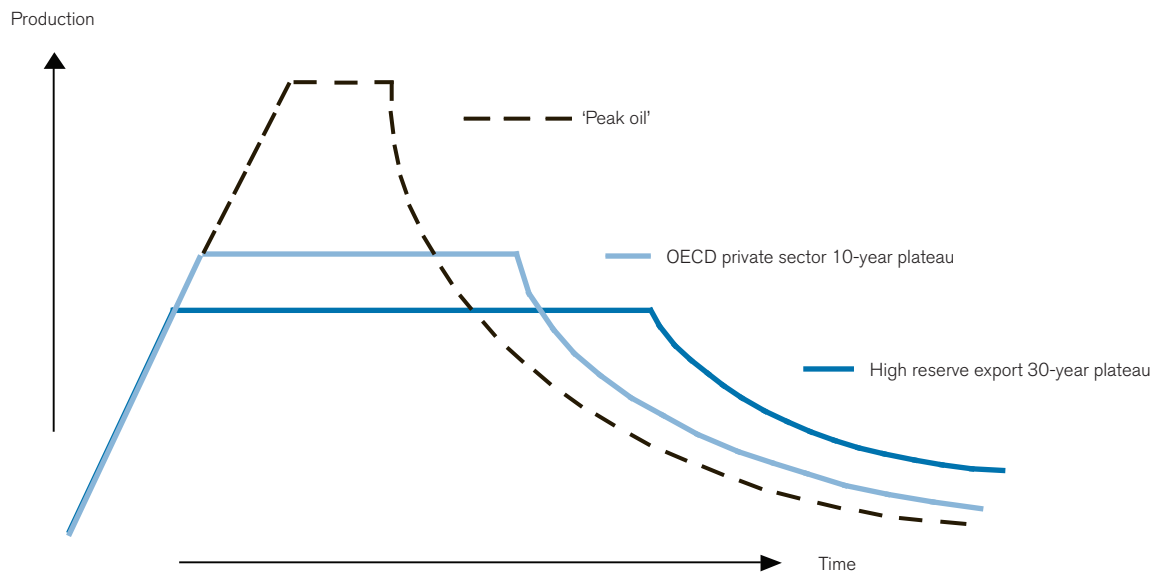
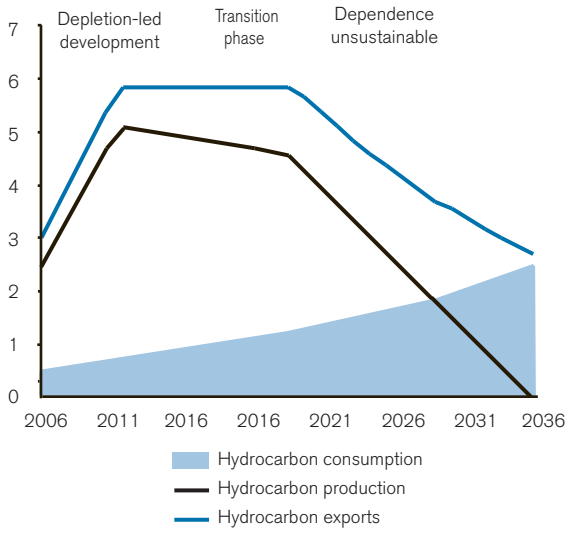


Figure 2: Example: turning points in the hydrocarbon balance of Nigeria (reference case)



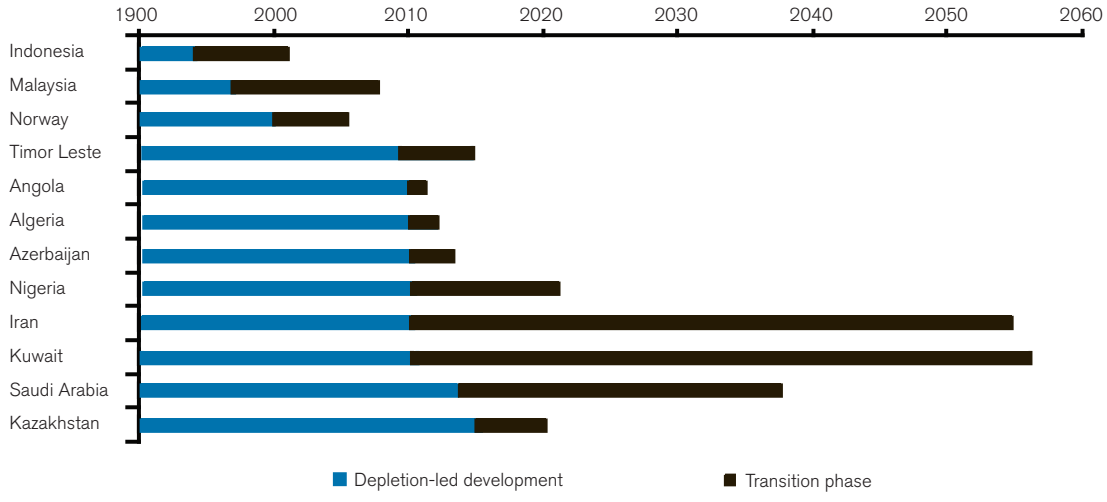
Source: Model results.

effects of changes in price are discussed below. Broadly speaking, when production is increasing, depletion supports accelerated development by increasing financing of the fiscal and foreign exchange deficits of the non-hydrocarbon sectors. When hydrocarbon production levels out, exports will fall, so long as a country's domestic consumption continues to rise with growth in the dependent non-hydrocarbon sectors. Figure 2 illustrates as an example the case of Nigeria in the reference simulation of the project's model, assuming current proven hydrocarbon reserves, a chosen plateau of 3 mbd oil production, a maximum depletion rate of 5%, and energy consumption growing at 4.8%.[6]

To support continued growth, the country must begin reducing its reliance on the hydrocarbon sector to finance the fiscal and foreign exchange deficits of the non-hydrocarbon economy. This will mean less expenditure and higher taxes, and lower imports or higher exports in the non-hydrocarbon sectors. After hydrocarbon production declines, the need for these alternatives will accelerate, not only to maintain growth but to prevent economic decline.

For some countries (Indonesia, Malaysia, Norway) depletion-driven development has already ended. The transition has begun and this is already reflected in government fiscal and development policy. Timor-Leste, without additional reserves, may be on the brink of this transition. For other countries, current development plans would extend the period. For some – Angola, Algeria and Azerbaijan – the transition period will be short because production is already high relative to reserves. Kazakhstan, even with the high production levels embodied in its plans and intentions, could maintain depletion-driven development into the next decade, but would need to complete a transition to lower

Figure 3: Timelines for depletion-led development and transition from hydrocarbons dependence



Source: Model results. Notes: Additional reserves would allow these levels of production to be extended, as Table 2 shows.

Table 2: Reserves and production

Country	2006 production	Reference case		Higher reserves	
	mboe/d	Plateau production (mboe/d)	Years sustainable	Plateau production (mboe/d)	Years extra for transition
Algeria (gas)	1.4	2.2 (peak)	peak 2027	no change	5
Algeria (oil)	2	2.3	2010-11	no change	2
Angola	1.4	2.0	peak 2010	no change	7
Azerbaijan (gas)	0.1	0.5	2011-16	no change	1
Azerbaijan (oil)	0.7	1.3	2010-13	no change	6
Indonesia (gas)	1.3	1.6	2012-14	no change	14
Indonesia (oil)	1.1	in decline		no change	
Kazakhstan (oil)	1.4	3.5	2015-20	no change	7
Malaysia (gas)	1	1.4	peak 2016	no change	2
Malaysia (oil)	0.7	0.6	1995-09	no change	2
Norway (gas)	1.5	2	2015-25	no change	5
Norway (oil)	2.8	in decline		no change	

Source: Model results.
Note: In Figure 2 and Table 2 'oil' includes natural gas liquids (NGLs). Saudi Arabia includes the Saudi share of the Neutral Zone production. 2006 reserve and production figures are taken from the BP Statistical Review 2007. Plateau production levels are taken from government or national oil company (NOC) statements. The length of the plateau is calculated by reference to the reserves figure and the maximum allowed rate of depletion: generally 5% of the remaining reserves (3% in Saudi Arabia, 10% in Norway). Additional reserves are generally 10–20% in the case of oil and 20–40% in the case of gas, informed by NOC and official statements.

Table 3: Higher production

Country	2006 production	Reference case		Higher reserves/plateau	
	mboe/d	Plateau production (mboe/d)	Years sustainable	Plateau production (mboe/d)	Years extra for transition
Saudia Arabia	10.9	13.0	2014-38	16.0	2014-42
Iran	4.3	5.0	2010-56+	6.0	2015-52
Kuwait	2.7	3.5	2010-56+	4.0	2015-47
Kazakhstan (gas)	0.4	0.9	2015-35	1.4	2027-peak
Nigeria	2.5	3.0	2010-21	4.0	2015-19

Source: Model results.
Note: Saudi Arabia includes its share of the Neutral Zone.

dependence before 2020. Nigeria needs to begin the transition by 2010, but then probably has over a decade to complete it. Production levels in Kuwait and Iran would level off around 2010, according to current statements, but could then be sustained for several decades. Saudi Arabia is in a well-defined position. Its production, based on an announced 12.5 mbd crude capacity, would level off in 2014, and the transition period should then begin, but on known reserves production could be sustained for thirty years before it would need to decline to maintain Saudi policy of a maximum 3% annual depletion of the remaining reserves.

Additional reserves could also support higher levels of plateau production. In the case of Saudi Arabia, the additional reserves targeted by Saudi Aramco management would permit both higher production (based on 15 mbd capacity) and a longer transition period. In the other countries, though the higher plateau would be sustainable for a decade or more, the assumptions in the study would bring the eventual decline forward by a few years, as Table 3 shows.

Consumption and exports

Oil and gas consumed domestically clearly do not contribute to exports. Moreover, domestic sales do not generally yield the same tax revenue as oil and gas which are exported, because domestic prices are controlled so that the producing enterprises earn less profit or even incur losses. In most of these countries there are also direct subsidies from the government to the state companies to protect the latter's cash flow.[7] The size and growth of domestic consumption therefore affect the contribution which the oil and gas sector is able to make to support the fiscal and current account deficits of the non-hydrocarbon sectors. The larger the domestic market, the more its growth will restrict the growth of exports.

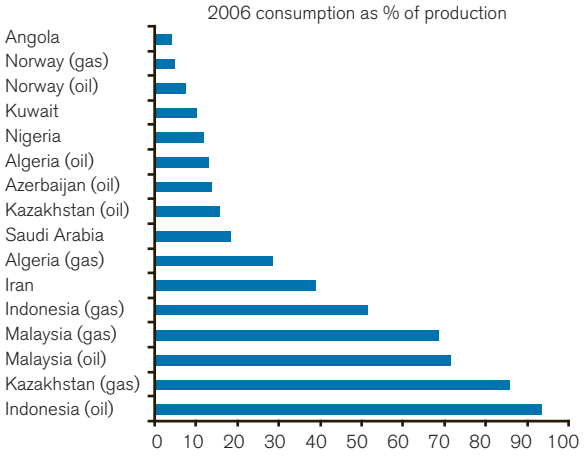
During depletion-led development, while production is growing, exports may grow or be sustained. But once production levels off at a plateau, exports will decline. In Malaysia and Indonesia, exports have already ceased or will soon cease.

Exporting countries differ in the size of domestic consumption relative to exports, reflecting the size of their non-hydrocarbon economy and the availability and use of other energy sources (such as coal in Indonesia and Kazakhstan and hydropower in Malaysia and Norway). Figure 4 shows the share of production consumed in the exporting country in 2006. This share will increase as production levels out and falls.

In our simulations, consumption is projected to grow at 80% of the growth rate projected for the non-hydrocarbon economy in which consumption occurs (so that consumption grows at 4% when the non-hydrocarbon sectors grow at 5%). On this basis, countries with a high proportion of production consumed locally will cease to export soon after production has stopped growing. In some countries (Algeria, Malaysia, Indonesia, Nigeria) oil exports will cease before gas exports.

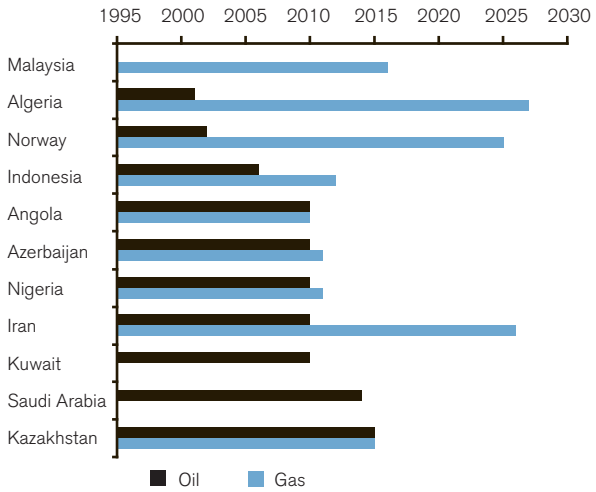
Figure 5 shows the period until exports will decline, given existing reserves, the production levels shown in Table 2, and consumption trends in the reference case. The transition to replacing oil export revenues and earnings must begin by the date shown.

Figure 4: Domestic consumption as a share of production



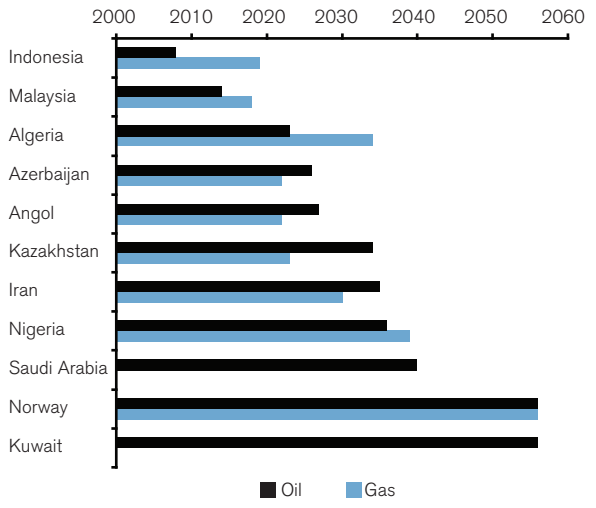
Sources: *BP Statistical Review 2007* and national statistics.

Figure 5: Period to decline of exports (reference case)



Source: Model results.

Figure 6: Period to end exports (reference case)



Source: Model results.

Eventually, under the model's reference assumptions, exports will end. Figure 6 shows the timelines. By these later dates the exporting countries will have adapted to survival or continued growth without oil export revenues and earnings. Importers, conversely, will have to look elsewhere for supplies.

Energy mix

In most countries, the oil output available for export could be higher (and gas exports lower) if there were more substitution of gas for oil, especially in power generation and industry. Such a policy would be subject to two constraints: the maximum of gas which could be absorbed in the stationary energy market (after the absorption of other local and presumably cheaper fuels such as coal and hydroelectricity, and renewables where these are significant in a country's plans); and commitments to export markets through long-term contracts, foreign partners and investment in liquefied natural gas (LNG) or pipeline infrastructure. In general the model assumes that currently announced plans for gas export are carried out, but that eventually supplies to the domestic market will take precedence over gas exports. Variant cases examine the alternatives, which in Indonesia, Kazakhstan, Malaysia and Nigeria could result in slightly longer periods of oil export. Shorter periods of gas export than in the reference case involve complicated choices. In Kuwait, on the reference case assumptions, gas imports would be required from 2020 to support even the present share of gas in the energy market.

Dependence on hydrocarbon exports can also be prolonged by the substitution of other fuels for hydrocarbons: Malaysia and Indonesia – both countries whose oil production is in decline and whose exports of oil either have ceased or will soon cease – have active policies to promote the use of biofuels. Both are leading world producers of palm oil, with potential for expanding its production to supply biofuels (at the expense of further deforestation of natural forests, and/or supplies to the food markets). The Iran nuclear power proposals would address similar objectives. There is a general lesson here: even oil- or gas-exporting countries need energy policies that look forward to a future mix of fuels which optimizes the balance between domestic consumption and exports according to the competitiveness of the country's resources.

Like energy efficiency policies, fuel mix policies can be implemented through the state enterprises which dominate the petrochemical and power sectors. In Indonesia, achieving the government's targets for non-hydrocarbon fuels (with a five-year delay) would realize 6 billion barrels (bn bbls) of oil and 1 bn bbls of oil equivalent (boe) of gas for export between 2007 and 2025. In Malaysia, the reference case assumes that government targets would similarly reduce hydrocarbon consumption by 2025 by 100,000 boe/day. In Indonesia, the government target is to reduce the oil share of energy consumption from the current 45% to 20% by 2025, mainly by increased use of coal. A more recent objective (not reflected in the simulations) is to increase the use of biofuels, hydro and possibly nuclear power to 17% of energy consumption by 2025, compared with 2% today. Iran also has a policy of increasing use of non-hydrocarbon fuel (nuclear) and the simulations include a variant which allows 5% of Iranian energy consumption to be met from non-hydrocarbon sources by 2020, extending the life of oil exports by three years. In Iran, a 20% share of primary energy switched to non-hydrocarbon fuels by 2025 would generate 15 bn bbls of hydrocarbon exports between 2007 and 2025.

Energy efficiency

The countries in the study, and some other oil-exporting countries, appear to have higher energy intensities than countries with similar incomes per head. There could be various explanations for this, including the likelihood that lower energy prices in the exporting countries lead to more intensive energy use. In Figure 7 the energy intensity per unit of GNI is compared on the basis of purchasing power parity (PPP) (World Bank Atlas method[8]). For most countries (Norway and Sweden are the exception) the gross national income at PPP is higher than the figure at current exchange rates – in other words, more or less, energy is valued at US prices and the national income enhanced accordingly, to show lower energy intensities than would appear if countries were compared on the bases of current exchange rates. Nevertheless, Figure 7 indicates that there should be scope for energy efficiency in the countries in the study.

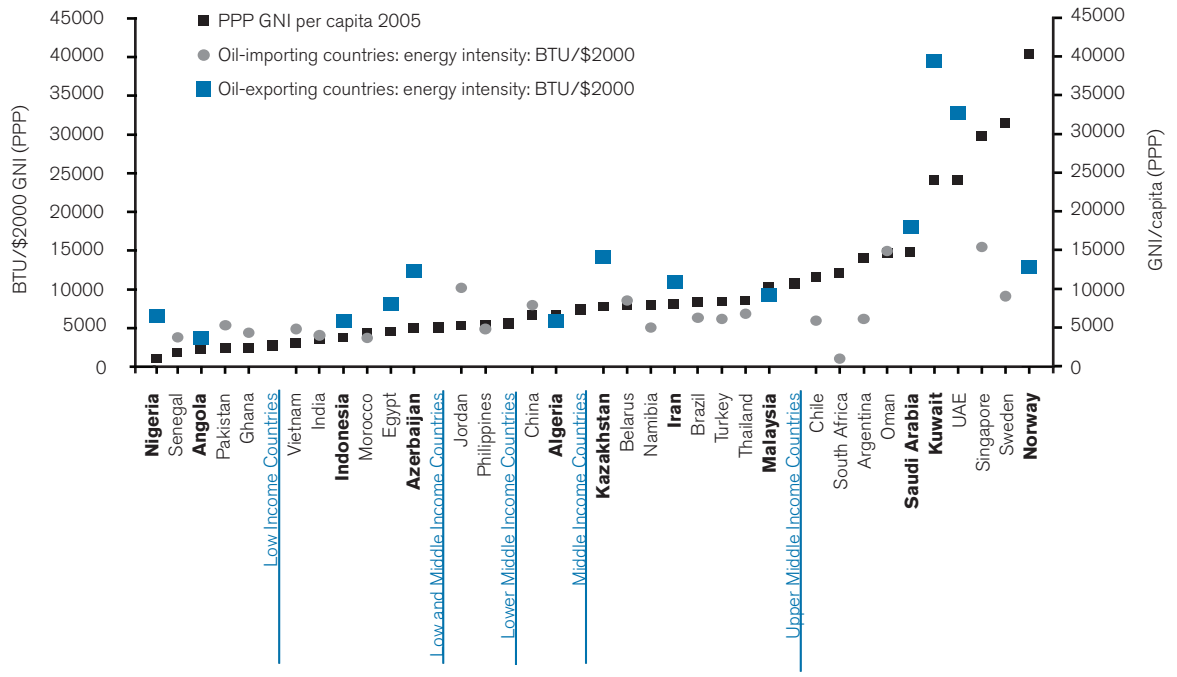
The future validity of 'cheap' energy is put in question by the prospect of plateau production and diminishing exports. Some countries have a legacy of investment in energy-intensive downstream industries which were established in the 1970s and 1980s during periods of oil surpluses and low prices. Only in rare cases – such as the Saudi petrochemical industries – do these industries command a global position which is supported by their added value. In all countries, greater efficiency in the use of energy would ease the problems of adjustment to lower hydrocarbon support.

The study simulated the effect of greater energy efficiency in variants which assumed that energy consumption would grow at 67% of the rate of growth in the non-hydrocarbon economy's GDP (instead of 80% in the reference case). The effect was to reduce oil and gas consumption and, depending on the energy mix and the size of the domestic market relative to production, to extend the period of exports by two to four years.

The economics of dependence

In this study, the propensities of the non-hydrocarbon economy to generate government revenue, absorb government expenditure, and generate exports and imports are assumed to be constant, based on current

Figure 7: Energy intensity of gross national income



Sources: World Development Indicators and Energy Information Administration (EIA), *International Energy Annual*, 2005.

relationships: in other words there is a 'business as usual' relationship between the non-hydrocarbon economy and the hydrocarbon sector. Part 2 discusses the prospects for changing these relationships. A further phase of the study will discuss the possibility of lower-growth paths.

The model

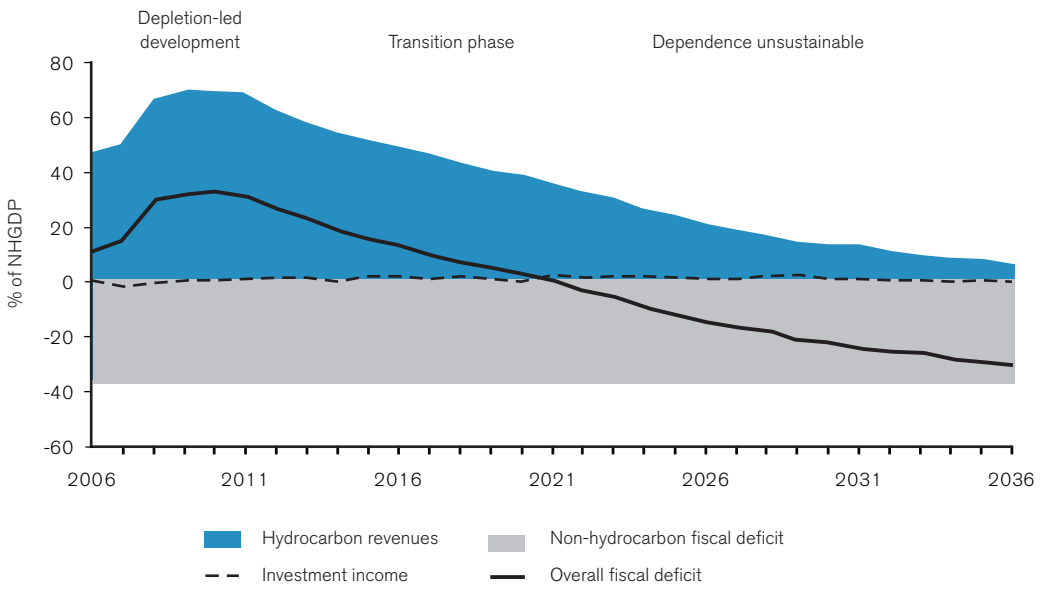
The simulation model (explained in Appendix 1) is designed to show in broad terms how the support that hydrocarbon sectors of ten countries[9] give to their non-hydrocarbon economies could develop over periods of 20–40 years under various assumptions about oil and gas reserves and prices, production profiles, fuel mix, energy efficiency, and the rates of growth of oil and gas consumption.

The results show how much the non-hydrocarbon sector would have to improve its fiscal and foreign exchange performance. They are reported for a benchmark date of 2025. This is not necessarily the beginning of the transition period for all countries, but the common date allows a comparison to be made between the efforts required by different countries over roughly the next two decades in order to bring the fiscal and current accounts of the country into balance: the bigger the deficit by 2025, as a percentage of non-hydrocarbon GDP, the more adjustment is necessary. Figure 8 illustrates the challenge for Nigeria at $100 bbl (2006 $) oil prices. Investment of surpluses during the depletion-led phase does not compensate for dwindling revenues during the transition and later phases. There is no escape from the need to reduce the dependence on oil revenues, which is assumed to continue at 35% of the non-hydrocarbon GDP.

The model also illustrates, in broad terms, the effect of oil- and gas-exporting countries' investments in sovereign wealth funds and other forms of financial investment outside their own economies. The alternatives are evaluated by reference to the Net Present Values (NPVs) of projected government revenue and for current exchange deficits.[10] Normally the 'adjustment' measures produce the same priorities as the NPV measures, but this is not always the case; early depletion may improve NPVs but leave a large adjustment problem at any given time in the future.

Apart from the direct fiscal and current account effects and the investment surpluses, the case studies do not model industrial and employment links between the hydrocarbon and non-hydrocarbon sector. These are discussed in Part 2 below.

Figure 8: Example of fiscal challenges – Nigerian government finance @ $100/bbl



Benchmarks

The measures for the results of the simulation analysis are related to the non-hydrocarbon GDP *(NHGDP)*. It is in the non-hydrocarbon sectors that most of the population lives and works and these are the sectors on which the government spends its hydrocarbon revenues. Trends in these sectors are more stable than in the economy as a whole where the weight of the hydrocarbon sector and its exports dominates the numbers. Hydrocarbon prices and volumes are volatile, and there are technical difficulties in finding a simple measure of 'real' economic growth.[11] The central banks of most of the countries studied, and the IMF, provide a statistical basis for separating the hydrocarbon and non-hydrocarbon economies (without detailed modelling of the linkages and multiplier effects). Using these definitions, the critical variables are the future *fiscal and current account balances* – normally deficits – of the non-hydrocarbon economy. These deficits are what the export earnings and government revenues from the hydrocarbon sector support now, as shown in Table 1.

Prices

The economic results depend on the prices assumed for oil and gas. There are three critical prices in the model:

- The assumed international crude oil price – Brent or Brent quality and location.
- The f.o.b. export price[12] for the country's basket of crude, related to Brent by transport and quality differentials. This directly affects hydrocarbon export earnings for the current account.
- The government revenue per barrel of oil production (or, with some differences, on exports and production for the domestic market), after allowing for costs including investment cash flow costs. This directly affects government revenue and budget surplus of the hydrocarbon sector.[13]

The reference case price scenario is for $60 per barrel for Brent crude, expressed in 2006 $, from 2008 onwards. Variants loom, at prices rising from $60 to $100, from $75 to $100, and at $100 flat from 2008. For the purpose of this study it is assumed that:

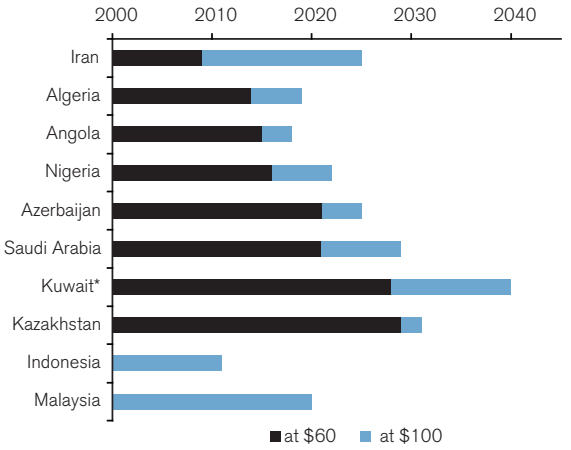
- $100 represents a cap set by alternative fuels and longer-term demand responses, none of which are represented explicitly in the model, although these are discussed in the case of Saudi Arabia.
- International gas prices are assumed to track international oil prices.
- The price assumptions are smooth paths for price and do not simulate cyclical movements or any feedback between volumes and prices.

Growth rates

The simulations assume that the non-hydrocarbon economy for each country for the period up to 2010 grows in line with recent trends and projections in IMF Country Reports, national planning documents and government statements. Between 2010 and 2015 this is assumed to move towards a long-term target aspiration: in most cases 6%, with lower variants. This rate broadly covers the expected long-term increase in the economically active population, plus factor productivity increase, to allow for some increase in real per capita income, and a reversal of the present tendency, in some countries, for unemployment to increase.

The general conclusion of the study is that these growth assumptions are unsustainable without reducing dependence on hydrocarbon revenues during a transition period which will begin within the next decade for some countries. Figure 9 shows, under the price assumptions of

Figure 9: Time to end of fiscal surplus



Source: Model results.

* Before contributions to the Fund for Future Generations. Budget deficits, after that contribution, would begin in 2025.

$60 flat and $100 flat, the time remaining before hydrocarbon revenues will fail to cover the fiscal deficit of the hydrocarbon economy. In Malaysia and Indonesia, this is already the case: the overall fiscal deficit is financed by borrowing as in other developing countries. This option would be available to the other hydrocarbon-dependent countries, but not to the ever-expanding degree necessary to offset declining hydrocarbon revenues. The shift to a structural deficit (for example of 3% of GDP) would also introduce a degree of accountability to financial markets which some oil-rich governments have so far avoided.

Further adjustment is necessary even in Malaysia and Indonesia, where dependence is low and governments have responded to the decline in oil export revenues and earnings. Beyond the transition period, when oil and gas production begins to decline, the challenge for some countries may be not so much to maintain growth as to prevent decline.[14]

Unfortunately for the planners in the countries concerned, the scale of adjustment depends critically on the price of oil, in the long term, over which they have individually little control (see Box 2).

Table 4 illustrates the fiscal adjustment which would need to be made in the non-hydrocarbon sectors, given the growth rates assumed for those sectors, no change in their propensity to absorb government revenue and imports, and the production profiles of the reference scenario.

Box 2: The price of oil

The price of oil is the result of the balance between supply and demand, intermediated by the structure of the markets for oil and the ownership of the resources. None are stationary.

For its first century (1870s to 1970s) oil supply was driven by an ever-expanding supply of oil at decreasing costs as a result of new discoveries and production and transport technologies, encouraged by the governments of countries in which new oil was discovered. International oil companies, controlling the international market through vertical integration and cross-shareholdings in concessions in exporting countries, tried to protect the price against collapse and to expand demand to absorb supply.

By the early 1970s circumstances had changed: demand trends, derived from consumers' investment in using 'cheap oil', outran supply and the governments of oil-producing countries demanded and got control over the production and pricing of their oil. The supply disruptions of 1973, reinforced by the change in control, led to a quadrupling of oil prices. The second disruption, in 1979–80, doubled them again, for a short time. Finally, the vertically integrated markets of the international oil companies were replaced by a world market in which the oil-producing countries' state companies sold directly to refining companies. Anti-inflation policies in importing countries induced a recession: oil demand fell absolutely and oil lost 10% of the world energy market.

The surplus production capacity was managed, as far as it could be, by governments of the Organization of Petroleum Exporting Countries (OPEC) through quotas and price agreements, but by 1986 the oil price had stabilized at around $30 (in 2006 $), below its 1970s level. It fluctuated around this level until around 2003. The demand generated at this price has again outrun supply.

The structural surplus of capacity created by the 1970s oil shock has disappeared and, unless there is a world recession, is unlikely to be recreated. In the long term, oil at $60 (in 2006 $) and above will compete with gas, with other fuels, and with investments in technologies which reduce energy and oil demand, none of which are under OPEC's control.

See John V. Mitchell, *A New Era for Oil Prices*, Chatham House Report, August 2006.

Table 4: Fiscal balances in 2025 as % of non-hydrocarbon GDP

	at $60/bbl	at $100/bbl	Difference
Angola	-36	-21	15
Algeria	-32	-17	15
Azerbaijan	-23	-1	22
Nigeria	-18	-10	8
Saudi Arabia	-16	19	35
Iran	-15	-1	14
Malaysia	-11	-3	8
Indonesia	-6	-6	0
Kazakhstan	6	115	109
Kuwait	8	115	107

* Includes income from sovereign wealth funds and investments.
Source: Model results.

The differences between countries are large. The short plateau production levels for Angola, Algeria and Azerbaijan explain the large adjustments they would require in the $60 scenarios. Saudi Arabia, Nigeria and Iran, with long production plateaux, would nevertheless need to make significant adjustments by 2025, but over a 20-year period the cumulative improvements required in the fiscal and current account deficits of the non-hydrocarbon sector seem plausible. For different reasons (mainly lower dependence and more diversification) Malaysia, Kazakhstan and Indonesia face lesser challenges. Even at $60 and 3.5 mbd production, Kuwait would still run a fiscal surplus in 2025.

The benefits of $100 oil through to 2025 (assuming the same production volumes) are uneven – suggesting that these countries would find it difficult to define a common interest in the level of oil prices. Those with most oil produced and exported during the period would gain more: Saudi Arabia, Kuwait, followed by Kazakhstan and Iran. Angola and Algeria would still face a serious challenge to improve the fiscal and external performances of their non-hydrocarbon sectors. The effect of price on the current account deficits differs in some respects from the effect on the fiscal balances: countries with high non-hydrocarbon exports, such as Malaysia (which is also still a gas exporter in this period), face the fewest challenges. Indonesia, as an oil importer in this period, would be adversely affected by the higher oil price. Angola and Algeria would face serious challenges even at $100 oil prices, while Saudi Arabia and Kuwait would develop even higher foreign exchange reserves (the effect on exchange rates, real or nominal, is not dealt with in the model, which assumes constant 2006 real rates). There are of course many other possible scenarios.

The current account displays a similar pattern, as Table 5 shows.

The difference between flat prices (at any level) and rising prices is important in deciding production profiles: for flat-price scenarios, countries will generally be better off by producing their reserves early and investing the results. If prices are expected to rise, it may be better to produce less now and more when prices are higher. However, these are risky decisions, since the price developments are uncertain. This is a particularly acute problem for Malaysia and Indonesia, which will be oil importers within a couple of decades. As will be discussed further below, one function of 'oil funds' is to provide a hedge against these risks.

Table 5: Current account balances in 2025 as % of non-hydrocarbon GDP

	at $60	at $100
Angola	-53	-39
Algeria	-42	-30
Azerbaijan	-20	-9
Nigeria	-11	-3
Iran	-9	3
Kazakhstan	-3	5
Saudi Arabia	-5	30
Indonesia	-5	-9
Malaysia	4	5
Kuwait	39	110

Source: Model results.

Economics of higher reserves and production

Higher reserves may be influenced by government policies towards exploration: licensing, funding for national oil companies, and use of foreign technology through partnerships, joint ventures, or production-sharing contracts. Higher production, if the reserves will support it, would be

the direct result of government policy in the state-dominated hydrocarbon sectors of these countries. The economic results of the production scenarios described in Tables 2 and 3 above are set out in Table 6 for the reference case price assumption of $60 per barrel. Predictably, more reserves benefit both the fiscal and the current account surpluses of the hydrocarbon sector. It is not surprising that hydrocarbon-dependent economies seek to ease their transition towards lower dependence by adding reserves, which could prolong the period of transition. However, without adjustment to the fiscal and current account performance of the non-hydrocarbon economy such additions and higher production profiles merely defer the inevitable change.

These numbers should be taken very broadly, since the higher production and reserves case reflects the arbitrary assumption used in the model to represent future opportunities. Combined with the priorities suggested by the reference case fiscal balances, they suggest interesting implications for the incentives which countries may be prepared to offer to their own or foreign oil and gas companies for future exploration and development.

Saudi Arabia is in a special position: its long-standing policy of a 2–3% maximum depletion rate means that even for the country with the largest oil reserves in the world, there is a case for adding reserves, as Saudi Aramco's active exploration policy shows. Higher production levels are a different question. A plateau based on 15 mbd crude capacity would not be sustainable beyond 2028 without additional reserves, given the 2–3% depletion rate constraint. If 70% of Saudi Aramco's target of 100 bn bbls of additional reserves were achieved by 2025, there would be a choice of production policies. The higher plateau could be sustained until 2038 and would remain above the reference plateau until 2050: beyond that, the 'higher' production would fall below the reference level, because of the depletion constraint, and the support for the non-hydrocarbon sectors would be less. Higher production would deplete the reserves sooner, yielding a higher net present value for government revenues, but the costs of adjustment in the non-hydrocarbon sectors are not represented in the model. These two problems are common to all the countries in choosing a production policy.

Earlier depletion (higher production in the near term) means higher value of government revenues now, but less output and a larger adjustment to the non-hydrocarbon sectors at a later date, for example when production would have turned down under the lower and longer production profile. While reserves will undoubtedly be added to those assumed by the reference case in the model, nobody knows how fast they will be added or how large the addition will be. Commitment to higher outputs and earlier downturns is therefore risky for the producing countries (and for the importing countries dependent on their trade).

Relaxation of the policies of 5% or 3% maximum depletion would also open up options for higher production. These constraints are partly technical, but mainly policy-based. Among the countries studied it is notable that Norway and Malaysia accept higher depletion rates, and operate to lower ratios of reserves to production – down to ten years or even less. These low ratios are accepted in the expectation that the reserves will be at least partly replaced.

Table 6: Effect of higher reserves and production on the fiscal deficit in 2025

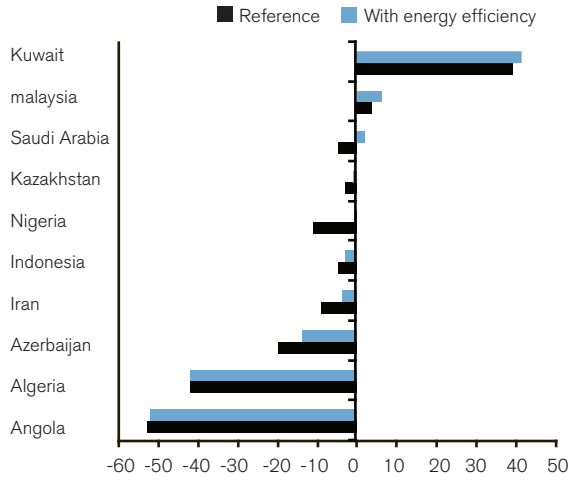
	Fiscal balance as % of NHGDP (2025) at $60		
	Reference production	Additional reserves/ *high production	Gain from higher reserves and production
Azerbaijan	-23	-2	21
Angola	-36	-16	20
Kuwait*	8	23	15
Saudi Arabia	-16	-6	10
Saudi Arabia*	-16	-4	12
Nigeria	-18	-7	11
Algeria	-32	-29	3
Iran*	-15	-12	3
Kazakhstan	6	9	3
Malaysia	-11	-9	2
Indonesia	-6	-6	0

Source: Model results.

Energy efficiency

The simulations examined (in countries with significant local consumption relative to exports) the effect of

Figure 10: Effect on 2025 current account of lower energy consumption per unit of GDP*



Source: Model results * Elasticity of 0.67 instead of 0.8.

reducing the rate of growth of energy consumption from 80% of the rate of growth of the non-hydrocarbon GDP (the reference case assumption) to 67%. There are some quirks in the results, because of the way energy balances work in different countries. The greatest effect was on the current account balances, since reductions in oil consumption do not affect revenue based on oil production, but do affect the volume available for export.

For some countries, with relatively simple dependence on oil for domestic energy, even these small savings can have significant results. Figure 10 shows the effects in the balance of payments in the reference case of the alternative assumptions in energy consumption. All the countries which would benefit significantly from the small improvement in energy intensity assumed are countries which were shown in Figure 7 to have significantly higher energy intensities than countries of similar GDP per capita.

Investment funds

The studies show that, even if prices remain flat at $60, current levels of production will generate fiscal and financial surpluses in these exporting countries. Higher prices would generate higher surpluses, and high production volumes would do the same. These surpluses will necessarily be invested. The surpluses will not, however, increase without limit, since the fiscal deficits and current account deficits will also expand (and high revenues would undoubtedly drive further increases in dependence on hydrocarbon revenues). Investments have two purposes: to provide stabilization for government revenues when oil and gas revenues fluctuate in the short term; and in the long term to provide an alternative source of income for the government.[15]

Drawing on the simulation results, Table 7 shows the level of funds which would accumulate by 2025 in the reference case. Under the reference case assumption, only in Kuwait and Kazakhstan (under its aggressive production assumptions) would funds still be growing by 2025.

The investment funds have two advantages over 'oil in the ground':

- They provide an income which is not directly dependent on oil and gas prices.
- The capital sum provides a strategic hedge against the failure of oil prices to rise, and the failure of the non-hydrocarbon economy to make the changes necessary to replace oil and gas income during the transition from oil dependence.

There is thus a case for the oil- and gas-exporting countries to consider the build-up of investment funds as a strategic objective in its own right, not merely as a by-product of surpluses generated by a combination of production policy and international market prices. They also carry some risks: currency and financial market risks and, in extreme circumstances, the risk of exposure to foreign financial sanctions.

Table 7: Fiscal surpluses invested by 2025

	Refernce	High production
	$ bn	$ bn
Nigeria	42	199
Azerbaijan	107	158
Kazakhstan	355	366
Kuwait	685	825
Saudi Arabia	817	1000

Source: Model results.

Part 2
The Non-Hydrocarbon Economy

Similarities and differences

Each of the twelve countries in this study was, for part of the last century, under foreign domination of some kind. For most, gaining control over their natural resources has been both a motive and a means to establish national independence and identity. To maintain this independence in the long term now requires reducing their dependence on the oil and gas sectors. The state-led approach to control in other sectors has neither the same justification nor the likelihood of success that it has had in the oil and gas sector, where revenues mainly arise from rent rather than competitive efficiency.

The differences between the countries in terms of their present economic and income levels, sources of development, and social and political institutions affect how diversification will need to implemented. These capacities are illustrated in Table 8, using indicators published by the World Bank. The competitiveness ranking is an indication of the potential of the non-hydrocarbon economy. The top four countries in the group are also the top four in the ranking of the UNDP's Human Development Index. There is a similar correspondence for the next four, though within each category both rankings vary widely. These do not correspond closely to the dependence on hydrocarbons: in 2006, Norway, Indonesia, Malaysia and Kazakhstan were the least dependent on hydrocarbon revenues for support of their non-hydrocarbon fiscal deficits; while Kuwait, Angola, Nigeria and Saudi Arabia were the most dependent.

The timing and degree of the reduction needed in hydrocarbon dependence differ between countries (as explained in Part 1), but there are four groups within each of which the depletion challenge is similar:

- **'Near sustainable'** – *Indonesia, Malaysia and Norway*: their oil production is already at a plateau or in

Table 8: Competitiveness, development and dependence indicators

Country	Competitiveness ranking (out of 133 countries)	HDI ranking (out of 133 countries)	Infant mortality (per 1,000 live births)	Literacy rate (% of population aged 15 and above)	Fiscal dependence on hydrocarbons (2006)*
Norway	16	2	3	n/a	-4
Malaysia	21	63	10	88	-13
Kuwait	30	33	9	93	-84
Saudi Arabia	35	61	21	78	-51
Indonesia	54	107	28	90	-8
Kazakhstan	61	73	63	99	-4
Azerbaijan	66	98	74	99	-29
Algeria	81	104	34	70	-42
Nigeria	95	158	100	69	-35
Timor-Leste	127	150	52	n/a	n/a
Angola	n/a	162	154	67	-69
Iran	n/a	94	31	82	-27

Sources: World Bank Development Indicators; UNDP; World Economic Forum, Global Competitiveness Index, 2007/08.
*Measured as % of non-hydrocarbon GDP as in Table 1.

decline (though gas production will continue to increase) but their economies are robust and continuing growth may be expected despite reduced dependence on hydrocarbons.

- **'Soon in transition'** – *Algeria and Nigeria*: both need to begin to reduce dependence around 2010; for Nigeria the period of adjustment may be long;
- **'Early dependence'** – *Angola, Azerbaijan, Kazakhstan and Timor–Leste*: all are experiencing depletion-led explosions of development, but only Kazakhstan can expect these to continue beyond 2010 on the basis of present reserves;
- **'Long-term depletion options'** – *Saudi Arabia, Kuwait and Iran*: all have large reserves relative to their economies. Although the transition may continue for two to four decades, it nevertheless needs to begin in oil within the next ten years.

'Near sustainable' – *Indonesia, Malaysia, Norway*

These three countries appear to have succeeded in their attempts at diversification. This success has been important since in Indonesia and Norway, as can be seen by the oil plateau sustainability in Table 2, the hydrocarbon sector is in relative decline and in Malaysia it is close to decline. In all three cases there are very positive signs that the transition away from a hydrocarbon-dependent economy is likely to succeed.

Norway explicitly stated in 1971 as part of its strategy to develop its hydrocarbon resources that it wanted to avoid excessive dependency on oil. Government policies were tailored to achieve this end. In particular, North Sea field developments were slowed to allow time for the Norwegian service industry to develop. Thus today the Norwegian 'petroleum cluster' has over 2,000 companies, many of them small and medium-sized enterprises (SMEs), of which more than 200 are expanding their operations internationally. In the last decade oil exports accounted for 50% of Norway's exports, 25% of GDP and 25% of government revenue, although the recent rises in oil price have rather increased those percentages.

Malaysia has also managed to reduce its dependence on hydrocarbons through its emphasis on developing the manufacturing sector. In 2006, manufacturing accounted for 31% of GDP, 81% of exports and 29% of employment. Previously it was agriculture which had made significant contributions. Currently the Malaysian government's policy is aimed at increasing the size of the 'knowledge-based economy' by restructuring and reforming education.

Indonesia has also gone to great lengths to reduce hydrocarbon dependence. In 2006 manufacturing and agriculture accounted for 29% and 13% of GDP respectively.

All three countries need to use the development of the non-hydrocarbon economy as a means to create more jobs.

Table 9: Differences in dependence between the countries and groups

Country	Fiscal dependence (2006)*	Current account dependence (2006)	Transition begins (see Fig. 3 above)
Near sustainable			
Norway	-4	-9	2001
Mayaysia	-13	-8	1995
Indonesia	-8	1	1993
Soon in transition			
Algeria	-42	-82	2010
Nigeria	-35	-13	2010
Early dependence			
Angola	-69	-30	2010
Azerbaijan	-29	-30	2010
Kazakhstan	-4	-58	2015
Timor-Leste	n/a	n/a	2008
Long-term depletion options			
Kuwait	-84	-28	2010
Iran	-27	-25	2010
Saudi Arabia	-16	-57	2015

Sources: Project country studies and Part 1 of this report.
*Measured as % of non-hydrocarbon GDP as in Table 1.

'Soon in transition' – *Algeria, Nigeria*

These countries have a fairly urgent need to reduce dependence on the hydrocarbon sector or face the prospects of a painful and imminent transition, because previous efforts to diversify over a long history of hydrocarbon dominance have failed. Furthermore, as indicated in Table 1, their reserves of hydrocarbons suggest that plateau production may well be limited. Their failure so far to begin the relatively urgent process of transition has in large part been the result of a lack of human capital plus a

failure of leadership and the political system to provide an environment for the development of other sectors.

The Nigerian non-hydrocarbon economy has been in decline for the last 50 years. Thus in the 1960s, agriculture (where most are employed) accounted for 70% of non-hydrocarbon GDP. In the 1970s this fell to 41% and in the last five years has averaged a mere 5.6% of GDP. The result has been a sustained growth in poverty for the majority of the population. Thus hydrocarbon dependence is high, accounting for 70% of government revenue, 40% of GDP and 90% of foreign exchange. There have been recent attempts to reverse this by means of a reform agenda, which has resulted in some growth in the non-hydrocarbon sector. Efforts have also been made to increase the backward linkages into the oil sector by imposing minimum local content legislation. The official target is a minimum local content of 70% by 2010 but this is regarded as hopelessly optimistic, given that current estimates put local content at only 5%. It simply encourages administrative fiddling to give the appearance of local content to material which is still imported.

Algeria's story is of great state efforts in the 1970s to diversify by trying to develop heavy industry. However, for the most part these efforts failed. The industries required ever-increasing protection, further aggravating their levels of inefficiency. The political upheavals in the 1990s (amounting to a civil war) have also seriously inhibited the process of diversification, not least because of their negative impact on private-sector development. There is widespread acceptance that Algeria remains hobbled by a lack of capacity to use all the funds at its disposal.

'Early dependence' – *Angola, Azerbaijan, Kazakhstan, Timor-Leste*

These four countries are relatively new to large-scale hydrocarbon wealth.[16] However, their window of opportunity to solve the diversification problem as defined by the plateau period in Table 1 is small, assuming limited additions to reserves. Furthermore all four face considerable barriers to diversification which will be considered in more detail below. So far there are few signs of a successful process beginning. All four suffer from a lack of infrastructure coupled with problems of inefficient spending and a general lack of administrative capacity within the government.

As former Soviet republics, Azerbaijan and Kazakhstan underwent an economic transition during the 1990s which effectively destroyed much of the non-hydrocarbon economy. For example, in Kazakhstan between 1992 and 1996 GDP fell by 40% and manufacturing output by over 50%. To some extent, recovery has been inhibited by a 'crowding out' phenomenon whereby the oil sector takes for itself the best factor inputs, starving the other sectors. Furthermore the private sector, which in all cases is the key to developing a sound non-hydrocarbon economy, is suffering from the aftermath of Soviet economic policy's domination of the state. Certainly for Azerbaijan, little reduction in hydrocarbon dependence is expected in the near future. In 2006, oil revenues increased by 67% and hydrocarbon exports accounted for 90% of all exports.

Kazakhstan has the potential, not least because its hydrocarbon dependence is much lower, with oil accounting for 60% of exports and 37% of total revenue. However, to fulfil this potential will require an economic reform process which has stalled in the presence of high oil revenues. As this project's country commentary finds, Kazakhstan is well positioned to manage the transition from oil dependence compared to many oil exporters, but the principal obstacle to sound policy is rent-seeking.

In Timor-Leste, the dominance of the oil sector is complete: it accounts for 95% of government revenue, 73% of GDP and virtually all exports. It has been estimated that when the Greater Sunshine Field comes on-stream in 2010, the sector will account for 89% of GDP and 94% of government revenue. The rest of the economy is essentially subsistence agriculture.

In Angola the non-hydrocarbon sectors of the economy, dominated by agriculture, were effectively destroyed by decades of civil war. Thus the total cropped area fell by 40% between 1975 and 2003. Agriculture has also faced serious infrastructure constraints, especially transportation. The Angolan economy is very dependent upon oil. In 2006, the sector accounted for 58% of GDP, 81% of government revenue and 96% of exports. The country commentary estimates that during 2001–05 the genuine savings rate was –44%, which means all the natural capital from oil has been consumed to sustain a highly skewed income distribution, making little or no contribution to the economy's productive

base. Angola faces not just a development challenge, but a reconstruction task. The civil war destroyed infrastructure, leaving large parts of the country – rich in other natural resources – without power, communications, schools, hospitals and public order.

'Long-term depletion options' – *Saudi Arabia, Kuwait, Iran*

There may be less urgency for these three countries to develop a non-hydrocarbon economy since they appear from Table 1 to have a long oil plateau period.[17] The urgency may depend on how much needs to be done by a given date, rather than when to begin. All three have long espoused the need to reduce dependence on exporting crude oil, but to date with relatively little success. For example, in Kuwait oil accounted for 50% of GDP, 95% of exports and 80% of government revenues in 2006. Although both Kuwait and Saudi Arabia have had some success with the development of petrochemicals, since this is dependent on hydrocarbon feedstock it is a moot point as to how far this constitutes diversification.

Diversification has been an explicit policy in Iran since the early 1970s but the process was hampered, first by the Revolution and then by the Iraq–Iran war. In the case of Saudi Arabia the weakness of the private sector has inhibited diversification despite great efforts by the government to encourage the private sector to play a greater role domestically. In Kuwait, attempts at diversification have failed, partly owing to a similar weakness within the private sector but also because of the political paralysis which has characterized the country since its liberation from Iraq in 1991.

Demographics and market size

The size of the domestic market is clearly an important factor in the ability of a country to expand the non-hydrocarbon economy. This is a function of population and per capita income. As can be seen from Table 10, the twelve countries have very different population sizes. Equally, their projected annual percentage population growth rates vary from high (Timor-Leste, Angola, Kuwait, Saudi Arabia, Nigeria) to medium (Algeria, Malaysia, Iran, Indonesia) to low (Azerbaijan, Kazakhstan, Norway).

Table 10 shows that there are also enormous differences in domestic purchasing power between the case study countries. To talk of developing non-oil economies in countries such as Indonesia and Iran makes eminent sense. For small markets such as Timor-Leste, Angola and Azerbaijan it is less obvious that the domestic market can support a vibrant non-hydrocarbon economy.

However, market size is far more complex. One only has to think of the examples of economic success stories such as

Table 10: Demographic characteristics and some consequences

Country	Population (m)	Projected average annual population growth (2006–15)	Population density per sq km	GNI (US$ per capita)	GNI PPP (US$ per capita)	Market size (US$bn)
Algeria	33.4	1.5	14	3,030	5,940	115
Angola	16.6	2.8	13	1,970	3,890	45
Azerbaijan	8.5	0.9	103	1,840	5,430	20
Indonesia	223.0	1.0	123	1,420	3,310	365
Iran	70.1	1.3	43	2,930	9,800	218
Kazakhstan	15.3	0.8	6	3,870	8,700	81
Kuwait	2.6	2.2	146	30,630	48,310	81
Malaysia	26.1	1.5	79	5,620	12,160	151
Nigeria	144.7	2.1	159	620	1,410	115
Norway	4.7	0.6	15	68,440	50,070	335
Saudi Arabia	23.7	2.1	12	13,980	22,300	349
Timor-Leste	1.0	3.7	69	840	5100	0.36

Source: World Bank Development Indicators 2008.

Notes: Data are for 2006. Market size is measured as gross domestic product (GDP). GNI = gross national income; PPP = purchasing power parity.

Hong Kong and Singapore to see this. Thus access to international markets is of key importance. For example, Norway, with its preferential access to the European Union market, need fear no constraints from a relatively small domestic market. Similarly, Saudi Arabia, with its very favourable access to the international market for petrochemicals where it currently holds some 10%, need not fear market constraints.[18] In general, membership of multilateral trade organizations such as the World Trade Organization (WTO) will assist in this process. Countries in the 'Early dependence' group tend to have small markets and it may well pay them to think seriously about increasing regional integration where possible to expand their market potential.

Federal versus unified

Federal structures complicate the incentive systems and can make a difference in terms of revenue deployment. Certainly Malaysia, Indonesia, Nigeria have formal revenue-sharing systems. Dissatisfaction with revenue-sharing is the basis of civil conflict in Nigeria and (until recently) in Indonesia. For a regional or state government, arguing for a larger share of oil revenues may be an easy alternative to diversification, especially where other local economic opportunities are limited.

The resource base

Obviously a country's ability to develop a non-hydrocarbon base will be strongly dependent upon its access to other resources. Resources have a multitude of dimensions which received considerable attention in both the case studies and the workshop.

Human resources and employment

All the evidence in the development literature points to one unequivocal conclusion. Investing in developing human capital through education and health generates the greatest return of all investment. The key success factor for countries is the existence of an educated and skilled workforce. However, as will be explained below, having the labour force and making best use of it are two different things.

The human resource endowment of the case study countries varies enormously. In Norway, Malaysia and Indonesia there is a strong human capital base which has been put to good use; this helps explain why these three countries have succeeded in starting the process of diversification. For example, Malaysia explicitly focused in its 9th Five-Year Plan (2006–10) on strengthening human capital as the means to maintain global competitiveness. This was to be achieved by education reforms and an emphasis on skills training, specifically improving English language competency. In all three cases, developing the non-hydrocarbon sectors is seen as a necessary condition to provide jobs for the growing labour force.

In Azerbaijan, Kazakhstan and Iran there is a strong legacy of educated labour but the system has failed to make the most of this advantage. In the two former Soviet republics, the official unemployment figure is above 6% but appears to have declined slightly over the last couple of years. Iran has skilled labour and well trained management but the labour laws are highly protective and positively discourage the private sector from taking on workers. The result is that underemployment is over 20% and the economy needs to create 650,000 to one million jobs annually just to accommodate the school leavers. This target has not been met in any year since 1988.

The final group of countries – Algeria, Angola, Kuwait, Nigeria, Saudi Arabia and Timor-Leste – face the problem of a shortage of human capital. Thus Nigeria has a low level of technical expertise and a poor management culture. Despite very high spending on education over the years there has been a very sharp decline in the quality of education and attainment rates and only 57% of the adult population is literate. The situation changed little in the 1990s. There has also been poor maintenance of the education infrastructure and many public education institutions lack the most basic of facilities. In Kuwait, where considerable resources have been put into education, a major problem of 'diploma trafficking' has developed, whereby private institutions effectively 'sell' qualifications. This illustrates an important point relevant for other countries in this group, namely that simply throwing more money at education is not necessarily the answer if spending efficiency is poor. In Angola

deficient human capital is a key obstacle to effective oil revenue deployment.

Saudi Arabia also faces the major problem of increasing youth unemployment as a result of years of rapid (though now declining) growth in the Saudi population. Part of the reason is that many young Saudis are poorly educated and weakly motivated while expatriate labour is far cheaper, more productive and more flexible from the employers' perspective. Saudi wages are two to three times higher than those of expatriates and, once employed, Saudis are difficult to sack. The data in the study's country commentary suggest that only 20% of the civilian labour force are Saudi. With 75% of the population under 30 this presents a serious challenge. Specifically, if the government continues to pursue its Saudi-ization policy there is a real danger that it will damage Saudi Arabia's competitive position in the global market and indeed domestically, since its accession to the WTO means the domestic market is now open to competition. The only way to employ more Saudis would be through a new 'social contract' based upon lower wages in return for more public goods of better quality.

Kuwait has an extreme version of the population challenge to sustained development. Half of Kuwait's population of 3 million[19] are temporarily immigrant non-nationals, most of whom work in the private sector, while 90% of Kuwaiti nationals work in the public sector. Long-term projects need a view of the future population balance: if immigration continues at historical trends, it will double by 2027. If the non-national population were capped at its present level, the total population in 2027 would be 20% lower. Either way, employment of Kuwaitis in the private sector will need to increase, and the distribution of social benefits will come under increasing strain.

Other natural resources

The presence of natural resources is not a necessary condition to promote economic diversification. Switzerland and Japan both illustrate the point well. Also, as the theory paper *Resource Depletion, Dependence and Development: Can Theory Help?* illustrates, much of the literature on 'resource curse' attributes the problem to the presence of 'natural resources' generally rather than just hydrocarbons or minerals. Some of the case study countries do have other natural resources such as agricultural land and forestry which could be used to promote the non-hydrocarbon sectors. Nigeria has a large and diverse mineral base but the oil boom of the 1970s prompted a decline. For example, in 1958 Nigeria produced 1 million tonnes of coal but by 1992 this had fallen to under 20,000 tonnes. Kazakhstan's substantial mineral exports help explain its lower hydrocarbon dependence outlined above.

Infrastructure

The role of infrastructure in promoting private-sector activity is crucial and in many of the case studies weak infrastructure presents a serious barrier to economic diversification. Many of the countries which have been producers for some time did develop their infrastructure as a consequence of the oil revenue windfalls of the 1970s. However, in many cases this has been neglected and poorly maintained. For example, in Kuwait the good infrastructure developed in the 1970s has suffered from capital under-spending as a result of very high current expenditure levels. In other cases the infrastructure was never developed and this has resulted in serious barriers to development. In Angola, for example, poor transportation has been a major handicap for rural development. In Nigeria poor enabling infrastructure (mainly power and roads) remains a major constraint on development. One consequence is that resources are diverted from directly productive investment into the self-provision of utility services such as small-scale power generation. It has been estimated that this increases costs in some activities in Nigeria by 20%. Timor-Leste suffers similar problems.

In one sense the recent revenue windfalls present a major opportunity since they accrue to the government and normally it is the government's role to ensure adequate investment in infrastructure and other public goods. This is beginning to happen in many of the countries studied. For example, the Algerian government is spending on new roads and homes around Algiers and other cities, something it failed to do in the earlier boom. Not only is this popular domestically, it is also a necessary condition for the development of the non-hydrocarbon economy.

Capital

Access to capital is clearly another necessary condition for diversification and development of the non-hydrocarbon economy. At first sight, given the very high oil price levels and the consequent revenue windfall, capital shortage might not seem to be a problem. However, the case studies indicate a more complicated situation. The revenue accrues to the government. Even though this may assist in the development of infrastructure, as outlined above, there is a grave danger that the way the government deploys the revenue could well create a bad attack of 'resource curse', an issue explored further in the theory paper.[20] In Angola the government actually borrowed in anticipation of oil revenues but the terms of the borrowing were opaque, outside the formal budget, and were effectively used to facilitate patronage recycling. This is one example of the negative consequences of revenue windfall, which is being used similarly in a number of the case study countries.

However, the real problem with capital is how to allow the private sector to get access in an efficient and effective manner. In most cases, it faces serious constraints on securing capital as a result of institutional weakness in the financial sector. This is especially important for SMEs, which are normally the main source of job creation. The list of examples of problems with access to capital from the case studies is long and depressing.

In Indonesia access to capital is difficult. In Azerbaijan local capital markets are very weak. This is not helped by very poor transparency in financial management, and the non-hydrocarbon sector is described as 'capital hungry'. Nigeria faces acute shortages of capital, especially for SMEs, although since 2003 robust banking sector reform has resulted in greater domestic and foreign capital inflows. Nigerian banks raised $3 billion from the domestic capital market and attracted some $600 million of foreign direct investment (FDI). One problem in many of the countries studied is that large amounts of capital end up abroad. For example, the civil disorder in Timor-Leste in 2006 created a significant capital flight. Private assets estimated at $1,000 billion are held abroad by Saudis; if returned these could have a strong impact on investment and the development of the private sector.

Only in Norway and Malaysia does private-sector access to capital not present a barrier to economic growth. Norway, as a member of the OECD, has long had effective financial institutions in place. In Malaysia in the late 1980s the capital market was deregulated. The sector has since been closely supervised by the Central Bank, which was given very strong legal powers to do so. The result is a strong sector which managed to ride the worst of the Asian financial crisis in the late 1990s.

Institutions

Leadership, political elites and the quality of decision-making

There is general agreement in the literature on development that governance is the key to an economy's ability to develop. Specifically, the ability to manage oil revenue windfalls and to promote the development of the non-hydrocarbon economy is seen to depend upon the quality of institutions. Good institutions equal a good outcome.[21] The record and prospects of the twelve countries are very mixed. Three of them – Norway, Malaysia and Indonesia – are often quoted as being success stories,[22] not least because they are well along the road to reaching a level of diversification which is sustainable as hydrocarbon resources decline. Norway is a mature democracy[23] with well-developed civil society institutions. The success of Malaysia and Indonesia is less straightforward to explain since they have been characterized by a degree of 'crony capitalism'. Indonesia, in particular, faces a growing problem with corruption: Transparency International's Corruption Perception Index puts the country 143rd out of 180, although there have been recent attempts to improve governance.

However, other country groupings in the study are far more problematic, not least because many face an urgent need to begin the process of diversification. Angola presents a classic example: here the principal obstacle to the effective deployment of its oil revenue is a rent-seeking polity and a strongly distorted economy. Forty years of civil war have created huge distortions in the political economy, which translates into a rent-seeking autocracy. Lax revenue deployment has greatly increased rent-

seeking opportunities for the elite. This elite has established three mechanisms to siphon off the rent. High public expenditure has led to over-invoicing and contracts to 'ghost' civil servants; public expenditure is pro-wealthy; and finally, the elite controls the monopoly on import trade and manufacturing.

There is a similar story in Kazakhstan. Here rent-seeking and corruption[24] are rife after decades of central planning and present the principal obstacle to sound policy. However, herein lies another problem common to many of the case studies. The view is that Kazakhstan has the administrative capacity to take full advantage of its favourable resource endowment if the regime appreciates the importance of economic reform. However, when oil prices are high, the imperative for change falters and invariably reform programmes slip. This is also true in Kuwait and Saudi Arabia, where typical patterns of 'patron-client' political and economic relations also encourage weak governance in the presence of large oil revenues.

Sometimes, part of the story of poor governance is simply a lack of administrative capacity. For example, Timor-Leste faces very serious capacity constraints and relies heavily on external advice, but this can only be limited in scope. One consequence is very poor budget execution. This means that, so far at least, higher oil revenues have not translated into economic growth.

On a more positive note, governance issues have moved up the political agenda and case study countries are increasingly concerned, if only because of their external image. Thus, for example, in 2003 Nigeria introduced its 'National Economic Empowerment Development Strategy' (NEEDS) – a home-grown reform agenda aimed very much at improving governance, especially in the context of the corruption which has been rife in Nigeria for many decades. This was intended to provide a platform for sustained economic growth, to entrench stability in the economy and to improve the budgetary process and generate fiscal prudence. However, the case studies suggest that on balance those countries which need to act quickly to promote diversification – those in the 'Soon in transition' and 'Early dependence' groups – also face the greatest challenges over improving governance.

Characteristics of the private sector and entrepreneurship

Diversification requires the development and encouragement of the private sector. One of the continuing problems is that hydrocarbon-dependent countries, by virtue of the fact that revenues accrue to government, are *de facto* forced into greater government involvement in the economy. The record of private-sector development in the case study countries is mixed but generally not encouraging.

In Norway and Malaysia the situation is positive. In Malaysia the business governance framework and operation is well defined. For much of the time it has been an open economy with a long history of integration into the global economy, welcoming FDI and foreign technology, and with foreign multinationals dominating their manufacturing exports. Norway has a strong private sector but even here, the IMF is of the opinion that the government should do much more to withdraw from the economy and leave more options for the private sector. The precise balance between public and private has long been a subject of considerable debate within Norway.

The story in Azerbaijan appears to be promising. It is claimed that the hydrocarbon sector has been 'the locomotive of private-sector development'. Knowledge and technical spill-over and spending have stimulated private-sector activity outside the hydrocarbon sector. The process has been helped by the creation of a 'one-stop shop' approach to licensing and permits to register commercial companies. Efforts to gain accession to the WTO are also helping to improve the legal framework for business. In Timor-Leste doing business is difficult because of excessive bureaucracy and the private sector lacks competitiveness. Moreover political uncertainties will inevitably inhibit private-sector investment, but at least the regulatory framework, based upon external advice, is beginning to take shape.

In most of the case studies the private sector is weak although there is quite a wide range of what can be described as failure.

In Indonesia, the private sector flourished in the 1980s and 1990s, and this was reflected in the relative success in developing a non-hydrocarbon economy. However, since 1998 and the Asian financial crisis, the business climate has

become more difficult. The private sector complains about conflicting and easily changed regulations. The biggest burden is the labour laws, which are extremely protective of workers and make it difficult to get rid of poor performers.

In Saudi Arabia, the government has long claimed to believe in a growing role for the private sector to act as the creator of jobs for Saudi nationals. However, this has proved difficult to achieve, not least because members of the ruling elite have tended to take the best deals for themselves and therefore much of what could invigorate the Saudi private sector operates outside the Kingdom. The current strategy is to leave all but the most capital-intensive productive activities to the private sector. Government spending is expected to be increasingly directed away from directly productive activities to focus on health, education and infrastructure. Saudi's recent accession to the WTO could also help to give a greater role to the private sector.

The private sector in Kuwait suffers similar problems. The state ownership and control of oil severely constrains private-sector involvement and impedes the creation of stronger private business interests. This is further inhibited by the political paralysis which has characterized the country since 1991.

In Kazakhstan, the private sector is viewed in the study's country commentary as weak. In 2005, the state generated 35% of GDP, almost double the expected level. Thus corruption and inadequate safeguards to private property continue to discourage non-mineral private-sector investment, and recycling oil revenues by means of patronage channels represses markets and feeds corruption. Furthermore, at regional level *Oblast* [district] governors recycle revenues in a way that represses private business, not least by blocking the privatization of their state-owned firms. Unfortunately, the initial reforms which accelerated the privatization process typically slowed when oil revenues increased.

In Iran, the official policy has been to encourage the private sector, but because of a bloated public sector (contributing more than 65% of GDP) and the failure of the privatization drive, the private sector has underperformed and has been starved of good government deals. The economy is highly centralized and excessively bureaucratic; every aspect of the economy is micro-managed, largely through a process of permits for virtually all elements of economic life.

Algeria has been plagued by 'crony capitalism' and the government has failed to create a favourable business climate, especially for SMEs, and influence peddling remains an integral part of business. The privatization programme has largely failed and there is too little scope for individual initiative.

In Angola there is a strong statist legacy, especially in agriculture where the government continues to impose price caps on produce. Business competitiveness is very poor: indices in the country commentary put the country last of 128 countries.

In Nigeria there have been attempts to introduce land reform since the 1976 Land Act vested ownership of all land with the government. The aim is to transfer land to farmers to encourage a positive incentive system.

In all cases, the secret of building the strong private sector necessary to develop the non-hydrocarbon sector is to create the right incentive system. This must come from the leadership and many oil producers are lacking in this respect. Much needs to be done if they are to have any hope of moving towards greater diversification.

Spending efficiency and 'resource curse' issues

While private-sector development is crucial to the promotion of the non-hydrocarbon economy, the reality is that government deployment of the hydrocarbon revenues remains a central issue in terms of determining how the economy develops. There are two choices, although these are by no means mutually exclusive. One is to spend the revenues domestically; the other is to save them abroad through the use of sovereign wealth funds.

The effectiveness of spending domestically depends upon how efficiently the revenues can be deployed, which in turn depends upon the ability of the government to avoid an attack of 'resource curse'. The theory paper discusses the issue of 'resource curse' at length.[25] What emerges from the country case studies is that many of the issues surrounding 'resource curse' are now much better understood than they were in the 1970s, when most of the oil producers suffered considerably as a result of an inability to manage the revenue windfalls. However,

this has not prevented a number of the case study countries from experiencing problems more recently, in particular the 'Dutch disease' dimension of 'recourse curse'.[26] A serious attack of Dutch disease in Angola has seriously eroded the viability of the agricultural sector, which employs over 75% of the workforce; not until 2007 was some control over inflation restored. Azerbaijan too has experienced an appreciating real exchange rate in the last four to five years, leading to a fall in non-oil exports and a sharp rise in imports. In the 1990s, Kazakhstan also suffered from Dutch disease (during 1994–98 the real exchange rate appreciated by 30%), although over the last five years or so, macro-economic control has been restored and the very high levels of inflation have been managed. In Kuwait, the problem has been excessive spending, with 75% of the budget going into current spending on the public sector, of which salaries and subsidies account for 80–85%.[27]

These problems illustrate the importance of governance in the story. Simply understanding what needs to be done is not enough if the political will and ability are lacking. In general, however, in contrast to the 1970s, the macro-economic policies have been much more effective, with much of the post-2003 windfall revenues being used to pay off debt, and most countries have tried to manage their revenues in a more responsible manner. For example, since 2003, as part of its reforms to improve the efficiency of government spending, Nigeria has put in place a 'medium-term expenditure framework' to reflect government priorities. This has been replaced by the '2008–10 fiscal strategy'. The monthly publication of all revenue shared with the three tiers of government has increased transparency and accountability. This has been further strengthened by the passing of two acts, on the Bureau for Public Procurement and on Fiscal Responsibility. Nigeria has also signed up to the Extractive Industry Transparency Initiative (EITI). However, in many of the case study countries the efficiency with which the governments spend money still leaves much to be desired.

Oil funds

The alternative choice for governments to deploy hydrocarbon revenues is to save them. Whether this requires some form of 'oil fund' is a moot point. The arguments for and against oil funds have been laid out in detail in the theory paper, together with an appendix which outlines many of the existing funds.[28] Probably the most famous is the Norwegian fund.[29] Created in 1990 as the 'Norwegian Petroleum Fund', it received its first revenues only in 1996, some 25 years after oil production began. It is both a stabilization and a savings fund and currently holds some $371 billion in assets. It was renamed the 'Government Pension Fund' (GPF) in 1996. Norway has a 'fiscal rule' designed to control government spending out of that fund; for most of the time, however, this rule is effectively broken. The GPF was an integral part of the general budgetary process and its only explicit use was to support non-oil fiscal deficits. In 2003, as a result of Nigeria's NEED Strategy, public expenditure was de-linked from oil price volatility via an 'oil price-based fiscal rule'. The budget provision was fixed to a (low) oil price and anything above this went into an 'excess crude account'. Saudi Arabia is planning to start a sovereign wealth fund in 2008 with $5.3 billion. Total foreign assets held by the Kingdom's government reached $319 billion in 2007 and are expected to rise to $420 billion by 2010.

However, the main view about such funds to emerge from the April 2008 workshop was that they do not of themselves guarantee prudent fiscal management or indeed a commitment to savings. Their effectiveness requires wider fiscal discipline and quality control of public investment. Of crucial importance is that the fund should operate in a coordinated manner with the general budget. For example, Indonesia, which might be regarded as a success in the period 1969–98, did so without an oil fund. As the theory paper concludes in its discussion of funds, if the governance of a country's financial institutions and central budget is sound, then an oil fund is not essential. If the governance is poor, however, then a fund will not help and will simply act as a magnet for corrupt politicians.[30]

Summary and Conclusions

The challenges of hydrocarbon depletion

- Most oil-exporting countries must prepare to reduce their dependence on oil. Of the twelve countries in this study, oil production is in decline or at a plateau in three: Indonesia, Malaysia and Norway. In a further seven countries, the plateau will be reached around 2010. Saudi Arabia and Kazakhstan will reach a plateau before 2020. Production will move from plateau to decline before or around 2020 in all countries except Saudi Arabia, where a plateau based on 12.5 mb/d crude capacity and current stated reserves may continue until nearly 2040, and Iran and Kuwait, where the plateau could continue beyond 2050.
- Oil exports from many countries will begin to fall within ten years unless there are significant additions to reserves. The growth in their own consumption means that oil exports will decline once the plateau of production is reached. On consumption trends linked to a 6% long-term growth in the non-hydrocarbon sectors, as Figure 6 shows, half the countries in the study will have ceased to export beyond 2030. Iran, Nigeria and Saudi Arabia will cease to export beyond 2040, and only Norway and Kuwait would be exporting beyond 2050.
- The non-hydrocarbon sectors, where the population of these countries lives and works, need to reduce their dependence on oil and gas soon in order to sustain their long-term economic growth. Fiscal and current account deficits of the non-hydrocarbon sectors must be reduced. The size and timing of the reduction depend mainly on the future price of oil, but it is inevitable.
- At a flat price trend of $60/bbl (2006 $) – probably a worst case – the non-hydrocarbon fiscal deficits on 'business as usual' scenarios will not be supported beyond 2030 in any of the countries, and be supported beyond 2020 in only four: Saudi Arabia, Kuwait, Kazakhstan and Azerbaijan. Even in these countries, support will be inadequate beyond 2030.
- A flat price trend of $100 (2006 $) would still leave an overall and escalating fiscal deficit for Algeria and Angola before 2020, Iran and Nigeria before 2025, and Saudi Arabia before 2030. To fill the gap left by falling oil revenues, while maintaining a 6% growth target, would require, by 2025, major adjustments (20–30% of non-hydrocarbon GDP) in Algeria, Angola, and Azerbaijan, and significant adjustments (15–20% of non-hydrocarbon GDP) in Iran, Saudi Arabia and Nigeria. The gaps in foreign exchange balances would evolve in a similar way, with some differences between countries.
- Government policies to expand reserves through exploration and new technology, and invest in higher production, could extend the period of economic support from the hydrocarbon to the non-hydrocarbon sectors. Depending on the country, the reserve additions assumed in the model would extend the plateau, and therefore oil exports, by two to seven years. By 2025, Angola, Algeria, Iran and Malaysia would still need to have improved the fiscal balance of their non-hydrocarbon sectors by 10% or more.
- Slowing the growth of domestic energy consumption would also prolong and reduce the period of transition to lower dependence on oil and gas. The reference cases assume that energy consumption grows at four-fifths (80%) of the rate of growth of the non-hydrocarbon GDP. If this ratio were reduced to two-thirds (67%), there would be improvements of 5–10% of the non-hydrocarbon GDP in Nigeria, Saudi Arabia, Iran and Azerbaijan in our simulations.

- The financial surpluses invested abroad (e.g. in sovereign wealth funds) are an essential strategic protection for the exporting countries against the uncertainties of future oil prices, future reserves, and above all the uncertainty of their non-hydrocarbon economies to adapt to declining oil revenues on the scale and in the time required. If these investments are frustrated by policies in the investing or receiving countries, or by bad management, the long-term stability of the oil-exporting countries will suffer.

The challenges of response

The conclusions to Part 2 of this report are rather depressing. While three countries – the 'Near sustainable' countries – appear to be well on the road to moving towards a non-hydrocarbon-dependent economy, others face serious barriers and constraints. These revolve around weak governance, poorly performing private sectors and an inadequate programme of economic and political reform. In particular:

- The long-term challenge of depletion is masked by the current high oil prices. The surge in revenues is increasing the dependence of the economies on the hydrocarbon sector, but at the same time it removes the sense of urgency over reform that is desperately needed to promote diversification.
- The challenge is a long-term one, which requires long-term leadership and political support for the strategy appropriate to the country. In many countries, programmes of necessary political and economic reforms – such as opening the non-hydrocarbon sectors, promoting competition, regularizing the role of the state and raising domestic energy prices – meet opposition from vested interests, mobilized in many cases through parliamentary and democratic processes.
- In some countries there are multiple problems which reinforce each other. It is difficult to deal successfully with one obstacle without progress on others: simple insistence on local hire and procurement will not diversify the economy unless local businesses can be established, compete on fair terms, and draw on global technology and management skills.
- Diversification of the non-hydrocarbon economy depends on access to international markets, entrepreneurial capital, and global technology: even in the larger countries, the best solutions are unlikely to be based on one-country policies.
- Time, not oil, is running out. A number of countries – those in the 'Soon in transition' and 'Early dependence' groups – urgently need to accelerate progress outside the hydrocarbon sector if they are to survive the eventual fall in hydrocarbon revenues and foreign exchange suggested in the simulations. These case study simulations were based upon a 'business as usual' future for the non-hydrocarbon economy. Unfortunately this appears to be close to a reality that is unsustainable, rather than merely being a simplifying assumption. This does not bode well for the countries concerned.

Appendix 1: Simulation model

The model[31] is a spreadsheet model which projects annual data under rules for projection from an input starting date (2006) for a period of 30–50 years. There are four modules – Hydrocarbons, Fiscal, Current Account and Results. The structure, main input assumptions and rules are summarized below. More details are given on the project website: www.chathamhouse.org.uk/rddd.

General approach to inputs

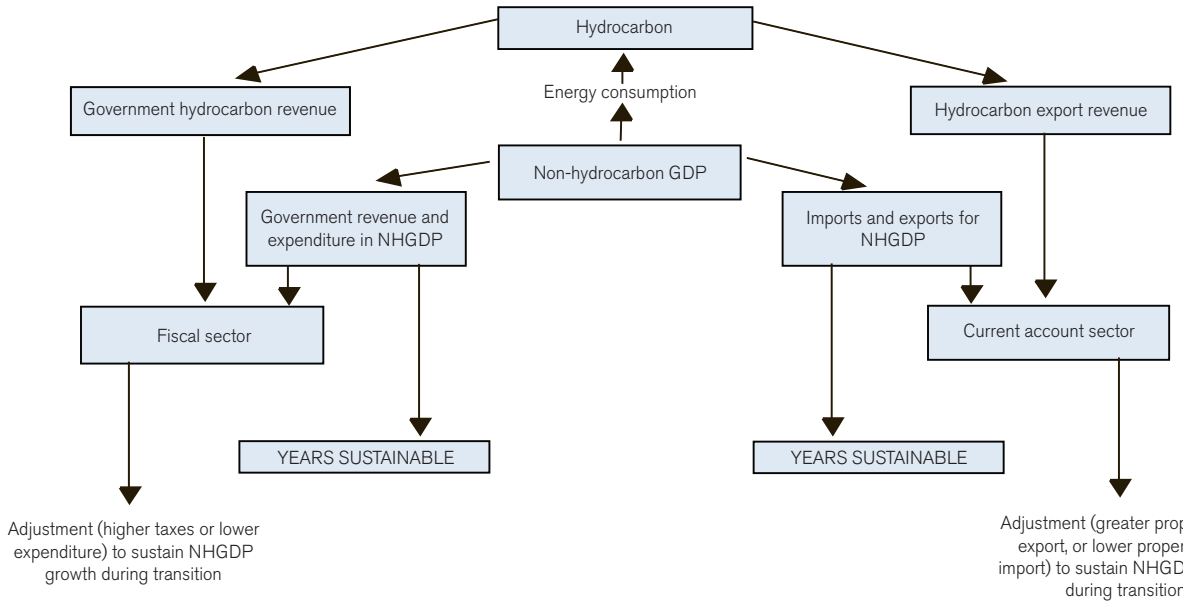
Hydrocarbon sector

1. Actual data for 2003–06 are derived from national sources, adjusted to conform to the definitions in the *BP Statistical Review* where necessary.
2. Production profiles and reserves in the 'reference case' are more or less in line with current government policies and declarations. In some countries, such as Saudi Arabia, the government has considerable freedom in choosing a depletion profile, owing to the size of the reserves.
3. Production is subject to the policy constraint (in the Saudi case) that a plateau should be maintained for at least 30 years, after which a 3% depletion rate would apply.
4. No reserve replacement is assumed in the reference cases but replacements are assumed in variants.
5. Price scenarios compare 'high' ($100) and 'low' ($60) flat Brent price scenarios with one in which prices grow from $60 (or $75) to $100 at a rate of 2% – one which should provide a rough breakeven, for the rent element in the prices, with the 3% real return assumed for investments abroad. This case is thus appropriate for comparing investment in oil in ground with investment abroad. Adjustments are made to bring the exporter's f.o.b. price and government revenue per barrel to their historical ratios to the Brent price.
6. In the reference cases, energy demand is projected in most countries to grow at 80% of the rate of growth assumed for non-hydrocarbon GDP. It is assumed that domestic supplies of natural gas and coal (in countries where these are available) are used, up to some realistic maximum market share, to meet domestic energy consumption (and exports, in the case of gas-exporting countries). The balance is met from domestic supplies of oil. The result in some countries is a switch from oil to gas as gas production develops, and a switch back if gas production reaches a plateau before oil production. Growth in domestic gas supplies for domestic consumption therefore has an effect on the availability of oil for export.
7. Variations look at greater energy efficiency and at substitution of gas for oil in countries where that opportunity exists.

Non-hydrocarbon sectors

1. The rate of growth of the non-hydrocarbon GDP is set in the early years in line with government pronouncements (usually those reflected in the IMF reports), falling to rates around 5–6% (depending on the country) after about ten years.
2. Variations look at lower rates of non-hydrocarbon GDP growth (but always above the expected rate of growth in population).
3. Non-hydrocarbon imports, and government revenues from and expenditure in the non-hydrocarbon sector, expand at the same rate as the non-hydrocarbon GDP. This inertia assumption means that the non-hydrocarbon fiscal and current account deficits expand at the rate of non-hydrocarbon GDP unless they are reduced by investment income from

Figure A1: Structure of DDD model



abroad. Since investment income from abroad depends on accumulated surpluses (and therefore on the relations between past oil prices and government expenditure), the expansion of the deficits differs between countries: those with large surpluses are less dependent on future oil revenues to sustain expenditure. High initial surpluses and early production create large surpluses.

4. Surpluses invested abroad are assumed to earn income at 3% in real terms (the simulations from 2007 onwards are in real (2006) terms). No financing of deficits is simulated, since the object is to identify the timing and scale of adjustments necessary to replace oil revenue on a permanent basis, rather than to develop a medium-term plan. For the same reason, no drawdown of capital invested abroad is assumed.

Appendix 2: Basic data

Country	Population (millions)	Projected average annual growth rate of population (2006–15) (% per year)	Hydrocarbon reserves per capita (per capita oil and gas barrels of oil equivalent)	GNI per capita (US$)
Norway	4.7	0.6	1,808 (oil) 3,868 (gas)	68,440
Kuwait	2.6	2.2	39,038 (oil) 4,306 (gas)	30,630
Saudi Arabia	23.7	2.1	11,150 (oil) 1,876 (gas)	13,980
Malaysia	26.1	1.5	161 (oil) 598 (gas)	5,620
Kazakhstan	15.3	0.8	2,603 (oil) 1,233 (gas)	3,870
Algeria	33.4	1.5	367 (oil) 847 (gas)	3,030
Iran	70.1	1.3	1,961 (oil) 2,524 (gas)	2,930
Angola	16.6	2.8	544 (oil) n/a (gas)	1,970
Azerbaijan	8.5	0.9	824 (oil) 999 (gas)	1,840
Indonesia	223	1.0	19 (oil) 74 (gas)	1,420
Timor-Leste	1.0	3.7	n/a	840
Nigeria	144.7	2.1	250 (oil) 226 (gas)	620

Sources: World Bank Development Indicators 2008; *BP Statistical Review, 2007*. Data are for 2006 and countries are ranked in order of gross national income (GNI) per capita.

Notes

1 Algeria, Angola, Azerbaijan, Indonesia, Iran, Kazakhstan, Kuwait, Malaysia, Nigeria, Norway, Saudi Arabia and Timor-Leste.

2 As reported by the Saudi Press Agency, 'Saudi king says keeping some oil finds for future', Reuters, 13 April 2008. This position seems to have been modified at the Jeddah summit meeting of producing and consuming countries on 22 June 2008.

3 See Box 1 for more information.

4 See Box 1 for more information.

5 Timor-Leste is excluded for lack of data.

6 In this case the growth of the non-hydrocarbon economy is assumed to fall to 6% after 2015, and there is some substitution of gas for oil in domestic consumption.

7 As far as possible, these various treatments are reflected in the simulation model. However, the model representation is inevitably simplistic.

8 See http://go.worldbank.org/O927GNI3O0.

9 As mentioned in Box 1, there are no simulations for Norway, already with a diversified economy and declining oil production, or Timor-Leste, at the beginning of depletion-dependent growth.

10 In the model, the discount rate for NPVs is 3% in real terms. This reflects the rate assumed in the model as a real return on financial investment abroad.

11 The problem is that 'real' GDP is measured at constant prices, but oil prices really change and have a real effect. Strictly, their 'real' effect can be captured though the terms of trade effect on the net national income (NNI), a less familiar measure.

12 The 'free on board' (f.o.b.) price excludes the cost of shipping and insurance and is therefore lower than the import price.

13 Taxation or government revenue also follows recent averages, which roughly allow for costs of production including investment costs. In countries with foreign investors, government revenues follow a rough approximation of recent terms for government's share of the export value. In some countries where domestic prices are not explicitly subsidized through the government budget, lower domestic prices are reflected by the government taking a lower share of the export value which could be realized if the oil or gas were exported.

14 This will be addressed in phase 2 of the project.

15 Further discussion of the role of investment funds can be found in *Resource Depletion, Dependence and Development: Can Theory Help?,* pp. 48–68, www.chathamhouse.org.uk/rddd.

16 It should be pointed out that Azerbaijan experienced an earlier period of oil boom at the start of the 20th century.

17 There was some debate during the workshop over whether Iran should be included in this group since it clearly had much greater potential for diversification than Saudi Arabia or Kuwait. There was also some scepticism regarding the estimates for Iran's ability to stay on plateau until 2056.

18 A key factor in this was Saudi Arabia's very successful negotiations to enter the WTO. Under the terms agreed it was permitted to export petrochemicals on roughly the same costing basis as in the past, allowing the price of feedstock and energy to be well below the international prices.

19 Figures for the current (est. 2007) population vary: the CIA Factbook quotes 2.5 million; according to the National Bank of Kuwait it is 3 million.

20 See Resource *Depletion, Dependence and Development: Can Theory Help?*, pp. 26–29.

21 Unfortunately the literature is extremely unhelpful when it comes to explaining why a country has good institutions or why poor institutions become better. For a discussion of these issues and a review of the literature see P. Stevens and E. Dietsche, 'Resource Curse: An analysis of causes, experiences and possible ways forward', *Energy Policy* 36: 1 (January 2008), 56–65.

22 For further details see P. Stevens, 'Resource Curse and How to Avoid It', *Journal of Energy and Development* 31: 1 (Autumn 2005), 1–20.

23 It is important to note that democracy, as defined by free elections, is not a necessary condition for good governance and hence good economic performance. Rather, it appears to be the presence of checks and balances which is more important. See P. Collier and A. Hoeffler, 'Testing the Neocon Agenda: Democracy in Resource-Rich Societies', Department of Economics, University of Oxford, October 2006.

24 There is an important distinction. Rent-seeking is a perfectly legal and normal part of human behaviour to absorb resource to improve working conditions for the individual (at the expense of others). Corruption, on the other hand, is an illegal activity. However, the problem with both is that they increase the transactions costs of doing business.

25 See Resource Depletion, *Dependence and Development: Can Theory Help?* pp. 26–29.

26 This is when inflation leads to an overvaluation of the real exchange rate. The consequent cheapening of imports and the increase in the price of non-hydrocarbon exports lead to a contraction of the non-hydrocarbon sector. This is exactly the reverse of the outcome desired if the economy is to be made sustainable after hydrocarbons. The phenomenon is now well understood and there is no excuse for any government to suffer an attack of 'Dutch disease'. The macro-economic policy cures are well known and well understood.

27 To be fair, budget spending in Kuwait omits revenue allocated to the savings funds.

28 See Resource *Depletion, Dependence and Development: Can Theory Help?*, pp. 30–33 and 48–68.

29 In some ways the Norwegian experience is not helpful. Paul Collier expressed this beautifully at a Club de Madrid meeting in 2006. He described managing oil revenues as like jumping a hurdle. Norway chose to do this wearing a hat, i.e. its oil fund. Other countries, seeing Norway's success, rushed to get a 'hat' of their own, not realizing that Norway was an athlete before it began the run-up to the hurdle. Thus it was a functioning, accountable democracy, relatively rich, with a highly educated population and a significant capacity in shipbuilding and other activities associated with oil development.

30 See Resource *Depletion, Dependence and Development: Can Theory Help?*, pp. 30–33.

31 This model was developed by John V. Mitchell and Daniela Schmidt.

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