GLOBAL CHANGE

Dutch National Research Programme on Global Air Pollution and Climate Change

Analysis of the impact of the Kyoto Protocol on the export revenues of OPEC member states and on the oil import requirements of non-Annex I countries

Report no.: 410 200 044 (2000)
ISBN: 90 5851 025 5

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This project was carried out in the framework of the Dutch National Research Programme on Global Air Pollution and Climate Change; registered under no. 953290, entitled: Impact of the implementation of GHG's mitigation measures on the oil and gas export revenues of OPEC countries.

ABSTRACT

The members of the Organisation of Petroleum Exporting Countries (OPEC) continue to voice their concerns about the adverse impact of the implementation of greenhouse gas emission reduction policies on the oil exporting countries. Referring to Article 4.8 of the UNFCCC, the OPEC is of the opinion that the agreed reduction targets will lead to a significant decrease in revenue from petroleum exports, with the result that OPEC countries are unfairly affected by measures proposed to mitigate global climate change.

The current study aims to provide quantitative information on the impact of global climate change abatement policies on the revenues of OPEC countries generated from the export of oil. The outcome of this study shows that OPEC countries, but also other net-oil exporting countries, will incur a substantial decline in potential oil income as a result of the implementation of the Kyoto Protocol.

Depending on how OPEC reacts to a decline in oil demand of the Annex I countries, the estimated reduction in oil export revenues resulting from the implementation of Kyoto agreements will be between 15 and 30% compared to the reference scenario.

The most important recommendation of the study then is to establish a sort of fund, managed by the World Bank and the IMF, which can be used to support the balance of payment (IMF) or the restructuring of the petroleum economy (World Bank) in the oil producing countries. The resources for this fund can be generated by putting a levy on oil in the Annex I countries or by making money available for this fund in some other way.

SAMENVATTING

De landen van de Organisatie van Olie-exporterende Landen (OPEC) blijven zich verzetten tegen de implementatie van het Kyoto Protocol. Onder verwijzing naar artikel 4.8 van UNFCCC meent de OPEC dat de reductiedoelstellingen zoals die zijn afgesproken zullen leiden tot een aanzienlijke daling van hun inkomsten uit olie-exporten, en dat de OPEC landen daardoor onredelijk worden getroffen door de maatregelen die zijn voorgesteld om mondiale klimaatverandering tegen te gaan. Om de visie van de OPEC op zijn juiste waarde te kunnen beoordelen moet allereerst kwantitatief aangegeven worden hoe groot het te verwachten verlies aan exportinkomsten is voor de OPEC wanneer de afspraken in het Kyoto Protocol gerealiseerd worden. Dit verlies aan inkomsten moet gezien worden in de context van de economische situatie waarin de OPEC landen zich nu bevinden en die gekenmerkt wordt door een grote afhankelijkheid van olie export. Nadat de economische gevolgen voor OPEC beter inzichtelijk zijn gemaakt, kan nagedacht worden in hoeverre en op welke wijze tegemoet gekomen kan worden aan de bezwaren van de OPEC. Het uitgangspunt is dan om te komen tot een verkenning van de mogelijke vormen van samenwerking met de OPEC landen die optimaal bijdraagt aan de implementatie van het Kyoto Protocol. Dit is van bijzonder belang niet alleen voor het mondiale klimaat, maar ook voor de politieke stabiliteit in de OPEC regio.

Om het effect te bepalen van de Kyoto afspraken op de OPEC olie exporten, is allereerst gekeken naar de invloed van de reductiedoelstelling op de olieconsumptie in de Annex I landen, waarbij dan een uitsplitsing is gemaakt naar de regio's Noord-Amerika, West Europa, Azië/Pacific en Oost Europa en de voormalige Sovjet-Unie. Voor deze regio's zijn ontwikkeld een 'Business As Usual' (BAU) scenario zonder Kyoto doelstelling en een mitigatiescenario waarbij de Kyoto doelstelling het uitgangspunt is. Het verschil in uitkomsten tussen deze twee scenario's geeft de verandering in olieconsumptie voortkomend uit de afspraken gemaakt in Kyoto. Vervolgens is het effect van deze verandering bepaald op de OPEC olie exporten, waarbij de volgende veronderstellingen zijn gedaan met betrekking tot de reactie van OPEC op de daling in de vraag naar olie: case-A: OPEC zal de gehele vermindering van de consumptie absorberen waardoor de prijs van olie op hetzelfde niveau van $20 per vat blijft; case-B: de

OPEC landen streven naar behoud van het marktaandeel waardoor de olieprijs zal dalen naar $15 per vat; en case-C: een combinatie van case A en case B waarbij de OPEC landen 1/3 van de daling in Annex-I consumptie absorberen, de niet-OPEC landen de rest absorberen en uitgegaan wordt van een lage olieprijs. De belangrijkste resultaten voor de drie cases zijn samengevat in onderstaande tabel.

Tabel S.1 Effect van implementatie van Kyoto op de OPEC olie-export in het jaar 2010 voor case A, case B en case C

	BAU 2010	Case A 2010	Case B 2010	Case C 2010
prijs per barrel in US$	20	20	15	15
OPEC produktie(mb/d)	52.2	45	52.2	49.8
non-OPEC produktie (mb/d)	39.9	39.9	32.8	35.2
OPEC export (mb/d)	44.7	37.6	44.7	42.4
Opbrengsten OPEC olie export (miljard US$)	326.7	274.7	245.0	232.0
OPEC markt aandeel(%)	55	52	60	57
Jaarlijkse groei olie export 1998 -2010 (%)	4.4	3.3	2.4	1.9
Jaarlijkse bevolkingsgroei belangrijkste OPEC landen 2000-2010 (%)				
- Saudi Arabie	3.4	3.4	3.4	3.4
- Iraq	3.0	3.0	3.0	3.0
- Iran	1.4	1.4	1.4	1.4
- Indonesie	1.3	1.3	1.3	1.3
- Libya	2.3	2.3	2.3	2.3
- Venezuela	1.5	1.5	1.5	1.5
- Nigeria	2.5	2.5	2.5	2.5

De OPEC olie export neemt onder het BAU scenario toe van 25.4 miljoen barrels per dag in 1998 tot 44.7 miljoen barrels per dag in 2010. In het mitigatiescenario case A neemt de export af ten opzichte van het BAU scenario met 7.1 miljoen barrels per dag wat resulteert in een inkomens daling van US$ 52 miljard (16% daling tov BAU). Voor case B bedraagt het inkomensverlies ruim US$ 81 miljard (25% daling tov BAU) en voor case C is dit ruim US$ 94 miljard (29% daling tov BAU). Gezien de huidige voorzichtige trend in de internationale oliemarkt naar liberalisering en privatisering lijkt case A het minst waarschijnlijke scenario, en moet meer rekening gehouden worden met case B en case C.

Alhoewel er dus sprake is van een daling van de inkomsten uit olie exporten door de implementatie van Kyoto, blijft er nog steeds sprake van een groei in inkomsten ten opzichte van 1998 (voor case C is dit 1.9% per jaar). Dat komt omdat de daling in export naar Annex I landen gecompenseerd wordt door een aanzienlijke stijging van de export naar de niet Annex I landen die geen reductiedoelstelling hebben. Relateren we echter de stijging van de olie-inkomsten aan de bevolkingsgroei in de OPEC landen, dan wordt duidelijk dat de nominale stijging van de exportopbrengsten voor een aantal landen achterblijft bij de bevolkingsgroei. De meerderheid van de OPEC landen verkeren op dit moment in een economische precaire situatie. De schulden zijn groot en de politieke instabiliteit is aanzienlijk in landen als Iran, Irak, Indonesië Nigeria, Venezuela en Algerije. Daarnaast is de economisch en politieke situatie in landen als Libië en Saodi Arabie allerminst zeker als rekening gehouden wordt met de naderende opvolgingsproblemen van de huidige leiders. Koeweit, Qatar en de Emiraten zijn als kleine landen erg gevoelig voor de economische en politieke ontwikkelingen in de naburige (olie)landen. Deze negatieve ontwikkeling kan nog duidelijk versterkt worden door maatregelen genomen in het kader van het internationaal klimaatbeleid. Het is niet ondenkbaar dat het Kyoto Protocol de bekende druppel zal blijken te zijn. In een situatie van economische instabiliteit kan de politieke instabiliteit in de regio een probleem vormen. Daarom moet er gezocht worden naar creatieve oplossingen die ertoe bijdragen dat de OPEC nauwer betrokken wordt bij mondiale klimaatbeleid en die ook kunnen rekenen op een breed internationaal draagvlak.

Echter, de resultaten in tabel 1 laten zien dat de speelruimte voor de OPEC landen klein is. Ze zullen hoe dan ook de economische last ondervinden van de maatregelen. Het precieze effect hangt echter erg af van de ontwikkelingen in de internationale oliemarkt en dan met name de prijsontwikkeling. Van maart 1999 tot maart 2000 beperken de OPEC landen het aanbod van olie ter ondersteuning van de prijs. Gelet op de voortgaande investeringen in nieuwe productiecapaciteit van olie, met name in Niet-OPEC landen zal het aanbod en daarmee de prijs van olie onder druk komen te staan. De zeer aanzienlijke oliereserves van de OPEC landen zijn immers geen garantie voor een overeenstemmend aandeel in de wereld olieproductie. De geringe voortgang in de olielanden om de economie wat minder afhankelijk te maken van olie zal alleen maar leiden tot meer instabiliteit van de oliemarkt.

Het onderzoek wijst uit dat oplossingen in de sfeer van het verbeteren van de handelsvoorwaarden met de Annex I landen of betere mogelijkheden voor investeringen in de olielanden nog weinig soelaas bieden omdat er nog te veel barrières zijn. De belangrijkste aanbeveling is om tot een vorm van samenwerking te komen met de olie producerende landen door middelen beschikbaar te maken via het Internationaal Monetair Fonds en de Wereld Bank voor het verstevigen van de macro-economische stabiliteit. De middelen voor dit fonds kunnen gegenereerd worden door een belasting op olie te heffen in de Annex I landen of anderzijds middelen ter beschikking te stellen voor dit fonds. Dit fonds kan gebruikt worden voor betalingsbalans ondersteuning (IMF) of voor herstructurering van de olie economie (Wereld Bank). Beide organisaties zijn bedreven in het type problemen waar de OPEC landen in het verleden en in de toekomst mee te maken krijgen. Belangrijk is hierbij dat er pro-actief gehandeld wordt. Het vooruitzicht voor de OPEC landen is ook zonder klimaatbeleid niet al te rooskleurig wat betekent dat de flexibiliteit om daarbovenop ook nog een terugval in de vraag vanuit de Annex I landen te kunnen opvangen gering is. Het wegnemen van het vooruitzicht van de expansie van de oliesector kunnen deze landen zich slechts moeilijk permitteren. Voor de Annex-I landen blijft echter de afhankelijkheid van olie-importen uit de OPEC landen van groot belang. Daar de olie niet alleen milieu en economische dimensies heeft, maar ook politieke, is het negeren van de problematiek geen verstandige optie. De grootste olievoorraden komen voor in de politiek instabiele regio's in het Midden-Oosten en Kaukasus/Rusland, Centraal Azië. Een vroegtijdige betrokkenheid bij het economisch welvaren van deze landen is dan ook, een 'must'.

EXECUTIVE SUMMARY

The countries of the Organisation of Petroleum Exporting Countries (OPEC) continue to resist the implementation of the Kyoto Protocol. With reference to article 4.8 of UNFCCC, the OPEC thinks that the reduction targets that were agreed upon will lead to a significant decrease in revenue from petroleum exports, as a result of which OPEC countries are unfairly affected by measures that were proposed to mitigate global climate change. In order to correctly assess OPEC's view there should first of all be a quantitative assessment of OPEC's expected oil export losses when the agreements of the Kyoto Protocol are implemented. This loss in revenue should be seen in the context of the current economic situation of the OPEC countries, which is characterised by a great dependence on oil exports. After the consequences for the OPEC have become more transparent, the issue of how to meet the objections of OPEC can be tackled. Starting point will be to explore the possible forms of co-operation with OPEC countries that will contribute optimally to the implementation of the Kyoto Protocol. This is especially important not only for global climate, but also for political stability in the OPEC region.

In order to determine the effect of Kyoto agreements on OPEC petroleum export, focus is firstly directed towards the influence of the reduction target on petroleum consumption in Annex I countries, with a further distinction of the regions North-America, Western Europe, Asia/Pacific and Eastern Europe and the former Soviet Union. A 'Business As Usual' (BAU) scenario has been developed for these regions without Kyoto agreements as well as a mitigation scenario in which the Kyoto target is the starting point. The differences in outcome between the two scenarios will indicate the change in petroleum consumption stemming from the Kyoto agreements. In the following step, the influence of this change on OPEC petroleum exports is established, based on the following assumptions with respect to OPEC's reaction to the decrease in petroleum demand; case A: OPEC will absorb the entire decrease in consumption as a result of which the price of petroleum per barrel will remain $20; case B: OPEC countries will strive to maintain the market share as a result of which the petroleum price will decrease to $15 per barrel; case C: a combination of cases A and B in which OPEC

countries absorb 1/3 of the decrease in Annex I consumption, non-OPEC countries absorb the rest of and a low petroleum price is assumed. The main results are summarised in Table S.1 below.

Table E.1 Effect of implementation van Kyoto op de OPEC petroleum-export in the year 2010 for case A, case B and case C.

	BAU 2010	Case 2010	ACase 2010	BCase 2010	C
Price per barrel in US$	20	20	15	15	
OPEC production(mb/d)	52.2	45	52.2	49.8	
non-OPEC production (mb/d)	39.9	39.9	32.8	35.2	
OPEC export (mb/d)	44.7	37.6	44.7	42.4	
Profits OPEC petroleum export (billion US$)	326.7	274.7	245.0	232.0	
OPEC market share(%)	55	52	60	57	
Yearly growth petroleum export 1998 - 2010 (%)	4.4	3.3	2.4	1.9	
Yearly population growth main OPEC countries 2000-2010 (%)					
- Saudi Arabia	3.4	3.4	3.4	3.4	
- Iraq	3.0	3.0	3.0	3.0	
- Iran	1.4	1.4	1.4	1.4	
- Indonesia	1.3	1.3	1.3	1.3	
- Libya	2.3	2.3	2.3	2.3	
- Venezuela	1.5	1.5	1.5	1.5	
- Nigeria	2.5	2.5	2.5	2.5	

OPEC petroleum export is increasing in the BAU scenario from 25.4 million barrels per day in 1998 to 44.7 million barrels per day in 2010. In mitigation scenario A export is decreasing with 7.1 million barrels per day compared to the BAU scenario, resulting in an income decrease of US$ 52 billion (16% decrease compared to BAU). In case B income decreases over US$ 81 billion (25% compared to BAU) and in case C this amounts to over US$ 94 billion (29% decrease compared to BAU). Given the current trend in the international petroleum market towards liberalisation and privatisation, case A is the least likely scenario and case B and case C should be taken into account more.

Although this is a matter of decease in revenue from petroleum export, because of the implementation of Kyoto, there is still a growth in revenue compared to 1998 (for case C this is 1.9% per year). This is because the decrease in export to Annex I countries is compensated by a significant increase in export to non-Annex I countries that do not have a reduction target. However, if we relate the increase in petroleum revenue to the increase in population in the OPEC countries, it becomes clear that the nominal increase of the export revenue of a number of countries lags behind compared to population growth. The majority of OPEC countries are currently in an economically precarious

situation. Debts are larger and political instability is considerable in countries such as Iran, Iraq, Indonesia, Nigeria, Venezuela and Algeria. Moreover, the economical and political situation in countries such as Libya and Saudi Arabia is quite uncertain if one takes into account the problems concerning the succession of current leaders in the near future. Kuwait, Qatar and the Emirates are small countries and as such quite sensitive to economical and political developments in neighbourly (petroleum) countries. This negative development can clearly be amplified by measures that are taken in the framework of international climate policy. It is not unlikely that the Kyoto Protocol will be the last straw that broke the camels back. In a situation of economic instability, political stability might be difficult to maintain. Therefore, creative solutions need to be sought that will contribute to closer involvement of OPEC in global climate policy and that can count on broad international support.

However, the results in Table 1 show that margins for OPEC countries are small. They will suffer economical problems from the measures anyway. The exact effect depends largely on developments in the international petroleum market and price developments more specifically. At this moment OPEC countries limit the supply of petroleum in support of the price. Considering the ongoing investments in new production capacity of petroleum, especially in non-OPEC countries, supply and thus also the price of petroleum will be put under pressure. The considerable petroleum reserves of the OPEC countries are not a guarantee for a corresponding share in the global petroleum production. The minor progression in the petroleum countries towards an economy that is less dependent on petroleum will only lead to even more instability in the petroleum market.

Research shows that solutions in the area of improvement of trade conditions with Annex I countries or improved possibilities for investment in petroleum countries are not a sufficient as there are too many barriers. The most important recommendation is to come to a form of co-operation by making funding available through the IMF and the WorldBank to assist in the achievement of macro-economic stability in the region. The means for this fund can be generated by putting a levy on petroleum in Annex I countries or making means available to this fund some other way. This fund can be used for support of payment balance (IMF) or restructuring of the petroleum economy (Worldbank). Both organisations are experienced in the type of problems that OPEC countries encountered in the past and will encounter in the future. It is important here that things

are managed pro-actively. The prospects for OPEC countries are not very promising, even without considering climate policy, which means that there is little flexibility left to handle a setback in demand from Annex I countries on top of all this. Taking away the prospects of expansion of the petroleum sector is something these countries cannot afford themselves. For Annex I countries dependence on oil import from OPEC countries remains very important. As oil does not only have environmental and economical dimensions but also political dimensions, ignoring this issue is not an option that is recommended. The main oil supplies are in politically unstable regions in the Middle East and Caucasus/Russia and Central Asia. An early involvement in the economical well-being of these countries is a must.

CONTENTS

1 INTRODUCTION

1.1 Background

During the third session of the Conference of the Parties (CoP) to the United Nations Convention of Climate Change (UNFCCC), held in December 1997 in Kyoto, Japan, reduction targets for greenhouse gas (GHG) emissions for the period 2008-2012 (compared to the reference year) were agreed for the Annex I[1] countries, in particular for the US (7%), the EU (8%) and Japan (6%).

Achievement of the reduction targets will have an impact on energy demand and therefore on the market for fossil fuels. In general it is expected that the international natural gas sector stands to benefit of the emission reduction policies, while the international coal sector generally stands to loose. The impact on the international oil industry is less clear cut. The level of dependence on income derived from oil production, export and processing varies among the different oil producing countries. In general, there is a fair number of countries, of which 11 are organised in the Organisation of Petroleum Exporting Countries (OPEC) [2], that is highly dependent on income derived from the oil sector. It is natural that these countries have a particular interest in the debate on climate change, and the expected impact on their economies.

Once the emission reduction targets were set, the debate shifted to the measures and policies with which to achieve the Kyoto targets. These debates do not only take place at the national level in the Annex-I countries, but because the policy choices have a potentially large impact on the international energy markets, also in the international fora. In these debates, the distribution of the positive and negative effects among producing and consuming countries and among Annex-I and non-Annex I countries are featuring among the subjects. It is understandable that an organised group of energy producing countries, like the OPEC countries, tries to make its voice heard in these debates, particularly because Article 4.8 of the UNFCCC provides a ground for their voice. In Article 4.8 it is stated that in the implementation of policies

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[1] Annex I Countries are defined as the countries listed in the Annex I to the UN Framework Convention on Climate Change that, as Parties, are committed to adopt national policies and take measures to mitigate climate change. Annex I Parties consist of the 24 original countries belonging to the Organization for Economic Co-operation and Development (OECD), the European Union and countries designated as Economies in Transition.

[2] The Organisation of Petroleum Exporting Countries (OPEC) comprises Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates, Algeria, Libya, Nigeria, Indonesia and Venezuela.

aiming at a reduction of GHG emissions the Parties shall give full consideration to what actions are necessary under the Convention, including actions related to funding, insurance and the transfer of technology, to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures, especially on:

- Small island countries;
- Countries with low-lying coastal areas;
- Countries with arid and semi-arid areas, forested areas and areas liable to forest decay;
- Countries with areas prone to natural disasters;
- Countries with areas liable to drought and desertification;
- Countries with areas of high urban atmospheric pollution;
- Countries with areas with fragile ecosystems, including mountainous ecosystems;
- Countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products; and
- Land-locked and transit countries.

The OPEC countries have repeatedly made references to Article 4.8 to emphasise that due account should be taken of the adverse impacts of greenhouse gases mitigation measures on the oil and gas revenues of the OPEC countries. The OPEC countries argue that the abatement policies will have a negative impact on the oil industry and, as a result, the OPEC member states have not responded enthusiastically to the efforts to achieve the Kyoto reduction targets.

However, global climate change mitigation policies also offer possibilities to non-Annex I countries to increase the efficiency of their energy sector and, thus, can contribute to the economic development of these countries. Several non-Annex I countries consider the Kyoto agreement as a means to acquire modern efficient technology and therefore express a more positive attitude towards GHG emission reduction measures.

As a result of these different interests, the non-Annex-I countries do not form a coherent group and this places this group in a rather ambivalent position in the negotiation process.

So far, only limited research has been carried out to quantify these different positions. For this reason, the Dutch National Research Programme on Global Air Pollution and Climate Change has initiated this study, which aims to quantify:

- the potential reduction in revenues from oil and gas exports of the OPEC countries as a result of the implementation of the Kyoto Protocol,
- the impact of global climate change policies on the oil import requirements of non-Annex I countries.

The Netherlands Energy Research Foundation ECN jointly with the Institute of International Relations Clingendael has been commissioned to conduct this study. The study was conducted during the period September 1999 to March 2000.

1.1 Objectives

The principal objective of the present study is to examine the source of the different positions towards global climate change mitigation policies within the group of non-Annex I countries (sometimes referred to as 'G77 and China'). The group of energy producing countries in this study was narrowed to the OPEC countries, since they are the most vocal and organised group of opponents of the abatement policies. However, focusing in this study on OPEC does not mean that non-OPEC oil producing countries will not be affected by the abatement policies. Further study should include these other oil-producers in order to determine the position and the effects on non-Annex-I energy producing countries.

Focusing on OPEC member states alone has advantages and disadvantages. On the one hand, the OPEC member states form a clear group of countries with fairly, but not entirely, similar interests. Even within the group of OPEC countries there is a distinct difference between 'poor' and 'rich' member states, with different vulnerabilities to the abatement policies. This difference in vulnerability among the OPEC countries are related to their dependence on oil exports, their production capacity, the contribution of the oil sector to GDP, but also the ability to expand gas production and exports in relation to the changing interfuel competition. Also these elements should be included in a follow-up study.
On the other hand, focussing on OPEC does not do justice to other oil or energy producing countries that are similarly impacted by the policies. Moreover, focussing on OPEC member states alone also introduces a more political element in the study. In 1999, OPEC again man-

aged to set oil prices by implementing a production reduction agreement. In a short period of time, prices increased from $10-12 a barrel to more than $25 a barrel in the first quarter of 2000. After much diplomatic pressure on the part of the United States, production was relaxed again in March 2000. Such policies by OPEC impact the world economy and the interfuel competition. For this study, it complicates the quantification of the impact because oil prices are not only subject to market forces but also subject to political agenda-setting. Moreover, sympathy for negative projections on OPEC income as a result of the abatement policies quickly fades away in the midst of such a display of market behaviour. In this study, we focussed on the long term trends in the international oil industry, and treated the current OPEC market behaviour as a short term event. Further research into the vulnerability of individual oil producing countries, rather than a group of countries, would certainly help to better identify the impact of the abatement policies, and can result in a more precise recommendation how to assist, if at all, these countries in overcoming the impact.

The following derived project aims have been identified:

1. assessment of the impact of global climate change abatement policies on the revenues of OPEC countries generated from the production, processing and export of fossil fuels;
2. assessment of the 'no-regret' potential in the non-Annex I countries and determination of oil import savings in non-Annex I countries if this potential is realised; and
3. suggestions for policy options for international policy making aiming at a reduction of global GHG emissions which may be more acceptable to the group of OPEC countries and thus more effective globally.

1.2 Scope of the study

The position of the group of the non-Annex I countries towards the global climate change mitigation policies is not always very clear. On the one hand, the oil exporting countries fear substantial revenue losses resulting from the implementation of the Kyoto agreement; on the other hand, some non-Annex I countries argue that the implementation of the Kyoto Protocol could lead to an increase in pace of the transfer of more efficient energy technology which, consequently, could reduce the oil import requirements of the non-Annex I countries.
The focus of this study is to provide quantitative information on both viewpoints. The 'Business As Usual' (BAU) scenario designed by the International Energy Agency (IEA) is used in this study as the reference scenario for both the Annex I as well as the non-Annex I countries.

A compilation and evaluation of greenhouse gas mitigation studies for Annex I and non-Annex I countries was performed to assess the impact of global climate change mitigation policies on the export revenues of OPEC countries and on the non-Annex I oil import requirements.

Although this information provides a firm basis for detailed analysis of the above viewpoints, the results should nevertheless be interpreted with caution. It was not within the scope of this study to verify or correct the underlying data, even when there were evident shortcomings. Some adaptations have been made to the underlying data extracted from the studies to ensure consistency between the reference and the mitigation scenarios. Furthermore, we have already indicated that a more detailed study into the vulnerability of oil producing countries is required to arrive at more precise answers on the possible impact per country.

1.3 Organisation of the report

This report is laid out as follows. Chapter 2 provides a description of the international oil market over the past 20 years. Chapter 3 presents an analysis of the impact of global climate change abatement policies on the OPEC oil export revenues. Chapter 4 presents an analysis of the potential reduction in oil imports in non-Annex I countries as a result of the implementation of the oil-related 'no-regret' measures in the energy sector. Chapter 5 discusses new modes of co-operation with the OPEC countries and, finally, Chapter 6 present the conclusions.

2 DEVELOPMENTS OF THE INTERNATIONAL OIL MARKET IN THE PAST 20 YEARS

2.1 Economic instability

The OPEC countries have suffered to varying degrees from serious macro-economic instabilities as a result of oil market developments in the last 30 years (Van der Linde, 1999). Periods of very high income levels in the 1970s were followed by periods of much lower oil income levels in the 1980s, while in the same period, the expenditure levels continued to increase. The high oil prices between 1973 and 1985 had greatly stimulated investments in oil production outside the OPEC countries. These investments were stimulated partly because the OPEC countries had nationalized or partially nationalized their oil industries, which denied international oil companies access to "low extraction cost" oil and partly because OPEC was prepared to stabilise the oil price at a fairly high level, which made "high extraction cost" oil economic to produce as long as OPEC was prepared to defend this price. OPEC's price policy was, therefore, instrumental in increasing the number of oil producing countries in this period.

In the space of ten years, OPEC lost its dominant position as the worlds' supplier of oil, despite its large oil reserves. This situation persists until today, although OPEC has regained some of its market share in the 1990s. The conclusion is that even a cartel like OPEC, with such a large economic and political impact, is not strong enough to suppress the rivalling economic interests and maintain a uniform policy (De Jong, 1985, p. 150-64). The cohesion of OPEC was very large in 1973, but quickly dissipating when the oil incomes were invested in the domestic economies. The level of dependence on oil income, oil reserves and production capacity was too widely diversified among the OPEC member states to support a long-term unified oil policy. The fact that OPEC maintained fairly high price levels in the early 1980s required ever lower production levels, and thus they created their own competition from new oil producing countries.

From the mid-1980s, oil prices were determined by the market rather than by OPEC. Lower oil prices and sluggish demand in the 1990s created both balance of payments and domestic economic instabilities in most OPEC countries and other oil producing countries. Quite a few oil-producing countries experienced debt-servicing problems in the mid-1980s (Venezuela, Nigeria, Algeria, etc.), that persisted into the 1990s. In 1995, Nigeria's external debt as a percentage of GNP was still 140.5% and as a percentage of exports of goods and services 274.5%. Although in 1995, Indonesia's, Algeria's and Venezuela's external debt was smaller as a percentage of GNP than Nigeria's (56.9%, 83.1% and 49% respectively), their debts in terms of exports of goods and services were nevertheless substantial (202.9%, 264.2% and 160%). (World Bank Development Report, 1997, p. 246) Given that the dependence on oil imports as a share of total exports is large in most OPEC member states (see table 2.1), the financial health of these countries continues to be closely linked to the development of oil demand, supply and prices.

Table 2.1 Values of (petroleum) exports of the OPEC countries in 1997

	Value of exports $97million	Value of petroleum exp. $97million	% of oil export of total export values
Algeria	13,900	8,800	63.3
Indonesia	53,443	7,410	13.9
Iran	23,861	17,662	74.0
Iraq	4,731	4,589	97.0
Kuwait	14,280	13,318	93.3
Libya	9,889	8,905	90.0
Nigeria	15,600	14,622	93.7
Qatar	5,464	4,665	85.4
Saudi Arabia	56,700	48,218	85.0
UAE	30,642	15,269	49.8
Venezuela	23,070	18,145	78.7
Total OPEC	251,580	161,593	64.2

Source: OPEC Annual Statistical Bulletin 1997, p. 5-6.

Since the mid-1980s, oil-producing countries have been part of the major financial disruptions that occurred in the world. Although their dependence on oil cannot be seen as the only cause for their financial difficulties, oil does increase their economic vulnerability. In 1995, the pesos crisis in Mexico (not an OPEC member state) also caused economic disruptions in other Latin American countries, including Venezuela. In 1997 Indonesia was the worst affected country in the Asian crisis, and the default of Russia in 1998 caused further disruption to an already feeble economy. Oil income had been the cork that kept the country afloat, until oil prices declined to very low levels indeed in the middle of 1998.

In 1997, the average GDP per capita of the OPEC member states (excluding Iraq) was 1,930 US$ (OPEC Annual Statistical Bulletin 1997, p.3). Kuwait, Qatar and the United Arab Emirates had a GDP per capita that are comparable to industrialised countries (over 15,000 US$ per capita). However, Nigeria, Algeria and Indonesia have a per capita GDP that is substantially lower than 2,000 US$. In the ranking of the World Bank, these countries belong to the low and lower middle income group. A country like Saudi Arabia, the largest oil producer of the OPEC, has a per capita GDP that ranks the country in the upper-middle income group (7,510 US$). In Annex F, the relationship between GDP and oil export revenue at current market prices reveals that

OPEC member states remain fairly dependent on crude oil exports. In the annex, the relationship between GDP and oil export revenues per country shows that countries like Kuwait, Libya, Nigeria, Qatar, Saudi Arabia and the United Arab Emirates is substantial. Except for Nigeria, these countries are the more prosperous of the oil producing countries, but at the same time the most vulnerable for a fall in per capita income when oil incomes would decline. In Venezuela, the severe economic problems have caused the relationship between GDP and oil export revenues to become stronger again.

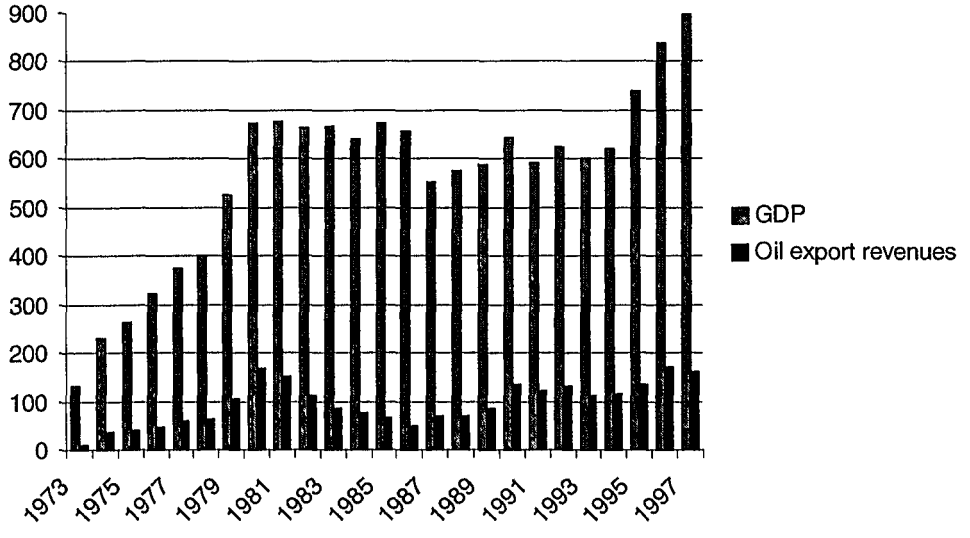


Figure 2.1 GDP and oil export revenues of OPEC countries at current market prices [million 1997US$]

Although the serious economic adjustment problems of the last 10 years cannot only be attributed to the oil industry, but also to other domestic economic and political problems, the instability of the international oil market has certainly compounded the problems and contributed to the vulnerability of these countries to external shocks. In the 1998 and early 1999 low oil price climate, even countries such as Saudi Arabia were faltering under pressure. In a 7 months period Saudi Arabia had to make two large currency interventions to support the Saudi Riyal, and the budget deficit that had finally been brought under control to a low of 2.9% in 1997 from a peak level in 1987, when the ratio of the budget deficit to GDP was 25% (Saudi Arabian Monetary Agency, 1998), threatened to rise again to almost 10% (Zonis, 1999). In Saudi Arabia the dependence on oil revenues is still very large (down from 98% in 1982 to 78% in

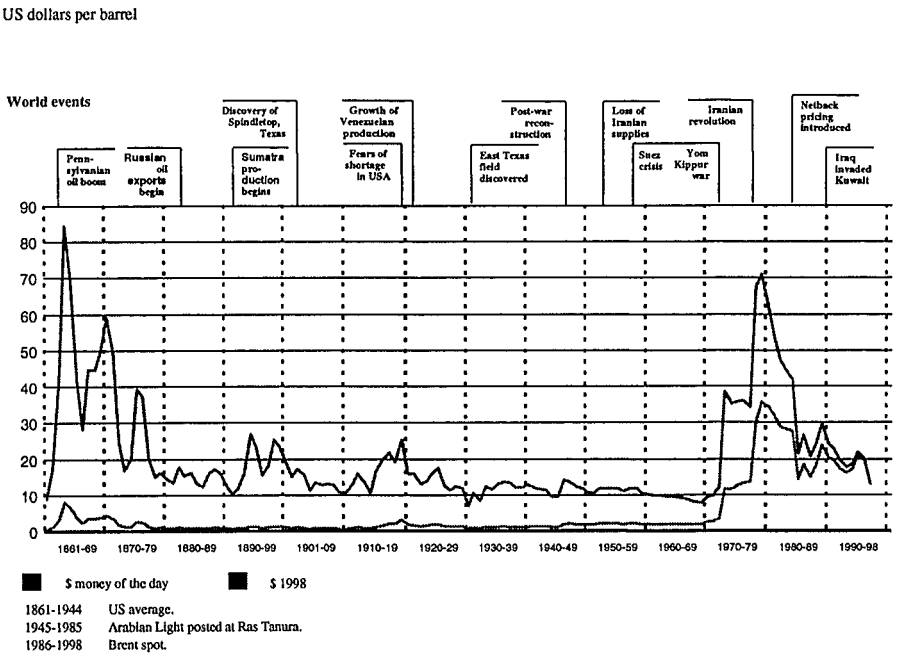
1998), and shows that 20 years of diversification policy and investments in the oil processing industry has not been altogether effective in reducing the dependency on oil (Gelb, 1988).

Other oil producing countries have also failed to substantially reduce the dependency on oil revenues. In the early 1990s, Iran's government revenues rely on oil revenues for 36%, Algeria's for 58% and Nigeria's for 60% (Van der Linde, 1994). This has not changed much since. In terms of foreign currency receipts, oil is still the most important export product for these countries. In some countries, such as Saudi Arabia, Algeria, Iran, Nigeria and Venezuela this resulted in a dependency on oil for more than 80% of the foreign currency receipts. In countries such as Indonesia with substantial other natural resources and a large absorption capacity of the economy, there was a relatively 'low' (23%) dependency on oil revenues.

2.2 OPEC price and production policies

The economic difficulties in the 1980s and 1990s seriously undermined the ability of the OPEC member states to agree on a common price and production policy. This group of countries has mixed interests with regard to the optimum price and production policy. They have different (oil revenue) absorption rates, crude oil reserves and production capacities. The economic difficulties in the 1980s and 1990s only complicated matters because most member states, to varying degrees, switched to short-term policies to fend off financial default, rather than take the long-term and/or a sustainable development view. Although OPEC production agreements were regularly proposed and agreed, cheating by member states in serious political and/or economic problems (for example Iran, Iraq, Nigeria, and Venezuela) frustrated the efficiency of the agreements and made them very short-lived (Van der Linde, 1994 and 1999). As a result, prices remained predominantly below $20 a barrel, except during the Gulf war in 1990-1991. They also became more volatile.

Figure 2.2 Crude oil prices since 1861



Source: BP Amoco Statistical Review of World Energy 1999.

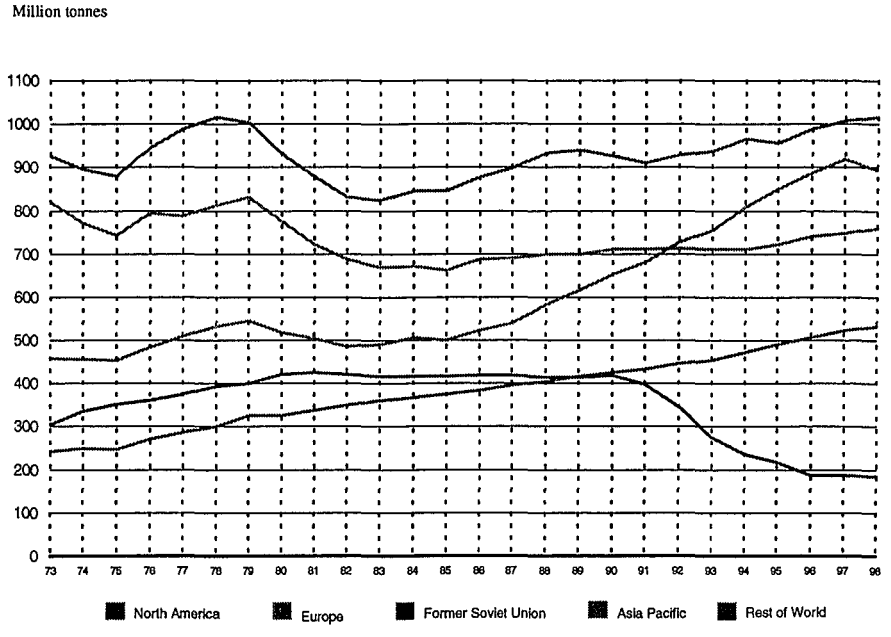
In March 1999, after prices had been at very low levels (around $10-12 per barrel) for more than 8 months, a production agreement between Saudi Arabia, Venezuela and Mexico was concluded and that was further underpinned by an OPEC agreement. The agreements became effective on 1 April 1999. In the space of 3 months, prices more than doubled, and levels of country and company crude stocks decreased (Richard, 1999). The high level of adherence to the agreement in the first few months greatly diminished the crude overhang on the international oil market, and fuelled fears that the supply reductions would overshoot demand in the 4th and 1st quarters of 1999/2000. The overshooting of the supply reductions drove oil prices well above the $25 per barrel level. When in February 2000 the United States experienced a two-week cold spell, product prices soared and led to a strong diplomatic offensive by the United States to relax OPEC production. Although such a relaxation of production would not immediately reduce product prices, because of bottlenecks in US refining, a downward price trend was deemed necessary to control inflation. Already in their 2 March 2000 meeting, Venezuela, Saudi Arabia and Mexico, agreed to increase production, and advised the other OPEC member states to follow suit. The high oil prices of the first quarter of 2000 were not in the long-term interests of the large

producers, since it would draw additional oil to the market. Only smaller producers or countries with short-term economic interests maintained a preference for $25 plus per barrel of oil. The discussions in OPEC in late March 2000, yet again, showed that OPEC member states have widely diverging oil policies and economic interests. Agreement on a longer-term oil price and production policy seems very unlikely. The extreme circumstances of low oil prices leading up to the production agreement of March 1999 are the only exception to this rule.

2.3 The oil trap

The stop-go policy, which has characterised OPEC agreements for the past 20 years, is undermining the macro-economic stability of oil producing countries both in the short-term and in the longer-term. The temporary respite as a result of the March 1999 production agreement is causing serious delays in the necessary regulatory reform of the oil producing economies (Van der Linde, 1999). Many oil-producing countries greatly depend on oil revenues to finance public expenditure. The attempts to diversify the economy in the late 1970s and 1980s have seriously failed to reduce the dependence of the economy on oil. Moreover, many non-oil industries depend on subsidies, because domestic regulations and/or monetary policies render most of these non-oil activities non-competitive (Gelb, 1988). Because the health of public finances depends greatly on oil revenues, the ability to subsidise fluctuates with oil income and/or with the level of public debt. With few exceptions, the large oil exporting countries, such as Saudi Arabia, Kuwait, Qatar, the United Arab Emirates, Nigeria, Venezuela, Iran and Iraq were unable to replace oil as their main economic activity. The shift in emphasis on energy industries is actually becoming stronger in some of these countries because their natural gas resources will become more attractive to develop. Countries without gas resources cannot benefit from this expected change in the interfuel competition, but must rely on the expansion of other oil markets than the traditional OECD markets. Presently, The OECD market is still the main market for crude oil exports, but markets like Asia are rapidly expanding (See Figure 2. 3).

Figure 2.3 Oil consumption by area



Source: BP Amoco Statistical Review of World Energy 1999.

In a study conducted by the OPEC-secretariat on the possible effects of the implementation of the Kyoto protocol, they calculated that the level of production of OPEC could not increase above 29 million b/d until 2010 if they wanted to minimise the loss in oil income (thus assuming that the compensation of lost supply must come from price stability and a more robust price) (Ghanem, 1999). Such a level of production (capacity) is already in place and would reduce the possibilities for expansion to virtually nothing. Given that investments in oil continue, also in OPEC countries, this would appear to be a non-sustainable scenario. If the OPEC Secretariat's scenario turns out to be accurate and we accept the proposition that investments in oil production will continue (particularly when OPEC decides to push up prices with production restraints in the short term), competition among oil producers for market share will increase and prices will soften. The last ten years, one important consuming area or another was suffering from some sort of economic recession or crisis[3], which depressed demand for crude oil and created supply overhang on the market because of the continued expansion of production capacity. The implementation of GHG emission reduction policies will depress oil demand in Annex-I countries and can create supply overhang again.

The distribution of revenue losses, compared to a BAU scenario, among oil producing countries, including OPEC countries, as a result of GHG emission reduction policies will be asymmetrical, and will depend on the national (economic) strategies. Further study should determine the vulnerability of individual oil producing countries, including OPEC countries. Given the diverging oil and economic interests of oil producing countries and the OPEC countries, a situation of asymmetrical revenue losses compared to a BAU scenario (or asymmetrical outlooks on being able to compete in the "Kyoto" market) among OPEC countries could be last straw that broke the camels back. OPEC could disintegrate as a market regulator. Countries that do not anticipate any of the changes might experience more severe economic instabilities and conflict.

[3] Early 1990s, recession in the US; early to mid-1990s recession in Europe and Japan and Eastern Europe; 1997-1998 financial crisis in Asia.

2.4 Economic instability and GHG emission policies

It is against this background of continuing economic problems, partly due to the movements in the international oil market and the inability to bring these under control and partly due to the organisation of the oil industry and the economy in the oil producing countries (Van der Linde, 1999), that the response of these countries to GHGs mitigation measures should be understood. The ability of the oil producing countries to secure a stable export income from oil has been very difficult in the past 15 years. The GHGs mitigation measures will only complicate this effort, and may seriously undermine the ability of OPEC to regulate the market.

The OECD countries represent an important part of the international oil market. In 1998, the OECD countries consumed 63% of world oil consumption. Although, consumption in the rest of the world, particularly Asia, is growing, OECD countries are still the most important clients of the oil producing countries. The mature markets in the OECD countries already have fairly low average growth rates. From 1988 to 1998, world consumption increased by 8,315 thousand b/d, an average growth of 1,3% per year (BP Amoco Statistical Review of World Energy 1999, p. 10). In that period, OECD consumption increased by 5,730 thousand b/d, an average of 1.4% a year. Consumption in the rest of the world, increased by 2,585 thousand b/d, an average growth of 1.1% a year. These latter growth rates are depressed because of a serious drop in demand in Asia in 1997 (-2.7%) as a result of the Asian financial crisis. A substantial reduction in OECD oil demand will, therefore, substantially impact the oil producing countries. To illustrate how severe this impact might be, a decline in consumption of the OECD countries of, for example, 6 million b/d from 1998 to 2008 requires an average yearly growth in oil consumption of 2.2% in the rest of the world to remain the same oil production levels.

The increased competition for market share, that we expect to occur, may pressure the oil producing countries into another domestic regulatory regime. In particular, the ongoing trend of liberalisation and privatisation in the crude oil industry is important enough to be considered in the context of co-operation with oil producing countries in the next 10 years. The national oil companies of most oil producing countries have been very inefficient in producing an optimum income from oil. If privatisation also

takes a firmer hold in major OPEC member states, the co-operation between oil producing and consumer governments will be different than in a situation where the state retains its dominant role. In a situation where the oil industry in OPEC countries is brought increasingly under private control, the government has little leverage with regard to production levels and pricing. Certainly, regulation of the international oil market under the OPEC flag will no longer be possible and oil-producing countries will attempt to maximise benefit at a national level. Private companies will decide to a large extent how much they will produce and from where. Rates of return on investment will be an important factor.

It is very likely that GHGs mitigation measures will actually stimulate this trend towards privatisation, in which case the entrepreneurial risks are shifted onto private parties and the oil producer governments will depend on oil taxes for their income. Taxes must be designed to attract investments into the country's oil industry, and to ensure investors a certain rate of return. Although, privatisation cannot guarantee the stability of government oil income, at least it will reduce the political impact on the international oil market. The attraction of the investment climate in the countries will be determined by the type of contracts, taxation levels, compensation schemes, types of crude, size of exploration acreage, size of wells, infrastructure, political landscape, and closeness to important markets. The impact of the GHGs mitigation measures will become part of these market conditions that investors have to take into account. The economic plight of the OPEC member states can push them into this private sector solution. The World Bank and IMF are already stimulating such a reorganisation of the oil sector (for example, the development of oil and gas production in Chad and the proposed privatisation of Pertamina, Indonesia).

The uncertain economic outlook that pressures the oil producing countries into making structural economic adjustments, also in the oil sector, coincides with the possible implementation phase of GHG mitigation measures. The past poor performance to adjust and the inability to substantially reduce the impact of oil on the economy makes the outlook for a successful absorption of the new oil market conditions rather bleak.

3 IMPACT OF GLOBAL CLIMATE CHANGE MITIGATION POLICIES ON THE OIL EXPORT REVENUES OF OPEC COUNTRIES

3.1 Introduction

The income generated from the export of oil and gas forms a major source of income for OPEC countries. A reduction in oil demand by the Annex I countries, their main consumers, could therefore significantly affect the economies in the OPEC countries. In this chapter, a quantitative assessment is presented of the reduction in oil consumption in the Annex I countries resulting from the implementation of the Kyoto Protocol, and the resulting impact on the export revenues of the OPEC countries.

For this analysis, the Annex I countries are divided into four broad regions: Western Europe, North America, Asia Pacific, and Eastern Europe and the Former Soviet Union (FSU). For each region, the impact of the agreed GHG emission reduction targets on the oil consumption is assessed for the year 2010, which is in the midst of the first budget period (2008-2012).

3.2 Methodology

The methodology is to a large extent based on review, comparison and evaluation of existing studies for the various regions. The methodology consists of the following main steps:

1. Design of a 'Business As Usual' (BAU) scenario for Annex I and non-Annex I countries;
2. Design of greenhouse gases mitigation scenarios for North America, Europe and Asia Pacific;
3. Assessment of the impact of the implementation of the agreed greenhouse gases reduction targets on the export revenues of OPEC.

1. Design of 'Business as Usual' scenario for Annex I and non-Annex I countries

In this study the 'Business as Usual' scenario is taken from the 1998 World Energy Outlook study of the International Energy Agency. This scenario is based on a extrapolation of past trends, and no emission reduction measures are included in this scenario. The main reason for choosing the IEA study is that it is the most up-to-date study, which presents a global picture on energy consumption and production. In the IEA study consistent BAU scenarios for both Annex I and non-Annex I countries are given. The IEA- BAU scenario has been compared with BAU scenarios used by other studies:

- The IPCC study (Intergovernmental Panel on Climate Change, 1995), including the IS-92 scenarios. This study was published in 1995 and is therefore considered to be outdated. The newest IPCC scenarios are not yet available.
- The IIASA-WEC (Global Energy Perspectives, 1998). This study was published in 1998 and has therefore taken into account the most recent political and economic developments. However, the IIASA-WEC study does not present a 'business as usual' scenario in the usual way, but rather explores different future developments by means of six scenarios which reflect different assumptions on economic growth, energy efficiency improvements and use of different types of energy. Furthermore, the year 2010 is not analysed in the IIASA-WEC study. A comparison between the IEA-BAU scenario and the IIASA-WEC scenarios for the year 2020 can be found in Annex A.

The IEA-BAU scenario describes the development of energy demand and supply over the period to 2020 and is presented by world region, by fuel type, by energy-related service, and, in some cases by consuming sector. Table 3.1 shows the assumptions on GNP growth on which the IEA-BAU scenario is based.

Table 3.1 GNP growth in world regions, averaged for 1971-1995 and projected by IEA

	1971-1995	1995-2020 (BAU)
OECD North America	2.7	2.1
OECD Europe	2.4	2.0
OECD Pacific	3.5	1.8
Transition Economies	-0.5	3.3
China	8.5	5.5
East Asia	6.9	4.5
South Asia	4.6	4.2
Latin America	3.4	3.3
Africa	2.6	2.5
Middle East	2.7	2.7
World	3.2	3.1

Table 3.1 shows that the large differences in economic growth between industrialised and developing countries, which prevailed in the past 20 years, will continue in the next 20 years, albeit at a less pronounced rate.

2. Design of greenhouse gases mitigation scenarios for North America, Europe and Asia Pacific

Two mitigation scenarios, Mit-CO_2 and Mit-GHG, have been developed for the Annex I regions North America, Western Europe and Asia Pacific. No mitigation scenario has been developed for Eastern Europe because for this region the BAU scenario is below the agreed Kyoto target, so no mitigation is required in the first budget period 2008-2012. The emission reduction required in 2010 is the difference between the IEA-BAU scenario and the agreed Kyoto target.

Because the 1998 World Energy Outlook of the IEA does not present greenhouse gases mitigation scenarios the following country studies have been used as reference for the development of the Mit-CO_2 and Mit-GHG scenarios:

1. A study conducted by the Energy Information Administration (EIA, DoE) on the impacts of the Kyoto Protocol on the US.
2. A study conducted by ECN on the Western European biomass potential for Western Europe (Gielen et. al., 1999).
3. A study conducted by the National Institute of Environmental Studies (NIES, Japan) for Japan (Kainuma, 1999).

For the Mit-CO_2 scenario, it is assumed that the required emission reduction target for each region will be achieved solely by energy-related CO_2 reduction measures.

For the Mit-GHG scenario, it is assumed that all the six greenhouse gases defined in the Kyoto Protocol will contribute to the achievement of the required emission reduction. From studies by Gielen(1998) and Jochem, the following assumptions on the contribution of non-CO_2 gases compared to 1990 have been made:

Table 3.2 CO_2 reduction targets for CO_2 only and for CO_2 as one of the greenhouse gases [%]

	CO_2 only [% reduction compared to 1990]	CO_2 as one of the GHG[4] [% reduction compared to 1990]
Annex I North America	7	2.45
Annex I Europe	8	2.8
Annex I Pacific	4	1.4

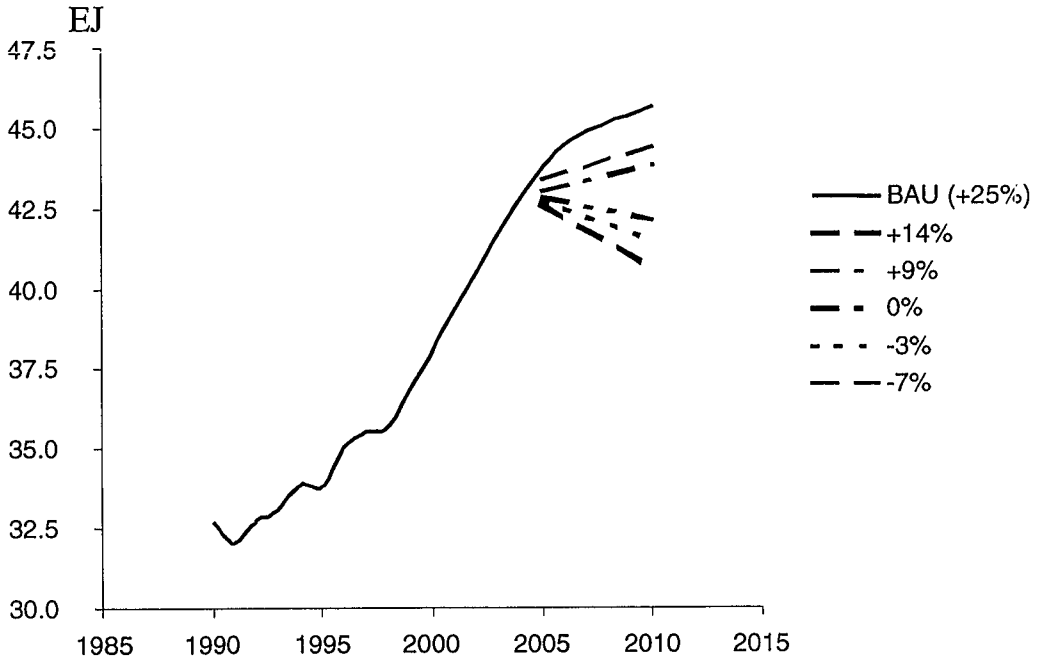
If these reduction percentages are applied to the IEA-BAU scenario, the contributions of non-CO_2 gases to the required emission reduction in 2010 are: North America 12.2%, Western Europe 11.8% and Asia Pacific 7.3%.

The North American region comprises America and Canada. The EIA study projects that if no CO_2 mitigation measures are implemented in the US, oil consumption in 2010 would be 25% higher than in 1990 (BAU scenario). Figure 3.1 shows the impact of various CO_2 reduction targets ranging from +14% to –7% relative to the 1990 level, on the oil consumption in the US analysed in the EIA study. The NEMS model has been used to produce these results.

In the most stringent reduction case of 7% CO_2 reduction compared to 1990, oil consumption is projected to decline by 10-11% in 2010 compared to the BAU scenario. The biggest impact however is on the use of coal, which will decrease by 77%. For Canada a similar reduction pattern has been assumed as for the US.

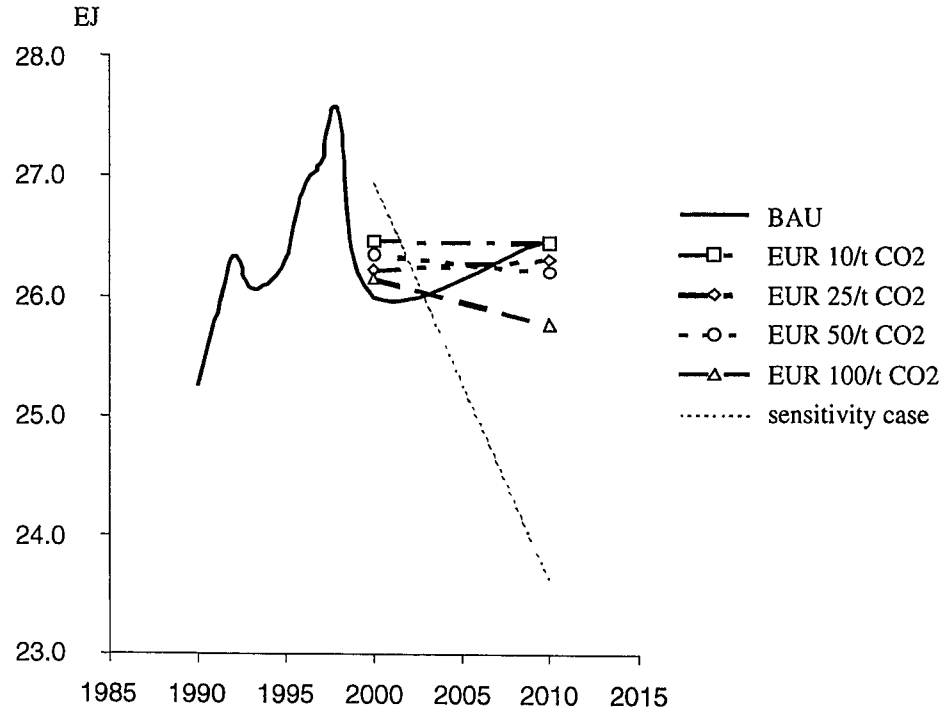
[4] GHG = greenhouse gases.

Figure 3.1 US oil consumption for various CO_2 reduction scenarios, based on the EIA, DoU study [EJ]



The Western European region comprises of the EU member states, Norway, Switzerland, Iceland and Turkey. Figure 3.2 depicts the impact of the imposition of various levels of a carbon tax on the oil consumption in Western Europe according to the study conducted by ECN. The MARKAL model has been used to produce these results.

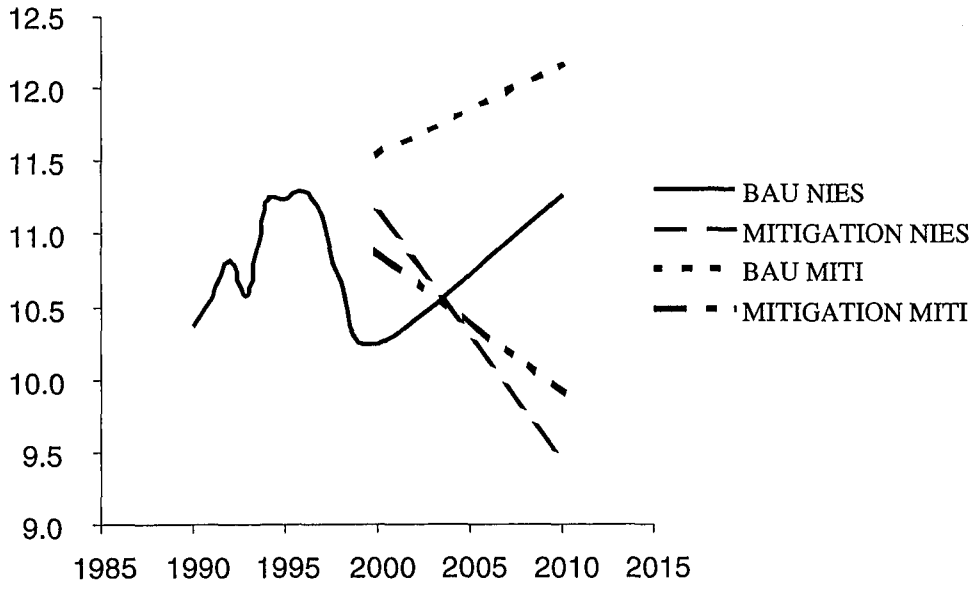
Figure 3.2 Western European oil consumption based on ECN study [EJ]



The study analyses a BAU scenario and four CO_2 reduction scenarios based on carbon taxes ranging from • 10/ton CO_2 to • 100/ton CO_2 in 2010. In the most stringent mitigation scenario, the oil consumption is reduced by 1-3% in 2010 compared to the BAU scenario. This reduction only considers the first order effects; if the effect of higher end use prices on the economy is taken into account, the decline in oil consumption would be significant higher (some 11% reduction in 2010 compared to BAU). The consumption of coal is affected most by the imposition of the carbon tax.

The region Asia Pacific comprises Japan, Australia and New Zealand. Figure 3.3 shows the mitigation scenarios prepared by NIES for Japan and by the Japanese Ministry of International Trade and Industry.

Figure 3.3 Oil consumption in Japan according to NIES and MITI studies [EJ]



In the NIES study the oil consumption is projected to decline by 16% compared to the BAU scenario by 2010, in the case of 6% CO_2 reduction. As a comparison, the Japanese Ministry of International Trade and Industry (MITI) published a somewhat different BAU and mitigation scenario (Fujime, 1998), but the impact on oil consumption is the same as in the NIES study. For Australia and New Zealand similar reduction patterns have been assumed, as for Japan.

The country studies of the US, Western Europe and Japan are not based on the IEA-BAU scenario, but have used their own developed BAU scenarios. However, the results of the mitigation scenarios have been applied to the IEA-BAU scenario. This has been done in three steps. In step 1, for each region, the mitigation scenario by which the Kyoto target is met is used as the reference. In step 2, the result of this scenario is applied to IEA-BAU. Finally, in step 3 the mitigation results are adjusted in such a way that the Kyoto target is reached using IEA-BAU as the reference.

3. Assessment of the impact of the implementation of the agreed greenhouse gases reduction targets on the export revenues of OPEC.

Finally, the impact of the reduction in oil demand on the OPEC oil export revenues has been determined by making assumptions on how OPEC will react to a decline in

Annex I oil demand. The following three cases have been analysed, each case reflecting a different possible OPEC behaviour:

1. In case A it is assumed that OPEC will absorb total reduction in Annex I oil demand in order to maintain a stable oil price of $ 20; this implies that the OPEC market share will decrease.
2. In case B it is assumed that OPEC will attempt to keep its production at the same level and, consequently, oil price will fall to $15.
3. In case C it is assumed that OPEC will absorb one-third of total reduction in Annex I oil demand, the remaining two-thirds will be at the expense of non-OPEC production. For this case an oil price is assumed of $ 15 per barrel

3.3 Results

3.3.1 'Business as Usual' scenario

The production, consumption and net exports of oil in the Annex I countries are given in Table 3.4. For the years 1990 and 1998 the figures are actual realisations. Consumption and production figures for 2010 are based on the IEA-BAU scenario.

Table 3.4 World oil production, consumption and net export in 1990, 1998 and the IEA-BAU scenario 2010 [mb/d]

	Production			Consumption			Net export		
	1990	1998	2010	1990	1998	2010	1990	1998	2010
Annex I	26.9	24.3	21.9	45.8	44.8	51.1	-18.9	-20.5	-29.2
Western Europe	4.4	6.7	4.5	13.2	14.5	16.4	-8.8	-7.8	-11.9
North America	10.7	10.4	8.6	18.1	19.7	21.6	-7.4	-9.3	-13
EE and FSU	11.2	6.6	8.5	8.5	4.3	5.6	2.7	2.3	2.9
Asia Pacific	.6	.6	.3	6.0	6.3	7.5	-5.4	-5.7	-7.2
Non-Annex I	40.2	49.9	70.2	20.3	26.7	39.4	19.9	23.2	30.8
OPEC	25.3	31.2	52.2	4.8	5.8	7.4	20.5	25.4	44.8
non-OPEC	14.9	18.7	18.0	15.5	20.9	32.0	-.6	-2.2	-14
Bunkers/stat.diff.							-1	-2.7	-1.6
WORLD	67.1	74.2	94.2	66.1	71.5	94.2	0	0	0

Source: BP (1998) and IEA (1998)

Table 3.4 clearly shows that in the IEA-BAU scenario oil consumption and production will continue to expand in the Annex I countries. As shown in Table 3.5 the share

of OPEC in world production, which was 42 % in 1998, is anticipated to increase substantially because oil production in the OECD countries will peak in the next five years and the new oil production from the Caspian Sea area (Russia, Azerbaijan, Kazakhstan, Turkmenistan, Uzbekistan) will not be able to fully compensate for this loss in OECD production, at least not by 2010 at the projected price level of $18-20 a barrel.

Table 3.5 Production shares (%)

	1990	1998	2010
OPEC	38	42	55
Non-OPEC	62	58	45
WORLD	100	100	100
WORLD (mb/d)	67	74	94

Source: BP (1998) and IEA (1998)

In the IEA-BAU scenario the OPEC share of production will develop in line with their share of world proven crude oil reserves (see Table 3.6). Presently, OPEC's share is 76%, sufficient for another 73.5 years of production at the 1998 level (=r/p ratio). The position of the Middle East producers stands out, even among the OPEC producers. It must be noted that IEA oil production projections for OPEC exceed the projections of the OPEC Secretariat (1999). According to the Secretariat OPEC's oil production will grow from 29 mb/d in 1997 to 40 mb/d in 2010. The OPEC Secretariat estimates a world oil production of 88 mb/d by 2010.

Table 3.6 Proven oil reserves in 1978 and 1998

Proven reserves	1978: thousand million barrels	1998: thousand million barrels	share in % of world total in 1998	r/p
North America	57.1	85.1	8	18.1
South and Central America	25.3	89.5	8.5	37.4
Europe	27.4	20.7	2	8.4
Former Soviet Union	71.0	65.4	6.3	24.8
Middle-East	369.6	673.7	64	83.2
of which Gulf:	*367.2*	*671.0*	*99.6*	
Africa	57.9	75.4	7	28
Asia /Pacific	40.0	43.1	4.2	15.9
World	648.3	1052.9	100	41
of which OPEC	*441.8*	*800.5*	*76*	*73.5*
share Gulf in OPEC	*367.2*	*671.0*	*83.8*	

Source: *BP Amoco Statistical Review of World Energy* 1999, p. 4.

The increased call on OPEC oil under the IEA-BAU scenario will be particularly important for the Middle East. The distribution of oil reserves in OPEC is asymmetric, and the producers around the Arabian/Iranian Gulf are exceptionally richly endowed with oil. The share of the countries around the Gulf in OPEC proven reserves is 83.8%. In terms of regional distribution of consumption and production, Table 3.6 clearly shows that the Middle East, of which the Gulf states are by far the dominant producers, is the most important net-exporting region in the world and Table 3.4 shows that the Annex I countries are the most important importers. With production in the OECD countries reaching a peak shortly after the year 2000, oil imports of the Annex I countries become a larger part of their oil consumption. Oil from the Middle East in particular will be used to make up the difference.

3.3.2 Mitigation scenarios

The results of the two mitigation scenarios Mit-CO_2 and Mit-GHG are presented in Table 3.7.

Table 3.7 World oil demand in 2010 according to the IEA-BAU and mitigation scenarios [PJ and mb/d]

	BAU		Mit-CO_2		Mit-GHG	
	[PJ]	[mb/d]	[PJ]	[mb/d]	[PJ]	[mb/d]
Western Europe	32,601	16.4	25,777	13.0	26,585	13.4
North America	42,896	21.6	38,652	19.5	39,969	20.1
Eastern Europe and FSU	11,111	5.6	11,111	5.6	11,111	5.6
Asia Pacific	14,801	7.5	11,727	5.9	12,041	6.1
Annex I	101,409	51.1	87,267	44.0	89,705	45.2
Non-Annex I	78,277	39.4	78,277	39.4	78,277	39.4
WORLD	179,687	90.5	165,545	83.4	167,982	84.6

In the Mit-CO_2 and Mit-GHG scenarios, Annex I oil consumption will not expand from 46 to 51 million mb/d as in the IEA-BAU scenario, but decline to 44 mb/d under the Mit-CO_2 mitigation scenario or to 45 mb/d in the Mit-GHG scenario. Compared to the IEA-BAU in 2010 it implies a loss of Annex I demand of 7.1 mb/d or 5.8 mb/d respectively.

It should be noted that projected oil consumption of Western Europe in 2010 in the IEA-BAU is significantly higher compared to the BAU scenarios used in the IIASA-WEC and ECN studies. The decrease in oil demand should therefore be regarded as an upper limit.

The Gulf producers will, compared to the IEA-BAU scenario, suffer most in terms of lost output and lost potential income from the introduction of global climate change mitigation policies. This is because these countries (particularly Saudi Arabia) are the countries with a large potential for additional production capacity, which would be used in the case of the IEA BAU scenario. However, in the case of the (CO_2) mitigation scenario, the largest costs will be borne by the large net oil exporters in the Gulf. It is therefore not surprising that these countries, which depend on the proceeds of oil exports for their economy, are most concerned about the implementation of Kyoto protocol.

The BAU scenario allows expansion in the oil industries again, after stagnation in their oil production in the 1980s and 1990s. The investments in non-oil sectors, although they have shifted the dependency on oil somewhat, have not been able to replace the oil industry as the most important sector of their economies. Moreover, the world at large has an interest in continued supplies of oil, albeit not at the same level as before. Economic theory[1] suggests that in circumstances where markets have become mature (in this case as a result of a policy decision) competition for market share will sharpen dramatically and that the market will become more concentrated as a result of merger and take-over activity. In the private sector, 1998 and 1999 already confirmed this trend with large take-overs and mergers among oil companies (BP Amoco/Arco, Exxon/Mobil, and Totalfina/Elf) in an attempt to consolidate their position and reduce costs by achieving synergies.

It should be noted that the fortune of the large net oil exporter of the Gulf not only depends on the question whether Kyoto policies will be implemented but also on the 'default' OPEC oil production under the BAU scenario as explained in section 3.3.1.

3.3.3 Impact of climate change policies on OPEC oil export revenues

The impact on the oil revenues of the OPEC countries has been determined for three different cases as described in section 2.1. The results of the three cases are presented in the Tables 3.8, 3.9 and 3.10.

Table 3.8 The impact on OPEC oil export revenues: case A

	BAU 2010	Mit-CO_2 2010	Difference	Mit-GHG 2010	Difference
$/barrel	20	20	20	20	20
Production OPEC (mb/d)	52.2	45.0	7.1	46.3	5.9
Production non-OPEC (mb/d)	39.9	39.9	0.0	39.9	0.0
Processing gains (mb/d)	2.1	2.1		2.1	
Total production (mb/d)[5]	94.2	87.0	7.1	88.3	5.9
OPEC export (mb/d)	44.7	37.6		38.9	
Revenues OPEC (million $)[6]	326,672	274,655	52,018	283,622	43,050
Reduction in revenues compared to BAU			15.9%		13.2%
Annual growth export revenues 1998-2010	4.4%	3.3%		3.6%	
OPEC market share	55%	52%		52%	

In case A, the OPEC fully absorbs the reduced OECD oil demand of 7.1 and 5.9 million barrels per day respectively to maintain the oil price level. This results in a reduction of export revenues of 15.9% in the Mit-CO_2 scenario and of 13.2% in the Mit-GHG scenario. OPEC's market share is projected to decline to 52%.

Table 3.9 The impact on OPEC oil revenues: case B

	BAU 2010	Mit-CO_2 2010	Difference	Mit-GHG 2010	Difference
$/barrel	20	15	15	15	15
Production OPEC (mb/d)	52.2	52.2	0.0	52.2	0.0
Production non-OPEC (mb/d)	39.9	32.8	7.1	34.0	5.9
Processing gains	2.1	2.1		2.1	
Total production (mb/d)	94.2	87.0	7.1	88.3	5.9
OPEC export (mb/d)	44.7	44.7		44.7	
Revenues OPEC (million $)	326,672	245,004	81,668	245,592	81,668
Reduction in revenues compared to BAU			25.0%		25.0%
Annual growth export revenues 1998-2010	4.4%	2.4%		2.4%	
OPEC market share (%)	55	60		59	

In case B the OPEC strategy is to retain their market share rather than to keep the oil price at the same level. The oil price is assumed to decrease to a level of $ 15 per bar-

[5] The total production figures include processing gains.

[6] *Based on production figures.* The figures presented are the gross revenues without taking domestic consumption and production costs into account.

rel. The non-OPEC oil producing countries will absorb the reduction in oil demand in Annex I countries. An example of the presumed drop in non-OPEC production is provided in an EIA study on the oil production potential of the West Siberian Basin (1997). This study indicates that, in case of little new oil discoveries (which could be caused by the less favourable oil price regime), the West Siberian oil production could fall from a high level of 8.5 million b/d to a level of 4 million b/d. Compared to case A, case B results in a higher market share for OPEC countries. However, the revenues are substantially lower.

One of the main uncertainties in case B is the extent to which non-OPEC producers will have to cut down their production as a consequence of the lower oil price ($ 15 per barrel). In case C it is assumed that non-OPEC oil producers will lower their production by two-thirds of the reduction in oil demand in Annex I countries. As shown in Table 3.10, in comparison with Tables 3.8 and 3.9, this would be the worst scenario for OPEC in terms of export revenues.

Table 3.10 The impact on OPEC oil revenues: case C

	BAU 2010	Mit-CO_2 2010	Difference	Mit-GHG 2010	Difference
$/barrel	20	15	15	15	15
Production OPEC (mb/d)	52.2	49.8	2.4	50.2	2.0
Production non-OPEC (mb/d)	39.9	35.2	4.8	36.0	3.9
Processing gains	2.1	2.1		2.1	
Total production (mb/d)	94.2	87.0	7.1	88.3	5.9
OPEC export (mb/d)	44.7	42.4		42.8	
Revenues OPEC (million $)	326,672	232,000	94,672	234,242	92,431
Reduction in revenues compared to BAU			29%		28.3%
Annual growth export revenues 1998-2010	4.4%	1.9%		2.0%	
OPEC market share (%)	55%	57%		57%	

Table 3.11 presents a summary of the results of the three cases and shows projected population growth rates for selected OPEC countries.

Table 3.11 The impact on OPEC oil revenues: cases A, B and C

	BAU 2010	Case A 2010	Case B 2010	Case C 2010
Price per barrel in US$	20	20	15	15
OPEC production(mb/d)	52.2	45	52.2	49.8
non-OPEC production (mb/d)	39.9	39.9	32.8	35.2
OPEC export (mb/d)	44.7	37.6	44.7	42.4
Profits OPEC petroleum export (billion US$)	326.7	274.7	245.0	232.0
OPEC market share(%)	55	52	60	57
Yearly growth petroleum export 1998 - 2010 (%)	4.4	3.3	2.4	1.9
Yearly population growth main OPEC countries 2000-2010 (%)				
- Saudi Arabia	3.4	3.4	3.4	3.4
- Iraq	3.0	3.0	3.0	3.0
- Iran	1.4	1.4	1.4	1.4
- Indonesia	1.3	1.3	1.3	1.3
- Libya	2.3	2.3	2.3	2.3
- Venezuela	1.5	1.5	1.5	1.5
- Nigeria	2.5	2.5	2.5	2.5

4 IMPACT OF THE IMPLEMENTATION OF 'NO-REGRET' REDUCTION OPTIONS ON OIL IMPORTS IN NON-ANNEX I COUNTRIES

4.1 Introduction

The articles 4.8 and 4.9 of the UNFCCC state that full consideration should be given to the adverse effects of the implementation of greenhouse gas mitigation measures. Chapter 3 of this report provides an analysis of the extent to which the income of oil producing non-Annex I countries is affected by a reduction in oil demand and Chapter 4 elaborates on the various modes of co-operation which could (partly) compensate the OPEC countries for these income losses.

However, the implementation of greenhouse gases mitigation measures could also be beneficial to the non-Annex I countries. The Kyoto Protocol offers the possibility to Annex I countries to realise a part of their national reduction targets abroad by means of the flexible mechanisms. The Clean Development Mechanism (CDM) has been defined in the Kyoto Protocol as a tool for Annex I countries to acquire Certified Emission Reduction units in non-Annex I countries. Although the specific modalities of the CDM are still being discussed, it is likely that this mechanism will lead to an accelerated transfer of more efficient technology to non-Annex I countries and, consequently, to a reduction in oil import requirements in these countries.

In this chapter an assessment is presented of the potential savings on oil imports in non-Annex I countries resulting from the implementation of greenhouse gases reduction projects. This assessment is largely based on a study conducted jointly by ECN, SEI-B and AED for the Ministry of Foreign Affairs, Directorate General International Co-operation (DGIS) The objective of the DGIS study was to identify the potential and cost for CDM options in the energy sector in the non-Annex I countries.

4.2 Methodology

The methodology to determine the potential oil import savings of greenhouse gases mitigation measures consists of the following main steps:

1. Assessment of oil import expenditures of non-Annex I countries
2. Identification of the potential and cost of GHG reduction options in the non-Annex I countries;
3. Assessment of potential oil-related 'no-regret' options; and
4. Determination of the impact of oil-related 'no-regret' options on oil import requirements in non-Annex I countries.

1. Assessment of oil import expenditures of non-Annex I countries

The first step is to assess the amount spent on oil imports by non-Annex I countries. In the IEA-BAU scenario oil demand in the non-Annex I countries is projected to increase by 3.3% per annum up to the year 2010. For the non-OPEC developing countries the growing oil demand can only be met by increasing oil imports which will lead, consequently, to higher expenditures on oil imports.

2. Identification of the potential and cost of GHG reduction options in the non-Annex I countries

The second step concerns the identification of the potential savings on oil imports by means of projects implemented in the framework of the CDM.

The DGIS study provides a detailed analysis of the potential and cost of CDM options in the year 2010. This potential has been assessed by means of a comprehensive compilation of abatement costing studies for 24 non-Annex I countries. Of the 24 countries covered in the DGIS study, thirteen are situated in Asia, seven in Africa, and four in Latin America. The principal national abatement studies have been obtained from the following sources:

- Asia Least-cost Greenhouse Abatement Strategy (ALGAS) project, sponsored by the UNDP/GEF and ADB in association with eleven Asian countries,
- UNEP Greenhouse Gas Abatement Costing Studies – nine countries,
- Country Studies Program with support from the United States – four countries.

Although there are some 180 non-Annex I countries, the 24 non-Annex I countries for which abatement costing studies were available comprise a fairly extensive sample. These 24 non-Annex 1 countries currently account for no less than two-thirds of total GHG emissions in non-Annex I countries. Information on the potential of more than 300 GHG reduction options and the associated costs could be obtained. This information and other relevant information such as type of option, sector, country and type of fuel have been entered into a CDM database and used to develop an aggregate GHG abatement cost curve for the non-Annex I countries for the year 2010. Finally, a simple extrapolation method has been applied to derive the GHG abatement cost curve for all non-Annex I countries.

The CDM database contains a wealth of information on reduction options in the energy sector in non-Annex I countries by type of option, by sector and by country. Furthermore, a distinction has been made between options eligible to CDM and options, which direct emission reduction, would be difficult to certify (e.g. taxes or subsidies).

3. Assessment of potential oil-related 'no-regret' options

From all the options included in the GHG emission abatement cost curve, only the options with positive net incremental cost (the 'no-regret' options) will be considered in this study because it seems reasonable to assume that these options will be implemented first. Next, from the set of 'no-regret' options, a sub-set has been created of those options, which bring about a reduction in oil consumption. To create this subset, each 'no-regret' option has been analysed for the particular fuel saved if the option is implemented.

For example, to assess the impact on oil consumption of a new wind farm in China, it has been assumed that the electricity generated by the wind farm will replace electricity generated from the existing thermal power plants. In China, oil constitutes approximately 6% of the fuels used in the power sector. Consequently, 6% of the total reduction potential of the wind farm is assumed to be oil-related and it is assumed that China imports 100% of its oil use.

4. *Determination of the impact of oil-related 'no-regret' options on oil import requirements in non-Annex I countries.*

Finally, the impact on oil import requirements has been determined for the implementation of the oil-related 'no-regret options. The IEA-BAU scenario for the non-Annex I countries is used as the reference scenario for the oil consumption in the year 2010. Next, the identified oil-related no-regret mitigation potential is converted into barrels of oil by applying a conversion coefficient. Finally, oil import requirements of the non-Annex I countries with and without climate change policies are compared based on the assumption that domestic oil production will not be affected by a reduction in oil consumption. In other words, the reduction in oil consumption will be absorbed by a similar reduction in oil imports.

The economic impact of abatement policies on non-Annex I countries is beyond the scope of this study but have been reported in several other studies. This chapter gives an overview of the share of oil/gas imports in the total GNP in 2010 for non-oil producing non-Annex I countries according to the IEA-BAU scenario.

4.3 Results

Table 4.1 shows oil consumption, production and imports in the non-Annex I countries during the period 1998 to 2010.

Table 4.1 Oil consumption, production, imports and import expenditures in non-Annex I countries in 1998 and 2010

	1998	2010
Oil consumption (mb/d)	26.7	39.4
Oil production (mb/d)	49.9	70.1
Oil import non OPEC countries (mb/d)	2.2	14.0
Oil import expenditure non OPEC (1990$US billion)	15.	102.2
GDP non OPEC countries (1990$US billion)	3860	6170
Oil import's share of GNP in non OPEC countries (%)	.4	1.7

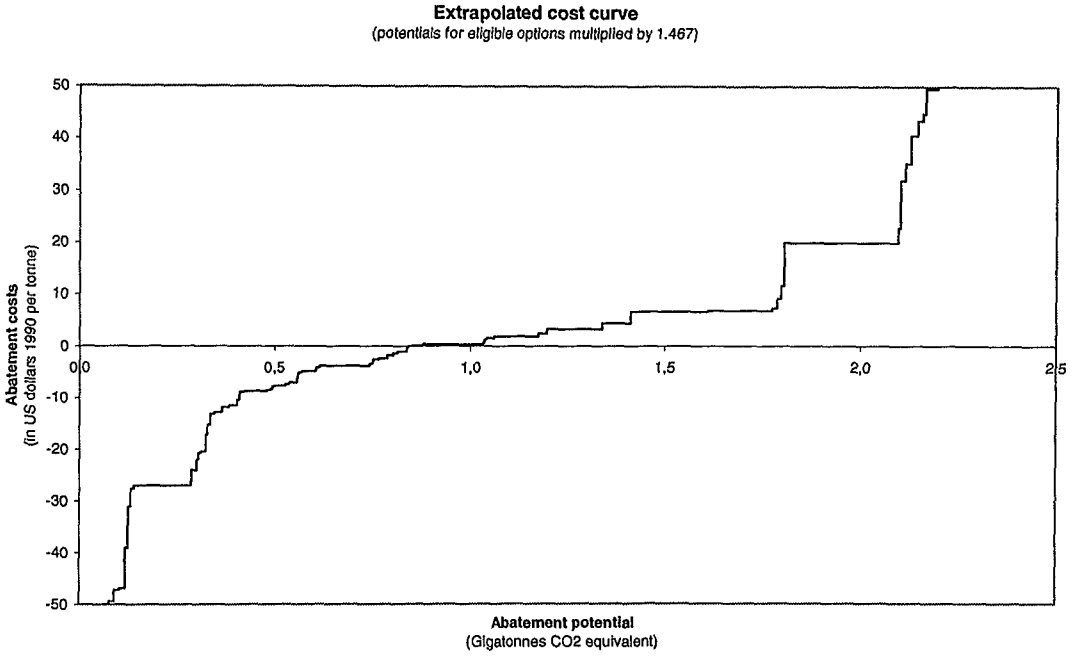
Oil consumption in the non-Annex I countries is expected to increase by 3.3% annually to 39.4 mb/d in 2010. Because the oil production levels in the non OPEC countries will not increase, the net imports of the non OPEC countries have to increase from -3.7 mb/d (exports) in 1998 to 9.2 mb/d in 2010 to meet the growing demand. After 2010 the dependence of non-OPEC countries on oil imports will continue to grow up to a level of 25.6 mb/d in the year 2020.

These figures clearly show the impact of economic development on oil imports in the non-oil producing developing countries and, obviously, this will also have a negative effect on the trade balance in these countries. Therefore, policies aimed at a reduction of oil consumption might be of particular interest to the non-Annex I countries and greenhouse gases mitigation policies could be a means to achieve this reduction.

The CDM has been defined in the Kyoto Protocol as the vehicle to implement projects to reduce greenhouse gases emissions in non-Annex I countries. The CDM options in the energy sector concern two broad categories: energy efficiency improvements (less consumption of energy) and a fuel switch to a cleaner fuel type.

In the DGIS study, an inventory of CDM options in the energy sector in non-Annex I countries has been made. Figure 4.1 depicts the total projected GHG abatement cost curve in the year 2010 based on this inventory. The total potential is derived by scaling up the potential of the 24 non-Annex I countries, for which mitigation studies have been obtained, by a factor of approximately 1.5.

Figure 4.1 'Abatement cost curve for non-Annex I countries in the year 2010



The total projected mitigation potential in the year 2010 in the cost range USD- 50 to USD50 is approximately 2.25 Gton of CO_2 equivalent. Of the total abatement potential, some 45% arises from options in only two of the countries, China and India. Note that for some of the larger non-Annex I countries (Brazil, South Africa) no information could be obtained.

The following limitations of the analysis applied to derive the aggregate abatement cost curve for the non-Annex I countries should be noted:

- Most of the 24 country studies on which the abatement cost curve is based have been carried out as a capacity building exercise. Therefore, the inventory of options and cost should not be viewed as a definitive and exhaustive analysis of national greenhouse gas emission reduction potential.
- In the 24 country studies different assumptions and approaches have been used which make it difficult to aggregate results across countries.
- Some studies do not present information of individual options, but mention only the total cost to achieve a certain reduction target.
- Estimates of mitigation potential depend very sensitively on assumptions about the baseline scenario.

Most of the identified 2.25 Gton CO_2 reduction potential in non-Annex I countries can be realised at a lower cost compared to reduction options in Annex I countries and therefore can be considered as an option for Annex I countries to achieve their national targets. However, in this study only the 'no-regret' potential (options with negative incremental cost) is considered.

Out of the 280 options on which the abatement cost curve is based, some 150 options have positive incremental costs (benefits exceed costs). The total estimated potential of these no-regret options is approximately 870 Mton CO_2 equivalent (some 35% of total identified potential). In order to determine the part of this potential, which reduces oil consumption, the 'no-regret' options have been reviewed for the type of fuel saved if the option is implemented. Table 4.2 shows the results of this analysis.

Table 4.2 Oil-related 'no-regret' potential in non-Annex I countries in 2010

Total non-Annex I IEA-BAU oil consumption in 2010	39.4 mb/d
Total oil-related 'no-regret' in 2010	2.4 mb/d
Percentage reduced consumption compared to BAU	6%
Oil expenditure savings based on $20/barrel	$ 17.3 billion

5 NEW MODES OF CO-OPERATION WITH THE GROUP OF OPEC COUNTRIES

5.1 Future developments of the international oil market

5.1.1 General outlook

In Chapter 2, the dependence on oil revenues of a substantial number of OPEC member states, e.g. Nigeria, Qatar, Kuwait, Libya, Saudi Arabia, the United Arab Emirates, and Venezuela, was revealed. Many oil-exporting countries depend nearly solely on oil exports for their foreign currency income. Also, Russia, Kazakstan, Azerbaijan etc. are very dependent on this source of foreign currency income. The foreign currency income is important with regard to financing non-oil import requirements, to debt-service their foreign loans, and to finance investments. Given the fairly high rate of population growth in OPEC member states (with 3.2% a year in the period 1977-1997), and given the dependence of GDP on oil export revenues, the OPEC member states heavily rely on a continuation of oil revenue growth for the expansion of per capita GDP.

If the expansion of oil revenues becomes smaller than the population growth, the member states must find alternative source of economic growth, reduce population growth or face a fall in per capita GDP. A stunted expansion of these foreign currency receipts, without an immediate alternative source of income from exports, will reduce the ability to import, to invest and will require sharp reductions in government spending. Such a prospect is threatening for the economic stability of the individual countries, also in the context of the regional rivalry among Iraq, Iran and Saudi Arabia, and will force them into a purely national strategy of economic survival. Such a strategy might not be in the interest of balanced oil market developments, nor in the interest of political stability in regions like the Middle East and potentially also in the Caspian Sea region.

The idea that in the next few years OPEC, as compared to attempts in the 1980s and 1990s to distribute the 'costs' of oil market stabilisation, would succeed in properly

distributing the 'costs', is a delusion. If the GHGs emission measures reduce the potential expansion of OPEC oil, it is very likely that the agreement to disagree will only become larger and the last remains of common interests will disappear (van der Linde, 1995). The decision to increase output in March 2000 was very hard to attain and created irritation among the member states. Moreover, during the discussions the underlying different economic and political interests among the oil producing countries again surfaced. The diplomatic pressure of the United States angered countries like Iran and Libya. Both countries are still subject to the investment restrictions of the D'Amato (anti-terrorist state) legislation, which cancels out any serious attraction of foreign direct investments in the oil sector. Moreover, critical remarks about the United States are still necessary for domestic public consumption. Nevertheless, the output increase was inevitable after Venezuela, Saudi Arabia and Mexico had decided on 2 March 2000 to increase oil production. The appeal of the United States to these countries was taken very serious. The proximity and importance of the American market for Mexico and Venezuela and the importance of American economic support made these two countries susceptible to American pressure. Moreover, the United States had rightly pointed out that a high oil price was not in the long term interests of the large oil producers like Saudi Arabia. In the end, the success of the output restrictions that restored the price level from a low $11 to $25-26 a barrel in the space of 8 months and the subsequent recovery of oil incomes, was tainted by the less than perfect follow-up agreement of March 2000.

If one looks beyond the success of the March 1999 agreement, one must also look at the costs at which this short-term success was achieved. Although, oil revenues have increased dramatically since March 1999, particularly compared to the revenues in 1998, the OPEC member states had to create idle production capacity to achieve this oil income. This is also costly to the economy and pressure will increase to increase the capacity utilisation rate in the near future. Countries like Venezuela had been opening up to foreign direct investors in the oil sector, but these projects have either been abandoned or scrapped completely. The investment climate was already insecure due to a change in government, and the uncertainty with regard to economic policy-making. Moreover, investments are also required to modernise the existing production and processing facilities, for which foreign capital is required. The March 1999 agreement must therefore be viewed as a short-term solution and was inspired by the

dramatic development of the government revenues in 1998. Government revenues have increased in 1999, but oil industry expansion has been hampered. In the longer term, the oil industry will continue with its expansion plans. Under a high price regime, like the present one, investments in oil become more attractive, and international oil companies will step up investments. If OPEC member states are not available for investment projects, non-member states will become more attractive. This poses a potential threat to the future market share of OPEC, because the new non-OPEC oil will compete with OPEC oil in the international market. Not surprising, some OPEC member states are now competing for that investment dollar. For instance, in December 1999, Kuwait auctioned exploration blocks to large international oil companies and Iraq is expected to make a similar move when it is released from the United Nations sanctions. Such a development sustains the trend of liberalisation and privatisation of the oil sector, and will increasingly include also the Gulf countries.

In a situation where OPEC will no longer be able to regulate the market and competition among private oil companies will increase, it is very likely that oil prices will decline. The Mit-CO_2 and Mit-GHG scenarios both foresee stagnation in oil demand in OECD countries. In the OPEC study, the authors calculate that, under the condition of stable oil revenues, OPEC production can only grow after 2005 to 29 million b/d (Ghanem, 1999). That production capacity is already in place. Although OECD oil production will peak in the next few years, the level of investments in new oil production elsewhere suggests that total production capacity will continue to increase rather than decline, and that the oil price will be increasingly under a downward pressure. The dependence of oil producing countries on oil revenues traditionally has the effect that, unless production agreements are concluded, output will be increased further in an attempt to make up the lost revenue in volumes sold. Such a competition for demand has occurred repeatedly in the past 15 years, only to be stopped by short-lived OPEC agreements to limit output. The prospects for successful OPEC interventions become smaller rather than larger in a situation where more private international oil companies produce the oil in the oil exporting countries. Part and parcel of the contracts with the private international oil companies is that they, within certain limits, determine the level of production. Otherwise the investments would become far too risky. Privatisation alone will make OPEC

intervention nearly impossible because the oil ministers have nothing to negotiate with.

The economic problems of oil-producing countries are to a large extent due to a combination of Dutch Disease effects and to unfortunate economic management. Furthermore, the main oil producing countries have delayed restructuring their economies for too long, and have resorted to short-term stopgap policies. The fragile domestic and/or regional politics have further hampered economic adjustments, which makes most oil-producing countries ill prepared for the impact of the mitigation policies. Today, many oil producing countries are experiencing serious domestic political problems in addition to their economic problems. In an IMF study, deep-seated corruption practises were found to be common in most raw material producing countries, which undermines an efficient reorganisation of the economy (Leite, 1999). It must be assumed that also oil-producing countries suffer from these practises. A substantial level of corruption is serious enough in a period in which oil incomes are large, but can create an explosive political situation in a period where oil incomes decline. In an attempt to stabilise the political and the economic situation, it is possible that the rent-seeking behaviour of the privileged will only become more urgent and geared towards short-term exploitation.

In general, the economic performance of the oil producing countries has been disappointing, and many countries are struggling to maintain political stability. In Venezuela, a new government has come to power that won a lot of support from the average Venezuelan, but its economic policies have scared investors away. In Nigeria, the political and economic problems have been so large that the new government will need more time to turn the economy around. In Saudi Arabia, some signs of more openness in the oil and gas sector are appearing, it is expected that far-reaching initiatives on economic restructuring are awaiting the succession of the ailing Fahd by Abdullah. Iraq is still under Saddam Hussein's rule, and therefore not released from the UN sanctions which were imposed in 1991. In Iran reformers are battling with the religious elite for economic and political change. In Indonesia, the new government is faced with the enormous task to find workable solutions for the political and economic problems inherited from the previous government. The political domestic battles in many OPEC countries will continue to hamper their economic fortitude to

deal with the changes on the international oil market. The increased oil revenues as a result of the March 1999 production agreement are predominantly used to overcome the large fall in oil incomes in 1998 and to delay or soften the painful policy measures announced in 1998.

Two possible future developments of the international oil market are conceivable. Firstly, the situation where the process of privatisation will continue at a high pace, and, secondly, a situation where the privatisation process is much slower. Both situations are described in detail in the sections 5.1.2 and 5.1.3 respectively.

5.1.2 Privatised oil market

If the proposition is accepted that more and more the crude oil assets will be privatised and that oil production, also in the OPEC member states, will be organised by private firms, either investing alone or in joint-ventures, the implementation of the Kyoto protocol will affect the OPEC revenues differently. This is due to the fact that privatisation shifts the entrepreneurial risks to the oil companies. A lower demand for oil from Annex I countries in conjunction with softer prices will force the private oil companies into further cost reduction, a re-orientation on their investment plans and a re-negotiation of their contracts with host governments. The new market conditions, which are harder than the current ones, will phase out the marginal oil companies that cannot produce at a profit. Very likely, the implementation of the Kyoto protocol will further force the large international oil companies into consolidation of their market position. However, the large international companies are already planning their investments on fairly low average production costs of about $10-12 per barrel and that falls within the limits of the expected price reduction.

Table 5.1 Oil and gas supply costs for the various regions

Oil and gas supply costs*	In USD per barrel
North America	11
Mexico	10
Venezuela	7
North Sea	11
Nigeria	7
Gulf States**	2
Russia	14
Indonesia	6

* Includes production, finding and development costs; $ per barrel of oil equivalent
**assumes finding and development costs minimal until output exceeds 20m barrels per day.
Source: The Economist, March 6th 1999, p. 23.

Producing countries or regions with high production costs will become less attractive for investments. But they will be uneconomic under any scenario for the next 10-15 years, unless prices can be stabilised at least at a level of about $20. In a privatised market, the mitigation policies could be absorbed more easily. They would just become part of the investment conditions in the market, and supply would be adjusted to the new demand conditions in the international market. However, the impact on marginal producing regions could still be serious. For marginal producing countries, the investment climate would have to be improved by offering all sorts of benefits to the companies. Moreover, once oil investments have been made, the decision to stop production from a marginal field is delayed as long as variable costs can be recovered (Adelman, 1993 and Frankel,1989).

In a privatised international oil market, oil revenues must be collected in taxes. Most modern resource taxation takes the special cost structure and long lead-times into account. However, if as a result of the implementation of the Kyoto protocol, profit margins of oil companies decline, the tax receipts of oil producing countries will also decline. Although privatisation shifts a substantial part of the entrepreneurial risk to private oil companies, the governments of oil-producing countries cannot avoid the risk that oil tax incomes will decline too.

5.1.3 Mixed oil market

In a situation where the privatisation process is much slower, and the implementation of the Kyoto protocol takes place in a mixed market (like the current one), it is not unlikely that unfair competition among state oil companies and private oil companies will exist (persist). For example, if a country has little alternative sources of hard currency income, it can decide, in the short term, to supply the international market with additional oil from existing sources and allow oil companies (state or private) to ignore normal business practises. In 1998 in Russia, there were examples of state or state affiliated companies that do not pay their labour costs or their interest payments, while their competitors are not allowed such practises. The lack of bankruptcy laws or the willingness to implements them and the continued preference of governments to subsidise these companies creates unfair competition. The protection of the domestic oil industry can be inspired by the fact that these industries produce an even more precious commodity than oil, namely dollars. Protectionism of the domestic oil industry, for whatever reason, can hamper the adjustment of the domestic oil industry to the international market conditions.

5.2 Modes of co-operation with oil producing countries

5.2.1 Why is co-operation with oil producing countries important?

Co-operation must imply that Annex-I countries somehow include the oil-producing countries in their efforts to meet the Kyoto targets. Since the GHGs measures will affect all oil producing countries, including the OPEC countries, the efforts to co-operate should be directed at all oil producing countries. OPEC represents 11 of these countries, including very large net-producers that are important for the international oil market. Although the macro-economic effects of the implementation on the international oil market appear less dramatic than expected, depending on the application of the Kyoto protocol market mechanisms[7], the impact on the individual producer countries can be very large indeed. This depends on their level of dependence on oil revenues, the ability to diversify away from oil, and on their national oil regimes. In 1997 the dependence on oil in export revenues for the group of OPEC countries was very large, except for Indonesia (see Table 2.1). It shows that any loss of export income (either through a loss of volume, lower prices or a combination of both) from oil will substantially affect OPEC countries. Moreover, the lack of alternative sources of hard currency income will be hard to compensate in a very short period of time (in the ten years to 2010).

The potential loss of revenue compared to the BAU scenario, as a direct result of the implementation of the Kyoto protocol, is a serious issue for some oil producer countries. This is partly due to the fact that OPEC countries perceive that they have carried the costs, since 1982, of international oil market stabilisation. The benefits of the self-imposed role of market regulator lasted only 10 years, after which the costs of this role began to bear down on some key member states of the organisation. Particularly, the Gulf countries carried these costs in terms of lost output and revenues until they demanded their fair share of OPEC output on the world market in 1986. As a result of their production restraints, non-OPEC oil could be developed and expanded. Moreover, after 1986, consumer governments, particularly in Europe, taxed away a substantial part of the price decline in final consumer markets, which stunted the expansion

[7] J. Pershing, *Fossil Fuel Implications of Climate Change Mitigation Responses*, International Energy Agency, undated, distributed at UNFCCC workshop 13-15 March 2000, Bonn, Germany, p.21; K.

of demand. Since then, various environmental taxes and levies have been imposed on final oil products that benefited the government coffers of consumer countries. The oil producer countries are drawing attention to their special dependence on oil and their economic vulnerability. The interest of the Annex-I countries in co-operating with the oil producing countries is that the world depends on the continued production of oil. The fact that the OPEC countries represent 76% of the world's proven oil reserves, of which the Gulf producers represent 84%, necessarily includes these countries in the efforts to co-operate.

If the Annex I countries wish to include the oil producing countries, including OPEC member states, in the reduction of greenhouse gases policies, facilities should be contemplated that may assist the oil producer countries in absorbing the "costs" of changing and less expansive demand conditions in the coming decades.

5.2.2 Different formats of co-operation

Several modes of co-operations may be established to enhance the involvement of the oil producing countries in the implementation of the Kyoto Protocol. In this chapter the following formats of co-operations will be examined:

1. Improved market access to the European Union
2. Non-oil investments in the oil producing countries
3. Strengthening of producer-consumer relations
4. Oil market organisation
5. Imposition of CO_2 tax

1. Improved market access to the European Market

Since revenue is such an important issue, the focus is first on co-operation in which revenues are redistributed to oil producers/OPEC. Under revenue redistribution types of co-operation, other technical co-operation schemes can be instituted which help the oil producing countries to develop their non-oil sectors and diversify away from their dependence on oil export revenues. For example, since the non-oil domestic markets in oil producing countries are relatively small, achieving economies of scale will de-

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Alfsen, *The Kyoto Protocol and its impact on global oil markets up to 2020*, presentation UNFCCC workshop 13-15 March 2000, Bonn, Germany, p. 26.

pend largely on trade to the world market. Improved market access to the European Union, for instance in petrochemical products, can constitute an important element in a diversification effort on the part of the oil producing countries. In the past, oil-producing countries, particularly in the Gulf, have built up a large export capacity in refined and petrochemical products. However, market access in the EU has always been difficult as long as the oil processing industry in Europe was in the process of restructuring this sector. Many efforts on the part of the Gulf countries to gain access to the European market have failed (EU-Gulf Co-operation Council talks). The economic relations between the EU and oil producing countries would improve substantially with a more liberalised treatment of processed products from oil producing countries. Such a revision of the EU trade policy would underpin the efforts of the oil producing countries to increase value-added exports and exploit their competitive advantage.

2. Non-oil investments in the oil producing countries

Stimulating non-oil investments in producer countries and free or nearly free market access for the products of these industries, may be an attractive format of co-operation. However, labour is in short supply in some key producer countries, and it might be hard to develop new competitive advantages in capital and/or knowledge intensive industries. Moreover, the competitive advantage will, despite the impact of the GHG-emission reduction policies, remain in the energy-intense industries in a substantial number of OPEC countries. Increased imports of final oil products in the EU, for instance, would imply a further contraction of the refining sector in the EU. However, the EU will prefer to maintain a certain level of refining capacity for strategic and balance of payment reasons, which implies that it will not accept a large import dependency on these products.

The pre-condition for increased co-operation in investments would be the liberalisation of the producer country economies in order to attract and sustain these investments. Presently many oil-producing countries have unattractive investment regimes. (Pershing, p. 20) With regard to greater market access for countries that can develop other competitive advantages, particularly in the labour intensive industrial sectors, it must be remembered that the EU is making great efforts to integrate Eastern European countries into the EU-economy. It is therefore not very likely that the oil producer

countries will receive a preferential treatment over these countries. The outlook for greater or preferential market access for oil producer countries does not look very good because EU priorities are somewhere else. We must therefore reduce our optimism that trade negotiations, in combination with investment stimuli, will convince the OPEC countries that alternative export revenues can be generated to replace the loss of potential export revenues.

3. Strengthening of producer-consumer relations

With regard to the oil sector in oil producing countries, we must bear in mind that Annex I countries have a vested interest in maintaining oil production at a certain level, because oil imports will stabilise and will maintain their strategic importance. The import dependence of Annex-I countries will continue to remain substantial and the import dependence of Asia/Pacific will only grow. Creating a situation in which the oil producing countries become more economically and perhaps also politically destabilised is not in the interest of Annex-I countries. To that extent it really does matter that the implementation of the Kyoto protocol is executed with OPEC's co-operation.

Co-operation with OPEC to enhance the involvement in the implementation of FCCC pre-supposes that OPEC will survive these market developments as an organisation. Co-operation then depends on the type of organisation, if at all, OPEC will develop into, since effective market regulation by OPEC is not very likely, despite the fact that OPEC member states represent such a large share of proven reserves. More likely is that OPEC must transform in an organisation that professionally provides the member states with market intelligence and a platform to discuss developments on the international oil markets along the lines of the IEA for the OECD countries. Although such a new type of OPEC is a far cry from the type of organisation and the role the organisation had for the member states in the 1970s, such a development can also have its advantages for co-operation with Annex I countries. If OPEC is no longer involved in market intervention of the type that we have seen in the last 20 years, but evolves into a policy co-operation platform like the IEA, they can engage in discussions with the IEA at a similar level. However, these discussions can only lead to something if the IEA countries acknowledge and understand the difficult economic position of the OPEC member states.

Earlier attempts at consumer-producer discussions always failed because the participants could not overcome the fundamental contradiction in interests and rent seeking. The producer countries can maximise rents in a sellers' market, while consumer countries can maximise rents in a buyers' market (van der Linde, 1991). Both groups of countries can maximise income from oil under these different circumstances. In the 1970s, OPEC countries managed to capture a large revenue stream from oil production as a result of the sellers' market that OPEC underpinned with its price and production policy and the nationalisation of oil reserves and production capacity. In the 1980 and 1990s, a buyers market has prevailed. This allowed the governments of the consumer countries to apply all sorts of taxes and levies on final oil consumption that benefited their government income. In the late 1980s, around the time of the RIO environmental conference, the combined sum of levies and taxes (including environmental taxes) implied that consumer governments earned a higher income stream from oil than producer governments (van der Linde, 1995). The suggestion, at that time, that CO_2 emission reductions could only be achieved with additional tax upset the OPEC governments, because they claimed that the costs of CO_2 mitigation were transferred on them. This study has shown that a continuation of a consumer market is very likely, and that a substantial part of the costs of GHG-mitigation policies will be transferred to OPEC countries in the form of reduced expansion possibilities.

When producer-consumer talks took place in the 1980s, the economic circumstances and particularly the government finances in most OECD countries did not permit any discussion about transferring rents to producers. Although the new taxes had primarily an environmental goal, the budgetary benefits were certainly a welcome side effect. It was this contradiction that prevented any further discussions; even though in the longer run both parties admitted to have mutual benefits in a stabilised international oil market. However, the distribution of the costs of stabilising the market remained highly disputed among producers and among producers and consumers.

4. Oil market organisation

Interestingly, the other inconsistency between consumer and producer governments, that prevented them to engage into some form of co-operation in the past, was the organisation of the international oil industry. The producer governments favoured state

oil companies and strong government intervention, while consumer governments were turning away from state intervention in the economy towards a more free market model. The strong preference for state intervention among producer countries always lingered in the background as a power issue in the international relations. Particularly when the producer countries embarked on an internationalisation strategy and allowed the state oil companies to invest in processing and distribution facilities abroad. They were seeking security of demand like the consumer governments earlier had tried to achieve security of supply. The fact that state oil companies were engaged in foreign direct investments created large fears in the consumer countries that their strategic interests might get hurt. The governments enacted all sorts of arguments and policies to prevent the take-over of domestic oil companies, refineries and distribution facilities by state oil companies. They were afraid that the state oil companies would engage in anti-competitive practises and through subsidiaries would achieve undue influence on the domestic energy markets. As a matter of fact, the Mergers and Monopoly Commission in England forced Kuwait to sell a large part of its shares in BP. The government had sold a large part of its holdings in 1987 and Kuwait had built up a 20% interest in the company.

Different insights in market organisation and the perceived strategic interests of the OECD-countries constrained the market access of the state oil companies in the OECD countries. Although the state oil companies of Kuwait, Venezuela and Saudi Arabia gained some access to the consumer markets oil industry, they never achieved the level of vertical integration that private international oil companies did. In a sense, the OECD-countries, by increasing the barriers-to-entry in consumer markets, engaged in non-competitive practises themselves, and successfully defended the interests of the private oil companies. Moreover, the OECD-countries actively support the re-entry of the private international oil companies in OPEC countries.

In this attempt, the OECD countries are supported by the policies of the IMF and World Bank, and the rules and regulations of the WTO that attempt to liberalise international markets. In the aftermath of the Asian financial crisis, the IMF insisted on introducing competition in the domestic markets and proper supervisory structures in the domestic financial markets, in addition to removing other barriers to trade. In the

proposals for a new architecture of the financial system, these new policy principles are part of the safeguards to reduce the risk of a new crisis.

Given the increasing penetration of private (oil) capital in the oil and gas industry in OPEC countries, the dialogue in the coming years could be of a different nature than before. The large international oil companies have always served the OECD countries' strategic interests. The increased penetration of private capital in oil production will only enhance this role. This allows future producer-consumer discussions to focus on the impact of CO_2 mitigation policies on government revenue streams, rather than on company or country revenue streams. The producer governments can shift some of the risks on the private companies, and secure basic oil (profit) taxation and exploration auction income streams. However, we must also admit that this will not fully replace the lost potential incomes from oil as a result of the mitigation policies.

5. Imposition of CO_2 tax

The attempts of the various parties are to limit the costs (both compliance and impact costs) of the implementation of the Kyoto Protocol. Studies indicate that the costs for both Annex-I and non Annex-I countries are the lowest when the full range of Kyoto Protocol market mechanisms can be used (Pershing, p. 17; Alfsen, p.5 and 26; R. Knapp, slide 27[8]). Obviously, agreeing on the least costly method to implement the GHGs emission measures is an important issue for establishing the terms of co-operation. Furthermore, the distribution of these welfare costs is a primary concern to both Annex-I and non-Annex-I countries. The oil producer-oil consumer countries have, since 1973, been in a tug of war about the distribution of oil rents. OPEC has repeatedly attempted to increase and stabilise oil prices at a higher level through a policy of production cuts, while OECD consumer countries have, over the years, increased taxes on oil products. Particularly in Europe, taxes on oil consumption are high. A reduction in these taxes is unlikely because they form a substantial part of their government revenues and because part of these taxes were imposed with the aim to reduce oil demand and/or are part of the environmental policies of these countries. Yet, a reduction in oil product taxes in OECD countries may offer an opportunity to oil producing countries to increase their share of the oil rent without increasing the fi-

nal consumer price (Pershing, p. 20). In the context of taxation and allowing oil-producing countries to obtain a larger share of the economic rents, two formats for co-operation may be envisioned.

5.1 Taxes levied at the source, i.e. the producer countries will be allowed to levy taxes on oil. Such a tax would greatly benefit oil-producing countries, but would be very costly to oil consuming countries, which makes it a very unlikely proposition. According to Rutherford, the "welfare costs of Kyoto for oil exporters is on the order of 5-10% of GDP under a destination tax. This changes to a 50% welfare *increase* when taxes are applied on a source basis." [9] Moreover, a source tax does also affect the oil consuming non-Annex-I countries. In order to deal with this problem, the tax should not be levied on oil destined to non-Annex-I countries. However, this would increase the danger of trade diversion and/or trade deflection to take place. Of course, documents of origin could be required by Annex I countries, but the disadvantages are that cheating is hard to avoid and the administrative costs are high. Moreover, the administration could interfere with the free market. Taxation at the source can only be applied efficiently if the tax was levied on all oil production. Moreover, oil produced for the domestic Annex-I market would have to be taxed at the same level in order not to create unfair competition. For governments wishing to stimulate domestic production it can be tempting to provide the oil industry with all sorts of exemptions and subsidies.

In addition to our practical reservation with regard to taxation at the source, the prospects for such a tax are not good because OPEC already has great difficulty to raise oil prices under the present market conditions. In effect, the Kyoto targets could be achieved if OPEC was strong enough to exert effective cartel power and charge substantially higher prices for oil. The drawback of achieving the Kyoto targets through cartel pricing is that it does not discriminate Annex-I countries from non-Annex-I countries, and would economically hurt non-Annex-I countries. Since it was agreed that Annex-I countries would implement the mitigation policies, non-discriminatory

[8] K. Alfsen, *The Kyoto Protocol and its impact on global oil markets;* and R. Knapp, *Impact of response measures*, UNFCCC workshop Bonn 13-15 March 2000.

[9] T. Rutherford, The Economic Impact of the Implementation of response Measures: An Overview from a Modeler's Perspective, UNFCCC workshop 13-15 March 2000, slide 27.

taxation of oil would distribute the mitigation costs to all oil consumers, including the developing countries.

Since there is no authority than can properly monitor and supervise the source tax system, it is very unlikely that the Annex-I countries would agree to such a discriminatory taxation model or any variation thereof. Also, the costs of the implementation of the Kyoto Protocol, according to Rutherford, would increase substantially for OECD countries. The history of corruption in OPEC countries, the previous lack of co-operation among the producer and consumer countries, the ongoing state intervention in the market and the lack of transparency in the market, all result in a weak level of trust among the parties and make this an unlikely solution. Moreover, even if the Annex-I countries would consider such an option, they will insist on some guarantees that the tax revenues are used to improve the (non-) oil economy and benefit sustainable growth.

5.2 Taxes can be levied in the Annex-I countries, but the revenues or part of the revenues are somehow redistributed to oil producer countries.[10] This presupposes that any additional taxes on oil products do not have a general revenue purpose but are meant to reduce oil demand. The idea would be to maintain the present oil rent distribution, while increasing the destination tax. Again such a proposal carries a fair number of problems, apart from the perceived costs to Annex-I countries. If the redistribution of oil rents would only continue the large dependence of oil producer countries on oil revenues, and stymie any attempts to diversify away from oil, to improve on the investment climate and to create a more stable macro-economic environment, such scheme would never come off the ground. The oil producing countries, including OPEC member states, would also have to defer from any intervention in the oil market. Moreover, some OPEC countries have fragile political regimes and/or are located in regions of conflict. The moral hazard will be perceived as very large indeed. This moral hazard created by such a policy can be reduced but not eliminated by redistributing these rents through a special facility at the IMF and World Bank. The exact level of a potential deposit in the facility could be subject to negotiations by the Annex-I countries and oil producing countries or OPEC.

5.2.3 IMF and Worldbank Involvement

The idea behind a special fund or a special facility under the IMF and/or World Bank programmes is that oil producer countries can ask assistance from these funds when severe macro-economic instabilities arise from the GHG mitigation policies. Balance of payments assistance is normally provided by the International Monetary Fund, while the World Bank invests in projects that change the structure of the economy. In the event of severe balance-of-payments problems, the IMF is called upon. One could argue that the oil producer countries could call on the IMF anyway. However, in this case we are aware ahead of time that balance-of-payments and macro-economic instabilities may occur in individual producer countries. The existing facilities are called upon when a country suffers from a structural balance of payments problem. In this case, we would like to argue that pro-active assistance, like in the case of Brazil in 1998, should be contemplated. A new facility was created recently by the Group of 22 in addition to the General Agreement to Borrow (GAB) and has extended the potential financial reserves of the IMF. This facility is intended for countries that are anticipated to become undue victims of contagion, despite the fact that they employ sound economic and monetary policies and despite the fact that they perform proper governance rules. This facility cannot be made available to oil producer countries, unless the task of the facility is widened.

Involving both organisations, i.e. IMF and World Bank, early on in assisting oil producer countries has several advantages. The short-term balance-of-payments and the macro-economic instability problems can be dealt with by the IMF and the restructuring of the oil economies into less oil-dependent economies can be underpinned by World Bank projects. The assistance to oil-producing countries can be financed from new or existing environmental tax incomes (one possibility is that (part of) the tax receipts are deposited in a special fund at the IMF and World Bank[11]) or from other monies that are made available to these organisations. The latter applies if a causal

[10] Other studies presented at the workshop of 13-15 March 2000 also suggest that some transfer may be required to balance oil revenues for oil producing countries (Alawadhi, Alfsen, Pershing).

[11] Such a fund bears similarities with the special oil facility that was created to help oil-consumer developing countries in the 1970s.

relationship between the level of assistance and the Annex-I country environmental tax income must be avoided.

Assistance through the IMF programmes or facilities can address the very likely occurrence of balance-of-payments difficulties and macro-economic instabilities in some of the oil producer countries. Although it must be noted that some of the instabilities are not strictly related to the implementation of the Kyoto Protocol, but are pre-existing economic problems, and that studies into the vulnerabilities of individual countries could offer more insight into the precise impact. Nevertheless, these countries must be assumed to be extra vulnerable to the impact of the measures. In this case it is suggested that, rather than let these economies completely derail first (which increases the costs of stabilisation policies), monies are made available to the IMF and World Bank to prevent such severe instabilities. The oil producer countries or OPEC countries can apply for assistance under the new 'oil' facility if they can accept the general policy principles of both organisations. The IMF (in conjunction with the World Bank) will, in co-operation with the member country, devise an adjustment policy. This adjustment policy attempts to cushion the impact of reduced oil income compared to GDP as a result of the GHG-mitigation policies, while the result of the adjustment policy should be the achievement of sustainable non-oil growth. The compensation or level of assistance can be based on a 'needs' basis or based on the share in Annex-I/world oil production or Annex-I/world oil exports. The latter would only compensate for the mitigation effects and not deal with the instabilities arising from unsound economic policies.

The World Bank could provide a window for investment projects that emphasise the growth of the non-oil sectors and the oil-processing sectors to stimulate more value added production in the oil producer countries themselves. For some countries, investments in gas production, exports and export-infrastructure could cushion the impact of the mitigation policies because gas demand is expected increase. Co-financing from private international oil and gas companies is very likely, if the oil producer countries liberalise their natural resource regimes. Evidence of such a development were the recent discussions of Saudi Arabia with private oil companies to develop their gas sector.

The Annex-I countries, if they are willing to contemplate such co-operation, will very likely prefer a proposal in which the IMF and World Bank are included to a proposal to create a stand-alone facility. Their preference to use the present institutional structure has the benefit of an existing relationship between the institutions and the oil producer countries. Also, knowledge about these types of economies is present in both institutions. Moreover, the Annex-I countries have substantial influence over policy-making in these institutions and can monitor the use of funds. The new emphasis on good governance rules and the stricter rules to report to the IMF also gives the donator countries the guarantee that certain regimes will be excluded from assistance. Unfortunately, some oil producer countries have political regimes that have isolated them from the world community of countries. For instance Iraq could be excluded from compensation/assistance as long as it does not comply with UN resolutions. Drawing on the 'Kyoto facilities' is impossible if the policy goals of the IMF and World Bank are not accepted and if sanctions of the Security Council are applied.

In the past, developing countries turned to international capital markets to avoid the strict economic policy terms of the IMF. However, in the 1990s, the lack of a letter-of-intent increasingly prevented economically and politically weak countries from commercial lending at normal interest rates. The awareness of increased commercial risks in these countries resulted in a *de facto* situation of no access to the international capital market, which made the role of the IMF and World Bank more prominent again.

The reluctance on the part of the OECD countries to consider any sort of redistribution, which may be justified on efficiency grounds, may be matched equally by the severe ambivalence on the part of the oil producing countries to participate in a scheme that will assist them with the absorption of the GHG mitigation policies through the IMF and World Bank. On the one hand, they will welcome the recognition of their economic stake in the redistribution of the costs of implementing the GHG mitigation policies, and the assistance that is offered to adjust to the new market situation. On the other hand, the involvement of the IMF and World Bank implies large policy changes (like liberalisation, the introduction of anti-trust laws, bankruptcy laws, the reduction of subsidies and corruption practises) and strict monitoring of their economies. For instance, the likelihood that they can finance their defence budgets under such a scheme, like in the past, is not very large. The oil producer countries will have a strong sense that Annex-I countries, through the international institutions, are meddling in their internal politics. The Annex-I countries will have a strong preference for international institu-

tional involvement, because they can kill two birds with one stone. This way they not only help the developing producer countries to adjust to the impact of the GHG mitigation policies (or for that matter coal and oil producer countries), but they also gain the compliance with good governance rules and the liberalisation of these countries' economies that will benefit investors from Annex-I countries.

Of course it is possible to contemplate a fund, independent of the IMF and World Bank. In such a case joint supervision of the fund becomes an option that oil producer countries will prefer over the previous option. An independent fund cannot function under the IMF, but must function either as a separate World Bank lending window, or a FCCC facility or as a stand-alone fund with its own management and supervision structure. In the latter case, such a structure would particularly benefit the larger oil producing countries because they must necessarily be involved in management of the fund. The type of compensation could become specially geared towards the larger oil producing countries, and become less focussed on the needs of the smaller oil producing countries. The fund should then be instructed to deal with the alleviation of oil revenue losses of all net-oil-exporting developing countries. However, the creation of a fund separate from the existing institutions will only increase management costs, and fewer monies will be used to compensate for revenue losses. The danger that the fund is being used for political purposes, rather than economic ones, is also larger for a separate entity. Moreover, compliance of such a fund with the general principles of the IMF/Worldbank group will be unavoidable.

5.3 Concluding remarks

It is possible to locate modes of co-operation between Annex-I countries and oil producing countries. However, each proposal to co-operate carries its own respective trade-offs. The uncertainties regarding the distribution of costs and benefits of GHGs-mitigation measures complicate any precise recommendations. The uncertainty about the coming international oil market organisation in terms of the slow liberalisation and privatisation process in some producer countries make predictions on the available room to manoeuvre hard to predict. In particular the role of OPEC in the coming years adds a political dimension to the problem of reducing the impact on oil producing countries of the implementation of the Kyoto Protocol. In this sense, it is hard to

view the impact of the Kyoto Protocol isolated from the past relations with OPEC. Also, the distribution of costs and benefits of the GHG-mitigation measures depends as much on the flexibility of the instruments that can be used, as on the wider economic and political stability of the oil producing countries.

Oil will remain an important input in the world economy for years to come. Denying this importance and the role of the oil producer countries in seeking a reduction of the impact of the GHG-mitigation measures would be a mistake. The Annex-I countries continue to rely on imported oil and emerging market economies, like Asia, are becoming important oil consumers as well. The stability of the international oil market is important for the global economy. The price peak in the first quarter of 2000, and the danger of inflation and an economic slowdown related to oil prices, again made us aware that a stable oil market is in everyone's interest. Although the conflict over the distribution of oil rents will be persistent and may complicate any attempts to find an adequate mode of co-operation with the oil producer countries, most of the parties have a stake in finding a solution. The initial steps to co-operate may be small ones only, but they can provide for improved relationships and may serve as stepping-stones to the more daring attempts at co-operation.

If the European Union prefers to seek the co-operation of the OPEC countries in a European initiative (in trade, in technical assistance, in investment co-operation or even in some redistribution scheme), the advantage of burden sharing with all Annex-I countries disappears. It may be that the economic cost on the EU will be much larger, and it is very likely that the US will oppose any separate EU-OPEC agreement to co-operate. In fact, the strategic importance of oil from the Middle East oil producing countries to the US make it unlikely that they will agree to any such an initiative. Earlier attempts in the 1970s to co-operate in the Euro-Arab Dialogue were frustrated by the American demands that oil policies could not be discussed. The Americans will not accept any type of co-operation that would give the European governments or European oil companies an advantage over American economic, political and strategic interests. Consequently, strategies for co-operation can only be successful if they acknowledge these interests.

6 CONCLUSIONS

In Article 4.8 of the UNFCCC it is clearly stated that policies aiming at a reduction of GHG emissions should duly take into consideration the impact of the implementation of these policies on countries whose economies are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy intensive products. In particular, the group of oil and gas producing countries repeatedly makes references to Article 4.8 to emphasise that due account should be taken of the adverse impacts of greenhouse gases mitigation measures on the oil and gas revenues of the OPEC countries.

The aim of the present study is to provide quantitative information on the impact of the Kyoto Protocol on the export revenues of the OPEC member states and on the oil import requirements of non-Annex I countries. The following important conclusions can be drawn from the study:

1. According to the Business as Usual scenario, oil consumption in the Annex I countries is projected to grow from 44.8 mb/d in 1998 to 51.1 mb/d in 2010. Oil consumption in the non-Annex I countries will increase during the same period from 26.7 mb/d in 1998 to 39.4 in 2010. The implementation of the Kyoto agreement will result in a decline of oil consumption in the Annex I countries in the range of 5.9 - 7.1 million barrels per day, depending on the extent to which non-CO_2 gases will contribute to the achievement of the Kyoto targets.
2. According to the Business as Usual scenario, OPEC oil export is projected to increase from 25.4 mb/d in 1998 to 44.7 mb/d in 2010, an average annual growth of 4.8%. Compared to the projected population growth in OPEC of 2.6% annually, this implies a real growth of 2.2 % per annum if expressed in per capita figures. In the Mit-CO_2 scenario, the OPEC oil export in 2010 is projected to reach a level of 37.6 mb/d (case A). This means an annual average growth of 3.3% or .7% if expressed on a per capita basis. The Mit-CO_2 scenario projects a loss in OPEC oil export revenues in the range of 13 % to 29% compared to the 'Business as Usual' scenario, depending on the assumed OPEC behaviour

3. An inventory of energy-related GHG reduction measures in the non-Annex I countries reveals that the total reduction potential in these countries amounts to roughly 2.2 Gt CO_2 equivalent. For some 35% of the total identified reduction options, the benefits exceed the costs ('no-regret' options), and approximately 40% of the 'no-regret' options are oil-related. This implies that if all no-regret options are implemented in the non-Annex I countries, oil import requirements will be reduced by 2.4 mb/d, or 6% compared to the Business as Usual scenario.
4. The outcome of this study clearly shows that OPEC countries, but also other net-oil exporting countries, will incur a substantial decline in potential oil income (compared to the Business as Usual scenario) as a result of the implementation of the Kyoto protocol. The expected decline in potential income is due to a reduced level of oil exports, a price decline or a combination of both. The level of dependence on these oil revenues is substantial for the larger part of OPEC member states. The dependence is so large that balance-of-payments and macro-economic instabilities will occur. The assistance of the IMF and World Bank to address these problems will be required in the near future. The co-operation with OPEC countries in the implementation of the Kyoto protocol could be advanced if the Annex-I countries offer facilities to address these problems.

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ANNEX A COMPARISON BETWEEN IEA AND IIASA-WEC SCENARIOS

In this study, the BAU scenario has been taken from the 1998 World Energy Outlook of the IEA. In this Annex, a comparison is presented between the IEA-BAU scenario and the scenarios presented in the WEC-IIASA study: 'Global Energy Perspectives' (1998).

Figure A.1 shows the energy mix of the IEA-BAU scenario for Northern America, compared to the corresponding IIASA-WEC scenarios A1, A2, A3, B, C1 and C2 scenarios for Northern America.

Figure A.1 Primary energy demand Northern America 2020, IEA BAU and IIASA-WEC

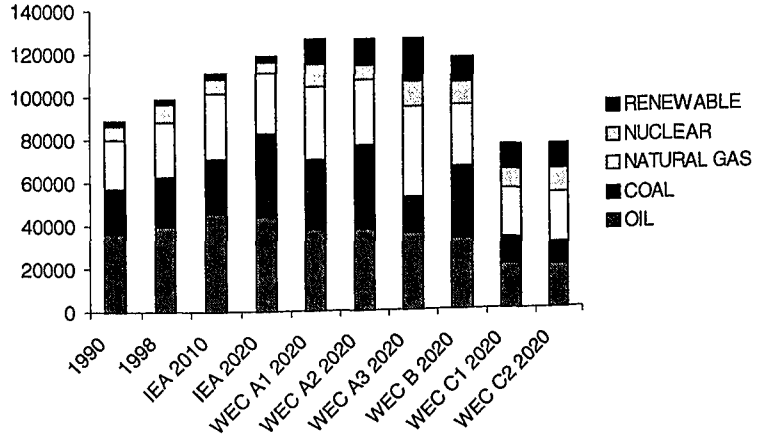


Figure A.2 presents the same information for 'Western Europe' (including Hungary and the Czech Republic) and the corresponding IIASA-WEC scenarios for Western Europe (excluding of Hungary and the Czech Republic).

Figure A.2 Primary energy demand Western Europe 2020, IEA BAU and IIASA-WEC

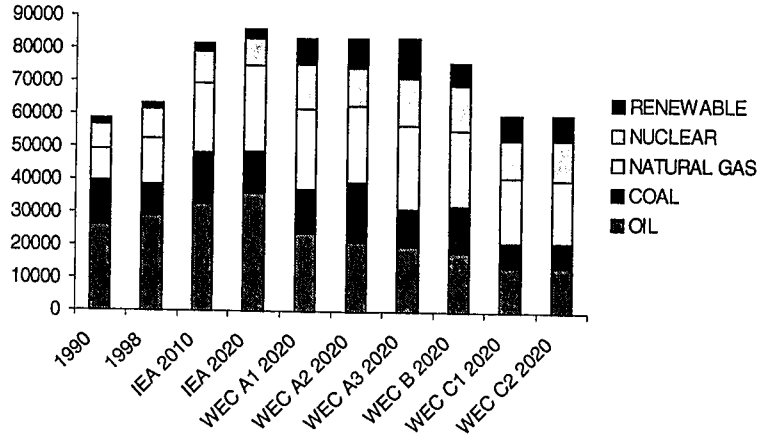
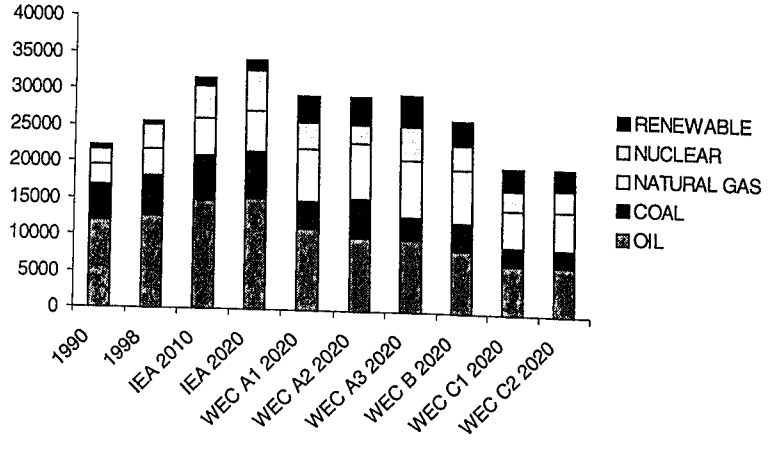


Figure A.3 presents the energy-mix of the IEA BAU scenario for OECD Pacific and the corresponding IIASA-WEC scenarios for OECD Pacific.

Figure A.3 Primary energy demand OECD Pacific 2020, IEA BAU and IIASA-WEC



Because the IIASA-WEC study does not present a BAU scenario but rather explores different future developments by means of six scenarios, a direct comparison between the two studies is difficult. However, the following observations can be made based on the above comparison:

- for Northern America, total primary energy demand the IEA-BAU scenario is comparable to the IIASA-WEC scenarios A1, A2, A3 and B. Scenario B seems to be most in line with IEA-BAU.

- for 'Western Europe' (IEA-BAU includes Hungary and the Czech Republic) total energy demand in 2010 in the IEA-BAU scenario is higher than the IIASA-WEC scenarios. For this region the IIASA-WEC A1 scenario is closest to the IEA-BAU.
- for the OECD Pacific, total energy demand in the IEA-BAU scenario is significantly higher than in the IIASA-WEC scenarios.

ANNEX B SCENARIOS FOR ANNEX I NORTH AMERICA

The region 'Annex I North America' consists of the United States and Canada. In order to estimate the effects of greenhouse gas (GHG) emission reduction, scenarios developed by the EIA (Energy Information Administration, US DoE) have been used. The EIA has used the NEMS model to develop different scenarios to analyse the consequences of the Kyoto Protocol for the energy consumption and production and the economy in general of the USA.

Figure B.1 depicts the IEA-BAU scenario for North America in 2010. The use of oil is estimated to increase by 19%, coal by 46%, and natural gas by 30%, compared to the year 1990. The corresponding figures for nuclear energy and renewable energy are 15% and 10% respectively.

The EIA study presents an own BAU scenario and five mitigation scenarios which simulate the situation with different CO_2 reduction targets for the USA. The results of the EIA mitigation scenario describing a reduction of 7% compared to 1990 have been applied to the IEA-BAU scenario. Where necessary, the figures are reduced proportionally in order to achieve an aggregate 7% CO_2 reduction, according to the Kyoto Protocol. The resulting energy mix is shown in Figure B.2.

Next, the other greenhouse gases, such as methane (CH_4), N_2O, etc. ahve been incorporated. Gielen (1998) and Jochem show in their analyses for Western Europe that other greenhouse gases can be reduced by higher percentages than CO_2 in the period until 2010. Accordingly, CO_2 in Annex-I North America would have to be reduced by merely 2.45%, as shown in Figure B.3.

The results of the three scenarios in terms of primary energy use and CO_2 emission are summarised in Table B.1.

Table A.1 Primary energy use and CO_2 emission in Annex I North America for three scenarios

			IEA-BAU	-7%	-2.45%
		1990	2010	2010	2010
Oil (exclusive of bunkers)	[PJ]	35981	42896	38652	39969
Coal	[PJ]	21177	30838	8516	10065
Natural gas	[PJ]	22688	29496	32821	33293
Nuclear	[PJ]	7049	7620	7844	7620
Renewable	[PJ]	2098	3266	3977	3705
Total	[PJ]	88994	114116	91810	94651
CO_2	[Mton]	5903	7694	5490	5758
	[% 1990]		30%	-7%	-2.45%

In the GHG emission reduction scenario (2.45% CO_2 reduction), oil use is 7% lower than in the BAU scenario, coal decreases by 67%, and gas increases by 13%.

During the period 1990 -2010 (2.45% CO_2 reduction scenario) the use of oil increases slightly (by 11%), coal decreases by 52%, and gas increases by 47%. So, the main difference is the substitution of coal by natural gas. The 2.45% reduction scenario entails substantial energy conservation in households, the commercial and the industrial sector. Transport is characterised by efficiency increases in vehicles and minor contributions from advanced technologies like hybrid vehicles and fuel cell vehicles. Power generation shows a large shift from coal-fired power towards gas-fired power. Nuclear energy remains unchanged compared to the BAU scenario: no additional nuclear power plants are envisaged before 2010. The shift towards renewable energy is modest.

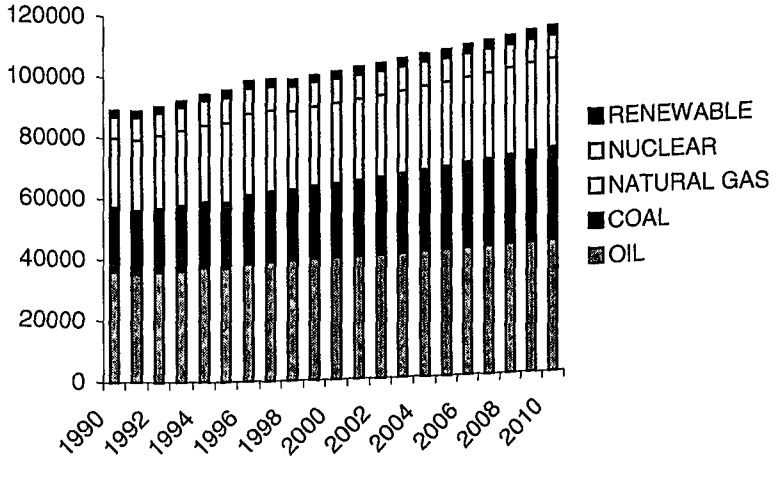


Figure B.1 'Business as Usual' Annex I North America

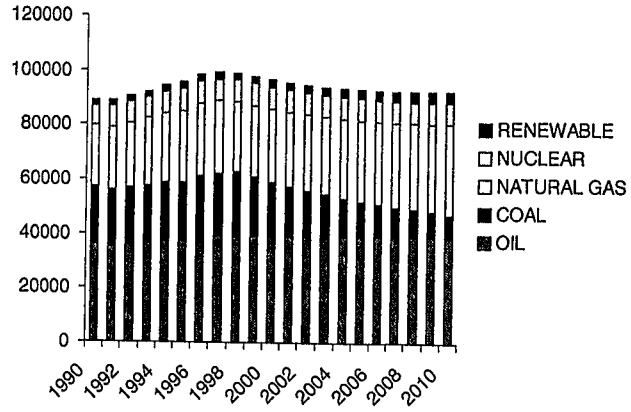
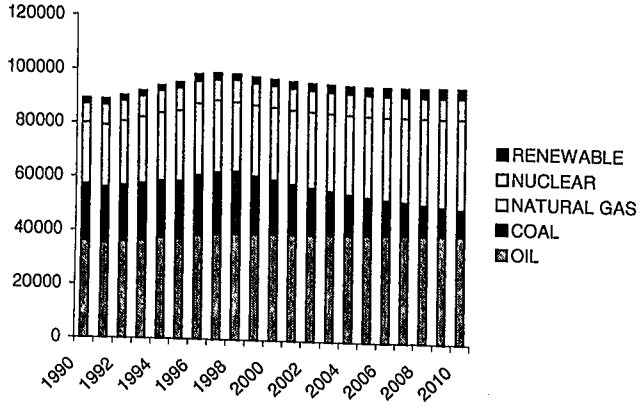


Figure B.2 'Mitigation CO_2' Annex I North America



ANNEX C SCENARIOS FOR ANNEX I EUROPE

The region 'Annex-I Europe' consists of the EU countries, Norway, Switzerland, Iceland, Turkey, and the Baltic states. The mitigation scenario has been taken from the ECN study on the potential of renewable energy technologies (Gielen, 1999). In the ECN study the MARKLAL model has been employed to develop several GHG emission reduction scenarios. These scenarios have been defined for the above mentioned countries minus Turkey and the Baltic states (Gielen, 1999).

The IEA-BAU scenario is used as the reference scenario for primary energy use in 2010. Figure C.1 shows the energy mix of the reference scenario. The use of oil increases by 25%, coal by 17%, and natural gas by 120%, compared to the year 1990. The corresponding figures for nuclear energy and renewable energy are 17% and 15% respectively.

The results of the mitigation scenarios developed in the ECN study have been applied to the IEA-BAU scenarios for Western Europe . Where necessary, the figures are reduced proportionally in order to achieve an aggregate 8% CO_2 reduction, according to the Kyoto Protocol. The resulting energy mix is shown in Figure C.2.

Next, the other greenhouse gases, such as methane (CH_4), N_2O, etc. have been incorporated into the analysis. Gielen (1998) and Jochem show in their analyses for Western Europe that other greenhouse gases can be reduced by higher percentages than CO_2 in the period until 2010. In that case, CO_2 emissions in Annex I Europe have to be reduced by merely 2.8%, which is shown in Figure C.3.

The results of the three scenarios in terms of primary energy use and CO_2 emission are summarised in Table C.1.

Table C.1 Primary energy use and CO_2 emission in Annex I Europe for three scenarios

			IEA-BAU	-8%	-2.8%
		1990	2010	2010	2010
Oil (exclusive of bunkers)	[PJ]	26172	32601	25777	26585
Coal	[PJ]	13331	15553	3918	5098
Natural gas	[PJ]	9660	21200	20498	20928
Nuclear	[PJ]	7671	9420	9698	9420
Renewable	[PJ]	1641	2554	3111	2897
Total	[PJ]	58475	81328	63001	64928
CO_2	[Mton]	3717	5046	3420	3613
	[% 1990]		36%	-8%	-2.8%

In the GHG emission reduction scenario (2.8% CO_2 reduction), oil use is about 18% lower than in the BAU scenario, coal decreases by 67%, and gas decreases by 1%.

Between 1990 and 2010 (2.8% CO_2 reduction scenario) the use of oil remains almost stable, coal decreases by 62%, and gas increases by 117%. So, the main difference is the substitution of coal by natural gas. The 2.8% CO_2 reduction scenario entails substantial energy conservation in households, the commercial and the industrial sector. Transport is characterised by efficiency increases in vehicles and minor contributions from advanced technologies like fuel cell vehicles. Power generation shows a substantial shift from coal to natural gas, and – to a lesser extent – to nuclear energy (the 2.8% CO_2 reduction scenario is identical to BAU) and renewable energy.

Figure C.1 'Business as Usual' Annex I Europe

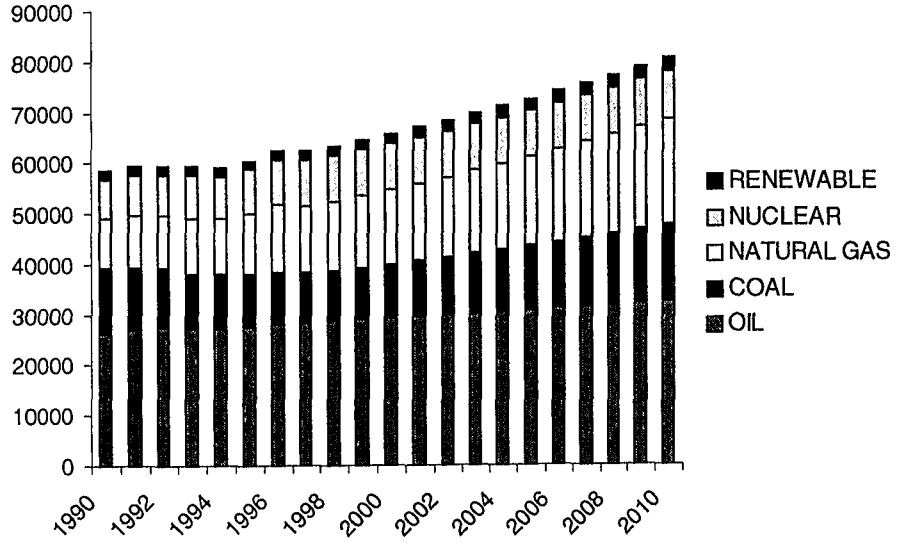


Figure C.2 'Mitigation CO_2' Annex I Europe

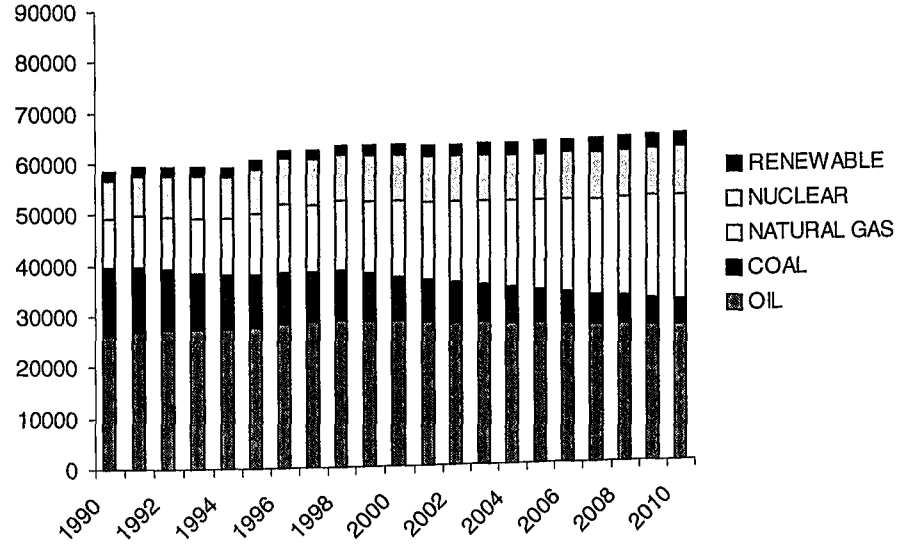
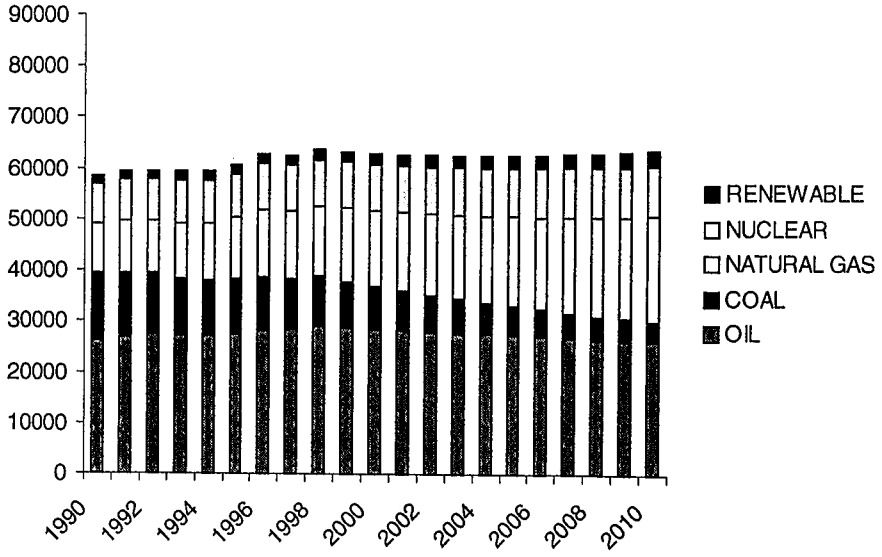


Figure C.3 'Mitigation GHG' Annex I Europe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NUCLEAR
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ANNEX D SCENARIOS FOR ANNEX I PACIFIC

The region 'Annex I Pacific' consists of Japan, Australia, and New Zealand. The mitigation scenario for this region has been taken from the study conducted by the National Institute of Environmental Studies (NIES, Japan). The AIM was used in the NIES study to develop a reference scenario and a mitigation scenario for Japan.

Figure D.1 shows the IEA-BAU scenario for this region. The use of oil increases by 24%, coal by 27%, and natural gas by 79%, compared to the year 1990. The corresponding figures for nuclear energy and renewable energy are 63% and 12% respectively.

Two scenarios for Japan are presented in the NIES study: the 'Fixed Technology Case' (BAU) and the 'Intervention Case'. The difference in energy use for each energy carrier between these cases is expressed in a percentage growth or reduction. These percentages are applied to the corresponding energy use figures of the IEA-BAU scenario for the region Annex I Pacific. Where necessary, the figures are reduced proportionally in order to achieve an aggregate 4% CO_2 reduction. This percentage CO_2 reduction is based on 6% CO_2 reduction in Japan, 4% growth in Australia, and 2% reduction in New Zealand, according to the Kyoto Protocol. The resulting energy mix is shown in Figure D.2.

Next, the other greenhouse gases, such as methane (CH_4), N_2O, etc. are incorporated. Gielen [2,3] and Jochem [4] show in their analyses for Western Europe that other greenhouse gases can be reduced by larger percentages than CO_2 in the period until 2010. Accordingly, CO2 in the Annex-I Pacific region has to be reduced by merely 1.4%, as shown in Figure D.3.

The results of the three scenarios in terms of primary energy use and CO_2 emission are summarised in Table D.1.

Table D.1 Primary energy use and CO_2 emission in Annex-I Pacific for three scenarios

			IEA-BAU	-4%	-1.4%
		1990	2010	2010	2010
Oil	[PJ]	11899	14801	11727	12041
Coal	[PJ]	4890	6215	2983	3062
Natural gas	[PJ]	2780	4965	5117	5254
Nuclear	[PJ]	2097	4564	4886	4886
Renewable	[PJ]	477	1047	1312	1312
Total	[PJ]	22143	31591	26025	26555
CO_2	[Mton]	1491	1951	1432	1470
	[% 1990]		31%	-4%	-1.4%

In the GHG emission reduction scenario (1.4% CO_2 reduction), oil use in 19% lower than in the BAU scenario, coal use even 51% lower, and gas use 6% higher.

Between 1990 and 2010 (1.4% reduction scenario) the use of oil remains stable, coal decreases by 37%, and gas increases by 89%. So, the main difference between 2010 and 1990 is substitution of coal by natural gas. The 1.4% reduction scenario entails a substantial energy conservation effort in the residential, the commercial, and the industry sector. Transport sector is characterised by modest efficiency increases. Fuel cell vehicles are not introduced to a large extent. Power generation shows a shift from coal to natural gas, nuclear and renewable energy.

Figure D.1 'Business as Usual' Annex I Pacific

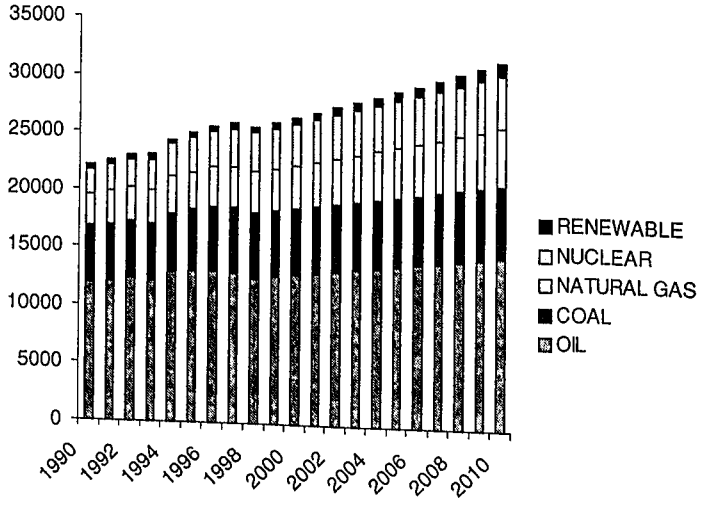


Figure D.2 'Mitigation CO_2' Annex 1 Pacific

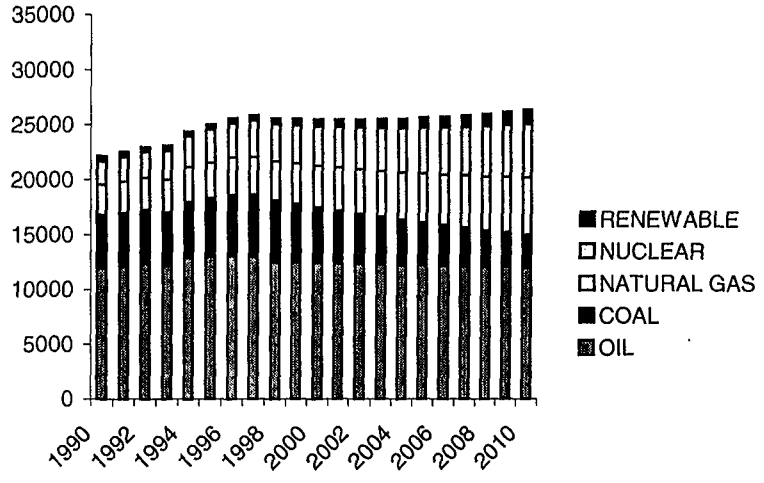
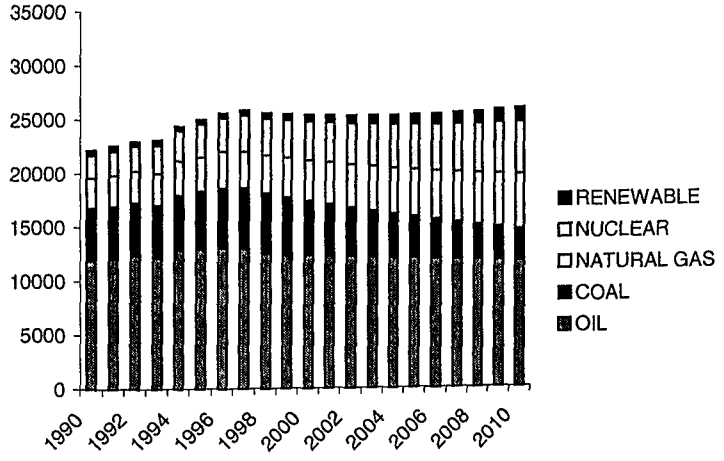


Figure D.3 'Mitigation GHG' Annex 1 Pacific



ANNEX E CONVERSION FACTORS

BP oil 1990-98	1 mb/d = 49,8 Mtoe/year
IEA oil 2010	1 mb/d = 47.4 Mtoe/year
IEA gas	1 tcf = 23.31 Mtoe
Emission factor oil	74 kg/GJ
Emission factor gas	56 kg/GJ
Emission factor coal	93 kg/GJ

ANNEX F GDP AND OIL EXPORT REVENUES OF THE OPEC COUNTRIES

Figure F.1 GDP and oil export revenues of Algeria at current market prices [million US$]

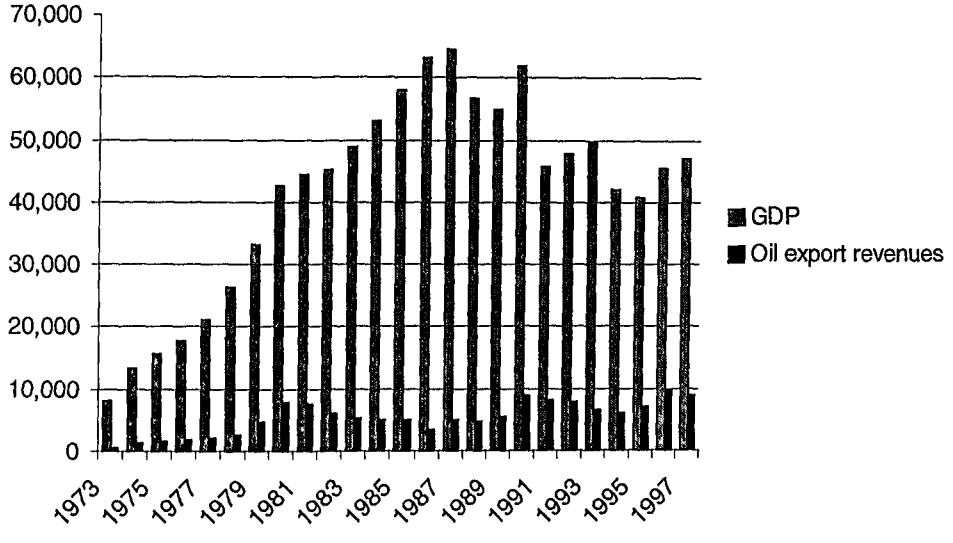


Figure F.1 shows that Algeria's GDP has developed steadily until 1987. After that, GDP declined, and only recovered during the last few years. The contribution of oil export revenues to the GDP is relatively high, viz. 19% in 1997. What is more, Algeria's income from gas exports (not shown here) is considerable. These revenues also depend on the oil price level.

Figure F.2 GDP and oil export revenues of Indonesia at current market prices [million US$]

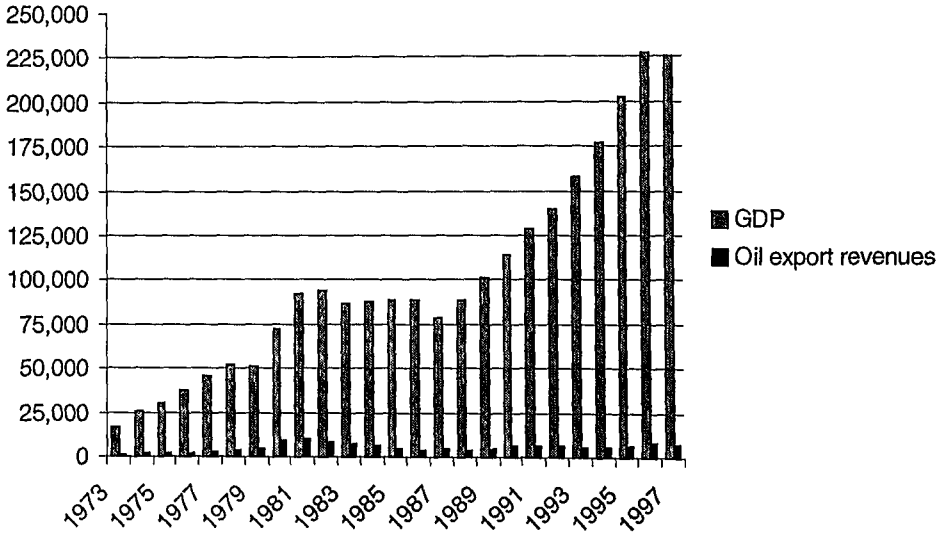
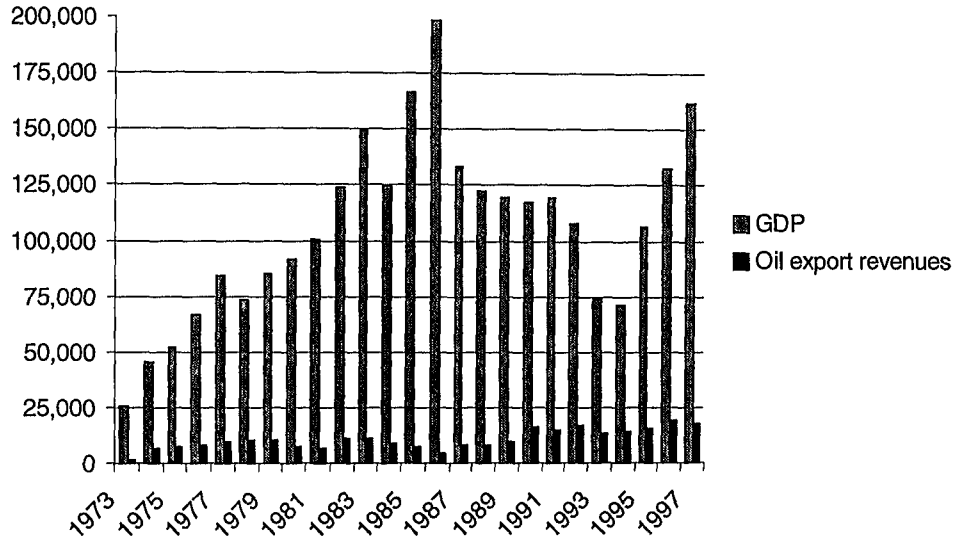


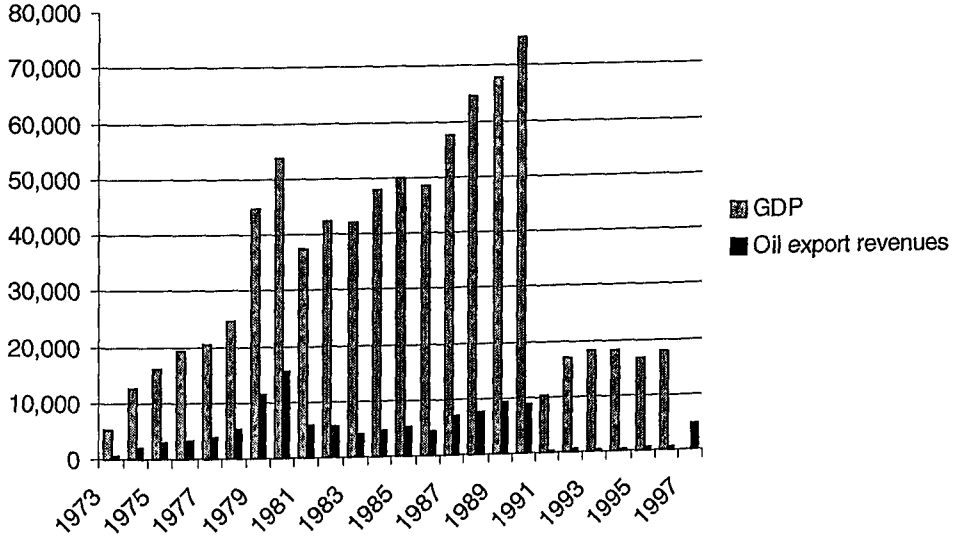
Figure F.2 shows that Indonesia's GDP has developed steadily. GDP declined in the first half of the eighties, when the international oil price collapsed. The dependence of the Indonesian economy on oil export revenues is small, viz. 3% of GDP in 1997. The revenues from export of natural gas (not shown here) are appreciable. This adds to the dependence of the economy on the oil price level.

Figure F.3 GDP and oil export revenues of Iran at current market prices [million US$]



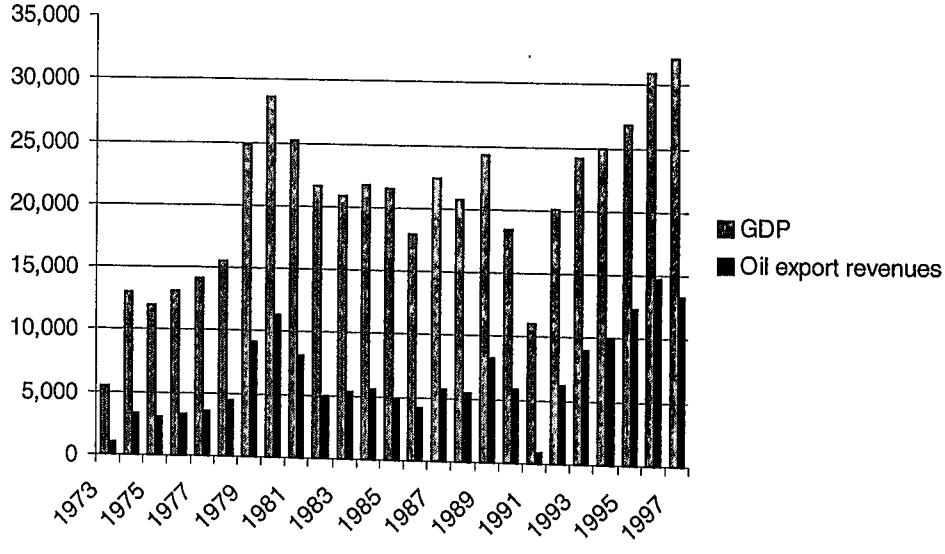
The Iranian GDP has shown a severe decline in the second half of the eighties. The economy recovered strongly during the last few years. Oil export revenues amount to 11% of the GDP (1997 data).

Figure F.4 GDP and oil export revenues of Iraq at current market prices [million US$]



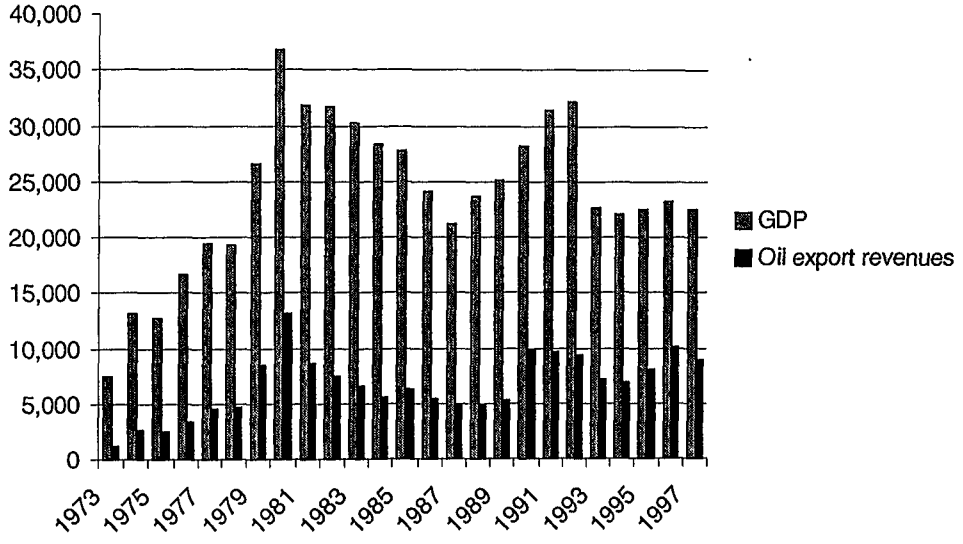
Iraq's economy has suffered from the successive wars with Iran and Kuwait. Oil exports were reduced to negligible levels in the wake of the Gulf war with Kuwait. Only in the last few years these exports recovered. They contribute some 25% to Iraq' current GDP, which is at a depressed level (at or below the level first half of the seventies). It seems that both the (energy) infrastructure and the (oil) industry are a shadow of their pre-war state.

Figure F.5 GDP and oil export revenues of Kuwait at current market prices [million US$]



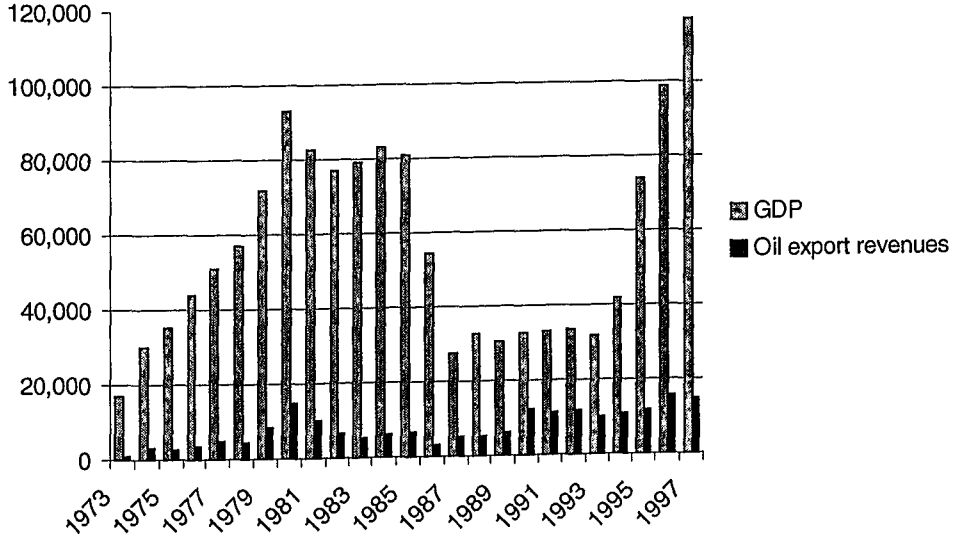
Kuwait's economy got a severe blow during the Gulf war with Iraq. After that it recovered relatively fast. However, the contribution of oil export revenues to the nation's GDP was as high as 41% in 1997. This is twice the level of the early seventies.

Figure F.6 GDP and oil export revenues of Libya at current market prices [million US$]



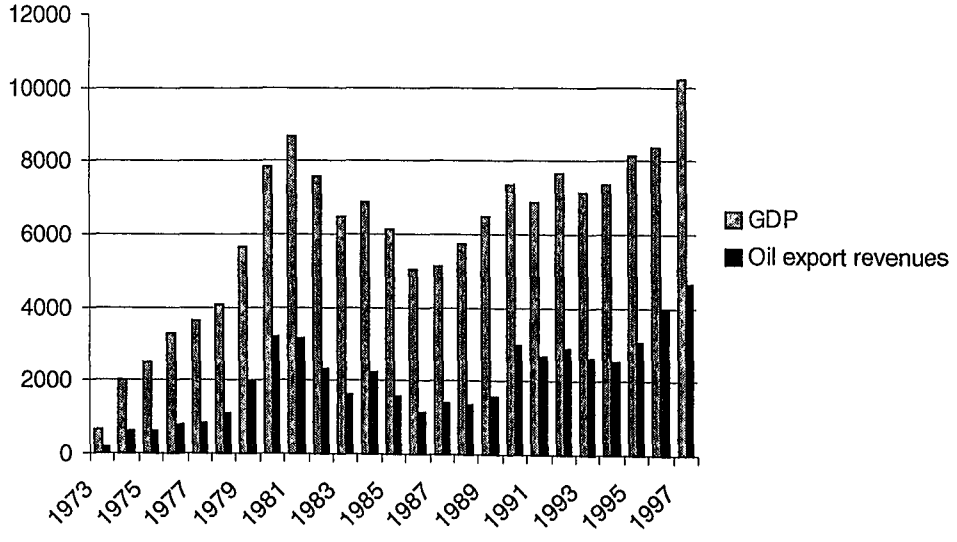
The Libyan economy did not show a steady growth since the first half of the eighties, when the international oil price collapsed. The contribution of oil export revenues to Libya's GDP is as high as 40%. In the early seventies the figure was much lower, viz. 15% in 1973.

Figure F.7 GDP and oil export revenues of Nigeria at current market prices [million US$]



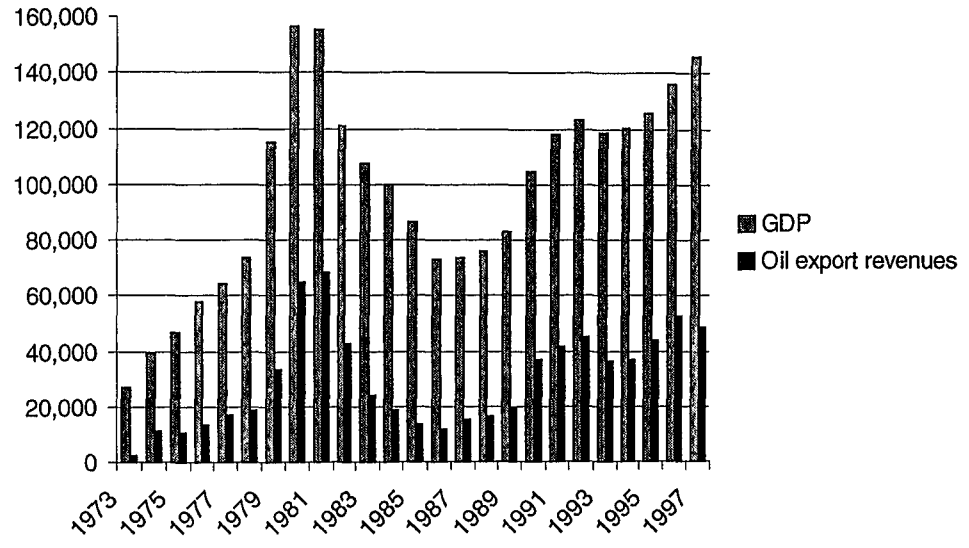
The economy of Nigeria suffered a lot from the collapse of the international oil price in the first half of the eighties. During the last few years GDP rose considerably. The contribution of oil export revenues to the GDP was 12% in 1997. Nigeria is becoming an important gas exporting nation. This adds to the relatively high dependence of the economy on the oil price level.

Figure F.8 GDP and oil export revenues of Quatar at current market prices [million US$]



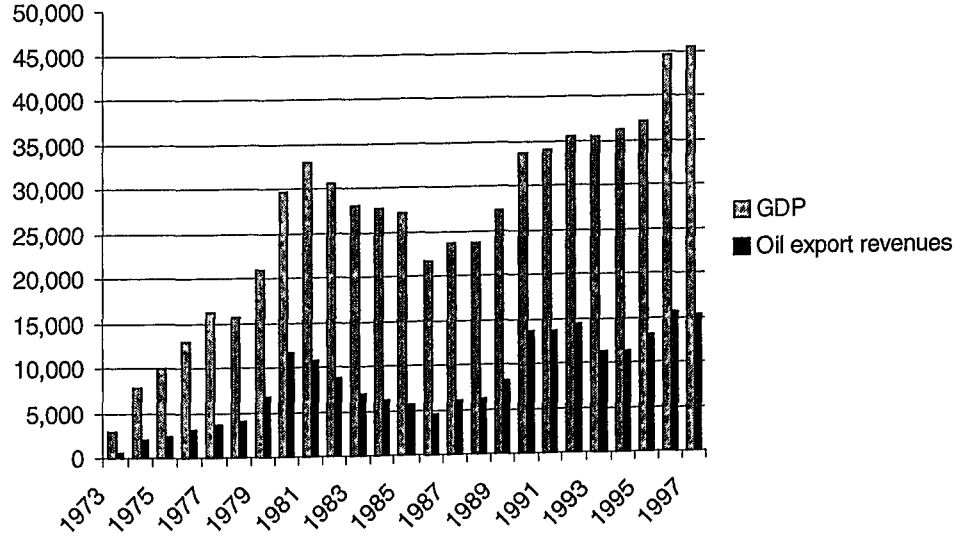
The economy of Quatar developed relatively steadily, except for the first half of the eighties, with the collapse of the international oil price. The contribution of oil export revenues to the GDP was as high as 46% in 1997, considerably more than in 1973 when it was 27%.

Figure F.9 GDP and oil export revenues of Saudi Arabia at current market prices [million US$]



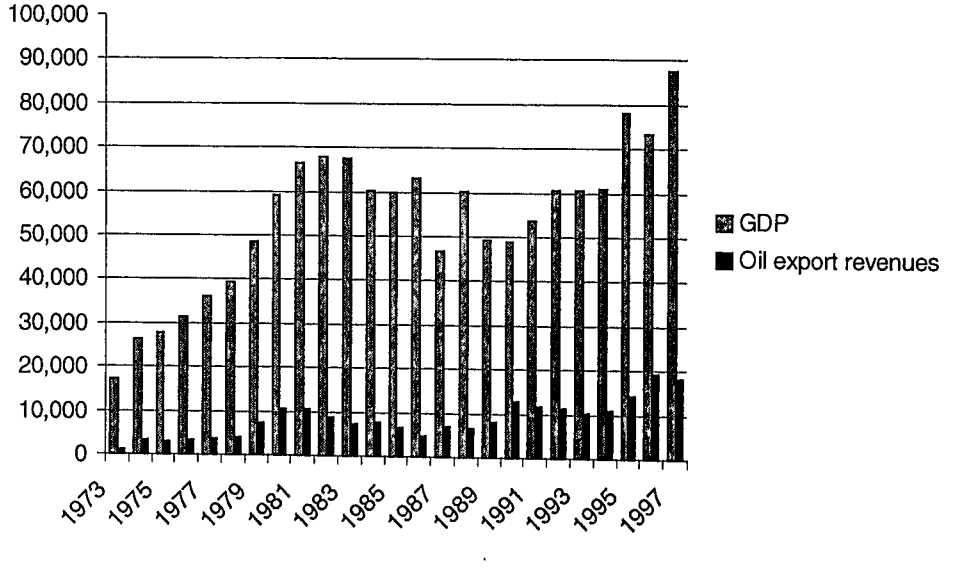
Saudi Arabia's economy recovered strongly from the severe setback during the first half of the eighties, when the oil price was driven down by Saudi Arabia's expansion of it's oil production. The contribution of oil export revenues to the GDP was as high as 33% in 1997. In 1973 it was a mere 10%.

Figure F.10 GDP and oil export revenues of the United Arab Emirates at current market prices [million US$]



The economy of the United Arab Emirates showed a rather steady growth, except for the period 1982-1986, when the oil price dropped considerably. The contribution of oil export revenues to the GDP was as high as 34% in 1997, nearly the same as the figure of Saudi Arabia.

Figure F.11 GDP and oil export revenues of Venezuela at current market prices [million US$]



Venezuela has a relatively diversified economy in comparison with some of the Middle East oil exporting nations. This is why Venezuela's economy was not hit as hard as e.g. the Saudi Arabian economy, when the international oil price collapsed in the first half of the eighties. The economic recovery since then has been modest. The contribution of oil export revenues to the GDP was 21% in 1997 (up from 7% in 1973).

ANNEX G PROJECT DESCRIPTION

1. General information

Project title: Impact of the implementation of GHGs mitigation measures on the oil and gas export revenues of OPEC countries (in English)
Effect van de implementatie van broeikasgassen reductiemaatregelen op de inkomsten uit olie en gas exporten van de OPEC landen (in Dutch)

NRP theme: THEME III Duration: 3 months

2. Contracting organization

Name organization	Netherlands Energy Research Foundation	para-univ.: no
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3. Project leader

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4. Subcontracted institute

Nr.	Organization and address	Responsible scientist
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5. Abstract of the project

The proposed study aims to investigate the underlying factors which determine the impact of the implementation of greenhouse gas reduction measures on the export revenues of the OPEC countries and will recommend new modes of co-operation which could result in greater involvement of OPEC countries in the implementation of the FCCC. The study will be a joint effort of ECN, unit ECN Policy Studies, and the Clingendael Institute. The approach to the research consists of 4 main tasks: task 1 involves an assessment of current and future oil and gas consumption in the Annex I countries; the focus of task 2 will be on an assessment of current and future oil and gas consumption in the non-Annnex I countries; task 3 is meant to analyse the impact of the implementation of greenhouse gas mitigation measures on the oxport revenues of the OPEC countries; and finally, task 4 will look at new modes of cooperation with the OPEC countries to bring about a greater involvement of these countries in the implementation of FCCC.

6. Rationale for the study

During the third session of the Conference of the Parties to the United Nations Convention of Climate Change (UNFCCC), held in December 1997 in Kyoto, Japan, reduction targets for GHG emissions for the period 2008-2012 (compared to the reference year) were agreed for the US (7%), the EU (8%) and Japan (6%). Subsequently, during the meeting of the European Council in June 1998, an agreement was negotiated to divide the EU reduction target between the various EU member states. The Netherlands agreed on a reduction target of 6%, which corresponds to 50 million ton CO_2 equivalent per year below the expected baseline scenario.

The Dutch government is currently in the process of formulating policies to achieve the agreed reduction target. In addition to reduction options in the Netherlands, the Kyoto Protocol offers the possibility of meeting national commitments by reducing GHG emissions abroad. Three flexible instruments - Clean Development Mechanism (CDM) for non-Annex I countries, Joint Implementation (JI) for Annex I countries and emission trading between Annex I countries - have been adopted in the Kyoto Protocol although the specific conditions under which the CDM can become operational still have to be defined. The process should result in a concrete plan of action for the implementation of reduction measures to achieve the agreed reduction targets.

In Article 4.8 of the UNFCCC it is clearly stated that policies aiming at a reduction of GHG emissions should duly take into consideration the impact of the implementation of these policies on countries whose economies are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy intensive products. In particular, the group of oil and gas producing countries (OPEC countries) repeatedly makes references to Article 4.8 to emphasise that due account should be taken of the adverse impacts of greenhouse gases mitigation measures on the oil and gas revenues of the OPEC countries.

However, so far no systematic research has been done on the extent to which the OPEC countries will be affected by global change policies. For this reason, the Dutch National Research Programme on Global Air Pollution and Climate Change has initiated a study which aims to analyse the potential reduction in net revenues from oil and gas exports of the OPEC countries as a result of the implementation of greenhouse gases mitigation measures in the Annex I countries.

7. Objectives, expected results and deliverables

The main objectives of the proposed study are to:

1. Analyse the impact of greenhouse gases mitigation policy on the income of OPEC countries generated from the production, processing and export of fossil fuels; and
2. Suggest directions for Dutch policy making aiming at a reduction of GHG emissions which will be more acceptable to the OPEC countries and thus more effective globally.

The main results of the study will include: 1) assessment of the fraction of oil and gas imported by the Annex I countries from the OPEC countries; 2) analysis of the impact on the import of oil and gas from the OPEC countries by the Annex I countries as a result of implementation of the Kyoto agreement; 3) identification of the fraction of oil and gas imports by non-Annex I countries from OPEC countries; 4) analysis of IPCC business as usual scenarios;5) assessment of the share of total BNP spent on imports of oil and gas by non-Annex I countries; 6) analysis of net reduction in revenues from oil and gas sales resulting from the implementation of GHG emission reduction policies; 7) identification of the potential of 'no-regret' options in non-Annex I countries.

7.a Description and planning of deliverables

Description	**Date**		**Subproject**	**Lead Institute**[12]
1. Report on Task 1: current and future consumption of oil and gas in Annex I countries	August	1999	1	ECN
2. Report on Task 2: current and future consumption of oil and gas in non-Annex I countries	September	1999	2	ECN
3. Report on Task 3: analysis of the im-	September	199	3	ECN

[12] The lead institute has the overall responsibility for a particular activity, although all project partners will be involved in the activity.

pact of implementation of greenhouse gas emission mitigation measures on the OPEC countries		9		
4. Report on Task 4: identification of new modes of co-operation with the group of OPEC countries	September	1999	4	Clingendael
5. Draft Final Report	Early October	1999		ECN/Clingendael
6. Final Report	Early November	1999		ECN/Clingendael

8. Relevance and potential use of the expected results for science and policy

The results of the research are of particular relevance to the Taakgroep Kyoto Protocol (TKP), established by the Dutch Government to prepare the policy on climate change. The results will enable TKP to formulate policies which fit into the national development priorities of the OPEC countries and thus trigger these countries to become involved. From a scientific point of view, the socio-political research approach, combined with concrete proposals on new mode of co-operation in line with the national priorities of the OPEC countries is new and innovative.

9. Scientific approach and innovative aspects.

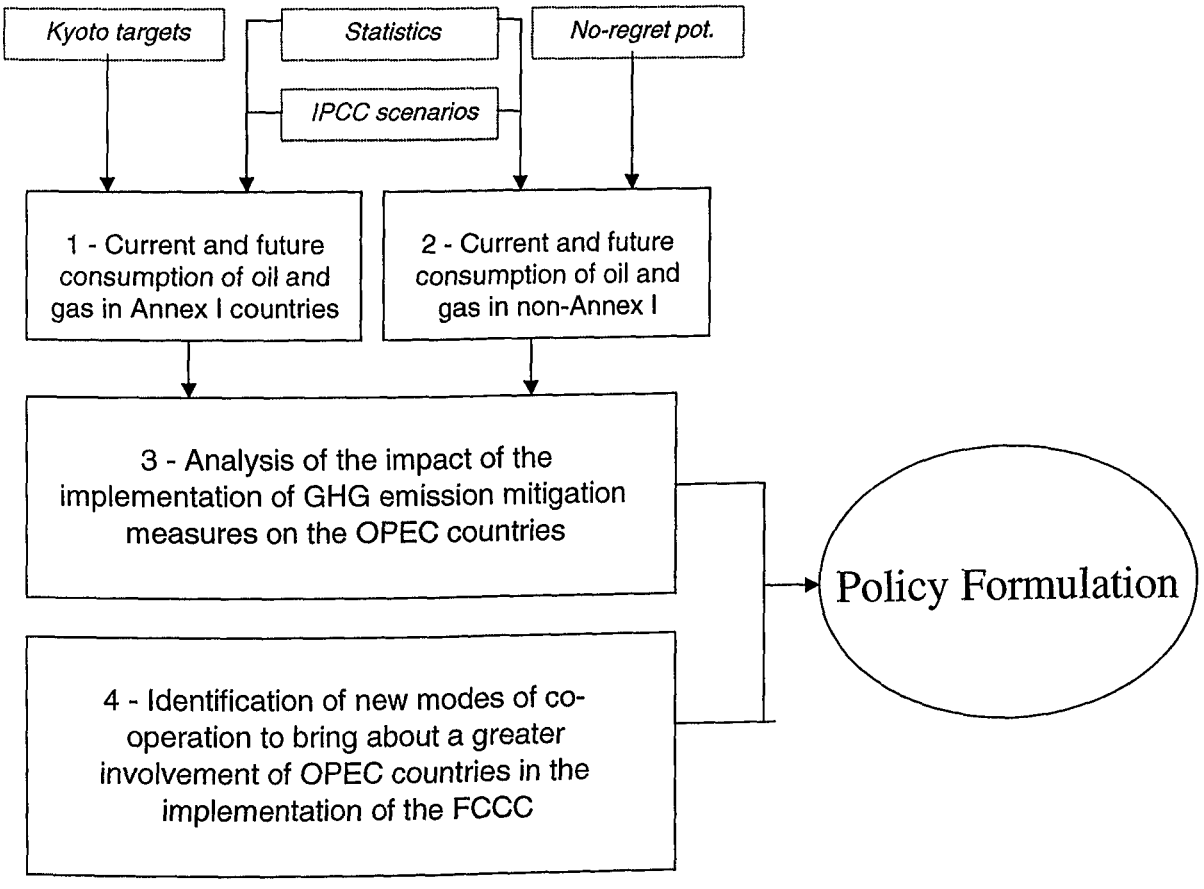
The approach for the proposed study will mainly be based on a review of statistics and of already completed or ongoing studies. The proposed approach comprises of the following main tasks:

1. Analysis of current and future consumption of oil and gas in the Annex I countries: this task aims to design scenarios for the next 10 years for imports of oil and gas by the Annex I countries from the OPEC countries;
2. Analysis of current and future consumption of oil and gas in the non-Annex I countries: the purpose of this task is to examine how oil and gas imports by the non-Annex I coun-

tries from the OPEC countries will be affected over the next ten years if the agreed greenhouse gas reduction targets will be achieved;

3. Analysis of the impact of the implementation of greenhouse gas mitigation measures on the OPEC countries: this tasks aims to determine how the implementation of mitigation measures will affect the net revenues of OPEC countries generated from oil and gas exports;
4. Identification of new mode of co-operation with the OPEC countries: this task aims to analyse various modes of co-operation which could result in greater involvement of OPEC countries in the implementation of the FCCC.

The tasks are illustrated schematically in the Figure below



Each task consists of several activities which need to be undertaken. Brief descriptions of tasks and activities are given below.

Task 1 Analysis of current and future oil and gas consumption in the Annex I countries

Activity 1.a: this activity involves an assessment of current consumption, production, exports and imports from OPEC countries of oil and gas in the Annex I countries. This information can be obtained from trade-statistics, the IEA statistics and the statistics published by the various oil companies (for example, BP Statistical Review of World Energy).

In addition, the data base developed as part of the studies conducted on behalf of VROM: 'Long Term Propects for Fossil Fuel Prices'[13] and 'Voorraden en prijzen van fossiele brandstoffen: schattingen en projecties voor de 21ste eeuw met het oog op klimaatbeleid'[14]contains time series on production, export and import flows. It is proposed to use this data base as a starting point for the proposed study and to update and extend the data base where necessary to meet the requirements of the proposed study.

Activity 1.b: this activity aims at the design of scenarios for the oil and gas imports by Annex I countries from OPEC countries in the middle budget year 2010. Two scenarios will be developed:

1. a 'business as usual scenario'; and
2. a 'mitigation' scenario based on the assumption that the Annex I countries will achieve the agreed reduction targets.

The 'business as usual' scenario will be based on the BAU scenario developed by the IPCC, and, if necessary, updated and/or adjusted according to recent country studies conducted in the framework of the ETSAP.

For the design of the 'mitigation scenario' the following aspects have to be taken into account:

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[13] *Long Term Propects for Fossil Fuel Prices;ECN/EEMConsult BV;* J.C. Jansen, P.Lako, F.W. Mansvelt Beck, N.H. van der Linden; March 1996, ECN-C-95-046

[14] *Voorraden en prijzen van fossiele brandstoffen. Schattingen en projecties voor de 21ste eeuw met het oog op klimaatbeleid;ECN/RIVM;*. P. Lako, H.J.M. de Vries. ECN-C—99-022, April 1999.

- contribution of the non-CO2 gases (methane, nitrous oxide, hydrofluorocarbons, per-fluorocarbons and sulphur hexafluoride) to the achievement of the reduction target; a first rough estimate is that some 25% of the overall target of the Annex I countries will be achieved by non-CO2 greenhouse gases; this contribution is not energy related;
- fraction of the total Annex I reduction that will be realized in non-Annex I countries by means of the Clean Development Mechanism; and
- fraction of future oil and gas imports by Annex I countries from OPEC countries

The results of task 1 show the current level of oil and gas imports by the Annex I countries and how these imports will change up to the year 2010 based on the assumption that 1) no mitigation policy will be implemented; and 2) Annex I countries will achieve their Kyoto targets.

Task 2 Analysis of current and future oil and gas consumption in the non-Annex I countries

Activity 2.a involves an assessment of current production, consumption, imports and exports of oil and gas in non-Annex I countries and the imports from the OPEC countries. For this activity the same statistics can be examined as mentioned under task 1 for the Annex I countries.

Activity 2.b concerns an assessment of the fraction of total GNP of non-Annex I countries spent on energy. It seems useful in this regard to establish a 'classification' of the group of non-Annex I countries to reflect the fact that large differences in position exist among the non-Annex I countries. A number of the larger and faster industrialising nations (particularly China and India) have been characterized by some observers as antagonistic to efforts to combat climate change, while a number of other countries, particularly smaller ones, are known to have co-operated from an early stage.

Activity 2.c concerns the design of scenarios for future consumption of oil and gas in the non-Annex I countries. Two scenarios will be developed:

1. a 'business as usual scenario'; and
2. a scenario based on the assumption that a part of the identified 'no-regret' potential in the non-Annex I countries will be implemented

The business as usual scenario will be based on the most recent IPCC BAU scenario, and, if necessary, adjusted according to recent country studies.

For an assessment of the potential of 'no-regret' options in the non-Annex I countries, the data base developed within the framework of the ongoing ECN study "Flexible Instruments and Renewable Energy in International Climate Policy Formulation" can be used. One of the objectives of this study is to identify a broad range of available options in the non-Annex I countries to reduce the GHG emissions and to determine the reduction potential and associated cost for each option. To this end, a number of available abatement studies for non-Annex I countries were analysed and the results compiled in an inventory of the abatement options, their projected potential in the year 2010, and their associated project and GHG mitigation costs.

So far, GHG abatement studies for 24 non-Annex I countries have been acquired. Of the countries covered 13 are situated in Asia, 7 in Africa, and 4 in Latin America. The principal national abatement studies have been obtained from the following sources:

- Asia Least-cost Greenhouse Abatement Strategy (ALGAS) project, sponsored by the UNDP/GEF and ADB in association with 11 Asian countries;
- UNEP Greenhouse Gas Abatement Costing Studies – 9 countries;
- Country Studies Program with support from the United States – 4 countries.

Although there are roughly 150 non-Annex I countries, the 24 non-Annex I countries for which abatement costing studies have been collected comprise a fairly extensive sample. These 24 non-Annex 1 countries currently account for no less than two thirds of total GHG emissions in non-Annex I countries.

A data base has been developed which contains all the information extracted from the country reports. The main purpose of this data base is to systematically store the large amount of information and to facilitate the processing of this information. In this way information can be produced for specific sub-sets of options, for example all options with zero or negative incremental cost (the 'no-regret' options).

A simple extrapolation method can be employed to estimate the reduction potential for the missing non-Annex 1 countries (corresponding to the remaining one-third of non-Annex I

emissions) based on the 24 non-Annex 1 countries for which abatements studies have been collected.

Task 3 Analysis of the impact of the implementation of GHG emission reduction measures on OPEC oil and gas export revenues

The following aspects are relevant with regard to the determination of the impact of GHG emission mitigation measures on the net revenues generated by oil and gas exports of OPEC countries:

- change in import levels of oil and gas by the Annex I countries from the OPEC countries (result of task 1);
- change in import levels of oil and gas by the non-Annex I countries from the OPEC countries (result of task 2);and
- future developments of oil and gas prices in relation to the oil and gas reserves and technological developments.

Regarding the future developments of oil and gas prices, the studies mentioned under task 1 are an important source of information

Task 4 Identification of new modes of co-operation which could result in greater involvement of the OPEC countries in the implementation of the FCCC

The OPEC countries have experienced serious economic problems since the mid-1980s. Oil prices were no longer under their complete control, and the dependence on oil income (particularly the government budget) remained large despite investments in other economic sectors. Earlier studies (Gelb 1985 and Auty 1990/1991) indicated that the oil producing countries suffered, although to a varying extent, of 'Dutch Disease'. In the 1980s, it also became clear that OPEC could not regulate the international oil market in such a way that the interests of the individual member states were optimally served. The international oil market moved from a seller's market in the 1970s to a buyer's market in the 1980s and 1990's. In such a market, governments of consuming countries are successful in capturing part of the economic

rents through taxation (just like the seller's market allowed the OPEC countries to capture these rents in the 1970s). For the oil producing countries, security of demand became paramount to their existence, and efforts to limit oil demand for environmental (and also to limit strategic import dependence on oil and efforts to create a more balanced energy demand mix) reasons, were seen as an attack on the countries' most important livelihood. Proposals to implement a tax at the source rather than on final products should be considered, although the present international market organization and present price structure makes the viability of such a tax bleak.

The pressures on OPEC countries are manifold and alternative approaches to involve OPEC countries in the implementation in FCCC will have to take account of the complexity of the working of the international oil market, that presently creates oversupply and crowds out OPEC oil (share of oil production not in relation to share in reserves) and reduces oil income. Based on the importance of OPEC oil for the world market (task 1,2, 3 results), an assessment of the future organization of the international oil market (crude oil supplied by state oil companies, private international oil companies or a mixture of the two), and the political position of OPEC countries (complications with political unacceptable regimes, like in Iraq, Iran, Nigeria, Algeria, Libya), new modes of co-operation with OPEC countries that will be investigated in the proposed study include:

1. co-operation in energy taxation;
2. possible co-operation in a consumer-producer country forum;
3. improve the ability of OPEC countries to export oil products to consumer markets rather than crude (reduction of import tariffs);
4. co-operation in energy and other investments, transfer of technology (possibly in the framework of the Clean Development Mechanism), etc. that will enhance sustainable economic development;
5. co-operate to enhance the stability of income from oil
6. co-operation to create alternative sources of income for the government;
7. create a form of income transfer that compensates lost income to oil producing countries.