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POSSIBILITIES OF INTERREGIONAL COLLABORATION IN NATURAL GAS UTILIZATION

Note by the ESCAP secretariat

This paper is issued without formal editing.

92-0204

I

Introduction

As early as 1982 ESCAP and ESCWA had consultations in Baghdad about possible collaboration in gas projects. For various reasons projects could not be initiated at that time. It is indeed a great pleasure to have the opportunity of possibly reviving such collaboration, made timely and topical again as an alternative to life in a "greenhouse"!

II

The effects of natural gas penetration

In August 1990, the ESCAP secretariat initiated a natural gas market survey among the "natural gas focal points" of some ESCAP member countries interested in joining a "Natural Gas Working Group" under the UNDP/ESCAP "Regional Energy Development Programme (REDP)". Subsequently, 10 national groups have prepared market surveys and presented these at a subsequent executive seminar and study tour (Indonesia and New Zealand) in February 1991. The study tour also allowed participants to look at the first-hand experience of some countries (e.g. Indonesia, New Zealand) that have embarked on large scale natural gas exploitation and utilization strategies [8, 9, 10, 11, 14, 15, 23].

The above activity - further illustrated below by some market survey results from Malaysia - has not represented the beginning of ESCAP's natural gas activities. These activities have started much earlier [5, 6], presented at the 1987 Asia Pacific Conference on Gas Markets [26], originating in even earlier, technology-oriented studies under REDP [18, 21].

Subsequently, due to worldwide interest in global warming (and the "green-house effect") related issues [12, 27] as well as economic and resources surveys [1, 2, 3, 4, 13, 16, 17, 19, 22, 25] natural gas issues have come to the forefront again and are of paramount interest in the context of the current conference.

An ESCAP Study on Climatic Effects [27] with the generous support of the Government of Japan has come to the following conclusion:

1. The developing Asia-Pacific region will add to the atmospheric CO_2 stock about 2.4 GT per year of carbon equivalent by the year 2010 (roughly trebling current rates).
2. With maximum feasible intervention (including efficiency measures and fuel switching) this could only be reduced to no less than 1.8 GT per year.
3. To illustrate, in the case of China, 470 million tons of the above estimated reduction is due to efficiency improvements and only about 30 million tons come from fuel switching.
4. Cost estimates vary from $2,000 per ton in Japan to about $100 per ton for China to achieve atmospheric carbon reductions via fuel switching and other measures.
5. Given efficiency improvements <u>are already economic by assumption</u> (although hindered by capital budgeting constraints!). The net <u>additional</u> costs to the regional economies can be estimated by fuel switching costs. Using the figures from China, for the whole region, this would imply by 2010 an additional cumulative real economic cost (in 1990 constant dollars) of about $US100

billion as the "insurance cost" against the green house hazard for the developing Asia-Pacific.

What is apparent from the above is that no matter how hard we try it is unlikely that we would be able to substantially effect global warming trends.

However, clean energy and energy efficiency are worthwile objectives in themselves. What we argue below is that a gas based strategy is likely to contribute to these objectives, through certain "synergies", to a larger extent than the simple sector-by-sector substitution accounting would lead us to expect. There is an "efficiency bonus" from gas, both technological and organizational.

To illustrate the above point let us review first the Malaysian gas penetration study [23] and then see how its implementation may lead to unanticipated efficiency gains drawing on the technological and organizational references introduced [8, 9, 10, 11, 20, 26].

Following Sulaiman bin Abdullah [23], the gas penetration and demand for Malaysia is given in Table 1.

What can be seen from this is that a careful assessment in the framework of Annex I has produced what we can consider as a "feasible" gas plan. Cautionary notes are needed, though:

1. Interaction effects between the various demand sectors have not been sufficiently taken into account. As an example, some of the industrial penetration maybe through combined heat and power (CHP) systems, reducing, thus, the need for some of the power generation requirements. This is an example of "efficiency gains" reducing overall energy demand.

Table 1

Gas and Petrochemical
Development Division
Project Development
(Commercial)
SA/HBJ/JANUARY 31, 1991

FORECAST FOR GAS DEMAND IN MALAYSIA
(IN MMSCFD)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
A. PENINSULAR MALAYSIA																				
o Power Sector	129	152	366	412	470	536	545	622	706	793	890	849	960	1082	1202	1239	1206	1309	1429	1548
o Petroleum Refinery	4	4	18	19	36	70	70	79	81	81	81	81	81	81	81	90	92	92	92	92
o Gas Processing	4	4	36	36	36	36	52	52	52	68	68	68	84	84	100	100	100	100	116	132
o Crude Oil Terminal	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10
o Petrochemical	0	0	0	6	10	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
o Manufacturing	1	1	9	95	116	121	126	129	134	138	194	214	222	231	241	254	264	275	286	298
o Residential and Commercial	0	0	0	0	1	2	3	5	7	10	13	16	19	21	23	26	28	30	32	35
o Transportation (NGV)	0	0	0	3	9	16	25	31	34	39	45	48	50	53	56	59	60	61	63	64
TOTAL PENINSULAR MALAYSIA	142	165	434	576	683	800	840	937	1034	1150	1312	1297	1438	1575	1726	1790	1772	1890	2042	2193
B. SARAWAK																				
1. Bintulu																				
o Power Sector	6	7	16	20	21	22	25	26	29	32	35	35	37	39	41	43	45	47	49	51
o MLNG	1119	1250	1250	1250	1322	1778	1961	2292	2429	2491	2508	2508	2508	2508	2508	2508	2508	2508	2508	2508
o Ammonia/Urea	37	51	49	52	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
o Middle Distillate	0	0	80	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
o Crude Oil Terminal (COT)	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	8	8	9	9	9
2. Miri	16	16	16	19	19	20	20	21	13	24	28	32	33	35	36	38	39	41	42	44
TOTAL SARAWAK	1183	1329	1416	1447	1517	1975	2161	2494	2627	2703	2727	2731	2735	2739	2742	2746	2749	2753	2756	2761
C. SABAH	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
D. POSSIBLE NEW PROJECTS	0	0	0	0	0	0	0	0	0	0	66	110	110	110	110	110	110	110	110	110
E. EXPORT TO SINGAPORE	0	0	150	155	156	156	157	157	158	159	310	311	312	313	314	316	317	319	321	323
GRAND TOTAL	1411	1580	2086	2264	2441	3017	3244	3675	3905	4098	4501	4535	4680	4822	4978	5047	5035	5159	5315	5472

NOTES:

1. Miri gas demand from: SESCO, Refinery, COT and Distribution.
2. SABAH gas demand from: Power plant, Methanol and HBI.
3. Possible new projects gas demand from: Ammonia/Urea and Methanol.

2. In order to achieve such a degree of gas penetration, competent sales engineers with a process knowledge of each of their customer's businesses in all the major industrial subsectors are required. Although such personnel can be internationally recruited, especially since national gas utilities are growing increasingly international, as examplified by British Gas [15], Gaz de France [26, paper "T" by Paul G. Millard] and others, the training and manpower requirements in the Asia-Pacific should not be underestimated. (This is the "raison d'etre" of the Natural Gas Working Group.)
3. The efficiency gain (not only of technology but of organization!) that allow the conclusion of gas pricing deals between resource developers and customers has to be insured. We present a framework for this in the concluding Summary section, here we merely wish to argue that gas penetration strategies such as that of Malaysia (and, on a regional basis, that presented by TOTAL [3]) are plausible only if both the technological and organizational gains are, in fact, achieved. On the other hand the arrows of causality are not unambiguous: one could argue that "gas plans" resulting in natural gas penetration (as exemplified by Malaysia above) will lead to the technological and organizational efficiencies expected, enhancing thus sustainable economic development prospects in Asia as a "bonus" from a natural gas strategy originally formulated because of environmental concerns. On this hopeful note we now turn to our concluding section; describing the environmental

economics of natural gas penetration and interregional collaboration.

III

Conclusions: the gas economy and economic growth through efficiency

Looking at the natural gas penetration picture one is struck by the expected large penetration of natural gas on the one hand and, at the same time, by the neglect of secondary effects in such competitive fuel penetration studies concentrating on end-use sectors, on the other!

Historically, as described by Laura Hein for the Japanese economy [19], efficiency gains have been associated with fuel switching (e.g.: from coal to oil in the case of Japan, through such a process importing the newest technology in the 1960-s). The use of higher grade energy (LPG, gas, photovoltaic electricity, etc.) allows for the use of less primary fuels, especially if the locational advantages are conscientiously taken advantage of for multiple process uses (e.g.: combined heat and power, etc.). The use of gas involves a qualitative change in energy use: from single objective efficiency limits one is able to switch to "multi-objective efficiency" via better organization, possibly halving, then, the primary energy need for the same (combined!) energy services.

One may, perhaps, illustrate these issues via the use of some simple economic diagrammes - the more so because these illustrate also some general principles of environmentally sound energy (business) planning.

Analysing lease-buy decisions (Annex) the usual trade-off curves intersect at a unique asset price and equivalent lease payment. Usual analysis stops right there, ignoring the asymmetry in the graphs: to the left of the intersection several deals are possible, while to the right of the intersection, no deal is possible between buyer and seller (or lessee/lessor!). The different slopes of the two lines represent different capital structures and preferences of lessee and lessor.

Now if we apply this analysis to energy system with "internalized" environmental costs (e.g.: coal systems, oil systems, gas systems, electricity systems) it is easily seen that systems with fixed commodity prices (especially if these would incorporate some notional environmental tax!) are likely to push asset costs to the right of the intersection, allowing for no deals between suppliers of energy commodities and consumers, at such inflated user costs! A general contraction and "downward spiral" of the economy would thus result from such well-intentioned (but misguided!) policies ..... (Note that such effects are already seen in, e.g. the difficulties of rural electrification, where we seem to be operating chronically at the right side of the intersection on Figure 1).

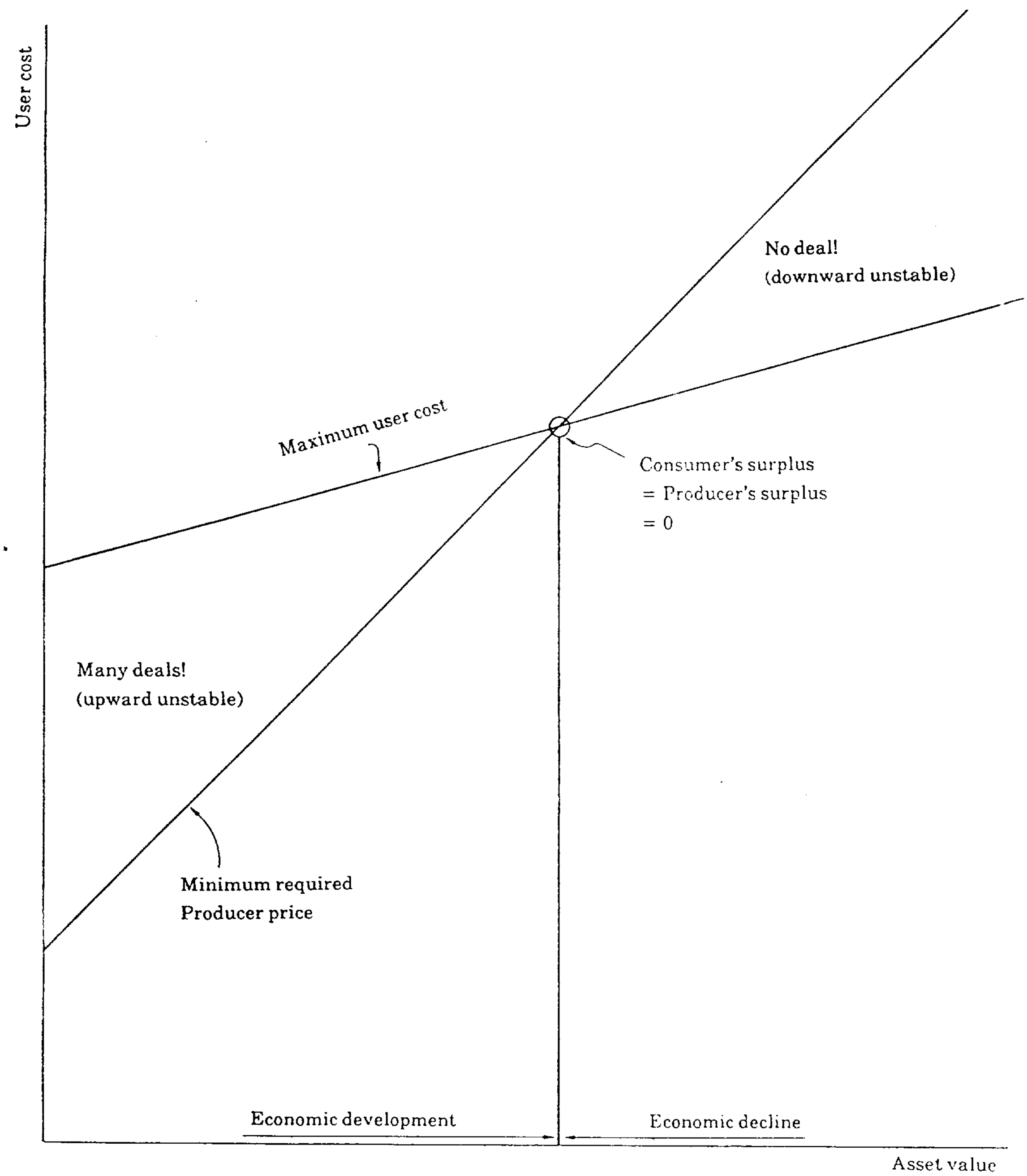

__Figure 1__. Simple Environmental Economics

(Note that economic development, rises of standards of living, will push acceptable user costs upward, and thus allow continued development!)

Asia has some gas to develop [33] however large scale supplies could only come from the countries of the ESCWA region, Islamic Republic of Iran, or perhaps the Russian Federation.

In an interregional context this translates to linking large population centres with abundant gas supplies. As introduced by OME [31]:

"Iran has expressed its interest to implement an LNG export scheme as a way to mainly serve the Japanese market with the offshore Pars field as the front running source of supply. Japanese trading authorities have welcomed the proposal but the scheme has still to be detailed, the construction of a liquefaction plant at Bandar Abbas or at Qeshm Island is considered.

In January 1991, it has been reported that a consortium headed by the Sharjah-based Crescent Petroleum has a letter of intent to construct a 1,600 km natural gas pipeline linking Qatar and Pakistan. The project will have an estimated cost of $ 3 billion.

Recently, Iran has proposed a pipeline to India through Pakistan. The $ 12 billion, 3,300 km-line would lay from Bandar Abbas to Calcutta. Its capacity would be 36 billion cu m/year with Iran using 10 per cent of this in its eastern provinces, Pakistan taking 20 per cent and India the rest, China and Bangladesh might be interested in an extension east from Calcutta.

This is partly definite plan and partly pipedream. But there is little doubt that TransAsia gasline would benefit many, and there is no need for gas to travel from one end to the other. In fact, backout deals similar to those proposed for the Iran-

USSR-Europe trade would provide the most economic ways of moving supplies to markets."

Other projects (mainly LNG schemes) are also on the drawing board and could help to supply energy-hungry Asia with clean energy at more and more affordable prices as standards of living rise in Asia through economic development, while large projects remain commercially attractive due to economies of scale and possible future "dove tailing" into a hydrogen economy in the next century.

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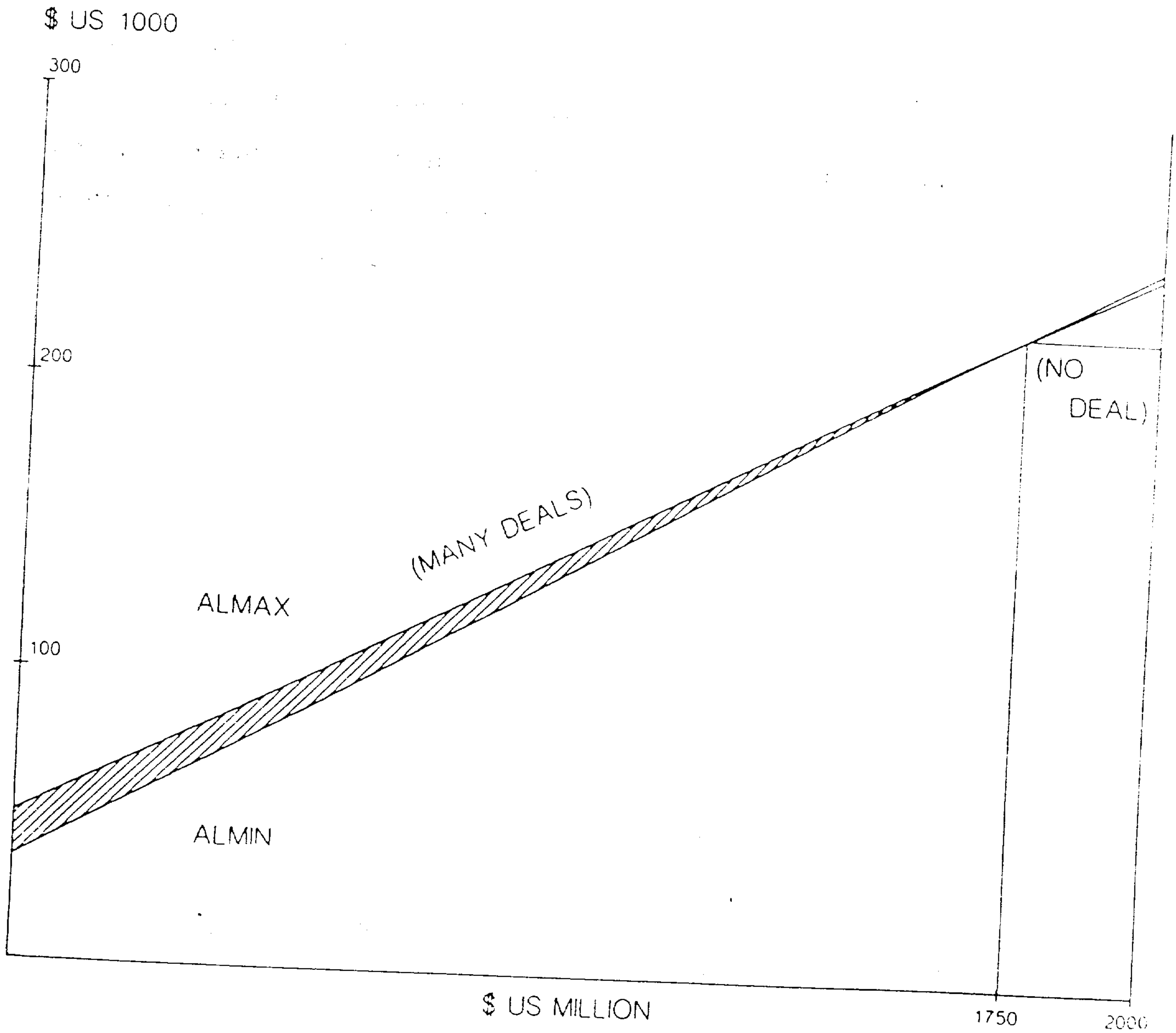
Annex

Lease-buy decisions and resource economies

While working on "lease-buy decisions" in 1976 (as examples of oil business expansion policy) the genuine multi- objective nature of these decision was striking: under certain circumstances it was possible to achieve simultaneous benefits for both lessee and lessor. The reason for this is the complementary capital and services structure of the two partners, as well as the different taxation treatment due to their different asset structure. Thus for a "long lease", low rates are possible, satisfying the lessee, while at the same time, high target rates of returns are achieved by the lessor on capital invested. A computer programme, using standard discounted cash-flow technics, was developed for analysing such problems [30]. Here we merely present some illustrative results.

The computer programme required as input maximum and minimum asset values, number of years (life of the asset), cost of capital for the lessor, annual revenue from the asset, acquisition cost of the asset for the lessor, tax rate faced buy the lessee, tax rate faced by the lessor, running cost of the asset if owned by lessee, running cost of the asset if owned by lessor.

With these data, for a trial time period of 10 years, and minimum and maximum asset values of 1,000 million and 2,000 million dollars, the programme calculated the maximum amount the lessee is willing to pay as an annual lease rather than buying the asset (ALMAX), and, at the same time, the minimum amount the lessor is willing to accept as lease rather than selling the asset (ALMIN). In Figure 2 below (that the reader will recognize as a "stylized" Figure 1, with a different "labelling") we find that at an asset value of 1,750, ALMAX = ALMIN, or that there is a unique lease payment 224.9 (thousand dollars) satisfying both lessor and lessee.



<u>Figure 2</u>. Lease/buy decisions

<u>LEGEND</u>: A1 = 1,000, TAXB = 25%, REV = 100, A2 = 2,000, TAXS = 10% AIB = 9.25%, N = 10, C = 50, AIS = 7.25% ACQCOS = 800, CS = 40,

Additional observations are that in the shaded area (to the left of the intersection) several deals are possible, since the amount the lessee is willing to pay (ALMAX) lies above the amount the lessor is willing to accept (ALMIN). On the other hand no deal is possible to the right of the intersection, since what the lessor is willing to accept is more than what the lessee is willing to pay.

How are assets valued? Either by "cost-build-up", or by "market". (In general, there exists some uncertainty!) In the former case, the value would be 800 million (the cost of "making the asset") while in the latter it could be anything, freely negotiated. For a natural resources related asset such as, for instance, a gas field, the 800 million may represent field exploration, development and production costs, while figures to the right would add to this depletion premia, resource rent, etc., the former, perhaps, pushing the value to 1,000 million while the latter to, perhaps, 1,750 million. If environmental degradation is added to this, we might push costs up to the "no deal" area under certain circumstances! It is merely this cautionary note that we wish to add to normal energy/environment economic analysis.

UNITED NATIONS
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Sixteenth session
16-20 September 1991
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ENERGY MANAGEMENT IN ASIA AND THE PACIFIC, INCLUDING REGIONAL COOPERATION: REGIONAL ENERGY RESOURCES MANAGEMENT: EXCHANGE OF EXPERIENCE THROUGH TCDC WORKING GROUPS

(Item 5 (d) of the provisional agenda)

PROGRESS OF THE REGIONAL WORKING GROUP ON NATURAL GAS

Note by the secretariat

CONTENTS

A. Issues relating to gas development in the Asian and Pacific region

1. The position of natural gas as a competitive fuel is shown in the following table, which has been modified slightly.

Table. Some potential environmental and public risks of energy systems

	Coal	Oil	Gas	Nu-clear	Geo-ther-mal	Hydro	Wind	Solar
Climatic modification	x	x	x		x			x
Acidic precipitation	x	x						
Changes in hydrological cycle	x	x	x					x
Large oil spills		x						
Fires and explosions	x	x	x	x				
Exposure to carcinogenes	x	x	x	x				
Disruption of wildlife	x	x				x	x	x
Catastrophes				x		x		

Source: U. Farinelli and P. Valant, "Energy as a source of potential conflicts", International Journal of Global Energy Issues, vol. 2, No.1, 1990, pp. 31-41.

2. Although one may agree with the above table and various individuals would value different risks at different rates of severity based not only on objective measures but intangible psychological fears and attitudes towards risk, it is hard to disagree with Farinelli and Valant when they say:

> The worsening of environmental conditions (including possible global changes to the climate) may induce countries and international organizations to adopt restrictive measures that, to be effective, should be enforced worldwide. Since a number of countries may consider these restrictions to be unbearable, considerable international tension is bound to build up.

/3.

3. The utilization of natural gas is potentially one of the supply sources that may reduce such tension: thus the importance of the continuing intercountry regional (Asian and Pacific) energy programmes of ESCAP for 1992-1996 and within it the continued coordination of the activities of the Regional Working Group on Natural Gas, as well as activities on the management of environmental risks.

4. Gas can contribute not only because it is a clean fuel (with less carbon dioxide than oil or coal) but also because its use may lead to economic efficiency on the utilization side, especially when used in conjunction with electric systems (combined heat and power applications etc.). The activities and future plans of the Working Group are reviewed below.

B. Activities of the Working Group

5. The UNDP/ESCAP Regional Energy Development Programme has scheduled four activities on natural gas in 1990-1991. These include: natural gas market surveys in 10 countries (including New Zealand) discussed at the Executive Seminar and Study Tour held in Indonesia and New Zealand in February 1991; a natural gas marketing seminar was held at Bangkok in January 1991 and a policy seminar is being planned for this year.

6. A paper by the ESCAP natural gas focal point servicing the Working Group was prepared for the Conference on Environmental Strategies for Asia-Pacific Energy, held at Kuala Lumpur on 26 and 27 August 1991, entitled "Asian natural gas: an environmental response strategy", drawing on the results of the Working Group activities in 1990-1991. Indonesia has been asked to coordinate Working Group activities for another year (1992), and Thailand has agreed to host the next Working Group meeting in November 1991.

7. The Government of New Zealand was asked to continue supporting Working Group activities, especially in the area of natural gas vehicles.

/C.

C. Tentative work programme for 1992-1996

	Activity	Timing
1.	Exchange of information on gas technology (newsletter, workshops)	1992-1996
1.1	Infrastructure establishment (distribution and processing)	1992-1996
1.2	Fuel substitution technology in industry	1992-1996
1.3	Use of natural gas in the transport sector	1992-1996
1.4	Technology for peak-shaving requirements	1992-1996
2.	Technical cooperation (advisory services, exchange of experts)	
2.1	Infrastructure establishment (distribution and processing)	1992-1996
2.2	Fuel substitution technology in industry	1992-1996
2.3	Use of natural gas in the transport sector	1992-1996
2.4	Technology for peak-shaving requirements	1992-1996
3.	Gas resource utilization training (group and on-the-job training)	
3.1	Infrastructure establishment (distribution and processing)	1992
3.2	Fuel substitution technology in industry	1993
3.3	Use of natural gas in the transport sector	1992
3.4	Technology for peak-shaving requirements	1993
4.	Regulatory and policy studies (studies, advisory services)	
4.1	Codes/standards/regulations/practice	1993
4.2	Pricing studies	1994
4.3	Gas use planning (resource utilization efficiency and environmental benefits)	1992
5.	Technical Advisory Group meeting	1992, 1993, 1994, 1995 and 1996

/Annex

Annex

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