# THE INTERNATIONAL ENERGY WORKSHOP: A Progress Report

Alan S. Manne
*Department of Operations Research*
*Stanford University*
*Palo Alto, California, USA*

Leo Schrattenholzer
*International Institute for Applied Systems Analysis*
*Laxenburg, Austria*

RR–88–6
November 1988

Reprinted from *OPEC Review*, Spring, 35–48 (1988).

**INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS**
**Laxenburg, Austria**

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Printed by Novographic, Vienna, Austria

# FOREWORD

The International Energy Workshop (IEW) is a network of analysts concerned with international energy issues. It aims to compare long-term energy projections and to understand the reasons for diverging views. The IEW conducts iterative polling on key energy issues and publishes the results of these polls semiannually. The poll results are discussed at annual meetings, alternating between Europe and North America. Participation in th IEW is informal and is open to anyone supporting the goals of the Workshop.

This report by Professor Manne from Stanford University and Dr. Schrattenholzer from IIASA describes the status and progress of the IEW in mid-1987. It also summarizes the discussions from the meeting held at IIASA in June 1987.

F. SCHMIDT-BLEEK
*Program Leader*
Technology, Economy and Society Program

# The International Energy Workshop — a progress report

**Prof Alan S. Manne and Dr Leo Schrattenholzer**

THE INTERNATIONAL Energy Workshop (IEW) provides an informal network for communication between energy analysts throughout the world. Its general aim is to compare energy projections, collected through an ongoing poll, and to obtain a better understanding of the reasons for their differences. The IEW began in 1981, when it held its first meeting at Stanford University, US. Since that date, meetings have been held once a year — alternating between IIASA and North American locations. Poll results are published at six-monthly intervals. The January 1987 edition contains 192 individual responses from 71 participating organizations.

Typically, the poll responses are 'surprise-free' projections, but some bear labels such as 'restructuring' or 'muddling through'. To ensure comparability, respondents are asked to provide their estimates for a statistical base year, and for three points in the future: 1990, 2000 and 2010. **Figure 1** shows the most recent update of the poll form.

Each edition of the poll includes frequency distributions comparing the responses provided for individual countries and for the following regional groupings:

1. Soviet Union and Eastern Europe (SU/EE)
2. People's Republic of China
3. Centrally planned economies (CPE)
4. OECD
5. OPEC
6. Non-OPEC developing countries (NODC)
7. Market economies
8. World, total

The most recent IEW meeting took place at IIASA on 16–18 June 1987. Some 100 participants from governments, industry and academia exchanged views on the long-term prospects for international energy prices, supply and demand. Two topics received special emphasis: the global outlook for natural gas and energy growth prospects in the developing countries.

This paper focuses on the presentations and discussions during this meeting. Since these were based largely on IEW results obtained in the years

*Prof Manne is from Stanford University, Stanford, California, US, and Dr Schrattenholzer from the International Institute for Applied Systems Analysis, Laxenburg, Austria.The authors were assisted by Susan Riley, from IIASA.*

**Figure 1**
**Updated poll form (1985 base year)**

Country/region: _____
Organization/project: _____
Reference (including date) of most recent report: _____
_____
_____

| | 1985 | 1990 | 2000 | 2010 |
|---|---|---|---|---|
| 1. International price of crude oil (e.g. Arabian Light) in $85/b | | | | |
| 2. Real GNP (or GDP) Units: Index numbers, constant purchasing power, 1985 = 100 | 100 | | | |
| Primary energy, commercial, million tons of oil equivalent (mtoe) | | | | |
| 3. Total consumption | | | | |
| 4. Total production | | | | |
| 5. Oil, consumption | | | | |
| 6. Oil, production | | | | |
| 7. Oil, exports-imports | | | | |
| 8. Natural gas, consumption | | | | |
| 9. Natural gas, production | | | | |
| 10. Natural gas, exports-imports | | | | |
| 11. Coal, consumption | | | | |
| 12. Coal, production | | | | |
| 13. Coal, exports-imports | | | | |
| 14. Hydroelectric and geothermal | | | | |
| 15. Nuclear energy | | | | |
| 16. Solar and other renewables | | | | |
| Secondary energy, terawatthours (TWh) | | | | |
| 17. Total electricity generation | | | | |

1986–87, this report leaves no gap in reporting on IEW activities since our previous paper in the Autumn 1986 issue of the OPEC Review.

## The international price of crude oil

Despite OPEC's attempts at stabilization, the international price of crude oil has been highly volatile during the years since 1973. In **figure 2**, both actual and projected prices are shown as an index number — in currency units of constant purchasing power with 1980=100. This chart shows the two price hikes of the 1970s, followed by the collapse of the 1980s. As of 1986, the real price of oil (measured in US dollars) was only a third of its 1980 value.

According to figure 2, long-term price projections have mirrored the instability in the world oil market. Figure 2 contains the medians of the IEW's projections published at five successive dates from 1981 through 1987. During these years, the projections follow a pattern that may be described as 'adaptive expectations'. Each new projection begins with the current oil price. Past trends are then extrapolated from that point. **Table 1** quantifies this statement. It shows implied growth rates of the oil price

**Table 1**
**Implied oil price growth rates**

| Poll | Oil price index in the preceding year | Oil price index in the year 2000 (median) | Annual growth rate |
|---|---|---|---|
| **12/81** | 100 | 175 | 2.80 |
| **7/83** | 85 | 148 | 3.08 |
| **1/85** | 67 | 109 | 3.04 |
| **1/86** | 61 | 96 | 3.02 |
| **1/87** | 33 | 73 | 6.57 |

between the date of its projection and the year 2000. This table shows a remarkable pattern, i.e. the implied annual oil price growth has remained almost constant (at three per cent per year) between 1983 and 1986! In early 1987, just one year after a sharp decline in the oil price, this growth rate almost doubles. Looking at the medians suggests that the information content of the 'conventional wisdom' is small. A possible explanation for this phenomenon is that many projections are aimed at being consistent with as many others as possible.

The extreme responses are particularly instructive (**figure 3**). These describe future developments that are believed to bring about either very high or very low oil prices. Fortunately, they were supplemented with detailed explanations by their authors. Dermot Gately, projecting a price of $60/b in the year 2000, assumes that OPEC will continue to maintain some elements

**Figure 2**

**Comparison of five successive IEW Polls and actual crude oil prices**

*constant $ (1980 = 100)*

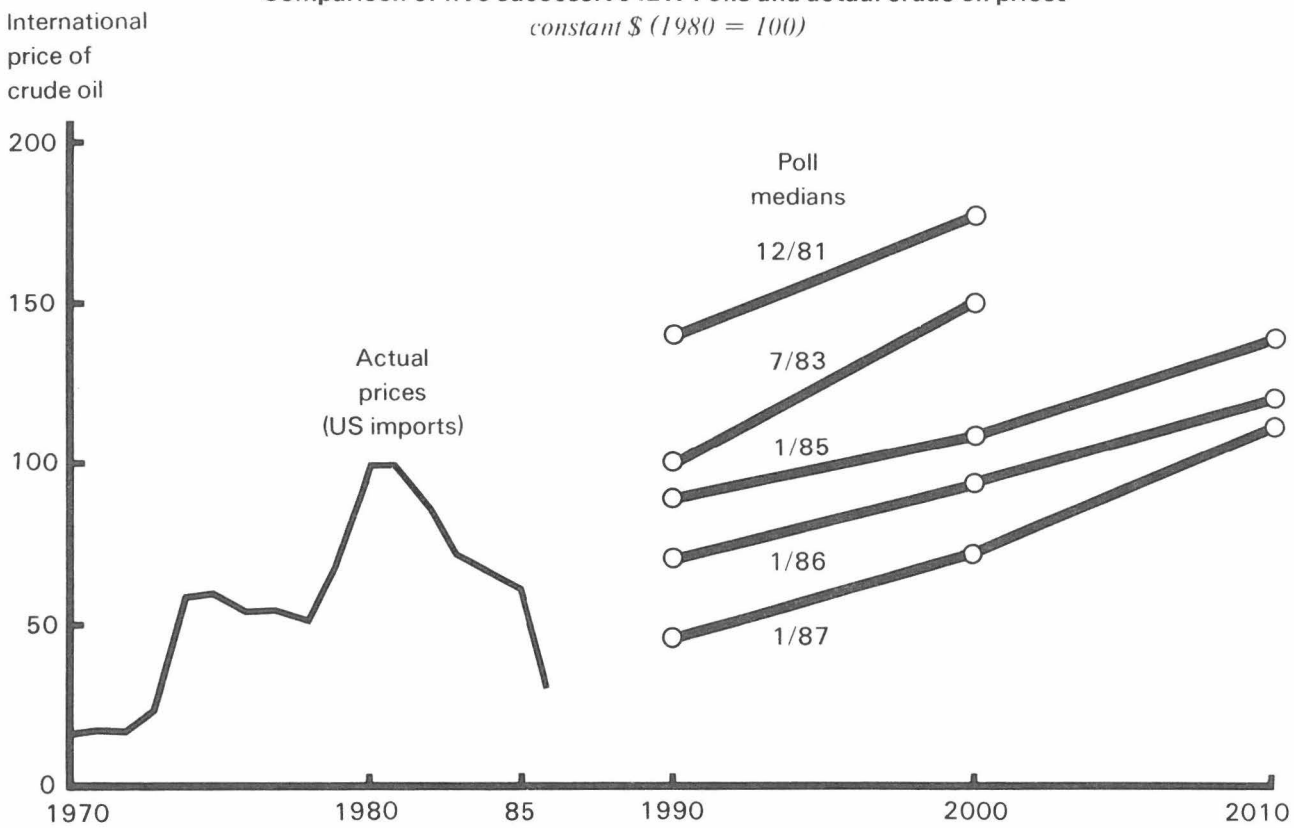
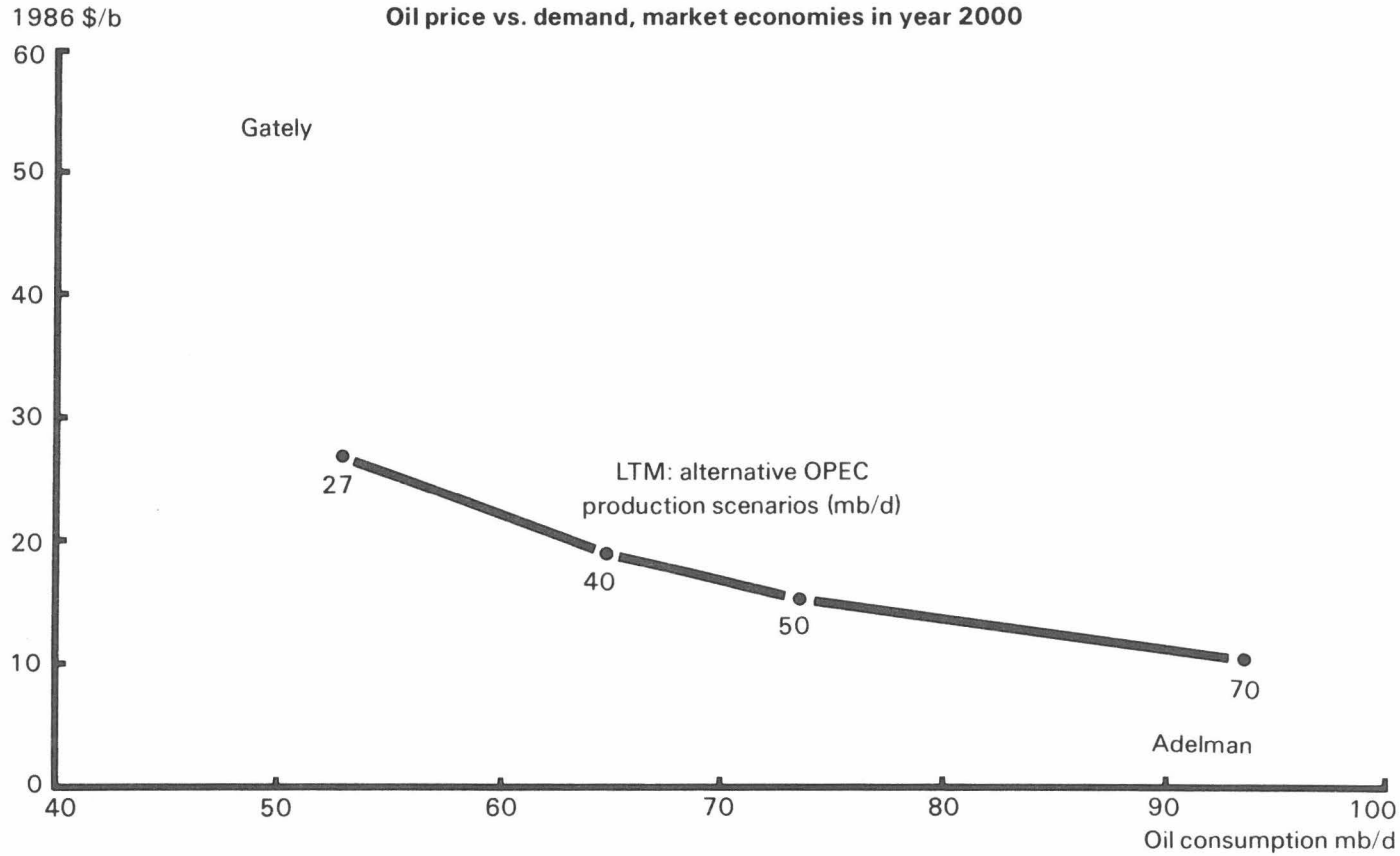


**Figure 3**
**Oil price vs. demand, market economies in year 2000**



of market discipline, and that the price elasticity of demand is lower than is assumed by other poll participants. Sooner rather than later, this leads to a tightening of world oil markets. In contrast, Maurice Adelman describes a competitive scenario, in which the world's resource base is large enough to accommodate a major expansion of oil supplies through the year 2000 at a price of $8/b. These two estimates are a long way from each other, but the discussion brought out many of the reasons for the disagreement between these two perspectives.

## Energy forecasts for developing countries

For a number of reasons, developing countries are under-represented among the IEW poll respondents. Moreover, the responses received for the NODC region and its sub-regions show a peculiar pattern. All responses for the region as a whole have been received from organizations outside this region, and most responses for individual countries within this region have been received from the countries themselves. This leads to the comparison shown in **figures 4** and **5**. They indicate the implied growth rates for GNP

**Figure 4**
**GNP growth in developing countries**

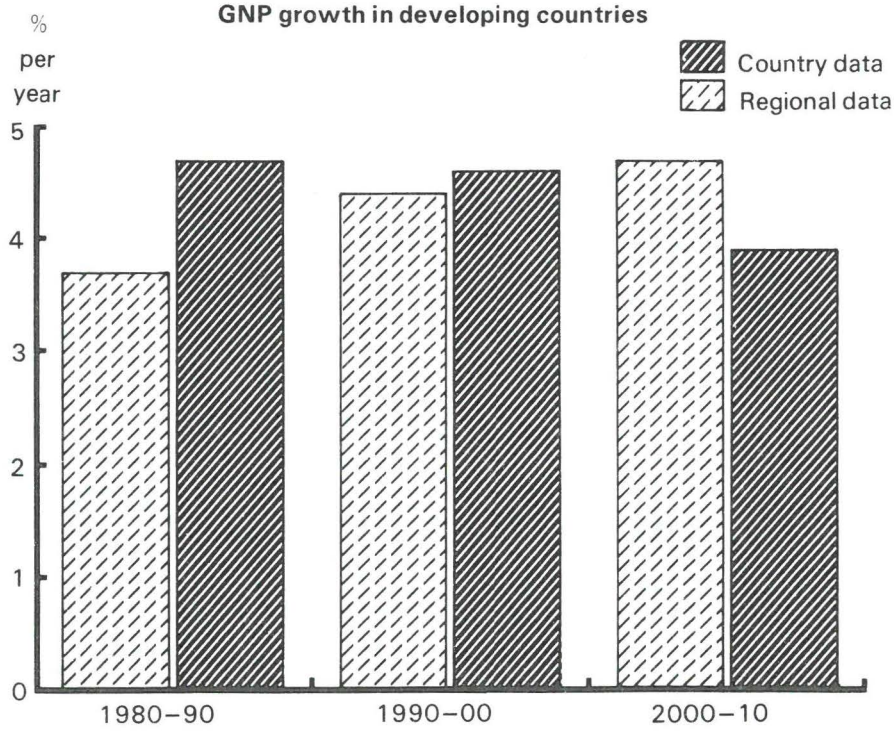
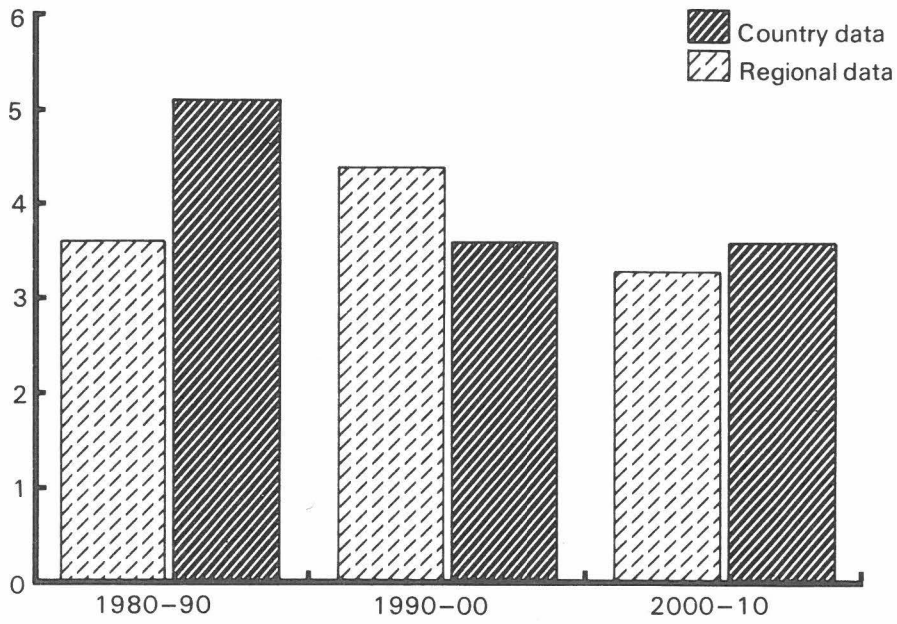


**Figure 5**
**Total primary energy growth in developing countries**




and for total primary energy consumption, expressed as the medians of these derived quantities, once for the responses on the whole region, and once for the responses for individual countries within this region. The emerging picture shows a significant difference. The growth rates are higher in the near term when projected for individual countries. This trend is reversed for projections that go further into the future, the net result being comparable levels in both cases in the year 2010. Although the sample size is too small to draw definite conclusions from this phenomenon, it served as a hypothesis for discussion at the meeting. It was suggested that the projections from within the developing countries came from government agencies, and that most such forecasts (in all countries) show a tendency towards optimism in the near future.

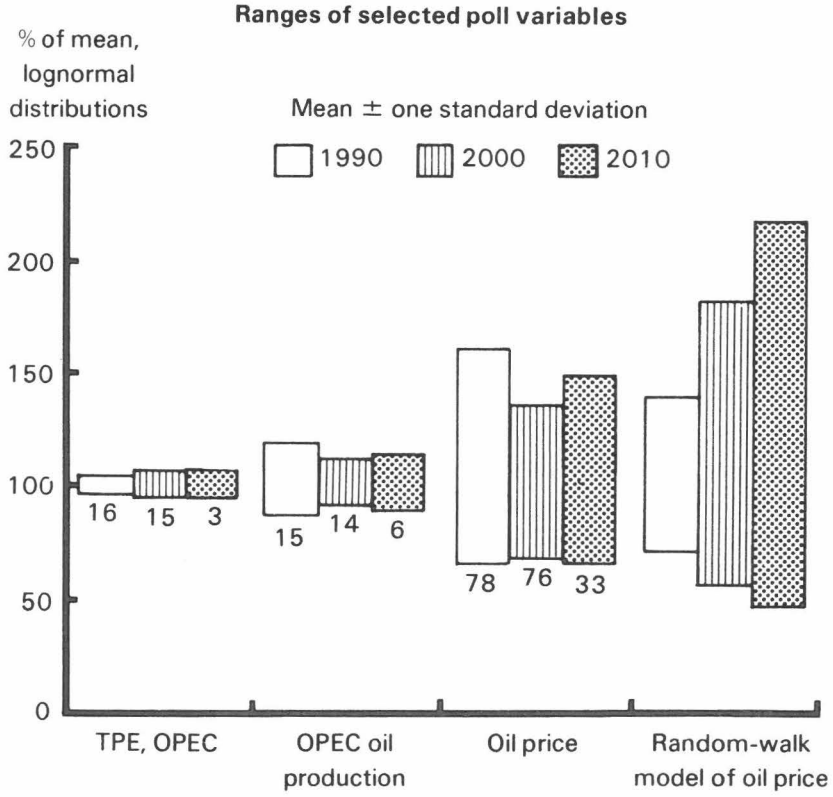
## Ranges

The medians of the poll responses can be regarded as the 'conventional wisdom' pertaining to the future development of a particular variable. Another statistical descriptor is the range which can be calculated for any suitably

chosen probability distribution. The log-normal distribution is the one we think best suited for most poll items (clearly this is inappropriate for exports-imports, which can take on negative values). The log-normal distribution has the useful property that, for example, twice the mean value is as likely as half the mean. In **figure 6**, we show the size of the interval that is centred around the mean value (here represented as 100 per cent) and which extends one standard deviation above and below (since the distribution is not symmetric on an absolute scale, these intervals do not appear symmetric on the figure). This span is commonly used and covers about two-thirds of the total probability range. The numbers below the bars are the sample sizes (the number of responses received for the item in question).

The first item shown on figure 6, total primary energy consumption in the OECD region, is an example of an overwhelming consensus. The sample

**Figure 6**
**Ranges of selected poll variables**




*Note: TPE is total primary energy consumption.*

range for the year 2000 is not more than six per cent in either direction! Under the given circumstances, this amounts to unanimity among energy forecasters. At the IEW meeting, the hardly flattering term 'sheep effect' was used to describe this phenomenon.

Another interesting result is the development of the ranges of oil forecasts in time. Both for the international price of crude oil and for OPEC's oil production, the range of the projections decreases for the year 2000 when compared with the 1990 value! This implies that the uncertainty about these two items is larger in the short term than in the long term, or, in other words, that the fluctuations of the oil price are expected to stay with us for a while. Here it may be helpful to compare these ranges with those observed in the past. If one were to interpret the movements of oil prices between 1974 and 1985 as a random-walk process, the observed one-year ranges would result in the interval (58 per cent, 171 per cent) around the mean when compounded until the year 2000 (see the rightmost group of bars in figure 6). This interval is significantly larger than the range of the IEW oil price projections. For the year 2000 — and even more so for 2010 — this suggests that the inherent uncertainties of oil price development is underestimated by the poll respondents. This observation was confirmed in a presentation by Gary Yohe who arrived at the same conclusion, with different means.

## The prospects for natural gas

### Methane as a future world fuel

It has been the tradition at the IEW to have contrasting views on a particular subject presented and, through discussion, try to identify the sources of disagreement and assumptions leading to either view. In the June 1987 meeting, two very different scenarios on the future of natural gas were presented.

First, Daniel Dreyfus (US Gas Research Institute) presented a cautious projection of global gas consumption, expecting it to remain in the 20 per cent range (as the share of gas in total primary energy consumption). He also pointed out that, while huge resources of gas have been discovered, for example, on the North Coast of Alaska, current energy uses and technologies, the existing global infrastructure, and the well established international commodity trade place the emphasis on liquid petroleum in the world energy mix. He contended that there are no currently foreseeable demographic, cultural or technological trends that will impair the competitive advantages that oil now enjoys.

On the other hand, Cesare Marchetti (IIASA) presented the outlook for natural gas based on a logistic substitution model. This comparatively

simple model, originally developed to describe the growth of a species in a limited environment, and which describes the development of the global energy system remarkably well for the last 120 years, shows the share of natural gas reaching well over 50 per cent of total primary energy consumption in the first decade after the year 2000.

Dreyfus agreed that, while the global resource base of natural gas was large enough to support Marchetti's forecasts through 2010, this rate of market penetration was unlikely in view of the present infrastructure, policies and business environment.

### The European natural gas market

Three speakers presented papers that attempted to put the European market into perspective. The first, Gunnar Austvik (Norway), discussed the energy security questions that may be associated with the selection among different natural gas sources in Europe, and what significance they may have in economic terms in decreasing the dependence upon a single source of supply. He argued that, since the gas trade in Europe crosses several historical, political, economic and cultural borders, the overall political context will be important for the development of the gas trade, and that, in turn, the trade itself will also have the possibility of influencing these political, economic and cultural links. He concluded that gas import prices are close enough to each other to permit buyers to diversify the sources of their gas supply.

Anatoli Golovin (IIASA) presented the prospects for natural gas, as seen in the Soviet Union. This showed a picture of the Soviet potential reaching the 1.1 bn cu m production level in the year 2000 with existing reserves, and perhaps up to 1.3 bn cu m after additional exploration. This contribution of natural gas to total primary energy supply in the Soviet Union could therefore well exceed 30 per cent by the year 2000 and, at the same time, permit increasing exports.

Hans-Holger Rogner (IIASA) presented the results of IIASA's International Natural Gas Study, aimed at the identification of the long-run techno-economic potential of natural gas in European energy markets, and on the possible impact of anticipated technical change on the mix of primary energy consumption. Using two distinctly different scenarios of future technical change, he argued that the productivity increases derived from the evolution of technical change give natural gas a decisive edge over coal in the bulk application, such as electricity generation and as an under-boiler fuel, and that technical improvements at the energy end-use side continue to improve the relative position of natural gas in the residential and commercial sectors. His main result was that the deployment of new technologies for

natural gas utilization could increase natural gas's share of total European primary energy consumption to some 30 per cent by 2010.

## Developing countries

Between 1970 and 1985, the developing countries' share of commercial energy use in the world has increased from ten to 15 per cent. Although it is important not to generalize among developing countries, there are some commonalities (high population and GDP growth, urbanization and a pronounced shift from agriculture to industry) which explain some of the great growth in commercial fuels seen in the IEW statistics. This year, the IEW attempted to correct a past deficiency of less than the desired participation of people from developing countries or those who know about the situation, by three presentations that complemented each other in their focus.

The first speaker, Charles Blitzer (MIT, US), reported on energy demand studies undertaken by MIT for oil-importing and oil-exporting developing countries. Comparing his results with the IEW poll medians, he found that the IEW results show higher GDP growth, lower energy growth but comparable levels of total primary energy. He also sees more oil substitution by domestic natural gas, coal and renewables. In particular, he mentioned the examples of Brazil and India who have already significantly reduced their dependency on imported oil. As a general observation, he emphasized that the individual countries are sufficiently different to limit the number of generic statements for the developing countries. Individual energy and GDP developments will depend on country-specific developments of energy intensity, energy prices, the shift from traditional to commercial fuels and urbanization.

### Energy system development in the People's Republic of China

Lu Yingzhong (Institute for Technoeconomic and Energy System Analysis, Beijing) presented an overview of energy system development and forecasts for the People's Republic of China. There, one billion people currently consume over 700 million tons of coal equivalent per year, with a projection that this will rise to about four billion by the year 2030. With nuclear energy utilization just beginning in China, and comparatively low shares for oil, gas and hydropower, coal today constitutes 75 per cent of energy consumption. With estimated reserves of 62 billion tons, this present and expected future dominant position of coal presents two very challenging problems: transportation and environmental pollution.

Approximately 70 per cent of the coal resources are concentrated in Northern China, but over 50 per cent of the coal is consumed in southern China. Almost 300 million tons of coal will need to be transported over

thousands of miles by the year 2000. This is a challenging technical and economic problem. At the same time, environmental pollution in some regions is already exceeding allowable levels and acid rain has been identified in vast regions of south-west China. Rural regions also face the additional problem of overburning of agricultural wastes. This leads to a decrease in the organic content of the soil, which in turn leads to a reduction in agricultural production.

To cope with these problems will require the introduction of various policy reforms for both urban and rural regions. In urban regions, this will include providing gaseous fuel supplies for cooking, as well as district heating with cogeneration stations equipped with improved flue-gas treatment and conversion efficiency. This also provides an incentive for the introduction of nuclear heating reactors. Nuclear energy is projected to contribute to total primary energy, with a 10–20 per cent share by the year 2030. In industrial regions, the emphasis will be placed on gasification instead of direct coal burning for furnaces. In rural regions, energy policies will have to be based on the diversification of rural energy sources, including fast-growing trees, small local decentralized coal mines, mini-hydropower, biogas, solar, wind and geothermal energy.

Along with other policy reforms in the economy, energy pricing and institutional management, the continuing development of energy education will also play an important role at all levels, from academic, vocational and on-the-job training.

### Integrated rural energy planning programme in India

S.K. Chopra (Planning Commission, Government of India) presented a more detailed description of the background, rationale, design and contents of the IREP, the new Integrated Rural Energy Planning Programme in India. He detailed how this programme is being developed and utilized to bring economic transformation to the rural areas by the year 2000.

In India, over 70 per cent of the total population live in rural areas, with nearly 90 per cent of their energy consumption consisting of non-commercial fuels such as firewood, cow dung and agricultural wastes. The continued widespread use of these non-commercial sources of energy in the rural regions has resulted in large-scale destruction of the environment. The all-round shortage of energy, especially commercial and fossil energy, has necessitated massive investments through various rural energy supply programmes, including those for rural electrification, forestry, the supply of kerosene and other petroleum products, biogas, improved stoves and other renewable energy programmes such as solar, wind, biomass, etc. These rural energy programmes can only be possible with an integrated rural energy

policy planning framework, which links demand for end-use with the various energy supply programmes aimed at meeting the energy needs of the different income groups in the rural areas.

Initiated in 1981 on a 'pilot' basis in selected states, IREP has since been developed, modified and enlarged, to consist of developing institutional mechanisms, training preparation, implementation, financial incentives and monitoring in all states and union territories of India. Based on the results of the IREP computer models and previous field experiences, the optimum mix of the different energy programmes for meeting the needs for subsistence and productive activities in rural areas are being worked out and should become operational by 1990.

### *Future IEW activities*

*The next meeting of the IEW will be held in Honolulu, Hawaii, on 14 – 15 June, and it will be sponsored jointly by the East-West Centre, Honolulu, and IIASA.*

*All interested readers are invited to send one or more poll responses to one of the two authors. Partial responses are also welcome, but responders are requested to type the information they submit.*

*Anybody interested in just receiving the IEW announcements will be included in our mailing list on request.*

### *Addresses*

*Since no formal proceedings have been published for the IEW meeting, the addresses of the authors and those participants whose contributions have been quoted in this paper are given below.*

*Prof Morris Adelman*
*Department of Economics*
*Massachusetts Institute of Technology*
*Cambridge 39, MA 02139*
*USA*

*Mr Ole Gunnar Austvik*
*Research Associate*
*Norwegian Institute of International Affairs*
*PO Box 8159 Dep.*
*0033 Oslo 1*
*Norway*

*Dr Charles R. Blitzer*
*International Energy Studies Programme*
*Energy Laboratory*
*Room E40-343a*
*Massachusetts Institute of Technology*
*Cambridge, MA 02139*
*USA*

*Mr S.K. Chopra*
*Advisor*
*Planning Commission*
*Government of India*
*Yojana Bhawan*
*Parliament Street*
*New Delhi 110001*
*India*

*Dr Daniel A. Dreyfus*
*Vice President*
*Strategic Analysis and Energy Forecasting*
*Gas Research Institute*
*1331 Pennsylvania Avenue, NW, Suite 730*
*Washington DC, 20004-1703*
*USA*

*Prof Dermot Gately*
*Department of Economics*
*269 Mercer Street*
*New York University*
*New York, NY 10003*
*USA*

*Dr Anatoli Golovin*
*Research Scholar*
*IIASA*
*A-2361 Laxenburg*
*Austria*

*Prof Lu Yingzhong*
*Institute of Nuclear Energy Technology*
*PO Box 1021*
*Beijing*
*China*

*Prof Alan S. Manne*
*Department of Operations Research*
*Stanford University*
*Stanford, CA 94305*
*USA*

*Dr Cesare Marchetti*
*Research Scholar*
*IIASA*
*A-2361 Laxenburg*
*Austria*

*Dr Holger Rogner*
*Research Scholar*
*IIASA*
*A-2361 Laxenburg*
*Austria*

*Dr Leo Schrattenholzer*
*Guest Scholar*
*IIASA*
*A-2361 Laxenburg*
*Austria*

*Prof Gary W. Yohe*
*Department of Economics*
*Wesleyan University*
*Middletown, Connecticut 06457*
*USA*