# FUTURE ENERGY NEEDS

by

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## 1. INTRODUCTION

**Mr. Chairman, Ladies and Gentlemen,**

My presentation this morning is based on the key findings of the World Energy Council's Commission "Energy for Tomorrow's World" which I have had the honour and pleasure to chair since the World Energy Congress in Montreal in 1989.

The Commission which is unique in its approach, has has as its primary objective to reconcile major views on the important global energy issues confronting our times with realistic prospects for the economic, technical, environmental, social and institutional development in the various regions of the world.

From a global point of view, the study has concentrated on those key issues which will shape energy provision and use in the future such as population growth, economic and social development, access to sufficient energy for the developing world, local and regional environmental impact, potential global climate change, efficiency of energy supply and use, financial and institutional issues and technological innovation and transfer of this information around the world.

Nine regional groups, which in total covered the World area, analyzed their own regional

energy issues and requirements. These were tested with the facts, uncertainties and probabilities of the Global Energy Scene prior to assessing the regions own priorities for energy development, expectations and options.

## 2. THE NEED FOR CHANGE

I will start this presentation on the key findings of the Commission by first relating its overall message which - above all - is the need for change. Change of attitude, change of systems, change of dimensions and - not least - change to development planning are required. With world population expected to double by the middle of the next century, and urban population expected to more than treble, we cannot carry on using energy in the ways we currently do.

Demands for the services which energy provides - heating, cooling, lighting, cooking, mobility and motive power - will rise massively. The growth will primarily be in the developing countries. Energy is a provider of basic needs and services. It is an essential ingredient of social development and economic growth. The challenge is to provide the energy services required by the world's expanding population while avoiding environmental impacts which could eventually become overwhelming.

Meeting this challenge requires massive changes to the global energy sector as we know it today. But change can only come about slowly. It involves phasing out many existing investments, the introduction and diffusion of new technologies, generations of successively improved new investment, changes in energy policy and consumers' behavioural patterns. Realizing that energy systems cannot be changed rapidly is not a reason for laissez-faire attitudes today. Rather on the contrary, the next 30 years will represent a critically important transition phase if long-term goals are to be realised.

Hence we need to initiate change now if we are to achieve successful, sustainable development some time in the next century.

## 3. THE CHALLENGE OF THE DEVELOPING WORLD

At least 85% of the global energy consumption increase anticipated over the next few decades is expected to come from the developing world as a result of the alleviation of poverty and material progress. Greatly increased commercial opportunities and changed trading patterns for the developed and developing world are likely to result.

However, some regions experiencing rapid population increases and less well-endowed to meet the various challenges, may not achieve rises in per capita energy consumption. Sub Saharan Africa is one of the areas that appears particularly vulnerable in this regard.

## 4. THE NEED FOR IMPROVED ENERGY EFFICIENCY

The more rational world-wide use of energy on a cost/benefit basis is of immediate importance. Hitherto, changes in economic structure and the turnover of plant and equipment have been the main cause of reducing the energy intensity of economic output. Changes in energy prices and regulations have been much less significant.

The Commission stresses the scope for, and benefits of, energy efficiency improvements. Once seriously tackled, the early gains will be large but the rate of improvement cannot be sustained forever. It is now primarily up to energy consumers and energy policy-makers, to an extent never previously contemplated, to ensure that the desirable improvements in energy efficiency are achieved.

Improvements in energy efficiency in the developing world and economies in transition, particularly, are only likely to occur simultaneously with other improvements - in general policy-making, accessing finance and technology, managerial skills and manpower training.

## 5. TECHNOLOGY TRANSFER

The development and diffusion of the technology necessary for meeting global energy

requirements and mitigating environmental impacts is of crucial importance. Technology transfers need to be speeded up, with due protection of intellectual property rights, and it is essential to get the market system to function for this purpose. The industrialised countries bear a major responsibility for developing the technologies required for the future, and for facilitating the applicability of these technologies to local circumstances.

## 6. FOSSIL FUELS WILL DOMINATE

Fossil fuels will continue to provide the bulk of energy needs for the next few decades. Coal has some 250 years of reserves at current consumption rates. Oil at over 40 years, and natural gas at over 65 years, may come under real pressure in the decades following 2020, and concerns about availability may cause price increases well before 2020. Import dependency for oil natural gas and coal will increase, and supply lines will lengthen. There are likely to be impacts on price levels and stability from these shifts.

To assess the possible developments in energy demand and supply, the Commission developed four energy cases, each representing different assumptions in terms of economic development, energy intensity reduction, technology transfer and institutional improvements.

The four cases are characterized in summary form in **Figure 1**.

The Reference Case (B) represents an updated version of that developed by the World Energy Council at its 14th Congress in Montreal in 1989. The other three are variants to illustrate sensitivities to changes in the basic assumptions.

Case A assumes a higher economic growth than the Reference Case, and this increase is only taking place in the developing world. Otherwise, Case A assumes a similar improvement in energy intensity, institutional development and technology transfer as in the Reference Case.

Case B1 has an economic growth rate as the Reference Case, but represents a world that

is not so clever in improving energy intensity, developing the proper institutions and in transferring the necessary technology.

Case C is what we have termed an ecologically driven case. It is included to illustrate the size of the challenge and the far-reaching and immediate actions which are required if annual carbon dioxide emissions are to be broadly stabilized by 2020 at their 1990 levels.

As can be seen from **Figure 2**, it is only in the OECD and CEE/CIS that there is potential for containing future energy demand. Population "explosion" and economic development in many of the presently categorised developing countries make it inevitable that they will, for many decades, consume considerably increased amounts of energy. Even the Ecologically Driven Case C (which assumes a dramatic improvement in developing countries' energy efficiency far beyond historic experience, and despite static per capita energy consumption in some areas resulting from continuing poverty) projects major increases of energy consumption within these countries.

**Figure 3** compares possible global energy supply mixes for the four Cases in the year 2020 with the corresponding mix for 1990. It will be seen that fossil fuels continue to dominate the energy mix over the next three decades and are likely to do so well beyond this period. The only exception is shown in the Ecologically Driven Case C which is based on extreme assumptions thought unlikely to be achievable before the horizon year of 2020.

Many of the energy mix elements in the four Cases line up against their theoretical maxima on today's knowledge and capabilities. Two, however, demand special consideration, i.e. the contribution from nuclear power and renewable energy sources and in particular the so-called "new renewables".

## 7. THE NUCLEAR POWER DILEMMA

Nuclear power is faced with a dilemma. Public and political concerns with safety and proliferation currently curb expansion, and even maintenance of current output, in many countries. Interest in the fast breeder reactor and in long-term fusion prospects seems to be waning. Yet long term, beyond 2020, there is likely to be growing recognition that

nuclear power and coal are the two options most readily available in substantial quantities.

As becomes apparent from **Figure 4**, the Commission has assumed in its various cases that the contribution from nuclear power will increase. This presupposes, however, that satisfactory solutions will be found that will lead to public acceptance of such expansion. It is also recognised that this may not happen, in which case coal is likely to be the most dominating substitute (natural gas already being greatly in demand, and new renewable energy availability only gradually expanding).

## 8. THE ROLE OF RENEWABLE ENERGY SOURCES

Under current policies renewable energy, contributing 18% of world primary energy supply in 1990, will not increase its aggregate share significantly in the next three decades. Some 60% of renewable energy in 1990 came from traditional biomass. Large hydro accounted for 30%. Modern biomass accounted for a further 8%. Solar, wind, geothermal, small hydro and ocean/tidal combined - the so-called "new" renewables - totalled under 2%.

The WEC's study on "new" Renewable Energy Sources concluded that, under current policies, the current 2% figure might double to 4% (and triple in volume) by 2020. Accelerated development through concerted and effective governmental action, based on appropriate economic and environmental criteria, could result in new renewables approaching 12% of global supply by 2020. **Figure 5** shows the absolute contribution from new renewables assumed in the four energy cases.

Beyond 2020 a steadily growing volume and proportion of global primary energy supply is expected to come from new renewable sources, especially solar.

## 9. THE CLIMATE CHANGE ISSUE

Despite the aspirations of the 1992 Rio Declaration, there is no realistic possibility, under current policies, of the developed countries in aggregate containing man-made greenhouse gas emissions at 1990 levels by the year 2000. Greenhouse gas emissions and atmospheric concentrations from global energy activities are bound to rise for many decades to come. This is illustrated in **Figure 6** that compares the $CO_2$ emissions and concentrations in 1990 with the emissions and concentrations in 2020 for the four different energy cases. (The concentrations have been provided for the four cases by the Climatic Research Unit at the University of East Anglia, using the so-called MAGICC climate model).

The UN Framework Convention on Climate Change, though currently unrealistic in its expectations, has indicated some of the required policy shifts. The developed countries will be required to lead by example, and to engage in technological and financial support on a massive and comprehensive world-wide scale if abatement action is to have a chance of success. The UNCED Secretariat in 1992 made the rough estimate that US$ 125 billion annually would be required to carry out its Agenda for resource transfers from North to South. This is more than double present aid flows from the North to the South.

The Commission advocates taking practical and cost-effective precautionary action for the mitigation and avoidance of environmental damage now as an interim measure. This is likely to yield a variety of other benefits in the areas of efficiency, technological and financial opportunities.

## 10. PERCEIVED PRIORITIES IN THE DEVELOPING WORLD

The developing countries, faced with their own priorities for using scarce resources, place the highest priority on local and regional pollution issues and not on potential global climate change. Only one of the Commission's nine Regions gave top priority to global environmental issues.

Understandably, developing countries place local environmental concerns - pollution of water, land and air; lack of sanitation, decent housing, health care and refuse disposal; and local development goals before global environmental concerns.

## 11. FINANCIAL IMPLICATIONS

Historically, energy has represented some 5% of world GDP while energy investments have typically accounted for about 15% of total world investments. These figures will rise in the coming decades and could easily reach 8-12% to maintain and widen supply availability and cope with environmental concerns. The issue is how many of the developing countries, and economies in transition, will obtain the financing and technology required for energy development and energy efficiency.

Some constraints to financing are likely, particularly among developing countries. Massive global investment in energy systems is anticipated at the same time as competition for international funds is likely to intensify to meet the challenges in many other areas; also brought about by the population explosion.

Much more local capital than hitherto will be needed, and more joint ventures. This will require radical changes to local institutions, markets, training and energy management, if local and international finance is to be raised and channelled into attractive energy investment - particularly in the developing world and economies in transition. And as these issues become recognisably more global in dimension so global institutions will require review and reform.

## 12. CONCLUDING REMARKS

Each of the key findings I have dealt with in my presentation reinforces the need for change now and the importance of the next 30 years as the transitional period in which the foundation for the post-2020 impact should be laid. Having through the Commission demonstrated its ability to mobilise the know-how resources of its broad international membership and other relevant institutions and individuals for the development of a

realistic framework for policy responses to the major challenges on the world energy scene, WEC has already decided to follow up many of the implications and recommendations of its Commission. This is now being implemented in WEC's 1993-1995 work programme that will be reported on at the 16th WEC Congress in Tokyo in October, 1995.

Some key problems to be tackled in this programme are:

- The oil and gas resource base beyond 2020 and in particular in relation to the demand for these resources in the developing countries.

- How to mobilise the necessary finance in the developing countries?

- How to ensure the effective transfer of technology to the economies in transition?

- More detailed assessment of the priorities set by the overall environmental considerations.

- Follow the development of the climate change issue as the science of it develops and assessing the implications for the energy developments around the world.

- Assess the energy perspective beyond 2020 and take key elements all the way to 2100.

Let me conclude with a few remarks on the sustainability question. The Commission demonstrates clearly that the perception of what is important in the further development of the world energy system varies widely from region to region. In finding a path to sustainable global and regional energy development it will be of utmost importance to address these widely different concerns in a realistic and balanced manner to reduce - as far as possible - the associated stresses between countries and regions. Without sufficient attention to this dimension of the world energy problem, there will not be sustainable development consistent with the expected population explosion in the developing world. Although there is no single universal formula, there are a number of important measures which when taken together indicate a path to worldwide sustainable energy developments:

- To ensure that the available resources are used in the most cost-effective and productive manner.

- To ensure that markets function as effectively as possible to attract the capital necessary to provide the energy services needed.

- To ensure that governmental measures are mainly directed at providing the framework which permit markets to function and to avoid market distortions which prevent the development of the necessary longer term solutions, in particular with respect to research and development.

- To ensure that energy efficiency and conservation, wherever justified on cost/benefit grounds, are maintained to reflect both economical and environmental goals.

- To place energy issues in their broader social and institutional context globally, recognising that people seek the services which energy can provide - not energy as such. Policies, processes and equipment related to energy provision and use should focus on how the energy services can be more effectively and efficiently provided in the future.

Figure 1.

# THE FOUR WEC ENERGY CASES

| CASE | A | B1 | B | C |
|---|---|---|---|---|
| Name | High Growth | Modified Reference | Reference | Ecologically Driven |
| Economic Growth % p.a. | 3.8 | 3.3 | 3.3 | 3.3 |
| Energy Intensity Reduction % p.a.<br>OECD<br>CEE/CIS<br>DCs | <br>High<br>High<br>Moderate | <br>High<br>Moderate<br>Moderate | <br>High<br>High<br>High | <br>Very high<br>Very high<br>Very high |
| Technology Transfer | High | Moderate | High | Very high |
| Institutional Improvements (World) | High | Moderate | High | Very high |
| Possible Total Demand (Gtoe) | Very high<br>17.2 | High<br>16.0 | Moderate<br>13.4 | Low<br>11.3 |

Figure 2.

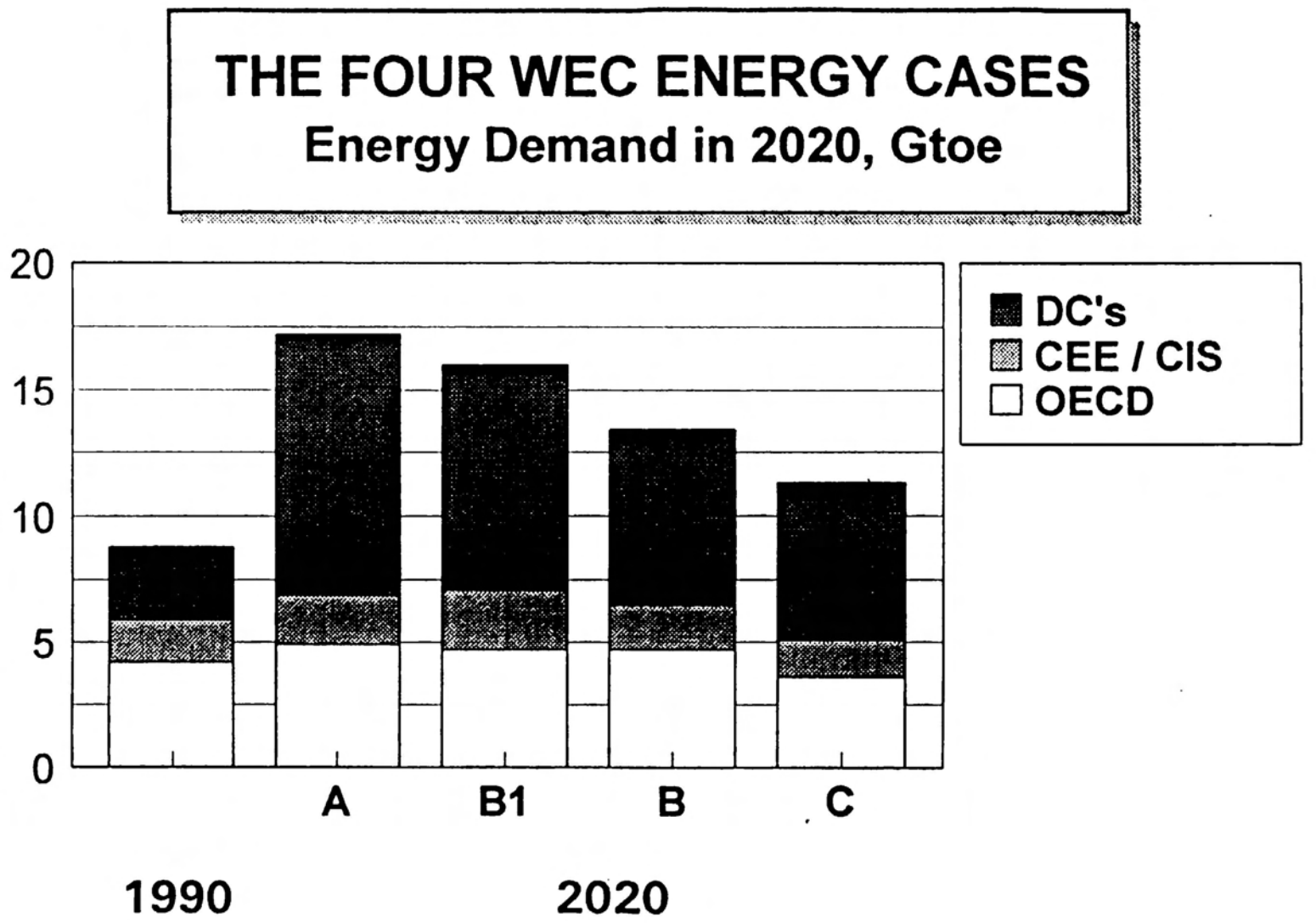
THE FOUR WEC ENERGY CASES
Energy Demand in 2020, Gtoe
20
15
10
5
0
DC's
CEE / CIS
OECD
A
B1
B
C
1990
2020

Figure 3.

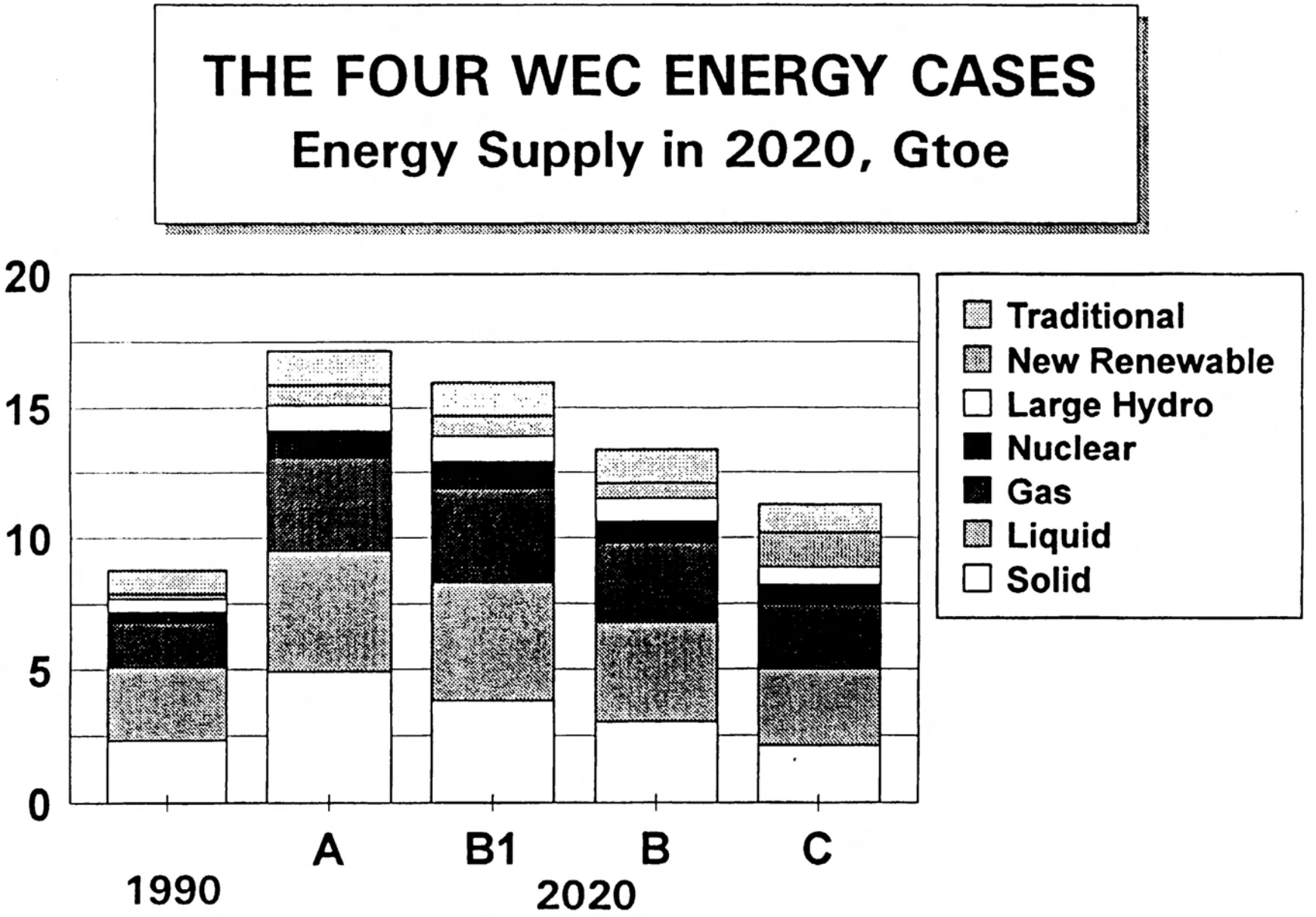
THE FOUR WEC ENERGY CASES
Energy Supply in 2020, Gtoe
20
15
10
5
0
Traditional
New Renewable
Large Hydro
Nuclear
Gas
Liquid
Solid
1990
A
B1
B
C
2020

Figure 4.

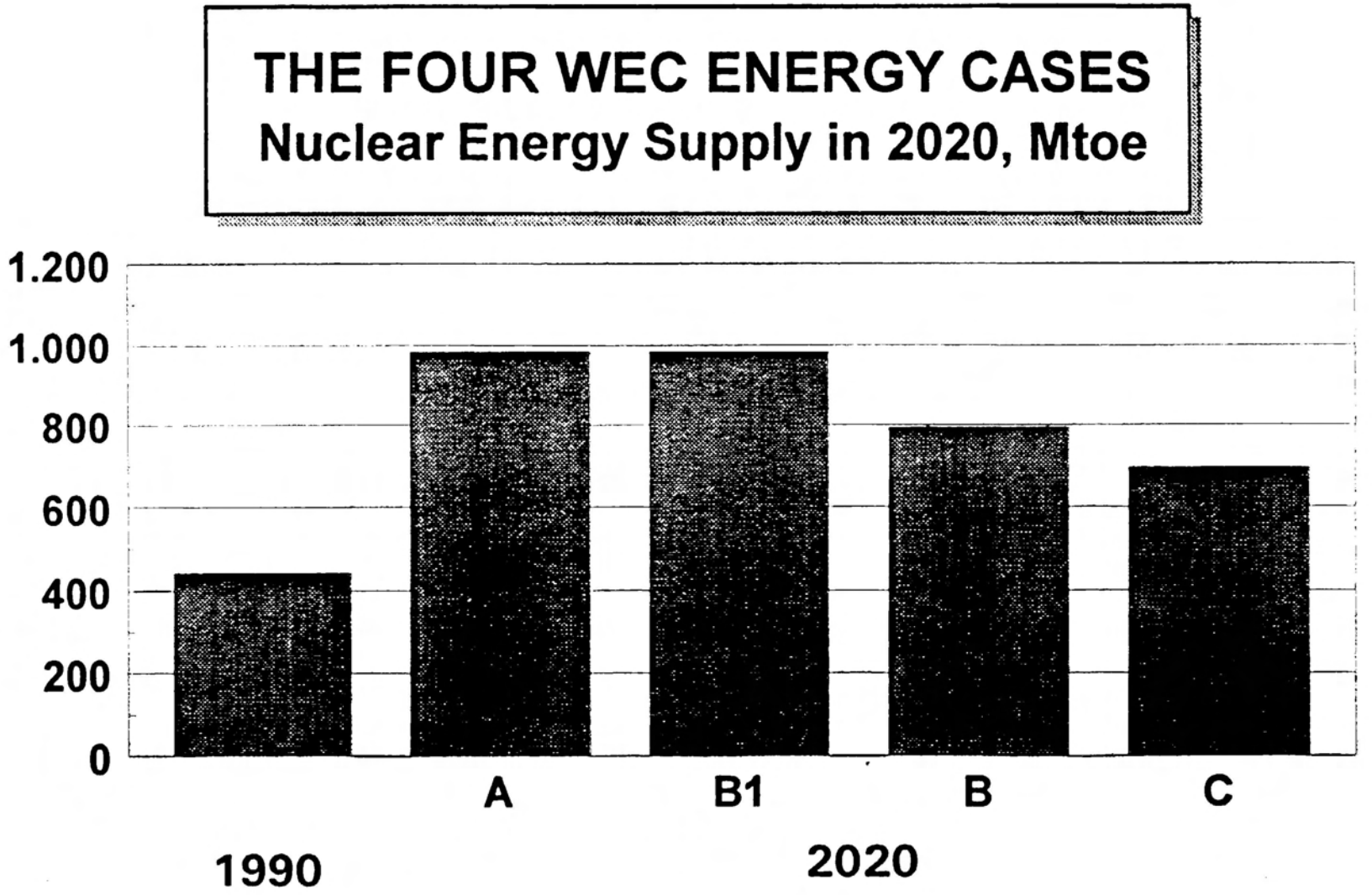
THE FOUR WEC ENERGY CASES
Nuclear Energy Supply in 2020, Mtoe
1.200
1.000
800
600
400
200
0
A
B1
B
C
1990
2020

Figure 5.

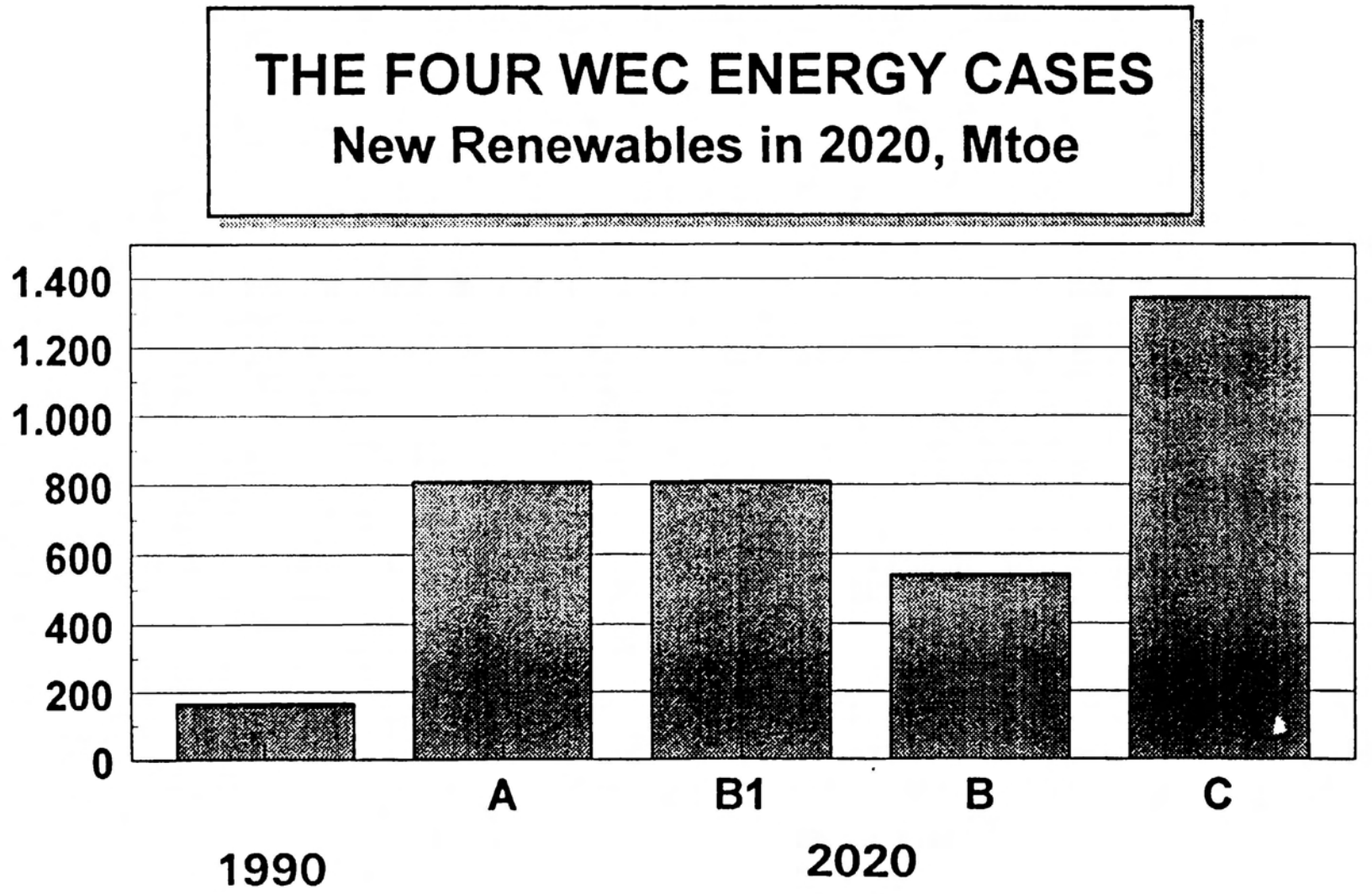
THE FOUR WEC ENERGY CASES
New Renewables in 2020, Mtoe
1.400
1.200
1.000
800
600
400
200
0
A
B1
B
C
1990
2020

Figure 6.

# CARBON DIOXIDE EMISSIONS AND CONCENTRATIONS

| CASES | 1990 | 2020 | | | |
|---|---|---|---|---|---|
| | | A | B1 | B | C |
| Emissions (GtC) | 5.9 | 11.5 | 10.2 | 8.4 | 6.3 |
| Concentrations (ppmv) | 355 | 434 | 426 | 416 | 404 |