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REPORT ON THE BROWN COAL AND PEST INDUSTRIES IN THE EUROPEAN COMMUNITY

(Communication from the Commission to the Council)

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CONTENTS

CHAPTER I

Introduction

(1) During the 787th Council meeting (on energy matters) held on 13 July 1982 it was pointed out during the discussion on the part to be played by coal in the Community energy strategy, that the energy-policy debate should also include the other solid fuels, i.e. brown coal and peat. The Commission expressed its readiness on this occasion to provide the Council with a report on brown coal and peat. This communication contains that report.

(2) When compared with coal in the production of indigenous energy, and even more when viewed against the Community's overall energy consumption, brown coal and peat are both disproportionately insignificant. In 1981, these two fuels represented an energy equivalent of 32.2 million toe, of which brown coal accounted for 31.2 million tonnes. Overall brown coal accounted for 6.4% and peat 0.2% of the Community's primary energy production (EUR 10).

The relative percentages of the Community's primary energy consumption accounted for by these fuels were 3.4% and 0.1%. There is no trade in brown coal and peat within the Community. Conversely coal accounted for 20.4% of the EEC's energy consumption and 31.2% of indigenous energy production (1981).

(3) This and the fact that none of the six founder members of the European Coal and Steel Community has economically viable reserves of peat explains why Annex I to the ECSC Treaty has restricted the activities of the High Authority to coal and coal products. Furthermore, brown coal and peat have no technical or economic links with iron and steel production. Therefore, the activities of the High Authority only extend to brown coal briquettes because they compete with coal on the home heating market, whereas raw brown coal for electricity generation only falls within the jurisdication of the ECSC Executive, according to Section 3 in Annex I, where "this is made necessary as a result of tangible disruptions of the fuel market caused by it". Hitherto, this has not been the case. In order to simplify matters, it can thus be stated, that brown coal and peat are covered by the Treaty establishing the European Economic Community and are to be treated on the same footing as all other branches of industry.

(4) The relative importance of brown coal and peat in the Community's energy supplies mentioned above should not however create the false impression that the two industries involved are only "quantités négligeables", or, in other words, insignificant. In some Member States, both fuels are considerably important energy sources. Energy price trends and the growing insecurity of oil supplies now guarantee growing interest in brown coal and peat as energy sources, especially since they are abundant and relatively cheap to extract. Since the relevant countries also count heavily upon both industries for regional development purposes, their importance to the Community as a whole should not be under-estimated.

(5) The rest of this report gives information on the production and use of brown coal (II) and peat (III) in each of the Community's Member States. Chapter IV reports on the extent to which the Community is already involved in the development of both industries. Chapter V contains the conclusions, while Tables 1-7 contain statistical reviews of existing brown coal and peat reserves, plus production and consumption figures. Annexes A and B provide information on the nature of brown coal and peat, and how they are both won and used.

CHAPTER II

Brown Coal in the Community

1. Brown coal deposits

(6) There are brown coal deposits in six Member States of the Community (see Table 1 in the Annex).

No information is given for Denmark and the Netherlands as brown coal production was abandoned there several years ago because the deposits were uneconomical to work.

There are 60 thousand million tonnes of geological brown coal in four other Member States (D, GR, F, I) of which about 40 thousand million tonnes are considered to be economically workable. About 90% of the deposits lie within the Federal Republic of Germany, while the Rhineland field contains the largest continuous brown coal deposit in Europe.

2. Use of the Community's brown coal deposits

(7) In 1981, a total of 163 million tonnes of brown coal were extracted in the Community[1], the breakdown among the individual countries being as follows:

	1980	1981 Mio t (t=t)
Federal Republic of Germany	129.9	130.6
France	2.6	3.0
Greece	23.2	27.1
Italy	1.9	2.0
Total	157.6	162.7

(1) In Europe, there is also a brown coal mining industry in Spain. Spanish brown coal production has increased very rapidly in past years and amounted to 20.8 million tonnes in 1981. 6.1 million tonnes of total production were older brown coal and 14.7 million tonnes younger brown coal. 98% of this brown coal is consumed in power plants and so helps to substitute oil.

In 1981, roughly 31 million toe (= 45 million tce) of brown coal were extracted in the Community, or in other words 6.4% of the Community's overall primary energy production.

In the same year, brown coal accounted for 3.4% of the Community's total energy consumption.

(8) The position and prospects for brown coal mining in the individual countries are as follows:

(a) FEDERAL REPUBLIC OF GERMANY

(9) Brown coal is extracted from four fields in the Federal Republic: (Figures for 1981):

	Production Mt (t=t)	Number of employees (annual average)	Shift output in t (t=t)	O/C ratio [1)]
Rhineland	119.5	16 907	98.6	3.5 : 1
Helmstedt	4.2	2 332	24.2	3.0 : 1
Hessen	2.5	1 298	15.9	2.5 : 1
Bavaria	4.5	843	50.4	0.5 : 1
TOTAL	130.6	21 380	81.5	3.4 : 1

In 1981, total output was equivalent in energy terms to 26.8 million toe and a 21% share in the Federal Republic's total primary energy production (see Table 2 in Annex).

The average output per shift in the Federal Republic of 81.5 t brown coal is equivalent to 23.9 tce and is thus about six times higher than that for German hard coal mining.

(10) The brown coal pits in Germany are operated independently, but are in the main linked with large electricity utilities by means of majority shareholdings or single-entity contracts. The links with their parent companies confer

[1)] The O/C ratio represents the relationship between the amounts of overburden and coal extracted (see Annex A, page 2, Section 5).

economic advantages on the mining companies, e.g. in procuring the necessary investment resources and in tailoring output and consumption to electricity generation requirements, etc.

(11) About 1.1 thousand million DM (438 million ECU) were invested in German brown coal mining in 1981. It is to be expected that the rate of investment will have to be stepped up by 20-30% in real terms if output is to be maintained.

(12) As regards profitability it can be seen from the managing board's reports that the earnings situation is generally good. Indeed, extraction costs per tonne are not published, but it is pointed out in press articles that on some fields they lie well below the comparative prices for oil or imported hard coal.

(13) It can therefore be assumed that the individual fields offer differing prospects as regards the future of German brown coal production.

The reserves on the Bavarian field are depleting. Output will continue to drop and cease completely in 1982. It is to be expected that future output from the Hessen field will not increase, owing to shrinking coal reserves. On the Helmstedt field 850 million DM are being spent on opening up a new deposit of about 40 million tonnes, thereby guaranteeing that output can be maintained.

The production structure of brown coal mining in the Rhineland is about to change so that instead of the five existing open cast workings, there will be only three by 1995.

These measures will ensure that from 1995, production in the Rhineland will be concentrated on the following three open cast pits (millions of tonnes t=t):

Hambach	45 - 55
Garzweiler	45 - 55
Inden	20 - 25
TOTAL	110 - 135

(14) Output in the Rhineland cannot be expanded beyond that mentioned here because of the environmental impact to be expected from new pits and additional power stations.

(15) The figures contained in Table 2 in the annex show that in 1981 almost 11% of all German primary energy consumption derived from German brown coal. Overwhelmingly (86%), brown coal is consumed in the form of feed coal for electricity generation, which could thus provide about 26% of all Germany electricity production (1981).

(16) About 13% of total consumption is in the form of feed coal for conversion into solid fuels. The conversion products: briquettes, coal-dust and dried coal[1]. together with brown coal coke, are used in homes and industry and are also exported (see Table 2 in the Annex).

(17) It should be mentioned here that the Federal German brown coal industry - and in this case solely the Rhineland fields - is practically the only Community producer of brown coal conversion products[2]. The market prospects and research into improving product quality mentioned in the Annex (see pages 6 and 7) only apply to brown coal mined in the Rhineland. The same applies to the research into brown coal gasification and liquefaction.

(18) Overall, the future of brown coal mining in Germany can be considered optimistic since it is profitable to extract and its products and conversion products are versatile. Virtually no market adaptation problems are to be expected since the large parent companies are able constantly to coordinate consumption and production since they themselves are both the consumer and producer.

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[1] Only limited quantities of coal dust and dried coal are available since there is inadequate production capacity

[2] Very small amounts of brown coal are also briquetted in Greece.

(b) FRANCE

(19) As shown by the figures in Table 3 in the Annex, brown coal has virtually no significance as an energy source in France. In 1981, brown coal accounted for 1.7% of total primary energy production, 0.5% of total primary energy consumption and about 1% of total electricity generation.

(20) In France, brown coal is extracted from two fields:

	(1 000 t, t=t)	
	1980	1981
Arjuzanx (Aquitaine)	1 005	1 354
Meyreuil (Provence)	1 580	1 591
TOTAL	2 585	2 945

(21) On the Arjuzanx field younger brown coal is extracted from open cast workings. There are estimated reserves of 40 - 50 million tonnes, the calorific value of the coal is 8 000 kJ/kg and its sulphur content is 0.4%. It emerges from press articles that the mines earnings are good, and that the extraction costs are claimed to be 50% of the equivalent oil price.

(22) Older brown coal is extracted from deep workings on the Meyreuil field. A new 27 million tonne seam has been opened up by sinking two deeper shafts[1], thereby guaranteeing production for the next 15 - 20 years. Up to 1980, the mine was unprofitable and State aid had to be provided to cover operating losses. However, the mine moved back into profitability in 1981.

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[1] One of the shafts will extent to a maximum depth of 1 150 metres and thus be the deepest brown coal mine in the world

(23) It can be seen from the above that coal can continue to be extracted from both French brown coal fields under economically satisfactory conditions, but no increase in brown coal production should be expected.

(c) GREECE

(24) There are three opencast brown coal fields in Greece (1981 figures):

	Output 1000 t (t=t)	Payroll	Shift output in t (t=t)	O/C ratio[1)]
Ptolemais	18 813	4 000	17	5 : 1
Aliveri	690	500	..	..
Megalopolis	7 620	1 000	26	2 : 1
TOTAL	27 123	5 500	-	-

[1)] The O/C ratio represents the relative amounts of over-burden and coal

(25) Total production in 1981 was equivalent to 3.2 million toe (see Table 4 in the Annex). This is relatively low since the calorific value of the brown coal mined at Megalopolis is low.

	Ptolemais	Megalopolis
Calorific value	6 300 - 7 500 kJ/kg	4 200 kJ/kg
Ash	8 - 10%	12 - 15%
Sulphur	0.5 - 0.6%	0.8 - 0.9%

In 1981, brown coal accounted for about 90% of all Greek primary energy production, which means that apart from small amounts of oil and hydropower, it is, in view of its potential, the only primary energy vector that Greece can produce in large quantities.

(26) The mining companies are operated as separate entities, but they are wholly owned by the nationalized Greek electricity utility, the Public Power Corporation (PPC). This guarantees coordination of brown coal production and consumption. At the end of 1981, the PPC employed about 27 000 people, of whom 5 500 in mining. In addition to the PPC, a number of small companies produce a total of roughly 300 000 t of brown coal every year.

(27) The fluctuations in company earnings show that the PPC's electricity pricing policy is subject to Government supervision. Permission to raise electricity prices is only given reluctantly so that earnings do not keep pace with cost increases on a year-by-year basis, but are balanced out in the longer-term average.

It must be stressed that brown coal is a great asset to the Greek economy, since production costs, which are not published, are way below comparative prices for oil or imported hard coal.

(28) The company has received no instructions to reclaim the worked-out opencast pits. Suitable legislation is currently being prepared by the Greek Government.

(29) In view of the economic advantages conferred upon Greece by brown coal, and in view of the considerable reserves, it is planned to boost production and consumption sharply. From 1981 to 1990 output will more than double

Probable developments in Greek brown coal production

(millions of tonnes, t=t)

Coalfield	1981	1985	1990
Ptolemais	18.8	35.5	40.5
Aliveri (Deep-mined)	0.7	0.5[1)]	..
Megalopolis	7.6	7.8	12.5
Amynteo	..	0.6[2)]	8.2
Komnina	..	..	4.3
TOTAL	27.1	44.4	65.5

[1)] Production to stop in 1986

[2)] Full production to begin in 1986.

(30) There are also financial problems affecting not only mining operations but also the company as a whole. Investment for the period 1981/90 (in mining and power utilities) will be 360 000 million drachmas[1] (= 5.8 thousand million ECU). Since this will be 25% self-financed about 75% of the ir investment must be financed via outside capital.

(31) It can be seen from Table 4 in the Annex that in 1981 about 94% of the brown coal mined was converted into electricity, which amounted to around 53% of all electricity generated in the country. 5% of the brown coal produced went to industry and 1% for briquetting.

(32) It can be assumed that in future, the consumption of brown coal in power stations could more than double between 1981 and 1990. It is currently not planned to expand the production of briquettes since there will probably be no market for them. The use of brown coal is likely to change the face of Greek electricity generation since hydro-power will probably remain constant in providing 17-18% of the electricity produced between 1980 and 1990, while the proportion provided by brown coal is likely to increase from 46% to 82% by replacing heating oil, whose share would drop from 37% to 0%[2].

(d) ITALY

(33) In Italy, brown coal is mined on two fields:

	(1 000 t, t=t) 1980	1981
Castelnuovo dei Sabbioni (Arezzo Province)	1 447	1 340
Pietrafitta (Perugia Province)	463	630
TOTAL	1 910	1 970

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1) Calculated according to the prices prevailing

2) No nuclear power plants or new hard coal power stations are planned to enter service before 1990.

The energy equivalent of all of the brown coal produced is 0.3 million toe and therefore 1.7 - 18.% of Italy's total primary energy production (see Table 5 in the Annex). Brown coal only accounts for 0.2% of all primary energy consumption and 1% of electricity production.

The pits are owned by the state-owned Italian electricity company (ENEL) which uses almost 100% of the coal to supply the power stations at Santa Barbara (Arezzo Province) and Pietrafitta (Perugia Province). Italian brown coal can satisfactorily match imported energy prices.

(34) Brown coal is extracted from the open cast pit at Castelnuovo in Arezzo Province (1.2 million t) and from the new Allori field (0.1 million t). The O/C ratio is currently about 7 : 1 and there is a payroll of 600. The calorific value of the coal is 8 000 kJ/kg.

(35) In Perugia Province brown coal is extracted from open cast pits at an O/C ratio of 3 : 1, the payroll being 180. The coal has a relatively low calorific value of 4 000 - 5 000 kJ/kg.

(36) The reserves in both of the pits can support long-term extraction at the present rate. The worked-out opencast pits will be reclaimed for agricultural use.

(37) In addition to the two fields mentioned above, Italy has coal measures in Sulcis (Sardinia). It is intended to resume coal extraction and to gasify the coal[1]. Suitable preliminary work is in progress. Despite its low calorific value, the coal is not brown but a low quality, high sulphur content hard coal (low rank subbituminous coal).

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[1] According to the plans an annual output of 3 million tonnes is considered possible.

CHAPTER III

Peat in the Community

1. Peat deposits in the Community

(38) Apart from Belgium and Luxembourg there are peat deposits in all of the Member States of the Community, but their size and economic significance vary widely. Table 6 in the annex contains overall figures per country, partly broken down according to region, without however going into specific local details. It should be pointed out in comparison with the rest of the world, that the most extensive peat beds are to be found in Canada (170 million hectares), the USSR (150 million hectares) and the USA (40 million hectares).

(39) Generally speaking peat reserves are measured not only by quantity but also by their extent in hectares. This latter figure is sometimes estimated since not all peat deposits have actually been measured. The problems involved in quantifying reserves - which sometimes occur in the literature - must also be made clear. The depth of the peat beds can vary between 3 and 10 metres so that accurate calculations are impossible. In Greece, there are peat beds up to 100 metres and more thick. According to estimates, the United Kingdom's peat deposits (1.6 million hectares) contain an energy equivalent of about 400 million toe while those of Ireland (1.2 million hectares) represent about 300 million toe.

(40) The peat reserves of the Community as a whole represent a less significant energy source than other fossil fuels, but peat's economic importance for individual countries or regions should not be underestimated, as will be shown.

2. Use of the Community's peat deposits

(41) The peat industries in the individual Member States of the Community have developed in different ways.

The relatively small peat reserves in Denmark, France, Italy and the Netherlands are only used for agricultural purposes, where indeed there is any peat production at all[1].

In France, in 1980, only 50 000 tonnes of peat fuel were produced.

The insignificance of the peat industry as a source of energy in the above countries will not change in future.

Despite the relatively large deposits, peat is mainly produced for agricultural purposes in the Federal Republic of Germany[2]. In 1980, 250 000 tonnes of burnable peat were excavated and largely converted into coke and activated carbon. This quantity is of no importance in the energy balance of the Federal Republic and it must be assumed that it will not be possible to step up peat production in future for environmental reasons.

(42) We will therefore discuss below the three Member States of the Community where either a large peat industry exists (Ireland) or where there are major peat reserves and a peat industry relevant to the energy economy could develop in future (the United Kingdom and Greece).

(a) <u>IRELAND</u>

(43) Peat winning in Ireland is mainly in the hands of a large organization: Bórd na Mona (BnM).

BnM was founded as a quasi-governmental body financed by State credits by an act of law in 1946[3]. The Irish government has some influence over the activities of the company, which employs about 6 500 full-time workers and 1 000 seasonal workers. It has had decades of experience in the production and use of peat. This know-how could also be used in developing the peat industries of the other two Community countries.

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1)For production figures see footnote 1 on page 3, Annex B

2)For production figures see footnote 1 on page 3, Annex B

3)Turf Development Act of 1946

(44) As a result of oil price increases, BnM has been able to expand, particularly since 1973/74. In Ireland, the peat excavated is about 50% cheaper than oil, while about 60% of overall production costs are due to labour charges.

(45) In 1981, Ireland produced roughly 4 million tonnes, or about 1 million toe of peat (See Table 7 in the Annex), of which 3 million tonnes were machine cut (with a water content of about 50%) and 0.8 million tonnes were in the form of peat blocks (35% water content). Peat production accounts for more than 40% of total primary energy production and 10% of primary energy consumption in Ireland.

(46) In recent years, the production capacity of the BnM has risen constantly, thereby creating a need for further investment funds. Because of the very high interest rate (21%), financing of the company's investments is causing great difficulties. Financing is predominantly from outside capital since self-financing is restricted by the BnM's modest profits.

The company makes adequate profits, but the Irish government holds down prices for peat and peat products in order to slow general inflation in Ireland as much as possible.

(47) In view of the environmental problems deriving from peat production BnM is required to avoid damage to flora and fauna. The old peat workings are being reafforested and demonstration projects on the production of biomass are in progress.

(48) About 70% of the peat produced by BnM is sold to the Electricity Supply Board (ESB) which uses it to generate electricity (about 2.8 million tonnes). In 1980, the ESB ran 7 peat-fired power stations having an installed output of 430 MW, which thus met 22% of Ireland's total electricity requirements. The individual power station units are relatively small (on average 40-50 MW) since, in order to avoid transport costs, they must be sited as close as possible to the various peat extracting points.

In 1981, about 20% of total peat production was converted into 340 000 tonnes of briquettes almost exclusively for use in households. The calorific value of the briquettes was about 18 000 kJ/kg. The remaining peat was used directly by industry or households.

(49) As far as the future of the Irish peat industry is concerned, there are plans for considerable expansion. The BnM intends to raise peat production from its current level of about 1 million toe to roughly 1.6 million toe by 1985 and 1.7 million toe by 1990. An actual peat tonnage of 6.7 million would be produced by 1990. Consequently the propostion of Ireland's overall primary energy production accounted for by peat would rise from 43% (1981) to about 50% (1990). When expressed in terms of overall primary energy consumption peat would rise from 10% to account for 11-12%.

(50) Most of the extra peat produced will be burned in new power stations. Over a relatively short period, an extra 1 million tonnes or so of peat could be burned both in two 40 MW power units now being built and in existing power stations receiving more peat.

(51) Likewise, by 1990, additional peat briquetting capacity will have been installed. Two new facilities are planned (annual capacities of 130 000 t and 260 000 t respectively), so that total peat briquetting capacity would be about 750 000 tonnes in 1990. These would take account not only of future household and industrial requirements but would also cover the present shortfall in briquetting production which has meant that certain quantities of brown coal briquettes have had to be imported from the Federal Republic of Germany.

There are currently no definite plans to gasify or liquefy peat.

(52) Neither technically nor financially will it be possible to step up peat production and expand the markets for it easily in the ways mentioned above. In several areas, therefore, there must be further research and development and - since the investments needed are high - it must be ensured that the credit requirements of both the BnM and the ESB are met.

b) UNITED KINGDOM

(53) The United Kingdom has relatively extensive peat reserves (about 1.6 million hectares[1], see Table 6 in the Annex), but nevertheless has so far not developed any industry to exploit them. Even in the largest of the four British peat regions - Scotland - there is neither a market nor any industry worth mentioning. The several small private companies making up the British peat industry produce about 0.5 million tonnes of peat per year for agricultural purposes[2]. Only very small quantities are used in whisky distilling.

(54) Extraction of the energy contained in the British peat deposits is a problem for the future which will mainly concentrate on Scotland. This would improve not only energy supplies but also Scotland's regional economic structure. Several local authorities[3] are cooperating on the development work:

- the Highland Regional Council (HRC)
- the Scottish Peat and Land Development Association (SPALDA)
- the Highland and Islands Development Board (HIDB)
- the Macauly Institute for Soil Research.

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[1] The British peat reserves are assessed quantitively at 2 500 million t

[2] See footnote 1, page 3 Annex B

[3] Only the local authorities are dealing with peat problems. Peat plays no part in the British energy programme since the British government is working on the assumption that peat can make no worthwhile contribution towards solving the country's energy problems

It is planned to develop the peat reserves in Caithness and Sutherland. The Macauly Institute estimates that about 100 million tonnes of peat can be recovered from the Caithness deposits.

The HIDB is testing three potential markets for peat:

- households and industry (space heating)
- peat coke for metal processing
- Agricultural peat.

The HRC has decided to convert the heating of Halkirk primary school to peat firing as a demonstration project. If the project is successful it is intended to launch a large scale project and build district heating facilities.

The SPALDA intends to build a peat-fired power station on the Isle of Lewis.

(55) All of these projects point the way to further developments. At the moment, they are in their infancy but they could spawn new industrial structures based on the potential of the peat reserves. It is still unclear whether Scottish peat production could climb to some millions of tonnes annually, because too many problems are still under scrutiny.

c) GREECE

(56) Although Greece has significant peat reserves (see Table 6 in the Annex), no start has been made on extracting their energy content. The PPC would be responsible for winning the peat and using it in peat-fired power stations.

The PPC is currently negotiating with landowners but the outcome is uncertain owing to the high asking prices.

If agreements can be reached it is planned to being expanding peat production by about 1985, so that maximum annual production could be about 6 million tonnes from 1991. Three 200 MW power station units would have to be built in order to burn the peat.

CHAPTER IV

The Community's activities in respect of brown coal and peat

(57) As shown in Chapters II and III both the brown coal and peat industries are faced with specific problems which in the past have led the Commission to take steps to make it both easier and quicker to expand production.

(58) The Commission has concentrated on the following areas in view of the instruments provided under the EEC Treaty and of the problems to be solved in both branches of industry :

Brown coal

- In 1981 an investment loan of 350 million French francs (= 56 million ECU) was granted at the normal rate of interest in order to develop new coal reserves in the Meyreuil field in France and to build a new power station.

- In 1982 a credit of 125 million ECU was granted at the normal rate of interest to finance investments in brown-coal mining in Greece.

- Between 1976 and 1981 the Commission granted assistance amounting to roughly 1 million ECU for research in the Federal Republic of Germany to improve brown coal production processes and raise coke quality.

Peat

The Commission's measures regarding peat have so far related exclusively to Ireland.

- Between 1976 and 1980 credits of 22.2 million ECU were granted to finance investment in peat production, and an interest rebate of 2.9 million ECU was also granted.

- Between 1976 and 1980 11.7 million ECU in credits with an interest rebate of 2.5 million ECU were granted for the building of new peat-fired power stations.

- Between 1975 and 1979 the Commission granted 0.3 million ECU in support of demonstration projects on the production of biomass in Ireland. Support amounting to 0.5 million ECU will probably be granted in 1979/83 to cover further Irish work in this area. The Commission has also earmarked 0.4 million ECU for research into the technical improvement of planting and harvesting equipment.

(59) It can be seen from these measures that the Commission has been involved in every member country where financing and research problems affecting brown coal and peat have had to be solved or simplified. The development trends set out in chapters II and III lead one to expect that the Commission's activities in the brown coal and peat industries will in future concentrate mainly on these two problem areas.

CHAPTER V

Conclusions

(60) The discussions above have shown that brown coal and peat are secure and economically viable energy sources in those countries where they are produced and that above all they are an important primary energy source for power stations. However, these fuels are also sold on the industrial and household heating markets. Their importance will be boosted further in Greece and Ireland, whereas development of the peat reserves in Scotland is still an open question. In general the potential reserves of these energy vectors are considerable and will enable both of them to be extracted for a further long period wherever they occur in the Member States.

(61) The methods of extraction have reached a high performance level and work is continuing on their further development. Productivity is high. Earnings fully cover costs and thus guarantee a return on ivested capital. These solid fuels are encountering no marketing difficulties because their individual forms - crude brown coal, brown coal briquettes - and coke, coal dust and slack, milled and machine cut peat and peat briquettes - are fully competitive on their various markets and in some cases demand is still rising. Furthermore the extraction and consumption of brown coal and peat can be coordinated by the relevant parent companies (electricity utilities). It is therefore a pleasure to be able to note that both branches of industry are economically in good shape.

(62) Since almost all brown coal and peat is extracted by the open cast method involving large surface areas, the impact on their environment is immense. Consequently the lawmakers have given producers comprehensive instructions regarding to land reclamation - sometimes very prematurely. Similar legislation is currently at the draft stage in Greece. The results obtained (Rhineland) have paved the way for several other countries, but in some cases the most promising methods are still being tested (Ireland). It will be possible to assert that in most cases replanting has greatly increased and the utility of the land affected, or indeed has made it usable for the first time. The cost advantage of both fuels is any case so great that the financial burden borne by the companies as a result of reclamation poses no economic problems.

(63) Apart from the indisputable advantage in having an indigenous energy vector for the security of a given country's energy supply, a further economic advantage is the reduced pressure on the balance of payments of the less industrialized Member States whose energy requirements must essentially be met by imports.

(64) Finally, brown coal and peat extraction create a lot of jobs, especially in Greece and Ireland where production is often concentrated in sparsely populated regions. Peat production can correctly be said to be labour intensive. It has been possible to halt population shifts and the arrival of suppliers, services and retailers has created further jobs.

(65) The appeal of brown coal and peat production in the relevant Member States is obvious. It should therefore be assumed that the authorities grant the companies a free hand in their pricing and marketing policies and avoid interference which would disrupt supply and demand relationships.
Prices must constantly keep pace in those countries with a high inflation rate in order to guarantee financing of the necessary investments. As in other energy producing industries investment in brown coal and peat has long lead times and the attendant financing problems (especially when extremely high interest rates apply). In addition the Irish peat industry must maintain extensive stocks for climatic reasons.

(66) In view of the reasons given above the Community desirability of maintaining economically healthy brown coal and peat industries needs no further explanation. [1]

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1) The Commission would like in this connection to call attention to the report by the European Parliament on peat (Rapporteur : Mr Gallagher) of 1 December 1980 (Document No 1-572/80).

The Community should continue to use its financial instruments (EIB loans, NCI - credits) to provide adequate investment funds under the best possible conditions.

The Commission also feels that the draft regulations on demonstration projects in the fields of solid fuel gasification and liquefaction before the Council are likely to speed up the changeover from oil-fired plant, while the R & D programme on new solid-fuel combustion technologies it has announced, could open up additional avenues of brown coal and peat use. The Commission feels that the Community would fulfill hereby a general duty to help the economically less developed members of the Community in their efforts to tap their existing energy resources.

Table 1

Reviews of the Community's brown coal reserves

in million tonnes

		Geological reserves		Reserves which can be mined profitably
1. Federal Republic of Germany				
Rhineland (Cologne and Aachen		55.000		35.000
Hessen (Kassel)		..		100 – 120
Bavaria (Braunschweig)		..		small
Helmstedt (Braunschweig)		..		200 – 250
Total	approx.	55.000	approx.	35.000
2. Greece				
West Macedonia				
Ptolemais		2 080		1 450 1)
Amynteo		483		..
Servia-Kozani		508		280 1)
Komnina		150		.. 1)
Proastio		400		..
Others				
Total	approx.	3 770	approx.	2 000
Peleponnese				
Megalopolis		540		470 1)
Others		30		..
Total	approx.	570	approx.	..
Total for all Greece		5 000		2 700
3. Italy		80		41
4. France	approx.	190	approx.	70 – 80
5. Netherlands		.. 2)		.. 2)
6. Denmark		.. 2)		.. 2)

[1] Not yet assessed

[2] Not available

Table 2

Brown coal : Federal Republic of Germany

(A) Balance sheet

(in 1 0000 toe)

	1980	1981
Home production	26 509	26 825
Imports (i.e. Czechoslovak hard brown coal)	730	891
Variations in stocks	- 1	- 8
Consumption	27 238	27 708
Conversion		
for generating electricity	23 129	23 786
for briquetting	2 443	2 165
for producing coal dust and slack	1 150	1 272
for coke (i.e. low-temperture-coke) production	88	84
Total converted	26 810	27 307
Direct consumption		
Own requirements	32	32
Industry	392	365
Others	5	4
Total direct consumption	429	401

(B) Upgrading

			1980	1981
1.	Briquetting	(1 000 t)	4 446	4 169
	Briquette imports	(1 000 t)	1 061	1 265
	Total briquette supply	(1 000 t)	5 507	5 434
	Briquette sales			
	Households	(1 000 t)	3 658	3 324
	Power stations	"	910	958
	Industry	"	260	422
	Exports	"	582	578
	Others	"	147	142
2.	Coal dust and slack	(1 000 t)	1 934	2 247

(C) Significance of brown coal in relation to total energy supplies

	1980	1981
Share taken by brown coal in total production of primary sources	21.9%	21.1%
Share taken by brown coal in total consumption of primary energy	10.1%	10.7%
Share taken by electricity generated from brown coal in total electricity output	26%	26%

Table 3

Brown coal : France

(A) Balance sheet

(in 1 000 toe)

		1980		1981
Home production		841		906
Stocks, imports and exports	up by	11	down by	107
Consumption		852		799
Burnt to generate electricity		733		700
Direct consumption				
Industry		74		61
Households and others		29		27

(B) Significance of brown coal in relation to total energy supplies

	1980	1981
Share taken by brown coal in total production of primary sources	1.9%	1.7%
Share taken by brown coal in total consumption of primary energy	0.5%	0.5%
Share taken by electricity generated from brown coal in total electricity output	1.%	1%

Table 4

Brown coal : Greece

(A) Balance sheet

(in 1 000 t toe)

	1980	1981
Home production	3 031	3 200
Variations in stocks	- 66	+ 52
Consumption	2 965	3 252
Conversion		
for generating electricity	2 703	3 022
for briquetting	84	51
Total converted	2 787	3 073
Direct consumption by industry	171	179

(B) Upgrading

Briquetting	(1 000 t)	246	205
Briquette sales			
to industry	(1 000 t)	149	125
to households	(1 000 t)	97	80

(C) Significance of brown coal in relation to total energy supplies

Share taken by brown coal in total production of primary sources	91.8%	88.9%
Share taken by brown coal in total consumption of primary energy	19.4%	22.4%
Share taken by electricity generated from brown coal in total electricity output	45%	53%

Table 5

Brown coal : Italy

(A) Balance sheet

(in 1 000 t toe)

	1980	1981
Home production	312	304
Variations in stocks	+ 15	+ 16
Consumption	327	320
Burnt to generate electricity	322	305
Direct consumption by industry	5	15

(B) Significance of brown coal in relation to total energy supplies

Share taken by brown coal in total production of primary sources	1,8%	1.7%
Share taken by brown coal in total consumption of primary energy	0.2%	0.2%
Share taken by electricity generated from brown coal in total electricity output	1%	1%

Table 6

Survey of the Community's geological peat reserves

1. United Kingdom (in hectares)

Scotland	820 000
Northern England	360 000
Northern Ireland	240 000
Wales	160 000
Total	1 580 000

2. Republic of Ireland

Total 1 200 000 hectares

Area which can be harvested profitably : 600 000 hectares

3. Greece (in million cubic metres)

Peloponnese (Koroni)	12 Mio
West Macedonia (Agras)	50 Mio
East Macedonia (Philippi)	4 300 Mio
Total	4 362 Mio

4. Federal Republic of Germany (in hectares)

Northern Germany	550 000
Southern Germany	250 000
Total	800 000

of which upland bogs account for : 350 000 hectares

5. Denmark	120 000
6. Italy	120 000
7. France (Brittany)	100 000
8. Netherlands	50 000

Table 7

Peat : Ireland

(A) Balance sheet

(in 1 000 t toe)

	1980	1981
Home production	888	945
Variations in stocks	+ 70	- 132
Consumption	958	813
Conversion		
for generating electricity	606	585
for briquetting	164	167
Total converted	770	752
Direct consumption		
Industry	1	4
Households	212	88
Total direct consumption	213	92
Statistical error	- 25	- 31

(B) Upgrading

Briquetting	(1 000 t)	338	340
Household sales	(1 000 t)	342	330

(C) Significance of peat in relation to total energy supplies

Share taken by peat in total production of primary sources	45%	43%
Share taken by peat in total consumption of primary energy	11%	10%
Share taken by peat in total consumption of primary energy	22%	22%

ANNEX A

I GENERAL INFORMATION ON THE PRODUCTION AND USE OF BROWN COAL

1. Definition of brown coal

1. Brown coal is a fossil solid energy vector which in geological terms comes between peat and hard coal. Coalification has gone on longer than with peat (whose geological age is 10 000 to 12 000 years), but not as long as with hard coal (whose geological age is some 300 million years).

   The world's known reserves of brown coal have a geological age of 30-70 million years and are found in zones where climate and topography have formed bogs and marshy forests.

   The coalification of bogs and forests caused a reduction of the water content and the hardening and carbon-enrichment of the residue, which is usually designated brown coal or lignite. The name "brown coal" derives from the colour (light to dark brown), while the term "lignite" arises from the lignin content of the coalified wood.

2. Different biochemical and thermal processes have resulted in different types of coalification and have accordingly produced various forms of brown coal, namely :
   - older brown coal,
   - hard brown coal,
   - immature brown coal.

3. It is difficult to distinguish brown coal from hard coal, because different degrees of coalification have given rise in part to substances which cannot be classified accurately. The classification that was nevertheless necessary for numerous practical reasons was thus established in the normal way on the basis of carbon content and calorific value. Accordingly, the upper limits for brown coal are a carbon content of 75 % by weight and a calorific value of 23 860 Kj/Kg[1] (water and ash free). Coals which have a higher carbon content or calorific value are regarded as hard coals.

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(1) Equivalent to 5 700 Kcal/kg.

2. Brown coal winning methods

4. In the Community, brown coal is predominantly produced by opencast mining (99%). Only in France (Provence) and the Federal Republic of Germany (Hessen) is brown coal mined underground - an operation similar to the underground mining of hard coal. Underground production methods are not discussed further in this paper.

In opencast operations, the type of cutting method generally depends on the depth and condition of the overburden, the thickness of the coal seam, the condition of the coal and the water-retention problems that have to be solved. Once the coal has been extracted the resultant voids are generally filled in with rubble and the ground relandscaped.

5. The most important problem technically and economically which has to be solved when the overburden is removed and the coal extracted, is the movement of the large masses involved[1]. Operating units, which are as large as possible and cover a correspondingly large area are selected for this purpose, and high-performance excavators with a large depth of cut are used to hold down costs. The German brown coal industry uses bucket-wheel excavators with a daily output of 240 000 m^3. Large machines of this type have been developed from experience stretching back over decades and have reached a level of performance which from the technical and economic view-point leaves little room for improvement.

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[1] Brown coal mining is probably the industry in the Federal Republic with the largest bulk turn-over. In 1980, the extraction of some 930 million tonnes involved the shifting of 444 million m^3 of bulk.

The efficiency of large machines makes it possible today to strip overburden which is 350 to 400 m thick, provided of course that the ground can be excavated (gravel, sand, clay). Surface stripping is expensive and ought to be seen as a preliminary investment before brown coal production can actually start. The cost breakdown and profitability of brown coal production depend essentially on the overburden/coal ratio[1] since the coal seam may be 10-20 m or as much as 150-200 m deep. In many opencast operations in the Community this ratio is about 3:1, but it is tending to increase. On the Hambach coalfield in the Federal Republic of Germany (which is about to be developed) the O/C ratio is about 6.9:1.

6. The presence of ground water in the overburden is a problem, especially when seams lie deep. The water-level must be lowered throughout the opencast pit so that even the lowest layers in the seam can be cut without hindrance, and the pit must be rendered impervious to lateral ground water ingress for operating periods which may last decades. The requisite measures differ from one place to another, since they are adapted to local conditions, and can represent a considerable burden in a company's cost and revenue account.

7. Regulations on the conservation of the environment, which are not uniform in all the Member States, provide that land must be reclaimed after the pit has been worked out[2]. Once a layer of top soil has been applied, the land is generally afforested or made suitable for agricultural purposes. Any hollows remaining as a result of coal extraction fill up with ground water so that, as for instance in the Rhineland, an area of wooded lakes is formed which is appreciated by the population at large.

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[1] Generally designated the O/C ratio (overburden:coal).

[2] This type of regulation does not exist in Greece, although the Greek Government is busy preparing legislation.

3. The product and its uses

8. As already mentioned, the varying degree of coalification has resulted in different types of brown coal.

- Older brown coals. In the Community these are produced only in France (Provence) and in the Federal Republic (Hessen), specifically in underground mines. The calorific value is about 19 000 KJ/kg for a water content of 20-25% and an ash content of 9-13%. In 1981, production in France amounted to 1.6 million tonnes and in the Federal Republic to 0.5 million tonnes, together making up about 1% of total brown coal production in the Community. Older brown coal is only of local significance in the Community.

- Hard brown coals. These are not produced in the Community, but imported into Southern Germany from Czechoslovakia (2.4 million tonnes in 1981) to fuel power stations. The energy characteristics are:

water content	25-40%
ash content	8-14%
calorific value	13 400-16 700 KJ/kg

In the Community, hard brown coals are of local significance only.

- Immature brown coals. These provide about 99% of total brown coal production in the Community and are the principal subject of the discussion in Chapter II of this report.

9. Depending on their condition, immature brown coals are used for the following purposes:

- as boiler coal for steam/electricity generation;
- as briquetting coal for the manufacture of briquettes;
- for the manufacture of coke;
- to produce coal dust and slack.

For use as boiler coal, immature brown coal must have the following energy characteristics:

water content	40-70%
ash content	2-8%
sulphur	0.3-0.6%
calorific value	6 600-8 500 KJ/kg

The figures relate to average values and the reality may be different in individual cases. Two features have a decisive effect as regards the marketing of immature brown coal: its low calorific value and high moisture content[1].

10. Although brown coal represents for the Community a significant source of energy, which is relatively cheap to extract and whose supply is secure, these two features mean that the geographical area in which it can be used is limited. For economic reasons[2] brown coal cannot be transported very far. Of total Community production in 1981, 87% was fired in power stations close by the coalfield and brown coal production and electricity generation were mostly performed by the same company. Narrow transport constraints and integrated production and consumption by a single company mean that there is practically no market price for brown coal, but only an intercompany price which is established between parent company and subsidiary in each case.
A good 10% of brown coal production (in 1981) was upgraded into briquettes, coke etc., and only 1-2% was sold to industry and the household sector.

11. The upgrading of brown coal[3] provides the only possibility of expanding its market. Upgrading consists in reducing the water content and raising the calorific value. The most important upgraded products are:

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[1] By contrast, hard coal has a calorific value of 25 000-35 000 KJ/kg and a moisture content of 6-8%.
[2] In terms of energy content, 1 t crude oil = about 5 t brown coal (volume to be transported = 7 m^3).
[3] Assuming that the upgraded product takes the form of a solid fuel. The firing of brown coal for electricity generation is an alternative form of upgrading and indirectly - by transmission of the electricity - opens up an extensive market for brown coal.

	approx. calorific value (KJ/kg)
- brown coal briquettes	20 000
- brown coal coke	30 000
- coal dust and slack	21 000

Markets exist for these upgraded products both at home and abroad. Briquettes are supplied predominantly to industry and the household sector; coke has many uses in the metal industries and as a filter in water treatment; coal dust and slack are being used increasingly in the lime and cement industry, as a substitute for oil.

12. With regard to future uses in the Community, the following general points can be made:

- Depending on availability, brown coal will continue to be used, and in increasing measure, to generate electricity (especially in Greece).

- The production of brown coal briquettes will depend on the development of the market, i.e. on household demand, which although generally regarded as static may vary from country to country. Certain scope for expansion exists for briquettes in the steel industry, in the production of sponge iron.

- It will presumably be possible to make increasing use of browncoal coke in industry as a result of further research. This is concentrating on the development of by-products, the manufacture of fine coke, qualitative improvements and the use of brown coal as an adsorption medium.

- There are further potential uses for pulverized coal and slack in industry.

- Mention should also be made of brown coal's gasification and liquefaction potential, areas where intensive research is being carried out. The main topics being investigated are:

  - the production of methanol-synthesis gas using the high-temperature Winkler process;

  - the manufacture of synthetic natural gas using fludized-bed gasification with hydrogen as the medium;

  - the development of liquefaction via the use of hydrogen.

  The point of all these measures is to provide a starting point from which it will be possible to decide on how brown coal can best be used, depending on the energy-policy situation and economic considerations. The conversion processes are about 50-60% efficient. Profitability has not yet been achieved, except as regards the production of hydrogenous synthetic gas.

- Finally, a large-scale experimental plant has been brought into operation at Jülich in the Federal Republic of Germany to produce methane from brown coal, using process heat from a nuclear-power plant.

ANNEX B

I GENERAL INFORMATION ON THE PRODUCTION AND USE OF PEAT

1. Definition of peat

1. Peat is a substance of varying organic composition formed from plant remains. It is the product of the first stage of coalification and forms in zones of saturation which are cut off from aeration. The resultant loose fibrous substance can be regarded as a half-way stage between natural vegetable matter and brown coal. Depending on the coalification and nature of the plant fibres which it contains, peat varies in colour from off-yellow to dark brown.

Temperate regions at between 35° and 70° latitude in both the Northern and Southern hemispheres offer the most propitious climatic and topographical conditions for peat-bog formation. However, coalification proceeds relatively slowly in such regions: it can take between 10 000 and 12 000 years for upland bogs between 5 metres and 8 metres thick to form.

2. Peat-winning methods

2. Peat bogs contain as much as 95% water. Needless to say, peat with such a high water content is useless. Consequently, before the peat-winning operations proper can start the bogs must be drained and access provided. First, the bogs are drained by digging drainage ditches; this reduces the water content of the peat from 95% to between 85% and 88%. While the drainage work is in progress - or immediately thereafter - a road or rail link to the bogs must be laid to solve the problem of transporting the peat. This drainage and other preparatory work takes a relatively long time (between five and six years) and requires a heavy financial outlay - in the nature of a priming investment before peat production as such can start. Prefinancing that investment is one of the major financial problems facing the peat industry.

3. Once the preparatory work has been completed, peat-winning can start - either by hand[1] or by machine.

There are two mechanical methods of winning peat:

(i) the peat is cut out in the form of blocks ("turves"), which are then spread out to dry on the surface or on the overburden which has been stripped away. Air-drying reduces the water content of the blocks to around 35%;

(ii) the upper layers of the peat (i.e. the top 5 cm or so) are milled off to produce "milled peat", which is then macerated so that it will dry out faster. Once the moisture content of the peat has fallen to between 45% and 55%, the peat is harvested and stored for future use. In fine summer weather, this procedure can be repeated several times over[2]. Relatively thick seams can be worked like this for decades, until all but the last 0.5 m of the seam has been extracted.

4. The machines employed for peat-winning are purpose-built machines, often developed by the peat companies themselves. In Finland, the Soviet Union and Ireland, the industry has done extensive development work on them. Major improvements have been made to the technical design of the peat-winning machines, but problems still remain when it comes to matching them to the prevalent peat-winning conditions, particularly in hilly terrain.

5. Once the peat has been extracted, the land can be reclaimed for agricultural or forestry use. Firstly, the land is deep-ploughed to mix the subsoil and any remaining peat. Then, lime and mineral fertilizers are added to produce a richer soil. Land recultivated in this way is suitable as pastureland, for crop cultivation or for forestry.

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1) Hand-cutting plays such a marginal rôle that it will not be dealt with in the rest of this Annex.

2) The fact that peat production depends so heavily on the climate creates major problems with regard to storage facilities and the provision of a steady supply for peat-fired power stations.

If the land is reafforested afterwards, alternative fuels could be grown. For instance, large-scale planting of quick-growing trees could be the start of large-scale biomass production. Preliminary research work is to be continued with a view to running a project along these lines in Ireland.

6. However, recultivation of exhausted peat bogs is not the answer to all the environmental problems caused by peat harvesting. Conversion of the peat bogs into agricultural land and forests nevertheless causes the disappearance of wetlands and thereby destroys the basis for the existence of rare species of flora as well as decisively affecting the chances of survival of wetland fauna. Peat-winning is even banned outright from some of the bogs in the Community, whilst elsewhere experiments are being conducted to resaturate exhausted peat bogs in the hope of restoring their typical upland bog flora.

3. The product and its uses

7. There are many possible applications for industrial-scale peat harvests, the two most important being:

(i) non-energy uses for agricultural or horticultural purposes. Many small and medium-sized peat producers base their businesses on the production of peat manure, which is even traded on international markets[1];

[1] This Annex does not go into this branch of the peat industry. For information the 1980 production figures for peat for agricultural purposes are set out below (within the limits of the available statistics).

	(in 1 000 t)
United Kingdom	500
Ireland	380
Federal Republic of Germany	2 000
Denmark	110
France	100

(ii) energy applications, i.e. either for direct combustion or for upgrading, e.g. for briquetting or coke production.

8. The following data are of particular interest in connection with the combustion of peat as a fuel:

	"Turves"	Milled peat
Calorific value	14 000 kJ/kg	8 000 kJ/kg
Ash content	2 - 4%	2 - 4%
Sulphur content	0.5%	0.4%
Water content	30 - 35%	45 - 55%

of course, these are only average values and the actual figure is sometimes different in practice. Nevertheless, the main environmental agrument in favour of burning peat centres on its low sulphur content.

9. Upgrading the coal to briquettes or coke substantially reduces its water content while considerably increasing its calorific value.

	Calorific value	Water content
Briquettes	approx. 16 000-18 000 kJ/kg	Between 10 and 11%
Coke	approx. 31 000 kJ/kg	between 6 and 7%

Peat briquettes are burnt for space heating, whilst peat coke is a valuable fuel for the metal industries, since it produces far faster chemical reactions than coke produced from hard coal.

Both these upgraded products are produced to be sold, i.e. with specific - albeit often purely local - markets in mind.

Recently, a series of trials were started in Ireland with a view to upgrading peat to produce pellets, which display similar properties to briquettes and are well-suited to industrial furnaces and large heating plants. This could open up promising new markets for peat.

10. Peat-burning power stations are the leading customers for direct-combustion fuel peat. It is not profitable to transport peat over more than very short distances. Consequently, it must be burnt in relatively small power plants close to the peatlands, with the peat producers and the power plant operators coordinating their activities in order to balance supply and consumption.

11. Although purpose-built peat furnaces for power plants are already available, there is still room for further technical development. For instance, improvements could be made by:

- specially pre-drying the peat to reduce its water content from around 50% to 20%;
- introducing cyclone boilers;
- fluidized-bed combustion.

Promising results have already been achieved at the various experimental plants set up to test these types of furnace.

12. In addition to increasing peat burn in power stations, thought is also being given to possible applications for fuel peat in industry or in large heating plants. However, this raises more than just technical problems - there is also the difficulty of transporting the peat and of providing the requisite infrastructure. It is still too early to predict the economic results.

13. Leaving aside the prospects for increases in thermal applications of peat or for more widespread upgrading, gasification or liquefaction are also distinct possibilities. Considerable importance is being attached to these possible uses, particularly in Finland, Sweden and in the USA and Canada. However, the research has yet to proceed beyond the laboratory stage. In all probability, not until the distant future will commercial-scale plants of this type provide an economic alternative to crude-oil derivatives.