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REPORT

drawn up on behalf of the Committee on Energy and Research

on the use of biomass as a source of energy

Rapporteur: Mr. M. SELIGMAN

PE 77.281/fin.

English Edition

On 16 January 1981 the President of the European Parliament referred the motion for a resolution by Mr d'Ormesson and others on the use of biomass as a source of energy (Doc. 1-818/80) to the Committee on Energy and Research as the committee responsible and to the Committee on Agriculture for its opinion.

On 19 March 1981 the Committee on Energy and Research appointed Mr SELIGMAN rapporteur.

It considered the report at its meetings of 28 October 1981, 29 April 1982 and 25 June 1982. At this last meeting the committee unanimously adopted the motion for a resolution and the explanatory statement.

The following took part in the vote: Mrs Walz, chairman; Mr Seligman, rapporteur; Mr Beazley, Mr Calvez (deputizing for Mr Pintat), Mr K. Fuchs, Mr Herman (deputizing for Mr Müller-Hermann), Mr Markopoulos,Mr Moreland, Mr Nielsen (deputizing for Mr Galland), Mr Percheron, Mr Peters (deputizing for Mr Schmid), Mr Rogalla and Mr Veronesi.

The opinion of the Committee on Agriculture is attached.

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The Committee on Energy and Research hereby submits to the European Parliament the following motion for a resolution together with explanatory statement:

MOTION FOR A RESOLUTION

on the use of biomass as a source of energy

The European Parliament,

A. having regard to the motion for a resolution tabled by Mr d'Ormesson and others on the use of biomass as a source of energy (Doc. 1-818/80),

B. having regard to its earlier resolutions in the energy sector and particularly those concerning the promotion of renewable energy and its possible role in the pattern of energy supplies,

C. having regard to the report of the Committee on Energy and Research and the opinion of the Committee on Agriculture (Doc. 1-460/82),

D. whereas the Community continues to be dependent on imported fossil fuels and non-renewable energy sources, and whereas the effect that this has had and will continue to have on the reliability of energy supplies and in particular on the economies of the individual Member States is well-known and calls for appropriate counter-measures,

E. whereas any economically viable contribution which can be made by indigenous energy sources, and in particular renewable energy sources, must be developed and exploited for political, strategic and economic reasons,

F. whereas the use of biomass as a source of energy in this respect can make a positive contribution and could in the medium term meet 5% of the Community's energy requirements,

G. whereas biomass materials which can be converted into energy are already available in the form of farm and forestry waste and further biomass resources can be produced in the form of energy crops,

H. aware, however, that conversion of millions of hectares of land from, for example, milk production to energy crops would have enormous structural implications in the agricultural sector and could only be carried out in small steps as part of a long-term plan, unless there was a major emergency,

I. whereas, although the economic viability of energy from biomass is obviously subject to the fluctuations in the price of other fuels, such as oil, this should not be allowed to interrupt long-term research and development,

J. whereas the increased exploitation of biomass will have a positive effect on, inter alia, employment, the pursuit of regional policy measures, the environment and the balance of payments,

K. whereas a new pattern of land use, i.e. the growing of energy crops instead of unwanted farm surpluses, could alleviate many of the problems connected with the common agricultural policy, and help to achieve its main objectives,

L. whereas, although national and international bodies have been carrying out a number of research projects on the exploitation of biomass for energy which have produced promising results, the number of practical pilot and demonstration projects launched by the Commission is regrettably small and is not comprehensive,

1. Emphasizes the need to move forward from the research to the practical implementation phase and recommends that any future biomass programmes should be directed principally toward setting up experimental and pilot studies on the one hand and demonstration projects on the other, aimed at assessing the technical, economic and social viability of using biomass for energy in a wide variety of territories, climates and soils in the EEC and, even more importantly, in the ACP and associated developing nations;

2. Asks the Commission, therefore, to formulate and launch as soon as possible a new biomass programme to provide a realistic assessment of the contribution biomass can make as a source of energy and an indication of the economic and financial effects of an increased use of biomass;

3. Recommends that since it is impossible to generalize on the suitability of biomass in all circumstances, RD & D projects dealing with such biomass sources as sugar, artichokes, maize, vegetable oils, coppice trees, reeds and agricultural wastes etc. should be designed to provide a detailed and reliable indication of the following factors:

(i) which biomass products are most promising for EEC and ACP nations, and which regions, climates and soil types would be most suitable for the cultivation of these products,

(ii) how much suitable land is available in each region,

(iii) what yield can be achieved per hectare per annum in m toe and calorific value, and at what cost, compared with conventional energy sources,

(iv) how much imported oil, coal or gas could be replaced by biomass energy in EEC and ACP nations,

(v) whether, and to what extent, increased biomass production will affect land use, taking into account the probable keen competition between these main sectors: agriculture, energy and other raw materials (e.g. timber),

(vi) the optimal use of end products and by-products from conversion of biomass materials into energy,

(vii) what market control instruments it would be necessary to develop and introduce,

(viii) what distribution systems would have to be set up,

(ix) what would be the expected employment, social and environmental effects,

(x) to what extent national tax incentives, subsidies and/or intervention systems for growers and processors would be necessary,

(xi) whether the energy balance is favourable, i.e. whether the energy consumed in producing biomass is less than the energy available from it;

4. Calls on the Commission to assess the cost to the Community budget of this programme;

5. Calls on the Commission to produce proposals for the development of biomass, with estimates of the probable cost, as part of the Community's forthcoming research programmes on renewable energy;

6. Notes that the Community's budget for the period 1979-1983 allows 68.5 m ECU for solar energy research and demonstration projects of which about one-third is allocated to biomass;

7. Considers this sum to be quite inadequate and recommends that the 1983 budget should include increased appropriations for the following suggested five-year programme:

(a) Biomass research and pilot experiments:	50 m ECU
(b) Demonstration projects:	40 m ECU
(c) Agricultural grants for biomass:	20 m ECU
(d) Assistance to ACP nations to introduce biomass energy:	20 m ECU
	130 m ECU

8. Notes that a programme of assistance in technological innovation in biomass could play an important part in fulfilling the energy commitments of the Community vis-à-vis developing countries, many of whom are finding it difficult to pay for their oil imports;

9. Considers that the transfer of biomass technology to Community and ACP farmers must be carried out through appropriate training courses and temporary attachment of technical experts;

10. Considers that conversion at source of cheap cereal crops such as manioc into gasohol would both assist the economies of many developing nations and also reduce the competitive pressure on Community-produced cereals;

11. Does not consider that a sufficient quantity of biomass fuel will be available in the developing world to enable exports to industrialized nations to take place, since it will be needed mainly to reduce their dependence on imported oil;

12. Notes that while there is a growing shortage of food in many parts of the developing world, this shortage is caused more by cyclical climatic factors, organizational problems of finance and distribution and shortage of energy and fertilizers than by shortage of suitable land; the world food shortage is not in itself a reason for preventing the use of certain surplus land for energy crops;

13. Draws attention to the fact that a change of fuel on the farm from imported, taxable diesel and petrol to untaxable, self-grown gas or gasohol would benefit farmers, but cause problems for revenue authorities;

14. Emphasizes the growing importance of research in biomolecular engineering in the development of new, energy-rich plant species and improved enzymes and yeasts, and stresses the role of the Community in indicating political and economic requirements to guide research in this field;

15. Stresses the seriousness of the deforestation crisis which is destroying this basic energy source in Africa and elsewhere, and calls for an immediate five-fold increase in tree planting in the developing world;

16. Instructs its President to forward this resolution and the report of its committee to the Commission and Council, and to the appropriate bodies in the United Nations Organization.

B

EXPLANATORY STATEMENT

I. INTRODUCTION

1. The main concern of the motion for a resolution tabled by Mr d'ORMESSON and others is the proposal that agricultural land at present used for the production of expensive surpluses which are a burden on the common agricultural organisation could better be used for the production of energy crops which would make farmers self-sufficient in energy and also contribute to meeting national energy requirements.

2. During its initial discussion of this motion for a resolution, the committee decided to discuss not only those aspects of the use of biomass as a source of energy mentioned in it, but also the exploitation of biomass as a whole. The European Parliament has not done so in the past; it has simply given its views on the use of biomass in its opinions on proposals for demonstration projects in the field of energy saving and solar energy[1].

3. If the Communities are to promote the use of biomass as a source of energy, this must at least comply with the established energy policy objectives on which there is general agreement.

These may be summed up as:

- a reduction in energy imports, especially oil,
- the promotion of internal sources of energy;
- greater security of energy supplies, and their diversification;
- coordination with other Community policies.

4. The increased use of biomass would clearly meet these objectives and would produce the following additional effects:

- more jobs;
- better balances of payments;
- in some cases, better or alternative use of land, and the use of various kinds of waste, which would otherwise have to be regarded as pure waste (unused);
- development of research potential in the form of saleable technology on the one hand, and on the other hand the opportunity of technology transfers, especially to developing countries;
- some scope for regional improvements (social, economic, employment);
- great opportunities to solve environmental problems at the same time;
- reduced pressure on the EAGGF in connection with export refunds;

[1] The Commission's decisions of 6.3.1980, 5.6.and 5.10.1981 on the granting of financial support for demonstration projects in the field of energy saving and solar energy, all based on Council Regulation 1303/78 of 12.6.78 on the same subject, granted nearly 5.8m EUA for demonstration projects involving biomass (up to 40% of total cost)

- reduced costs for storing agricultural surpluses

The aim of this report is to identify what measures should be taken to maximize the potential contribution of biomass energy to achieving these objectives.

5. For the most part these consequences of the increased use of biomass can be regarded as benefits, regardless of whether the production of energy from biomass offers economic advantages over other energy sources or reduces the cost of imported energy.

6. It is also clear that:

- biomass for energy purposes already exists to a certain extent, in the form of waste for example, and is immediately available, its economic viability depending primarily on the technology to hand;

- certain forms of biomass are already being used, and therefore must be regarded as assets in the national energy balance sheets, albeit marginal ones.

7. Various techniques for using different forms of biomass are already known. Much research and even more development work is necessary if biomass is to be used more extensively and more efficiently. If the contribution from this renewable source of energy is to be raised more than marginally, decisions on changed land use and substantial conversion or innovation of production processes, involving sizeable investment, will also be required. Increased commercial use of known or further developed technology will call for more reliable information on:

- the cost of using the technology (development and marketing);
- better possible alternative uses for biomass raw materials;
- alternative land use.

II. BIOMASS AS A SOURCE OF ENERGY

A. Definition

8. The main sources of biomass[1], which may be used direct for the production of energy or processed into other forms of fuel, are:

(a) waste and surplus production from agriculture and forestry
(b) animal and household waste

[1] Much of this report is based on individual papers submitted to the Commission's 1st Conference on the Biomass (November 1980, Brighton) printed in 'Energy from Biomass', edited by Palz, Cartier and Hall. This Conference, attended by biomass experts from throughout the world, was intended to provide an up-to-the-minute conspectus of research and development in this field. 'Energy from Biomass in Europe' edited by Palz and Cartier and published by the Commission, and many other individual articles and papers too numerous to mention, were also used.

It therefore has its origin in every case in solar energy, fixed in vegetation by photosynthesis. This also means that the quantity and quality of biomass depend to a certain extent on the quality of the land and the climate, which vary widely from one part of the Community to the other.

While the production of energy from waste has already been proved economically viable, further research and development work is needed before it can be shown, that energy crops can provide a basis for the production of more energy than that required to grow and process the crops.

It is important to draw a distinction between the biomass energy which is well-suited to local utilization (by farmers and others) and the biomass energy which could be exploited nationally, i.e. on an industrial scale. The basic question is to what extent European agriculture can be adjusted to:

- meet its own energy requirements
- reduce the Community's dependence on imported energy.

B. Conversion of agricultural land and its use for the production of biomass energy.

9. The Community as a whole is marked by a shortage of land (1.5 million sq. km, i.e. 150 million ha, of which 57% is tillable farmland, 21% wooded and 22% urban areas, roads and uncultivable land), a high population density and high energy consumption.

C. Assessment of various biomass crops and energy crops

10. In assessing the relative value and suitability of various alternative biomass materials for energy production, the following factors are important in the assessment given in the following chapters:

a. whether the biomass resources are suitable for exploitation in the Community or in developing countries
b. the energy yield per hectare per annum in mtoe and calorific value which can reasonably be expected under normal conditions,
c. whether it would be better to allocate the area at present used for growing food crops, animal feedstuffs and industrial crops to the production of energy crops,
d. the net income per hectare which the farmer, the processing industries and the tax authorities could expect in comparison with other possible crops,
e. how much imported oil or other energy source could be replaced by biomass energy,
f. how much suitable or good arable land is available in each region for the various energy crops,

g. what are the most suitable distribution and marketing methods,
h. what effect would a switch from conventional agriculture to suitable energy crops have on the environment, social policy and employment,
i. would biomass crops require temporary or permanent subsidies,
j. could crops be improved by genetic engineering to produce the kind of plant best suited to various types of region and climate,
k. whether energy crops could have a dual purpose, i.e. as fuel and as proteins (e.g. colza or sunflower seed).

11. The farmer must see an economic benefit if he is to be persuaded to switch part or all of his available arable land to the cultivation of energy crops. So far this has not been the case. This report proposes certain measures which it is hoped that the Commission will be in a position to take in this regard.

D. Energy crops

12. Since there is a limit in practice to energy production based on waste and by-products from agriculture and forestry, it is therefore natural to turn our attention to crops cultivated specifically with a view to energy production. These crops, in contrast with the biomass resources mentioned earlier, will affect the current structures of production and land use.

1. Field crops as raw material for energy production

13. These biomass crops must either:

(i) be cultivated within the existing area used with few or minor changes; that is to say the yield from certain existing crops must be increased so that space can be released,

or

(ii) involve an alternative use of space with the following consequences: reduction of production within

- the grain sector
- the meat sector
- the dairy sector
- the wine sector
- the olive oil sector

It is clear that the second possibility would require either a political decision, for example through reductions in production and directions regarding other utilization or, more realistically, financial incentives in the form of investment facilities, premium schemes and such like for growing energy crops.

(a) Ethanol/methanol

14. These alcohol products are particularly important as they represent the best alternatives to mineral oil fuel for transport. As ethanol is a type of fuel which is primarily produced on the basis of tropical plants, it is unlikely that it would be as good a source of energy for the EEC as methanol which can be produced from wood or straw, or from coal, oil or natural gas.

Ethanol shows more promise as a transport fuel for tropical developing countries. Public interest in ethanol, which is also known as gasohol, stems partly from the Brazilian PRO·ALCOHOL programme and partly from the world's recurrent production surplus of sugar beet and cane and certain types of grain. Alcohol, or gasohol, can be used pure or blended (10-20%) with petrol.

Ethanol (Ethyl alcohol)

15. Suitable feedstocks for ethanol production are sugar cane and beet, particularly attractive with regard to warmer climates and the tropics because of the possibility of a continuous growing season. These plants can be fermented directly, which means that they require a simpler and consequently cheaper conversion process than other starchy plants such as maize, cassava (tapioca), potatoes and ligneous plants (all of which have a higher cellulose content), to produce fermentable sugar.

- sugar cane: after the juice has been extracted for further treatment, the residual fibre can be used to make building board or as a fuel for the distillation of alcohol. A by product of fermentation is carbon dioxide gas which can be compressed for sale as a refrigerant.
- sugar beet : the alcohol production process is much the same as for sugar cane. By-products can be used as feed for animals or the production of biogas (which can be used as fuel in the alcohol distillation process).
- grain: after milling and washing with water at a series of controlled temperatures, the starch is liquefied (by enzymes) and converted into fermentable sugar. The residue can be used as cattle feed. Straw is another useful by-product.
- cassava (manioc or tapioca): is a starchy plant which can be hydrolyzed to produce fermentable sugar. This is a relatively expensive process. The advantage is that it can be grown throughout the year in warm climates.
- Jerusalem artichokes: a catch crop which can be grown in winter. It contains inulin or fructose ($C_6H_{12}O_2$) in solid form which can be fermented and distilled in the usual way into ethyl-alochol.
- cellulose-rich trees and plants: much research has been carried out into the use of enzymes to convert ligneous plants into fermentable sugar, which can then be used as a raw material for ethyl-alcohol. Although the potential of this liquid fuel is enormous it is not yet known whether it is an economical proposition.
- cheesewhey: whey is a serious source of pollution. The fermentation of thelactose in the whey seems to be a promising basis for the production of competitively-priced ethanol.
- potatoes and yams: give a high alcohol yield and can be stored, but conversion costs are high (more expensive than for grain and sugar beet).

Energy required for processing in relation to the energy content of the alcohol produced.

16. It is often said that the production of gasohol consumes more energy than the amount produced. However, this is not so if the residue from suqar cane known as bagasse is used as fuel in the alcohol distillation process.

It is also possible that genetic engineering may produce a yeast which will give more concentrated alcohol and thus reduce the quantity of water which has to be distilled out.

b. Methanol

17. Methanol is normally produced from coal or other hydrocarbons, but it can also be extracted from ligneous material by pyrolysis (heating without fire) or by steam gasification. Costs are around $280 per tonne as compared with about $240 per tonne for methanol extracted from coal and $210 per tonne for petrol. It is a more promising motor fuel substitute than ethanol despite a number of drawbacks (it is toxic, extremely corrosive in untreated engines and does not yield the same amount of energy as petrol).

There is a need for further research into these problems, perhaps taking ACETO-BUTANOL or MTBE (METHYL TERTIARY BUTYL ETHER) as an emulsion when methanol is used as a petrol additive.

c. The use of alcohol as a motor vehicle fuel

18. The needs are known to everybody. Alcohol derived from biomass would have a number of advantages, including the following (when used in motor vehicles):

- alcohol is one of the few indigenous fuels which could replace imported oil in cars and aircraft
- an alcohol fire can be extinguished with water
- it would create a market for agricultural products and waste
- it is indefinitely renewable
- it has high-octane rating for high-compression engines
- it could improve certain engine operations (anti-knock, reduction of lead content)
- no toxic emissions such as sulphurous carbon dioxide and lead.

If it is not to be used as a pure fuel, it is possible to blend it with petrol (up to 20% ethanol or 15% methanol) without major modifications to the engine. It must be admitted that there is a need for further research into the effects of ethanol and methanol on engine efficiency, increased or reduced mileage, damage to metallic parts and corrosion,etc. One purely social problem is the fact that ethyl and methyl alcohol are toxic.
The following disadvantages can be listed:

- ethanol costs three times as much to produce as methanol, which is no dearer than petrol.
- the high boiling points of ethanol and methanol cause starting problems at low temperatures.

d. Brazil's PRO-ALCOHOL programme

19. Brazil introduced its ambitious programme in 1975. It is difficult to say whether it is a success or a fiasco. It was launched to cope with the cane sugar surplus and high fuel imports. The increased production of sugar cane was favoured by an ideal climate and, it seemed, unlimited ailability of land. Brazil produces about 120m tonnes of sugar cane ear. This allows production of 4,300m litres of alcohol and 2.5m s of sugar. The target is 10,700m litres of alcohol per year, for 4.6m hectares will have to be planted with sugar cane (2.7m at present).

20. In 1981 Brazilian petrol contained 20% ethanol, and in 1980 cars which ran on pure alcohol were introduced and accounted for 80% of purchases of new cars. This figure had drastically changed by the end of 1981 - to 10%. There were several reasons for this:

- it was stated that alcohol fuel demand might not be met if sales continued at the same rate. At the same time not inconsiderable amounts of ethanol were being exported to the US
- prices rose from 35% to 65% of the petrol price to put a damper on demand (overall savings were now only 15% vis-à-vis petrol)
- severe corrosion of engines and other technical problems.

21. Brazil has experienced other problems with unforeseeable consequences. Because of the speed with which the project was carried out, the bulk of the rapidly expanding business fell into the hands of planters and distillers. The rest of society gained little from the programme. Huge plantation areas in the Amazon Delta have been turned into desert by soil erosion and untreated waste from alcohol production has helped to create environmental pollution on an immense scale.

In the USA a gosohol programme based on grain was deemed uneconomic and abandoned by the present Administration.

2. Catch crops as a source of energy

22. Relevant energy crops also include catch crops, i.e. those cultivated in that part of the growing season which is not taken up by the main crop. Crops that can be considered for this purpose are certain cereals, potatoes, artichokes, peas, beans, tomatoes and rape. These crops can be grown after the harvesting in particular of cereal crops (harvesting finishes in July/August, whereas artichokes are harvested in January/February).

The yield, expressed in energy content, will primarily depend on the climate and the length of the growth period, so there will be large differences within the territory of the EEC. Irrespective of the kind of crop grown, where harvesting takes place after the end of the growth period, the crops will typically be green, with a high moisture content. Conversion methods will therefore be limited to anaerobic treatment or alcoholic fermentation.

23. Whereas residues and waste are raw materials involving no expense, these crops require seeds, fertilizer, labour and energy. On top of this comes the expense of harvesting and processing, so that today these crops are not considered to be an economic proposition. Furthermore, it would be necessary in most cases to invest in extra machinery and labour.

Finally it should be pointed out that precisely here a great deal of research still needs to be done in practically all sectors, ranging from the selection (and possibly development) of suitable plant species, to harvesting machines.

3. Annual energy crops

24. There has been a great deal of speculation about extracting energy from these crops (typical grasses, lucerne, clover and various cereals) but it is unrealistic for various reasons, inter alia:

- converted to biogas (in which process much energy is lost), this source is too expensive, especially as harvesting involves all the costs of labour, machinery, energy consumption., further processing and land use,
- converted into alcohol the product is not competitive, especially not with alcohol obtained from plants grown in tropical areas,
- land use would have to be radically altered if any great quantity of alcohol were to be produced. Studies by the Commission show that to produce enough alcohol from sugar cane to cover 1% of the EEC's energy requirement more than 4.5 million ha of good agricultural land would be needed.

4. Perennial energy crops

25. Perennial plant species, for example certain grasses, lucerne and others look promising, since a maximum growing period can be attained, which is important in view of the climate prevailing in the territory of the EEC.

Here too much research still needs to be done in order to determine the energy output of various plant species in relation to soil condition, climate, harvesting methods etc. and, as with annual crops, recourse must be had to agricultural land which is at present being used for other purposes.

5. Summing-up: energy crops

26. Assuming optimum conditions, which also means properly implemented political decisions regarding, among other things, land use (limitation of other crops, possibly through quota schemes) and that the (private/public) financial resources for energy crops are available, the Commission has made the following calculations:

Energy potential from all energy crops according to land use objectives

Land use policy	cultivated area (1000 ha)	% of energy requirement 1985
Without major changes in area of land used	4,318	5.5%
25% reduction in areas permanently under grass in France, Germany, Italy UK and Ireland	12,942	10.38
Any changes in area of land used that do not alter composition and quantities of food production in the agricultural sector	34,718	17.5
With changes in food production	52,012	32.36

Source: 'Energy from Biomass in Europe', table 5.4

27. It must be emphasized that the two last-mentioned options in particular are radical and highly speculative and can hardly be considered feasible unless the EEC should find itself obliged to produce energy based on biomass. Furthermore it would require decisions of a political nature spread out in time over the rest of this century. An additional speculative element is that it is hardly possible at present to foresee the financial consequences.

6. Other energy crops

28. A number of major and minor research projects have been carried out (particularly in the US and countries with warm climates) with many different plants, which is hardly surprising in view of the tens of thousands of eligible varieties and the great range of conditions under which the selected plants can grow or be cultivated. Here we shall take just one example, the sunflower, although many other oleaginous plants could be considered (peanut, maize, soya bean, olive and a whole series of exotic plants).

Sunflowers

29. Vegetable oil could be an alternative to or mixed with diesel oil for use in the transport sector (including agricultural transport). It is extracted simply by pressing and can be used without further treatment in engines modified for that purpose. The energy content is only 10% less than that of conventional diesel oil and the fuel efficiency only 4% less. It is believed that, with some further refinement, such vegetable oils could be a better proposition than diesel oil.

Another calculation shows the potential of vegetable oil in that a farmer (in a tropical or subtropical climate) who devotes 10% of his land to the cultivation of sunflowers can produce enough oil to be self-sufficient in fuel. It is a distinct advantage that vegetable oil can be extracted from a number of different plants (and the production and use of the oil is a simple matter), and that there are few pollutant by-products, one of which can in any case be used as protein-rich animal fodder. But use of the oil in engines does raise some technical problems which could probably be overcome by further research and experimentation.

7. Genetic engineering

30. Another aspect of the possible future of biomass fuels is the promising prospect of developing plant varieties with a higher energy content which is offered by genetic engineering and tissue culture. Priority should be given to developing vegetable oils with a high energy content and low viscosity for use in tractors (e.g. rape seed and sunflower oils).

A more daring suggestion is that agricultural products - even including cellulose-rich plants - which are at present produced in quantities that exceed requirements and have to be heavily subsidized, could probably, with the help of genetic engineering, become an economic asset for Europe if they were converted into energy.

8. Marine algae: seaweed

31. This source of biomass is much talked about, if only because of its abundance in European waters, There is also a long tradition of using it for food and fertilizer and as a raw material for the chemical industry.

32. The use of seaweed for energy production, i.e. exploiting it on a large scale, would require:
- the development of harvesting techniques suited to the site of the harvest (coastal geography, sea conditions) and the design of specially equipped vessels,
- the development of storage and processing techniques (seaweed contains a large amount of water)
- consideration of environmental problems, since the collection of substantial quantities of seaweed would affect the marine environment.

9. Cultivation of micro-algae

33. The idea of cultivating algae is put forward from time to time in the debate. On the basis of the literature available in this field, the rapporteur considers that at present there are insufficient grounds for continuing research into this source of biomass. There appear to be

very high costs associated with production and a warm climate throughout the year is essential for it to be profitable. This restricts the use of micro-algae as an energy source to the tropical ACP countries.

E. Farm waste and surpluses

(a) Straw

34. Straw from all types of cereal together with maize and rice, is the most common form in which biomass occurs as agricultural waste or surplus production. It is estimated that 80-82 million tons of straw were produced in the Member States in 1978 (the quantity of straw and residues being arrived at on the basis of careful calculation and experiment, using well-documented figures for cereal production). The figure represents a maximum including everything other than the actual grain. Depending on the patterns of farming in the various countries and regions, it is estimated that 20 - 40% of it is not used i.e. burnt off or ploughed in) and therefore would not be immediately available as biomass.

This amount of straw corresponds to 33.4mtoe(million tons oil equivalent) distributed as follows:[1]

Germany	7.84 mtoe
France	12.65
Italy	5.31
Holland	0.37
Belgium	0.58
Luxembourg	0.03
UK	4.35
Ireland	0.50
Denmark	2.24

35. Straw may be used directly for combustion (heat) or processed into fuel (liquid or gas) by pyrolysis or fermentation. Direct combustion in straw furnaces is the simplest and cheapest solution and can take place at the point of energy consumption.

Denmark offers a good and comparatively well-documented example of the production of energy from straw (1979 figures):

[1] According to 1985 energey targets, net energy imports are expected to be 595-655 m toe, including 468-528 m toe of oil (imports were 576 m toe in 1979) (Source: EUROSTAT)

Total straw production: approx 7 million tons

Surplus production approx 2 million tons

About one farm in five has had straw furnaces installed.

Straw furnaces installed (Min.): 20,000 (using about 15% of total surplus production)

Oil saving: 50 - 100,000 tonnes corresponding to 1% of oil imports

Denmark, a leading manufacturer of straw furnaces, probably also makes relatively most use of them (under its energy-saving programme the State pays up to 40% of installed cost).

36. Optimum use of surplus straw could make a substantial contribution to our energy supplies. There are few technical problems in local use. However, the example quoted above is probably as much as can be realistically hoped for, as the extra cost of extending this use is considerable, viz.:

- animal husbandry uses large quantities of straw. Changes in methods would require heavy investment in buildings;
- a large and steadily rising proportion of straw is used as feedstuff (with a new process using ammonia to enhance its food value);
- the removal of stubble from fields also removes valuable soil nutrients;
- improved and possibly changed harvesting methods would be required;
- there would be at least the cost of purchasing straw furnaces and collecting and transporting the straw, although this would not be prohibitive;
- individual financial decisions on local use would be involved, as transport costs would rule out any centralized combustion of straw.

(b) Live-stock manure

37. Live-stock manure is the largest farm by-product.

With the manure converted to methane gas by anaerobic digestion various analyses give an estimated total energy production of 12-15 mtoe[1]. This figure includes the conversion of cattle, pig and poultry manure, on the basis of total animal numbers in the Community.

38. This is a theoretical figure, as it assumes that all animals are housed all year, and that all the manure they produce is used. At most it indicates a potential maximum, which could replace 3-5% of EEC oil consumption.

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[1] With present techniques much of the energy is lost in conversion. The total amount of energy has been calculated at just under 40 mtoe, which gives an efficiency figure of over 36%.

One major constraint on maximum exploitation, at least in the short term; would be:

- the size of cattle herds, as cattle manure accounts for about 80% of the potential. One survey claims that farmers with herds of over 200 head of cattle would find it economically worthwhile to install their own biogas plant, because of the quantities of manure produced and the need for energy. However, a Danish study has shown that a treatment plant could be profitable with as few as 25 head of cattle. The cattle would have to be housed all year and energy consumption would have to be more or less constant (which is seldom the case).

39. It is of course quite vital to know whether the minimum herd for installing a separate biogas plant is 25-30 or 200 head of cattle, because:

- about 18% of all cattle in the Community are in herds of 100 or more (varying from 10.7% for Italy to 42.2% in the UK); the figure for herds of 200 or over is not known;
- 26.7% of cattle in the Community are in herds of 50-99 head (varying from 11% in Italy to 44% in Luxembourg).

In other words, about 45% of EEC cattle are in herds of 50 or over, which is probably the practical minimum for on-farm biogas installations. Applying the energy potential figures mentioned above, we obtain a maximum of 4.2 - 5.4 mtoe (assuming that cattle produce 80% of total animal waste, of which at present only 45% can be used). Knowing that herd sizes are tending to increase, we can expect the energy contribution to rise in the long-term.

However, if we allow for the fact that many herds, or at least dairy herds, are put to graze for part of the year, this contribution will be reduced further.

40. The most important constraint is the need for local consumption of the energy produced, centralized operations being ruled out by the difficulties and economics of transport. This implies that individual financial considerations will decide whether or not a plant is installed. There are unlikely to be many decisions to do so without substantial financial encouragement by the authorities (tax relief and investment incentives etc.). If enough interest is aroused, this can become a financial problem (as has been found in several countries with fixed public spending ceilings for energy-saving measures).

41. In the foregoing it has been assumed that plant can be connected up to the public energy grid. If not, seasonal variations in production and demand alone might rule out an installation.

42. Some of these considerations would also apply to pig farming. A minimum of 400 pigs would probably be required for a separate biogas installation. About 22% of pigs in the Community are in holdings of 400 or more.

43. Although the contribution would be smaller at national level, there would be advantages if plant were installed in all major establishments involved in the processing and manufacture of farm products, such as slaughterhouses etc., because of the large amounts of waste generated. In many cases this would be justified both economically and on the grounds of energy consumption, while it would also solve a serious environmental problem.

(c) Green plant waste

44. Green plant waste and residues are also fairly important. They include vegetables, potatoes, and sugar beet, as well as grass, lucerne, peas etc. used as feedingstuffs. The potential here is even more difficult to calculate, and the amounts of biomass possibly available as feedstock depend, even more than in the case of straw, on alternative uses, and harvesting and collection methods. The recovery of energy is further complicated by the high moisture content of these residues.

45. The table below gives an overall view of potential energy from the various types of agricultural waste, residues and surplus production[1]. It is assumed that all residues and surpluses are used, regardless of whether they could actually be collected at present or are used for other purposes. Energy lost in anaerobic digestion has however been excluded.

[1] Energy from Biomass in Europe, table 4.22, page 99

Estimated national figures for potential energy from agricultural residues in GJ/year and mtoe

	Cereal, maize and rice	Livestock wastes	Green plant matter	Total	Total in mtoe
Germany	327.1	129.7	40.0	496.8	11.29
France	556.6	171.2	59.3	787.1	17.89
Italy	233.7	81.7	37.3	352.7	8.02
Holland	16.4	45.6	17.7	79.7	1.81
Belgium and Luxembourg	27.1	27.3	12.3	66.7	1.52
UK	191.4	99.2	20.7	311.3	7.08
Ireland	21.9	38.1	3.3	63.3	1.44
Denmark	98.7	29.2	6.4	134.3	3.05
Total	1,427.9	622.0	197.0	2,291.9	52.10

F. Forestry

46. The size of wooded areas and their utilization varies greatly within the territory of the Community (Greece excepted) and this is best illustrated by the following statistics:

	Woodland		Yield			Trees felled for fuel	
	total 1978 (1,000 ha)	% of land area	m^3ha 1974[1]	roundwood 1,000 m^3 1976	% of EEC	1,000 m^3	% of total yield
Belgium	615	20	4.0	2,526	3.5	199	7.00
Denmark	470	11	3.6	1,615	2.2	62	3.80
Germany	7,200	29	4.4	28,603	39.5	650	2.27
France	13,950	25	2.2	27,462	37.9	1,074	3.90
Ireland	330	4	0.7	479	0.6	7	1.46
Italy	6,300	21	1.1	7,063	9.7	3,603	51.00
Luxembourg	85	32	2.4	200	0.2	16	8.00
Netherlands	310	8	2.8	963	1.3	24	2.49
UK	2,020	8	1.6	3,420	4.7	135	3.90
Total	31,280	21		72,331[2]		5,775[3]	7.98

Sources: Eurostat, 'Forest Policy within the EEC', ref. Biomass Conference, pp. 172-78 and 'Biomass in Europe', pp.95 et seq.

1. average figures, which can comprise wide variations, depending on the the tree species and the felling age
2. equal to about 17 mtoe (1 million m^3 = 0.24 mtoe)
3. another source puts the yield at 8 million m^3 in 1978.

A few remarks should be added here:

- in five countries more than 20% of the land area is woodland and almost a half of the EEC's woodland is situated in France,
- there are wide variations in the m^3/ha yield, Germany having, for example, many more older and taller forests than France and Italy,
- forests are often situated in less accessible areas. The UK's low production is partly due to its large number of young forests,
- there are relatively low average m^3/ha yields. These can be considerably improved, for instance by better thinning and more efficient forest management.

Utilization of wood and waste wood

47. Wood is mainly used in the building industry and for various wood products and paper pulp. Nevertheless, 8% is already being used for fuel. A great deal of the wood waste in the wood industry is already being used directly as fuel and, even more important, the 8% quoted represents only the industrial fuel production. Italy is a special case, since more than half of its production is used for fuel. It is also known that a very considerable amount of fuel wood is collected privately, but it is difficult to estimate exactly how much (one study puts it at more than 20 million m^3).

48. The EEC produces at present almost 800 million m^3 of wood. At the same time imports total about 120 million m^3, a trade deficit exceeded only by oil. World demand is increasing relatively fast and at sharply rising prices. Demand in the EEC is expected to rise by 2% per annum, and its internal production by only 1% per annum. There will therefore be fierce competition for the available wood between the energy and the industrial sectors.

There are, however, further ways in which wood can be used for energy:

- it is estimated that a marginal area of 4-5 million ha is unused. Afforestation could make an important contribution (demand in competition with industry). Even in the case of industrial use, there would be a considerable amount left over for fuel,
- after felling operations about 45% of the wood is left behind in the form of tops, branches, bark, stumps and roots. With better felling and collection methods, wood remnants equivalent to 20% of the EEC's industrial yield of wood could be recovered and used possibly as fuel,
- at the moment only two thirds of the waste from sawmills is used; that means about 8 million m^3 could be recovered here.

For all these categories, however, extra yield depends on the planting of trees and the improvement of investments (and the consumption of energy). At all events, it will often be possible for the final product to be used industrially.

49. The above analyses, like those mentioned earlier regarding biomass potential in agriculture, are based on total quantities and almost optimum utilization using current technology. Where forestry is concerned, a decisive factor must be mentioned that will reduce the possible yield, namely the fact that 60% of the EEC's 3 million woodland owners have woods on less than 50 ha and that a large number of these owners live in the immediate vicinity of their woods. These circumstances will automatically limit industrial exploitation for energy purposes, although sales to private persons could be substantial.

France's energy balance sheet based on biomass from forestry[1]

50. Intensive studies have been undertaken in France into forestry's contribution to energy production. It should be remembered that France has a wooded area of about 14 million ha (EEC: about 31 million ha), of which 9 million ha are used commercially, with a yield of almost 30 million m^3 per annum. About 4 million m^3 are already being used for fuel. 5 million ha alone are under coppice, which is not particularly suited to industrial use (and has therefore not been used), but on the other hand is very suitable for fuel. So there are considerable reserves here, though their exploitation will probably remain very local. The following analysis has also been drawn up for France's biomass production from forestry (per annum):

- coppice (old) exploited over 10 years	:	1.5-2 mtoe
- early thinning of woodland and vines	:	0.4-0.8 mtoe
- remnants after felling operations	:	0.3-0.7 mtoe
- remnants from wood industries	:	0.8-1.0 mtoe
		3 -4.5 mtoe

To this should be added 3 mtoe already being used as fuel (direct production of 4 million m^3 and other remnants/waste).

SRF (short rotation forestry): energy production from forestry

51. This type of forestry is able to produce high yields in the shortest time possible. The standard method involves plantations of densely growing, broad-leaved species of trees which can be felled several times in cycles of less than ten years. After felling, the roots are left intact to ensure rapid regrowth.

52. A number of factors are of crucial economic importance in connection with the use of SRF for energy production:

- the choice of tree species (this depends on soil and climate, but genetic research seems certain to contribute substantially to raising yield levels);
- a large input of energy is required, chiefly in the form of the fertilizer needed to ensure sufficiently high yields;
- SRF is highly labour-intensive, which must be seen as a virtue, although extensive training schemes would presumably have to be set up;

[1] Energy from biomass, pp.172-79

- a range of machinery would have to be developed specifically for SRF, adapted to its geographical siting; SRF would probably have to be practised in outlying areas to which access is often difficult (marginal forestry or agricultural land);

- large-scale SRF would involve, in certain areas of the Community, the cultivation of land which is at present used for agriculture (grazing land) or traditional forestry, i.e. the alternative costs and benefits would be a key factor.

53. Given the present structure of forestry and agriculture in the Community, it seems as though (only?) three countries possess enough large and suitable tracts of land for SRF to be considered feasible, namely France, the UK and Ireland. These countries suffer less than the other Member States from a shortage of land.

54. The potential for SRF in Ireland is relatively well-established (the prospects there being particularly favourable). Ireland already produces a substantial amount of energy from peat. On the basis of intensive studies carried out in Ireland, it is possible to arrive at the following calculations for the country:
(Source: 'Energy from Biomass', p.234)

Areas of land available for SRF plantations: IRELAND

Type of land/ topography	Area (million ha)	Potential fuel yield (mtoe/year)
1. Hill and mountain areas	1.45	7.83
2. Wet drumlin (peat soil)	0.22	1.19
3. Organic soil	0.50	2.70
TOTAL	2.17 (31% of Ireland's land area)	11.72 mtoe

55. As with the previous examples of energy potential, the above figures represent the optimal utilization. However, the following facts remain:

- large areas in Ireland are currently used for grazing, but are expected to become unutilized in the near future because of poor returns (however, much of this land may be unsuitable for SRF because of its inaccessibility)

- the State owns no less than 80,000 ha of peat land (organic soil) which is unexploited at present but is expected to be drained over the next 30 years. These areas could be used for SRF and could alone yield 0.4 mtoe per year, or 4.7% of Ireland's primary energy needs.

56. Although experiments with SRF are being carried out in several Community countries, only in Ireland has its potential been fairly well established. Before calculations of profitability can be made, accurate information on a number of factors must be obtained, such as climate, soil, tree species and siting on the one hand, and the development of an effective range of machinery and efficient conversion processes on the other. Management techniques are an additional factor. Nevertheless, it is estimated that in Ireland, SRF could produce domestic returns of 15%.

57. Several calculations have been made of the returns from SRF, but regardless of the results (and in most cases these were positive), it must be remembered that most SRF experiments have been conducted on very small areas and usually under favourable soil conditions. These conditions would change radically if SRF were to be practised on an industrial basis, and the question of alternative use of the land would come into play (perhaps less so in Ireland).

Finally, a factor of both economic and psychological importance should be mentioned. A decision to practise SRF would not only involve a high level of investment (planting, upkeep, etc.); it would also mean that a financial return could not be expected until five years after planting at the earliest. Some degree of state funding and/or investment incentives in one form or another would therefore have to be reckoned with.

III. GENERAL REMARKS: BIOMASS IN THEORY AND PRACTICE

58. The report has so far attempted to summarize the various biomass resources which can be converted into energy.

It must be strongly emphasized that all the estimates are purely speculative. An extremely wide range of literature exists on the subject, testifying to the enormous amount of research in this field, which in turn illustrates the clear hope that biomass will be able to contribute more than marginally to Europe's energy supplies. However, we now seem to be in a state of permanent anticipation.There are several reasons for this, the most important being that:

- while there is extensive research into utilization of the biomass in nearly all fields, it still has the major weakness - from the point of view of economic and political decisions on commercial exploitation - that most experiments are conducted under controlled laboratory conditions. These are virtually optimal conditions. On the other hand, it should be noted that most of the theory associated with biomass has been examined in practice, i.e. the basic research has been carried out;
- several estimates of the energy potential of different forms of biomass in various countries are based on global assessments, in which the possible yields are extrapolated from the results of the laboratory experiments referred to above;

- a number of practical requirements for commercial exploitation, and perhaps practical difficulties, are still unknown quantities;
- the calculations of profitability which have been made vary widely and depend on the (frequently optimal) conditions under which each individual experiment has been conducted. They can thus only be regarded as indicative in nature;
- while the utilization of biomass for energy purposes is profitable in theory, at least two further factors would have a crucial bearing on its exploitation (the rapporteur draws no conclusions on the matter):

(a) the prospects for selling the end product; whether major technical adjustments are requiered on the part of customers (new or modified technology)

(b) whether financing is available, especially in those cases where the conversion of biomass into energy entails a large-scale operation.

59. Neither of the above questions can be answered satisfactorily until proper demonstration projects and plant have been set up on a large enough scale for an assessment to be made of the prospects for commercial exploitation of the biomass. There is no doubt that biomass represents a genuine alternative and renewable source of energy, but except for the simplest forms of exploitation, it remains difficult to assess its potential and profitability at the present stage of development.

IV. CONVERSION PROCESSES IN THE UTILIZATION OF BIOMASS

60. Depending on the type of biomass and the end product required, various conversion processes are used to extract the original solar energy which has been fixed in vegetation by photosynthesis. The end product is:

either: energy in the form of heat, in which case the conversion occurs through combustion

or: solid, liquid or gaseous fuel, in which case the conversion occurs through
physical/chemical processes at high temperatures and sometimes under pressure; or biological processes in the form of fermentation or digestion by living organisms, which usually takes place at normal temperatures and pressures.

61. The following table gives a general picture of the techniques which - at the present stage of research - it is most appropriate to use for the conversion of various biomass resources, together with the end products and their applications (source: 'Energy from Biomass in Europe', Chap. 6 and Table 6.1). It should be pointed out that research into conversion processes is expanding, and that the theory is by and large established. However, there is no doubt that the processes could be substantially improved, particularly in terms of their efficiency, i.e. the amount of energy which is extracted.

Method	Feedstock	Output	Examples of use
Direct Combustion	Timber, logging wastes, sawdust, straw etc. all with > 15% water content	Heating energy. Combustion efficiency 30 - 60%	Room and water heating, cooking, steam to produce electricity for local or central use on a permanent or seasonal basis Residue: mineral ash
Pyrolysis Physical or chemical resolution of organic materials by heating at 200° - 1100° C	Timber, waste, straw, starch crops including cereals, all with > 15% water content	Charcoal 30-35% Distillate, tars, methanol, etc. up to 20%	
	Seaweed and algae, greencrop residues, after drying	Gas CO, CO_2 CH_4 up to 20% of original mass converted (the higher the temperature, the greater the content of gas and hydrocarbons)	
Gasification (using reactor)	Organic waste, animal waste, wood waste	Gas mixture	Combustion techniques Production of electricity (for local use)
Fermentation (physical/chemical breakdown and conversion into sugar - fermented to produce alcohol)	Sugar crops Starch crops Wood crops	Ethanol yield varies with feedstock and process	Synthetic fuels or petrol
Digestion using bacteria	Animal wastes Green plant matter	Biogas mixture with considerable proportion of methane (50-70%)	Direct combustion or use in combustion engines Residue: organic fertilizer

V. THE USE OF BIOMASS IN THE DEVELOPING COUNTRIES

A. The energy crisis in the developing countries

62. Whilst the Community feels hard-hit by the energy crisis, the crisis has been an economic one rather than one of supplies. For the developing countries, the crisis is of both dimensions and far more disastrous proportions. It is difficult to see how the developing countries can afford to increase their imports of energy sources (even if the latter are available and even if prices increase only slightly or remain static). The problem for these countries is first and foremost their domestic sources of energy, which for the most part consist of wood. Their energy crisis is a disastrous wood crisis, the scale of which is only gradually dawning on the rest of the world. If consumption of wood continues at the present rate, the continent of Africa will be without forests in 50 years or less; in other words, if the present stock of woodland is to be maintained, the amount of planting done each year must be increased fivefold.

B. Africa: the supply situation and the consumption of wood[1]

63. It is estimated that supplies of wood in Africa amount to some 500 million m^3 per year[2], although there are wide disparities between regions, as opposed to an estimated consumption of 370 million m^3 per year. This apparent surplus should be viewed with strong reservations, because:

- this mean figure conceals major disparities, since there are now large areas in Africa which are without forests;
- the distances between the point of consumption and the source of supply are large and rapidly increasing;
- wood is being used more and more as building timber and for commercial purposes;
- for transportation, bulk wood is difficult to handle.

In East Africa, it is not uncommon for people to travel distances of up to 100 km to gather fuel. In Tanzania, a family spends between 200 and 250 man days per year collecting wood.

Wood fuel covers 65-70% of total needs in Africa, being used chiefly for domestic purposes and less in industry.

64. It is estimated that 90% of all wood fuel is used for cooking and heating in rural areas. Cooking in particular involves an energy loss of almost 90%, and there are secondary problems such as smoke and the risk of fire. The use of ovens would bring about substantial savings. Whereas wood collected in the wild used to be, and in some well-wooded areas still is, a 'free' raw material, this situation is changing rapidly, partly because of transport difficulties and partly because of the shortage created by the growing needs of energy-intensive industries in Africa; these include the tobacco, brick, cement, fish-smoking and tea industries, all of which are of great local importance and consume large quantities of wood.

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[1] 'Energy from Biomass', p. 735-52

[2] 365 million m^3 in Latin America, 560 million m^3 in Asia

65. Charcoal is being used to a greater extent, particularly in urban areas. In Africa as a whole, about 35% on average of the round timber felled is converted into charcoal, a trend due on the one hand to commercial and transport factors and on the other hand to the farming of plantations of suitable species of trees. However, there is a possibility of seriously exhausting the soil in existing forests.

66. To illustrate the scale of the problem, it should be pointed out that Algeria, Tunisia and Morocco have only 10% of their original woodland areas left, the Gambia 4% and tropical Africa 35%. Deforestation is due not only to energy consumption, but also to the clearance of land for agricultural purposes. It is probably unnecessary to mention the effects on the natural environment (desertification, soil erosion), which should be viewed in conjunction with the energy-related problems referred to above.

67. Although attempts are now being made to use alternative sources of energy (e.g. biomass in the broad sense) and to make more rational use of wood (such as a project on the island of Réunion in which special ovens save 75% of the energy previously consumed), wood is still being wasted on a large scale.

C. The role of biomass in the developing countries

68. A brief decade's awareness of the economic impossibility of importing the energy needed and of the catastrophic effects of forest clearances has led to the establishment of energy plans in which the use of biomass to produce energy assumes a crucial role. Biomass in its various forms is either found or can be cultivated in abundance in the climatic zones where most of the developing countries are situated. Another advantage of biomass is that it can be used in rural areas without causing upheavals in the socio-economic and cultural environment of the villages where most of the population live. Animal and vegetable waste or crops grown for the purpose can be converted, with little financial outlay, into biogas for cooking, light and heating.

69. A number of developing countries have extensive schemes for plantations of sugar cane and plants with a high oil content, which can either be converted into synthetic petrol (as in Brazil) or simply have the plant oils extracted for use in combustion engines, directly or in mixtures. Although the use of these types of fuels has given rise to problems, it seems reasonable to assume that the technical problems posed by the need for modified engines and/or a different choice of materials are not so great as to be insoluble.

Of particular interest is a project on the island of Réunion, in which the Beaufond electric power station will produce 24.6 mw by burning bagasse residue from sugar cane in the season from July to November. It will also burn bagasse pellets from other parts of the island from December to February, i.e. after the sugar cane season.

The project is being financed jointly by the Community, the Commission d'Energie Solaire (COMES) in France and Réunion's sugar industry.

VI. REMARKS ON THE COMMITTEE ON AGRICULTURE'S OPINION

70. The committee endorsed the rapporteur's views on the opinion of the Committee on Agriculture, particularly paragraphs 30 and 31 of its conclusions. During its discussions, the committee expressed opposition to the following recommendations contained in the opinion:

(i) paragraph 30(a): The committee considers it unrealistic to think that production of concentrated biomass could assume such proportions that developing countries would be able to become exporters, especially if it is borne in mind that the energy situation in those countries is far more difficult than in the Community in terms of supplies and finance. If concentrated biomass were to be transported, that in itself would probably render exports uneconomic.

(ii) paragraph 31(a): The committee is opposed on principle to the setting up of new research centres dispersed through the Community. Instead, new research must be concentrated in the Joint Research Centre, which was set up for the purpose, and/or in existing research establishments by means of contracts.

The committee is also against preferential treatment being given to the African ACP countries. All research carried out into biomass with a view to improving the ACP countries' energy situation must be uniformly applied.

VII. CONCLUSIONS AND RECOMMENDATIONS

71. According to an estimate compiled by the Commission, about 5% of the Community's energy requirements could be met in 1990-2000 by fuels produced from biomass; of this half, would be from farm and forestry waste and the other half from energy crops.

However, energy crops on this scale would take up some 8-9 million hectares. Present wasteland and areas to be given up for economic reasons in the future would provide about 5 million hectares. The remaining 4-5 million hectares would have to be taken from present agricultural land. This is estimated to correspond to the area required to produce the present surplus of farm products, which could therefore be switched to energy purposes. The idea has also been put forward that the subsidies swallowed up by this surplus production could instead be used to finance energy crops.

72. The problem of the alternative use of agricultural land (for energy crop is a political and economic one. Farmers wishing to become principally producers and consumers of biomass fuels will base their decision to switch production on economic benefits and costs. For example: what is more profitable - milk or biomass?

73. At national level there is another question connected with land use. There is a shortage of other raw materials, particularly wood. In other words, when it comes to deciding for what purpose the land is to be used there will b keen competition between agriculture, forestry and other raw materials. It wou be desirable for comprehensive guidelines to be issued by the Community institutions.

74. Given the fact that:
- the developing countries enjoy climates which make it easier for them to produce energy crops at a profit than industrialised countries, and
- the industrialised countries produce more agricultural products than they need,

some people have suggested that food could be exported in exchange for biomass fuels.

Your rapporteur finds this idea neither morally justifiable nor a realistic possibility, for the following reasons:

- biomass fuels produced in the developing countries could or should be used to meet their own requirements. If possible, these countries have a greater need than Europe to promote renewable energy,
- at all events, the more energy these countries produce, the less pressure there will be on the world market, to the advantage of both parties,
- the Community's surplus does not represent the products which the developing countries need most, nor is it probable that these products will be sold at a price they can afford. Hunger in the world is less a problem of production capacity in the agricultural sector than one of financing production and/or imports.

75. Throughout this report it has been noted that comprehensive research has already been carried out, but that the next step in the research process has only just begun. The need now is to organise pilot and demonstration projects which will give a realistic view of conditions for marketing the developed know-how and indicate the range of the political and financial decisions arising in connection with the promotion of the use of biomass for energy production.

76. The Committee on Energy and Research therefore requests the Commission to draw up and submit a proposal for a research and development programme in the field of the use of biomass as a source of energy, and stresses the importance of focussing the programme on pilot and demonstration projects. As with every research programme the aim must be to coordinate the research already carried out at national, Community and international level.

In the medium term two main objectives must be given priority:

- the use of biomass waste and energy crops to make agriculture self-sufficient in energy. Positive final results must not be clouded by fiscal measures;
- to make it possible to use ethanol and methanol for blending with petrol in the transport sector.

The important thing is that in its recommendations regarding alternative production processes and the use of biomass energy, the Commission should assess in detail, and take account of, the criteria set out in Chapter IIC.

OPINION OF THE COMMITTEE ON AGRICULTURE

Draftsman: Mr O. d'ORMESSON

At its meeting of 11/12 May 1981 the Committee on Agriculture appointed Mr d'Ormesson draftsman.

It considered the draft opinion at its meetings of 27/28 April 1982 and 22/23 June 1982. At this last meeting it adopted the draft opinion by 15 votes to 2 with 3 abstentions.

The following took part in the vote: Mr Curry, chairman; Mr Colleselli and Mr Delatte, vice-chairmen; Mr d'Ormesson, draftsman; Mr Adamou, Mr Battersby, Mr Clinton, Mr Dalsass, Mr Davern, Mrs Desouches (deputizing for Mrs Pery), Mr Herklotz, Mr Kaloyannis, Mr Kirk, Mr Marck, Mr Mertens, Mr Provan, Mr Thareau, Mr Tolman, Mr Vgenopoulos and Mr Woltjer.

I. INTRODUCTION

1. Living standards in Western societies have risen sharply since the end of the Second World War. This has been accompanied by a massive increase in energy consumption.

However, the oil crisis which has been affecting the world economy since 1974 has served to highlight the vulnerability of Western economies, the prosperity of which depends to a large extent on imports of a single energy product - oil.

2. The steady rise in the price of oil since 1974 has prompted research into alternative sources of energy, the economic viability of which has increased as the cost of hydrocarbons has escalated. The search for oil substitutes is under way. Alcohol, in the form of ethanol and methanol, is one of these substitutes. Brazil, for example, has launched a large-scale programme to produce ethanol from cane sugar and hopes to meet 20% of its fuel requirements in this way by 1984. Similarly, South Africa covers part of its production from its coal reserves; research being carried out in New Zealand has shown that ethanol (from fodder beet) and methanol (from wood) could be used as fuels.

3. The reason why there is so much interest in the production of oil substitutes is simply that our economies would be very vulnerable to an embargo. As the World's largest agricultural bloc, Europe cannot afford to ignore the production of biomass energy because 60% of its energy requirements are imported and it has very few natural energy resources of its own. It should also be borne in mind that the remarkable increase in agricultural productivity in Europe is largely the result of mechanization and the use of fertilizers; an oil embargo would therefore have disastrous consequences not only for industry but also for agriculture. It would also have a detrimental effect on the Community's self-sufficiency in food.

4. Consideration should therefore be given to how far agriculture can:

(a) meet its own energy requirements;
(b) contribute to reducing the Community's energy dependence;
(c) contribute to reducing the energy dependence of States which are signatories to the Lomé agreements.

5. These, then, are the objectives and the European Community must acquire the means to achieve them, although everything will clearly depend on the economic and political situation in which the leaders of the Member States take the necessary decisions. Providing that the security of shipping lanes could be guaranteed, it would seem worthwhile to encourage developing countries - principally the African A.C.P. states - to produce concentrated biomass in order to meet their own energy requirements and part of the Community's, assuming, of course, that they had enough to export. However, if supply lines were seriously threatened, the Community would have to be in a position to produce and utilize energy-generating biomass at very short notice in order to make up the shortfall in energy which would result from a serious threat to shipping lanes or the closure of certain oil or gas pipelines.

II. GENERAL REMARKS ON BIOMASS

6. At this stage, the notion of biomasss should perhaps be defined.

The biomass is the sum total of organic matter produced by photosynthesis. It is a renewable source of energy, but becomes dispersed in the atmosphere and is often inaccessible. Man uses a part of the biomass to feed and clothe himself and as a building material. 'Energy-generating biomass' is thus, a much more restricted concept than biomass in general.

7. Energy-generating biomass, essentially, covers those products from which methane and methanol can be obtained; for example, agricultural and forestry wastes and residues, such as dung, straw and coppice wood, and organic wastes from agri-foodstuff industries and urban refuse. This list would not be complete without reference to the wood produced with a view to obtaining methanol (e.g. poplar) or to the crops grown to provide large quantities of dry matter in a short space of time (e.g. short-cycle coppices, donax-reeds, water hyacinths....).

The term also covers alcohol (ethanol)-producing plants such as sugar beet, grain sorghum, maize, and the Jeruselam artichoke, to name but a few. The cellulose, starch and sugar from these plants are processed into a syrup, fermented and then distilled into ethanol.

Also included in the definition are a number of oilseeds, such as colza, sunflower and soya. These produce oils which are suitable for diesel engines.

8. There are two main methods of obtaining energy from biomass:

(a) The biochemical method, whereby biomass can be used without the raw materials having to go through a drying process, which would use up energy.

This method is used principally to produce ethanol, from the fermentation and distillation of syrups, methane from anaerobic fermentation, and heat which is obtained directly from aerobic fermentation.

(b) The thermochemical method which requires relatively dry material such as straw or wood. This method is mainly used to produce heat by combustion, charcoal, pyroligneous gases and liquors obtained by pyrolysis, lean gasses produced in gas generators and methanol, which is derived from a gas.

Finally, oils are extracted from oleagineous plants by mechanical pressing or by means of chemical solvents.

9. Studies carried out in the Community show that agricultural and forestry residues alone could, at present, provide between 30 and 40 million tonnes oil equivalent (toe). It should be borne in mind that the Community uses 950 m toe annually.

If the Community developed its energy-generating crops, it could be producing between 30 and 40 m toe between now and the year 2000.

Since, according to F.A.O. calculations, agricultural production in Western Europe will probably require approximately 68 m toe by 1985/6 it is possible that the agricultural sector could become self-sufficient in energy.

This is an important point because food supplies would then be guaranteed and, at the same time, fuel which could be used for other purposes such as transport, would not, as a matter of priority, be channelled into agriculture.

10. It is difficult at the present stage to forecast how much it will cost to produce and distribute energy from biomass, what market characteristics will emerge or how much interdependence will be created with other markets; this applies both to raw materials and to finished products.

The use of agricultural and forestry waste to produce energy for farms or villages is already an economically viable proposition. Such waste could supply part of the energy required by agriculture at a lower price than traditional energy sources.

However the production and use of energy-generating crops is still very much at the experimental stage and there is no guarantee of economic viability. Although the costs of such operations are a crucial factor, the energy balance[1] of biomass production must also be taken into account. In this connection, the Member States of the Community should pool their ideas on energy analysis and make the system more precise.

III. SITUATIONS FAVOURABLE TO THE DEVELOPMENT OF ENERGY-PRODUCING BIOMASS

11. The development of energy-producing biomass is closely linked to the price of oil. As distinct from previous years, the latter would now appear to be stablizing owing to:

(a) the use of substitute energies, particularly nuclear power,

(b) the energy-saving policies of the major industrialized countries.

If new sources of energy (nuclear, solar, coal etc.) were developed on a large scale, the price of oil would stabilize at the level of substitute energy sources, which would cast doubt on the development of biomass sources. However, the future of this form of energy would be assured in the event of an oil embargo.

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1 This is the ratio between the amount of energy derived from biomass and the amount of energy required to produce that energy. It is worked out from the energy analysis.

12. On this assumption, two different sets of circumstances would favour the development of biomass energy. First, in a free-trade context Europe could encourage developing countries to produce concentrated biomass which it would then import. Second, in the event of an oil embargo, Europe would be forced into a position where it would have to be able to produce energy from crops at very short notice.

A. A system of free-trade geared towards the ACP States

13. The Community could help non-oil producing developing countries, particularly the African ACP States, to develop and process energy-generating crops by supplying 'turn-key' factories. It could then purchase the concentrated biomass[1] from them at a price equal to the tonnes oil/coal equivalent price. This would have two immediate benefits:

- a reduction of crude oil imports, which impose a considerable burden on the balance of payments of developing countries
- export of concentrated biomass, which would improve their balance of payments.

14. A political solution along these lines would create a real sense of common purpose between the Community and developing countries, would make the Community less dependent for its energy on a small group of supplier countries, and would permit the rational utilization of tropical forests, the uncontrolled and indiscriminate exploitation of which is a factor in the underdevelopment and impoverishment of the land concerned.

15. Energy-generating crops would not of course compete with food crops in developing countries. Experience has shown that developing countries, taken together, could meet their food requirements. The problem of hunger in the world is caused by cyclical factors (drought, floods, etc...) and agriculture is, of course, subject to the vagaries of climatic conditions, favourable or otherwise.

16. Many factions in the Community oppose imports of substitute products on the grounds that they have adverse consequences for Community farmers and the Community budget. The voluntary restraint agreements concluded with a number of countries (such as Thailand) are not really effective because supplies can always be obtained elsewhere. The Community could therefore offer the developing countries the opportunity of growing energy-producing crops instead of manioc, sugar cane, etc.

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[1] It is highly unlikely that Europe would be able to import crude biomass because the considerable volumes that would have to be transported by sea would be far in excess of present shipping capacity.

It could, for example, propose setting up a STABEX mechanism to cover the concentrated biomass that it would eventually import from these countries. It could also offer to give an undertaking, under the Lomé Convention, to buy concentrated biomass produced in ACP countries instead of the 1,300,000 tonnes of sugar it is committed to importing from them every year, even through it is already more than self-sufficient in this sector.

Moreover if a viable development programme for energy-generating crops were set up in developing countries, their oil imports could be reduced by a factor of 5 to 8 over a period of five years.

B. Embargo

17. If an embargo were declared and oil substitutes could not be obtained from outside the Community, Europe would have to begin utilizing biomass immediately.

In this connection, three essential conditions would have to be met:

- the energy potential per unit area would have to be maximized because the amount of agricultural land in Europe is limited,
- steps should be taken to ensure that the energy produced is used economically,
- the Community would need the appropriate expertise and, if possible, a number of production units to supply, at very short notice, concentrated biomass for priority sectors upon which the survival of the Member States depended.

18. Before moving on to a detailed analysis of the various methods of deriving maximum advantage from biomass energy it should be pointed out that, with existing production methods, sugar beet is not the most ideal source. More suitable crops are the Jerusalem artichoke, the donax-reed and alfalfa, which is also a source of protein. The most promising results have been obtained from dry vegetable matter and charcoal, which produces very high yields.

19. It would be useful to combine the production of energy-generating biomass with the production of proteins. Alfalfa is the most suitable crop in this respect. However, the development of protein production in the Community is hampered by soya imports. The Community should perhaps therefore promote a common protein policy and safeguard production. In this way the Community would solve its own problems and ease the financial burden on the Member States at the same time as producing energy.

20. However, because funds are limited, the Community will have to develop crops which are suited to a European climate and soil, i.e. crops which would be viable in terms of the energy analysis. The Community will also have to set up skeleton production facilities which in the event of a serious crisis could, at least, meet the requirements of the priority sectors.

21. At this juncture, consideration should be given to the solutions offered by the utilization of biomass in both micro-economic and macro-economic terms.

IV. HOW BIOMASS CAN HELP TO SOLVE THE ENERGY PROBLEM

22. First, energy could be saved on farms.

- If dung is sealed in a tank, it will ferment to produce methane which can then be used to drive motors or generate electricity.
- In cow sheds, heat from the milk can be used to provide hot water or heating.
- Other solutions which are unconnected with biomass include better maintenance of agricultural machinery, insulation of buildings, the research into new types of nitrogen-fixing crops; these solutions would save on the use of minerals, which account for 40% of the energy consumed in the agricultural sector.

23. There is also scope for cutting energy losses in the agri-foodstuffs industries and using waste products to generate energy.

24. Although these measures would help to solve the energy problem, the production of energy-generating biomass would have to be developed on a large scale if it were to make any significant contribution to alleviating Europe's problems.

25. The Community should therefore foster the development of energy-generating crops which could be used to produce combustible dry materials or which could be processed into ethanol or methanol or into oils directly suitable for use in motors. Finally, it should be pointed out that energy can also be obtained in various ways from wood.

26. Among the promising plants in the first category are the domax-reed (7-8 toe per hectare) and the water hyacinth (40 toe per hectare). The latter is a prolific aquatic plant which grows rapidly in waters at temperatures of 25-35°C, doubling its mass in such conditions every 8 to 10 days.

It would be valuable to find out whether this plant could be grown in the vicinity of nuclear power stations with a view to utilizing the heat which is normally dispersed into the atmosphere. Attention should also be drawn to the euphorbia which grows on dry, poor soil. The sap of this plant is rich in latex, the composition of which is similar to that of hydrocarbons.

27. The second category of plants can be used for food or industrial purposes and as a means of producing energy:

(a) Mention should be made here of plants which can be processed to produce alcohol. These are sugar beet, fodder beet, sugar sorghum, with Jerusalem artichoke, maize, the potato, and fodder kale.

(b) This category also includes algae and a number of studies are being carried out in this area.

28. It would be useful to illustrate the problems that are encountered with some of these crops.

(a) Sugar beet could be used to produce ethyl alcohol if less sugar was extracted from every tonne (i.e. only 100 kg. instead of 130-140 kg., thus producing enriched molasses) and if distilleries were operated not on oil but on the methane derived from the by-products of the distilling process and from the pulp which at present is used as cattle-feed. The aim would be to reorganize beet production so as to obtain a mixture of alcohol fuel and sugar for human consumption. It remains to be seen whether this would be the best way of producing energy under economically viable conditions.

(b) The production of oleaginous and protein plants is more economical. One hectare of colza, for example, produces 2 tonnes of oilcake, 0.9 tonnes of oil and 3 tonnes of straw. Oleaginous crops (colza, sunflower) are grown extensively in Europe: the by-products are used to supplement animal feed (oilcakes). Although the extraction of the oils is a simple matter their viscosity still poses a number of technical problems.

(c) Wood is another of the European Community's resources which should not be underestimated. There are 31.7 million hectares of woodland and forests on Community territory. However, these forests are not always worked, either because they are inaccessible or because they have not been turned to good account by their owners. Wood and forestry waste can be used without further processing to produce heat by means of combustion. In addition, trees could be cultivated to produce charcoal or synthetic gas which could then be used to manufacture fuels, particularly methanol.

Of the suitable species of trees, the poplar gives a very quick yield over a period of seven years. This does, however, require the use of fertilizers, which in turn detracts from the energy balance for this particular tree.

This raises the general problem of competition between wood used for energy purposes and wood used for pulp (of which there is a deficit in the Community) or for wood industries (furniture, construction etc....).

29. In its decisions of 6 March 1979, 29 July 1980, and 5 June and 5 October 1981, pursuant to Council Regulation (EEC) No. 1303/78 of 12 June 1978, the Commission allocated roughly 5.8 m ECU to demonstration projects, some based on biomass, in the field of energy saving and solar energy. In its reply to Written Question No. 1293/81 by Mrs Rabbethge, it expressed its point of view on this subject (see annex) and outlined how the money would be spent.

V. CONCLUSIONS

30. The above examples show that the production of energy-generating crops could compete with other types of crops.

Decisions taken in this area should:

(a) be consistent with the objectives of the Common Agricultural Policy,

(b) encourage the growing of crops that would yield a positive energy balance,

(c) take account of the financial costs involved,

(d) aim to reduce the Community's energy dependence,

(e) encourage trials of new energy-saving agricultural production methods.

Bearing in mind that the Community does not yet have a true energy Policy, and without wishing to prejudice the issue, the Committee on Agriculture recommends that such a policy should, inter alia:

(a) encourage the development of energy-generating crops in developing countries, particularly in the African A.C.P. states, and help those countries to produce concentrated biomass, a part of which would be for export;

(b) ensure that the Community could produce concentrated biomass at very short notice if energy supplies were cut off in a a serious crisis;

(c) encourage the utilization of agricultural waste (straw, manure, etc.) on the farm so as to reduce farmers' dependence on energy.

31. This opinion therefore recommends that:

(a) A European centre should be set up for the study of and research into biomass; this centre would be responsible for the pilot projects essential to ascertaining which particular crops could eventually meet some of the Community's energy requirements. Pilot projects would also be encouraged and monitored in African A.C.P. countries.

(b) The Community should promote an exchange of information and experience in the field of energy analysis with a view to making methods more reliable.

(c) The Community should provide funds which would at least partially cover the financing of the experimental units from which it would acquire the expertise necessary to produce concentrated biomass on a large scale if the need arose.

With this basic industrial plant it could, over a very short period, immediately meet the energy requirements of those sectors designated as priority areas. In the longer term the experience acquired would enable it to produce concentrated biomass on a large scale.

(d) Before any decision is taken, the Community authorities should consult the European Parliament so that Europe's elected representatives can debate possible options.

32. Although the use of biomass will not provide all the answers to Europe's energy problem, it will help to cut the Community's oil bill and reduce its energy dependence. It will also help to solve the serious energy problems of developing countries. An added advantage of biomass is that it is a source of energy which is available anywhere. If farmers could be persuaded to use their own crops and farm waste to produce biomass energy, the Community's agricultural sector would be less vulnerable because it would be protected against any serious world crisis.

33. Biomass is one way - but not the only way - of reducing the Community's energy dependence. It should be regarded as one of a number of new energy sources, including nuclear, solar or wind power. The Community will overcome the oil crisis only if it combines these different sources of energy. This opinion therefore concludes with an appeal for the implementation of a common energy policy to replace the futile and fragmented efforts of the Member States that make up the European Community.

PILOT PROJECTS FOR THE PRODUCTION OF METHANOL

At the beginning of 1981 the Commission of the European Communities published an invitation to tender (Official Journal C 18 of 27 January 1981) on the subject of biomass pilot projects. These projects form part of a four-year research programme, which is due to be completed by 30 June 1983[1], and which includes the implementation of Project E, 'Energy from biomass'.

The aim of the invitation to tender was to develop pilot projects for the production of methanol from wood and other cellulose materials. Plants would have to treat 20 tonnes of wood per day or more and operational units might well have to cope with ten times that amount in order to be viable. The Commission also stressed that proposed plants should have a high production potential.

The emphasis of the projects should be on the production of gas that would be suitable for synthesis into methanol. If synthesis could not be performed, projects could include an anlysis of the gas and a study proving that methanol could be produced.

The invitation to tender specified that the Commission would contribute up to 50% of the overall cost of a pilot project, with an upper ceiling of 600,000 ECU for each project. A bonus of 20% could be envisaged if the project was completed and operational within the specified time of two years, excluding the experimental phase.

Finally, consideration would also be given to other pilot projects for the production and use of algae, but these would receive less financial support.

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On 18 November 1981, Mrs Rabbethge tabled Written Question No. 1293/81[2] to the Commission. The question read as follows:

How many proposals has the Commission received concerning a programme for energy from biomass?

Are there any feasible proposals among them and, if so, when are they expected to be developed into pilot projects?

What is the likely duration of the experimental period?

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[1] OJ No. L 231 of 13.9.1979, p. 30

[2] Bulletin of the European Parliament No. 45 of 18.11.1981

The Commission's answer was as follows[1]:

In all 23 proposals were received in response to the call to submit pilot projects on biomass[2] - mostly methanol plants, though there were some based on algae.

The Commission has now started talks with four companies interested in producing synthesis gas (to make methanol) from wood and other cellulosic material. The pilot plants will probably be built in the United Kingdom, France, the Federal Republic of Germany and Italy, and should be completed in the second half of 1983.

The actual duration of the experimental phase will vary from one project to another and will not be known until early 1983.

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1 OJ No. C 43 of 17.2.1982

2 OJ No. C 18 of 27.1.1981

MOTION FOR A RESOLUTION (Doc. 1-818/80)

tabled by Mr d'ORMESSON, Mrs CASSANMAGNAGO CERRETTI, Mr ALBER, Mr FRÜH, Mr LIGIOS, Mr TOLMAN, Mrs WALZ, Mr MÜLLER-HERMANN, Mr HERMAN, Mr von BISMARCK, Mr LÜCKER, Mr CLINTON, Mr DALSASS, Mr BERSANI, Mrs LENTZ-CORNETTE, Mrs SCHLEICHER, Mr GHERGO, Mr DE KEERSMAEKER, Mr WAWRZIK, Mr HELMS, Mr JANSSEN VAN RAAY, Mr K. FUCHS, Mr COSTANZO, Mr BARBAGLI, Mrs MAIJ-WEGGEN, Mrs RABBETHGE, Mr MERTENS, Mr PEDINI, Mr McCARTIN and Mr von HASSEL

ON BEHALF OF THE Group of the European People's Party

pursuant to Rule 25 of the Rules of Procedure

on the use of biomass as a source of energy

The European Parliament,

- whereas agriculture in the Community, which until recently used draught animals and was thus self-sufficient, is now dependent on energy to power its agricultural machinery which includes 4,900,000 tractors and 480,000 combine harvesters,

- whereas there has been a parallel development in demand for mineral fertilizers, fungicides, pesticides and weedkillers for crops,

- whereas demand for processed products is growing,

- whereas annual Community demand calculated in toe (tonnes oil equivalent) is running at 17.9 million for agricultural machinery, 12.8 million for the abovementioned associated uses and 20 million for the food industry, totalling 50.7 million representing a consumption of petroleum products in the region of 500 million tonnes,

- noting the increasing dangers in the Middle East and the fact that the reference price for oil has risen from $2.40 per barrel in 1974 to $12.70 in 1977, $24 per barrel in January 1978 and $34 at the end of last year,

1. Concludes that there is no time to be lost in safeguarding the independence of Community food production in terms of energy;

2. Notes in this context that one new form of energy based on agricultural products is the vegetable biomass which offers various possibilities either in solid or liquid form and which can be converted into fuel in a number of stages: ethanol, methanol, aceto-butanol, mtbe (methyltertiobutylether), synthetic petrol;

3. Notes that although the biomass, which consists of the residue of wood or vegetable crops, is dispersed over a large area giving a ratio of value/weight or value/volume which at first sight appears unprofitable and requires enormous areas and energy-generating plant located near the sites of production, the profitability of this source of energy can nonetheless be justified in terms of the need to direct the producers of surplus crops towards new types of crop, particularly those capable of use in generating energy (giant reeds, poplars, various types of short-rotation trees, water hyacinths, etc..) while use can also be made of agricultural and forestry residues (cereals, maize and rice stalks, vegetable residue, beet, ligneous residues, wood residue estimated to amount to 64 million tonnes of dry matter each year or 26 million toe);

4. Notes the scale of the areas being used to produce surpluses estimated on average at 3 million tonnes of milk and 6 million hectolitres of wine;

5. Emphasizes in this connection the need to encourage new forms of production by farmers who conclude development contracts or receive reconversion bonuses;

6. Notes furthermore that the various methods of exploiting the biomass developed by agricultural research involve production costs ranging from 150 EUA per toe for solid fuels to 325 EUA per toe for methanol and 760 EUA per toe for ethanol;

7. Notes that the ex-refinery price for fuel oil and petrol derived from crude oil amounts to between 220 and 270 EUA per toe (price f.o.b. Rotterdam 250 and 300 EUA per toe), and that there is a discrepancy of only 20% between the production costs of petrol and methanol; the comparison is even more favourable if allowance is made for the additional indirect costs of very high marine insurance premiums and the measures to safeguard oil supplies from the Persian Gulf which are so expensive that they double the real cost price according to recent studies in America;

8. Notes in conclusion, on the basis of the relevant studies, that the cost price for fuel substitutes of agricultural origin provides a comparable return per hectare to the average income from agriculture;

9. Considers that production of such fuel would be eligible for annual Community aid by means of a transfer of appropriations currently devoted to the agricultural surplus sectors;

10. Considers finally that the implementation of this economic option will open up the possibility of exports and its use in developing countries,

11. With a view to the ways in which agriculture ought to be reformed, invites the Commission to submit a report as soon as possible on the possibilities for producing and exploiting the potential of the biomass.