COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 15.10.1997
COM(97) 514 final

COMMUNICATION FROM THE COMMISSION

TO THE COUNCIL, THE EUROPEAN PARLIAMENT,
THE ECONOMIC AND SOCIAL COMMITTEE
AND THE COMMITTEE OF THE REGIONS

A Community strategy to promote combined heat and power (CHP) and to dismantle barriers to its development

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1. Why a Community strategy on Combined Heat and Power (CHP)[1].

1. In the White Paper "An Energy Policy for the European Union" [2] the Commission committed itself to present a strategy offering a coherent approach for the promotion of Combined Heat and Power (or CHP) in the European Union. This initiative is to ensure the necessary co-operation between the Community, its Member States, utilities and consumers of electricity and heat to assist in dismantling barriers to the development of this environmentally friendly and energy saving concept.

2. Global climate change poses a major challenge to us all. In preparation for the 3rd Conference of the Parties in Framework Convention of the United Nations on Climate Change in *Kyoto* in December 1997, the Council adopted a negotiating position for industrialised countries for a 15% reduction in the emissions of the principal greenhouse gases by the year 2010 and at least 7,5% by the year 2005 compared with 1990 levels. The present trend in emissions, based on the application of current policies and measures, indicates an increase in CO2 emissions of approximately 8% by 2010, which means that a reduction in real terms of 23 % may well be required. Major effort in several policy areas will be required, and in particular as regards energy production and use, as outlined in a recent Commission Communication on Climate Change- The EU Approach for Kyoto.[3]

3. Since the efficient use of energy reduces the emission of pollutants (CO2, SO2, N2O etc.) to the atmosphere, it is recognised as the single most important policy objective in attaining the E.U.'s stated objective of stabilising CO2 emissions. CHP is one of the very few technologies which can offer a significant short or medium term contribution to the energy efficiency issue in the European Union.[4] and can make a positive contribution to the environmental policies of the EU. According to estimations and in comparison to separate production of heat and electricity, the CO2 savings from 1 Mwh of CHP electricity production vary from 132 kg to 909 kg with a reasonable average of 500 kg saved CO2 per Mwh. However this does not mean that the development of CHP is a panacea for our energy management and environmental protection problems.

4. Different studies[5],[6] assess the maximum technical electricity production potential of CHP in the E.U.-15 to 900-1000 Twh per year which is about four times the

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[1] Combined Heat and Power is an interchangeable term with Cogeneration

[2] White Paper on Energy COM (95) 682 Final 13.12.95

[3] COM (97) 481 final 1.10.97

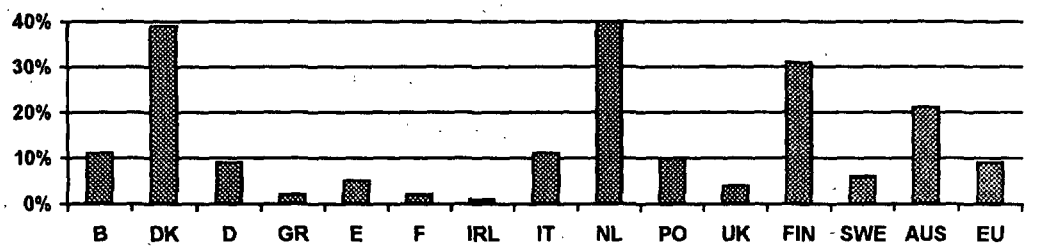
[4] The possible use of biomass as a primary fuel source make CHP schemes even more environmentally friendly. The use of natural gas as input fuel in the place of coal or oil has also a positive environmental impact.

[5] DEA Sigurd Lauge Petersen. 2.06.97

[6] Regulation and Energy Conservation; the case of Combined heat and Power in the EU. Situation and Prospects. Chris Hendriks and al. Feb. 1995.

amount of CHP produced electricity in 1994 and represents 40% of the total annual electricity generation in the Community in 1994. Rough estimations indicate that full exploitation of this potential replacing existing electricity and heat production plants, could reduce CO2 emissions by 300 Mt per year or 9% of the EU-15 total of 3457 Mt in 2010 (conventional wisdom scenario)[7]. Despite this, the penetration of CHP in the E.U. (expressed as the CHP electricity production by private and public utilities as a fraction of the total electricity production) had decreased in the period 1974-1990. The electricity production by CHP plants in the European Union is disappointing and varies significantly between Member States, from 1% to 40%. Only in recent years has this negative trend been reversed.

% of total gross electricity generation by CHP in the EU.



5. New E.U. initiatives are now shaping the future structure and function of Europe's energy industries. This changing legal framework creates a new situation for CHP, where there is less price stability and increased environmental concerns. In this new framework for the energy industry CHP should play more than a marginal role and it is vital that efforts to promote CHP should be consistent with the new industry dynamic. The Commission fully shares the Council's[8] opinion that CHP production should be promoted as a measure "protecting the environment and reducing energy dependence on satisfactory economic terms". It also shares the Parliament's[9] view "to publish as quickly its communication on CHP ...to encourage the use of CHP in the Member states and to eliminate existing hindrances...".

6. **The purpose of this communication is to propose a strategy, in the context of E.U. energy policy, which will facilitate the development of CHP in Europe and its penetration in the European energy market as an energy saving and environmentally friendly system of heat and power production. The Commission believes that this strategy has to be based on an appropriate combination of mutually reinforcing measures at both the Community and Member State levels. It must also be consistent with and take into account the different Community policies which will potentially be affected.**

[7] European Energy to 2020. A scenario approach. EC spring 1996
[8] Council Resolution on the Green Paper for a European Union Energy Policy O.J. C327 of 7.12.95.
[9] Report on the Commission's White Paper on an Energy Policy: PE 217.771/fin

2. Existing Community Measures in Support of CHP.

Legislative

7. The Community has promoted the concept of CHP since 1974 when an industrial expert group was set up to investigate the possibilities of improving the conversion efficiency of thermal power stations. Following a suggestion of this group a Council Recommendation (77/714/EEC) was adopted on 25 October 1977, inviting Member States to set up advisory bodies or committees with the objectives of :
a) giving an opinion on all measures likely to lead to increased efficiency in the supply of power and heat,
b) identifying and eliminating non-technical obstacles to the development of CHP,
c) encouraging CHP and heat transport schemes.
Almost all countries set up these advisory bodies which made an effort to promote the idea of CHP under the difficult conditions of a non-liberalised energy market, at a period of low electricity prices and less environmental concerns.

8. A second Council Recommendation (88/611/EEC) of November 1988 dealt with the promotion of co-operation between public utilities and auto-producers of electricity essentially using renewables, waste fuels and CHP. Its main purpose was to remove legal and administrative obstacles by introducing the following policy principles:
   - obligation on public utilities to purchase surplus electricity from auto-producers,
   - fair authorisation procedures for privately owned power stations,
   - remuneration by public utilities in line with the principle of avoided costs, that means fuel as well as capacity costs, and
   - non-discriminatory treatment as regards supplies of electricity to the public grid.

   In July 1992 the Commission reported to the Council[10] on the progress with this Recommendation. The overall conclusions were that co-operation between auto-producers and public utilities had considerably improved, but that there were still constraints to be removed if CHP was to realise its potential. The relationship between auto producers and electricity production utilities and the lack of progress in achieving the internal market in electricity were considered as the main obstacles for the CHP development.

9. The Energy Charter Treaty introduces a framework for energy co-operation and trade between the signatories. The Treaty addresses a number of issues, including transit of energy supplies, energy efficiency, and foreign investment in energy plant. The Energy Efficiency Protocol, when implemented by all partners, will represent an important new framework for CHP in the signatory countries. In the

[10] SEC (92)1411 final of 22 July 1992

protocol, support to promotion of CHP and measures to increase the efficiency of District Heating are explicitly mentioned.

10. The Directive concerning the liberalisation of the electricity internal market[11] offers the possibility to Member States to give priority to CHP plants when the system operator is dispatching generating installations. The new Directive concerning "common rules for the internal market in natural gas", under discussion by the Council and the European Parliament, is expected to increase the availability of gas at more competitive prices and so contribute to the economic viability of gas fired CHP plants.

11. A new proposal for a Council Directive entitled "Restructuring the Community framework for the taxation of energy products"[12] was adopted by the Commission on 12 March 1997 and offers the possibility to Member States to grant fiscal advantages to renewable energy sources and to cogenerated heat.

Technological:

12. Energy saving was among the most prominent fields in the Research and Demonstration programmes which the Community undertook since 1974. JOULE and THERMIE being the Research and Demonstration component of the Non Nuclear Energy programme in the context of the 4th Framework programme supported several activities concerning CHP. Urban heating and cooling, heat transport, heat storage and district heating have been priority fields of support for these programmes. The THERMIE programme have supported for example, in the industrial and tertiary sectors, 37 demonstration projects with about 27 MECU in the period 1990-1995. Dissemination and promotional activities have also been supported under the THERMIE programme. This includes the publication of Maxi Brochures and reports, studies into emissions of NO_x, co-operation with third countries, and promotional events.

Non-technological:

13. The SAVE programme aims at promoting energy efficiency through policy measures, through pilot actions in support of Member States' energy efficiency infrastructures, and through a comprehensive information programme. Twelve CHP projects have been supported within the SAVE I programme. They consisted in the main of studies of the various barriers to the implementation of CHP. Their aim was to identify and disseminate practical ways of overcoming non-technical obstacles to the efficient working of the market. SAVE has also supported through EUROSTAT the gathering of coherent statistics on CHP development in the 15 Member States.

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[11] Directive 96/92/EC O.J. L27/30.01.97

[12] COM (97)30 final

14. Energy and environment have been priority sectors for the PHARE and TACIS programmes which also support activities promoting energy efficiency and CHP in Central and Eastern European Countries and the New Independent States. Under the PHARE programme, the improvement of existing district heating systems in the cities of Central and Eastern European Countries has been supported.
TACIS runs a wide range of energy projects in the New Independent States which were supported with 228 MECU during the period 1991-1995. Energy saving methods and co-operation with municipalities to evaluate District Heating systems are priority areas for this programme.

15. The SYNERGY programme financed actions promoting CHP in four Latin American countries. In the framework of economic co-operation with Asia a project was launched to promote industrial heat and power generation from biomass or residues. Additionally the European Investment Bank funded several projects promoting CHP in the EU, and in CEEC's. In the period 1992-1996, the bank signed individual loans concerning CHP plants amounting 1195 MECU.

16. All these measures were complementary to national policies promoting CHP. The attached annex gives a description of CHP and its development in Europe.

3. The barriers to CHP and District Heating and Cooling.

17 A review of the barriers to the development of CHP in the E.U. Member States was carried out by Cogen Europe and the SAVE Programme in 1995[13]. This section provides a summary of the highlights of that report and other work done on the subject. In examining the conditions which affect the development of CHP in each Member State, the highly heterogeneous nature of that development becomes obvious. Different barriers arise in different economies. These depend on the structure of the energy system, the nature of the demand for heat and electricity etc. Therefore, the governments of Member States have established very different policy approaches.

18. The over-riding factor in all cases is the national policy on CHP. The cases of Denmark, Finland and the Netherlands indicate that sustained co-ordinated policy initiatives can be successful in overcoming the obstacles to growth in CHP and in providing a favourable framework for its development.

19. The relation of CHP plants with the power market is still of greater importance. An independent cogenerator relates to the power grid in three ways. First he buys power from the grid to meet his peak power loads or to substitute purchased power for self-generated power when this is an economical option during particular periods. Secondly he sells his extra power production to the grid. Thirdly he takes back-up power from the grid when his own plant is out of order. In most countries these transactions are not regulated in a way to guarantee the independent producers a non-discriminatory access to the power grid. On the first

[13] The Barriers to Combined Heat and Power in Europe, Cogen Europe. May 1995. The European Cogeneration Review May 1997.

issue, the satisfactory practice of applying the general tariff conditions on the peak and additional electricity consumption of the cogenerators is in place in many areas. Remuneration of power sold to the grid remains a critical point even when the principle of "avoided costs" is widely accepted. For independent CHP plants a major problem remains the provision of back up power by the grid. Loaded back up power payments especially dissuade industrial and commercial investors in CHP.

20. The classification of different types of barriers and the consideration of their impact is, of course, a subjective exercise. Three broad classes of barriers have been defined. These are:

Economic barriers. These include, for example, unreasonably low rates of remuneration for cogenerated electricity exports, high prices for grid electricity in case of unavailability of the CHP plant, non availability of natural gas at competitive prices, high rates for input fuels (e.g. natural gas), short term contracts and unpredictability in energy prices, hence difficulties in financing CHP systems and District Heating networks, lack of relevant market instruments to internalise external environmental costs;
Regulatory barriers. These include emissions and planning regulations, bureaucratic time consuming or expensive procedures to obtain operating licences, etc.
Institutional barriers. These include the attitude of utilities to the connection of CHP plant, delays and lack of transparency in obtaining permits, etc. There are very few countries where there is totally free access to the electricity network; in some although, access is possible but it is restricted and costly.

As a conclusion it seems that many of the important barriers to the development of CHP in Europe result from the relationship between cogenerators and electricity production utilities. Obstacles to free access to the grid, inadequate payments for sales of surplus capacity to the grid and high tariffs for stand-by and top-up supplies are key factors impeding the penetration of CHP even in a partly liberalised European Energy market.

21. Comparisons can be made between the situations in different Member States. The situation in France and Italy appears to be strongly influenced by the market dominance of the existing utilities. This market power could, of course, be harnessed in favour of CHP if the regulatory situation were to change. In the current situation, it acts as a barrier to new market entrants by distorting the economics in such a way as to make CHP appear to be economically unattractive. This situation can be contrasted with the UK where the market liberalisation is nearly complete, and many of these artificial barriers have been overcome or reduced. The UK has generally been a below average performer in the development of CHP, although in recent years the trend has changed significantly and the market has grown. The reasons were liberalisation and gradual removal of market barriers. Since fuel taxes do not mostly reflect the environnemental costs of energy production, CHP is not favoured. In some cases, the structure of the tax itself is unfavourable. In Finland and Sweden, for example, heat from CHP is taxed but the waste heat of conventional generators is not.

Other differences in CHP penetration relate to fuel mix, but since some modes of electricity production do not generate CO2, the impact of low CHP penetration on greenhouse gas emissions in different Member States varies. Sweden and France are examples where the nuclear and hydro capacity does not leave much room for CHP development. In the cases of Greece and Portugal the limited availability of natural gas, presently the favoured fuel for CHP, creates difficulties for CHP penetration, even though CHP can also be generated in oil or solid fuel plants.

Specific barriers to district heating and cooling (DH&C)

22. The barriers examined above affect the development of CHP. However, there are a number of specific barriers which affect DH systems. The first is an economic one. Because of the distances over which heat must be transported, the cost of installing an extensive DH network is significantly higher than the costs of installing a CHP system. This may mean that the pay back period for DH can be more than ten years. During its operational lifetime, the DH network needs a steady market for the heat output, must secure fuel inputs at competitive prices and must be prepared to match competing sources of heat for price and availability. The very competitive situation of gas distribution networks also can act as a disincentive for investment in District Heating schemes.

23. Trends in energy consumption indicate an increasing use of electricity and a stagnant market for heating. Electricity consumption is rising due to increasing use of domestic appliances, information technology equipment and industrial automation, while improved building standards and insulation result in static demand for heating. In these conditions existing DH networks meet increased difficulties to their development. New CHP plants with lower heat to power ratios might be needed. It appears that future developments in DH will be in reasonable extension to existing networks and in smaller scale systems where the distances over which heat is transported are limited. It will, of course, be necessary to optimise such installations for heat demand. Another development may involve small systems of only a few MWe in terms of power capacity which might gradually be interconnected as the heat load is growing.

24. A key aspect for the development of DH&C systems, which are complementary, are local climatic conditions; longer heating / cooling period shortens the payback. The technology behind district cooling is rather new for Europe and is not yet sufficiently economic to widely enter the market. Large scale district cooling systems face high capital costs for energy transfer infrastructure. The efficiency of existing technologies, and the high investment costs are limiting factors for the development DH&C concept today.

4. A European Combined Heat and Power Strategy

25. The 1995 White Paper for Energy outlines three central tenets to establish a coherent framework for implementing a Community energy policy; competitiveness of European businesses in the context of the growing globalisation of markets, environmental protection and security of supply. The more recent Communication "An overall view of energy policy and actions"[14] reaffirmed those strategic challenges.

26. The potential of CHP to contribute significantly, and cost effectively, to all three tenets of energy policy is clear. CHP as an energy saving concept increases the competitiveness of enterprises, is environmentally friendly and contributes to the safeguarding of energy supplies. Therefore, a strategy for the promotion of CHP represents a re-enforcement of the Community energy policy. The contribution of national energy policies to Community energy objectives is essential. The Community proposal for a promotion strategy of CHP provides guidelines for these policies while ensuring that the market conditions implied by the Community's Internal Market proposals are consistent with the application of new energy options. It is worth mentioning that CHP schemes also contribute to the competitiveness of the industrial and commercial sectors and at the same time generate jobs.[15] [16] An analysis of the employment effects due to the penetration of CHP in the electricity generation system in the Netherlands, based on two scenarios for the electricity generation system, shows that a 44% penetration of CHP (compared to 12% in the reference case) would increase the net employment for construction by 19% and the annual employment for operation and maintenance by 22%.

27. One of the features of the development of a sustainable E.U. energy policy, within a climate of increasing competitiveness, is the growing importance of decentralised or localised power production. This trend will lead to new technological innovations and changes in electricity industry structures, and result in smaller scale production of electricity, often at the point of use. A coherent Community energy policy must take account of these trends by ensuring that both CHP and renewable energy sources are fully exploited as mentioned in the Commission Green Paper titled "Energy for the future: Renewable Sources of Energy"[17].

28. This strategy aims to set out the main actions and policies which are required at the E.U. level to ensure that the benefits which CHP can bring, in terms of energy saving, cost-effective environmental improvement and sustainable development, are fully achieved. On the basis of the analysis in the first part of this Communication the Commission believes that an overall Community strategy to promote CHP should be based on the following elements:

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[14] COM (97)167 final of 23.04.97

[15] CHP : The impact on employment. CHPA.The New Economics Foundation . October 1995.

[16] Employment and energy efficiency improvement. A case study for CHP in the NL.

[17] COM (96)576 final of 20.11.96

4.1 Objectives of the strategy

29. In 1994 the electricity generation by CHP plants was 204 Twh[18] (9% of the total electricity generation in 1994). With 29 GWe of new CHP installed capacity (conventional wisdom scenario) or 48 GWe (pre Kyoto scenario) in the period 1994-2010[19] this production could reach the 11% or the 14%[20] respectively of the total electricity generation in 2010. The Commission believes that this anticipated growth has to be reached and if possible exceeded. A significant effort is required to achieve significant results. According to analyses made, a doubling of the current share of CHP from 9% to 18% of the total gross electricity generation of the Community produced by CHP by the year 2010, is realistically achievable. This would imply doubling the existing installed CHP electrical capacity and increasing the annual load factor by 30% and would require that Member states remove the various obstacles to greater penetration of CHP in their energy systems. The environmental benefits would be significant. A rough estimate indicates that if a doubling of CHP share were achieved, considered as replacement of existing electricity and heat production plants, could reduce CO2 emissions by 150 Mt. per year or approx. 4% of the total EU CO2 emissions in 2010[21].

    Some industry sources consider that the potential of CHP development should be even further exploited, and have suggtested that as much as 30% share of CHP in gross electricity generation is possible by 2010[22]. However, the Commission believes that it would be more realistic to aim for least the doubling of the current 9% share of CHP until 2010.

30. Policy objectives are important in order to give a clear signal to all market players of the importance which the Community attaches to a particular initiative. Apart from the overall Community strategy and objectives it is important for Member States to develop their own national strategies and objectives. The Commission recognises that there has been very heterogeneous development of CHP in the Member States,and appreciates that national objectives for CHP would be dependent on national circumstances and requirements. While the Community can play a useful supporting and coordinating role for promoting CHP, the main focus of the effort has to lie with the Member States. Several Member States have already set specific objectives for CHP and the Commission underlines the need for the other Member States to do so as well.. This would make possible the achievement of the necessary significant increase of CHP at Community level.referred to earlier. The CHP development in the Netherlands, Denmark and Finland (see annex) shows that consistent strategies and objectives can result in extended penetration of CHP in the energy markets.

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[18] EUROSTAT see annex

[19] European Energy to 2020. A scenario approach. EC spring 1996.

[20] assuming an average load factor of 3.500 hours.

[21] Emissions: 3457 Mt. in 2010 according to the conventional wisdom scenario.

[22] "Programmes and Prospects for the European Electricity Sector", UNIPEDE 1996

31. The establishment of national objectives requires strengthened cooperation and the use of a common methodology, for which the Commission will provide the necessary guidance. These objectives should be expressed in terms of national electricity production and progress at national level should be reported to the Commission regularly. The overall development in CHP penetration at European level should be monitored annually. Amongst other benefits this would allow the Commission to better quantify the achievement of CO2 emission reduction/stabilisation.

4.2 CHP and environment

32. Global environmental problems arising from a growing world-wide energy demand have to be seen in the context of an increasingly internationalised economy. CHP is an environmentally friendly concept of energy production having the potential to contribute significantly and cost effectively to the security of supply and competitiveness policy aims of the Community.
The synergy between combined heat and power production and district heating or cooling networks should be better exploited and the use of biomass in CHP, as the experience of Finland and Denmark shows, could be a factor in increasing the penetration of this environmentally friendly option. CHP will constitute an important element of the Community CO2 reduction policies and, as it is mentioned in the Council Common Position[23] on the European Community programme "Towards sustainability", a priority. The Fifth environmental programme activities should also continue to promote CHP as a CO2 saving technology through tax incentives, internalisation of external costs and benefits, and the setting of emission standards for combustion plants.

4.3 Increased share of funding to CHP by E.U. programmes.

33. While it is recognised that it is for Member States to undertake the main financing efforts, a reorientation of E.U. programmes emphasising CHP is essential given the limited alternative possibilities open to the Community to rapidly decrease CO2 emissions. CHP has a demonstrated advantage in this area specifically when biomass and organic waste are used as input fuel. There are also large energy saving potentials and CO2 emission reduction possibilities through CHP in third countries.

34. **JOULE-THERMIE**: While CHP and DH&C technologies are generally quite mature in their development, and are widely used under full market conditions, there is a continued need for their further technological development. The European Parliament has recognised this fact and asked the Commission to encourage the 'wider application of CHP technology'.[24]

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[23] Common Position (EC) No 20/97 adopted by the Council on 17 April 1997. O. J. No. C 157 , 24/05/1997 P. 0012

[24] Report on the Commission's White Paper on an Energy Policy: PE 217.771/fin

These developments include improvements to cost effectiveness, adaptation to new types of application, integration of non conventional fuel process (renewables, gasified coal, landfill gas, waste,...) and improvements to combustion systems to meet tightening emissions standards. Without such development, the use of CHP may not be extended and may not be adjusted to the continuously changing energy market. Biomass as a fuel for CHP/DH systems deserve specific support. This applies also to the use of new coal cycles, and energy from waste technologies. Within CHP production, the short term development targets focus on improving the performance and reducing the equipment cost through development of better materials and manufacturing processes, as well as improving control and monitoring systems. In spite of the fact that best practice in design and operation of CHP systems are well developed, knowledge and experience are not as widely available as may should be.

35. In the context of the preparatory work for the 5th Framework programme the identified[25] key areas for technological development in CHP include:
    - Higher conversion efficiency, leading to greater energy savings;
    - Monitoring, control and optimisation of DH networks;
    - Increased reliability, leading to lower maintenance costs;
    - Lower emission technologies, particularly to reduce NO_x emissions from gas turbines and reciprocating engines;
    - Cost effective mini CHP, below 30 kW_e ; and micro CHP to as low as 0.5 kWe;
    - Materials and construction procedures for CHP boilers as well as low cost pipe materials;
    - Low cost pre-fabricated components for low temperature DH systems;
    - CHP for use in the high temperature industries;
    - CHP using renewable fuels, e.g. biomass, LHV (low heating value) fuels and mixed fuels;
    - Alternative prime movers, e.g. Stirling engines, fuel cells.
    - Solutions of the environmental problem caused by the smooth water technology

    In the district cooling sector the development of technologies which could lead to larger differential temperatures and lower flow rates in central generation and transport systems, as well as the development of heat driven absorption chillers should be supported; they will significantly improve the economics and annual load of DC systems. Additionally research into the development of methods and instruments helping to suppress the non-technical barriers to the implementation of eco-efficient technologies and more generally of sustainable development should also be promoted.

    The Commission's proposal for the 5th Framework programme has objectives having scope for advancing technological development of CHP and the

[25] Improving Market Penetration for New Energy Technologies: Prospects for Pre-Competitive Support, DG XVII. October 1996. Henrik Lund. Confederation of Danish Industries

Commission will strengthen its support to the dissemination of best practice expertise via appropriate channels and programmes.

36. SAVE II and ALTENER: The existing SAVE II and ALTENER programmes are designed to find solutions to overcome non-technical barriers which restrict the use of energy efficiency and renewable energy technologies. They can be used as tools to ease CHP penetration in the European market. SAVE II will increase its support to actions promoting CHP and more specifically to actions which:
    - improve awareness of financial solutions and Energy Service Company (ESCO) involvement[26] (e.g. third party financing of CHP projects);
    - map the demand for energy services which could be met by CHP;
    - determine CHP potentials based on economic, energy and environmental criteria;
    - further investigate barriers to CHP and DH&C in the new liberalised energy market and find ways to overcome them, taking into consideration social and economic factors, environmental impact and security of supply;
    - disseminate information on CHP and DH&C. International Associations could play a major role in this field.
    - Specific attention will be paid to the market penetration of cooling by DH driven cooling machines

    The ALTENER programme will continue to promote market penetration of biomass- fired boilers including CHP/DH&C schemes.

37. **PHARE, TACIS, Synergy and MEDA**: The E.U. PHARE and TACIS programmes are European initiatives for the Central and Eastern European Countries, the New Independent States and Mongolia. They provide support to the process of transformation of these countries to market economies and to strengthen democracy. Energy is one of the main priorities of TACIS and CHP projects are frequently supported especially in conjunction with the existing CHP based District Heating networks.
    The SYNERGY programme, responds to the need for international co-operation in the energy sector and finances actions promoting CHP in Latin America and Asia. This programme could be an important vehicle for the promotion of CHP applications in a wide range of third countries.
    As mentioned in the guidelines for the indicative programmes concerning the financial and technical measures in the framework of the Euro-Mediterranean partnership (MEDA), energy and environment are sectors where particular attention should be paid. Promotion of CHP through technical assistance and preparatory studies related with district cooling presents an environmental and economic challenge for the countries of this region.
    In ACP-EC co-operation particular emphasis is placed on energy programming, operations for saving and making efficient use of energy, reconnaissance of energy potential and the economically and technically appropriate promotion of new and renewable sources of energy (art. 105 of the LOME IV Convention). Promotion

[26] idem

of CHP could be one element in the energy development strategy of these countries.
As part of an overall strategy to open up the market to CHP, the Commission will strengthen the CHP and DH&C actions within all these programmes.

38. **Structural Funds:** Less favoured European regions (and mainly regions of Objective 1) can be granted Community support for the development of energy efficiency schemes. In Greece for instance, CHP is one of the priorities of the operational programme for energy. The Commission will encourage Member States to adopt the development of CHP as a priority of national energy programmes financed by the above funds.

4.4 Negotiated agreements with industry, technology procurements

39. The Commission proposal for the review of the Fifth Environmental Action programme (a major action plan aimed at speeding the process of improving the environment of the Union) which was adopted by the Commission on 24th January 1996, indicates that special attention should be given to agreements with industry in order to broaden the range of instruments, and this is underlined in the Commission Communication on Environmental Agreements[27].

40. Agreements could be negotiated containing specific efficiency targets with those industrial sectors where there is a high potential of energy saving by using CHP. It is essential that utilities are associated with this agreement because of the important influence which they can have on CHP through the pricing for export or wheeling, and by determining the conformity of CHP with technical requirements for grid connection.

41. In order to upgrade the CHP concept, the Commission will also encourage the development of innovative and economic CHP schemes through the so called technology procurement mechanisms. The idea is to bring a group of purchasers together, identifying potential improvements of a product or a manufacturing process and issuing a specification. Manufacturers are then free to send in tenders; these are evaluated and the selected winner is assured of a certain initial order. These procedures have been used successfully by Member States and facilitated the penetration of innovative technologies in the market.

42. CHP modules of wide application will be defined and a call for tender could be launched where interested parties could bid low-priced and innovative CHP technology solutions which could be attractive to a large buyers group, e.g. industries, hospitals, large administration buildings etc.

[27] COM(96) 561 of 27.11.96

4.5 *Information exchange and co-operation between Member States*

43. In the Council Resolution of 8th July 1996[28] on the White Paper for Energy the Commission was asked to put in place a process of co-operation between the Community and the Member States in order to ensure the compatibility of Community and national policies with the agreed common energy policies.

44. In line with the above Resolution, the Commission adopted on 4 October 1996 a proposal for a Council Decision concerning the organisation of co-operation around agreed Community Energy Objectives[29]. The draft decision identifies the promotion of the rational and efficient use of energy resources as one of these objectives.

45. In the Commission's opinion the above proposed Council Decision will create a framework facilitating the co-operation and the exchange of information and experience between Member States on CHP. An expert group acting as consultative committee could ensure the permanent collaboration between national authorities and the Commission and an information exchange on policies and measures concerning CHP and DH in Europe.
Targeted information actions in specific industrial and tertiary sectors (hospitals,sport centres etc.) will be undertaken in the context of existing E.U. programmes.

4.6 *Monitoring of the impact of the liberalisation of the European energy markets on CHP/DH.*

46. One of the Commission's main energy policy objectives is the liberalisation of energy markets. This liberalisation will provide competition in the supply of energy, increasing transparency in pricing, improving access to electricity and gas networks, and promoting utility and Energy Service Companies (ESCO) involvement in CHP. Although the overall impact of liberalisation on CHP is likely to be positive, it will have different impacts on the different CHP applications[30]. The price reductions that liberalisation is likely to bring about represent both an opportunity and a threat to CHP. Input fuels might be available at lower cost but CHP produced electricity will have to compete with lowered electricity prices. One of the principal remaining barriers to CHP in the liberalised markets is the failure of energy prices to reflect the cost of environmental externalities.

    It is, therefore, essential to monitor the influence and to assess the impact of the new energy market rules on CHP and DH schemes and to propose, if necessary, appropriate measures to prevent negative effects. In this context the national CHP committees, created under the Council Recommendation 77/714/EEC, could play a useful role.

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[28] O.J. no. C 224 of 1.8.96

[29] COM (96) 431 final. O.J. C 027/ 28.1.97

[30] An assessment of the impact of the liberalisation of the European energy markets on CHP, energy efficiency and the environment. ILEX Ass. & Ramboll. Dec. 1996

47. The monitoring of the Community achievement for progress in CHP share of the market, as recommended in this Strategy, would entail annual statistics gathering. The Commission, will require Member States to continue to report statistics annually and, through EUROSTAT, will ensure that a common statistical basis is used for this survey.

4.7 Internalisation of external costs

48. As it was already mentioned the use of market instruments to accomplish environmental objectives will require the use of methodologies which internalise the environmental costs of energy supply. In the context of the Fifth Environmental Action programme[31] the internalisation of external costs and benefits in the energy sector through tax incentives is a key priority for the integration of the environment into other Community policy areas. Energy taxes could act as a stimulus reinforcing CHP's already existing competitiveness in the field of electricity and heat production. The Commission in its proposals for restructuring the framework of taxation of energy products[32], gave consideration to the energy and environmental benefits of CHP, and proposed tax exemptions.
Further support of CHP plants using biomass as input fuel should also be envisaged. It has been indicated that the internalisation of external costs offers an effective means of reflecting environmental challenges within the internal market, without prejudice to the rules of the Treaty governing State Aid.
CHP is a means of improving energy efficiency and of reducing pollutant emissions and as such the principle of internalisation of costs could stimulate the use of CHP technologies. The imposition on the energy distributors of a purchase obligation for electricity produced by CHP plants is a concept which could be examined in the context of the additional measures needed for the reduction of CO2 emissions to 2010.
The Commission will further examine ways in which it can integrate the energy and environmental benefits of CHP in its taxation policy.

4.8 Financial instruments

49. Third party financing was developed to help companies finance investment without affecting their balance sheets. A user of an efficient and environmentally friendly concept such as CHP does not finance the initial outlay. Instead he reimburses the technology supplier by making payments related to the performance of the technology installed. Other forms of TPF include energy services contracts provided by energy service companies (ESCOs) or utilities which through CHP can offer new services to their customers. A wide variety of arrangements are possible. Under these contracts an energy service provider, which can be an energy utility, agrees with the user on the site needs for heating, lighting, power etc. It is the responsibility of the contractor to find the most economic method of providing these services, which often involves installing cogeneration plant. This investment is made and managed by the ESCO, who

[31] COM(95)647 final O.J. C 140 / 14.5.96
[32] COM (97) 30 final OJ C139/6.5.97

covers it in the charges for the energy services. The efficiency of cogeneration means that these charges will be lower than the previous site energy costs. In this scenario, all sides of the financial deal profit. Different Community programmes can promote this financial scheme stimulating activities and co-ordinating interested parties.

The European Investment Bank (EIB) in the period 1992-1996 supported CHP with loans amounting 1195 MECU. This effort is important and EIB should strengthen its support to CHP projects in industry and the tertiary sector.

5. Conclusions

50. The Commission is of the opinion that the CHP share in E.U. energy production should be increased significantly in order for the EU to achieve its energy policy objective of improving energy efficiency and its environmental objective of reducing greenhouse gas emissions. The strategy put forward in this communication is essential, if the Community is to increase significantly its total gross electricity generation by CHP by at least doubling the current share by the year 2010, and if it is to seriously promote Combined Heat and Power (CHP) and District Heating and Cooling (DH&C). While there is scope for action at European level, the major responsibility for promoting CHP has to lie with the Member States. The Commission therefore calls on Member States to evaluate policies for removing_obstacles to CHP penetration and to base their national strategies and objectives for promoting CHP on this evaluation within a coordinated Community strategy framework.

This Communication responds to the Council's and the European Parliament's call for Community measures promoting CHP which, as the Council has recognised, "protects the environment and reduces energy dependency, on satisfactory economic terms". On the basis of the reactions from the other European Institutions to this proposed strategy, and taking into account the final outcome of the Kyoto negotiations, the Commission will consider how best to propose and implement an Action programme to promote CHP.

51. The Commission invites the Council, the European Parliament, the Economic and Social Committee and the Committee of Regions.

- to consider the proposals contained in the present Communication and come forward with further suggestions for actions both at Community and Member State level;
- to confirm the general strategy put forward under chapter 4 above and promote the development of strategies at national level;
- to collaborate with the Commission in the realisation of future actions for the promotion of CHP.

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ANNEX

1. General principles of CHP

1.1 Description of CHP

CHP involves the simultaneous production of thermal and electric energy from the same primary fuel source. For a given application, this is achieved through one of a number of different electricity generation technologies in which heat is diverted part-way through the electricity production process and used to satisfy thermal requirements. From a thermodynamic perspective, CHP offers efficiency advantages relative to the available alternatives.

The efficiency gains represented by CHP may be significant, but will vary depending upon the technology and fuel source employed and displaced by CHP systems. An efficient CHP plant can convert approximately 85-90% of the energy content of the fuel into useful energy. Although a small part of the heat will be lost before the heat reaches the consumers the total efficiency will remain in the area of 80% or more. Conventional electric production systems typically convert 30-40%, with new combined-cycle gas turbine systems capable of up to 55%. In the case that the heat demand will be covered by heat generation plants with an efficiency of 90% the total efficiency for the separate production of electricity and heat will be up to 70%.

The development of CHP/DH offers high energy conversion rates and lower emissions of CO_2 which is the most important greenhouse gas. Another opportunity that CHP offers is the development of decentralised forms of electricity generation providing high efficiency and avoiding transmission losses. Summarising, optimised CHP/DH is an environmentally friendly method of energy production reducing fuel need and increasing competition in generation; for this reason it could be considered as a vehicle promoting liberalisation in energy markets.

1.1.1. Industrial CHP

CHP is a technique in use from industry for more than 50 years. What is necessary for the user is to have medium or high demand for thermal energy (steam, hot water, hot gases, cooling etc.) over prolonged periods of time (more than 5000 hours/year). Power generation industry, manufacturing industry (chemicals, paper industry, iron and steel, ceramics, motors, food, textile, timber, bricks and heavy clays etc.) and service industry (hospitals, sport centres, hotels) are areas where CHP systems are an option for the investors.

Industrial CHP installations can operate for 8000 hours/year or more. Therefore, in industrialised countries, the heat potential in industry is large enough to enable CHP to provide a significant proportion of the baseload demand for electricity.

1.1.2. District heating and cooling (DH&C) CHP

District heating or cooling means centralised production and distribution of thermal energy. The heat is produced in thermal plants, and is circulated through a pipe network to the users in the form of steam or hot water. The DH&C system can be thought as the sum of the production facilities and distribution / return network. The most common competitor to DH are individual heating systems. A considerable number of DH schemes continue to be supplied by heat only boilers. However DH has become is a major application of CHP and extensive large systems have been developed in Scandinavia, Germany and central/eastern Europe. These are mostly owned and operated by municipal authorities and can be fed by waste incineration plants and other means including geothermal heated heat pumps. In addition, district cooling offers considerable potential in Europe. With recent developments in engine and gas turbine technology, there is now great potential for the development of more localised DH/CHP systems - sized to meet the heat demand - and serving smaller heat distribution networks. The penetration of CHP in DH is different in the Member States, rising from 22% in France to 92% in the Netherlands .[33] (percentage of DH systems running in CHP mode).
In several Member States electricity consumption for cooling produced by compression equipment can reach 50 % of total electricity consumption in summer. The coexistence of District cooling and Heating systems can achieve significant reductions in costs by transforming part of the electricity consumption into heat consumption and increasing the working time of the CHP/DH systems.

1.1.3 Residential and commercial

These CHP systems are used in hotels, sport and leisure centres, hospitals and multi-residential accommodations. They are smaller units comprising a diesel engine which has been converted to run on natural gas, a generator and a heat recovery system, generally housed in a container. The diesel engines can also be dual- fuelled. The heat recovery is via the engine's cooling circuits and its exhaust. To ensure a high availability of electricity there must be a simultaneous use for the heat or heat storage facilities. A method increasing the use of recovered heat is to produce cooling using absorption chillers. This allows the CHP system to run during the summer months, when the lower demand for heating would otherwise reduce the opportunity for system operation.
For larger building complexes, gas turbines and larger reciprocating engines are used, as in industry.

1.2. The economics of CHP

The energy user wants cheap energy. CHP will therefore be promoted only if it offers cost benefits in comparison to separate heat and electricity generation.

[33] CHP in IEA Member States / Paris October 1994

Factors that govern the economics of CHP projects are mostly analysed in three interrelated groups: load factors, plant characteristics and terms of trade with the outside energy markets. A CHP plant has maximised benefits when it is sized according to heat demand. Suitable and available heating and cooling loads are therefore prerequisite for the CHP development.
Patterns of heat and electricity demand and annual operating hours set the technical and economic limits for the technological choices. The type of technology, the scale of the plant, and the type of prime mover all depend on the loads one will have to face. Plant characteristics such as capital cost, operating and maintenance expenses, efficiencies, etc. of course have their impact on the profitability of CHP projects. But what makes CHP projects particular is the interrelation with the energy markets. On the one hand the market for fossil fuels set the price conditions for the prime mover (natural gas, oil or coal in most CHP plants), the energy input being a major cost item of all CHP plants. On the other hand one of the CHP outputs, i.e. heat or steam, competes with single heat or steam raising facilities also fired with fossil fuels.

While CHP provides an undoubted cost-effective energy option in the right circumstances, the investment requirement for CHP systems can represent challenges. Obtaining finance for a CHP installation is a barrier which has to be faced by many potential users. Some users are also reluctant to invest their own funds, or borrow funds, to invest in energy production as this is seldom a core part of their normal activities. Financial instruments as Third Party Financing (TPF) can be used for CHP investments in industry and in the tertiary sector.

2. CHP in E.U. Member States

A geographically and vertically fragmented structure of the electricity industry favoured in the past the industrial auto production but it mainly eased the activities of heat and electricity distributors, as in Germany . The CHP development in this country, where it plays an important role, was based on the existing heat and electricity networks of local distributors, which were supported after the oil crisis of the seventies. In Denmark where municipal heat networks also existed CHP was developed by the managers of these networks supported by local distributors and in the case of big cities by local producers-distributors linked to the municipalities. In the Netherlands where the heat networks are less developed, gas and electricity distributors developed industrial CHP units based on the benefits from gas savings. On the other hand in monopoly energy markets as in France, Belgium, Greece and Ireland auto production and CHP are less developed. The unbundling of an electricity system in production, transport and distribution sectors may favour the development of CHP and may offer opportunities to interested parties to search for profit opportunities as we can actually see in the United Kingdom.
The circumstances for the development of CHP in the 15 Member States of the E.U. are very different. Not only the climate and the population density vary considerably, but also factors like fuel prices and availability, competitiveness of the electricity provided on the grid, industrial structure and environmental considerations are quite different; specific factors such as the presence of large natural gas resources in the Netherlands and heat distribution networks in Denmark also play an important role.

In the following table the present situation of CHP development in the 15 countries of the European Union is presented:

Total gross electrical installed capacity (MW) and total gross electricity generation in 1994 (GWh) in E.U.-15. Source : EUROSTAT

Countries	Total gross electrical installed Capacity in MW	of which CHP	%	Total gross electricity generation in GWh	of which CHP	%	National targets (MWe/ in 2000)
Belgium	14899	1805	12	72236	7645	11	1000[34]
Denmark	10604	7496	71	40096	15724	39	
Germany	114811	26184	23	528229	47750	9	
Greece	9545	182	2	38936	845	2	
Spain	44489	1533	3	161775	8537	5	2222
France	107232	3222	3	476337	9492	2	
Ireland	4039	58	1	15147	192	1	
Italy	64163	6328	10	231498	26477	11	
Netherlands	18348	6148	34	79677	31543	40	8000
Portugal	8833	892	10	31380	3112	10	
UK	69019	3042	4	325379	11996	4	5.000
Finland	14143	4085	29	65546	20312	31	
Sweden	35914	2808	8	142850	9257	6	
Austria	16032	3247	20	54645	11722	21	
E.U. 15	532559	67030	13	2263191	204604	9	

IMPORTANT NOTES

1. Data for GR and IRL are provisional and concern 1993
2. In Germany for units operated as pure CHP during part of the year, the total installed capacity is recorded, but only the electricity generated during the period of pure CHP operation is included in the figure of 47.750 GWh for 1994. This explains the big difference between the 9% part of electricity generation and 23% in installed capacity.
3. In Denmark CHP units operated over part of the year in cogeneration mode, have been included in the installed capacity. However only part of electricity generation (i.e. cogeneration mode) during that period of time is included in the electricity generation figure of 15724 GWh. The total electricity generation from CHP units was 32734 Gwh.

[34] Investment plan for the Belgian Electricity sector foresees 1000 MWe in new CHP plants before 2005.

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