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1. Introduction

There were three main purposes of my study:

1. to analyse energy policies of four western european countries: Norway, Sweden, Italy and Greece,
2. to describe actions taken by the European Union Countries leading to environment protection against harmful influence of energy production and consumption and to explain the role of renewable sources of energy,
3. to get knowledge about the teaching programes in that field which are implemented into academic didactic activity.

The research methodology included:

1.Statistical data analysis,
2.Scientific publications overwiev,
3.Interviewing of energy and enviromental policy specialists,
4.Teaching programs analysis.

The research activity consisted of two stages:

The first one - August 1995 collecting data in Norway and Sweden September 1995 - February 1996 data analysis and preparing an interim report.

The second one - June 1996 collecting data in Italy and Greece July 1996 - November 1996 data analysis, January - June 1997 elaborating of the final report and preparing the final product for publication.

During my trip I visited many institution and I met many specialists in the field of energy policy and environment protection. All visits were

very fruitful and useful for my research work. I have collected a lot of data and publication. NATO recommendation letter helped me very much to establish interesting meetings and to get all materials needed.

I am grateful to all people I met for their advise, hospitality and information delivered and NATO Officials for giving me possibility to carry on my research work.

Special words of appreciation I address to Dr Spyros C. Phylippas - Academic Affairs Officer for his kindness and help.

2.Main findings

2.1.Energy and environment

2.1.1.Energy sector in Sweden

In 1970, total energy supply amounted to 457 TWh, while by 1994 it had risen only slightly to 461 TWh. However, major changes have occurred in the Swedish energy system during that period. The most important of these changes is that the proportion of the country's energy supplied by oil has fallen substantially, from 70% in 1970 to 42% in 1994. Over the period, the proportion of the country's total energy supply accounted for by electricity has risen from 10% to 31%. At the same time, electricity production from hydro power has almost doubled.

Coal and coke, together with biofuels, peat etc., have also increased their market shares at the expense of oil products. In 1994, they accounted for 6% and 17% respectively of total energy supply, which can be compared with corresponding values of 4% and 9% in 1970.

Comparisons of this type must, however, be treated with caution. In international contexts, for the purposes of overall comparisons, it is common to convert electricity quantities produced by hydro and nuclear power to corresponding quantities of fossil fuels, which makes it easier to compare statistics for different countries' energy systems. Normally, about 2.5 energy units of fuel are needed to produce one unit of electricity in a fossil-fired power station. On such a basis, Sweden's total energy supply today would show an increase relative to 1970. A further factor that should be noted in connection with

statistical comparison of this type is that climatic conditions vary from year to year. If 1970 had been statistically average climatic year, energy supply would have been about 7 TWh less, while for 1994, which was warmer than normal, the statistically average energy supply quantity would have been about 4TWh more.

The relative proportions of final energy use accounted for by industry, transport and the residential/service sectors etc. have remained more or less stable between 1970 and 1994. The industry and residential/service sector proportions have each fallen some-what, while the transport sector has increased: industry's proportion has fallen from 41% to 37%, and the residential/service sector from 44% to 41%, while the domestic transport sector's proportion of the country's total energy has risen from 15% to 22%.

The greatest increase was found in the residential, commercial and service sector, where electricity use has increase by an annual average of 5% since 1970, to more than 71 TWh in 1994, or 52% of the country’s total electricity use. Most of this increase is due to a change from oil to electricity for heating, coupled with greater use of electricity for building service system.

On average the use of electricity in industry has increased by 1.7% per annum since 1970. During 1994, industrial use amounted to 50 TWh, equivalent to 35% of the country’s total use of electricity. The use of electricity by industry is linked to industrial output. Between 1970 and 1983, industrial output grew by 0.8% per annum, with the average annual rate of increase of electricity use during the period amounting to 1.9%. During the boom years of 1983-1989, industrial output rose by 2.8% per annum on average, and electricity use by 4.2%. However, during the

subsequent recession years from 1990 to 1992, industrial output fell by an average of about 4.5% per annum, accompanied by a corresponding average fall in the use of electricity in industry of 3.3% per annum.

Most of Sweden's electricity is produced by hydro power and nuclear power, as these sources have the lowest production costs, but some is produced with more expensive techniques such as combined heat and power (CHP), oil-fired cold condensing power, gas turbines and wind power. Together, hydro power and nuclear power supplied 93% of the county's total electricity supply, with the remainder being generated in industrial combined heat and power plants (2.9% or 4.0 TWh) and in district heating (3.3% or 4.6 TWh). Oil-fired cold condensing power plants and gas turbines contributed only less than 1% (0.9 TWh) of total electricity production.

2.1.2. The Swedish environmental policy

Over the past century, Sweden has developed from society of largely farming and peasantry into a technologically advanced welfare state characterized by high living standard and social equality.

Sweden's industry is historically based on the country's natural resources - its forests, ore deposits and hydroelectric power - but emphasis has shifted toward increasingly advanced products that are often still based on indigenous raw material. Today, Swedish industry exports products to the international market in several fields, including pulp, paper, metals, pharmaceuticals, and a large variety of engineering products for automotive, areospaces, energy and electronic sectors.

Sweden's industrial development brought increases in living standards that rank among the highest in the world today. This growth was not achieved without determine effects on the environment were implemented at an early stage and Sweden has used a significant portion of its wealth in the fight against pollution.

The environmentally destructive effects that have been noted in Sweden include acidification and greenhouse effect. The major costs associated with measures attempting to deal with these problems mean that it is most important that available resources should be properly utilized, i.e. that effective energy and environmental policy instruments are employed. The following are the fundamental principles of environmental protection adopted by the Swedish Government:

- The environmental targets that are to govern sustainable development of the society must be based on man's and environment's own tolerance limits vis-á-vis pollutants and other damage to the environment.
- In all economical activity the Best Available technology and good environmental practice should be used.
- Knowledge of environmental effect is often incomplete and emissions of pollutants and the use of natural resources may give demonstrable effects only after a long time. It is therefore important to apply the precautionary principle. This means that, in case of uncertainly, authorities can act to prevent, for example, the use of a chemical, or the implementation of building plan, without conclusive evidence of their detrimental effects on human health or the environment.

The precautionary principle was applied in Sweden already in the Environmental Protection Act of 1969 and has gradually been implemented also in other areas.

The OECD adopted the polluter pays principle (PPP) in 1972, and, in brief, it means that the polluter or the person responsible is to bear the cost of protecting the environment and cover others environmental costs of operations. This increase the chance that the pricing of end products will reflect their real cost.

Declaration 21, adopted at the United Nations Conference of the Human Environment in Stockholm in 1972, contains an important principle, intended to safeguard a country's right to be the master of its own environment. This principle is also incorporated in the Conventional on Long-range Transboundary Air Pollutants signed in Geneva in 1979, and again in the Rio Declaration.

Sweden is acting for a limitation of total West-European emission of carbon dioxide. The goal is to reduce emission by the year 2000 down to the 1990 level, and to lower them even further in subsequent years.

To restore the stratospheric ozone layer, the chlorine level must be reduced to 1.5-2 parts per billion (volume). In Sweden, the sound goals are set to achieve that goal.

The precipitation of acidifying air pollution must be limited to levels that do not harm nature and human health. As about 90% of the sulphur deposited in southern Sweden originates from foreign sources, reaching Swedish goals depends on international action. The emission of sulphur shall be reduced by 80% between 1980 and 2000.

Emission of nitrogen oxides shall be reduced by about 30% by the year 1998, compared to emission during any of the years between 1980 and 1986 (requirement in the international convention on transboundury air pollution, signed by 11 countries including Sweden).

The emission of carcinogenic substances shall be cut by half by year 2005.

The use of nonylphenol ethoxilates and plastic additives shall be sharply curtailed and eventually phased out.

Use of pesticides shall be cut by half by 1996. The goal is to completely abandon the use of mercury, cadmium and lead.

The difficulty for authorities to monitor each and every substanceharmful for an environment has forced the introduction of the substitution regulation. This regulation forces by law importers, manufacturers, industrial users and consumers to use the least hazardous substancies available that can achieve the required effect.

Goals and guidelines have been laid down for the use of natural resources and in protection of the natural environment. Renewable resources are to be utilized within the framework of the ecosystem's production capacity.

There are about 160 wind power plants in the country, but their contribution to the total electricity balance is still very small (0.08 TWh in 1994). During 1994, use of biofuels, peat etc amounted to about 78 TWh. The use of peat has declined over the last tree years, and amounts today to about 2.8 TWh. For economics reasons, the forest industry has always used its byproducts for heating and electricity production. Wood fuels in the form of row materials residues are used in both the cellulose industry and in sawmills. They consist mainly of wood chips, bark and others waste from the manufacturing processes. The use of wood fuels by the district heating sector has tripled over the last five years. In 1994 use increased by 2.2 TWh or almost 30%. The main form of the fuel is harvesting residues and forest byproducts, although processed fuels such as briquettes and pellets have also been increasingly used in recent years, as has tall oil (a residue from pulp production). Refuse has been used for district heating

production since 1970s, and amounts today to over 4 TWh. The problems of removal of dixon emission have now been satisfactorily solved.

The use of non-renewable natural resources is to be characterized by a greater degree of responsible management than hitherto. In exploitation of land and water for housing, industrial plants and infrastructure the specific goals are as follows: to take consideration of nature's ecocycles in community planing. Plan to reduce transportation, locate industries in safe zones in relation to dwellings, and set aside recreation areas. The goal is to practice good housekeeping of resources and limit the release of pollutants from waste handling so that the ecocycles for long-term sustainable development can be established.

Biological diversity and genetic variation are to be secured. Flora and fauna are to be preserved so that sustainable populations of species naturally occurring in Sweden are able to survive under natural conditions.

2.1.3. Energy sector in Norway

Norway has a population density of about 13 inhabitants per km^2 is among the lowest in Europe. Viewed in an international context the Norwegian energy supply situation is very favorable. Ninety percent of the country's total energy demand is met by electricity and petroleum products. Norwegian production of oil and gas is currently about 15 times the level of domestic consumption of petroleum products. Electricity demand is entirely met by indigenous hydroelectric power production. The remaining ten percent of total energy demand is met by solid fuels, mainly coal and wood. Most of this can also be supplied using indigenous resources, although about seventy present of coal consumption is at present met by imports.

Hydro power is excepted to remain the dominant primary energy resource for electricity production in the foreseeable future. Today the total economically feasible mean annual hydro power potential is estimated to be about 176 TWh. Of this, 108.1 TWh has already been developed and 1.6 TWh is under development. Of the remaining potential capacity, about 22 TWh is protected. In June 1992 government proposed further protection of rivers with a power potential of 11.6 TWh from hydro power development, leaving a potential for development of about 32 TWh.

The abundant supply of hydroelectric power is reflected in the dominant role of electricity in the energy mix. Electricity in Norway accounts for a higher fraction of the total energy consumption that in any other country: in 1990, electricity met near 50% of our total final energy demand.

The availability of hydroelectric power has also influenced the industrial structure of the country. Amongst the most important industries are the energy-intensive basic metal, metal alloys, wood processing and chemical

industries, which together account for almost thirty percent of total electricity consumption.

In 1990 the Norwegian Parliament, the Storing, passed a bill that introduced new energy policy measures, in particular transmission and marketing of electricity. Market forces are to take over where this is natural. The electricity supply sector is to be organized in such a way that natural monopolies (the transmission grid function) are separated from activities subject to competition (production). Producers must from now on compete with one another, and distribution companies no longer have a monopoly on electricity sales within their areas. Spot prices for electricity are quoted daily.

The abundance of both hydroelectric power and oil and natural gas puts Norway in a unique position among most western countries.

The Norwegian Petroleum Directorate (NPD) has recently complained a comprehensive assessment of total recoverable petroleum resources on the Norwegian Continental Shelf. NPD now estimates recoverable resources to be approximately 10 billion tonnes, or about 70 billion barrels of oil equivalent.

This new estimate for hydrocarbon reserves is about 12% higher than the 1988 figures. About 60% of resources have so far been discovered. 35% of the total estimated resources includes reserves in mapped but hitherto undrilled structures, and reserves in defined exploration zones without mapped structures. The remaining 5% represents the potential for improved recovery from fields already in production.

Assuming average annual oil production of 80 million tons (average of last 5 years) and average annual gas production of 25 million toe, these oil

resources could last approximately 45 years and the gas resources approximately 200 years.

The paramount objective of Norwegian petroleum policy is to maintain the hydrocarbon reserve base and the production level in the long term. The NPD study indicates that undiscovered resources are approximately 3700 million toe, of which about two-thirds are expected to be gas and one-third oil.

The long-term view is that Norwegian hydrocarbon production will remain relatively stable over the next three decades, and that the relative share of natural gas will increase from approximately 25% to approximately 50%.

Norway accounts for more than half of Western European gas reserves, and production presently meets about 10% of Western European demand. Fields in production on the Norwegian Continental Shelf have an average size of 90 million toe. If we exclude the Troll field from the assessments, the average size for fields under development is less than half of those already in production, or around 40 million toe. However there is a further 50% reduction as regards fields already discovered but not yet to come on stream.

Assuming proven gas reserves and efficient use of existing infrastructure, Norway could export about 60-70 billion m^3 annually from the turn of the century. Norway's strategy for gas sales has been kept under review. A crucial point when agreeing the terns of new gas sales contracts is the distribution of risk. Sovereign rights to natural resources, state ownership of these resources and national resource management are naturally main elements of Norwegian policy.

Norwegian petroleum policy is designed to attract the participation of international companies in Norwegian petroleum activities. The Norwegian petroleum sector represents an open market for competing suppliers of goods and services from many countries.

2.1.4.Ecological policy of Norway

In Norway CO_2 emissions will rise unless new effective measures are taken to prevent this, mainly because of the importance of emissions from oil production in North Sea. Norwegian CO_2 emissions are to be limited so that they are no higher in the year 2000 than in 1989. Norway will draw up a national action plan designed to limit emission and increase the uptake of greenhouse gases.

Until now, the most important instrument for the reduction of CO_2 emissions has been the general CO_2 tax introduced in 1991. The tax , which is the highest in the world, applies to petrol, fuel oil and the use of natural gas in the North Sea. The processing industry, coastal shipping and air traffic are excepted for reasons related to competitiveness. The consumption of petrol and fuel oils has dropped since the tax was introduced. It is possible to determine how much of the drop is due to tax and how much to other factors.

Analyses show that the tax alone will probably not result in the stabilization of emissions before the year 2000. Other factors which can make an important contribution will be tradable quotas, more stringent

energy efficiency standards, growth in public transport, coordinated transport plans and time-differentiated road tolls.

Through the 1989 Montreal Protocol, Norway has undertaken to reduce and gradually eliminate all consumption of CFCs and halons. Norway has already achieved its national and international goals for reductions in the consumption if ozone-depleting substances.

Norway has no specific national goals for the reduction of local air pollution and noise. In 1992, the State Pollution Control Authority drew up a new set for recommended air quality criteria for towns and urban areas. These set out the maximum recommended concentrations of pollutants below which direct effects on health are avoided. There are also recommended threshold limits for noise in residential seas, which apply to noise immediately outside the building.

Emission of NO_X from road traffic rose steeply at the beginning of the 1980s as the traffic volume increased, and then declined somewhat until 1990. Between 1990 and 2010, NO_X and CO emissions are excepted to drop as a result of emission standards for motor vehicles which have been introduced or will be brought in during the next few years.

Sales of new cars dropped, and older cars are therefore not being replaced as fast as was originally expected. According to prognoses drawn up by the Directorate of Public Roads, the volume of traffic will grow by about 8% by the year 2000. Norway currently has no specific goals concerning emissions methane and nitrous oxide.

The introduction of stricter standards for studded tires will reduce the amounts of dust released and thus the number of people who are exposed to excessive amounts of such dust. Sales of unleaded petrol will rise, and will by 1998 account for about 80% of total petrol sales. Thus, emission of

lead from road traffic will be further reduced and will no longer represent a health hazard.

2.1.5. Greek Energy System

With recent development in the industry sector, energy consumption in Greece has risen steeply. Greek industry has remained oriented towards energy-intensive processes, has not responded to the challenges and has kept consuming a relatively high percentage of energy. Underpriced fuel and the lack of an integrated national energy efficiency programme have been factors leading Greek industry to fall behind the achievements of Greek major partners. Insufficient information and the absence of incentives have caused private consumption to follow along the same lines. As to the manner in which the energy demand is actually met, it is worth noting: a) the substantial increase (in both absolute and comparative terms) in the contribution of electricity, in all final consumption sectors (except transports where is an obvious predominance in liquid fuel consumption) b) the fact that the rapidly increasing electricity demand is met through domestic power generation, which from the 1970s onwards made an impressive switch over to nationally extracted lignite, to the point where it now realise almost 75% on the combustion of this solid fuel, c) the similarly important increase in solid fuel consumption by the industrial sector d) the absence of other energy forms (gas fuels, nuclear energy,

renewable sources), the sole exception being the limited contribution of hydroelectric energy to power generation.

The drop in energy prices initially led to a slacking of efforts toward more efficient energy uses. However, after a relatively long period of adaptation to the Community environment and following the recently completed unification process, the domestic industrial sector has finally begun to respond to market deregulation and increase competition. Though relatively few in numbers due to general stagnation, recent industrial investments principally involve the improvement of product quality or the production of new goods, while production modernisation is achieved through the use of imported and usually more energy efficient equipment. It should be pointed out that it is particularly difficult for the numerous small industrial units to follow suit. The substantial delays, that have been noted in this respect, are attributed to the decision markets' lack of awareness and/or to the lack of adaptation in the necessary information and financing mechanisms.

The adverse evolution in energy intensity is primarily attributed to the domestic, commercial and -both private and public-service sectors. The building reserve has, in the long term, sharply increased. This tendency was and/or still is attributed to multiple factors, such as: a) intense internal migration and the expansion of urban centres, b) the ambition of the average Greek family to acquire a first home and to eventually purchase a country-house, c) the sharp development of tourism, and d) the equally sharp growth of commerce and services, due to the pressures mentioned beforehand or as a result of technological developments.

Greek energy policy objectives, as defined in the five-years economic and social development plan (1983-1987), have as a main goal the

reduction of Greece's oil dependency. This involves the accelerated development of indigenous energy sources and the exploitation of oil, gas and hydropower resources.

Today the energy balance of the country is as follows. The percentage of each primary energy sources contribution to the total yearly energy supply corresponds to almost 22Mtoe. Oil has the highest share, and the share of natural gas is almost negligible. However, a new natural gas project involves bringing gas by pipeline from Russia to Athens, through the Greek border with Bulgaria, as well as the construction of storage facilities in Attika for Algerian liquefied gas , and local urban distribution centres along the length of the pipeline. The project will have favourable repercussions for the environment due to the replacement of oil as an energy source. Public Gas Corporation of Greece (DEPA S.A) was established in September 1988 as a 100% subsidiary of DEP S.A and was assigned the responsibility to implement the introduction of natural gas into the Greek energy system. The establishment of natural gas industry and Greece will foster regional development, enhance the diversification of primary energy supply away from oil, make a major contribution the improvement of the environment via the reduction of pollution particularly in Athens, Thessaloniki and other urban areas introduce new degree of freedom in electricity production.

Oil supplies amounted to 13.8Mtoe in 1992, an increase of 1.4% from 1991. Oil supplies fell 1.7% of total primary energy supply (TPES). This share, one of the highest of the IEA countries, with an average of about 42%, is expected to decrease progressively to less than 55% by 2005, due to the excepted substitution of other fuels for oil in power generation, industry and residential heating.

About 95% of the crude oil supply is imported, mostly from Iran, Libya and Saudi Arabia. The state owned refineries cover domestic requirements in oil products, and the private refineries Motoroil and Petrola export significant quantities of refined products (5.4Mtoe in1992). Investment plans in the refinery industry are mainly oriented towards improving quality through, for instance, construction desulphurisation units to produce gas oil conforming with the new EU regulation limiting sulphur content to 0.05% by weight.

Public Petroleum Corporate of Greece (DEP S.A) dominates in the Greek oil market. It is wholly state-owned and was founded in 1975. DEP was created in order to develop all aspects of the oil industry in Greece.

Both private companies and the wholly state-owned company EKO are currently active in the oil product retail market in Greece. EKO, a subsidiary of DEP, is the market leader with 20% share. Private companies include branched of all major international oil companies as well as independent Greek companies. In May 1994 the government granted a licence to ELDA-E to set up its own gasoline retail network and some ELDA-E service began operating that year. All companies begin active in the oil product retail market can buy oil products either from domestic state-owned and private refineries or from abroad.

According to the law, oil companies are obliged to keep strategic stocks the level of which is determined by the level of oil products sales in a 90 day period of the previous year. For the keeping of these stocks oil companies could use storage facilities of refineries. The quantities of strategic depots that each oil company keeps in refinery storage facility are absolutely proportional to oil product quantities that oil companies

purchase from these. Oil companies are obliged to keep strategic deports corresponding to oil products imports, in their own storage facilities.

The electric energy generation system of Greece consists of thermal and hydroelectric units and a small percentage of renewable. The installed capacity of PPC's generating system at the end of 1994 was 9208 MW (98% of total installed capacity in Greece), broken down by fuel type was as follows: Lignite-fired 49.2% Oil-fired 23.1% Hydroelectric 27.4% Renewables 0.3%. The Public Power Corporation (PPC) was established in 1950, as a State owned public utility. A few years later the exclusive rights of distribution was also granted to the utility. PPC is today the largest enterprise in Greek islands. The utility is a vertical integrated corporation responsible for lignite mining, generation transmission and distribution of electricity over the mainland and the numerous island in Greek. The activities of PPC are supervised by Ministry of National Economy and Ministry of Energy Industry and Technology. PPC is obliged to submits to the forth mentioned miniseries, the electricity tariff policy as well as its finance and development programmes for approval. The annual budget is also approved by the Ministry of National Economy.

By the end of 1993, the mainland power system of PPC consist of 32 thermal and 43 hydroelectric units, located in West Macedonia, Southern Greece, and Central Greece. The thermal generating units account for 90% of the total generation of electricity, of which 78% is generated by lignite-burning plants. The lignite mines owned by PPC are located in Northern Greece and Southern Greece. New lignite mines are in developing stage in the same areas in order to supply new lignite-fired units, while exploration for new lignite reserves are carried on by the corporation and the Institute of Geological and Mineral Research (IGME) nation-wide. In 1991, the

economically recoverable lignite reserves were estimated 4000 million tons (550 millions TOE).

On the other hand, hydroelectric production, with an installed capacity of approximately 30% of total capacity of the system, accounts for only 8% of the total generation of electricity in 1993. It has been estimated that the hydropower potential may reach $20*10^6$MWh per year while the wind potential is estimated to exceed $5*10^6$MWh per year in the mainland Greece and the Aegean islands.

The electricity demand of PPC in 1994 covered mainly from generation by lignite-fired power units and to a smaller extent by oil-fired and hydro generation. A small percentage of electricity came from renewable forms (mainly wind energy) and imports from neighbouring power systems. The participation of the different types of incoming electricity to transmission network to cover the demand for the year 1994 are presented in the following Figure:

PPC's 1994 Energy Supply Balance

Electricity Source	Electricity Supply	
	TWh	%
Lignite-fired	27.0	73.0
Oil-fired	6.8	18.4
Hydroelectric	2.8	7.5
Renewables	0.03	0.0
Imports	0.4	1.1
Total	**37.0**	**100.0**

The electricity sales grew up to 32.7TWh in 1994 while the per capita consumption of electricity in Greece reached 3300kWh.

The main objectives considered by PPC during its present planning procedures are the following:

- to meet the country's needs in electrical energy at the lowest possible cost, with a high degree of reliability;
- intensively utilising the country's indigenous energy resources, e.g. lignite, hydro-potential and renewable forms of energy;
- to implement a rational tariff policy, aiming at reflecting and fairly sharing implied costs among consumers;
- efficiently utilising available energy resources, in order to secure a ration use and conservation of energy;
- securing a reasonable financial surplus, for self-financing and for reducing borrowing.

2.1.6. The environmental policy of Greece

Greece, like many others countries, was affected by the oil crisis. This event triggered the intensive use of environment-friendly renewable energy sources (RES) and the rational use of energy (RUE). However, the use of RES is not yet widespread enough and it is estimated that by the year 2000 the potential of these sources could cover approximately half of the country's energy demands. Additionally by the rational use of energy an energy saving of 25% per year could be achieved - quite an encouraging figure since it has been estimated that energy conservation of 1% results in an annual saving of about 60 millions ECUs.

Energy generation and consumption are responsible for 88% of all greenhouse gas emission and, in particular, for 98% of the CO_2 emission. Any effort to tackle the greenhouse gas problem must therefore obviously be based on knowledge of the Greek national energy system. Before the Greek programme for reducing greenhouse gas emission was elaborated, the domestic energy demand and domestic energy production were both carefully analysed. he level, structure and evolution of the domestic energy demand depend on the corresponding domestic economy activity, and the economy/energy ratio. Although the average per capita income remains comparatively low, the Greek economy nevertheless underwent a period of intense development in the recent past, especially during the 1960s. Economic growth slackened in 1970s, and was plunged into crisis during 1980s, following the second energy crisis of 1979. Singes of temporary recovery were observed during the 1986-89 period, while a more stable and long-term phrase of growth is anticipated for the second half of the 1990s, with the implementation of European Convergence Programme.

The unsatisfactory evolution of the Greek economy's energy intensity over 1970-1990 period brought about similar evolution in the emissions of CO_2 emitted increased from 22Mt in 1970 to respectively 54Mt in 1980 and approximately 82Mt in 1990. The mean annual increase rate, which was particularly high in the 1970s (approaching the 10% level), decreased considerably during the 1980s, though still remaining at very high levels (4.5%).

This restriction of the increasing trend in CO_2emission is directly linked to the stagnation of economic activity (as the mean annual increase GDP fell from approximately 4.5% in 1970s to 1.5% in the 1980s). The drastic

increases in energy losses, energy intensity and CO_2 emissions included by the switch to lignite-fired power generation are nevertheless most evident.

During the same period (1975-1985), the rapid development of domestic cement industry led to a doubling of production levels, and consequently to the release of additional quantities of CO_2 resulting not only from combustion, but also from the production process.

The evolution of CO_2 emission in Greece, over 12970-1990 period, is the worst of those noticed within the entire European Community. Thus, while the emission per inhabitant remained low due to discrepancies in the level of economic activity, the emission of CO_2 per unit GDP actually surpassed the respective levels of all the other Community members.

Although the electricity generation sector has the highest level of direct contribution to CO_2 emissions, a major reason for concern lies in the fact that this contribution has drastically increased from 32% in 1970 to 50% in 1990. As far as the other sectors are concerned, their direct proportional contribution appears either to have remained stable (transport) or to have even decreased (domestic and commercial sectors). However, if the emission arising from electricity generation and oil products productions are redistributed to their final users, we see that the domestic-commercial-services sector, in fact, presents the highest increase and the highest total contribution to CO_2 emissions in 1990 (rising from 32% in 1970 to 39% in 1990). This same „redistribution" procedure reveals that, while the CO_2 emissions from the industrial sector increased in absolute numbers, their proportional contribution to total CO_2 emissions actually decreased (from approximately 46% in 1970 to 41% in 1990). As for the transport sector, its relative contribution to total CO_2 emissions has remained stable (20%).

In the absence of any interventions from 1990 onwards, the spontaneous evolution of CO_2 emissions (based on the present structure and operation of the Greek energy system) would normally be characterised by a further and considerable increase. These calculations are based on: projected magnitudes for Greek economy in view of the European Convergence Programme's application, international forecast concerning energy prices, the impact of recent technologies and of policies which were initially implemented prior to 1990. In the absence of the additional post- 1990 measures, it is therefore estimated that CO_2 emissions would increase from 82Mt in 19909 to some 104Mt by the year 2000.

Although resulting from what were at the time entirely justified decisions, this trend towards an increase by 22Mt in the 1990s - i.e. of 27% over the decade or 2.4%, on average, per year - is in contradiction with the European Union's stabilisation objective.

In reality however, Greece has, since 1990, adopted measurements which directly or indirectly affect CO_2 emissions, and has thereby aligned its efforts with those of the EU and the approach to the threats induced by the greenhouse effect.

CO_2 emissions are estimated to have amounted to a total 82Mt in 1990. A thorough analysis of these 1990 emissions is provided in the Technical Report. Although the overall CO_2 emission estimated for 1990 are roughly the same as those presented in the Inertium Report noticeable differences can nevertheless be spotted for individual sectors:

- The CO_2 emissions arising from the Public Power Corporation (PPC) lignite-fired power generation plants are approximately 1.1Mt CO_2 lower than in 1990.

- CO_2 emission levels from the transport sector were also found to be approximately 2.5Mt CO_2 lower, due to a change in recording procedure which now acknowledges than the emission form international air transport are not to be imputed to solely one country.
- CO_2 emissions from the domestic-commercial sector were also some 2.1Mt CO_2 lower as the use of wood (biomass) for heating proposes was redefined as largely carbon-neutral.
- CO_2 emissions from the industrial sector were, on the contrary, increased by approximately 5.9Mt CO_2 due to the inclusion of emission from non energy-related users.

The objective of the EU is to achieve a stabilisation of CO_2 emissions to return them to 1990 levels by the year 2000. In the absence of additional abatement measures, CO_2 emissions in Greece would, by the year 2000, increase roughly 27% in comparison with 1990 levels

The target of Greek abatement programme has therefore been set within these two extremes 90%-27%). Aside from the measures and policies already in application, provided form, so as to increase the feasibility of this objectives. Consideration has also been given to: a) past commitments (for ex. Involving the use of lignite); b) basic political decision; c) the availability of funds for the programme's financing; d) current technical infrastructure levels; e) the Greek Administration's previous experience with programmes of such importance and, what is more with such strict time restrictions; f) the ability of Greek economy and society to adopt to the implications of the proposed changes.

The realisation of the programme's objectives calls for: a) the rationalisation of energy consumption; b)a diversification in the means

used for satisfaction the energy demand (for ex. substitution the conventional fuels).

At a primary level, the proposed measures aim at bringing about small or large-scale improvements in the manner in which energy is either produced or used. At the secondary level, they also aim at inducing changes either in user mentality and behaviour, or in operating conditions of the entire parts of the energy system.

- The state in order to promote the use of renewable energy sources, has establish the possibility for private users to produce electrical energy as self-consumers from RES. According to the low the state contributes 40%-55% to investments in RES and energy efficiency. Also the state has established the Energy Council, a body responsible for the country's energy policy. In 1997 by presidential decree the Centre for Renewable Energy Sources (CRES) was founded. CRES is public entity under the supervision of the Ministry of Industry, Energy and Technology, but functions under private low and has financial and administrative independence. The objectives of CRES are the promotion of the applications of renewable energy sources and rational use of energy in Greece and internationally.

Wind energy is a renewable source of energy with great prospects of application especially on the islands and along the coastal regions of Greece. The serious scientific exploitation of wind energy in Greece started in 1975. From measurements taken it is evident that there is excellent wind potential, and has been estimated by the PPC that this potential is equivalent to 13.6% of the total demand of energy in Greece.

The state has planned the installation of 400MW wind turbines until the year 2000, out of which 150MW will be installed by PPC and the

remainder by private sector. The electrical power produced will cover 2%-3% of the country's needs.

The prospectus for wind energy applications are very good, especially on the small islands where electricity supply is mainly by diesel generators, and can give power to desalination plants, water pumping to reservations, food processing, etc.

•Biomass is one of the most promising renewable sources in Greece. The main sources of biomass are: agricultural and forest residues, energy crops and solid urban wastes. It is estimated that energy from biomass can meet 53% of Greece's energy consumption (1990). However, there are some serious drawback which hinder the full exploitation of biomass. The most serious is the production cost which is relatively high compared to the cost of production of energy from oil.

On the other hand, if one takes into consideration the environmental damage caused by solid fuels and cost of measures taken against environmental pollution, then the cost is comparatively lower.

Greece has 3,000 hours of sunshine per year on horizontal-solar activity 5,000-6,000MJ/m^2/yr. Active solar system are widely used, especially for water heating in houses and hotels, thust placing Greece among the first countries in EU with large-scale use of such system. Up to the end of 1991, 1,450,000m^2 of solar collectors had been installed, and it has been estimated that an electric energy conservation of 227ktoe per year is achieved.

CRES is actively involved in a number of projects in the field of active solar systems. It co-operates with the Demokritos National Research Centre for testing solar collectors with ISO for the promotion of standards on a national level.

Hydraulic energy is mainly found in northern parts of the country and is of considerable importance. According to measurements taken by CRES, 38% of hydraulic energy potential is located in Eripius. However most of that energy is lost , amounting to 11.5TWh per year. Small hydro applications are today very limited with regard to the potential available.

It is permitted the production of electric energy, except for PPC, in two situation:

- in autoproceures, which means the people who produce electric energy, for self consumption, and the possible surplus is disposed to PPC;
- in independent produces, which means the people who produce electric energy, not for themselves, but to dispose it to PPC exclusively.

In general, the transmission and distribution of electricity continues a monopoly of the state utility PPC established by the Law 1468/50. However, the Law 2165/93 permits also any individual or corporate body to establish, built or operate new power plants, after common decision of the Ministry of National Economy, Finance and Industry, Energy, Technology.

Anyway the Law 1559/85 which concern the „Regularisation of matters regarding alternative forms of energy and special matters regarding the production of electricity by conventional fuels and other provisions", this Law broke the monopoly which the national electric utility (PPC). Production of electricity by autonomous power station not connected to PPC network covering only the needs of self-producers, is permitted for the exploitation of solar, wind, geothermal and biomass energy, energy

from the seas and small-hydro energy, with the power station capacity up to 5MW.

The commercialisation of energy conservation technologies has evolved slowly despite wide-scale publicity and their undisputed value. Nonetheless, great efforts are being made by the private sector to arouse public awareness, using energy buses as a basic tool. Energy audits are industries, giving information about the new technologies and giving technical advice and assistance.

2.1.7. Italian power sector

A new investment plan announced by ENEL in June 1994 forecasts a demand for energy to the ENEL grid of 290TWh at 2002 and calls for an ENEL capacity increase of around 11.000MW (net of old plants dismission) and investments in the order of 19.22 billion ECU (44.000BL) in 5 years. The main objectives of the plan are the reduction of the cost of kWh and the achievement of a more balanced mix of resources; this means that coal will have to increase its share from present situation and revert the declining trend of last decade.

Although the Italian power sector is dominated by large, vertically integrated national power industry ENEL (ENTE NAZIONALE per l`ENERGIA ELECTTRICA) is second only to Electricite de France in the European market - the situation was quite different less than fifty years ago. Up to ‘50s the composition of the Italian power companies was made

up by 6 major private companies, which controlled about 60% of the market, and about 1400 smaller private ones, which controlled slightly less than 15%; autogenerators and municipal power companies shared the rest of the market (20%-60%). Despite widespread perception of the need for change, industry structure was not reformed for several decades.

The prevailing oligopolistic cartel was replaced by public monopoly in 1962 when ENEL was established nationalisation among the possible instruments to deal with private inefficiencies.

Since 1962 ENEL has had almost exclusive right to operate in the power sector. It is based on a central operating unit - with planing, financial and co-ordinating tasks and several regional units mainly in charge of generation, transmission, distribution and customers' service. Other companies allowed in the market were municipal companies, autogenerators consuming at least 70% of produced energy and monitor private companies (they did not produce more than 15 million kWh per year).

Nationalisation brought about several improvements: transmission and distribution grids previously very limited and inefficient, are now national in scope with much lower distribution losses; supply was constantly expanded to meet growing demands due to industry development and improvement in living standards.

There are tree main events underlying the recent shift in Italian Energy Policy: the Kuwait war, the move away from centralised planning in general, and the budget deficit. As far as the first is concerned, the implications of the Kuwait war in term of energy policy were radically different from those previous international oil crises. Whereas the events of the '70s and '80s, which motivated fear of increasing instability and

scarcity of resources in the international energy markets, justified strong public intervention in the sector, this time the very limited consequences on oil supply and prices reduced the importance historically attached to energy security. Second, similar to other West and East European countries, Italy started to recognise the limitations of centralised planning in general; in particular, the principles stated in National Energy Plans (NEPs 1988 and 1991) have rarely been implemented. Finally, the huge Italian public sector encompasses several economic activities ranging from utilities to banks, insurance and manufacturing companies. Although there are notable exceptions, it is characterised by inefficiencies, excessive reliance on public funds and politically rather than economically based management criteria, all which have led to considerable public pressure for the radical change.

The first important reform occurred in 1991, when laws n.9 and 10 allowed independent power producers (IPPs), particularly those producing electricity from renewables, to play a more significant role in electricity generation. All power produced is sold to ENEL.

In July ’92 ENEL became a Ltd, although currently the sole shareholders is the Treasury Ministry. The objectives of privatisation can be summarised, following, in economic, financial and political terms. Economic priorities favour the maximum efficiency and customers’ satisfaction. Achievement of this objective is though to require a completed restructuring of the sector modifying its horizontal and vertical degree of integration. This would be achieved by selling the entire company. The final objective, of a more political nature, consist in limiting the degree of political influence in the company management and requires,

as a first step, the creation of an independent regulatory body with well defined tasks.

In November 1994 the government announced a plan aimed at splitting production between several companies by June 1995; ENEL was meant to keep control of the generations in first stage, and to sell a substantial quota of its share within tree years; distribution activities were also planned to be opened to several companies; notably, although the proposal gave rise to different interpretations, a new body was established for dispatching and transmission activities. The 1994 plan was never put into practice due to the political turmoil that led to a new government in February 1995. A totally different plan has recently been put forward by the new Industry Minister, who announced that it would make more economic sense to sell ENEL as a whole.

In order for the picture to be complete, the role of the regulatory body has to be specified. Currently details of tasks of three Authorities for public utilities - the firs of which for energy and gas - are under discussion within Parliament. The latest draft includes tree main objectives: to ensure quality of the service and low costs to individual customers; to ensure reasonable profits to new shareholders; to ensure revenue maximisation to the State from the sale of the utilities. Other societal goals, such an environmental protection or efficient resources use are not even mentioned in the draft.

The text on the Energy Regulatory Authority includes new criteria of setting tariffs. The proposed system is based on the price-cap method, with the following parameters: the change in the retail price index, expected productivity variation, a quality component and one for unexpected costs.

In recent years electricity production capacity has increased in tree ways. First, ENEL's own generation capacity is being expanded; new investments consist mainly of combined cycle coals and gas turbines (CCGTs), multifuel power stations and repowering of existing stations. These additions amounted to 1338MW in 1991, 3370MW in 1992 and 1049MW in 1993. Second, imports of electricity from neighbouring countries (Switzerland, France and Austria) - now representing about 16% of total supply - are recognised as a resource option to be pursued as long as it is economically worthwhile. This could be affected by the lira's prolonged weakness on international exchange markets.

Third, new investments by IPPs are forecaster to account for 9% of total national generation capacity by 2000. Approved IPPs investments include „pure renewables" as well as processes regarded as „quasi renewables" such as cogeneration. Electricity produced by these IPPs will be soled to ENEL at prices that have two components: the avoided cost (0.031 ECU/kWh or 72L/kWh) and an incentive. Incentives are only paid for the first eight years of life of the plant and vary according to the type of fuel used and process efficiency

2.1.8. The environment protection in Italy

As in most developed countries, the environmental situation in Italy is difficult, but although energy production is partly responsible for this situation, the energy output has nevertheless to be increased

•Recently ENEL presented a scenario for the evolution of the system up to 2010, based on the MEDEE methodological approach.

According to this scenario, if no nuclear plant is built, CO_2 emissions by electric sector will grow by 48% (reaching 215Mt) from 2000 to 2010. ENEL proposed that this increase in emissions could be gradually commissioned starting in 2005. In 1990 the electric sector contributed to the total CO_2 emissions by 30% (120 out of 413Mt). So not surprisingly the report states that „Such projections are strongly diverging from the theoretical stabilisation target at the 1990 level, and show that in Italy this is unrealistic".

.A large quota of new investments is made up by gas fuelled cogeneration plants while renewables still have a rather lower share.

New generation plants by IPPs up to 2000

Type of power plant	Power (MW)
Biomass	257.3
Wind	184.3
Hydro	224.5
total renewables	*666.1*
total quasi renevables	*5228.4*
total	***5894.5***

A recent study, (Ferrari and Terrinoni 1994), evaluates a levelised cost of 0.045 ECU/kWh (103 L/kWh) for good wind sites in Italy. Taking into account the fact that after 8 years the price paid to producers falls from 0.065 ECU/kWh (150L/kWh) to 0.031 ECU/kWh (72 L/kWh),

Internal Rate of Return (IRR) is around 6-7%. The authors suggest that an increase of 40% of price (up to 0.092/0.065 ECU/kWh or 210/150 L/kWh) is required in order to stimulate the development of 300-600MW forecasted by the 1988 NEP from the 12MW wind power already installed in 1995. The situation is better for electricity from biomasses, which receives 0.097 ECU/kWh (222 L/kWh).

Now under the proposed Public Utilities Authority Bill, incentives to IPPs might be abolished, both for renewables and :quasi renewables". One of the main reason for the recent change was the concern expressed by new Industry Ministry A. Cló that continued incentives would impair the prospect for a truly competitive market. Seen from another point of view the abolition of the only existing mechanism for internalising at least part of environmental external costs of electricity production

The environmental compatibility of photovoltalic (PV) technology, together with its innovative features, makes photovoltalics one of the most promising alternatives for electric power production. Moreover, due to the favourable climatic conditions, in Italy photovoltalics appeared to be a potential source for large-scale energy production.

At present the diffusion of photovoltalics is limited mainly by the high cost of PV systems. Current cost can be reduced by developing less expensive production processes, based on innovative technologies, and promoting mass production of modules and components. According to this strategy, the National Energy Plan contains a PV programme based both on research and development activities and on the demonstration of large-scale applications. In particular, the goal of the demonstration programme was the construction of 25MW by the end of 1995. The principal

operators of Italian PV programme are ENEA (the National Agency for New Technology, Energy and the Environment) and ENEL.

Today, the most important applications of photovoltalics in Italy are:

- Electrification of remote houses: at present Italian grid does not supply several thousand rural dwellings, vacation houses and mountain huts. Up to now more than 5000 of this dwelling have been powered using a small delicate PV plant;
- Lighting: PV lighting systems have been successfully used in isolated areas and archaeological parks, at a small airports;
- Aids of navigation, telecommunications and telemetry: PV systems are routinely used to power communication systems, alarm bells, warning lights, remote control;
- Cathodic protection of pipelines, bridges and metallic infrastructure;
- Desalination: PV generators can be used to power reverse-osmosis desalination systems in isolated areas.

In the framework of the National Plan a well-defined role is assigned to ENEA and ENEL, identified as the main operators of the PV programme.

ENEA activities cover R&D, industrial promotion and demonstration, with a particular emphasis on research and innovate PV materials and devices.

After a careful analyses of components to the plant cost, a standard of 100kW Photovoltaic Low Cost Utility Generator (PLUG) has been designed by ENEA with co-operation with Italian firms.

The PLUG is PV plant to be used grid-connected both as a single unit and as a elementary unit of a larger power plant. ENEA has defined a large programme to demonstrate the technical and economic feasibility of photovoltaics on small islands that are not connected with the national

network. In this case, due to the high cost of fuel transportation and conventional plant operation, photovoltaics can already be cost effective, besides avoiding any pollution effect. ENEL is about to complete building a 3.3.MW demonstration PV power station, which will be connected to the national grid, in order to acquire experience in the constructions and operation of industry-size PV systems. This plant will also contribute to the development of a strategic technology and will verify the industry's ability at the present cost of solar energy. The plant will be produce 5 million kWh/year to fulfil the electricity demand of 7500 people.

At present wood, crop and agro-industrial residues and animal and municipal wastes are produced at a rate of about 66 million tonnes of dry matter per year, which is equivalent to 27 million tonnes of oil. Only 14% of this energy potential is actually used. Residual biomass is mainly used. Residual biomass in mainly used for heating and cooking by means of domestic applicants of the small power (15-50kW) and for process heat production and cogeneration in agro-industrial plants (1-20MW). More than 60 firms are involved in the manufacturing and trading of heat generations for domestic use and about 15 operate in the industrial field.

The production of biogas from animals wastes has been also considered in Italy. Since 1979 over 140 plants, ranging in volume for some tens of cubic meters to over 1000m^3, have been installed for the production of biogas in the livestock and agro-industrial sectors. About 10 firms are involved in designing and implementing biogas digesters.

Wood and residue gasifiers for mechanical and electric power production in the range of 10-1kW, and for heat process generation (1-4Mw), in this field include the development and the promotion of small-size gasifiers suited for rural areas of developing countries, and of gasifiers

for retrofitting to oil-fired boilers like those in operation in brickyards and cement works.

Concerning the possibility of producing new biomasses from forests or from energy crops, the situation is rather depressed. Italy is not a country lacking in forests, but the Italian forests are of a poor quality and are left without any care. At present, the biomass taken from these forests is one-third of the forests' natural productivity. If the national plan for reforestation and forests maintenance is implemented, new biomass could be made available at a rate of about 2Mtoe/yr.

Besides the existing forests, new conventional plantations could be established over 2 million hectares of marginal lands which have been abandoned by farmers because of their low productivity. These lands are mainly located in the centre and south of the country and are characterised by very poor solid and climatic conditions. The only possible use for these lands is to plant conventional forests with the main aim of preserving the territory from the hydro-geological failure. Nevertheless, biomass can be obtained from the management of these new forests at rate of about 1Mtoe/yr.

At the beginning of 1991 the Italian parliament approved two Acts aimed at promoting and supporting the use of renewable energy sources, including biomass. These Acts renew and improve similar laws that come into force some years ago. For biomass the goal is to raise the present contribution of commercially available biomass from 1Mtoe/yr to 2.5Mtoe/yr by 2000. Incentives are also planned for those farms or factories that self-produce residue biomass and which are going to build up cogeneration and district-heating plants.

2.1.9. Summary on energy and environment

The production and use of energy are major sources of damage to human and natural environment, and no country is an exception in this respect. Examples range from the ecological effects of construction of hydro power schemes through oil splits from tankers to vehicle exhaust emission. Although significant steps have been taken to counter these mechanisms, such as the imposition of statutory regulations, taxation and encouragement of the development of low-pollution technology, much still remains to be done in order to tackle the destruction of the environment resulting from our present energy system.

That is why substantial attention should be payed to the development of rules and regulation in the energy field. What is more there are a lot of common, global, transboundary problems and development of a new framework in this area must be balanced. The interests of products and exporters be taken into account in the same way as the interests of importers and consumers and all sources of energy be taken into consideration, to the benefit of all members of the Community.

Environmental protection plays a significant role in the energy system. The introduction of natural gas as a fuel will contribute to environmental pollution reduction. Electrostatic filters installed in the energy production units, which will retain 90% of the emissions. Sound development of indigenous, renewable energy sources and a comprehensive energy conservation policy, can help to achieve major energy saving and cleaner and healthier environment.

The developments in the electricity sector in the last two decades have intensified the greenhouse effect. In particular, the electric power industries around the drastically adjusted their production structure to encounter the enormous oil price increase of the 1970s and, effectively, substituted away from oil-fired technologies. This will call for energy production technologies compatible with environmental requirements, so as to ensure social and economic development

Several changes have taken place in the European gas markets over recent years. Natural gas is sold into new market segments. Forecasts regarding the future gas market suggest substantial increase in demand. For these reasons, buyers are now faced with the real possibility of supply shortage. Energy prices in general have decreased, leading to the risk of a mismatch between the cost of extracting the gas and bringing in to the markets and prices paid for gas on these markets. This will inevitably bring deliverability of gas under pressure in the long run.

Unless countermeasures are taken, emissions of CO_2 from most sources will rise substantially in the future. In the Climate Convention, signed at the UN conference in Rio in 1992, the industrial states undertook to draw up national strategies to limit emissions and increase absorption of greenhouse gases. The convention does not include undertakings to set specific emissions limits, and each country is still responsible for deciding on its own nationals goals.

2.2.Ecological education
- development and problems

The setting for universities and other institution of higher education is changing rapidly, both economically and socialy. In most countries new developments, not least the globalisation of the economy have led to restructuring teaching programs and more international approches to the teaching .

To remain at the driving edge, European economic and political progress is complemented by offering an 'European vision' to her young people by education and training efforts. Europe's education system in its development takes into account three major imperatives:

- the need to strenghten European competitiveness in economic, technological, innovatory scientific and organizational terms,
- the need to appreciate the difficulties af the current situation,
- the need to respect the basis principle of education, whose aims go far beyond a purly utilitarian perspective.

However the necessity for qualifications and knowledge-based skills for daily life and ordinary teaching programes intend include all the most important cultural, social and economical problems. One of them is the problem of the environment protection.

Strategy for development of education in the enviromental protection puts forwards several goals:

-to foster clear awareness of economic, social, political and ecological interdependence in urban and rural areas,

-to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect the environment,

-to create new patterns of behavior of individuals, groups and society as a whole towards the environment.

Subordinate goals are:

-Awareness: to help social groups and individuals acquire an awareness of and sensitivity to the total environment and its allied problems

-Knowledge: to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems

-Attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection

-Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems

-Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working towards resolution of environmental problems.

The universities and colleges of higher education create and communicate knowledge and are therefore central institutions for developing the environmental competence of the population, especially through teacher training and other vocational training.

Environmental concerns and international problems of development are making institution of higher education more aware of the importance of

finding multilateral solutions.Many programmes aims to enable students to tackle legal problems that have a cross border charakter, that are treatet under international law systems or ivolve international clients by encouraging flexibility in thinking and problem solving skills within the kontext of different legal systems.

But such a respense from institution od higher education of different countries have not been systematic up to now and the underlying implications for reform have not been assessed coherently. However there are very good examples as well.

In Norway work to integrate environment into the educational system began in the 1970s and has been given considerable political priority. White Paper no. 46 (1988-89), "On Environment and Development", states that the education system has an important role to play in meeting the challenge of sustainable development, and the contents and methods of EE (Environmental education) are integrated into the new curriculum guidelines. The central idea behind the Norwegian EE policy is that EE should be integrated into a wide spectrum of educational activities for all age groups: *environmental education for all.*

There are two reasons for integrating EE into all subjects at all age levels. First, environmental considerations need to be broadly integrated so that all citizens can acquire the necessary skills, knowledge, attitudes and behaviors to contribute to sustainable development. Second, the fundamental principle of equal educational opportunities mandates that the kind of learning opportunities provided by good EE should not just be available to a few students, but to all.

The Ministry of Education, Research and Church Affairs and the Ministry of Environment have followed up White Paper No. 46 with

policies and strategies for integrating environment and development issues into the educational system and environmental management at all levels. The education ministry's strategy for EE emphasizes competence-building, international programs, intersectoral cooperation, supporting schools and school networks through national EE programs, and increased responsibility for EE development at the sub-national school administrative levels. The environment ministry plays a supportive and supplementary role by providing environmental expertise, producing information material, supporting NGOs, and providing opportunities for educational institutions to cooperate with national, regional and local environmental authorities. The work of the education and environment ministries is carried out in cooperation with other ministries, universities, research institutions and teacher training institutions.

Progress has clearly been made as a result of these efforts, but we are still far from reaching the goal of full integration of high quality EE in educational activities for all age groups. EE in the Norwegian educational system today is characterized by a high level of activity by teachers and institutions. Many actors outside the school system are involved, including NGOs, business interests, and local people and institutions. However, both the quality and the quantity of EE should be further improved.

In good EE, students need to learn not only to understand environmental change, but also to make value judgments and actively participate in local decision-making. Experiences indicate that providing EE with these qualities for all students necessitates changing the educational system itself: its mandate, internal organization, level of competence and relationship to the real world outside the school. This approach to developing EE can be called a *systemic approach* because it

aims to improve teaching practice by developing the system within which teachers work. EE is therefore not treated as an isolated and short-term development effort, but rather as an integral part of more comprehensive educational change.

In a systemic approach, an attempt is made to create an institutional framework which at all levels promotes EE and in which EE is compulsory and fully integrated into normal activities. The status of EE today is the result of the interaction between international policy, national policy, and local conditions. The work of UNESCO and UNCED have been particularly important in laying the premises EE policy and practice.

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