No 8. April 1996

The Newsletter of the UNEP Collaborating Centre on Energy and Environment

UNEP

C2E2 News

In this issue:

The UNEP Collaborating Centre on Energy and Environment (UCCEE) at Risø National Laboratory, Denmark supports the United Nations Environment Programme (UNEP) in pursuing its aim of incorporating environmental aspects into energy planning and policy world-wide, with special emphasis on developing countries. UCCEE works catalytically, encouraging, promoting and supporting research by local research institutions, coordinating projects and disseminating information, as well as carrying out a full in-house research programme in close collaboration with colleagues at Risø National Laboratory - the main public scientific research institute in Denmark.

Economics of Greenhouse Gas Limitation

Launch of a UNEP/GEF project: eight country studies, two regional studies and methodological development

UNEP is launching a new project comprising national and regional climate change mitigation studies, along with the development of a comprehensive methodological framework for the economics of mitigation. The UNEP Centre will coordinate and implement the project which is supported by the Global Environmental Facility (GEF) and entitled *"Economics of Greenhouse Gas Limitations"*. The project will extend and enhance the existing methodology to cover areas particularly relevant to developing countries and countries with economies in transition. The project builds on the work of the IPCC and earlier UNEP studies, and will also benefit substantially from the guidance on mitigation methods prepared for the US Country Studies Program by Lawrence Berkeley National Laboratory (LBL).

To be continued on page 4

Energy and the environment

statement by Elisabeth Dowdeswell, UNEP Executive Director

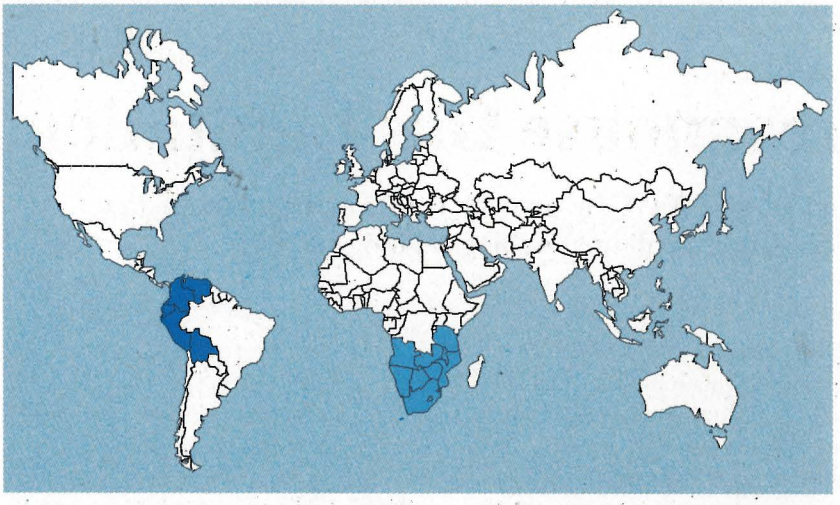
Energy is a major component of economic development. Its production and consumption has, however, major short- and long-term impacts on the environment. Governments and industry should therefore intensify efforts to formulate sustainable energy policies and develop technologies for production and use of energy in an economically efficient and environmentally sound manner.

UNEP, as the United Nations organisation charged with the responsibility for the environment, is in a unique position to promote sustainable energy production and consumption. Although UNEP's own resources for energy activities are limited, it can act as a broker, at national and regional levels, between the environmental institutions and the economic decision making processes.

UNEP's possibilities for having an impact on energy-environment issues have been significantly strengthened by the presence of the Collaborating Centre on Energy and Environment. The Centre, which has been established with significant support from the Danish Government and the host institution Risø National Laboratory, has since its inception in 1990 grown into an international centre of excellence on energy, environment and climate issues. The Centre provides valuable support to UNEP's programme in the areas of energy, climate and GEF and in addition promotes UNEP's mandate through collaborative activities in developing countries with financial support from other multilateral and bilateral organisations.

In May Risø will inaugurate new premises for the expanding Centre and I would like to take this opportunity of thanking the Danish Government and Risø National Laboratory for their positive support to UNEP. I look forward to continuing and expanding the collaboration in the coming years.

Regional mitigation studies in the UNEP/GEF project



SADC, the Southern African Development Community, comprises Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

The Andean Group comprises members Bolivia, Colombia, Ecuador, Peru, Venezuela, and associate member Panama.

The new GEF study will include two regional studies. Regional implementation of climate change mitigation is mentioned specifically in the Convention, but, so far, very limited analytical work has been undertaken at this level. This is a logical consequence of the fact that it is the national governments that sign the convention and who therefore take on commitments under it. National studies undertaken so far indicate, however, that some mitigation options may involve inter-country or sub-regional collaboration issues. Regional mitigation options, such as shared power systems, trade arrangements, or energy markets, may be able to make a significant contribution to mitigation. There is therefore a need to address climate change mitigation issues at multi-country level.

Two sub-regions have been chosen for study: the SADC countries in Southern Africa and the Andean Group in South America.

The studies are deliberately focused on "sub-regions" like the SADC countries, rather than "regions" such as the whole of Sub-Saharan Africa in recognition of the realities of collaboration and geographical proximity. The realistic level of collaboration for specific mitigation activities is rarely at the level of full region, but rather concentrated in more coherent sub-regions with a tradition of economic and/or technical collaboration. The regional analysis activities will include specific regional mitigation assessment for the power sector and broader studies of possible regional and sub-regional cooperation in energy markets, trade, transport, etc.

In both areas selected for regional studies, political and institutional set-ups for collaboration exist and there is a clearly identified potential for joint mitigation activities, for example, in power supply. In addition, the regional work will be able to benefit from existing mitigation activities in most of the member countries. Regional "centres of excellence", based on their track record and recommendations from national institutions, have been identified for the implementation of the two studies. For the SADC region, the study will be a joint activity between the Southern Centre for Energy and Environment (SCEE) in Zimbabwe and the Centre for Energy, Environment, Science and Technology (CEEST) in Tanzania. In the South American study responsibility will be shared between the Latin American Energy Organisation (OLADE) and Instituto de Economia Energética (IDEE-Bariloche), Argentina.

The regional analysis will consider the regional implications of major mitigation options implemented either in one or more countries in the region. These may include technical options implemented in the emitting sectors (energy, forestry, agriculture, industry or transport) or policy instruments like taxes, financial schemes and investment grants or common standards. The analysis will assess the regional and national economic consequences of implementing alternative mitigation options.

The study will consider effects related to large regional investments in power-supply and transmission systems, the transportation sector, fuel transmission pipelines, oil refineries and possibly coal mining. Regional mitigation options may appear either by their very nature (use of common resources such as rivers, requiring collective action) or through the existence of economies of scale when an option is implemented at the multi-country level.

In addition, general economic effects on the relative strengths of production sectors and countries may arise from the implementation of various national mitigation options. Such effects will also be considered

A fully quantified regional baseline scenario is beyond the scope of the study. Nevertheless some reference frame is required to discuss the possible mitigation options. The regional development perspective is intended to provide a reference point for the assessment of positive effects of regional collaboration on larger technical systems, and negative effects of implementing abatement options in individual countries, which implies loss of regional competitiveness for the country in question.

The sub-regional studies will establish an initial framework for the analysis and identify key possibilities and constraints. The regional focus will be further enhanced through Regional Conferences held near the completion of the two-year UNEP/GEF project.

Efficiency Strategies in the Indian Power Sector

Report from a recent workshop in New Delhi

A National Workshop on "Efficiency Strategies in the Power Sector for a Sustainable Environment", was held on 19 February 1996 in New Delhi. The workshop was organised by the Energy Management Centre, New Delhi, with support from the UNEP Centre and the Ministry of Power, Government of India.

The workshop was attended by representatives from several power utilities of India: National Thermal Power Corporation (NTPC), National Hydro-electric Power Corporation (NHPC), Damodar Valley Corporation (DVC), Bombay Suburban Electric Supply (BSES) and from several State Electricity Boards. There were representatives from National Productivity Council (NPC), Power Finance Corporation (PFC), Energy Management Centre (EMC) and Indira Gandhi Institute of Development Research (IGIDR).

Prof. Kirit Parikh (Director of IGIDR) in his inaugural address highlighted some of the aspects of the IGIDR study on Environmentally Sound Energy Development Strategies carried out earlier. Dr. Pramod Deo (UNEP Centre) in his introductory address highlighted UNEP's role in funding mechanisms and the implementation of some pilot projects on energy efficiency. Mr.M.P.Bagchee (Special Secretary, Ministry of Power, Government of India) highlighted the energy needs of India with special emphasis on energy efficiency and sustainable environment. Prof. Jyoti Parikh (IGIDR) then discussed the findings of the IGIDR study on Environmentally Sound Energy Development Strategies. There were three technical sessions during the day comprising reduction of auxiliary consumption from thermal power plants, reduction of transmission and distribution losses and demand side management.

The workshop recommended the setting up of a task force with a target-oriented approach, to work out short-term and long-term measures and implement them. The primary aim of the task force would be the reduction of auxiliary consumption and adoption of other measures related to upgrading power-plant technology, The workshop also recommended the formation of an expert group in the state electricity boards (SEBs) at apex level. This group would be responsible for drawing up short-term and long-term measures for technological upgrading for plants and T&D lines and conservation programmes including DSM.

It was recommended that a consortium comprising representatives from SEBs, industry (equipment manufacturers), associations like the Confederation of Indian Industries (CII), governmental agencies and research institutes working in this area, to initiate a pilot project for demand side management (DSM).

It was suggested that the Energy Service Companies (ESCOs) could take up the task of implementing a DSM measure and recover the cost from the savings made by consumers on account of the DSM programme. The ESCOs would however, require support through appropriate regulatory and financial mechanisms and power pricing policies.

Restructuring and reform of power pricing policies is vital to the success of conservation programmes. Policies can be framed in such a manner that consumers as well as utilities experience incentives for conservation. Price reforms will not only help a utility to generate internal funds for such programmes, but also empower it to use markets to raise resources.

It was suggested that the DSM programmes need demonstration through a pilot project to establish their viability. Some incentive schemes and financial mechanisms need to be worked out. Considering the environmental perspective, the risk and uncertainty involved, and the high payback period of some of the options, external funding of demonstration projects, for example by GEF, would be relevant. Once the viability of such a programme is established, it may be easier to raise support from other sources. ESCOs would also be able to raise funds from the market and from banks, once the viability of these programmes is established.

Latin American Climate Change Seminar in Bogota, Colombia

A Latin American and Caribbean Seminar on Energy and Environment was convened by the Centre jointly with the Latin American Energy Organisation (OLADE) from 28 to 30 November 1995. The aim of the seminar was to provide national teams working on climate change mitigation and vulnerability issues with an appropriated forum for exchanging experience, highlighting methodological issues and identifying gaps for further research and collaboration.

Over 60 participants from 15 countries in the region attended the event which was hosted by the Ministry for Energy and Mines in Bogota. From the experience of accomplished and ongoing national studies the seminar concluded that a number of methodological and conceptual questions still need to be answered. In particular, there is a need for assessing joint regional mitigation activities since many options identified in national studies have inter-regional links. Finally, the seminar stressed the need for establishing collaborative linkages between the national teams to promote regional co-operation, and OLADE was called on to play a catalytic role in such work.

The Centre was represented at the Seminar by Arturo Villavicencio and Jørgen Fenhann.

Economics of Greenhouse Gas Limitations (continued)

The UN Framework Convention on Climate Change states that Climate Change (CC) mitigation should be done in a cost-effective way. This requires global coordination as well as a consistent and widely accepted approach for assessing the economic costs of mitigation options. These costs are important indicators for the technological and financial transfers which will have to take place, either bilaterally or multilaterally, or both, when the Convention is fully implemented.

The limitation of GHG emissions is a complex issue, intimately connected with economic development at national, regional and global levels. Key economic sectors such as energy, agriculture, industry and forestry all produce GHGs, and are likely to be affected directly and indirectly by any mitigation policy. The *UNEP Greenhouse Gas Abatement Costing Studies,* initiated in 1991 and coordinated by UCCEE, attempted to address these complex issues, developing a methodological framework and testing it through practical application in ten countries. The results of Phase Two were published in 1994 and described in earlier issues of c_2e_2 news. The third phase, extending the approach to other gases and sectors, and applying it in two countries, was completed at the end of 1995 and will be published in the near future.

The new GEF project will comprise eight national and two regional studies in parallel with a methodological development programme. UCCEE will be responsible for coordination of the individual studies as well as development of the methodological framework, working in close collaboration with LBL. The national and regional studies will be carried out by centres and government agencies in the participating countries and regions.

Participating countries are: Argentina, Ecuador, Estonia, Hungary, Indonesia, Mauritius, Senegal and Vietnam. The two sub-regional studies will focus on the SADC countries in Southern Africa and the Andean Group countries in South America. The participating countries were chosen, from among a number of national requests, to represent the three primary developing regions (Africa, Latin America and Asia) as well as Eastern Europe. Of these countries several have already embarked on or completed CC mitigation studies, while others have yet to gain experience in the procedure. The new studies will take full advantage of existing or ongoing studies, for example those conducted under the US Country Studies Program, in order to avoid overlap, exploit synergies and gain as much capacity building experience and useful information as possible.

Mix of countries

The eight countries represent a wide mix of systems with respect to energy and other sectors, and in terms of level of development, rural/urban mix, availability of natural resources, etc. this diversity will facilitate the broad development of methodological guidelines to treat a variety of circumstances and settings. In particular, the broadening of the analysis from simply energy, as in the early phases of mitigation studies, to treat forestry, land-use and agriculture introduces significant challenges.

Comparing options from different sectors

Phase Three of the UNEP GHG Abatement Studies (completed at the end of 1995 and to be published shortly) has shown that it is possible to relate mitigation options in different sectors to each other, but that this requires careful consideration of the accounting procedures. The time profile of forestry and energy options are, for instance, quite different in general. Energy sector options, such as the introduction of a more efficient and therefore lower emitting technology, are generally assumed to lead to a permanent reduction in GHG emissions. Forestry options, like tree plantations, have a limited lifetime because net CO_2 absorption occurs only while the trees grow to maturity. Accounting of the CO_2 reduction, and comparison of the two types of options in terms of cost per reduced unit of GHG in the atmosphere requires this different time profile to be considered. Guidelines for such procedures will be provided to country study teams.

First project workshop

The project commences on 1 April 1996. The first workshop will take place in June when all participating teams will meet at Risø. Here the first draft of the methodological guidelines will be presented and discussed, along with detailed discussion of the individual situation of each country.

Energy and Environment:

Local and Regional Issues

World Energy Council
CONSEIL MONDIAL DE L'ENERGIE
16th
CONGRESS
TOKYO
'95

A study for the World Energy Council

The energy agenda has been dominated in recent years by global environmental issues, in particular the threat of rapid climate change. Local and regional environmental effects associated with energy production and utilisation have received comparatively little international attention, with the exception of the acid rain problem.

Serious local and regional threats

Local and regional environmental effects associated with energy, such as air pollution and degradation of land, are already presenting serious problems, both in developing and industrialised countries. With the projected large growth in energy consumption in the developing world these local and regional effects are bound to cause increasing damage to ecosystems, agricultural land and crops, and human health.

Local, regional and global environmental effects cannot be seen in isolation. Often the same root causes contribute to environmental degradation at the different levels. Thus, addressing the local environmental threat can contribute to alleviating the global problem.

The World Energy Council (WEC) established Working Group 4C in the 1993-95 studies programme to address local and regional environmental issues related to energy, and in particular to illustrate real practical experience in dealing with such environmental impacts and their causes. The focus was on developing countries and countries with economies in transition. The group was chaired by Hans Larsen, Head of the Department of Systems Analysis, and John Christensen and Gordon Mackenzie of the UNEP Centre acted as secretariat. Participation of developing country members in working group meetings was supported financially by Danida.

Working group members contributed case studies (listed in Box) which, along with a review of the underlying environmental issues, established the basis for the report of the group, *"Local and Regional Energy-Related Environmental Issues"* which was published by WEC in connection with the Tokyo Congress in October 1995.

Review of environmental issues

The review of local and regional energy-related environmental issues, focused on some of the major environmental problem areas such as urban air pollution, indoor air pollution, disturbance and occupation of land, and electromagnetic fields. The review concentrated mainly on the environmental impacts, but also presented information on key energy areas with multiple environmental effects, such as coal, oil and transport. The case studies in particular provide a broad body of experience on energy-related environmental issues on which to base recommendations.

The importance of considering local and regional environmental issues alongside the global ones is not new, but this multi-level view is being increasingly re-emphasised. It emerged clearly from the WEC Tokyo Congress that the immediate policy priorities focus on local and regional issues, especially for developing countries and countries in transition. There is a general willingness to see problems in a more integrated manner and to expand interaction and collaboration aimed at the transfer of technological and financial resources.

The report "Local and Regional Energy-Related Environmental Issues" is available from the World Energy Council, London.

Case studies included in WEC Working Group 4C

- Environmental issues of power production from fossil fuels
  - Germany
  - Poland
  - Russia
- Environmental issues related to hydropower
  - The Serra da Mesa hydropower plant, Brazil
  - The Saguling hydropower plant, Indonesia
- Environmental consequences of windpower
- Electrification in rural areas, grid expansion and transmission lines
- Urban air pollution:
  - The Mexico City Metropolitan Area
  - Autoexhaust pollutants in Greater Cairo
- Biomass energy
  - Environmental implications of small-scale use of biomass
  - Large-scale biomass utilisation, the pulp and paper industry in Portugal
- Impacts of energy scenarios on regional acidification
- Environmental impacts of the oil and gas sector in Nigeria
- Spontaneous combustion in Chinese coal mines and its environmental impact

Savanna Burning in West Africa

By Thomas Theis Nielsen, Inst. of Geography, University of Copenhagen and Jørgen Fenhann, UNEP Centre

Developing countries who have ratified the UN Framework Convention on Climate Change are obliged to submit reports on the inventory of GHG emissions, including the emissions of greenhouse gases from savanna burning. Since April 1995 the UNEP Centre has collaborated with the Government of Burkina Faso in building indigenous capability to establish this initial reporting to the UNFCCC. The Ministry of Environment and Water in Burkina Faso is co-ordinating the local activities and a preliminary greenhouse gas inventory has now been established.

One of the largest sources of GHG in developing countries is the burning of biomass, either for energy use or, as in this case, for other uses or simply due to accidents. Combustion of biomass causes a prompt release of the greenhouse gas CO_2 to the atmosphere, but this does not necessarily mean a net release of CO_2. The carbon that is lost to the atmosphere in the CO_2 may be returned by subsequent regrowth of vegetation. There is, however, a net emission of other greenhouse gases such as methane (CH_4) and nitrous oxide (N_2O). Other trace gases are also emitted, giving rise to acidification and indirect greenhouse effects. In addition, the total amount of smoke particles (aerosols) emitted is of the same magnitude as that of sulphate particles arising from the global SO_2 emissions of fossil fuel burning. The exact details of the climatic effect of these smoke particles is not yet fully understood, but it is known that they affect the radiative properties of clouds and the Earth's radiation balance, and they may also disturb the hydrological cycle in the tropics.

One of the largest biomass sources of atmospheric pollutants is savanna burning. Globally the savannas cover 1300-1900 million ha., and it is estimated that about 3700 million tonnes of dry matter are burned annually. This is more than 40% of the total amount of biomass burned annually and about three times larger than the amount of biomass burned annually in tropical forests. The emissions of CH_4, N_2O and other gases are assumed proportional to the emission of carbon from the biomass burning. The emission of carbon itself is only known within a factor of 5, so the calculated emission levels of the other pollutants are also very uncertain. This uncertainty is further increased by uncertainties in the estimation of the savanna areas burned, in the biomass density and in the emission factors used.

The current best estimate of annual global emissions from savanna burning is 8.2 Mt CH_4 and 0.1 Mt N_2O. Almost all (95%) of these emissions originate from developing countries, the last 5% is a contribution from Australia.

West African savannas (about 250 million ha) play an important role in the global carbon cycle due to their large productivity. The annual release is estimated to be in the range of 50-250 Mt of carbon, and the resulting mean CH_4 emission is estimated at 1.8 Mt.

Research collaboration has also been established with the Sahel-Sudan Environmental Research Initiative (SEREIN) of the Danish Environmental Research Programme. The particular activity covered by the collaboration is the study of savanna fires in Burkina Faso by remote sensing. Daytime satellite images from the NOAA AVHRR satellite, covering Burkina Faso and surrounding areas, in total 440,000 km^2, have been used to assess the level of fire activity in the period 1 June 1990 - 1 June 1991. These images are at present the best tool for fire monitoring because of the wavelength sensitivity of the AVHRR sensors, centred around 3.6 mm in the infrared spectrum, and the diurnal coverage of the NOAA satellite.

Fires can be distinguished from their surroundings in two ways: the heat of the actual fire, or the charred surface left by a fire. However, no suitable algorithm has so far been found to distinguish an already burnt surface from its non-burnt neighbour. The only possibility available at present is to monitor the fires while they are actually alight. All contemporary algorithms rely on the setting of a number of thermal thresholds for the various channels before a pixel is classified as having had a fire. In this study three generally quoted sets of constants (EOS, Kaufmann and Kennedy) were tested with highly fluctuating results. The first two sets of constants yielded similar orders of results 158,885 and 154,996 fires in the period while the Kennedy set resulted in only 21,217 fires. All three sets of constants showed differing seasonal results.

The first two sets of constants overestimate the number of fires since they indicate a large number of fires in the whole period in connection to open water surfaces, e.g. along the Niger river. This is one of the reasons for the high number of fires in the EOS and Kaufmann data sets in the first 100 days

on Figure 1, which is within the rainy season. In this period the Kennedy set gives a reasonable number of fires, it is however suspected that the number of fires in the rest of the period is underestimated by the Kennedy set.

These results reinforce earlier suggestions that it is impossible to establish a globally acceptable set of constants for fire monitoring. In order to obtain reliable results, the constants can only be determined by careful field experiments. This is also important for the second half of the analysis which aimed to estimate the amount of biomass burnt. A new set of constants is being developed to fit local conditions better. These constants will be calibrated using calculations done on satellite pictures of experimental fires to be done in Senegal.

Grassland, bush and woodland fires play an important role in tropical (agro-) ecosystems. They are used for a variety of purposes and have planned as well as unplanned effects on ecosystem properties and evolution. Changes in the extent, timing and physical properties of fires, partly correlated with population growth and other elements of social change, have important impacts on human livelihoods, production systems and biodiversity at both local and regional levels.

In order to increase knowledge about the impact of fires in tropical ecosystems (including savannas) in the Sahelian-to-Guinean zone of Africa a four year research project "Fires in Tropical Ecosystems, Natural Resource Management, Biodiversity and Climate" has been started with support from the Danish Council for Development Research. The main activities in the project will take place in Senegal, Burkina Faso, Ghana and Ethiopia. The project will be a joint effort between UCCEE and a number of institutes at the University of Copenhagen: Geography, Plant Ecology, General Microbiology, Population Biology and the Zoological and Botanical Museums.

The project will be organised in three closely linked sub-projects:

- Effects of the fire regime on plant nutrient uptake, ecology and diversity of higher plants and soil invertebrates.
- Effects of the fire regime on soil microbiological processes, plant nutrient release and emission of methane and nitrogen-oxides.

Macro-scale analysis of the distribution in time and space of fire, of emissions of greenhouse gases and of natural and human controls of fire distribution.

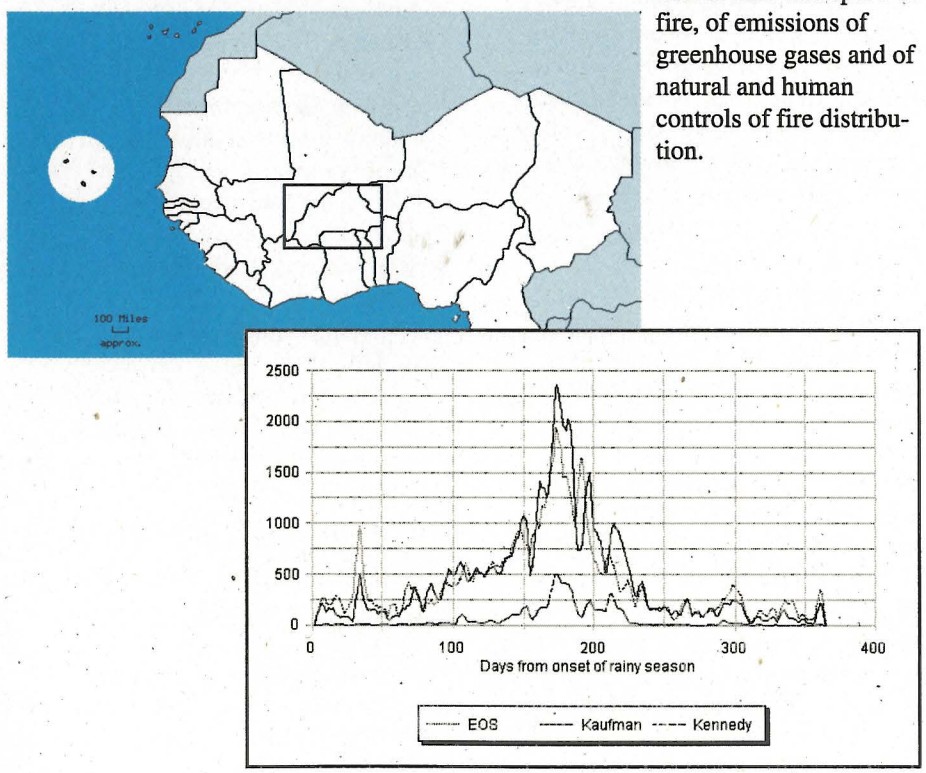


Figure 1 Estimated fire incidents in Burkina Faso, 1990-91

Centre's Scientific Advisory Panel Meets for First Time

A Scientific Advisory Panel (SAP) has been established for the UNEP Centre and the first meeting was held on 7 December 1995. Creation of the panel was one of the recommendations of the independent evaluation of the Centre carried out in 1994.

The purpose of the SAP is to provide strategic advice on the directions which the Centre should take in the future. Such advice should reflect existing and emerging regional issues in energy and environment, following the general mandate of the Centre. SAP should advise on strategic directions for future Centre activities and provide scientific advice on existing programmes

SAP also provides a link with national, regional and international institutions which may benefit from or contribute to the work of the Centre. The panel is scheduled to meet annually at Risø.

Members of the Centre's Scientific Advisory Panel

Mariano Bauer
(UNAM, Mexico)
Giap van Dang
(AIT, Bangkok)
Stephen Karekezi
(AFREPREN, Nairobi)
Lars Kristofferson
(SEI, Stockholm)
R.K. Pachauri
(TERI, New Delhi)
Janos Pasztor
(UNFCCC Secretariat)
Youba Sokona
(ENDA, Dakar)
Carlos Suarez
(IDEE, Bariloche)

Electricity, Health and the Environment - A UNEP Perspective

Extract of the UNEP keynote address presented at the International Symposium on Electricity, Health and the Environment Vienna, 16-19 October 1995.

The need for this symposium is prompted by two potentially conflicting realities: on the one hand, the world needs more electricity and, on the other hand, we are committed to pursuing a path of sustainable development. Projections indicate rapidly growing energy demand in the developing world, particularly in Asia. At the same time there is a growing recognition of the potential negative environmental and social impacts of increasing energy consumption and production. Meeting this growing demand requires investment in power plants and infrastructure, and of course in the appliances and equipment which consume electricity.

If the growing electricity demand is to be satisfied in a way which is sustainable, then we have to ensure that investment decisions take into account all relevant aspects of the environment, at the local, regional and global levels.

Electricity is one component of the energy spectrum and must enter as an option along with other forms of energy, and indeed other means of providing the services required for human comfort, welfare, industry and transport. The challenge faced by energy policy makers, public utilities, private power companies and other industries, now and increasingly in the future, is to provide these services in the most sustainable way.

The aim of this symposium is to share our experience in methods and tools for comparing the disparate environmental and health impacts of different technical solutions and options, so that the necessary planning, policy and investments in the power sector can be compatible with our objective of a sustainable future.

UNEP's role in energy

UNEP is the United Nations organisation charged with responsibility for the environment. The energy programme of UNEP is a relatively modest component of UNEP's activities, but it is of central importance. Within the United Nations system moreover, UNEP's energy programme is in a unique position, spanning all forms of energy production and use, in all types of countries, by virtue of the common environmental dimension.

One of UNEP's aims in the field of energy is to reach out beyond the environmental community and encourage greater incorporation of environmental concerns into the economic decision-making process affecting energy production, transportation and consumption.

UNEP does not have a special policy with regard to electricity as such, nor to any other energy form, carrier or technology. Electricity is nevertheless unique among energy forms. It is an essentially "clean" fuel, giving rise to virtually no environmental damage at the point of consumption, but as we are all aware the generation of electricity can give rise to serious environmental damage.

Electricity provides the possibility for clean and efficient energy use in households, transport and industry, with enormous potential benefits to human health and well-being. To provide electricity to growing populations with increasing standards of living and expanding industries, however, power must be generated in massive amounts. This implies potentially serious environmental impacts, such as air pollution, inundation of land for hydropower, or the spread of radioactive material.

UNEP's prime role in this area is to foster environmental awareness on the part of member countries: to encourage greater incorporation of environmental issues into energy planning and policy.

New priorities for UNEP's energy programme

Over the past year, internal discussions and consultations have been going on within UNEP to define more precisely its role in the field of energy. Some of the objectives of the new energy programme are:

- Establishing UNEP as a key source of information on reducing the environmental impacts of energy utilisation
- Encouraging environmental sustainability in governmental and private-sector decisions on new energy policies, programmes and infrastructure in developing countries.
- Encouraging the increased use of energy efficient technologies and renewable energy technologies through market forces in developing countries.
- Encouraging integrated resource planning (IRP) in developing countries
- Defining environmental requirements in contracts for private power producers
- Identifying and encouraging removal of barriers against implementation of environmentally sound energy options,
- Providing the mechanisms to improve the scientific and technical information used by countries to implement the Framework Convention on Climate Change.

Environmental benefits of electrification in developing countries

The use of electricity of course has beneficial effects, not least for the local environment. The use of electricity in certain industrial and household uses, instead of fuel consumption, often

means higher efficiency as well as less pollution and fewer health hazards.

While the availability of electricity has penetrated virtually 100% in the industrialised countries, there is still a huge potential for electrification in developing countries. Within the household sector for example, the use of biomass fuels for cooking leads to serious local and indoor air pollution. It has been estimated that several hundred million people (according to the WHO Consultation Study on Indoor Air Pollution and Biomass Fuel, 1991), mainly women and children, are exposed to dangerous levels of pollutants every day, with serious consequences for health. Indeed respiratory illnesses directly attributable to smoke from biomass fuels are a major cause of serious health problems in many developing countries.

The provision of biomass fuels often involves environmental damage. It is now generally accepted that the harvesting of wood for fuel is rarely the main cause of deforestation. Clearing for new agricultural land is the most frequent culprit. Nevertheless there can be severe local impacts, with large areas of forest being cleared for conversion to charcoal to satisfy the urban household demand for cooking fuel.

Proper ventilation and improved stoves offer possibilities for improving indoor conditions, and sustainable forestry can reduce or eliminate the loss of trees. Nevertheless, in a great many cases electrification would provide an optimal solution. Electrification of peri-urban areas in developing countries generally requires external assistance, but considerable long-term social benefits are expected. The provision of electricity can contribute to better standards of living, as well as eliminating indoor and local air pollution. Substitution of biomass fuels may also have environmental benefits, although, as noted above, the connection is not always a clear one of reduced deforestation.

Rural electrification, on the other hand, while advocated extensively in the 70s and 80s as a catalyst for rural development, has not always been successful on its own. Often the costs of centralised grid connection are extremely high, and it is here that decentralised renewable energy technologies can play an important role.

UNEP's contribution to a sustainable future

Working towards a sustainable future means fulfilling the needs of society - households, services, industry, transport - in a way which causes least damage to the immediate environment, minimises greenhouse gas emissions, minimises the use of non-renewable resources, and does not expose local populations to undue risk. All this should be done as economically as possible, thus freeing resources for other essential sectors.

One of UNEP's primary roles is to help and encourage governments, and international organisations, to take better account of the environment in order to facilitate choices that promote sustainability. This means building experience and institutional capacity, developing methodological frameworks and tools for assessment of the comparative costs and benefits of different options, and encouraging, demonstrating and promoting the use of these methods.

The UNEP activities on Fuel Chain Analysis and the GHG Abatement Costing Studies, are examples of how capacity building and methodological development can be fostered through international collaboration, and the results disseminated to all interested parties, for the good of the local, regional and global environment. This symposium provides an excellent opportunity to share our views on the issues and our experience with different methods, to learn from the examples, and to discuss how these results and techniques can be applied to help provide electricity in a sustainable way.

(The full version of the address will be published in the proceedings of the International Symposium on Electricity, Health and the Environment, Vienna 16-19 October 1995., IAEA, Vienna).

Expansion of the Centre

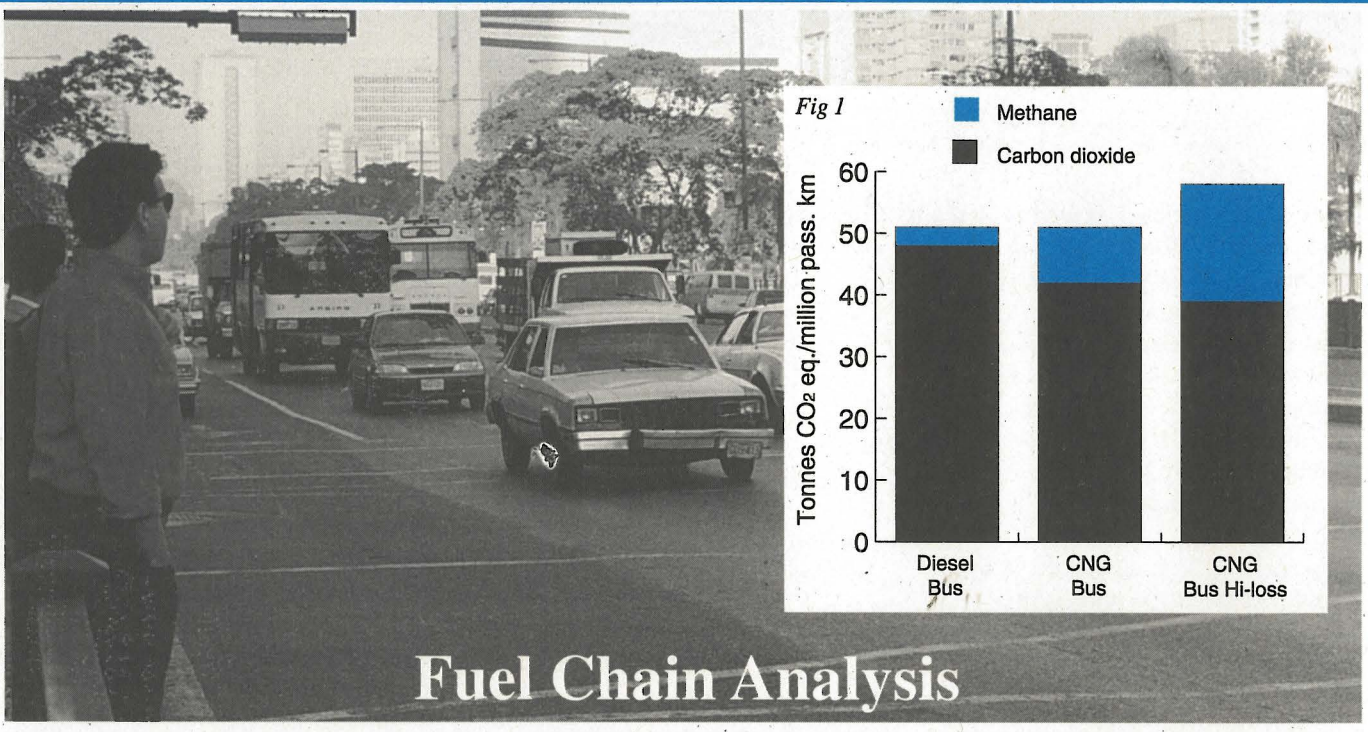
The Centre has now entered its third phase and has been strengthened significantly with the addition of two senior staff members and one postdoctoral researcher. A further senior staff member will join the Centre in the near future and an additional postdoctoral researcher will join towards the end of the year. We will continue to host visiting researchers for shorter periods. The long-term professional staff of the Centre now numbers ten, with a wide spread of expertise and experience in fields such as energy, environmental and resource economics; energy-environment planning; energy technologies; industrial energy management; and forestry and land-use issues.

Diversification of activities

Much of the Centre's work over the past five years has been on issues related to climate change, and in particular the economics of GHG abatement. This will remain an important activity in the future, but the expanded staff allows a diversification of activities and areas of interest. This parallels the definition of a new energy programme within UNEP which also focuses on local and regional environmental issues related to energy. Issues to be taken up include demand side management and integrated resource planning in developing countries, environmental issues related to liberalisation of the power sector, energy and environmental effects of transport, and promotion of renewable energy and efficiency.

New offices

The Centre will move to a new office building at Risø in April 1996. The move will improve links to staff in the parent Systems Analysis Department, while maintaining the unity of the UNEP Centre. The opening of the new premises will be marked by a ceremony and symposium on 7 May 1996 with participation at Danish ministerial and UNEP director level.



Fuel Chain Analysis

Charlie Heaps†, Michael Lazarus†, David Hill† and Gordon Mackenzie ‡

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In 1995 the Stockholm Environment Institute's Boston Centre (SEI-B) and the UNEP Centre completed a two-year project to develop and apply a tool for fuel-chain analysis in developing countries. The tool is an extension of the LEAP/EDB model developed by SEI-B and the work was carried out in close collaboration with counterparts in Venezuela and Sri Lanka where the tool was tested through case studies.

Energy requirements and environmental loadings are tracked through chains of conversion processes on the basis of the efficiencies and process energy requirements of each process. Since each process can potentially require many different inputs, an analysis can quickly become quite complex.

Substantial environmental impacts often occur in conjunction with stages of the energy process other than combustion. Many renewable energy technologies are highly intensive in material input, and the associated environmental impacts may weigh heavily. Fossil fuel processes on the other hand embody environmental impacts at the mining or fuel extraction stage, as well as in the disposal of waste. A realistic comparison of alternative means of supplying energy thus requires that the whole chain of processes, and the associated environmental effects, be taken into account.

Fuel chain analysis forces the analyst to explicitly draw boundaries around systems and to allocate impacts within and between co- and by-products of the energy system. A software tool like the LEAP Fuel Chain Program can make fuel chain analysis more accessible in a wide range of applications by providing user-friendly guidance to this new and complex analytical methodology, and by helping to overcome local data constraints with default energy and environmental data. Technology and environmental databases are particularly useful in the developing country context where planners are attempting to compare the environmental consequences of developing new resources and/or technologies. Local data is often not available, and well-documented sources of international data provide the best chance of promoting rational decision making.

The UNEP/SEI Fuel Chain Analysis project represents one of the first applications of this technique in developing country settings. Case study countries were selected to give broad coverage of four important fuel chains: oil and gas (Venezuela), and coal and biomass (Sri Lanka). The new LEAP fuel chain program was employed to study the impacts of fuel and technology choices including the greenhouse gas emissions of each fuel chain.

Figure1 shows results of a calculation of GHG emissions (in global warming potential) for two alternative fuel supply strategies for buses in Caracas, Venezuela. The analysis showed that leakage of methane from the natural gas distribution system could outweigh the advantage gained by substituting compressed natural gas (CNG) for diesel. Local air pollution on the other hand is reduced in the CNG alternative.

The results of the Venezuela and Sri Lanka case studies show that the comparison of fuel chains often presents distinct trade-offs between different local and global environmental impacts (e.g. local air pollution vs. global warming).

The results of the project were presented and the tool demonstrated at the International Symposium on Electricity, Health and the Environment in Vienna[1] and the tool and case studies are fully described in a report from SEI-B[2].

*[ref 1] **"Heaps, C., Lazarus, M., Hill, D. and Mackenzie, G.A.,** The SEI/UNEP Fuel Chain Project: Using LEAP/EDB for Fuel Chain Analysis in Developing Countries, The International Symposium on Electricity, Health and the Environment, Vienna, 16-19 October, 1995*

*[ref 2] **Lazarus, M., Heaps, C., Hill, D.,** "The SEI/UNEP Fuel Chain Project: Methods, Issues and Case Studies in Developing Countries", Stockholm Environment Institute – Boston (1995)*

Staff profiles

John M. Christensen, MSc, PhD (engineering), experience in renewable energy technologies and energy planning in developing countries, joined Risø's Energy Systems Group in 1984, Programme Officer at the Energy Unit, UNEP HQ 1988-90, Head of UNEP Centre since its formation in October 1990. Main activities are management of the Centre, project initiation, UN contacts and coordination particularly participation in Climate Change fora, lead author of IPCC Working Group II Report. (john.christensen@risoe.dk)

Pramod Deo, MSc (physics) PhD (infrastructure economics) Senior Energy Economist, Founder Director of Maharashtra Energy Development Agency (1986-88) and Indian Energy Management Centre (1989-93). Previously with Asian Energy Institute, Bangkok (1985-86) and Energy Policy Consultant at World Bank (1993) before joining the UNEP Centre in 1994. Main activities are energy-environment planning in developing countries, project development and management, support to UNEP. (pramod.deo@risoe.dk)

Jørgen Fenhann, MSc (physics with maths. and chemistry) Senior Scientist, a physicist with experience in energy modelling and planning at Risø since 1978. Activities include development of energy planning models, new and renewable energy technologies, emissions from energy systems and energy-environment planning for Eastern European and developing countries. Currently attached to the UNEP Centre where activities include support to mitigation assessment country studies in Africa and Latin America. (j.fenhann@risoe.dk)

Kirsten Halsnæs, MEcon. Senior Economist, joined the Centre in 1992 after five years with the Energy System Group at Risø where main activity was methodological development for energy and environment modelling, particularly in the Nordic countries. Principal activities at the Centre are development of methodology for climate change mitigation assessment in developing countries, and environmental economics. Lead author of IPCC Working Group III Report. (kirsten.halsnaes@risoe.dk)

Gordon A. Mackenzie, BSc, PhD (physics) Senior Energy Planner, experience in energy modelling and planning with Energy Systems Group at Risø since 1980, Deputy Director/ Adviser in Dept. of Energy, Zambia (1984-87), leader of Environmental Modelling Group at Risø (1988-90), founder member of UNEP Centre in 1990, interests include energy/ environment database and modelling, transport energy and the environment, energy and environment in Southern and Eastern Africa, electronic media and publications. (gordon.mackenzie@risoe.dk)

Henrik J. Meyer, Economist, joined the Centre in 1995 after two years in the Energy Systems Group at Risø. Previous positions at Rockwool Foundation Research Unit (1990-93) and Technical University of Denmark (1993). Activities and interests include environmental externalities of energy production, valuation of environmental benefits and damages, macroeconomic consequences of GHG abatement. (henrik.meyer@risoe.dk)

Steffen Rønsholdt Nielsen, MSc (technology and social studies) PhD student at Risø since 1995. Thesis project on climate change mitigation, especially impact of alternative land-use patterns in developing countries, case study in Ecuador. (steffen.nielsen@risoe.dk)

Arturo Villavicencio, MSc (maths.) Senior Energy Scientist, joined the Centre in its first phase in 1991 after extensive experience in energy planning and modelling for Latin America in National Energy Institute, Ecuador (1979-85), Energy Planning Consultant for OLADE/CEC/World Bank (1985-88), Energy Adviser at OLADE (1988-90). Main activities at the Centre are energy-environment modelling and integrated energy-environment planning. (arturo.villavicencio@risoe.dk)

Maria M. Andreasen, Secretary, joined the Centre in 1994 after a number of years with the Energy Systems Group at Risø. (maria.andreasen@risoe.dk)

New

John "Mac" Callaway, MS (Agricultural and Resource Economics) joined the UNEP Centre as a Senior Economist in January 1996. He was previously at Hagler, Bailly Consulting in Boulder, Colorado. Prior to that, he worked as a Senior Economist at Battelle Pacific Northwest Laboratories. For the last four years, his work has been primarily concentrated in three areas: Developing and applying economic sector models to assess policies to offset GHG emissions by manipulating terrestrial carbon sinks; Developing and applying methods for incorporating environmental externalities into the planning of new electric generating capacity and integrated resource planning programmes, and Developing guide-lines for Joint Implementation of GHG reduction programmes and projects. (mac.callaway@risoe.dk)

New

Robert "Bob" Redlinger, MS (Environmental Engineering & Science), PE, joined the UNEP Centre in February 1996 as a Senior Energy Scientist. Prior to joining the Centre, Bob was employed at Synergic Resources Corporation (SRC)in Oakland, California, where he specialised in electric utility planning methodologies, energy efficiency, and renewable energy. Bob has worked in Argentina, Egypt, India, Kazakhstan, Kyrgyzstan, Malaysia, Philippines, and Russia. Born and raised in Japan, Bob also worked with numerous Japanese research institutes and utilities. Prior to his work at SRC, Bob was employed as an environmental engineer at Kennedy/ Jenks/ Chilton Inc. of San Francisco, California. (robert.redlinger@risoe.dk)

New

John Turkson, PhD (Energy Management and Policy) joined UNEP Centre in February 1996 as Energy Economist after completion of his doctoral degree at the University of Pennsylvania. The focus of his research was on ownership restructuring and regulatory reforms of the electric utility industry in developing countries. Before pursuing his doctoral programme, John managed a World Bank/UNDP ESMAP Improved Charcoal Stoves Project in Ghana. Prior to that, John worked as a lecturer in the Department of Planning of the University of Science and Technology in Ghana. (john.turkson@risoe.dk)

Visiting Researchers

Risø has a long tradition of hosting guest researchers for periods of one to twelve months. The UNEP Centre continues this tradition and has been privileged to host the following colleagues in the course of the past year:

Lugard Majoro, of AFREPREN, Nairobi, Kenya working on a study of the transport sector in Eastern Africa aimed at quantifying the contribution to greenhouse gas emissions and identifying the potential for reductions.

Honadia Mamadou, from the Ministry of Environment and Water in Ouagadougou, Burkina Faso visited Denmark for two weeks in January. He presented the result of the collaboration with UCCEE at the 8th Danish Sahel Workshop 3-5 January (published in SEREIN - occasional Paper No. 3, Institute of Geography, Copenhagen)

Hubert Meena, from the Centre for Energy, Environment, Science and Technology (CEEST), Dar es Salaam, Tanzania, working on a GTZ-sponsored (German Technical Assistance) GHG inventory and CC mitigation country study of Tanzania.

Abdoulaye Ouedraogo, from the Meteorological Service in Ouagadougou, Burkina Faso also visited Risø for two weeks in January working on the preliminary inventory of greenhouse gases for Burkina Faso.

Peter Zhou, Director of the Energy, Environment and Geophysics Consultants (EECG) based in Gaborone, Botswana, working on a review of transport energy and emissions in the Southern African region in connection with AFREPREN. Peter was also involved in preliminary CC mitigation studies of Botswana and the SADC countries.

UNEP Centre Publications

The following publications are available on request from the UNEP Centre:

Energy options for Africa. Environmentally sustainable alternatives. S. Karekezi and G.A. Mackenzie, (eds.), (Zed Books, London, 1993) 184 pages.

UNEP Greenhouse Gas Abatement Costing Studies. Analysis of abatement costing issues and preparation of a methodology to undertake national greenhouse gas abatement costing studies. Phase Two. (Part 1: Main report. Part 2: Country summaries. Appendix: Guidelines.) 1994.

National Action to Mitigate Climate Change, Proceedings of the International Conference, 7-9 June Copenhagen, Denmark. 392 pages.

Energy and Environment in Argentina: Past and Prospective Evolution, G.D. de Hasson, C.E. Suárez, . and H. Pistonesi, (Instituto de Economica Energética/Fundación, Bariloche, Argentina) Working Paper No. 1, April 1995. 169 pages.

End-use energy modelling for developing countries: A review of the end-use approach for projecting long-term energy use and GHG emissions. J. A. Sathaye, Working Paper No. 2, April 1995. 36 pages.

Economic Instruments: Application to Environmental Problems J.P. Painuly, J. P. (Indira Gandhi Institute of Development Research, Bombay, India) Working Paper No. 3, August 1995. 25 pages.

Environmentally sound energy development strategies for Maharashtra J. Parikh, J.P. Painuly and K. Bhattacharya (Indira Gandhi Institute of Development Research, Bombay, India) Working Paper No. 4. December 1995. 40 pages.

Environmental Considerations and Options in Managing India's Long-Term Energy Strategy, Vol. 1 Main Report (November 1995), Vol. 2 Sectoral Details (December 1995). UNEP and Tata Energy Research Institute, New Delhi India.

c_2e_2 news provides up-to-date information at regular intervals on the activities of the UNEP Centre, UNEP and related events and developments. Information on forthcoming conferences, reports, studies, etc. are welcome. The views expressed in this newsletter do not necessarily represent those of the United Nations Environment Programme, Risø National Laboratory or Danida.

c_2e_2 news on the web

This newsletter (and back issues) is available on the World Wide Web at www.risoe.dk/sys/c2e2.html as part of the Risø site. The other Risø web pages include descriptions of all departments and research activities at Risø as well as useful links to Danish and international web sites. Point your browser to www.risoe.dk.

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